MITSUBISHI ELECTRIC

700 series

INVERTER

FR-A700/F700 E700/D700

FR-A700/F700/E700/D700 series

TECHNICAL MANUAL

B

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1 SPECIFICATIONS

1.1 Specification list

1.1.1 Rating

(1) FR-A700

●Three-phase 200V class

Type FR-A720-□□K			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Applicable motor capacity (kW)*1			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Output	Rated capacity (kVA)*2		1.1	1.9	3.1	4.2	6.7	9.2	12.6	17.6	23.3	29	34	44	55	67	82	110	132
Output	Rated current (A)*3		3	5	8	11	17.5	24	33	46	61	76	90	115	145	175	215	288 (245)	346 (294)
Output	Overload current rating*4		150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50℃																
Output	Voltage*5		Three-phase 200 to 240V																
Output	Regenerative braking torque	Maximum value/ permissible duty	150% torque /3%ED *6			100% torque/ 3%ED *6		100% torque/ 2%ED *6		20% torque/continuous*6				20% torque/continuous				10% torque/ continuous	
Power supply	Rated input AC voltage/frequency		Three-phase 200 to 220V 50Hz, 200 to 240V 60Hz																
Power supply	Permissible AC voltage fluctuation		170 to 242V 50Hz, 170 to 264V 60Hz																
Power supply	Permissible frequency fluctuation		±5%																
Power supply	Power supply system capacity (kVA)*7	Without DC reactor	1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100	—	—
Power supply	Power supply system capacity (kVA)*7	With DC reactor	0.9	1.4	2.9	3.8	5.7	8.5	11	16	20	25.5	31	41	51	62	75	110	132
Protective structure (JEM 1030)*9			Enclosed type (IP20)*8											Open type (IP00)					
Cooling system			Self-cooling	Forced air cooling															
Approximate mass (kg)			1.9	2.3	3.8	3.8	3.8	7.1	7.1	7.5	13	13	14	23	35	35	58	70	70

●Three-phase 400V class

Type FR-A740-□□K			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Applicable motor capacity (kW)*1			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output	Rated capacity (kVA)*2		1.1	1.9	3	4.6	6.9	9.1	13	17.5	23.6	29	32.8	43.4	54	65	84
Output	Rated current (A)		1.5	2.5	4	6	9	12	17	23	31	38	44	57	71	86	110
Output	Overload current rating*4		150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50℃														
Output	Voltage*5		Three-phase 380 to 480V														
Output	Regenerative braking torque	Maximum value/ permissible duty	100% torque/2%ED *6							20% torque/continuous*6				20% torque/continuous			
Power supply	Rated input AC voltage/frequency		Three-phase 380 to 480V 50Hz/60Hz														
Power supply	Permissible AC voltage fluctuation		323 to 528V 50Hz/60Hz														
Power supply	Permissible frequency fluctuation		±5%														
Power supply	Power supply system capacity (kVA)*7	Without DC reactor	1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100
Power supply	Power supply system capacity (kVA)*7	With DC reactor	0.9	1.4	2.9	3.8	5.7	8.5	11	16	20	25.5	31	41	51	62	75
Protective structure (JEM 1030)*9			Enclosed type (IP20)*8									Open type (IP00)			
Cooling system			Self-cooling			Forced air cooling											
Approximate mass (kg)			3.8	3.8	3.8	3.8	3.8	7.1	7.1	7.5	7.5	13	13	23	35	35	37

Type FR-A740-□□K			75	90	110	132	160	185	220	250	280	315	355	400	450	500
Applicable motor capacity (kW)*1			75	90	110	132	160	185	220	250	280	315	355	400	450	500
Output	Rated capacity (kVA)*2		110	137	165	198	248	275	329	367	417	465	521	587	660	733
Output	Rated current (A)*3		144 (122)	180 (153)	216 (184)	260 (221)	325 (276)	361 (307)	432 (367)	481 (409)	547 (465)	610 (519)	683 (581)	770 (655)	866 (736)	962 (818)
Output	Overload current rating*4		150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50℃													
Output	Voltage*5		Three-phase 380 to 480V													
Output	Regenerative braking torque	Maximum value/ permissible duty	10% torque/continuous													
Power supply	Rated input AC voltage/ frequency		Three-phase 380 to 480V 50Hz/60Hz													
Power supply	Permissible AC voltage fluctuation		323 to 528V 50Hz/60Hz													
Power supply	Permissible frequency fluctuation		±5%													
Power supply	Power supply system capacity (kVA)*7	Without DC reactor	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Power supply	Power supply system capacity (kVA)*7	With DC reactor	110	137	165	198	248	275	329	367	417	465	521	587	660	733
Protective structure (JEM 1030)*9			Open type (IP00)													
Cooling system			Forced air cooling													
Approximate mass (kg)			50	57	72	72	110	110	175	175	175	260	260	370	370	370

*1 The applied motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2 The rated output capacity indicated assumes that the output voltage is 220V for 200V class and 440V for 400V class.

*3 When operating the inverter of 75K or more with a value larger than 2kHz set in [*Pr. 72 PWM frequency selection*], the rated output current is the value in parenthesis.

*4 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*6 200V: When FR-ABR (option) is connected, 150% torque 10% ED for 0.4K and 0.75K, 100% torque 10%ED for 1.5K to 7.5K, 100% torque 6%ED for 11K to 22K.
400V: When FR-ABR-H (option) is connected, 15% torque 10% ED for 0.4K to 7.5K, 100% torque 6% ED for 11K to 22K.

*7 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).

*8 When the hook of the inverter front cover is cut off for installation of the plug-in option, protective structure of the inverter changes to an open type (IP00).

*9 FR-DU07 : IP40 (except for the PU connector)

(2) FR-F700

●Three-phase 200V class

Type FR-F720-□□K		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Applicable motor capacity (kW)*1		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Output	Rated capacity (kVA)*2	1.6	2.7	3.7	5.8	8.8	11.8	17.1	22.1	27	32	43	53	65	81	110	132	165
Output	Rated current (A)*3	4.2 (3.6)	7.0 (6.0)	9.6 (8.2)	15.2 (13)	23 (20)	31 (26)	45 (38)	58 (49)	70 (60)	85 (72)	114 (97)	140 (119)	170 (145)	212 (180)	288 (244)	346 (294)	432 (367)
Output	Overload current rating*4	120% 60s, 150% 3s (inverse-time characteristics)																
Output	Voltage*5	Three-phase 200 to 240V																
Output	Regenerative braking torque: Maximum value/ permissible duty	15% torque/continuous														10% torque/ continuous		
Power supply	Rated input AC voltage/ frequency	Three-phase 200 to 220V 50Hz, 200 to 240V 60Hz																
Power supply	Permissible AC voltage fluctuation	170 to 242V 50Hz, 170 to 264V 60Hz																
Power supply	Permissible frequency fluctuation	±5%																
Power supply	Power supply system capacity (kVA)*6: Without DC reactor	2.1	4.0	4.8	8.0	11.5	16	20	27	32	41	52	65	79	99	—	—	—
Power supply	Power supply system capacity (kVA)*6: With DC reactor	1.2	2.6	3.3	5.0	8.1	10	16	19	24	31	41	50	61	74	110	132	165
Protective structure (JEM 1030)*8		Enclosed type (IP20)*7										Open type (IP00)						
Cooling system		Self-cooling	Forced air cooling															
Approximate mass (kg)		1.8	2.2	3.5	3.5	3.5	6.5	6.5	7.8	13	13	14	23	35	35	67	70	70

●Three-phase 400V class

Type FR-F740-□□K		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Applicable motor capacity (kW)*1		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output	Rated capacity (kVA)*2	1.6	2.7	3.7	5.8	8.8	12.2	17.5	22.1	26.7	32.8	43.4	53.3	64.8	80.8
Output	Rated current (A)*3	2.1 (1.8)	3.5 (3.0)	4.8 (4.1)	7.6 (6.4)	11.5 (9.8)	16 (13)	23 (19)	29 (24)	35 (30)	43 (36)	57 (48)	70 (60)	85 (72)	106 (90)
Output	Overload current rating*4	120% 60s, 150% 3s (inverse-time characteristics)													
Output	Voltage*5	Three-phase 380 to 480V													
Output	Regenerative braking torque: Maximum value/ permissible duty	15% torque/continuous													
Power supply	Rated input AC voltage/ frequency	Three-phase 380 to 480V 50Hz/60Hz													
Power supply	Permissible AC voltage fluctuation	323 to 528V 50Hz/60Hz													
Power supply	Permissible frequency fluctuation	±5%													
Power supply	Power supply system capacity (kVA)*6: Without DC reactor	2.1	4.0	4.8	8.0	11.5	16	20	27	32	41	52	65	79	99
Power supply	Power supply system capacity (kVA)*6: With DC reactor	1.2	2.6	3.3	5.0	8.1	10	16	19	24	31	41	50	61	74
Protective structure (JEM 1030)*8		Enclosed type (IP20)*7											Open type (IP00)		
Cooling system		Self-cooling			Forced air cooling										
Approximate mass (kg)		3.5	3.5	3.5	3.5	3.5	6.5	6.5	7.5	7.5	13	13	23	35	35

Type FR-F740-□□K			75	90	110	132	160	185	220	250	280	315	355	400	450	500	560
Applicable motor capacity (kW)*1			75	90	110	132	160	185	220	250	280	315	355	400	450	500	560
Output	Rated capacity (kVA)*2		110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
Output	Rated current (A)*3		144 (122)	180 (153)	216 (183)	260 (221)	325 (276)	361 (306)	432 (367)	481 (408)	547 (464)	610 (518)	683 (580)	770 (654)	866 (736)	962 (817)	1094 (929)
Output	Overload current rating*4		120% 60s, 150% 3s (inverse-time characteristics)														
Output	Voltage*5		Three-phase 380 to 480V														
Output	Regenerative braking torque	Maximum value/ permissible duty	10% torque/continuous														
Power supply	Rated input AC voltage/ frequency		Three-phase 380 to 480V 50Hz/60Hz														
Power supply	Permissible AC voltage fluctuation		323 to 528V 50Hz/60Hz														
Power supply	Permissible frequency fluctuation		±5%														
Power supply	Power supply system capacity (kVA)*6	Without DC reactor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Power supply	Power supply system capacity (kVA)*6	With DC reactor	110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
Protective structure (JEM 1030)*8			Open type (IP00)														
Cooling system			Forced air cooling														
Approximate mass (kg)			37	50	57	72	72	110	110	175	175	175	260	260	370	370	370

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2 The rated output capacity indicated assumes that the output voltage is 220V for 200V class and 440V for 400V class.

*3 When operating the inverter with the carrier frequency set to 3kHz or more, the carrier frequency will automatically decrease if the output current of the inverter exceeds the value in parenthesis of the rated current. This may cause the motor noise to increase.

*4 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*6 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).

*7 When the hook of the inverter front cover is cut off for installation of the plug-in option, the inverter changes to an open type (IP00).

*8 FR-DU07 : IP40 (except for the PU connector)

(3) FR-E700

● Three-phase 200V power supply

Type FR-E720-□K(-C) *8		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Applicable motor capacity (kW) *1		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Output	Rated capacity (kVA) *2	0.3	0.6	1.2	2.0	3.2	4.4	7.0	9.5	13.1	18.7	23.9
	Rated current (A) *6	0.8 (0.8)	1.5 (1.4)	3 (2.5)	5 (4.1)	8 (7)	11 (10)	17.5 (16.5)	24 (23)	33 (31)	47 (44)	60 (57)
	Overload current rating *3	150% 60s, 200% 3s (inverse-time characteristics)										
	Voltage *4	Three-phase 200 to 240V										
Power supply	Rated input AC (DC) voltage/frequency	Three-phase 200 to 240V 50Hz/60Hz (283 to 339VDC *7)										
	Permissible AC (DC) voltage fluctuation	170 to 264V 50Hz/60Hz (240 to 373VDC *7)										
	Permissible frequency fluctuation	±5%										
	Power supply capacity (kVA) *5	0.4	0.8	1.5	2.5	4.5	5.5	9	12	17	20	28
Protective structure (JEM1030)		Enclosed type (IP20). IP40 for totally enclosed structure series.										
Cooling system		Self-cooling				Forced air cooling						
Approximate mass (kg)		0.5	0.5	0.7	1.0	1.4	1.4	1.7	4.3	4.3	9.0	9.0

● Three-phase 400V power supply

Type FR-E740-□K(-C)*8		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Applicable motor capacity (kW)*1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Output	Rated capacity (kVA)*2	1.2	2.0	3.0	4.6	7.2	9.1	13.0	17.5	23.0
	Rated current (A)*6	1.6 (1.4)	2.6 (2.2)	4.0 (3.8)	6.0 (5.4)	9.5 (8.7)	12	17	23	30
	Overload current rating*3	150% 60s, 200% 3s (inverse-time characteristics)								
	Voltage*4	Three-phase 380 to 480V								
Power supply	Rated input voltage/frequency	Three-phase 380 to 480V 50Hz/60Hz								
	Permissible AC voltage fluctuation	325 to 528V 50Hz/60Hz								
	Permissible frequency fluctuation	±5%								
	Power supply capacity (kVA)*5	1.5	2.5	4.5	5.5	9.5	12	17	20	28
Protective structure (JEM1030)		Enclosed type (IP20). IP40 for totally enclosed structure series.								
Cooling system		Self-cooling		Forced air cooling						
Approximate mass (kg)		1.4	1.4	1.9	1.9	1.9	3.2	3.2	5.9	5.9

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2 The rated output capacity indicated assumes that the output voltage is 230V for three-phase 200V class and 440V for three-phase 400V class.

*3 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*4 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*5 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).

*6 Setting 2kHz or more in *Pr. 72 PWM frequency selection* to perform low acoustic noise operation in the surrounding air temperature exceeding 40°C (totally-enclosed structure is 30°C), the rated output current is the value in parenthesis.

*7 •Connect DC power supply to terminal P/+ and N/-. Connect the plus side of the power supply to terminal P/+ and minus side to terminal N/-.
- Since the voltage between P/+ and N/- may increase due to the regeneration energy from the motor and exceeds 415V temporarily, select the DC power supply which can withstand the voltage/energy during regeneration. If using the power supply which can not withstand voltage/energy during regeneration, insert diodes in series for reverse current prevention.
- Although the FR-E700 series has the built-in inrush current limit circuit, select the DC power supply considering the inrush current at powering ON as the inrush current four times of the rated inverter flows at powering ON.
- Since the power supply capacity depends on the output impedance of the power, select the power supply capacity which has enough allowance according to the AC power supply system capacity.

*8 Totally enclosed structure series ends with -C.

(4) FR-D700

● Three-phase 400V power supply

Model FR-D740-□K(-C)*7		0.4	0.75	1.5	2.2	3.7	5.5	7.5
Applicable motor capacity (kW)*1		0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Rated capacity (kVA)*2	0.9	1.7	2.7	3.8	6.1	9.1	12.2
	Rated current (A)	1.2	2.2	3.6	5.0	8.0	12.0	16.0
	Overload current rating*4	150% 60s, 200% 0.5s (inverse-time characteristics)						
	Voltage*5	Three-phase 380 to 480V						
Power supply	Rated input AC voltage/frequency	Three-phase 380 to 480V 50Hz/60Hz						
	Permissible AC voltage fluctuation	325 to 528V 50Hz/60Hz						
	Permissible frequency fluctuation	±5%						
	Power supply capacity (kVA)*6	1.5	2.5	4.5	5.5	9.5	12.0	17.0
Protective structure (JEM1030)		Enclosed type (IP20). IP40 for totally enclosed structure series.						
Cooling system		Self-cooling		Forced air cooling				
Approximate mass (kg)		1.3	1.3	1.4	1.5	1.5	3.3	3.3

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2 The rated output capacity indicated assumes that the output voltage is 440V.

*3 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*4 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*5 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).

*6 Totally enclosed structure series ends with -C.

1.1.2 Common specifications

(1) FR-A700

Control specifications	Control method		Soft-PWM control/high carrier frequency PWM control (selectable from among V/F control, Advanced magnetic flux vector control, Real sensorless vector control, and vector control[*1])
	Output frequency range		0.2 to 400Hz (The maximum frequency is 120Hz under Real sensorless vector control and vector control.)
	Frequency setting resolution	Analog input	0.015Hz/0 to 60Hz (terminal 2, 4 : 0 to 10V/12bit) 0.03Hz/0 to 60Hz (terminal 2, 4 : 0 to 5V/11bit, 0 to 20mA/about 11bit, terminal 1: 0 to ±10V/12bit) 0.06Hz/0 to 60Hz (terminal1: 0 to ±5V/11bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	Within ±0.2% of the max. output frequency (25°C ±10°C)
		Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics		Base frequency can be set from 0 to 400Hz, constant torque/variable torque pattern or adjustable 5 points V/F can be selected
	Starting torque		200% at 0.3Hz (0.4K to 3.7K), 150% at 0.3Hz (5.5K or more) (under Real sensorless vector control, vector control)
	Torque boost		Manual torque boost
	Acceleration/deceleration time setting		0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode, backlash measures acceleration/deceleration can be selected
	DC injection brake		Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable
	Stall prevention operation level		Operation current level can be set (0 to 220% adjustable), whether to use the function or not can be selected
	Torque limit level		Torque limit value can be set (0 to 400% variable)
Operation specifications	Frequency setting signal	Analog input	Terminal 2, 4 : 0 to 10V, 0 to 5V, 4 to 20mA (0 to 20mA) can be selected Terminal 1 : -10 to +10V, -5 to +5V can be selected
		Digital input	Input using the setting dial of the operation panel or parameter unit BCD 4 digit or 16 bit binary (when used with option FR-A7AX)
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected
	Input signal		You can select any twelve signals using [*Pr. 178 to Pr. 189 Input terminal function selection*] from among multi-speed selection, remote setting, stop-on contact selection, second and third function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure/flying start, external thermal input, inverter operation ready signal (FR-HC/FR-CV connection), FR-HC connection (instantaneous power failure detection), PU operation external interlock signal, external DC injection brake start, PID control valid terminal, brake opening completion signal, PU-external operation switchover, load pattern selection forward rotation reverse rotation boost, V/F switchover, load torque high-speed frequency, S-pattern acceleration/deceleration C switchover, pre-excitation, output stop, start self-holding selection, control mode changing, torque limit selection, start-time tuning start external input, torque bias selection 1, 2[*1], P/PI control switchover, forward rotation command, reverse rotation command, inverter reset,PTC thermistor input, PID forward/rotation operation switchover, PU-NET operation switchover, external-NET operation switchover, command source switchover, conditional position pulse train sign[*1], conditional position droop pulse clear[*1], DC feeding operation permission, and DC feeding operation cancel, magnetic flux decay output shutoff.
		Pulse train input	100kpps
	Operational functions		Maximum/minimum frequency setting, frequency jump, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure operation, bypass operation, forward/reverse rotation prevention, remote setting, brake sequence, second and third function, multi-speed operation, operation continuation at instantaneous power failure, stop-on contact control, load torque high speed frequency control, droop control, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, online auto tuning function, PID control, computer link operation (RS-485), motor end orientation[*1], machine end orientation[*1], pre-excitation, notch filter, machine analyzer[*1], easy gain tuning, speed feed forward, torque bias[*1]
	Output signal	Operating status	You can select any signals using [*Pr. 190 to Pr. 196 Output terminal function selection*] from among inverter running 1 and 2, inverter running start command ON, up-to-frequency, instantaneous power failure/under voltage, over load warning, first, second, and third output frequency (speed, detection, regeneration brake prealarm, electronic thermal relay function prealarm, PU operation mode, inverter operation ready 1 and 2, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, electronic bypass MC1, 2, 3, orientation completion[*1], orientation fault[*1], brake opening request, fan alarm output, heatsink overheat pre-alarm, deceleration at an instantaneous power failure, PID control activated, during retry, PID output interruption, preparation ready[*1], life alarm, power savings average value update timing, current average monitor, fault output 1, 2, and 3 (power-off signal), maintenance timer alarm, remote output, forward rotation, reverse rotation output[*1], low-speed output, torque detection, regeneration status output[*1], start-time tuning completion, in-position[*1], minor fault output1, 2. Open collector output (5 points), relay output (2 points) and alarm code of the inverter can be output (4 bit) from the open collector.
		When used with the FR-A7AY, FR-A7AR (option)	In addition to the above, you can select any signals using [*Pr. 313 to Pr. 322 Extension output terminal function selection*] from among control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life. (only positive logic can be set for extension terminals of the FR-A7AR)
		Pulse train output	50kpps
		Pulse/analog output	You can select using [*Pr. 54 FM terminal function selection*] (pulse train output), [*Pr. 158 AM terminal function selection*] (analog output) from among output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, reference voltage output, motor load factor, power saving effect, regenerative brake duty, PID set point, PID measured value, motor output, torque command, torque current command, and torque monitor.

Indication	PU (FR-DU07/ FR-PU04/ FR-PU07)	Operating status	Output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, overload, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, cumulative energization time, actual operation time, motor load factor, cumulative power, power saving effect, cumulative saving power, regenerative brake duty, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*2, output terminal option monitor*2, option fitting status*3, terminal assignment status*3, torque command, torque current command, feed back pulse*1, motor output
		Alarm description	Fault definition is displayed during fault occurrence, the output voltage/current/frequency/cumulative energization time right before the fault occurs and past eight fault definitions are stored.
		Interactive guidance	Function (help) for operation guide*3
Protective/warning function			Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase failure*6, motor overload, output side earth (ground) fault overcurrent, output short circuit, main circuit element overheat, output phase loss, external thermal relay operation*6, PTC thermistor operation*6, option alarm, parameter error, PU disconnection, retry count excess*6, CPU alarm, operation panel power supply short circuit, 24VDC power output short circuit, output current detection value excess*6, inrush resistance overheat, communication alarm (inverter), USB error, analog input error, fan fault, overcurrent stall prevention, overvoltage stall prevention, electronic thermal relay function prealarm, PU stop, maintenance timer alarm*2 *6, brake transistor alarm, parameter write error, copy operation error, operation panel lock, parameter copy alarm, encoder no-signal*1, speed deviation large*1 *6, overspeed*1 *6, position error large*1 *6, encoder phase error*1 *6, signal loss detection*1 *6, brake sequence error*6
Environment	Surrounding air temperature		-10℃ to +50℃ (non-freezing)
	Ambient humidity		90%RH maximum (non-condensing)
	Storage temperature*4		-20℃ to +65℃
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration		Maximum 1000m above sea level, 5.9m/s^2 or less at 10 to 55Hz (directions of X, Y, Z axes) *5

*1 Available only when the option (FR-A7AP/FR-A7AL) is mounted.
*2 Can be displayed only on the operation panel (FR-DU07).
*3 Can be displayed only on the parameter unit (FR-PU07/FR-PU04).
*4 Temperature applicable for a short period in transit, etc.
*5 2.9m/s^2 or less for the 160K or more.
*6 This protective function does not function in the initial status.

(2) FR-F700

Control specifications	Control method		Soft-PWM control/high carrier frequency PWM control (V/F control, Optimum excitation control, Simple magnetic flux vector control)
	Output frequency range		0.5 to 400Hz
	Frequency setting resolution	Analog input	0.015Hz/0 to 60Hz (terminal 2, 4 : 0 to 10V/12bit) 0.03Hz/0 to 60Hz (terminal 2, 4 : 0 to 5V/11 bit, 0 to 20mA/about 11 bit, terminal 1 : 0 to ± 10V/12 bit) 0.06Hz/0 to 60Hz (terminal1: 0 to ± 5V/11bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	Within ±0.2% of the maximum output frequency (25℃ ±10℃)
		Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics		Base frequency can be set from 0 to 400Hz Constant torque/variable torque pattern or adjustable 5 points V/F can be selected
	Starting torque		120% at 3Hz when set to simple magnetic flux vector control and slip compensation
	Acceleration/deceleration time setting		0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.
	DC injection brake		Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable
	Stall prevention operation level		Operation current level can be set (0 to 150% adjustable), whether to use the function or not can be selected
Operation specifications	Frequency setting signal	Analog input	Terminal 2, 4: 0 to 10V, 0 to 5V, 4 to 20mA (0 to 20mA) can be selected Terminal 1: -10 to +10V, -5 to 5V can be selected
		Digital input	Four-digit BCD or16-bit binary using the setting dial of the operation panel (when used with the option FR-A7AX)
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected
	Input signal		You can select any twelve signals using [*Pr. 178 to Pr. 189 Input terminal function selection*] from among multi speed selection, second function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, external thermal relay input, HC/CV connection (inverter operation enable signal), HC connection (instantaneous power failure detection), PU operation/external inter lock signal, PID control enable terminal, PU operation/external operation switchover, output stop, start self-holding selection, forward rotation command, reverse rotation command, inverter reset, PTC thermistor input, PID forward reverse operation switchover, PU-NET operation switchover, NET-external operation switchover, and command source switchover.
	Operational functions		Maximum and minimum frequency settings, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure, original operation continuation at instantaneous power failure, bypass operation, forward/reverse rotation prevention, operation mode selection, PID control, computer link operation (RS-485)
	Output signal — Operating status		You can select any seven signals using [*Pr. 190 to Pr. 196 Output terminal function selection*] from among inverter running, up-to-speed, instantaneous power failure/undervoltage, overload warning, output frequency detection, second output frequency detection, regenerative brake pre-alarm*4, electronic thermal relay function pre-alarm, PU operation mode, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward rotation reverse rotation output, electronic bypass MC1, electronic bypass MC2, electronic bypass MC3, fan alarm output, heatsink overheat pre-alarm, inverter running/start command on, deceleration at an instantaneous power failure, PID control activated, during retry, PID output interruption, life alarm, fault output 3 (power-off signal), power savings average value update timing, current average monitor, fault output 2, maintenance timer alarm, remote output, alarm output, fault output. Open collector output (5 points), relay output (2 points) and alarm code of the inverter can be output (4 bit) from the open collector.
		When used with the FR-A7AY, FR-A7AR (option)	In addition to the above, you can select any signals using [*Pr. 313 to Pr. 322 Extension output terminal function selection*] from among control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life. (only positive logic can be set for extension terminals of the FR-A7AR)
	Output signal — Pulse/analog output		You can select using [*Pr. 54 FM terminal function selection*] (pulse train output)and [*Pr. 158 AM terminal function selection*] (analog output) from among output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, reference voltage output, motor load factor, power saving effect, regenerative brake duty*4, PID set point, PID measured value.
Indication	PU (FR-DU07/ FR-PU04/ FR-PU07)	Operating status	Output frequency, motor current (steady or peak value), output voltage, fault or alarm indication, frequency setting, running speed, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, cumulative energization time, actual operation time, motor load factor, cumulative power, power saving effect, cumulative saving power, regenerative brake duty*4, PID set point, PID process value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*1, output terminal option monitor*1, option fitting status monitor*2, terminal assignment status*2.
		Alarm description	Fault definition is displayed during fault occurrence, the output voltage/current/frequency/cumulative energization time right before the fault occurs and past eight fault definitions are stored.
		Interactive guidance	Operation guide/trouble shooting with a help function*2

Protective/warning function		Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase loss *6, motor overload, output side earth (ground) fault overcurrent, output phase loss, external thermal relay operation *6, PTC thermistor operation *6, option fault, parameter error, PU disconnection, retry count excess *6, CPU fault, operation panel power supply short circuit, 24VDC power output short circuit, output current detection value excess *6, inrush current limit circuit fault, communication fault (inverter), analog input fault, internal circuit fault (15V power supply), fan alarm, overcurrent stall prevention, overvoltage stall prevention, regenerative brake prealarm *6, electronic thermal relay function prealarm, PU stop, maintenance timer alarm *1*6, brake transistor alarm detection *4, parameter write error, copy operation error, operation panel lock, parameter copy
Environment	Surrounding air temperature	-10℃ to +50℃ (non-freezing)
	Ambient humidity	90%RH maximum (non-condensing)
	Storage temperature*3	-20℃ to +65℃
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration	Maximum 1000m above sea level, 5.9m/s^2 or less at 10 to 55Hz (directions of X, Y, Z axes) *5

*1 Can be displayed only on the operation panel (FR-DU07).

*2 Can be displayed only on the parameter unit (FR-PU07/FR-PU04).

*3 Temperature applicable for a short period in transit, etc.

*4 Functions for 75K or more.

*5 2.9m/s^2 or less for the 185K or more.

*6 This protective function does not function in the initial status.

(3) FR-E700

Control specifications	Control method		Soft-PWM control/high carrier frequency PWM control (V/F control, Advanced magnetic flux vector control, General-purpose magnetic flux vector control, Optimum excitation control can be selected)
	Output frequency range		0.2 to 400Hz
	Frequency setting resolution	Analog input	0.06Hz/60Hz (terminal2, 4: 0 to 10V/10bit) 0.12Hz/60Hz (terminal2, 4: 0 to 5V/9bit) 0.06Hz/60Hz (terminal4: 0 to 20mA/10bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	Within ±0.5% of the max. output frequency (25°C ±10°C)
		Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics		Base frequency can be set from 0 to 400Hz, constant-torque/variable torque pattern can be selected
	Starting torque		200% or more (at 0.5Hz)...when Advanced magnetic flux vector control is set (3.7K or less)
	Torque boost		Manual torque boost
	Acceleration/deceleration time setting		0.01 to 360s, 0.1 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/ deceleration mode can be selected.
	Braking torque	Regenerative*1	0.1K, 0.2K ..... 150%, 0.4K, 0.75K ..... 100%, 1.5K ..... 50%, 2.2K or more 20%
		DC injection brake	Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable
	Stall prevention operation level		Operation current level can be set (0 to 200% adjustable), whether to use the function or not can be selected
Operation specifications	Frequency setting signal	Analog input	Two points Terminal 2: 0 to 10V, 0 to 5V can be selected Terminal 4: 0 to 10V, 0 to 5V, 4 to 20mA can be selected
		Digital input	Entered from operation panel and parameter unit
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signal		Seven points You can select from among multi-speed selection, remote setting, stop-on contact selection, second function selection, terminal 4 input selection, JOG operation selection, PID control valid terminal, brake opening completion signal, external thermal input, PU-External operation switchover, V/F switchover, output stop, start self-holding selection, forward rotation, reverse rotation command, inverter reset, PU-NET operation switchover, External-NET operation switchover, command source switchover, inverter operation enable signal, and PU operation external interlock
	Operational functions		Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart after instantaneous power failure operation, forward/reverse rotation prevention, remote setting, brake sequence, second function, multi-speed operation, stop-on contact control, droop control, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485)
	Output signal: Output signal points	Open collector output	Two points
		Relay output	One point
	Output signal: Operating status		You can select from among inverter operation, up-to-frequency, overload alarm, output frequency detection, regenerative brake prealarm, electronic thermal relay function prealarm, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, brake opening request, fan alarm*3, heatsink overheat pre-alarm, deceleration at an instantaneous power failure, PID control activated, during retry, life alarm, current average value monitor, remote output, alarm output, fault output, fault output 3, and maintenance timer alarm
	Output signal: Output point for meter	Pulse output	MAX 2.4kHz: one point
	Output signal: For meter		You can select from among output frequency, motor current (steady), output voltage, frequency setting, motor torque, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, reference voltage output, motor load factor, PID set point, PID measured value, output power Pulse train output (1440 pulse/s/full scale)
Indication	Operation panel Parameter unit (FR-PU07)	Operating status	You can select from among output frequency, motor current (steady), output voltage, frequency setting, cumulative energization time, actual operation time, motor torque, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, motor load factor, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, I/O terminal option monitor, output power, cumulative power, motor thermal load factor, and inverter thermal load factor.
		Fault definition	Fault definition is displayed when the fault occurs and the past 8 fault definitions (output voltage/current/ frequency/cumulative energization time right before the fault occurs) are stored
	Additional display by the parameter unit (FR-PU04/FR-PU07) only	Operating status	Not used
		Fault definition	Output voltage/current/frequency/cumulative energization time immediately before the fault occurs
		Interactive guidance	Function (help) for operation guide

Protective/warning function	Protective functions	Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, input phase failure, output side earth (ground) fault overcurrent at start*5, output phase failure, external thermal relay operation *5, option fault, parameter error, PU disconnection, retry count excess *5, CPU fault, brake transistor alarm, inrush resistance overheat, communication error, analog input error, USB communication error, brake sequence error 4 to 7 *5
	Warning functions	Fan alarm*3, overcurrent stall prevention, overvoltage stall prevention, PU stop, parameter write error, regenerative brake prealarm *5, electronic thermal relay function prealarm, maintenance output *5, undervoltage
Environment	Surrounding air temperature	-10°C to +50°C (non-freezing) (-10°C to +40°C for totally-enclosed structure feature) *4
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature*2	-20°C to +65°C
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration	Maximum 1000m above sea level, 5.9m/s ^{2} or less at 10 to 55Hz (directions of X, Y, Z axes)

*1 The braking torque indicated is a short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 60Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. (Not available for 0.1K and 0.2K.) A brake unit (FR-BU2) may also be used.

*2 Temperatures applicable for a short time, e.g. in transit.

*3 As the 0.75K or less are not provided with the cooling fan, this alarm does not function.

*4 When using the inverters at the surrounding air temperature of 40°C or less, the inverters can be installed closely attached (0cm clearance).

*5 This protective function does not function in the initial status.

(4) FR-D700

Control specifications	Control method			Soft-PWM control/high carrier frequency PWM control (V/F control, General-purpose magnetic flux vector control, Optimum excitation control can be selected)
	Output frequency range			0.2 to 400Hz
	Frequency setting resolution		Analog input	0.06Hz/60Hz (terminal2, 4: 0 to 10V/10bit) 0.12Hz/60Hz (terminal2, 4: 0 to 5V/9bit) 0.06Hz/60Hz (terminal4: 0 to 20mA/10bit)
			Digital input	0.01Hz
	Frequency accuracy		Analog input	Within ±1% of the max. output frequency (25°C ±10°C)
			Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics			Base frequency can be set from 0 to 400Hz. Constant-torque/variable torque pattern can be selected
	Starting torque			150% or more (at 1Hz)...when General-purpose magnetic flux vector control and slip compensation is set
	Torque boost			Manual torque boost
	Acceleration/deceleration time setting			0.1 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.
	Braking torque		Regenerative*1	0.1K, 0.2K ... 150%, 0.4K, 0.75K ... 100%, 1.5K ... 50%, 2.2K or more ... 20%
			DC injection brake	Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable
	Stall prevention operation level			Operation current level can be set (0 to 200% adjustable), whether to use the function or not can be selected
Operation specifications	Frequency setting signal		Analog input	Two points Terminal 2: 0 to 10V, 0 to 5V can be selected Terminal 4: 0 to 10V, 0 to 5V, 4 to 20mA can be selected
			Digital input	Entered from operation panel and parameter unit. Frequency setting increments is selectable
	Start signal			Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signal (Five terminals)			You can select from among multi-speed selection, remote setting, second function selection, terminal 4 input selection, JOG operation selection, PID control valid terminal, external thermal input, PU-External operation switchover, V/F switchover, output stop, start self-holding selection, forward rotation, reverse rotation command, inverter reset, PU-NET operation switchover, External-NET operation switchover, command source switchover, inverter operation enable signal, and PU operation external interlock.
	Operational functions			Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart after instantaneous power failure operation, forward/reverse rotation prevention, remote setting, second function, multi-speed operation, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485), Optimum excitation control, power failure stop, speed smoothing control, Modbus-RTU
	Output signal	Open collector output		One terminal
		Relay output		One terminal
		Operating status		You can select from among inverter operation, up-to-frequency, overload alarm, output frequency detection, regenerative brake prealarm, electronic thermal relay function prealarm, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, fan alarm*3, heatsink overheat pre-alarm, deceleration at an instantaneous power failure, PID control activated, PID output interruption, during retry, life alarm, current average value monitor, remote output, alarm output, fault output, fault output 3, and maintenance timer alarm.
		Output point for meter	Pulse output	MAX 2.4kHz: one point
		For meter Pulse train output (MAX 2.4kHz: one terminal)		You can select from among output frequency, output current (steady), output voltage, frequency setting, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, reference voltage output, motor load factor, PID set point, PID measured value, output power, PID deviation, motor thermal load factor, and inverter thermal load factor. Pulse train output (1440 pulse/s/full scale)
Indication	Operation panel Parameter unit (FR-PU07)		Operating status	You can select from among output frequency, output current (steady), output voltage, frequency setting, cumulative energization time, actual operation time, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, motor load factor, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, output power, cumulative power, motor thermal load factor, inverter thermal load factor, PTC thermistor resistance.
			Fault definition	Fault definition is displayed when the fault occurs and the past 8 fault definitions (output voltage/current/frequency/cumulative energization time right before the fault occurs) are stored
			Interactive guidance	Function (help) for operation guide

Protective/warning function	Protective functions	Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, input phase loss *5, output side earth (ground) fault overcurrent at start*5, output phase loss, external thermal relay operation *5, PTC thermistor operation*5, parameter error, PU disconnection, retry count excess *5, CPU fault, brake transistor alarm, inrush resistance overheat, analog input error, stall prevention operation, output current detection value exceeded *5, safety circuit fault
	Warning functions	Fan alarm*3, overcurrent stall prevention, overvoltage stall prevention, PU stop, parameter write error, regenerative brake prealarm *5, electronic thermal relay function prealarm, maintenance output *5, undervoltage, operation panel lock, password locked, inverter reset, safety stop
Environment	Surrounding air temperature	-10°C to +50°C maximum (non-freezing) (-10°C to +40°C for totally-enclosed structure feature) *4
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature*2	-20°C to +65°C
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration	Maximum 1000m above sea level, 5.9m/s ^{2} or less at 10 to 55Hz (directions of X, Y, Z axes)

*1 The braking torque indicated is a short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 60Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. A brake unit (FR-BU2) may also be used.

*2 Temperatures applicable for a short time, e.g. in transit.

*3 As the 0.75K or less are not provided with the cooling fan, this alarm does not function.

*4 When using the inverters at the surrounding air temperature of 40°C or less, the inverters can be installed closely attached (0cm clearance).

*5 This protective function does not function in the initial status.

1.2 Specification comparison list

1.2.1 Specification comparison list

Item		FR-A700	FR-A500 (L)	FR-V500 (L)	FR-F700	FR-F500 (L)
Capacity range	Three-phase 200V class	0.4K to 90K (17 models)	A500 : 0.4K to 55K (15 models) A500L : 75K to 90K (2 models)	V500 : 1.5K to 55K (13 models) V500L : 75K (1model)	0.75K to 110K (17 models)	F500 : 0.75K to 55K (14 models) F500L : 75K to 110K (3 models)
	Three-phase 400V class	0.4K to 500K (29 models)	A500 : 0.4K to 55K (15 models) A500L : 75K to 450K (9 models)	V500 : 11.5K to 55K (13 models) V500L : 75K to 250K (7 models)	0.75K to 560K (29 models)	F500 : 0.75K to 55K (14models) F500L : 75K to 530K (11 models)
	Single-phase 200V class	—	—	—	—	—
	Single-phase 100V class	—	—	—	—	—
Control method	Switching method	Soft-PWM control High carrier frequency PWM control	Soft-PWM control A500 : High carrier frequency PWM control A500L : Sine wave PWM control	Soft-PWM control V500 : High carrier frequency PWM control V500L : Sine wave PWM control	Soft-PWM control High carrier frequency PWM control	Soft-PWM control F500 : High carrier frequency PWM control F500L : Sine wave PWM control
	Control mode	V/F control, Advanced magnetic flux vector control, Real sensorless vector control, vector control (when used with the option FR-A7AP/FR-A7AL)	V/F control, Advanced magnetic flux vector control, vector control (when used with the option FR-A5AP)	V/F control, vector control	V/F control, Optimum excitation control, Simple magnetic flux vector control	V/F control, Optimum excitation control
Motor noise		Ultra low noise	A500 : ultra low noise A500L : non-low noise	A500 : ultra low noise V500L : non-low noise	Ultra low noise	F500 : ultra low noise F500L : non-low noise
	Carrier frequency	55K or less : 0.7kHz to 14.5kHz (initial setting 2kHz Soft-PWM control) 75K or more : 0.7kHz to 6kHz (initial setting 2kHz Soft-PWM control)	A500 0.7kHz to 14.5kHz (initial setting 2kHz Soft-PWM control) A500L 0.7, 1, 2.5kHz (initial setting 1kHz Soft-PWM control)	V500 2.25kHz to 13.5kHz (initial setting 2.25kHz) V500L 2.25kHz (initial setting 2.25kHz)	55K or less : 0.7kHz to 14.5kHz (initial setting 2kHz Soft-PWM control) 75K or more : 0.7kHz to 6kHz (initial setting 2kHz Soft-PWM control)	F500 : 0.7kHz to 14.5kHz (initial setting 2kHz Soft-PWM control) F500L : 0.7, 1, 2.5kHz (initial setting 1kHz Soft-PWM control)
Overload current rating		150% 60s, 200% 3s (inverse-time characteristics)	150% 60s, 200% 0.5s (inverse-time characteristics)	150% 60s, 200% 0.5s (inverse-time characteristics)	120% 60s, 150% 3s (inverse-time characteristics)	120% 60s, 150% 0.5s (inverse-time characteristics)
Current limit	Stall prevention	○	○	○	○	○
	Fast-response current limit	○	○	○	○	○
Torque limit		○ (under Real sensorless vector control, vector control)	○ (under vector control)	○ (under vector control)	—	—
Braking capability		200V class 0.4K to 1.5K 150% (built-in resistor)	200V class 0.4K to 1.5K 150% (built-in resistor)	1.5K to 5.5K 100% (built-in resistor)	0.75K to 55K 15% (capacitor regeneration)	0.75K to 55K 15% (capacitor regeneration)
		200V class 2.2K to 7.5K 400V class 0.4K to 7.5K 100% (built-in resistor)	200V class 2.2K to 7.5K 400V class 0.4K to 7.5K 100% (built-in resistor)			
		11K to 55K 20% (capacitor regeneration)	11K to 55K 20% (capacitor regeneration)	7.5K to 55K 20% (capacitor regeneration)		
		75K or more 10% (capacitor regeneration)	75K or more 10% (capacitor regeneration)	75K or more 10% (capacitor regeneration)	75K or more 10% (capacitor regeneration)	75K or more 10% (capacitor regeneration)
Built-in brake transistor		0.4K to 22K	0.4K to 7.5K	1.5K to 5.5K	—	—
Built-in brake resistor (capacity available as standard)		0.4K to 7.5K	0.4K to 7.5K	1.5K to 5.5K	—	—
Compatibility by the outline dimension		Some of capacities of A500 and V500 series are not compatible (intercompatibility attachment (option) is available) Some of capacities of A500L and V500L series are not compatible (intercompatibility attachment (option) is unavailable)	—	—	Some of capacities of F500 series are not compatible (intercompatibility attachment (option) is available) Some of capacities of F500L series are not compatible (intercompatibility attachment (option) is unavailable)	—

○: Available △: Partially available —: Not available

FRL-E700	FR-E500	FR-D700	FR-S500	FR-F500J
0.1K to 15K (11 models)	0.1K to 7.5K(9 models)	0.1K to 15K (11 models)	0.1K to 3.7K (7 models)	0.4K to 15K (9 models)
0.4K to 15K (9 models)	0.4K to 7.5K (7 models)	0.4K to 15K (9 models)	0.4K to 3.7K (5 models)	0.4K to 15K (9 models)
0.1K to 2.2K (6 models)	0.1K to 0.75K (4 models)	0.1K to 2.2K (6 models)	0.1K to 1.5K (5 models)	—
0.1K to 0.75K (4 models)	0.1K to 0.75K (4 models)	0.1K to 0.75K (4 models)	0.1K to 0.75K (4 models)	—
Soft-PWM control High carrier frequency PWM control	Soft-PWM control High carrier frequency PWM control	Soft-PWM control High carrier frequency PWM control	Soft-PWM control High carrier frequency PWM control	Soft-PWM control High carrier frequency PWM control
V/F control, General-purpose magnetic flux vector control, Advanced magnetic flux vector control, Optimum excitation control	V/F control, General-purpose magnetic flux vector control	V/F control, General-purpose magnetic flux vector control, Optimum excitation control	V/F control, automatic torque boost	V/F control, automatic torque boost
Ultra low noise	Ultra low noise	Ultra low noise	Ultra low noise	Ultra low noise
0.7kHz to 14.5kHz (initial setting 1kHz Soft-PWM control)	0.7kHz to 14.5kHz (initial setting 1kHz Soft-PWM control)	0.7kHz to 14.5kHz (initial setting 1kHz Soft-PWM control)	0.7kHz to 14.5kHz (initial setting 1kHz Soft-PWM control)	0.7kHz to 14.5kHz (initial setting 1kHz Soft-PWM control)
150% 60s, 200% 3s (inverse-time characteristics)	150% 60s, 200% 0.5s (inverse-time characteristics)	150% 60s, 200% 0.5s (inverse-time characteristics)	150% 60s, 200% 0.5s (inverse-time characteristics)	120% 60s, 150% 0.5s (inverse-time characteristics)
○	○	○	○	○
○	○	○	○	○
○ (Simple torque limit)	—	—	—	—
0.1K, 0.2K 75%(capacitor regeneration)	0.1K, 0.2K 75%(capacitor regeneration)	0.1K, 0.2K 75%(capacitor regeneration)	0.1K, 0.2K 75%(capacitor regeneration)	15%(capacitor regeneration)
0.4K, 0.75K 50%(capacitor regeneration)	0.4K, 0.75K 50%(capacitor regeneration)	0.4K, 0.75K 50%(capacitor regeneration)	0.4K, 0.75K 50%(capacitor regeneration)	
1.5K 25%(capacitor regeneration)	1.5K 25%(capacitor regeneration)	1.5K 25%(capacitor regeneration)	1.5K 25%(capacitor regeneration)	
2.2K or more 20%(capacitor regeneration)	2.2K or more 20%(capacitor regeneration)	2.2K or more 20%(capacitor regeneration)	2.2K or more 20%(capacitor regeneration)	
0.4K to 15K	0.4K to 7.5K	0.4K to 15K	FR-S520E-0.4K to 3.7K (Not built-in to the S500E or S500 except for the above)	—
—	—	—	—	—
Compatible with E500 series	—	Compatible with S500 series	—	—

Item		FR-A700	FR-A500 (L)	FR-V500 (L)	FR-F700	FR-F500 (L)
Instantaneous power failure	Instant immunity	15ms	15ms	15ms	15ms	15ms
	Restart function	With frequency search method (rotation direction can be detected) Without frequency search method	With frequency search method Without frequency search method	With frequency search method Without frequency search method	With frequency search method (rotation direction can be detected) Without frequency search method	With frequency search method Without frequency search method
	Operation continuance at power failure function	○	—	—	○	—
	Power failure-time deceleration-to-stop function	○	○	○	○	—
Operation function	Multi speed	15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)	15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)	15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)	15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)	15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)
	Multi speed compensation	○	○	○	○	○
	Reversible operation (polarity reversible)	○	○	○	○	○
	Slip compensation	○	○ (except for V/F control)	○ (except for V/F control)	○	—
	PID operation function	○	○	○	○	○
	Electronic bypass sequence function	○	○	—	○	○
	Brake sequence function	○	○	○	—	—
	High speed frequency control	○	○	—	○	○
	Stop-on-contact control	○	○	—	—	—
	Output current detection	○	○	○	○	—
	Cooling fan on/off control	○	○	○	○	○
	Retry at a fault	○	○	○	○	○
	Regeneration avoidance function	○	—	—	○	—
	Zero current detection	○	○	○	○	○
	Machine analyzer function (under vector control)	○ (use FR Configurator)	—	○ (use FR Configurator)	—	—
	Intelligent mode	Shortest acceleration/ deceleration, Optimum acceleration/ deceleration, energy saving, lift, brake sequence	Shortest acceleration/ deceleration, Optimum acceleration/ deceleration, energy saving, lift, brake sequence	Brake sequence	Energy saving, Optimum excitation control	Optimum acceleration/ deceleration, energy saving, Optimum excitation control

FRL-E700	FR-E500	FR-D700	FR-S500	FR-F500J
10ms	10ms	10ms	10ms	10ms
With frequency search method (rotation direction can be detected) Without frequency search method	Without frequency search method	With frequency search method (rotation direction can be detected) Without frequency search method	With frequency search method (only for S500E) Without frequency search method	Without frequency search method
○	—	○	—	—
○	—	○	—	—
15 speed (18 speed maximum by combination of JOG, upper limit, and lower limit)	15 speed (17 speed maximum by combination of upper limit and lower limit)	15 speed (17 speed maximum by combination of upper limit and lower limit)	15 speed (17 speed maximum by combination of upper limit and lower limit)	15 speed (17 speed maximum by combination of upper limit and lower limit)
—	—	—	—	—
○	—	○	—	—
○	○	○	○	○
○	○	○	○	○
—	—	—	—	—
○	—	—	—	—
—	—	—	—	—
○	—	—	—	—
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	—	○	—	—
○	○	○	○	○
—	—	—	—	—
Shortest acceleration/ deceleration, Optimum excitation control, brake sequence	Shortest acceleration/ deceleration	Optimum excitation control	—	—

1

SPECIFICATIONS

	Item	FR-A700	FR-A500 (L)	FR-V500 (L)	FR-F700	FR-F500 (L)
Operation panel・Parameter unit		FR-DU07 is equipped as standard	FR-DU04 is equipped as standard	FR-DU04-1 is equipped as standard	FR-DU07 is equipped as standard	FR-DU04 is equipped as standard
	[Pr.] group registration	○	○	—	○	○
	[Pr.] initial value setting	△ (available by using [Pr.] copy)	○	○	△ (available by using [Pr.] copy)	○
	Copy function	○	○	○	○	○
	Password lock	—	—	—	—	—
	Language display	FR-DU07 : no language display FR-PU07 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	FR-DU04 : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	FR-DU04-1 : no language display FR-PU04V : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	FR-DU07 : no language display FR-PU07 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	FR-DU04 : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)
	FR-PU01	—	—	—	—	—
	FR-PU02/FR-ARW	—	—	—	—	—
	FR-PU03/FR-ARW03	—	—	—	—	—
	FR-PU04	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)
	FR-PU04V	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)
	FR-DU04	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)
	FR-DU04-1	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)
	E500 operation panel PA02	—	—	—	—	—
	FR-PU07	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)
	FR-DU07	○ ([Pr.] can be copied)	—	—	○ ([Pr.] can be copied)	—
	FR-PA07	△	—	—	△	—
Communication functions	RS-422/RS-485	○ Two ports as standard	○ One port as standard and another as plug-in	○ One port as standard and another as plug-in	○ Two ports as standard	○ One port as standard and another as plug-in
	Modbus-RTU	○	—	—	○	—
	CC-Link	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)
	PROFIBUS-DP	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)
	DeviceNetTM	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)	○ (plug-in option)
	Modbus Plus	×	○ (plug-in option)	—	—	○ (plug-in option)
	LONWORKS	○ (plug-in option)	—	—	○ (plug-in option)	○ (plug-in option)
	EtherNet	—	—	○ (plug-in option)	—	—
	SSCNET	—	—	○ (plug-in option)	—	—
	SSCNETIII	○ (plug-in option)	—	—	—	—
	USB	○	—	—	—	—

	FRL-E700	FR-E500	FR-D700	FR-S500	FR-F500J
	Built-in operation panel (not removable)	DA02 is equipped as standard	Built-in operation panel (not removable)	Built-in operation panel (not removable)	Built-in operation panel (not removable)
	○	○	—	—	—
	△ (available by using [Pr.] copy)	△ (available by using [Pr.] copy)	△ (available by using [Pr.] copy)	△ (available by using [Pr.] copy)	△ (available by using [Pr.] copy)
	—	—	—	—	—
	—	—	○	—	—
	Built-in operation panel : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	PA02 : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	Built-in operation panel : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	Built-in operation panel : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)	Built-in operation panel : no language display FR-PU04 : eight languages (Japanese, English, German, French, Spanish, Italian, Swedish, Finnish)
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	○ ([Pr.] can be copied)
	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)	△ ([Pr.] can not be copied)
	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	○ ([Pr.] can be copied)
	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	△ ([Pr.] can not be copied)	○ ([Pr.] can be copied)	○ ([Pr.] can be copied)
	○	○	○	—	—
	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)	○ ([Pr.] of three models can be copied)
	△	—	△	—	—
	○	—	○	—	—
	○ One port as standard	○ One port as standard	○ One port as standard	○ One port as standard	○ One port as standard
	○	—	○	○ (Only for FR-S520E-□K-NMR)	—
	○ (plug-in option)	○(only for the following) (Three-phase 200V : dedicated model Three-phase 400V : plug-in option)	—	—	—
	○ (plug-in option)	—	—	—	—
	○ (plug-in option)	○(only for the following) (Three-phase 200V : dedicated model Three-phase 400V : plug-in option)	—	—	—
	—	—	—	—	—
	○ (plug-in option)	○(only for the following) (Three-phase 400V : plug-in option)	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	○	—	—	—	—

Item		FR-A700	FR-A500 (L)	FR-V500 (L)	FR-F700	FR-F500 (L)
I/O	Input terminal assignment	Available in 12 terminals	Available in 7 terminals	Available in 5 terminals	Available in 12 terminals	Available in 7 terminals
	Output terminal assignment	Available in 5 terminals	Available in 5 terminals	Available in 3 terminals	Available in 5 terminals	Available in 5 terminals
	Fault output assignment	Available in 2 terminals (ABC1, ABC2)	Available in 1 terminal (ABC)	Available in 1 terminal (ABC)	Available in 2 terminals (ABC1, ABC2)	Available in 1 terminal (ABC)
	PC terminal	○	○	○	○	○
	24V power	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)
	Sink-source logic switchover	○	○	○	○	○
	Alarm code output	○	○	—	○	○
	Pulse train I/O	○	Pulse train input : plug-in option	Pulse train input : plug-in option	—	—
Frequency setting signal		0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA) 0 to ±5VDC, 0 to ±10V	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA) 0 to ±5VDC, 0 to ±10V	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA) 0 to ±5VDC, 0 to ±10V	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA) 0 to ±5VDC, 0 to ±10V	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA) 0 to ±5VDC, 0 to ±10V
Structure	Control circuit terminal	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)
	Main circuit terminal	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)
	Control circuit's separate power supply	○	○	○	○	○
	Cooling fan cassette changing method	○ (cooling fans are provided on top of the inverter)	○	○	○ (cooling fans are provided on top of the inverter)	○
	Removable terminal block	○	○	○	○	○
Life	Main circuit capacitor	10 years	10 years	10 years	10 years	10 years
	Control circuit capacitor	10 years	10 years	10 years	10 years	10 years
	Cooling fan	10 years	2 to 3 years	2 to 3 years	10 years	2 to 3 years
Life diagnosis	Main circuit capacitor	○	—	—	○	—
	Control circuit capacitor	○	—	—	○	—
	Cooling fan	○	—	—	○	—
	Inrush current limit circuit	○	—	—	○	—
Built-in EMC filter		○ (2nd Environment)	—	—	○ (2nd Environment)	—
Plug-in option		Up to three single-function options may be plugged in	Up to three single-function options may be plugged in	Up to three single-function options may be plugged in	A single-function option can be plugged in	Up to three single-function options may be plugged in
Setup software		FR Configurator (FR-SW2-SETUP-WJ, FR-SW3-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ, FR-SW2-SETUP-WJ, FR-SW3-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)
Harmonic suppression	AC reactor	○ (option)	○ (option)	○ (option)	○ (option)	○ (option)
	DC reactor	○ (option, provided for 75K or more)	○ (option, provided for 75K or more)	○ (option, provided for 75K or more)	○ (option, provided for 75K or more)	○ (option, provided for 75K or more)
	High power factor converter	○ (option)	○ (option)	○ (option)	○ (option)	○ (option)
Safety stop function		—	—	—	—	—

FRL-E700	FR-E500	FR-D700	FR-S500	FR-F500J
Available in 7 terminals	Available in 4 terminals	Available in 5 terminals	Available in 4 terminals	Available in 4 terminals
Available in 2 terminals	Available in 2 terminals	Available in one terminals	Available in one terminals	Available in one terminals
Available in 1 terminal (ABC)	Available in 1 terminal (ABC)	Available in 1 terminal (ABC)	Available in 1 terminal (ABC)	Available in 1 terminal (ABC)
○	○	○	○	○
○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)	○ (PC terminal is used as power supply)
○	○	○	○	○
—	—	—	—	—
—	—	—	—	—
0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA)	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA)	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA)	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA)	0 to 5VDC, 0 to 10V 4 to 20mADC (0 to 20mA)
Screw type terminal (Using blade terminal)	Screw type terminal (Using blade terminal)	Spring clamp type terminal (Using blade terminal)	Screw type terminal (Using blade terminal)	Screw type terminal (Using blade terminal)
Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)	Screw type terminal (Using ring tongue terminal)
—	—	—	—	—
○ (cooling fans are provided on top of the inverter)	○	○ (cooling fans are provided on top of the inverter)	○	○
○	—	—	—	—
10 years	5 years	10 years	5 years	10 years
10 years	5 years	10 years	5 years	10 years
10 years	2 to 3 years	10 years	2 to 3 years	2 to 3 years
○	—	○	—	—
○	—	○	—	—
○	—	○	—	—
○	—	○	—	—
—	—	—	—	—
A single-function option can be plugged in	A single-function option can be plugged in (only for 400V class)	—	—	—
FR Configurator (FR-SW3-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)	FR Configurator (FR-SW3-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)	FR Configurator (FR-SW1-SETUP-WJ)
○ (option)	○ (option)	○ (option)	○ (option)	○ (option)
○ (option)	○ (option)	○ (option)	○ (option)	○ (option)
○ (option)	○ (option)	○ (option)	○ (option, not available for FR-S520E-0.1K to 0.75K)	○ (option)
—	—	○	—	—

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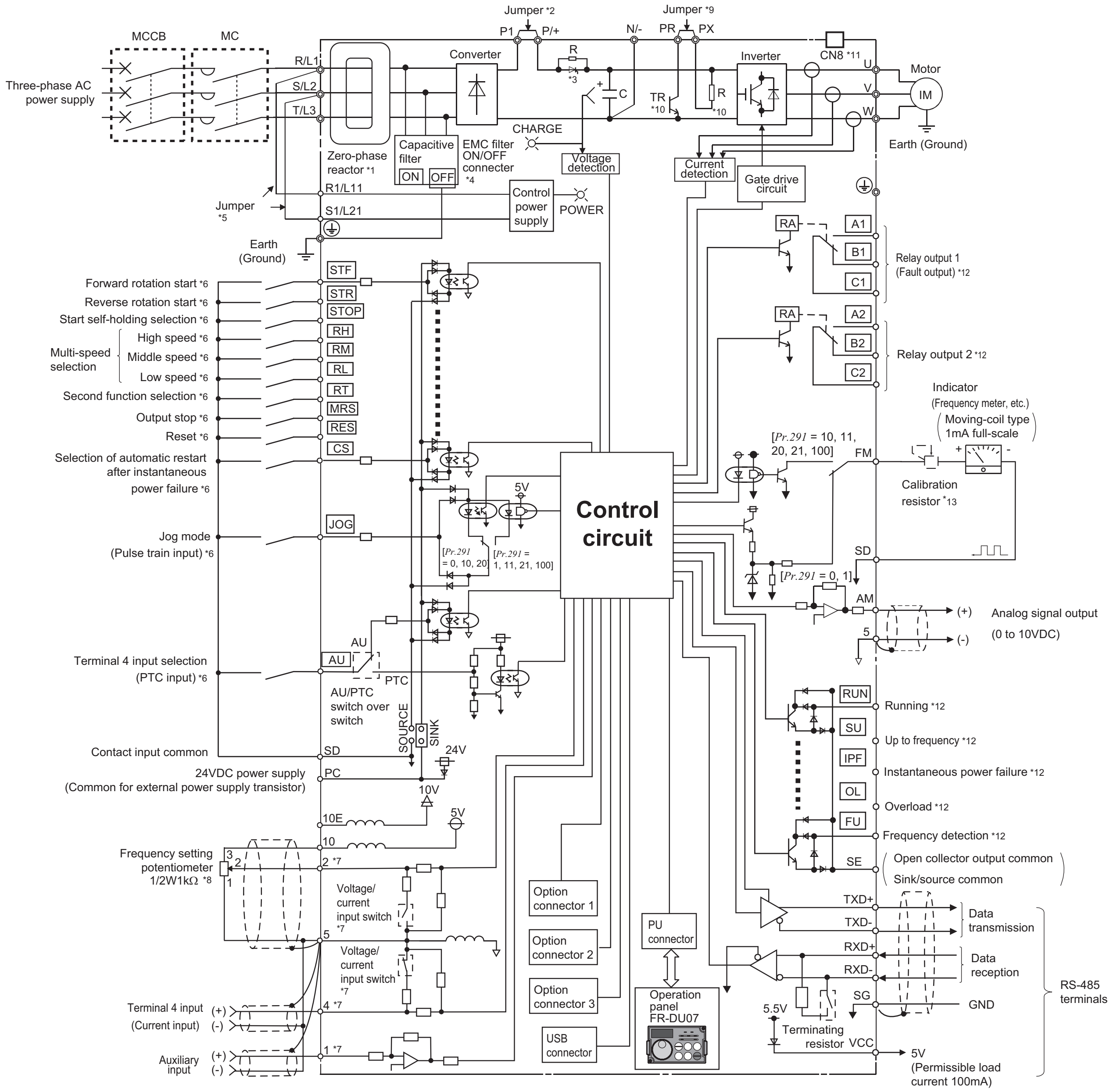
SPECIFICATIONS

1.3 Standard connection diagram and terminal specifications

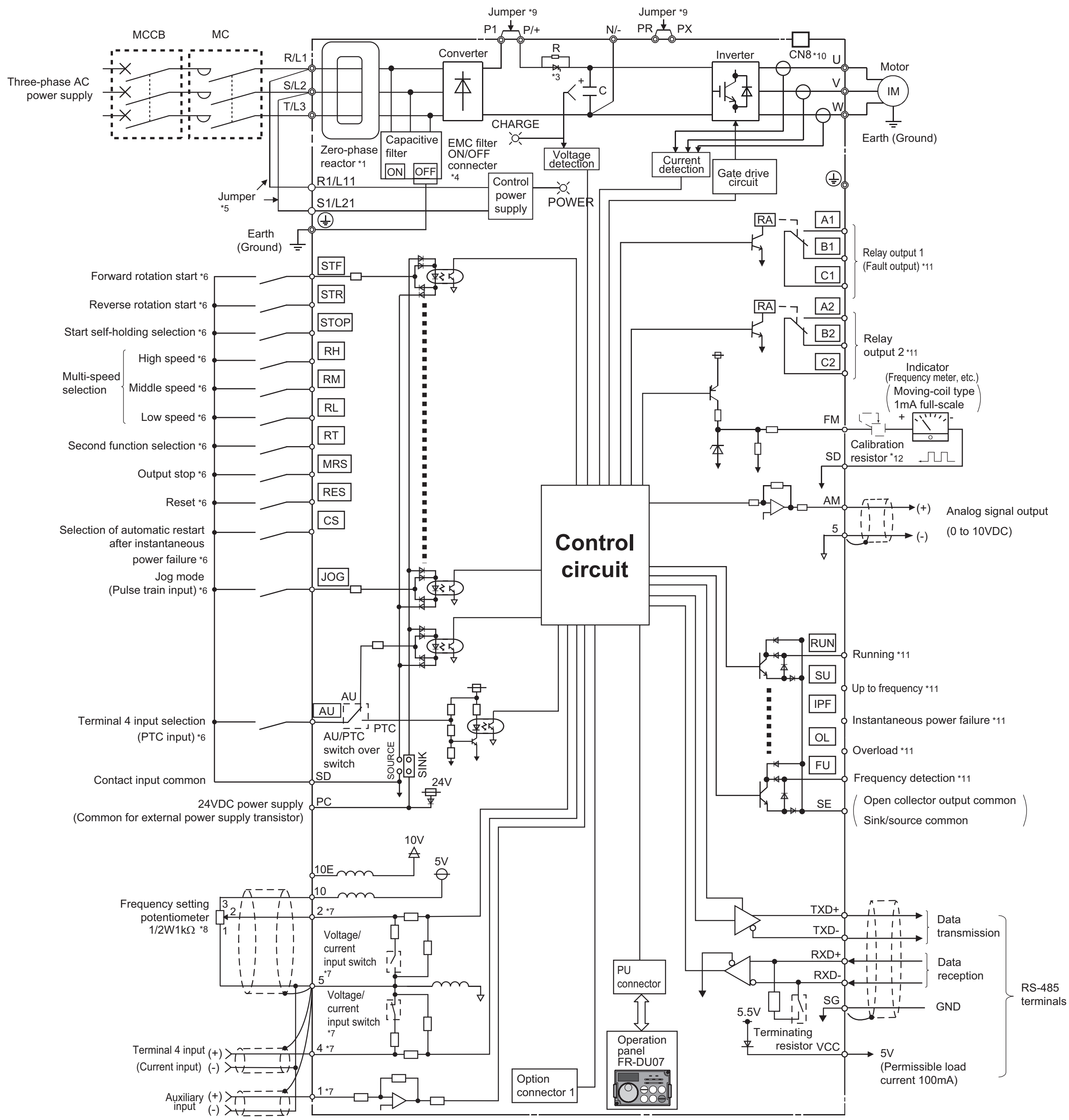
1.3.1 Internal block diagram

(1) FR-A700



*1 A common mode choke is provided for the 55K or less.
*2 For the 75K or more, a jumper across terminal P1-P/+ is not provided. Always connect a DC reactor provided. When a DC reactor is connected to the 55K or less, remove the jumper across P1-P/+.
*3 A relay is used for the 200V class 11K and 30K to 90K and 400V class 11K, 15K and 110K to 500K.
*4 The 200V class 0.4K and 0.75K are not provided with the EMC filter ON/OFF connector.
*5 To supply power to the control circuit separately, remove the jumper across R/L1-R1/L11 and S/L2-S1/L21.
*6 Terminal function can be changed using [*Pr. 178 to Pr. 189 Input terminal selection*].
*7 Terminal input specifications can be changed by analog input specifications switchover ([*Pr. 73, Pr. 267*]). Note that the current at terminal 2 and 4 is always 4 to 20mA when the voltage/current input switch is set to ON.
Terminal 2 : Initial value 0 to 5VDC (can be changed to 0 to 10VDC, 4 to 20mADC)
Terminal 4 : Initial value 4 to 20mADC (can be changed to 0 to 5VDC, 0 to 10VDC)
Terminal 1 : Initial value 0 to ±10VDC (can be changed to 0 to ±5VDC)
*8 It is recommended to use 2W1kΩ when the frequency setting signal is changed frequently.
*9 Remove the jumper across terminal PR-PX when connecting a brake resistor. (0.4K to 7.5K)
Terminal PR is provided for the 0.4K to 22K.
*10 The built-in brake resistor is provided for the 7.5K or less. A brake transistor is provided for the 22K or less.
*11 A CN8 connector is provided for the 75K or more.
*12 Terminal function can be changed using [*Pr. 190 to Pr. 196 Output terminal selection*].
*13 It is not necessary when calibrating the meter from the operation panel.

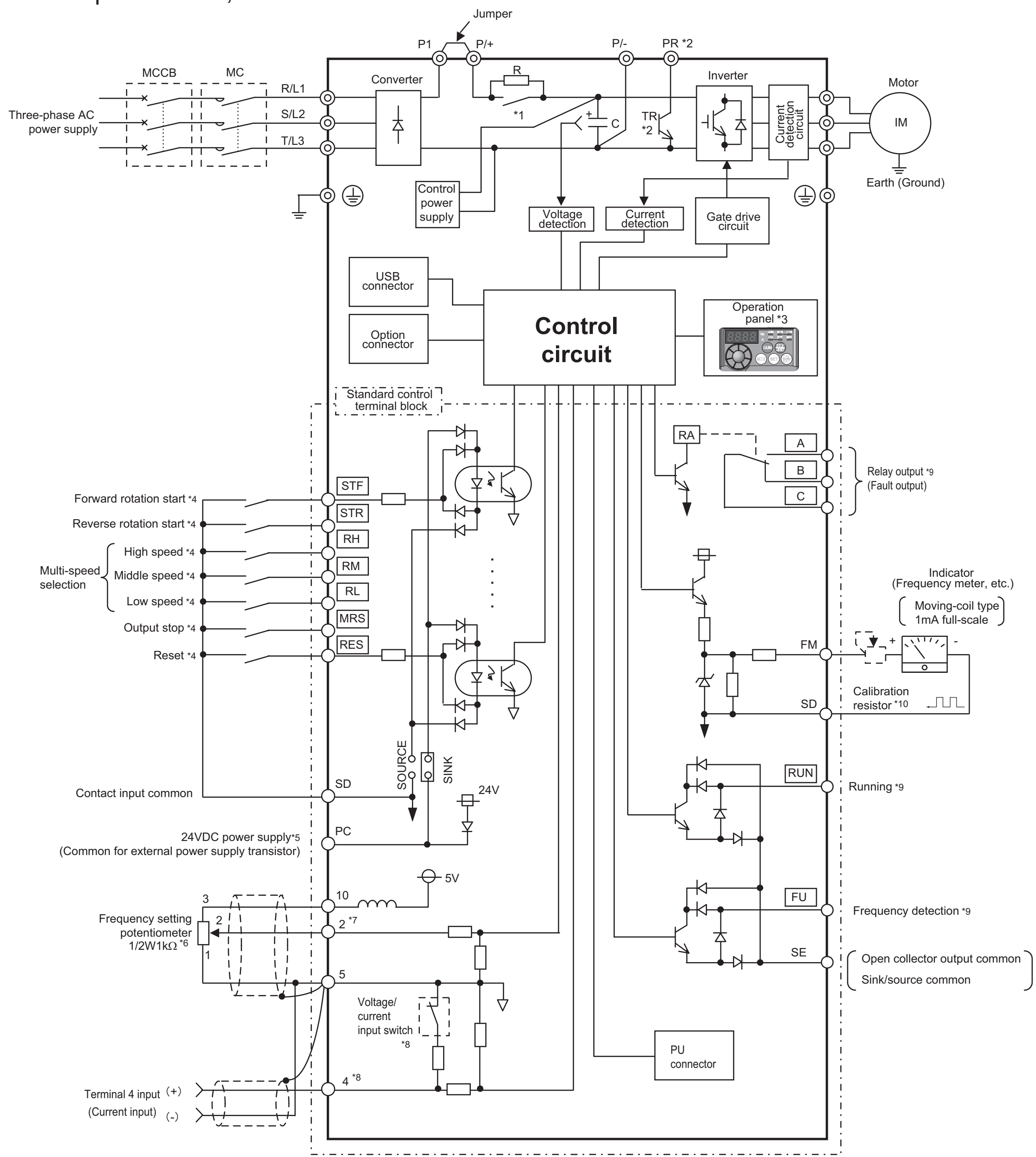
(2) FR-F700



*1 A common mode choke is provided for the 55K or less.
*2 For the 75K or more, a jumper across terminal P1-P/+ is not provided. Always connect a DC reactor provided. When a DC reactor is connected to the 55K or less, remove the jumper across P1-P/+.
*3 A relay is used for the 200V class 15K and 37K to 110K and 400V class 15K, 18.5K and 132K to 560K.
*4 The 200V class 0.75K and 1.5K are not provided with the EMC filter ON/OFF connector.
*5 To supply power to the control circuit separately, remove the jumper across R/L1-R1/L11 and S/L2-S1/L21.
*6 Terminal function can be changed using [*Pr. 178 to Pr. 189 Input terminal selection*].
*7 Terminal input specifications can be changed by analog input specifications switchover ([*Pr. 73, Pr. 267*]). Note that the current at terminal 2 and 4 is always 4 to 20mA when the voltage/current input switch is set to ON.
Terminal 2 : Initial value 0 to 5VDC (can be changed to 0 to 10VDC, 4 to 20mADC)
Terminal 4 : Initial value 4 to 20mADC (can be changed to 0 to 5VDC, 0 to 10VDC)
Terminal 1 : Initial value 0 to ±10VDC (can be changed to 0 to ±5VDC)
*8 It is recommended to use 2W1kΩ when the frequency setting signal is changed frequently.
*9 Do not use PR and PX terminals. Please do not remove the jumper connected to terminal PR and PX.
*10 A CN8 connector is provided for the 75K or more.
*11 Terminal function can be changed using [*Pr. 190 to Pr. 196 Output terminal selection*].
*12 It is not necessary when calibrating the meter from the operation panel.

(3) FR-E700

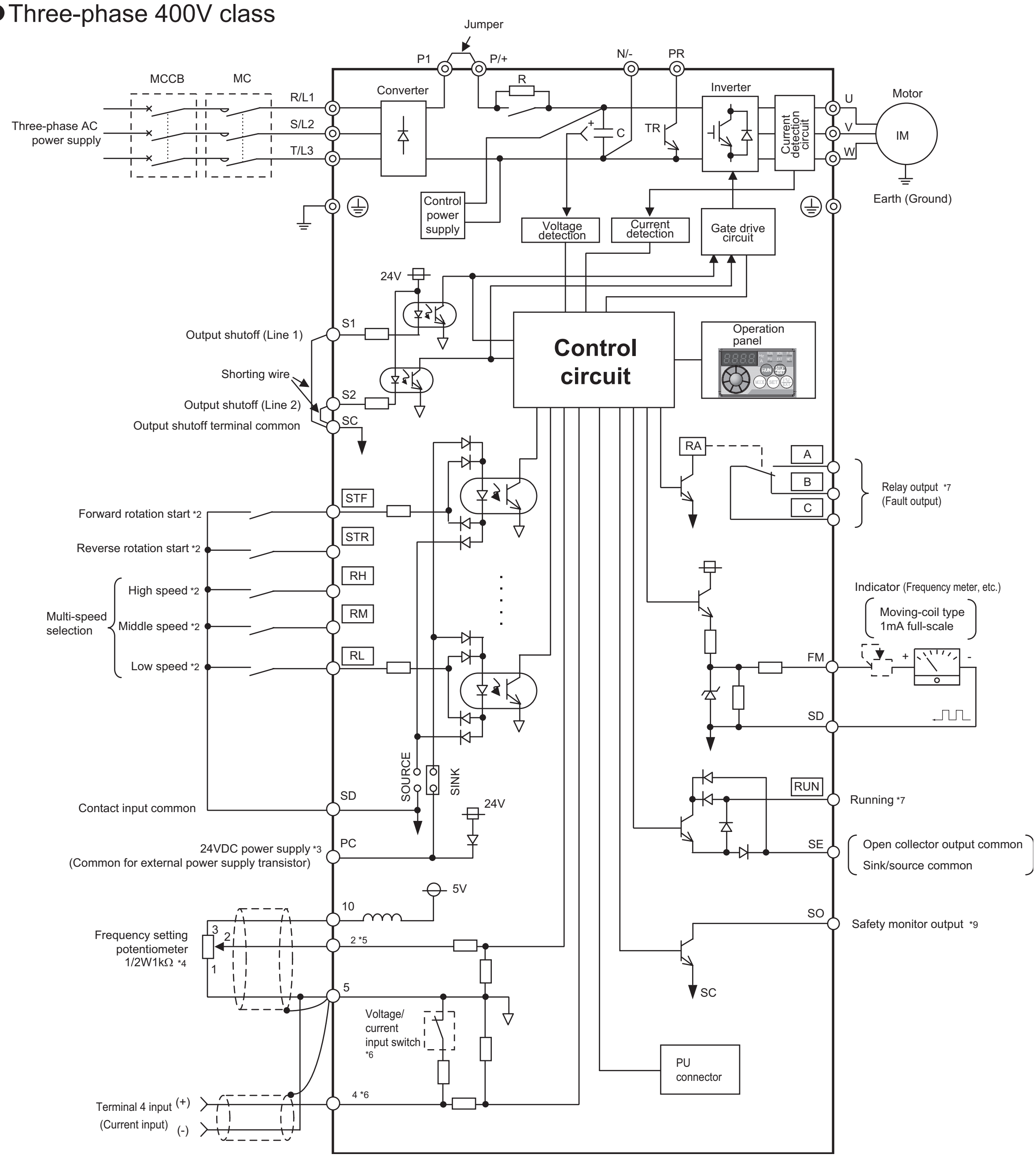
●Three-phase 200V, 400V class



*1 Thyristor is used for three-phase 200V class 11K/15K.
*2 Brake resistor is unavailable for 0.1K and 0.2K as these inverters do not have brake transistor plugged-in.
*3 Operation panel is not removable from the inverter.
*4 Terminal function can be changed using [*Pr. 178 to Pr. 184 Input terminal selection*].
*5 Take caution not to short across terminals PC and SD when using between those terminals as 24VDC power supply.
*6 It is recommended to use 2W1kΩ when the frequency setting signal is changed frequently.
*7 Can be changed by switching analog input specification ([*Pr.73*])
*8 Can be changed by switching analog input specification ([*Pr.267*])
To input voltage, set the voltage/current input switch to "V". To input current, set the voltage/current input switch to "I" (initial setting).
*9 Terminal function can be changed using [*Pr. 190 to Pr. 192 Output terminal selection*].
*10 It is not necessary when calibrating the meter from the operation panel.

(4) FR-D700

●Three-phase 400V class



*1 Operation panel is not removable from the inverter.
*2 Terminal function can be changed using [*Pr. 178 to Pr. 182 Input terminal selection*].
*3 Take caution not to short across terminals PC and SD when using between those terminals as 24VDC power supply.
*4 It is recommended to use 2W1kΩ when the frequency setting signal is changed frequently.
*5 Can be changed by switching analog input specification ([*Pr.73*]) Terminal 10 and 2 can be used as PTC input terminals ([*Pr.561*]).
*6 Can be changed by switching analog input specification ([*Pr.267*])
To input voltage, set the voltage/current input switch to "V". To input current, set the voltage/current input switch to "I" (initial setting).
*7 Terminal function can be changed using [*Pr. 190 and Pr. 192 Output terminal selection*].
*8 It is not necessary when calibrating the meter from the operation panel.
*9 Common terminal for terminal SO is terminal SC (Terminal SC is connected to terminal SD inside of the inverter.)

1

SPECIFICATIONS

1.3.2 Explanation of I/O terminal specifications

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters A700	F700	E700	D700	Refer to Page
Main circuit	R/L1, S/L2, T/L3	AC power input terminal	Three-phase 200V to 220V 50Hz 200 to 240V 60Hz Three-phase 380V to 480V 50/60Hz	Connect to a commercial power supply. An AC reactor should be used when measures for power harmonics are taken, the power factor is to be improved or the inverter is installed near a large-capacity power supply system (1000kVA or more). Refer to page 507 for installation instructions. Keep these terminals open when using the high power factor converter (FR-HC, MT-HC) or power regeneration common converter (FR-CV).	○	○	○	○	34
	U, V, W	Inverter output terminal	—	Connect a three-phase squirrel-cage motor. The maximum output voltage does not exceed the power supply voltage.	○	○	○	○	37
	R1/L11, S1/L21	Power supply for control circuit	Same rating as the AC power input terminal R/L1, S/L2, T/L3 Power consumption	Connected to the AC power supply terminals R/L1 and S/L2. To retain the fault display and fault output or when using the high power factor converter (FR-HC, MT-HC) or power regeneration common converter (FR-CV), remove the jumpers from terminals R/L1-R1/L11 and S/L2-S1/L21 and apply external power to these terminals.	○	○	—	—	36
	P/+, PR	Brake resistor connection terminal (22K or less)	—	A700 Remove the jumper from terminals PR-PX (7.5K or less) and connect an optional brake resistor (FR-ABR) across terminals P/+-PR. F700 Keep terminal PR open. E700 D700 Connect an optional brake resistor (MRS, MYS, FR-ABR) between terminal P/+ and PR. Not compatible for 0.1K and 0.2K models.	○	—	○	○	537
	P/+, N/-	Brake unit connection terminal	—	Connect the brake unit (FR-BU2), power regeneration common converter (FR-CV), power regeneration converter (MT-RC) or high power factor converter (FR-HC, MT-HC).	○	○	○	○	538
	P/+, P1	DC reactor connection terminal	—	For the 55K or less, remove the jumper across terminals P/+-P1 and connect the DC reactor (FR-HEL). (As a DC reactor is supplied with the 75K or more, be sure to connect the DC reactor.)	○	○	○	○	
	PR, PX	Built-in brake circuit connection terminal	—	When the jumper is connected across terminals PX-PR (initial status), the built-in brake circuit is valid. The PX terminal is provided for the 7.5K or less. F700 Keep terminal PR and PX open.	○	—	—	—	537
	⏚	Earth terminal	—	Terminal for earthing (grounding) the inverter chassis. Must be earthed (grounded).	○	○	○	○	117

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters				Refer to Page
					A700	F700	E700	D700	
Contact input	STF *1	Forward rotation start input signal terminal	Input resistance : 4.7kΩ Voltage when contacts are open : A700 F700 21 to 27VDC E700 D700 21 to 26VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal.	Turning ON STF signal gives forward command and off gives stop command. Turning ON STR signal gives reverse command and off gives stop command. Turning ON STF and STR signals simultaneously gives stop command.	○	○	○	○	41
	STR *1	Reverse rotation start input signal terminal			○	○	○	○	
	STOP *1	Start self-holding selection terminal	Input resistance : 4.7kΩ Voltage when contacts are open : 21 to 27VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal.	Turning ON STOP signal selects the self-hodling start method. If the start signal STF (STR) is once turned ON, the start signal is held and the inverter continues running. To stop the motor, turn OFF terminal STOP. To change the rotation direction, turn ON, then OFF the start signal STR (STF). The self-holding start method prevents the inverter from automatically restarting when power is restored after a power failure.	○	○	—	—	
	RH, RM, RL *1	Three speeds selection	Input resistance : 4.7kΩ Voltage when contacts are open : A700 F700 21 to 27VDC E700 D700 21 to 26VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal.	Turn ON RH signal to perform operation at the frequency set in [*Pr. 4*]. Turn ON RM signal to perform operation at the frequency set in [*Pr. 5*] or turn ON RL signal to perform operation at the frequency set in [*Pr. 6*]. When any two or more terminals of RH, RM and RL are turned ON at the same time, priority is given to the lower-speed signal. Three speeds selection has higher priority than the analog frequency setting signal.	○	○	○	○	48
		Multi-speed selection terminal		For multi-speed selection, setting multi-speed frequencies in [*Pr. 24 to Pr. 27, Pr. 232 to Pr. 239*] allows up to 15 speeds to be selected by the combinations of RH, RM, RL, REX signal. Allocate REX signal to any of the terminals using input terminal function selection. Multi-speed selection has higher priority than the analog frequency setting signal.	○	○	○	○	
	JOG *1	Jog mode selection terminal	Input resistance 4.7kΩ Voltage when contacts are open : 21 to 27VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal	Turn ON JOG signal and use terminal STF (STR) signal to run/stop.	○	○	—	—	49
		Pulse train input terminal	Input resistance : 2kΩ When contacts are short-circuited : 8 to 13 mADC Maximum input pulse : 100kpulse/s Isolated by photocoupler Controllable by open collector output or complementary output (power supply voltage 24V)	JOG terminal can be used as pulse train input terminal. To use as pulse train input terminal, the [*Pr. 291*] setting needs to be changed.	○	—	—	—	228
	RT *1	Second function selection terminal	Input resistance 4.7kΩ Voltage when contacts are open : 21 to 27VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal	When second function such as [*Pr. 44, Pr. 45, Pr. 46*] is set, turning ON RT signal selects the second function.	○	○	—	—	54

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters A700	F700	E700	D700	Refer to Page
Contact input	MRS *1	Inverter output stop terminal	Input resistance : 4.7kΩ Voltage when contacts are open : A700 F700 21 to 27VDC E700 21 to 26VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal	Shuts off the inverter output and coasts the motor to a stop. When stopping the motor with a mechanical brake etc., this terminal is used to shut off the inverter output. Before applying the brake, turn ON MRS signal for 20ms or longer. Turning OFF MRS signal causes the inverter to operate as usual. Hence, while the mechanical brake is operating, keep MRS signal turned ON or turn the start signal STF (STR) OFF to set the inverter in a non-output status.	○	○	○	—	56
	RES *1	Reset terminal		Designed to reset the inverter trip by the protective circuit operated when a fault occurs. Immediately sets each portion of the control circuit to the initial state and shuts off the inverter output at the same time. To provide this reset input, turn RES signal ON for 0.1s or longer, then turn OFF. Inverter recovers about 1s after reset is cancelled. Initial setting is for reset always. By setting [*Pr. 75*], reset can be set to enabled only at fault occurrence. Note that the initial reset at power-ON is made automatically in the inverter, requiring 1s after power-ON. During reset, the inverter does not provide output.	○	○	○	—	57
	AU *1	Terminal 4 input selection terminal (current input selection)	Input resistance : 4.7kΩ Voltage when contacts are open : 21 to 27VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal	Only when AU signal is turned ON, the 4 to 20mADC frequency setting signal input to across terminals 4-5 can be used to perform operation. When AU signal is ON, the input signal across terminals 2-5 (voltage input) is invalid. The terminal is overridden by the multi-speed terminal.	○	○	—	—	43
		PTC input terminal	Specification of PTC thermistor resistance Normal: 0Ω to 500Ω Boundary: 500Ω to 4kΩ Overheat: 4.7kΩ or higher	Terminal AU is used as PTC input terminal (thermal protection of the motor). When using it as PTC input terminal, set the AU/PTC switch to PTC.	○	○	—	—	50
	CS *1	Automatic restart after instantaneous power failure selection terminal	Input resistance : 4.7kΩ Voltage when contacts are open : 21 to 27VDC When contacts are short-circuited : 4 to 6mADC Isolated by photocoupler Controls by open collector output or no voltage contact signal	Turn ON CS signal to enable automatic restart control when power is restored from an instantaneous power failure. Note that restart setting is necessary for this operation. In the initial setting, a restart is disabled.	○	○	—	—	58
	SD	Contact input common (sink) (initial setting)	—	Common terminal for contact input terminal (sink logic) and terminal FM. Isolated from terminals 5 and SE.	○	○	○	○	80
		External transistor common (source)		When connecting the transistor output (open collector output), such as a programmable controller, when source logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents.					
		24VDC power supply common		Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.					

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters A700	F700	E700	D700	Refer to Page
Contact input	PC	Contact input common terminal (source)	Power supply voltage range : A700 F700 19.2 to 28.8VDC E700 D700 22 to 26.5VDC Permissible load current : 100mA	When connecting the transistor output (open collector output), such as a programmable controller, when sink logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents.	○	○	○	○	60
		External transistor common terminal (initial setting)		Common terminal for contact input terminal (source logic).					
		24VDC power supply		Can be used as 24VDC 0.1A power supply.					
Frequency setting	10E	Frequency setting power supply terminal	10V±0.4VDC Permissible load current : 10mA	Used as power supply when connecting potentiometer for frequency setting (speed setting) from outside of the inverter. When connecting a frequency setting potentiometer to A700 F700 at an initial status, connect it to terminal 10. Change the input specifications of terminal 2 with [*Pr. 73*] when connecting it to terminal 10E.	○	○	—	—	43
	10		A700 F700 E700 5.2V±0.2VDC D700 5.0V±0.2VDC Permissible load current : 10mA		○	○	○	○	
	2	Frequency setting signal terminal (voltage signal)	A700 F700 [Voltage input] Input resistance : 10kΩ±1kΩ Maximum permissible voltage : 20VDC [Current input] Input resistance : 245Ω±5Ω Maximum permissible current : 30mA E700 D700 [Voltage input] Input resistance : 10kΩ±1kΩ Maximum permissible voltage : 20VDC	Inputting 0 to 5VDC (or 0 to 10V, 0 to 20mA) provides the maximum output frequency at 5V (10V, 20mA) and makes input and output proportional. Use [*Pr. 73*] to switch from among input 0 to 5VDC (initial setting), 0 to 10VDC, and 0 to 20mA. For A700 F700, set the voltage/current input switch in the ON position to select current input (0 to 20mA).	○	○	○	○	
		PTC input terminal	Specification of applicable PTC thermistor Overheat detection resistance: 500Ω to 30kΩ (set to [*Pr. 561*])	Connect a PTC thermistor between terminal 10 and 2. Setting PTC thermistor active ([*Pr. 561* ≠ 9999]) disables the frequency setting in terminal 2.	—	—	—	○	50
	4	Frequency setting signal terminal (current signal)	[Current input] Input resistance : A700 F700 245Ω±5Ω E700 D700 233Ω±5Ω Maximum permissible current : 30mA [Voltage input] Input resistance : 10kΩ±1kΩ Maximum permissible voltage : 20VDC	Inputting 4 to 20mADC (or 0 to 5V, 0 to 10V) provides the maximum output frequency at 20mA and makes input and output proportional. This input signal is valid only when the AU signal is ON (terminal 2 input is invalid). Use [*Pr. 267*] to switch from among input 4 to 20mA (initial setting), 0 to 5VDC and 0 to 10VDC. For A700 F700, set the voltage/current input switch in the OFF position to select voltage input (0 to 5V/0 to 10V). Use [*Pr. 858*] to switch terminal functions. To input voltage (0 to 5V / 0 to 10V) in E700 D700, set the voltage/current input switch to "V".,	○	○	○	○	43
	1	Frequency setting auxiliary input terminal	Input resistance : 10kΩ±1kΩ Maximum permissible voltage : ±20VDC	Inputting 0 to ±5 VDC or 0 to ±10VDC adds this signal to terminal 2 or 4 frequency setting signal. Use [*Pr. 73*] to switch between input 0 to ±5VDC and 0 to ±10VDC (initial setting) input.	○	○	—	—	43
	5	Frequency setting signal terminal common terminal	—	Common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM. Isolated from terminals SD and SE. Do not earth (ground).	○	○	○	○	80

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters A700	F700	E700	D700	Refer to Page
Relay	A1, B1, C1 (A, B, C) *2	Relay output terminal 1 (Fault output terminal)	Contact capacity : 230VAC 0.3A (power factor 0.4) 30VDC 0.3A	1 changeover contact output indicates that the inverter fault occurs. When a fault occurs, terminals B-C are open (A-C are closed). In the normal state, terminals B-C are closed (A-C are open). When this signal is output, the motor coasts.	○	○	○	○	65
Relay	A2, B2, C2 *2	Relay output terminal 2		1 changeover contact output	○	○	—	—	
Open collector	RUN *2	Inverter running terminal	Open collector output A700 F700 Permissible load: 24VDC 0.1A (Maximum 27VDC) (Maximum voltage drop at ON status is 2.8V) E700 D700 Permissible load: 24VDC 0.1A (Maximum 27VDC) (Maximum voltage drop at ON status is 3.4V)	Switched low when the inverter output frequency is equal to or higher than the starting frequency (initial value 0.5Hz). Switched high during stop or DC injection brake operation.*5	○	○	○	○	66
Open collector	SU *2 *3	Up to frequency terminal		Switched low when the output frequency reaches within the range of ±10% (initial value) of the set frequency. Switched high during acceleration/deceleration and at a stop.*5	○	○	—	—	70
Open collector	OL *2 *3	Overload alarm terminal		Switched low when stall prevention is activated by the stall prevention function. Switched high when stall prevention is cancelled. *5	○	○	—	—	69
Open collector	IPF *2 *3	Instantaneous power failure terminal		Switched low when the protective circuit is activated due to an instantaneous power failure and under voltage. *5	○	○	—	—	68
Open collector	FU *2 *3	Frequency detection terminal		This open collector output is switched low when the output frequency reaches or exceeds the detection frequency set in [*Pr. 42*] (initial value is 6Hz) and [*Pr. 43*] (initial value is 9999 (same as the [*Pr. 42*] setting)) and is high when it is less than the detection frequency. *5	○	○	○	—	71
Open collector	SE	Open collector output common terminal	—	Common terminal for terminals RUN, SU, OL, IPF, and FU. Isolated from terminals SD and 5. Do not earth (ground).	○	○	○	○	80
Pulse	FM *5	Terminal for meter	Isolated by photocoupler Permissible load current : A700 F700 : 2mA E700 D700 : 1mA 1440 pulse/s at 60Hz	The output voltage is a 8VDC pulse-shaped waveform. Connect a 1mA moving-coil type DC ammeter. When the frequency is as set in [*Pr. 55*] (initial value is 60Hz), the output pulse frequency is 1440pulse/s.	○	○	○	○	78
Pulse	FM *5	NPN open collector output terminal	NPN open collector output Permissible load current : 80mA Maximum output pulse: 50kpulse/s	Terminal FM is used as high speed pulse train output terminal of open collector output. To use as pulse train output terminal, the [*Pr. 291*] setting needs to be changed.	○	—	—	—	352
Analog	AM *6	Analog signal output terminal	Non-isolated 0 to 10VDC Permissible load current : 1mA (load impedance 10kΩ or more) Resolution : 8 bit	Factory-set to provide 10VDC at full-scale value, which is proportional to the monitor value. When the frequency is as set in [*Pr. 55*] (initial value is 60Hz), the output voltage is 10VDC.	○	○	—	—	80
RS-485	—	PU connector	Conforming standard : EIA-485 (RS-485) Transmission form : Multidrop link Communication speed : 4800 to 38400bps Overall extension : 500m	With the PU connector, communication can be made through RS-485. (1:1 connection only)	○	○	○	○	81
RS-485	RS-485 terminals: TXD+, TXD-	Inverter transmission terminal	Conforming standard : EIA-485 (RS-485) Transmission form: Multidrop link Communication speed : 300 to 38400bps Overall extension : 500m	With the RS-485 terminals, communication can be made through RS-485.	○	○	—	—	83
RS-485	RS-485 terminals: RXD+, RXD-	Inverter reception terminal							
RS-485	RS-485 terminals: SG	Ground terminal							

Type	Terminal Symbol	Terminal Name	Rating, etc.	Application Explanation	Available Inverters A700	F700	E700	D700	Refer to Page
USB	—	USB connector	Interface : conforms to USB1.1 Transmission speed : 12Mbps Connector : A700 USB B connector (B receptacle) E700 USB mini B connector (mini B receptacle)	FR Configurator can be operated by connecting the inverter to the personal computer through USB.	○	—	○	—	85
Safety function	S1	Inverter output shutoff (Line 1)	—	Inverter output is shutoff depending on shorting/opening between S1 and SC, or between S2 and SC. At initial state, terminal S1 and S2 are shorted to terminal SC with a shorting wire. When using the safety stop function, remove this shorting wire, and connect to a safety relay module.	—	—	—	○	
	S2	Inverter output shutoff (Line 2)			—	—	—	○	
	SO	Safety monitor output (open collector output)		Switched low when inverter output is shutoff by safety stop function, and high during other state. *4	—	—	—	○	
	SC	Output shutoff terminal common		Common terminal for terminals S1, S2 and SO. Connected to terminal SD inside of the inverter.	—	—	—	○	

*1 Terminal function can be changed using [*Pr. 178 to Pr. 189 Input terminal assignment*].
*2 Terminal function can be changed using [*Pr. 190 to Pr. 196 Output terminal assignment*].
*3 The description at a fault occurrence can be output by 4 bit digital signal using [*Pr. 76 Fault code output selection*].
*4 Low indicates that the open collector output transistor is ON (conducts).
High indicates that the transistor is OFF (does not conduct).
*5 Monitor to be output to terminal FM can be changed using [*Pr. 54 FM terminal function selection*].
*6 Monitor to be output to terminal AM can be changed using [*Pr. 158 AM terminal function selection*].

1.4 Information on use of external terminals

1.4.1 Switching the inverter power ON/OFF (R/L1, S/L2, T/L3) common

(1) No-fuse breaker and magnetic contactor on the inverter power supply side common

1) Install a specified moulded case circuit breaker (MCCB) on the power receiving side to protect the wiring to the inverter. An MCCB of greater capacity may be required as compared to commercial power operation because of the low power factor of the power supply resulting from the distorted input current in the inverter input power supply side. Refer to page 526)

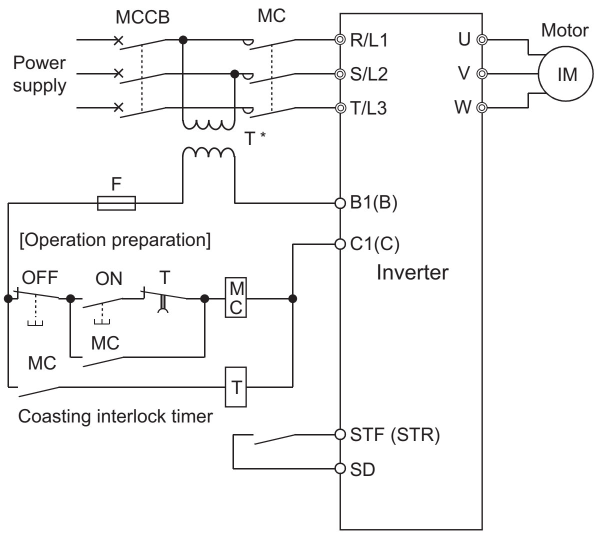
2) It is recommended to install a magnetic contactor on the inverter power supply side to ensure safety at fault occurrence. (See the circuit in the lower right.) The circuit should be made up to protect the inverter from any accident etc. that may be caused by automatic restart when the power is restored without magnetic contactor after power failure.

3) Start and stop the motor by switching ON/OFF the STF or STR signal. If the MC is used to stop the motor, the motor coasts to a stop because regenerative braking inherent in the inverter is not applied. If the MC is used to start the motor during coasting when, for example, load inertia is extremely large, the protective circuit (overvoltage E.OV1 to E.OV3) may be activated to shut off the inverter output.
When performing Jog operation, the MC must not be used to start and stop the motor. Otherwise, slow response will result because of a start delay due to the initial reset time (approximately 1s) after power ON.

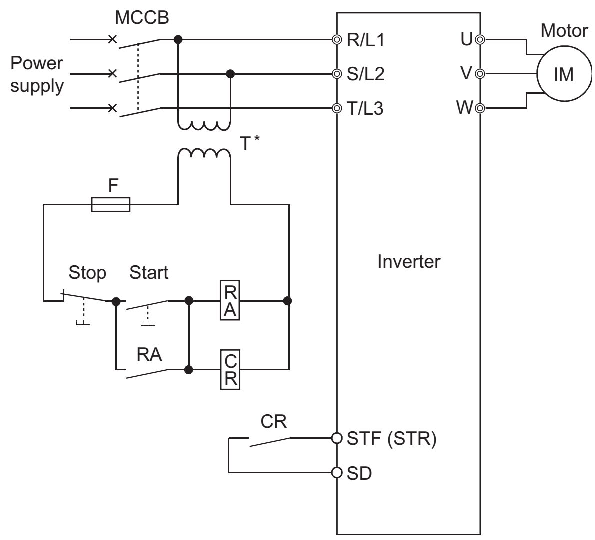
4) In case of the forced cooling, the cooling fan starts rotating as soon as the power is switched ON. However, cooling fan operation selection [*Pr. 244 Cooling fan operation selection*] may also be used to exercise cooling fan ON-OFF control.

* When the power supply is 400V class, install a step-down transformer.

The MC in the inverter power supply side can be used to start and stop the motor. However, the MC must not be used frequently to start and stop the motor as repeated inrush current generated at power ON will shorten the life of the converter section of the inverter.

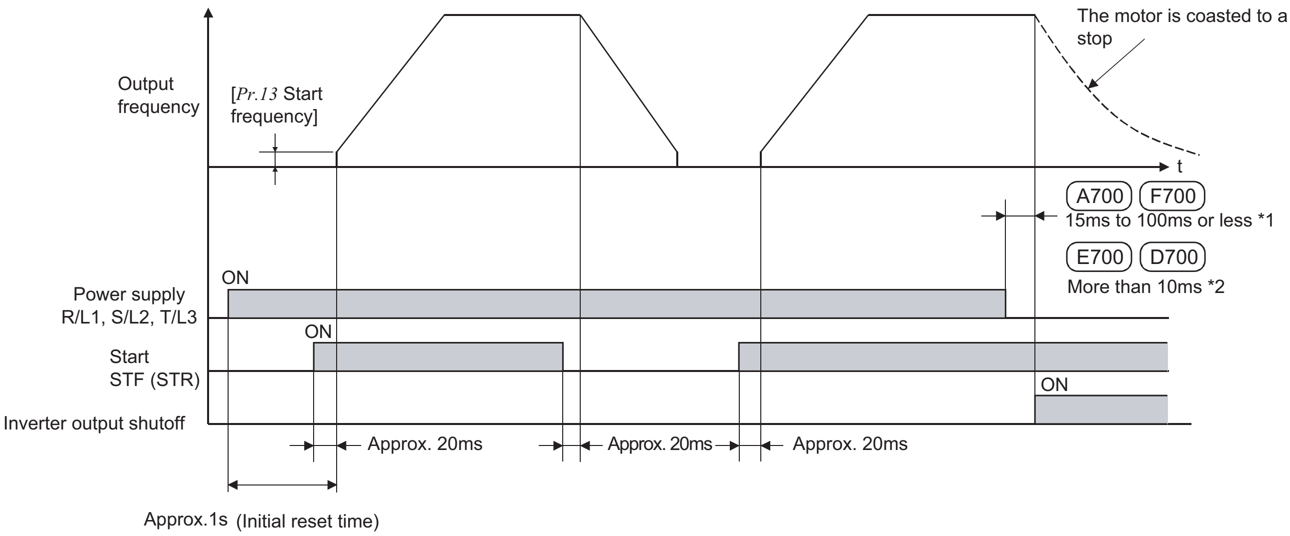


Magnetic contactor used in the power supply side



No magnetic contactor in the power supply side (automatic restart prevented when power is restored)

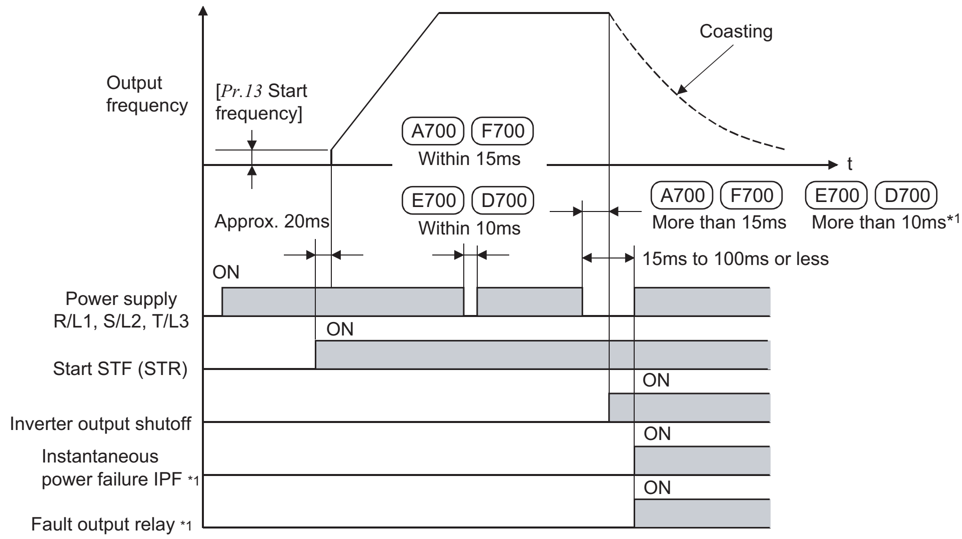
(2) Inverter power ON/OFF timing chart (common)



*1 The inverter output is shut off immediately (between more than 15ms and less than 100ms) after the power is switched OFF. If more than 100ms has elapsed after the power is switched OFF, the inverter protective circuit is automatically reset by powering ON again.

*2 Inverter output immediately shuts off if bus voltage of inverter drops to the specified value or lower for more than 10ms after power OFF.

(3) Inverter instantaneous power failure timing chart (common)



*1 For (A700)(F700), instantaneous power failure IPF activates when the power is restored within 15 to 100ms. Note that automatic restart after instantaneous power failure is activated and fault output signal is not switched ON when 0 or any of 0.1 to 5s is set in [*Pr. 57*] for the 55K or less and 0 or any of 0.1 to 30s is set for the 75K or more.

When power is restored after inverter output shutoff in (E700)(D700), the inverter does not output fault and re-starts from the starting frequency. However, automatic restart after instantaneous power failure becomes active when the automatic restart after instantaneous power failure function [*Pr.57*] is set to "0" or "0.1 to 5s".

*2 An instantaneous power failure of longer than 100ms is identical to a long-time power failure. (Refer to (2) inverter power ON/OFF timing chart.) If the start signal is ON, the inverter is restarted when the power is restored.

1.4.2 Connecting external power supply to the control circuit (R1/L11, S1/L21) (A700) (F700)

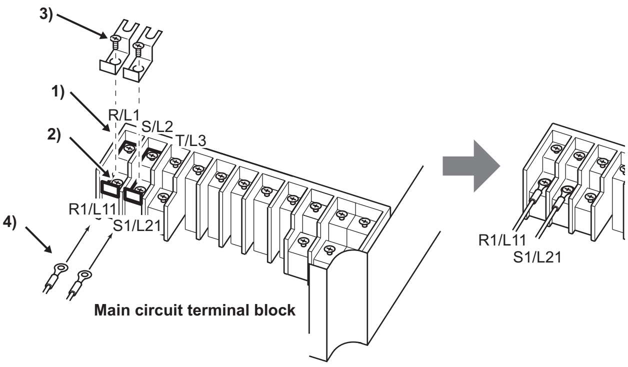
If any of the protective functions (other than fan alarm, stall prevention, and current limit functions) are activated, the alarm indicator lamp is lit and the corresponding fault signal is output. If the MC etc. in the inverter power supply is switched OFF by the fault signal at this time, the control power is lost and the fault output cannot be kept ON. To keep this fault output ON, use the other power supply with the control circuit (power supply with the same voltage as the one used with the main circuit).

Connection

Never connect the power cable to the terminals in the wrong stand. Doing so will damage the inverter. The other power supply connection terminal block on the printed circuit board is a two-step type terminal block and jumpers are connected across the upper and lower terminals before shipment from the factory. After loosening (and removing) the screws and removing the jumpers as shown below, connect an external power supply in the procedure shown below.

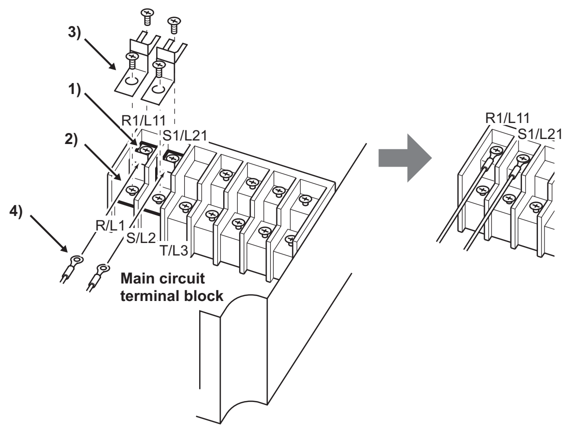
- FR-A720-0.4K to 3.7K, FR-A740-0.4K to 3.7K
  FR-F720-0.75K to 5.5K, FR-F740-0.75K to 5.5K

1) Loosen the upper screws.
2) Remove the lower screws.
3) Remove the jumpers.
4) Connect the separate power supply cable for the control circuit to the lower terminals (R1/L11, S1/L21).



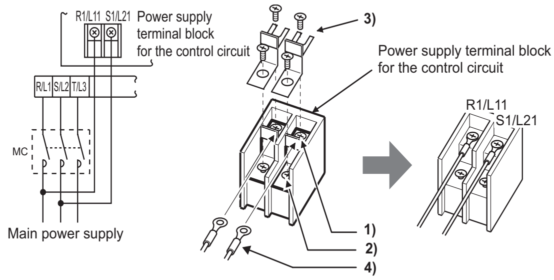
- FR-A720-5.5K, 7.5K, FR-A740-5.5K, 7.5K
  FR-F720-7.5K, 11K, FR-F740-7.5K, 11K

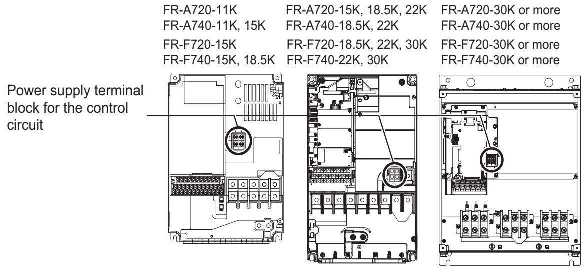
1) Remove the upper screws.
2) Remove the lower screws.
3) Remove the jumpers.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).



- FR-A720-11K or more, FR-A740-11K or more,
  FR-F720-15K or more, FR-F740-15K or more

1) Remove the upper screws.
2) Remove the lower screws.
3) Remove the jumpers.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).





(1) Do not turn OFF the control power (terminal R1/L11, S1/L21) with the main circuit power (terminal R/L1, S/L2, T/L3) ON.
When the main circuit power supply is ON, a DC voltage exists in the converter output area and the voltage is being applied to the transistors. If a signal enters the transistor gate circuit due to noise etc., the transistors conduct and the terminals P/+ and N) are connected, which may damage the transistor modules. When the control power supply is ON, an inverse bias voltage is applied to the gate circuit to prevent the transistors from conducting.
The circuit should be configured so that the main circuit power is also turned OFF when the control power is OFF.

(2) If the MC of the main circuit power supply is switched OFF (for more than 0.1s), then ON, the inverter is reset. Hence, the method may be used to perform fault-on reset.

(3) If the MC for the main circuit power is switched OFF once (for more than 0.1s), then ON during the inverter output (operation), the inverter is initial-reset and the motor is restarted in the coasting state.
If the MC is switched OFF, the undervoltage (E.UVT) protection is not activated.

(4) If the MC in the main circuit power is switched OFF, the fault output signal is not switched ON. When the MC is OFF, the operation panel and parameter unit (FR-DU07, FR-PU07) can be operated. (The motor cannot be run)

(5) Capacity (VA) of separate power supply
The following power capacity is necessary when separate power is supplied from R1/L11 and S1/L21.
FR-A720-11K or less, FR-A740-15K or less…60VA or more
FR-A720-15K or more, FR-A740-18.5K or more…80VA or more
FR-F720-15K or less, FR-F740-18.5K or less…60VA or more
FR-F720-18.5K or more, FR-F740-22K or more…80VA or more

1.4.3 Switching the inverter output MC ON/OFF (U, V, W) (common)

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When an MC is provided to switch to a commercial power supply, for example, it is recommended to use bypass-inverter switchover function [*Pr. 135 to Pr. 139*] (refer to page 416).

(1) When inverter output MC switch-ON (common)

Inverter State \ Motor State before Power on	Motor Running (Coasting)	Motor at Stop
Inverter operating	MC may not be switched ON	MC may not be switched ON
Inverter at stop	MC may not be switched ON	MC may be switched ON

*1 MC switch-ON might become available by selecting an appropriate inverter capacity. (For example, select an inverter capacity considering the start current of the motor. Refer to page 476.)

*2 Because overcurrent protection and electronic thermal protection may occur at an inverter start, use of automatic restart after instantaneous power failure/flying start (refer to page 367) is recommended.

(2) When inverter output MC switch-OFF (common)

Inverter State \ Motor State before Power on	Motor Running	Motor Running (Coasting)	Motor at Stop
Inverter operating	MC may be switched OFF (The motor coasts to a stop)	—	—
Inverter at stop	—	MC may be switched OFF	MC may be switched OFF

1.4.4 Input signal (STF, STR, RL, RM, RH, RT, AU, JOG, CS, MRS, STOP, RES) (common)

(1) Input terminal function assignment (common)

Use these parameters to select/change the input terminal functions.

1) (A700) (F700)

[Pr.]	Name	Initial Value
178	STF terminal function selection	60
179	STR terminal function selection	61
180	RL terminal function selection	0
181	RM terminal function selection	1
182	RH terminal function selection	2
183	RT terminal function selection	3
184	AU terminal function selection	4
185	JOG terminal function selection	5
186	CS terminal function selection	6
187	MRS terminal function selection	24
188	STOP terminal function selection	25
189	RES terminal function selection	62

2) (E700)

[Pr.]	Name	Initial Value
178	STF terminal function selection	60
179	STR terminal function selection	61
180	RL terminal function selection	0
181	RM terminal function selection	1
182	RH terminal function selection	2
183	MRS terminal function selection	24
184	RES terminal function selection	62

3) (D700)

[Pr.]	Name	Initial Value
178	STF terminal function selection	60
179	STR terminal function selection	61
180	RL terminal function selection	0
181	RM terminal function selection	1
182	RH terminal function selection	2

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Using [*Pr. 178 to Pr. 189*], set the functions of the input terminals.
Refer to the following table and set the parameters :

Setting	Signal	Functions		Available Inverters			
				A700	F700	E700	D700
0	RL	[*Pr. 59 = 0*] (initial value)	Low-speed operation command	○	○	○	○
		[*Pr. 59 ≠ 0*] [*1]	Remote setting (setting clear)				
		[*Pr. 270 = 1, 3*] [*2]	Stop-on contact selection 0	○	—	○	—
1	RM	[*Pr. 59 = 0*] (initial value)	Middle-speed operation command	○	○	○	○
		[*Pr. 59 ≠ 0*] [*1]	Remote setting (deceleration)				
2	RH	[*Pr. 59 = 0*] (initial value)	High-speed operation command				
		[*Pr. 59 ≠ 0*] [*1]	Remote setting (acceleration)				
3	RT	Second function selection		○	○	○	○
		[*Pr. 270 = 1, 3*] [*2]	Stop-on contact selection 1	○	—	○	—
4	AU	Terminal 4 input selection		○	○	○	○
5	JOG	Jog operation selection		○	○	○	○
6	CS	Selection of automatic restart after instantaneous power failure, flying start		○	○	—	—
		Commercial power supply-inverter switchover function					
7	OH	External thermal relay input [*3]		○	○	○	○
8	REX	15-speed selection (combination with three speeds RL, RM, RH)		○	○	○	○
9	X9	Third function selection		○	—	—	—
10	X10	Inverter run enable signal (FR-HC, MT-HC/FR-CV connection)		○	○	○	○
11	X11	FR-HC, MT-HC connection, instantaneous power failure detection		○	○	—	—
12	X12	PU operation external interlock		○	○	○	○
13	X13	External DC injection brake operation start		○	—	—	—
14	X14	PID control valid terminal		○	○	○	○
15	BRI	Brake opening completion signal		○	—	○	—
16	X16	PU-external operation switchover		○	○	○	○
17	X17	Load pattern selection forward rotation reverse rotation boost		○	—	—	—
18	X18	V/F switchover (V/F control is exercised when X18 is ON)		○	—	○	○
19	X19	Load torque high-speed frequency		○	—	—	—
20	X20	S-pattern acceleration/deceleration C switchover		○	—	—	—
22	X22	Orientation command [*4] [*6]		○	—	—	—
23	LX	Pre-excitation/servo ON [*5]		○	—	—	—
24	MRS	Output stop		○	○	○	○
		Commercial power supply-inverter switchover function		○	○	—	—
25	STOP	Start self-holding selection		○	○	○	○
26	MC	Control mode switchover		○	—	—	—
27	TL	Torque limit selection		○	—	—	—
28	X28	Start-time tuning start external input		○	—	—	—
42	X42	Torque bias selection1 [*6]		○	—	—	—
43	X43	Torque bias selection2 [*6]		○	—	—	—
44	X44	P/PI control switchover		○	—	—	—
60	STF	Forward rotation (assigned to STF terminal [*Pr. 178*] only)		○	○	○	○
61	STR	Reverse rotation (assigned to STR terminal [*Pr. 179*] only)		○	○	○	○
62	RES	Inverter reset		○	○	○	○
63	PTC	PTC thermistor input (assigned to AU terminal ([*Pr. 184*]) only)		○	○	—	—
64	X64	PID forward/reverse action switchover		○	○	—	—
65	X65	PU/NET operation switchover		○	○	○	○
66	X66	External/NET operation switchover		○	○	○	○
67	X67	Command source switchover		○	○	○	○
68	NP	Conditional position pulse train sign [*6]		○	—	—	—
69	CLR	Conditional position droop pulse clear [*6]		○	—	—	—
70	X70	DC feeding operation permission		○	○	—	—

Setting	Signal	Functions	Available Inverters			
			A700	F700	E700	D700
71	X71	DC feeding cancel	○	○	—	—
74	X74	Magnetic flux decay output shutoff signal	○	—	—	—
9999	—	No function	○	○	○	○

*1 When [*Pr. 59 Remote function selection ≠ 0*], the functions of the RL, RM and RH signals change as listed above.
*2 When [*Pr. 270 Stop-on contact, load torque high-speed frequency control selection = 1 (or 3)*], the functions of the RL and RT signals change as listed above.
*3 The OH signal turns ON when the relay contact "opens".
*4 The FR-A7AX (16-bit digital input) is needed to externally input a stop position under orientation control.
*5 Servo ON is valid during position control under vector control operation.
*6 This parameter is valid when the FR-A7AP or FR-A7AL (option) is mounted.
*7 Changing the terminal assignment using [*Pr. 178 to Pr. 189 Input terminal function selection*] may affect the other functions. Please make setting after confirming the function of each terminal.
*8 Same function can be assigned to two or more terminals. In this case, the logic of terminal input is OR.
*9 The priorities of the speed commands are in order of jog, multi-speed setting (RH, RM, RL, REX) and PID (X14).
*10 When the X10 signal (FR-HC, MT-HT, FR-CV connection - inverter operation enable signal) is not set or when the PU operation external interlock (X12) signal is not assigned at the [*Pr. 79 Operation mode selection = 7*], the MRS signal shares this function.
*11 Use common terminals to assign multi-speeds (7 speeds) and remote setting. These cannot be set individually. (Common terminals are used since these functions are designed for speed setting and need not be set at the same time.
*12 When V/F switching (X18) signal and load pattern selection forward rotation reverse rotation boost (X17) signal are not assigned in A700, the RT signal shares this function. ([*Pr. 81 Number of motor poles = 12, 14, 16, 18, 20*])
In this case, V/F control is valid in the second function.

1

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(2) Response time of each signal

The response time of the X10 signal is within 2ms. However, when the X10 signal is not assigned at the [*Pr. 30 Regenerative function selection = 2*] (FR-HC, MT-HC, FR-CV connection), the response time of the MRS signal is within 2ms in A700 F700, and [*Pr. 17 MRS input selection*] is invalid.

[Pr. 30] Setting	MRS Assignment	X10 Assignment	Response Time MRS	Response Time X10	[Pr. 17]
2	○	×	Within 2ms	—	Invalid
	×	○	—	Within 2ms	—
	○	○	Within 20ms	Within 2ms	Valid
Other than 2	○	×	Within 20ms	—	Valid
	×	○	—	—	—
	○	○	Within 20ms	—	Valid

Response time of X10 signal and MRS signal in E700 D700 is within 2ms.

(3) Changing the control logic common

The input signals are set to sink logic (SINK) when shipped from the factory.

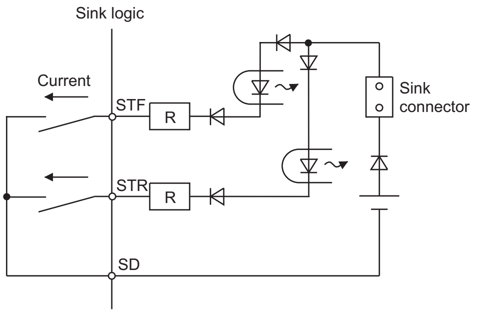
In sink logic, a signal switches ON when a current flows from the corresponding signal input terminal.

Terminal SD is common to the contact input signals.

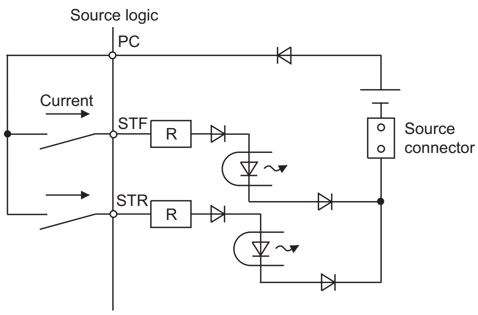
In source logic, a signal switches ON when a current flows into the corresponding signal input terminal.

Terminal PC is common to the contact input signals.

● **Current flow concerning the input/output signal when sink logic is selected**



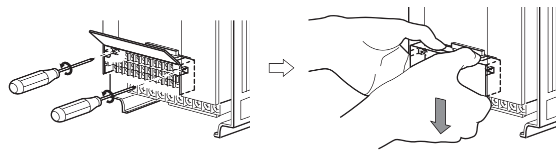
● **Current flow concerning the input/output signal when source logic is selected**



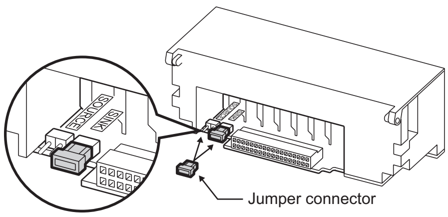
1) Changing the control logic for A700 F700

To change the control logic, the jumper connector on the back of the control circuit terminal block must be moved to the other position. (The output signals may be used in either the sink or source logic independently of the jumper connector position.)

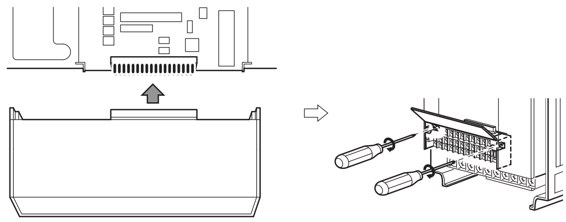
(a) Loosen the two installation screws in both ends of the control circuit terminal block. (These screws cannot be removed.)
Pull down the terminal block from behind the control circuit terminals.



(b) Change the jumper connector set to the sink logic (SINK) on the rear panel of the control circuit terminal block to source logic (SOURCE).



(c) Using care not to bend the pins of the drive unit's control circuit connector, reinstall the control circuit terminal block and fix it with the mounting screws.



*1 Make sure that the control circuit connector is fitted correctly.

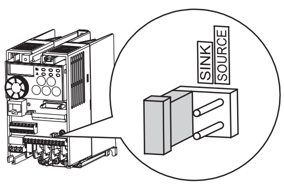
*2 While power is ON, never disconnect the control circuit terminal block.

2) Changing the control logic for E700 D700

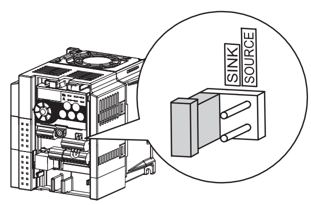
To change the control logic, the jumper connector above the control terminal must be moved to the other position.

Change the jumper connector in the sink logic (SINK) position to source logic (SOURCE) position using tweezers, a pair of long-nose pliers etc.

Change the jumper connector position before switching power ON.



For FR-E700



For FR-D700

1.4.5 Run and stop (STF, STR, STOP) (common)

To start and stop the motor, first switch ON the input power of the inverter (turn ON the MC at the operation-ready when there is an MC on the input side). Then start the motor with the forward or reverse rotation start signal.

(1) Two-wire type (STF, STR) (common)

A two-wire type connection is shown below.

1) Forward/reverse rotation signal is used as both the start and stop signals. Turn ON either of the forward and reverse rotation signals to start the motor in the corresponding direction. Switching ON or OFF both the start signals during operation will decelerate the inverter to a stop.
2) The speed setting signals may either be given by entering 0 to 5VDC across the frequency setting input terminal 2-5, by setting three speed [*Pr. 4 to Pr. 6*] (high, middle, low speeds), etc.
(For multi-speed operation, refer to page 48.)
3) After the start signal has been input, the inverter starts operating when the frequency setting signal reaches or exceeds the [*Pr. 13 Starting frequency*].
If the motor load torque is large or the [*Pr. 0 Torque boost*] setting is small, operation may not be started due to insufficient torque until the inverter output frequency reaches about 3 to 6Hz.
If the [*Pr. 2 Minimum frequency*] is set to 6Hz, for example, merely entering the start signal causes the running frequency to reach the minimum frequency of 6Hz according to the [*Pr. 7 Acceleration time*].
4) To stop the motor, operate the DC injection brake for the period of time set in [*Pr. 11 DC injection brake operation time*] at not more than the DC injection brake operation frequency or at not more than 0.5Hz.
To disable the DC injection brake function, set 0 in either of [*Pr. 11 DC injection brake operation time*] or [*Pr. 12 DC injection brake voltage*].
In this case, the motor is coasted to a stop at not more than the frequency set in [*Pr. 10 DC injection brake operation frequency*] or at not more than 0.5Hz (when the DC injection brake is not operated).
5) If the reverse rotation signal is input during forward rotation or the forward rotation signal is input during reverse rotation, output characteristics change without going through the stop mode.

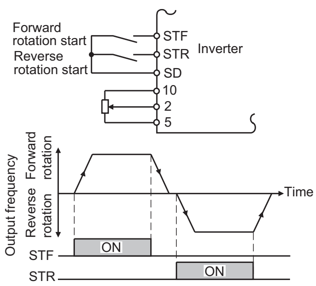
(2) Three-wire type connection (STF, STR, STOP) (common)

A three-wire type connection is shown below.

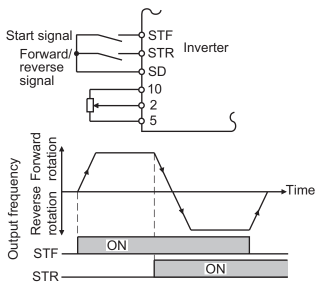
1) Turn ON the STOP signal to enable the start self-holding function. In this case, the forward/reverse rotation signal functions only as a start signal.
2) If the start signals STF (STR) are turned ON once, then OFF, the start signals are kept ON and starts the inverter. When changing the direction of rotation, turn STR (STF) signal ON once and then OFF.
3) The inverter is decelerated to a stop by turning OFF the STOP signal once. For the frequency setting signal and the operation of DC injection brake at a stop time, refer to paragraphs 2) to 4) in (1) Two-wire type connection.
4) When the signal JOG is turned ON, terminal STOP signal is invalid and JOG operation has precedence.
5) If MRS signal is turned ON, the self-holding function is not deactivated.

(3) Start signal selection

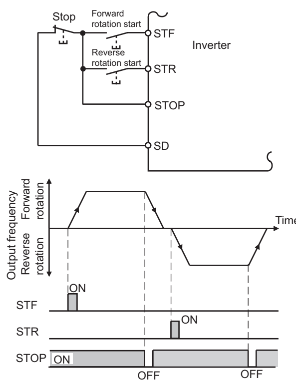
STF	STR	[*Pr. 250*] Setting Inverter State 0 to 100s, 9999	[*Pr. 250*] Setting Inverter State 1000 to 1100s, 8888
OFF	OFF	Stop	Stop
OFF	ON	Reverse rotation	
ON	OFF	Forward rotation	Forward rotation
ON	ON	Stop	Reverse rotation



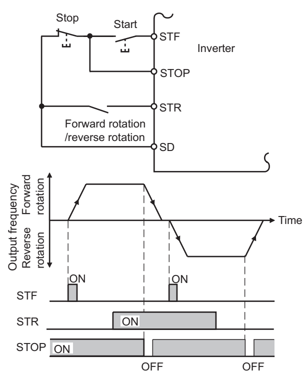
Two wire-type connection
([*Pr. 250 = 9999*])



Two wire-type connection
([*Pr. 250 = 8888*])



Three wire-type connection Example
[*Pr. 250 = 9999*]



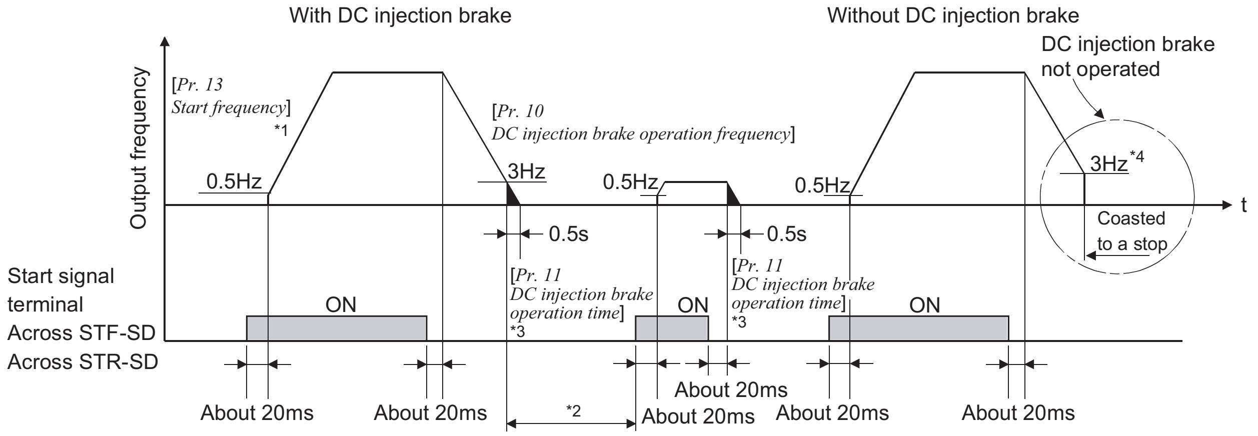
Three wire-type connection Example
([*Pr. 250 = 8888*])

DC Injection Brake and Coasting to Stop

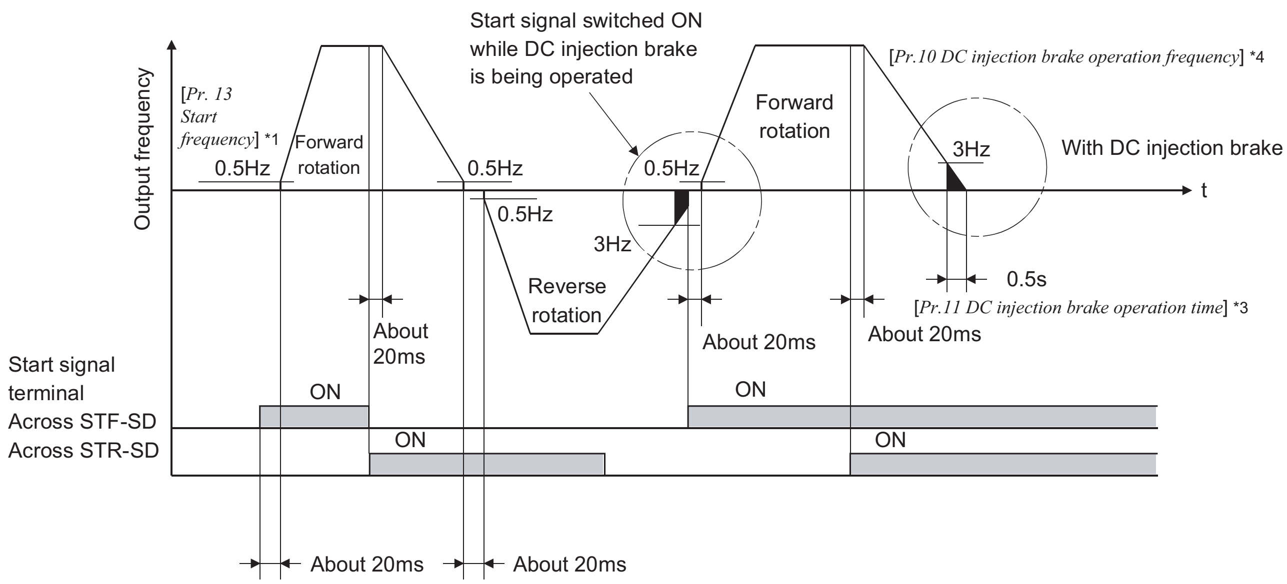
Operation Mode / DC injection Brake	External Operation or Combined Operation When [Pr. 79 = 0, 2, 3]		PU Operation or Combined Operation When [Pr. 79 = 0, 1, 4]	
	Terminals STF (STR) turn OFF *1	Terminals STF (STR) trun ON *2 and 0V across terminals 2-5	STOP key	Set frequency changed to 0Hz
DC injection brake enabled	DC injection brake operated at not more than [*Pr. 10 DC injection brake operation frequency*]	DC injection brake at 0.5Hz or less	DC injection brake operated at not more than [*Pr. 10 DC injection brake operation frequency*]	DC injection brake at 0.5Hz or less
DC injection brake disabled	Coasting to stop at not more than [*Pr. 10 DC injection brake operation frequency*]	Coasting to stop at 0.5Hz or less	Coasting to stop at not more than [*Pr. 10 DC injection brake operation frequency*]	Coasting to stop at 0.5Hz or less

*1 Also stopped by the STOP key. (Refer to page 382.)

*2 For multi-speed operation, the same operation is performed when RH, RM, RL signals are OFF.



Start/Stop Timing Chart (for two-wire type)



Forward-Reverse Rotation Switch-Over Timing Chart

*1 The [*Pr. 13 Starting frequency*] (initial value 0.5Hz) may be set between 0 and 60Hz.

*2 If the next start signal is given during DC injection brake operation, the DC injection brake is disabled and restart is made.

*3 The [*Pr. 11 DC injection brake operation time*] (initial value 0.5s) may be set between 0 and 10s.

*4 The frequency at which the motor is coasted to a stop is not more than the [*Pr. 10 DC injection brake operation frequency*] (initial value is 3Hz; may be set between 0 and 120Hz) or not more than 0.5Hz.

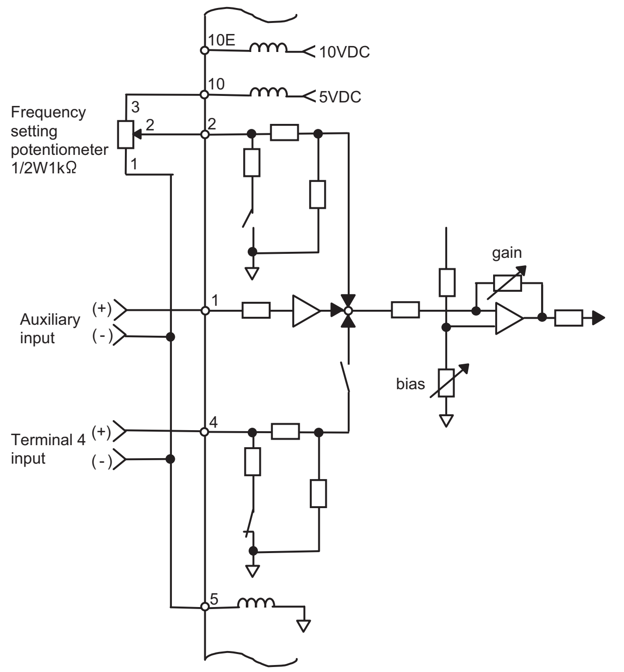
*5 The settings of [*Pr. 13 Starting frequency*], [*Pr. 11 DC injection brake operation time*], and [*Pr. 10 DC injection brake operation frequency*] are the initial values.

1.4.6 Relationships between frequency setting input signals and output frequencies (10, 10E*, 2, 5, 1*, 6*, 4, AU) (common)

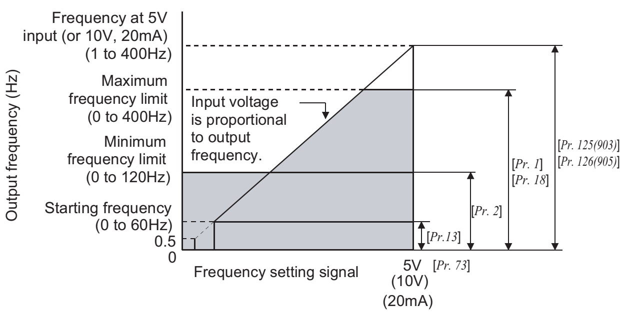
(*(E700)(D700) do not have terminal 10E nor terminal 1.)

(*Terminal 6 is available only in the (A700) with FR-A7AZ.)

The analog frequency setting input signals that may be entered are voltage and current signals.
For the relationships between the frequency setting input voltages (currents) and output frequencies, refer to the following diagram. The frequency setting input signals are proportional to the output frequencies. Note that when the input signal is less than the starting frequency, the output frequency of the inverter is 0Hz.
If the input signal of 5VDC (or 10V, 20mA) or higher is entered, the output frequency does not exceed the maximum output frequency.



(A700)(F700) **Analog Input Block Diagram**



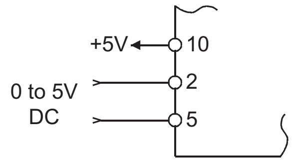
Relationships between Frequency Setting Inputs and Output Frequencies

(1) Voltage input (10, 10E*, 2, 6*, 4, 5) (common)

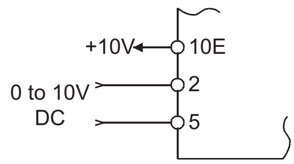
(*(E700)(D700) do not have terminal 10E.)

(*Terminal 6 is available only in the (A700) with FR-A7AZ.)
Enter the frequency setting input signal of 0 to 5VDC (or 0 to 10VDC) across terminals 2 (or 4)-5. The maximum output frequency is reached when 5V (10V) is input across terminals 2 (or 4)-5. When using (A700) with FR-A7AZ, terminal 6 is available for frequency setting input.
The power supply used may either be the inverter's built-in power supply or an external power supply. The internal power supply outputs 5VDC across terminals 10-5, or 10V across terminals 10E-5.

- For operation at 0 to 5VDC, set [*Pr. 73 Analog input selection*] to 0 to 5VDC input. Use terminal 10 for the built-in power supply.

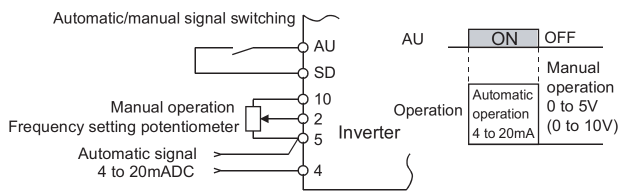


- For operation at 0 to 10VDC, set [*Pr. 73*] to 0 to 10VDC input. Use terminal 10E for the built-in power supply.



(2) Current input selection (2*, 4, 5, AU) (common)

(*Current input with terminal 2 is not available for (E700)(D700))
To automatically perform operation under constant pressure or temperature control using a fan, pump etc., enter the controller output signal of 4 to 20mADC across terminals 4 (or 2)-5.
AU signal must be turned ON to use terminal 4.
When the multi-speed signal is input, the current input is ignored.



Manual-Automatic Switching

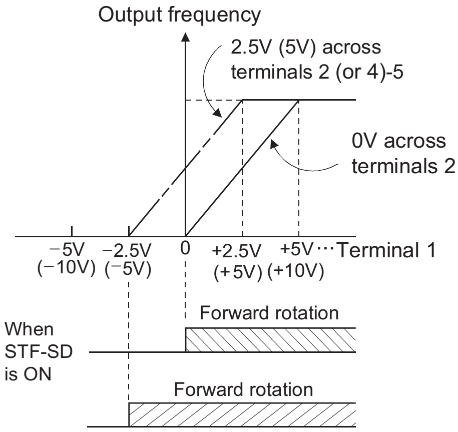
(3) Auxiliary input (1, 5) (A700)(F700)

The compensation signal can be input to the main speed setting (terminals 2 (or 4)-5) for synchronous/ continuous speed control operation, etc.

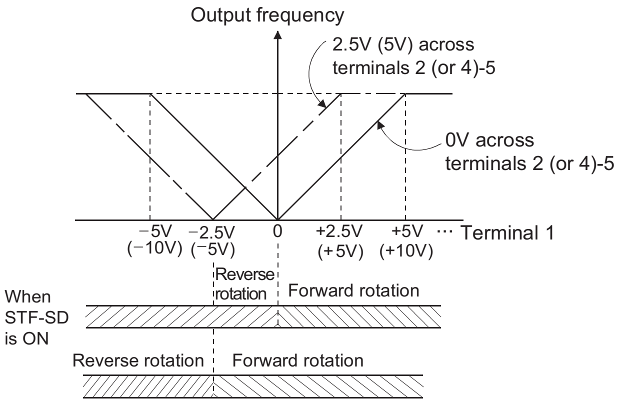
Terminals 1-5 : 0 to ±10VDC, ±5V

Functions of terminal 1 varies with the [*Pr. 73*] setting.

(a) The [*Pr. 73*] setting is 0 to 3, 6, 7 (initial value is 1)
The voltage signal across terminals 1-5 is added to the voltage signal (positive) across terminals 2 (or 4)-5. If the result of addition is negative, it is regarded as 0 and the motor comes to a stop.



(b) When the [*Pr. 73*] setting is 10 to 13, 16, 17
The polarity reversible operation function is selected. The voltage signal across terminals 1-5 is added to the voltage signal (positive) across terminals 2 (or 4)-5. A positive addition result start forward rotation (if terminal STF is ON) and a negative result starts reverse rotation (if terminal STF is ON).



The compensation signal of terminal 1 can also be added to the multi-speed setting or 4 to 20mA current input.

Inverter Output According to Start Signal and Auxiliary Input Terminal Polarity

[Pr. 73] Setting	Added Command Voltage	Start Signal Input	
		STF	STR
0 to 3, 6, 7	+	Forward rotation	Reverse rotation
	-	Stop	Stop
10 to 13, 16, 17	+	Forward rotation	Reverse rotation
	-	Reverse rotation	Forward rotation

1) Multi-speed input compensation
Setting 1 in [*Pr.28 Multi-speed input compensation selection*] (initial value 0) adds voltage of terminal 1 to multi-speed operation on page 48.

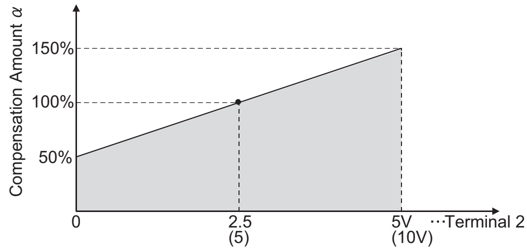
2) Override
For the above compensation input, the fixed compensation amount is applied to each speed. Using the override function easily varies each speed equally.
Set any of 4, 5, 14, 15 in [*Pr.73*] to use the override. The override allows the multi-speeds set in the parameters, analog input across terminals 1-5, or current input across terminals 4-5 to be changed at a constant rate between 50% and 150% (when initial value is set) according to the external analog signal input to across terminals 2-5.

How to find each speed (frequency (f))

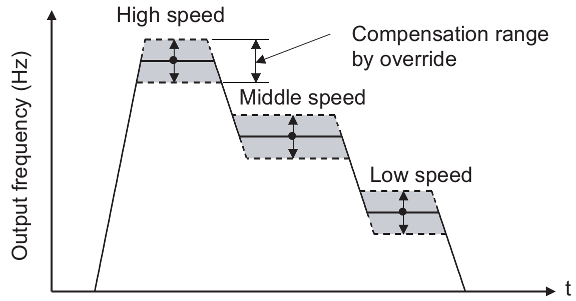
$$f = f_{pr.} \times \frac{\alpha}{100} \text{ [Hz]}$$

$f_{pr.}$: speed setting value [Hz]
(Multi-speed
Terminal 1-5 analog input
Current across terminals 4-5)

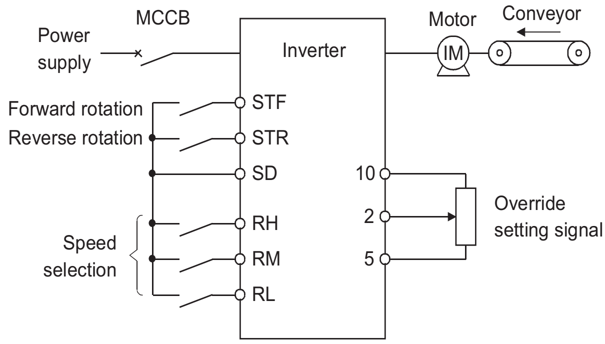
α : override compensation amount [%]
(terminal 2-5 analog input)



Override Setting Signal and Compensation Amount



Multi-speed Override Operation

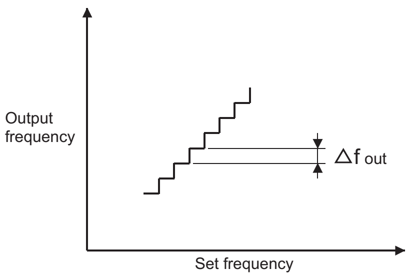


Override connection diagram

(4) Frequency resolution (common)

The running frequency of the inverter can be set by the analog input to the frequency setting input terminal and the digital input from the operation panel or parameter unit. The operation panel allows setting in increments of 0.01Hz up to 100Hz and 0.1Hz at more than 100Hz, and the parameter unit allows setting in increments of 0.01Hz from its numeric keypad.

1) Output frequency resolution
For the output frequency resolution $\triangle f_{OUT}$, refer to the common specifications on page 8.
The output frequency resolution does not change if the output frequency varies between 0 and 400Hz.



Output frequency resolution

2) Set frequency resolution
The set frequency resolution for the digital input is determined by the number of digits set by the operation panel (parameter unit). The set frequency resolution for the analog input is determined by the number of analog-to-digital converter bits.

Input Condition	Set Frequency Resolution Δf
Analog input *1 Terminals 2-5 Terminals 1*2 -5 Terminals 4-5 Terminals 6 *3-5	For set frequency resolution, refer to page 8 and page 92.
Digital input (setting from operation panel, parameter unit, or RS-485 terminal)	Δf = 0.01Hz (Δf = 0.1Hz at 100Hz or more for operation panel)
Digital input *1 (setting from option)	Depends on the setting resolution of the FR-A7AX (16 bit digital input).

*1 Since the frequency resolution in the inverter is 0.01Hz, control cannot be exercised if the resolution setting is less than 0.01Hz.

*2 E700 D700 do not have terminal 1.

*3 Terminal 6 is available in the A700 with FR-A7AZ.

1 SPECIFICATIONS

(5) Function assignment to analog input terminal 1, terminal 4, and terminal 6 (FR-A7AZ) A700

Functions of terminal 1, terminal 4, and terminal 6 (FR-A7AZ) of analog input can be selected and changed by parameter.
For the terminal 1, terminal 4, and terminal 6 (FR-A7AZ) used for analog input, frequency (speed) command, torque command, etc. can be selected. In addition, functions change according to the control mode.

[*Pr.*]	Name	Initial Value	Setting Range	Description
406	High resolution analog input selection AZ	9999	0, 2 to 6, 9999	Selection of terminal 6 function (refer to the table below)
858	Terminal 4 function assignment	0	0, 1, 4, 9999	Selection of terminal 4 function (refer to the table below)
868	Terminal 1 function assignment	0	0 to 6, 9999	Selection of terminal 1 function (refer to the table below)

- Terminal 1 function according to control

[*Pr. 868*] setting	V/F Control, Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control, Vector Control		Vector Control
		Speed control	Torque control	Position control
0 (initial value)	Frequency setting auxiliary	Speed setting auxiliary	Speed limit auxiliary	—
1 *1	—	Magnetic flux command	Magnetic flux command	Magnetic flux command
2	—	Regenerative torque limit ([*Pr. 810 = 1*])	—	Regenerative torque limit [*Pr. 810 = 1*]
3	—	—	Torque command ([*Pr. 804 = 0*]	—
4 *1	Stall prevention operation level input	Torque limit [*Pr. 810 = 1*]	Torque command ([*Pr. 804 = 0*]	Torque limit [*Pr. 810 = 1*]
5	—	—	Forward/reverse rotation speed limit ([*Pr. 807 = 2*]	—
6	—	Torque bias input [*Pr. 840 = 1, 2, 3*]	—	—
9999	—	—	—	—

- Terminal 4 function according to control

[*Pr. 858*] Setting	V/F Control, Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control, Vector Control		Vector Control
		Speed control	Torque control	Position Control
0 (initial value)	Frequency command (AU signal-ON)	Speed command (AU signal-ON)	Speed limit (AU signal-ON)	—
1 *1 *2	—	Magnetic flux command	Magnetic flux command	Magnetic flux command
4 *1 *2	Stall prevention operation level input	Torque limit [*Pr. 810 = 1*]	—	Torque limit [*Pr. 810 = 1*]
9999	—	—	—	—

— : No function

*1 When the same value (1 or 4) is set in [*Pr. 868, 858*], terminal 1 is made valid and terminal 4 has no function.
*2 When [*Pr. 858 = 1, 4*], functions of terminal 4 become valid independently of whether the terminal AU is ON or OFF.

● Terminal 6 function according to control(FR-A7AZ)

[*Pr. 406*] Setting	V/F Control, Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control, Vector Control		Vector Control	Remarks
		Speed control	Torque control	Position Control	
0	Frequency command	Speed command	Speed limit	—	Speed command and speed limit are not available with terminal 2.
2	—	Regenerative torque limit ([*Pr. 810* = 1])	—	Regenerative torque limit ([*Pr. 810* = 1])	Regenerative torque limit is not available with terminal 1.
3	—	—	Torque command ([*Pr. 804* = 0])	—	Torque command is not available with terminal 1.
4	Stall prevention operation level input	Torque limit ([*Pr. 810* = 1])	Torque command ([*Pr. 804* = 0])	Torque limit ([*Pr. 810* = 1])	Stall prevention operation level input and torque limit are not available with terminal 1 or 4. Torque command is not available with terminal 1.
5	—	—	Forward/reverse rotation speed limit ([*Pr. 807* = 2])	—	Forward/reverse rotation speed limit is not available with terminal 1.
6	—	Torque bias ([*Pr. 840* = 1, 2, 3])	—	—	Torque bias is not available with terminal 1.
9999 (initial value)	—	—	—	—	Terminal 6 is invalid.

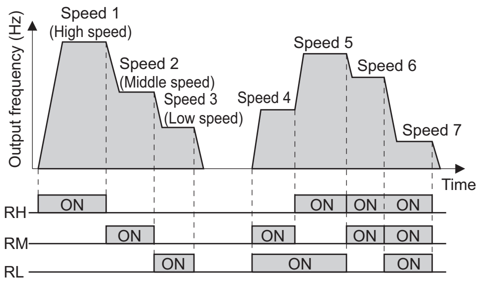
— : No function

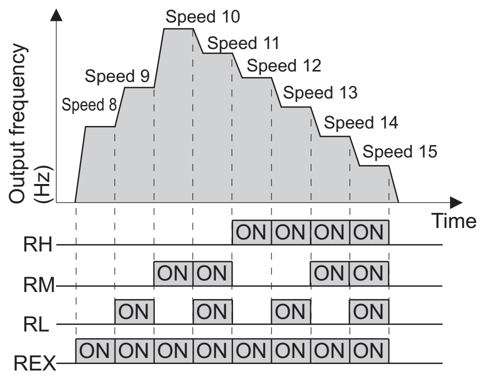
* Function assigned to terminal 1, 2, and 4 inputs become invalid if overlapping function is assigned to terminal 6.

1.4.7 External frequency selection (REX, RH, RM, RL) (common)

Up to 15 speeds may be selected according to the combination of REX *1, RH, RM and RL signals, and multi-speed operation can be performed as shown below by turning ON STF (STR) signal.
Speeds (frequencies) may be specified as desired as listed below.

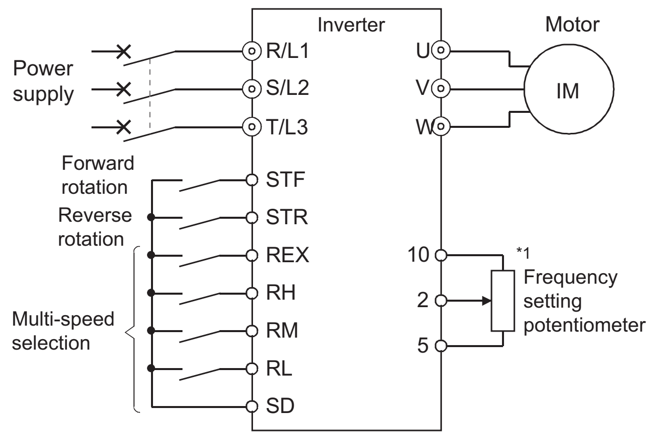
*1 Assign function of 15-speed select signal (REX) by setting 8 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*].
*2 Each of the multiple speeds may be compensated for by the external analog signal in (A700)(F700).
*3 Has precedence over the main speed setting signal (0 to 5V, 0 to 10V, 4 to 20mADC).





Multi-speed setting

Speed	Terminal Input				[*Pr.*]	Set Frequency Range	Remarks
	REX	RH	RM	RL			
Speed 1 (high speed)	OFF	ON	OFF	OFF	[*Pr. 4*]	0 to 400Hz	
Speed 2 (middle speed)	OFF	OFF	ON	OFF	[*Pr. 5*]	0 to 400Hz	
Speed 3 (low speed)	OFF	OFF	OFF	ON	[*Pr. 6*]	0 to 400Hz	
Speed 4	OFF	OFF	ON	ON	[*Pr. 24*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 24 = 9999*]
Speed 5	OFF	ON	OFF	ON	[*Pr. 25*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 25 = 9999*]
Speed 6	OFF	ON	ON	OFF	[*Pr. 26*]	0 to 400Hz, 9999	Setting value of [*Pr. 5*] when [*Pr. 26 = 9999*]
Speed 7	OFF	ON	ON	ON	[*Pr. 27*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 27 = 9999*]
Speed 8	ON	OFF	OFF	OFF	[*Pr. 232*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 232 = 9999*]
Speed 9	ON	OFF	OFF	ON	[*Pr. 233*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 233 = 9999*]
Speed 10	ON	OFF	ON	OFF	[*Pr. 234*]	0 to 400Hz, 9999	Setting value of [*Pr. 5*] when [*Pr. 234 = 9999*]
Speed 11	ON	OFF	ON	ON	[*Pr. 235*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 235 = 9999*]
Speed 12	ON	ON	OFF	OFF	[*Pr. 236*]	0 to 400Hz, 9999	Setting value of [*Pr. 4*] when [*Pr. 236 = 9999*]
Speed 13	ON	ON	OFF	ON	[*Pr. 237*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 237 = 9999*]
Speed 14	ON	ON	ON	OFF	[*Pr. 238*]	0 to 400Hz, 9999	Setting value of [*Pr. 5*] when [*Pr. 238 = 9999*]
Speed 15	ON	ON	ON	ON	[*Pr. 239*]	0 to 400Hz, 9999	Setting value of [*Pr. 6*] when [*Pr. 239 = 9999*]
External setting	OFF	OFF	OFF	OFF	Frequency setting potentiometer	0 to maximum setting value	



*1 When the frequency setting potentiometer is connected, the input signal of the frequency setting potentiometer is ignored if the multi-speed select signal is switched ON. (This also applies to the 4 to 20mA input signal.)

Setting example 4

Speed	[Pr.]	Setting	Terminal Input				Running Frequency (Hz)
			REX	RH	RM	RL	
Speed 1 (high speed)	[*Pr. 4*]	60Hz	OFF	ON	OFF	OFF	60
Speed 2 (middle speed)	[*Pr. 5*]	30Hz	OFF	OFF	ON	OFF	30
Speed 3 (low speed)	[*Pr. 6*]	10Hz	OFF	OFF	OFF	ON	10
Speed 4	[*Pr. 24*]	15Hz	OFF	OFF	ON	ON	15
Speed 5	[*Pr. 25*]	9999	OFF	ON	OFF	ON	10
Speed 6	[*Pr. 26*]	9999	OFF	ON	ON	OFF	30
Speed 7	[*Pr. 27*]	9999	OFF	ON	ON	ON	10
Speed 8	[*Pr. 232*]	9999	ON	OFF	OFF	OFF	10
Speed 9	[*Pr. 233*]	9999	ON	OFF	OFF	ON	10
Speed 10	[*Pr. 234*]	9999	ON	OFF	ON	OFF	30
Speed 11	[*Pr. 235*]	9999	ON	OFF	ON	ON	10
Speed 12	[*Pr. 236*]	9999	ON	ON	OFF	OFF	60
Speed 13	[*Pr. 237*]	9999	ON	ON	OFF	ON	10
Speed 14	[*Pr. 238*]	9999	ON	ON	ON	OFF	30
Speed 15	[*Pr. 239*]	9999	ON	ON	ON	ON	10

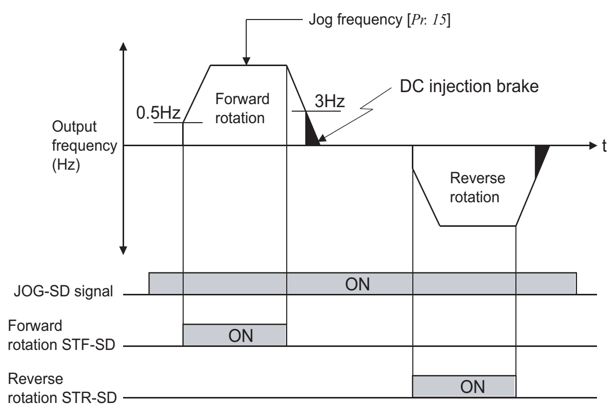
1.4.8 Jog operation (JOG signal) (common)

(1) Jog operation using external signals (common)

Jog operation can be started/stopped by turning ON the JOG signal* and turning ON/OFF the start signal STF or STR.
Jog frequency and JOG acceleration/deceleration time can be changed using [*Pr. 15*] (initial value 5Hz, variable between 0 and 400Hz) and [*Pr. 16*] (initial value 0.5s, variable between 0 and 3600s).

(2) JOG operation using operation panel or parameter unit (common)

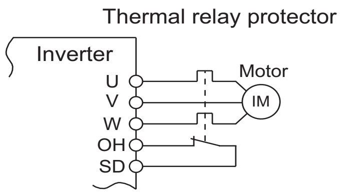
Also, the PU operation mode of the operation panel or parameter unit may be used to perform Jog operation.
In this case, the Jog frequency is set in [*Pr. 15*] and Jog acceleration/deceleration time in [*Pr. 16*] and the forward and reverse rotation keys are used to perform Jog operation.
In the Jog operation mode, multi-speed compensation and polarity reversible operation are invalid.



* Set "5" to any of [*Pr.178 to Pr.184 Input terminal function selection*] to assign JOG signal in (E700)(D700).

1.4.9 External thermal relay input (OH) (common)

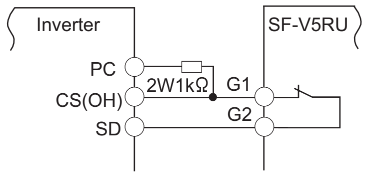
To protect the motor against overheat, use the OH signal when using an external thermal relay or the built-in thermal protector of the motor.
When the thermal relay operates, the inverter trips and outputs the fault signal (E.OHT).
For the terminal used for OH signal input, assign the function by setting 7 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*].



External thermal relay input connection example

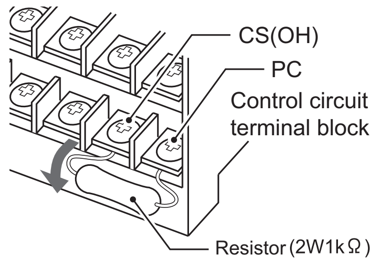
A thermal protector is provided for a vector control dedicated motor (SF-V5RU).
When using the motor dedicated for vector control (SF-V5RU) in (A700), assign OH (external thermal input) signal to the CS terminal. [*Pr. 186 = 7*]

Connect a 2W1kΩ resistor between the terminal PC and CS (OH).



Connection of the thermal relay protector of the SF-V5RU

Install the resistor pushing it against the bottom part of the terminal block so as to avoid a contact with other cables.
Refer to page 37 for details of [*Pr. 186 CS terminal function selection*].



1.4.10 Thermistor input (PTC) (A700) (F700) (10, 2) (D700) (TH1*, TH2*)(A700)

(*Terminal TH1, TH2 are available only in the (A700) with FR-A7AZ.)

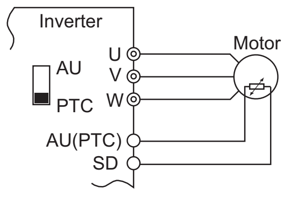
(1) When using PTC signal ((A700)(F700))

Built-in PTC thermistor output of the motor can be input to the PTC signal (terminal AU).
For the terminal used for PTC signal input, assign the function by setting 63 in [*Pr.184 AU terminal function selection*] and also set the AU/PTC switchover switch to the PTC terminal function.
When the overheat status of the motor is detected for 10s or more by the PTC thermistor input, output from the inverter is shut off and PTC thermal alarm signal (E.PTC) is output.
The input specifications of the PTC thermistor are shown below.

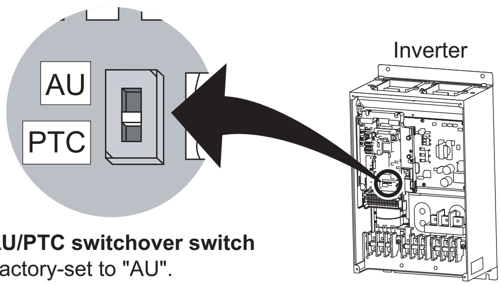
Motor Temperature	PTC Thermistor Resistance (Ω)
Normal	0 to 500
Boundary	500 to 4k
Overheat	4k or higher

*1 When the PTC signal was not assigned to [*Pr. 184*] and the AU/PTC switchover switch was set to the PTC terminal function, the function assigned to the AU terminal is always OFF. Reversely, when the PTC signal was assigned to [*Pr. 184*] and the AU/PTC switchover switch was set to the AU terminal function, a PTC thermal error (E.PTC) occurs since the function is always in a motor overheat state.

*2 When you want to input a current, assign the AU signal to the other signal.



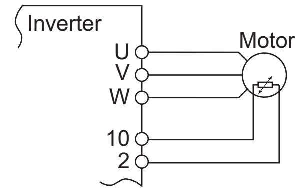
PTC thermistor input connection example



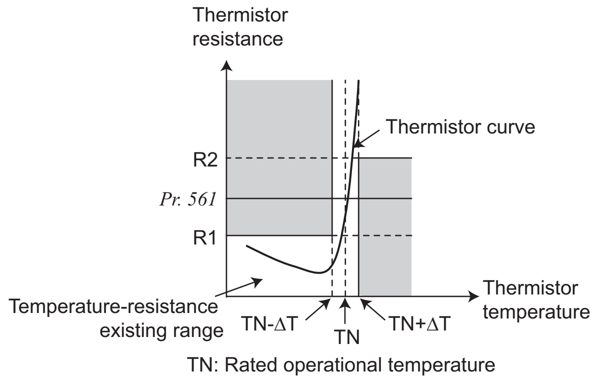
AU/PTC switchover switch
Factory-set to "AU".
Set to the "PTC" position to validate the PTC signal input.

(2) When using terminal 10 and 2(D700)

Terminal 2 and terminal 10 are available for inputting of motor built-in PTC thermistor output.
For the power supply terminal of PTC thermistor input, do not use power supply other than terminal 10 (external power supply, etc). PTC thermistor does not work properly.
When the PTC thermistor input reaches to the resistance value set in [*Pr. 561 PTC thermistor protection level*], inverter outputs PTC thermistor operation error signal (E.PTC) and trips.
Check the characteristics of the using PTC thermistor, and set the resistance value within a protection providing temperature TN, just around the center of R1 and R2 in a right figure. If the [*Pr. 561*] setting is closer to R1 or R2, the working temperature of protection goes higher (protection works later), or lower (protection works earlier).
PTC thermistor resistance can be displayed in operation panel, parameter unit (FR-PU07), or RS-485 communication when PTC thermistor protection is active ([*Pr. 561* ≠ "9999"]).



PTC thermistor input connection



PTC thermistor characteristics

[Pr.]	Name	Initial Value	Setting Range	Description
561	PTC thermistor protection level	9999	0.5 to 30kΩ	Set the level (resistance value) for PTC thermistor protection activates.
			9999	PTC thermistor protection is inactive.

*1 When using terminal 2 as PTC thermistor input ([*Pr. 561* ≠ "9999"]), terminal 2 is not available for analog frequency command. Also unavailable when using terminal 2 for PID control and Dancer control. When PID control and Dancer control is not active ([*Pr. 128 PID action selection* = "0"]), terminal 4 functions as follows.
When [*Pr. 79* = "4"] or in external operation mode......... Terminal 4 is active whether AU signal is ON/OFF
When [*Pr. 79* = "3"] .... Terminal 4 is active for frequency command when AU signal is ON

(3) When using terminal TH1 and TH2(FR-A7AZ) (A700)

When using a dedicated motor with thermistor for vector control (SF-V5RU□□□□□T/A), feeding back the motor temperature detected by the motor side thermistor to the inverter can reduce fluctuation of torque generated due to temperature.

Torque accuracy is ±3%.

Also, when [*Pr. 407* ≠ "9999"], thermal protection function by the motor thermistor is valid.

When [*Pr. 407* = "9999"] (initial value), thermal protection function by motor thermistor is not activated.

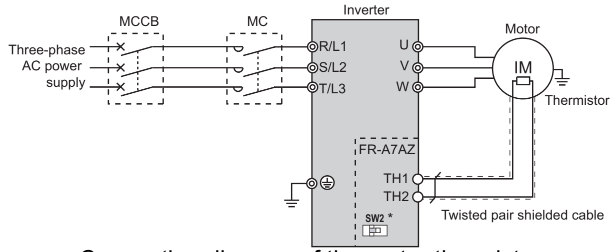
(Electronic thermal relays operate following the current value set in [*Pr.9 Electronic thermal O/L relay*].)

When the motor temperature remains at 145°C for 10s, the inverter protection function (E.THM) activates to shut off the inverter output.

When the motor temperature goes below -30°C during operation, the inverter protection function (E.THM) activates to shut off the inverter output. Motor thermal (E.THM) does not occur during a stop.

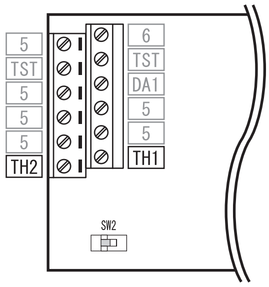
When operation is performed with thermal protection function valid without a thermistor or in the calibration status, protection function activates to shut off the inverter output.

Since a dedicated motor with thermistor has no thermal protector, always set a value other than "9999" in [*Pr. 407 Motor temperature detection filter*] to make the thermal protection function valid. When the setting remains "9999", motor protection is not activated.



Connection diagram of the motor thermistor dedicated for vector control with thermistor

* When calibrating the thermistor, change the thermistor calibration status switch.



Layout of terminals in FR-A7AZ

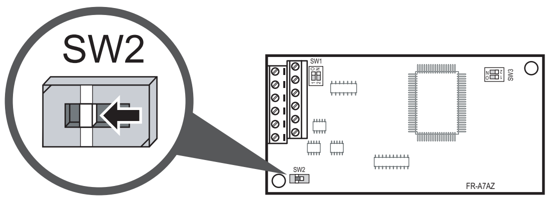
Terminal Symbol	Terminal Name	Description
TH1	Thermistor input 1	Input the motor side thermistor output signal.
TH2	Thermistor input 2	
SW2	Thermistor calibration status switch	When calibrating at installation, change the switch to place the inverter in calibration status.

[Pr.]	Name	Initial Value	Setting Range	Description
407	Motor temperature detection filter AZ	1	0 to 100s	Set the response level to detect motor temperature. In normal condition, set it around 30s. If the response level is not satisfactory, decrease the setting value.
			9999	Motor thermistor input invalid
408	Motor thermistor selection AZ	0	0	SF-V5RU□□□□□T
			1	SF-V5RU□□□□□A
C29(925)	Motor temperature detection calibration (analog input) AZ	100%	0 to 200%	Calibration value for an inverter and FR-A7AZ (thermistor interface).

●Thermistor calibration method [*C29(Pr.925)*]

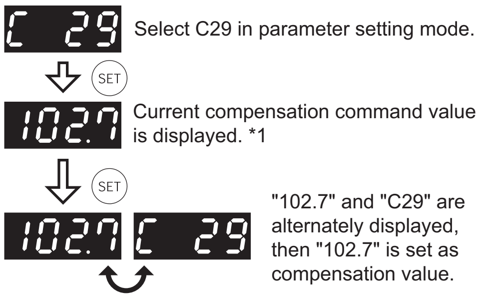
Perform calibration of the inverter and FR-A7AZ (thermistor interface) before starting the motor at installation. Calibration must be performed at installation.

1) Set the thermistor calibration status switch (SW2) to the line to place the FR-A7AZ in the calibration status.



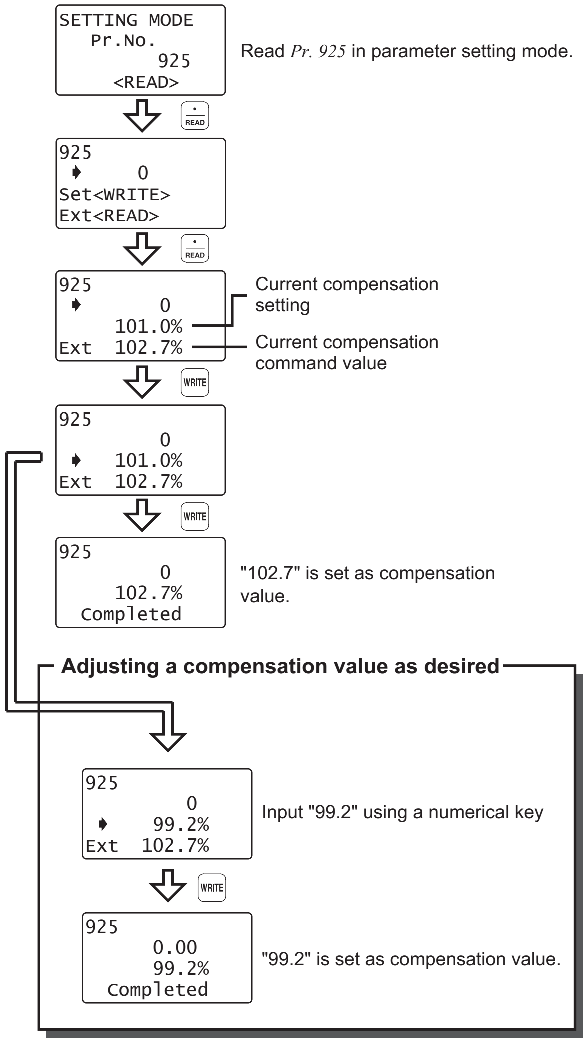
2) Read [*C29 (Pr. 925)*] and set the compensation value.

(a) Compensation using the operation panel (FR-DU07)



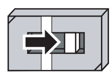
*1 Take caution not to turn at this point.

(b) Calibration using the parameter unit (FR-PU07)



3) After compensation, reset the thermistor calibration status switch (SW2) to the original position.
Always return the SW2 to the original position after calibration. Starting the motor in the calibration status results in motor thermal (E. THM), shutting off the inverter output.

SW2



1.4.11 Second function selection signal, third function selection signal (RT, X9 *) common

(*X9 is not available for the F700 E700 D700.)

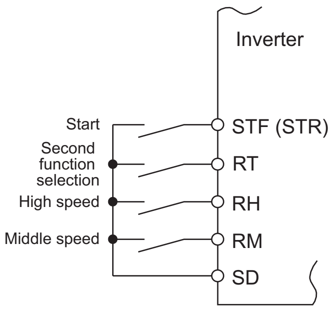
Second (third) function can be selected with the RT (X9) signal.
When the RT signal turns ON, the second function becomes valid.
When the X9 signal turns ON, the third function becomes valid.
For RT signal, set "3" to any of [*Pr.178 to 189 Input terminal function selection*] to assign the function. For X9 signal, set "9" to any of [*Pr.178 to 189 Input terminal function selection*] to assign the function.

The second (third) function has the following applications.

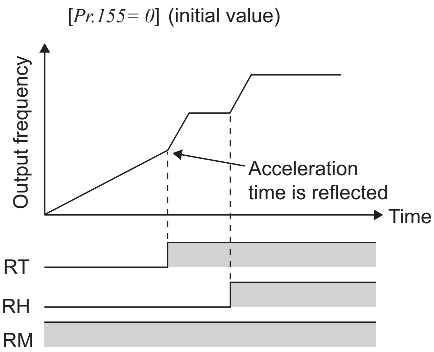
1) Switching between normal use and emergency use
2) Switching between heavy load and light load
3) Changing of acceleration/deceleration time by broken line acceleration/deceleration
4) Switching of characteristic between the main motor and sub motor

You can set the operating condition (reflection timing) for second (third) function with [*Pr.155*] in A700 F700.
The function immediately activates by turning ON/OFF the RT signal in E700 D700.

[Pr.]	Name	Initial Value	Setting Range	Description	Setting Range A700 F700	Setting Range E700 D700
155	RT signal function validity condition selection	0	0	Second (third) function is immediately made valid with ON of the RT (X9) signal.	○	—
			10	Second (third) function is valid only during the RT (X9) signal is ON and constant speed operation. (invalid during acceleration/deceleration)		



Second function connection diagram



Second acceleration/deceleration time example

The list below shows functions which can be set as second and third functions.

Function	First Function [*Pr.*]	Second Function [*Pr.*]	Third Function [*Pr.*]	Refer to Page	Available Inverters			
					A700	F700	E700	D700
Torque boost	[*Pr. 0*]	[*Pr. 46*]	[*Pr. 112*] *1	244	○	○	○	○
Base frequency	[*Pr. 3*]	[*Pr. 47*]	[*Pr. 113*] *1	244	○	○	○	○
Acceleration time	[*Pr. 7*]	[*Pr. 44*]	[*Pr. 110*] *1	234	○	○	○	○
Deceleration time	[*Pr. 8*]	[*Pr. 44, 45*]	[*Pr. 110, 111*] *1	234	○	○	○	○
Electronic thermal O/L relay	[*Pr. 9*]	[*Pr. 51*]	—	379	○	○	○	○
Stall prevention	[*Pr. 22*]	[*Pr. 48, 49*] *2	[*Pr. 114, 115*] *1	335	○	○	○	○
Frequency detection	[*Pr. 42 (43)*]	[*Pr. 50*] *3	[*Pr. 116*] *1 *3	70	○	○	—	—
Applied motor	[*Pr. 71*]	[*Pr. 450*]	—	266	○	—	○	○
Motor constants	[*Pr. 80 to 84, 89, 90 to 94, 96 ,859*]	[*Pr. 453 to 457, 569, 458 to 462, 463, 860*]	—	268	○	—	—	—
Online auto tuning	[*Pr. 95*]	[*Pr. 574*]	—	276	○	—	—	—
Motor control method	[*Pr. 800*]	[*Pr. 451*]	—	252	○	—	—	—
Speed control gain	[*Pr. 820, 821*]	[*Pr. 830, 831*]	—	286	○	—	—	—
Analog input filter	[*Pr. 822, 826*]	[*Pr. 832, 836*]	—	323	○	—	—	—
Speed detection filter	[*Pr. 823*]	[*Pr. 833*]	—	324	○	—	—	—
Torque control gain	[*Pr. 824, 825*]	[*Pr. 834, 835*]	—	306	○	—	—	—
Torque detection filter	[*Pr. 827*]	[*Pr. 837*]	—	324	○	—	—	—

*1 [*110 to 116*] are not available for F700 E700 D700.

*2 [*Pr. 49*] is not available for E700 D700.

*3 It functions regardless of ON/OFF of RT and X9 signals.

1.4.12 Inverter output stop (MRS) (common)

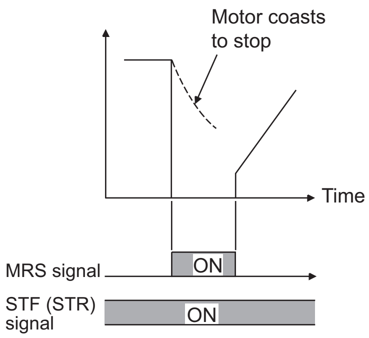
(1) Output shutoff signal (common)

Turning ON the output shutoff signal (MRS) during inverter running shuts OFF the output immediately.

Terminal MRS may be used as described below.

1) To stop the motor by mechanical brake (e.g. electromagnetic brake)
   The inverter output is shut off when the mechanical brake is operated.
2) To provide interlock to disable operation by the inverter
   With the MRS signal ON, the inverter cannot be operated if the start signal is given to the inverter.
3) To coast the motor to stop
   When the start signal is turned OFF, the motor decelerates to stop according to the preset deceleration time, but when the MRS signal is turned ON, the motor coasts to stop.

*1 For MRS signal in (D700), set "24" to any of [*Pr.178 to 182 Input terminal function selection*] to assign the function.

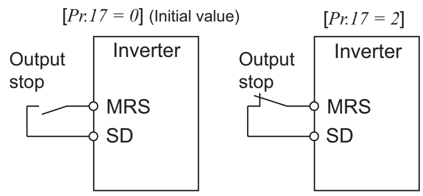


(2) MRS signal logic inversion (common)

When [*Pr. 17* = 2] , the MRS signal (output stop) can be changed to the normally closed (NC contact) input specification. When the MRS signal turns ON (opens), the inverter shuts off the output.

When (A700)(E700)(D700) [*Pr. 17* = 4], the MRS signal from external terminal (output stop) can be changed to the normally closed (NC contact) input, and the MRS signal from communication can be changed to the normally open (NO contact) input. This function is used to perform operation by communication with MRS signal from external terminal remained ON.

[Pr. 17] Setting	Terminal MRS Function		Available Inverters	
	Normally open input	Normally closed input	A700 E700 D700	F700
0	○ (Communication, external terminal)	—	○	○
2	—	○ (Communication, external terminal)	○	○
4	○ (communication)	○ (external terminal)	○	—



External MRS Signal	Communication MRS Signal	[Pr. 17] Setting		
		0	2	4
OFF	OFF	Operation enabled	Output shutoff	Output shutoff
OFF	ON	Output shutoff	Output shutoff	Output shutoff
ON	OFF	Output shutoff	Output shutoff	Operation enabled
ON	ON	Output shutoff	Operation enabled	Output shutoff

1.4.13 Reset signal (RES) common

Used to reset the fault stop state established when the inverter's protective function is activated. The reset signal immediately sets the control circuit to the initial (cold) status, e.g. initializes the electronic thermal relay function, built-in brake resistor overheat protection circuit. It shuts off the inverter output at the same time. During reset, the inverter output is kept shut off. To give this reset input, turn ON signal RES *1 for more than 0.1s. When the shorting time is long, the operation panel or parameter unit displays the initial screen, which is not a fault.
Operation is enabled within 1s after turning OFF signal RES *1 .

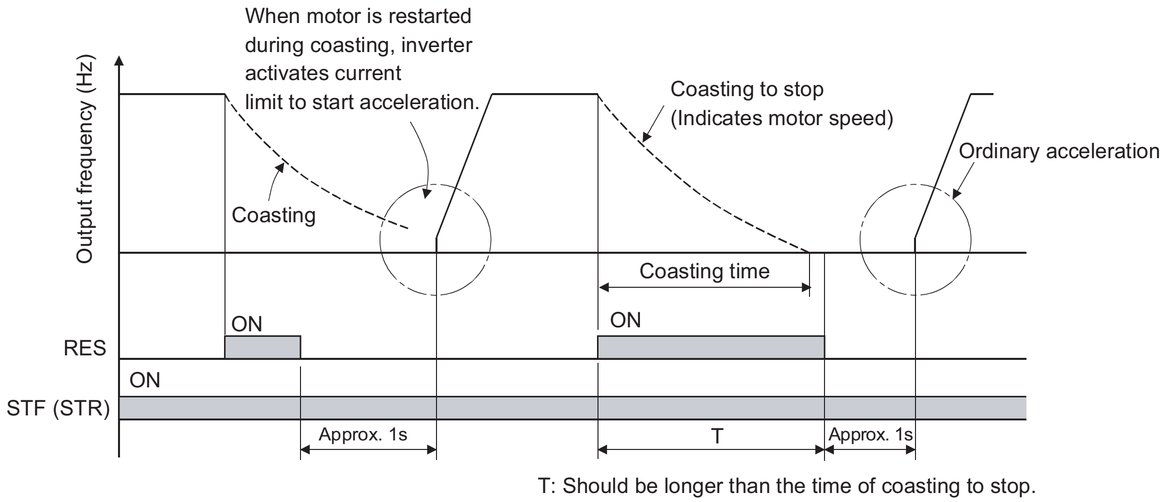
*1 For RES signal in D700, set "62" to any of [*Pr.178 to 182 Input terminal function selection*] to assign the function.

The reset terminal is used to reset the inverter fault stop state.
When the reset terminal is turned ON, then OFF while the inverter is running, the motor may be restarted during coasting (refer to the timing chart below) and the output may be shut off due to overvoltage.
Setting either 1, 3, 15, 17 in [*Pr. 75*] allows the accidental input of the reset signal during operation to be unaccepted.

*2 Frequent resetting will make the electronic thermal relay function and brake resistor overheat protection invalid.

Setting reset input selection [Pr. 75]

[Pr. 75] Setting	Reset Selection	Disconnected PU Detection	PU Stop Selection
0	Reset input normally enabled	If the PU is disconnected, operation will be continued.	Pressing STOP RESET decelerates the motor to a stop only in the PU operation mode.
1	Reset input is enabled only when the protective function is activated.		
2	Reset input normally enabled	When the PU is disconnected, error is displayed on the PU and the inverter trips.	
3	Reset input is enabled only when the protective function is activated.		
14 (initial value)	Reset input normally enabled	If the PU is disconnected, operation will be continued.	Pressing STOP RESET decelerates the motor to a stop in any of the PU, external and communication operation modes.
15	Reset input is enabled only when the protective function is activated.		
16	Reset input normally enabled	When the PU is disconnected, error is displayed on the PU and the inverter trips.	
17	Reset input is enabled only when the protective function is activated.		



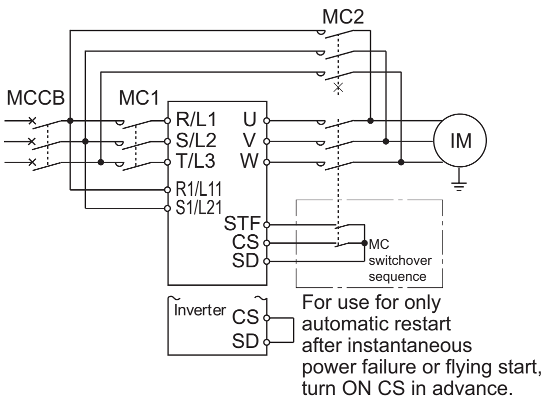
Reset Input Timing Chart during Normal Operation

1.4.14 Automatic restart after instantaneous power failure selection (CS) (A700) (F700)

This function allows the inverter to re-control the motor automatically when power is restored after an instantaneous power failure. (E700) (D700) do not have CS signal but have automatic restart after instantaneous power failure function. (Refer to page 367 for details.)

When the automatic restart after instantaneous power failure selection signal (CS) is turned ON, automatic restart operation is enabled.

When [*Pr. 57* ≠ 9999] (automatic restart operation enabled), the inverter will not operate if used with the CS signal remained OFF.



CS signal is also used to switch inverter/bypass operation when bypass-inverter switchover function is active (Refer to page 416.)

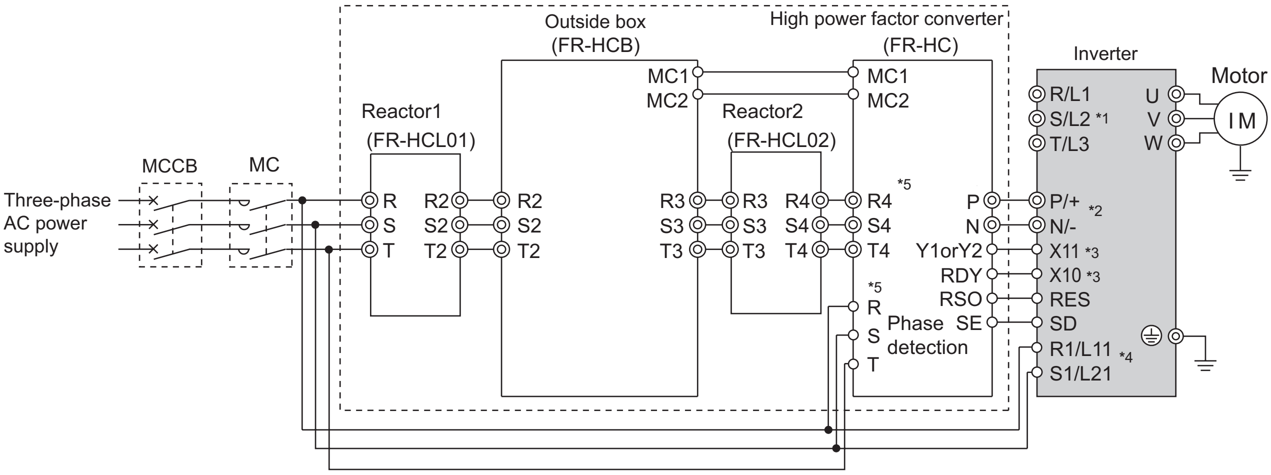
1.4.15 High power factor converter connection (X10, X11) common

Used with the inverter in accordance with the Japanese harmonic suppression guidelines issued by the Agency for Natural Resources and Energy of Japanese Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry), the high power factor converter (FR-HC, MT-HC) is an optional high power factor converter unit designed to suppress harmonics to the input power supply.
When connecting the high power factor converter, perform wiring securely as shown in figure (1) and (2). Incorrect connection will damage the high power factor converter and inverter.
After making sure that the wiring is correct, set [*Pr.30 Regenerative function selection* = 2] for A700 F700, or set [*Pr.30 Regenerative function selection* =0 or 2] in E700 D700. (Refer to page 340)

Having a power regeneration function, the high power factor converter returns power in the regeneration mode.

For the A700 7.5K or less, the brake circuit built-in the inverter is not activated.
Undervoltage and instantaneous power failure are detected by the high power factor converter. When the protective function of the high power factor converter is activated, the inverter operation enable signal shuts off the inverter output. The undervoltage and instantaneous power failure protective functions of the inverter itself are invalid.
When you need automatic restart after instantaneous power failure, choose automatic restart after instantaneous power failure in the inverter and also set the parameter to activate automatic restart after instantaneous power failure in the high power factor converter. The inverter restarts in accordance with the automatic restart after instantaneous

(1) Connection with the FR-HC (55K or less) common



*1 Always keep terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter. (In A700 F700, E.OPT (Option fault) will occur. (Refer to page 97))

*2 Do not insert an MCCB between terminals P/+ and N/- (between P and P/+, between N and N/-). Opposite polarity of terminals N/-, P/+ will damage the inverter.

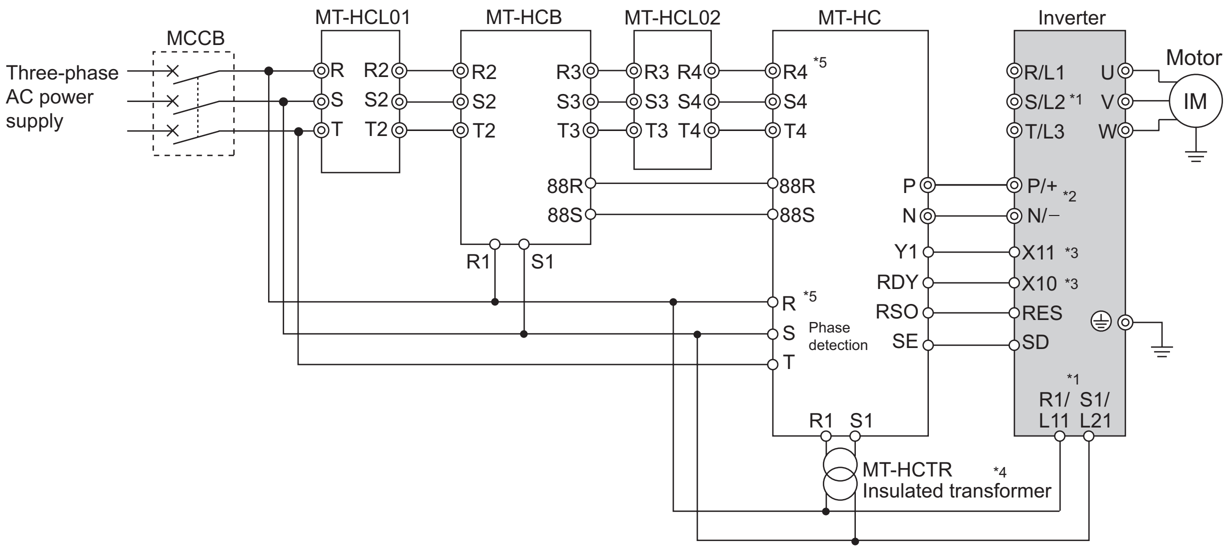
*3 Use [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign terminals used for X10 and X11 signal.
For E700 D700, X11 signal is unavailable. (Refer to page 37)
Terminal MRS can be used when not using inverter operation enable signal (X10).
For communication where the start command is sent only once, for example RS-485 communication operation, use the X11 signal when making setting to hold the mode at occurrence of an instantaneous power failure. (Refer to page 331)

*4 For A700 F700, remove jumpers between terminal R/L1 and R/L11 as well as between S/L2 and S1/S21, and connect the power supply for the control circuit to terminals R1/L11 and S1/L21.
For E700 D700, connection is unnecessary because E700 D700 do not have terminal R1/L11 and S1/L21.

*5 The voltage phases of terminals R, S, T and terminals R4, S4, T4 must be matched.

*6 Use sink logic (factory setting) when the FR-HC is connected. The FR-HC cannot be connected when source logic is selected.

(2) Connection with the MT-HC (75K or more)



*1 Remove the jumpers across the inverter terminals R/L1 and R1/L11, S/L2 and S1/L21, and connect the control circuit power supply to terminals R1/L11 and S1/L21. Always keep terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter. (E.OPT (Option fault) will occur.) (Refer to page 97)

*2 Do not insert an MCCB between terminals P/+ and N/- (between P and P/+, between N and N/-). Opposite polarity of terminals N/-, P/+ will damage the inverter.

*3 Use [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign terminals used for X10 and X11 signal. (Refer to page 37)
Terminal MRS can be used when not using inverter operation enable signal (X10).
For communication where the start command is sent only once, e.g. RS-485 communication operation, use the X11 signal when making setting to hold the mode at occurrence of an instantaneous power failure. (Refer to page 331)

*4 Connect the power supply to terminals R1 and S1 of the MT-HC via an insulated transformer.

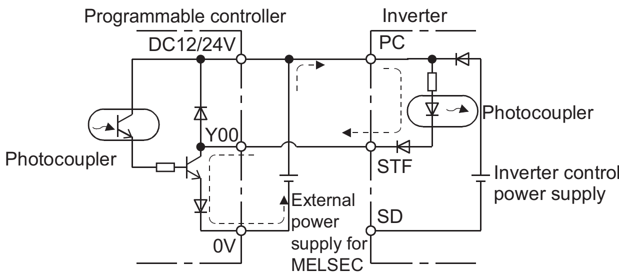
*5 The voltage phases of terminals R, S, T and terminals R4, S4, T4 must be matched.

*6 Use sink logic (factory setting) when the MT-HC is connected. The MT-HC cannot be connected when source logic is selected.

*7 When connecting the inverter to the MT-HC, do not connect the DC reactor provided to the inverter.

1.4.16 24VDC and external transistor common (PC) (common)

When the transistor output (open collector) of a programmable controller having an external power supply is input to the inverter, supply external interface power to prevent a malfunction from occurring due to undesirable current as shown below.
Making connections as shown on the right supplies external power to the photocoupler in the inverter as indicated by the dotted lines. Since terminal SD is not connected, no power is supplied to the photocoupler from the control power supply of the inverter.
Also, terminals PC-SD may be used as a 24VDC 0.1A power output. When using terminals PC-SD as a 24VDC power supply, malfunction due to undesirable currents can not be prevented.

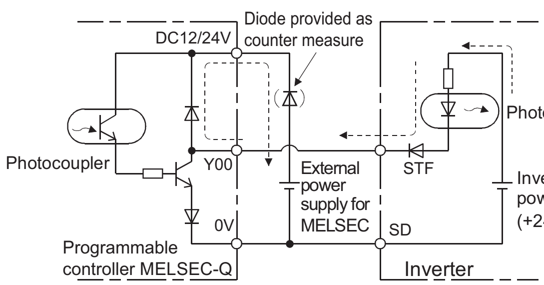


When terminal PC is not used

When the control power voltage in the inverter connected with the output module (open collector output) of the programmable controller has become higher than the external power supply voltage of the programmable controller as shown on the right, a current indicated by the dotted lines flows if the transistor of the programmable controller is not on, accidentally giving the inverter a command signal.

- Measures

(1)Insert a diode to prevent undesirable currents.
(2) Use an all-point independent type output module.
(such as QY68A)



1.4.17 Output signal (RUN, SU, IPF, OL, FU, A1(A), B1(B), C1(C), A2, B2, C2, Y0*, Y1*, Y2*, Y3*, Y4*, Y5*, Y6*, 1A*, 1B*, 1C*, 2A*, 2B*, 2C*, 3A*, 3B*, 3C*) (common)

(*Y0, Y1, Y2, Y3, Y4, Y5, Y6 are output terminal of the FR-A7AY (option). 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B, 3C are output terminal of the FR-A7AR (option)).

(1) Terminal assignment of output terminal (common)

The inverter has the output terminals of which functions can be changed by parameter setting.

1) (A700)(F700)

[Pr.]	Name		Initial Value
190	RUN terminal function selection	Open collector output terminal	0
191	SU terminal function selection		1
192	IPF terminal function selection		2
193	OL terminal function selection		3
194	FU terminal function selection		4
195	ABC1 terminal function selection	Relay output terminal	99
196	ABC2 terminal function selection		9999

2) (E700)

[Pr.]	Name		Initial Value
190	RUN terminal function selection	Open collector output terminal	0
191	FU terminal function selection		4
192	ABC terminal function selection	Relay output terminal	99

3) (D700)

[Pr.]	Name		Initial Value
190	RUN terminal function selection	Open collector output terminal	0
192	ABC terminal function selection	Relay output terminal	99

4) Plug-in options (FR-A7AY and FR-A7AR)

(These options are not available for (D700).)

[Pr.]	Name		Initial Value
313	DO0 output selection AY	Open collector output terminal	9999
314	DO1 output selection AY		9999
315	DO2 output selection AY		9999
316	DO3 output selection AY		9999
317	DO4 output selection AY		9999
318	DO5 output selection AY		9999
319	DO6 output selection AY		9999
320	RA1 output selection AR	Relay output terminal	0
321	RA2 output selection AR		1
322	RA3 output selection AR		2

Refer to the following table and set the parameters: (0 to 99: positive logic, 100 to 199: negative logic)

Setting		Signal Name	Functions	Operation	Available Inverters			
Positive logic	Negative logic				A700	F700	E700	D700
0	100	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above [*Pr. 13 Starting frequency*].	○	○	○	○
1	101	SU	Up to frequency [*1]	Output when the output frequency reaches to the set frequency.	○	○	○	○
2	102	IPF	Instantaneous power failure/undervoltage	Output at occurrence of an instantaneous power failure or undervoltage protection activation.	○	○	—	—
3	103	OL	Overload alarm	Output while stall prevention function is activated.	○	○	○	○
4	104	FU	Output frequency detection	Output when the output frequency reaches the frequency set in [*Pr. 42*] (for reverse rotation [*Pr. 43*]).	○	○	○	○
5	105	FU2	Second output frequency detection	Output when the output frequency reaches the frequency set in [*Pr. 50*].	○	○	—	—
6	106	FU3	Third output frequency detection	Output when the output frequency reaches the frequency set in [*Pr. 116*].	○	—	—	—
7	107	RBP	Regenerative brake prealarm	Output when 85% of the regenerative brake duty set in [*Pr. 70*] is reached. For F700, setting can be made for the 75K or more.	○	○	○	○
8	108	THP	Electronic thermal relay function prealarm	Output when the electronic thermal value reaches 85% of the trip level. (Electronic thermal relay function protection (E.THT/E.THM) activates, when the value reached 100%.)	○	○	○	○
10	110	PU	PU operation mode	Output when the PU operation mode is selected.	○	○	—	—
11	111	RY	Inverter operation ready	Output when reset process is completed (when the inverter can be started by switching the start signal ON or while it is running) after powering ON the inverter.	○	○	○	○
12	112	Y12	Output current detection	Output when the output current is higher than the [*Pr. 150*] setting for longer than the time set in [*Pr. 151*].	○	○	○	○
13	113	Y13	Zero current detection	Output when the output current is higher than the [*Pr. 152*] setting for longer than the time set in [*Pr. 153*].	○	○	○	○
14	114	FDN	PID lower limit	Output when the feedback value falls below the lower limit of PID control.	○	○	○	○
15	115	FUP	PID upper limit	Output when the feedback value rises above the upper limit of PID control	○	○	○	○
16	116	RL	PID forward/reverse rotation output	Output when forward rotation is performed in PID control.	○	○	○	○
17	—	MC1	Electronic bypass MC1	Used when the bypass-inverter switchover function is used.	○	○	—	—
18	—	MC2	Electronic bypass MC2		○	○	—	—
19	—	MC3	Electronic bypass MC3		○	○	—	—
20	120	BOF	Brake opening request	Output to open the brake when the brake sequence function is selected.	○	—	○	—
25	125	FAN	Fan alarm output	Output at the time of a fan alarm.	○	○	○	○
26	126	FIN	Heatsink overheat pre-alarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	○	○	○	○
27	127	ORA	Orientation completion	When orientation is valid[*4]	○	—	—	—
28	128	ORM	Orientation fault		○	—	—	—
30	130	Y30	Forward rotation output	Output when the motor is running in forward direction.[*4]	○	—	—	—
31	131	Y31	Reverse rotation output	Output when the motor is running in reverse direction.[*4]	○	—	—	—
32	132	Y32	Regenerative status output	Output in the regeneration status under vector control operation.[*4]	○	—	—	—
33	133	RY2	Operation ready 2	Output during vector control or pre-excitation operation under Real sensorless vector control or vector control.	○	—	—	—
34	134	LS	Low speed output	Output when the output frequency reduces below the [*Pr. 865*] setting.	○	—	—	—
35	135	TU	Torque detection	Output when the motor torque rises above the [*Pr. 864*] setting.	○	—	—	—
36	136	Y36	In-position	Output when the number of droop pulses has fallen below the setting value.	○	—	—	—
39	139	Y39	Start-time tuning completion signal	Output on completion of start-time tuning.	○	—	—	—

Setting		Signal Name	Functions	Operation	Available Inverters			
Positive logic	Negative logic				A700	F700	E700	D700
41	141	FB	Speed detection	Output when the actual motor speed (estimated actual speed value) reaches the [*Pr. 42 (Pr. 50, Pr. 116)*] setting.	○	—	—	—
42	142	FB2	Second speed detection		○	—	—	—
43	143	FB3	Third speed detection		○	—	—	—
44	144	RUN2	Inverter running 2	• Output during forward rotation or the reverse rotation signal is ON. • Output at deceleration even during forward rotation or the reverse rotation signal is OFF. (Does not output during pre-excitation LX is ON.) • Output during the orientation command signal (X22) is ON. • Switched ON when the servo is ON (LX-ON) under position control. (Switched OFF when the servo is OFF (LX-OFF).	○	—	—	—
45	145	RUN3	Inverter running and start command is on	Output when the inverter running and start commands are ON.	○	○	—	—
46	146	Y46	During deceleration due to power failure stop function	Output when the power failure-time deceleration function is executed(retained until release).	○	○	○	○
47	147	PID	During PID control activated	Output during PID control.	○	○	○	○
64	164	Y64	During retry	Output during retry processing.	○	○	○	○
70	170	SLEEP	PID output interruption	Output when the PID output interruption function is executed.	○	○	—	○
80	180	SAFE	Safety monitor output	Output while safety stop function is activated.	—	—	—	○
84	184	RDY	Position control preparation ready	Signal is output when the servo is ON (LX-ON) and ready to operate.*4	○	—	—	—
85	185	Y85	DC feeding	Output during power failure or under voltage of AC power.	○	—	—	—
86	186	Y86	Control circuit capacitor life*5	Output when the control circuit capacitor life falls below 10% of ([*Pr. 257*]).	○	○	○	—
87	187	Y87	Main circuit capacitor life*5	Output when the main circuit capacitor life falls below 85% of ([*Pr. 258*]).	○	○	○	—
88	188	Y88	Cooling fan life*5	Output when the speed of the cooling fan falls below 50%.	○	○	○	—
89	189	Y89	Inrush current limit circuit life*5	Output when the inrush current limit circuit life falls below 10% of ([*Pr. 256*]).	○	○	○	—
90	190	Y90	Life alarm	Output when any of the control circuit capacitor, main circuit capacitor and inrush current limit circuit or the cooling fan approaches the end of its service life.	○	○	○	○
91	191	Y91	Fault output 3 (power-off signal)	Output when a fault occurs due to the internal circuit failure of the inverter wiring mistake.	○	○	○	○
92	192	Y92	Energy saving average value updated timing	Turned ON and OFF alternately every time the power saving average value is updated when the power saving monitor is used. Cannot be set to a relay output terminal.	○	○	—	—
93	193	Y93	Current average value monitor signal	Average current value and maintenance timer value are output as pulses. Cannot be set to a relay output terminal.	○	○	○	○
94	194	ALM2	Fault output 2	Output when the inverter protective function is activated to stop the output (fault). Continue outputting the signal during inverter reset and stop outputting after reset is cancelled.*3	○	○	—	—
95	195	Y95	Maintenance timer signal	Output when [*Pr. 503*] rises to or above the [*Pr. 504*] setting.	○	○	○	○
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	○	○	○	○
97	197	ER	Alarm output 2	When [*Pr. 875* = "0"] (initial value), the signal is output when the inverter protective function is activated to stop the output (major fault). When [*Pr. 875* = "1"], the signal is output when the inverter protective function is activated at occurrence of OHT/THM/PTC error and deceleration is started. Output when other protective functions are activated to stop output.	○	—	—	—

1

SPECIFICATIONS

Setting		Signal Name	Functions	Operation	Available Inverters			
Positive logic	Negative logic				A700	F700	E700	D700
98	198	LF	Alarm output	Output when an alarm (fan failure or communication error warning) occurs.	○	○	○	○
99	199	ALM	Fault output	Output when the inverter protective function is activated to stop the output (fault). The signal output is stopped when the fault is reset.	○	○	○	○
9999		—	No function	—	○	○	○	○

*1 Note that when the frequency setting is varied using an analog signal or setting dial of the operation panel (FR-DU07), the output of the SU (up to frequency) signal may alternate ON and OFF depending on that varying speed and the timing of the varying speed due to acceleration/ deceleration time setting. (The output will not alternate ON and OFF when the acceleration/deceleration time setting is "0s".)

*2 Up to frequency SU, frequency detection FU, FU2, FU3 under encoder feedback control or vector control (option FR-A7AP is mounted) signals output as below.
SU, FU: Output when the actual speed (frequency) by the encoder feedback signal exceeds detected specification frequency.
FU2, FU3: Output when the inverter output frequency exceeds detected specification frequency.

*3 When a power supply reset is performed, the alarm output 2 signal (ALM2) turns OFF as soon as the power supply switches OFF.

*4 Available only when used with the FR-A7AP or FR-A7AL (option).

*5 This can be assigned to only when the FR-A7AY or FR-A7AR (option) is mounted. This cannot be set to [*Pr. 190 to Pr. 196*]

*6 When the function is executed, the terminal conducts at the setting of any of 0 to 99, and does not conduct at the setting of any of 100 to 199.

*7 When [*Pr. 76 Fault code output selection* = 1] in A700 F700, the output signals of terminals SU, IPF, OL and FU are switched as set in [*Pr. 76*]. (When an inverter fault occurs, the signal output is switched to the fault output.)

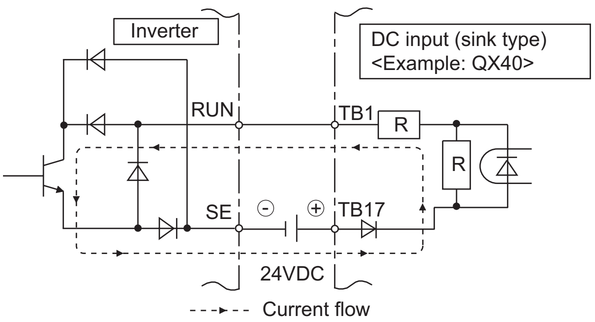
*8 Changing the terminal assignment using [*Pr. 190 to Pr. 196, Pr. 313 to Pr. 322 Output terminal function selection*] may affect the other functions. Please make setting after confirming the function of each terminal.

*9 Do not assign signals which repeat frequent ON/OFF to the relay output terminal. Otherwise, the life of the relay contact decreases.

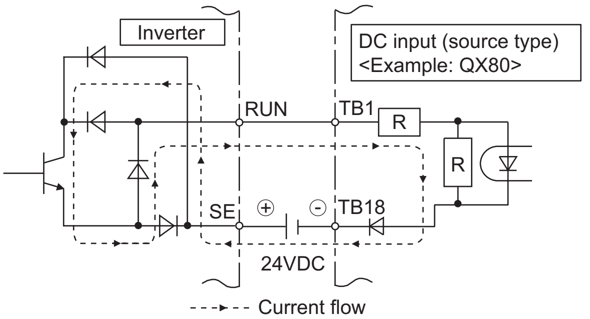
(2) Sink logic type and source logic type (common)

In sink logic, a signal switches ON when a current flows from the corresponding signal input terminal.
Terminal SE is common to the open collector output signals.
In source logic, a signal switches ON when a current flows into the corresponding signal input terminal.
Terminal SE is common to the open collector output signals.

● **Current flow concerning the input/output signal when sink logic is selected**



● **Current flow concerning the input/output signal when source logic is selected**



(3) Relay output (fault output) (common)

1changeover contact is used for fault alarm output and the following table shows its operations.

When a fault occurs in (A700)(F700), ALARM lamp is lit, and fault output remains lit. If the contact is opened by the magnetic contactor, etc. provided on the inverter power supply side, the inverter control power is lost and the fault output is not kept ON. To keep the fault output signal ON, the fault alarm output contact (across terminals B-C) must be kept open by the external circuit.

In (A700)(F700), fault output signal can be kept ON by using terminal R1/L11, S1/L21 to connect the control circuit to the other power supply. (Refer to page 36)
Note that even if current limit function, stall prevention, fan fault, brake discharge resistor overheat protection function operates, or fault alarm output is not activated and terminal B-C remains closed. In addition, ALARM lamp is not lit.
Fault description when a fault occurs can be read in fault history in monitor mode of the operation panel or parameter unit.

Open/close of fault alarm relay and lamp indication

	Open/Close of Contact	(A700) (F700) ALARM Lamp	Terminal
During normal operation and the inverter power-OFF	The relay coli is non-excitation and NO contact is closed.	Off	C A B
Abnormal	When a fault occurs, the coil of the relay is excited to open NO contact and close NC contact. Note that the protective function is not activated at the time of a fan alarm.	On	C A B

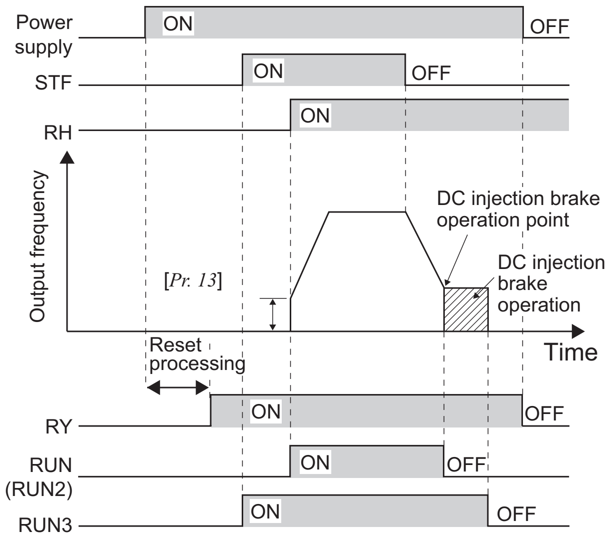
1.4.18 Inverter operating status output signal (RUN, RUN2*, RUN3*, RY, RY2*, Y30*, Y31*, Y32*, ALM, ALM2*, IPF*, Y91, OL, RBP, THP, FIN) common

(*RUN2, RY2, Y30, Y31, Y32 are not available for F700.)

(*RUN2, RUN3, RY2, Y30, Y31, Y32, ALM2, IPF are not available for E700 D700.)

(1) Inverter operation ready signal (RY, RY2*) and inverter running signal (RUN, RUN2*, RUN3) common
(*RY2, RUN2 are not available for F700 .)
(*RY2, RUN2, RUN3 are not available for E700 D700.)

1) **During V/F control, Advanced magnetic flux vector control *1, General-purpose magnetic flux vector control, Simple magnetic flux vector control *1 common**
When the inverter is ready to operate, the output of the operation ready signal (RY) is ON.
(It is also ON during inverter running.)
When the output frequency of the inverter rises to or above [*Pr. 13 Starting frequency*], the output of the inverter running signals (RUN, RUN2) is turned ON. During an inverter stop or DC injection brake operation, the output is OFF.
For the RUN3 signal, the output is ON while the inverter is running and the start signal is ON. (For the RUN3 signal, output is ON if the start command is on even when a fault occurs or the MRS signal is ON.)
The output is ON during DC injection brake operation and OFF during an inverter stop.



*1 Advanced magnetic flux vector control can be set with A700 E700, General-purpose magnetic flux vector control can be set with E700 D700 and Simple magnetic flux vector control can be set with F700.

Output Signal	Start Signal OFF (during stop)	Start Signal ON (during stop)	Start Signal ON (during operation)	Under DC Injection Brake	At Alarm Occurrence or MRS Signal ON (output shutoff)		Automatic Restart after Instantaneous Power Failure		
							Coasting		Restarting
					Start signal ON	Start signal OFF	Start signal ON	Start signal OFF	
RY	ON	ON	ON	ON	OFF		ON*1		ON
RY2	OFF	OFF	OFF	OFF	OFF		OFF		OFF
RUN	OFF	OFF	ON	OFF	OFF		OFF		ON
RUN2	OFF	OFF	ON	OFF	OFF		OFF		ON
RUN3	OFF	ON	ON	ON	ON	OFF	ON	OFF	ON

*1 This signal turns OFF during power failure or undervoltage.

2) **Real sensorless vector control, vector control**

(A700)

When the inverter is ready to operate, the output of the operation ready signal (RY) is ON. (It is also ON during inverter running.)

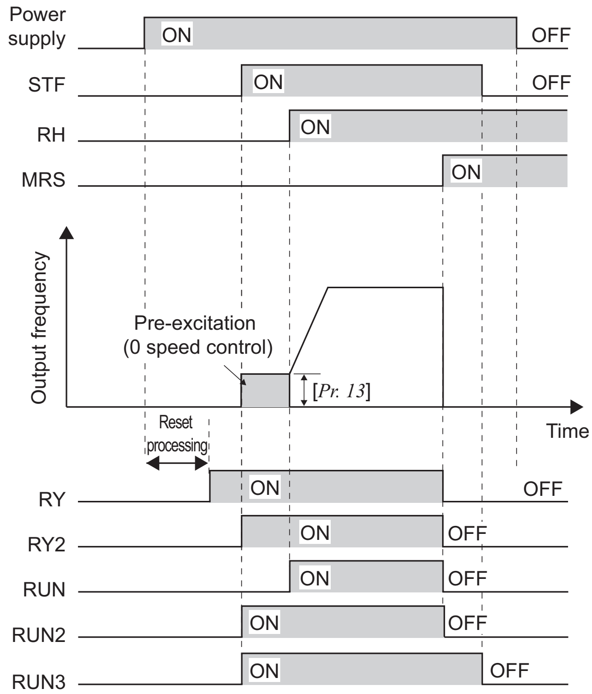
When the inverter output frequency rises to or above the [*Pr. 13 Starting frequency*] setting, turn ON the output of the inverter running signal (RUN). During an inverter stop, DC injection brake operation, start time tuning or pre-excitation, the output is OFF.

For the RUN2 signal, the output is ON while the inverter is running and the start signal is ON. (The RUN2 signal shuts OFF output when a fault occur and the MRS signal is ON.)

For the RUN3 signal, the output is ON while the inverter is running and the start signal is ON.

The RUN2 and RUN3 signals are ON when the start command is ON and even during pre-excitation with "0" set in speed command. (Note that the RUN2 signal turns OFF during pre-excitation by turning the LX signal ON.)

The RY2 signal turns ON at the start of pre-excitation. The signal is ON while pre-excitation is activated even during an inverter stop. The signal turns OFF while the output is shut off (MRS signal).



Output Signal	Start Signal OFF (during stop)	Start Signal ON*1 (pre-excitation)	Start Signal ON (during operation)	LX Signal ON (pre-excitation)	Under DC Injection Brake (pre-excitation)	At Alarm Occurrence or MRS Signal is ON (output shutoff)		Automatic Restart after Instantaneous Power Failure		
								Coasting		Restarting
						Start signal ON	Start signal OFF	Start signal ON	Start signal OFF	
RY	ON	ON	ON	ON	ON	OFF		ON*2		ON
RY2	OFF	ON	ON	ON*3	ON	OFF		OFF		OFF
RUN	OFF	OFF	ON	OFF	OFF	OFF		OFF		ON
RUN2	OFF	ON	ON	OFF*4	OFF	OFF		OFF		ON
RUN3	OFF	ON	ON	ON	ON	ON	OFF	ON	OFF	ON

* 1 Pre-excitation is made when the start signal is ON and frequency command is 0Hz.
* 2 This signal turns OFF during power failure or undervoltage.
* 3 There is a delay of 100ms (500ms for the 75K or more) when the signal is ON.
* 4 This signal turns ON during servo ON (LX signal is ON) under position control.

When using the RY, RY2, RUN2 and RUN3 signals, assign functions to [*Pr. 190 to Pr. 196 Output terminal selection function*] referring to the table below.

Output signal	[Pr. 190 to Pr. 196] Setting	
	Positive logic	Negative logic
RY	11	111
RY2	33	133
RUN2	44	144
RUN3	45	145

(2) Forward rotation and reverse rotation signal (Y30, Y31) (A700)

The status during forward rotation (Y30) and reverse rotation (Y31) are output from the actual motor speed under vector control.

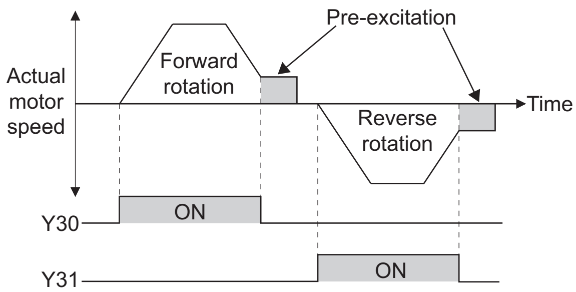
Y30 and Y31 signals turn OFF during pre-excitation (zero speed, servo lock) under speed control or torque control operation. Note that signals are output according to the motor rotation during servo lock under position control as same as inverter running.

When using the Y30, Y31 signal, set 30, 31 (positive logic) or 130, 131 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to the output terminal.

*1 This signal is always OFF during V/F control, Advanced magnetic flux vector control or Real sensorless vector control.

*2 If the motor is made to run by external force, etc. during an inverter stop, Y30 and Y31 remain OFF.

*3 The FR-A7AP (option) is necessary for vector control.



(3) Regenerative mode output signal (Y32) (A700)

While the motor is in regeneration status (motor is in power regeneration status), the regenerative status output signal (Y32) is turned ON.

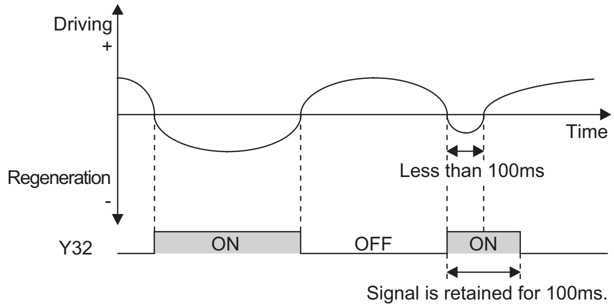
If the signal is turned ON once, it will be retained for at least 100ms.

It turns OFF while the inverter is stopped and during pre-excitation.

When using the Y32 signal, set 32 (positive logic) or 132 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to the output terminal.

*1 This signal is always OFF during V/F control, Advanced magnetic flux vector control or Real sensorless vector control.

*2 The FR-A7AP (option) is necessary for vector control.

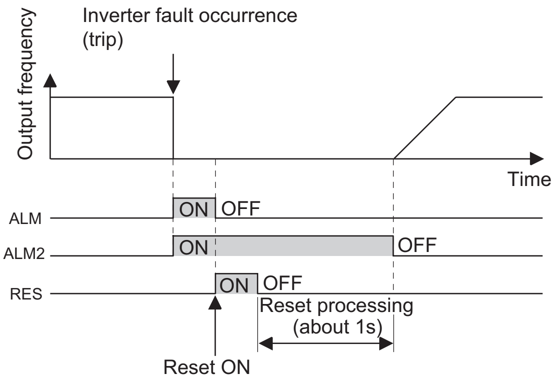


(4) Fault output (ALM, ALM2) (common)

(* ALM2 is not available for (E700)(D700))

If the inverter comes to a fault stop, the ALM and ALM2 signals are output. The ALM2 signal remains ON during a reset period after fault occurrence.

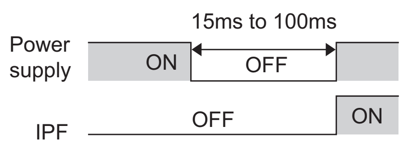
When using the ALM2 signal, set 94 (positive logic) or 194 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to the output terminal.



(5) Instantaneous power failure/undervoltage (IPF) (A700)(F700)

When instantaneous power failure protection (E.IPF) and undervoltage protection (E.UVT) are activated, the inverter trips. (Refer to page 97 for E.IPF and E.UVT)

When E.IPF and E.UVT are activated, instantaneous power failure/under voltage signal (IPF) is output.



(6) Power shut off signal (Y91) (common)

The Y91 signal is output at occurrence of a fault due to the failure of the inverter circuit or a fault caused by a wiring mistake.
When using the Y91 signal, set 91 (positive logic) or 191 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to the output terminal.
The following table indicates the faults that will output the Y91 signal. (Refer to page 97 for the fault description.)

No.	Alarm Description
1	Inrush current limit circuit fault (E.IOH)
2	CPU fault (E.CPU)
3	CPU fault (E.6) *2
4	CPU fault (E.7) *2
5	Parameter storage device fault (E.PE)
6	Parameter storage device fault (E.PE2) *2
7	24VDC power output short circuit(E.P24) *1 *2
8	Operation panel power supply short circuit, RS-485 terminal power supply short circuit (E.CTE) *1 *2
9	Output side earth (ground) fault overcurrent (E.GF)
10	Output phase loss (E.LF)
11	Brake transistor alarm detection (E.BE)

*1 Not available for (E700)

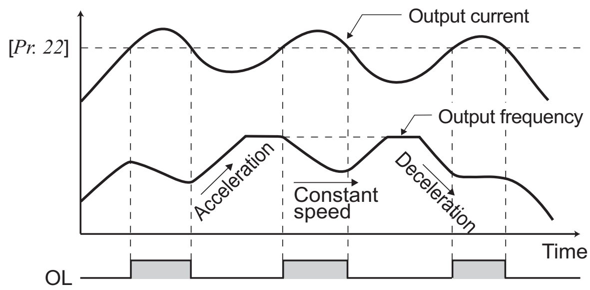
*2 Not available for (D700)

(7) Stall prevention (overcurrent) alarm output signal (OL) (common)

When the output current exceeds the stall prevention operation level and stall prevention is activated, the stall prevention operation signal (OL signal) turns ON for longer than 100ms. When the output power falls to or below the stall prevention operation level, the output signal turns OFF.
Stall prevention operation stops acceleration (makes deceleration) during acceleration, makes deceleration during constant speed, and stops deceleration (makes acceleration) during deceleration.
The inverter does not trip even when the alarm signal is output.

*1 If an overload status lasts long, an inverter trip (for example electronic thermal O/L relay (E.THM)) may occur.

*2 When [*Pr. 156*] has been set to activate the fast-response current limit (initial value), the [*Pr. 22*] setting should not be higher than 170%. The torque will not be developed by doing so.

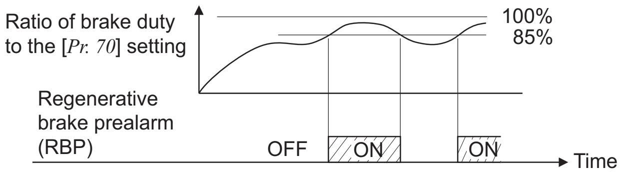


Stall prevention operation example

(8) Regenerative brake duty alarm output signal (RBP) (common)

[RB] appears on the operation panel and an alarm signal (RBP) is output when 85% of the regenerative brake duty set in [*Pr. 70*] is reached. If the regenerative brake duty reaches 100% of the [*Pr. 70*] setting, a regenerative overvoltage (E.OV1 to E.OV3) occurs.
(Refer to page 331 for details of [*Pr. 70*] .)
For the terminal used for the RBP signal output, assign the function by setting 7 (positive logic) or 107 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] .

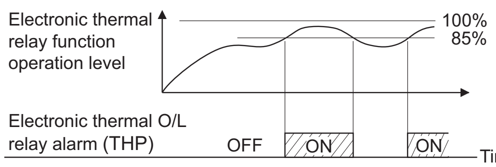
*1 For (F700), setting can be made for the 75K or more.



(9) Electronic thermal O/L relay alarm output signal (THP) (common)

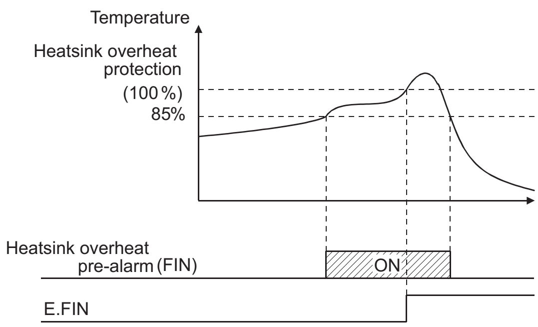
The alarm signal (THP) is output when the electronic thermal value reaches 85% of the level set in [*Pr. 9*] or [*Pr. 51*]. If the regenerative brake duty reaches 100% of the [*Pr. 9*] setting, electronic thermal relay function protection (E.THM/E.THT) activates.
For the terminal used for the THP signal output, assign the function by setting 8 (positive logic) or 108 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] .

100%: Electronic thermal relay function alarm operation value



(10) Fin overheat alarm output signal (FIN) (common)

The alarm signal (FIN) is output when the temperature becomes approximately 85% of the heatsink overheat protection operation temperature. Heatsink overheat (E.FIN) occurs if the temperature reaches 100%.
For the terminal used for the FIN signal output, assign the function by setting 26 (positive logic) or 126 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*].



1.4.19 Detection of output frequency (SU, FU, FU2*, FU3*, FB*, FB2*, FB3*, LS*) common

(*FU3, FB, FB2, FB3, LS are not available for F700.)

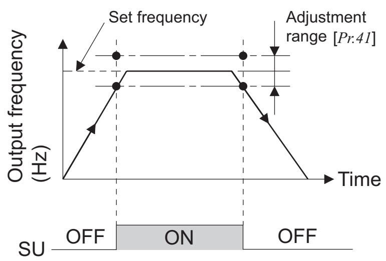
(*FU2, FU3, FB, FB2, FB3, LS are not available for E700 D700.)

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters		
					A700	F700	E700 D700
41	Up-to-frequency sensitivity	10%	0 to 100%	Set the level where the SU signal turns ON.	○	○	○
42	Output frequency detection	6Hz	0 to 400Hz	Set the frequency where the FU (FB) signal turns ON.			
43	Output frequency detection for reverse rotation	9999	0 to 400Hz	Set the frequency where the FU (FB) signal turns ON in reverse rotation.			
			9999	Same as [*Pr. 42*] setting			
50	Second output frequency detection	30Hz	0 to 400Hz	Set the frequency where the FU2 (FB2) signal turns ON.			—
116	Third output frequency detection	60Hz	0 to 400Hz	Set the frequency where the FU3 (FB3) signal turns ON.	○	—	
865	Low speed detection	1.5Hz	0 to 400Hz	Set the frequency where the LS signal turns ON.			

(1) Up-to-frequency sensitivity (SU) common

When the output frequency reaches the running frequency, the up-to-frequency signal (SU) is output. The [*Pr. 41*] value can be adjusted within the range ±1% to ±100% on the assumption that the set frequency is 100%.

This parameter can be used to ensure that the running frequency has been reached to provide the operation start signal etc. for related equipment.

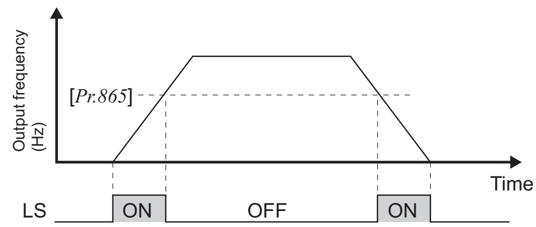


(2) Low speed detection (LS) A700

The low speed detection signal (LS) is output when the output frequency decreases below the [*Pr. 865*] setting.

When speed control is performed by Real sensorless vector control or vector control, a fault (E.OLT) is displayed and the inverter output is stopped if frequency drops to the [*Pr. 865*] setting by torque limit operation and the output torque exceeds [*Pr. 874 OLT level setting*] and remains for more than 3s.

For the LS signal, set 34 (positive logic) or 134 (negative logic) in [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign functions to the output terminal.

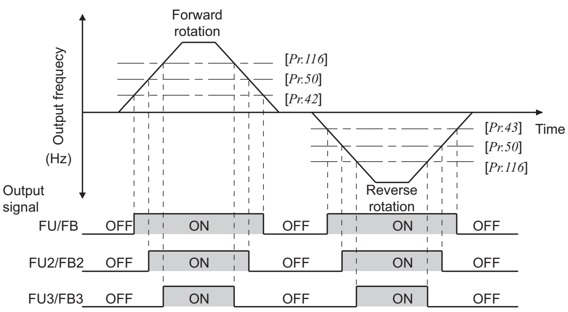


*1 The output frequency to be compared with the set frequency at the SU signal and LS signal differs according to the control method.

Control Method	Compared Output Frequency
V/F control common	Output frequency
Simple magnetic flux vector control F700, Advanced magnetic flux vector control A700	Output frequency before slip compensation
Real sensorless vector control A700	Frequency (actual motor speed) estimated value
Encoder feedback control A700 or vector control A700	Value of actual motor rotation represented in terms of frequency setting

(3) Detection of output frequency (FU, FU2*, FU3*, FB*, FB2*, FB3*) (common)
(*FU3, FB, FB2, FB3 are not available for (F700).)
(*FU2,FU3, FB, FB2, FB3 are not available for (E700)(D700).)

The output frequency detection signal (FU (FB)) is output when the output frequency reaches or exceeds the [*Pr. 42*] setting.
FU (FU2, FU3) signal can be used for electromagnetic brake operation, open signal, etc.
The FU (FU2 and FU3) signal is output when the output frequency reaches the speed command value and output the FB (FB2, FB3) signal when the output frequency reaches the actual motor speed (estimated actual speed value under Real sensorless vector control, feedback value under vector control). The FU signal and FB signal are output simultaneously during V/F control and Advanced magnetic flux vector control.
When the detection frequency is set in [*Pr. 43*], frequency detection used exclusively for reverse rotation can also be set. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation, etc.
When [*Pr. 43* ≠ 9999], the [*Pr. 42*] setting is used for forward rotation and the [*Pr. 43*] setting is used for reverse rotation.
When outputting a frequency detection signal besides the FU signal, set the detection frequency to [*Pr. 50*] or [*Pr. 116*]. The FU2 (FB2) signal is output when the output frequency reaches or exceeds the [*Pr. 50*] setting (FU3 (FB3) signal is output when reaches or exceeds the [*Pr. 116*] setting).



Refer to the table below to assign FU2, FU3, FB, FB2, FB3 signal to [*Pr. 190 to Pr. 196 Output terminal function selection*].

Output Signal	[Pr. 190 to Pr. 196] Setting	
	Positive logic	Negative logic
FB	41	141
FU2	5	105
FB2	42	142
FU3	6	106
FB3	43	143

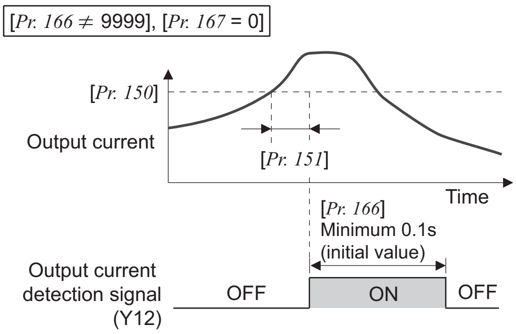
1
SPECIFICATIONS

1.4.20 Output current detection function (Y12, Y13) (common)

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters	
					A700 F700 D700	E700
150	Output current detection level	A700 E700 D700 150% F700 120%	A700 0 to 220% F700 0 to 150% E700 D700 0 to 200%	Set the output current detection level. 100% is the rated inverter current.	○	○
151	Output current detection signal delay time	0s	0 to 10s	Set the output current detection period. Set the time from when the output current has risen above the setting until the output current detection signal (Y12) is output.	○	○
152	Zero current detection level	5%	A700 0 to 220% F700 0 to 150% E700 D700 0 to 200%	Set the zero current detection level. Suppose that the rated inverter current is 100%.	○	○
153	Zero current detection period	0.5s	0 to 1s	Set this parameter to define the period from when the output current drops below the [*Pr. 152*] setting until the zero current detection signal (Y13) is output.	○	○
166	Output current detection signal retention time	0.1s	0 to 10s	Set the retention time when the Y12 signal is ON.	○	—
			9999	The Y12 signal ON status is retained. The signal is turned OFF at the next start.		
167	Output current detection operation selection	0	0	Operation continues when the Y12 signal is ON.	○	—
			1	The inverter is brought to trip (E.CDO) when the Y12 signal is ON.		

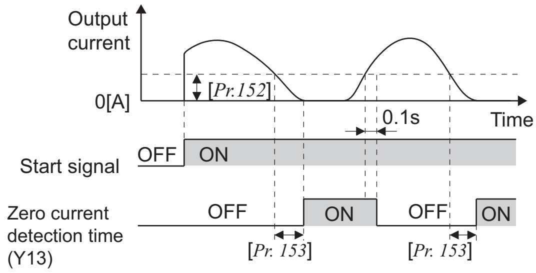
(1) Output current detection(Y12) (common)

The output current detection function can be used for excessive torque detection, etc.
If the output current remains higher than the [*Pr. 150*] setting during inverter operation for longer than the time set in [*Pr. 151*], the output current detection signal (Y12) is output from the inverter's open collector or relay output terminal.
After Y12 turns ON, ON status is held for 0.1s in (E700). ON status is held for the set time in [*Pr.166*] in (A700)(D700)(E700).
When [*Pr. 166* = 9999], the ON state is held until a next start.
When [*Pr. 167* = 1], the inverter output is stopped and the output current detection alarm (E.CDO) is displayed when the Y12 signal turns ON. When an alarm stop occurs, the Y12 signal is on for the time set in [*Pr. 166*] at the [*Pr. 166 ≠ 9999*], and remains on until a reset is made at the [*Pr. 166 = 9999*]. E.CDO does not occur even if [*Pr. 167* = 1] while Y12 is ON. The [*Pr. 167*] setting is made valid after the Y12 turns OFF.
For the Y12 signal, set 12 (positive logic) or 112 (negative logic) in [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign functions to the output terminal.



(2) Zero current detection (Y13) (common)

If the output current remains lower than the [*Pr. 152*] setting during inverter operation for longer than the time set in [*Pr. 153*], the zero current detection (Y13) signal is output from the inverter's open collector or relay output terminal.
When the inverter's output current falls to 0, torque will not be generated. This may cause a drop due to gravity when the inverter is used in vertical lift application.
To prevent this, the Y13 signal can be output from the inverter to close the mechanical brake when the output current has fallen to 0.
Once turned ON, the zero current detection time (Y13) signal is held on for at least 100ms.
For the Y13 signal, set 13 (positive logic) or 113 (negative logic) in [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign functions to the output terminal.

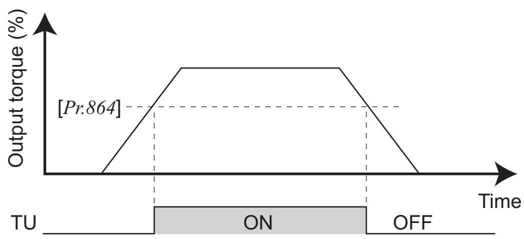


*1 This function is also valid during execution of the online or offline auto tuning.
*2 The response time of Y12 and Y13 signals is approximately 350ms.
*3 The zero current detection level setting should not be too high, and the zero current detection time setting not too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.
*4 To prevent the machine and equipment from resulting in hazardous conditions by use of the zero current detection signal, install a safety backup such as an emergency brake.

1.4.21 Output torque detection (TU) (A700)

[Pr.]	Name	Initial Value	Setting Range	Description
864	Torque detection	150%	0 to 400%	Set the torque value where the TU signal turns ON.

When the output torque reaches or exceeds the detected torque value set in [*Pr. 864*] under Advanced magnetic flux vector control, Real sensorless vector control, or vector control, the torque detection signal (TU) turns ON. It turns OFF when the torque falls below the detection torque value.
The signal is used as operation and open signal for an electromagnetic brake.
For the TU signal, set 35 (positive logic) or 135 (negative logic) in [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign functions to the output terminal.



1.4.22 Maintenance timer alarm signal (Y95) (common)

When the cumulative energization time of the inverter reaches the parameter set time, the maintenance timer output signal (Y95) is output. MT (MT) is displayed on the operation panel (FR-DU07).

This can be used as a guideline for the maintenance time of peripheral devices.

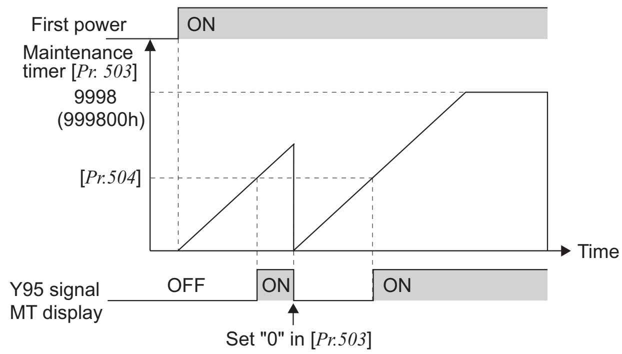
[Pr.]	Name	Initial Value	Setting Range	Description
503	Maintenance timer	0	0(1 to 9998)	Displays the cumulative energization time of the inverter in 100h increments. Reading only Writing the setting of 0 clears the cumulative energization time.
504	Maintenance timer alarm output set time	9999	0 to 9998	Set the time taken until when the maintenance timer alarm output signal (Y95) is output.
			9999	No function

The cumulative energization time of the inverter is stored into the EEPROM every hour and indicated in [*Pr. 503 Maintenance timer*] in 100h increments. [*Pr. 503*] is clamped at 9998 (999800h).

When the [*Pr. 503*] setting reaches the time set in [*Pr. 504 Maintenance timer alarm output set time*] (100h increments), the maintenance timer alarm output signal (Y95) is output.

For the terminal used for the Y95 signal output, assign the function by setting 95 (positive logic) or 195 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*].

*1 The cumulative energization time is counted every hour. The energization time of less than 1h is not counted.

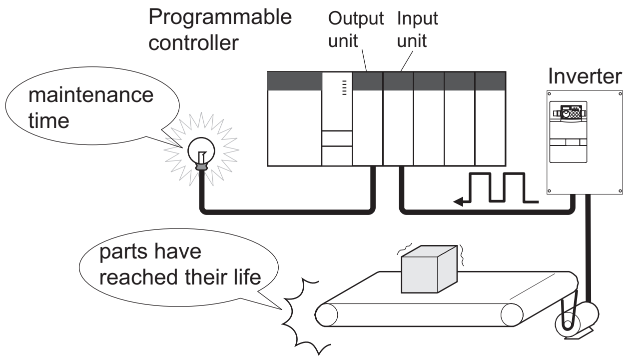


1.4.23 Current average value monitor signal (Y93) (common)

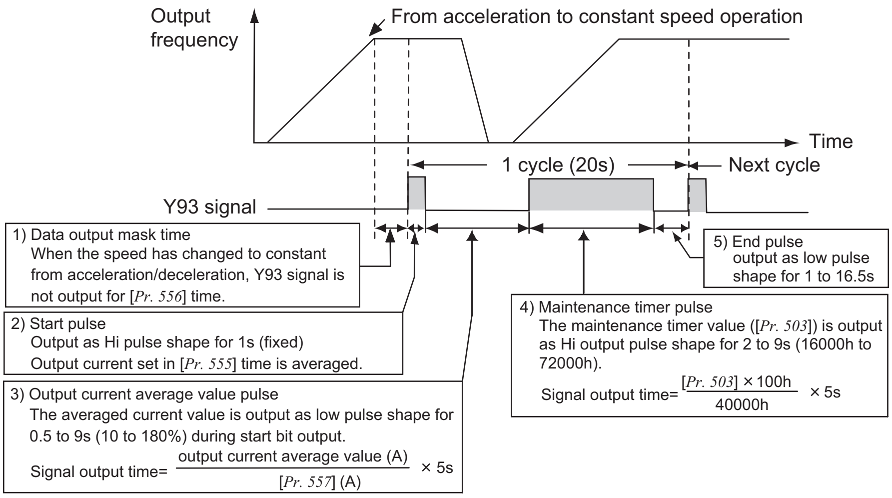
The average value of the output current during constant speed operation and the maintenance timer value are output as a pulse to the current average value monitor signal (Y93).

The pulse width output to the I/O module of the programmable controller or the like can be used as a guideline due to abrasion of machines and elongation of belt and for aged deterioration of devices to know the maintenance time.

The current average value monitor signal (Y93) is output as pulse for 20s as 1 cycle and repeatedly output during constant speed operation.



[Pr.]	Name	Initial Value	Setting Range		Description
555	Current average time	1s	0.1 to 1.0s		Set the time taken to average the current during start pulse output (1s).
556	Data output mask time	0s	0.0 to 20.0s		Set the time for not obtaining (mask) transient state data.
557	Current average value monitor signal output reference current	Rated inverter current	55K or less	0 to 500A	Set the reference (100%) for outputting the signal of the current average value.
			75K or more	0 to 3600A	



The output pulse of Y93 signal

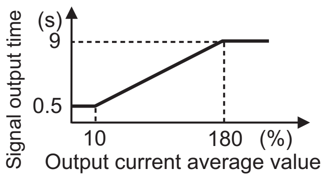
For the terminal used for the Y93 signal output, assign the function by setting 93 (positive logic) or 193 (negative logic) to a [*Output terminal function selection*]. (The function can not be assigned to a relay output terminal.)

1) Setting of [*Pr. 556 Data output mask time*]
   The output current is unstable (transient state) right after the operation is changed from the acceleration/deceleration state to the constant speed operation. Set the time for not obtaining (mask) transient state data in [*Pr. 556*].
2) Setting of [*Pr. 555 Current average time*]
   The average output current is calculated during Hi output of start pulse (1s). Set the time taken to average the current during start bit output in [*Pr. 555*].
3) Setting of [*Pr. 557 Current average value monitor signal output reference current*]
   Set the reference (100%) for outputting the signal of the current average value. Obtain the time to output the signal from the following calculation.

$$\frac{\textbf{Output current average value}}{\textbf{[}\textit{Pr. 557}\textbf{] Setting}} \times \textbf{5s (output current average value 100\%/5s)}$$

   Note that the output time range is 0.5 to 9s, and it is 0.5s when the output current average value is less than 10% of the [*Pr. 557*] setting and 9s when exceeds 180%.

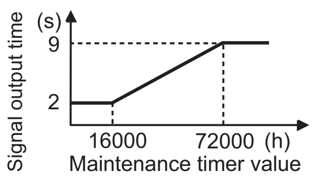
[Example] when [*Pr. 557* = 10A] and output current average value is 15A.
As 15A/10A × 5s = 7.5, the current average value monitor signal is output as low pulse shape for 7.5s.



4) Output of [*Pr. 503 Maintenance timer*]
   After the output current average value is output as low pulse shape, the maintenance timer value is output as high pulse shape.
   The output time of the maintenance timer value is obtained from the following calculation.

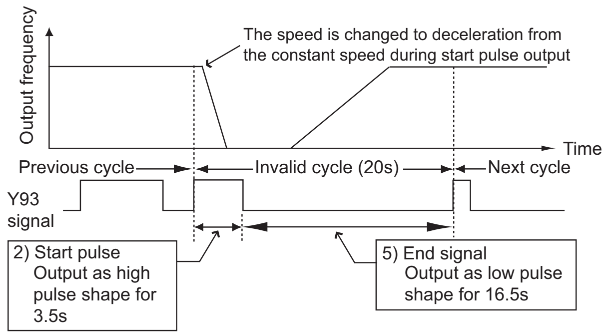
$$\frac{\textbf{[}\textit{Pr. 503}\textbf{]}}{\textbf{40000h}} \times \textbf{5s (Maintenance timer value 100\%/5s)}$$

   Note that the output time range is 2 to 9s, and it is 2s when the [*Pr. 503*] setting is less than 16000h and 9s when exceeds 72000h.



*1 Mask of data output and sampling of output current are not performed during acceleration/deceleration.

*2 When the speed is changed to acceleration/deceleration from constant speed during start pulse output, the data is judged as invalid, the start pulse is output as high pulse shape for 3.5s, and the end signal is output as low pulse shape for 16.5s.
The signal is output for at least 1 cycle even when acceleration/deceleration state continues after the start pulse output is completed.



*3 When the output current value (inverter output current monitor) is 0A on completion of the 1 cycle signal output, the signal is not output until the speed becomes constant next time.

*4 The current average value monitor signal (Y93) is output as low pulse shape for 20s (without data output) under the following condition.
(a) When the motor is in the acceleration/deceleration state on completion of the 1 cycle signal output
(b) When 1-cycle signal output was ended during restart operation with the setting of automatic restart after instantaneous power failure [*Pr. 57* ≠ 9999]
(c) When restart operation was being performed at the point of data output mask end with the setting of automatic restart after instantaneous power failure [*Pr. 57* ≠ 9999]

1.4.24 Remote output function (REM) (common)

[Pr.]	Name	Initial Value	Setting Range	Description		Available Inverters A700 F700 E700	D700
495	Remote output selection	0	0	Remote output data clear at powering OFF	Remote output data clear at inverter reset	○	○
			1	Remote output data retention even at powering OFF			
			10	Remote output data clear at powering OFF	Remote output data retention at inverter reset	○	○
			11	Remote output data retention even at powering OFF			
496	Remote output data 1	0	0 to 4095	Refer to the following diagram.		○	○
497	Remote output data 2	0	0 to 4095			○	—

You can utilize the ON/OFF of the inverter's output signals instead of the remote output terminal of the programmable controller.

The output terminal can be turned ON/OFF depending on the [*Pr. 496 or Pr. 497*] setting. The remote output selection can be controlled ON/OFF by computer link communication from the PU connector or RS-485 terminal or by communication from the communication option.

Set 96 (positive logic) or 196 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*], and assign the remote output (REM) signal to the terminal used for remote output.

When you refer to the following diagram and set 1 to the terminal bit (terminal where the REM signal has been assigned) of [*Pr. 496 or Pr. 497*], the output terminal turns ON (OFF for negative logic). By setting 0, the output terminal turns OFF (ON for negative logic).

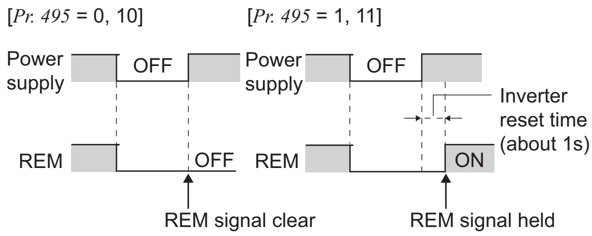
The output terminal where the REM signal is not assigned using any of [*Pr. 190 to Pr. 196*] does not turn ON/OFF if 0/1 is set to the terminal bit of [*Pr. 496, Pr. 497*]. (It turns ON/OFF with the assigned function.)

For example when [*Pr. 190 RUN terminal function selection* = 96] (positive logic) and set 1 (H01) in [*Pr. 496*], the terminal RUN turns ON.

When [*Pr. 495* = 0, 10], performing a power ON reset (including a power failure) clears the REM signal output. (The ON/OFF status of the terminals are as set in [*Pr. 190 to Pr. 196*].) The [*Pr. 496, 497*] settings are also 0.

When [*Pr. 495* = 1, 11], the remote output data before power OFF is stored into the EEPROM, so the signal output at power recovery is the same as before power OFF. However, it is not stored into EEPROM when the inverter is reset (terminal reset, reset request through communication). (Refer to the following diagram)

When [*Pr. 495* = 10, 11], signal before reset is saved even at inverter reset.



ON/OFF example for positive logic

*1 When [*Pr. 495* = 1, 11] (remote output data retention even at powering OFF), take such corrective action as connection of R1/L11, S1/L21 and P/+, N/-, to hold the control power supply. If you do not take such a step, the output signals provided after power-ON are not guaranteed.

<Remote output data>

1) (A700)(F700)

[*Pr. 496*]

b11											b0
*1	*1	*1	*1	*1	ABC2	ABC1	FU	OL	IPF	SU	RUN

[*Pr. 497*]

b11											b0
*1	*1	RA3 *3	RA2 *3	RA1 *3	Y6 *2	Y5 *2	Y4 *2	Y3 *2	Y2 *2	Y1 *2	Y0 *2

*1 As desired

*2 Terminal Y0 to Y6 are available only when the extension output option (FR-A7AY) is fitted

*3 Terminal RA1 to RA3 are available only when the relay output option (FR-A7AR) is fitted

2) E700

[*Pr.496*]

b11											b0
*1	*1	*1	*1	*1	*1	ABC	FU	*1	*1	*1	RUN

[*Pr.497*]

b11											b0
*1	*1	RA3 *3	RA2 *3	RA1 *3	Y6 *2	Y5 *2	Y4 *2	Y3 *2	Y2 *2	Y1 *2	Y0 *2

*1 As desired

*2 Terminal Y0 to Y6 are available only when the extension output option (FR-A7AY E kit) is fitted

*3 Terminal RA1 to RA3 are available only when the relay output option (FR-A7AR E kit) is fitted

3) D700

[*Pr.496*]

b11											b0
*	*	*	*	*	*	ABC	*	*	*	*	RUN

* As desired

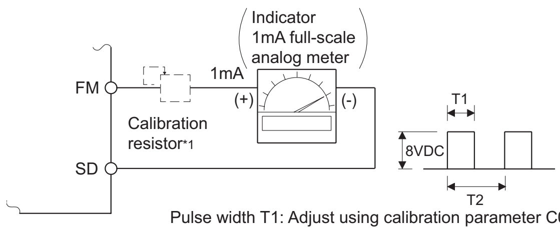
1.4.25 Indicator connection and adjustment (FM) common

Pulse train of 8VDC maximum, 2400pulse/s is output. (When [*Pr. 291 Pulse train I/O selection* = 0, 1] in A700, FM output is selected.) The pulse width can be adjusted by calibration parameter [*Calibration parameter C0 (Pr. 900) FM terminal calibration*] using the operation panel and parameter unit.

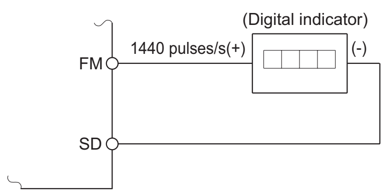
The output frequency, etc. of the inverter can be indicated by a DC ammeter of 1mA full-scale deflection and maximum 300Ω internal resistance or a commercially available digital indicator which is connected across terminals FM-SD.

The indicator can be calibrated from the operation panel or parameter unit. Note that the reading varies according to the wiring distance if the indicator is placed away from the inverter. In this case, connect a calibration resistor in series with the indicator as shown below and adjust until the reading matches the operation panel or parameter unit indication (indicator monitoring mode).

The wiring length of the terminal FM should be 200m maximum and use the twisted cable or shielded cable.



Pulse width T1: Adjust using calibration parameter C0
Pulse cycle T2: Set with [*Pr. 55*] (frequency monitor)
Set with [*Pr.56*] (current monitor)



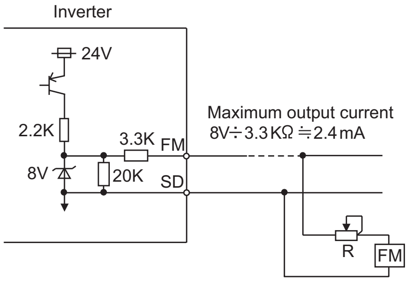
*1 It is not necessary when the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) is used for calibration.
Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter.
However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, use this resistor and operation panel or parameter unit together.

*2 The default settings are 1mA full-scale and 1440 pulse/s terminal FM frequency at 60Hz.

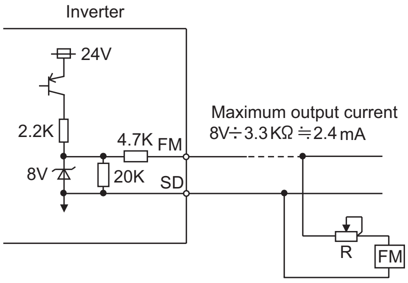
Up to two 1mA analog indicators can be used in parallel for A700 F700, but only one 1mA analog indicator can be used for E700 D700. To use analog indicators in parallel, select such as 0.5mA fullscale indicators so that these will not exceed the maximum current of the inverter.

A digital indicator and analog indicator can not be used together.

The type and number of digital indicators are limited according to the input impedance and input voltage specifications.



A700 F700

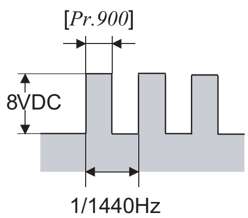


E700 D700

(1) Output waveform of terminal FM (common)

The output signal of terminal FM has a pulse waveform as shown in the table below and the number of its pulse is proportional to the inverter output frequency.

The output voltage (average voltage) is also proportional to the output frequency.

	Specifications
Output waveform	
Number of output pulse (pulse/s)	Max. 2400 pulse/s Set a full-scale value which achieves 1440 pulse/s. [*Pr. 55*]: frequency monitoring reference [*Pr. 56*]: current monitoring reference
Output voltage	0 to 8VDC max*1. (approx. 3.5V*2 at 1440 pulse/s (in the initial setting))

*1 Output voltage is 0.5V or less when a DC ammeter of 300Ω or less internal resistance is connected to measure the output voltage.

*2 Output voltage is approximately 4.7V in E700 D700

(2) Calibration of terminal FM

Calibrate the terminal FM in the following procedure.

1) Connect an indicator (frequency meter) across terminals FM-SD of the inverter. (Note the polarity. The terminal FM is positive.)
2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
3) Refer to the monitor description list (page 345) and set [*Pr. 54*].
   When you selected the running frequency or inverter output current as monitor, preset the running frequency or current value, at which the output signal will be 1440 pulse/s, to [*Pr. 55 Frequency monitoring reference*] or [*Pr. 56 Current monitoring reference*].
   At 1440 pulse/s, the meter generally shows to full-scale.

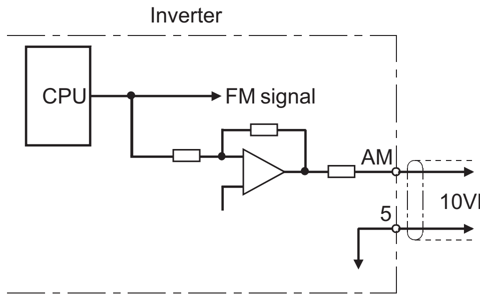
*1 When calibrating a monitor output which does not easily point to 100% even with an actual load, output current for example, set [*Pr. 54 = 21*] (reference voltage output) and make calibration. 1440 pulse/s are output from the terminal FM.

*2 When a frequency meter is connected to across terminals FM and SD to monitor the running frequency, the FM terminal output reaches to the maximum when output frequency is 100Hz or more in the initial setting. In this case, the [*Pr. 55*] setting has to be changed to the maximum frequency.

*3 For A700 , calibration with [*Calibration parameter CO (Pr.900)*] is unavailable when [*Pr.291 Pulse train I/O selection* =10,11,20,21,100] (fast pulse train output).

1.4.26 Calibration of analog output (AM) (A700) (F700)

The terminal AM is factory-set to provide a 10VDC output in the full-scale status of the corresponding monitor item. [*Calibration parameter C1* (*Pr. 901*)] allows the output voltage ratios (gains) to be adjusted according to the meter scale. Note that the maximum output voltage is 10VDC.
The analog output level can be calibrated by the operation panel or parameter unit.
Terminal AM function selection can be set in [*Pr. 158*].
Since the terminal AM is not isolated from the control circuit of the inverter, use a shielded cable of shorter than 30m.



(1) Calibration of terminal AM

Calibrate the terminal AM in the following procedure.

1) Connect a 0-10VDC meter (frequency meter) to across inverter terminals AM-5. (Note the polarity. The terminal AM is positive.)
2) Refer to the monitor description list (page 345) and set [*Pr. 158*].
   When you selected the running frequency, inverter output current or the like as monitor, preset the running frequency or current value at which the output signal will be 10V in [*Pr. 55*] or [*Pr. 56*].

*1 When calibrating a monitor output signal, which cannot adjust to a 100% value without an actual load and a measurement equipment, set [*Pr. 158* = 21] (reference voltage output) and make calibration. 10VDC is output from the terminal AM.

1.4.27 Control circuit common terminals (SD, 5, SE) (common)

The terminals SD, 5, and SE are all common terminals (0V) for I/O signals and are isolated from each other. Do not earth (ground).
Avoid connecting the terminal SD and 5 and the terminal SE and 5.
Terminal SD is a common terminal for the contact input terminals (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) and frequency output signal (FM).
The open collector circuit is isolated from the internal control circuit by photocoupler.
The terminal 5 is a common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM. It should be protected from external noise using a shielded or twisted cable.
Terminal SE is a common terminal for the open collector output terminal (RUN, SU, OL, IPF, FU). The contact input circuit is isolated from the internal control circuit by photocoupler.

1.4.28 Signal inputs by contact-less switches (common)

The contacted input terminals of the inverter (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) can be controlled using a transistor instead of a contacted switch as shown on the right.

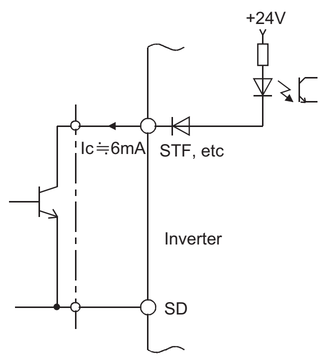
(1) Electrical characteristics required for the external transistor (common)

1)IC (collector current [10mA or more])
If the rating is small, the external transistor may be damaged or the inverter input may not be active.

2)VCEX (open-time permissible collector-to-emitter voltage [30V or more])
If the rating is small, the external transistor may be damaged.

3)VCE(sat) (conduction time collector-to-emitter saturation voltage [3V or less])
If the saturation voltage is large, the inverter input may not be active.

4)ICEX (collector shut-off current (leakage current) [100μA or less]
If the shut-off current is large, it may be accidentally input to the inverter.



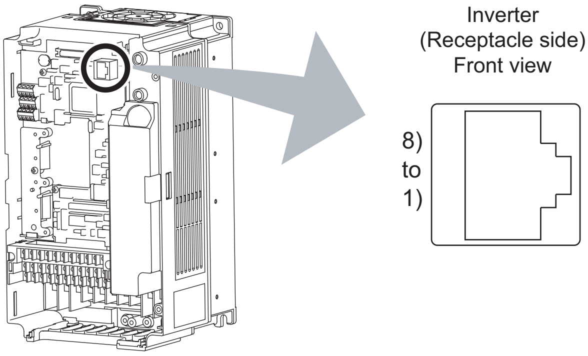
External signal input using transistor

*1 When using an external transistor connected to an external power supply, use terminal PC to prevent malfunctions due to undesirable currents. (Refer to page 60)
*2 Note that an SSR (solid-state relay) has a relatively large leakage current at OFF time and it may be accidentally input to the inverter.

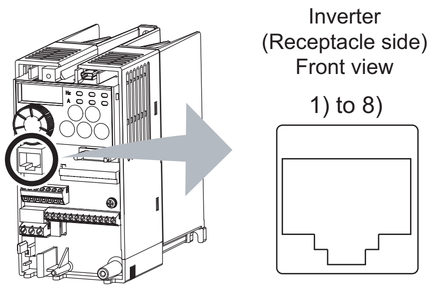
1.4.29 Wiring and configuration of PU connector (common)

(1) PU connector pin-outs (common)

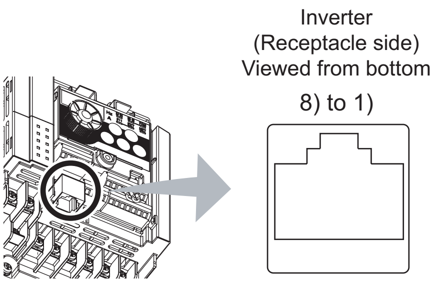
1)(A700)(F700)



2)(E700)



3)(D700)



Pin Number	Name	Description
1)	SG	Earth (Ground) (connected to terminal 5)
2)	—	Power supply for operation panel and PU
3)	RDA	Inverter receive+
4)	SDB	Inverter send-
5)	SDA	Inverter send+
6)	RDB	Inverter receive-
7)	SG	Earth (Ground)(connected to terminal 5)
8)	—	Power supply for operation panel and PU

*1 Pins No.2 and 8 provide power to the operation panel or parameter unit.
Do not use these pins for RS-485 communication.

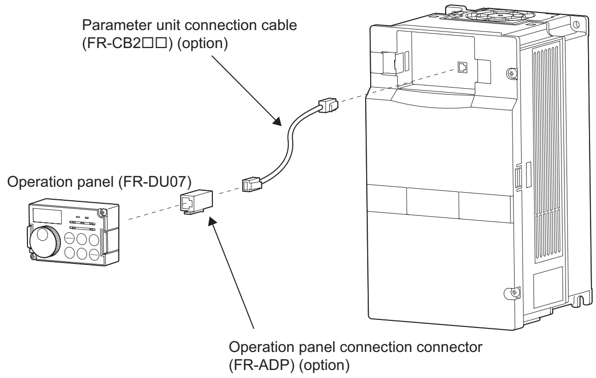
*2 Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.

(2) When connecting the operation panel using a parameter unit connection cable (common)

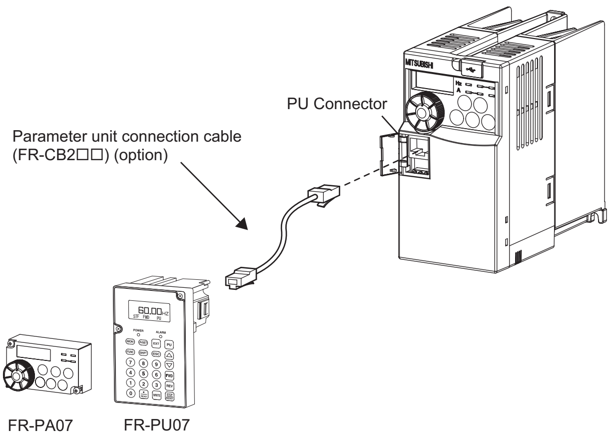
When connecting the operation panel (FR-DU07) to the inverter using a cable, the operation panel can be installed on the panel and operationality is improved.

*1 Overall wiring length when the operation panel is connected should be less than 20m

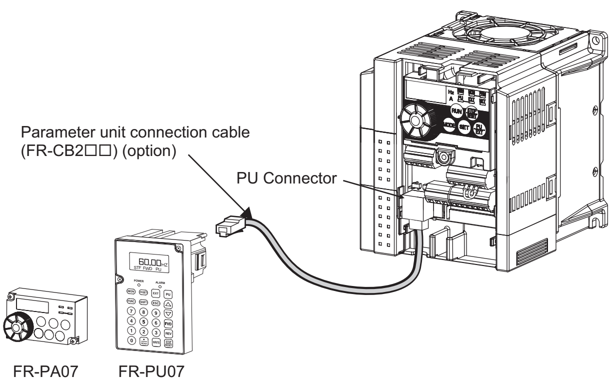
1)(A700)(F700)



2)(E700)



3)(D700)



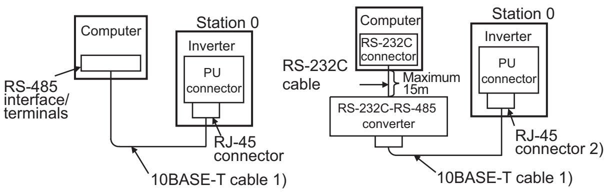
(3) PU connector communication system configuration and wiring (common)

Using the PU connector, you can perform communication operation from a personal computer etc.

When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to parameters.

When performing RS-485 communication with multiple inverters, use the RS-485 terminal. (Refer to page 83)

1) System configuration



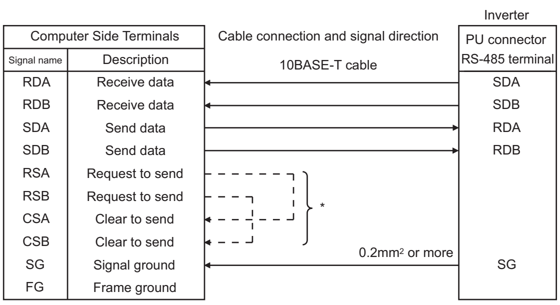
(a) Refer to the following when fabricating the cable on the user side.

Examples of product available on the market (as of February, 2008)

	Product	Type	Maker
1)	10BASE-T Cable	SGLPEV-T 0.5mm×4P*1	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 Connector	5-554720-3	Tyco Electronics Corporation

*1 Do not use pins No. 2, 8 of the 10BASE-T cable.

2) Connection with RS-485 computer

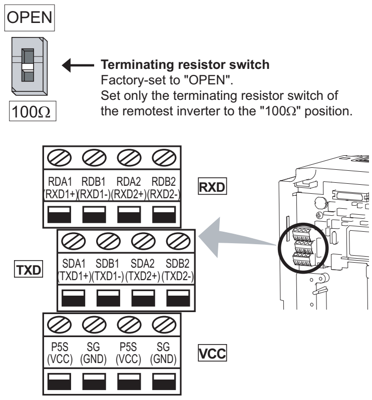


* Make connections in accordance with the manual of the computer used.
Fully check the terminal numbers of the computer since these vary with the model.

1.4.30 Wiring and arrangement of RS-485 terminals (A700) (F700) (E700)

(1) RS-485 terminal block (A700) (F700)

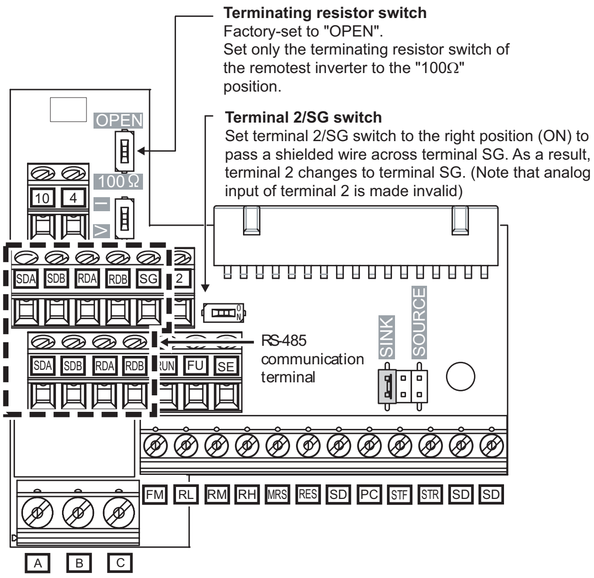
Conforming standard	EIA-485 (RS-485)
Transmission format	Multidrop link
Communication speed	MAX38400bps
Overall length	500m
Connection cable	Twisted pair cable (4 pairs)



Name	Description
RDA1(RXD1+)	Inverter receive+
RDB1(RXD1-)	Inverter receive-
RDA2(RXD2+)	Inverter receive+ (for branch)
RDB2(RXD2-)	Inverter receive- (for branch)
SDA1(TXD1+)	Inverter send+
SDB1(TXD1-)	Inverter send-
SDA2(TXD2+)	Inverter send+ (for branch)
SDB2(TXD2-)	Inverter send- (for branch)
P5S(VCC)	5V Permissible load current 100mA
SG(GND)	Ground (connected to terminal SD)

(2) FR-E7TR RS-485 terminal block (E700)

RS-485 terminal can be used instead of a PU connector connected to a standard control circuit terminal to perform RS-485 communication. To do this, attach a control terminal option, FR-E7TR.
Parameters need to be set are the same as ones need for RS-485 communication with a PU connector.
Refer to page 365 for the detail of initial settings and specification of RS-485 communication with RS485 terminal.

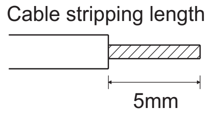


FR-E7TR

Name	Description
RDA (2 points)	Inverter send+
RDB (2 points)	Inverter send-
SDA (2 points)	Inverter send+
SDB (2 points)	Inverter send-
SG	RS-485 communication common, Analog common(terminai2, 4)

(3) Connection of RS-485 terminals and wires (common)

Loosen the terminal screw and insert the cable into the terminal.
Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.
Use a bar terminal as necessary.



Screw size	M2
Tightening torque*1	0.22N·m to 0.25N·m
Cable size	0.3mm^2 to 0.75mm^2
Screwdriver	Small ⊖ flathead screwdriver (tip thickness: 0.4mm/tip width: 2.5mm)

*1 Undertightening can cause cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.

Information on bar terminals

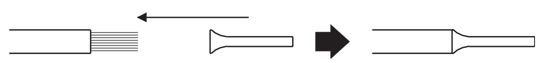
Introduced products (as of September, 2006)
: Phoenix Contact Co.,Ltd.

Terminal Screw Size	Bar Terminal Model (with insulation sleeve)	Bar Terminal Model (without insulation sleeve)	Wire Size (mm^2)
M2	AI 0.5-6WH	A 0.5-6	0.3 to 0.5

Bar terminal crimping tool: CRIMPFOX ZA3
(Phoenix Contact Co.,Ltd.)

Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).

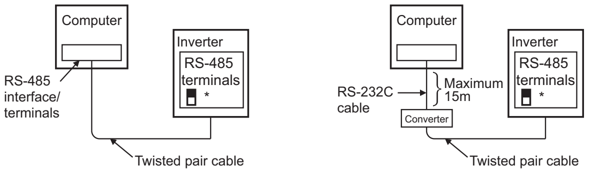
When using the bar terminal (without insulation sleeve), use care so that the twisted wires do not come out.



(4) RS-485 terminal system configuration (common)

Use the RS-485 terminals to perform communication operation from a personal computer etc. When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to parameters.

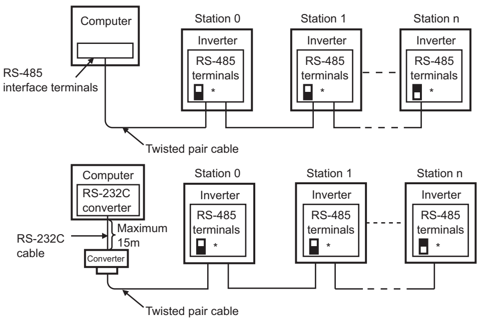
1) Connection of a computer to the inverter (1:1 connection)



*Set the terminating resistor switch to the "100Ω" position.

* Set the terminating resistor switch to the 100Ω position.

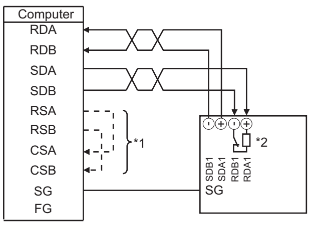
2) Combination of computer and multiple inverters (1:n connection)



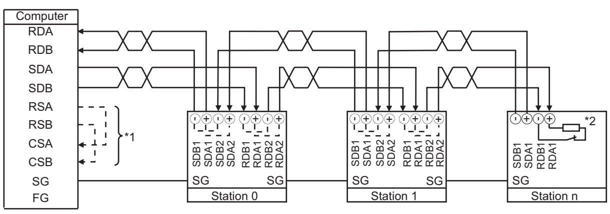
* Set only the terminating resistor switch of the remotest inverter to the 100Ω position.

(5) RS-485 terminal wiring method (common)

1) Wiring of one RS-485 computer and one inverter



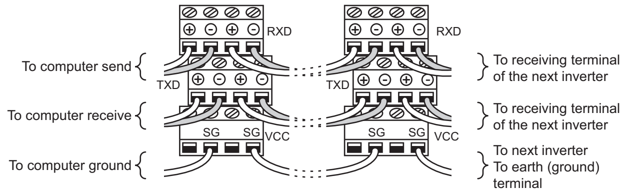
2) Wiring of one RS-485 computer and n (multiple) inverters



*1 Make connection in accordance with the instruction manual of the computer. Check the terminal numbers of the computer since terminal number differs with the model.

*2 For the inverter farthest from the computer, set the terminating resistor switch to ON (100Ω position).

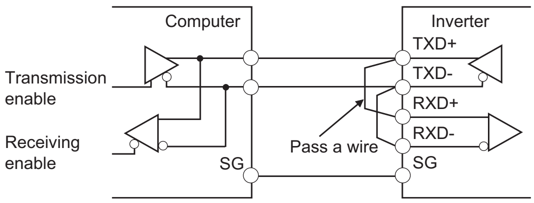
*3 For branching, connect the wires as shown below.



(6) Two-wire type connection (common)

If the computer is 2-wire type, a connection from the inverter can be changed to 2-wire type by passing wires across reception terminals and transmission terminals of the RS-485 terminal.

A program should be created so that transmission is disabled (receiving state) when the computer is not sending and receiving is disabled (sending state) during sending to prevent the computer from receiving its own data.



1.4.31 USB connector (A700) (E700)

Connect the inverter and PC with USB cable and use FR Configurator to make the inverter setup easily.
When using USB communication, set [*Pr. 551 PU mode operation command source selection* = 3].

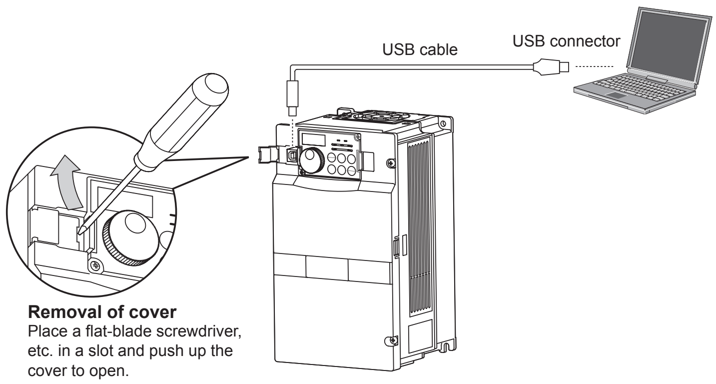
Parameter setting and monitoring are performed using FR Configurator. Refer to the instruction manual of FR Configurator for details.
It is recommended to fit a ferrite core to the USB cable to reduce the effect of noises from the inverter.

[Pr.]	Name	Initial Value	Setting Range	Description
547	USB communication station number	0	0 to 31	Specifies the inverter station number.
548	USB communication check time interval	9999	0	USB communication is enabled. However, the inverter will come to an alarm stop (E. USB) if operation is changed to PU operation mode.
			0.1 to 999.8s	Set the interval of communication check time. If a no-communication state persists for longer than the permissible time, the inverter will come to trip (E.USB).
			9999	No communication check

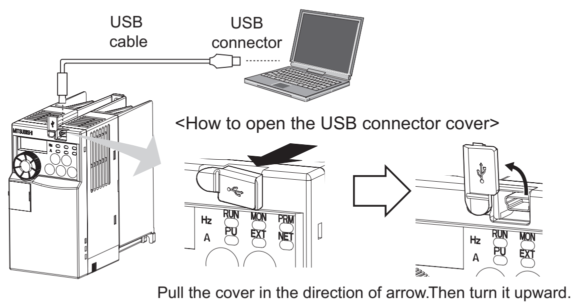
● **USB communication specifications**

Interface	Conforms to USB1.1
Transmission Speed:	12Mbps
Wiring length	Maximum 5m
Connector	(A700) USB B connector (B receptacle) (E700) USB mini B connector (receptacle mini B type)
Power supply	Self-power supply

(1) (A700)



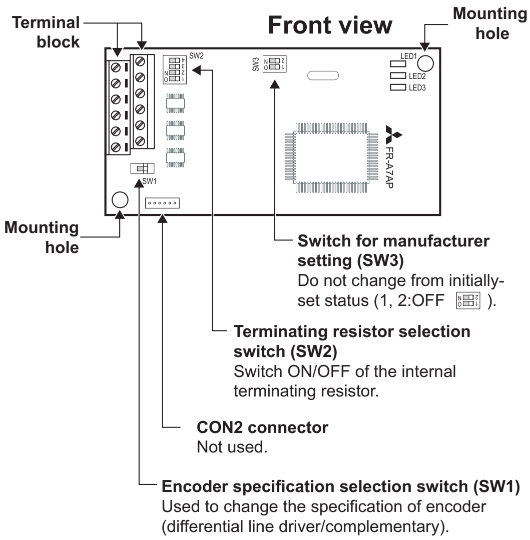
(2) (E700)

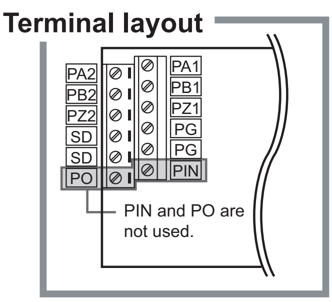


1.4.32 Connection of motor with encoder (vector control) (A700)

Orientation control and encoder feedback control, and speed control, torque control and position control by full-scale vector control operation can be performed using a motor with encoder and a plug-in option FR-A7AP.

(1) Structure of the FR-A7AP



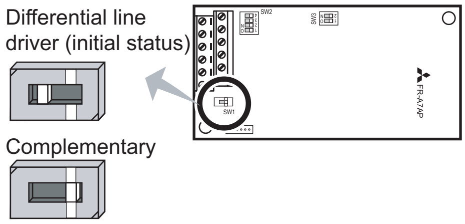


(2) Terminals of the FR-A7AP

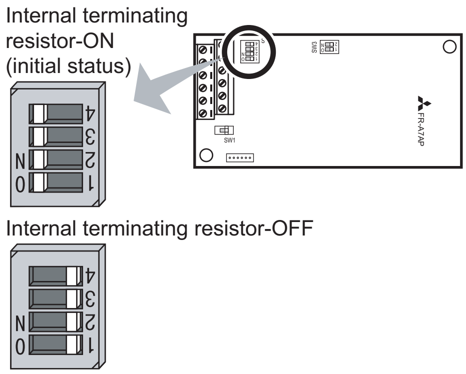
Terminal Symbol	Terminal Name	Application Explanation
PA1	Encoder A-phase signal input	A-, B- and Z-phase signals are input from the encoder.
PA2	Encoder A-phase inverse signal input	
PB1	Encoder B-phase signal input terminal	
PB2	Encoder B-phase inverse signal input terminal	
PZ1	Encoder Z-phase signal input terminal	
PZ2	Encoder Z-phase inverse signal input terminal	
PG	Encoder power supply (positive side) input terminal	Input terminal for the encoder power supply. Connect the external power supply (5V, 12V, 15V, 24V) and the power cable from encoder.
SD	Encoder power ground terminal	
PIN	Not used.	
PO		

(3) Terminals of the FR-A7AP

1) Encoder specification selection switch (SW1)
Select either differential line driver or complementary
It is initially set to the differential line driver. Switch its position according to output circuit.



2) Terminating resistor selection switch (SW2)
Select ON/OFF of the internal terminating resistor. Set the switch to ON (initial status) when an encoder output type is differential line driver and set to OFF when complementary.
ON: with internal terminating resistor (initial setting status)
OFF: without internal terminating resistor
*1 Set all switches to the same setting (ON/OFF).
*2 If the encoder output type is differential line driver, set the terminating resistor switch to the "OFF" position when sharing the same encoder with other unit (NC (numerical controller), etc) and a terminating resistor is connected to other unit.



3) Motor used and switch setting

Motor		Encoder Specifications Switch (SW1)	Terminating Resistor Switch (SW2)	Power Specifications *2
Mitsubishi standard motor with encoder, Mitsubishi high efficiency motor with encoder	SF-JR	Differential	ON	5V
	SF-HR	Differential	ON	5V
	Others	*1	*1	*1
Mitsubishi constant torque motor with encoder	SF-JRCA	Differential	ON	5V
	SF-HRCA	Differential	ON	5V
	Others	*1	*1	*1
Vector dedicated motor	SF-V5RU	Complementary	OFF	12V
Other manufacturer's motor with encoder		*1	*1	*1

*1 Set according to the motor (encoder) used.

*2 Choose a power supply (5V/12V/15V/24V) for encoder according to the encoder used. Control terminal option (FR-A7PS) has built-in 12VDC power supply for encoder.

*3 SW3 switch is for manufacturer setting. Do not change the setting.

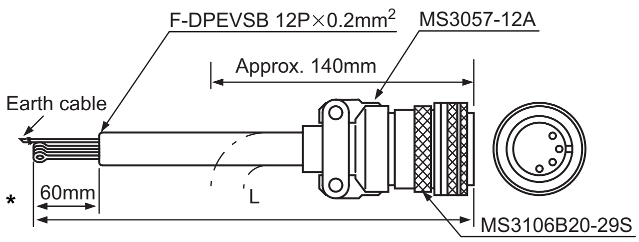
4) Encoder specifications

Item	Encoder for SF-JR	Encoder for SF-V5RU
Resolution	1024 pulse/rev	2048 pulse/rev
Power supply voltage	5VDC±10%	12VDC±10%
Current consumption	150mA	150mA
Output signal form	A, B phases (90° phase shift) Z-phase: 1 pulse/rev	A, B phases (90° phase shift) Z-phase: 1 pulse/rev
Output circuit	Differential line driver 74LS113 equivalent	Complementary
Output voltage	"H" level 2.4V or more "L" level 0.5V or less	"H" level power supply voltage for encoder -3V or more "L" level 3V or less

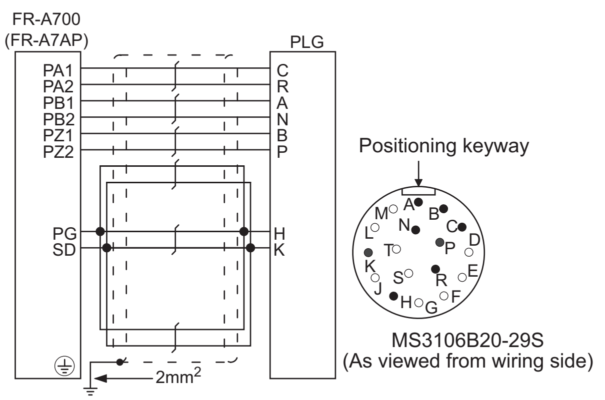
*1 Encoder with resolution of 1000 to 4096 pulse/rev is recommended.

(4) Encoder cable

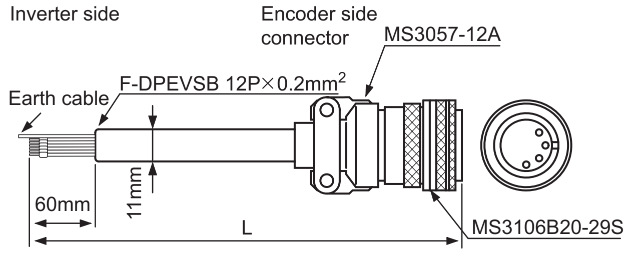
SF-JR/HR/JRCA/HRCA with encoder



Model	Length L (m)
FR-JCBL5	5
FR-JCBL15	15
FR-JCBL30	30

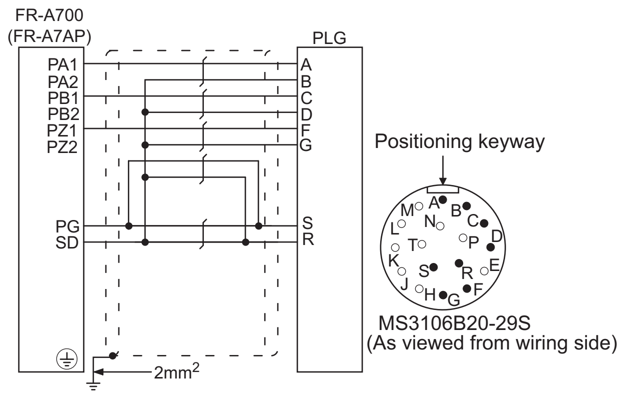


SF-V5RU, SF-THY



- P clip for earthing (grounding) a shielded cable is provided.

Model	Length L (m)
FR-V7CBL5	5
FR-V7CBL15	15
FR-V7CBL30	30



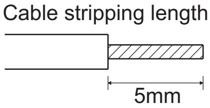
* As the terminal block of the FR-A7AP is an insertion type, cables need to be modified. (Refer to page 83)

When using the dedicated encoder cable (FR-JCBL, FR-V5CBL, etc.) for the conventional motor, cut the crimpling terminal of the encoder cable and strip its sheath to make its cables loose.

Also, perform protective treatment of the shield to ensure that it will not make contact with the conductive area.

Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.

Use a bar terminal as necessary.



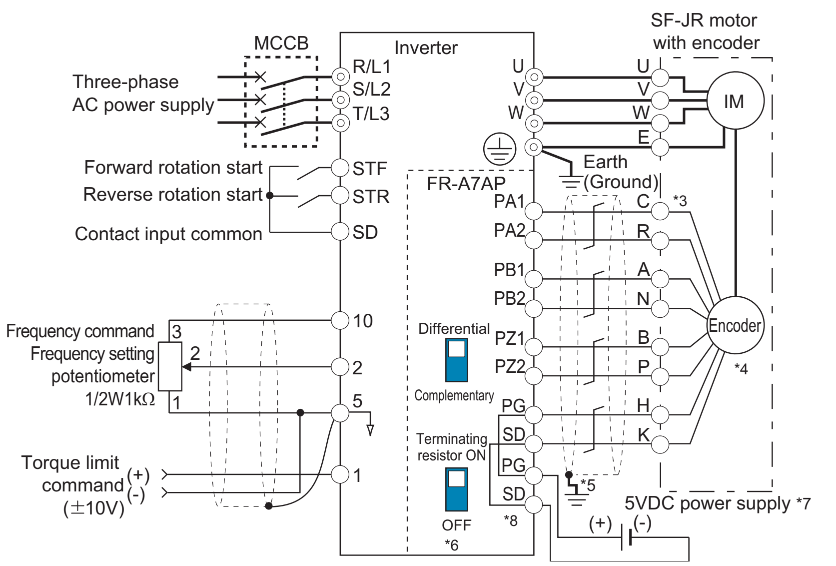
Connection terminal compatibility table

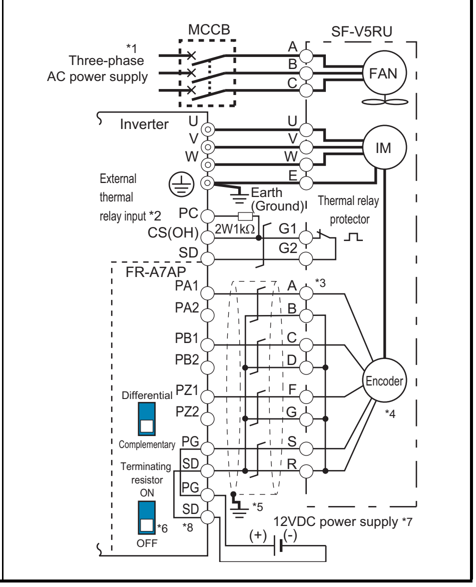
Motor		SF-V5RU SF-THY	SF-JR/HR/ JRCA/HRCA (with encoder)
Encoder cable		FR-V7CBL	FR-JCBL
FR-A7AP terminal	PA1	PA	PA
	PA2	Keep this open	PAR
	PB1	PB	PB
	PB2	Keep this open	PBR
	PZ1	PZ	PZ
	PZ2	Keep this open	PZR
	PG	PG	5E
	SD	SD	AG2

(5) Wiring

1) Speed control

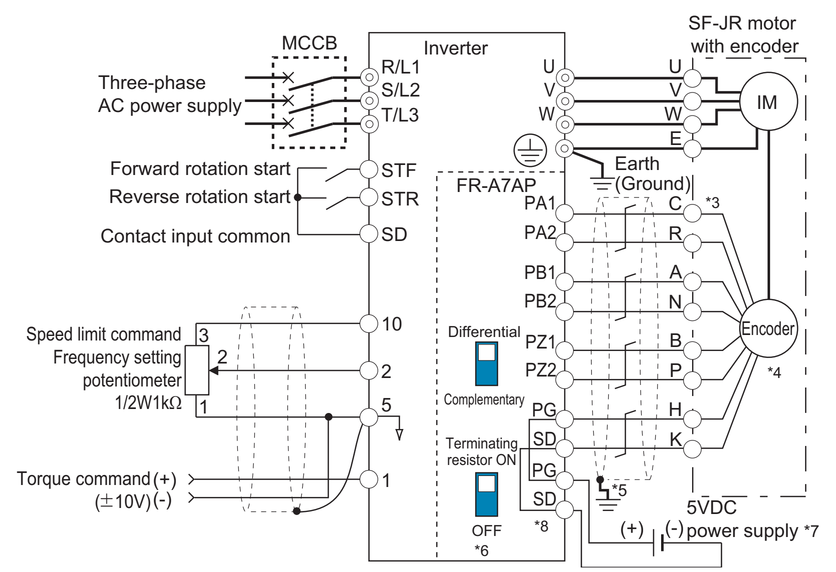
Standard Motor with Encoder (SF-JR), 5V Differential Line Driver	Vector Control Dedicated Motor (SF-V5RU), For 12V Complementary Type

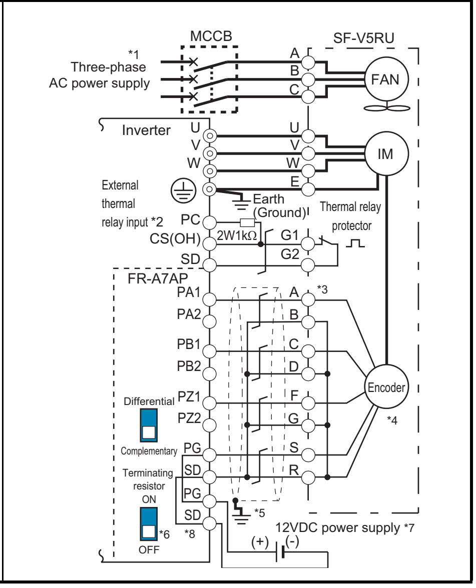




2) Torque control

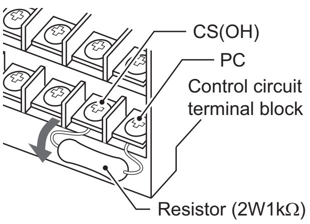
Standard Motor with Encoder (SF-JR), 5V Differential Line Driver	Vector Control Dedicated Motor (SF-V5RU), For 12V Complementary Type





*1 For the fan of the 7.5kW or less dedicated motor, the power supply is single phase (200V/50Hz, 200 to 230V/60Hz).

*2 Assign OH (external thermal input) signal to the terminal CS. ([*Pr. 186* = 7])
Connect a 2W1kΩ resistor between terminals PC and CS (OH). Install the resistor pushing it against the bottom part of the terminal block so as to avoid a contact with other cables.
Refer to page 37 for details of [*Pr. 186 CS terminal function selection*].



*3 The pin number differs according to the encoder used.
Speed control and torque control are properly performed even without connecting Z-phase.

*4 The encoder should be coupled on the same axis with the motor shaft without any mechanical looseness. Speed ratio should be 1:1.

*5 Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P clip, etc. (Refer to page 91)

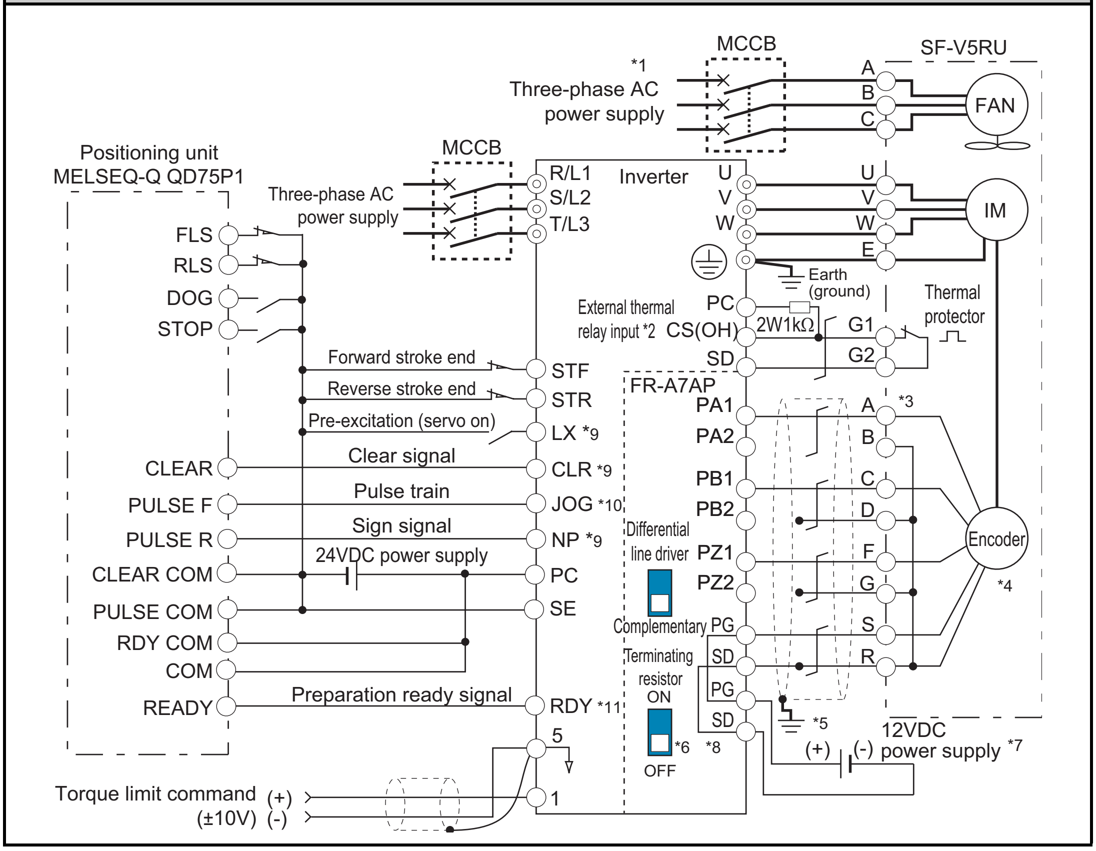
*6 For the complementary, set the terminating resistor selection switch to OFF position. (Refer to page 86)

*7 A separate power supply of 5V/12V/15V/24V is necessary according to the encoder power specification.
When performing encoder feedback control and vector control together, an encoder and power supply can be shared.

*8 Refer to page 88 for terminal compatibility of the FR-JCBL, FR-V7CBL and FR-A7AP.

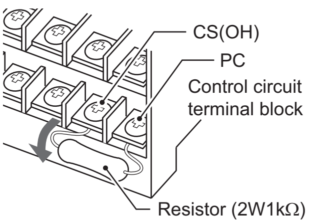
3) Position control

Vector Control Dedicated Motor (SF-V5RU), 12V Complementary



*1 For the fan of the 7.5kW or less dedicated motor, the power supply is single phase (200V/50Hz, 200 to 230V/60Hz).

*2 Assign OH (external thermal input) signal to the terminal CS. ([*Pr. 186* = 7])
Connect a 2W1kΩ resistor between terminals PC and CS (OH).
Install the resistor pushing it against the bottom part of the terminal block so as to avoid a contact with other cables.
Refer to page 37 for details of [*Pr. 186 CS terminal function selection*].



*3 The pin number differs according to the encoder used.
Position control by pulse train input is properly performed even without connecting Z phase.

*4 The encoder should be coupled on the same axis with the motor shaft without any mechanical looseness. Speed ratio should be 1:1.

*5 Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P clip, etc. (Refer to page 91)

*6 For the complementary, set the terminating resistor selection switch to OFF position. (Refer to page 86)

*7 A separate power supply of 5V/12V/15V/24V is necessary according to the encoder power specification.
When performing encoder feedback control and vector control together, an encoder and power supply can be shared.

*8 Refer to page 88 for terminal compatibility of the FR-JCBL, FR-V7CBL and FR-A7AP.

*9 Assign the function using [*Pr. 178 to Pr. 184, Pr. 187 to Pr. 189 Input terminal function selection*].

*10 When position control is selected, terminal JOG function is made invalid and conditional position pulse train input terminal becomes valid.

*11 Assign the function using [*Pr. 190 to Pr. 194 Output terminal function selection*].

(6) Instructions for encoder cable wiring

Use twisted pair shield cables (0.2mm^2 or larger) to connect the FR-A7AP and position detector. Cables to terminals PG and SD should be connected in parallel or be larger in size according to the cable length.

To protect the cables from noise, run them away from any source of noise (e.g. the main circuit and power voltage).

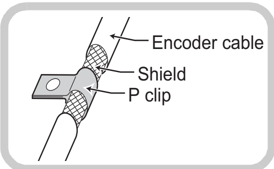
Wiring Length	Parallel Connection		Larger-size Cable
Within 10m	At least two cables in parallel	Cable gauge 0.2mm^2	0.4mm^2 or larger
Within 20m	At least four cables in parallel		0.75mm^2 or larger
Within 100m*	At least six cables in parallel		1.25mm^2 or larger

* When encoder type is differential line driver and a wiring length is 30m or more

The wiring length can be extended to 100m by slightly increasing the power by 5V (approx. 5.5V) using six or more cables with gauge size of 0.2mm^2 in parallel or a cable with gauge size of 1.25mm^2 or more. Note that the voltage applied should be within power supply specifications of encoder.

To reduce noise of the encoder cable, earth (ground) the encoder shielded cable to the enclosure (as near as the inverter) with a P clip or U clip made of metal.

Earthing (grounding) example using a P clip



*1 For details of the optional encoder dedicated cable (FR-JCBL/FR-V7CBL), refer to page 88.

*2 The FR-V7CBL is provided with a P clip for earthing (grounding) shielded cable.

1.4.33 I/O function plug-in option (FR-A7AX, FR-A7AY, FR-A7AR, FR-A7AZ*) A700 F700 E700

(* FR-A7AZ is compatible with only A700)

(1) Terminals A700 F700 E700

1) FR-A7AX

Terminal Symbol	Terminal Name	Rating, etc.	Description	Refer to Page
X0 to X15	Digital signal input terminal (frequency setting signal terminal)	Input current: 5mA(24VDC) for each circuit Isolated by photocoupler Controls by open collector output or no voltage contact signal.	For the digital signal input, you can choose either the BCD code input or binary input. BCD code input: 3 digits (999 maximum) or 4 digits (9999 maximum) Binary input: Binary 12 bits (X0 to X11, FFFH maximum) or binary 16 bits (X0 to X15, FFFFH maximum)	229
DY	Data read timing signal input terminal		Used when a digital signal read timing signal is necessary. Data is read only during the terminal DY is ON. By switching the terminal DY OFF, the terminal X0 to X15 data before signal-OFF can be retained.	

2) FR-A7AY

Terminal Symbol	Terminal Name	Rating, etc.	Description	Refer to Page
AM0	Voltage output terminal	Output voltage: 0 to 10VDC Output resolution: 3mV Maximum wiring length: 10m Non-isolated	Connect a DC voltmeter (full-scale 10V, internal impedance 10kΩ or more) Change the monitor to be output using [*Pr. 306*].	345
AM1	Current output terminal	Output voltage: 0 to 20mADC Output resolution: 10 μ A Maximum wiring length: 10m Non-isolated	Connect a DC voltmeter (full-scale 20mA, internal impedance 300Ω or less). Change the monitor to be output using [*Pr. 306, Pr. 310*].	
AMC	Common terminal (for analog output)	—	Common terminal for the terminal AM0, AM1. Isolated from the terminal SE, SD of the inverter and terminal SD of the FR-A7AY. Do not earth (ground).	—
Y0 to Y6	Digital output terminals	Open collector output Permissible load: 24VDC 0.1A	Use [*Pr. 313 to Pr. 319*] to assign functions.	61
SE	Common terminal (for digital output)	—	Common terminal for the terminal Y0 to Y6. (for sink and source) Isolated from the terminal SE, SD, and 5 of the inverter and terminal AMC of the FR-A7AY. Do not earth (ground).	—
NC	—	—	This is an empty terminal. Do not use.	—

3) FR-A7AR

Terminal Symbol	Terminal Name	Rating, etc.	Description	Refer to Page
1A, 1B, 1C	Relay output terminal RA1	Contact capacity: 230VAC 0.3A 30VDC 0.3A	1 changeover contact output Use [*Pr. 320 to Pr. 322*] to assign functions.	61
2A, 2B, 2C	Relay output terminal RA2			
3A, 3B, 3C	Relay output terminal RA3			

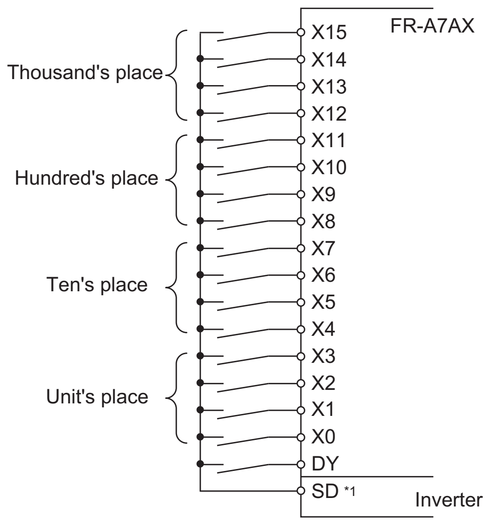
4) FR-A7AZ

Terminal Symbol	Terminal Name	Rating, etc.	Description	Refer to Page
DA1	Bipolar analog output terminal	Output voltage : -10 to +10VDC	Connect a DC indicator (±10VDC). Change the monitor to be output with [*Pr.838*].	345
6	High resolution input terminal	Frequency setting resolution : 0.01Hz/0 to 60Hz (-10 to +10V)(0.015Hz/0 to 60Hz when option is not mounted) Torque setting resolution : 0.024%/0 to 100% (-10 to +10V)(0.1%/0 to 100% when option is not mounted) Input resistance : 10kΩ Maximum input voltage : ± 20VDC	Terminal for 0 to ±10VDC high resolution (16bit) analog voltage input. Use [*Pr. 406*] High resolution analog input selection to select terminal function.	43, 217, 283, 291, 301, 304, 320, 323, 335
5	Common terminal	—	Common terminal of terminal 6 and the DA1.	—
TH1	Thermistor input 1	—	Enter thermistor output signal for the motor dedicated to vector control (SF-V5RU)	50
TH2	Thermistor input 2			
SW2	Thermistor calibration status switch		When calibrating at installation, change the switch to place the inverter in calibration status.	

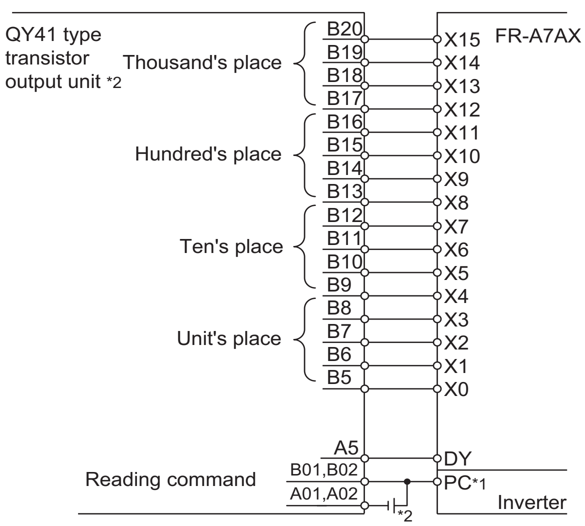
(2) 16Bit digital input connection example

(A700) (F700) (E700)

1) Relay contact signal input *4(sink logic*3)



2) Open collector signal input*5
(Sink logic*3)

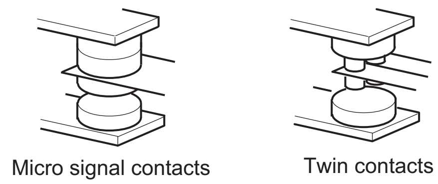


*1 Use terminals SD or PC on the inverter.

*2 AY41 type unit requires 24VDC power.
Example of connection with the output module (AY41 type) of Mitsubishi programmable controller. Refer to the output module manual for details of the output module.

*3 The control logic is the same as that of the inverter (factory-set to sink). When the logic of the inverter is changed to source, the option logic also switches to source. To change the control logic, refer to page 40.

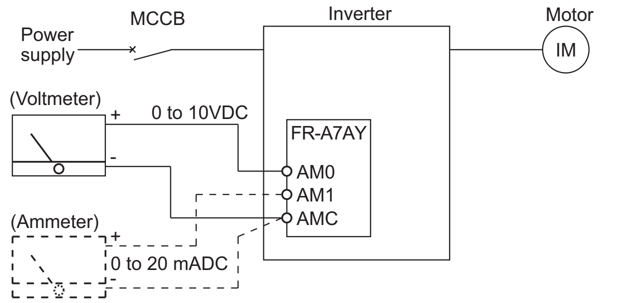
*4 As the input signals are at low level, use two parallel micro signal contacts or a twin contact for relay contact inputs to prevent a contact fault.



*5 A transistor of the following specifications should be selected for the open collector signal:
Electrical characteristics of the transistor used
- $I_c \geq 10mA$
- Leakage current: 100μA or less
- $VCE \geq 30V$
- When $I_c \geq 10mA$, VCE(sat) voltage 3V or less.

(3) Extension analog output connection example (A700)(F700)(E700)

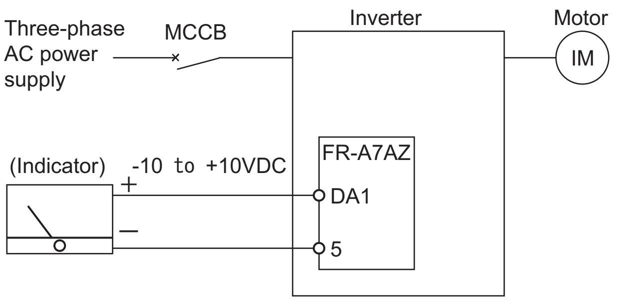
By setting the [*Pr. 306 to Pr. 312*] values, analog signals such as the output frequency and output current can be output from terminal AM0 and AM1.



* The wiring distance between the FR-A7AY and the voltmeter/ammeter should be 10m maximum.

(4) Bipolar analog signal output connection example (A700)

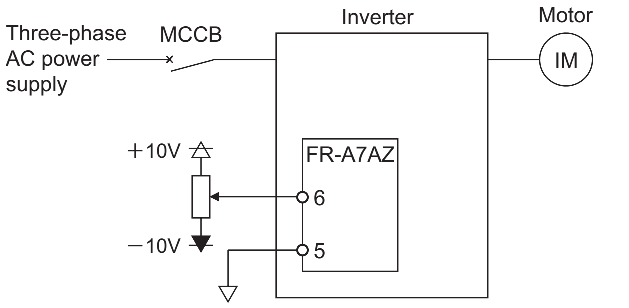
By setting [*Pr.838*] values, output analog signals, such as output frequency and output current, can be output from terminal DA1.



* The wiring distance to the voltmeter should be 30m maximum.

(5) High resolution analog input connection example (A700)

Analog voltage (-10 to 10VDC) can be input in high resolution (16bit). Set the function of terminal 6 by setting [*Pr.406*].



1.4.34 Safety stop function (S1, S2, SO,SC) (D700)

This inverter has two lines of input terminal for inverter output shutoff, and one monitor output terminal for monitoring output shutoff state. Using these terminals, compliance with Machinery Directive in EU becomes more accessible.

*1 At initial state, terminal S1 and S2 are shorted to terminal SC with a shorting wire. When using the safety stop function, remove this shorting wire, and connect to a safety relay module.

*2 Set "80 (positive logic) or 180 (negative logic)" in [*Pr. 190, Pr. 192 (output terminal function selection)*] when assigning safety monitor output signal (SAFE) to other terminals.

* Changing the terminal assignment using [*Pr. 190, Pr. 192 (output terminal function selection)*] may affect the other functions. Make setting after confirming the function of each terminal.

1.5 Protective functions

When a fault occurs, the inverter trips and the PU display automatically changes to any of the following fault indications.
If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

1) Retention of fault output signal
When the magnetic contactor (MC) provided on the input side of the inverter is opened when a fault occurs, the inverter's control power will be lost and the fault output will not be held.
2) Fault or alarm indication
When a fault or alarm occurs, the operation panel display automatically switches to the fault or alarm indication.
3) Reset
When a fault occurrs, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart.
When any failure occurrs, take the appropriate corrective action, then reset the inverter, and resume operation. Not doing so may lead to the inverter failure and damage.

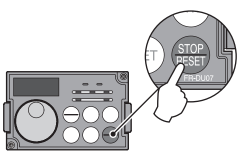
Inverter fault or alarm indications are roughly divided as below.

1) Faults
When a fault occurrs, the inverter trips and a fault signal is output.
2) Alarms
The inverter does not trip. You can also output an alarm signal by making parameter setting.
3) Warning
The inverter does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
4) Error message
A message regarding operational fault and setting fault by the operation panel (FR-DU07) and parameter unit (FR-PU04 /FR-PU07) is displayed. The inverter does not trip.

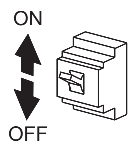
1.5.1 Reset method of fault (common)

The inverter can be reset by performing any of the following operations. Note that the internal thermal integrated value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter. Recover about 1s after reset is cancelled.

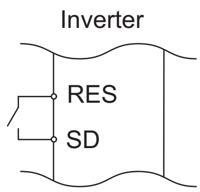
Operation 1 · · · · Using the operation panel, press STOP/RESET to reset the inverter.
(enabled only when the inverter protective function (fault) is activated)



Operation 2 · · · · Switch power OFF once, then switch it ON again.



Operation 3 · · · · Turn ON the reset signal (RES) for more than 0.1s. (If the RES signal is kept ON, "Err." appears (flickers) to indicate that the inverter is in a reset status.



1.5.2 List of fault or alarm display (common)

(1) Fault (common)

<table>
<tr><th colspan="2" rowspan="3">Name</th><th rowspan="3">Description</th><th colspan="3">Indication</th><th colspan="4">Available Inverters</th></tr>
<tr><th rowspan="2">Operation panel</th><th colspan="2">Parameter unit</th><th rowspan="2">A700</th><th rowspan="2">F700</th><th rowspan="2">E700</th><th rowspan="2">D700</th></tr>
<tr><th>FR-PU04</th><th>FR-PU07</th></tr>
<tr><td rowspan="3">Overcurrent shut-off</td><td>During acceleration</td><td rowspan="3">When the inverter output current reaches or exceeds specific value (approximately 220% of the rated current for A700, 170% for F700, 230% for E700, 200% for D700) of the rated current during acceleration/ deceleration or constant speed operation (when the output frequency is within ± 2Hz range of the set frequency), the protective circuit is activated to stop the inverter output.</td><td>E.OC 1
(E.OC1)</td><td colspan="2">OC During Acc</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Constant speed</td><td>E.OC 2
(E.OC2)</td><td colspan="2">Stedy Spd OC</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>During deceleration or stop</td><td>E.OC 3
(E.OC3)</td><td colspan="2">OC During Dec</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Regenerative overvoltage shut-off</td><td>During acceleration</td><td rowspan="3">If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specific value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.
Definition of constant speed is when the output frequency is within ± 2Hz of the set frequency.</td><td>E.Ov 1
(E.OV1)</td><td colspan="2">OV During Acc</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Constant speed</td><td>E.Ov 2
(E.OV2)</td><td colspan="2">Stedy Spd OV</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>During deceleration or stop</td><td>E.Ov 3
(E.OV3)</td><td colspan="2">OV During Dec</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">Overload shut-off (electronic thermal relay function)</td><td>Inverter</td><td>If a current of 150% or larger (120% for F700) of the rated output current flows and overcurrent trip does not occur in A700 F700, the electronic thermal relay activates to stop the inverter output in order to protect the output transistors. (Overload capacity 150% (F700 is 120%) 60s)
Resetting the inverter initializes the internal thermal integrated data.
For E700 D700, if the temperature of the output transistor element exceeds the protection level under the condition that a current not less than the rated inverter current flows and overcurrent trip does not occur (200% or less), the electronic thermal relay activates to stop the inverter output. (Overload capacity 150% 60s, 200% 0.5s)</td><td>E.THT
(E.THT)</td><td colspan="2">Inv. Overload</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Motor</td><td>The electronic thermal relay function built in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation. If the internal thermal integrated data reaches 100% of the value set in [Pr. 9 Electronic thermal O/L relay], the protective circuit is activated to stop the inverter output. When running a special motor such as a multi-pole motor or multiple motors, provide a thermal relay on the inverter output side since such motor(s) cannot be protected by the electronic thermal relay function.
Resetting the inverter initializes the internal thermal integrated data.</td><td>E.THM
(E.THM)</td><td colspan="2">Motor Ovrload</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table>

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SPECIFICATIONS

Name		Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	Available Inverters: A700	F700	E700	D700
Fin overheat		If the heatsink overheats, the temperature sensor is actuated to stop the inverter output.	(E.FIN)	H/Sink O/Temp		○	○	○	○
Instantaneous power failure		If a power failure occurs for longer than 15ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to trip the inverter in order to prevent the control circuit from malfunctioning. If a power failure persists for longer than 100ms, the fault output is not provided, and the inverter restarts if the start signal is ON upon power restoration. (The inverter continues operating if an instantaneous power failure is within 15ms.) In some operating status (load magnitude, acceleration/deceleration time setting, etc.), overcurrent or other protection may be activated upon power restoration.	(E.IPF)	Inst. Pwr. Loss		○	○	—	—
Undervoltage		If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below approx. 150VAC (approx. 300V for the 400V class or less), this function stops the inverter output. When a jumper is not connected across P/+ and P1, the undervoltage protective function is activated.	(E.UVT)	Under Voltage		○	○	—	—
Phase loss	Input	This fault is output when function valid setting (= 1) is set in [*Pr. 872 Input phase loss protection selection*] and one phase of the three phase power input is lost. This fault is also output when phase-to-phase voltage of the three-phase power input becomes unbalanced by large in E700 D700 .	(E.ILF)	Fault 14	Input phase loss	○	○	○	○
Phase loss	Output	Because [*Pr.251 Output phase failure protection selection*] is set valid (=1), this function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) is lost.	(E.LF)	E.LF		○	○	○	○
Stall prevention		If the output frequency has fallen to 0.5Hz by stall prevention operation and remains for 3s, the inverter trips. (OL appears while stall prevention is being activated.) For A700 , when speed control is performed by Real sensorless vector control or vector control, the inverter output is stopped if frequency drops to the [*Pr. 865 Low speed detection*] (initial value is 1.5Hz) setting by torque limit operation and the output torque exceeds [*Pr. 874 OLT level setting*] (initial value is 150%) and remains for more than 3s.	(E.OLT)	Stll Prev STP		○	○	○	○

Name		Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	A700	F700	E700	D700
Output side earth (ground) fault overcurrent		The inverter trips if an earth (ground) fault overcurrent flows due to an earth (ground) fault that occurred on the inverter's output side (load side).	E. GF (E.GF)	Ground Fault		○	○	—	—
Output side earth (ground) fault overcurrent at start		The inverter trips if [*Pr. 249 Earth (ground) fault detection at start*] is set active (=1) and an earth (ground) fault overcurrent flows at start due to an earth (ground) fault that occurred on the inverter's output side (load side).	E. GF (E.GF)	Ground Fault		—	—	○	○
External thermal relay operation		If the external thermal relay provided for motor overheat protection or the internally mounted temperature relay in the motor, etc. switches ON (contacts open), the inverter output is stopped.	E.OHT (E.OHT)	OH Fault		○	○	○	○
PTC thermistor operation		For A700 F700, the fault appears when the motor overheat status is detected for 10s or more by the external PTC thermistor input connected to the terminal AU. For D700, inverter trips when resistance of PTC thermistor connected between terminal 2 and terminal 10 is more than the value set in [*Pr.561 PTC thermistor protection level*].	E.PTC (E.PTC)	Fault 14	PTC activated	○	○	—	○
Option fault		Appears when the AC power supply is connected to the terminal R/L1, S/L2, T/L3 accidentally when a high power factor converter is connected. Appears when the switch for the manufacturer setting of the plug-in option is changed. For A700, it appears when torque command by the plug-in option is selected using [*Pr. 804 Torque command source selection*] and no plug-in option is mounted.	E.OPT (E.OPT)	Option Fault		○	○	—	—
Communication option fault		Stops the inverter output when a communication line fault occurs in the communication option.	E.OP1 (E.OP1)	Option1 Fault		—	○	○	—
			E.OP3 (E.OP3)	Option3 Fault		○	—	—	—
Option fault		Stops the inverter output if a contact fault or the like of the connector between the inverter and built-in option occurs or if a communication option is fitted to the connector 1 or 2 (A700 only). Appears when the switch for the manufacturer setting of the plug-in option is changed.	E. 1 (E.1)	Fault 1		○	○	○	—
			E. 2 (E.2)	Fault 2		○	—	—	—
			E. 3 (E.3)	Fault 3		○	—	—	—
Parameter storage device fault	Control circuit board	Appears when a fault occurred in parameters stored (EEPROM failure)	E. PE (E.PE)	Corrupt Memry		○	○	○	○
	Main circuit board		E.PE2 (E.PE2)	Fault 14	PR storage alarm	○	○	—	—
Internal board fault		When a combination of control board and main circuit board is wrong, the inverter is tripped.	E.PE2 (E.PE2)	Fault 14	PR storage alarm	—	—	○	—

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SPECIFICATIONS

Name	Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	Available Inverters: A700	F700	E700	D700
PU disconnection	• This function stops the inverter output if communication between the inverter and PU is suspended, for example the operation panel and parameter unit is disconnected, when 2, 3, 16 or 17 was set in [*Pr. 75 Reset selection/disconnected PU detection/PU stop selection*]. • This function stops the inverter output when communication errors occurred consecutively for more than permissible number of retries when [*Pr. 121 Number of PU communication retries* ≠ 9999] during the RS-485 communication with the PU connector. • This function also stops the inverter output if communication is broken for the period of time set in [*Pr. 122 PU communication check time interval*].	E.PUE (E.PUE)	PU Leave Out		○	○	○	○
Retry count excess	If operation cannot be resumed properly within the number of retries set, this function trips the inverter.	E.rEt (E.RET)	Retry No Over		○	○	○	○
CPU Fault	Stops the inverter output if the communication fault of the built-in CPU occurs.	E. 5 (E.5)	Fault 5		○	○	○	○
		E. 6 (E.6)	Fault 6		○	○	○	—
		E. 7 (E.7)	Fault 7		○	○	○	—
		E.CPU (CPU)	CPU Fault		○	○	○	○
Short circuit of power supply for operation panel, power supply for RS-485 terminals	When the operation panel power supply (PU connector) is shorted, this function trips the inverter. At this time, the operation panel (parameter unit) cannot be used and RS-485 communication from the PU connector cannot be made. When the internal power supply for RS-485 terminals are shorted, this function shuts off the power output. At this time, communication from the RS-485 terminals cannot be made. To reset, enter the RES signal or switch power OFF, then ON again.	E.CTE (E.CTE)	E.CTE		○	○	—	—
24VDC power output short circuit	When the 24VDC power output from the terminal PC is shorted, this function shuts off the power output. At this time, all external contact inputs switch OFF. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power OFF, then ON again.	E.P24 (E.P24)	E.P24		○	○	—	—
Output current detection value exceeded	Because [*Pr.167 Output current detection operation selection*] is set to the alarm stop setting (=1), this function is activated when the output current exceeds the [*Pr. 150 Output current detection level*] setting.	E.CdO (E.CDO)	Fault 14	OC detect level	○	○	—	○
Inrush current limit circuit fault	This function is activated when the resistor of the inrush current limit circuit overheats. Activates if the inrush current limit circuit fault occurs.	E.IOH (E.IOH)	Fault 14	Inrush overheat	○	○	○	○

Name	Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	Available Inverters: A700	Available Inverters: F700	Available Inverters: E700	Available Inverters: D700
Communication fault (inverter)	This function stops the inverter output when communication error occurs consecutively for more than permissible retry count when a value other than "9999" is set in [*Pr. 335 RS-485 communication retry*] during RS-485 communication from the RS-485 terminals. This function also stops the inverter output if communication is broken for the period of time set in [*Pr. 336 RS-485 communication check time interval*].	E.SEr (E.SER)	Fault 14	VFD Comm error	○	○	—	—
Analog input fault	For A700 F700, the fault appears when 30mA or more is input or a voltage (7.5V or more) is input with the terminal 2 or 4 set to current input. For E700 D700, the fault appears if voltage(current) is input to terminal 4 when the setting in [*Pr.267 Terminal 4 input selection*] and the setting of voltage/current input switch are different.	E.AIE (E.AIE)	Fault 14	Analog in error	○	○	○	○
Overspeed occurrence	Indicates that the motor speed exceeds the over speed setting level during encoder feedback control and vector control.	E. OS (E.OS)	E.OS		○	—	—	—
Speed deviation excess detection	Stops the inverter output if the motor speed is increased or decreased under the influence of the load etc. during vector control and cannot be controlled in accordance with the speed command value.	E.OSd (E.OSD)	E.OSd		○	—	—	—
Signal loss detection	Trips the inverter output when the encoder signal is shut off under orientation control, encoder feedback control or vector control.	E.ECT (E.ECT)	E.ECT		○	—	—	—
Excessive position error	Indicates that the difference between the position command and position feedback exceeded the reference under position control.	E. Od (E.OD)	Fault 14	E.Od	○	—	—	—
Brake sequence error	The inverter output is stopped when a sequence error occurs during use of the brake sequence function [*Pr. 278 to Pr. 285 Brake sequence function*] .	E.Mb1 **to** E.Mb7 (E.MB1to E.MB7)	E.MB1 Fault to E.MB7 Fault		○	—	○	—
Encoder phase error	Appears when rotation command of the inverter differs from the actual motor rotation direction detected from the encoder during offline auto tuning.	E.EP (E.EP)	Fault 14	Encoder phase error	○	—	—	—
Brake transistor alarm detection	This function stops the inverter output if an alarm occurs in the brake circuit, e.g. damaged brake transistors. In this case, the inverter must be powered OFF immediately. For A700 F700, it also appears when an internal circuit fault occurs.	E. bE (E.BE)	Br. Cct. Fault		○	○	○	○
USB communication fault	When communication has broken during the time set in [*Pr. 548 USB communication check time interval*], this function trips the inverter.	E.USb (E.USB)	Fault 14	USB comm error	○	—	○	—

Name	Description	Indication			Available Inverters			
		Operation panel	Parameter unit		A700	F700	E700	D700
			FR-PU04	FR-PU07				
Opposite rotation deceleration fault	The speed may not decelerate during low speed operation if the rotation direction of the speed command and the estimated speed differ when the rotation is changing from forward to reverse or from reverse to forward under torque control of Real sensorless vector control. At this time, the inverter output is stopped if the rotation direction will not change, causing overload.	E. 11 (E.11)	Fault 11		○	—	—	—
Internal circuit fault	Appears when an internal circuit fault occurred.	E. 13 (E.13)	Fault 13		○	○	○	—
Safety circuit fault	Appears when safety circuit is malfunctioning, or when one of the lines between S1 and SC, or between S2 and SC is opened.	E.SAF (E.SAF)	Fault 14	Fault E.SAF	—	—	—	○

(2) Alarms (common)

Name	Description	Indication			Available Inverters			
		Operation panel	Parameter unit		A700	F700	E700	D700
			FR-PU04	FR-PU07				
Fan alarm	For the inverter that contains a cooling fan, Fn appears on the operation panel when the cooling fan stops due to a fault or different operation from the setting of [*Pr. 244 Cooling fan operation selection*].	Fn (FN)	FN		○	○	○	○

(3) Warning (common)

Name			Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	A700	F700	E700	D700
Stall prevention	Overcurrent	During acceleration	When the output current (output torque during real sensorless vector control and vector control) of the inverter exceeds the stall prevention operation level ([*Pr. 22 Stall prevention operation level*], etc.), this function stops the increase in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency again.	OL (OL)	OL	OL	○	○	○	○
Stall prevention	Overcurrent	Constant speed	When the output current (output torque during real sensorless vector control and vector control) of the inverter exceeds the stall prevention operation level ([*Pr. 22 Stall prevention operation level*], etc.), this function reduces frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency up to the set value. Definition of constant speed is when the output frequency is within ±2Hz of the set frequency.	OL (OL)	OL	OL	○	○	○	○
Stall prevention	Overcurrent	During deceleration	When the output current (output torque during real sensorless vector control and vector control) of the inverter exceeds the stall prevention operation level ([*Pr. 22 Stall prevention operation level*], etc.), this function stops the decrease in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function decreases the frequency again.	OL (OL)	OL	OL	○	○	○	○
Stall prevention	Overvoltage	During deceleration	If the regenerative energy of the motor becomes excessive and exceeds the regenerative energy consumption capability, this function stops the decrease in frequency to prevent overvoltage trip. As soon as the regenerative energy has reduced, deceleration resumes.	oL (oL)	oL	oL	○	○	○	○
Regenerative brake prealarm			Appears if the regenerative brake duty reaches or exceeds 85% of the [*Pr. 70 Special regenerative brake duty*] value. If the regenerative brake duty reaches 100%, a regenerative overvoltage (E. OV1 to E.OV3) occurs. For F700, this warning appears only for the 75K or more.	rb (RB)	RB	RB	○	○	○	○

Name	Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	Available Inverters: A700	F700	E700	D700
Electronic thermal relay function prealarm	Appears if the cumulative value of the [*Pr. 9 Electronic thermal O/L relay*] reaches or exceeds 85% of the preset level. If it reaches 100% of the [*Pr. 9 Electric thermal O/L relay*] setting, a motor overload trip (E. THM) occurs.	(TH)	TH		○	○	○	○
PU Stop	Stop with of the PU is set in [*Pr. 75 Reset selection/disconnected PU detection/PU stop selection*].	(PS)	PS		○	○	○	○
Maintenance signal output	Indicates that the cumulative energization time of the inverter has reached a given time.	(MT)	—	MT	○	○	○	○
Parameter copy	Appears when parameters are copied between models with capacities of 55K or less and 75K or more.	(CP)	—	CP	○	○	—	—
Speed limit display (output during speed control)	Output if the speed limit level is exceeded during torque control.	(SL)	—	SL	○	—	—	—
Undervoltage	If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below about 115VAC (about 230VAC for 400V class), this function stops the inverter output and displays . An alarm is reset when the voltage returns to normal.	(UV)	—		—	—	○	○

(4) Error Message (common)

Name		Description	Indication: Operation panel	Indication: Parameter unit FR-PU04	Indication: Parameter unit FR-PU07	Available Inverters: A700	Available Inverters: F700	Available Inverters: E700	Available Inverters: D700
Operation panel lock		Operation lock mode is set. Operation other than STOP/RESET is invalid.	(HOLD)	—		○	○	○	○
Password locked		Password function is active. Display and setting of parameter is restricted.	(LOCD)	—		—	—	—	○
Parameter write error	Write disable error	1) You attempted to make parameter setting when [*Pr. 77 Parameter write selection*] has been set to disable parameter write. 2) Frequency jump setting range overlapped. 3) Adjustable 5 points V/F setting overlapped 4) The PU and inverter cannot make normal communication	(Er1)	—		○	○	○	○
	Write error during operation	When parameter write was performed during operation with [*Pr. 77* ≠ 2] and the STF (STR) is ON.	(Er2)	—		○	○	○	○
	Calibration error	Analog input bias and gain calibration values are too close.	(Er3)	—		○	○	○	○
	Mode designation error	You attempted to make parameter setting in the NET operation mode when [*Pr. 77* ≠ 2].	(Er4)	—		○	○	○	○
Copy operation error	Parameter read error	An error occurred in the EEPROM on the operation panel side during parameter copy reading.	(rE1)	—		○	○	○	○
	Parameter write error	1) You attempted to perform parameter copy write during operation. 2) An error occurred in the EEPROM on the operation panel side during parameter copy writing.	(rE2)	—		○	○	○	○
	Parameter verification error	1) Data on the operation panel side and inverter side are different. 2) An error occurred in the EEPROM on the operation panel side during parameter verification.	(rE3)	—		○	○	○	○
	Model error	1) A different model was used for parameter write and verification during parameter copy. 2) When parameter copy write is stopped after parameter copy read is stopped	(rE4)	—		○	○	○	○
Error		1) The RES signal is ON 2) The PU and inverter cannot make normal communication (contact fault of the connector) 3) This indication may appear at turning ON the main circuit when the control circuit power (terminal R1/L11, S1/L21) and the main circuit power (terminal R/L1, S/L2, T/L3) are connected to separate power.	(Err.)	—		○	○	○	○

1.5.3 Overcurrent protection (OC1 to OC3) (common)

To protect IGBT from overcurrent, the following protective functions are activated by detecting the output current of the inverter.

1) Rated output current (100%)
↓
2) Overload current rating (150%) *1
↓
3) Current limit operation
(stall prevention (overcurrent) operation)
↓
Overcurrent shut-off ((A700) 220% or more) *2

*1 (F700) 120% or more

*2 (F700) 170% or more, (E700) 230% or more, (D700) 200% or more,

1) **Rated output current**
Maximum current allowed to flow continuously.
2) **Overload current rating**
Current allowed to flow one minute continuously. Sufficient cooling time is required for repeated use.
3) **Current limit operation**
The current limit is activated.
4) **Overcurrent shut-off**
Activates the protective circuit instantaneously to shut off the transistor gate. Causes the electronic thermal relay to shut off the gate to protect the transistor if a current smaller than this value flows continuously for a long time.

1.5.4 Stall prevention (overcurrent) function and fast response current limit function (common)

Both functions are activated against the output current (output torque under Real sensorless vector control and vector control). If a rise in current is sharp, the overcurrent protection is activated because the stall prevention function cannot suppress the current. Better for current suppression (limit) capability than the stall prevention function, the fast response current limit function has a less possibility of activating the overcurrent protection, thus ensuring operation highly resistant to overload.
You can activate these functions using [*Pr. 156*].
Note that if an overload state is continued, the electronic thermal relay (E.THT) may be operated. Unlike the stall prevention (overvoltage), the current limit function does not function against regenerative overvoltage during deceleration.

(1) Stall prevention (overcurrent) (during acceleration, during constant-speed operation) (common)

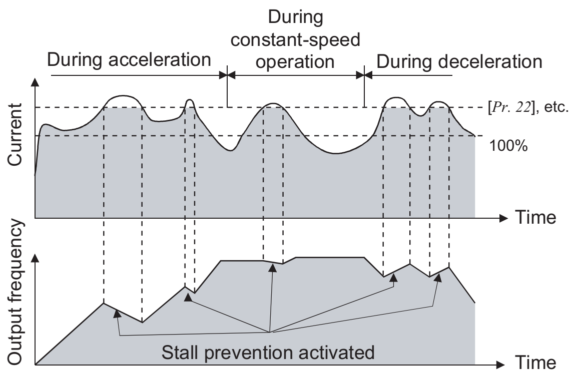
The inverter has a function for limiting the motor current. If the current reaches or exceeds [*Pr. 22 Stall prevention operation level*], the inverter lowers the output frequency during acceleration operation to reduce the load current and waits for the decrease of the load current. The inverter decreases the output frequency during constant speed operation and waits for decrease of the load current. When the current returns to within [*Pr. 22 Stall prevention operation level*] etc., the inverter increases the frequency again, accelerates and operates at the set frequency.
The current limit function may not prevent overcurrent shut-off if the current changes suddenly as in a short circuit occurring in the output side.

(2) Stall prevention (overcurrent) (during deceleration) (common)

If the current reaches or exceeds [*Pr. 22 Stall prevention operation level*] etc., the inverter increases the output frequency to reduce the load current and waits for the decrease of the load current. When the current returns to within [*Pr. 22 Stall prevention operation level*] etc., the inverter decreases the frequency again and decelerates to the set frequency or stops.

(3) Fast-response current limit (common)

When the output current exceeds the specified value (independently of [*Pr. 22*]), the inverter shuts off the outputs, decelerates to the specified value and cancels the output shut-off. Action is the same regardless of acceleration, constant speed, and deceleration operation. Although response speed is fast, the output torque also decreases rapidly due to the rapid decrease of output voltage.



Operation at stall prevention (overcurrent)

1.5.5 Regenerative overvoltage protection (OV1 to OV3) common

When the motor is decelerated by the inverter, the output frequency falls according to the deceleration time set value. When the load is light or inertia J (moment of inertia) is large, the motor speed may exceed the synchronous speed and enter the power regeneration range. At this time, the regeneration energy of the load is converted (regenerated) into electric energy and consumed by the motor itself and in the inverter. The regeneration overvoltage function is provided to prevent the built-in capacitor terminal voltage from rising abnormally due to large regenerative energy when motor slip has increased.
Braking torque of approximately 20% of the rated motor torque is generated by the regenerative energy consumed in the motor and inverter. When the brake unit is used, braking torque of 100 to 150% of the rated torque is generated by the electrical energy consumed by the discharging resistor.

The regenerative energy of the transistorized inverter is not returned to the commercial power supply. Install the power supply regenerating converter (FR-CV) and high power factor converter (FR-HC, MT-HC) options to return the regenerative energy to the power supply.
If the regenerative energy from the motor has become excessive and the regenerative brake torque (current) has exceeded the specified value during motor deceleration, the stall prevention (overvoltage) function stops the fall of the output frequency to prevent regenerative overvoltage shut-off from being activated. If the deceleration time is extremely short or the load inertia J (moment of inertia) is very large, the stall prevention (overvoltage) function may not be enough to prevent regenerative overvoltage shut-off.
The stall prevention function is not available for regenerative overvoltage during constant-speed operation. When working with a negative load (in descending operation) which always is in the regenerative status, fit the power supply regenerating converter option to avoid regenerative overvoltage shut-off to activate. Also, to use power supply regenerating converter, install a brake register and inverter with sufficient heat capacities.

Deceleration start

↓

1) Regenerative brake operation
(approximately 360VDC)*1

↓

2) Regenerative brake duty excessive

↓

3) Regenerative overvoltage shut-off
(200Vclass : approximately 400VDC)*2
400Vclass : approximately 800VDC

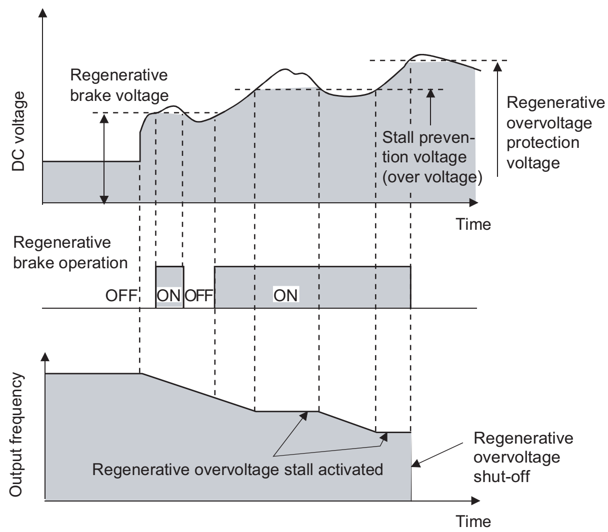
*1 Voltage where the function activates differ according to the model. Refer to the below table.

	A700		F700	E700 D700
	22K or less	75K or more	75K or more	0.4K or more
200V class	DC380V	DC376V	DC376V	DC390V
400V class	DC760V	DC785V	DC785V	DC760V

	FR-BU2		
	BU mode	FR-BU2 mode	MT-BU5 mode
200V class	DC360V	DC370V	DC376V
400V class	DC740V	DC740V	DC784V

*2 Voltage where inverter trips differ according to the model.

1) Regenerative brake operation
Switches ON the brake transistor to start current in the brake discharge resistor.
2) Regenerative brake duty excessive
Stops use of the regenerative brake temporarily if the regenerative brake duty value exceeds the specified value. Resumes use of the regenerative brake when the brake discharge resistor has cooled down.
3) Regenerative overvoltage shut-off
Instantly activates the protective circuit to shut off the transistor gate.



Operation of regenerative overvoltage stall prevention

1.5.6 Brake resistor overheat protection and brake transistor alarm detection common

(1) Brake resistor overheat protection A700

Any of the inverters 0.4K to 7.5K have a built-in regenerative brake discharge resistor. This brake resistor has a heat capacity of 100 to 150% torque and is used for a short time. (within 5 to 8s continuously)

If the regenerative brake beyond the above value is required (the brake transistor ON time has exceeded the permissible value), the brake resistor overheat protection is activated to shut off the brake transistor gate. The regenerative brake may be used again when the discharge resistor has cooled after the regenerative brake is shut off.

The heat capacity can be increased by using the external brake discharging resistor instead. (Refer to page 489)

The brake resistor overheat protection function is reset to the initial (cold) state by switching ON the inverter power or the reset signal (RES signal). Unnecessary reset and power-OFF should therefore be avoided. The inverter must not be installed on any combustible surface, such as wood, because the temperature of the built-in brake resistor reaches approximately 200°C maximum.

If the brake transistor output voltage becomes excessive during deceleration, the regenerative overvoltage protection may be activated to stop the inverter output.

(2) Brake transistor circuit alarm detection (BE) common

When the regenerative brake transistor has been damaged due to an external brake discharge resistor wiring fault etc. (F700 at internal circuit alarm for the 55K or less), this function detects the fault, shuts off the inverter output, and gives the alarm output signal. When this alarm output signal is provided, shut off the inverter power supply to protect the discharge resistor from overheating.

1.5.7 Electronic thermal relay function(THM, THT) common

(1) Function common

On detecting the overload of the motor or transistor, the electronic thermal relay in the inverter stops the transistor operation and output, and keeps them stopped.

*1 Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.

*2 When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal function. Install an external thermal relay to each motor.

*3 A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.

*4 The operation time of the transistor protection thermal shortens when the [*Pr. 72 PWM frequency selection*] setting is increased.

(2) Setting the electronic thermal relay function common

Define the protection characteristic of the electronic thermal relay on the basis of the rated current value of the motor as indicated below:

Setting value = rated current value $\times\ \alpha$ (A)

α: 200V(400V) 50Hz 1.0
200/220V(400/440V) 60Hz 1.1

Set the value in terms of amperes from the operation panel (parameter unit). ([*Pr. 9*])

*1 Set 0 in [*Pr. 9*] when you do not want to operate the electronic thermal relay function when using the motor with the external thermal relay, etc. (Note that the output transistor protection (E.THT) of the inverter functions.)

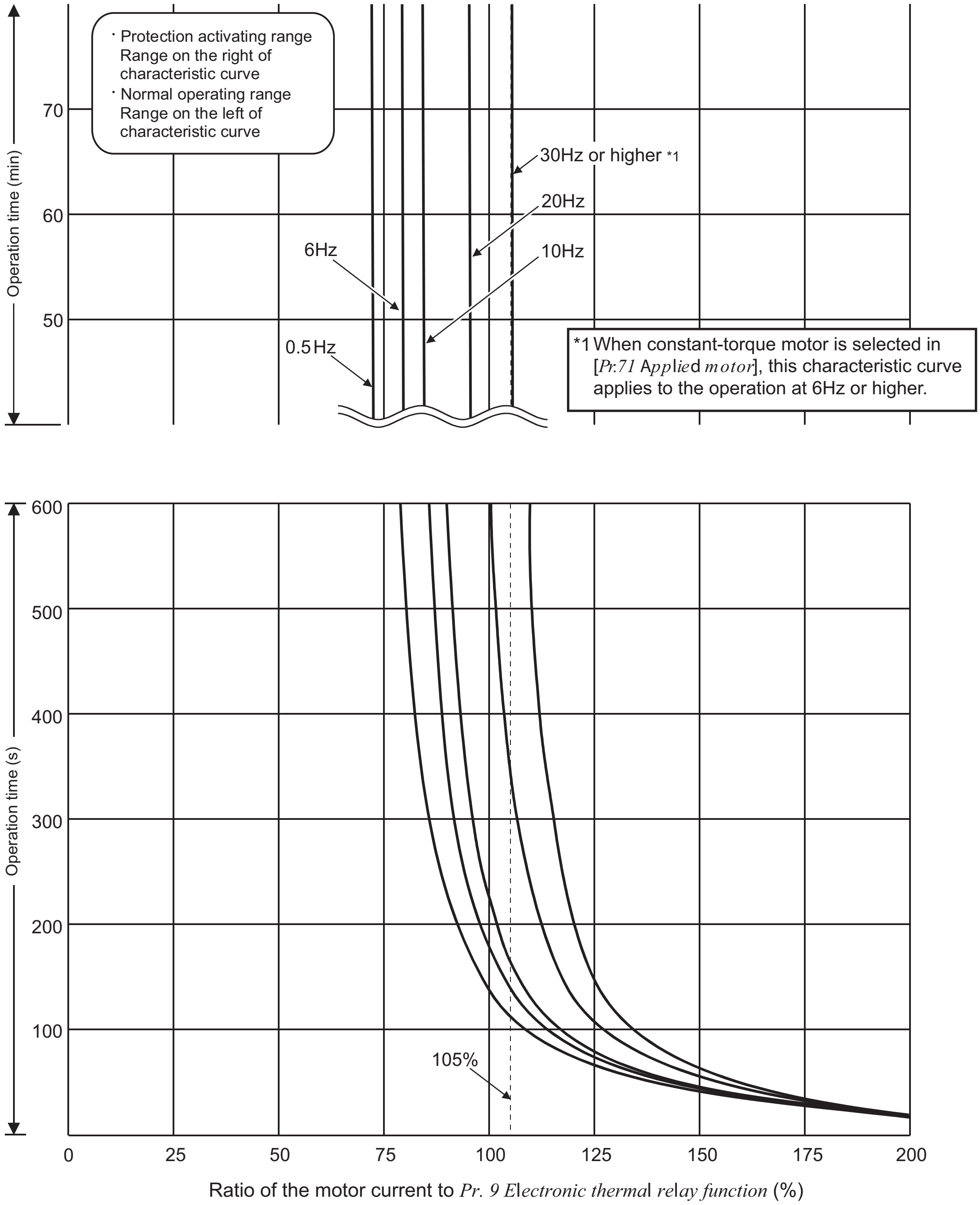
*2 Since a thermal relay protector is built in a motor dedicated for vector control (SF-V5RU), set [*Pr. 9* = 0] to use the motor.

*3 When a difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.

*4 Electronic thermal relay may not function when 5% or less of inverter rated current is set to electronic thermal relay setting.

(3) Electronic thermal relay function operation characteristic (THM) (common)

Electronic thermal relay function operation characteristics of the inverter when the ratio of the motor current to the [*Pr. 9 Electronic thermal O/L relay*] is presented in horizontal axis. Horizontal axis is calculated as follows: (motor current [A]/[*Pr. 9*] [A]) × 100 [%]).

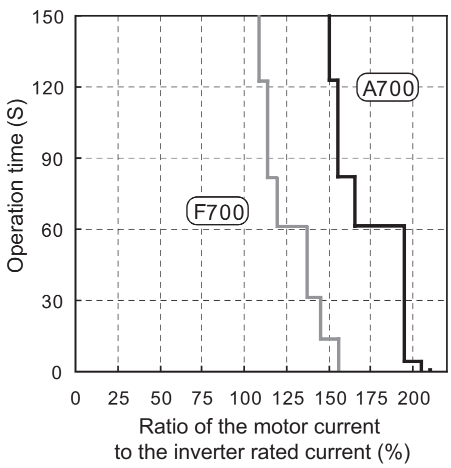
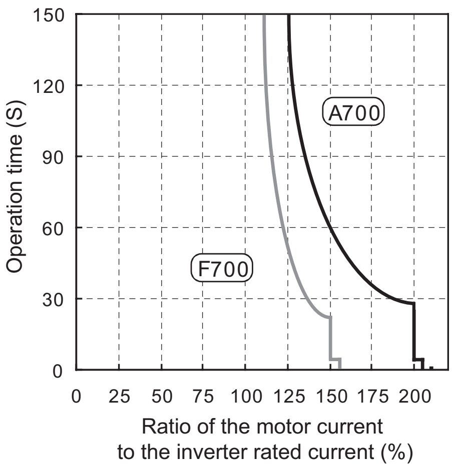
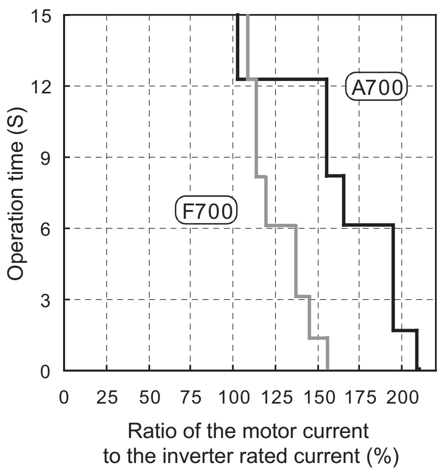
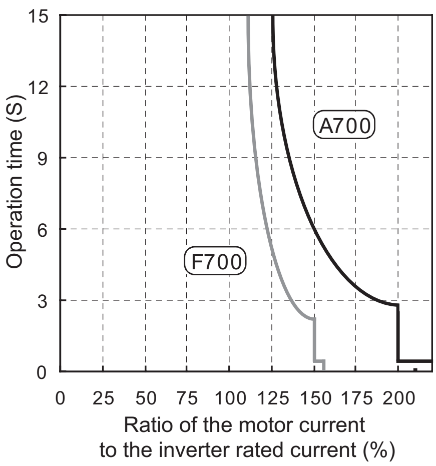


Electronic thermal relay function operation characteristic

(4) Electronic thermal relay function operation characteristic (THT) (common)

This electronic thermal relay function operates to protect output transistor in an inverter. Characteristic of the electronic thermal relay function is determined by the inverter, and cannot be changed with parameters.

Electronic thermal relay function (transistor protection thermal) operation characteristics of (A700)(F700) when the ratio of the motor current to the inverter rated current is presented in horizontal axis. Horizontal axis is calculated as follows:
(motor current [A]/inverter rated current [A]) x 100 [%]).

<table>
<tr><th rowspan="2">Optimum Conditions</th><th colspan="2">(A700)(F700)</th></tr>
<tr><th>55K or less</th><th>75K or more</th></tr>
<tr><td>Running frequency : 1Hz or more
Carrier frequency: 2kHz</td><td>
</td><td>
</td></tr>
<tr><td>Running frequency : 1Hz or less
Carrier frequency: 2kHz</td><td>
</td><td>
</td></tr>
</table>

1.5.8 Instantaneous power failure protection (IPF) (A700) (F700)

(1) Instantaneous power failure protection (IPF) (A700) (F700)

If the power supply voltage of the inverter has reduced or the power is lost due to instantaneous power failure, etc., this function activates the protective circuit and shuts off the IPM gate to stop the output.
Operation is continued properly if the instantaneous power failure is within 15ms (fault output is not provided). If it exceeds 15ms, the instantaneous power failure protection circuit is activated to stop the inverter output. A fault output is provided (terminals B and C are open) when the instantaneous power failure is within approximately 100ms. When the power failure is longer than approximately 100ms, fault output is not provided. (Refer to page 35.)
When the power is restored after the instantaneous power failure, the inverter must be restarted after the motor has stopped completely.
Set a value other than 9999 in [*Pr. 57 Automatic restart after instantaneous power failure*] to make a restart while the motor is coasting.

(2) Power supply undervoltage protection (UVT) (A700) (F700)

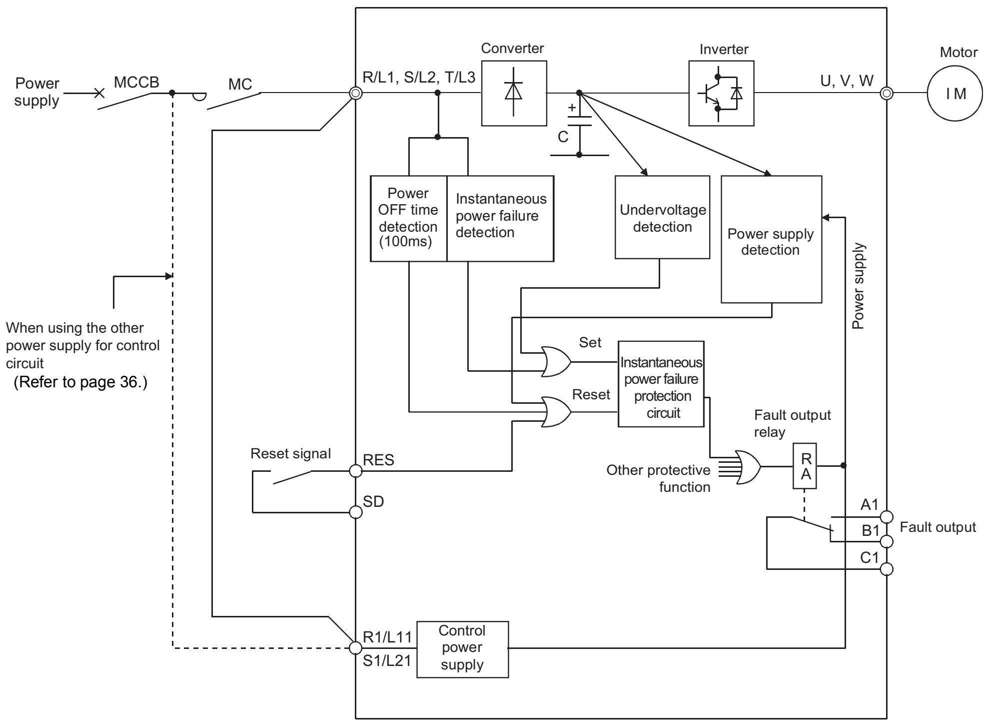
Activates the protective function if the power supply voltage drops below approximately 150VAC (approximately 300VAC for the 400V class).

(3) Reset (A700) (F700)

Once activated, the instantaneous power failure protection function remains activated. To reset, switch OFF the start signal, then recovers the inverter by referring to page 96.
The protective circuit is automatically reset by the reset function if the power failure persists for longer than approximately 100ms.

[Explanation of the instantaneous power failure protection circuit block diagram]

When the inverter power supply (R/L1, S/L2, T/L3) is switched ON, the converter smoothing capacitor (C) is charged. In the meantime, when the control power supply establishment pulse resets the instantaneous power failure protection circuit to the initial state. If the DC voltage of the smoothing capacitor is reduced by an instantaneous power failure (longer than 15ms and within approximately 100ms) or a power supply voltage reduction during inverter operation, the undervoltage detection circuit is activated to set the instantaneous power failure protection circuit and shut off the inverter at the gate. When the power is then restored, a fault display is switched ON (terminals B-C open, A-C closed).
The reset function is activated when the inverter power remains OFF for more than approximately 100ms. (Fault is not output).
If the fault output relay is switched ON (terminals B-C open, A-C closed) by other than the instantaneous power failure protection circuit to switch OFF the inverter power supply MC, the control power is lost, whereby the fault display and fault output relay are switched OFF (terminals B-C closed, A-C open).



Instantaneous Power Failure Protection Circuit Block Diagram

1.5.9 Input/output phase loss protection selection (common)

(1) Input phase loss protection (E.ILF) (common)

When [*Pr. 872* = 1], input phase loss protection (E.ILF) is provided if a phase loss of one phase among the three phases is detected for 1s continuously.*1

If input phase is lost when [*Pr. 872* = 1] (with input phase loss protection) and [*Pr. 261* ≠ 0] (instantaneous power failure stop function is enabled) are set in A700 F700, input phase failure protection (E.ILF) is not provided but power-failure deceleration is made. For E700 D700, input phase failure protection (E.ILF) is activated.

*1 As phase loss is detected according to the bus voltage change in E700 D700, phase loss cannot be detected if the load is light. As phase loss is detected according to the bus voltage change, it can not be detected if the load is light. Large unbalanced phase-to-phase voltage of the three-phase power supply may also cause input phase loss protection (E.ILF).

*2 When an input phase loss occurs in the R/L1 and S/L2 phases of A700 F700, input phase loss protection is not provided but the inverter output is shut off.

*3 If an input phase loss continues for a long time, the converter section and capacitor lives of the inverter will be shorter.

[Pr.]	Name	Initial Value	Setting Range	Description
872	Input phase loss protection selection	A700 F700 D700: 0 E700: 1	0	Without input phase loss protection
			1	With input phase loss protection

(2) Output phase loss protection (LF) (common)

The output current unbalance due to the phase loss is checked by the output phase loss detection. When the current value between the lost phase and other two phases differs, it is regarded as output phase loss and the inverter will come to a fault.

When [*Pr. 251* = 0], output phase loss protection (E.LF) becomes invalid.

[Pr.]	Name	Initial Value	Setting Range	Description
251	Output phase failure protection selection	1	0	Without output phase loss protection
			1	With output phase loss protection

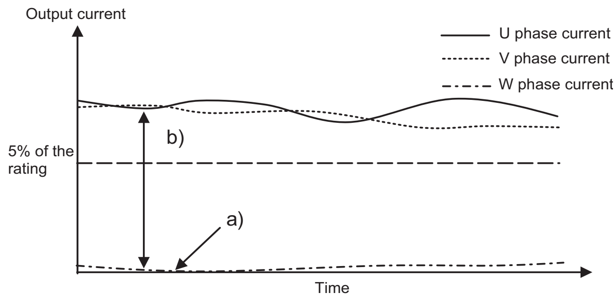
1) When the output phase loss protection activates properly

The output phase loss protection (E.LF) activates when

a) The average output current of the phase where lowest current flows is 5% or less than the rated inverter current

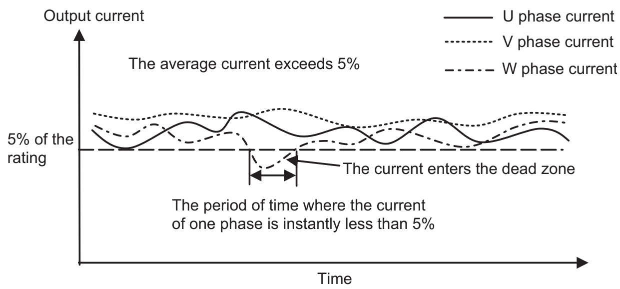
and

b) The difference between the average output current of other two phases and rated inverter current is 5% or more



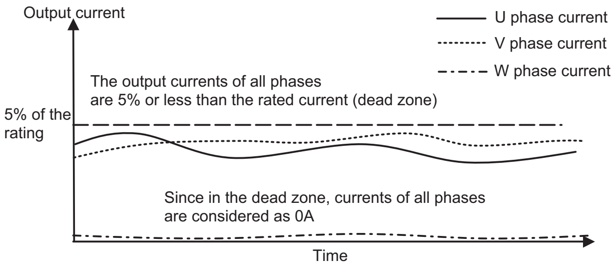
2) When the output phase loss protection malfunctions

When the motor capacity is smaller than the inverter capacity, the output current value is small as compared to the rated inverter current. At this time, if any of the phases enters the dead zone (assumed as 0A if within 5% of the rated inverter current value) due to noises, etc. when the output current flows more than 5% on average, the output phase loss protection (E.LF) may malfunction. To prevent this, set 0 in [*Pr. 251 Output phase loss protection selection*] and make output phase loss protection invalid.



3) When the output phase loss protection does not function

When the motor capacity is too small as compared to the inverter capacity, the output current becomes too small. At this time, when the average output current of all phases is 5% or less of the rated inverter current, the output phase loss protection (E.LF) does not function assuming that all phases is 0A even if one of the three phases is lost since all phases enter the dead zone (assumed as 0A if within 5% of the rated inverter current value).



When multiple motors are operated by a single inverter, output phase loss protection (E.LF) does not function.

The output phase loss protection (E.LF) functions when one phase is lost. This function is invalid if two phases or three phases are lost. Note that it may functions even if two phases are lost when an earth (ground) fault occurs. When an earth (ground) fault occurs in the lost phase, output phase loss protection (E.LF) may not function.

1.5.10 Inverter status and reset method at occurrence of fault (common)

Inverter Status	Fault Occurrence	Reset terminal Connected	Output Stop Terminal Connected
IGBT	Gate is shut OFF instantly.	Gate is shut OFF instantly.	Gate is shut OFF instantly.
Frequency meter display	Reset to 0Hz instantly	Reset to 0Hz instantly	Reset to 0Hz instantly
Operation panel	Fault code indication	Short terminals to erase the indication once. Keep RES signal ON to display	Value being monitored is reset to 0 instantly. Note that this depends on the data monitored.
Parameter unit display	Fault description display Frequency, current, et., at fault occurrence can be read in the monitor mode.	Short terminals to erase the indication once. Keep RES signal ON to display (flicker) the communication fault display screen. Frequency and current at fault occurrence are cleared.	Value being monitored is reset to 0 instantly. Note that this depends on the data monitored.
Fault output (relay output)	Excited instantly (terminals B-C open)	Drops instantly (terminals B-C closed)	No operation
RUN signal	Switched OFF instantly.	Switched OFF instantly.	Switched OFF instantly.
SU signal	Switched OFF instantly.	Switched OFF instantly.	Switched OFF instantly.
Reset method	Reset or switch the power OFF, then ON	Turn OFF RES signal	Turn OFF MRS signal

*1 If a fault has occurred, the IGBT gate is instantly shut off to stop the output. Hence, the inverter power may remain ON. If the power is switched OFF by using the MC etc., the inverter control power is lost and the fault signal cannot be output. To keep only the fault signal ON, keep the fault output contact (across terminals A-C) closed in the external circuit. The fault description is stored in the inverter and can be read later.

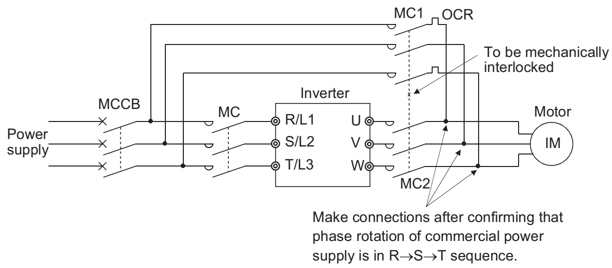
1.6 Precautions for use of the inverter

The FR series is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.
Before starting operation, always recheck the following items.

1.6.1 Instructions on the inverter output side (common)

Do not connect the power supply to the inverter output side terminal (U, V, W).

Application of power to the output terminals U, V, W of the inverter will damage the inverter module. Especially when there is a commercial power supply-inverter switchover circuit, use mechanically interlocked magnetic circuit (MC1, MC2) as shown on the right to prevent accidental application of commercial power to the inverter output side. To select the MC, refer to page 526 and use the ones which have sufficient capacities from the magnetic switch data. If the MC used have small capacities, this may be connected with the commercial power supply by arcs at current shut-off.
Also make connections so that the motor rotates in the same direction (phase rotation) in both the commercial power supply operation and inverter operation.



Bypass/inverter switch-over circuit

A short circuit or earth (ground) fault on the inverter output side may damage the inverter modules.

Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter modules.

1) Fully check the to-earth (ground) insulation and phase to phase insulation of the inverter output side before power-ON.
   Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance etc.
2) When 人-△ start is made during commercial powers supply operation or a pole-change motor is used, make up a circuit which provides mechanical interlock and sufficient timing so that the circuit is not shorted on the inverter output side (including arc short).

Do not install a power factor correction capacitor, surge suppressor or capacitor type filter on the inverter output side.

This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are connected, immediately remove them.

1.6.2 MC on the inverter power supply side (common)

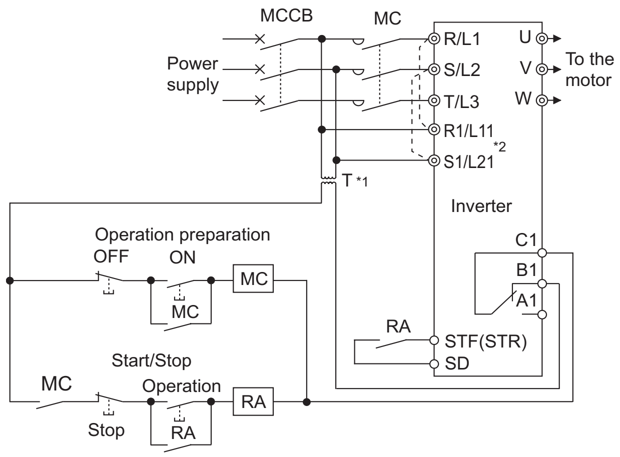
Do not use the inverter power supply side MC to start/stop the inverter.

On the inverter input side, it is recommended to provide an MC for the following purposes.

1) **To release the inverter from the power supply when the inverter protective function is activated or the drive becomes faulty (e.g. emergency stop operation)**
   When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, overheat and burnout of the discharging resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the discharging resistor and excess regenerative brake duty.
2) **To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure**
3) **To rest the inverter for an extended period of time**
   The control power supply for inverter is always running and consumes a little power. When stopping the inverter for an extended period of time, powering OFF the inverter will save power slightly.
4) **To separate the inverter from the power supply to ensure safety of maintenance/ inspection work**
   The inverter's input side MC is used for the above purpose, select class JEM1038-AC3 MC for the inverter input side current when making an emergency stop during normal operation.

Since repeated inrush current at powering ON will shorten the life of the converter circuit (switching life is 1 million times (about 500,000 times for the 200V class 37K or more), frequent starts/stops must be avoided.

As shown below, always use the start signal (turn ON/OFF terminals STF, STR-SD) to start/stop the inverter.



Inverter's Start/Stop Circuit Example

*1 When the power supply is 400V class, install a step-down transformer.

*2 For (A700)(F700), connect the power supply terminals R1/L11, S1/L21 of the control circuit to the input side of the MC to hold an fault signal when the inverter's protective circuit is activated. At this time, remove jumpers across terminals R/L1 and R1/L11, and across S/L2 and S1/L21. (Refer to page 36 for removal of the jumper)

1.6.3 Inverter power restart (common)

The inverter may trip if it is restarted while the motor is coasting.

When the motor is driven by the inverter, direct-on line starting is always made at a low frequency to suppress the motor starting current and the frequency is increased gradually. Hence, when the coasting motor is started by the inverter, the inverter attempts to draw the motor frequency into the starting frequency. However, if the load energy is large, a large current may flow to the inverter side due to the power returned from the motor to the inverter, causing an overcurrent shut-off (E.OC1 to E.OC3). Therefore, provide a coasting interlock circuit so that the inverter may only start the motor at a motor stop state. (Refer to page 559)

Since a similar phenomenon will take place when terminal RES is used during inverter operation, note the design of the circuit.(Refer to page 56)

However, the fast-response current limit function of the inverter makes it difficult to trip the inverter if the inverter is restarted during coasting.

Note that the function of automatic restart after instantaneous power failure may be used to restart the inverter while the motor is coasting.

1.6.4 Regenerative brake duty (A700) (E700) (D700)

Across P/+ and PR terminals, connect only an external regenerative brake discharge resistor.

Do not connect an electronic magnetic brake. When using an external, large thermal-capacity discharge resistor for regenerative brake in (A700), always remove the jumper (between terminal PR and PX) of the built-in discharge resistor for regenerative brake.

1.6.5 I/O signal (common)

Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.

The I/O devices may be damaged if a voltage higher than the value indicated on page 28 is applied to the inverter I/O signal circuits or reverse polarity is used. Especially check the wiring to prevent the frequency setting potentiometer from being connected incorrectly to short terminals 10 (E)-5.

1.6.6 Connection to a large-capacity power supply (common)

When connecting the inverter near a large-capacity power supply, insert a power factor improving reactor.

The inverter input current varies with the impedance of the power supply. (i.e. the power supply's power factor varies.) When the power supply capacity is 1000KVA or more for (A700)(F700) (500kVA or more for (E700)(D700)), insert a power factor improving reactor. (Refer to page 507 for details)

1.6.7 Earthing (grounding) (common)

Always earth (ground) the motor and inverter.

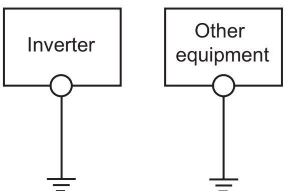
(1) Purpose of earthing (grounding)

Generally, an electrical apparatus has an earth (ground) terminal, which must be connected to the ground before use.
An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flows into the case. The purpose of earthing (grounding) the case of an electrical apparatus is to prevent operator from getting an electric shock from this leakage current when touching it.
To avoid the influence of external noises, this earthing (grounding) is important to audio equipment, sensors, computers and other apparatuses that handle low-level signals or operate very fast.

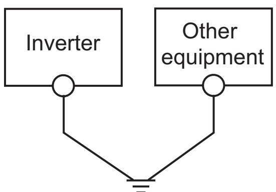
(2) Earthing (grounding) methods and earthing (grounding) work

As described previously, earthing (grounding) is roughly classified into an electrical shock prevention type and a noise-affected malfunction prevention type. Therefore, these two types should be discriminated clearly, and the following work must be done to prevent the leakage current having the inverter's high frequency components from entering the malfunction prevention type earthing (grounding):

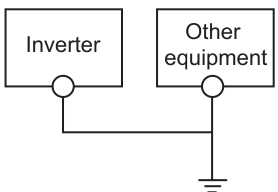
1) If possible, use (I) independent earthing (grounding) in figure below for the inverter. If independent earthing (grounding) is not available, use (II) joint earthing (grounding) in the figure below which the inverter is connected with the other equipment at an earthing (grounding) point. The (III) common earthing (grounding) as in the figure below, which inverter shares a common earth (ground) cable with the other equipment, must be avoided.
A leakage current including many high frequency components flows in the earth (ground) cables of the inverter and inverter-driven motor. Therefore, use the independent earthing (grounding) and separated the earthing (grounding) cable of the inverter from equipments sensitive to EMI.
In a high building, it may be effective to use the EMI prevention type earthing (grounding) connecting to an iron structure frame, and electric shock prevention type earthing (grounding) with the independent earthing (grounding) together.
2) This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code. (NEC section 250, IEC 536 class 1 and other applicable standards).
3) Use the thickest possible earth (ground) cable. The earth (ground) cable should be of not less than the size indicated in the table on the page 530.
4) The grounding point should be as near as possible to the inverter, and the ground wire length should be as short as possible.
5) Run the earth (ground) cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.



(I) Independent earthing (grounding).......Best



(II) Common earthing (grounding).......Good



(III) Common earthing (grounding).......Not allowed

1.6.8 Wiring (common)

After wiring, wire offcuts must not be left in the inverter.

Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.

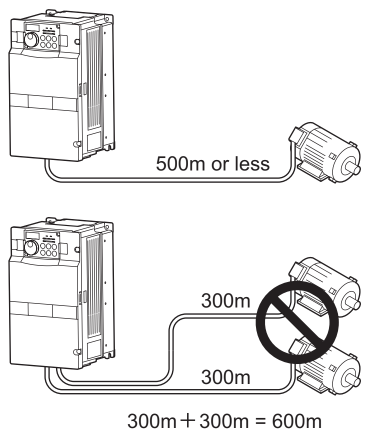
Use cables of the size to make a voltage drop 2% maximum.

If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
Refer to page 530 for the recommended wire sizes.

The overall wiring length should be 500m or less (within 100m during vector control)

Especially for long distance wiring, the fast-response current limit function may decrease or the equipment connected to the output side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length.
The overall wiring length for connection of a single motor or multiple motors should be within the value in the table on the right. (The wiring length should be 100m maximum for vector control.)
When driving a 400V class motor by the inverter, surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor. In this case, refer to page 504.

Overall wiring length (example: FR-A720-1.5K)



1) A700

[*Pr. 72 PWM Frequency Selection*] Setting (carrier frequency)	0.4K	0.75K	1.5K or more
2 (2kHz) or less	300m	500m	500m
3 to 15 (3kHz to 14.5kHz)	200m	300m	500m

2) F700

[*Pr. 72 PWM Frequency Selection*] Setting (carrier frequency)	0.75K	1.5K	2.2K or more
2 (2kHz) or less	300m	500m	500m
3 to 15 (3kHz to 14.5kHz)	200m	300m	500m

3) E700 D700

[*Pr. 72 PWM Frequency Selection*] Setting (carrier frequency)		0.1K	0.2K	0.4K	0.75K	1.5K	2.2K	3.7K or more
1(1kHz) or less	200V class	200m	200m	300m	500m	500m	500m	500m
	400V class	—	—	200m	200m	300m	500m	500m
2 to 15(2kHz to 14.5kHz)	200V class	30m	100m	200m	300m	500m	500m	500m
	400V class	—	—	30m	100m	200m	300m	500m

2 PARAMETER

2.1 Parameter list

2.1.1 FR-A700

For simple variable-speed operation of the inverter, the initial setting of the parameters may be used. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel (FR-DU07).

- ◎ indicates simple mode parameters. (initial setting is extended mode)
- The parameters marked with [shaded] in the table allow its setting to be changed during operation even if 0 (initial value) is set in [*Pr. 77 Parameter write selection*].

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Basic functions	◎ 0	Torque boost	0 to 30%	0.1%	6/4/3/2/1% *1	244
	◎ 1	Maximum frequency	0 to 120Hz	0.01Hz	120/60Hz *2	232
	◎ 2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	232
	◎ 3	Base frequency	0 to 400Hz	0.01Hz	60Hz	244
	◎ 4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	216, 395
	◎ 5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	216, 395
	◎ 6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	216, 396
	◎ 7	Acceleration time	0 to 3600/360s	0.1/0.01s	5/15s *3	234
	◎ 8	Deceleration time	0 to 3600/360s	0.1/0.01s	5/15s *3	234
	◎ 9	Electronic thermal O/L relay	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	379
DC injection brake	10	DC injection brake operation frequency	0 to 120Hz, 9999	0.01Hz	3Hz	325, 328
	11	DC injection brake operation time	0 to 10s, 8888	0.1s	0.5s	325, 328
	12	DC injection brake operation voltage	0 to 30%	0.1%	4/2/1% *4	328
—	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	232
—	14	Load pattern selection	0 to 5	1	0	244
JOG operation	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	215
	16	Jog acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	0.5s	215, 234
—	17	MRS input selection	0, 2, 4	1	0	56
—	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120/60Hz *2	232
—	19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	244
Acceleration/deceleration time	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	234
	21	Acceleration/deceleration time increments	0, 1	1	0	234

- Symbols in the table indicate parameters which function when an option is mounted.

AX ...... FR-A7AX, AY ....FR-A7AY, AR FR-A7AR,
AP ...... FR-A7AP, AL .....FR-A7AL, AZ FR-A7AZ,
NC ...... FR-A7NC, ND ....FR-A7ND, NL FR-A7NL,
NP ...... FR-A7NP, NS .....FR-A7NS, NF FR-A7NF

- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication.
- Symbols in the control mode-based correspondence table indicate the following;
  - ○: Usable parameter
  - ×: Unusable parameter
  - Δ: Parameters available only during position control set by parameter
- Symbols in the parameter copy, parameter clear, and all parameter clear columns indicate the following;
  - ○: Valid
  - ×: Invalid

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table							Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	Vector control			Real sensorless vector control				
							Speed control	Torque control	Position control	Speed control	Torque control			
0		00	80	0	○	×	×	×	×	×	×	○	○	○
1		01	81	0	○	○	○	○	○	○	○	○	○	○
2		02	82	0	○	○	○	○	×	○	○	○	○	○
3		03	83	0	○	×	×	×	×	×	×	○	○	○
4		04	84	0	○	○	○	○	Δ	○	○	○	○	○
5		05	85	0	○	○	○	○	Δ	○	○	○	○	○
6		06	86	0	○	○	○	○	Δ	○	○	○	○	○
7		07	87	0	○	○	○	○	Δ	○	○	○	○	○
8		08	88	0	○	○	○	○	Δ	○	○	○	○	○
9		09	89	0	○	○	○	○	○	○	○	○	○	○
10		0A	8A	0	○	○	○	○	×	○	○	○	○	○
11		0B	8B	0	○	○	○	○	×	○	○	○	○	○
12		0C	8C	0	○	○	×	×	×	×	×	○	○	○
13		0D	8D	0	○	○	○	○	×	○	○	○	○	○
14		0E	8E	0	○	×	×	×	×	×	×	○	○	○
15		0F	8F	0	○	○	○	○	×	○	○	○	○	○
16		10	90	0	○	○	○	○	×	○	○	○	○	○
17		11	91	0	○	○	○	○	○	○	○	○	○	○
18		12	92	0	○	○	×	×	×	×	×	○	○	○
19		13	93	0	○	×	×	×	×	×	×	○	○	○
20		14	94	0	○	○	○	○	Δ	○	○	○	○	○
21		15	95	0	○	○	○	○	Δ	○	○	○	○	○

2

PARAMETER

PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
Stall prevention	22	Stall prevention operation level (torque limit level)	0 to 400%	0.1%	150%	283, 335	22		16	96	0	○	○	○	×	○	○	×	○	○	○
	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	335	23		17	97	0	○	○	×	×	×	×	×	○	○	○
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	216	24		18	98	0	○	○	○	○	Δ	○	○	○	○	○
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	216	25		19	99	0	○	○	○	○	Δ	○	○	○	○	○
	26	Multi-speed setting (speed6)	0 to 400Hz, 9999	0.01Hz	9999	216	26		1A	9A	0	○	○	○	○	Δ	○	○	○	○	○
	27	Multi-speed setting (speed7)	0 to 400Hz, 9999	0.01Hz	9999	216	27		1B	9B	0	○	○	○	○	Δ	○	○	○	○	○
—	28	Multi-speed input compensation selection	0, 1	1	0	227	28		1C	9C	0	○	○	○	○	×	○	○	○	○	○
—	29	Acceleration/deceleration pattern selection	0 to 5	1	0	238	29		1D	9D	0	○	○	○	○	×	○	○	○	○	○
—	30	Regenerative function selection	0, 1, 2, 10, 11, 20, 21	1	0	331	30		1E	9E	0	○	○	○	○	○	○	○	○	○	○
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	233	31		1F	9F	0	○	○	○	○	×	○	○	○	○	○
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	233	32		20	A0	0	○	○	○	○	×	○	○	○	○	○
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	233	33		21	A1	0	○	○	○	○	×	○	○	○	○	○
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	233	34		22	A2	0	○	○	○	○	×	○	○	○	○	○
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	233	35		23	A3	0	○	○	○	○	×	○	○	○	○	○
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	233	36		24	A4	0	○	○	○	○	×	○	○	○	○	○
—	37	Speed display	0, 1 to 9998	1	0	343	37		25	A5	0	○	○	○	○	○	○	○	○	○	○
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	70	41		29	A9	0	○	○	○	×	×	○	×	○	○	○
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	70	42		2A	AA	0	○	○	○	○	○	○	○	○	○	○
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	70	43		2B	AB	0	○	○	○	○	○	○	○	○	○	○
Second functions	44	Second acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	5s	234	44		2C	AC	0	○	○	○	○	Δ	○	○	○	○	○
	45	Second deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	234	45		2D	AD	0	○	○	○	○	Δ	○	○	○	○	○
	46	Second torque boost	0 to 30%, 9999	0.1%	9999	244	46		2E	AE	0	○	×	×	×	×	×	×	○	○	○
	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	244	47		2F	AF	0	○	×	×	×	×	×	×	○	○	○
	48	Second stall prevention operation current	0 to 220%	0.1%	150%	335, 396	48		30	B0	0	○	○	×	×	×	×	×	○	○	○
	49	Second stall prevention operation frequency	0 to 400Hz, 9999	0.01Hz	0Hz	335	49		31	B1	0	○	○	×	×	×	×	×	○	○	○
	50	Second output frequency detection	0 to 400Hz	0.01Hz	30Hz	70	50		32	B2	0	○	○	○	○	○	○	○	○	○	○
	51	Second electronic thermal O/L relay	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	379	51		33	B3	0	○	○	○	○	○	○	○	○	○	○
Monitor functions	52	DU/PU main display data selection	0, 5 to 14, 17 to 20, 22 to 25, 32 to 35, 50 to 57, 100	1	0	345	52		34	B4	0	○	○	○	○	○	○	○	○	○	○
	54	FM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53	1	1	345	54		36	B6	0	○	○	○	○	○	○	○	○	○	○
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	352	55		37	B7	0	○	○	○	○	○	○	○	○	○	○
	56	Current monitoring reference	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	352	56		38	B8	0	○	○	○	○	○	○	○	○	○	○
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999/ 0, 0.1 to 30s, 9999 *2	0.1s	9999	367, 416	57		39	B9	0	○	○	○	○	×	○	○	○	○	○
	58	Restart cushion time	0 to 60s	0.1s	1s	367, 416	58		3A	BA	0	○	○	×	×	×	×	×	○	○	○
—	59	Remote function selection	0, 1, 2, 3	1	0	226	59		3B	BB	0	○	○	○	○	×	○	○	○	○	○
—	60	Energy saving control selection	0, 4	1	0	250	60		3C	BC	0	○	×	×	×	×	×	×	○	○	○
Automatic acceleration/deceleration	61	Reference current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	241, 249	61		3D	BD	0	○	○	○	×	×	○	×	○	○	○
	62	Reference value at acceleration	0 to 220%, 9999	0.1%	9999	241	62		3E	BE	0	○	○	○	×	×	○	×	○	○	○
	63	Reference value at deceleration	0 to 220%, 9999	0.1%	9999	241	63		3F	BF	0	○	○	○	×	×	○	×	○	○	○
	64	Starting frequency for elevator mode	0 to 10Hz, 9999	0.01Hz	9999	249	64		40	C0	0	○	×	×	×	×	×	×	○	○	○
—	65	Retry selection	0 to 5	1	0	376	65		41	C1	0	○	○	○	○	×	○	○	○	○	○
—	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	335	66		42	C2	0	○	○	×	×	×	×	×	○	○	○
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	376	67		43	C3	0	○	○	○	○	×	○	○	○	○	○
	68	Retry waiting time	0 to 10s	0.1s	1s	376	68		44	C4	0	○	○	○	○	×	○	○	○	○	○
	69	Retry count display erase	0	1	0	376	69		45	C5	0	○	○	○	○	×	○	○	○	○	○
—	70	Special regenerative brake duty	0 to 30%/0 to 10% *2	0.1%	0%	331	70		46	C6	0	○	○	○	○	○	○	○	○	○	○

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PARAMETER

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
—	71	Applied motor	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54	1	0	266	71		47	C7	0	○	○	○	○	○	○	○	○	○	○
—	72	PWM frequency selection	0 to 15/0 to 6, 25 *2	1	2	430	72		48	C8	0	○	○	○	○	○	○	○	○	○	○
—	73	Analog input selection	0 to 7, 10 to 17	1	1	217	73		49	C9	0	○	○	○	○	×	○	○	○	×	○
—	74	Input filter time constant	0 to 8	1	1	217	74		4A	CA	0	○	○	○	○	×	○	○	○	○	○
—	75	Reset selection/disconnected PU detection/ PU stop selection	0 to 3, 14 to 17	1	14	382	75		4B	CB	0	○	○	○	○	○	○	○	○	×	×
—	76	Fault code output selection	0, 1, 2	1	0	378	76		4C	CC	0	○	○	○	○	○	○	○	○	○	○
	77	Parameter write selection	0, 1, 2	1	0	384	77		4D *6	CD *6	0	○	○	○	○	○	○	○	○	○	○
	78	Reverse rotation prevention selection	0, 1, 2	1	0	385	78		4E	CE	0	○	○	○	○	○	○	○	○	○	○
	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	209, 434	79		4F *6	CF *6	0	○	○	○	○	○	○	○	○	○	○
Motor constants	80	Motor capacity	0.4 to 55kW, 9999/ 0 to 3600kW, 9999 *2	0.01/0.1kW *2	9999	252, 258, 261, 263	80		50	D0	0	×	○	○	○	○	○	○	○	○	○
	81	Number of motor poles	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 9999	1	9999	252, 258, 261, 263	81		51	D1	0	×	○	○	○	○	○	○	○	○	○
	82	Motor excitation current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	268	82		52	D2	0	×	○	○	○	○	○	○	○	×	○
	83	Rated motor voltage	0 to 1000V	0.1V	200/400V *5	268	83		53	D3	0	×	○	○	○	○	○	○	○	○	○
	84	Rated motor frequency	10 to 120Hz	0.01Hz	60Hz	268	84		54	D4	0	×	○	○	○	○	○	○	○	○	○
	89	Speed control gain (Advanced magnetic flux vector)	0 to 200%, 9999	0.1%	9999	258	89		59	D9	0	×	○	×	×	×	×	×	○	×	○
	90	Motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	268	90		5A	DA	0	×	○	○	○	○	○	○	○	×	○
	91	Motor constant (R2)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	268	91		5B	DB	0	×	○	○	○	○	○	○	○	×	○
	92	Motor constant (L1)	0 to 50Ω (0 to 1000mH), 9999/ 0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω (0.1mH)/ 0.01mΩ (0.01mH) *2	9999	268	92		5C	DC	0	×	○	○	○	○	○	○	○	×	○
	93	Motor constant (L2)	0 to 50Ω (0 to 1000mH), 9999/ 0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω (0.1mH)/ 0.01mΩ (0.01mH) *2	9999	268	93		5D	DD	0	×	○	○	○	○	○	○	○	×	○
	94	Motor constant (X)	0 to 500Ω (0 to 100%), 9999/ 0100Ω (0 to 100%), 9999 *2	0.01Ω (0.1%)/ 0.01Ω (0.01%) *2	9999	268	94		5E	DE	0	×	○	○	○	○	○	○	○	×	○
	95	Online auto tuning selection	0 to 2	1	0	276	95		5F	DF	0	×	○	○	○	○	○	○	○	○	○
	96	Auto tuning setting/status	0, 1, 101	1	0	268	96		60	E0	0	×	○	○	○	○	○	○	○	×	○
Adjustable 5 points V/F	100	V/F1(first frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	100		00	80	1	○	×	×	×	×	×	×	○	○	○
	101	V/F1(first frequency voltage)	0 to 1000V	0.1V	0V	248	101		01	81	1	○	×	×	×	×	×	×	○	○	○
	102	V/F2(second frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	102		02	82	1	○	×	×	×	×	×	×	○	○	○
	103	V/F2(second frequency voltage)	0 to 1000V	0.1V	0V	248	103		03	83	1	○	×	×	×	×	×	×	○	○	○
	104	V/F3(third frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	104		04	84	1	○	×	×	×	×	×	×	○	○	○
	105	V/F3(third frequency voltage)	0 to 1000V	0.1V	0V	248	105		05	85	1	○	×	×	×	×	×	×	○	○	○
	106	V/F4(fourth frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	106		06	86	1	○	×	×	×	×	×	×	○	○	○
	107	V/F4(fourth frequency voltage)	0 to 1000V	0.1V	0V	248	107		07	87	1	○	×	×	×	×	×	×	○	○	○
	108	V/F5(fifth frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	108		08	88	1	○	×	×	×	×	×	×	○	○	○
	109	V/F5(fifth frequency voltage)	0 to 1000V	0.1V	0V	248	109		09	89	1	○	×	×	×	×	×	×	○	○	○
Third function	110	Third acceleration/deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	234	110		0A	8A	1	○	○	○	○	Δ	○	○	○	○	○
	111	Third deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	234	111		0B	8B	1	○	○	○	○	Δ	○	○	○	○	○
	112	Third torque boost	0 to 30%, 9999	0.1%	9999	244	112		0C	8C	1	○	×	×	×	×	×	×	○	○	○
	113	Third V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	244	113		0D	8D	1	○	×	×	×	×	×	×	○	○	○
	114	Third stall prevention operation current	0 to 220%	0.1%	150%	335	114		0E	8E	1	○	○	×	×	×	×	×	○	○	○
	115	Third stall prevention operation frequency	0 to 400Hz	0.01Hz	0	335	115		0F	8F	1	○	○	×	×	×	×	×	○	○	○
	116	Third output frequency detection	0 to 400Hz	0.01Hz	60Hz	70	116		10	90	1	○	○	○	○	○	○	○	○	○	○
PU connector communication	117	PU communication station number	0 to 31	1	0	441	117		11	91	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	118	PU communication speed	48, 96, 192, 384	1	192	441	118		12	92	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	119	PU communication stop bit length	0, 1, 10, 11	1	1	441	119		13	93	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	120	PU communication parity check	0, 1, 2	1	2	441	120		14	94	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	121	Number of PU communication retries	0 to 10, 9999	1	1	441	121		15	95	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	9999	441	122		16	96	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	441	123		17	97	1	○	○	○	○	○	○	○	○	○ *8	○ *8
	124	PU communication CR/LF selection	0, 1, 2	1	1	441	124		18	98	1	○	○	○	○	○	○	○	○	○ *8	○ *8
—	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	125		19	99	1	○	○	○	○	×	○	○	○	×	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
—	◎ 126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217		126		1A	9A	1	○	○	○	○	×	○	○	○	×	○
PID	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	402		127		1B	9B	1	○	○	○	×	×	○	×	○	○	○
PID	128	PID action selection	10, 11, 20, 21, 50, 51, 60, 61	1	10	402		128		1C	9C	1	○	○	○	×	×	○	×	○	○	○
PID	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	402		129		1D	9D	1	○	○	○	×	×	○	×	○	○	○
PID	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	402		130		1E	9E	1	○	○	○	×	×	○	×	○	○	○
PID	131	PID upper limit	0 to 100%, 9999	0.1%	9999	402		131		1F	9F	1	○	○	○	×	×	○	×	○	○	○
PID	132	PID lower limit	0 to 100%, 9999	0.1%	9999	402		132		20	A0	1	○	○	○	×	×	○	×	○	○	○
PID	133	PID action set point	0 to 100%, 9999	0.01%	9999	402		133		21	A1	1	○	○	○	×	×	○	×	○	○	○
PID	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	402		134		22	A2	1	○	○	○	×	×	○	×	○	○	○
Electronic bypass	135	Electronic bypass sequence selection	0, 1	1	0	416		135		23	A3	1	○	○	○	×	×	○	×	○	○	○
Electronic bypass	136	MC switchover interlock time	0 to 100s	0.1s	1s	416		136		24	A4	1	○	○	○	×	×	○	×	○	○	○
Electronic bypass	137	Start waiting time	0 to 100s	0.1s	0.5s	416		137		25	A5	1	○	○	○	×	×	○	×	○	○	○
Electronic bypass	138	Bypass selection at a fault	0, 1	1	0	416		138		26	A6	1	○	○	○	×	×	○	×	○	○	○
Electronic bypass	139	Automatic switchover frequency from inverter to bypass operation	0 to 60Hz, 9999	0.01Hz	9999	416		139		27	A7	1	○	○	○	×	×	○	×	○	○	○
Backlash measures	140	Backlash acceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	238		140		28	A8	1	○	○	○	○	×	○	○	○	○	○
Backlash measures	141	Backlash acceleration stopping time	0 to 360s	0.1s	0.5s	238		141		29	A9	1	○	○	○	○	×	○	○	○	○	○
Backlash measures	142	Backlash deceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	238		142		2A	AA	1	○	○	○	○	×	○	○	○	○	○
Backlash measures	143	Backlash deceleration stopping time	0 to 360s	0.1s	0.5s	238		143		2B	AB	1	○	○	○	○	×	○	○	○	○	○
—	144	Speed setting switchover	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	343, 392		144		2C	AC	1	○	○	○	○	○	○	○	○	○	○
PU	145	PU display language selection	0 to 7	1	0	389		145		2D	AD	1	○	○	○	○	○	○	○	○	×	×
Current detection	148	Stall prevention level at 0V input	0 to 220%	0.1%	150%	335		148		30	B0	1	○	○	×	×	×	×	×	○	○	○
Current detection	149	Stall prevention level at 10V input	0 to 220%	0.1%	200%	335		149		31	B1	1	○	○	×	×	×	×	×	○	○	○
Current detection	150	Output current detection level	0 to 220%	0.1%	150%	72		150		32	B2	1	○	○	○	○	○	○	○	○	○	○
Current detection	151	Output current detection signal delay time	0 to 10s	0.1s	0s	72		151		33	B3	1	○	○	○	○	○	○	○	○	○	○
Current detection	152	Zero current detection level	0 to 220%	0.1%	5%	72		152		34	B4	1	○	○	○	○	○	○	○	○	○	○
Current detection	153	Zero current detection time	0 to 1s	0.01s	0.5s	72		153		35	B5	1	○	○	○	○	○	○	○	○	○	○
—	154	Voltage reduction selection during stall prevention operation	0, 1	1	1	335		154		36	B6	1	○	○	×	×	×	×	×	○	○	○
—	155	RT signal function validity condition selection	0, 10	1	0	54		155		37	B7	1	○	○	○	×	×	○	×	○	○	○
—	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	335		156		38	B8	1	○	○	×	×	×	×	×	○	○	○
—	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	335		157		39	B9	1	○	○	○	○	○	○	○	○	○	○
—	158	AM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53	1	1	345		158		3A	BA	1	○	○	○	○	○	○	○	○	○	○
—	159	Automatic switchover frequency range from bypass to inverter operation	0 to 10Hz, 9999	0.01Hz	9999	416		159		3B	BB	1	○	○	○	×	×	○	×	○	○	○
—	◎ 160	User group read selection	0, 1, 9999	1	0	386		160		00	80	2	○	○	○	○	○	○	○	○	○	○
—	161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	214, 389		161		01	81	2	○	○	○	○	○	○	○	○	×	○
Automatic restart	162	Automatic restart after instantaneous power failure selection	0, 1, 2, 10, 11, 12	1	0	367		162		02	82	2	○	○	○	○	×	○	○	○	○	○
Automatic restart	163	First cushion time for restart	0 to 20s	0.1s	0s	367		163		03	83	2	○	○	×	×	×	×	×	○	○	○
Automatic restart	164	First cushion voltage for restart	0 to 100%	0.1%	0%	367		164		04	84	2	○	○	×	×	×	×	×	○	○	○
Automatic restart	165	Stall prevention operation level for restart	0 to 220%	0.1%	150%	367		165		05	85	2	○	○	×	×	×	×	×	○	○	○
Current detection	166	Output current detection signal retention time	0 to 10s, 9999	0.1s	0.1s	72		166		06	86	2	○	○	○	○	○	○	○	○	○	○
Current detection	167	Output current detection operation selection	0, 1	1	0	72		167		07	87	2	○	○	○	○	○	○	○	○	○	○
—	168	Parameter for manufacturer setting. Do not set.						168	Parameter for manufacturer setting. Do not set.													
—	169							169														
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999	1	9999	345		170		0A	8A	2	○	○	○	○	○	○	○	○	×	○
Cumulative monitor clear	171	Operation hour meter clear	0, 9999	1	9999	345		171		0B	8B	2	○	○	○	○	○	○	○	×	×	×

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
User group	172	User group registered display/batch clear	9999, (0 to 16)	1	0	386		172		0C	8C	2	○	○	○	○	○	○	○	○	×	×
	173	User group registration	0 to 999, 9999	1	9999	386		173		0D	8D	2	○	○	○	○	○	○	○	×	×	×
	174	User group clear	0 to 999, 9999	1	9999	386		174		0E	8E	2	○	○	○	○	○	○	○	×	×	×
Input terminal function assignment	178	STF terminal function selection	0 to 20, 22 to 28, 42 to 44, 60, 62, 64 to 71, 9999	1	60	37		178		12	92	2	○	○	○	○	○	○	○	○	×	○
	179	STR terminal function selection	0 to 20, 22 to 28, 42 to 44, 61, 62, 64 to 71, 9999	1	61	37		179		13	93	2	○	○	○	○	○	○	○	○	×	○
	180	RL terminal function selection	0 to 20, 22 to 28, 42 to 44, 62, 64 to 71, 9999	1	0	37		180		14	94	2	○	○	○	○	○	○	○	○	×	○
	181	RM terminal function selection		1	1	37		181		15	95	2	○	○	○	○	○	○	○	○	×	○
	182	RH terminal function selection		1	2	37		182		16	96	2	○	○	○	○	○	○	○	○	×	○
	183	RT terminal function selection		1	3	37		183		17	97	2	○	○	○	○	○	○	○	○	×	○
	184	AU terminal function selection	0 to 20, 22 to 28, 42 to 44, 62 to 71, 9999	1	4	37		184		18	98	2	○	○	○	○	○	○	○	○	×	○
	185	JOG terminal function selection	0 to 20, 22 to 28, 42 to 44, 62, 64 to 71, 9999	1	5	37		185		19	99	2	○	○	○	○	○	○	○	○	×	○
	186	CS terminal function selection		1	6	37		186		1A	9A	2	○	○	○	○	○	○	○	○	×	○
	187	MRS terminal function selection		1	24	37		187		1B	9B	2	○	○	○	○	○	○	○	○	×	○
	188	STOP terminal function selection		1	25	37		188		1C	9C	2	○	○	○	○	○	○	○	○	×	○
	189	RES terminal function selection		1	62	37		189		1D	9D	2	○	○	○	○	○	○	○	○	×	○
Output terminal function assignment	190	RUN terminal function selection	0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84, 85, 90 to 99, 100 to 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184, 185, 190 to 199, 9999	1	0	61		190		1E	9E	2	○	○	○	○	○	○	○	○	×	○
	191	SU terminal function selection		1	1	61		191		1F	9F	2	○	○	○	○	○	○	○	○	×	○
	192	IPF terminal function selection		1	2	61		192		20	A0	2	○	○	○	○	○	○	○	○	×	○
	193	OL terminal function selection		1	3	61		193		21	A1	2	○	○	○	○	○	○	○	○	×	○
	194	FU terminal function selection		1	4	61		194		22	A2	2	○	○	○	○	○	○	○	○	×	○
	195	ABC1 terminal function selection	0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84, 85, 90, 91, 94 to 99,100 to 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184, 185, 190, 191, 194 to 199, 9999	1	99	61		195		23	A3	2	○	○	○	○	○	○	○	○	×	○
	196	ABC2 terminal function selection		1	9999	61		196		24	A4	2	○	○	○	○	○	○	○	○	×	○
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	216		232		28	A8	2	○	○	○	○	Δ	○	○	○	○	○
	233	Multi-speed setting (speed 9)				216		233		29	A9	2	○	○	○	○	Δ	○	○	○	○	○
	234	Multi-speed setting (speed 10)				216		234		2A	AA	2	○	○	○	○	Δ	○	○	○	○	○
	235	Multi-speed setting (speed 11)				216		235		2B	AB	2	○	○	○	○	Δ	○	○	○	○	○
	236	Multi-speed setting (speed 12)				216		236		2C	AC	2	○	○	○	○	Δ	○	○	○	○	○
	237	Multi-speed setting (speed 13)				216		237		2D	AD	2	○	○	○	○	Δ	○	○	○	○	○
	238	Multi-speed setting (speed 14)				216		238		2E	AE	2	○	○	○	○	Δ	○	○	○	○	○
	239	Multi-speed setting (speed 15)				216		239		2F	AF	2	○	○	○	○	Δ	○	○	○	○	○
—	240	Soft-PWM operation selection	0, 1	1	1	430		240		30	B0	2	○	○	○	○	○	○	○	○	○	○
—	241	Analog input display unit switchover	0, 1	1	0	217, 320		241		31	B1	2	○	○	○	○	○	○	○	○	○	○
—	242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	0.1%	100%	217		242		32	B2	2	○	○	○	○	×	○	○	○	○	○
—	243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	0.1%	75%	217		243		33	B3	2	○	○	○	○	×	○	○	○	○	○
—	244	Cooling fan operation selection	0, 1	1	1	431		244		34	B4	2	○	○	○	○	○	○	○	○	○	○
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	391		245		35	B5	2	○	×	×	×	×	×	×	○	○	○
	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	391		246		36	B6	2	○	×	×	×	×	×	×	○	○	○
	247	Constant-power range slip compensation selection	0, 9999	1	9999	391		247		37	B7	2	○	×	×	×	×	×	×	○	○	○
—	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	330		250		3A	BA	2	○	○	○	○	×	○	○	○	○	○
—	251	Output phase loss protection selection	0, 1	1	1	380		251		3B	BB	2	○	○	○	○	○	○	○	○	○	○

PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Frequency compensation function	252	Override bias	0 to 200%	0.1%	50%	217
Frequency compensation function	253	Override gain	0 to 200%	0.1%	150%	217
Life diagnosis	255	Life alarm status display	(0 to 15)	1	0	364
Life diagnosis	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	364
Life diagnosis	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	364
Life diagnosis	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	364
Life diagnosis	259	Main circuit capacitor life measuring	0, 1	1	0	364
Power failure stop	261	Power failure stop selection	0, 1, 2, 11, 12	1	0	373
Power failure stop	262	Subtracted frequency at deceleration start	0 to 20Hz	0.01Hz	3Hz	373
Power failure stop	263	Subtraction starting frequency	0 to 120Hz, 9999	0.01Hz	60Hz	373
Power failure stop	264	Power-failure deceleration time 1	0 to 3600/360s	0.1/0.01s	5s	373
Power failure stop	265	Power-failure deceleration time 2	0 to 3600/360s, 9999	0.1/0.01s	9999	373
Power failure stop	266	Power failure deceleration time switchover frequency	0 to 400Hz	0.01Hz	60Hz	373
—	267	Terminal 4 input selection	0, 1, 2	1	0	217
—	268	Monitor decimal digits selection	0, 1, 9999	1	9999	345
—	269	Parameter for manufacturer setting. Do not set.				
—	270	Stop-on contact/load torque high-speed frequency control selection	0, 1, 2, 3	1	0	395, 396
Load torque high speed frequency control	271	High-speed setting maximum current	0 to 220%	0.1%	50%	395
Load torque high speed frequency control	272	Middle-speed setting minimum current	0 to 220%	0.1%	100%	395
Load torque high speed frequency control	273	Current averaging range	0 to 400Hz, 9999	0.01Hz	9999	395
Load torque high speed frequency control	274	Current averaging filter time constant	1 to 4000	1	16	395
Stop-on-contact control	275	Stop-on contact excitation current low-speed multiplying factor	0 to 1000%, 9999	0.1%	9999	396
Stop-on-contact control	276	PWM carrier frequency at stop-on contact	0 to 9, 9999/0 to 4, 9999 *2	1	9999	396
Brake sequence	278	Brake opening frequency	0 to 30Hz	0.01Hz	3Hz	399
Brake sequence	279	Brake opening current	0 to 220%	0.1%	130%	399
Brake sequence	280	Brake opening current detection time	0 to 2s	0.1s	0.3s	399
Brake sequence	281	Brake operation time at a start	0 to 5s	0.1s	0.3s	399
Brake sequence	282	Brake operation frequency	0 to 30Hz	0.01Hz	6Hz	399
Brake sequence	283	Brake operation time at stop	0 to 5s	0.1s	0.3s	399
Brake sequence	284	Deceleration detection function selection	0, 1	1	0	399
Brake sequence	285	Overspeed detection frequency (Excessive speed deviation detection frequency)	0 to 30Hz, 9999	0.01Hz	9999	294, 392, 399
Droop control	286	Droop gain	0 to 100%	0.1%	0%	394
Droop control	287	Droop filter time constant	0 to 1s	0.01s	0.3s	394
Droop control	288	Droop function activation selection	0, 1, 2, 10, 11	1	0	394
—	291	Pulse train I/O selection	0, 1, 10, 11, 20, 21, 100	1	0	228, 352
—	292	Automatic acceleration/deceleration	0, 1, 3, 5 to 8, 11	1	0	241, 249, 399
—	293	Acceleration/deceleration separate selection	0 to 2	1	0	241
—	294	UV avoidance voltage gain	0 to 200%	0.1%	100%	373
—	299	Rotation direction detection selection at restarting	0, 1, 9999	1	0	367

[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
252		3C	BC	2	○	○	○	○	×	○	○	○	○	○
253		3D	BD	2	○	○	○	○	×	○	○	○	○	○
255		3F	BF	2	○	○	○	○	○	○	○	×	×	×
256		40	C0	2	○	○	○	○	○	○	○	×	×	×
257		41	C1	2	○	○	○	○	○	○	○	×	×	×
258		42	C2	2	○	○	○	○	○	○	○	×	×	×
259		43	C3	2	○	○	○	○	○	○	○	○	○	○
261		45	C5	2	○	○	○	○	×	○	○	○	○	○
262		46	C6	2	○	○	○	○	×	○	○	○	○	○
263		47	C7	2	○	○	○	○	×	○	○	○	○	○
264		48	C8	2	○	○	○	○	×	○	○	○	○	○
265		49	C9	2	○	○	○	○	×	○	○	○	○	○
266		4A	CA	2	○	○	○	○	×	○	○	○	○	○
267		4B	CB	2	○	○	○	○	○	○	○	○	×	○
268		4C	CC	2	○	○	○	○	○	○	○	○	○	○
269	Parameter for manufacturer setting. Do not set.													
270		4E	CE	2	○	○	○	×	×	○	×	○	○	○
271		4F	CF	2	○	○	○	×	×	○	×	○	○	○
272		50	D0	2	○	○	○	×	×	○	×	○	○	○
273		51	D1	2	○	○	○	×	×	○	×	○	○	○
274		52	D2	2	○	○	○	×	×	○	×	○	○	○
275		53	D3	2	×	○	×	×	×	×	×	○	○	○
276		54	D4	2	×	○	×	×	×	×	×	○	○	○
278		56	D6	2	×	○	○	×	×	○	×	○	○	○
279		57	D7	2	×	○	○	×	×	○	×	○	○	○
280		58	D8	2	×	○	○	×	×	○	×	○	○	○
281		59	D9	2	×	○	○	×	×	○	×	○	○	○
282		5A	DA	2	×	○	○	×	×	○	×	○	○	○
283		5B	DB	2	×	○	○	×	×	○	×	○	○	○
284		5C	DC	2	○	○	○	×	×	×	×	○	○	○
285		5D	DD	2	○	○	○	×	×	○	×	○	○	○
286		5E	DE	2	×	○	○	×	×	○	×	○	○	○
287		5F	DF	2	×	○	○	×	×	○	×	○	○	○
288		60	E0	2	×	×	○	×	×	○	×	○	○	○
291		63	E3	2	○	○	○	○	×	○	○	○	×	○
292		64	E4	2	○	○	○	×	×	○	×	○	○	○
293		65	E5	2	○	○	○	×	×	○	×	○	○	○
294		66	E6	2	○	○	○	○	×	○	○	○	○	○
299		6B	EB	2	○	○	×	×	×	○	×	○	○	○

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PARAMETER

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
16 bits digital input	300	BCD input bias	0 to 400Hz	0.01Hz	0Hz	229
	301	BCD input gain	0 to 400Hz, 9999	0.01Hz	60Hz	229
	302	BIN input bias	0 to 400Hz	0.01Hz	0Hz	229
	303	BIN input gain	0 to 400Hz, 9999	0.01Hz	60Hz	229
	304	Digital input and analog input compensation enable/disable selection	0 to 4, 10 to 14, 9999	1	9999	229, 301
	305	Read timing operation selection	0, 1, 10	1	0	229, 301
Extension analog output	306	Analog output signal selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53	1	2	345
	307	Setting for zero analog output	0 to 100%	0.1%	0%	357
	308	Setting for maximum analog output	0 to 100%	0.1%	100%	357
	309	Analog output signal voltage/current switchover	0, 1, 10, 11	1	0	357
	310	Analog meter voltage output selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53	1	2	345
	311	Setting for zero analog meter voltage output	0 to 100%	0.1%	0%	357
	312	Setting for maximum analog meter voltage output	0 to 100%	0.1%	100%	357
Digital output	313	DO0 output selection	0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84 to 99, 100 to 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184 to 199, 9999	1	9999	61
	314	DO1 output selection		1	9999	61
	315	DO2 output selection		1	9999	61
	316	DO3 output selection		1	9999	61
	317	DO4 output selection		1	9999	61
	318	DO5 output selection		1	9999	61
	319	DO6 output selection		1	9999	61
Relay output	320	RA1 output selection	0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84 to 91, 94 to 99, 9999	1	0	61
	321	RA2 output selection		1	1	61
	322	RA3 output selection		1	2	61
Calibration	323	AM0 0V adjustment	900 to 1100%	1	1000%	357
	324	AM1 0mA adjustment	900 to 1100%	1	1000%	357
—	329	Digital input unit selection	0, 1, 2, 3	1	1	229
RS-485 communication	331	RS-485 communication station number	0 to 31 (0 to 247)	1	0	441, 459
	332	RS-485 communication speed	3, 6, 12, 24, 48, 96, 192, 384	1	96	441, 459
	333	RS-485 communication stop bit length	0, 1, 10, 11	1	1	441
	334	RS-485 communication parity check selection	0, 1, 2	1	2	441, 459
	335	RS-485 communication retry count	0 to 10, 9999	1	1	441
	336	RS-485 communication check time interval	0 to 999.8s, 9999	0.1s	0s	441
	337	RS-485 communication waiting time setting	0 to 150ms, 9999	1	9999	441
	338	Communication operation command source	0, 1	1	0	436
	339	Communication speed command source	0, 1, 2	1	0	436
	340	Communication startup mode selection	0, 1, 2, 10, 12	1	0	434
	341	RS-485 communication CR/LF selection	0, 1, 2	1	1	441
	342	Communication EEPROM write selection	0, 1	1	0	443
	343	Communication error count	—	1	0	459
Device Net communication	345	DeviceNet address	0 to 4095	1	63	—
	346	DeviceNet baud rate	0 to 4095	1	132	—
Communication	349	Communication reset selection	0, 1	1	0	—

PARAMETER

[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
300	AX	00	80	3	O	O	O	O	×	O	O	O	O	O
301	AX	01	81	3	O	O	O	O	×	O	O	O	O	O
302	AX	02	82	3	O	O	O	O	×	O	O	O	O	O
303	AX	03	83	3	O	O	O	O	×	O	O	O	O	O
304	AX	04	84	3	O	O	O	O	×	O	O	O	O	O
305	AX	05	85	3	O	O	O	O	×	O	O	O	O	O
306	AY	06	86	3	O	O	O	O	O	O	O	O	O	O
307	AY	07	87	3	O	O	O	O	O	O	O	O	O	O
308	AY	08	88	3	O	O	O	O	O	O	O	O	O	O
309	AY	09	89	3	O	O	O	O	O	O	O	O	O	O
310	AY	0A	8A	3	O	O	O	O	O	O	O	O	O	O
311	AY	0B	8B	3	O	O	O	O	O	O	O	O	O	O
312	AY	0C	8C	3	O	O	O	O	O	O	O	O	O	O
313	AY NC	0D	8D	3	O	O	O	O	O	O	O	O	O	O
314	AY NC	0E	8E	3	O	O	O	O	O	O	O	O	O	O
315	AY NC	0F	8F	3	O	O	O	O	O	O	O	O	O	O
316	AY	10	90	3	O	O	O	O	O	O	O	O	O	O
317	AY	11	91	3	O	O	O	O	O	O	O	O	O	O
318	AY	12	92	3	O	O	O	O	O	O	O	O	O	O
319	AY	13	93	3	O	O	O	O	O	O	O	O	O	O
320	AR	14	94	3	O	O	O	O	O	O	O	O	O	O
321	AR	15	95	3	O	O	O	O	O	O	O	O	O	O
322	AR	16	96	3	O	O	O	O	O	O	O	O	O	O
323	AY	17	97	3	O	O	O	O	O	O	O	O	×	O
324	AY	18	98	3	O	O	O	O	O	O	O	O	×	O
329	AX	1D	9D	3	O	O	O	O	×	O	O	O	×	O
331		1F	9F	3	O	O	O	O	O	O	O	O	O *8	O *8
332		20	A0	3	O	O	O	O	O	O	O	O	O *8	O *8
333		21	A1	3	O	O	O	O	O	O	O	O	O *8	O *8
334		22	A2	3	O	O	O	O	O	O	O	O	O *8	O *8
335		23	A3	3	O	O	O	O	O	O	O	O	O *8	O *8
336		24	A4	3	O	O	O	O	O	O	O	O	O *8	O *8
337		25	A5	3	O	O	O	O	O	O	O	O	O *8	O *8
338		26	A6	3	O	O	O	O	O	O	O	O	O *8	O *8
339		27	A7	3	O	O	O	O	O	O	O	O	O *8	O *8
340		28	A8	3	O	O	O	O	O	O	O	O	O *8	O *8
341		29	A9	3	O	O	O	O	O	O	O	O	O *8	O *8
342		2A	AA	3	O	O	O	O	O	O	O	O	O	O
343		2B	AB	3	O	O	O	O	O	O	O	×	×	×
345	ND	2D	AD	3	O	O	O	O	O	O	O	O	O *8	O *8
346	ND	2E	AE	3	O	O	O	O	O	O	O	O	O *8	O *8
349	NC ND NL NP	31	B1	3	O	O	O	O	O	O	O	O	O *8	O *8

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Orientation control	350	Stop position command selection	0, 1, 9999	1	9999	421
	351	Orientation speed	0 to 30Hz	0.01Hz	2Hz	421
	352	Creep speed	0 to 10Hz	0.01Hz	0.5Hz	421
	353	Creep switchover position	0 to 16383	1	511	421
	354	Position loop switchover position	0 to 8191	1	96	421
	355	DC injection brake start position	0 to 255	1	5	421
	356	Internal stop position command	0 to 16383	1	0	421
	357	Orientation in-position zone	0 to 255	1	5	421
	358	Servo torque selection	0 to 13	1	1	421
	359	Encoder rotation direction	0, 1	1	1	263, 392, 421
	360	16 bit data selection	0 to 127	1	0	421
	361	Position shift	0 to 16383	1	0	421
	362	Orientation position loop gain	0.1 to 100	0.1	1	421
	363	Completion signal output delay time	0 to 5s	0.1s	0.5s	421
	364	Encoder stop check time	0 to 5s	0.1s	0.5s	421
	365	Orientation limit	0 to 60s, 9999	1s	9999	421
	366	Recheck time	0 to 5s, 9999	0.1s	9999	421
Encoder feedback	367	Speed feedback range	0 to 400Hz, 9999	0.01Hz	9999	392
	368	Feedback gain	0 to 100	0.1	1	392
	369	Number of encoder pulses	0 to 4096	1	1024	263, 392, 421
	374	Overspeed detection level	0 to 400Hz	0.01Hz	140Hz	381
	376	Encoder signal loss detection enable/disable selection	0, 1	1	0	381
SSCNET III communication	379	SSCNET III rotation direction selection	0, 1	1	0	—
S-pattern acceleration/deceleration C	380	Acceleration S-pattern 1	0 to 50%	1%	0	238
	381	Deceleration S-pattern 1	0 to 50%	1%	0	238
	382	Acceleration S-pattern 2	0 to 50%	1%	0	238
	383	Deceleration S-pattern 2	0 to 50%	1%	0	238
Pulse train input	384	Input pulse division scaling factor	0 to 250	1	0	228
	385	Frequency for zero input pulse	0 to 400Hz	0.01Hz	0	228
	386	Frequency for maximum input pulse	0 to 400Hz	0.01Hz	60Hz	228
LONWORKS communication	387	Initial communication delay time	0 to 120s	0.1s	0s	—
	388	Heartbeat send time interval	0 to 999.8s	0.1s	0s	—
	389	Minimum heartbeat send time	0 to 999.8s	0.1s	0.5s	—
	390	% setting reference frequency	1 to 400Hz	0.01Hz	60Hz	—
	391	Heartbeat receive time interval	0 to 999.8s	0.1s	0s	—
	392	Event driven detection width	0.00 to 163.83%	0.01%	0%	—

PARAMETER

[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
350	AP	32	B2	3	○	○	○	×	×	×	×	○	○	○
351	AP	33	B3	3	○	○	○	×	×	×	×	○	○	○
352	AP	34	B4	3	○	○	○	×	×	×	×	○	○	○
353	AP	35	B5	3	○	○	○	×	×	×	×	○	○	○
354	AP	36	B6	3	○	○	○	×	×	×	×	○	○	○
355	AP	37	B7	3	○	○	○	×	×	×	×	○	○	○
356	AP	38	B8	3	○	○	○	×	×	×	×	○	○	○
357	AP	39	B9	3	○	○	○	×	×	×	×	○	○	○
358	AP	3A	BA	3	○	○	○	×	×	×	×	○	○	○
359	AP	3B	BB	3	○	○	○	○	○	×	×	○	○	○
360	AP	3C	BC	3	○	○	○	×	×	×	×	○	○	○
361	AP	3D	BD	3	○	○	○	×	×	×	×	○	○	○
362	AP	3E	BE	3	○	○	○	×	×	×	×	○	○	○
363	AP	3F	BF	3	○	○	○	×	×	×	×	○	○	○
364	AP	40	C0	3	○	○	○	×	×	×	×	○	○	○
365	AP	41	C1	3	○	○	○	×	×	×	×	○	○	○
366	AP	42	C2	3	○	○	○	×	×	×	×	○	○	○
367	AP	43	C3	3	○	○	○	×	×	×	×	○	○	○
368	AP	44	C4	3	○	○	×	×	×	×	×	○	○	○
369	AP	45	C5	3	○	○	○	○	○	×	×	○	○	○
374		4A	CA	3	×	×	○	○	○	○	○	○	○	○
376	AP	4C	CC	3	○	○	○	○	○	×	×	○	○	○
379	NS	4F	CF	3	×	×	○	○	○	×	×	○	○	○
380		50	D0	3	○	○	○	○	×	○	○	○	○	○
381		51	D1	3	○	○	○	○	×	○	○	○	○	○
382		52	D2	3	○	○	○	○	×	○	○	○	○	○
383		53	D3	3	○	○	○	○	×	○	○	○	○	○
384		54	D4	3	○	○	○	○	×	○	○	○	○	○
385		55	D5	3	○	○	○	○	×	○	○	○	○	○
386		56	D6	3	○	○	○	○	×	○	○	○	○	○
387	NL	57	D7	3	○	○	○	○	○	○	○	○	○	○
388	NL	58	D8	3	○	○	○	○	○	○	○	○	○	○
389	NL	59	D9	3	○	○	○	○	○	○	○	○	○	○
390	NL	5A	DA	3	○	○	○	○	○	○	○	○	○	○
391	NL	5B	DB	3	○	○	○	○	○	○	○	○	○	○
392	NL	5C	DC	3	○	○	○	○	○	○	○	○	○	○

PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
Orientation control	393	Orientation selection	0, 1, 2	1	0	421	393	AP	5D	DD	3	×	×	○	×	×	×	×	○	○	○
	396	Orientation speed gain (P term)	0 to 1000	1	60	421	396	AP	60	E0	3	×	×	○	×	×	×	×	○	○	○
	397	Orientation speed integral time	0 to 20s	0.001s	0.333s	421	397	AP	61	E1	3	×	×	○	×	×	×	×	○	○	○
	398	Orientation speed gain (D term)	0 to 100	0.1	1	421	398	AP	62	E2	3	×	×	○	×	×	×	×	○	○	○
	399	Orientation deceleration ratio	0 to 1000	1	20	421	399	AP	63	E3	3	×	×	○	×	×	×	×	○	○	○
—	406	High resolution analog input selection	0, 2 to 6, 9999	1	9999	43	406	AZ	06	86	4	○	○	○	○	○	○	○	○	×	○
Motor thermistor	407	Motor temperature detection filter	0 to 100s, 9999	1	9999	50	407	AZ	07	87	4	○	○	○	○	○	○	○	○	○	○
	408	Motor thermistor selection	0, 1	1	0	50	408	AZ	08	88	4	○	○	○	○	○	○	○	○	○	○
Encoder pulse division output	413	Encoder pulse division ratio	1 to 32767	1	1	432	413	AZ	0D	8D	4	○	○	○	○	○	○	○	○	○	○
Position control	419	Position command source selection	0, 2	1	0	309, 311	419	AP	13	93	4	×	×	×	×	○	×	×	○	○	○
	420	Command pulse scaling factor numerator	0 to 32767	1	1	315	420	AP	14	94	4	×	×	×	×	○	×	×	○	○	○
	421	Command pulse scaling factor denominator	0 to 32767	1	1	315	421	AP	15	95	4	×	×	×	×	○	×	×	○	○	○
	422	Position loop gain	0 to 150sec^{-1}	1sec^{-1}	25sec^{-1}	317	422	AP	16	96	4	×	×	×	×	○	×	×	○	○	○
	423	Position feed forward gain	0 to 100%	1%	0	317	423	AP	17	97	4	×	×	×	×	○	×	×	○	○	○
	424	Position command acceleration/ deceleration time constant	0 to 50s	0.001s	0s	315	424	AP	18	98	4	×	×	×	×	○	×	×	○	○	○
	425	Position feed forward command filter	0 to 5s	0.001s	0s	317	425	AP	19	99	4	×	×	×	×	○	×	×	○	○	○
	426	In-position width	0 to 32767 pulses	1	100	317	426	AP	1A	9A	4	×	×	×	×	○	×	×	○	○	○
	427	Excessive level error	0 to 400, 9999	1	40	317	427	AP	1B	9B	4	×	×	×	×	○	×	×	○	○	○
	428	Command pulse selection	0 to 5	1	0	311	428	AP	1C	9C	4	×	×	×	×	○	×	×	○	○	○
	429	Clear signal selection	0, 1	1	1	311	429	AP	1D	9D	4	×	×	×	×	○	×	×	○	○	○
	430	Pulse monitor selection	0 to 5, 9999	1	9999	311	430	AP	1E	9E	4	×	×	×	×	○	×	×	○	○	○
—	432	Pulse train torque command bias	0 to 400%	1%	0%	301	432	AL	20	A0	4	×	×	×	○	×	×	○	○	○	○
	433	Pulse train torque command gain	0 to 400%	1%	150%	301	433	AL	21	A1	4	×	×	×	○	×	×	○	○	○	○
—	447	Digital torque command bias	0 to 400%	1%	0%	301	447	AX	2F	AF	4	×	×	×	○	×	×	○	○	○	○
—	448	Digital torque command gain	0 to 400%, 9999	1%	150%	301	448	AX	30	B0	4	×	×	×	○	×	×	○	○	○	○
SSCNET III communication	449	SSCNET III input filter setting	0 to 4	1	4	—	449	NS	31	B1	4	×	×	○	○	○	×	×	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
Second motor constant	450	Second applied motor	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54, 9999	1	9999	266	450		32	B2	4	○	○	×	×	×	○	○	○	○	○
	451	Second motor control method selection	10, 11, 12, 20, 9999	1	9999	252, 258, 261	451		33	B3	4	○	○	×	×	×	○	○	○	○	○
	453	Second motor capacity	0.4 to 55kW, 9999/ 0 to 3600kW, 9999 *2	0.01kW/0.1kW *2	9999	252, 258, 261	453		35	B5	4	×	○	×	×	×	○	○	○	○	○
	454	Number of second motor poles	2, 4, 6, 8, 10, 9999	1	9999	252, 258, 261	454		36	B6	4	×	○	×	×	×	○	○	○	○	○
	455	Second motor excitation current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	268	455		37	B7	4	×	○	×	×	×	○	○	○	×	○
	456	Rated second motor voltage	0 to 1000V	0.1V	200/400V*5	268	456		38	B8	4	×	○	×	×	×	○	○	○	○	○
	457	Rated second motor frequency	10 to 120Hz	0.01Hz	60Hz	268	457		39	B9	4	×	○	×	×	×	○	○	○	○	○
	458	Second motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	268	458		3A	BA	4	×	○	×	×	×	○	○	○	×	○
	459	Second motor constant (R2)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	268	459		3B	BB	4	×	○	×	×	×	○	○	○	×	○
	460	Second motor constant (L1)	0 to 50Ω (0 to 1000mH), 9999/ 0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω (0.1mH)/ 0.01mΩ (0.01mH) *2	9999	268	460		3C	BC	4	×	○	×	×	×	○	○	○	×	○
	461	Second motor constant (L2)	0 to 50Ω (0 to 1000mH), 9999/ 0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω (0.1mH)/ 0.01mΩ (0.01mH)*2	9999	268	461		3D	BD	4	×	○	×	×	×	○	○	○	×	○
	462	Second motor constant (X)	0 to 500Ω (0 to 100%), 9999/ 0 to 100Ω (0 to 100%), 9999 *2	0.01Ω (0.1%)/0.01Ω (0.01%) *2	9999	268	462		3E	BE	4	×	○	×	×	×	○	○	○	×	○
	463	Second motor auto tuning setting/status	0, 1, 101	1	0	268	463		3F	BF	4	×	○	×	×	×	○	○	○	×	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Conditional position control	464	Digital position control sudden stop deceleration time	0 to 360.0s	0.1s	0	309
	465	First position feed amount lower 4 digits	0 to 9999	1	0	309
	466	First position feed amount upper 4 digits	0 to 9999	1	0	309
	467	Second position feed amount lower 4 digits	0 to 9999	1	0	309
	468	Second position feed amount upper 4 digits	0 to 9999	1	0	309
	469	Third position feed amount lower 4 digits	0 to 9999	1	0	309
	470	Third position feed amount upper 4 digits	0 to 9999	1	0	309
	471	Fourth position feed amount lower 4 digits	0 to 9999	1	0	309
	472	Fourth position feed amount upper 4 digits	0 to 9999	1	0	309
	473	Fifth position feed amount lower 4 digits	0 to 9999	1	0	309
	474	Fifth position feed amount upper 4 digits	0 to 9999	1	0	309
	475	Sixth position feed amount lower 4 digits	0 to 9999	1	0	309
	476	Sixth position feed amount upper 4 digits	0 to 9999	1	0	309
	477	Seventh position feed amount lower 4 digits	0 to 9999	1	0	309
	478	Seventh position feed amount upper 4 digits	0 to 9999	1	0	309
	479	Eighth position feed amount lower 4 digits	0 to 9999	1	0	309
	480	Eighth position feed amount upper 4 digits	0 to 9999	1	0	309
	481	Nineth position feed amount lower 4 digits	0 to 9999	1	0	309
	482	Nineth position feed amount upper 4 digits	0 to 9999	1	0	309
	483	Tenth position feed amount lower 4 digits	0 to 9999	1	0	309
	484	Tenth position feed amount upper 4 digits	0 to 9999	1	0	309
	485	Eleventh position feed amount lower 4 digits	0 to 9999	1	0	309
	486	Eleventh position feed amount upper 4 digits	0 to 9999	1	0	309
	487	Twelfth position feed amount lower 4 digits	0 to 9999	1	0	309
	488	Twelfth position feed amount upper 4 digits	0 to 9999	1	0	309
	489	Thirteenth position feed amount lower 4 digits	0 to 9999	1	0	309
	490	Thirteenth position feed amount upper 4 digits	0 to 9999	1	0	309
	491	Fourteenth position feed amount lower 4 digits	0 to 9999	1	0	309
	492	Fourteenth position feed amount upper 4 digits	0 to 9999	1	0	309
	493	Fifteenth position feed amount lower 4 digits	0 to 9999	1	0	309
	494	Fifteenth position feed amount upper 4 digits	0 to 9999	1	0	309
Remote output	495	Remote output selection	0, 1, 10, 11	1	0	77
	496	Remote output data 1	0 to 4095	1	0	77
	497	Remote output data 2	0 to 4095	1	0	77
SSCNET III communication	499	SSCNET III operation selection	0, 1(10, 11), 9999	1	0	—
Communication	500	Communication error execution waiting time	0 to 999.8s	0.1s	0	—
	501	Communication error occurrence count display	0	1	0	—
	502	Stop mode selection at communication error	0, 1, 2, 3	1	0	—

PARAMETER

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table							Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	Vector control			Real sensorless vector control				
							Speed control	Torque control	Position control	Speed control	Torque control			
464	AP AL	40	C0	4	×	×	×	×	○	×	×	○	○	○
465	AP AL	41	C1	4	×	×	×	×	○	×	×	○	○	○
466	AP AL	42	C2	4	×	×	×	×	○	×	×	○	○	○
467	AP AL	43	C3	4	×	×	×	×	○	×	×	○	○	○
468	AP AL	44	C4	4	×	×	×	×	○	×	×	○	○	○
469	AP AL	45	C5	4	×	×	×	×	○	×	×	○	○	○
470	AP AL	46	C6	4	×	×	×	×	○	×	×	○	○	○
471	AP AL	47	C7	4	×	×	×	×	○	×	×	○	○	○
472	AP AL	48	C8	4	×	×	×	×	○	×	×	○	○	○
473	AP AL	49	C9	4	×	×	×	×	○	×	×	○	○	○
474	AP AL	4A	CA	4	×	×	×	×	○	×	×	○	○	○
475	AP AL	4B	CB	4	×	×	×	×	○	×	×	○	○	○
476	AP AL	4C	CC	4	×	×	×	×	○	×	×	○	○	○
477	AP AL	4D	CD	4	×	×	×	×	○	×	×	○	○	○
478	AP AL	4E	CE	4	×	×	×	×	○	×	×	○	○	○
479	AP AL	4F	CF	4	×	×	×	×	○	×	×	○	○	○
480	AP AL	50	D0	4	×	×	×	×	○	×	×	○	○	○
481	AP AL	51	D1	4	×	×	×	×	○	×	×	○	○	○
482	AP AL	52	D2	4	×	×	×	×	○	×	×	○	○	○
483	AP AL	53	D3	4	×	×	×	×	○	×	×	○	○	○
484	AP AL	54	D4	4	×	×	×	×	○	×	×	○	○	○
485	AP AL	55	D5	4	×	×	×	×	○	×	×	○	○	○
486	AP AL	56	D6	4	×	×	×	×	○	×	×	○	○	○
487	AP AL	57	D7	4	×	×	×	×	○	×	×	○	○	○
488	AP AL	58	D8	4	×	×	×	×	○	×	×	○	○	○
489	AP AL	59	D9	4	×	×	×	×	○	×	×	○	○	○
490	AP AL	5A	DA	4	×	×	×	×	○	×	×	○	○	○
491	AP AL	5B	DB	4	×	×	×	×	○	×	×	○	○	○
492	AP AL	5C	DC	4	×	×	×	×	○	×	×	○	○	○
493	AP AL	5D	DD	4	×	×	×	×	○	×	×	○	○	○
494	AP AL	5E	DE	4	×	×	×	×	○	×	×	○	○	○
495		5F	DF	4	○	○	○	○	○	○	○	○	○	○
496		60	E0	4	○	○	○	○	○	○	○	×	×	×
497		61	E1	4	○	○	○	○	○	○	○	×	×	×
499	NS	63	E3	4	×	×	○	○	○	×	×	○	○	○
500	NC ND NL NP	00	80	5	○	○	○	○	○	○	○	○	○	○
501	NC ND NL NP	01	81	5	○	○	○	○	○	○	○	×	○	○
502	NC ND NL NP	02	82	5	○	○	○	○	○	○	○	○	○	○

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PARAMETER

PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Maintenance	503	Maintenance timer	0(1 to 9998)	1	0	74
	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	74
—	505	Speed setting reference	1 to 120Hz	0.01Hz	60Hz	343
S-pattern acceleration/ deceleration D	516	S-pattern time at a start of acceleration	0.1 to 2.5s	0.1s	0.1s	238
	517	S-pattern time at a completion of acceleration	0.1 to 2.5s	0.1s	0.1s	238
	518	S-pattern time at a start of deceleration	0.1 to 2.5s	0.1s	0.1s	238
	519	S-pattern time at a completion of deceleration	0.1 to 2.5s	0.1s	0.1s	238
—	539	Modbus-RTU communication check time interval	0 to 999.8s, 9999	0.1s	9999	459
CC-Link communication	541	Frequency command sign selection (CC-Link)	0, 1	1	0	—
	542	Communication station number (CC-Link)	1 to 64	1	1	—
	543	Baud rate (CC-Link)	0 to 4	1	0	—
	544	CC-Link extended setting	0, 1, 12, 14, 18	1	0	—
USB	547	USB communication station number	0 to 31	1	0	473
	548	USB communication check time interval	0 to 999.8s, 9999	0.1s	9999	473
Communication	549	Protocol selection	0, 1	1	0	441, 459
	550	NET mode operation command source selection	0, 1, 9999	1	9999	436
	551	PU mode operation command source selection	1, 2, 3	1	2	436
Current average value monitor	555	Current average time	0.1 to 1.0s	0.1s	1s	75
	556	Data output mask time	0.0 to 20.0s	0.1s	0s	75
	557	Current average value monitor signal output reference current	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	75
—	563	Energization time carrying-over times	(0 to 65535)	1	0	345
—	564	Operating time carrying-over times	(0 to 65535)	1	0	345
Second motor constants	569	Second motor speed control gain	0 to 200%, 9999	0.1%	9999	258
—	571	Holding time at a start	0.0 to 10.0s, 9999	0.1s	9999	232
—	574	Second motor online auto tuning	0, 1	1	0	276
PID control	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	402
	576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	402
	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	402
—	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	5/15s *2	367
—	665	Regeneration avoidance frequency gain	0 to 200%	0.1%	100%	340
—	684	Tuning data unit switchover	0, 1	1	0	268
—	800	Control method selection	0 to 5, 9 to 12, 20	1	20	252, 258, 261
—	802	Pre-excitation selection	0, 1	1	0	325
Torque command	803	Constant power range torque characteristic selection	0, 1	1	0	283, 301
	804	Torque command source selection	0, 1, 3 to 6	1	0	301
	805	Torque command value (RAM)	600 to 1400%	1%	1000%	301
	806	Torque command value (RAM,EEPROM)	600 to 1400%	1%	1000%	301

[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
503		03	83	5	○	○	○	○	○	○	○	×	×	×
504		04	84	5	○	○	○	○	○	○	○	○	×	○
505		05	85	5	○	○	○	○	○	○	○	○	○	○
516		10	90	5	○	○	○	○	×	○	○	○	○	○
517		11	91	5	○	○	○	○	×	○	○	○	○	○
518		12	92	5	○	○	○	○	×	○	○	○	○	○
519		13	93	5	○	○	○	○	×	○	○	○	○	○
539		27	A7	5	○	○	○	○	○	○	○	○	○ *8	○ *8
541	NC	29	A9	5	○	○	○	×	×	○	×	○	○ *8	○ *8
542	NC	2A	AA	5	○	○	○	○	○	○	○	○	○ *8	○ *8
543	NC	2B	AB	5	○	○	○	○	○	○	○	○	○ *8	○ *8
544	NC	2C	AC	5	○	○	○	○	○	○	○	○	○ *8	○ *8
547		2F	AF	5	○	○	○	○	○	○	○	○	○ *8	○ *8
548		30	B0	5	○	○	○	○	○	○	○	○	○ *8	○ *8
549		31	B1	5	○	○	○	○	○	○	○	○	○ *8	○ *8
550		32	B2	5	○	○	○	○	○	○	○	○	○ *8	○ *8
551		33	B3	5	○	○	○	○	○	○	○	○	○ *8	○ *8
555		37	B7	5	○	○	○	○	○	○	○	○	○	○
556		38	B8	5	○	○	○	○	○	○	○	○	○	○
557		39	B9	5	○	○	○	○	○	○	○	○	○	○
563		3F	BF	5	○	○	○	○	○	○	○	×	×	×
564		40	C0	5	○	○	○	○	○	○	○	×	×	×
569		45	C5	5	×	○	×	×	×	×	×	○	×	○
571		47	C7	5	○	○	○	○	×	○	○	○	○	○
574		4A	CA	5	×	○	×	×	×	○	○	○	○	○
575		4B	CB	5	○	○	○	×	×	○	×	○	○	○
576		4C	CC	5	○	○	○	×	×	○	×	○	○	○
577		4D	CD	5	○	○	○	×	×	○	×	○	○	○
611		0B	8B	6	○	○	○	×	×	○	×	○	○	○
665		41	C1	6	○	○	○	×	×	○	×	○	○	○
684		54	D4	6	×	○	○	○	○	○	○	○	○	○
800		00	80	8	○	○	○	○	○	○	○	○	○	○
802	AP AL	02	82	8	×	×	○	×	×	×	×	○	○	○
803		03	83	8	×	×	○	○	○	○	○	○	○	○
804		04	84	8	×	×	×	○	×	×	○	○	○	○
805		05	85	8	×	×	×	○	×	×	○	×	○	○
806		06	86	8	×	×	×	○	×	×	○	○	○	○

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PARAMETER

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
Speed limit	807	Speed limit selection	0, 1, 2	1	0	304	807		07	87	8	×	×	×	○	×	×	○	○	○	○
	808	Forward rotation speed limit	0 to 120Hz	0.01Hz	60Hz	304	808		08	88	8	×	×	×	○	×	×	○	○	○	○
	809	Reverse rotation speed limit	0 to 120Hz, 9999	0.01Hz	9999	304	809		09	89	8	×	×	×	○	×	×	○	○	○	○
Torque limit	810	Torque limit input method selection	0, 1	1	0	283	810		0A	8A	8	×	×	○	×	○	○	×	○	○	○
	811	Set resolution switchover	0, 1, 10, 11	1	0	283, 343	811		0B	8B	8	○	○	○	○	○	○	○	○	○	○
	812	Torque limit level (regeneration)	0 to 400%, 9999	0.1%	9999	283	812		0C	8C	8	×	×	○	×	○	○	×	○	○	○
	813	Torque limit level (3rd quadrant)	0 to 400%, 9999	0.1%	9999	283	813		0D	8D	8	×	×	○	×	○	○	×	○	○	○
	814	Torque limit level (4th quadrant)	0 to 400%, 9999	0.1%	9999	283	814		0E	8E	8	×	×	○	×	○	○	×	○	○	○
	815	Torque limit level 2	0 to 400%, 9999	0.1%	9999	283	815		0F	8F	8	×	×	○	×	○	○	×	○	○	○
	816	Torque limit level during acceleration	0 to 400%, 9999	0.1%	9999	283	816		10	90	8	×	×	○	×	○	○	×	○	○	○
	817	Torque limit level during deceleration	0 to 400%, 9999	0.1%	9999	283	817		11	91	8	×	×	○	×	○	○	×	○	○	○
Easy gain tuning	818	Easy gain tuning response level setting	1 to 15	1	2	286	818		12	92	8	×	×	○	×	○	○	×	○	○	○
	819	Easy gain tuning selection	0 to 2	1	0	286	819		13	93	8	×	×	○	×	○	○	×	○	×	○
Adjustment function	820	Speed control P gain 1	0 to 1000%	1%	60%	286	820		14	94	8	×	×	○	×	○	○	×	○	○	○
	821	Speed control integral time 1	0 to 20s	0.001s	0.333s	286	821		15	95	8	×	×	○	×	○	○	×	○	○	○
	822	Speed setting filter 1	0 to 5s, 9999	0.001s	9999	323	822		16	96	8	×	×	○	○	×	○	○	○	○	○
	823	Speed detection filter 1	0 to 0.1s	0.001s	0.001s	324	823	AP AL	17	97	8	×	×	○	○	○	×	×	○	○	○
	824	Torque control P gain 1	0 to 200%	1%	100%	306	824		18	98	8	×	×	○	○	○	○	○	○	○	○
	825	Torque control integral time 1	0 to 500ms	0.1ms	5ms	306	825		19	99	8	×	×	○	○	○	○	○	○	○	○
	826	Torque setting filter 1	0 to 5s, 9999	0.001s	9999	323	826		1A	9A	8	×	×	○	○	○	○	○	○	○	○
	827	Torque detection filter 1	0 to 0.1s	0.001s	0s	324	827		1B	9B	8	×	×	○	○	○	○	○	○	○	○
	828	Model speed control gain	0 to 1000%	1%	60%	289	828		1C	9C	8	×	×	○	×	○	○	×	○	○	○
	829	Number of machine end encoder pulses	0 to 4096, 9999	1	9999	421	829	AL	1D	9D	8	○	○	○	×	×	×	×	○	○	○
	830	Speed control P gain 2	0 to 1000%, 9999	1%	9999	286	830		1E	9E	8	×	×	○	×	○	○	×	○	○	○
	831	Speed control integral time 2	0 to 20s, 9999	0.001s	9999	286	831		1F	9F	8	×	×	○	×	○	○	×	○	○	○
	832	Speed setting filter 2	0 to 5s, 9999	0.001s	9999	323	832		20	A0	8	×	×	○	○	×	○	○	○	○	○
	833	Speed detection filter 2	0 to 0.1s, 9999	0.001s	9999	324	833	AP AL	21	A1	8	×	×	○	×	○	×	×	○	○	○
	834	Torque control P gain 2	0 to 200%, 9999	1%	9999	306	834		22	A2	8	×	×	○	○	○	○	○	○	○	○
	835	Torque control integral time 2	0 to 500ms, 9999	0.1ms	9999	306	835		23	A3	8	×	×	○	○	○	○	○	○	○	○
	836	Torque setting filter 2	0 to 5s, 9999	0.001s	9999	323	836		24	A4	8	×	×	○	○	○	○	○	○	○	○
	837	Torque detection filter 2	0 to 0.1s, 9999	0.001s	9999	324	837		25	A5	8	×	×	○	○	○	○	○	○	○	○
##Signed analog signal output	838	DA1 terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 36, 50, 52, 53	1	2	345	838	AZ	26	A6	8	○	○	○	○	○	○	○	○	○	○
	839	DA1 output filter	0 to 5s	0.001s	0.05s	345	839	AZ	27	A7	8	○	○	○	○	○	○	○	○	○	○
Torque bias	840	Torque bias selection	0 to 3, 9999	1	9999	291	840	AP AL	28	A8	8	×	×	○	×	×	×	×	○	○	○
	841	Torque bias 1	600 to 1400%, 9999	1%	9999	291	841	AP AL	29	A9	8	×	×	○	×	×	×	×	○	○	○
	842	Torque bias 2	600 to 1400%, 9999	1%	9999	291	842	AP AL	2A	AA	8	×	×	○	×	×	×	×	○	○	○
	843	Torque bias 3	600 to 1400%, 9999	1%	9999	291	843	AP AL	2B	AB	8	×	×	○	×	×	×	×	○	○	○
	844	Torque bias filter	0 to 5s, 9999	0.001s	9999	291	844	AP AL	2C	AC	8	×	×	○	×	×	×	×	○	○	○
	845	Torque bias operation time	0 to 5s, 9999	0.01s	9999	291	845	AP AL	2D	AD	8	×	×	○	×	×	×	×	○	○	○
	846	Torque bias balance compensation	0 to 10V, 9999	0.1V	9999	291	846	AP AL	2E	AE	8	×	×	○	×	×	×	×	○	○	○
	847	Fall-time torque bias terminal 1 bias	0 to 400%, 9999	1%	9999	291	847	AP AL	2F	AF	8	×	×	○	×	×	×	×	○	○	○
	848	Fall-time torque bias terminal 1 gain	0 to 400%, 9999	1%	9999	291	848	AP AL	30	B0	8	×	×	○	×	×	×	×	○	○	○
Additional function	849	Analog input offset adjustment	0 to 200%	0.1%	100%	217	849		31	B1	8	○	○	○	○	○	○	○	○	○	○
	850	Brake operation selection	0, 1	1	0	325	850		32	B2	8	×	×	×	×	×	○	○	○	○	○
	853	Speed deviation time	0 to 100s	0.1s	1s	294	853	AP AL	35	B5	8	×	×	○	×	×	×	×	○	○	○
	854	Excitation ratio	0 to 100%	1%	100%	324	854		36	B6	8	×	×	○	○	○	○	○	○	○	○
—	857	DA1-0V adjustment	900 to 1100%	1%	1000%	345	857	AZ	39	B9	8	○	○	○	○	○	○	○	○	×	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control	Parameter Copy	Parameter Clear	All Parameter Clear
Additional function	858	Terminal 4 function assignment	0, 1, 4, 9999	1	0	46, 283, 335	858		3A	BA	8	○	○	○	○	○	○	○	○	×	○
	859	Torque current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A*2	9999	268	859		3B	BB	8	×	○	○	○	○	○	○	○	×	○
	860	Second motor torque current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A*2	9999	268	860		3C	BC	8	×	○	×	×	×	○	○	○	×	○
	862	Notch filter time constant	0 to 60	1	0	295	862		3E	BE	8	×	×	○	×	○	○	×	○	○	○
	863	Notch filter depth	0, 1, 2, 3	1	0	295	863		3F	BF	8	×	×	○	×	○	○	×	○	○	○
	864	Torque detection	0 to 400%	0.1%	150%	73	864		40	C0	8	×	×	○	○	○	○	○	○	○	○
	865	Low speed detection	0 to 400Hz	0.01Hz	1.5Hz	283	865		41	C1	8	×	×	○	○	○	○	○	○	○	○
Display functions	866	Torque monitoring reference	0 to 400%	0.1%	150%	352	866		42	C2	8	×	○	○	○	○	○	○	○	○	○
—	867	AM output filter	0 to 5s	0.01s	0.01s	352	867		43	C3	8	○	○	○	○	○	○	○	○	○	○
—	868	Terminal 1 function assignment	0 to 6, 9999	1	0	46, 283, 335	868		44	C4	8	○	○	○	○	○	○	○	○	×	○
Protective functions	872	Input phase loss protection selection	0, 1	1	0	380	872		48	C8	8	○	○	○	○	○	○	○	○	×	○
	873	Speed limit	0 to 120Hz	0.01Hz	20Hz	294	873	AP AL	49	C9	8	×	×	○	×	×	×	×	○	○	○
	874	OLT level setting	0 to 200%	0.1%	150%	283	874		4A	CA	8	×	×	○	×	○	○	×	○	○	○
	875	Fault definition	0, 1	1	0	379	875		4B	CB	8	○	○	○	○	×	○	○	○	○	○
Control system functions	877	Speed feed forward control/model adaptive speed control selection	0, 1, 2	1	0	289	877		4D	CD	8	×	×	○	×	○	○	×	○	○	○
	878	Speed feed forward filter	0 to 1s	0.01s	0s	289	878		4E	CE	8	×	×	○	×	○	○	×	○	○	○
	879	Speed feed forward torque limit	0 to 400%	0.1%	150%	289	879		4F	CF	8	×	×	○	×	○	○	×	○	○	○
	880	Load inertia ratio	0 to 200 times	0.1	7	286, 289	880		50	D0	8	×	×	○	×	○	○	×	○	×	○
	881	Speed feed forward gain	0 to 1000%	1%	0%	289	881		51	D1	8	×	×	○	×	○	○	×	○	○	○
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1, 2	1	0	340	882		52	D2	8	○	○	○	×	×	○	×	○	○	○
	883	Regeneration avoidance operation level	300 to 800V	0.1V	380/ 760VDC *5	340	883		53	D3	8	○	○	○	×	×	○	×	○	○	○
	884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	1	0	340	884		54	D4	8	○	○	○	×	×	○	×	○	○	○
	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	340	885		55	D5	8	○	○	○	×	×	○	×	○	○	○
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	340	886		56	D6	8	○	○	○	×	×	○	×	○	○	○
Free parameter	888	Free parameter 1	0 to 9999	1	9999	388	888		58	D8	8	○	○	○	○	○	○	○	○	×	×
	889	Free parameter 2	0 to 9999	1	9999	388	889		59	D9	8	○	○	○	○	○	○	○	○	×	×
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	345, 360	891		5B	DB	8	○	○	○	○	○	○	○	○	○	○
	892	Load factor	30 to 150%	0.1%	100%	360	892		5C	DC	8	○	○	○	○	○	○	○	○	○	○
	893	Energy saving monitor reference (motor capacity)	0.1 to 55/0 to 3600kW *2	0.01/0.1kW *2	Rated inverter capacity	360	893		5D	DD	8	○	○	○	○	○	○	○	○	○	○
	894	Control selection during commercial power-supply operation	0, 1, 2, 3	1	0	360	894		5E	DE	8	○	○	○	○	○	○	○	○	○	○
	895	Power saving rate reference value	0, 1, 9999	1	9999	360	895		5F	DF	8	○	○	○	○	○	○	○	○	○	○
	896	Power unit cost	0 to 500, 9999	0.01	9999	360	896		60	E0	8	○	○	○	○	○	○	○	○	○	○
	897	Power saving monitor average time	0, 1 to 1000h, 9999	1h	9999	360	897		61	E1	8	○	○	○	○	○	○	○	○	○	○
	898	Power saving cumulative monitor clear	0, 1, 10, 9999	1	9999	360	898		62	E2	8	○	○	○	○	○	○	○	○	×	○
	899	Operation time rate (estimated value)	0 to 100%, 9999	0.1%	9999	360	899		63	E3	8	○	○	○	○	○	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Calibration parameters	C0 (900) *7	FM terminal calibration	—	—	—	356
	C1 (901) *7	AM terminal calibration	—	—	—	356
	C2 (902) *7	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217
	C3 (902) *7	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	217
	125 (903) *7	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217
	C4 (903) *7	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	217
	C5 (904) *7	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217
	C6 (904) *7	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	217
	126 (905) *7	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217
	C7 (905) *7	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	217
	C12 (917) *7	Terminal 1 bias frequency (speed)	0 to 400Hz	0.01Hz	0Hz	304
	C13 (917) *7	Terminal 1 bias (speed)	0 to 300%	0.1%	0%	304
	C14 (918) *7	Terminal 1 gain frequency (speed)	0 to 400Hz	0.01Hz	60Hz	304
	C15 (918) *7	Terminal 1 gain (speed)	0 to 300%	0.1%	100%	304
	C16 (919) *7	Terminal 1 bias command (torque/magnetic flux)	0 to 400%	0.1%	0%	320
	C17 (919) *7	Terminal 1 bias (torque/magnetic flux)	0 to 300%	0.1%	0%	320
	C18 (920) *7	Terminal 1 gain command (torque/magnetic flux)	0 to 400%	0.1%	150%	320
	C19 (920) *7	Terminal 1 gain (torque/magnetic flux)	0 to 300%	0.1%	100%	320

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[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table							Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	Vector control: Speed control	Vector control: Torque control	Vector control: Position control	Real sensorless vector control: Speed control	Real sensorless vector control: Torque control			
C0 (900)		5C	DC	1	○	○	○	○	○	○	○	○	×	○
C1 (901)		5D	DD	1	○	○	○	○	○	○	○	○	×	○
C2 (902)		5E	DE	1	○	○	○	○	○	○	○	○	×	○
C3 (902)		5E	DE	1	○	○	○	○	○	○	○	○	×	○
125 (903)		5F	DF	1	○	○	○	○	○	○	○	○	×	○
C4 (903)		5F	DF	1	○	○	○	○	○	○	○	○	×	○
C5 (904)		60	E0	1	○	○	○	○	○	○	○	○	×	○
C6 (904)		60	E0	1	○	○	○	○	○	○	○	○	×	○
126 (905)		61	E1	1	○	○	○	○	○	○	○	○	×	○
C7 (905)		61	E1	1	○	○	○	○	○	○	○	○	×	○
C12 (917)		11	91	9	×	×	○	○	○	○	○	○	×	○
C13 (917)		11	91	9	×	×	○	○	○	○	○	○	×	○
C14 (918)		12	92	9	×	×	○	○	○	○	○	○	×	○
C15 (918)		12	92	9	×	×	○	○	○	○	○	○	×	○
C16 (919)		13	93	9	×	×	○	○	○	○	○	○	×	○
C17 (919)		13	93	9	×	×	○	○	○	○	○	○	×	○
C18 (920)		14	94	9	×	×	○	○	○	○	○	○	×	○
C19 (920)		14	94	9	×	×	○	○	○	○	○	○	×	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Calibration parameters	C29 (925) *7	Motor temperature detection calibration (analog input)	0 to 200%	0.1%	100%	50
	C30 (926) *7	Terminal 6 bias frequency (speed)	0 to 400Hz	0.01Hz	0Hz	217, 304
	C31 (926) *7	Terminal 6 bias (speed)	0 to 300%	0.1%	0%	217, 304
	C32 (927) *7	Terminal 6 gain frequency (speed)	0 to 400Hz	0.01Hz	60Hz	217, 304
	C33 (927) *7	Terminal 6 gain (speed)	0 to 300%	0.1%	100%	217, 304
	C34 (928) *7	Terminal 6 bias command (torque)	0 to 400%	0.1%	0%	320
	C35 (928) *7	Terminal 6 bias (torque)	0 to 300%	0.1%	0%	320
	C36 (929) *7	Terminal 6 gain command (torque)	0 to 400%	0.1%	150%	320
	C37 (929) *7	Terminal 6 gain (torque)	0 to 300%	0.1%	100%	320
	C38 (932) *7	Terminal 4 bias command (torque/magnetic flux)	0 to 400%	0.1%	0%	320
	C39 (932) *7	Terminal 4 bias (torque/magnetic flux)	0 to 300%	0.1%	20%	320
	C40 (933) *7	Terminal 4 gain command (torque/magnetic flux)	0 to 400%	0.1%	150%	320
	C41 (933) *7	Terminal 4 gain (torque/magnetic flux)	0 to 300%	0.1%	100%	320
—	989	Parameter copy alarm release	10, 100	1	10/100 *2	—
PU	990	PU buzzer control	0, 1	1	1	389
	991	PU contrast adjustment	0 to 63	1	58	389
Clear parameters	Pr.CL	Parameter clear	0, 1	1	0	—
	ALLC	All parameter clear	0, 1	1	0	—
	Er.CL	Faults history clear	0, 1	1	0	—
	PCPY	Parameter copy	0, 1, 2, 3	1	0	—

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table							Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	Vector control			Real sensorless vector control				
							Speed control	Torque control	Position control	Speed control	Torque control			
C29 (925)	AZ	19	99	9	○	○	○	○	○	○	○	○	×	○
C30 (926)	AZ	1A	9A	9	○	○	○	○	○	○	○	○	×	○
C31 (926)	AZ	1A	9A	9	○	○	○	○	○	○	○	○	×	○
C32 (927)	AZ	1B	9B	9	○	○	○	○	○	○	○	○	×	○
C33 (927)	AZ	1B	9B	9	○	○	○	○	○	○	○	○	×	○
C34 (928)	AZ	1C	9C	9	×	×	○	○	○	○	○	○	×	○
C35 (928)	AZ	1C	9C	9	×	×	○	○	○	○	○	○	×	○
C36 (929)	AZ	1D	9D	9	×	×	○	○	○	○	○	○	×	○
C37 (929)	AZ	1D	9D	9	×	×	○	○	○	○	○	○	×	○
C38 (932)		20	A0	9	×	×	○	○	○	○	○	○	×	○
C39 (932)		20	A0	9	×	×	○	○	○	○	○	○	×	○
C40 (933)		21	A1	9	×	×	○	○	○	○	○	○	×	○
C41 (933)		21	A1	9	×	×	○	○	○	○	○	○	×	○
989		59	D9	9	○	○	○	○	○	○	○	○	×	○
990		5A	DA	9	○	○	○	○	○	○	○	○	○	○
991		5B	DB	9	○	○	○	○	○	○	○	○	×	○
Pr.CL		—	FC	—	—	—	—	—	—	—	—	—	—	—
ALLC		—	FC	—	—	—	—	—	—	—	—	—	—	—
Er.CL		—	F4	—	—	—	—	—	—	—	—	—	—	—
PCPY		—	—	—	—	—	—	—	—	—	—	—	—	—

*1 Differ according to capacities. (0.4K, 0.75K/1.5K to 3.7K/5.5K, 7.5K/11K to 55K/75K or more)
*2 Differ according to capacities. (55K or less/75K or more)
*3 Differ according to capacities. (7.5K or less/11K or more)
*4 Differ according to capacities. (7.5K or less/11K to 55K/75K or more)
*5 The initial value differs according to the voltage class. (200V class/400V class)
*6 Can be read and written by only communication from the PU connector.
*7 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*8 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (Refer to page 441 for RS-485 communication)

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2.1.2 FR-F700

In the initial setting, only the simple mode parameters are displayed. Set [*Pr. 160 User group read selection*] as required.

- ◎ indicates simple mode parameters.
- The parameters marked with [shaded box] in the table allow its setting to be changed during operation even if 0 (initial value) is set in [*Pr. 77 Parameter write selection*] .

[Pr.]	Name	Initial Value	Setting Range	Remarks
160	User group read selection	9999	9999	Only the simple mode parameters can be displayed.
			0	Simple mode+extended mode parameters can be displayed.
			1	Only the parameters registered to the user group can be displayed.

- Symbols in the option column indicate parameters which function when an option is mounted.
  AX .... FR-A7AX, AY .... FR-A7AY, AR FR-A7AR,
  NC .... FR-A7NC, ND .... FR-A7ND, NL FR-A7NL,
  NP FR-A7NP
- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication.
- Symbols in the control mode-based correspondence table indicate the following;
  ○: Usable parameter
  ×: Unusable parameter
- Symbols in the parameter copy, parameter clear, and all parameter clear columns indicate the following;
  ○: Valid
  ×: Invalid

	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference
Basic functions	◎ 0	Torque boost	0 to 30%	0.1%	6/4/3/2/ 1.5/1% *1	244
	◎ 1	Maximum frequency	0 to 120Hz	0.01Hz	120/60Hz *2	232
	◎ 2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	232
	◎ 3	Base frequency	0 to 400Hz	0.01Hz	60Hz	244
	◎ 4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	216
	◎ 5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	216
	◎ 6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	216
	◎ 7	Acceleration time	0 to 3600/360s	0.1/0.01s	5/15s *3	234
	◎ 8	Deceleration time	0 to 3600/360s	0.1/0.01s	10/30s *3	234
	◎ 9	Electronic thermal O/L relay	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	379
DC injection brake	10	DC injection brake operation frequency	0 to 120Hz, 9999	0.01Hz	3Hz	328
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	328
	12	DC injection brake operation voltage	0 to 30%	0.1%	4/2/1% *4	328
—	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	232
—	14	Load pattern selection	0, 1	1	1	244
Jog operation	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	215
	16	Jog acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	0.5s	215, 234
—	17	MRS input selection	0, 2	1	0	56
—	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120/60Hz *2	232
—	19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	244
Acceleration/ deceleration time	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	234
	21	Acceleration/deceleration time increments	0, 1	1	0	234
Stall prevention	22	Stall prevention operation level	0 to 150%, 9999	0.1%	120%	335
	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	335
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	216
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	216
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	216
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	216

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Simple magnetic flux vector control			
0		00	80	0	○	×	○	○	○
1		01	81	0	○	○	○	○	○
2		02	82	0	○	○	○	○	○
3		03	83	0	○	○	○	○	○
4		04	84	0	○	○	○	○	○
5		05	85	0	○	○	○	○	○
6		06	86	0	○	○	○	○	○
7		07	87	0	○	○	○	○	○
8		08	88	0	○	○	○	○	○
9		09	89	0	○	○	○	○	○
10		0A	8A	0	○	○	○	○	○
11		0B	8B	0	○	○	○	○	○
12		0C	8C	0	○	○	○	○	○
13		0D	8D	0	○	○	○	○	○
14		0E	8E	0	○	○	○	○	○
15		0F	8F	0	○	○	○	○	○
16		10	90	0	○	○	○	○	○
17		11	91	0	○	○	○	○	○
18		12	92	0	○	○	○	○	○
19		13	93	0	○	○	○	○	○
20		14	94	0	○	○	○	○	○
21		15	95	0	○	○	○	○	○
22		16	96	0	○	○	○	○	○
23		17	97	0	○	○	○	○	○
24		18	98	0	○	○	○	○	○
25		19	99	0	○	○	○	○	○
26		1A	9A	0	○	○	○	○	○
27		1B	9B	0	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Control Mode-based Correspondence Table: Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
—	28	Multi-speed input compensation selection	0, 1	1	0	227	28		1C	9C	0	○	○	○	○	○
—	29	Acceleration/deceleration pattern selection	0, 1, 2, 3	1	0	238	29		1D	9D	0	○	○	○	○	○
—	30	Regenerative function selection	0, 2/0, 1, 2 *2	1	0	331	30		1E	9E	0	○	○	○	○	○
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	233	31		1F	9F	0	○	○	○	○	○
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	233	32		20	A0	0	○	○	○	○	○
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	233	33		21	A1	0	○	○	○	○	○
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	233	34		22	A2	0	○	○	○	○	○
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	233	35		23	A3	0	○	○	○	○	○
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	233	36		24	A4	0	○	○	○	○	○
—	37	Speed display	0, 1 to 9998	1	0	343	37		25	A5	0	○	○	○	○	○
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	70	41		29	A9	0	○	○	○	○	○
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	70	42		2A	AA	0	○	○	○	○	○
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	70	43		2B	AB	0	○	○	○	○	○
Second functions	44	Second acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	5s	234	44		2C	AC	0	○	○	○	○	○
	45	Second deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	234	45		2D	AD	0	○	○	○	○	○
	46	Second torque boost	0 to 30%, 9999	0.1%	9999	244	46		2E	AE	0	○	×	○	○	○
	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	244	47		2F	AF	0	○	×	○	○	○
	48	Second stall prevention operation current	0 to 150%	0.1%	120%	335	48		30	B0	0	○	○	○	○	○
	49	Second stall prevention operation frequency	0 to 400Hz, 9999	0.01Hz	0Hz	335	49		31	B1	0	○	○	○	○	○
	50	Second output frequency detection	0 to 400Hz	0.01Hz	30Hz	70	50		32	B2	0	○	○	○	○	○
	51	Second electronic thermal O/L relay	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	379	51		33	B3	0	○	○	○	○	○
Monitor functions	52	DU/PU main display data selection	0, 5, 6, 8 to 14, 17, 20, 23 to 25, 50 to 57, 100	1	0	345	52		34	B4	0	○	○	○	○	○
	54	FM terminal function selection	1 to 3, 5, 6, 8 to 14, 17, 18, 21, 24, 50, 52, 53	1	1	345	54		36	B6	0	○	○	○	○	○
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	352	55		37	B7	0	○	○	○	○	○
	56	Current monitoring reference	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	352	56		38	B8	0	○	○	○	○	○
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999/ 0, 0.1 to 30s, 9999 *2	0.1s	9999	367, 416	57		39	B9	0	○	○	○	○	○
	58	Restart cushion time	0 to 60s	0.1s	1s	367, 416	58		3A	BA	0	○	○	○	○	○
—	59	Remote function selection	0, 1, 2, 3	1	0	226	59		3B	BB	0	○	○	○	○	○
—	◎ 60	Energy saving control selection	0, 4, 9	1	0	250	60		3C	BC	0	○	×	○	○	○
—	65	Retry selection	0 to 5	1	0	376	65		41	C1	0	○	○	○	○	○
—	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	335	66		42	C2	0	○	○	○	○	○
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	376	67		43	C3	0	○	○	○	○	○
	68	Retry waiting time	0 to 10s	0.1s	1s	376	68		44	C4	0	○	○	○	○	○
	69	Retry count display erase	0	1	0	376	69		45	C5	0	○	○	○	○	○
—	70	Special regenerative brake duty *5	0 to 10%	0.1%	0%	331	70		46	C6	0	○	○	○	○	○
—	71	Applied motor	0, 1, 2, 20	1	0	266	71		47	C7	0	○	○	○	○	○
—	72	PWM frequency selection	0 to 15/0 to 6, 25 *2	1	2	430	72		48	C8	0	○	○	○	○	○
—	73	Analog input selection	0 to 7, 10 to 17	1	1	217	73		49	C9	0	○	○	○	×	○
—	74	Input filter time constant	0 to 8	1	1	217	74		4A	CA	0	○	○	○	○	○
—	75	Reset selection/disconnected PU detection/ PU stop selection	0 to 3, 14 to 17	1	14	382	75		4B	CB	0	○	○	○	×	×
—	76	Fault code output selection	0, 1, 2	1	0	378	76		4C	CC	0	○	○	○	○	○
—	77	Parameter write selection	0, 1, 2	1	0	384	77		4D *7	CD *7	0	○	○	○	○	○
—	78	Reverse rotation prevention selection	0, 1, 2	1	0	385	78		4E	CE	0	○	○	○	○	○
—	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	209, 434	79		4F *7	CF *7	0	○	○	○	○	○
Simple magnetic flux vector control	80	Motor capacity (simple magnetic flux vector control)	0.4 to 55kW, 9999/ 0 to 3600kW, 9999 *2	0.01/0.1kW *2	9999	252, 256	80		50	D0	0	×	○	○	○	○
	90	Motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	256	90		5A	DA	0	×	○	○	×	○

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	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	
Adjustable 5 points V/F	100	V/F1(first frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	
	101	V/F1(first frequency voltage)	0 to 1000V	0.1V	0V	248	
	102	V/F2(second frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	
	103	V/F2(second frequency voltage)	0 to 1000V	0.1V	0V	248	
	104	V/F3(third frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	
	105	V/F3(third frequency voltage)	0 to 1000V	0.1V	0V	248	
	106	V/F4(fourth frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	
	107	V/F4(fourth frequency voltage)	0 to 1000V	0.1V	0V	248	
	108	V/F5(fifth frequency)	0 to 400Hz, 9999	0.01Hz	9999	248	
	109	V/F5(fifth frequency voltage)	0 to 1000V	0.1V	0V	248	
PU connector communication	117	PU communication station number	0 to 31	1	0	441	
	118	PU communication speed	48, 96, 192, 384	1	192	441	
	119	PU communication stop bit length	0, 1, 10, 11	1	1	441	
	120	PU communication parity check	0, 1, 2	1	2	441	
	121	Number of PU communication retries	0 to 10, 9999	1	1	441	
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	9999	441	
	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	441	
	124	PU communication CR/LF selection	0, 1, 2	1	1	441	
—	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	
—	◎ 126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	
PID operation	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	402	
	128	PID action selection	10, 11, 20, 21, 50, 51, 60, 61	1	10	402	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	402	
	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	402	
	131	PID upper limit	0 to 100%, 9999	0.1%	9999	402	
	132	PID lower limit	0 to 100%, 9999	0.1%	9999	402	
	133	PID action set point	0 to 100%, 9999	0.01%	9999	402	
	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	402	
Electronic bypass	135	Electronic bypass sequence selection	0, 1	1	0	416	
	136	MC switchover interlock time	0 to 100s	0.1s	1s	416	
	137	Start waiting time	0 to 100s	0.1s	0.5s	416	
	138	Bypass selection at a fault	0, 1	1	0	416	
	139	Automatic switchover frequency from inverter to bypass operation	0 to 60Hz, 9999	0.01Hz	9999	416	
Backlash measures	140	Backlash acceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	238	
	141	Backlash acceleration stopping time	0 to 360s	0.1s	0.5s	238	
	142	Backlash deceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	238	
	143	Backlash deceleration stopping time	0 to 360s	0.1s	0.5s	238	
—	144	Speed setting switchover	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	343	
PU	145	PU display language selection	0 to 7	1	0	389	
Current detection	148	Stall prevention level at 0V input	0 to 150%	0.1%	120%	335	
	149	Stall prevention level at 10V input	0 to 150%	0.1%	150%	335	
	150	Output current detection level	0 to 150%	0.1%	120%	72	
	151	Output current detection signal delay time	0 to 10s	0.1s	0s	72	
	152	Zero current detection level	0 to 150%	0.1%	5%	72	
	153	Zero current detection time	0 to 1s	0.01s	0.5s	72	
—	154	Voltage reduction selection during stall prevention operation	0, 1	1	1	335	
—	155	RT signal function validity condition selection	0, 10	1	0	54	
—	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	335	
—	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	335	
—	158	AM terminal function selection	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	1	1	345	
—	159	Automatic switchover frequency range from bypass to inverter operation	0 to 10Hz, 9999	0.01Hz	9999	416	
—	◎ 160	User group read selection	0, 1, 9999	1	9999	386	

[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Control Mode-based Correspondence Table Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
100		00	80	1	○	×	○	○	○
101		01	81	1	○	×	○	○	○
102		02	82	1	○	×	○	○	○
103		03	83	1	○	×	○	○	○
104		04	84	1	○	×	○	○	○
105		05	85	1	○	×	○	○	○
106		06	86	1	○	×	○	○	○
107		07	87	1	○	×	○	○	○
108		08	88	1	○	×	○	○	○
109		09	89	1	○	×	○	○	○
117		11	91	1	○	○	○	○ *9	○ *9
118		12	92	1	○	○	○	○ *9	○ *9
119		13	93	1	○	○	○	○ *9	○ *9
120		14	94	1	○	○	○	○ *9	○ *9
121		15	95	1	○	○	○	○ *9	○ *9
122		16	96	1	○	○	○	○ *9	○ *9
123		17	97	1	○	○	○	○ *9	○ *9
124		18	98	1	○	○	○	○ *9	○ *9
125		19	99	1	○	○	○	×	○
126		1A	9A	1	○	○	○	×	○
127		1B	9B	1	○	○	○	○	○
128		1C	9C	1	○	○	○	○	○
129		1D	9D	1	○	○	○	○	○
130		1E	9E	1	○	○	○	○	○
131		1F	9F	1	○	○	○	○	○
132		20	A0	1	○	○	○	○	○
133		21	A1	1	○	○	○	○	○
134		22	A2	1	○	○	○	○	○
135		23	A3	1	○	○	○	○	○
136		24	A4	1	○	○	○	○	○
137		25	A5	1	○	○	○	○	○
138		26	A6	1	○	○	○	○	○
139		27	A7	1	○	○	○	○	○
140		28	A8	1	○	○	○	○	○
141		29	A9	1	○	○	○	○	○
142		2A	AA	1	○	○	○	○	○
143		2B	AB	1	○	○	○	○	○
144		2C	AC	1	○	○	○	○	○
145		2D	AD	1	○	○	○	×	×
148		30	B0	1	○	○	○	○	○
149		31	B1	1	○	○	○	○	○
150		32	B2	1	○	○	○	○	○
151		33	B3	1	○	○	○	○	○
152		34	B4	1	○	○	○	○	○
153		35	B5	1	○	○	○	○	○
154		36	B6	1	○	○	○	○	○
155		37	B7	1	○	○	○	○	○
156		38	B8	1	○	○	○	○	○
157		39	B9	1	○	○	○	○	○
158		3A	BA	1	○	○	○	○	○
159		3B	BB	1	○	○	○	○	○
160		00	80	2	○	○	○	○	○

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference
—	161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	214, 389
Automatic restart functions	162	Automatic restart after instantaneous power failure selection	0, 1, 10, 11	1	0	367
	163	First cushion time for restart	0 to 20s	0.1s	0s	367
	164	First cushion voltage for restart	0 to 100%	0.1%	0%	367
	165	Stall prevention operation level for restart	0 to 150%	0.1%	120%	367
Current detection	166	Output current detection signal retention time	0 to 10s, 9999	0.1s	0.1s	72
	167	Output current detection operation selection	0, 1	1	0	72
—	168	Parameter for manufacturer setting. Do not set.				
—	169					
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999	1	9999	345
	171	Operation hour meter clear	0, 9999	1	9999	345
User group	172	User group registered display/batch clear	9999 (0 to 16)	1	0	386
	173	User group registration	0 to 999, 9999	1	9999	386
	174	User group clear	0 to 999, 9999	1	9999	386
Input terminal function assignment	178	STF terminal function selection	0 to 8, 10 to 12, 14, 16, 24, 25, 60, 62, 64 to 67, 9999	1	60	37
	179	STR terminal function selection	0 to 8, 10 to 12, 14, 16, 24, 25, 61, 62, 64 to 67, 9999	1	61	37
	180	RL terminal function selection	0 to 8, 10 to 12, 14, 16, 24, 25, 62, 64 to 67, 9999	1	0	37
	181	RM terminal function selection		1	1	37
	182	RH terminal function selection		1	2	37
	183	RT terminal function selection		1	3	37
	184	AU terminal function selection	0 to 8, 10 to 12, 14, 16, 24, 25, 62 to 67, 9999	1	4	37
	185	JOG terminal function selection	0 to 8, 10 to 12, 14, 16, 24, 25, 62, 64 to 67, 9999	1	5	37
	186	CS terminal function selection		1	6	37
	187	MRS terminal function selection		1	24	37
	188	STOP terminal function selection		1	25	37
	189	RES terminal function selection		1	62	37
Output terminal function assignment	190	RUN terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70, 90 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190 to 196, 198, 199, 9999	1	0	61
	191	SU terminal function selection		1	1	61
	192	IPF terminal function selection		1	2	61
	193	OL terminal function selection		1	3	61
	194	FU terminal function selection		1	4	61
	195	ABC1 terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70, 90, 91, 94 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190, 191, 194 to 196, 198, 199, 9999	1	99	61
	196	ABC2 terminal function selection		1	9999	61
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	216
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	216
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	216
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	216
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	216
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	216
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	216
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	216
—	240	Soft-PWM operation selection	0, 1	1	1	430
—	241	Analog input display unit switchover	0, 1	1	0	217
—	242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	0.1%	100%	217
—	243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	0.1%	75%	217

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Simple magnetic flux vector control			
161		01	81	2	○	○	○	×	○
162		02	82	2	○	○	○	○	○
163		03	83	2	○	○	○	○	○
164		04	84	2	○	○	○	○	○
165		05	85	2	○	○	○	○	○
166		06	86	2	○	○	○	○	○
167		07	87	2	○	○	○	○	○
168	Parameter for manufacturer setting. Do not set.								
169									
170		0A	8A	2	○	○	○	×	○
171		0B	8B	2	○	○	×	×	×
172		0C	8C	2	○	○	○	×	×
173		0D	8D	2	○	○	×	×	×
174		0E	8E	2	○	○	×	×	×
178		12	92	2	○	○	○	×	○
179		13	93	2	○	○	○	×	○
180		14	94	2	○	○	○	×	○
181		15	95	2	○	○	○	×	○
182		16	96	2	○	○	○	×	○
183		17	97	2	○	○	○	×	○
184		18	98	2	○	○	○	×	○
185		19	99	2	○	○	○	×	○
186		1A	9A	2	○	○	○	×	○
187		1B	9B	2	○	○	○	×	○
188		1C	9C	2	○	○	○	×	○
189		1D	9D	2	○	○	○	×	○
190		1E	9E	2	○	○	○	×	○
191		1F	9F	2	○	○	○	×	○
192		20	A0	2	○	○	○	×	○
193		21	A1	2	○	○	○	×	○
194		22	A2	2	○	○	○	×	○
195		23	A3	2	○	○	○	×	○
196		24	A4	2	○	○	○	×	○
232		28	A8	2	○	○	○	○	○
233		29	A9	2	○	○	○	○	○
234		2A	AA	2	○	○	○	○	○
235		2B	AB	2	○	○	○	○	○
236		2C	AC	2	○	○	○	○	○
237		2D	AD	2	○	○	○	○	○
238		2E	AE	2	○	○	○	○	○
239		2F	AF	2	○	○	○	○	○
240		30	B0	2	○	○	○	○	○
241		31	B1	2	○	○	○	○	○
242		32	B2	2	○	○	○	○	○
243		33	B3	2	○	○	○	○	○

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PARAMETER

PARAMETER

	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Control Mode-based Correspondence Table Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
—	244	Cooling fan operation selection	0, 1	1	1	431	244		34	B4	2	○	○	○	○	○
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	391	245		35	B5	2	○	○	○	○	○
	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	391	246		36	B6	2	○	○	○	○	○
	247	Constant-power range slip compensation selection	0, 9999	1	9999	391	247		37	B7	2	○	○	○	○	○
—	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	330	250		3A	BA	2	○	○	○	○	○
—	251	Output phase loss protection selection	0, 1	1	1	380	251		3B	BB	2	○	○	○	○	○
Frequency compensation	252	Override bias	0 to 200%	0.1%	50%	217	252		3C	BC	2	○	○	○	○	○
	253	Override gain	0 to 200%	0.1%	150%	217	253		3D	BD	2	○	○	○	○	○
Life diagnosis	255	Life alarm status display	(0 to 15)	1	0	364	255		3F	BF	2	○	○	×	×	×
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	364	256		40	C0	2	○	○	×	×	×
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	364	257		41	C1	2	○	○	×	×	×
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	364	258		42	C2	2	○	○	×	×	×
	259	Main circuit capacitor life measuring	0, 1	1	0	364	259		43	C3	2	○	○	○	○	○
—	260	PWM frequency automatic switchover	0, 1	1	1	430	260		44	C4	2	○	○	○	○	○
Power failure stop	261	Power failure stop selection	0, 1, 2	1	0	373	261		45	C5	2	○	○	○	○	○
	262	Subtracted frequency at deceleration start	0 to 20Hz	0.01Hz	3Hz	373	262		46	C6	2	○	○	○	○	○
	263	Subtraction starting frequency	0 to 120Hz, 9999	0.01Hz	60Hz	373	263		47	C7	2	○	○	○	○	○
	264	Power-failure deceleration time 1	0 to 3600/360s	0.1/0.01s	5s	373	264		48	C8	2	○	○	○	○	○
	265	Power-failure deceleration time 2	0 to 3600/360s, 9999	0.1/0.01s	9999	373	265		49	C9	2	○	○	○	○	○
	266	Power failure deceleration time switchover frequency	0 to 400Hz	0.01Hz	60Hz	373	266		4A	CA	2	○	○	○	○	○
—	267	Terminal 4 input selection	0, 1, 2	1	0	217	267		4B	CB	2	○	○	○	×	○
—	268	Monitor decimal digits selection	0, 1, 9999	1	9999	345	268		4C	CC	2	○	○	○	○	○
—	269	Parameter for manufacturer setting. Do not set.					269	Parameter for manufacturer setting. Do not set.								
—	299	Rotation direction detection selection at restarting	0, 1, 9999	1	9999	367	299		6B	EB	2	○	○	○	○	○
16 bits digital input	300	BCD input bias	0 to 400Hz	0.01Hz	0Hz	229	300	AX	00	80	3	○	○	○	○	○
	301	BCD input gain	0 to 400Hz, 9999	0.01Hz	60Hz	229	301	AX	01	81	3	○	○	○	○	○
	302	BIN input bias	0 to 400Hz	0.01Hz	0Hz	229	302	AX	02	82	3	○	○	○	○	○
	303	BIN input gain	0 to 400Hz, 9999	0.01Hz	60Hz	229	303	AX	03	83	3	○	○	○	○	○
	304	Digital input and analog input compensation enable/disable selection	0 to 3, 10 to 13, 9999	1	9999	229	304	AX	04	84	3	○	○	○	○	○
	305	Read timing operation selection	0, 1, 10	1	0	229	305	AX	05	85	3	○	○	○	○	○
Extension analog output	306	Analog output signal selection	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	1	2	345	306	AY	06	86	3	○	○	○	○	○
	307	Setting for zero analog output	0 to 100%	0.1%	0%	357	307	AY	07	87	3	○	○	○	○	○
	308	Setting for maximum analog output	0 to 100%	0.1%	100%	357	308	AY	08	88	3	○	○	○	○	○
	309	Analog output signal voltage/current switchover	0, 1, 10, 11	1	0	357	309	AY	09	89	3	○	○	○	○	○
	310	Analog meter voltage output selection	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	1	2	345	310	AY	0A	8A	3	○	○	○	○	○
	311	Setting for zero analog meter voltage output	0 to 100%	0.1%	0%	357	311	AY	0B	8B	3	○	○	○	○	○
	312	Setting for maximum analog meter voltage output	0 to 100%	0.1%	100%	357	312	AY	0C	8C	3	○	○	○	○	○
Digital output	313	DO0 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70, 86 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 186 to 196, 198, 199, 9999	1	9999	61	313	AY NC	0D	8D	3	○	○	○	○	○
	314	DO1 output selection		1	9999	61	314	AY NC	0E	8E	3	○	○	○	○	○
	315	DO2 output selection		1	9999	61	315	AY NC	0F	8F	3	○	○	○	○	○
	316	DO3 output selection		1	9999	61	316	AY	10	90	3	○	○	○	○	○
	317	DO4 output selection		1	9999	61	317	AY	11	91	3	○	○	○	○	○
	318	DO5 output selection		1	9999	61	318	AY	12	92	3	○	○	○	○	○
	319	DO6 output selection		1	9999	61	319	AY	13	93	3	○	○	○	○	○

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	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Control Mode-based Correspondence Table Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
Output relay	320	RA1 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70, 86 to 91, 94 to 96, 98, 99, 9999	1	0	61	320	AR	14	94	3	○	○	○	○	○
	321	RA2 output selection		1	1	61	321	AR	15	95	3	○	○	○	○	○
	322	RA3 output selection		1	2	61	322	AR	16	96	3	○	○	○	○	○
Calibration	323	AM0 0V adjustment	900 to 1100%	1	1000%	357	323	AY	17	97	3	○	○	○	×	○
	324	AM1 0mA adjustment	900 to 1100%	1	1000%	357	324	AY	18	98	3	○	○	○	×	○
—	329	Digital input unit selection	0, 1, 2, 3	1	1	229	329	AX	1D	9D	3	○	○	○	×	○
RS-485 communication	331	RS-485 communication station number	0 to 31 (0 to 247)	1	0	441, 459	331		1F	9F	3	○	○	○	○ *9	○ *9
	332	RS-485 communication speed	3, 6, 12, 24, 48, 96, 192, 384	1	96	441, 459	332		20	A0	3	○	○	○	○ *9	○ *9
	333	RS-485 communication stop bit length	0, 1, 10, 11	1	1	441	333		21	A1	3	○	○	○	○ *9	○ *9
	334	RS-485 communication parity check selection	0, 1, 2	1	2	441, 459	334		22	A2	3	○	○	○	○ *9	○ *9
	335	RS-485 communication retry count	0 to 10, 9999	1	1	441	335		23	A3	3	○	○	○	○ *9	○ *9
	336	RS-485 communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0s	441	336		24	A4	3	○	○	○	○ *9	○ *9
	337	RS-485 communication waiting time setting	0 to 150ms, 9999	1	9999	441	337		25	A5	3	○	○	○	○ *9	○ *9
	338	Communication operation command source	0, 1	1	0	436	338		26	A6	3	○	○	○	○ *9	○ *9
	339	Communication speed command source	0, 1, 2	1	0	436	339		27	A7	3	○	○	○	○ *9	○ *9
	340	Communication startup mode selection	0, 1, 2, 10, 12	1	0	434	340		28	A8	3	○	○	○	○ *9	○ *9
	341	RS-485 communication CR/LF selection	0, 1, 2	1	1	441	341		29	A9	3	○	○	○	○ *9	○ *9
	342	Communication EEPROM write selection	0, 1	1	0	443	342		2A	AA	3	○	○	○	○	○
	343	Communication error count	—	1	0	459	343		2B	AB	3	○	○	×	×	×
Device Net communication	345	DeviceNet address	0 to 4095	1	63	—	345	ND	2D	AD	3	○	○	○	○ *9	○ *9
	346	DeviceNet baud rate	0 to 4095	1	132	—	346	ND	2E	AE	3	○	○	○	○ *9	○ *9
Communication	349	Communication reset selection	0, 1	1	0	—	349	NC ND NL NP	31	B1	3	○	○	○	○ *9	○ *9
LonWorks communication	387	Initial communication delay time	0 to 120s	0.1s	0s	—	387	NL	57	D7	3	○	○	○	○	○
	388	Send time interval at heart beat	0 to 999.8s	0.1s	0s	—	388	NL	58	D8	3	○	○	○	○	○
	389	Minimum sending time at heart beat	0 to 999.8s	0.1s	0.5s	—	389	NL	59	D9	3	○	○	○	○	○
	390	% setting reference frequency	1 to 400Hz	0.01Hz	60Hz	—	390	NL	5A	DA	3	○	○	○	○	○
	391	Receive time interval at heart beat	0 to 999.8s	0.1s	0s	—	391	NL	5B	DB	3	○	○	○	○	○
	392	Event driven detection width	0.00 to 163.83%	0.01%	0%	—	392	NL	5C	DC	3	○	○	○	○	○
Remote output	495	Remote output selection	0, 1, 10, 11	1	0	77	495		5F	DF	4	○	○	○	○	○
	496	Remote output data 1	0 to 4095	1	0	77	496		60	E0	4	○	○	×	×	×
	497	Remote output data 2	0 to 4095	1	0	77	497		61	E1	4	○	○	×	×	×
Communication	500	Communication error execution waiting time	0 to 999.8s	0.1s	0	—	500	NC ND NL NP	00	80	5	○	○	○	○	○
	501	Communication error occurrence count display	0	1	0	—	501	NC ND NL NP	01	81	5	○	○	×	○	○
	502	Stop mode selection at communication error	0, 1, 2, 3	1	0	—	502	NC ND NL NP	02	82	5	○	○	○	○	○
Maintenance	503	Maintenance timer	0(1 to 9998)	1	0	74	503		03	83	5	○	○	×	×	×
	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	74	504		04	84	5	○	○	○	×	○

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	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Control Mode-based Correspondence Table Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
—	539	Modbus-RTU communication check time interval	0 to 999.8s, 9999	0.1s	9999	459	539		27	A7	5	○	○	○	○ *9	○ *9
CC-Link communication	542	Communication station number (CC-Link)	1 to 64	1	1	—	542	NC	2A	AA	5	○	○	○	○ *9	○ *9
	543	Baud rate (CC-Link)	0 to 4	1	0	—	543	NC	2B	AB	5	○	○	○	○ *9	○ *9
	544	CC-Link extended setting	0, 1, 12, 14, 18	1	0	—	544	NC	2C	AC	5	○	○	○	○ *9	○ *9
Communication	549	Protocol selection	0, 1	1	0	441, 459	549		31	B1	5	○	○	○	○ *9	○ *9
	550	NET mode operation command source selection	0, 1, 9999	1	9999	436	550		32	B2	5	○	○	○	○ *9	○ *9
	551	PU mode operation command source selection	1, 2	1	2	436	551		33	B3	5	○	○	○	○ *9	○ *9
Current average value monitor	555	Current average time	0.1 to 1.0s	0.1s	1s	75	555		37	B7	5	○	○	○	○	○
	556	Data output mask time	0.0 to 20.0s	0.1s	0s	75	556		38	B8	5	○	○	○	○	○
	557	Current average value monitor signal output reference current	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	75	557		39	B9	5	○	○	○	○	○
—	563	Energization time carrying-over times	(0 to 65535)	1	0	345	563		3F	BF	5	○	○	×	×	×
—	564	Operating time carrying-over times	(0 to 65535)	1	0	345	564		40	C0	5	○	○	×	×	×
—	571	Holding time at a start	0.0 to 10.0s, 9999	0.1s	9999	232	571		47	C7	5	○	○	○	○	○
PID control	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	402	575		4B	CB	5	○	○	○	○	○
	576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	402	576		4C	CC	5	○	○	○	○	○
	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	402	577		4D	CD	5	○	○	○	○	○
—	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	5/15s *2	367	611		0B	8B	6	○	○	○	○	○
—	867	AM output filter	0 to 5s	0.01s	0.01s	352	867		43	C3	8	○	○	○	○	○
—	872	Input phase loss protection selection	0, 1	1	0	380	872		48	C8	8	○	○	○	○	○
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1	1	0	340	882		52	D2	8	○	○	○	○	○
	883	Regeneration avoidance operation level	300 to 800V	0.1V	380/760VDC *6	340	883		53	D3	8	○	○	○	○	○
	884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	1	0	340	884		54	D4	8	○	○	○	○	○
	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	340	885		55	D5	8	○	○	○	○	○
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	340	886		56	D6	8	○	○	○	○	○
Free parameter	888	Free parameter 1	0 to 9999	1	9999	388	888		58	D8	8	○	○	○	×	×
	889	Free parameter 2	0 to 9999	1	9999	388	889		59	D9	8	○	○	○	×	×
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	345, 360	891		5B	DB	8	○	○	○	○	○
	892	Load factor	30 to 150%	0.1%	100%	360	892		5C	DC	8	○	○	○	○	○
	893	Energy saving monitor reference (motor capacity)	0.1 to 55/0 to 3600kW *2	0.01/0.1kW *2	Rated inverter capacity	360	893		5D	DD	8	○	○	○	○	○
	894	Control selection during commercial power-supply operation	0, 1, 2, 3	1	0	360	894		5E	DE	8	○	○	○	○	○
	895	Power saving rate reference value	0, 1, 9999	1	9999	360	895		5F	DF	8	○	○	○	○	○
	896	Power unit cost	0 to 500, 9999	0.01	9999	360	896		60	E0	8	○	○	○	○	○
	897	Power saving monitor average time	0, 1 to 1000h, 9999	1h	9999	360	897		61	E1	8	○	○	○	○	○
	898	Power saving cumulative monitor clear	0, 1, 10, 9999	1	9999	360	898		62	E2	8	○	○	○	×	○
	899	Operation time rate (estimated value)	0 to 100%, 9999	0.1%	9999	360	899		63	E3	8	○	○	○	○	○

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PARAMETER

	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial value	Reference	[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Control Mode-based Correspondence Table Simple magnetic flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
Calibration parameters	C0 (900) *8	FM terminal calibration	—	—	—	356	C0 (900)		5C	DC	1	○	○	○	×	○
	C1 (901) *8	AM terminal calibration	—	—	—	356	C1 (901)		5D	DD	1	○	○	○	×	○
	C2 (902) *8	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217	C2 (902)		5E	DE	1	○	○	○	×	○
	C3 (902) *8	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	217	C3 (902)		5E	DE	1	○	○	○	×	○
	125 (903) *8	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	125 (903)		5F	DF	1	○	○	○	×	○
	C4 (903) *8	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	217	C4 (903)		5F	DF	1	○	○	○	×	○
	C5 (904) *8	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217	C5 (904)		60	E0	1	○	○	○	×	○
	C6 (904) *8	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	217	C6 (904)		60	E0	1	○	○	○	×	○
	126 (905) *8	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	126 (905)		61	E1	1	○	○	○	×	○
	C7 (905) *8	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	217	C7 (905)		61	E1	1	○	○	○	×	○
—	989	Parameter copy alarm release	10, 100	1	10/100 *2	—	989		59	D9	9	○	○	○	×	○
PU	990	PU buzzer control	0, 1	1	1	389	990		5A	DA	9	○	○	○	○	○
	991	PU contrast adjustment	0 to 63	1	58	389	991		5B	DB	9	○	○	○	×	○
Clear parameters	Pr.CL	Parameter clear	0, 1	1	0	—	Pr.CL		—	FC	—	—	—	—	—	—
	ALLC	All parameter clear	0, 1	1	0	—	ALLC		—	FC	—	—	—	—	—	—
	Er.CL	Faults history clear	0, 1	1	0	—	Er.CL		—	F4	—	—	—	—	—	—
	PCPY	Parameter copy	0, 1, 2, 3	1	0	—	PCPY		—	—	—	—	—	—	—	—

*1 Differ according to capacities. (0.75K/1.5K to 3.7K/5.5K, 7.5K/11K to 37K/45K, 55K/75K or more)
*2 Differ according to capacities. (55K or less/75K or more)
*3 Differ according to capacities. (7.5K or less/11K or more)
*4 Differ according to capacities. (7.5K or less/11K to 55K/75K or more)
*5 Setting can be made for the 75K or more.
*6 The initial value differs according to the voltage class. (200V class/400V class)
*7 Can be read and written by only communication from the PU connector.
*8 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*9 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (Refer to page 441 for RS-485 communication)

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2.1.3 FR-E700

For simple variable-speed operation of the inverter, the initial setting of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel.

- ◎ indicates simple mode parameters. (initially set to extended mode)
- The parameters marked with [ ] in the table allow its setting to be changed during operation even if "0" (initial value) is set in [*Pr. 77 Parameter write selection*].

- Symbols in the table indicate parameters which function when an option is mounted.
  AX ••••FR-A7AX E kit, AY ••••FR-A7AY E kit,
  AR ••••FR-A7AR E kit, NC ••••FR-A7NC E kit,
  ND ••••FR-A7ND E kit, NL ••••FR-A7NL E kit,
  NP ••••FR-A7NP E kit
- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication.
- Symbols in the control mode-based correspondence table indicate the following;
  ○: Usable parameter
  ×: Unusable parameter
- Symbols in the parameter copy, parameter clear, and all parameter clear columns indicate the following;
  ○: Valid
  ×: Invalid

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Option	Instruction Code Read	Instruction Code Write	Instruction Code Extended	Control Mode-based Correspondence Table V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
Basic functions	◎ 0	Torque boost	0 to 30%	0.1%	6/4/3/2% *1	244		◎ 0		00	80	0	○	×	×	○	○	○
	◎ 1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	232		◎ 1		01	81	0	○	○	○	○	○	○
	◎ 2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	232		◎ 2		02	82	0	○	○	○	○	○	○
	◎ 3	Base frequency	0 to 400Hz	0.01Hz	60Hz	244		◎ 3		03	83	0	○	×	×	○	○	○
	◎ 4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	216		◎ 4		04	84	0	○	○	○	○	○	○
	◎ 5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	216		◎ 5		05	85	0	○	○	○	○	○	○
	◎ 6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	216, 396		◎ 6		06	86	0	○	○	○	○	○	○
	◎ 7	Acceleration time	0 to 3600/ 360s	0.1/0.01s	5/10/15s *2	234		◎ 7		07	87	0	○	○	○	○	○	○
	◎ 8	Deceleration time	0 to 3600/ 360s	0.1/0.01s	5/10/15s *2	234		◎ 8		08	88	0	○	○	○	○	○	○
	◎ 9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated inverter current	379		◎ 9		09	89	0	○	○	○	○	○	○
DC injection brake	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	328		10		0A	8A	0	○	○	○	○	○	○
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	328		11		0B	8B	0	○	○	○	○	○	○
	12	DC injection brake operation voltage	0 to 30%	0.1%	6/4/2% *3	328		12		0C	8C	0	○	○	○	○	○	○
-	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	232		13		0D	8D	0	○	○	○	○	○	○
-	14	Load pattern selection	0 to 3	1	0	244		14		0E	8E	0	○	×	×	○	○	○
JOG operation	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	215		15		0F	8F	0	○	○	○	○	○	○
	16	Jog acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	0.5s	215, 234		16		10	90	0	○	○	○	○	○	○
-	17	MRS input selection	0, 2, 4	1	0	56		17		11	91	0	○	○	○	○	○	○
-	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120Hz	232		18		12	92	0	○	○	○	○	○	○
-	19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	244		19		13	93	0	○	×	×	○	○	○
Acceleration/ deceleration time	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	234		20		14	94	0	○	○	○	○	○	○
	21	Acceleration/deceleration time increments	0, 1	1	0	234		21		15	95	0	○	○	○	○	○	○
Stall prevention	22	Stall prevention operation level	0 to 200%	0.1%	150%	335		22		16	96	0	○	○	○	○	○	○
	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	335		23		17	97	0	○	○	○	○	○	○

PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	216
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	216
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	216
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	216
-	29	Acceleration/deceleration pattern selection	0, 1, 2	1	0	238
-	30	Regenerative function selection	0, 1, 2	1	0	331
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	233
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	233
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	233
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	233
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	233
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	233
-	37	Speed display	0, 0.01 to 9998	0.001	0	343
-	40	RUN key rotation direction selection	0, 1	1	0	389
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	70
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	70
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	70
Second functions	44	Second acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	5/10/15s *2	234
	45	Second deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	234
	46	Second torque boost	0 to 30%, 9999	0.1%	9999	244
	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	244
	48	Second stall prevention operation current	0 to 200%, 9999	0.1%	9999	335, 396
	51	Second electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	379
Monitor functions	52	DU/PU main display data selection	0, 5, 7 to 12, 14, 20, 23 to 25, 52 to 57, 61, 62, 100	1	0	345
	54	FM terminal function selection	1 to 3, 5, 7 to 12, 14, 21, 24, 52, 53, 61, 62	1	1	345
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	352
	56	Current monitoring reference	0 to 500A	0.01A	Rated inverter current	352
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999	0.1s	9999	367
	58	Restart cushion time	0 to 60s	0.1s	1s	367
-	59	Remote function selection	0, 1, 2, 3	1	0	226
-	60	Energy saving control selection	0, 9	1	0	250
Automatic acceleration /deceleration	61	Reference current	0 to 500A, 9999	0.01A	9999	241
	62	Reference value at acceleration	0 to 200%, 9999	1%	9999	241
	63	Reference value at deceleration	0 to 200%, 9999	1%	9999	241
-	65	Retry selection	0 to 5	1	0	376
-	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	335
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	376
	68	Retry waiting time	0.1 to 360s	0.1s	1s	376
	69	Retry count display erase	0	1	0	376

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
24		18	98	0	○	○	○	○	○	○
25		19	99	0	○	○	○	○	○	○
26		1A	9A	0	○	○	○	○	○	○
27		1B	9B	0	○	○	○	○	○	○
29		1D	9D	0	○	○	○	○	○	○
30		1E	9E	0	○	○	○	○	○	○
31		1F	9F	0	○	○	○	○	○	○
32		20	A0	0	○	○	○	○	○	○
33		21	A1	0	○	○	○	○	○	○
34		22	A2	0	○	○	○	○	○	○
35		23	A3	0	○	○	○	○	○	○
36		24	A4	0	○	○	○	○	○	○
37		25	A5	0	○	○	○	○	○	○
40		28	A8	0	○	○	○	○	○	○
41		29	A9	0	○	○	○	○	○	○
42		2A	AA	0	○	○	○	○	○	○
43		2B	AB	0	○	○	○	○	○	○
44		2C	AC	0	○	○	○	○	○	○
45		2D	AD	0	○	○	○	○	○	○
46		2E	AE	0	○	×	×	○	○	○
47		2F	AF	0	○	×	×	○	○	○
48		30	B0	0	○	○	○	○	○	○
51		33	B3	0	○	○	○	○	○	○
52		34	B4	0	○	○	○	○	○	○
54		36	B6	0	○	○	○	○	○	○
55		37	B7	0	○	○	○	○	○	○
56		38	B8	0	○	○	○	○	○	○
57		39	B9	0	○	○	○	○	○	○
58		3A	BA	0	○	○	○	○	○	○
59		3B	BB	0	○	○	○	○	○	○
60		3C	BC	0	○	×	×	○	○	○
61		3D	BD	0	○	○	○	○	○	○
62		3E	BE	0	○	○	○	○	○	○
63		3F	BF	0	○	○	○	○	○	○
65		41	C1	0	○	○	○	○	○	○
66		42	C2	0	○	○	○	○	○	○
67		43	C3	0	○	○	○	○	○	○
68		44	C4	0	○	○	○	○	○	○
69		45	C5	0	○	○	○	○	○	○

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PARAMETER

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Control Mode-based Correspondence Table: Advanced magnetic flux vector control	Control Mode-based Correspondence Table: General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
-	70	Special regenerative brake duty	0 to 30%	0.1%	0%	331		70		46	C6	0	○	○	○	○	○	○
-	71	Applied motor	0, 1, 3 to 6, 13 to 16, 23, 24, 40, 43, 44, 50, 53, 54	1	0	266		71		47	C7	0	○	○	○	○	○	○
-	72	PWM frequency selection	0 to 15	1	1	430		72		48	C8	0	○	○	○	○	○	○
-	73	Analog input selection	0, 1, 10, 11	1	1	217		73		49	C9	0	○	○	○	○	×	○
-	74	Input filter time constant	0 to 8	1	1	217		74		4A	CA	0	○	○	○	○	○	○
-	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	382		75		4B	CB	0	○	○	○	○	×	×
-	77	Parameter write selection	0, 1, 2	1	0	384		77		4D	CD *4	0	○	○	○	○	○	○
-	78	Reverse rotation prevention selection	0, 1, 2	1	0	385		78		4E	CE	0	○	○	○	○	○	○
-	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	209, 434		◎ 79		4F	CF *4	0	○	○	○	○	○	○
Motor constants	80	Motor capacity	0.1 to 15kW, 9999	0.01kW	9999	252, 258, 261		80		50	D0	0	×	○	○	○	○	○
Motor constants	81	Number of motor poles	2, 4, 6, 8, 10, 9999	1	9999	252, 258		81		51	D1	0	×	○	○	○	○	○
Motor constants	82	Motor excitation current	0 to 500A (0 to ****), 9999 *6	0.01A (1) *6	9999	268		82		52	D2	0	×	○	○	○	×	○
Motor constants	83	Rated motor voltage	0 to 1000V	0.1V	200V/400V *5	268		83		53	D3	0	×	○	○	○	○	○
Motor constants	84	Rated motor frequency	10 to 120Hz	0.01Hz	60Hz	268		84		54	D4	0	×	○	○	○	○	○
Motor constants	89	Speed control gain (Advanced magnetic flux vector)	0 to 200%, 9999	0.1%	9999	258		89		59	D9	0	×	○	×	○	×	○
Motor constants	90	Motor constant (R1)	0 to 50Ω (0 to ****), 9999 *6	0.001Ω (1) *6	9999	268		90		5A	DA	0	○	○	○	○	×	○
Motor constants	91	Motor constant (R2)	0 to 50Ω (0 to ****), 9999 *6	0.001Ω (1) *6	9999	268		91		5B	DB	0	×	○	○	○	×	○
Motor constants	92	Motor constant (L1)	0 to 1000mH (0 to 50Ω, 0 to ****), 9999 *6	0.1mH (0.001Ω, 1) *6	9999	268		92		5C	DC	0	×	○	○	○	×	○
Motor constants	93	Motor constant (L2)	0 to 1000mH (0 to 50Ω, 0 to ****), 9999 *6	0.1mH (0.001Ω, 1) *6	9999	268		93		5D	DD	0	×	○	○	○	×	○
Motor constants	94	Motor constant (X)	0 to 100% (0 to 500Ω, 0 to ****), 9999 *6	0.1% (0.01Ω, 1) *6	9999	268		94		5E	DE	0	×	○	○	○	×	○
Motor constants	96	Auto tuning setting/status	0, 1, 11, 21	1	0	268, 367		96		60	E0	0	○	○	○	○	×	○
PU connector communication	117	PU communication station number	0 to 31 (0 to 247)	1	0	441		117		11	91	1	○	○	○	○	○ *9	○ *9
PU connector communication	118	PU communication speed	48, 96, 192, 384	1	192	441		118		12	92	1	○	○	○	○	○ *9	○ *9
PU connector communication	119	PU communication stop bit length	0, 1, 10, 11	1	1	441		119		13	93	1	○	○	○	○	○ *9	○ *9
PU connector communication	120	PU communication parity check	0, 1, 2	1	2	441		120		14	94	1	○	○	○	○	○ *9	○ *9
PU connector communication	121	Number of PU communication retries	0 to 10, 9999	1	1	441		121		15	95	1	○	○	○	○	○ *9	○ *9
PU connector communication	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0	441		122		16	96	1	○	○	○	○	○ *9	○ *9
PU connector communication	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	441		123		17	97	1	○	○	○	○	○ *9	○ *9
PU connector communication	124	PU communication CR/LF selection	0, 1, 2	1	1	441		124		18	98	1	○	○	○	○	○ *9	○ *9
-	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217		◎ 125		19	99	1	○	○	○	○	×	○
-	◎ 126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217		◎ 126		1A	9A	1	○	○	○	○	×	○
PID operation	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	402		127		1B	9B	1	○	○	○	○	○	○
PID operation	128	PID action selection	0, 20, 21, 40 to 43, 50, 51, 60, 61	1	0	402		128		1C	9C	1	○	○	○	○	○	○
PID operation	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	402		129		1D	9D	1	○	○	○	○	○	○
PID operation	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	402		130		1E	9E	1	○	○	○	○	○	○
PID operation	131	PID upper limit	0 to 100%, 9999	0.1%	9999	402		131		1F	9F	1	○	○	○	○	○	○
PID operation	132	PID lower limit	0 to 100%, 9999	0.1%	9999	402		132		20	A0	1	○	○	○	○	○	○
PID operation	133	PID action set point	0 to 100%, 9999	0.01%	9999	402		133		21	A1	1	○	○	○	○	○	○
PID operation	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	402		134		22	A2	1	○	○	○	○	○	○
PU	145	PU display language selection	0 to 7	1	0	389		145		2D	AD	1	○	○	○	○	×	×

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
-	146 *7	Built-in potentiometer switching	0, 1	1	1	390
-	147	Acceleration/deceleration time switching frequency	0 to 400Hz, 9999	0.01Hz	9999	234
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	72
Current detection	151	Output current detection signal delay time	0 to 10s	0.1s	0s	72
Current detection	152	Zero current detection level	0 to 200%	0.1%	5%	72
Current detection	153	Zero current detection time	0 to 1s	0.01s	0.5s	72
-	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	335
-	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	335
-	◎ 160	User group read selection	0, 1, 9999	1	0	386
-	161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	214, 389
Automatic restart functions	162	Automatic restart after instantaneous power failure selection	0, 1, 10, 11	1	1	367
Automatic restart functions	165	Stall prevention operation level for restart	0 to 200%	0.1%	150%	367
-	168	Parameter for manufacturer setting. Do not set.				
-	169	Parameter for manufacturer setting. Do not set.				
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999	1	9999	345
Cumulative monitor clear	171	Operation hour meter clear	0, 9999	1	9999	345
User group	172	User group registered display/batch clear	9999, (0 to 16)	1	0	386
User group	173	User group registration	0 to 999, 9999	1	9999	386
User group	174	User group clear	0 to 999, 9999	1	9999	386
Input terminal function assignment	178	STF terminal function selection	0 to 5, 7, 8, 10, 12, 14 to 16, 18, 24, 25, 60, 62, 65 to 67, 9999	1	60	37
Input terminal function assignment	179	STR terminal function selection	0 to 5, 7, 8, 10, 12, 14 to 16, 18, 24, 25, 61, 62, 65 to 67, 9999	1	61	37
Input terminal function assignment	180	RL terminal function selection	0 to 5, 7, 8, 10, 12, 14 to 16, 18, 24, 25, 62, 65 to 67, 9999	1	0	37
Input terminal function assignment	181	RM terminal function selection		1	1	37
Input terminal function assignment	182	RH terminal function selection		1	2	37
Input terminal function assignment	183	MRS terminal function selection		1	24	37
Input terminal function assignment	184	RES terminal function selection		1	62	37

[Pr.]	Option	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
146		2E	AE	1	○	○	○	○	×	×
147		2F	AF	1	○	○	○	○	○	○
150		32	B2	1	○	○	○	○	○	○
151		33	B3	1	○	○	○	○	○	○
152		34	B4	1	○	○	○	○	○	○
153		35	B5	1	○	○	○	○	○	○
156		38	B8	1	○	○	○	○	○	○
157		39	B9	1	○	○	○	○	○	○
◎ 160		00	80	2	○	○	○	○	○	○
161		01	81	2	○	○	○	○	×	○
162		02	82	2	○	○	○	○	○	○
165		05	85	2	○	○	○	○	○	○
168	Parameter for manufacturer setting. Do not set.									
169	Parameter for manufacturer setting. Do not set.									
170		0A	8A	2	○	○	○	○	×	○
171		0B	8B	2	○	○	○	×	×	×
172		0C	8C	2	○	○	○	○	×	×
173		0D	8D	2	○	○	○	×	×	×
174		0E	8E	2	○	○	○	×	×	×
178		12	92	2	○	○	○	○	×	○
179		13	93	2	○	○	○	○	×	○
180		14	94	2	○	○	○	○	×	○
181		15	95	2	○	○	○	○	×	○
182		16	96	2	○	○	○	○	×	○
183		17	97	2	○	○	○	○	×	○
184		18	98	2	○	○	○	○	×	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Output terminal function assignment	190	RUN terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 25, 26, 46, 47, 64, 90, 91, 93, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 120, 125, 126, 146, 147, 164, 190, 191, 193, 195, 196, 198, 199, 9999	1	0	61
	191	FU terminal function selection		1	4	61
	192	A,B,C terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 25, 26, 46, 47, 64, 90, 91, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 120, 125, 126, 146, 147, 164, 190, 191, 195, 196, 198, 199, 9999	1	99	61
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	216
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	216
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	216
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	216
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	216
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	216
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	216
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	216
-	240	Soft-PWM operation selection	0, 1	1	1	430
-	241	Analog input display unit switchover	0, 1	1	0	217
-	244	Cooling fan operation selection	0, 1	1	1	431
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	391
	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	391
	247	Constant-power range slip compensation selection	0, 9999	1	9999	391
-	249	Earth (ground) fault detection at start	0, 1	1	0	381
-	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	330
-	251	Output phase loss protection selection	0, 1	1	1	380
Life diagnosis	255	Life alarm status display	(0 to 15)	1	0	364
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	364
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	364
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	364
	259	Main circuit capacitor life measuring	0, 1 (2, 3, 8, 9)	1	0	364
Power failure stop	261	Power failure stop selection	0, 1, 2	1	0	373
-	267	Terminal 4 input selection	0, 1, 2	1	0	217
-	268	Monitor decimal digits selection	0, 1, 9999	1	9999	345
-	269	Parameter for manufacturer setting. Do not set.				
-	270	Stop-on contact control selection	0, 1	1	0	396

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
190		1E	9E	2	○	○	○	○	×	○
191		1F	9F	2	○	○	○	○	×	○
192		20	A0	2	○	○	○	○	×	○
232		28	A8	2	○	○	○	○	○	○
233		29	A9	2	○	○	○	○	○	○
234		2A	AA	2	○	○	○	○	○	○
235		2B	AB	2	○	○	○	○	○	○
236		2C	AC	2	○	○	○	○	○	○
237		2D	AD	2	○	○	○	○	○	○
238		2E	AE	2	○	○	○	○	○	○
239		2F	AF	2	○	○	○	○	○	○
240		30	B0	2	○	○	○	○	○	○
241		31	B1	2	○	○	○	○	○	○
244		34	B4	2	○	○	○	○	○	○
245		35	B5	2	○	×	○	○	○	○
246		36	B6	2	○	×	○	○	○	○
247		37	B7	2	○	×	○	○	○	○
249		39	B9	2	○	○	○	○	○	○
250		3A	BA	2	○	○	○	○	○	○
251		3B	BB	2	○	○	○	○	○	○
255		3F	BF	2	○	○	○	×	×	×
256		40	C0	2	○	○	○	×	×	×
257		41	C1	2	○	○	○	×	×	×
258		42	C2	2	○	○	○	×	×	×
259		43	C3	2	○	○	○	○	○	○
261		45	C5	2	○	○	○	○	○	○
267		4B	CB	2	○	○	○	○	×	○
268		4C	CC	2	○	○	○	○	○	○
269	Parameter for manufacturer setting. Do not set.									
270		4E	CE	2	×	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
									Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
Stop-on contact control	275	Stop-on contact excitation current low-speed multiplying factor	0 to 300%, 9999	0.1%	9999	396	275		53	D3	2	×	○	○	○	○	○
	276	PWM carrier frequency at stop-on contact	0 to 9, 9999	1	9999	396	276		54	D4	2	×	○	○	○	○	○
-	277	Stall prevention operation current switchover	0, 1	1	0	396	277		55	D5	2	○	○	○	○	○	○
Brake sequence function	278	Brake opening frequency	0 to 30Hz	0.01Hz	3Hz	399	278		56	D6	2	×	○	○	○	○	○
	279	Brake opening current	0 to 200%	0.1%	130%	399	279		57	D7	2	×	○	○	○	○	○
	280	Brake opening current detection time	0 to 2s	0.1s	0.3s	399	280		58	D8	2	×	○	○	○	○	○
	281	Brake operation time at start	0 to 5s	0.1s	0.3s	399	281		59	D9	2	×	○	○	○	○	○
	282	Brake operation frequency	0 to 30Hz	0.01Hz	6Hz	399	282		5A	DA	2	×	○	○	○	○	○
	283	Brake operation time at stop	0 to 5s	0.1s	0.3s	399	283		5B	DB	2	×	○	○	○	○	○
Droop control	286	Droop gain	0 to 100%	0.1%	0%	394	286		5E	DE	2	×	○	×	○	○	○
	287	Droop filter time constant	0 to 1s	0.01s	0.3s	394	287		5F	DF	2	×	○	×	○	○	○
-	292	Automatic acceleration/deceleration	0, 1, 7, 8, 11	1	0	241, 399	292		64	E4	2	○	○	○	○	○	○
-	293	Acceleration/deceleration separate selection	0 to 2	1	0	241	293		65	E5	2	○	○	○	○	○	○
-	295	Magnitude of frequency change setting	0, 0.01, 0.10, 1.00, 10.00	0.01	0	389	295		67	E7	2	○	○	○	○	○	○
-	298	Frequency search gain	0 to 32767, 9999	1	9999	367	298		6A	EA	2	○	○	○	○	×	○
-	299	Rotation direction detection selection at restarting	0, 1, 9999	1	0	367	299		6B	EB	2	○	○	○	○	○	○
16bit digital input	300	BCD input bias	0 to 400Hz	0.01Hz	0	229	300	AX	00	80	3	○	○	○	○	○	○
	301	BCD input gain	0 to 400Hz, 9999	0.01Hz	60	229	301	AX	01	81	3	○	○	○	○	○	○
	302	BIN input bias	0 to 400Hz	0.01Hz	0	229	302	AX	02	82	3	○	○	○	○	○	○
	303	BIN input gain	0 to 400Hz, 9999	0.01Hz	60	229	303	AX	03	83	3	○	○	○	○	○	○
	304	Digital input and analog input compensation enable/disable selection	0, 1, 10, 11, 9999	1	9999	229	304	AX	04	84	3	○	○	○	○	○	○
	305	Read timing operation selection	0, 1, 10	1	0	229	305	AX	05	85	3	○	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	
Analog output	306	Analog output signal selection	1 to 3, 5, 7 to 12, 14, 21, 24, 52, 53, 61, 62	1	2	345	
	307	Setting for zero analog output	0 to 100%	0.1%	0	357	
	308	Setting for maximum analog output	0 to 100%	0.1%	100	357	
	309	Analog output signal voltage/current switchover	0, 1, 10, 11	1	0	357	
	310	Analog meter voltage output selection	1 to 3, 5, 7 to 12, 14, 21, 24, 52, 53, 61, 62	1	2	345	
	311	Setting for zero analog meter voltage output	0 to 100%	0.1%	0	357	
	312	Setting for maximum analog meter voltage output	0 to 100%	0.1%	100	357	
Digital output	313	DO0 output selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 25, 26, 46, 47, 64, 90, 91, 93, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 120, 125, 126, 146, 147, 164, 190, 191, 193, 195, 196, 198, 199, 9999	1	9999	61	
	314	DO1 output selection		1	9999	61	
	315	DO2 output selection		1	9999	61	
	316	DO3 output selection		1	9999	61	
	317	DO4 output selection		1	9999	61	
	318	DO5 output selection		1	9999	61	
	319	DO6 output selection		1	9999	61	
Relay output	320	RA1 output selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 25, 26, 46, 47, 64, 90, 91, 95, 96, 98, 99, 9999	1	0	61	
	321	RA2 output selection		1	1	61	
	322	RA3 output selection		1	4	61	
Analog output	323	AM0 0V adjustment	900 to 1100%	1%	1000	357	
	324	AM1 0mA adjustment	900 to 1100%	1%	1000	357	
-	329	Digital input unit selection	0, 1, 2, 3	1	1	229	
RS-485 communication	338	Communication operation command source	0, 1	1	0	436	
	339	Communication speed command source	0, 1, 2	1	0	436	
	340	Communication startup mode selection	0, 1, 10	1	0	434	
	342	Communication EEPROM write selection	0, 1	1	0	443	
	343	Communication error count	-	1	0	459	
DeviceNet communication	345	DeviceNet address	0 to 4095	1	63	—	
	346	DeviceNet baud rate	0 to 4095	1	132	—	
-	349	Communication reset selection	0, 1	1	0	—	
LonWorks communication	387	Initial communication delay time	0 to 120s	0.1s	0s	—	
	388	Send time interval at heart beat	0 to 999.8s	0.1s	0s	—	
	389	Minimum sending time at heart beat	0 to 999.8s	0.1s	0.5s	—	
	390	% setting reference frequency	1 to 400Hz	0.01Hz	60Hz	—	
	391	Receive time interval at heart beat	0 to 999.8s	0.1s	0s	—	
	392	Event driven detection width	0.00 to 163.83%	0.01%	0%	—	
Second motor constant	450	Second applied motor	0, 1, 9999	1	9999	266	

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[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
306	AY	06	86	3	○	○	○	○	○	○
307	AY	07	87	3	○	○	○	○	○	○
308	AY	08	88	3	○	○	○	○	○	○
309	AY	09	89	3	○	○	○	○	○	○
310	AY	0A	8A	3	○	○	○	○	○	○
311	AY	0B	8B	3	○	○	○	○	○	○
312	AY	0C	8C	3	○	○	○	○	○	○
313	AY NC	0D	8D	3	○	○	○	○	○	○
314	AY NC	0E	8E	3	○	○	○	○	○	○
315	AY NC	0F	8F	3	○	○	○	○	○	○
316	AY	10	90	3	○	○	○	○	○	○
317	AY	11	91	3	○	○	○	○	○	○
318	AY	12	92	3	○	○	○	○	○	○
319	AY	13	93	3	○	○	○	○	○	○
320	AR	14	94	3	○	○	○	○	○	○
321	AR	15	95	3	○	○	○	○	○	○
322	AR	16	96	3	○	○	○	○	○	○
323	AY	17	97	3	○	○	○	○	×	○
324	AY	18	98	3	○	○	○	○	×	○
329	AX	1D	9D	3	○	○	○	○	×	○
338		26	A6	3	○	○	○	○	○ *9	○ *9
339		27	A7	3	○	○	○	○	○ *9	○ *9
340		28	A8	3	○	○	○	○	○ *9	○ *9
342		2A	AA	3	○	○	○	○	○	○
343		2B	AB	3	○	○	○	×	×	×
345	ND	2D	AD	3	○	○	○	○	○ *9	○ *9
346	ND	2E	AE	3	○	○	○	○	○ *9	○ *9
349	NC ND NL NP	31	B1	3	○	○	○	○	○ *9	○ *9
387	NL	57	D7	3	○	○	○	○	○	○
388	NL	58	D8	3	○	○	○	○	○	○
389	NL	59	D9	3	○	○	○	○	○	○
390	NL	5A	DA	3	○	○	○	○	○	○
391	NL	5B	DB	3	○	○	○	○	○	○
392	NL	5C	DC	3	○	○	○	○	○	○
450		32	B2	4	○	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Remote output	495	Remote output selection	0, 1, 10, 11	1	0	77
	496	Remote output data 1	0 to 4095	1	0	77
	497	Remote output data 2	0 to 4095	1	0	77
Communication	500	Communication error execution waiting time	0 to 999.8s	0.1s	0	—
	501	Communication error occurrence count display	0	1	0	—
-	502	Stop mode selection at communication error	0, 1, 2, 3	1	0	—
Maintenance	503	Maintenance timer	0 (1 to 9998)	1	0	74
	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	74
CC-Link	541	Frequency command sign selection (CC-Link)	0, 1	1	0	—
	542	Communication station number (CC-Link)	1 to 64	1	1	—
	543	Baud rate (CC-Link)	0 to 4	1	0	—
	544	CC-Link extended setting	0, 1, 12, 14, 18	1	0	—
USB	547	USB communication station number	0 to 31	1	0	473
	548	USB communication check time interval	0 to 999.8s, 9999	0.1s	9999	473
Communication	549	Protocol selection	0, 1	1	0	441, 459
	550	NET mode operation command source selection	0, 2, 9999	1	9999	436
	551	PU mode operation command source selection	2 to 4, 9999	1	9999	436
Current average time monitor	555	Current average time	0.1 to 1.0s	0.1s	1s	75
	556	Data output mask time	0.0 to 20.0s	0.1s	0s	75
	557	Current average value monitor signal output reference current	0 to 500A	0.01A	Rated inverter current	75
-	563	Energization time carrying-over times	(0 to 65535)	1	0	345
-	564	Operating time carrying-over times	(0 to 65535)	1	0	345
-	571	Holding time at a start	0.0 to 10.0s, 9999	0.1s	9999	232
-	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	9999	367
-	653	Speed smoothing control	0 to 200%	0.1%	0	433
-	665	Regeneration avoidance frequency gain	0 to 200%	0.1%	100	340
-	800	Control method selection	20, 30	1	20	252, 258
-	859	Torque current	0 to 500A (0 to ****), 9999 *6	0.01A (1)*6	9999	268
Protective functions	872	Input phase loss protection selection	0, 1	1	1	380
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1, 2	1	0	340
	883	Regeneration avoidance operation level	300 to 800V	0.1V	400VDC/ 780VDC *5	340
	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	340
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	340

[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
		Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
495		5F	DF	4	○	○	○	○	○	○
496		60	E0	4	○	○	○	×	×	×
497		61	E1	4	○	○	○	×	×	×
500	NC ND NL NP	00	80	5	○	○	○	○	○	○
501	NC ND NL NP	01	81	5	○	○	○	×	○	○
502		02	82	5	○	○	○	○	○	○
503		03	83	5	○	○	○	×	×	×
504		04	84	5	○	○	○	○	×	○
541	NC	29	A9	5	○	○	○	○	○ *9	○ *9
542	NC	2A	AA	5	○	○	○	○	○ *9	○ *9
543	NC	2B	AB	5	○	○	○	○	○ *9	○ *9
544	NC	2C	AC	5	○	○	○	○	○ *9	○ *9
547		2F	AF	5	○	○	○	○	○ *9	○ *9
548		30	B0	5	○	○	○	○	○ *9	○ *9
549		31	B1	5	○	○	○	○	○ *9	○ *9
550		32	B2	5	○	○	○	○	○ *9	○ *9
551		33	B3	5	○	○	○	○	○ *9	○ *9
555		37	B7	5	○	○	○	○	○	○
556		38	B8	5	○	○	○	○	○	○
557		39	B9	5	○	○	○	○	○	○
563		3F	BF	5	○	○	○	×	×	×
564		40	C0	5	○	○	○	×	×	×
571		47	C7	5	○	○	○	○	○	○
611		0B	8B	6	○	○	○	○	○	○
653		35	B5	6	○	○	○	○	○	○
665		41	C1	6	○	○	○	○	○	○
800		00	80	8	×	○	○	○	○	○
859		3B	BB	8	×	○	○	○	×	○
872		48	C8	8	○	○	○	○	○	○
882		52	D2	8	○	○	○	○	○	○
883		53	D3	8	○	○	○	○	○	○
885		55	D5	8	○	○	○	○	○	○
886		56	D6	8	○	○	○	○	○	○

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PARAMETER

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
										Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
Free parameter	888	Free parameter 1	0 to 9999	1	9999	388		888		58	D8	8	○	○	○	○	×	×
	889	Free parameter 2	0 to 9999	1	9999	388		889		59	D9	8	○	○	○	○	×	×
Calibration parameters	C0 (900)*8	FM terminal calibration	-	-	-	356		C0 (900)		5C	DC	1	○	○	○	○	×	○
	C1 (901)*8	AM terminal calibration	-	-	-	356		C1 (901)	AY	5D	DD	1	○	○	○	○	×	○
	C2 (902)*8	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217		C2 (902)		5E	DE	1	○	○	○	○	×	○
	C3 (902)*8	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	217		C3 (902)		5E	DE	1	○	○	○	○	×	○
	125 (903)*8	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217		125 (903)		5F	DF	1	○	○	○	○	×	○
	C4 (903)*8	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	217		C4 (903)		5F	DF	1	○	○	○	○	×	○
	C5 (904)*8	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217		C5 (904)		60	E0	1	○	○	○	○	×	○
	C6 (904)*8	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	217		C6 (904)		60	E0	1	○	○	○	○	×	○
	126 (905)*8	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217		126 (905)		61	E1	1	○	○	○	○	×	○
	C7 (905)*8	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	217		C7 (905)		61	E1	1	○	○	○	○	×	○
	C22 (922) *7 *8	Frequency setting voltage bias frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	0	390		C22 (922)		16	96	9	○	○	○	○	×	○
	C23 (922) *7 *8	Frequency setting voltage bias (built-in potentiometer)	0 to 300%	0.1%	0	390		C23 (922)		16	96	9	○	○	○	○	×	○
	C24 (923) *7 *8	Frequency setting voltage gain frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	60Hz	390		C24 (923)		17	97	9	○	○	○	○	×	○
	C25 (923) *7 *8	Frequency setting voltage gain (built-in potentiometer)	0 to 300%	0.1%	100%	390		C25 (923)		17	97	9	○	○	○	○	×	○

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PARAMETER

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Option	Instruction Code			Control Mode-based Correspondence Table			Parameter Copy	Parameter Clear	All Parameter Clear
									Read	Write	Extended	V/F control	Advanced magnetic flux vector control	General-purpose magnetic-flux vector control			
PU	990	PU buzzer control	0, 1	1	1	389	990		5A	DA	9	○	○	○	○	○	○
	991	PU contrast adjustment	0 to 63	1	58	389	991		5B	DB	9	○	○	○	○	×	○
Clear parameters Initial value change list	Pr.CL	Parameter clear	0, 1	1	0	—	Pr.CL		-	FC	-	-	-	-	-	-	-
	ALLC	All parameter clear	0, 1	1	0	—	ALLC		-	FC	-	-	-	-	-	-	-
	Er.CL	Faults history clear	0, 1	1	0	—	Er.CL		-	F4	-	-	-	-	-	-	-
	Pr.CH	Initial value change list	-	-	-	—	Pr.CH		-	-	-	-	-	-	-	-	-

*1 Differ according to capacities.
6%: 0.75K or less
4%: 1.5K to 3.7K
3%: 5.5K, 7.5K
2%: 11K, 15K

*2 Differ according to capacities.
5s: 3.7K or less
10s: 5.5K, 7.5K
15s: 11K, 15K

*3 Differ according to capacities.
6%: 0.1K, 0.2K
4%: 0.4K to 7.5K
2%: 11K, 15K

*4 Write is disabled in the communication mode (Network operation mode) from the PU connector.

*5 The initial value differs according to the voltage class. (200V class/400V class)

*6 Differ according to [*Pr. 71*] setting.

*7 Set this parameter when calibrating the operation panel built-in potentiometer for the FR-E500 series operation panel (PA02) connected with cable.

*8 The parameter number in parentheses is the one for use with the operation panel (PA02) for the FR-E500 series or parameter unit (FR-PU04/FR-PU07).

*9 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (Refer to page 441 for RS-485 communication)

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2.1.4 FR-D700

In the initial setting, only the simple mode parameters are displayed. Set [*Pr. 160 User group read selection*] as required.

- ◎ indicates simple mode parameters.
- The parameters marked with ▭ in the table allow its setting to be changed during operation even if 0 (initial value) is set in [*Pr. 77 Parameter write selection*]

[Pr.]	Name	Initial Value	Setting Range	Remarks
160	User group read selection	9999	9999	Only the simple mode parameters can be displayed.
			0	Simple mode+extended mode parameters can be displayed.

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- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication.
- Symbols in the control mode-based correspondence table indicate the following;
  - ○: Usable parameter
  - ×: Unusable parameter
- Symbols in the parameter copy, parameter clear, and all parameter clear columns indicate the following;
  - ○: Valid
  - ×: Invalid

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Basic functions	◎ 0	Torque boost	0 to 30%	0.1%	6/4/3% *1	244
	◎ 1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	232
	◎ 2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	232
	◎ 3	Base frequency	0 to 400Hz	0.01Hz	60Hz	244
	◎ 4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	216
	◎ 5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	216
	◎ 6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	216
	◎ 7	Acceleration time	0 to 3600s	0.1s	5/10s *2	234
	◎ 8	Deceleration time	0 to 3600s	0.1s	5/10s *2	234
	◎ 9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated inverter current	379
DC injection brake	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	325
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	325
	12	DC injection brake operation voltage	0 to 30%	0.1%	4%	328
-	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	232
-	14	Load pattern selection	0 to 3	1	0	244
JOG operation	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	215
	16	Jog acceleration/deceleration time	0 to 3600s	0.1s	0.5s	215, 234
-	17	MRS input selection	0, 2, 4	1	0	56
-	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120Hz	232
-	19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	244
Acceleration/ deceleration time	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	234
Stall prevention	22	Stall prevention operation level	0 to 200%	0.1%	150%	283
	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	335
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	216
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	216
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	216
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	216
-	29	Acceleration/deceleration pattern selection	0, 1, 2	1	0	238
-	30	Regenerative function selection	0, 1, 2	1	0	331

[Pr.]	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Control Mode-based Correspondence Table: General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
◎ 0	00	80	0	○	×	○	○	○
◎ 1	01	81	0	○	○	○	○	○
◎ 2	02	82	0	○	○	○	○	○
◎ 3	03	83	0	○	×	○	○	○
◎ 4	04	84	0	○	○	○	○	○
◎ 5	05	85	0	○	○	○	○	○
◎ 6	06	86	0	○	○	○	○	○
◎ 7	07	87	0	○	○	○	○	○
◎ 8	08	88	0	○	○	○	○	○
◎ 9	09	89	0	○	○	○	○	○
10	0A	8A	0	○	○	○	○	○
11	0B	8B	0	○	○	○	○	○
12	0C	8C	0	○	○	○	○	○
13	0D	8D	0	○	○	○	○	○
14	0E	8E	0	○	×	○	○	○
15	0F	8F	0	○	○	○	○	○
16	10	90	0	○	○	○	○	○
17	11	91	0	○	○	○	○	○
18	12	92	0	○	○	○	○	○
19	13	93	0	○	×	○	○	○
20	14	94	0	○	○	○	○	○
22	16	96	0	○	○	○	○	○
23	17	97	0	○	○	○	○	○
24	18	98	0	○	○	○	○	○
25	19	99	0	○	○	○	○	○
26	1A	9A	0	○	○	○	○	○
27	1B	9B	0	○	○	○	○	○
29	1D	9D	0	○	○	○	○	○
30	1E	9E	0	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Control Mode-based Correspondence Table: General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	233		31	1F	9F	0	○	○	○	○	○
Frequency jump	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	233		32	20	A0	0	○	○	○	○	○
Frequency jump	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	233		33	21	A1	0	○	○	○	○	○
Frequency jump	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	233		34	22	A2	0	○	○	○	○	○
Frequency jump	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	233		35	23	A3	0	○	○	○	○	○
Frequency jump	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	233		36	24	A4	0	○	○	○	○	○
-	37	Speed display	0, 0.01 to 9998	0.001	0	343		37	25	A5	0	○	○	○	○	○
-	40	RUN key rotation direction selection	0, 1	1	0	389		40	28	A8	0	○	○	○	○	○
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	70		41	29	A9	0	○	○	○	○	○
Frequency detection	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	70		42	2A	AA	0	○	○	○	○	○
Frequency detection	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	70		43	2B	AB	0	○	○	○	○	○
Second functions	44	Second acceleration/deceleration time	0 to 3600s	0.1s	5/10s *2	234		44	2C	AC	0	○	○	○	○	○
Second functions	45	Second deceleration time	0 to 3600s, 9999	0.1s	9999	234		45	2D	AD	0	○	○	○	○	○
Second functions	46	Second torque boost	0 to 30%, 9999	0.1%	9999	244		46	2E	AE	0	○	×	○	○	○
Second functions	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	244		47	2F	AF	0	○	×	○	○	○
Second functions	48	Second stall prevention operation current	0 to 200%, 9999	0.1%	9999	335		48	30	B0	0	○	○	○	○	○
Second functions	51	Second electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	379		51	33	B3	0	○	○	○	○	○
Monitor functions	52	DU/PU main display data selection	0, 5, 8 to 12, 14, 20, 23 to 25, 52 to 55, 61, 62, 64, 100	1	0	345		52	34	B4	0	○	○	○	○	○
Monitor functions	54	FM terminal function selection	1 to 3, 5, 8 to 12, 14, 21, 24, 52, 53, 61, 62	1	1	345		54	36	B6	0	○	○	○	○	○
Monitor functions	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	352		55	37	B7	0	○	○	○	○	○
Monitor functions	56	Current monitoring reference	0 to 500A	0.01A	Rated inverter current	352		56	38	B8	0	○	○	○	○	○
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999	0.1s	9999	367		57	39	B9	0	○	○	○	○	○
Automatic restart functions	58	Restart cushion time	0 to 60s	0.1s	1s	367		58	3A	BA	0	○	○	○	○	○
-	59	Remote function selection	0, 1, 2, 3	1	0	226		59	3B	BB	0	○	○	○	○	○
-	60	Energy saving control selection	0, 9	1	0	250		60	3C	BC	0	○	×	○	○	○
-	65	Retry selection	0 to 5	1	0	376		65	41	C1	0	○	○	○	○	○
-	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	335		66	42	C2	0	○	○	○	○	○
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	376		67	43	C3	0	○	○	○	○	○
Retry	68	Retry waiting time	0.1 to 600s	0.1s	1s	376		68	44	C4	0	○	○	○	○	○
Retry	69	Retry count display erase	0	1	0	376		69	45	C5	0	○	○	○	○	○
-	70	Special regenerative brake duty	0 to 30%	0.1%	0%	331		70	46	C6	0	○	○	○	○	○
-	71	Applied motor	0, 1, 3, 13, 23, 40, 43, 50, 53	1	0	266		71	47	C7	0	○	○	○	○	○
-	72	PWM frequency selection	0 to 15	1	1	430		72	48	C8	0	○	○	○	○	○
-	73	Analog input selection	0, 1, 10, 11	1	1	217		73	49	C9	0	○	○	○	×	○
-	74	Input filter time constant	0 to 8	1	1	217		74	4A	CA	0	○	○	○	○	○
-	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	382		75	4B	CB	0	○	○	○	×	×
-	77	Parameter write selection	0, 1, 2	1	0	384		77	4D	CD *3	0	○	○	○	○	○
-	78	Reverse rotation prevention selection	0, 1, 2	1	0	385		78	4E	CE	0	○	○	○	○	○
-	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	209, 434		◎ 79	4F	CF *3	0	○	○	○	○	○

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Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Motor constants	80	Motor capacity	0.1 to 7.5kW, 9999	0.01kW	9999	252, 258
Motor constants	82	Motor excitation current	0 to 500A, 9999	0.01A	9999	268
Motor constants	83	Rated motor voltage	0 to 1000V	0.1V	400V	268
Motor constants	84	Rated motor frequency	10 to 120Hz	0.01Hz	60Hz	268
Motor constants	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	268
Motor constants	96	Auto tuning setting/status	0, 11, 21	1	0	268, 367
PU connector communication	117	PU communication station number	0 to 31(0 to 247)	1	0	441
PU connector communication	118	PU communication speed	48, 96, 192, 384	1	192	441
PU connector communication	119	PU communication stop bit length	0, 1, 10, 11	1	1	441
PU connector communication	120	PU communication parity check	0, 1, 2	1	2	441
PU connector communication	121	Number of PU communication retries	0 to 10, 9999	1	1	441
PU connector communication	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0	441
PU connector communication	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	441
PU connector communication	124	PU communication CR/LF selection	0, 1, 2	1	1	441
-	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217
-	◎ 126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217
PID operation	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	402
PID operation	128	PID action selection	0, 20, 21, 40 to 43	1	0	402
PID operation	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	402
PID operation	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	402
PID operation	131	PID upper limit	0 to 100%, 9999	0.1%	9999	402
PID operation	132	PID lower limit	0 to 100%, 9999	0.1%	9999	402
PID operation	133	PID action set point	0 to 100%, 9999	0.01%	9999	402
PID operation	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	402
PU	145	PU display language selection	0 to 7	1	0	389
-	146 *4	Built-in potentiometer switching	0, 1	1	1	390
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	72
Current detection	151	Output current detection signal delay time	0 to 10s	0.1s	0s	72
Current detection	152	Zero current detection level	0 to 200%	0.1%	5%	72
Current detection	153	Zero current detection time	0 to 1s	0.01s	0.5s	72
-	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	335
-	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	335
-	◎ 160	Extended function display selection	0, 9999	1	9999	386
-	161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	214, 389
Automatic restart functions	162	Automatic restart after instantaneous power failure selection	0, 1, 10, 11	1	1	367
Automatic restart functions	165	Stall prevention operation level for restart	0 to 200%	0.1%	150%	367
Current detection	166	Output current detection signal retention time	0 to 10s, 9999	0.1s	0.1s	72
Current detection	167	Output current detection operation selection	0, 1	1	0	72
-	168	Parameter for manufacturer setting. Do not set.				
-	169					
Cumulative monitor	170	Watt-hour meter clear	0, 10, 9999	1	9999	345
Cumulative monitor	171	Operation hour meter clear	0, 9999	1	9999	345

[Pr.]	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
	Read	Write	Extended	V/F control	General-purpose magnetic-flux vector control			
80	50	D0	0	×	○	○	○	○
82	52	D2	0	×	○	○	×	○
83	53	D3	0	×	○	○	○	○
84	54	D4	0	×	○	○	○	○
90	5A	DA	0	○	○	○	×	○
96	60	E0	0	○	○	○	×	○
117	11	91	1	○	○	○	○ *6	○ *6
118	12	92	1	○	○	○	○ *6	○ *6
119	13	93	1	○	○	○	○ *6	○ *6
120	14	94	1	○	○	○	○ *6	○ *6
121	15	95	1	○	○	○	○ *6	○ *6
122	16	96	1	○	○	○	○ *6	○ *6
123	17	97	1	○	○	○	○ *6	○ *6
124	18	98	1	○	○	○	○ *6	○ *6
◎ 125	19	99	1	○	○	○	×	○
◎ 126	1A	9A	1	○	○	○	×	○
127	1B	9B	1	○	○	○	○	○
128	1C	9C	1	○	○	○	○	○
129	1D	9D	1	○	○	○	○	○
130	1E	9E	1	○	○	○	○	○
131	1F	9F	1	○	○	○	○	○
132	20	A0	1	○	○	○	○	○
133	21	A1	1	○	○	○	○	○
134	22	A2	1	○	○	○	○	○
145	2D	AD	1	○	○	○	×	×
146	2E	AE	1	○	○	○	×	×
150	32	B2	1	○	○	○	○	○
151	33	B3	1	○	○	○	○	○
152	34	B4	1	○	○	○	○	○
153	35	B5	1	○	○	○	○	○
156	38	B8	1	○	○	○	○	○
157	39	B9	1	○	○	○	○	○
◎ 160	00	80	2	○	○	○	○	○
161	01	81	2	○	○	○	×	○
162	02	82	2	○	○	○	○	○
165	05	85	2	○	○	○	○	○
166	06	86	2	○	○	○	○	○
167	07	87	2	○	○	○	○	○
168	Parameter for manufacturer setting. Do not set.							
169								
170	0A	8A	2	○	○	○	×	○
171	0B	8B	2	○	○	×	×	×

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PARAMETER

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page		[Pr.]	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
									Read	Write	Extended	V/F control	General-purpose magnetic-flux vector control			
Input terminal function assignment	178	STF terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 60, 62, 65 to 67, 9999	1	60	37		178	12	92	2	○	○	○	×	○
	179	STR terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 61, 62, 65 to 67, 9999	1	61	37		179	13	93	2	○	○	○	×	○
	180	RL terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 62, 65 to 67, 9999	1	0	37		180	14	94	2	○	○	○	×	○
	181	RM terminal function selection		1	1	37		181	15	95	2	○	○	○	×	○
	182	RH terminal function selection		1	2	37		182	16	96	2	○	○	○	×	○
Output terminal function assignment	190	RUN terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 80, 90, 91, 93, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 180, 190, 191, 193, 195, 196, 198, 199, 9999	1	0	61		190	1E	9E	2	○	○	○	×	○
	192	A,B,C terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 80, 90, 91, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 180, 190, 191, 195, 196, 198, 199, 9999	1	99	61		192	20	A0	2	○	○	○	×	○
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	216		232	28	A8	2	○	○	○	○	○
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	216		233	29	A9	2	○	○	○	○	○
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	216		234	2A	AA	2	○	○	○	○	○
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	216		235	2B	AB	2	○	○	○	○	○
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	216		236	2C	AC	2	○	○	○	○	○
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	216		237	2D	AD	2	○	○	○	○	○
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	216		238	2E	AE	2	○	○	○	○	○
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	216		239	2F	AF	2	○	○	○	○	○
-	240	Soft-PWM operation selection	0, 1	1	1	430		240	30	B0	2	○	○	○	○	○
-	241	Analog input display unit switchover	0, 1	1	0	217		241	31	B1	2	○	○	○	○	○
-	244	Cooling fan operation selection	0, 1	1	1	431		244	34	B4	2	○	○	○	○	○
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	391		245	35	B5	2	○	○	○	○	○
	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	391		246	36	B6	2	○	○	○	○	○
	247	Constant-power range slip compensation selection	0, 9999	1	9999	391		247	37	B7	2	○	○	○	○	○
-	249	Earth (ground) fault detection at start	0, 1	1	0	381		249	39	B9	2	○	○	○	○	○
-	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	330		250	3A	BA	2	○	○	○	○	○
-	251	Output phase loss protection selection	0, 1	1	1	380		251	3B	BB	2	○	○	○	○	○
Life diagnosis	255	Life alarm status display	(0 to 15)	1	0	364		255	3F	BF	2	○	○	×	×	×
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	364		256	40	C0	2	○	○	×	×	×
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	364		257	41	C1	2	○	○	×	×	×
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	364		258	42	C2	2	○	○	×	×	×
	259	Main circuit capacitor life measuring	0, 1 (2, 3, 8, 9)	1	0	364		259	43	C3	2	○	○	○	○	○
-	260	PWM frequency automatic switchover	0, 1	1	0	430		260	44	C4	2	○	○	○	○	○

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PARAMETER

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Instruction Code: Read	Instruction Code: Write	Instruction Code: Extended	Control Mode-based Correspondence Table: V/F control	Control Mode-based Correspondence Table: General-purpose magnetic-flux vector control	Parameter Copy	Parameter Clear	All Parameter Clear
Power failure stop	261	Power failure stop selection	0, 1, 2	1	0	373	45	C5	2	○	○	○	○	○
-	267	Terminal 4 input selection	0, 1, 2	1	0	217	4B	CB	2	○	○	○	×	○
-	268	Monitor decimal digits selection	0, 1, 9999	1	9999	345	4C	CC	2	○	○	○	○	○
-	269	Parameter for manufacturer setting. Do not set.					Parameter for manufacturer setting. Do not set.							
-	295	Magnitude of frequency change setting	0, 0.01, 0.10, 1.00, 10.00	0.01	0	389	67	E7	2	○	○	○	○	○
Password function	296	Password lock level	1 to 6, 101 to 106, 9999	1	9999	387	68	E8	2	○	○	○	×	○
Password function	297	Password lock/unlock	1000 to 9999(0 to 5, 9999)	1	9999	387	69	E9	2	○	○	○	×	○
-	298	Frequency search gain	0 to 32767, 9999	1	9999	367	6A	EA	2	○	○	○	×	○
-	299	Rotation direction detection selection at restarting	0, 1, 9999	1	0	367	6B	EB	2	○	○	○	○	○
RS-485 communication	338	Communication operation command source	0, 1	1	0	436	26	A6	3	○	○	○	○ *6	○ *6
RS-485 communication	339	Communication speed command source	0, 1, 2	1	0	436	27	A7	3	○	○	○	○ *6	○ *6
RS-485 communication	340	Communication startup mode selection	0, 1, 10	1	0	434	28	A8	3	○	○	○	○ *6	○ *6
RS-485 communication	342	Communication EEPROM write selection	0, 1	1	0	443	2A	AA	3	○	○	○	○	○
RS-485 communication	343	Communication error count	-	1	0	459	2B	AB	3	○	○	×	×	×
Second motor constant	450	Second applied motor	0, 1, 9999	1	9999	266	32	B2	4	○	○	○	○	○
Remote Output	495	Remote output selection	0, 1, 10, 11	1	0	77	5F	DF	4	○	○	○	○	○
Remote Output	496	Remote output data 1	0 to 4095	1	0	77	60	E0	4	○	○	×	×	×
-	502	Stop mode selection at communication error	0, 1, 2	1	0	-	02	82	5	○	○	○	○	○
Maintenance	503	Maintenance timer	0(1 to 9998)	1	0	74	03	83	5	○	○	×	×	×
Maintenance	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	74	04	84	5	○	○	○	×	○
Communication	549	Protocol selection	0, 1	1	0	441, 459	31	B1	5	○	○	○	○ *6	○ *6
Communication	551	PU mode operation command source selection	2, 4, 9999	1	9999	436	33	B3	5	○	○	○	○ *6	○ *6
Current average time monitor	555	Current average time	0.1 to 1s	0.1s	1s	75	37	B7	5	○	○	○	○	○
Current average time monitor	556	Data output mask time	0 to 20s	0.1s	0s	75	38	B8	5	○	○	○	○	○
Current average time monitor	557	Current average value monitor signal output reference current	0 to 500A	0.01A	Rated inverter current	75	39	B9	5	○	○	○	○	○
-	561	PTC thermistor protection level	0.5 to 30kΩ, 9999	0.01kΩ	9999	50	3D	BD	5	○	○	○	×	○
-	563	Energization time carrying-over times	(0 to 65535)	1	0	345	3F	BF	5	○	○	×	×	×
-	564	Operating time carrying-over times	(0 to 65535)	1	0	345	40	C0	5	○	○	×	×	×
-	571	Holding time at a start	0 to 10s, 9999	0.1s	9999	232	47	C7	5	○	○	○	○	○

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PARAMETER

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	[Pr.]	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
								Read	Write	Extended	V/F control	General-purpose magnetic-flux vector control			
PID operation	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	402	575	4B	CB	5	○	○	○	○	○
PID operation	576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	402	576	4C	CC	5	○	○	○	○	○
PID operation	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	402	577	4D	CD	5	○	○	○	○	○
-	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	9999	367	611	0B	8B	6	○	○	○	○	○
-	653	Speed smoothing control	0 to 200%	0.1%	0	433	653	35	B5	6	○	○	○	○	○
-	665	Regeneration avoidance frequency gain	0 to 200%	0.1%	100	340	665	41	C1	6	○	○	○	○	○
Protective functions	872	Input phase loss protection selection	0, 1	1	0	380	872	48	C8	8	○	○	○	○	○
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1, 2	1	0	340	882	52	D2	8	○	○	○	○	○
Regeneration avoidance function	883	Regeneration avoidance operation level	300 to 800V	0.1V	780VDC	340	883	53	D3	8	○	○	○	○	○
Regeneration avoidance function	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	340	885	55	D5	8	○	○	○	○	○
Regeneration avoidance function	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	340	886	56	D6	8	○	○	○	○	○
Free parameter	888	Free parameter 1	0 to 9999	1	9999	388	888	58	D8	8	○	○	○	×	×
Free parameter	889	Free parameter 2	0 to 9999	1	9999	388	889	59	D9	8	○	○	○	×	×
-	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	345	891	5B	DB	8	○	○	○	○	○
Calibration parameters	C0 (900)*5	FM terminal calibration	-	-	-	356	C0 (900)	5C	DC	1	○	○	○	×	○
Calibration parameters	C2 (902)*5	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217	C2 (902)	5E	DE	1	○	○	○	×	○
Calibration parameters	C3 (902)*5	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	217	C3 (902)	5E	DE	1	○	○	○	×	○
Calibration parameters	125 (903)*5	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	125 (903)	5F	DF	1	○	○	○	×	○
Calibration parameters	C4 (903)*5	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	217	C4 (903)	5F	DF	1	○	○	○	×	○
Calibration parameters	C5 (904)*5	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	217	C5 (904)	60	E0	1	○	○	○	×	○
Calibration parameters	C6 (904)*5	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	217	C6 (904)	60	E0	1	○	○	○	×	○
Calibration parameters	126 (905)*5	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	217	126 (905)	61	E1	1	○	○	○	×	○
Calibration parameters	C7 (905)*5	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	217	C7 (905)	61	E1	1	○	○	○	×	○
Calibration parameters	C22 (922) *4 *5	Frequency setting voltage bias frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	0	390	C22 (922)	16	96	9	○	○	○	×	○
Calibration parameters	C23 (922) *4 *5	Frequency setting voltage bias (built-in potentiometer)	0 to 300%	0.1%	0	390	C23 (922)	16	96	9	○	○	○	×	○
Calibration parameters	C24 (923) *4 *5	Frequency setting voltage gain frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	60Hz	390	C24 (923)	17	97	9	○	○	○	×	○
Calibration parameters	C25 (923) *4 *5	Frequency setting voltage gain (built-in potentiometer)	0 to 300%	0.1%	100%	390	C25 (923)	17	97	9	○	○	○	×	○
PU	990	PU buzzer control	0, 1	1	1	389	990	5A	DA	9	○	○	○	○	○
PU	991	PU contrast adjustment	0 to 63	1	58	389	991	5B	DB	9	○	○	○	×	○

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PARAMETER

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PARAMETER

Function	[Pr.]	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page
Clear parameters Initial value change list	Pr.CL	Parameter clear	0, 1	1	0	—
	ALLC	All parameter clear	0, 1	1	0	—
	Er.CL	Faults history clear	0, 1	1	0	—
	Pr.CH	Initial value change list	-	-	-	—

[Pr.]	Instruction Code			Control Mode-based Correspondence Table		Parameter Copy	Parameter Clear	All Parameter Clear
	Read	Write	Extended	V/F control	General-purpose magnetic-flux vector control			
Pr.CL	-	FC	-	-	-	-	-	-
ALLC	-	FC	-	-	-	-	-	-
Er.CL	-	F4	-	-	-	-	-	-
Pr.CH	-	-	-	-	-	-	-	-

*1 Differ according to capacities.
6%: 0.75K or less
4%: 1.5K to 3.7K
3%: 5.5K, 7.5K

*2 Differ according to capacities.
5s: 3.7K or less
10s: 5.5K, 7.5K

*3 Write is disabled in the communication mode (network operation mode) from the PU connector.

*4 Set this parameter when calibrating the operation panel built-in potentiometer for the FR-E500 series operation panel (PA02) connected with cable.

*5 The parameter number in parentheses is the one for use with the operation panel (PA02) for the FR-E500 series or parameter unit (FR-PU04/FR-PU07).

*6 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (Refer to page 441 for RS-485 communication)

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2.2 List of parameters classified by purpose of use

2.2.1 FR-A700, F700

Set parameters according to the operating conditions. The following list indicates purpose of use and corresponding parameters.

Purpose of Use		Parameter Number	
		FR-A700	FR-F700
Control mode	Change the control method	[*Pr. 80*], [*Pr. 81*], [*Pr. 451*], [*Pr. 800*]	[*Pr. 80*]
Speed control by Real sensorless vector control and vector control	Torque limit level setting for speed control	[*Pr. 22*], [*Pr. 803*], [*Pr. 810 to 817*], [*Pr. 858*], [*Pr. 868*], [*Pr. 874*]	—
	High accuracy and fast response control is desired (gain adjustment of Real sensorless vector control and vector control)	[*Pr. 818 to Pr. 821*], [*Pr. 830*], [*Pr. 831*], [*Pr. 880*]	—
	Speed feed forward control, model adaptive speed control	[*Pr. 828*], [*Pr. 877 to Pr. 881*]	—
	Torque bias	[*Pr. 840 to Pr. 848*]	—
	Prevent the motor from overrunning	[*Pr. 285*], [*Pr. 853*], [*Pr. 873*]	—
	Notch filter	[*Pr. 862*], [*Pr. 863*]	—
Torque control by Real sensorless vector control and vector control	Torque command	[*Pr. 803 to Pr. 806*]	—
	Speed limit	[*Pr. 807 to Pr. 809*]	—
	Gain adjustment for torque control	[*Pr. 824*], [*Pr. 825*], [*Pr. 834*], [*Pr. 835*]	—
Position control by vector control	Conditional position feed function by contact input	[*Pr. 419*], [*Pr. 464 to Pr. 494*]	—
	Position control by pulse train input of the inverter	[*Pr. 419*], [*Pr. 428 to Pr. 430*]	—
	Setting the electronic gear	[*Pr. 420*], [*Pr. 421*], [*Pr. 424*]	—
	Setting of positioning adjustment parameter	[*Pr. 426*], [*Pr. 427*]	—
	Gain adjustment of position control	[*Pr. 422*], [*Pr. 423*], [*Pr. 425*]	—
Adjust the output torque (current) of the motor	Torque boost	[*Pr. 0*], [*Pr. 46*], [*Pr. 112*]	[*Pr. 0*], [*Pr. 46*]
	Advanced magnetic flux vector control	[*Pr. 80*], [*Pr. 81*], [*Pr. 89*], [*Pr. 453*], [*Pr. 454*], [*Pr. 569*]	—
	Simple vector control	—	[*Pr. 80*], [*Pr. 90*]
	Slip compensation	[*Pr. 245 to Pr. 247*]	[*Pr. 245 to Pr. 247*]
	Stall prevention operation	[*Pr. 22*], [*Pr. 23*], [*Pr. 48*], [*Pr. 49*], [*Pr. 66*], [*Pr. 114*], [*Pr. 115*], [*Pr. 148*], [*Pr. 149*], [*Pr. 154*], [*Pr. 156*], [*Pr. 157*], [*Pr. 858*], [*Pr. 868*]	[*Pr. 22*], [*Pr. 23*], [*Pr. 48*], [*Pr. 49*], [*Pr. 66*], [*Pr. 148*], [*Pr. 149*], [*Pr. 154*], [*Pr. 156*], [*Pr. 157*]
Limit the output frequency	Maximum/minimum frequency	[*Pr. 1*], [*Pr. 2*], [*Pr. 18*]	[*Pr. 1*], [*Pr. 2*], [*Pr. 18*]
	Avoid mechanical resonance points (frequency jump)	[*Pr. 31 to 36*]	[*Pr. 31 to 36*]
	Speed limit	[*Pr. 807 to Pr. 809*]	—
Set V/F pattern	Base frequency, voltage	[*Pr. 3*], [*Pr. 19*], [*Pr. 47*], [*Pr. 113*]	[*Pr. 3*], [*Pr. 19*], [*Pr. 47*]
	V/F pattern matching applications	[*Pr. 14*]	[*Pr. 14*]
	Adjustable 5 points V/F	[*Pr. 71*], [*Pr. 100 to 109*]	[*Pr. 71*], [*Pr. 100 to Pr. 109*]
Frequency setting with terminals (contact input)	Multi-speed setting operation	[*Pr. 4 to Pr. 6*], [*Pr. 24 to Pr. 27*], [*Pr. 232 to Pr. 239*]	[*Pr. 4 to Pr. 6*], [*Pr. 24 to Pr. 27*], [*Pr. 232 to Pr. 239*]
	Jog operation	[*Pr. 15*], [*Pr. 16*]	[*Pr. 15*], [*Pr. 16*]
	Input compensation of multi-speed and remote setting	[*Pr. 28*]	[*Pr. 28*]
	Remote setting function	[*Pr. 59*]	[*Pr. 59*]

Purpose of Use		Parameter Number	
		FR-A700	FR-F700
Acceleration/ deceleration time/ pattern adjustment	Acceleration/deceleration time	[*Pr. 7*], [*Pr. 8*], [*Pr. 20*], [*Pr. 21*], [*Pr. 44*], [*Pr. 45*], [*Pr. 110*], [*Pr. 111*]	[*Pr. 7*], [*Pr. 8*], [*Pr. 20*], [*Pr. 21*], [*Pr. 44*], [*Pr. 45*]
	Starting frequency	[*Pr. 13*], [*Pr. 571*]	[*Pr. 13*]
	Acceleration/deceleration pattern and backlash measures	[*Pr. 29*], [*Pr. 140 to Pr. 143*], [*Pr. 380 to Pr. 383*], [*Pr. 516 to Pr. 519*]	[*Pr. 29*], [*Pr. 140 to Pr. 143*]
	Set a shortest and optimum acceleration/ deceleration time automatically (automatic acceleration/deceleration)	[*Pr. 61 to Pr. 64*], [*Pr. 292*], [*Pr. 293*]	—
	Regeneration avoidance function	[*Pr. 882 to Pr. 886*]	[*Pr. 882 to Pr. 886*]
Selection and protection of a motor	Motor protection from overheat (electronic thermal relay function)	[*Pr. 9*], [*Pr. 51*]	[*Pr. 9*], [*Pr. 51*]
	Use the constant-torque motor (applied motor)	[*Pr. 71*], [*Pr. 450*]	[*Pr. 71*]
	Offline auto tuning	[*Pr. 82 to Pr. 84*], [*Pr. 90 to 94*], [*Pr. 96*], [*Pr. 455 to Pr. 463*], [*Pr. 684*], [*Pr. 859*], [*Pr. 860*]	—
	Online auto tuning	[*Pr. 95*], [*Pr. 574*]	—
	Easy gain tuning	[*Pr. 818*], [*Pr. 819*]	—
Motor brake and stop operation	DC injection brake	[*Pr. 10 to Pr. 12*], [*Pr. 850*]	[*Pr. 10 to Pr. 12*]
	Selection of regeneration unit and DC feeding	[*Pr. 30*], [*Pr. 70*]	[*Pr. 30*], [*Pr. 70*]
	Selection of motor stopping method and start signal	[*Pr. 250*]	[*Pr. 250*]
	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	[*Pr. 261 to Pr. 266*], [*Pr. 294*]	[*Pr. 261 to Pr. 266*]
	Stop-on-contact control	[*Pr. 6*], [*Pr. 270*], [*Pr. 275*], [*Pr. 276*]	—
	Brake sequence function	[*Pr. 278 to Pr. 285*], [*Pr. 292*]	—
Function assignment of external terminal and control	Function assignment of input terminal	[*Pr. 178 to Pr. 189*]	[*Pr. 178 to Pr. 189*]
	Start signal selection	[*Pr. 250*]	[*Pr. 250*]
	Logic selection of output stop signal (MRS)	[*Pr. 17*]	[*Pr. 17*]
	Selection of action conditions of the second (third) function signal (RT (X9))	[*Pr. 155*]	[*Pr. 155*]
	Function assignment of output terminal	[*Pr. 190 to Pr. 196*]	[*Pr. 190 to Pr. 196*]
	Detection of output frequency (SU, FU, FU2, FU3, FB, FB2, FB3, LS signal)	[*Pr. 41 to Pr. 43*], [*Pr. 50*], [*Pr. 116*], [*Pr. 865*]	[*Pr. 41 to Pr. 43*], [*Pr. 50*]
	Detection of output current (Y12 signal) Detection of zero current (Y13 signal)	[*Pr. 150 to 153*], [*Pr. 166*], [*Pr. 167*]	[*Pr. 150 to 153*], [*Pr. 166*], [*Pr. 167*]
	Remote output function (REM signal)	[*Pr. 495 to Pr. 497*]	[*Pr. 495 to Pr. 497*]
Monitor display and monitor output signal	Speed display and speed setting	[*Pr. 37*], [*Pr. 144*]	[*Pr. 37*], [*Pr. 144*]
	Change of DU/PU monitor descriptions Cumulative monitor clear	[*Pr. 52*], [*Pr. 170*], [*Pr. 171*], [*Pr. 563*], [*Pr. 564*], [*Pr. 891*]	[*Pr. 52*], [*Pr. 170*], [*Pr. 171*], [*Pr. 563*], [*Pr. 564*], [*Pr. 891*]
	Change of the monitor output from terminal FM and AM	[*Pr. 54 to Pr. 56*], [*Pr. 158*], [*Pr. 866*], [*Pr. 867*]	[*Pr. 54 to Pr. 56*], [*Pr. 158*], [*Pr. 867*]
	Adjustment of terminal FM and AM output (calibration)	[*C0*]([*Pr. 900*]) [*C1*]([*Pr. 901*])	[*C0*]([*Pr. 900*]) [*C1*]([*Pr. 901*])
	Energy saving monitor	[*Pr. 891 to Pr. 899*]	[*Pr. 891 to Pr. 899*]
Detection of output frequency, current and torque	Detection of output frequency (SU, FU, FU2, FU3, FB, FB2, FB3, LS signal)	[*Pr. 41 to Pr. 43*], [*Pr. 50*], [*Pr. 116*], [*Pr. 865*]	[*Pr. 41 to Pr. 43*], [*Pr. 50*]
	Detection of output current (Y12 signal) Detection of zero current (Y13 signal)	[*Pr. 150* to *Pr. 153*], [*Pr. 166*], [*Pr. 167*]	[*Pr. 150 to Pr. 153*], [*Pr. 166*], [*Pr. 167*]
	Torque detection (TU signal)	[*Pr. 864*]	—

Purpose of Use		Parameter Number FR-A700	Parameter Number FR-F700
Operation selection at power failure and instantaneous power failure	Automatic restart operation after instantaneous power failure/flying start	[*Pr. 57*], [*Pr. 58*], [*Pr. 162 to Pr. 165*], [*Pr. 299*], [*Pr. 611*]	[*Pr. 57*], [*Pr. 58*], [*Pr. 162 to Pr. 165*], [*Pr. 299*], [*Pr. 611*]
	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop	[*Pr. 261 to Pr. 266*], [*Pr. 294*]	[*Pr. 261 to Pr. 266*]
Operation setting at fault occurrence	Retry function at fault occurrence	[*Pr. 65*], [*Pr. 67 to Pr. 69*]	[*Pr. 65*], [*Pr. 67 to Pr. 69*]
	Output function of fault code	[*Pr. 76*]	[*Pr. 76*]
	Input/output phase loss protection selection	[*Pr. 251*], [*Pr. 872*]	[*Pr. 251*], [*Pr. 872*]
	Fault definition	[*Pr. 875*]	—
	Regeneration avoidance function	[*Pr. 882 to Pr. 886*]	[*Pr. 882 to Pr. 886*]
Energy saving operation	Energy saving control selection (optimum excitation control)	[*Pr. 60*]	[*Pr. 60*]
	How much energy can be saved (energy saving monitor)	[*Pr. 891 to Pr. 899*]	[*Pr. 891 to Pr. 899*]
Reduction of the motor noise Measures against EMI and leakage currents	Carrier frequency and Soft-PWM selection	[*Pr. 72*], [*Pr. 240*]	[*Pr. 72*], [*Pr. 240*], [*Pr. 260*]
	Noise elimination at the analog input	[*Pr. 74*], [*Pr. 822*], [*Pr. 826*], [*Pr. 832*], [*Pr. 836*], [*Pr. 849*]	[*Pr. 74*]
Frequency setting by analog input	Analog input selection	[*Pr. 73*], [*Pr. 267*]	[*Pr. 73*], [*Pr. 267*]
	Override function	[*Pr. 73*], [*Pr. 252*], [*Pr. 253*]	[*Pr. 73*], [*Pr. 252*], [*Pr. 253*]
	Noise elimination at the analog input	[*Pr. 74*], [*Pr. 822*], [*Pr. 826*], [*Pr. 832*], [*Pr. 836*], [*Pr. 849*]	[*Pr. 74*]
	Change of analog input frequency, Adjustment of voltage, current input and frequency (calibration)	[*Pr. 125*], [*Pr. 126*], [*Pr. 241*], [*C2 to C7*] ([*Pr. 902 to Pr. 905*])	[*Pr. 125*], [*Pr. 126*], [*Pr. 241*], [*C2 to C7*] ([*Pr. 902 to 905*])
	Analog input compensation	[*Pr. 242*], [*Pr. 243*]	[*Pr. 242*], [*Pr. 243*]
Misoperation prevention and parameter setting restriction	Reset selection, disconnected PU detection	[*Pr. 75*]	[*Pr. 75*]
	Prevention of parameter rewrite	[*Pr. 77*]	[*Pr. 77*]
	Prevention of reverse rotation of the motor	[*Pr. 78*]	[*Pr. 78*]
	Display necessary parameters only (user group)	[*Pr. 160*], [*Pr. 172 to 174*]	[*Pr. 160*], [*Pr. 172 to 174*]
	Control of parameter write by communication	[*Pr. 342*]	[*Pr. 342*]
Selection of operation mode and operation location	Operation mode selection	[*Pr. 79*]	[*Pr. 79*]
	Operation mode when power is ON	[*Pr. 79*], [*Pr. 340*]	[*Pr. 79*], [*Pr. 340*]
	Operation command source and speed command source during communication operation	[*Pr. 338*], [*Pr. 339*]	[*Pr. 338*], [*Pr. 339*]
	NET mode command source selection	[*Pr. 550*]	[*Pr. 550*]
	PU mode command source selection	[*Pr. 551*]	[*Pr. 551*]

Purpose of Use		Parameter Number FR-A700	Parameter Number FR-F700
Communication operation and setting	RS-485 communication initial setting	[Pr. 117 to Pr. 124], [Pr. 331 to 337], [Pr. 341]	[Pr. 117 to 124], [Pr. 331 to 337], [Pr. 341]
	Control of parameter write by communication	[Pr. 342]	[Pr. 342]
	ModbusRTU communication specifications	[Pr. 343]	[Pr. 343]
	Operation command source and speed command source during communication operation	[Pr. 338], [Pr. 339]	[Pr. 338], [Pr. 339]
	Use setup software (USB communication)	[Pr. 547], [Pr. 548]	—
	NET mode command source selection	[Pr. 550]	[Pr. 550]
	Modbus RTU (communication protocol selection)	[Pr. 549]	[Pr. 549]
Special operation and frequency control	PID control	[Pr. 127 to 134], [Pr. 575 to Pr. 577]	[Pr. 127 to Pr. 134], [Pr. 575 to Pr. 577]
	Switch between the inverter operation and electronic bypass operation to use	[Pr. 135 to Pr. 139], [Pr. 159]	[Pr. 135 to Pr. 139], [Pr. 159]
	Operate at a high speed when a load is light. (load torque high speed frequency control)	[Pr. 4], [Pr. 5], [Pr. 270 to Pr. 274]	—
	Droop control	[Pr. 286 to Pr. 288]	—
	Frequency control by pulse train input	[Pr. 291], [Pr. 384 to Pr. 386]	—
Useful functions	Free parameter	[Pr. 888], [Pr. 889]	[Pr. 888], [Pr. 889]
	Increase cooling fan life	[Pr. 244]	[Pr. 244]
	To determine the maintenance time of parts	[Pr. 255 to Pr. 259], [Pr. 503], [Pr. 504]	[Pr. 255 to Pr. 259], [Pr. 503], [Pr. 504]
	How much energy can be saved (energy saving monitor)	[Pr. 60], [Pr. 891 to Pr. 899]	[Pr. 60], [Pr. 891 to Pr. 899]
Setting the parameter unit and operation panel	Parameter unit display language selection	[Pr. 145]	[Pr. 145]
	Operation selection of the operation panel	[Pr. 161]	[Pr. 161]
	Buzzer control of the operation panel	[Pr. 990]	[Pr. 990]
	Contrast adjustment of the parameter unit	[Pr. 991]	[Pr. 991]

2.2.2 FR-E700, D700

Set parameters according to the operating conditions. The following list indicates purpose of use and corresponding parameters.

Purpose of Use		Parameter Number	
		FR-E700	FR-D700
Control mode	Change the control method	[*Pr. 80*], [*Pr. 81*], [*Pr. 800*]	[*Pr. 80*]
Adjust the output torque (current) of the motor	Torque boost	[*Pr. 0*], [*Pr. 46*]	[*Pr. 0*], [*Pr. 46*]
	Advanced magnetic flux vector control	[*Pr. 80*], [*Pr. 81*], [*Pr. 89*], [*Pr. 800*]	—
	General-purpose magnetic-flux vector control	[*Pr. 80*], [*Pr. 81*], [*Pr. 800*]	[*Pr. 80*]
	Slip compensation	[*Pr. 245 to Pr. 247*]	[*Pr. 245 to Pr. 247*]
	Stall prevention operation	[*Pr. 22*], [*Pr. 23*], [*Pr. 48*], [*Pr. 66*], [*Pr. 156*], [*Pr. 157*], [*Pr. 277*]	[*Pr. 22*], [*Pr. 23*], [*Pr. 48*], [*Pr. 66*], [*Pr. 156*], [*Pr. 157*]
Limit the output frequency	Maximum/minimum frequency	[*Pr. 1*], [*Pr. 2*], [*Pr. 18*]	[*Pr. 1*], [*Pr. 2*], [*Pr. 18*]
	Avoid mechanical resonance points (frequency jump)	[*Pr. 31 to 36*]	[*Pr. 31 to 36*]
Set V/F pattern	Base frequency, voltage	[*Pr. 3*], [*Pr. 19*], [*Pr. 47*]	[*Pr. 3*], [*Pr. 19*], [*Pr. 47*]
	V/F pattern matching applications	[*Pr. 14*]	[*Pr. 14*]
Frequency setting with terminals (contact input)	Multi-speed setting operation	[*Pr. 4 to Pr. 6*], [*Pr. 24 to Pr. 27*], [*Pr. 232 to Pr. 239*]	[*Pr. 4 to Pr. 6*], [*Pr. 24 to Pr. 27*], [*Pr. 232 to Pr. 239*]
	Jog operation	[*Pr. 15*], [*Pr. 16*]	[*Pr. 15*], [*Pr. 16*]
	Remote setting function	[*Pr. 59*]	[*Pr. 59*]
Acceleration/ deceleration time/ pattern adjustment	Acceleration/deceleration time	[*Pr. 7*], [*Pr. 8*], [*Pr. 20*], [*Pr. 21*], [*Pr. 44*], [*Pr. 45*], [*Pr. 147*]	[*Pr. 7*], [*Pr. 8*], [*Pr. 20*], [*Pr. 44*], [*Pr. 45*]
	Starting frequency	[*Pr. 13*], [*Pr. 571*]	[*Pr. 13*], [*Pr. 571*]
	Acceleration/deceleration pattern	[*Pr. 29*]	[*Pr. 29*]
	Set a shortest and optimum acceleration/ deceleration time automatically (automatic acceleration/deceleration)	[*Pr. 61 to Pr. 63*], [*Pr. 292*], [*Pr. 293*]	—
	Regeneration avoidance function	[*Pr. 665*], [*Pr. 882*], [*Pr. 883*], [*Pr. 885*], [*Pr. 886*]	[*Pr. 665*], [*Pr. 882*], [*Pr. 883*], [*Pr. 885*], [*Pr. 886*]
Selection and protection of a motor	Motor protection from overheat (electronic thermal relay function)	[*Pr. 9*], [*Pr. 51*]	[*Pr. 9*], [*Pr. 51*]
	Use the constant-torque motor (applied motor)	[*Pr. 71*], [*Pr. 450*]	[*Pr. 71*], [*Pr. 450*]
	Offline auto tuning	[*Pr. 71*], [*Pr. 82 to Pr. 84*], [*Pr. 90 to 94*], [*Pr. 96*], [*Pr. 859*]	[*Pr. 71*], [*Pr. 82 to Pr. 84*], [*Pr. 90*], [*Pr. 96*]
Motor brake and stop operation	DC injection brake	[*Pr. 10 to Pr. 12*]	[*Pr. 10 to Pr. 12*]
	Selection of regeneration unit	[*Pr. 30*], [*Pr. 70*]	[*Pr. 30*], [*Pr. 70*]
	Selection of motor stopping method and start signal	[*Pr. 250*]	[*Pr. 250*]
	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	[*Pr. 261*]	[*Pr. 261*]
	Stop-on-contact control	[*Pr. 6*], [*Pr. 270*], [*Pr. 275*], [*Pr. 276*]	—
	Brake sequence function	[*Pr. 278 to Pr. 283*], [*Pr. 292*]	—

Purpose of Use		Parameter Number FR-E700	Parameter Number FR-D700
Function assignment of external terminal and control	Function assignment of input terminal	[Pr. 178 to Pr. 184]	[Pr. 178 to Pr. 182]
	Start signal selection	[Pr. 250]	[Pr. 250]
	Logic selection of output stop signal (MRS)	[Pr. 17]	[Pr. 17]
	Function assignment of output terminal	[Pr. 190 to Pr. 192]	[Pr. 190], [Pr. 192]
	Detection of output frequency (SU, FU signal)	[Pr. 41 to Pr. 43]	[Pr. 41 to Pr. 43]
	Detection of output current (Y12 signal) Detection of zero current (Y13 signal)	[Pr. 150 to 153]	[Pr. 150 to 153], [Pr. 166], [Pr. 167]
	Remote output function (REM signal)	[Pr. 495 to Pr. 497]	[Pr. 495], [Pr. 496]
Monitor display and monitor output signal	Speed display and speed setting	[Pr. 37]	[Pr. 37]
	Change of DU/PU monitor descriptions Cumulative monitor clear	[Pr. 52], [Pr. 170], [Pr. 171], [Pr. 563], [Pr. 564]	[Pr. 52], [Pr. 170], [Pr. 171], [Pr. 563], [Pr. 564], [Pr. 891]
	Change of the monitor output from terminal FM	[Pr. 54 to Pr. 56]	[Pr. 54 to Pr. 56]
	Selection of the decimal digits of the monitor	[Pr. 268]	[Pr. 268]
	Adjustment of terminal FM output (calibration)	[C0]([Pr. 900])	[C0]([Pr. 900])
Detection of output frequency, current	Detection of output frequency (SU, FU signal)	[Pr. 41 to Pr. 43]	[Pr. 41 to Pr. 43]
	Detection of output current (Y12 signal) Detection of zero current (Y13 signal)	[Pr. 150 to Pr. 153]	[Pr. 150 to Pr. 153], [Pr. 166], [Pr. 167]
Operation selection at power failure and instantaneous power failure	Automatic restart operation after instantaneous power failure/flying start	[Pr. 57], [Pr. 58], [Pr. 162], [Pr. 165], [Pr. 298], [Pr. 299], [Pr. 611]	[Pr. 57], [Pr. 58], [Pr. 162], [Pr. 165], [Pr. 298], [Pr. 299], [Pr. 611]
	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop	[Pr. 261]	[Pr. 261]
Operation setting at fault occurrence	Retry function at fault occurrence	[Pr. 65], [Pr. 67 to Pr. 69]	[Pr. 65], [Pr. 67 to Pr. 69]
	Input/output phase loss protection selection	[Pr. 251], [Pr. 872]	[Pr. 251], [Pr. 872]
	Earth (ground) fault detection at start	[Pr. 249]	[Pr. 249]
	Regeneration avoidance function	[Pr. 665], [Pr. 882], [Pr. 883], [Pr. 885], [Pr. 886]	[Pr. 665], [Pr. 882], [Pr. 883], [Pr. 885], [Pr. 886]
Energy saving operation	Energy saving control selection	[Pr. 60]	[Pr. 60]
Reduction of the motor noise Measures against EMI and leakage currents	Carrier frequency and Soft-PWM selection	[Pr. 72], [Pr. 240]	[Pr. 72], [Pr. 240], [Pr. 260]
	Noise elimination at the analog input	[Pr. 74]	[Pr. 74]
	Reduce mechanical resonance (speed smoothing control)	[Pr. 653]	[Pr. 653]
Frequency setting by analog input	Analog input selection	[Pr. 73], [Pr. 267]	[Pr. 73], [Pr. 267]
	Noise elimination at the analog input	[Pr. 74]	[Pr. 74]
	Change of analog input frequency, Adjustment of voltage, current input and frequency (calibration)	[Pr. 125], [Pr. 126], [Pr. 241], [C2 to C7] ([Pr. 902 to Pr. 905])	[Pr. 125], [Pr. 126], [Pr. 241], [C2 to C7] ([Pr. 902 to 905])

Purpose of Use		Parameter Number	
		FR-E700	FR-D700
Misoperation prevention and parameter setting restriction	Reset selection, disconnected PU detection	[*Pr. 75*]	[*Pr. 75*]
	Prevention of parameter rewrite	[*Pr. 77*]	[*Pr. 77*]
	Password function	—	[*Pr. 296*], [*Pr. 297*]
	Prevention of reverse rotation of the motor	[*Pr. 78*]	[*Pr. 78*]
	Display necessary parameters only (user group)	[*Pr. 160*], [*Pr. 172 to 174*]	[*Pr. 160*]
	Control of parameter write by communication	[*Pr. 342*]	[*Pr. 342*]
Selection of operation mode and operation location	Operation mode selection	[*Pr. 79*]	[*Pr. 79*]
	Operation mode when power is ON	[*Pr. 79*], [*Pr. 340*]	[*Pr. 79*], [*Pr. 340*]
	Operation command source and speed command source during communication operation	[*Pr. 338*], [*Pr. 339*]	[*Pr. 338*], [*Pr. 339*]
	NET mode command source selection	[*Pr. 550*]	[*Pr. 550*]
	PU mode command source selection	[*Pr. 551*]	[*Pr. 551*]
Communication operation and setting	RS-485 communication initial setting	[*Pr. 117 to Pr. 124*], [*Pr. 502*]	[*Pr. 117 to Pr. 124*], [*Pr. 502*]
	Control of parameter write by communication	[*Pr. 342*]	[*Pr. 342*]
	ModbusRTU communication specifications	[*Pr. 343*]	[*Pr. 343*]
	Operation command source and speed command source during communication operation	[*Pr. 338*], [*Pr. 339*], [*Pr. 550*], [*Pr. 551*]	[*Pr. 338*], [*Pr. 339*], [*Pr. 551*]
	Use setup software (USB communication)	[*Pr. 547*], [*Pr. 548*]	—
	NET mode command source selection	[*Pr. 550*]	—
	Modbus RTU (communication protocol selection)	[*Pr. 549*]	[*Pr. 549*]
Special operation and frequency control	PID control	[*Pr. 127 to 134*]	[*Pr. 127 to Pr. 134*], [*Pr. 575 to Pr. 577*]
	Dancer control	[*Pr. 128 to Pr. 134*]	[*Pr. 128 to Pr. 134*], [*Pr. 575 to Pr. 577*]
	Droop control	[*Pr. 286*], [*Pr. 287*]	—
Useful functions	Increase cooling fan life	[*Pr. 244*]	[*Pr. 244*]
	To determine the maintenance time of parts	[*Pr. 255 to Pr. 259*], [*Pr. 503*], [*Pr. 504*], [*Pr. 555 to Pr. 557*]	[*Pr. 255 to Pr. 259*], [*Pr. 503*], [*Pr. 504*], [*Pr. 555 to Pr. 557*], [*Pr. 563*], [*Pr. 564*]
	Use the operation panel (PA02) of the FR-E500 series.	[*Pr. 146*], [*C22 to C25 (Pr. 922 to Pr. 923)*]	[*Pr. 146*], [*C22 to C25 (Pr. 922 to Pr. 923)*]
Setting the parameter unit and operation panel	RUN key rotation direction selection	[*Pr. 40*]	[*Pr. 40*]
	Parameter unit display language selection	[*Pr. 145*]	[*Pr. 145*]
	Operation selection of the operation panel	[*Pr. 161*]	[*Pr. 161*]
	Buzzer control of the operation panel	[*Pr. 990*]	[*Pr. 990*]
	Contrast adjustment of the parameter unit	[*Pr. 991*]	[*Pr. 991*]

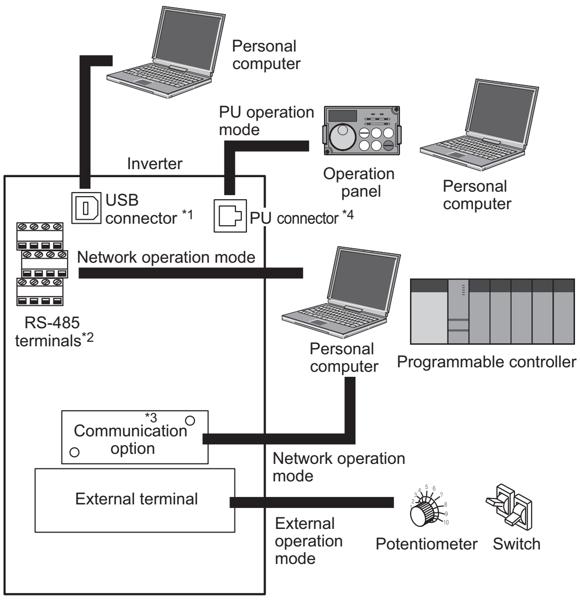
2.3 Operation mode

2.3.1 Operation mode selection [Pr. 79] (common)

The operation mode specifies the source of the start command and the frequency command for the inverter.
Basically, there are following operation modes.

- External operation mode: For inputting start command and frequency command with an external potentiometer and switches which are connected to the control circuit terminal.
- PU operation mode: For inputting start command and frequency command with the operation panel (FR-DU07 / FR-PA07), parameter unit (FR-PU04 / FR-PU07), or RS-485 communication *4 using PU connector.
- Network operation mode (NET operation mode): For inputting start command and frequency command with RS-485 terminal *2 or communication option *3.

The operation mode can be selected from the operation panel or with the communication instruction code.
The operation mode is factory-set to allow the "PU operation" or "External operation mode" to be selected by using (PU/EXT) and the "External operation mode" at power on.
Refer to page 434 for the "Network operation mode".



*1 B connector for (A700), and mini B connector for (E700)
(F700) and (D700) do not have USB connector.

*2 (E700) and (D700) do not have RS-485 terminal.

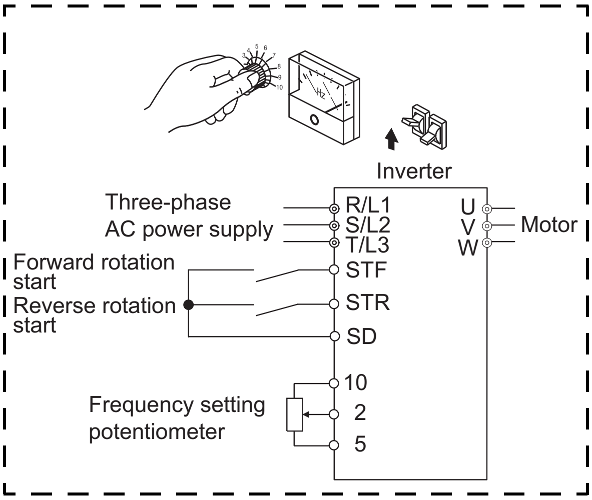
*3 Built-in option is not available for (D700).

*4 For (E700) and (D700), change to Network operation mode for RS-485 communication with PU connector.

[Pr.]	Name	Initial Value	Setting Range	Description	PU Operation		External Operation		Remarks
					Frequency command	Start command	Frequency command	Start command	
79	Operation mode selection	0	0	External/PU switching mode	○		○ (at powering ON)		Switch with (PU/EXT)
			1	Fixed to PU operation mode	○		×		
			2	Fixed to External operation mode	×		○		
			3	External/PU combined operation mode 1	○	×	×	○	
			4	External/PU combined operation mode 2	×	○	○	×	
			6	Switchover mode	○		○ (at powering ON)		Switching is enabled while running
			7	PU operation interlock	○		○ (at powering ON)		External operation can be fixed with X12 signal
			0, 6, 7	X16 signal External/PU switching mode	○		○		Operation mode can be switched with X16 signal

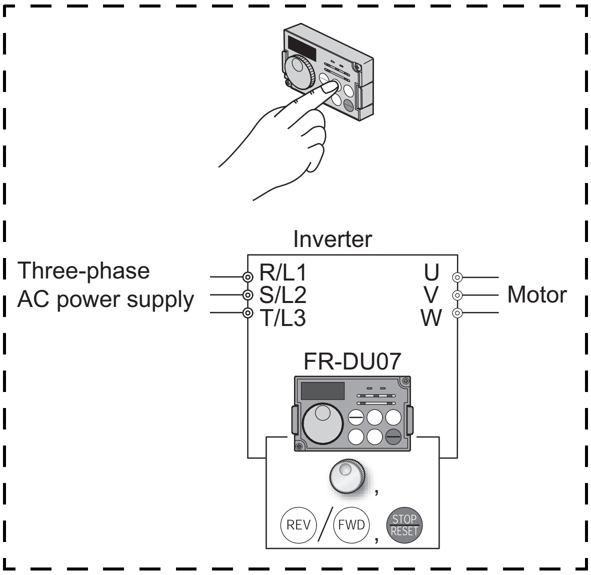
(1) External operation mode[*Pr. 79 = 0, 2*]

Select the External operation mode when the start command and the frequency command are applied from a frequency setting potentiometer, start switch, etc. which are provided externally and connecting them to the control circuit terminals of the inverter.
Basically, parameter changing is disabled in the External operation mode. (Refer to page 384 for availability of parameter write)
When [*Pr. 79 = 0, 2*] is selected, the inverter is the External operation mode at power-ON. (When using the Network operation mode, refer to page 434)
When parameter changing is seldom necessary, setting [*Pr. 79 = 2*] fixes the operation mode to the External operation mode.
When frequent parameter changing is necessary, setting [*Pr. 79 = 0*] allows the operation mode to be changed easily to the PU operation mode by pressing PU/EXT of the operation panel. When you switched to the PU operation mode for parameter change, always return to the External operation mode.
The STF and STR signal are used as a start command, and the voltage or current signal to terminal 2, 4, multi-speed signal, JOG signal, etc. are used as a frequency command.



(2) PU operation mode [*Pr. 79 = 0, 1*]

Select the PU operation mode when operating with a operation panel (FR-DU07/FR-PA07) or by keys on the parameter unit (FR-PU04/FR-PU07). For A700 F700, select PU operation mode for the communication using PU connector as well.
When [*Pr. 79 = 1*], the inverter enters the PU operation mode at power-ON. You cannot change to the other operation mode.
When [*Pr. 79 = 0*], External operation mode can be changed to PU operation mode with PU/EXT of the operation panel.
The setting dial of the operation panel can be used for setting like a potentiometer. ([*Pr. 161 Frequency setting/key lock operation selection*] Refer to page 214)
When PU operation mode is selected, the PU operation mode signal (PU) can be output. For the terminal used for the PU signal output, assign the function by setting 10 (positive logic) or 110 (negative logic) in any of [*Pr. 190 to Pr. 196 output terminal function selection*].

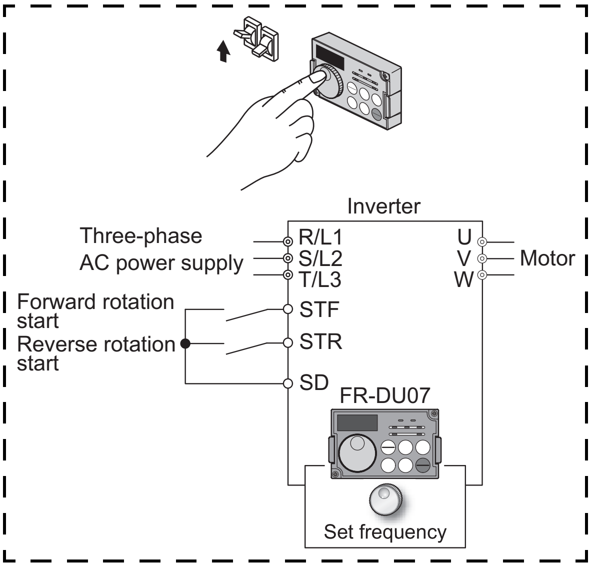


(3) PU/External combined operation mode 1 [*Pr. 79 = 3*]

Select the PU/External combined operation mode 1 when inputting the frequency command from the operation panel (FR-DU07/FR-PA07) or parameter unit (FR-PU04/FR-PU07) and inputting the start command with the external start switch.

Select [*Pr. 79 = 3*] . You cannot change to the other operation mode.

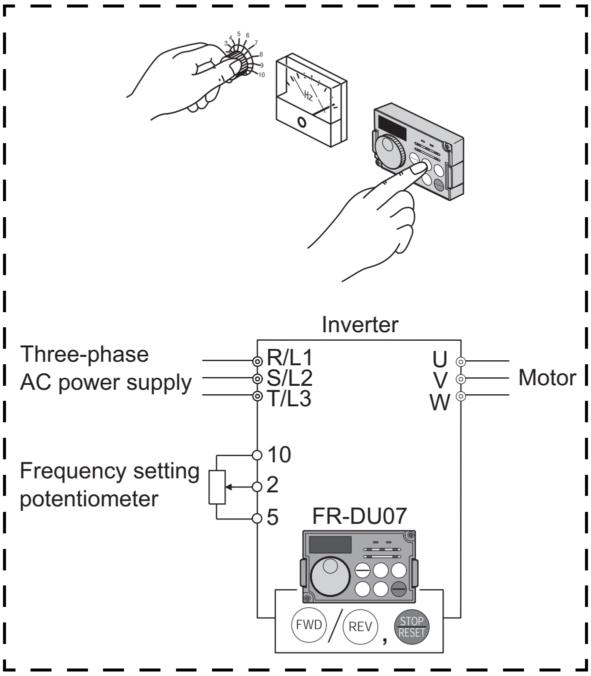
When a frequency is input from the external signal by multi-speed setting, it has a higher priority than the frequency command from the PU. When AU signal is ON, command signal is given to terminal 4.



(4) PU/External combined operation mode 2 [*Pr. 79 = 4*]

Select the PU/External combined operation mode 2 when inputting the frequency command from the external potentiometer, multi-speed or JOG signal and inputting the start command by key operation of the operation panel (FR-DU07/FR-PA07) or parameter unit (FR-PU04/FR-PU07).

Select [*Pr. 79 = 4*] . You cannot change to the other operation mode.



(5) Switchover mode [*Pr. 79 = 6*]

When [*Pr. 79 = 6*] is set, you can switch between the PU operation, External operation and Network operation (when RS-485 terminals or communication option is used) while continuing operation.

Operation Mode Switching	Switching Operation · Operating Status
External operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. • Rotation direction is the same as that of external operation. • The frequency set with the potentiometer (frequency command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the inverter is reset.)
External operation → NET operation	Send the mode change command to the Network operation mode through communication. • Rotation direction is the same as that of external operation. • The value set with the setting potentiometer (frequency command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the inverter is reset.)
PU operation → External operation	Press the external operation key of the parameter unit. • The rotation direction is determined by the input signal of the external operation. • The set frequency is determined by the external frequency command signal.
PU operation → NET operation	Send the mode change command to the Network operation mode through communication. • Rotation direction and set frequency are the same as those of PU operation.
NET operation → External operation	Command to change to external mode is transmitted by communication. • The rotation direction is determined by the input signal of the external operation. • The set frequency is determined by the external frequency command signal.
NET operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. • The rotation direction and frequency command in the Network operation mode are used unchanged.

(6) PU operation interlock [*Pr. 79 = 7*]

The PU operation interlock function is designed to forcibly change the operation mode to the External operation mode when the PU operation interlock signal (X12) input turns OFF.
This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unchanged from PU operation mode.
Select [*Pr. 79 = 7*] (PU operation interlock).

For the terminal used for the X12 signal (PU operation interlock signal) input, set 12 in [*Pr. 178 to Pr. 189 input terminal function selection*] to assign functions.
When the X12 signal is not assigned, function of the MRS signal switches from MRS (output stop) to PU operation interlock signal. When the MRS signal is used as the PU operation interlock signal, the logic of the signal is as set in [*Pr. 17*]. When [*Pr. 17 = 2*], read ON as OFF and OFF as ON in the above explanation.

X12 (MRS) signal	Function · Operation	
	Operation mode	**Parameter write**
ON	Operation mode (External, PU, NET) switching enabled Output stop during external operation	Parameter write enabled (depending on [*Pr. 77 Parameter write selection*] and each parameter write conditions)
OFF	Forcibly switched to External operation mode External operation allowed Switching to PU or NET operation mode is disabled	Parameter write disabled with exception of [*Pr. 79*]

<Function and operation changed by switching ON-OFF the X12 (MRS) signal>

Operating Condition		X12 (MRS) Signal	Operation Mode	Operating Status	Switching to PU, NET Operation Mode
Operation mode	**Status**				
PU/NET	During stop	ON → OFF *1	External *2	If external operation frequency setting and start signal are entered, operation is performed in that status.	Disabled
	Running	ON → OFF *1			Disabled
External	During stop	OFF → ON	External *2	During stop	Enabled
		ON → OFF			Disabled
	Running	OFF → ON		During operation → output stop	Disabled
		ON → OFF		Output stop → operation	Disabled

*1 The operation mode switches to the External operation mode independently of whether the start signal (STF, STR) is ON or OFF. Therefore, the motor is run in the External operation mode when the X12 (MRS) signal is turned OFF with either of STF and STR is ON.

*2 At fault occurrence, pressing 

 of the operation panel resets the inverter.

(7) Switching of operation mode by external signal (X16 signal)

When external operation and operation from the operation panel are used together, use of the PU-external operation switching signal (X16) allows switching between the PU operation mode and External operation mode during a stop (during a motor stop, start command OFF).

When [*Pr. 79 = 0, 6, 7*] , the operation mode can be switched between the PU operation mode and External operation mode. ([*Pr. 79 = 6*] At switch-over mode, operation mode can be changed during operation)

For the terminal used for X16 signal input, set 16 in any of [*Pr. 178 to 189 input terminal function selection*] to assign the function.

<table>
<tr><th colspan="2" rowspan="2">[Pr. 79] Setting</th><th colspan="2">X16 Signal State Operation Mode</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON (External)</th><th>OFF (PU)</th></tr>
<tr><td colspan="2">0(initial value)</td><td>External operation mode</td><td>PU operation mode</td><td>Can be switched to External, PU or NET operation mode</td></tr>
<tr><td colspan="2">1</td><td colspan="2">PU operation mode</td><td>Fixed to PU operation mode</td></tr>
<tr><td colspan="2">2</td><td colspan="2">External operation mode</td><td>Fixed to External operation mode (can be switched to NET operation mode)</td></tr>
<tr><td colspan="2">3, 4</td><td colspan="2">External/PU combined operation mode</td><td>Fixed to External/PU combined mode</td></tr>
<tr><td colspan="2">6</td><td>External operation mode</td><td>PU operation mode</td><td>Switching among the External, PU, and NET operation mode is enabled while running.</td></tr>
<tr><td rowspan="2">7</td><td>X12(MRS) ON</td><td>External operation mode</td><td>PU operation mode</td><td>Can be switched to External, PU or NET operation mode (Output stop in External operation mode)</td></tr>
<tr><td>X12(MRS) OFF</td><td colspan="2">External operation mode</td><td>Fixed to External operation mode (forcibly switched to External operation mode)</td></tr>
</table>

2.4 Frequency setting

2.4.1 When PU operation mode (key lock) [Pr. 161] (common)

Set the frequency setting from the operation panel (parameter unit).
When [*Pr. 161 = 0, 10*], turn the setting dial of the operation panel and press SET to set frequency. (Note that frequency changing is restricted by key lock setting.)
By setting [*Pr. 161 = 1, 11*], frequency can be set only by turning the setting dial of the operation panel without pressing SET. (Note that frequency changing is restricted by key lock setting.) In this case, when the frequency is changed, it will be stored in EEPROM as the set frequency after 10s.

Set [*Pr. 161 = 10, 11*], then press MODE for 2s to make the setting dial and key operation invalid. When the setting dial and key operation are invalid, HOLd appears on the operation panel. When the setting dial and key operation is invalid, HOLd appears if the setting dial or key operation is performed. (When the setting dial or key operation is not performed for 2s, the monitor display appears.)
To make the setting dial and key operation valid again, press MODE for 2s.
Even if the setting dial and key operation are disabled, the monitor display and STOP/RESET are valid.
When using the parameter unit, inverter operation and frequency setting etc. are available regardless of [*Pr. 161*] setting.

[*Pr.*]	Name	Initial Value	Setting Range	Description	
161	Frequency setting/key lock operation selection	0	0	Setting dial frequency setting mode	Key lock invalid
			1	Setting dial potentiometer mode	
			10	Setting dial frequency setting mode	Key lock valid
			11	Setting dial potentiometer mode	

2.4.2 When Jog operation [Pr. 15, 16] (common)

You can set the frequency and acceleration/deceleration time for Jog operation. Jog operation can be performed from either of the External or the PU operation mode.
This operation can be used for conveyor positioning, test operation, etc.

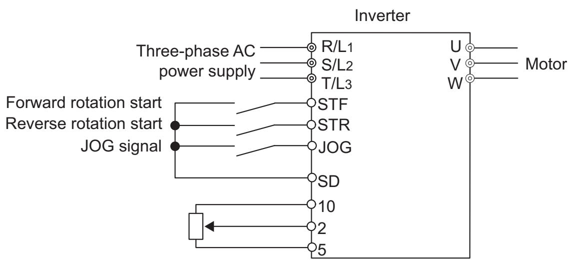
During Jog operation, the second acceleration/deceleration via RT signal cannot be selected. (The other second functions are valid)
This function is invalid when [*Pr. 79* = "3"].
Jog operation is invalid under position control. For (A700), Jog operation is invalid with the position control of vector control.

[*Pr.*]	Name	Initial Value	Setting Range	Description
15	Jog frequency	5Hz	0 to 400Hz	Set the frequency for Jog operation.
16	Jog acceleration/ deceleration time	0.5s	0 to 3600/ 360s*	Set the acceleration/deceleration time for Jog operation. As the acceleration/ deceleration time, set the time taken to reach the frequency (initial value is 60Hz) set in [*Pr. 20 Acceleration/deceleration reference frequency*]. Acceleration/deceleration time can not be set separately. When [*Pr. 29 Acceleration/deceleration pattern selection* = "1"], the acceleration/ deceleration time of S-pattern acceleration/deceleration A is the time required to reach [*Pr. 3 Rated motor frequency*].

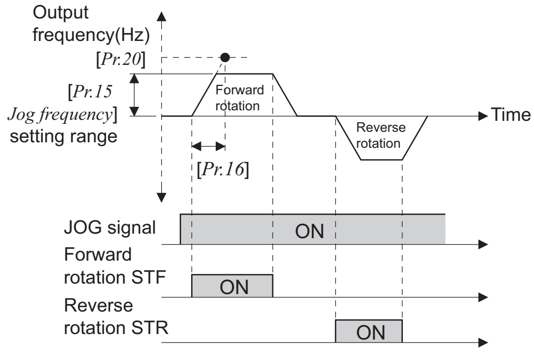
* When the setting of [*Pr. 21 Acceleration/deceleration time increments*] is "0" (initial value), the setting range is "0 to 3600s" and the setting increments are "0.1s", and when the setting is "1", the setting range is "0 to 360s" and the setting increments are "0.01s". [*Pr. 21*] is not available for (D700). Setting range of [*Pr. 16*] is 0 to 3600s, and the increment is 0.1s.

(1) Jog operation from outside

When the JOG signal is ON, a start and stop can be made by the start signal (STF, STR). (The JOG signal is assigned to the terminal JOG in the initial setting.)



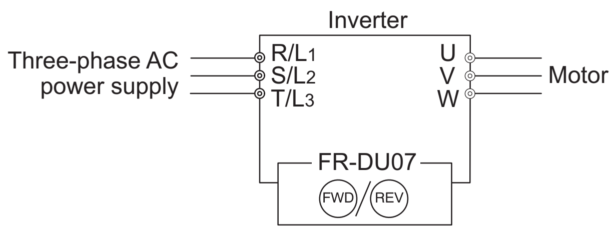
Connection diagram for external Jog operation



(2) Jog operation from PU

Press (PU/EXT) to choose the Jog operation mode.

Hold down the (FWD) (or (REV)) key to perform operation.
When [*Pr. 79 Operation mode selection* = "4"], pressing (FWD)/(REV) of the parameter unit starts the inverter and pressing (STOP/RESET) stops the inverter.



2.4.3 Multi-speed operation [Pr. 4 to 6, 24 to 27, 232 to 239] (common)

Can be used to change the preset speed in the parameter with the contact terminals.
Each speed can be selected by merely turning ON or OFF the contact signals (RH, RM, RL, REX signals).
Refer to page 48 for the detail of input signal combinations.

The priority of the frequency command by the external signals is "Jog operation > Multi-speed operation > Terminal 4 analog input > Pulse train input > Terminal 2 analog input".
Valid in the External operation mode [*Pr. 79 = 0, 2*] or PU/external combined operation mode [*Pr. 79 = 3, 4*].
Multi-speed parameters can also be set in the PU or External operation mode

.

[*Pr.*]	Name	Initial Value	Setting Range	Description
4	Multi-speed setting (high speed)	60Hz	0 to 400Hz	Frequency when RH turns ON
5	Multi-speed setting (middle speed)	30Hz	0 to 400Hz	Frequency when RM turns ON
6	Multi-speed setting (low speed)	10Hz	0 to 400Hz	Frequency when RL turns ON
24	Multi-speed setting (speed 4)	9999	0 to 400Hz, 9999	Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. 9999: Not selected
25	Multi-speed setting (speed 5)	9999	0 to 400Hz, 9999	
26	Multi-speed setting (speed 6)	9999	0 to 400Hz, 9999	
27	Multi-speed setting (speed 7)	9999	0 to 400Hz, 9999	
232	Multi-speed setting (speed 8)	9999	0 to 400Hz, 9999	
233	Multi-speed setting (speed 9)	9999	0 to 400Hz, 9999	
234	Multi-speed setting (speed 10)	9999	0 to 400Hz, 9999	
235	Multi-speed setting (speed 11)	9999	0 to 400Hz, 9999	
236	Multi-speed setting (speed 12)	9999	0 to 400Hz, 9999	
237	Multi-speed setting (speed 13)	9999	0 to 400Hz, 9999	
238	Multi-speed setting (speed 14)	9999	0 to 400Hz, 9999	
239	Multi-speed setting (speed 15)	9999	0 to 400Hz, 9999	

(1) 3-speed setting [*Pr. 4 to 6*]

The inverter operates at frequencies set in [*Pr. 4*] when RH signal is ON, [*Pr. 5*] when RM signal is ON and [*Pr. 6*] when RL signal is ON.
In the initial setting, if two or three signals are simultaneously selected, priority is given to the set frequency of the lower signal.
For example, when the RH and RM signals turn ON, the RM signal [*Pr. 5*] has a higher priority.

(2) Multi-speed setting for 4 or more speeds [*Pr. 24 to 27, 232 to 239*]

Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. Set the running frequencies in [*Pr. 24 to 27, 232 to 239*] (In the initial value setting, speed 4 to speed 15 are unavailable).
For the terminal used for REX signal input, set 8 in any of [*Pr. 178 to 189 input terminal function selection*] to assign the function.

2.4.4 When analog input (External operation mode) [Pr. 73, 74, 125, 126, 241, 242*, 243*, 252*, 253*, 267, 849*, C2 to C7 (Pr. 902 to Pr. 905), C30 to C33*(Pr. 926, 927)] common

(* [*Pr.849, C30 to C33 (Pr.926, 927)*] are not available for F700.)
(* [*Pr.242, 243, 252, 253, 849, C30 to C33 (Pr.926, 927)*] are not available for E700 D700.)

Frequency setting is available with 5VDC, 10VDC, 20mADC input and those combinations for external frequency command setting.

Select the input signal with [*Pr. 73 Analog input selection*] from 5VDC, 10VDC, and 4 to 20mADC.
And set frequency for maximum input voltage or current with [*Pr. 125, 126*].

Analog input

Input (DC)	Input Terminal		DC power supply
	A700 F700	E700 D700	
0 to + 5V	2 and 5, or 4 and 5	2 and 5, or 4 and 5	Internal (terminal 10) or external
0 to +10V	2 and 5, or 4 and 5	2 and 5, or 4 and 5	Internal (terminal 10E)*1 or external
4 to 20mA	4 and 5, or 2 and 5	4 and 5	External
0 to $\pm$5V	1 and 5	-	External
0 to $\pm$10V	1 and 5, or 6 and 5 *2	-	External

*1 Not available for E700 D700.

*2 Available in A700 with FR-A7AZ.

(1) Selection of analog input specifications [*Pr. 73, 267*] common

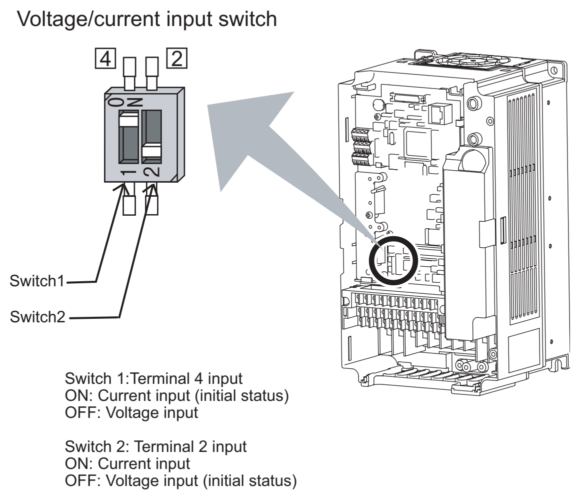
1) A700 F700

You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal selection specifications, the override function and the input signal polarity.

For the terminals 2, 4 used for analog input, voltage input (0 to 5V, 0 to 10V) or current input (4 to 20mA) can be selected.

The current at terminal 2 and 4 is always 4 to 20mA when the voltage/current input switch is set to ON. When turning ON the voltage/current input switch, set input specifications of terminal to current input using [*Pr. 73, 267*].

Terminal 2, 4 is fixed for voltage input when the voltage/current input switch is set to OFF. When turning OFF the voltage/current input switch, set input specifications of the terminal to voltage input using [*Pr. 73, 267*].



[*Pr.*]	Name	Initial Value	Setting Range	Description	
73	Analog input selection	1	0 to 7, 10 to 17	You can select the input specifications of terminal 2 (0 to 5V, 0 to 10V, 4 to 20mA) and input specifications of terminal 1 (0 to ±5V, 0 to ±10V). Set the voltage/current input switch along with the selected input specification (voltage/current). Override and reversible operation can be selected.	
267	Terminal 4 input selection	0	0	Terminal 4 input 4 to 20mA Switch 1 : OFF	Set the voltage/current input switch (Switch 1) along with the setting as shown on the left.
			1	Terminal 4 input 0 to 5V Switch 1 : ON	
			2	Terminal 4 input 0 to 10V Switch 1 : ON	

The terminal 1 (frequency setting auxiliary input) signal is added to the main speed setting signal of the terminal 2 or 4.

When an override is selected, the terminal 1 or 4 is used for the main speed setting and the terminal 2 for the override signal (50% to 150% at 0 to 5V or 0 to 10V). (When the main speed of the terminal 1 or terminal 4 is not input, compensation by the terminal 2 is invalid.)

Use [*Pr. 125* (*Pr. 126*) *frequency setting gain*] to change the maximum output frequency at input of the maximum output frequency command voltage (current).

At this time, the command voltage (current) need not be input.

Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference speed, is not affected by the change in [*Pr. 73*] setting.

When "4" is set in [*Pr. 858 Terminal 4 function assignment*], [*Pr. 868 Terminal 1 function assignment*], the setting of terminal 1, terminal 4 is used for stall prevention operation level setting. When terminal 1 and terminal 4 are used for frequency setting, set "0" (initial value) in [*Pr. 858*] and [*Pr. 868*].

Also when using A700 with FR-A7AZ, terminal 6 is available. To use terminal 6 for frequency setting, set [*Pr. 406* = 0]. (Refer to page 43)

[*Pr. 73*] setting	Terminal 2 input: Switch 2	Terminal 2 input	Terminal 1 input	Terminal 4 input	[*Pr. 73*] Setting Value	Compensation input terminal and compensation method	Polarity reversible
0	OFF	0 to 10V	0 to ±10V	When the AU signal is OFF ×	0	Terminal 1 Additional compensation	No (Indicates that a frequency command signal of negative polarity is not accepted.)
1 (initial value)	OFF	0 to 5V	0 to ±10V		1 (initial value)		
2	OFF	0 to 10V	0 to ±5V		2		
3	OFF	0 to 5V	0 to ±5V		3		
4	OFF	0 to 10V	0 to ±10V		4	Terminal 2 Override	
5	OFF	0 to 5V	0 to ±5V		5		
6	ON	4 to 20mA	0 to ±10V		6	Terminal 1 Additional compensation	
7	ON	4 to 20mA	0 to ±5V		7		
10	OFF	0 to 10V	0 to ±10V		10		Yes
11	OFF	0 to 5V	0 to ±10V		11		
12	OFF	0 to 10V	0 to ±5V		12		
13	OFF	0 to 5V	0 to ±5V		13		
14	OFF	0 to 10V	0 to ±10V		14	Terminal 2 Override	
15	OFF	0 to 5V	0 to ±5V		15		
16	ON	4 to 20mA	0 to ±10V		16	Terminal 1 Additional compensation	
17	ON	4 to 20mA	0 to ±5V		17		
0	×		0 to ±10V	When the AU signal is ON (see table below)	0	Terminal 1 Additional compensation	No (Indicates that a frequency command signal of negative polarity is not accepted.)
1 (initial value)			0 to ±10V		1 (initial value)		
2			0 to ±5V		2		
3			0 to ±5V		3		
4	OFF	0 to 10V	×		4	Terminal 2 Override	
5	OFF	0 to 5V			5		
6	×		0 to ±10V		6	Terminal 1 Additional compensation	
7			0 to ±5V		7		
10	×		0 to ±10V		10		Yes
11			0 to ±10V		11		
12			0 to ±5V		12		
13			0 to ±5V		13		
14	OFF	0 to 10V	×		14	Terminal 2 Override	
15	OFF	0 to 5V			15		
16	×		0 to ±10V		16	Terminal 1 Additional compensation	
17			0 to ±5V		17		

Input Specification	[*Pr. 267*] setting	Switch 1
4 to 20mA	0 (Initial value)	ON (Initial status)
0 to 5V	1	OFF
0 to 10V	2	OFF

(indicates the main speed setting)

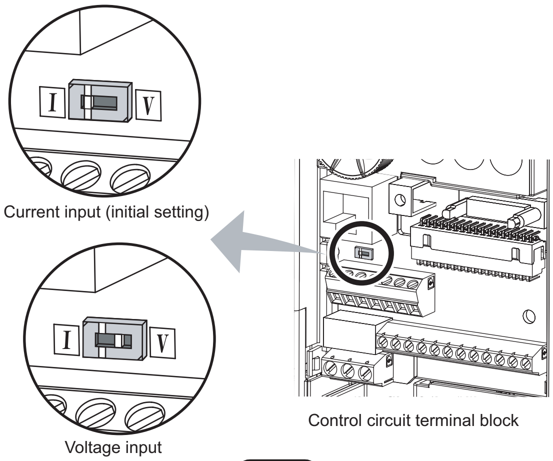
2) (E700)(D700)

You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal specifications and input signal.

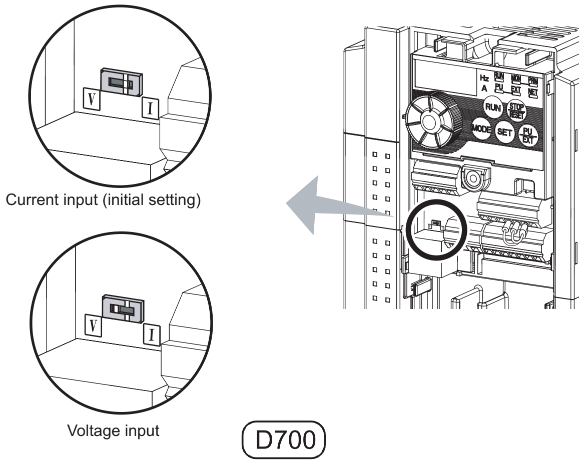
For the terminal 2 for analog voltage input, 0 to 5V (initial value) or 0 to 10V can be selected.

Either voltage input (0 to 5V, 0 to 10V) or current input (4 to 20mA initial value) can be selected for terminal 4 used for analog input.

Change the input specifications to change [*Pr. 267*] and voltage/current input switch.



E700



D700

[Pr.]	Name	Initial Value	Setting Range	Description	
73	**Analog input selection**	1	0	Terminal 2 input 0 to 10V	Without reversible operation
			1	Terminal 2 input 0 to 5V	
			10	Terminal 2 input 0 to 10V	With reversible operation
			11	Terminal 2 input 0 to 5V	
267	**Terminal 4 input selection**	0		**Voltage/current input switch**	**Description**
			0	Switch: I	Terminal 4 input 4 to 20mA
			1	Switch: V	Terminal 4 input 0 to 5V
			2		Terminal 4 input 0 to 10V

[*Pr.73*] Setting	Terminal 2 Input	Terminal 4 Input: AU signal	Terminal 4 Input	Reversible Operation
0	0 to 10V	OFF	-	Not function
1 (initial value)	0 to 5V			
10	0 to 10V			Yes
11	0 to 5V			
0	-	ON	According to the [*Pr. 267*] setting 0: 4 to 20mA (initial value) 1: 0 to 5V 2: 0 to 10V	Not function
1 (initial value)				
10	-			Yes
11				

([shaded] indicates main speed setting)

When [*Pr. 561 PTC thermistor protection level* ≠ 9999] in (D700), terminal 2 does not function as analog frequency command.

(2) Perform operation by analog input voltage

common

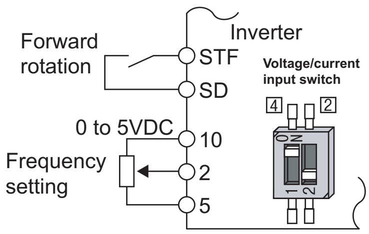
The frequency setting signal inputs 0 to 5VDC (or 0 to 10VDC) to across the terminals 2 and 5. The 5V (10V) input is the maximum output frequency. The wiring length of the terminal 10, 2, 5 should be within 30m. When using A700 with FR-A7AZ, terminal 6 is also available.

The power supply 5V (10V) can be input by either using the internal power supply or providing an external power supply. The internal power supply outputs 5VDC across terminals 10 and 5, or 10VDC across terminals 10E* and 5.

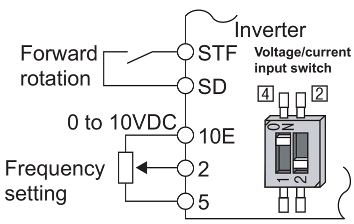
Terminal	Inverter built-in Power Supply Voltage	Frequency Setting Resolution	[*Pr, 73*] Terminal 2 Input Voltage
10	5VDC	A700 F700 0.030Hz/60Hz E700 D700 0.12Hz/60Hz	0 to 5VDC input
10E*	10VDC	A700 F700 0.015Hz/60Hz E700 D700 0.06Hz/60Hz	0 to 10VDC input

* Not available for E700 D700.

Set current/voltage input switch (switch 2) of terminal 2 OFF status (initial status) in A700 F700. To input 10VDC to terminal 2, set one of "0, 2, 4, 10, 12, 13" to [*Pr.73*]. (Initial value is 0 to 5V) To input 10VDC to the terminal 2 in E700 D700, set "0" or "10" to [*Pr.73*]. Initial value is 0 to 5V.

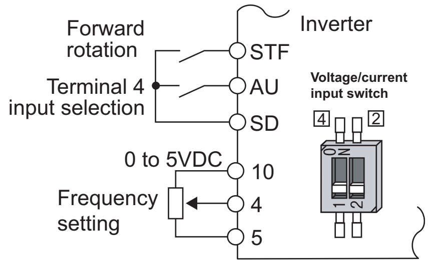


Connection diagram using terminal 2 (0 to 5VDC) (for A700)



Connection diagram using terminal 2 (0 to 10VDC) (for A700)

When "1" (0 to 5 VDC) or "2" (0 to 10VDC) is set to [*Pr. 267*] and voltage/current input switch (switch 1) for the terminal 4 is turned OFF in A700 F700, or turned to V in E700 D700, the specification of the terminal 4 is voltage input. When the AU signal turns ON, the terminal 4 input becomes valid.

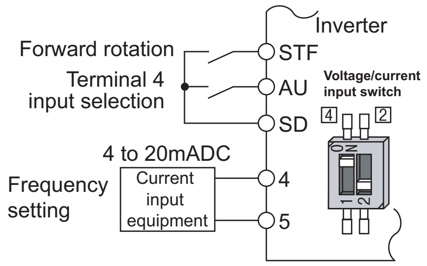


Connection diagram using terminal 4 (0 to 5VDC) (for A700)

(3) Perform operation by analog input current

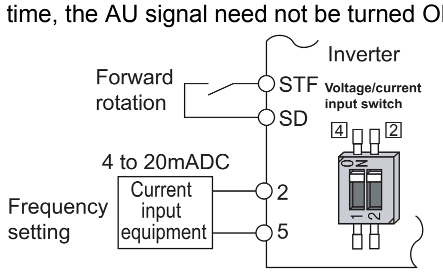
common

When the pressure or temperature is controlled constant by a fan, pump, etc., automatic operation can be performed by inputting the output signal 4 to 20mA of the adjuster to across the terminals 4 and 5. For A700 F700, set "0" (4 to 20mADC, initial value) to [*Pr.267*] and current/voltage input switch (switch 1) of terminal 4 ON status. For E700 D700, set "0" to [*Pr.267*] the current/voltage input switch to "I" (initial status). The AU signal must be turned ON to use the terminal 4.



Connection diagram using terminal 4 (4 to 20mADC) (for A700)

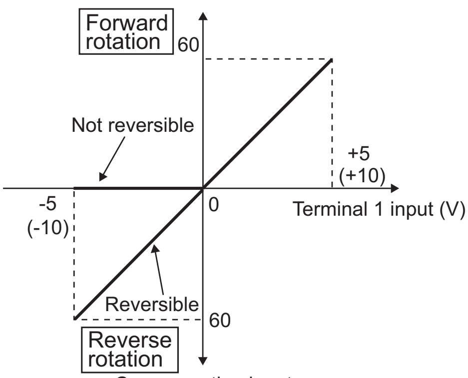
To input current to terminal 2 in A700 F700, set one of "6, 7, 16, 17" to [*Pr.73*] and current/voltage input switch (switch 2) of terminal 2 ON status. At this time, the AU signal need not be turned ON.



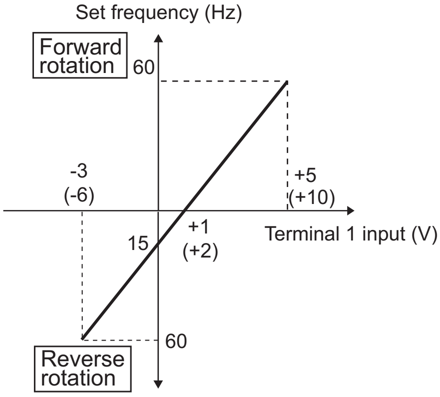
Connection diagram using terminal 2 (4 to 20mADC) (for A700)

(4) Perform forward/reverse rotation by analog input (polarity reversible operation)(common)

Setting any of "10 to 17" to [*Pr. 73*] in (A700)(F700) enables polarity reversible operation.
Providing ± input (0 to ±5V or 0 to ±10V) to the terminal 1 enables forward/reverse rotation operation according to the polarity.

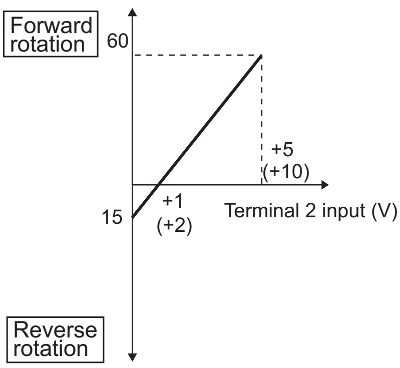


Compensation input characteristic when STF is ON



Calibration input characteristic when bias voltage is other than 0% (STF is ON).

To enable reversible operation, set "10 or 11" to [*Pr. 73*] in (E700)(D700) .



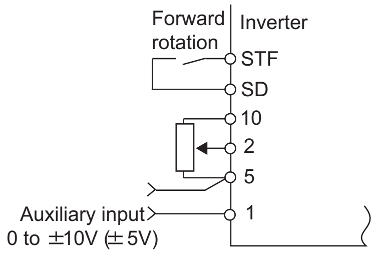
Characteristic of reversible operation when STF is ON

(5) Additional compensation (*Pr. 242, 243*) (A700) (F700)

The compensation signal can be added to the main speed setting for synchronous/continuous speed control operation, etc.
The compensation input of the terminal 1 can also be added to the multi-speed setting or terminal 4 (initial value 4 to 20mA).
The added compensation for terminal 2 can be adjusted by [*Pr. 242*], and the compensation for terminal 4 by [*Pr. 243*].

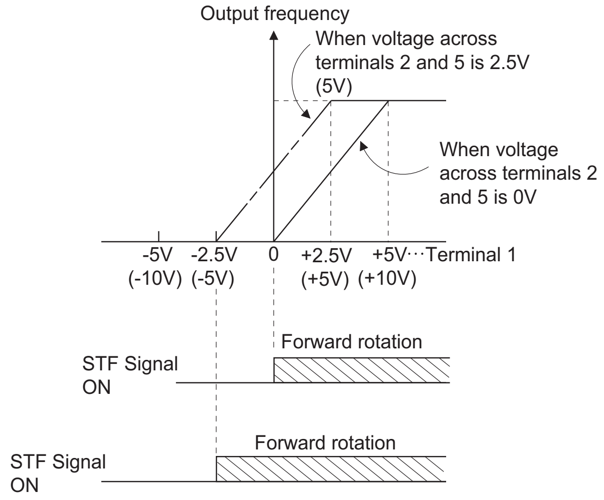
$$\text{Analog command value using terminal 2} = \text{Terminal 2 input} + \text{Terminal 1 input} \times \frac{[Pr.\ 242]}{100(\%)}$$

$$\text{Analog command value using terminal 4} = \text{Terminal 4 input} + \text{Terminal 1 input} \times \frac{[Pr.\ 243]}{100(\%)}$$

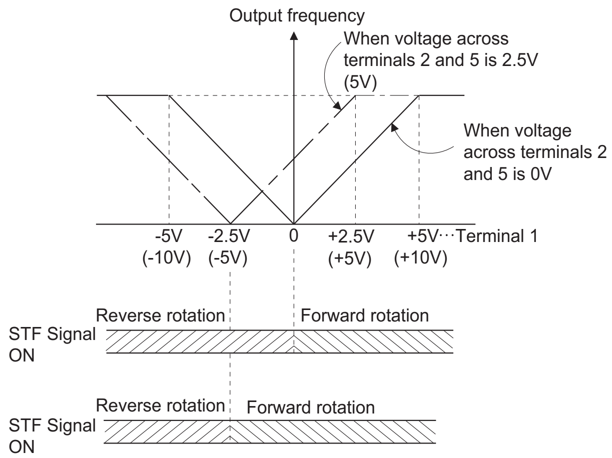


Added compensation connection example

Auxiliary input characteristics



When [*Pr. 73*] setting is 0 to 5



When [*Pr. 73*] setting is 10 to 15

[*Pr.*]	Name	Initial Value	Setting Range	Description
242	Terminal 1 added compensation amount (terminal 2)	100%	0 to 100%	Set the ratio of added compensation amount when terminal 2 is the main speed.
243	Terminal 1 added compensation amount (terminal 4)	75%	0 to 100%	Set the ratio of added compensation amount when terminal 4 is the main speed.

(6) Override function [*Pr. 252, 253*] (A700) (F700)

Use the override function to change the main speed at a fixed ratio.

When an override is selected, the terminal 1 or terminal 4 is used for the main speed setting and the terminal 2 for the override signal. (When the main speed of the terminal 1 or terminal 4 is not input, compensation by the terminal 2 is invalid.)

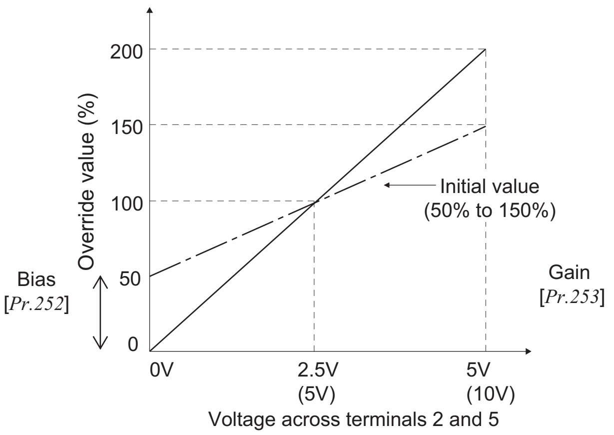
When inputting compensation to multi-speed operation or remote setting, set [*Pr. 28 Multi-speed input compensation selection* = 1] .(Refer to page 227)

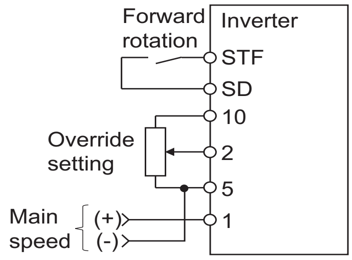
Using [*Pr. 252, 253*], set the override range. Use a following formula for the set frequency for override.

$$\text{Set frequency (Hz)} = \text{Main speed set frequency (Hz)} \times \frac{\text{Compensation amount(\%)}}{100(\%)}$$

Main speed set frequency (Hz): Terminal 1, 4 input, multi-speed setting

Compensation amount (%): Terminal 2 input

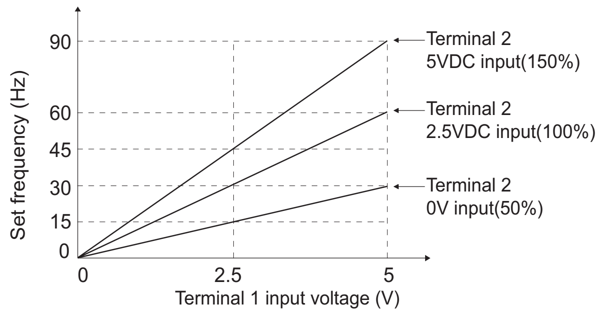




Override connection diagram

Example: When [*Pr. 73 = 5*]

The set frequency changes as shown below according to the terminal 1 (main speed) and terminal 2 (auxiliary) inputs.

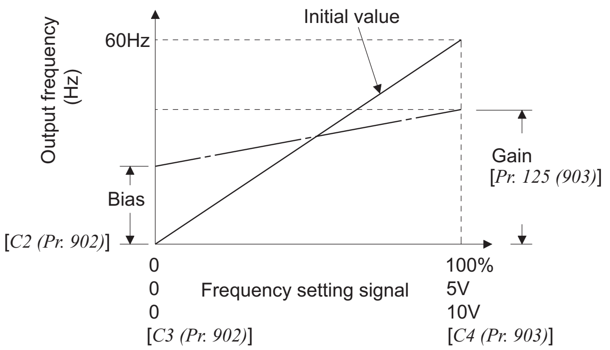


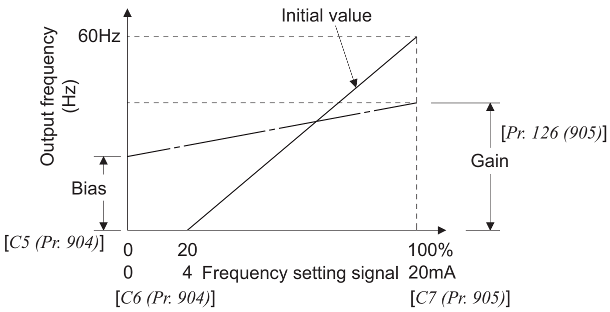
[*Pr.*]	Name	Initial Value	Setting Range	Description
252	Override bias	50%	0 to 200%	Set the bias side compensation value of override function.
253	Override gain	150%	0 to 200%	Set the gain side compensation value of override function.

(7) Bias and gain of frequency setting voltage (current) [*Pr. 125, 126, 241, C2 to C7(Pr. 902 to 905), C30 to C33* (Pr. 926, 927)*] (common) (Available in (A700) with FR-A7AZ.)

You can set the magnitude (slope) of the output frequency as desired in relation to the frequency setting signal (0 to 5VDC, 0 to 10VDC or 4 to 20mADC).

Refer to the following diagram for the relationships between the frequency setting signal and output frequencies. When using terminal 1 added compensation, terminal 2 (4) analog value + terminal 1 analog value is the analog calibration value.





1) Change the frequency at maximum analog input

   Set a value in [*Pr. 125 (126)*] when changing only the frequency setting (gain) of the maximum analog input voltage (current). [*(C2 (Pr. 902) to C7 (Pr. 905)*] setting need not be changed. Set a value in [*C32 (Pr. 927)*] when using terminal 6 in (A700) with FR-A7AZ.

2) Calibration of analog input bias and gain

   As for voltage between frequency setting power supply terminal 10 (10E) and terminal 5, and input impedance of analog input terminal, there are variability in each inverters. Therefore exact output frequency for the frequency setting input is different in each inverters. When using a common frequency setting input for multiple inverters, calibration of frequency setting bias [*C3 (C6)*] and gain [*C4(C7)*] is required for each inverters.

   When applying voltage (current) for calibration, the difference of the frequency setting input voltage (current) of [*C3*] and [*C4*] ([*C6*] and [*C7*]) should be 0.5V (2mA) or more. If the difference is 0.5V (2mA) or less, a setting error will occur. Calibrate with [*C31 to C33 (Pr. 926, 927)*] when using terminal 6 in (A700) with FR-A7AZ.

3) Analog input display unit changing

   You can change the analog input display unit (%/V/mA) for analog input bias/gain calibration.

   Depending on the terminal input specification set to [*Pr. 73*], [*Pr. 267*], the display units of [*C3(Pr. 902)*], [*C4(Pr. 903)*], [*C6(Pr. 904)*], [*C7(Pr. 905)*], [*C31(Pr. 926)*], [*C33(Pr. 927)*] change as shown below.

Analog Command (terminal 2, 4) [*Pr. 73, 267*]	[*Pr. 241 = 0*] (initial value)	[*Pr. 241 = 1*]
0 to 5V input	Displayed in 0 to 100% (0.1% increments)	Displayed in 0 to 5V (0.01V increments)
0 to 10V input	Displayed in 0 to 100% (0.1% increments)	Displayed in 0 to 10V (0.01V increments)
0 to 20mA input	Displayed in 0 to 100% (0.1% increments)	Displayed in 0 to 20mA (0.01mA increments)

   Analog input display is not displayed correctly if voltage is applied to terminal 1 when terminal 1 input specifications (0 to ±5V, 0 to ±10V) and main speed (terminal 2, terminal 4 input) specifications (0 to 5V, 0 to 10V, 0 to 20mA) differ. (For example, 5V (100%) is analog displayed when 0V and 10V are applied to terminal 2 and terminal 1 respectively in the initial status.)

   In this case, set [*Pr. 241 = 0*] (% display).

[*Pr.*]	Name	Initial Value	Setting Range	Description	
125(903)	Terminal 2 frequency setting gain frequency	60Hz	0 to 400Hz	Set the frequency of terminal 2 input gain (maximum).	
126(905)	Terminal 4 frequency setting gain frequency	60Hz	0 to 400Hz	Set the frequency of terminal 4 input gain (maximum).	
241	Analog input display unit switchover	0	0	Displayed in %	Selects the unit for analog input display.
			1	Displayed in V/mA	
C2(902)	Terminal 2 frequency setting bias frequency	0Hz	0 to 400Hz	Set the frequency on the bias side of terminal 2 input.	
C3(902)	Terminal 2 frequency setting bias	0%	0 to 300%	Set the converted % of the bias side voltage (current) of terminal 2 input.	
C4(903)	Terminal 2 frequency setting gain	100%	0 to 300%	Set the converted % of the gain side voltage of terminal 2 input.	
C5(904)	Terminal 4 frequency setting bias frequency	0Hz	0 to 400Hz	Set the frequency on the bias side of terminal 4 input.	
C6(904)	Terminal 4 frequency setting bias	20%	0 to 300%	Set the converted % of the bias side current (voltage) of terminal 4 input.	
C7(905)	Terminal 4 frequency setting gain	100%	0 to 300%	Set the converted % of the gain side current (voltage) of terminal 4 input.	
C30(926)	Terminal 6 bias frequency (speed) AZ	0Hz	0 to 400Hz	Set the frequency on the bias side of terminal 6 input.	
C31(926)	Terminal 6 bias (speed) AZ	0%	0 to 300%	Set the converted % on the bias side voltage of terminal 6 input.	
C32(927)	Terminal 6 gain frequency (speed) AZ	60Hz	0 to 400Hz	Set the frequency on the gain side of terminal 6 input.	
C33(927)	Terminal 6 gain (speed) AZ	100%	0 to 300%	Set the converted % on the gain side voltage of terminal 6 input.	

(8) Analog input filter and offset adjustment [*Pr.* 74, 849] (common)

You can adjust response level and stability of frequency command and torque command at analog input (terminal 1, 2, 4, terminal 6 (A700) when with FR-A7AZ))

For (A700), if the setting of [*Pr.* 822, 826] ([*Pr.* 832, 836] when RT signal is ON) is not 9999, [*Pr.* 74] setting is invalid. (Refer to page 323)

[*Pr.*]	Name	Initial Value	Setting Range	Description	Available Inverters A700	Available Inverters F700 E700 D700
74	Input filter time constant	1	0 to 8	Set the primary delay filter time constant for the analog input. A larger setting results in slower response.	○	○
849	Analog input offset adjustment	100%	0 to 200%	This function provides speed command by analog input (terminal 2) with offset. Motor rotation due to noise, etc. by analog input can be avoided at zero speed command.	○	—

1) Time constant of analog input [*Pr.* 74] (common)

Effective for eliminating noise in the frequency setting circuit.
Increase the filter time constant if steady operation cannot be performed due to noise. A larger setting results in slower response. (Refer to the following table for time constant.)

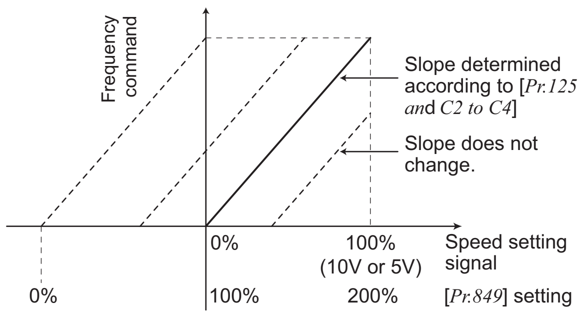
[*Pr.* 74] Setting	Time Constant
0	Approx. 5ms
1	Approx. 10ms
2	Approx. 20ms
3	Approx. 40ms
4	Approx. 80ms
5	Approx. 160ms
6	Approx. 320ms
7	Approx. 640ms
8	Approx. 1280ms

2) Offset adjustment of analog speed command input [*Pr.* 849] (A700)

When speed command by analog input is set, create the range where the motor remains stop to prevent malfunction at very low speed.
On the assumption that the [*Pr.* 849] setting 100% as 0, the offset voltage is offset as follows:
100% < [*Pr.* 849]......positive side
100% > [*Pr.* 849]......negative side

$$\text{Offset voltage} = \frac{\text{Voltage at 100\%}}{\text{(5V or 10V*)}} \times \frac{[Pr.849] - 100}{100} \text{[V]}$$

*According to the [*Pr.* 73] setting



2.4.5 Remote setting function [Pr. 59] (common)

When "1 to 3" is set in [*Pr. 59*], the functions of the RH, RM signals are changed to input function of remote setting. Setting is available for both PU operation mode and External operation mode.
Note that this is different with a function of motorized speed setter (FR-FK).

[*Pr.*]	Name	Initial Value	Setting Range	Description: RH, RM, RL signal function	Description: Frequency setting storage function
59	Remote function selection	0	0	Multi-Speed Setting	—
			1	Remote setting	Yes
			2	Remote setting	No
			3	Remote setting	No (Turning STF/STR OFF clears remotely-set frequency)

1)During acceleration
Set frequency increases when RH signal turns ON. Speed of increase depends on [*Pr. 44 Second acceleration/deceleration time*].*1
When RH signal turns OFF, increase of set frequency is stopped and the set frequency at that moment is retained.

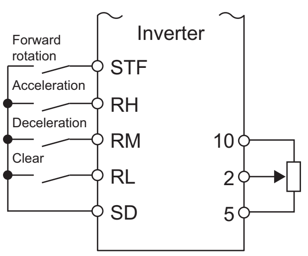
2)During deceleration
Set frequency decreases when RH signal turns ON. Speed of decrease depends on [*Pr. 45 Second deceleration time*]. When "9999" is set to [*Pr. 45*], the speed of decrease is equal to the [*Pr. 44*] setting.*1
When RH signal turns OFF, decrease of set frequency is stopped and the set frequency at that moment is retained.

3)Output frequency
External operation
Frequency set with RH and RM operation + external operation frequency other than multi-speed (When making input compensation (terminal 1), set [*Pr. 28 = 1*].)
PU operation
Frequency set with RH and RM operation + PU operation frequency

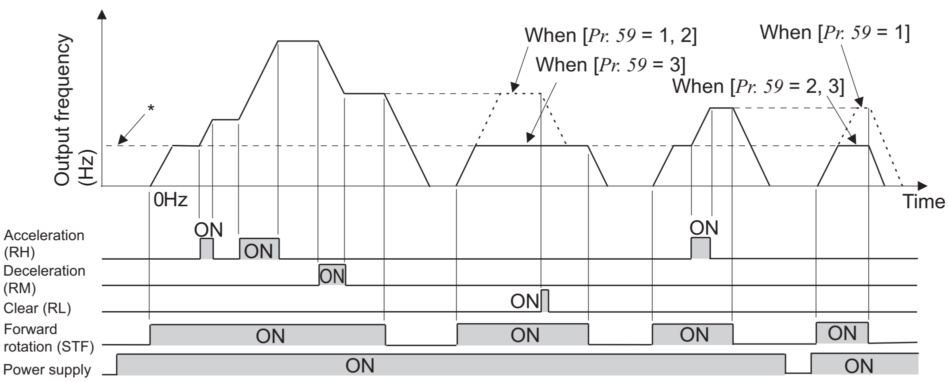
4)Frequency setting storage
When [*Pr. 59 = 1*], the remotely-set frequency is stored every minute after turning OFF (ON) of both the RH (acceleration) and RM (deceleration) signals. The set frequency when STF (STR) turned OFF is also stored. (The frequency is overwritten if the latest frequency is different from the past frequency when comparing the two. The state of the RL signal does not affect storing.)
When [*Pr. 59 = 2, 3*], set frequency is not stored. Therefore turning OFF the power and then turning ON will make the set frequency to 0Hz.

5)Setting Clear
Remotely-set frequency is cleared to 0Hz when RL signal turns ON with [*Pr.59 = 1 or 2*], or when STF(STR) signal turns OFF with [*Pr. 59 = 3*].

*1 When the acceleration or deceleration signal switches on, the set frequency varies according to the slope set in [*Pr. 44*] or [*Pr. 45*]. The acceleration/deceleration time of output frequency is as set in [*Pr. 7, 8*]. Therefore, the longer preset time is used to vary the actual output frequency.
*2 Multi-speed operation does not function when remote setting function is selected ("1 to 3" is set in [*Pr. 59*]).
*3 Remote setting function does not function when Jog operation or PID control is selected.
*4 Keeping RH signal ON does not increase frequency beyond the maximum frequency.
*5 The wiring length should be within 30m.



Connection diagram for remote setting



* External operation frequency (other than multi-speed) or PU running frequency

2.4.6 Input compensation of multi-speed and remote setting [Pr. 28] A700 F700

Compensation for frequency setting of three-speed operation or multi-speed operation is available with analog input. Compensation is not used as an initial value. Set "1" in [*Pr. 28*] to use compensation.

[*Pr.*]	Name	Initial Value	Setting Range	Description
28	Multi-speed input compensation selection	0	0	Without compensation
			1	With compensation

Use [*Pr. 73 Analog input selection*] to select the terminal (terminal 1, 2) used for compensation input voltage (0 to ±5V, 0 to ±10V) and compensation type.

[*Pr. 73*] Setting	Compensation Input Terminal	Compensation Method
4, 5, 14, 15	Terminal 2	Override
0 to 3, 6, 7	Terminal 1	Added compensation (not polarity reversible)
10 to 13, 16, 17	Terminal 1	Added compensation (polarity reversible)

2.4.7 Frequency setting by pulse train input [Pr. 291, 384 to 386] A700

The inverter speed can be set by inputting pulse train from terminal JOG.
In addition, synchronous speed operation of inverters can be performed by combining pulse train I/O.

[*Pr.*]	Name	Initial Value	Setting Range	Description	
				Pulse train input	**Pulse train output**
291	Pulse train I/O selection	0	0	Terminal JOG	FM output
			1	Pulse train input	FM output
			10	Terminal JOG	High speed pulse train output (50%Duty)
			11	Pulse train input	High speed pulse train output (50%Duty)
			20	Terminal JOG	High speed pulse train output (ON width is always same)
			21	Pulse train input	High speed pulse train output (ON width is always same)
			100	Pulse train input	High speed pulse train output (ON width is always same) The inverter outputs the pulse train input as it is
384	Input pulse division scaling factor	0	0	Pulse train input invalid	
			1 to 250	Indicates division scaling factor to the input pulse and the frequency resolution to the input pulse changes according to the value.	
385	Frequency for zero input pulse	0Hz	0 to 400Hz	Set the frequency when the input pulse is 0 (bias).	
386	Frequency for maximum input pulse	60Hz	0 to 400Hz	Set the frequency when the input pulse is maximum (gain).	

(1) Pulse train input selection [*Pr. 291, 384*]

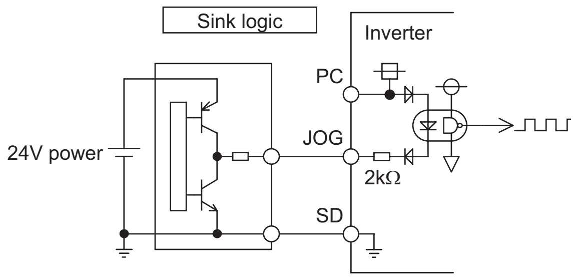
Setting any of "1, 11, 21, 100" in [*Pr. 291 Pulse train I/O selection*] and a value other than "0" in [*Pr. 384 Input pulse division scaling factor*] switches terminal JOG to pulse train input terminal and frequency setting of the inverter can be performed. (The initial value is JOG signal)
Pulse train input of maximum of 100k pulse/s is enabled.
When pulse train input is selected, a function assigned to terminal JOG using [*Pr. 185 JOG terminal function selection*] is invalid.
When [*Pr. 419 Position command source selection* = 2] (conditional position pulse train command by inverter pulse train input), JOG terminal serves as conditional position pulse train terminal regardless of the [*Pr. 291*].
The priority of the frequency command by the external signals is "Jog operation > Multi-speed operation > Terminal 4 analog input > Pulse train input > Terminal 2 analog input".

- Pulse train input specifications

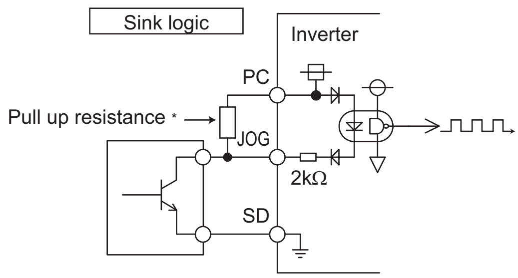
Item		Specifications
Available pulse method		Open collector output Complementary output (power supply voltage 24V)
H input level		20V or more (voltage between JOG-SD)
L input level		5V or less (voltage between JOG-SD)
Maximum input pulse rate		100kpps
Minimum input pulse width		2.5μs
Input resistance/load current		2kΩ (typ)/10mA(typ)
Maximum wiring length (reference value)	Open collector output method	10m (0.75mm^2/twisted pair)
	Complementary output method	100m (output resistance 50Ω)*
Detection resolution		1/3750

* The wiring length of complementary output depends on the output wiring specifications of complementary output device.
Stray capacitances of the wiring greatly differ according to the cable type and cable laying, the above maximum cable length is not a guaranteed value.

● **Connection with a complementary output system pulse generator**



● **Connection with an open collector output system pulse generator**



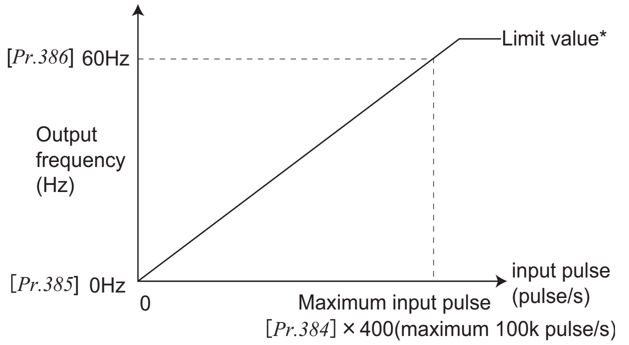
* When the wiring length of the open collector output connection is long, input pulse can not be recognized because of a pulse shape deformation due to the stray capacitances of the wiring.
When wiring length is long (10m or more of 0.75mm^2 twisted cable is recommended), connect an open collector output signal and power supply using a pull up resistance. The reference of resistance value to the wiring length is as in the table below.

Wiring Length	Less than 10m	10 to 50m	50 to 100m
Pull up resistance	Not necessary	1kΩ	470Ω
Load current (for reference)	10mA	35mA	65mA

Stray capacitances of the wiring greatly differ according to the cable type and cable laying, the above maximum cable length is not a guaranteed value.
When using a pull up resistance, check the permissible power of the resistor and permissible load current of output transistor and use them within a permissible range.

(2) Adjustment of pulse train input and frequency [*Pr. 385, 386*]

Frequency for zero input pulse can be set using [*Pr. 385 Frequency for zero input pulse*] and frequency at maximum input pulse can be set using [*Pr. 386 Frequency for maximum input pulse*].



* Limit value can be calculated from the following formula.
([*Pr. 386*] - [*Pr. 385*]) × 1.1 + [*Pr. 385*]

(3) Calculation method of scaling factor of input pulse [*Pr. 384*]

Maximum input pulse can be calculated from the following formula using [*Pr. 384 Input pulse division scaling factor*].

Maximum input pulse (pulse/s) = [*Pr. 384*] × 400

(maximum of 100k pulse/s
detectable pulse = 11.45 pulse/s)

For example, when you want to operate at 0Hz when pulse train input is zero and operate at 30Hz when pulse train is 4000 pulse/s, set parameters as below.

[*Pr. 384*] = 10
(maximum input pulse 4000 pulse/s)
[*Pr. 385*] = 0Hz
[*Pr. 386*] = 30Hz
(pulse train limit value is 33Hz)

2.4.8 Frequency setting by 16 bit digital input (FR-A7AX) [Pr. 300 to 305, 329] A700 F700 E700

16bit (12bit) digital input is available for the inverter with a plug-in option FR-A7AX installed and [*Pr. 304* ≠ *9999*] is set.
For A700, using digital input as a torque command is also available. (Refer to page 301)

[*Pr.*]	Name	Initial Value	Setting Range	Description / Input selection	Availability of Analog Input Compensation *1	A700	F700	E700
300	BCD input bias AX	0Hz	0 to 400Hz	Set bias frequency for BCD code input		○	○	○
301	BCD input gain AX	60Hz	0 to 400Hz	Set gain frequency for BCD code input		○	○	○
			9999	Digital input value is the output frequency				
302	BIN input bias AX	0Hz	0 to 400Hz	Set bias frequency for binary input		○	○	○
303	BIN input gain AX	60Hz	0 to 400Hz	Set gain frequency for binary input		○	○	○
			9999	Digital input value is the output frequency				
304	Digital input and analog input compensation enable/disable selection AX	9999	0	3 digits BCD code input *2	×	○	○	○
			1	12bit binary input *2	×	○	○	○
			2	3 digits BCD code input *2	○	○	○	—
			3	12bit binary input *2	○	○	○	—
			4	12bit binary Torque command value input*2	—	○	—	—
			10	4 digits BCD code input	×	○	○	○
			11	16bit binary input	×	○	○	○
			12	4 digits BCD code input	○	○	○	—
			13	16bit binary input	○	○	○	—
			14	16bit binary Torque command value input	—	○	—	—
			9999	No function		○	○	○
305	Read timing operation selection AX	0	0	Data is always read regardless of DY signal.		○	○	○
			1	Data is read only when DY signal is ON.				
			10	Data is always read regardless of DY signal. With filter at reading.				
329 *3	Digital input increments selection AX	1	0	Input value increments 10		○	○	○
			1	Input value increments 1				
			2	Input value increments 0.1				
			3	Input value increments 0.01				

*1 Use terminal 1 for analog input compensation.
*2 X12 to X15 signal of plug-in option FR-A7AX is invalid.
*3 Writing during running is unavailable even when [*Pr. 77 = 2*]. When changing the parameter setting, stop the operation. Also parameter clear is invalid.

2 PARAMETER

(1) Selection of digital input [*Pr. 304*]

16bit (12bit) digital input is available when [*Pr. 304 ≠ 9999*].

Use [*Pr. 304*] to select BCD code input ([*Pr. 304*] = 0, 2, 10, 12) or binary input ([*Pr. 304* = 1, 3, 11, 13]). For BCD code, input data is read as decimal. For binary input, input data is read as hexadecimal.

When 3 digits BCD code input or 12bit binary input is selected, X12 to X15 signal of plug-in option FR-A7AX is invalid.

When [*Pr. 304 = 2, 3, 12, 13*], output frequency is a sum of digital input command and terminal 1 compensation input.

When switching the inputs e.g. between volume input to perform manual operation and BCD code input to perform automatic operation, set the BCD code input to "0" under manual operation.

The priorities of the frequency setting are as follows.

"JOG ＞ Multi-speed operation (RH, RM, RL) ＞ PID (X14) ＞ AU (terminal 4) ＞ Digital command by the FR-A7AX ＞ terminal 2" (When digital input is valid, terminal 2 is invalid.)

[Example] To input BCD code 6325

BCD Code Input			
Digit	**Terminal name**	**Terminal input state**	**Input value**
1	X0	ON	5
	X1	OFF	
	X2	ON	
	X3	OFF	
10	X4	OFF	2
	X5	ON	
	X6	OFF	
	X7	OFF	
100	X8	ON	3
	X9	ON	
	X10	OFF	
	X11	OFF	
1000	X12	OFF	6
	X13	ON	
	X14	ON	
	X15	OFF	

* When the signal is used to enter a BCD code, 0AH to 0FH entries are ignored during operation and the previous inputs are used to continue operation. 0AH to 0FH input are ignored.
If binary input is changed to BCD code input with 0AH to 0FH input, the set frequency becomes 0Hz.

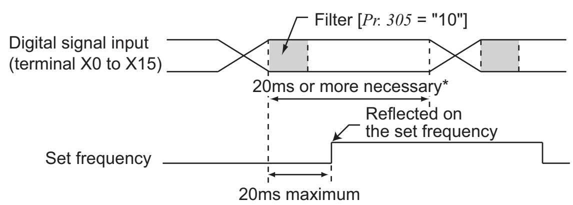
[Example] To input binary AB65H

Binary Input			
Terminal name	**Terminal input state**	**Input value (hexade-cimal)**	**Input value (decimal)**
X0	ON	5	43877
X1	OFF		
X2	ON		
X3	OFF		
X4	OFF	6	
X5	ON		
X6	ON		
X7	OFF		
X8	ON	B	
X9	ON		
X10	OFF		
X11	ON		
X12	OFF	A	
X13	ON		
X14	OFF		
X15	ON		

(2) Data read timing [*Pr. 305*]

When [*Pr. 305 = 0, 10*], the set frequency data entered from the digital signal input terminals (X0 to X15) is always imported independently of whether the DY signal of plug-in option FR-A7AX is ON or OFF.

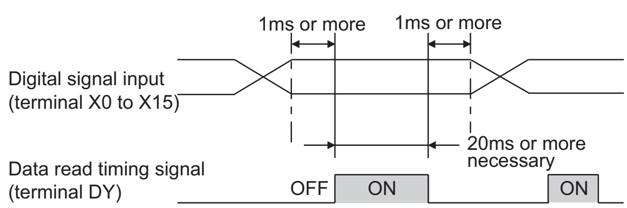
When [*Pr. 305 = 10*], filter is active for reading, and compensation for a digital signal change timing of each bit is available.



* Hold the digital signal input (X0 to X15) status for 20ms or more. Changing the signal within 20ms may not reflect it on the set frequency.

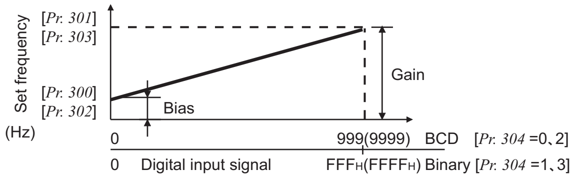
When [*Pr. 305 = 1*], the set frequency data entered from the digital signal input terminals (X0 to X15) is imported only when the DY signal is ON. The set frequency data is not imported when the DY signal is OFF. Therefore, even if the input status of the X0-X15 signal changes, the set frequency data before OFF of the DY signal is valid.

Each terminal from X0 to X15 is all recognized as OFF when the inverter is turned ON in terminal DY OFF status.



(3) Bias/gain adjustment [*Pr. 300 to 303, 329*]

For setting output frequency of when input signal is 0, use [*Pr. 300*] for BCD code input, and use [*Pr. 302*] for binary input.
For setting output frequency of maximum input signal (999 or 9999 for BCD code input, and FFFH or FFFFH for binary input), use [*Pr. 301*] for BCD code input, and use [*Pr. 303*] for binary input.

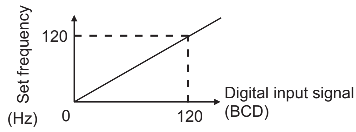


When "9999" is set in [*Pr. 301*] or [*Pr. 303*], the digital input value is set as the output frequency (when [*Pr. 329 = 1*]). When this setting method is used, "bias" setting ([*Pr. 300*] *or* [*Pr. 302*]) cannot be made.

When 9999 is set in [*Pr. 301*] or [*Pr. 303*], use [*Pr. 329*] for changing the setting increments.

$$\text{Set Frequency} = \text{Digital input signal value} \times [Pr.\ 329] \text{ input increments}$$

[Example] When [*Pr. 304 = 0*], [*Pr. 301 = 9999*], [*Pr. 329 = 1*] and BCD code = 120 is input



With the setting above, changing [*Pr. 329*] setting will change the output frequency as follows.

[*Pr. 329*] Setting	BCD Code	Set Frequency
0	120	1200Hz
1		120Hz
2		12.0Hz
3		1.20Hz

2.5 Output frequency and acceleration/deceleration time

2.5.1 Output frequency range [Pr. 1, 2, 13, 18, 571] (common)

Output frequency range is from 0.2 to 400Hz (0.5 to 400Hz for (F700)). Note that actual operating frequency is depending on parameter settings and operation mode as follows.

- For PU operation mode, three-speed operation and multi-speed operation of External operation mode, and for network operation mode, output up to 400Hz is available, though output frequency is limited by maximum frequency setting.
- For analog input of External operation mode, output frequency is limited by frequency setting gain frequency [*Pr. 125*] (or [*Pr. 126*]) and maximum frequency setting.
- Frequency at start is set in [*Pr. 13*].
- When decreasing the frequency command at constant speed, frequency up to 0.5Hz (when [*Pr. 13* ≥ 0.5Hz]) or up to [*Pr. 13*] setting (when [*Pr. 13* < 0.5Hz]) is output.
- When decreasing to stop with start signal OFF, up to DC injection brake operation frequency set in [*Pr. 10*] is output. And when decreasing to stop with frequency command 0Hz (with start signal ON), up to the above mentioned frequency at constant speed is output.

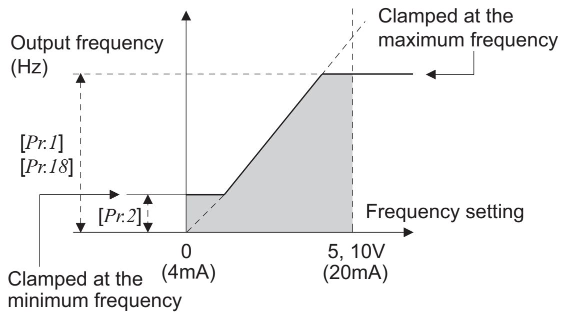
(1) Maximum frequency [*Pr. 1, 18*]

Set the maximum frequency for output using the operation panel (parameter unit). Set the maximum frequency limit of 0 to 120Hz in [*Pr. 1*].
Set the maximum frequency limit of 120 to 400Hz in [*Pr. 18*]. Parameter setting written in the last time between [*Pr. 1*] or [*Pr. 18*] is the valid maximum output frequency.
Maximum frequency for output is as follows.

1) For external analog input (voltage, current signal)
Lower frequency between maximum frequency [*Pr. 1*] (or [*Pr. 18*]) setting and frequency setting gain frequency [*Pr. 125*] (or [*Pr. 126*]) is the actual maximum output frequency. The output frequency is clamped at the maximum frequency limit if the frequency setting input given is higher than the maximum frequency limit.
2) For using operation panel (parameter unit)
Maximum frequency [*Pr. 1*] (or [*Pr. 18*]) setting is the maximum output frequency.

(2) Minimum frequency [*Pr. 2*]

Using the operation panel (parameter unit), set the minimum frequency limit that can be output during constant-speed operation. When the analog frequency setting input signal is used, the output frequency is clamped and does not drop below the minimum frequency limit if that frequency setting input signal is less than the minimum frequency limit in [*Pr. 2 Minimum frequency*] (this also applies to the input of 0). Any value less than the minimum frequency limit may be set from the operation panel (parameter unit) but the output frequency does not become less than the minimum frequency limit. (with the exception of the Jog frequency)
Note that when [*Pr. 2 Minimum frequency*] is set to any value equal to or more than [*Pr. 13 Starting frequency*], simply turning ON the start signal will accelerate the motor to the set frequency of [*Pr. 2 Minimum frequency*] according to the set acceleration time even if the command frequency is not input.
When stall prevention is activated to decrease the output frequency, the frequency may drop to [*Pr. 2*] or below.



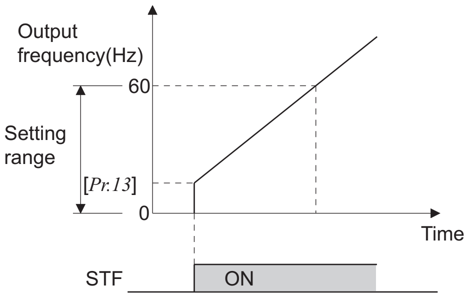
[*Pr.*]	Name	Initial Value		Setting Range	Description
1	Maximum frequency	55K or less	120Hz	0 to 120Hz	Set the upper limit of the output frequency.
		75K or more	60Hz		
2	Minimum frequency	0Hz		0 to 120Hz	Set the lower limit of the output frequency.
18	High speed maximum frequency	55K or less	120Hz	120 to 400Hz	Set when performing the operation at 120Hz or more.
		75K or more	60Hz		

(3) Starting frequency [*Pr. 13*]

Set the frequency at a voltage output start, which will be reached when the start signal is switched ON across terminals STF (or STR).

Starting frequency is used with [*Pr. 0 Torque boost*] to mainly adjust the starting torque. The rise in starting frequency not only raises the corresponding output voltage but also increases the starting current along with the starting torque. The following value is recommended as a guide to setting the starting frequency to keep the starting current less than the stall prevention operation current.

0.5Hz (initial value) for general application. 3Hz for a lifter and lowering device, etc. When the lifter and lowering device is started at a low starting frequency, the load may slip down due to insufficient starting torque as soon as the mechanical brake is released. The inverter cannot be started if the frequency setting is less than the starting frequency.



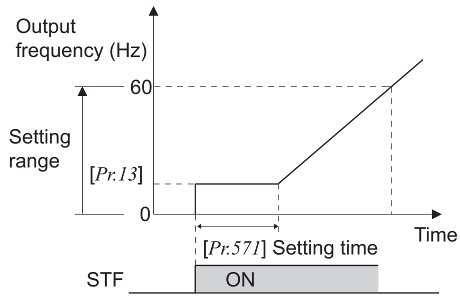
(4) Start-time hold function [*Pr. 571*]

For smooth motor driving at start, this function holds the output frequency set in [*Pr. 13 Starting frequency*] during the period set in [*Pr. 571*] to perform initial excitation for a motor.

At switching between forward rotation and reverse rotation, the starting frequency is valid but the start-time hold function is invalid.

When [*Pr. 13 = 0Hz*], the starting frequency is held at 0.01Hz.

For example, setting brake opening delay time for mechanical brake in [Pr. 571] limits current when brake is closed, makes the motor driving smooth at brake opening.



[*Pr.*]	Name	Initial Value	Setting Range	Description
13	Starting frequency	0.5Hz	0 to 60Hz	Frequency at start can be set in the range 0 to 60Hz. You can set the starting frequency at which the start signal is turned ON.
571	Holding time at a start	9999	0.0 to 10.0s	Set the holding time of [*Pr. 13 Staring frequency*].
			9999	Holding function at a start is invalid

2.5.2 Frequency jump [Pr. 31 to 36] (common)

If motor mechanical resonance occurs, this function allows the running frequency, at which the mechanical resonance has occurred, to be avoided (jumped). During acceleration/ deceleration, the running frequency within the set area is valid.
Frequency jump is not performed if the initial value (9999) is set.

[*Pr.*]	Name	Initial Value	Setting Range
31	Frequency jump 1A	9999	0 to 400Hz, 9999
32	Frequency jump 1B		
33	Frequency jump 2A		
34	Frequency jump 2B		
35	Frequency jump 3A		
36	Frequency jump 3B		

(1) Frequency jump area

Up to three areas may be specified. Areas may be specified in any order.

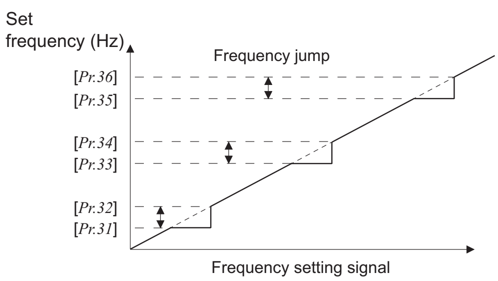
(2) Frequency jump range

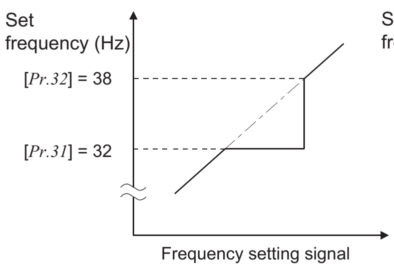
The range is determined by setting the top and bottom points to be avoided, not a jump value.

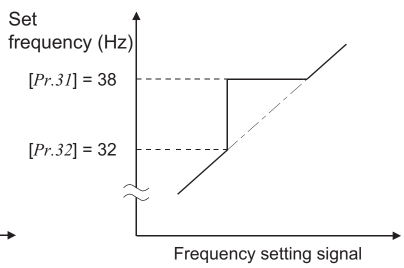
(3) Jump point

In the jump range, set the jump point at which operation is performed.

If the jump range setting is between 32 and 38Hz, for example, determine at which frequency, 32Hz or 38Hz, the operation is to be performed when the frequency setting signal is within the above range. This jump point is defined by the frequency set in Frequency jump 1A, 2A or 3A ([*Pr. 31*], [*Pr. 33*] or [*Pr. 35*]).







2.5.3 Acceleration/deceleration time [Pr. 7, 8, 16, 20, 21*, 44, 45, 110*, 111*, 147*] (common)

(*[*Pr. 110, 111*] are not available for (F700)(E700).)
(*[*Pr. 21 110, 111*] are not available for (D700).)
(*[*Pr. 147*] is available for only (E700).)

For the inverter operation, the output frequency is made to change linearly (linear acceleration/deceleration) to prevent the motor and inverter from excessive stress to reach the set frequency during start, acceleration, deceleration, stop, etc. when frequency changes. Linear acceleration/deceleration has a uniform frequency/time slope.
S-pattern acceleration/deceleration may also be set in [*Pr. 29*]. (Refer to page 238)
The acceleration and deceleration times set in [*Pr.7, 8, 44, 45, 110 and 111*] are the lengths of time required for the output frequency to change up to the acceleration/deceleration reference frequency set in [*Pr. 20*]. <u>The setting of the acceleration/deceleration time is based on [*Pr. 20 Acceleration/deceleration reference frequency*], independently of whether the operation mode is the External or PU operation mode.</u>

$$\text{Acceleration/Deceleration time setting} = \frac{[\textit{Pr. 20 Acceleration/deceleration reference frequency}]}{\text{Amount of output frequency change}} \times \left(\begin{array}{c}\text{Acceleration/deceleration}\\ \text{time for the amount of}\\ \text{output frequency change}\end{array}\right)$$

[Example 1]

Accelerating to the output frequency of 50Hz in 2.5s when [*Pr. 13 Starting frequency*] is 0Hz, and [*Pr. 20 Acceleration/deceleration reference frequency*] is 60Hz (initial setting)

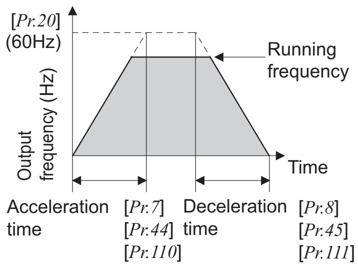
$$[\textit{Pr. 7 Acceleration time}]\ \text{setting value} = \frac{60\text{Hz}}{50\text{Hz}} \times 2.5\text{s} = 3.0\text{s}$$

[Example 2]

Accelerating to the output frequency of 90Hz in 12.5s when [*Pr. 13 Starting frequency*] is 0Hz, and [*Pr. 20 Acceleration/deceleration reference frequency*] is 90Hz

$$[\textit{Pr. 7 Acceleration time}]\ \text{setting value} = \frac{90\text{Hz}}{90\text{Hz}} \times 12.5\text{s} = 12.5\text{s}$$

The minimum input increments of the acceleration/deceleration time setting are factory-set to 0.1s. (When the value is set from the operation panel with [*Pr. 21 = 0*], the setting increments are 1s for the setting of 1000s or more.)
By changing the setting to [*Pr. 21 = 1*], the acceleration/deceleration time can be set in increments of 0.01s. (In this case, the maximum setting is 360s. When the value is set from the operation panel with [*Pr. 21 = 1*], the setting increments are 0.1s for the setting of 100s or more.)
Note that changing the [*Pr. 21*] setting changes the acceleration/deceleration time setting. When [*Pr. 21 = 0*] and [*Pr. 7 = 5s*], and if the setting is changed to [*Pr. 21 = 1*], the acceleration/deceleration time setting will change to [*Pr. 7 = 0.5s*].
The setting conditions of the related functions (parameters) are indicated in the table in the next page. The initial settings of the acceleration/deceleration times are temporary and should be changed to actually operable values. Actually operable values varies according to the load conditions (load torque and load GD2 reflected back to the motor shaft) and motor conditions (motor torque capability and motor GD2).
Refer to page 487 for the way of calculating the acceleration/deceleration time according to the load conditions and motor conditions.
When the load conditions are unknown, perform the operation and determine the acceleration/deceleration time which does not activate stall prevention.



[Pr.]	Name	Initial Value	Setting Range	Description		Available Inverters			
						A700	F700	E700	D700
7	Acceleration time	A700 F700 5/15s*1 E700 D700 5/10/15s*2	0 to 3600 / 360s*3	Set the motor acceleration time.		○	○	○	○
8	Deceleration time		0 to 3600 / 360s*3	Set the motor deceleration time.		○	○	○	○
16	Jog acceleration/ deceleration time	0.5s	0 to 3600/ 360s*3	Set the acceleration/deceleration time for Jog operation. Acceleration/deceleration time can not be set separately.		○	○	○	○
20	Acceleration/ deceleration reference frequency	60Hz	1 to 400Hz	Frequency that will be the basis of acceleration/ deceleration time. As acceleration/deceleration time, set the frequency change time from stop to [*Pr. 20*].		○	○	○	○
21	Acceleration/ deceleration time increments	0	0	Increments: 0.1s Range: 0 to 3600s	Increments and setting range of acceleration/ deceleration time setting can be changed.	○	○	○	—
			1	Increments: 0.01s Range: 0 to 360s					
44	Second acceleration/ deceleration time	A700 F700 5s E700 D700 5/10/15s*2	0 to 3600 / 360s*3	Set the acceleration/deceleration time when the RT signal is ON.		○	○	○	○
45	Second deceleration time	9999	0 to 3600 / 360s*3	Set the deceleration time when the RT signal is ON.		○	○	○	○
			9999	Acceleration time = deceleration time					
110	Third acceleration/ deceleration time	9999	0 to 3600 / 360s*3	Set the acceleration/deceleration time when the X9 signal is ON.		○	—	—	—
			9999	Without the third acceleration/deceleration function.					
111	Third deceleration time	9999	0 to 3600 / 360s*3	Set the deceleration time when the X9 signal is ON.		○	—	—	—
			9999	Acceleration time = deceleration time					
147	Acceleration/ deceleration time switching frequency	9999	0 to 400Hz	Frequency when automatically switching to the acceleration/deceleration time of [*Pr. 44*] and [*Pr. 45*].		—	—	○	—
			9999	No function					

*1 Differ according to capacities. (7.5K or less/ 11K or more)
*2 Differ according to capacities. (3.7K or less/ 5.5K, 7.5K/ 11K or more)
*3 Depends on the [*Pr. 21 Acceleration/deceleration time increments*] setting. The initial value for the setting range is "0 to 3600s" and setting increments is "0.1s". In D700, the setting range is "0 to 3600s" and setting increments is "0.1s".

(1) Acceleration time [*Pr. 7*] (common)

Calculate the period of time required for linear acceleration from a stop to the maximum operating frequency under the load and motor conditions used. Using the following formula, calculate the acceleration time from stop to [*Pr. 20 Acceleration/deceleration reference frequency*].

When the setting value of [*Pr. 7*] is 0.03s or less, acceleration time is 0.04s (when V/F control, General-purpose magnetic flux vector control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

For the acceleration time at automatic restart after instantaneous power failure, refer to [*Pr. 611 Acceleration time at a restart*] (page 367)

$$\text{Acceleration time setting} = \frac{[Pr.\ 20]}{\text{Maximum operating frequency} - [Pr.\ 13]} \times \text{Acceleration time from stop to maximum operating frequency}$$

[Example]

When [*Pr. 20* = 60Hz], and [*Pr. 10* = 0.5Hz], and acceleration can be made up to the maximum operating frequency of 50Hz in 10s

$$[Pr.\ 7] = \frac{60\text{Hz}}{50\text{Hz}-0.5\text{Hz}} \times 10\text{s} \fallingdotseq 12.1\text{s}$$

(2) Deceleration time [*Pr. 8*] (common)

Calculate the period of time required for linear deceleration from the maximum operating frequency to a stop under the load and motor conditions used. Using the following formula, calculate the deceleration time from [*Pr. 20 Acceleration/deceleration reference frequency*] to a stop.

When the setting value of [*Pr. 8*] is 0.03s or less, deceleration time is 0.04s (when V/F control, General-purpose magnetic flux vector control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

$$\text{Deceleration time setting} = \frac{[Pr.\ 20]}{\text{Maximum operating frequency} - [Pr.\ 10]} \times \text{Deceleration time from maximum operating frequency to stop}$$

[Example]

When the frequency can be decelerated down to the maximum operating frequency of 50Hz in 10s with [*Pr. 21* = 120Hz] and [*Pr. 10* = 3Hz]

$$[Pr.\ 8] = \frac{120\text{Hz}}{50\text{Hz}-3\text{Hz}} \times 10\text{s} \fallingdotseq 25.5\text{s}$$

(3) Second acceleration/deceleration time [*Pr. 44*] (common)

When the second function selection signal (RT) turns ON, the acceleration/deceleration time set in [*Pr. 7, 8*] is ignored and the acceleration/deceleration time set in [*Pr. 44*] is active. In this case, the acceleration time is equal to the deceleration time. When the setting value of [*Pr. 44*] is 0.03s or less, acceleration/deceleration time is 0.04s (when V/F control, General-purpose magnetic flux vector control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

(4) Second deceleration time [*Pr. 45*] (common)

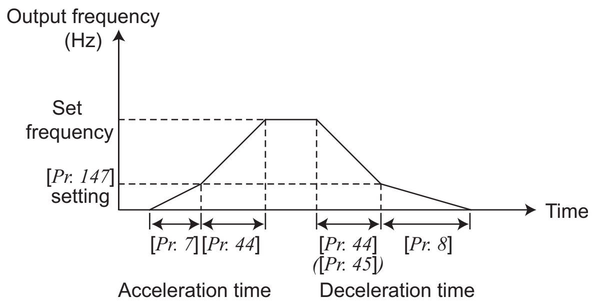
When the second function selection signal (RT) turns ON, the acceleration/deceleration time changes to the value set in [*Pr. 44*]. In this case, the acceleration time is equal to the deceleration time.

To set the acceleration time and deceleration time separately, set the second deceleration time in [*Pr. 45*] and the second acceleration time in [*Pr. 44*]. Setting of 9999 (initial value) in [*Pr. 45*] causes the second deceleration time to be the value set in [*Pr. 44*], making the acceleration and deceleration times equal.When the setting value of [*Pr. 45*] is 0.03s or less, deceleration time is 0.04s (when V/F control, General-purpose magnetic flux vector control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

(5) Second acceleration/deceleration time switching frequency [*Pr. 147*] (E700)

[*Pr. 44*] and [*Pr. 45*] are valid when the output frequency reaches or exceeds the setting of [*Pr. 147*]. When RT signal is OFF, automatic switching of the acceleration/deceleration time is available with [*Pr. 147*]. Even when automatic switching by the RT signal occurs at the frequency less than [*Pr. 147*] setting, the acceleration/deceleration time switches to the second acceleration/deceleration time.

[*Pr. 147*] Setting	Acceleration/ Deceleration Time	Description
9999 (initial value)	[*Pr. 7, 8*]	No automatic switching of the acceleration/ deceleration time
0.00Hz	[*Pr. 44, 45*]	Second acceleration/ deceleration time from a start
0.01Hz ≤ [*Pr.147*] ≤ Set frequency	Output frequency < [*Pr. 147*]: [*Pr. 7, 8*] [*Pr. 147*] ≤ Output frequency: [*Pr. 44, 45*]	Acceleration/ deceleration time automatic switching *
Set frequency < [*Pr. 147*]	[*Pr. 7, 8*]	No automatic switching, since output frequency will not reach the switching frequency



(6) Third acceleration/deceleration time [*Pr. 110*] (A700)

When the third function selection signal (X9) turns ON, the acceleration/deceleration time set in [*Pr. 7, 8*] is ignored and the acceleration/ deceleration time set in [*Pr. 110*] is active. In this case, the acceleration time is equal to the deceleration time. Set "9999" in [*Pr. 110*] to make this function invalid.
When both the RT and X9 signals are ON, [*Pr. 100, 111*] are valid.
When the setting value of [*Pr. 110*] is 0.03s or less, acceleration/deceleration time is 0.04s (when V/F control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

(7) Third deceleration time [*Pr. 111*] (A700)

When the third function selection signal (X9) turns ON, the acceleration/deceleration time changes to the value set in [*Pr. 110*]. In this case, the acceleration time equals to the deceleration time. In this case, the acceleration time is equal to the deceleration time.
To set the acceleration time and deceleration time separately, set the third deceleration time in [*Pr. 111*] and the third acceleration time in [*Pr. 110*]. Setting of 9999 (initial value) in [*Pr. 111*] causes the third deceleration time to be the value set in [*Pr. 111*], making the acceleration and deceleration times equal.
When both the RT and X9 signals are ON, [*Pr. 100, 111*] are valid.
When the setting value of [*Pr. 111*] is 0.03s or less, deceleration time is 0.04s (when V/F control, Advanced magnetic flux vector control, or Simple magnetic flux vector control). At that time, [*Pr. 20*] should be set to "120Hz" or less.

(8) Acceleration/deceleration time for Jog operation [*Pr. 16*] (common)

Allows the acceleration/deceleration time to be set for Jog operation in the PU or External operation mode. For Jog operation, the acceleration time is equal to the deceleration time. For details of the operation procedure, refer to page 215.
In the External operation mode, tuning Jog operation selection signal (JOG) enables the Jog operation.
The setting of the acceleration/deceleration time is as described in (1) and (2) Acceleration and deceleration times [*Pr. 7, 8*]. Set acceleration/ deceleration time until the [*Pr. 20 Acceleration/ deceleration reference frequency*] is reached.

2.5.4 S-pattern acceleration/deceleration and backlash measures [Pr. 29, 140 to 143*, 380 to 383*, 516 to 519*] common

(*[*Pr. 380 to 383, 516 to 519*] are not available for F700.)
(*[*Pr. 140 to 143, 380 to 383, 516 to 519*] are not available for E700 D700.)

[*Pr.*]	Name	Initial Value	Setting Range	Description	Available Inverters A700	Available Inverters F700	Available Inverters E700 D700
29	Acceleration/deceleration pattern selection	0	0	Linear acceleration/ deceleration	○	○	○
			1	S-pattern Acceleration/Deceleration A			
			2	S-pattern Acceleration/Deceleration B			
			3	Backlash measures			—
			4	S-pattern Acceleration/Deceleration C		—	
			5	S-pattern Acceleration/Deceleration D			
140	Backlash acceleration stopping frequency	1Hz	0 to 400Hz	Set the stopping frequency and time for backlash measures. Valid when [*Pr. 29 = 3*]	○	○	—
141	Backlash acceleration stopping time	0.5s	0 to 360s				
142	Backlash deceleration stopping frequency	1Hz	0 to 400Hz				
143	Backlash deceleration stopping time	0.5s	0 to 360s				
380	Acceleration S-pattern 1	0	0 to 50%	Valid when S-pattern acceleration/deceleration C [*Pr. 29 = 4*] is set. Set the time taken for S-pattern from starting of acceleration/deceleration to linear acceleration as % to the acceleration/deceleration time ([*Pr.7, 8*], etc.). An acceleration/deceleration pattern can be changed with the X20 signal.	○	—	—
381	Deceleration S-pattern 1	0	0 to 50%				
382	Acceleration S-pattern 2	0	0 to 50%				
383	Deceleration S-pattern 2	0	0 to 50%				
516	S-pattern time at a start of acceleration	0.1s	0.1 to 2.5s	Valid when S-pattern acceleration/deceleration D [*Pr. 29 = 5*] is set. Set the time taken for S-pattern acceleration/ deceleration (S-pattern operation).	○	—	—
517	S-pattern time at a completion of acceleration	0.1s	0.1 to 2.5s				
518	S-pattern time at a start of deceleration	0.1s	0.1 to 2.5s				
519	S-pattern time at a completion of deceleration	0.1s	0.1 to 2.5s				

(1) S-pattern acceleration/deceleration [*Pr. 29, 380 to 383, 516 to 519*]

Generally, frequency/time gradient of acceleration/ deceleration is a constant linear acceleration/ deceleration [*Pr. 29* = 0 (initial value)]. This acceleration/deceleration gradient can be changed into S-pattern.

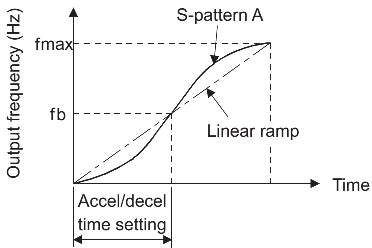
When the acceleration/deceleration time ([*Pr. 7, 8*] setting, etc.) setting under Real sensorless vector control or vector control is 0s, the S-pattern acceleration/deceleration A to D ([*Pr. 29 = 1, 2, 4, 5*]) is linear acceleration/deceleration.

Set linear acceleration/deceleration ([*Pr. 29* = 0 (initial value)]) when torque control is exercised under Real sensorless vector control or vector control. When acceleration/deceleration patterns other than the linear acceleration/deceleration are selected, the protective function of the inverter may function.

1) S-pattern acceleration/deceleration A [*Pr. 29 = 1*] common

In S-pattern acceleration/deceleration pattern, acceleration is maximum around [*Pr. 3 Base frequency*] (fb) as follows. Therefore using motor torque effectively, acceleration is fast for larger motor torque range, and slow for smaller motor torque range.

Effective for shortening the time taken to reach constant-power range where motor torque is small, when comparing with linear acceleration/ deceleration pattern. (Example: for machine tool)



S-pattern acceleration/deceleration A

As for the acceleration/deceleration time settings ([*Pr. 7, 8, 16, 44, 45, 110, 111*]) for S-pattern acceleration/deceleration A, set the time taken until [*Pr.3 Base frequency*] is reached, not [*Pr. 20 Acceleration/deceleration reference frequency*]. Refer to the following expression when set frequency is [*Pr. 3 Base frequency*] or more.

$$t = \frac{4}{9} \times \frac{T}{([Pr.\ 3])^2} \times f^2 + \frac{5}{9} T$$

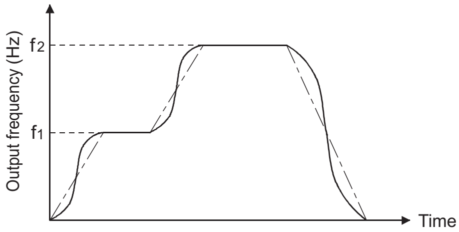
T: Acceleration/deceleration time setting (s)
f: Set frequency (Hz)

Guideline for acceleration/deceleration time (0Hz to set frequency) at [*Pr. 3 Base frequency* = 60Hz]

Setting Value of Acceleration/ Deceleration time (s)	Set frequency (Hz) 60	120	200	400
5	5	12	27	102
15	15	35	82	305

2) S-pattern acceleration/deceleration B [*Pr. 29 = 2*] (common)

S-pattern acceleration/deceleration B is for accelerating/decelerating in S-pattern when set frequency is changed (running frequency by external input signal or operation panel). Therefore reducing an impact during start or stop, and effective for load collapse prevention. For example, when set frequency changes as the following diagram, S-pattern is active. (Example: conveyor)

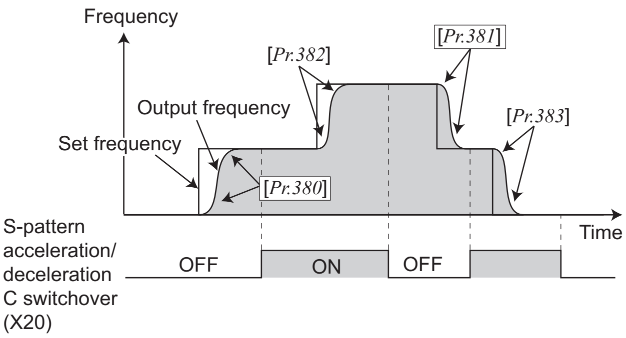


S-pattern acceleration/deceleration B

3) S-pattern acceleration/deceleration C [*Pr. 29 = 4, Pr. 380 to 383*] (A700)

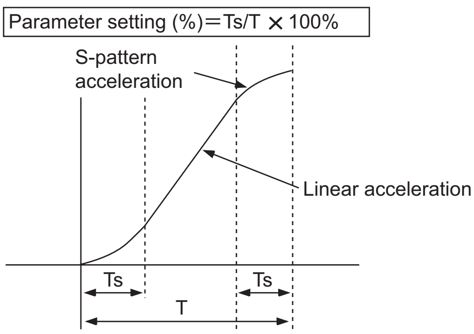
Assign S-pattern acceleration/deceleration C switching signal (X20) to an input terminal, and use S-pattern acceleration/deceleration C switching signal (X20) to switch the acceleration/ deceleration curve.

Change the S-pattern acceleration/deceleration C switch (X20 signal) after the speed becomes constant. S-pattern operation before switching continues even if the X20 signal is changed during acceleration or deceleration.



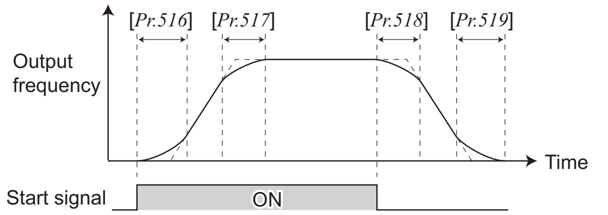
X20 Signal	During acceleration	During deceleration
OFF	[*Pr. 380 Acceleration S-pattern 1*]	[*Pr. 381 Deceleration S-pattern 1*]
ON	[*Pr. 382 Acceleration S-pattern 2*]	[*Pr. 383 Deceleration S-pattern 2*]

Set % of time taken for forming an S-pattern in [*Pr. 380, 383*] as acceleration/deceleration time is 100%.



4) S-pattern acceleration/deceleration D [*Pr. 29 = 5, Pr. 516 to 519*] (A700)

Set the time taken for S-pattern operation of S-pattern acceleration/deceleration using [*Pr. 516 to 519*].



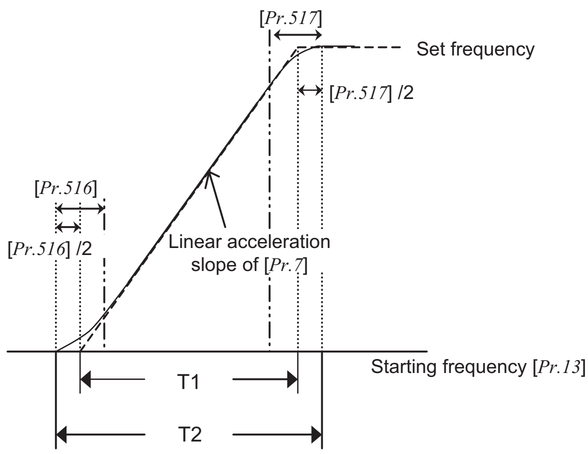
Even if the start signal is turned OFF during acceleration, the inverter will not decelerate immediately to avoid sudden frequency change. (Likewise, the inverter will not immediately accelerate when deceleration is changed to reacceleration by turning the start signal ON during deceleration, etc.)

When S-pattern acceleration/deceleration D is set, acceleration/deceleration time will become longer as follows:

The set acceleration/deceleration time T1 indicates the time taken for actual linear acceleration/deceleration calculated based on [*Pr. 7, 8, 44, 45, 110 or 111*].

Actual acceleration time T2 = set acceleration time T1+ (S-pattern time at a start of acceleration + S-pattern time at a completion of acceleration)/2 Actual deceleration time T2 = set deceleration time T1+ (S-pattern time at a start of deceleration + S-pattern time at a completion of deceleration)/2

[Example] When starting the inverter with an S-pattern acceleration/deceleration D selected from a stop to 60Hz in the parameter initial setting as shown below



Set acceleration time T1 = (Set frequency - [*Pr. 13*]) × [*Pr. 7*] / [*Pr. 20*]
= (60Hz - 0.5Hz)×5s/60Hz
≒ 4.96s (actual acceleration time at linear acceleration)

Set acceleration time T2 = set acceleration time T1 + ([*Pr. 516*] + [*Pr. 517*])/2
= 4.96s + (0.1s + 0.1s)/2
= 5.06s(acceleration time at S-pattern acceleration)

(2) Backlash measures [*Pr. 29, 140 to 143*]

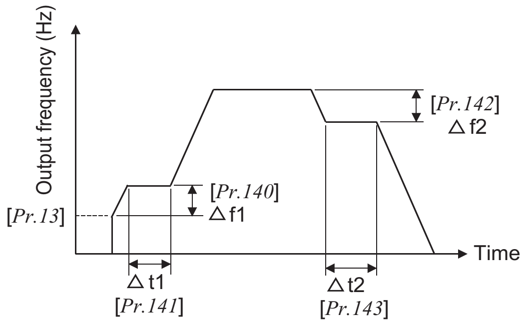
(A700) (F700)

Reduction gears have an engagement gap and have a dead zone between forward rotation and reverse rotation. This dead zone is called backlash, and this gap disables a mechanical system from following motor speed.

More specifically, a motor shaft develops excessive torque when the direction of rotation changes or when constant-speed operation shifts to deceleration. Resulting in a sudden motor current increase or regeneration status. Use "Backlash measures" to avoid these conditions.

Set [*Pr. 29 = 3*] to use Backlash measures [*Pr. 140 to 143*].

Acceleration/deceleration pattern of Backlash measures is linear acceleration/deceleration. The acceleration/deceleration time is increased by the stopping time.



2.5.5 Shortest acceleration/deceleration and optimum acceleration/deceleration (automatic acceleration/deceleration) [Pr. 61 to 63, 292, 293] (A700) (E700)

The inverter operates in the same conditions as when appropriate values are set in each parameter even if acceleration/deceleration time and V/F pattern are not set. This function is useful when you just want to operate, etc. without fine parameter setting.
Even if automatic acceleration/deceleration mode is selected, inputting the JOG signal (Jog operation) or RT signal (second function selection) or X9 signal (third function selection) during an inverter stop will switch to the normal operation and give priority to Jog operation or second and third function selection.
Note that JOG and RT signal input is invalid even if JOG signal and RT signal are input during operation in automatic acceleration/deceleration mode.
When PID control or load torque high speed frequency control is selected, optimum acceleration/deceleration is invalid.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	Available Inverters E700
61	Reference current	9999	55K or less: 0 to 500A 75K or more: 0 to 3600A	Set the reference current during shortest/ optimum acceleration/deceleration.	○	○
			9999	Rated inverter output current value is reference		
62	Reference value at acceleration	9999	(A700) 0 to 220% (E700) 0 to 200%	Set the limit value/optimum value during shortest/optimum acceleration.	○	○
			9999	Shortest acceleration/deceleration: 150% is a limit value Optimum acceleration/deceleration: 100% is an optimum value		
63	Reference value at deceleration	9999	(A700) 0 to 220% (E700) 0 to 200%	Set the limit value /optimum value during shortest/optimum deceleration.	○	○
			9999	Shortest acceleration/deceleration: 150% is a limit value Optimum acceleration/deceleration: 100% is an optimum value		
292	Automatic acceleration/ deceleration	0	0	Normal Mode	○	○
			1	Shortest acceleration/deceleration (without brake)		
			11	Shortest acceleration/deceleration (with brake)		
			3	Optimum acceleration/deceleration		—
			5, 6	Elevator mode1, 2 (refer to page 249)		
			7, 8	Brake sequence mode 1, 2 (refer to page 399)		○
293	Acceleration/ deceleration individual operation selection	0	0	Both acceleration and deceleration are made in the shortest (optimum) acceleration/ deceleration mode	○	○
			1	Only acceleration is made in the shortest (optimum) acceleration/deceleration mode		
			2	Only deceleration is made in the shortest (optimum) acceleration/deceleration mode		

(1) Optimum acceleration/deceleration mode [*Pr. 292 = 1, 11*] (common)

This function automatically controls acceleration/deceleration speed so as to achieve shortest time of acceleration/deceleration with using stall prevention function of the inverter.

Set [*Pr. 292 Automatic acceleration/deceleration = 1*] to use Shortest acceleration/deceleration. Set [*Pr. 292 = 11*] when using built-in brake resistor, high-duty brake resistor and brake unit.

Note that when proper values are set in [*Pr. 7 Acceleration time*] and [*Pr. 8 Deceleration time*], acceleration/deceleration time may be shorter than selecting shortest acceleration/deceleration mode.

1) Control method

Inverter regards that the shortest acceleration/deceleration time (0s) is set, and accelerates/decelerates with changing frequency with using stall prevention operation. Since accelerating/decelerating with using stall prevention function, acceleration/deceleration speed varies depending on load condition. (The setting values of [*Pr. 7, 8*] are not changed)

<u>Settings of [*Pr. 7 Acceleration time*], [*Pr. 8 Deceleration time*], and [*Pr. 22 Stall prevention operation level*] are ignored.</u> When the stall prevention operation level in [*Pr. 61 to 63*] are smaller than [*Pr. 22*], the setting of [*Pr. 22*] is valid. [*Pr. 22*] is valid when constant speed.

2) Applications

●Appropriate application

- To make acceleration/deceleration in a shorter time for a machine tool etc. but the design values of machine constants are unknown.
- To exhibit the best performance of the inverter and motor performance.
- To accelerate/decelerate in constant torque.

●Inappropriate application

- Machine with a large inertia (more than 10 times) such as a fan. Since current limit function will be activated for a long time, this type of machine may be brought to a fault due to motor overloading, etc.
- To perform operation always with a constant acceleration/deceleration time.

3) Setting of dedicated parameters

By setting the dedicated parameters, the application range can be made wider.

In the initial setting, the current limit function is activated at the 150% value of the rated inverter current.

Adjustment with [*Pr. 61 to 63*] is unavailable under real sensorless vector control and vector control. Operating with [*Pr. 22*] limit.

Since the [*Pr. 61 to 63*] settings automatically return to the initial value (9999) if the [*Pr. 292*] setting is changed, set [*Pr. 292*] first when you need to set [*Pr. 61 to 63*].

[*Pr.61*]: Set the current value (A) that is referenced for stall prevention operation level. When the motor and inverter are different in capacity, for example, and it is desired to define the motor rating as reference, set the reference current value in this parameter.

[*Pr. 62*]: Set the stall prevention operation level (%) for acceleration. Set to change the limit for acceleration/deceleration.

[*Pr. 63*]: Set the stall prevention operation level (%) for deceleration. Set to change the limit for acceleration/deceleration.

[*Pr.293*]: Set to select the Shortest acceleration/deceleration operation for only when accelerating or decelerating.

(2) Optimum acceleration/deceleration mode [*Pr. 292* = 3] (A700)

Automatic setting of [*Pr. 0 Torque boost*], [*Pr. 7 Acceleration time*] and [*Pr. 8 Deceleration time*] is available. Set [*Pr. 292 Automatic acceleration deceleration = 3*] and repeat actual operation to perform self learning of the inverter for proper current during acceleration/deceleration.

1) Control method

At the initial time when the optimum acceleration/deceleration mode has been selected, operation is performed at the values set in [*Pr. 0 Torque boost*], [*Pr. 7 Acceleration time*] and [*Pr. 8 Deceleration time*].

After operation, the average current and peak current are calculated from the motor current during acceleration/deceleration. These values are compared with the reference current (initial value is rated inverter current) and calculated for increase or decrease, then more appropriate values are set in [*Pr. 0, 7, 8*]. The calculated result is set in [*Pr. 0, 7, 8*] as the optimum value.

After that, operation is performed with that [*Pr. 0, 7, 8*] setting, and more appropriate values are calculated and set in [*Pr. 0, 7, 8*] as needed. Note that the [*Pr. 0*] value will not change under advanced magnetic flux vector control and real sensorless vector control and vector control.

Therefore, by repeating operations will automatically set the appropriate value regardless of the initial value, and optimized acceleration/deceleration operation is available. Calculation is performed only when acceleration from a stop to 30.01Hz or more, or when deceleration from 30.01Hz or more to stop.

When the motor is not connected or output current is less than 5% of the rated inverter current, optimum acceleration/deceleration mode will not function.

2) Storage of appropriate parameter setting

The optimum values of [*Pr. 0, 7, 8*] are written to both the parameter RAM and EEPROM only three times after the optimum acceleration/deceleration mode has been selected or after the power is switched ON or the inverter is reset. At of after the fourth attempt, these are not stored into EEPROM. Hence, after power-ON or inverter reset, the values changed at the third time are valid. Operation and display of the operation panel is based on the latest optimum value.

The [*Pr. 0, 7, 8*] value changed at the fourth or later time can be stored into EEPROM by reading and writing the values with the operation panel.

Number of Optimum Value Changes	[*Pr. 0*], [*Pr. 7*], [*Pr. 8*] EEPROM value	RAM value	Optimum Conditions
1 to 3 times	Updated	Updated	Updated
4 or more times	Unchanged from third value	Updated	Updated

3) Applications

●Appropriate application

- For applications such as automatic transfer machine, etc which is small in load change and is operated in a predetermined pattern.

●Inappropriate application

- For machines which change in load and operation conditions. Since the stored optimum values are used for the next operation, changing of the application condition causes miss setting, and results in non acceleration/deceleration or fault due to overcurrent protection function, etc.

4) Setting of dedicated parameters

By setting the dedicated parameters, the application range can be made wider.

In the initial setting, 100% of the rated inverter current is regarded as the optimum current value.

Since the [*Pr. 61 to 63*] settings automatically return to the initial value (9999) if the [*Pr. 292*] setting is changed, set [*Pr. 292*] first when you need to set [*Pr. 61 to 63*].

[*Pr. 61*]:Set the current value (A) that is referenced for optimum current value. When the motor and inverter are different in capacity, for example, and it is desired to define the motor rating as reference, set the reference current value in this parameter.

[*Pr. 62*]:Set the optimum current level (%) for acceleration. Set when you want to restrict average current at acceleration.

[*Pr. 63*]:Set the optimum current level (%) for deceleration. Set when you want to restrict average current at deceleration.

[*Pr. 293*]: Set to select the Optimum acceleration/deceleration operation for only when accelerating or decelerating.

2.6 Setting output voltage (V/F control)

2.6.1 V/F pattern and torque boost [Pr. 0, 3, 14, 19, 46, 47, 112*, 113*] (common)

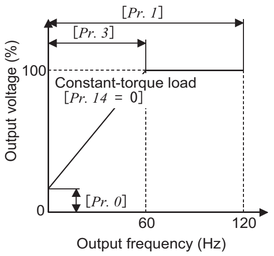
(*[*Pr. 112, Pr. 113*] are not available for (F700)(E700)(D700).)

The inverter controls not only the output frequency but also the output voltage. The relationship between the output frequency and voltage is as follows.

- [*Pr. 14*] allows the load pattern to be selected between a linear ramp (for constant torque load) and a square curve (for variable torque load) for the ratio of the output voltage to the output frequency at not more than the base frequency.
- When the base frequency is reached, the output voltage is maximum and is almost equal to the input power supply voltage. At not less than the base frequency, the output voltage is kept constant. [*Pr. 19*] allows the setting of the output voltage at not less than the base frequency. Note that the voltage output is less than the power supply voltage.
- When power supply voltage varies, the output voltage varies according to the power supply voltage. When a value other than 8888 and 9999 is set to [*Pr.19 Base frequency voltage*], output voltage is limited to within the set voltage.
- Set the base frequency in [*Pr. 3*] .
- Set the output voltage at the output frequency of 0 in [*Pr. 0 Torque boost*] to increase/decrease the motor starting torque.
- % indicated for the [*Pr. 0 Torque boost*], assumes that the output voltage (≒ power supply voltage) of the base frequency is 100%.
- When the advanced magnetic flux vector control, Simple magnetic flux vector control, Real sensorless vector control, and vector control are selected, [*Pr. 0, Pr. 3, Pr. 14, Pr. 19, Pr. 46, Pr. 47, Pr. 112, Pr. 113*] are invalid.

[*Pr.*]	Name	Initial Value	Setting Range		Available Inverters: A700	F700	E700 D700
14	Load pattern selection	(A700)(E700)(D700) 0 (F700) 1	0	For constant torque load	○	○	○
			1	For variable-torque load	○	○	○
			2	For constant torque elevators (at reverse rotation boost 0%)	○	—	○
			3	For constant torque elevators (at forward rotation boost 0%)	○	—	○
			4	When the RT signal is ON ....For constant torque load When the RT signal is OFF ....For constant torque elevators (at reverse rotation boost 0%)	○	—	—
			5	When the RT signal is ON ....For constant torque load When the RT signal is OFF ....For constant torque elevators (at forward rotation boost 0%)	○	—	—
3	V/F (base frequency)	60Hz	0 to 400Hz		○	○	○
47	Second V/F (base frequency)	9999	0 to 400Hz, 9999		○	○	○
113	Third V/F (base frequency)	9999	0 to 400Hz, 9999		○	—	—
19	Base frequency voltage	9999	0 to 1000V, 8888, 9999		○	○	○
0	Torque boost	(A700)(E700)(D700) 0.75K or less 6% 1.5K to 3.7K 4% 5.5K, 7.5K 3% 11K to 55K 2% 75K or more 1% (F700) 0.75K 6% 1.5K to 3.7K 4% 5.5K, 7.5K 3% 11K to 37K 2% 45K, 55K 1.5% 75K or more 1%	0 to 30%		○	○	○
46	Second torque boost	9999	0 to 30%, 9999		○	○	○
112	Third torque boost	9999	0 to 30%, 9999		○	—	—

The setting conditions of related parameters and the relationship between output frequency and output voltage for (A700) factory setting is indicated in the table in the last page and figure below.



Relationship between output frequency and output voltage for (A700) factory setting

(1) Load pattern selection [*Pr. 14*]

Allows the optimum V/F characteristic to be selected according to the load torque characteristic and operation method.

1) For constant torque load [*Pr. 14 = 0*] (common)

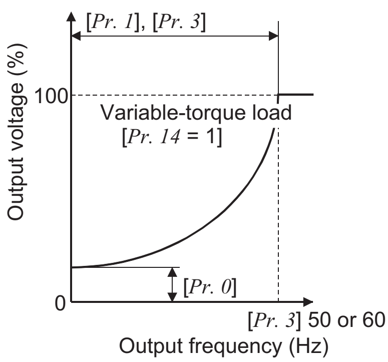
Set [*Pr. 14 = 0*] to drive a load which is constant in load torque if the speed varies, e.g. conveyor, cart, roll drive.

2) For variable-torque load [*Pr. 14 = 1*] (common)

Set [*Pr. 14 = 1*] when driving the load whose load torque varies in proportion to the square of the speed, e.g. fan or pump.
If the load is a fan or pump, select "for constant-torque load" in any of the following cases.

(a) When a blower of large load inertia J (moment of inertia) is accelerated in a short time.
(b) For constant-torque load such as rotary pump or gear pump.
(c) When load torque increases at low speed, e.g. screw pump.

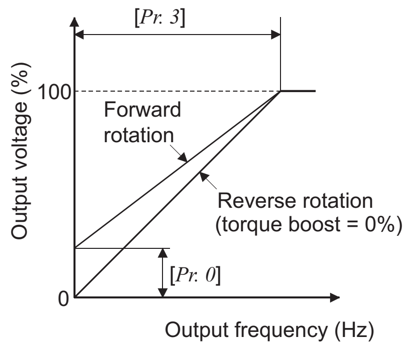
When the variable-torque load has been selected, [*Pr. 1 Maximum frequency*] should be equal to or less than the [*Pr. 3 Base frequency*] setting (normally 50Hz or 60Hz) unless the motor capacity is considerably sufficient. When the variable-torque load has been selected, the output voltage is approximately proportional to the square of the output frequency.



Output frequency and output voltage when variable-torque load is selected

3) For constant torque vertical lift load [*Pr. 14 = 2, 3*] (A700)(E700)(D700)

Set [*Pr. 14 = 2*] for a vertical lift which is kept in the driving mode during forward rotation and in the regenerative mode during reverse rotation. In this case the torque boost set in [*Pr. 0 Torque boost*] is made valid during forward rotation and the torque boost is automatically set to 0% during reverse rotation as shown below.



For vertical lift load output voltage

Set [*Pr. 14 = 3*] for an elevated load that is in the driving mode during reverse rotation and in the regenerative mode during forward rotation according to the load weight, e.g. counterweight system.
When torque is continuously regenerated as vertical lift load, it is effective to set the rated voltage in [*Pr. 19 Base frequency voltage*] to prevent trip due to current at regeneration.

4) Changing of load pattern selection [*Pr. 14 = 4, 5*] (A700)

Set [*Pr. 14 = 4, 5*] to change the load pattern selection according to the RT signal.
The RT signal may be replaced by the X17 signal.

[*Pr. 14*] setting	RT signal (X17 signal)	Output characteristics
4	ON	For constant torque load (same as when the setting is 0)
	OFF	For vertical lift (at reverse rotation boost 0%) (same as the setting 2)
5	ON	For constant torque load (same as when the setting is 0)
	OFF	For vertical lift (at forward rotation boost 0%) (same as the setting 3)

(2) Base frequency [*Pr. 3*] (common)
Second V/F (base frequency) [*Pr. 47*] (common)
Third V/F (base frequency) [*Pr. 113*] (A700)

The base frequency indicates a frequency at the rated torque of the motor. It is 50Hz or 60Hz for standard motors.

To perform the switch-over operation of two (or three) motors by one inverter, the base frequency dedicated to one motor can be set in [*Pr. 47 (Pr. 113)*]. (Active when RT(X9) signal is ON.) Set 9999 (initial value) in [*Pr. 47 (Pr. 113)*] to set the same value in [*Pr. 3*].

For (A700), [*Pr. 113*] is valid when both the RT and X9 signals are ON.

The base frequency of the standard motor is determined as follows:

1) When a new machine is installed, it is recommended to set the base frequency to 60Hz because 60Hz can be output even in a 50Hz district and the motor torque may be utilized more effectively by setting the base frequency to 60Hz instead of 50Hz.
2) Set the base frequency to 50Hz when using the inverter with the existing machine which is driven by the commercial power supply in a 50Hz district.
3) Generally, setting the base frequency to higher than 60Hz has no advantage.
4) The following depends on the whether the base frequency has been set to 50Hz or 60H:
   (a) Selection of data on the torque capability of the standard motor used with the inverter.
   (b) Rated torque value (in %) of the standard motor corresponding to 100% torque.

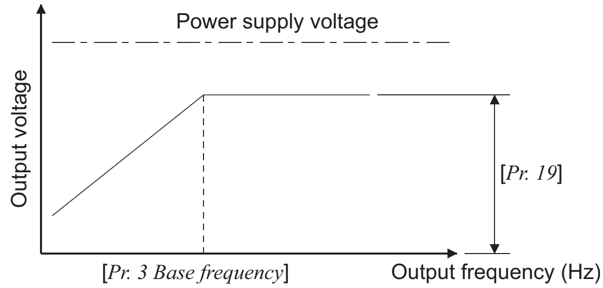
   If the base frequency used is other than 50Hz or 60Hz, a special motor designed to meet that base frequency is required.

(3) Base frequency voltage [*Pr. 19*] (common)

If the setting is equal to or less than the power supply voltage, the maximum output voltage of the inverter is the value set in [*Pr. 19*]. If the power supply voltage rises, the output voltage does not exceed the set value.

When [*Pr. 19 = 9999*], the maximum output voltage of the inverter is same as power supply voltage.

When [*Pr. 19 = 8888*], the maximum output voltage of the inverter is same as 95% of the power supply voltage.



Base frequency voltage

The base frequency voltage can be utilized for the following cases.

1) Regenerative frequencies are high (such as continuous regeneration)
   At the time of regeneration, the output voltage may become higher than the V/F reference value, causing an overcurrent trip due to the increase in motor current. This can be prevented.
2) Fluctuation of power supply voltage is large.
   If the power supply voltage exceeds the rated motor voltage, excessive torque or increased motor current may cause the speed to fluctuate greatly or the motor to overheat.

When operation is discontinued under vector control due to failure of an encoder, etc., setting 9999 in [*Pr. 80 Motor capacity*] or [*Pr. 81 Number of motor poles*] enables V/F control operation. Set parameters as below when running the vector control dedicated motor (SF-V5RU, SF-VR) under V/F control.

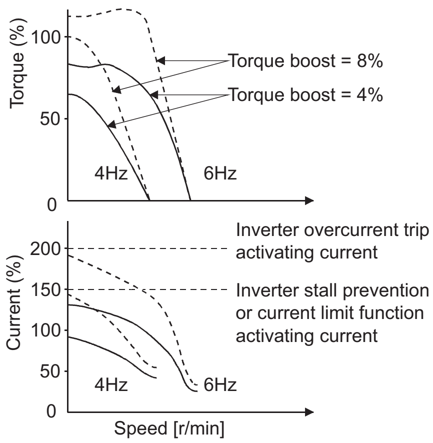
Motor Type	[*Pr. 19*] Setting	[*Pr. 3*] Setting
SF-V5RU-3.7kW or less	170V	50Hz
SF-V5RU-5.5kW or less	160V	
SF-V5RUH-3.7kW or less	340V	
SF-V5RUH-5.5kW or less	320V	
SF-VR	160V	
SF-VRH	320V	

(4) Torque boost [*Pr. 0*] (common)
Second torque boost [*Pr. 46*] (common)
Third torque boost [*Pr. 112*] (A700)

Allows the output voltage at the output frequency of 0Hz to be set to increase/decrease the motor starting torque. Change the setting of the torque boost only when the starting torque is not appropriate.
To perform the switch-over operation of two (or three) motors by one inverter, the torque boost dedicated to one motor can be set in [*Pr. 46 (Pr. 112)*]. (Active when RT(X9) signal is ON.) Set 9999 (initial value) in [*Pr. 46 (Pr. 112)*] to set the same value in [*Pr. 0*].

For (A700), [*Pr. 112*] is valid when both the RT and X9 signals are ON.

1) To increase the starting torque
   The following figure shows the motor torque and current characteristic examples in which the [*Pr. 13 Starting frequency*] is suppressed to a low value and the torque boost is increased so that the motor may be started at the starting current lower than the stall prevention current.



Torque boost, motor torque and current examples

When the torque boost setting is greater than the initial setting, the continuously usable frequency range is narrowed because the no-load current of the motor increases. When the torque boost value is 8%, for example, the frequency of 15Hz or less cannot be used continuously.
Too high setting of the torque boost saturates the magnetic flux of the motor iron core, which increases the motor current and activates the current limit function.
If the starting torque is insufficient when using the serge voltage suppression filter (FR-ASF-H), increase the [*Pr. 0*] value.

2) To suppress motor vibration at low frequency
   Vibration may be suppressed by setting the torque boost value to lower than the factory setting (this is applicable only when the motor capacity is sufficient). In this case, the motor starting torque is reduced.
   Change the torque boost setting according to actual operation and check that the above problem does not occur.

3) When using an inverter dedicated motor (constant-torque motor)
   When using the inverter dedicated motor (constant torque motor) and energy saving motor, set the setting of [*Pr. 0 Torque boost*] as shown below.

   In addition, when the [*Pr. 71 Applied motor*] setting is changed to the constant torque motor in the initial setting status, the [*Pr. 0*] setting is automatically changed as shown below. The [*Pr. 0*] setting is automatically changed also when the constant torque motor setting is changed to the standard motor setting.

	[*Pr. 71*] Setting	
	Standard motor (initial value)	Constant-torque motor
0.75K or less	6%	6%
1.5K to 3.7K	4%	4%
5.5K, 7.5K	3%	2%
11K to 37K	2%	2%
45K, 55K	(A700) 2% (F700) 1.5%	(A700) 2% (F700) 1.5%
75K or more	1%	1%

2

PARAMETER

2.6.2 Adjustable 5 points V/F [Pr. 71, 100 to 109] A700 F700

When V/F control has been selected, set [*Pr. 71 = 2*] and define five points as shown on the right to perform operation in the V/F pattern connected by straight lines in sequence.

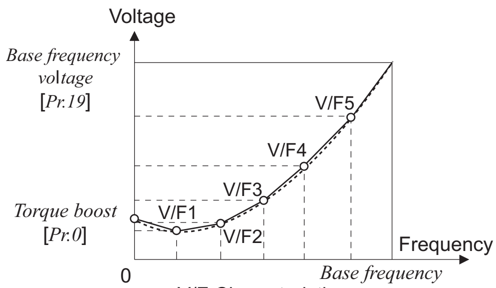
For a machine of large static friction coefficient and small dynamic static friction coefficient, for example, set a V/F pattern that will increase the voltage only in a low speed region since such a machine requires large torque at a start.

When [*Pr. 19 Base frequency voltage* = 8888, 9999], [*Pr. 71 = 2*] can not be set. Set the rated voltage value in [*Pr. 19*] to set [*Pr. 71 = 2*].

The five points can be set as desired within the range of the [*Pr. 3 Base frequency*], and [*Pr. 19 Base frequency voltage*].

Note that if you attempt to set the same frequency in any two of the five points, an outside-of -range error occurs.

The setting of inappropriate V/F values will cause excessive current, abnormal machine collision or vibration during acceleration and deceleration.



V/F Characteristic

When [*Pr. 71 = 2*] is set, [*Pr. 47 Second V/F*] and [*Pr. 113 Third V/F*] will not function.

The electronic thermal relay function calculates as standard motor.

Adjustable 5 points V/F does not function during Advanced magnetic flux vector control, Simple magnetic flux vector control, Real sensorless vector control, vector control.

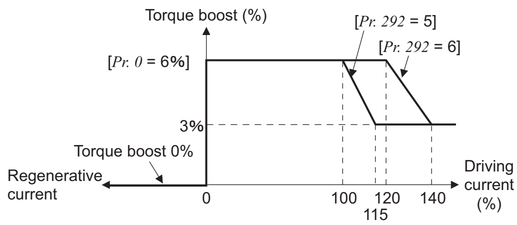
[*Pr.*]	Name	Initial Value	Setting Range	Description
71	Applied motor	0	A700: 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54 F700: 0, 1, 2, 20	Set 2 for adjustable 5 points V/F control.
100	V/F1 (first frequency)	9999	9999	No V/F1 setting
			0 to 400Hz	Set the V/F1 frequency
101	V/F1(first frequency voltage)	0V	0 to 1000V	Set the V/F1 voltage
102	V/F2 (second frequency)	9999	9999	No V/F2 setting
			0 to 400Hz	Set the V/F2 frequency
103	V/F2 (second frequency voltage)	0V	0 to 1000V	Set the V/F2 voltage
104	V/F3 (third frequency)	9999	9999	No V/F3 setting
			0 to 400Hz	Set the V/F3 frequency
105	V/F3 (third frequency voltage)	0V	0 to 1000V	Set the V/F3 voltage
106	V/F4 (fourth frequency)	9999	9999	No V/F4 setting
			0 to 400Hz	Set the V/F4 frequency
107	V/F4 (fourth frequency voltage)	0V	0 to 1000V	Set the V/F4 voltage
108	V/F5 (fifth frequency)	9999	9999	No V/F5 setting
			0 to 400Hz	Set the V/F5 frequency
109	V/F5 (fifth frequency voltage)	0V	0 to 1000V	Set the V/F5 voltage

2.6.3 Elevator mode [Pr. 61, 64, 292] A700

[*Pr.*]	Name	Initial Value	Setting Range		Description
61	Reference current	9999	55K or less	0 to 500A	Set the reference current for elevator mode.
			75K or more	0 to 3600A	
			9999		Rated inverter current value reference
64	Starting frequency for elevator mode	9999	0 to 10Hz		Set the starting frequency for the elevator mode.
			9999		Starting frequency 2Hz
292	Automatic acceleration/ deceleration	0	0		Normal mode
			1		Shortest acceleration/ deceleration (without brake) (Refer to page 241)
			11		Shortest acceleration/ deceleration (with brake) (Refer to page 241)
			3		Optimum acceleration/deceleration (Refer to page 241)
			5		Elevator mode 1 (stall prevention operation level 150%)
			6		Elevator mode 2 (stall prevention operation level 180%)
			7, 8		Brake sequence mode 1, 2 (Refer to page 399.)

Operation matching a load characteristic of elevator with counterweight can be performed.
Set 5 (stall prevention operation level 150%) or 6 (stall prevention operation level 180%) in [*Pr. 292 Automatic acceleration/deceleration*] to perform operation in the elevator mode 1 or 2.

1) Control method
   Sufficient torque is generated for the drive mode load. For the regenerative load and no load, the torque boost value is controlled with respect to the [*Pr. 0*] setting as shown below to prevent an overcurrent trip due to overexcitation.



Torque boost characteristics (when torque boost setting is 6%)

The starting frequency is factory-set to 2Hz, the stall prevention operation level to 150% (or 180%), and the base frequency voltage to 220V or 400V.

	Normal mode	Elevator mode [*Pr. 292 = 5*]	Elevator mode [*Pr. 292 = 6*]
Torque boost	[*Pr. 0*]	Changes according to the output current	
Starting frequency	[*Pr. 13*]	[*Pr. 64*] 2Hz Accelerate after maintaining 100ms	
Base frequency voltage	[*Pr. 19*]	220V/440V	
Stall prevention operation level	[*Pr. 22*]	150%	180%

Therefore settings of [*Pr. 13 Starting frequency*], [*Pr. 19 Base frequency voltage*], and [*Pr. 22 Stall prevention operation level*] are ignored.
The elevator modes 1 and 2 are different only in stall prevention operation level.
By returning [*Pr. 292 = 0*] (normal mode), the [*Pr. 0, 13, 19, 22*] setting becomes valid. [*Pr. 61, 64*] also automatically return to the initial value (9999).

2) Restriction conditions
   When the Advanced magnetic flux vector control, Real sensorless vector control or vector control is selected, elevator mode selection is invalid.
3) Applications
   ●Appropriate application
   - Elevator with counterweight

   ●Inappropriate application
   - Maximum torque may be insufficient for an elevator subjected to the load of higher than the rating.
     For an elevator without counterweight, setting 2 or 3 in [*Pr. 14 Load pattern selection*] and setting a proper value in [*Pr. 19 Base frequency voltage*] makes the maximum torque larger and is more advantageous than the selection of the elevator mode.
4) Setting of dedicated parameters
   By setting the dedicated parameters, the application range can be made wider.
   In the factory setting, the stall prevention function is activated at the 150% (180%) value of the rated inverter current.
   Since the [*Pr. 61, 64*] settings automatically return to the initial value (9999) if the [*Pr. 292*] setting is changed, set [*Pr. 292*] first when you need to set [*Pr. 61, 64*].

[*Pr. 61*]: Set the current value (A) that is referenced for stall prevention operation level (%). When the motor and inverter are different in capacity, for example, and it is desired to define the motor rating as reference, set the reference current value in this parameter.

[*Pr. 64*]: Used to set the starting frequency (Hz) in the elevator mode. Set this parameter when it is desired to increase/decrease the starting torque.

2.6.4 Energy saving control and optimum excitation control [Pr. 60] (common)

Without a fine parameter setting, the inverter automatically performs energy saving operation.

This inverter is optimum for fan and pump applications

[*Pr.*]	Name	Initial Value	Setting Range	Description	Available Inverters		
					A700	F700	E700 D700
60	Energy saving control selection	0	0	Normal operation mode	○	○	○
			4	Energy saving operation mode	○	○	—
			9	Optimum excitation control mode	—	○	○

(1) Energy saving operation mode [*Pr. 60 = 4*]

(A700) (F700)

Set [*Pr. 60 = 4*] to perform operation with the minimum output power.

1) Control method

After the output frequency has become constant (acceleration or deceleration is complete), the output voltage is reduced gradually and operation is performed with the output power (product of current and voltage) being minimum.
When the output current begins to increase due to the increase in load torque, the output voltage is increased up to the normal V/F pattern to generate the torque required to maintain the speed.
The output voltage is controlled within the range of +0% to -50% in relation to the normal V/F pattern, and the settings of [*Pr. 0 Torque boost*] and [*Pr. 14 Load pattern selection*] are ignored. By setting [*Pr. 60 = 0*] (Normal mode), the settings of [*Pr. 0, Pr. 14*] are valid.

2) Restriction conditions

- When Advanced magnetic flux vector control, Simple magnetic flux vector control, Real sensorless vector control, or vector control is selected, the selection of the energy-saving mode is invalid.
- When the encoder feedback function has been selected with the plug-in option (FR-A7AP) fitted to the inverter, the selection of the energy-saving mode is invalid.

3) Applications

●Appropriate application

- Machine which is operated for a long time at constant speed, e.g. fan, air conditioner.

●Inappropriate application

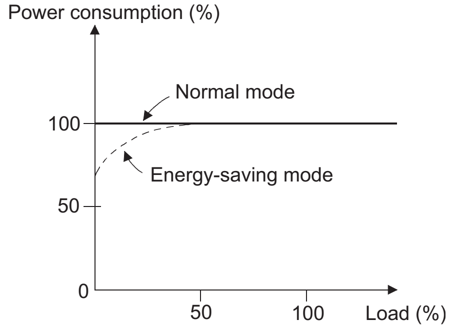
- Application in which large load torque is applied
  Since there is naturally little power consumption loss, no energy-saving effect is expected.
- Machine which makes frequent acceleration/ deceleration
  Since torque is necessary for acceleration/ deceleration, no energy-saving effect is expected.

4) Dedicated parameters

When constant speed is achieved in the energy-saving mode, the output voltage is automatically tuned and there are no dedicated parameters to be set.

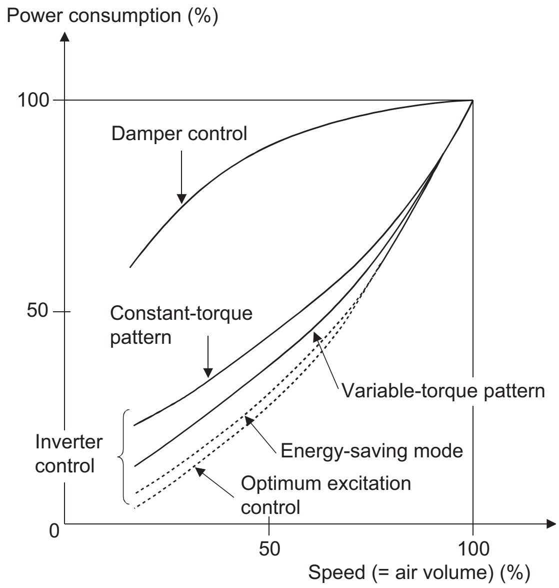
5) Energy-saving effect

The energy-saving effect depends greatly on the load magnitude.



Guideline of energy-saving mode

In applications such as air conditioning equipment, inverter operation produces a larger energy-saving effect on the running cost than damper control by commercial power supply operation. The energy-saving effect depends greatly on the speed (load).



Energy-saving effect by air-conditioning equipment

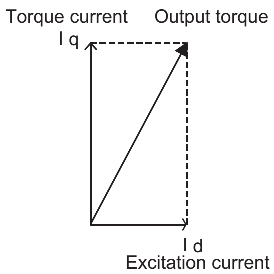
(2) Optimum excitation control mode

[*Pr. 60 = 9*] (F700)(E700)(D700)

Optimum excitation control is a control method which controls excitation current to improve the motor efficiency to maximum and determines output voltage.

1) Control method

By converting the motor current to d-q axis to find the excitation current Id and torque current Iq, then obtain the motor loss by an original method.
Since application is fan and pump, low speed torque is not required. Therefore, it controls excitation current Id to make the motor loss minimum focusing on the improvement of motor efficiency rather than torque generation.
Namely, it controls the ratio of the excitation current Id and torque current Iq becomes maximum efficiency of the motor.



2) Restrictions

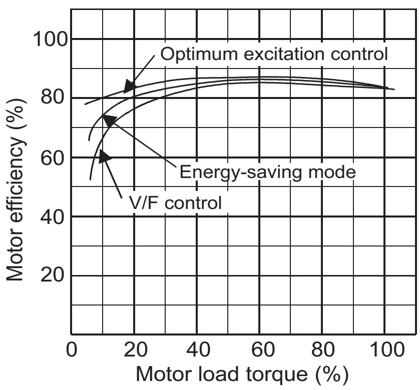
- Since it automatically sets the output voltage to V/F control, the output voltage is not as set in [*Pr. 0 Torque boost*] and [*Pr. 14 Load pattern selection*].
- When the motor capacity is too small as compared to the inverter capacity or two or more motors are connected to one inverter, the energy saving effect is not expected.
- Optimum excitation control functions only during V/F control. Optimum excitation control is disabled when Simple magnetic vector control, Advanced magnetic vector control or General-purpose magnetic vector control are selected.

3) Dedicated parameters

Dedicated parameters to automatically set the output voltage are not available.

4) Energy-saving effect

- Motor efficiency improvement example (when inverter operation frequency is 60Hz and the FR-F740-3.7K and motor SF-JR 4P3.7kW are used)



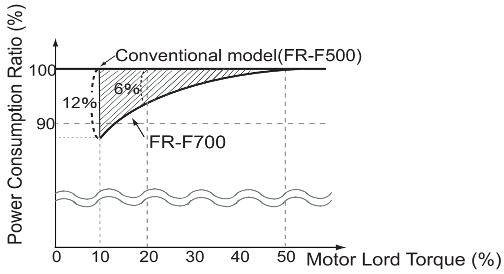
- The motor efficiency has further improved by the optimum excitation control and it is economical.

When the motor load torque is 10%

Control Method	Motor Efficiency
Conventional V/F mode	Approx. 65%
Energy-saving mode	Approx. 75%
Optimum excitation control	Approx. 80%

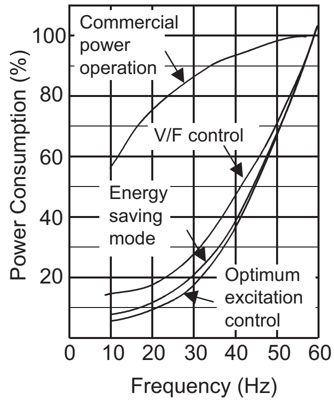
The motor efficiency has increased approx. 15% by the optimum excitation control as compared to conventional V/F control.

- The energy-saving effect of the FR-F700 has increased even during acceleration/deceleration as compared to the FR-F500.



Ratio of Motor Power Consumption during Acc./Dec.
(Driving of the Mitsubishi 400V
4 poles 45kW motors comparison)

- Ex. of blower operation characteristics (discharge side)
(when the V/F pattern is constant torque load [*Pr. 14 = 0*])



- The optimum excitation control reduces the motor loss to further save power consumption, and it is economical.

When the inverter running frequency is 20Hz

- The optimum excitation control has reduced approx.45% of the power consumption ratio as compared to the V/F control method.
- Approx. 5% of the power consumption ratio has been reduced as compared to the energy-saving mode.

2.7 Selection of control method

2.7.1 Selection of control method [Pr. 80, 81*, 450*, 451*, 453*, 454*, 800*] common

(*[*Pr. 81, 450, 451, 453, 454, 800*] are not available for F700.)
(*[*Pr. 451, 453, 454*] are not available for E700.)
(*[*Pr. 81, 451, 453, 454, 800*] are not available for D700.)

V/F control (initial setting), Simple magnetic flux vector control, Advanced magnetic flux vector control, Real sensorless vector control and vector control are available.

1) V/F control common
- It controls frequency and voltage so that the ratio of frequency (F) to voltage (V) is constant when changing frequency.
- You can choose energy-saving operation mode (A700 F700 only), optimum excitation control (F700 E700 D700 only), or adjustable 5 points V/F (A700 F700 only), and elevator mode (A700 only).

2) Simple magnetic flux vector control F700
- Providing optimum excitation to the motor can also produce high torque in a low-speed range.

3) General-purpose magnetic flux vector control E700 D700
- This control divides the inverter output current into an excitation current and a torque current by vector calculation and makes voltage compensation to flow a motor current which meets the load torque.

4) Advanced magnetic flux vector control A700 E700
- This control divides the inverter output current into an excitation current and a torque current by vector calculation and makes frequency and voltage compensation to flow a motor current which meets the load torque.

5) Real sensorless vector control A700
- By estimating the motor speed, speed control and torque control with more advanced current control function are enabled. When high accuracy and fast response control are necessary, select the Real sensorless vector control and perform offline auto tuning.
- This control can be applied to the following applications.
  - To minimize the speed fluctuation even at a severe load fluctuation
  - To generate low speed torque
  - To prevent machine from damage due to too large torque (torque limit)
  - To perform torque control

6) Vector control A700
- When the FR-A7AP or FR-A7AL is mounted, full-scale vector control operation can be performed using a motor with encoder. Fast response/high accuracy speed control (zero speed control, servo lock), torque control, and position control can be performed.
- What is vector control?

  It has excellent control characteristics when compared to V/F control and other control techniques, achieving the control characteristics equal to those of DC machines.
- It is suitable for applications below.
  - To minimize the speed fluctuation even at a severe load fluctuation
  - To generate low speed torque
  - To prevent machine from damage due to too large torque (torque limit)
  - To perform torque control or position control
  - Servo-lock torque control which generates torque at zero speed

(1) Selection of control method and control mode

1) FR-A700 series

Select the inverter control method from V/F control, Advanced magnetic flux vector control (speed control), Real sensorless vector control (speed control, torque control) and vector control (speed control, torque control, and position control).

When vector control test operation ([*Pr. 800 = 9*]) is selected, speed control test operation can be performed without the motor connected. The speed calculation value changes to track the speed command, and the transition can be checked with the operation panel and analog signal output at terminal FM and AM.

[*Pr.*]	Name	Initial Value	Setting Range		Description	
80	Motor capacity	9999	55K or less	0.4 to 55kW	Set the applied motor capacity.	
			75K or more	0 to 3600kW		
			9999		V/F control	
81	Number of motor poles	9999	2, 4, 6, 8, 10		Set the number of motor poles.	
			12, 14, 16, 18, 20		X18 signal-ON: V/F control	Set 10 + number of motor poles.
			9999		V/F control	
450	Second applied motor	9999	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		Set when using the second motor. (Same specifications as [*Pr. 117*])	
			9999		Function invalid ([*Pr. 71*] is valid.)	
451	Second motor control method selection	9999	10, 11, 12		Real sensorless vector control	
			20, 9999		V/F control (Advanced magnetic flux vector control)	
453	Second motor capacity	9999	55K or less	0.4 to 55kW	Set the capacity of the second motor.	
			75K or more	0 to 3600kW		
			9999		V/F control	
454	Number of second motor poles	9999	2, 4, 6, 8, 10		Set the number of poles of the second motor.	
			9999		V/F control	
800	Control method selection	20	0 to 5		V/F control *	Vector control
			9			Vector control test operation
			10, 11, 12			Real sensorless vector control
			20			Advanced magnetic flux vector control

* When [*Pr.80 Motor capacity = 9999*] or [*Pr.81 Number of motor poles = 9999*], control method is V/F control regardless of [*Pr.800*] setting.

<First motor selection>

[*Pr. 80, 81*]	[*Pr. 800*] Setting	Control Method	Control Mode	Remarks
Other than 9999	0	**Vector control**	Speed control	—
	1		Torque control	—
	2		Speed control/torque control switchover	MC signal: ON Torque control MC signal: OFF Speed control
	3		Position control	—
	4		Speed control/position control switchover	MC signal: ON Position control MC signal: OFF Speed control
	5		Position control/torque control switchover	MC signal: ON Torque control MC signal : OFF Position control
	9	**Vector control test operation**		
	10	**Real sensorless vector control**	Speed control	—
	11		Torque control	—
	12		Speed control/torque control switchover	MC signal: ON Torque control MC signal: OFF Speed control
	20 ([*Pr. 800*] initial value)	**Advanced magnetic flux vector control**	Speed control	—
9999	—*	**V/F control**		

* Control method is V/F control regardless of the setting value of [*Pr. 800*] when [*Pr. 80 Motor capacity* = 9999] or [*Pr. 81 Number of motor poles* = 9999].

<Second motor selection>

Setting [*Pr. 450* ≠ 9999] selects the second motor control.

[*Pr. 450*]	[*Pr. 453, Pr. 454*]	[*Pr. 451*] Setting	Control Method	Control Mode	Remarks
Other than 9999	Other than 9999	10	**Real sensorless vector control**	Speed control	—
		11		Torque control	—
		12		Speed control/torque control switchover	MC signal: ON Torque control MC signal: OFF Speed control
		20	**Advanced magnetic flux vector control**	Speed control	—
		9999 ([*Pr. 451*] initial value)	**Advanced magnetic flux vector control**	Speed control	—
	9999	—*	**V/F control**		
9999	—	—	**Second motor function is invalid**		

* Control method is V/F control regardless of the setting value of [*Pr. 451*] when [*Pr. 453 Second motor capacity = 9999*] or [*Pr. 454 Number of motor poles = 9999*].

2) FR-F700 series

Select the inverter control method from V/F control and Simple magnetic flux vector control.

[*Pr.*]	Name	Initial Value	Setting Range		Description
80	Motor capacity	9999	55K or less	0.4 to 55kW	**Simple magnetic flux vector control** Set the applied motor capacity.
			75K or more	0 to 3600kW	
			9999		**V/F control**

3) FR-E700 series

Select the inverter control method from V/F control, Advanced magnetic flux vector control, General-purpose magnetic flux vector control.

You can set the thermal characteristic of the electronic thermal for the second motor by setting [*Pr. 450 ≠ 9999*]. At this time, control method does not change.(Depends on the settings of [*Pr. 80, 81, 800*])

[*Pr.*]	Name	Initial Value	Setting Range	Description	
80	Motor capacity	9999	0.1 to 15kW	Set the applied motor capacity.	
			9999	**V/F control**	
81	Number of motor poles	9999	2, 4, 6, 8, 10	Set the number of motor poles.	
			9999	**V/F control**	
450	Second applied motor	9999	0, 1	Set when using the second motor.	
			9999	Function invalid ([*Pr. 71*] is valid.)	
800	Control method selection	20	20	**V/F control ***	**Advanced magnetic flux vector control**
			30		**General-purpose magnetic flux vector control**

* When [*Pr.80 Motor capacity = 9999*] or [*Pr.81 Number of motor poles = 9999*], control method is V/F control regardless of [*Pr.800*] setting.

[*Pr. 80, 81*]	[*Pr. 800*] Setting	Control Method
Other than 9999	20 ([*Pr. 800*] initial value)	**Advanced magnetic flux vector control**
	30	**General-purpose magnetic flux vector control**
9999	—*	**V/F control**

* Control method is V/F control regardless of the setting value of [*Pr. 800*] when [*Pr. 80 Motor capacity* = 9999] or [*Pr. 81 Number of motor poles* = 9999].

4) FR-D700 series

Select the inverter control method from V/F control and General-purpose magnetic flux vector control.

You can set the thermal characteristic for the second motor by setting [*Pr. 450 ≠ 9999*]. At this time, control method does not change. (Depends on the settings of [*Pr. 80*])

[*Pr.*]	Name	Initial Value	Setting Range	Description
80	Motor capacity	9999	0.1 to 7.5kW	**General-purpose magnetic flux vector control** Set the applied motor capacity.
			9999	**V/F control**
450	Second applied motor	9999	0, 1	Set when using the second motor.
			9999	Function invalid ([*Pr. 71*] is valid.)

(2) Control method switching by external terminals (RT signal, X18 signal)

A700 E700 D700

1) FR-A700 series

The switching of the control method (V/F control, Advanced magnetic flux vector control, Real sensorless vector control and vector control) by the external terminal may be made in either of the following two ways: switching by the second function selection signal (RT), or V/F switching signal (X18).
Two types of control method can be switched with the RT signal by setting the type of motor to be used as second motor in [*Pr. 450 Second applied motor*] and control method of the motor in [*Pr. 451 Second motor control method selection*]. Turn ON the RT signal to select the second function. Other second function is also made valid.

<table>
<tr><th>First Motor Control Method (RT signal-OFF)</th><th>Second Motor Control Method (RT signal-ON)</th><th>[Pr. 450] Setting</th><th>[Pr. 453] and [Pr. 454] Setting</th><th>[Pr. 451] Setting</th></tr>
<tr><td rowspan="4">V/F control</td><td rowspan="2">V/F control</td><td>9999</td><td>—</td><td>—</td></tr>
<tr><td rowspan="3">Other than 9999</td><td>9999</td><td>—</td></tr>
<tr><td>Advanced magnetic flux vector control</td><td rowspan="2">Other than 9999</td><td>20, 9999</td></tr>
<tr><td>Real sensorless vector control</td><td>10 to 12</td></tr>
<tr><td rowspan="4">Advanced magnetic flux vector control
Real sensorless vector control
Vector control</td><td>Same control as the first motor *</td><td>9999</td><td>—</td><td>—</td></tr>
<tr><td>V/F control</td><td rowspan="3">Other than 9999</td><td>9999</td><td>—</td></tr>
<tr><td>Advanced magnetic flux vector control</td><td rowspan="2">Other than 9999</td><td>20, 9999</td></tr>
<tr><td>Real sensorless vector control</td><td>10 to 12</td></tr>
</table>

* V/F control is selected when "12, 14, 16, 18, 20" is set in [*Pr. 81*] and the X18 signal is ON. When the X18 signal is not assigned, turning the RT signal ON selects V/F control as the RT signal shares this function.

For switching by the X18 signal, setting [*Pr. 81 Number of motor poles* = 12, 14, 16, 18, 20] and turning the X18 signal ON switches the currently selected control method (Advanced magnetic flux vector control, Real sensorless vector control or vector control) to V/F control. In this case, use this signal only for changing the control method of one motor since second function as electronic thermal relay characteristic, etc. can not be changed. (Use the RT signal to change the second function.)
For the terminal used for X18 signal input, set 18 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function.

First motor control method ([*Pr. 80 = Motor capacity*], [*Pr. 81 = 12, 14, 16, 18, 20*])	
X18 (RT) signal-OFF	**X18 (RT) signal-ON**
Advanced magnetic flux vector control Real sensorless vector control Vector control	V/F control

2) FR-E700, D700 series

To change the control method (V/F control to Advanced magnetic vector control or General purpose vector control) with an external terminal, use V/F switch signal (X18).
Turning X18 signal ON switches control from Advanced magnetic vector control or General-purpose magnetic vector control to V/F control.
For the terminal to input X18 signal, assign the function by setting "18" to any of [*Pr.178 to 184 Input terminal function selection*].
Switch the control method using external terminal (X18 signal) during an inverter stop. If control method between V/F control and General-purpose magnetic flux vector control is switched during the operation, the actual switchover does not take place until the inverter stops. In addition, if control method is switched to V/F control during the operation, only second function becomes valid as V/F control and second functions are selected simultaneously in V/F control.

(3) Switching the control method from the external terminal (MC signal) A700

When [*Pr. 800 = 12, 2*] and [*Pr. 451 = 12*], speed control is selected when the control mode switching signal (MC) is OFF, and torque control is selected when the signal is ON under Real sensorless vector control or vector control. Switching between speed control and torque control is always enabled independently of whether the motor is at a stop or running or the DC injection brake operation (pre-excitation).
Under vector control, speed control/position control switchover and torque control/position control switchover can be made by setting [*Pr. 800* = 4, 5]. Speed control/position control switchover and torque control/position control switchover is made when frequency decreases to or below the [*Pr. 865 Low speed detection*] setting.
For the terminal used for MC signal input, set 26 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function.
When an analog input terminal (terminal 1,4) is used for torque limit, torque command, etc., terminal functions also switch if control mode is switched.
For the terminal function in different control modes, refer to page 43.

2.7.2 Simple magnetic flux vector control [Pr. 71, 80, 90] (F700)

This control method improves the low speed torque when higher torque than V/F control is necessary in the low speed range. Simple magnetic flux vector control can be selected by setting the capacity and type of the motor used.

[*Pr.*]	Name	Initial Value	Setting Range		Description
71	Applied motor	0	0		Thermal characteristics of a standard motor
			1		Thermal characteristics of the Mitsubishi constant-torque motor
			2		Thermal characteristics of a standard motor Adjustable 5 points V/F (Refer to page 248)
			20		Mitsubishi standard motor (SF-JR 4P 1.5kW or less)
80	Motor capacity (Simple magnetic flux vector control)	9999	55K or less	0.4 to 55kW	Set the capacity of the motor used to select Simple magnetic flux vector control.
			75K or more	0 to 3600kW	
			9999		V/F control is performed.
90	Motor constant (R1)	9999	55K or less	0 to 50Ω	Used to set the motor primary resistance value. (Usually setting is not necessary.)
			75K or more	0 to 400mΩ	
			9999		Uses the Mitsubishi motor (SF-JR, SF-HRCA) constants

(1) Conditions of Simple magnetic flux vector control

Simple magnetic flux vector control may only be utilized effectively when all of the following conditions are satisfied.
If any of the conditions cannot be satisfied, torque shortage, speed fluctuation or another fault may occur.

- The motor capacity should be equal to or one rank lower than the inverter capacity.
- The number of motor poles should be 2, 4 or 6. (Only 4 poles for constant-torque motor. Setting is not necessary.)
- Single-motor operation (one motor run by one inverter) should be performed.
- The wiring length from inverter to motor should be within 30m

(2) Selection method of Simple magnetic flux vector control

Simple magnetic flux vector control is selected by simply setting [*Pr. 80 Motor capacity* ≠ 9999]. When [*Pr. 80* = 9999], V/F control is selected.
When using the Mitsubishi constant torque motor, set [*Pr. 71* = 1].
Set the rated motor frequency in [*Pr. 3*] and rated motor voltage in [*Pr. 19*] when Simple magnetic flux vector control is selected.
When [*Pr. 19*] is 9999 or 8888, motor voltage is regarded as 200V (200V class) or 400V (400V class).

(3) Motor constants setting

Although it is usually unnecessary, set the motor primary resistance value (R1) for 人 connection in [*Pr. 90*] when you need more torque under Simple magnetic flux vector control for other manufacturer's motor.
When the setting is 9999 (initial value), set by referring the motor constants of the Mitsubishi motor (SF-JR, SF-HRCA) as standard.

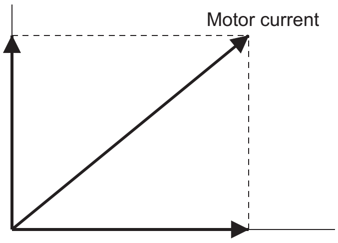
(4) Slip compensation setting

Since output frequency compensation is not performed under Simple magnetic flux vector control, the actual speed decreases by the motor slip (during driving load operation) if the load to the motor increases.
Set the slip compensation if you want to keep the actual speed constant even if the load to the motor varies. Refer to page 391 for slip compensation.

2.7.3 General-purpose magnetic flux vector control (Pr. 71, 80, 81*, 800*) E700 D700

(*[*Pr. 81, 800*] are not available for D700.)

General-purpose magnetic flux vector control is a control method which allows low-speed torque to be improved by dividing the motor current into an excitation current and a torque current and making voltage compensation to flow a motor current which meets the load torque.



Vector division of motor current

[*Pr.*]	Name	Initial Value	Setting Range	Description	Available Inverters E700	Available Inverters D700
71	Applied motor	0	E700 0, 1, 3 to 6, 13 to 16, 23, 24, 40, 43, 44, 50, 53, 54 D700 0, 1, 3, 13, 23, 40, 43, 50, 53	By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.	○	○
80	Motor capacity	9999	E700 0.1 to 15kW D700 0.1 to 7.5kW	Set the applied motor capacity.	○	○
			9999	V/F control		
81	Number of motor poles	9999	2, 4, 6, 8, 10	Set the number of motor poles.	○	—
			9999	V/F control		
800	Control method selection	20	20	Advanced magnetic flux vector control *	○	—
			30	General-purpose magnetic flux vector control *		

* Set [*Pr. 80* ≠ *9999*] or [*Pr. 81* ≠ *9999*].

(1) Conditions of General-purpose magnetic flux vector control

General-purpose magnetic flux vector control may only be utilized effectively when all of the following conditions are satisfied.
If any of the conditions cannot be satisfied, torque shortage, speed fluctuation or another fault may occur.

- The motor capacity should be equal to or one rank lower than the inverter capacity.
  Note that the motor capacity should be 0.1kW or more.
- Compatible motor is any of Mitsubishi standard motor, high efficiency motor (SF-JR, SF-HR 0.2kW or more) or Mitsubishi constant-torque motor (SF-JRCA four-pole, SF-HRCA 0.4kW to 15kW). When using a motor other than the above (other manufacturer's motor), always perform offline auto tuning.
- Single-motor operation (one motor run by one inverter) should be performed.
- Wiring length from inverter to motor should be within 30m. When the wiring length exceeds 30m, perform offline auto tuning with wires already in place.

(2) Selection method of General-purpose magnetic flux vector control

To select General-purpose magnetic flux control for E700, set [*Pr. 800* = 20] (initial value), and set a value other than 9999 in [*Pr. 80 Motor capacity*] and [*Pr. 81 Number of motor poles*]. If 9999 is set in either [*Pr. 80*] or [*Pr. 81*], the control method is V/F control.
To select General-purpose magnetic flux control for D700, set a value other than 9999 in [*Pr. 80 Motor capacity*]. If 9999 is set in [*Pr. 80*], the control method is V/F control.
Set [*Pr. 71*] depending on the motor.

(3) Motor constants setting

In most cases, the setting is not necessary, but perform offline auto tuning when using other manufacture’s motor or a long wiring.

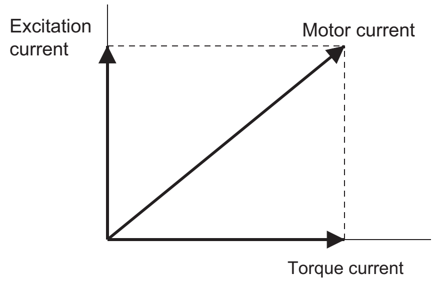
(4) Slip compensation setting

Since output frequency compensation is not performed under General-purpose magnetic flux vector control, the actual speed decreases by the motor slip (during driving load operation) if the load to the motor increases.
Set the slip compensation if you want to keep the actual speed constant even if the load to the motor varies. Refer to page 391 for slip compensation.

2.7.4 Advanced magnetic flux vector control [Pr. 71, 80, 81, 89, 450, 451*, 453*, 454*, 569*, 800] (A700) (E700)

(*[*Pr. 451, 453, 454, 569*] are not available for (E700).)

Advanced magnetic flux vector control is a control method which allows low-speed torque to be improved by dividing the motor current into an excitation current and a torque current and making voltage compensation to flow a motor current which meets the load torque.
The magnitude of a load torque (i.e. motor slip) is estimated from the magnitude of the torque current on the basis of more accurate motor constants, thereby controlling the output frequency (slip compensation) to make the actual motor speed nearer to the speed command value.
Advanced magnetic flux vector control can be selected by setting the capacity, poles and type of the motor.



Vector division of motor current

<table>
<tr><th rowspan="2">[Pr.]</th><th rowspan="2">Name</th><th rowspan="2">Initial Value</th><th rowspan="2" colspan="2">Setting Range</th><th rowspan="2" colspan="2">Description</th><th colspan="2">Available Inverters</th></tr>
<tr><th>(A700)</th><th>(D700)</th></tr>
<tr><td>71</td><td>Applied motor</td><td>0</td><td colspan="2">(A700)
0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54
(E700)
0, 1, 3 to 6, 13 to 16, 23, 24, 40, 43, 44, 50, 53, 54</td><td colspan="2">By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">80</td><td rowspan="2">Motor capacity</td><td rowspan="2">9999</td><td colspan="2">(A700)
55K or less: 0.4 to 55kW
75K or less: 0 to 3600kW
(E700)
0.1 to 15kW</td><td colspan="2">Set the applied motor capacity.</td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">V/F control</td></tr>
<tr><td rowspan="3">81</td><td rowspan="3">Number of motor poles</td><td rowspan="3">9999</td><td colspan="2">2, 4, 6, 8, 10</td><td colspan="2">Set the number of motor poles.</td><td>○</td><td>○</td></tr>
<tr><td colspan="2">12, 14, 16, 18, 20</td><td>X18 signal-ON:
V/F control *</td><td>Set 10 + number of motor poles.</td><td>○</td><td>—</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">V/F control</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">89</td><td rowspan="2">Speed control gain (magnetic flux vector)</td><td rowspan="2">9999</td><td colspan="2">0 to 200%</td><td colspan="2">Motor speed fluctuation due to load fluctuation is adjusted during Advanced magnetic flux vector control. 100% is a referenced value.</td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">Gain matching with the motor set in [Pr. 71].</td></tr>
<tr><td rowspan="2">450</td><td rowspan="2">Second applied motor</td><td rowspan="2">9999</td><td colspan="2">(A700)
0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54
(E700)
0, 1</td><td colspan="2">Set when using the second motor.
(Same specifications as [Pr. 71])</td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">Function invalid ([Pr. 71] is valid.)</td></tr>
<tr><td rowspan="2">451</td><td rowspan="2">Second motor control method selection</td><td rowspan="2">9999</td><td colspan="2">10, 11, 12</td><td colspan="2">Real sensorless vector control</td><td rowspan="2">○</td><td rowspan="2">—</td></tr>
<tr><td colspan="2">20, 9999</td><td colspan="2">V/F control (Advanced magnetic flux vector control)</td></tr>
<tr><td rowspan="3">453</td><td rowspan="3">Second motor capacity</td><td rowspan="3">9999</td><td>55K or less</td><td>0.4 to 55kW</td><td rowspan="2" colspan="2">Set the capacity of the second motor.</td><td rowspan="3">○</td><td rowspan="3">—</td></tr>
<tr><td>75K or more</td><td>0 to 3600kW</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">V/F control</td></tr>
<tr><td rowspan="2">454</td><td rowspan="2">Number of second motor poles</td><td rowspan="2">9999</td><td colspan="2">2, 4, 6, 8, 10</td><td colspan="2">Set the number of poles of the second motor.</td><td rowspan="2">○</td><td rowspan="2">—</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">V/F control</td></tr>
<tr><td rowspan="2">569</td><td rowspan="2">Second motor speed control gain</td><td rowspan="2">9999</td><td colspan="2">0 to 200%</td><td colspan="2">Second motor speed fluctuation due to load fluctuation is adjusted during Advanced magnetic flux vector control. 100% is a referenced value.</td><td rowspan="2">○</td><td rowspan="2">—</td></tr>
<tr><td colspan="2">9999</td><td colspan="2">Gain matching with the motor set in [Pr. 451]</td></tr>
<tr><td rowspan="5">800</td><td rowspan="5">Control method selection</td><td rowspan="5">20</td><td colspan="2">0 to 5</td><td rowspan="5">V/F control **</td><td>Vector control</td><td rowspan="3">○</td><td rowspan="3">—</td></tr>
<tr><td colspan="2">9</td><td>Vector control test operation</td></tr>
<tr><td colspan="2">10, 11, 12</td><td>Real sensorless vector control</td></tr>
<tr><td colspan="2">20</td><td>Advanced magnetic flux vector control</td><td></td><td rowspan="2">○</td></tr>
<tr><td colspan="2">30</td><td>General-purpose magnetic flux vector control</td><td>—</td></tr>
</table>

* Use [*Pr. 178 to Pr. 189*] to assign the terminals used for the X18 and MC signal.

** When [*Pr. 80 Motor capacity* = 9999] or [*Pr. 81 Number of motor poles* = 9999], control method is V/F control regardless of the [*Pr. 800*] setting.

(1) Conditions of Advanced magnetic flux vector control selection

Advanced magnetic flux vector control may only be utilized effectively when all of the following conditions are satisfied.
If any of the conditions cannot be satisfied, torque shortage, speed fluctuation or another fault may occur. Operate under V/F control in that case.

- The motor capacity should be equal to or one rank lower than the inverter capacity.
  Note that the motor capacity should be 0.4kW or more for A700, 0.1kW or more for E700.
- The motor type is the Mitsubishi standard motor, high efficiency motor (SF-JR, SF-HR 0.2kW or more) or Mitsubishi constant torque motor (SF-JRCA 4 poles, SF-HRCA 0.4kW to 55kW). When any other motor (other manufacturer standard motor, other manufacturer's constant torque motor) is used, perform offline auto tuning (refer to page 268) without fail.
- Single-motor operation (one motor run by one inverter) should be performed.
- The wiring length from inverter to motor should be within 30m. If the length is over 30m, perform offline auto tuning with the cables wired.
- For 75K or more, do not use an option sine wave filter (MT-BSL/BSC) between the inverter and motor.

(2) Selection method of Advanced magnetic flux vector control

Advanced magnetic flux vector control is selected by simply setting any value other than 9999 in [*Pr. 80 Motor capacity*] and [*Pr. 81 Number of motor poles*] when [*Pr. 800 = 20*] (initial value). V/F control is chosen when either of the [*Pr. 80*] or [*Pr. 81*] setting is 9999.

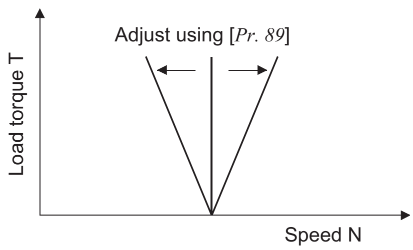
When [*Pr. 81* = 12, 14, 16, 18, 20] in A700, V/F control and Advanced magnetic flux vector control can be switched by turning X18 signal ON/OFF.
When Advanced magnetic vector control is set in E700, V/F control and Advanced magnetic vector control can be switched by turning X18 signal ON/OFF regardless of [*Pr. 81*] setting.
Set [*Pr. 71*] depending on the motor.

(3) Instructions on Advanced magnetic flux vector control

- A little inferior to V/F control in suppressing rotation ripple.
- There is an arithmetic operation delay of 0.1 to 0.2s at start-up.
- When a surge voltage suppression filter (FR-ASF-H) is connected between the inverter 55K or less and motor, output torque may decrease.
- Applications suitable for Advanced magnetic flux vector control
  - Machines requiring a large starting torque
  - Machines requiring a sufficient low-speed torque
  - Machines with load which varies greatly
- Applications unsuitable for Advanced magnetic flux vector control
  - Grinders, lapping machines and other machines for which speed fluctuation at low speed is important.

(4) Fine adjustment method for Advanced magnetic flux vector control

The motor speed fluctuation at load fluctuation can be adjusted using [*Pr. 89*].
When you have changed the conventional model FR-A500(L) series for the FR-A700 series, Advanced magnetic flux vector control is effective when motor speed does not match.



(5) Performing Advanced magnetic vector control by switching between two motors

Turning the RT signal ON allows the second motor to be controlled.
Set the second motor in [*Pr. 450 Second applied motor*]. (Initial setting is 9999 (without second applied motor). Refer to page 266.)

1) A700

Functions	RT Signal is ON (Second Motor)	RT Signal is OFF (First Motor)
Applied motor	[*Pr. 450*]	[*Pr. 71*]
Motor capacity	[*Pr. 453*]	[*Pr. 80*]
Number of motor poles	[*Pr. 454*]	[*Pr. 81*]
Speed control gain	[*Pr. 569*]	[*Pr. 89*]
Control method selection	[*Pr. 451*]	[*Pr. 800*]

2) E700

Turning the RT signal ON allows the second motor to be controlled. Set the second motor in [*Pr. 450 Second applied motor*].
Note that control method is not selectable for the second motor, so the same control method as the first motor applies. When Advanced magnetic vector control is selected, use same type of motor for the first and second motors. Use X18 signal when you want to use the second motor in V/F control.

2.7.5 Real sensorless vector control [Pr. 71, 80, 81, 450, 451, 453, 454, 800] A700

Real sensorless vector control is the control method which divides the inverter output current into an excitation current and a torque current by vector calculation, and improves low torque, speed control range, and speed response by controlling frequency and voltage optimally to flow a motor current which meets the load torque, achieving maximum of 200% (3.7kW or less) high torque at 0.3Hz.

It responds to the load variation quickly (high response) by torque current control and torque control is also enabled by giving torque command.

[*Pr.*]	Name	Initial Value	Setting Range		Description	
71	Applied motor	0	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.	
80	Motor capacity	9999	55K or less	0.4 to 55kW	Set the applied motor capacity.	
			75K or more	0 to 3600kW		
			9999		V/F control	
81	Number of motor poles	9999	2, 4, 6, 8, 10		Set the number of motor poles.	
			12, 14, 16, 18, 20		X18 signal-ON: V/F control *	Set 10 + number of motor poles.
			9999		V/F control	
450	Second applied motor	9999	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		Set when using the second motor. (Same specifications as [*Pr. 71*])	
			9999		Function invalid ([*Pr. 71*] is valid.)	
451	Second motor control method selection	9999	10, 11, 12		Real sensorless vector control	
			20, 9999		V/F control (Advanced magnetic flux vector control)	
453	Second motor capacity	9999	55K or less	0.4 to 55kW	Set the capacity of the second motor.	
			75K or more	0 to 3600kW		
			9999		V/F control	
454	Number of second motor poles	9999	2, 4, 6, 8, 10		Set the number of poles of the second motor.	
			9999		V/F control	
800	Control method selection	20	0 to 5		V/F control **	Vector control
			9			Vector control test operation
			10, 11, 12			Real sensorless vector control
			20			Advanced magnetic flux vector control

* Use [*Pr. 178 to Pr. 189*] to assign the terminals used for the X18 and MC signal.

** When [*Pr. 80 Motor capacity* = 9999] or [*Pr. 81 Number of motor poles* = 9999], control method is V/F control regardless of the [*Pr. 800*] setting.

(1) Conditions of Real sensorless vector control selection

Real sensorless vector control may only be utilized effectively when all of the following conditions are satisfied.

If any of the conditions cannot be satisfied, torque shortage, speed fluctuation or another fault may occur. Operate under V/F control in that case.

- The motor capacity should be equal to or one rank lower than the inverter capacity.
  Note that the motor capacity should be 0.4kW or more.
- Perform offline auto tuning (refer to page 268) independently of the Mitsubishi motor and other manufacturer’s motor.
- Single-motor operation (one motor run by one inverter) should be performed.

(2) Selection method of Real sensorless vector control

Set any of 10 to 12 in [*Pr. 800 Control method selection*].

Setting any value other than 9999 in [*Pr. 80 Motor capacity*] and [*Pr. 81 Number of motor poles*] selects Real sensorless vector control. V/F control is chosen when either of the [*Pr. 80 or Pr. 81*] setting is 9999.

When [*Pr. 81 = 12, 14, 16, 18, 20*], you can select between V/F control and Real sensorless vector control by switching ON/OFF the X18 signal.

Set [*Pr. 71*] according to the motor used. <u>Perform offline auto tuning without fail</u> to perform Real sensorless vector control even using the Mitsubishi motor.

Motor		[*Pr. 71*] *1	Remarks
Mitsubishi standard motor Mitsubishi high efficiency motor	SF-JR	3	Offline auto tuning is necessary.*2
	SF-JR 4P 1.5kW or less	23	
	SF-HR	43	
	Others	3	
Mitsubishi constant-torque motor	SF-JRCA	13	
	SF-HRCA	53	
	Others (SF-JRC etc.)	13	
Other manufacturer's standard motor	—	3	
Other manufacturer's constant-torque motor	—	13	

*1 For other settings of [*Pr. 71*], refer to page 266.

*2 Refer to page 268 for offline auto tuning.

After setting [*Pr. 9, 83, 84*], set [*Pr. 96 = 1 or 101*] to perform offline auto tuning. For details, refer to page 268.

(3) Instructions on Real sensorless vector control

- Make sure to perform offline auto tuning before performing Real sensorless vector control.
- The carrier frequencies are selectable from 2k, 6k, 10k, 14kHz for Real sensorless vector control. (2k and 6kHz for the 75K or more)
- Torque control cannot be performed in the low speed (about 10Hz or less) regeneration range or light load at low speed (about 20% or less of rated torque at about 5Hz or less). Choose vector control.
- Performing pre-excitation (LX signal and X13 signal) under torque control may start the motor running at a low speed even when the start signal (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.
- Do not switch between the forward rotation command (STF) and reverse rotation command (STR) during operation under torque control. Overcurrent trip (E.OC1 to 3) or opposite rotation deceleration fault (E.11) occurs.
- For the 0.4K to 3.7K, the speed deviation may become large at 20Hz or less and torque may become insufficient in the low speed range under 11Hz during continuous operation under Real sensorless vector control. In such case, stop operation once and reaccelerate to solve the problems.
- When the inverter is likely to start during motor coasting under Real sensorless vector control, set to make frequency search of automatic restart after instantaneous power failure valid ([*Pr. 57 ≠ 9999*], [*Pr. 162 = 10*]).

(4) Performing Real sensorless vector control by switching between two motors

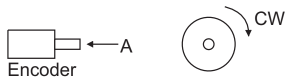
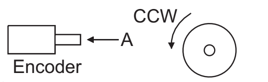
Turning the RT signal ON allows the second motor to be controlled.
Set the second motor in [*Pr. 450 Second applied motor*].
(Initial setting is 9999 (without second applied motor). Refer to page 266.)

Functions	RT Signal is ON (Second Motor)	RT Signal is OFF (First Motor)
Applied motor	[*Pr. 450*]	[*Pr. 71*]
Motor capacity	[*Pr. 453*]	[*Pr. 80*]
Number of motor poles	[*Pr. 454*]	[*Pr. 81*]
Speed control gain	[*Pr. 569*]	[*Pr. 89*]
Control method selection	[*Pr. 451*]	[*Pr. 800*]

2.7.6 Vector control [Pr. 71, 80, 81, 359, 369, 800] (A700)

This method divides the currents flowing in the motor into a current for making a magnetic flux in the motor and a current for causing the motor to develop a torque and controls each current separately. Therefore, very high response is obtained and torque at low speed can be generated stably.

It is necessary to know the motor speed to perform this control, and a motor with an encoder and a plug-in option FR-A7AP or FR-A7AL are required.
It responds to the load variation quickly (high response) by torque current control, and torque control is also enabled by giving torque command.
It has excellent control characteristics and achieves the control characteristics equal to those of DC machines.

[*Pr.*]	Name	Initial Value	Setting Range		Description	
71	Applied motor	0	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.	
80	Motor capacity	9999	55K or less	0.4 to 55kW	Set the applied motor capacity.	
			75K or more	0 to 3600kW		
			9999		V/F control	
81	Number of motor poles	9999	2, 4, 6, 8, 10		Set the number of motor poles.	
			12, 14, 16, 18, 20		X18 signal-ON: V/F control *	Set 10 + number of motor poles .
			9999		V/F control	
359	Encoder rotation direction AP AL	1	0		 Clockwise direction as viewed from A is forward rotation	
			1		 Counter clockwise direction as viewed from A is forward rotation	
369	Number of encoder pulses AP AL	1024	0 to 4096		Set the number of pulses of the encoder. Set the number of pulses before multiplied by four.	
800	Control method selection	20	0 to 5		V/F control **	Vector control
			9			Vector control test operation
			10, 11, 12			Real sensorless vector control
			20			Advanced magnetic flux vector control

* Use [*Pr. 178 to Pr. 189*] to assign the terminals used for the X18 and MC signal.
** When [*Pr. 80 Motor capacity* = 9999] or [*Pr. 81 Number of motor poles* = 9999], control method is V/F control regardless of the [*Pr. 800*] setting.

(1) Conditions of vector control selection

Vector control may only be utilized effectively when all of the following conditions are satisfied.
If any of the conditions cannot be satisfied, torque shortage, speed fluctuation or another fault may have occurred. Operate under V/F control in that case.

- A plug-in option FR-A7AP or FR-A7AL should be fitted to the inverter.
- The encoder should be coupled on the same axis with the motor shaft without any mechanical looseness. The speed ratio should be 1:1.
- When the standard motor or constant motor is used, the motor capacity should be equal to or one rank lower than the inverter capacity.
  Note that the motor capacity should be 0.4kW or more.
- For the vector control dedicated motor, the inverter one or two ranks higher than the motor in capacity needs to be selected depending on the motor capacity. Refer to the table on the next page for combination with a vector control dedicated motor.
- The motor type is the Mitsubishi standard motor with an encoder, Mitsubishi high efficiency motor (SF-JR, SF-HR 2 poles, 4 poles, 6 poles 0.4kW or more) or Mitsubishi constant torque motor (SF-JRCA 4 poles, SF-HRCA 0.4kW to 55kW), or vector control dedicated motor (SF-V5RU). When any other motor (other manufacturer standard motor, other manufacturer constant torque motor) is used, use this function after performing offline auto tuning (refer to page268) without fail .
- Single-motor operation (one motor run by one inverter) should be performed.
- Wiring length from inverter to motor should be within 30m. If the length is over 30m, perform offline auto tuning with the cables wired.

• Combination with the SF-V5RU and SF-THY

Voltage	200V Class			400V Class		
Rated speed	1500r/min					
Base frequency	50Hz					
Maximum speed	3000r/min					
Motor capacity	Motor frame number	Motor type	Inverter type	Motor frame number	Motor type	Inverter type
1.5kW	90L	SF-V5RU1K	FR-A720-2.2K	90L	SF-V5RUH1K	FR-A740-2.2K
2.2kW	100L	SF-V5RU2K	FR-A720-3.7K	100L	SF-V5RUH2K	FR-A740-2.2K
3.7kW	112M	SF-V5RU3K	FR-A720-5.5K	112M	SF-V5RUH3K	FR-A740-3.7K
5.5kW	132S	SF-V5RU5K	FR-A720-7.5K	132S	SF-V5RUH5K	FR-A740-7.5K
7.5kW	132M	SF-V5RU7K	FR-A720-11K	132M	SF-V5RUH7K	FR-A740-11K
11kW	160M	SF-V5RU11K	FR-A720-15K	160M	SF-V5RUH11K	FR-A740-15K
15kW	160L	SF-V5RU15K	FR-A720-18.5K	160L	SF-V5RUH15K	FR-A740-18.5K
18.5kW	180M	SF-V5RU18K	FR-A720-22K	180M	SF-V5RUH18K	FR-A740-22K
22kW	180M	SF-V5RU22K	FR-A720-30K	180M	SF-V5RUH22K	FR-A740-30K
30kW	200L*2	SF-V5RU30K	FR-A720-37K	200L*2	SF-V5RUH30K	FR-A740-37K
37kW	200L*2	SF-V5RU37K	FR-A720-45K	200L*2	SF-V5RUH37K	FR-A740-45K
45kW	200L*2	SF-V5RU45K	FR-A720-55K	200L*2	SF-V5RUH45K	FR-A740-55K
55kW	225S*1	SF-V5RU55K	FR-A720-75K	225S*1	SF-V5RUH55K	FR-A740-75K
75kW	250MD	SF-THY	FR-A720-90K	250MD	SF-THY	FR-A740-90K
90kW	—	—	—	250MD	SF-THY	FR-A740-110K
110kW	—	—	—	280MD	SF-THY	FR-A740-132K
132kW	—	—	—	280MD	SF-THY	FR-A740-160K
160kW	—	—	—	280MD	SF-THY	FR-A740-185K
200kW	—	—	—	280L	SF-THY	FR-A740-220K
250kW	—	—	—	315H	SF-THY	FR-A740-280K

• Combination with the SF-V5RU1, 3, 4 and SF-THY

	SF-V5RU□1 (1 : 2)			SF-V5RU□3 (1 : 3)			SF-V5RU□4 (1 : 4)		
Voltage	200V class								
Rated speed	1000r/min			1000r/min			500r/min		
Base frequency	33.33Hz			33.33Hz			16.6Hz		
Maximum speed	2000r/min			3000r/min			2000r/min		
Motor capacity	Motor flame number	Motor type	Inverter type	Motor flame number	Motor type	Inverter type	Motor flame number	Motor type	Inverter type
1.5kW	100L	SF-V5RU1K1	FR-A720-2.2K	112M	SF-V5RU1K3	FR-A720-2.2K	132M	SF-V5RU1K4	FR-A720-2.2K
2.2kW	112M	SF-V5RU2K1	FR-A720-3.7K	132S	SF-V5RU2K3	FR-A720-3.7K	160M	SF-V5RU2K4	FR-A720-3.7K
3.7kW	132S	SF-V5RU3K1	FR-A720-5.5K	132M	SF-V5RU3K3	FR-A720-5.5K	160L	SF-V5RU3K4	FR-A720-7.5K
5.5kW	132M	SF-V5RU5K1	FR-A720-7.5K	160M	SF-V5RU5K3	FR-A720-7.5K	180L	SF-V5RU5K4	FR-A720-7.5K
7.5kW	160M	SF-V5RU7K1	FR-A720-11K	160L	SF-V5RU7K3	FR-A720-11K	200L	SF-V5RU7K4	FR-A720-11K
11kW	160L	SF-V5RU11K1	FR-A720-15K	180M	SF-V5RU11K3	FR-A720-15K	225S	SF-V5RU11K4	FR-A720-15K
15kW	180M	SF-V5RU15K1	FR-A720-18.5K	180L	SF-V5RU15K3	FR-A720-18.5K	225S	SF-V5RU15K4	FR-A720-22K
18.5kW	180L	SF-V5RU18K1	FR-A720-22K	200L	SF-V5RU18K3	FR-A720-22K	250MD	SF-THY	FR-A720-22K
22kW	200L	SF-V5RU22K1	FR-A720-30K	200L	SF-V5RU22K3	FR-A720-30K	280MD	SF-THY	FR-A720-30K
30kW	200L*3	SF-V5RU30K1	FR-A720-37K	225S*1	SF-V5RU30K3	FR-A720-37K	280MD	SF-THY	FR-A720-37K
37kW	225S	SF-V5RU37K1	FR-A720-45K	250MD*1	SF-THY	FR-A720-45K	280MD	SF-THY	FR-A720-45K
45kW	250MD	SF-THY	FR-A720-55K	250MD*1	SF-THY	FR-A720-55K	280MD	SF-THY	FR-A720-55K
55kW	250MD	SF-THY	FR-A720-75K	280MD*1	SF-THY	FR-A720-75K	280L	SF-THY	FR-A720-75K

Models surrounded by ☐ and 400V class are developed upon receipt of order.

*1 The maximum speed is 2400r/min.

*2 80% output in the high-speed range. (The output is reduced when the speed is 2400r/min or more.)

*3 90% output in the high-speed range. (The output is reduced when the speed is 1000r/min or more.)

(2) Selection method of vector control

Set any of 0 to 5 in [*Pr. 800 Control method selection*].
Setting any value other than 9999 in [*Pr. 80 Motor capacity*] and [*Pr. 81 Number of motor poles*] selects vector control. V/F control is chosen when either of the [*Pr. 80 or 81*] setting is 9999.
When [*Pr. 81 = 12, 14, 16, 18, 20*], you can select between V/F control and vector control for operation by switching ON-OFF the X18 signal.

Set [*Pr. 71, 359, 369*] according to the motor and encoder used.

Vector control is controlled by the encoder at motor side. When performing vector control with the encoder on the machine side by using FR-A7AL, convert the number of encoder pulses at the machine side to the number equivalent for the motor side, and set the value to [*Pr. 396 Number of encoder pulses*]. When encoders at the motor side and machine side differ, set the same rotation direction as the motor side to [*Pr. 359 Encoder rotation direction*].

(3) Information on vector control

- The carrier frequencies are selectable from 2k, 6k, 10k, 14kHz for vector control. (2k and 6kHz for the 75K or more)

Motor Name		[*Pr. 9*] Electronic Thermal O/L Relay	[*Pr. 71*] Applicable Motor	[*Pr. 80*] Motor Capacity	[*Pr. 81*] Number of Motor Poles	[*Pr. 359*] Encoder Rotation Direction	[*Pr. 369*] Number of Encoder Pulses
Mitsubishi standard motor	SF-JR	Rated motor current	0	Motor capacity	Number of motor poles	1	1024
	SF-JR 4P 1.5kW or less	Rated motor current	20	Motor capacity	4	1	1024
	SF-HR	Rated motor current	40	Motor capacity	Number of motor poles	1	1024
	Others	Rated motor current	3 *1	Motor capacity	Number of motor poles	*2	*2
Mitsubishi constant-torque motor	SF-JRCA 4P	Rated motor current	1	Motor capacity	4	1	1024
	SF-HRCA	Rated motor current	50	Motor capacity	Number of motor poles	1	1024
	Others	Rated motor current	13 *1	Motor capacity	Number of motor poles	*2	*2
Vector dedicated motor	SF-V5RU (1500r/min series)	0 *3	30	Motor capacity	4	1	2048
	SF-V5RU (Other than 1500r/min series)	0 *3	13 *1	Motor capacity	4	1	2048
	SF-THY	0 *3	33 *1	Motor capacity	4	1	2048
Other manufacturer's standard motor	—	Rated motor current	3 *1	Motor capacity	Number of motor poles	*2	*2
Other manufacturer's constant-torque motor	—	Rated motor current	13*1	Motor capacity	Number of motor poles	*2	*2

Values in ▭ are initial values.

*1 Offline auto tuning is necessary. (Refer to page 268)

*2 Set this parameter according to the motor used.

*3 Use thermal relay protector input provided with the motor.

2

PARAMETER

2.8 Applied motor selection and auto tuning

2.8.1 Applied motor selection [Pr. 71, 450*] (common)

(*[*Pr. 450*] is not available for (F700).)

Setting the motor used selects the thermal characteristic appropriate for the motor stated below.

1) Electronic thermal relay function characteristic matching the motor (Refer to page 108)
2) Motor constants necessary for control when Advanced magnetic flux vector or Real sensorless vector control is selected

[*Pr.*]	Name	Initial Value	Setting Range	Description	Available Inverters: A700 E700 D700	Available Inverters: F700
71	Applied motor	0	(A700) 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54 (F700) 0, 1, 2, 20 (E700) 0, 1, 3 to 6, 13 to 16, 23, 24, 40, 43, 44, 50, 53, 54 (D700) 0, 1, 3, 13, 23, 40, 43, 50, 53	Selecting the standard motor or constant-torque motor sets the corresponding motor thermal characteristic.	○	○
450	Second applied motor	9999	(A700) 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54 (E700)(D700) 0, 1	Set when using the second motor. same specifications as [*Pr. 71*])	○	—
			9999	Not function		

(1) Applied motor setting

Refer to the following list and set this parameter according to the motor used.

[*Pr. 71 (Pr. 450)*] Setting [*Pr. 71*]*3	[*Pr. 450*]*4	Thermal Characteristic of the Electronic Thermal Relay Function		Motor (○: Used Motor) Standard (SF-JR, etc.)	Constant-torque (SF-JRCA, etc.)	Vector (SF-V5RU)
0 ([*Pr. 71*] initial value)		Thermal characteristics of a standard motor		○		
1		Thermal characteristics of the Mitsubishi constant-torque motor			○	
2		Thermal characteristics of a standard motor Adjustable 5 points V/F (refer to page 248)		○		
20		Mitsubishi standard motor (SF-JR 4P 1.5kW or less) Thermal characteristic for constant-torque motor		○		
30		Vector control dedicated motor (SF-V5RU (1500r/min series))				○
40		Thermal characteristic of Mitsubishi high efficiency motor SF-HR		○*1		
50		Thermal characteristic of Mitsubishi constant torque motor SF-HRCA			○*2	
3		Standard motor	Select "Offline auto tuning setting"	○		
13		Constant-torque motor Vector control dedicated motor SF-V5RU (except for 1500 r/min series).	Select "Offline auto tuning setting"		○	
23		Mitsubishi standard motor (SF-JR 4P 1.5kW or less)	Select "Offline auto tuning setting"	○		
33		Vector control dedicated motor (SF-V5RU (1500r/min series), SF-THY)	Select "Offline auto tuning setting"			○
43		Mitsubishi high efficiency motor (SF-HR)	Select "Offline auto tuning setting"	○*1		
53		Mitsubishi constant-torque motor (SF-HRCA)	Select "Offline auto tuning setting"		○*2	

<table>
<tr><th colspan="2">[Pr. 71 (Pr. 450)] Setting</th><th colspan="3" rowspan="2">Thermal Characteristic of the Electronic Thermal Relay Function</th><th colspan="3">Motor (○: Used Motor)</th></tr>
<tr><th>[Pr. 71]*3</th><th>[Pr. 450]*4</th><th>Standard
(SF-JR, etc.)</th><th>Constant-torque
(SF-JRCA, etc.)</th><th>Vector
(SF-V5RU)</th></tr>
<tr><td colspan="2">4</td><td>Standard motor</td><td colspan="2" rowspan="6">Auto tuning data can be read, changed, and set.</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">14</td><td>Constant-torque motor
Vector control dedicated motor
SF-V5RU (except for 1500 r/min series).</td><td></td><td>○</td><td></td></tr>
<tr><td colspan="2">24</td><td>Mitsubishi standard motor
(SF-JR 4P 1.5kW or less)</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">34</td><td>Vector control dedicated motor
(SF-V5RU (1500r/min series), SF-THY)</td><td></td><td></td><td>○</td></tr>
<tr><td colspan="2">44</td><td>Mitsubishi high efficiency motor (SF-HR)</td><td>○*1</td><td></td><td></td></tr>
<tr><td colspan="2">54</td><td>Mitsubishi constant-torque motor (SF-HRCA)</td><td></td><td>○*2</td><td></td></tr>
<tr><td colspan="2">5</td><td>Standard motor</td><td rowspan="2">Star connection</td><td rowspan="4">Direct input of motor constants is enabled</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">15</td><td>Constant-torque motor</td><td></td><td>○</td><td></td></tr>
<tr><td colspan="2">6</td><td>Standard motor</td><td rowspan="2">Delta connection</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">16</td><td>Constant-torque motor</td><td></td><td>○</td><td></td></tr>
<tr><td colspan="2">7</td><td>Standard motor</td><td rowspan="2">Star connection</td><td rowspan="4">Motor constants direct input
+
offline auto tuning</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">17</td><td>Constant-torque motor</td><td></td><td>○</td><td></td></tr>
<tr><td colspan="2">8</td><td>Standard motor</td><td rowspan="2">Delta connection</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="2">18</td><td>Constant-torque motor</td><td></td><td>○</td><td></td></tr>
<tr><td>—</td><td>9999
(initial value)</td><td colspan="6">Without second applied motor</td></tr>
</table>

*1 Motor constants of Mitsubishi high efficiency motor SF-HR
*2 Motor constants of Mitsubishi constant-torque motor SF-HRCA.
*3 Setting values for [*Pr. 71*] and [*Pr. 450*] differ by the model. Refer to the setting range in the table above for the setting values.
*4 [*Pr. 450*] is not available for F700.

2

PARAMETER

2.8.2 Offline auto tuning function [Pr. 71, 80 to 84*, 90 to 94*, 96, 450*, 453 to 463*, 684*, 859*, 860*] (A700)(E700)(D700)

(*[*Pr. 450, 453 to 463, 684, 860*] are not available for (F700).)
(*[*Pr. 81, 91 to 94, 450, 453 to 463, 684, 859, 860*] are not available for (F700).)

Auto tuning function is designed to automatically measures the motor constants necessary for Advanced magnetic flux vector control, Real sensorless vector control, and vector control operation.
The motor can be run with the optimum operating characteristics even when each motor constants differs, other manufacturer's motor is used, or the wiring length is long.
Also, tuning data (motor constants) can be copied to another inverter with the operation panel or FR-PU07 parameter unit.
Note that a high-slip motor, high-speed motor, or other special motor cannot be tuned. Also, the highest speed should be 120Hz.

What is auto tuning?
1) The motor performance can be maximized.
2) Auto tuning function is recommended for improvement of motor operation performance. (Always perform auto tuning when using Real sensorless vector control.)
3) There are two different auto tuning: offline auto tuning (measures motor constants before machine operation) and online auto tuning (measures motor constants at every start of the inverter).
4) Tuning without motor running and with motor running are available for offline auto tuning.
5) Accuracy of speed characteristics
Online ≫ offline (with motor running) > offline (without motor running) ≫ without tuning

1) (A700)

[*Pr.*]	Name	Initial Value	Setting Range		Description
71	Applied motor	0	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.
80	Motor capacity	9999	55K or less	0.4 to 55kW	Set the applied motor capacity.
			75K or more	0 to 3600kW	
			9999		V/F control
81	Number of motor poles	9999	2, 4, 6, 8, 10		Set the number of motor poles.
			12, 14, 16, 18, 20		X18 signal-ON: V/F control / Set 10 + number of motor poles .
			9999		V/F control
82	Motor excitation current	9999	55K or less	0 to 500A	Tuning data (The value measured by offline auto tuning is automatically set.)
			75K or more	0 to 3600A	
			9999		Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA, SF-V5RU(1500r/min series)) constants
83	Rated motor voltage	200/400V *	0 to 1000V		Set the rated motor voltage(V). *The initial value differs according to the voltage class. (200V/400V)
84	Rated motor frequency	60Hz	10 to 120Hz		Set the rated motor frequency (Hz).
90	Motor constant (R1)	9999	55K or less	0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA, SF-V5RU(1500r/min series)) constants
			75K or more	0 to 400mΩ, 9999	
91	Motor constant (R2)	9999	55K or less	0 to 50Ω, 9999	
			75K or more	0 to 400mΩ, 9999	
92	Motor constant (L1)	9999	55K or less	0 to 50 Ω (0 to 1000mH), 9999	
			75K or more	0 to 3600mΩ (0 to 400mH), 9999	
93	Motor constant (L2)	9999	55K or less	0 to 50 Ω (0 to 1000mH), 9999	
			75K or more	0 to 3600mΩ (0 to 400mH), 9999	
94	Motor constant (X)	9999	55K or less	0 to 500Ω (0 to 100%), 9999	
			75K or more	0 to 100Ω (0 to 100%), 9999	

[*Pr.*]	Name	Initial Value	Setting Range		Description
96	Auto tuning setting/ status	0	0		Offline auto tuning is not performed
			1		Offline auto tuning is performed without motor running
			101		Offline auto tuning is performed with motor running
450	Second applied motor	9999	0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54		Set when using the second motor. (same specifications as [*Pr. 71*])
			9999		Not function
453	Second motor capacity	9999	55K or less	0.4 to 55kW	Set the capacity of the second motor.
			75K or more	0 to 3600kW	
			9999		V/F control
454	Number of second motor poles	9999	2, 4, 6, 8, 10		Set the number of poles of the second motor.
			9999		V/F control
455	Second motor excitation current	9999	55K or less	0 to 500A	Tuning data of the second motor (The value measured by offline auto tuning is automatically set.)
			75K or more	0 to 3600A	
			9999		Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
456	Rated second motor voltage	200/ 400V*	0 to 1000V		Set the rated voltage (V) of the second motor. The initial value differs according to the voltage class. (200V/ 400V)
457	Rated second motor frequency	60Hz	10 to 120Hz		Set the rated motor frequency (Hz) of the second motor.
458	Second motor constant (R1)	9999	55K or less	0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA, SF-V5RU(1500r/min series)) constants
			75K or more	0 to 400mΩ, 9999	
459	Second motor constant (R2)	9999	55K or less	0 to 50Ω, 9999	
			75K or more	0 to 400mΩ, 9999	
460	Second motor constant (L1)	9999	55K or less	0 to 50 Ω (0 to 1000mH), 9999	
			75K or more	0 to 3600mΩ (0 to 400mH), 9999	
461	Second motor constant (L2)	9999	55K or less	0 to 50 Ω (0 to 1000mH), 9999	
			75K or more	0 to 3600mΩ (0 to 400mH), 9999	
462	Second motor constant (X)	9999	55K or less	0 to 500Ω (0 to 100%), 9999	
			75K or more	0 to 100Ω (0 to 100%), 9999	
463	Second motor auto tuning setting/status	0	0		Second motor auto tuning is not performed
			1		Offline auto tuning is performed without second motor running
			101		Offline auto tuning is performed with second motor running
684	Tuning data unit switchover	0	0		Internal data converted value
			1		Displayed in "A, Ω, mH, %".
859	Torque current	9999	55K or less	0 to 500A	Tuning data (The value measured by offline auto tuning is automatically set.)
			75K or more	0 to 3600A	
			9999		Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA, SF-V5RU(1500r/min series)) constants
860	Second motor torque current	9999	55K or less	0 to 500A	Tuning data of the second motor (The value measured by offline auto tuning is automatically set.)
			75K or more	0 to 3600A	
			9999		Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA, SF-V5RU(1500r/min series)) constants

2

PARAMETER

2) (E700)

[Pr.]	Name	Initial Value	Setting Range	Description
71	Applied motor	0	0, 1, 3 to 6, 13 to 16, 23, 24, 40, 43, 44, 50, 53, 54	By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.
80	Motor capacity	9999	0.1 to 15kW	Applied motor capacity.
			9999	V/F control
81	Number of motor poles	9999	2, 4, 6, 8, 10	Number of motor poles.
			9999	V/F control
82	Motor excitation current	9999	0 to 500A	Tuning data (The value measured by offline auto tuning is automatically set.)
			9999	Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
83	Rated motor voltage	200V class: 200V 400V class: 400V	0 to 1000V	Rated motor voltage(V).
84	Rated motor frequency	60Hz	10 to 120Hz	Rated motor frequency (Hz).
90	Motor constant (R1)	9999	0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
91	Motor constant (R2)	9999	0 to 50Ω, 9999	
92	Motor constant (L1)	9999	0 to 1000mH, 9999	
93	Motor constant (L2)	9999	0 to 1000mH, 9999	
94	Motor constant (X)	9999	0 to 100%, 9999	
96	Auto tuning setting/ status	0	0	Offline auto tuning is not performed
			1	For Advanced magnetic flux vector control Offline auto tuning is performed without motor running (all motor constants).
			11	For General-purpose magnetic flux vector control Offline auto tuning is performed without motor running. (motor constant (R1) only)
			21	Offline auto tuning for V/F control (automatic restart after instantaneous power failure (with frequency search))(Refer to page 367)
859	Torque current	9999	0 to 500A	Tuning data (The value measured by offline auto tuning is automatically set.)
			9999	Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants

3) (D700)

[Pr.]	Name	Initial Value	Setting Range	Description
71	Applied motor	0	0, 1, 3, 13, 23, 40, 43, 50, 53	By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set.
80	Motor capacity	9999	0.1 to 7.5kW	Applied motor capacity.
			9999	V/F control
82	Motor excitation current	9999	0 to 500A	Set motor excitation current (no load current)
			9999	Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
83	Rated motor voltage	400V	0 to 1000V	Rated motor voltage(V).
84	Rated motor frequency	60Hz	10 to 120Hz	Rated motor frequency (Hz).
90	Motor constant (R1)	9999	0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
96	Auto tuning setting/ status	0	0	Offline auto tuning is not performed
			11	For General-purpose magnetic flux vector control Offline auto tuning is performed without motor running. (motor constant (R1) only)
			21	Offline auto tuning for V/F control (automatic restart after instantaneous power failure (with frequency search)) (Refer to page 367)

(1) Wiring and load check

Check the following before performing auto tuning.

1) Connect the motor and select any of General-purpose magnetic flux vector control, Advanced magnetic flux control, Real sensorless vector control, or vector control. Note that the motor should be at a stop at a tuning start. Auto tuning can not be performed when V/F control is selected.

   (Except when [*Pr. 96* = 21] in E700 D700)
2) The motor capacity should be equal to or one rank lower than the inverter capacity. (Note that the motor capacity should be 04.kW or more for A700 and 0.1kW or more for E700 D700.)
3) Tuning is enabled even when a load (friction, steady load, etc.) is connected to the motor. Note that tuning accuracy is higher as the load is lighter. Tuning accuracy does not change even if the inertia is large.
4) Note the following matters when [*Pr. 96 = 101*] (offline auto tuning performed with motor running).
   (a) Torque is not enough during tuning.
   (b) The motor may be run at nearly its rated frequency ([*Pr. 84*] setting), make sure that there will be no problem in safety
   (c) The mechanical brake is open.
   (d) No external force is applied to rotate the motor.
5) Even if [*Pr. 96 = 1, 11, 21*] (tuning performed without motor running), the motor may run slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, and make sure that there will be no problem in safety if the motor runs.
   *Fix the motor securely especially for elevators.
   Note that tuning performance is unaffected even if the motor runs slightly.
6) Offline auto tuning will not be performed properly if it is performed with a reactor connected or surge voltage suppression filter (FR-ASF-H) to the 55K or less, or sine wave filter (MT-BSL/BSC) connected to the 75K or more between the inverter and motor. Remove it before tuning start.

(2) Parameter Setting

After General-purpose magnetic flux vector control, Advanced magnetic flux vector control, Real sensorless vector control, vector control is selected, refer to the parameter description to set the following parameters. Refer to page 367 for the auto tuning at [*Pr. 96* = 21] V/F control (automatic restart after instantaneous power failure (with frequency search)).

1) [*Pr. 96 Auto tuning setting/status*]
   .... Set 1 or 101 when performing Advanced magnetic vector control. Set 11 when performing General-purpose magnetic vector control.
   - When the setting is 1 (Advanced magnetic flux vector control)
     .... It is performed without motor running. It takes about 25 to 120s* until tuning is completed. Excitation noise is produced during tuning.
     *Tuning time differs according to the inverter capacity and motor type.
   - When the setting is 11 (General-purpose magnetic vector control)
     .... It tunes only the motor constant (R1) without running motor. It takes about 9s until tuning is completed.
   - When the setting is 101
     .... It is performed with motor running.
     It takes about 40s until tuning is completed. The motor rotates at 60Hz.
2) [*Pr. 9 Electronic thermal O/L relay*]
   .... Set the rated motor current (A).
3) [*Pr. 83 Rated motor voltage*] *
   .... Set the rated motor voltage (V).
4) [*Pr. 84 Rated motor frequency*] *
   .... Set the rated motor frequency (Hz).
5) [*Pr. 71 Applied motor*]
   .... Select the setting referring to the table below.

Motor		[*Pr. 71*] Setting
Mitsubishi standard motor Mitsubishi high efficiency motor	SF-JR, SF-TH	3
	SF-JR 4P 1.5kW or less	23
	SF-HR	43
	Others	3
Mitsubishi constant-torque motor	SF-JRCA 4P, SF-TH (constant torque)	13
	SF-HRCA	53
	Others (SF-JRC, etc.)	13
Vector control dedicated motor	SF-V5RU (1500r/min series) SF-THY	33
	SF-V5RU (except for 1500r/min series)	13
Other manufacturer's standard motor	—	3
Other manufacturer's constant-torque motor	—	13

* For the setting value, set the motor rating plate value. If there are several rating values as standard motor, set the value of 200V/60Hz or 400V/60Hz.
When using vector control dedicated motors, SF-V5RU and SF-THY, setting 33 or 34 to [*Pr. 71*] chooses the internal constant that meets the dedicated motor. Therefore, setting to [*Pr. 83 and 84*] is unnecessary.

(3) Auto tuning operation

When performing the auto tuning in PU operation mode, press FWD or REV key in A700, and RUN key in E700 D700. When performing auto tuning in the External operation mode, turn the starting switch (STF or STR signal) ON.
Since the motor runs when [*Pr. 96 = 101*], caution must be taken.
Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed.
During online auto tuning, only the following I/O signals are valid (when initial setting):

Input terminals <valid signal>	A700 STOP, OH, MRS, RT, RES, STF, STR E700 MRS, RES, STF, STR D700 STF, STR
Output terminal	A700 RUN, OL, IPF, FM*, AM*, A1B1C1 E700 D700 RUN, FM*, ABC

* When output frequency and rotation speed are output from terminal FM and AM, offline auto tuning status (full scale when ended normally) is output (in 15 levels in A700, 8 levels in E700, 5 levels in D700.)

<Reference> Auto tuning time

[*Pr. 96*]	Time
1: Non-rotation mode	Estimated time when the SF-JR is 4-pole 0.4kW : 22s 3.7kW : 37s 11kW : 50s 37kW : 90s 75kW : 130s
11: Non-rotation mode (Tunes only R1)	About 9s
101: Rotation mode	About 40s*

* Auto tuning time varies with the acceleration and deceleration time settings as indicated below.

Auto tuning time
= acceleration time + deceleration time + about 30s

● To force tuning to end

Enter signal to terminal MRS or RES, or press STOP RESET during PU operation mode. In External operation mode, turn OFF the starting switch (STR or STR signal) to end the operation.
Check the [*Pr. 96*] setting when auto tuning ended.

● Normal end................3 or 103 is displayed.

● Error-activated end........ any of 8, 9, 91, 92, 93 is displayed

Error Display	Error Cause	Remedy
8	Forced End	Set [*Pr. 96 = 1, 11 or 101*] and perform tuning again
9	Inverter protective function operation	Make setting again.
91	Current limit (stall prevention) function was activated.	Increase acceleration/ deceleration time. Set [*Pr. 156 = 1*].
92	Converter output voltage reached 75% of rated value.	Check for fluctuation of power supply voltage.
93	Calculation error A motor is not connected.	Check the motor wiring and make setting again.

When tuning ends normally, press the STOP RESET key for PU operation. For External operation, turn OFF the starting switch (STF or STR signal) once. This operation resets the auto tuning, and the PU's monitor display returns to the normal indication.
Without this operation, next operation cannot be done. When tuning was ended due to an error, the auto tuning did not end correctly and motor constants have not been set. Perform an inverter reset (refer to page 57) and restart tuning.

When using a motor which meets the below description, set [*Pr. 9 Electronic thermal O/L relay*] again as below after tuning has completed.

(a) When using motors with rated power specifications of 200/220V (400/440V) 60Hz, set the value multiplied by 1.1 for the rated motor current value in [*Pr. 9*].
(b) When using a motor with a temperature detector such as PTC thermistor and Klixon to protect the motor from heat, set [*Pr. 9* =0] (motor overheat protection by the inverter disabled).

Do not change the [*Pr. 96*] setting after completion of tuning (3, 13 or 103). When the [*Pr. 96*] setting is changed, tuning data is invalid. Therefore, perform tuning again. Monitor is displayed on the operation panel (FR-DU07) and parameter unit (FR-PU04, FR-PU07) during tuning as shown in the next page.

	Parameter Unit (FR-PU04, FR-PU07) Display			Operation Panel (FR-DU07) Display		
[*Pr. 96*] setting	1	11	101	1	11	101
(1) Setting	1 --- STOP PU	11 --- STOP PU	101 --- STOP PU	1	11	101
(2)Tuning in progress	TUNE 2 STF FWD PU	TUNE 12 STF FWD PU	TUNE 102 STF FWD PU	2	12	102
(3)Normal end	TUNE 3 COMPLETION STF STOP PU	TUNE 13 COMPLETION STF STOP PU	TUNE 103 COMPLETION STF STOP PU	3 *	13 *	103 *
(4)Error end (when the inverter protective function is activated)		TUNE 9 ERROR STF STOP PU			9	

* Operation status indication (FWD or REV in (A700), RUN in (E700)(D700)) flickers.

(4) Utilizing or changing offline auto tuning data for use (A700)(E700)

<Operating procedure>

1) Perform auto tuning.
2) Set the following value in [*Pr. 71*]

Motor		[*Pr. 71*] Setting
Mitsubishi standard motor Mitsubishi high efficiency motor	SF-JR, SF-TH	4
	SF-JR 4P 1.5kW or less	24
	SF-HR	44
	Others	4
Mitsubishi constant-torque motor	SF-JRCA 4P, SF-TH (constant torque)	14
	SF-HRCA	54
	Others (SF-JRC etc.)	14
Vector control dedicated motor	SF-V5RU (1500r/min series) SF-THY	34 *
	SF-V5RU (except for 1500r/min series)	14
Other manufacturer's standard motor	—	4
Other manufacturer's constant-torque motor	—	14

* Available only for (A700).

3) In the parameter setting mode, read the following parameters and set desired values. Mitsubishi motor constants are used when 9999 is set in [*Pr. 82, Pr. 90 to Pr. 94, Pr. 859*].

[*Pr.*]	Name	Setting Range	Incre-ments
82	Motor excitation current	0 to ****, 9999	1
90	Motor constant R1	0 to ****, 9999	1
91	Motor constant R2	0 to ****, 9999	1
92	Motor constant L1	0 to ****, 9999	1
93	Motor constant L2	0 to ****, 9999	1
94	Motor constant x	0 to ****, 9999	1
859	Torque current	0 to ****, 9999	1

Constants measured by offline auto tuning are used when [*Pr. 71 = 3, 13, 23, 33, 43, 53*] are set. Constants measured by offline auto tuning is overwritten when the motor constants are changed after the [*Pr. 71*] is set to "4,14,24,34,44,54"

As the motor constants measured in the offline auto tuning have been converted into internal data (****), refer to the following setting example when making setting:

Setting example: To slightly increase [*Pr. 90*] value (5%)
When [*Pr. 90 = 2516*] is displayed, set 2516 × 1.05 = 2641.8, i.e. [*Pr. 90 = 2642*].
(The value displayed has been converted into a value for internal use. Hence, simple addition of a given value to the displayed value has no significance.)

In (A700), display unit of motor constants can be changed by setting [*Pr. 684 Tuning data unit switchover*]. Note that tuning data can not be changed when [*Pr. 684 = 1*].

[*Pr.*]	Setting Increments		
	[*Pr. 684 = 0*]	[*Pr. 684 = 1*]	
		55K or less	75K or more
82	1 (internal data converted value)	0.01A	0.1A
90		0.001Ω	0.01mΩ
91		0.001Ω	0.01mΩ
92		0.1mH	0.01mH
93		0.1mH	0.01mH
94		0.1%	0.01%
859		0.01A	0.1A

(5) Setting the motor constants directly (A700)(E700)

When setting the motor constants without using offline auto tuning data, the [*Pr. 92, Pr. 93*] motor constants may either be entered in [Ω] or in [mH]. Before starting operation, confirm which motor constant unit is used.

● To enter the [*Pr. 92, Pr. 93*] motor constants in [Ω]

<Operating procedure>

1) Set the following value in [*Pr. 71*]. If "star connection" is mistaken for "delta connection" or vice versa during setting of [*Pr. 71*], General-purpose magnetic flux vector control, Advanced magnetic flux vector control, Real sensorless vector control, and vector control cannot be performed properly.

		Star Connection Motor	Delta Connection Motor
[*Pr. 71*] Setting	Standard motor	5(7)	6(8)
	Constant-torque motor	15(17)	16(18)

* When [*Pr. 71 = 7, 8, 17, 18*] in (A700), after setting the motor constants directly, offline auto tuning can be performed.

2) In the parameter setting mode, read the following parameters and set desired values. Mitsubishi motor constants are used when 9999 is set in [*Pr. 82, Pr. 90 to Pr. 94, Pr. 859*]. Use the following formula to find [*Pr. 859 Torque current*].

$$Iq = \sqrt{I_{100}^2 - I_0^2}$$

Iq: Torque current
I_{100}: Rated current
I_0: No load current

[*Pr.*]	Name	Setting Range (Upper line : 55K or less Lower line : 75K or more)	Setting Increments
82	Motor excitation current (no load current)	0 to 500A, 9999 0 to 3600A, 9999	0.01A 0.1A
90	Motor constant (r1)	0 to 50Ω, 9999 0 to 400mΩ, 9999	0.001Ω 0.01mΩ
91	Motor constant (r2)	0 to 50Ω, 9999 0 to 400mΩ, 9999	0.001Ω 0.01mΩ
92	Motor constant (x1)	0 to 50Ω, 9999 0 to 3600mΩ, 9999	0.001Ω 0.01mΩ
93	Motor constant (x2)	0 to 50Ω, 9999 0 to 3600mΩ, 9999	0.001Ω 0.01mΩ
94	Motor constant (xm)	0 to 500Ω, 9999 0 to 100Ω, 9999	0.01Ω
859	Torque current	0 to 500A, 9999 0 to 3600A, 9999	0.01A 0.1A

3) Refer to the following table and set [*Pr. 83 and Pr. 84*].

[*Pr.*]	Name	Setting Range	Setting Range
83	Rated motor voltage	0 to 1000V	0.1V
84	Rated motor frequency	10 to 120Hz	0.01Hz

● To enter the [*Pr. 92, 93*] motor constants in [mH]

<Operating procedure>

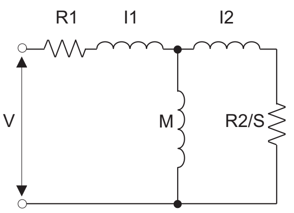
1) Set the following value in [*Pr. 71*]

Motor		[*Pr. 71*] Setting
Mitsubishi standard motor	SF-JR	0
	SF-JR 4P 1.5kW or less	20*
Mitsubishi high efficiency motor	SF-HR	40
Mitsubishi constant-torque motor	SF-JRCA 4P	1
	SF-HRCA	50
Vector control dedicated motor	SF-V5RU (1500r/min series)	30*

* Available only for A700.

2) In the parameter setting mode, read the following parameters and set desired values. Mitsubishi motor constants are used when 9999 is set in [*Pr. 82, 90 to 94, 859*].
Calculate the [*Pr. 94*] value from the following formula.

$$[Pr.\ 94]\ \text{Setting} = \left(1 - \frac{M^2}{L1 \times L2}\right) \times 100(\%)$$



R1: Primary resistance
R2: Secondary resistance
l1: Primary leakage inductance
l2: Secondary leakage inductance
M: Excitation inductance
S: Slip

L1= l1+ M: Primary inductance
L2= l2+ M: Secondary inductance

Motor equivalent circuit diagram

[*Pr.*]	Name	Setting Range (Upper line : 55K or less Lower line : 75K or more)	Setting Increments
82	Motor excitation current (no load current)	0 to 500A, 9999 0 to 3600A, 9999	0.01A 0.1A
90	Motor constant (R1)	0 to 50Ω, 9999 0 to 400mΩ, 9999	0.001Ω 0.01mΩ
91	Motor constant (R2)	0 to 50Ω, 9999 0 to 400mΩ, 9999	0.001Ω 0.01mΩ
92	Motor constant (L1)	0 to 1000mH, 9999 0 to 400mH, 9999	0.1mH 0.01mH
93	Motor constant (L2)	0 to 1000mH, 9999 0 to 400mH, 9999	0.1mH 0.01mH
94	Motor constant (X)	0 to 100%, 9999 0 to 100%, 9999	0.1% 0.01%
859	Torque current	0 to 500A, 9999 0 to 3600A, 9999	0.01A 0.1A

3) Refer to the following table and set [*Pr. 83, 84*].

[*Pr.*]	Name	Setting Range	Setting Range
83	Rated motor voltage	0 to 1000V	0.1V
84	Rated motor frequency	10 to 120Hz	0.01Hz

(6) Perform tuning of the second applied motor A700

When you want to switch between two motors with one inverter, set the second motor in [*Pr. 450 Second applied motor*] (refer to page 266). Initial setting is without second applied motor.
Turning the RT signal ON makes the following parameters for the second motor valid.
To perform auto tuning of the second motor, replace the parameter number stated in the previous explanation with the parameter number corresponding to the one for the second motor in the table below.

Functions	RT Signal is ON Second Motor	RT Signal is OFF First Motor
Motor capacity	[*Pr. 453*]	[*Pr. 80*]
Number of motor poles	[*Pr. 454*]	[*Pr. 81*]
Motor excitation current	[*Pr. 455*]	[*Pr. 82*]
Rated motor voltage	[*Pr. 456*]	[*Pr. 83*]
Rated motor frequency	[*Pr. 457*]	[*Pr. 84*]
Motor constant (R1)	[*Pr. 458*]	[*Pr. 90*]
Motor constant (R2)	[*Pr. 459*]	[*Pr. 91*]
Motor constant (L1)	[*Pr. 460*]	[*Pr. 92*]
Motor constant (L2)	[*Pr. 461*]	[*Pr. 93*]
Motor constant (X)	[*Pr. 462*]	[*Pr. 94*]
Auto tuning setting/ status	[*Pr. 463*]	[*Pr. 96*]

2.8.3 Online auto tuning function [Pr. 95, 574] (A700)

When online auto tuning is selected under Advanced magnetic flux vector control or Real sensorless vector control, excellent torque accuracy is provided by temperature compensation even if the secondary resistance value of the motor varies with the rise of the motor temperature.

[Pr.]	Name	Initial Value	Setting Range	Description	Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control	Vector Control
95	Online auto tuning selection	0	0	Online auto tuning is not performed	○	○	○
			1	Start-time online auto tuning	○	○	△ Although setting can be made, setting 2 is recommended
			2	Magnetic flux observer (normal tuning)	Invalid	Invalid*	○
574	Second motor online auto tuning	0	0	Second motor online auto tuning is not performed	○	○	Setting is disabled
			1	Online auto tuning at starting of the second motor	○	○	Setting is disabled

* Magnetic flux observer is always activated under Real sensorless vector control independently of [*Pr. 95, 574*] setting.

(1) Start-time online auto tuning [*Pr. 95 = 1, Pr. 574 = 1*]

By quickly tuning the motor constants at a start, high accuracy operation unaffected by the motor temperature and stable operation with high torque down to ultra low speed can be performed.

Set when performing start time tuning under Advanced magnetic flux vector control or Real sensorless vector control. It can be set under vector control. However, it is recommended to set 2 (magnetic flux observer) under vector control.

<Operation method>

1) Perform offline auto tuning.
2) Read [*Pr. 96*] and check that the setting is either 3 or 103 (offline auto tuning completed).
3) Set [*Pr. 95 = 1*].
4) Before starting operation, check that the following parameters have been set.

[Pr.]	Description
9	Used as rated motor current and electronic thermal relay parameters
71	Applied motor
80	Motor capacity (can be set down to one rank lower than the inverter capacity, note that the capacity should be 0.4kW or more)
81	Number of motor poles

5) Give the run command in the PU operation or External operation mode.

*1 Online auto tuning does not operate if the MRS signal is input, if the preset frequency is less than the [*Pr. 13 Starting frequency*], or if the starting conditions of the inverter are not satisfied, e.g. inverter error.

*2 Online auto tuning does not operate during deceleration or at a restart during DC brake operation.

*3 Invalid for Jog operation.

*4 Automatic restart after instantaneous power failure overrides when automatic restart after instantaneous power failure is selected.

*5 For using start-time tuning in elevator, examine the utilization of a brake sequence for the brake opening timing at a start or consider tuning with external terminal. Though the tuning ends in about a maximum of 500ms after a start, torque is not provided fully during that period. Therefore, note that there may be a possibility of drop of elevator due to gravity.

*6 Zero current detection and output current detection are valid during online auto tuning.

*7 The RUN signal is not output during online auto tuning. The RUN signal turns ON at a start.

*8 If the period from an inverter stop to a restart is within 4s, online auto tuning is performed but the tuning results are not reflected.

(2) Start-time online auto tuning from external terminal (X28 signal, Y39 signal) [*Pr. 95 = 1, Pr. 574 = 1*]

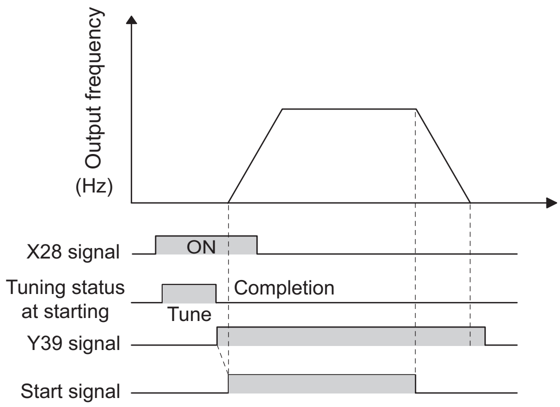
By turning ON the start-time tuning signal (X28) before the start signal (STF or STR) turns ON (at a stop), online tuning is performed and a starting delay after start signal turns ON due to tuning can be avoided.

Perform offline auto tuning and set [*Pr. 95 = 1*].

When the start-time tuning completion signal (Y39) is OFF, start-time tuning with the X28 signal is performed. Start-time tuning ends within 500ms maximum.

When using the X28 signal, set 28 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function to the input terminal.

When using the Y39 signal, set 39 (positive logic) or 139 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to the output terminal.



*1 Start-time tuning is performed when the start signal is turned ON during zero speed control or servo lock also.

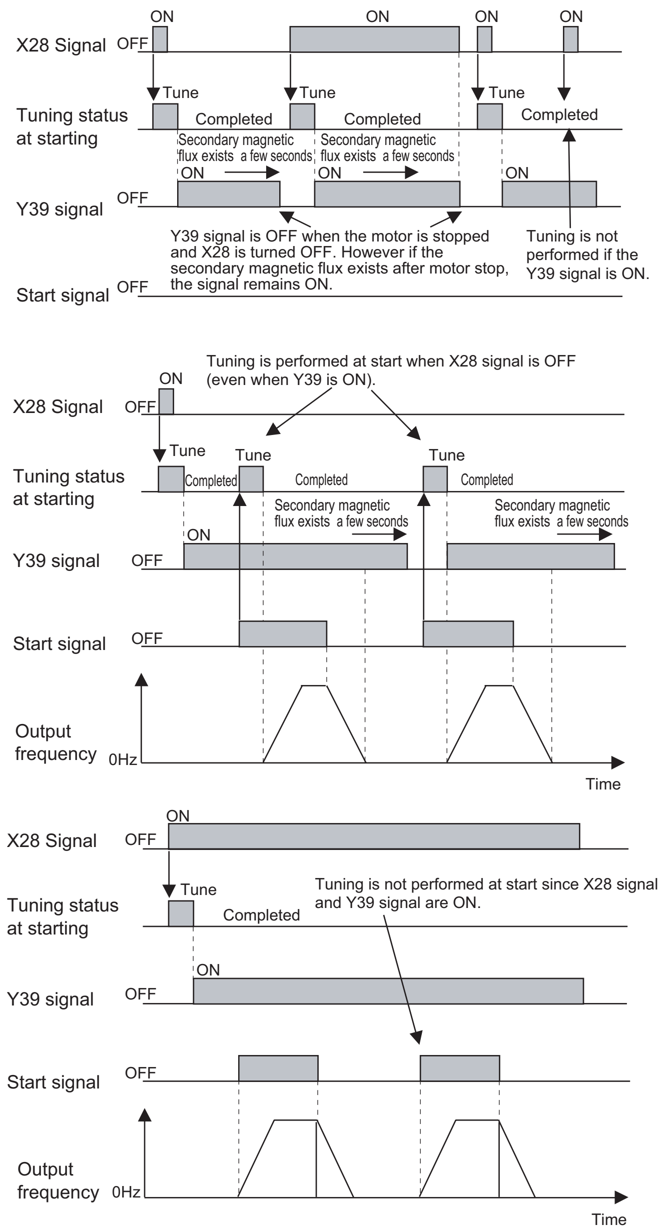
*2 The Y39 signal is in ON status while secondary magnetic flux exists after the motor stop.

*3 While the Y39 signal is ON, the X28 signal is not valid.

*4 The STF, STR signals are valid after completion of the start-time tuning.

*5 Only the output signals below are valid during tuning.
IPF, THP, PU, Y12, RY, ER, LF, MT, FM, AM, A1, B1, C1, A2, B2, C2

<Other operation timing chart>



(3) Magnetic flux observer (constant tuning) [*Pr. 95 = 2*]

When exercising vector control using a motor with encoder, it is effective for torque accuracy improvement.
The current flowing in the motor and the inverter output voltage are used to estimate/observe the magnetic flux in the motor. The magnetic flux of the motor is always (including during operation) detected with high accuracy so that an excellent characteristic is provided regardless of the change in the temperature of the secondary resistance.
Set when performing constant tuning under vector control. Even magnetic flux observer is set, magnetic flux observer is not activated under Advanced magnetic flux vector control. Magnetic flux observer is always activated under Real sensorless vector control independently of [*Pr. 95, 574*] setting.
For the SF-V5RU, SF-JR (with encoder), SF-HR (with encoder), SF-JRCA (with encoder) or SF-HRCA (with encoder), it is not necessary to perform offline auto tuning to select adaptive magnetic flux observer. (Note that it is necessary to perform offline auto tuning (non-rotation mode) for the wiring length resistance to be reflected on the control when the wiring length is long. (30m or longer as reference))

(4) Perform tuning of the second applied motor

When you want to switch between two motors with one inverter, set the second motor in [*Pr. 450 Second applied motor*]. (Initial setting is without second applied motor. (Refer to page 266))
Perform tuning using [*Pr. 574 Second motor online auto tuning*].
[*Pr. 574*] is valid when the RT signal is ON.

[*Pr.*]	Description
51	Used as rated motor current and electronic thermal relay parameters.
450	Applied motor
453	Motor capacity (can be used down to one rank lower than the inverter capacity, note that the capacity should be 0.4kW or more)
454	Number of motor poles

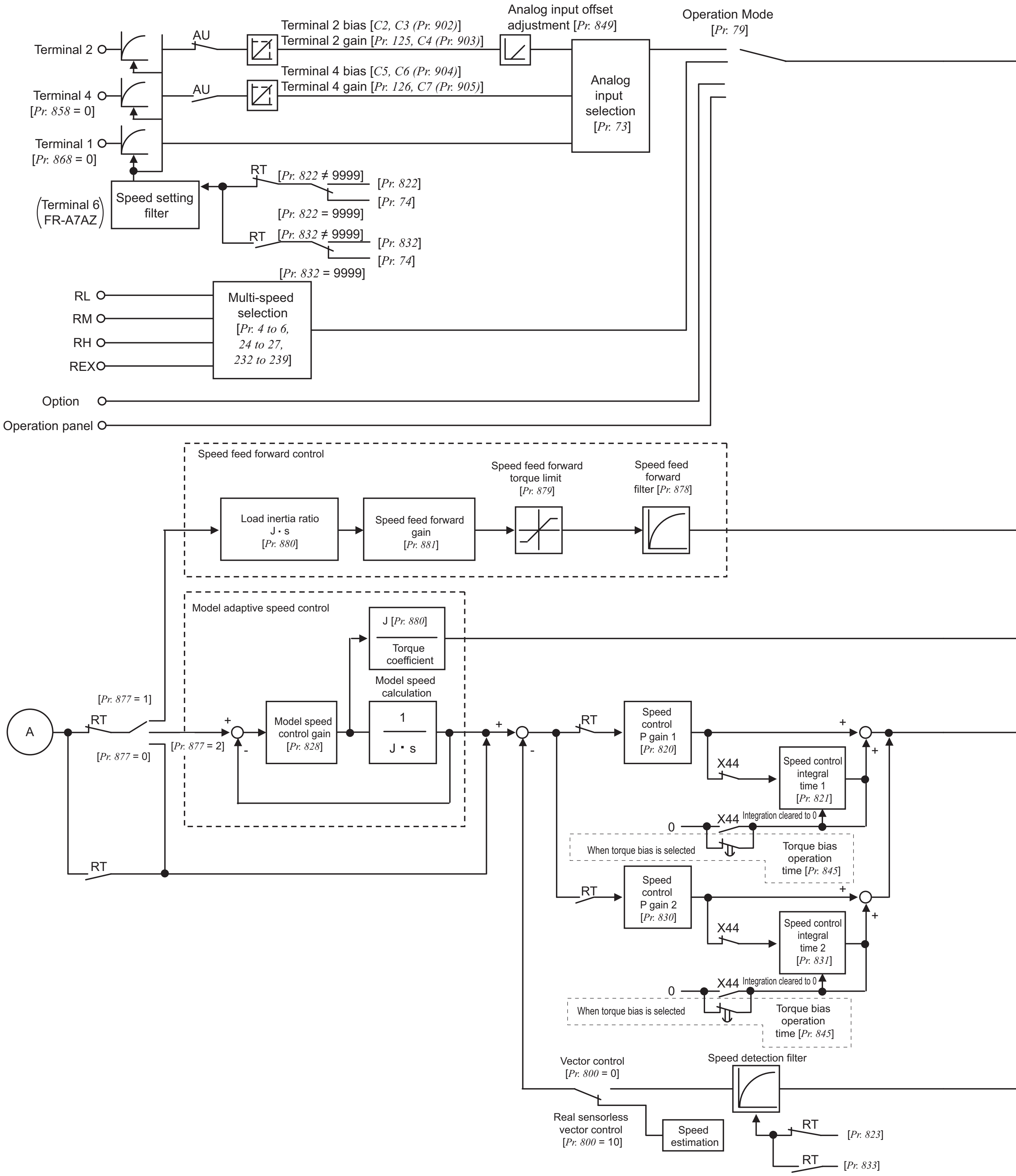
MEMO

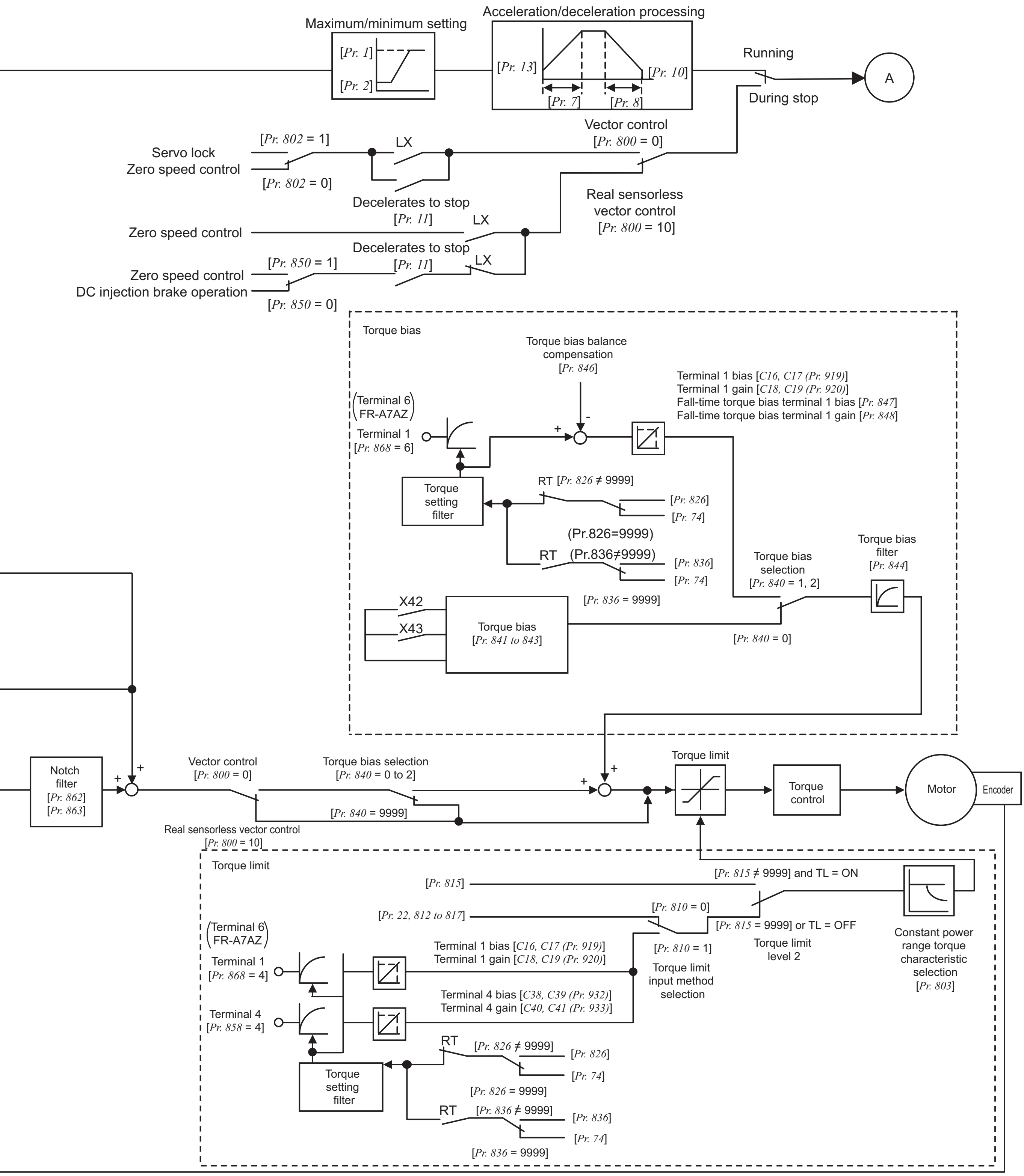
2.9 Speed control by Real sensorless vector control and vector control

2.9.1 What is speed control? A700

(1) Control block diagram

The following shows a basic control block diagram during speed control.



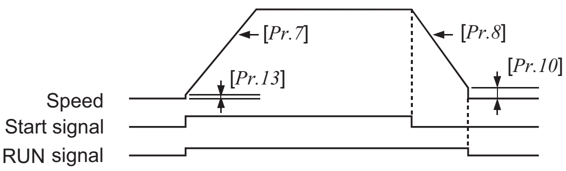

Maximum/minimum setting
[Pr. 1]
[Pr. 2]
Acceleration/deceleration processing
[Pr. 13]
[Pr. 10]
[Pr. 7]
[Pr. 8]
Running
During stop
A
Servo lock
Zero speed control
[Pr. 802 = 1]
[Pr. 802 = 0]
LX
Decelerates to stop
[Pr. 11]
Vector control
[Pr. 800 = 0]
Real sensorless vector control
[Pr. 800 = 10]
Zero speed control
Zero speed control
DC injection brake operation
[Pr. 850 = 1]
[Pr. 850 = 0]
Torque bias
Torque bias balance compensation
[Pr. 846]
Terminal 1 bias [C16, C17 (Pr. 919)]
Terminal 1 gain [C18, C19 (Pr. 920)]
Fall-time torque bias terminal 1 bias [Pr. 847]
Fall-time torque bias terminal 1 gain [Pr. 848]
Terminal 6 FR-A7AZ
Terminal 1
[Pr. 868 = 6]
Torque setting filter
RT [Pr. 826 ≠ 9999]
[Pr. 826]
[Pr. 74]
(Pr.826=9999)
RT (Pr.836≠9999)
[Pr. 836]
[Pr. 74]
[Pr. 836 = 9999]
Torque bias selection
[Pr. 840 = 1, 2]
Torque bias filter
[Pr. 844]
X42
X43
Torque bias
[Pr. 841 to 843]
[Pr. 840 = 0]
Notch filter
[Pr. 862]
[Pr. 863]
Vector control
[Pr. 800 = 0]
Torque bias selection
[Pr. 840 = 0 to 2]
[Pr. 840 = 9999]
Real sensorless vector control
[Pr. 800 = 10]
Torque limit
Torque control
Motor
Encoder
Torque limit
[Pr. 815]
[Pr. 815 ≠ 9999] and TL = ON
[Pr. 22, 812 to 817]
[Pr. 810 = 0]
[Pr. 815 = 9999] or TL = OFF
[Pr. 810 = 1]
Torque limit level 2
Torque limit input method selection
Constant power range torque characteristic selection
[Pr. 803]
Terminal 6 FR-A7AZ
Terminal 1
[Pr. 868 = 4]
Terminal 1 bias [C16, C17 (Pr. 919)]
Terminal 1 gain [C18, C19 (Pr. 920)]
Terminal 4
[Pr. 858 = 4]
Terminal 4 bias [C38, C39 (Pr. 932)]
Terminal 4 gain [C40, C41 (Pr. 933)]
RT
[Pr. 826 ≠ 9999]
[Pr. 826]
[Pr. 74]
[Pr. 826 = 9999]
Torque setting filter
RT
[Pr. 836 ≠ 9999]
[Pr. 836]
[Pr. 74]
[Pr. 836 = 9999]

2

PARAMETER

(2) Operation

Speed control adjusts the difference between the speed command and speed feedback (actual speed under vector control, estimated speed under Real sensorless vector control) is 0, i.e. to match the speed command and actual speed or estimated speed.
The speed loop gain parameter that adjusts speed control operation status is provided for the A700.
Although stable operation is possible with the initial value, refer to the following to make parameter adjustment when vibration, noise or any other unfavorable condition occurs due to large load inertia or gear backlash, for example, or when you want to exhibit the best performance that matches the machine.
The following figure indicates operation under speed control.

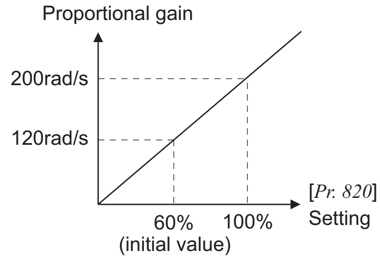


- Turning ON the start signal increases the speed up to the preset speed according to the acceleration time.
- Turning OFF the start signal decreases the speed according to the deceleration time. When the speed has decreased down to the DC brake operation speed, operation changes to DC injection brake operation.

(3) Concept of speed control gains

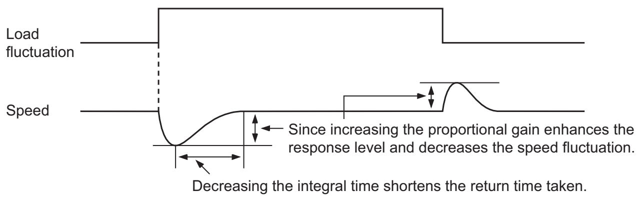
Speed control gain with motor alone is stated below. Refer to page 286 for how to adjust the speed control gain.

1) Speed control P (proportional) gain
   - During vector control, [*Pr. 820 = 60%*] is equivalent to 120rad/s. During Real sensorless vector control, [*Pr. 820 = 60%*] is equivalent to 60rad/s.
   - For the 75K or more, response level becomes half.
   - Increasing the proportional gain increases the response level. However, a too high gain will produce vibration and/or unusual noise.



Response under vector control (55K or less)

2) Speed control integral time
   - [*Pr. 821 = 0.333s*] is equivalent to 3rad/s.
   - Decreasing the integral time shortens the return time at a speed change. However, a too short time will generate an overshoot. (Refer to the drawing below.)



3) Speed gain when the load inertia is attached
   When there is load inertia, the actual speed gain decreases as indicated below.

$$\text{Actual speed gain} = \text{Speed gain when with a motor alone} \times \frac{J_M}{J_M + J_L}$$

J_M : Inertia of motor
J_L : Motor shaft-equivalent load inertia

2.9.2 Torque limit level setting [Pr. 22, 406, 803, 810 to 817, 858, 865, 868, 874] (A700)

This function limits the output torque to the predetermined value during speed control under Real sensorless vector control and vector control.
In [*Pr. 810 Torque limit input method selection*], you can select whether to set the torque limit level using parameters ([*Pr. 22(Pr. 812 to 814)*]) or using analog input terminals (terminal 1, 4, terminal 6 (FR-A7AZ)).
Turning TL signal ON sets [*Pr. 815 Torque limit level 2*] as the torque limit level.

In addition, you can set torque limit level for forward (power driving/regeneration) and reverse (power driving/ regeneration) operation individually.
Under Real sensorless vector control, the lower limit of torque limit level is set 30% if the value less than 30% is input.

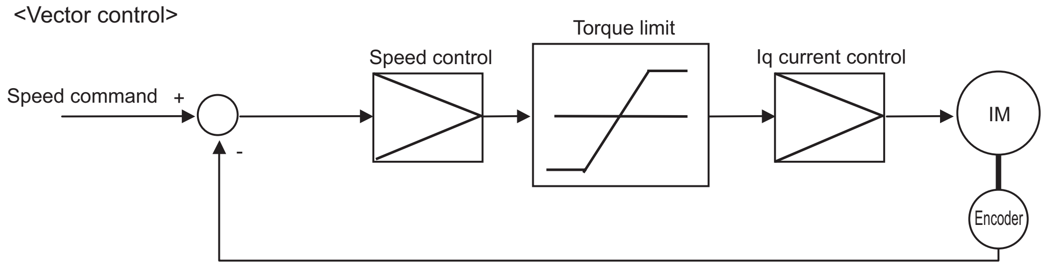
[*Pr.*]	Name	Initial Value	Setting Range	Description	
22	Stall prevention operation level (Torque limit level)	150/200% *1	0 to 400%	Set the torque limit level in % on the assumption that the rated torque is 100%. *1 For the 3.7K or less, the value changes from 150% to 200% when V/F control or Advanced magnetic flux vector control is changed to Real sensorless vector control or vector control.	
406	High resolution analog input selection AZ	9999	0, 2 to 6, 9999	When the setting value is "4", torque limit level can be changed with a signal to terminal 6. When the setting value is "2", regenerative torque limit level can be changed with a signal to terminal 6.	
803	Constant power range torque characteristic selection	0	0	Constant motor output limit	Select the torque limit in the constant power range by torque limit setting.
			1	Constant torque limit	
810	Torque limit input method selection	0	0	Internal torque limit (Torque limit by parameter setting)	
			1	External torque limit (Torque limit by terminal 1, 4*)	
811	Set resolution switchover	0	0	Speed setting and running speed monitor increments from the PU, RS-485 communication or communication option.	Torque limit setting increments [*Pr. 22*], [*Pr. 812 to Pr. 817*]
				1r/min	0.1%
			1	0.1r/min	
			10	1r/min	0.01%
			11	0.1r/min	
812	Torque limit level (regeneration)	9999	0 to 400%	Set the torque limit level for forward rotation regeneration.	
			9999	[*Pr. 22*]/limit at the analog terminal value	
813	Torque limit level (3rd quadrant)	9999	0 to 400%	Set the torque limit level for reverse rotation driving.	
			9999	[*Pr. 22*]/limit at the analog terminal value	
814	Torque limit level (4th quadrant)	9999	0 to 400%	Set the torque limit level for reverse rotation regeneration.	
			9999	[*Pr. 22*]/limit at the analog terminal value	
815	Torque limit level 2	9999	0 to 400%	When the torque limit selection (TL) signal is ON, the [*Pr. 815*] value is a torque limit value regardless of [*Pr. 810*] .	
			9999	Torque limit set in [*Pr. 810*] is valid.	
816	Acceleration torque limit level	9999	0 to 400%	Set the torque limit value during acceleration.	
			9999	Same torque limit as at constant speed	
817	Deceleration torque limit level	9999	0 to 400%	Set the torque limit value during deceleration.	
			9999	Same torque limit as at constant speed	
858	Terminal 4 function assignment	0	0, 4, 9999	When 4 is set, the torque limit can be changed with a signal to terminal 4.	
865	Low speed detection	1.5Hz	0 to 400Hz	The low speed detection signal (LS) is output when the output frequency decreases below the setting.	
868	Terminal 1 function assignment	0	0 to 6, 9999	When 4 is set, the torque limit can be changed with a signal to terminal 1. When 2 is set, the regenerative torque limit can be changed with a signal to terminal 1.	
874	OLT level setting	150%	0 to 200%	This function can make an inverter trip if the torque limit is activated to stall the motor. Set the output level for a trip.	

* When FR-A7AZ is installed, torque limit from terminal 6 is also available.

2

PARAMETER

(1) Torque limit block diagram



(2) Selection of torque limit input method [*Pr. 810*]

Set [*Pr. 810 Torque limit input method selection*] to select the method to limit output torque during speed control.

Torque limit by parameter setting is initially set.

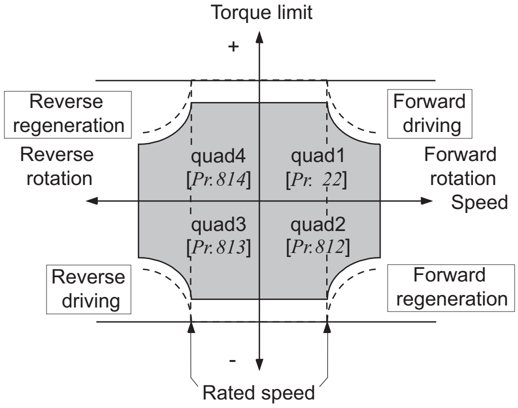
[*Pr.*]	Setting Range	Torque limit input method
810	0 (initial value)	Internal torque limit Parameter-set torque limit operation is performed. Changing the torque limit parameter value by communication enables torque limit to be input by communication.
	1	External torque limit Torque limit using the analog voltage (current) input to any of terminal 1, terminal 4 or terminal 6 (FR-A7AZ) is enabled.

(3) Torque limit level by parameter setting [*Pr. 810 = 0, Pr. 22, 812 to 814*]

In the initial setting, limit is made on all quadrants on the [*Pr. 22 Stall prevention operation level (torque limit level)*].

When you want to set the level on a quadrant basis, set the torque limit level in [*Pr. 812 Torque limit level (regeneration)*], [*Pr. 813 Torque limit level (3rd quadrant)*], [*Pr.814 Torque limit level (4th quadrant)*].

When 9999 is set, [*Pr. 22*] is the torque limit level.



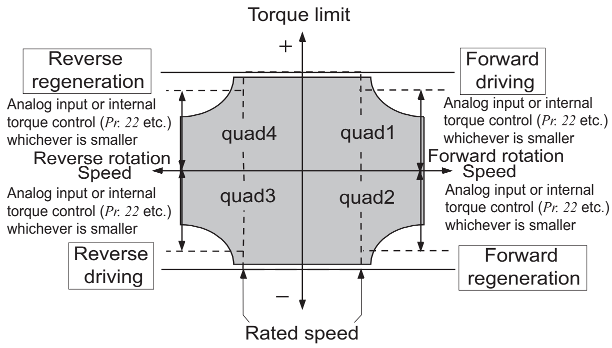
(4) Torque limit level by analog input (terminal 1, 4, 6 (FR-A7AZ)) [Pr.810=1, Pr. 406*, 858, 868]

(* Pr. 406 is available only when FR-A7AZ is installed)

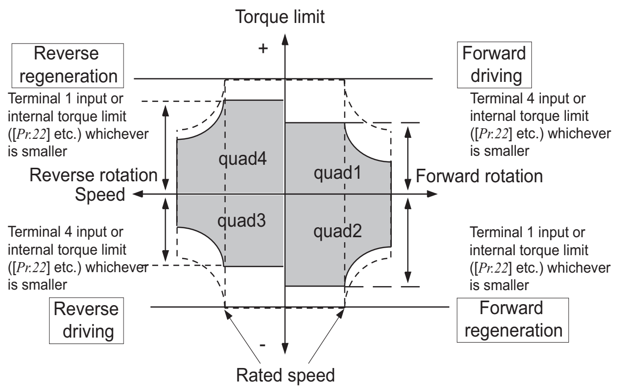
Upper limit of torque limit is [*Pr. 22*], and torque limit value is the analog input to terminal 1, terminal 4 or terminal 6.

When torque limit value is input to terminal 1, set [*Pr. 868 Terminal 1 function assignment = 4*]. When torque limit value is input to terminal 4, set [*Pr. 858 Terminal 4 function assignment* = 4]. Set [*Pr. 406 High resolution analog input selection* = 4] to input torque limit value to terminal 6 of FR-A7AZ. (Refer to page 46 for details of function assignment of analog input terminal.)

When [*Pr. 858 = 4*] and [*Pr. 868 = 4*], terminal 1 serves as torque limit input and terminal 4 as without function. When [*Pr. 858* = 4] and [*Pr. 868* = 4] while [*Pr. 406* = 4], terminal 6 is the torque limit input, and terminal 1 and terminal 4 do not have a function.



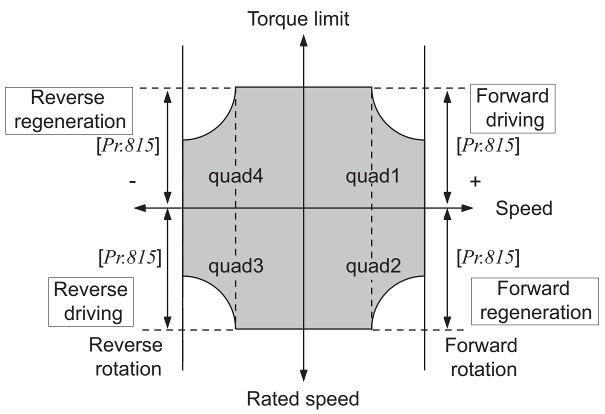
When [*Pr. 858 = 4*] and [*Pr. 868 = 2*], torque is limited by analog input to terminal 1 for regeneration and by terminal 4 for driving. If the setting of [*Pr. 406*] is same with [*Pr. 858*] or [*Pr. 868*], function of terminal 6 is valid, and terminal 1 or terminal 4 does not have a function.



Torque limit by analog input can be calibrated using calibration parameter [*C16 to C19 (Pr. 919, Pr. 920)*], [*C38 to C41 (Pr. 932, Pr. 933)*], [*C34 to C37 (Pr. 928, 929)*]. (Refer to page 320)

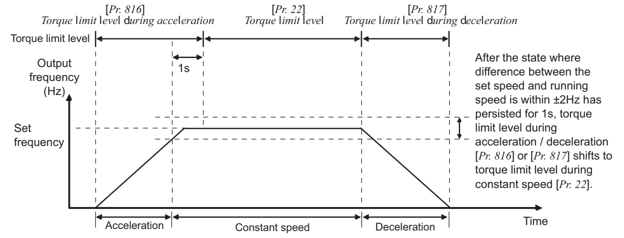
(5) Second torque limit level (TL signal) [*Pr. 815*]

For [*Pr. 815 Torque limit level 2*], the [*Pr. 815*] value is a torque limit value regardless of [*Pr. 810 Torque limit input method selection*] when the torque limit selection signal (TL) is ON.
Set [*Pr. 178 to 189 Input terminal function selection*] to assign a function to the TL signal.



(6) Torque limit value during acceleration/ deceleration [*Pr. 816, 817*]

You can set torque limit during acceleration and deceleration individually.
Torque limit by [*Pr. 816 Torque limit level during acceleration*] and [*Pr. 817 Torque limit level during deceleration*] is shown below.



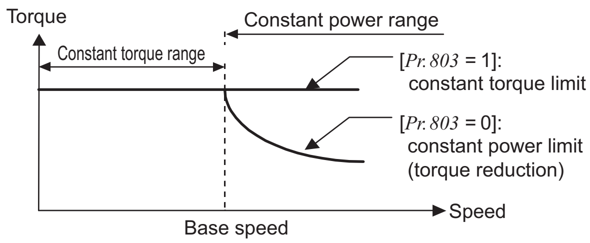
(7) Setting increments switchover of the torque limit level [*Pr. 811*]

By setting [*Pr. 811 Set resolution switchover = 10, 11*] under vector control, the setting increments of [*Pr. 22 Torque limit level*] and [*Pr. 812 to Pr. 817 Torque limit level*] can be switched to 0.01%.

Note that the internal resolution of the torque limit is 0.024% ($100/2^{12}$) and the fraction less than the resolution is rounded off.
The fraction less than the resolution equivalent to 0.1% is rounded off even if [*Pr. 811 = 10, 11*] when Real sensorless vector control is selected.
When the torque restriction setting increments have been changed (0.1% ⇔ 0.01%), reset is necessary because the settings of [*Pr. 22, Pr. 812 to Pr. 817*] are multiplied by 1/10 (ten times). For example, when [*Pr. 22 = 150.00%*] and [*Pr. 811 = 10 (0.01%) → 1 (0.1%)*], [*Pr. 22 = 1500.0%*] and the maximum torque is 400%.
(Refer to page 343 for switchover of speed setting increments.)

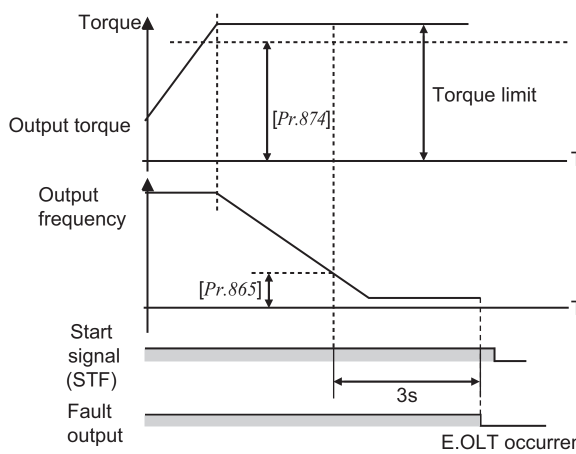
(8) Torque characteristic in the constant power range [*Pr. 803*].

You can select whether the torque limit in the constant power range be constant torque limit (setting is "1") or constant power limit (initial setting is "0") using [*Pr. 803 Constant power range torque characteristic selection*] under torque limit operation.



(9) Fault stop when torque limit is activated [*Pr. 865, 874*]

This function makes an inverter trip if the torque limit is activated to stall the motor.
The motor stalls if the torque limit is activated under a high load applied during speed control or position control. At this time, if the motor speed is lower than the speed set in [*Pr. 865 Low speed detection*] and also the output torque exceeds the level set in [*Pr. 874 OLT level setting*] for 3s, it is regarded as a stop effected by stall prevention and E. OLT is output, resulting in a fault.



2

PARAMETER

2.9.3 Gain adjustment [Pr. 818 to 821, 830, 831, 880] (A700)

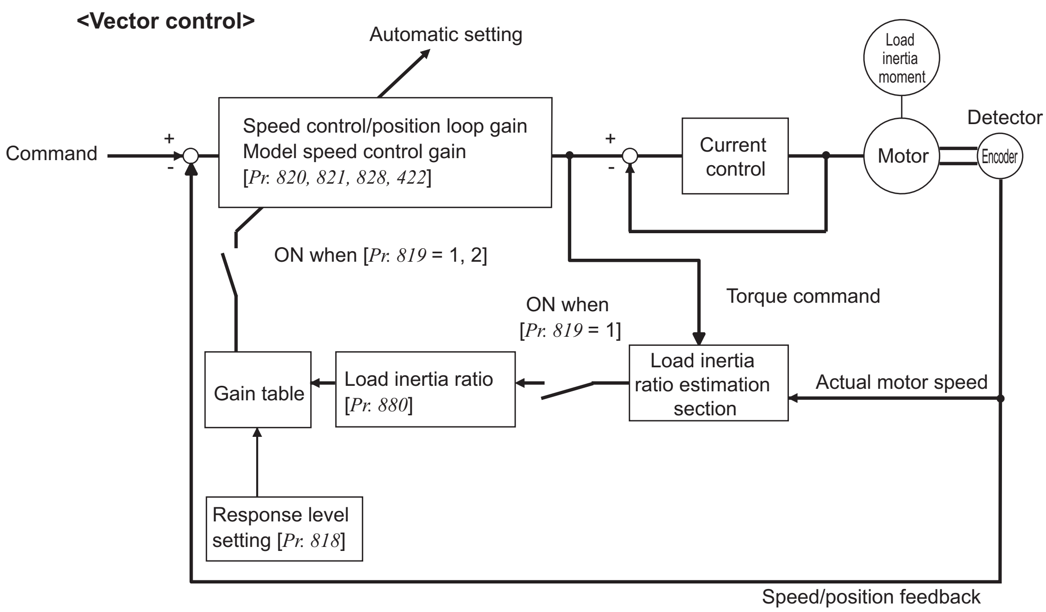
The ratio of the load inertia to the motor inertia (load inertia moment) is estimated in real time from the torque command and speed during motor operation by vector control. As optimum gain of speed control and position control are automatically set from the load inertia ratio and response level, time and effort of making gain adjustment are reduced. (Easy gain tuning)

When the load inertia ratio can not be estimated due to load fluctuation or Real sensorless vector control is performed, control gain is automatically set by manually inputting the load inertia ratio.

Make a manual input adjustment when vibration, noise or any other unfavorable condition occurs due to large load inertia or gear backlash, for example, or when you want to have the best performance that matches the machine.

[*Pr.*]	Name	Initial Value	Setting Range	Description
818	Easy gain tuning response level setting	2	1 to 15	Set the response level. 1: Slow response to 15: Fast response
819	Easy gain tuning selection	0	0	Without easy gain tuning
			1	With load inertia ratio estimation, with gain calculation (valid only during vector control)
			2	Load inertia ratio manual input [*Pr. 880*], with gain calculation
820	Speed control P gain 1	60%	0 to 1000%	Set the proportional gain for speed control. (Increasing the value improves trackability in response to a speed command change and reduces speed variation with disturbance.)
821	Speed control integral time 1	0.333s	0 to 20s	Set the integral time during speed control. (Decrease the value to shorten the time taken for returning to the original speed if speed variation with disturbance occurs.)
830	Speed control P gain 2	9999	0 to 1000%	Second function of [*Pr. 820*] (valid when RT signal is ON)
			9999	No function
831	Speed control integral time 2	9999	0 to 20s	Second function of [*Pr. 821*] (valid when RT signal is ON)
			9999	No function
880	Load inertia ratio	7 times	0 to 200 times	Set the load inertia ratio to the motor.

(1) Block diagram of easy gain tuning function

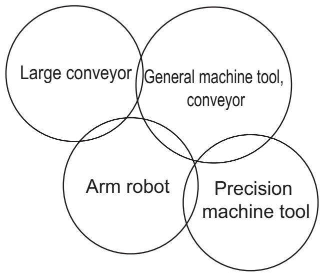


(2) Easy gain tuning execution procedure (load inertia ratio automatic estimation) [*Pr. 819 = 1, Pr. 818, 820, 821, 880*]

Easy gain tuning (load inertia ratio automatic estimation) is valid only in the speed control or position control mode under vector control.
It is invalid under torque control, V/F control, Advanced magnetic flux vector control and Real sensorless vector control.

1) Set the response level using [*Pr. 818 Easy gain tuning responsiveness setting*]. Refer to the diagram below and set the response level.
Increasing the value will improve trackability to the command, but too high value will generate vibration.
The relationship between the setting and response level are shown below.

[*Pr. 818*] setting	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Response level	Slow response		←		→			Medium response			←	→			Fast response
Guideline of mechanical resonance frequency (Hz)	8	10	12	15	18	22	28	34	42	52	64	79	98	122	150



2) Set [*Pr. 819 Easy gain tuning responsiveness setting = 1*] (load inertia ratio automatic estimation).
Each control gain (refer to the table below) is automatically set from the load inertia ratio estimated during acceleration/deceleration operation and the [*Pr. 818 Easy gain tuning response level setting*] value.
[*Pr. 880 Load inertia ratio*] is used as the initial value of the load inertia ratio for tuning. Estimated value is set in [*Pr. 880*] during tuning. Even when [*Pr. 819*] setting is returned to 0 after tuning, tuning results set in each parameter remain unchanged.

The load inertia ratio may not be estimated well, e.g. it takes a long time for estimation, if the following conditions are not satisfied.

- Time taken for acceleration/deceleration to reach 1500r/min should be 5s or less.
- Speed should be 150r/min or more.
- Acceleration/deceleration torque is 10% or more of the rated torque.
- Abrupt disturbance is not applied during acceleration/deceleration.
- Load inertia ratio is about 30 times or less.
- No gear backlash nor belt looseness is found.

3) Press FWD or REV to estimate the load inertia ratio or calculate gain any time.
(The operation command for external operation is the STF or STR signal.)

(3) Easy gain tuning execution procedure (load inertia ratio manual input) [*Pr. 819 = 2, Pr. 818, 820, 821, 880*]

Easy gain tuning (load inertia ratio manual input) is valid only in the speed control mode under Real sensorless vector control or in the speed control or position control mode under vector control.

1) Set the load inertia ratio to the motor in [*Pr. 880 Load inertia ratio*].
2) Set [*Pr. 819 Easy gain tuning responsiveness setting = 2*] (easy gain tuning is valid). When the value is set, each control gain (refer to the table below) is automatically set according to the gain calculation. Even when [*Pr. 819*] setting is returned to 0 after tuning, tuning results set in each parameter remain unchanged.
Operation is performed in a gain adjusted status from the next operation.
3) Perform a test run and set the response level in [*Pr. 818 Easy gain tuning response level setting*]. Increasing the value will improve trackability to the command, but too high value will generate vibration. When ([*Pr. 77 Parameter write selection = 2*] (parameter write enabled during operation) is set, response level adjustment can be made during operation.

Relationship between easy gain tuning and gain adjustment parameter

	[*Pr. 819 Easy Gain Tuning Selection*] Setting		
	0	1	2
[*Pr. 880 Load inertia ratio*]	Manual input	a) Inertia estimation result (RAM) by easy gain tuning is displayed. b) Set the value in the following cases: • Every hour after power-ON • When a value other than 1 is set in [*Pr. 819*]. • When vector control is changed to other control (V/F control etc.) using [*Pr. 800*]. c) Write is enabled only during a stop (manual input)	Manual input
[*Pr. 820 Speed control P gain 1*] [*Pr. 821 Speed control integral time 1*] [*Pr. 828 Model speed control gain*] [*Pr. 422 Position loop gain*]	Manual input	a)Tuning result (RAM) is displayed. b) Set the value in the following cases: • Every hour after power-ON • When a value other than 1 is set in [*Pr. 819*]. • When vector control is changed to other control (V/F control etc.) using [*Pr. 800*]. c) Write (manual input) disabled	a) Gain is calculated when 2 is set in [*Pr. 819*] and the result is set in the parameter. b) When the value is read, the tuning result (parameter setting value) is displayed. c) Write (manual input) disabled

(4) Manual input speed control gain adjustment [*Pr. 819 = 0, Pr. 820, 821*]

Make adjustment when case like unusual machine vibration/noise, low response level and overshoot has occurred.

When making manual input gain adjustment, set [*Pr. 819 Easy gain tuning selection = 0*] (without easy gain tuning) (initial value).

[*Pr. 830 Speed control P gain 2*] and [*Pr. 831 Speed control integral time 2*] are valid when the RT terminal is switched ON.

Check the conditions referring to the table below and make adjustment.

1) Adjust speed control P (proportional) gain.
2) Check that no unusual vibration nor noises are generated, response is enough, the current value is correct, etc.
3) If you can not make proper adjustment, slightly change the speed control integral time and repeat from 1) again.

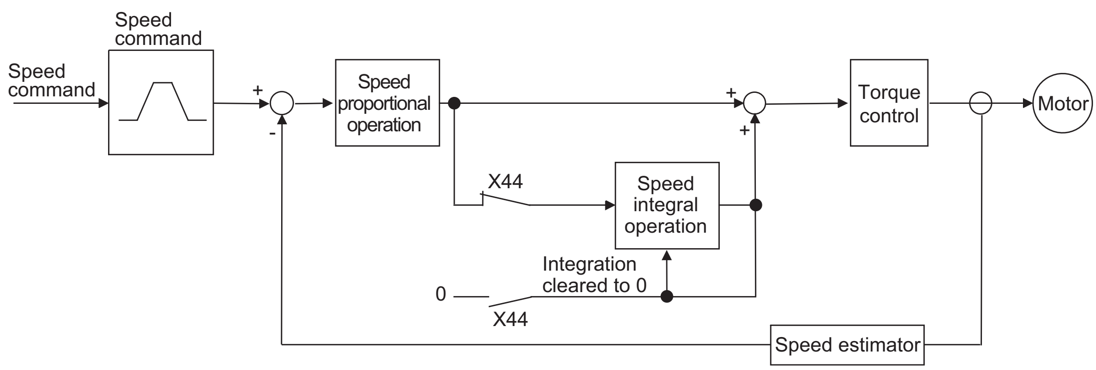
No.	Case/Condition	Adjustment Method	
1	Load inertia is large	Set the [*Pr. 820, Pr. 821*] value a little higher.	
		[*Pr. 802*]	When a speed rise is slow, increase the value by 10% until just before vibration/noise is produced, and set about 0.8 to 0.9 of that value.
		[*Pr. 821*]	If an overshoot occurs, double the value until an overshoot does not occur, and set about 0.8 to 0.9 of that value.
2	Vibration/noise generated from mechanical system	Set the [*Pr. 820*] value a little lower and the [*Pr. 821*] value a little higher.	
		[*Pr. 820*]	Decrease the value by 10% until just before vibration/noise is not produced, and set about 0.8 to 0.9 of that value.
		[*Pr. 821*]	If an overshoot occurs, double the value until an overshoot does not occur, and set about 0.8 to 0.9 of that value.
3	Slow response	Set the [*Pr. 820*] value a little higher.	
		[*Pr. 820*]	When a speed rise is slow, increase the value by 5% until just before vibration/noise is produced, and set about 0.8 to 0.9 of that value.
4	Long return time (response time)	Set the [*Pr. 821*] value a little lower.	
		Decrease the [*Pr. 821*] value by half until just before an overshoot or the unstable behavior does not occur, and set about 0.8 to 0.9 of that value.	
5	Overshoot or unstable phenomenon occurs.	Set the [*Pr. 821*] value a little higher.	
		Double the [*Pr. 821*] value until just before an overshoot or the unstable behavior does not occur, and set about 0.8 to 0.9 of that value.	

(5) Switching of P/PI control (X44 signal)

By turning the P/PI control switching signal (X44) ON/OFF during speed control operation under Real sensorless vector control and vector control, you can select whether to add the integral time (I) or not when performing gain adjustment with P gain and integral time.

When the X44 signal is OFF.......PI control
When the X44 signal is ON ....P control

For the terminal used for X44 signal input, set 44 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function.



2.9.4 Speed feed forward control, model adaptive speed control [Pr. 828, 877 to 881] (A700)

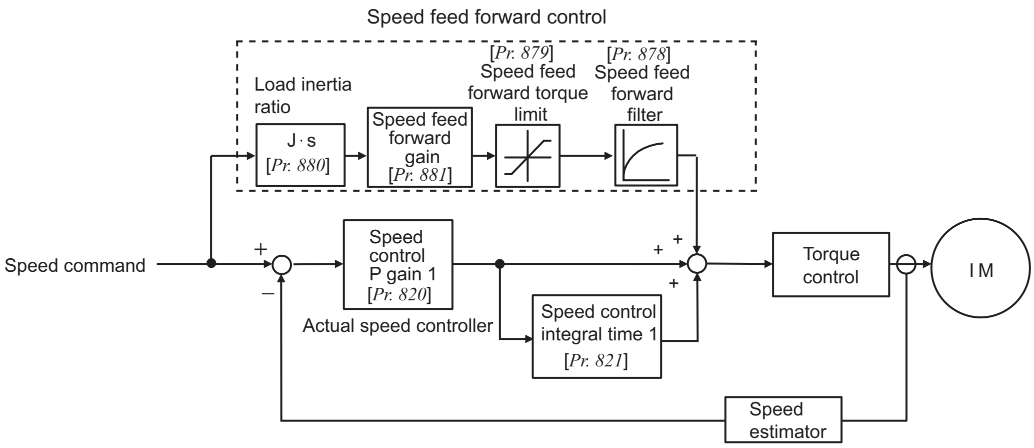
By making parameter setting, select the speed feed forward control or model adaptive speed control.
The speed feed forward control enhances the trackability of the motor in response to a speed command change.
The model adaptive speed control enables individual adjustment of speed trackability and motor disturbance torque response.

Since it is calculating the compensation amount according to the inertia ratio under any control, set the correct inertia ratio in [*Pr. 880*] or perform automatic estimation of the load inertia ratio using easy gain turning [*Pr. 819 = 1*].

[*Pr.*]	Name	Initial Value	Setting Range	Description
828	Model speed control gain	60%	0 to 1000%	Set the gain for model speed controller.
877	Speed feed forward control・model adaptive speed control selection	0	0	Normal speed control is performed.
			1	Speed feed forward control is performed.
			2	Model adaptive speed control is enabled.
878	Speed feed forward filter	0s	0 to 1s	Set the primary delay filter for the speed feed forward result calculated using the speed command and load inertia ratio.
879	Speed feed forward torque limit	150%	0 to 400%	Limits the maximum value of the speed feed forward torque.
880	Load inertia ratio	7 times	0 to 200 times	Set the load inertia ratio to the motor.
881	Speed feed forward gain	0%	0 to 1000%	Set the feed forward calculation result as a gain.

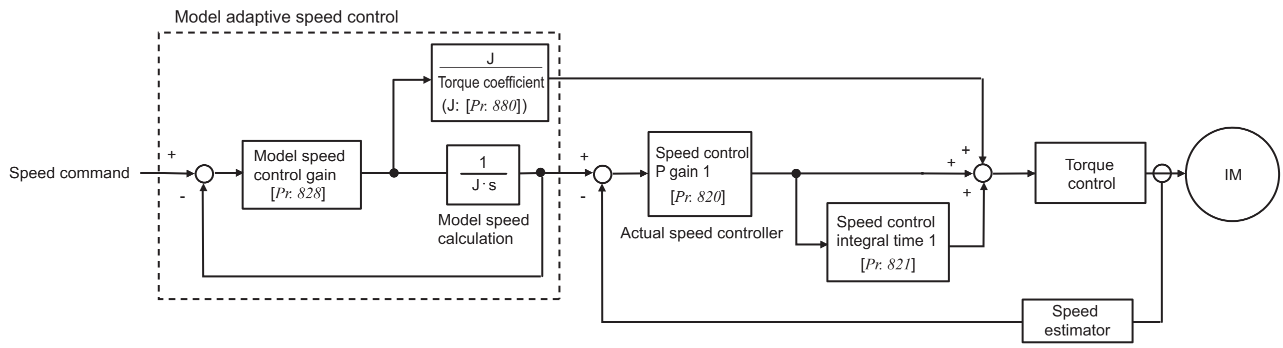
(1) Speed feed forward control [*Pr. 877 = 1, Pr. 878 to 881*]

Inverter calculates required torque in response to the acceleration/deceleration command for the inertia ratio set in [*Pr. 880*] and generates torque immediately.
When [*Pr. 881 = Speed feed forward gain = 100%*], the calculation result of the speed feed forward is reflected as it is.
If the speed command changes suddenly, large torque is generated due to the speed feed forward calculation. The maximum value of the speed feed forward is limited using [*Pr. 879*].
Using [*Pr. 878*], the speed feed forward result can be dulled by the primary delay filter.
The speed feed forward control is valid for the first motor only. When [*Pr. 877 = 1*], control target is switched to the second motor, and the second motor is handled as [*Pr. 877 = 0*].



(2) Model adaptive speed control [*Pr. 877 = 2, Pr. 828, 881*]

The motor's model speed is calculated to provide feed back to the model side speed controller.
This model speed is also used as the actual speed controller command. Acceleration/deceleration speed is limited by model speed calculation with [*Pr. 880 Load inertia ratio*]. Therefore, note that setting a larger value than the actual inertia in [*Pr. 880*] may extend the acceleration/deceleration time than the setting.
The inertia ratio in [*Pr. 880*] is used for calculation of the torque current command value given by the model side speed controller.
The torque current command value of the model side speed controller is added to the output of the actual speed controller, and the result is used as the torque control input.
[*Pr. 828*] is used for model side speed control (P control), and the first gain in [*Pr. 820*] is used for the actual speed controller. The model adaptive speed control is valid for the first motor only. When [*Pr. 877 = 2*], switching to the second motor handles the second motor as [*Pr. 877 = 0*].



(3) Combination of easy gain tuning

The following table indicates the relationships between the speed feed forward/model adaptive speed control and easy gain tuning function. Refer to page 286 for how to adjust the easy gain tuning function.

	[*Pr. 819 Easy Gain Tuning Selection*] Setting		
	0	1	2
[*Pr. 880 Load inertia ratio*]	Manual input	Inertia ratio estimation value found by easy gain tuning is displayed. Manual input enabled only during a stop.	Manual input
[*Pr. 820 Speed control P gain 1*]	Manual input	Tuning results are displayed. Write disabled	Tuning results are displayed. Write disabled
[*Pr. 821 Speed control integral time 1*]	Manual input	Tuning results are displayed. Write disabled	Tuning results are displayed. Write disabled
[*Pr. 828 Model speed control gain*]	Manual input	Tuning results are displayed. Write disabled	Tuning results are displayed. Write disabled
[*Pr. 881 Speed feed forward gain*]	Manual input	Manual input	Manual input

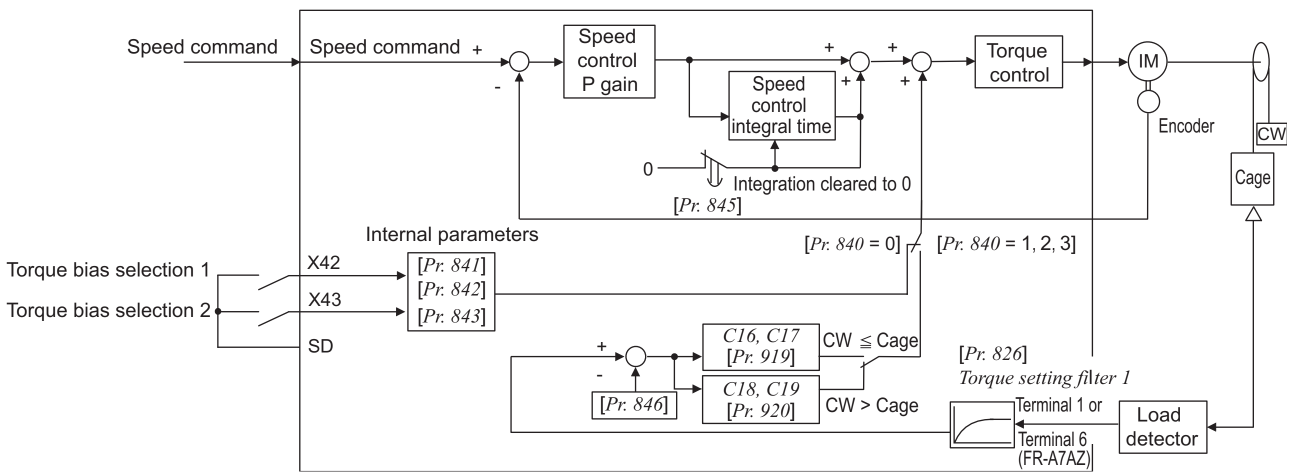
2.9.5 Torque bias [Pr. 840 to 848] (A700)

This function accelerates the rise of the torque at a start. Adjust the torque at a motor start using the contact signals or analog signals. Valid only during vector control.

[*Pr.*]	Name	Initial Value	Setting Range	Description
840	Torque bias selection AP AL	9999	0	Set the contact signal (X42, X43) based-torque bias amount using [*Pr. 841 to 843*].
			1	Set the terminal 1-based torque bias amount as desired in [*C16 to C19*]. * (in the case a cage goes up when a motor runs reversely)
			2	Set the terminal 1-based torque bias amount as desired in [*C16 to C19*]. * (in the case a cage goes up when a motor runs forward)
			3	The terminal 1-based torque bias amount can be set automatically in [*C16 to C19, Pr. 846*] according to the load. *
			9999	Without torque bias, rated torque 100%
841	Torque bias 1 AP AL	9999	600 to 999%	Negative torque bias amount (-400% to -1%)
842	Torque bias 2 AP AL		1000 to 1400%	Positive torque bias amount (0% to 400%)
843	Torque bias 3 AP AL		9999	Without torque bias setting
844	Torque bias filter AP AL	9999	0 to 5s	Time until torque rises.
			9999	Same operation as when 0s is set.
845	Torque bias operation time AP AL	9999	0 to 5s	Time for maintaining torque equivalent to the torque bias amount.
			9999	Same operation as when 0s is set.
846	Torque bias balance compensation AP AL	9999	0 to 10V	Set the voltage under balanced load.
			9999	Same operation as when 0V is set.
847	Fall-time torque bias terminal 1 bias AP AL	9999	0 to 400%	Set the bias value of the torque command.
			9999	Same as at a rise time [*C16, C17 (Pr. 919)*].
848	Fall-time torque bias terminal 1 gain AP AL	9999	0 to 400%	Set the gain value of the torque command.
			9999	Same as at a rise time [*C18, C19 (Pr. 919)*].

* When FR-A7AZ is installed, torque bias amount setting from terminal 6 is also available.

(1) Block diagram



(2) Torque bias amount setting by contact input (X42, X43 signal) [*Pr. 840 = 0, Pr. 841 to 843*]

Select the torque bias amount in the table below according to the combination of contact signals.
Set 42 in [*Pr. 178 to 189 Input terminal function selection*] for the terminal used for X42 signal input and set 43 for the terminal used for X43 signal input to assign functions.

X42 Signal	X43 Signal	Torque Bias Amount
OFF	OFF	0
ON	OFF	[*Pr. 841*]
OFF	ON	[*Pr. 842*]
ON	ON	[*Pr. 843*]

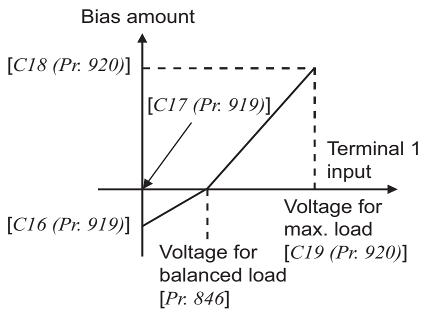
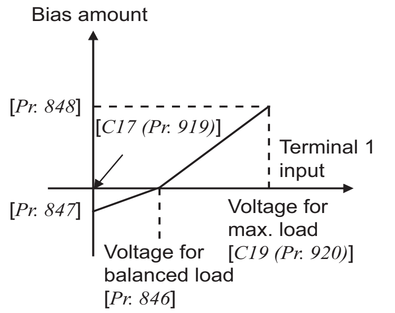
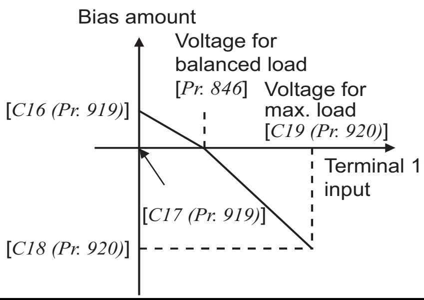
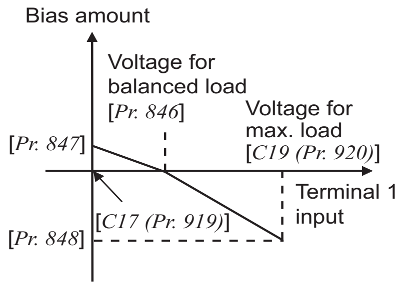
The setting 1000 of [*Pr. 841 to 843*] is the torque bias amount 0%.
Namely, on the assumption that the setting 1000 is the center value, (setting-1000) is the torque bias amount.
Therefore, setting 600 to 1400 corresponds to -400% to +400% torque bias amount.

[Example] When [*Pr. 841 = 1025*] ... 25%
When [*Pr. 842 = 975*] ... -25%
When [*Pr. 843 = 925*] ... -75%

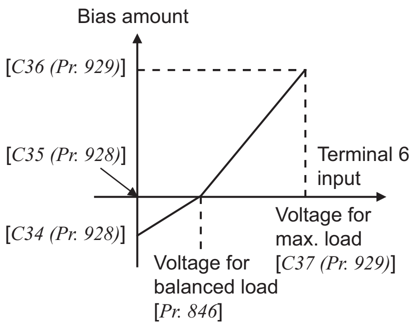
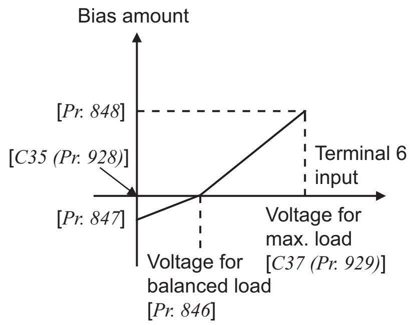
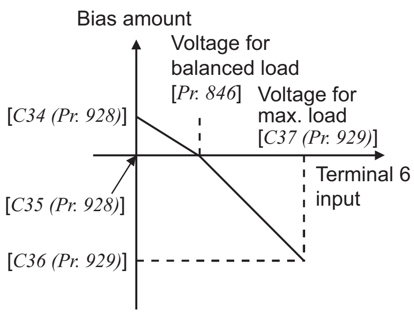
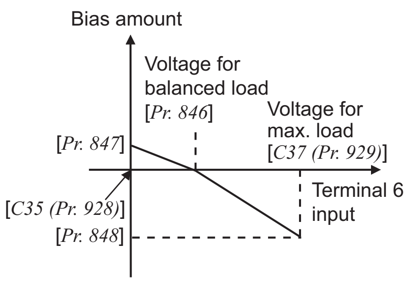
(3) Setting torque bias amount with terminal 1 or terminal 6 (FR-A7AZ)
[*Pr. 840 = 1, 2, Pr. 846 to 848, C16 to C19, C34 to C37*]

Calculate torque bias from the load input to terminal 1 or terminal 6 (FR-A7AZ) as shown below and multiply by the torque bias.
When torque bias amount is set to terminal 1, set [*Pr. 868 Terminal 1 function assignment* = 6]
When torque bias amount is set to terminal 6 (FR-A7AZ), set [*Pr. 406 High resolution analog input selection* = 6]. When [*Pr. 406* = 6] and [*Pr. 868* = 6], terminal 6 is the torque bias, and terminal 1 does not have a function.
For [*C16 to C19 (Pr. 919, 920)*] and [*C34 to C37 (Pr. 928, 929)*], refer to page 320.

- **Torque bias by terminal 1**

[*Pr. 840*] Setting	Rise (Motor Forward Rotation)	Fall (Motor Reverse Rotation)
1		
2		

- **Torque bias by terminal 6 (FR-A7AZ)**

[*Pr. 840*] Setting	Rise (Motor Forward Rotation)	Fall (Motor Reverse Rotation)
1		
2		

(4) Automatic setting of torque bias amount with terminal 1 or terminal 6 (FR-A7AZ) [*Pr. 840 = 3, Pr. 846, C16 to C19, C34 to C37*]

When [*Pr. 840* = 3] while using terminal 1, [*C16 to C19(Pr. 919, 920)*] and [*Pr. 846*] are automatically set according to the load. When [*Pr. 840* = 3] while using terminal 6, [*C34 to C37(Pr. 928, 929)*] and [*Pr. 846*] are automatically set according to the load. Refer to the following diagram for the setting method.

When torque bias amount is set to terminal 1, set [*Pr. 868 Terminal 1 function assignment* = 6]

To set torque bias amount to terminal 6 (FR-A7AZ), set [*Pr. 406 High resolution analog input selection* = 6]. When [*Pr. 406* = 6] and [*Pr. 868* = 6], terminal 6 is the torque bias, and terminal 1 does not have a function. When starting torque bias operation after completion of automatic setting, set 1 or 2 in [*Pr. 840*].

• **When using terminal 1**

	Setting Method				
Setting of [*C16, C17 (Pr. 919)*]	Operation without a load	→	Read [*C16, C17 (Pr. 919)*] when speed is stable	→	Press SET. Setting [*C16, C17 (Pr. 919)*] is completed
Setting of [*C18, C19 (Pr. 920)*]	Operation with a maximum load	→	Read [*C18, C19 (Pr. 920)*] when speed is stable	→	Press SET. Setting [*C18, C19 (Pr. 920)*] is completed
Setting of [*Pr. 846*]	Operation with a balanced load	→	Read [*Pr. 846*]	→	Press SET. Torque balance compensation is completed.

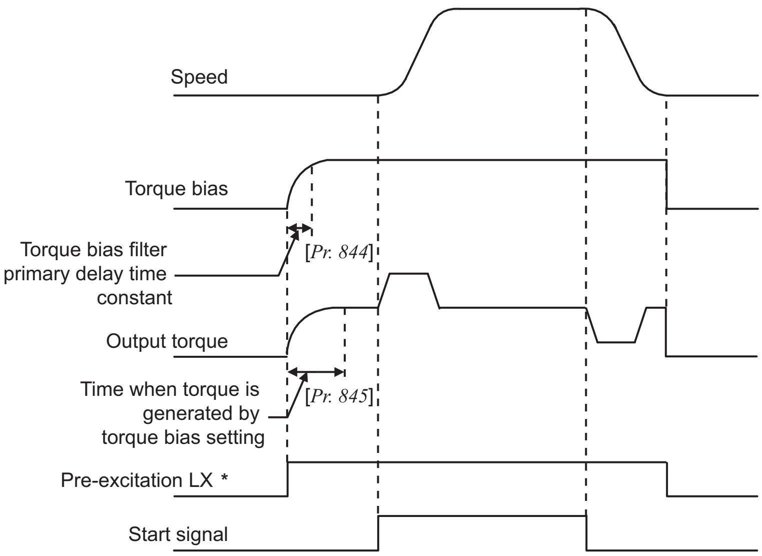
• **When using terminal 6 (FR-A7AZ)**

	Setting Method				
Setting of [*C34, C35 (Pr. 928)*]	Operation without a load	→	Read [*C34, C35 (Pr. 928)*] when speed is stable	→	Press SET. Setting [*C34, C35 (Pr. 928)*] is completed
Setting of [*C36, C37 (Pr. 929)*]	Operation with a maximum load	→	Read [*C36, C37 (Pr. 929)*] when speed is stable	→	Press SET. Setting [*C36, C37 (Pr. 929)*] is completed
Setting of [*Pr. 846*]	Operation with a balanced load	→	Read [*Pr. 846*]	→	Press SET. Torque balance compensation is completed.

(5) Torque bias operation [*Pr. 844, Pr. 845*]

When [*Pr. 844 Torque bias filter* ≠ 9999], you can slow the rise of torque. At this time, the torque rises according to the time constant of the primary delay filter.

Set the time for output torque be maintained with the torque bias command value alone in [*Pr. 845 Torque bias operation time*] .



* When not performing pre-excitation, the torque bias functions simultaneously with the start signal.

2.9.6 Speed limit [Pr. 285, 853, 873] (A700)

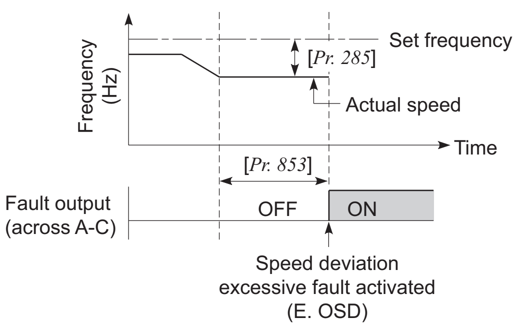
This function prevents the motor from overrunning when the load torque is too large and incorrect number of encoder is set.

[*Pr.*]	Name	Initial Value	Setting Range	Description
285	Speed deviation excess detection frequency *1	9999	9999	Without speed deviation excessive
			0 to 30Hz	If the difference (absolute value) between the speed command value and actual speed exceeds the [*Pr. 285 Speed deviation excess detection frequency*] setting for longer than the time set in [*Pr. 853 Speed deviation time*], speed deviation excessive occurs and error "E. OSD" appears, resulting in a stop.
853	Speed deviation time AP AL	1.0s	0 to 100s	
873	Speed limit AP AL	20Hz	0 to 120Hz	Frequency is limited at the set frequency + [*Pr. 873*].

*1 Acts as over speed detection frequency under encoder feedback operation. (Refer to page 392)

(1) Speed deviation excessive [*Pr. 285, 853*]

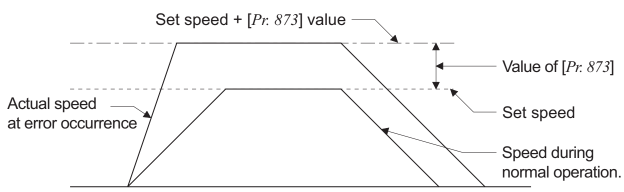
When the deviation between the set frequency and actual speed is large, e.g. too large load torque, this function can cause the inverter to provide a speed deviation excessive fault (E.OSD) and come to trip.



(2) Speed limit [*Pr. 873*]

This function prevents the motor from overrunning when the setting of number of encoder pulses and the actual number differ.

When the setting of number of encoder pulses is smaller than the actual number, the motor may increase its speed. To prevent this, restrict the output speed by the frequency(set frequency and [*Pr. 873*]).



2.9.7 Notch filter [Pr. 862, 863] (A700)

You can reduce the response level of speed control in the resonance frequency band of the mechanical system to avoid mechanical resonance.

[*Pr.*]	Name	Initial Value	Setting Range	Description
862	Notch filter time constant	0	0 to 60	Refer to the following table
863	Notch filter depth	0	0 to 3	0 (deep) → 3 (shallow)

(1) Notch filter time constant [*Pr. 862*]

If you do not know the mechanical resonance frequency, decrease notch frequency gradually from the highest value. The point at which the smallest vibration is generated is the notch frequency setting.
Machine characteristic can be obtained beforehand with machine analyzer by FR Configurator. Necessary notch frequency can be determined from this.

[*Pr. 862*] Setting	Frequency	[*Pr. 862*] Setting	Frequency
0	Invalid	30	33.3
1	1000	31	32.3
2	500	32	31.3
3	333.3	33	30.3
4	250	34	29.4
5	200	35	28.6
6	166.7	36	27.8
7	142.9	37	27.0
8	125	38	26.3
9	111.1	39	25.6
10	100	40	25.0
11	90.9	41	24.4
12	83.3	42	23.8
13	76.9	43	23.3
14	71.4	44	22.7
15	66.7	45	22.2
16	62.5	46	21.7
17	58.8	47	21.3
18	55.6	48	20.8
19	52.6	49	20.4
20	50	50	20.0
21	47.6	51	19.6
22	45.5	52	19.2
23	43.5	53	18.9
24	41.7	54	18.5
25	40	55	18.2
26	38.5	56	17.9
27	37	57	17.5
28	35.7	58	17.2
29	34.5	59	16.9
		60	16.7

(2) Notch filter depth [*Pr. 863*]

The notch filter with deeper depth has an effect on minimizing mechanical resonance. However, large vibration may be generated adversely due to substantial phase delay. Adjust notch depth from the shallower depth.

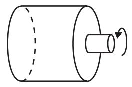
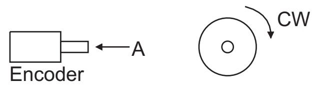
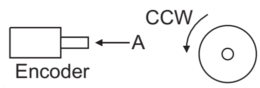
Setting	3	2	1	0
Depth	Shallow	→	←	Deep
Gain	-4dB	-8dB	-14dB	-40dB

2.9.8 Troubleshooting (speed control) (A700)

<table>
<tr><th></th><th>Case</th><th>Cause</th><th>Countermeasures</th></tr>
<tr><td>1</td><td>Motor does not rotate.
(vector control)</td><td>(1) The motor wiring is wrong

(2) Encoder specifications (encoder specification selection switch (FR-A7AP, FR-A7AL)) are wrong

(3) The encoder wiring is wrong.

(4)The [Pr. 369 Number of encoder pulses] setting and the number of encoder pulses used are different.
(5) Encoder power specifications are wrong. Or, power is not input.</td><td>(1) Wiring check
V/F control (set 9999 in either [Pr. 80] or [Pr. 81]) and check the motor rotation direction.
Check the speed monitor output from output terminal FM.
For the FR-V5RU, set 170V for 3.7kW or less and 160V for more in [Pr. 19 Base frequency voltage], and set 50Hz in [Pr. 3 Base frequency].

When the forward rotation signal is input, the motor running in the counterclockwise direction as viewed from the motor shaft is normal. (If it runs in the clockwise direction, the phase sequence of the inverter secondary side wiring is incorrect.)
(2) Check the encoder specifications
Check the encoder specifications selection switch (FR-A7AP, FR-A7AL) of differential/complementary.
(3) Check that FWD is displayed when running the motor in the counterclockwise direction from outside during a stop of the inverter with vector control setting.
If REV is displayed, the encoder phase sequence is wrong.
Perform the correct wiring or match the [Pr. 359 Encoder rotation direction] setting.
<table>
<tr><th>[Pr. 359] Setting</th><th>Relationship between the Motor and Encoder</th></tr>
<tr><td>0</td><td>
Clockwise direction as viewed from A is forward rotation</td></tr>
<tr><td>1
(initial value)</td><td>
Counterclockwise direction as viewed from A is forward rotation</td></tr>
</table>
(4) The motor will not run if the parameter setting is smaller than the number of encoder pulses used. Set the [Pr. 369 Number of encoder pulses] correctly.
(5) Check the power specifications (5V/12V/15V/24V) of encoder and input the external power supply.</td></tr>
<tr><td>2</td><td>Motor does not run at correct speed.
(Speed command does not match actual speed)</td><td>(1) The speed command from the command device is incorrect.
The speed command is compounded with noise.
(2) The speed command value does not match the inverter-recognized value.
(3) The number of encoder pulses setting is incorrect.</td><td>(1) Check that a correct speed command comes from the command device.
Decrease [Pr. 72 PWM frequency selection] .
(2) Readjust speed command bias/gain [Pr. 125, 126, C2 to C7, C12 to C15].
(3)Check the setting of [Pr. 369 Number of encoder pulses].
(vector control)</td></tr>
<tr><td>3</td><td>Speed does not rise to the speed command.</td><td>(1) Insufficient torque.
Torque limit is activated.

(2) Only P (proportional) control is selected.</td><td>(1)-1 Increase the torque limit value.
(Refer to torque limit of speed control on page 283)
(1)-2 Insufficient capacity
(2) When the load is heavy, speed deviation will occur under P (proportional) control. Select PI control.</td></tr>
</table>

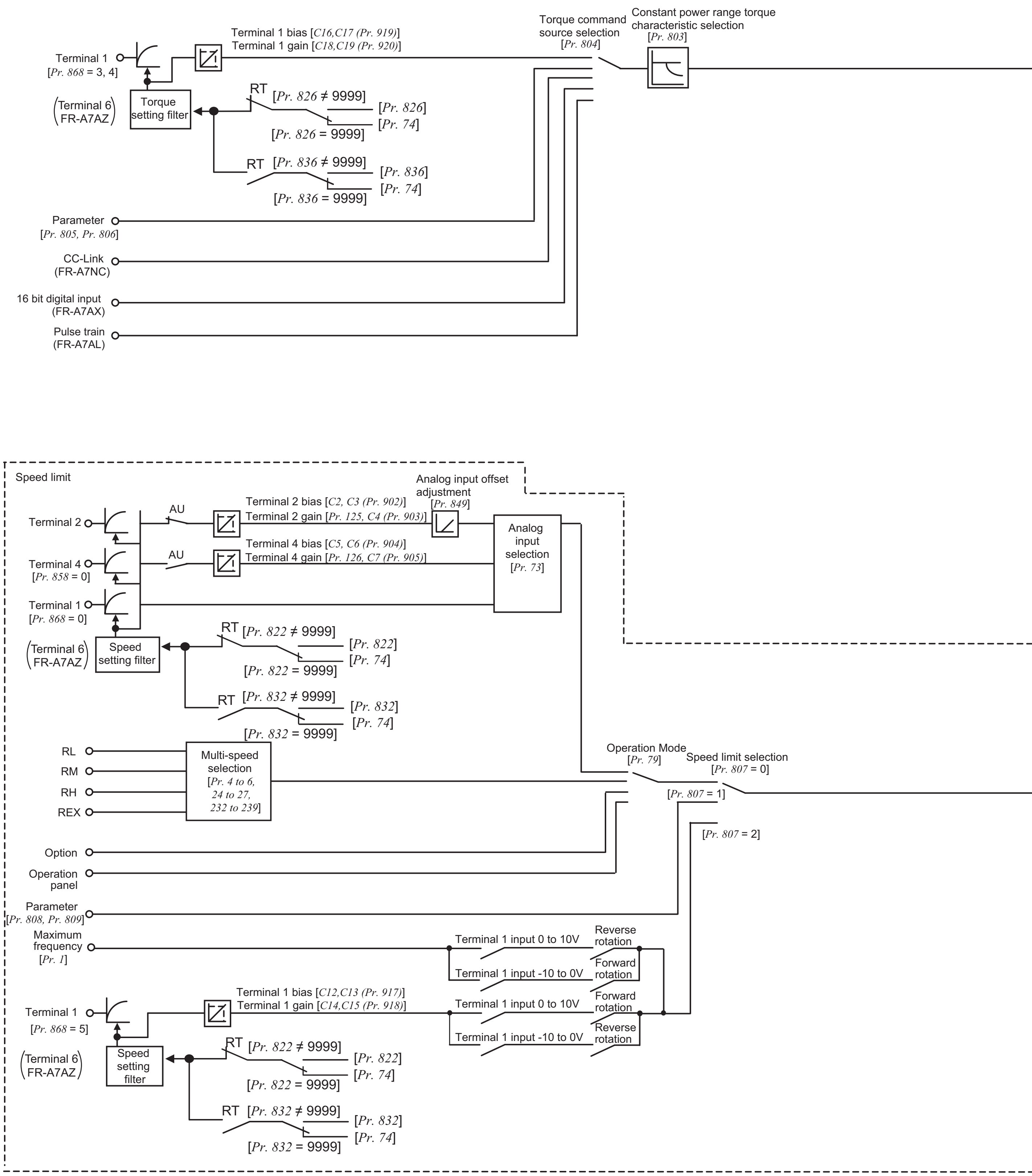
	Case	Cause	Countermeasures
4	Motor speed is unstable.	(1) The speed command varies. (2) Insufficient torque. (3) The speed control gains do not match the machine. (Machine resonances.)	(1)-1 Check that a correct speed command comes from the command device. (Take measures against noises.) (1)-2 Decrease [*Pr. 72 PWM frequency selection*] . (1)-3 Increase [*Pr. 822 Speed setting filter 1*] . (Refer to page 323) (2) Increase the torque limit value. (Refer to torque limit of speed control on page 283) (3)-1 Perform easy gain tuning. (3)-2 Adjust [*Pr. 820, 821*]. (3)-3 Perform speed feed forward/model adaptive speed control.
5	Motor or machine hunts (vibration/ noise is produced).	(1) The speed control gain is high. (2) The torque control gain is high. (3) The motor wiring is wrong	(1)-1 Perform easy gain tuning. (1)-2 Decrease [*Pr. 820*] and increase [*Pr. 821*] . (1)-3 Perform speed feed forward control and model adaptive speed control. (2) Decrease the [*Pr. 824*] value. (3) Check the wiring
6	Acceleration/ deceleration time does not match the setting.	(1) Insufficient torque. (2) Large load inertia.	(1)-1 Increase the torque limit value. (Refer to torque limit of speed control on page 283) (1)-2 Perform speed feed forward control. (2) Set the acceleration/deceleration time that meets the load.
7	Machine operation is unstable.	(1) The speed control gains do not match the machine. (2) Slow response because of improper acceleration/deceleration time of the inverter.	(1)-1 Perform easy gain tuning. (1)-2 Adjust [*Pr. 820, 821*] . (1)-3 Perform speed feed forward control and model adaptive speed control. (2) Change the acceleration/deceleration time to an optimum value.
8	Speed fluctuation at low speed.	(1) Adverse effect of high carrier frequency. (2) Low speed control gain.	(1) Decrease [*Pr. 72 PWM frequency selection*]. (2) Increase [*Pr. 820 Speed control P gain 1*].

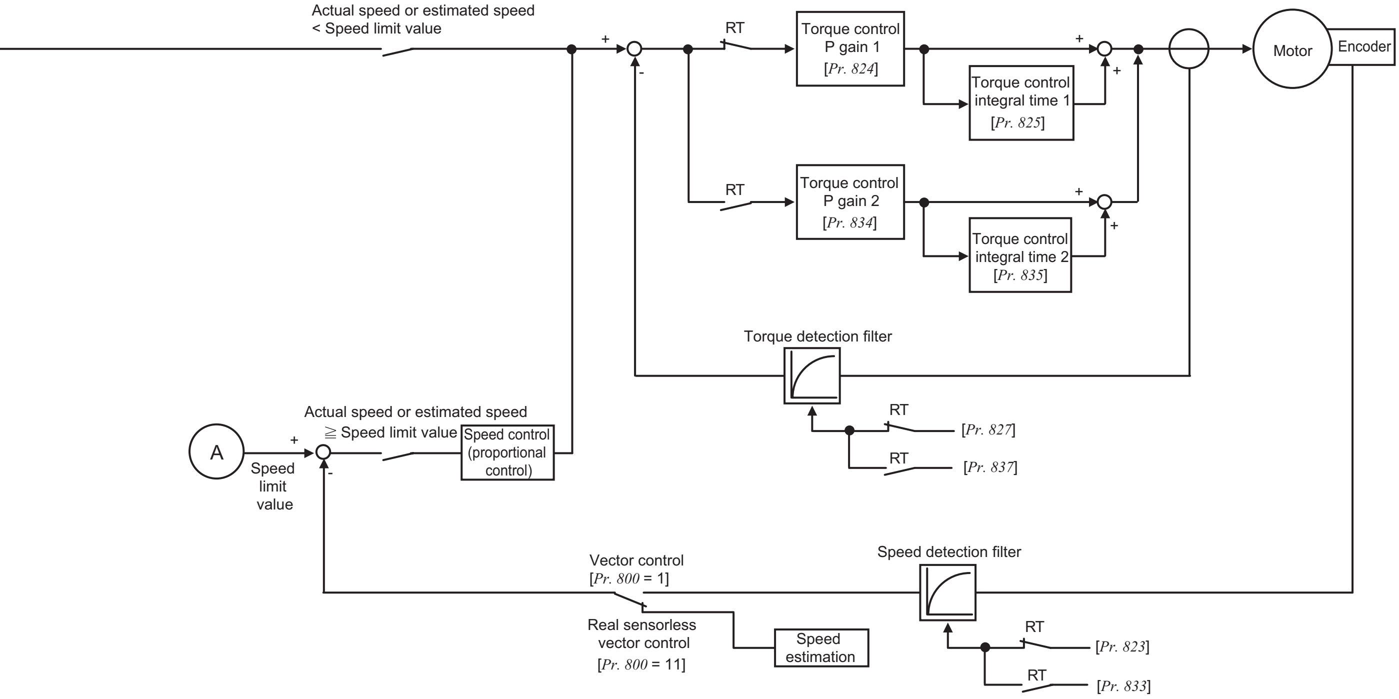
2.10 Torque control by Real sensorless vector control and vector control

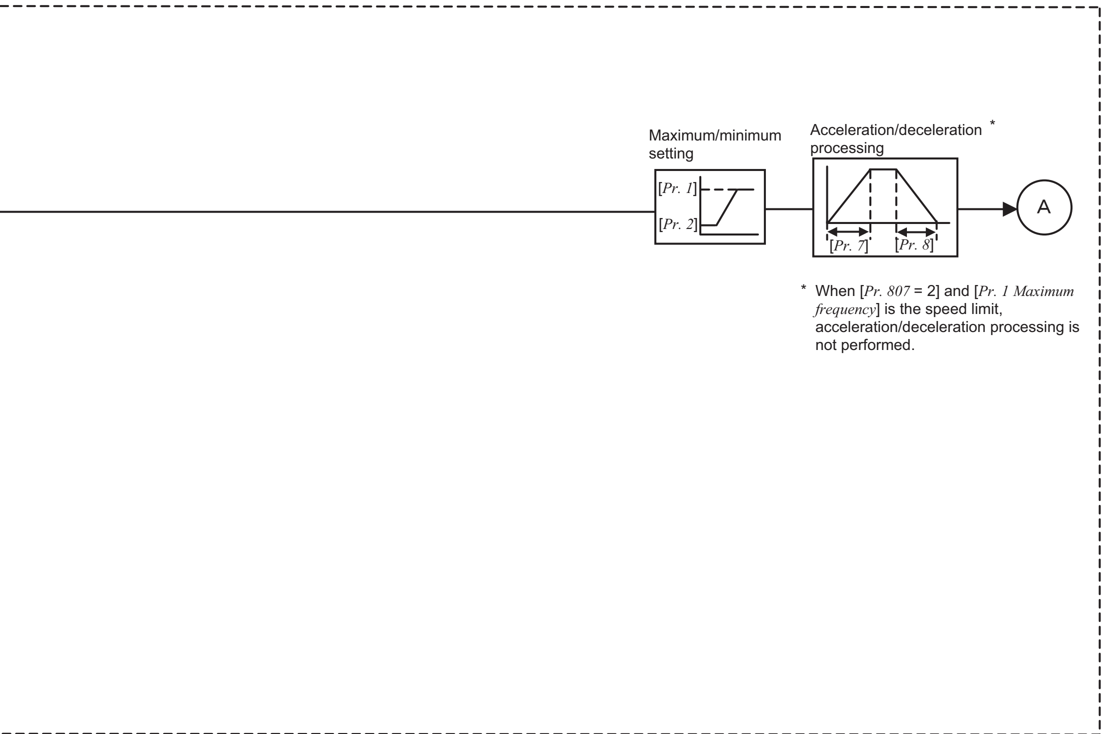
2.10.1 Torque control (A700)

(1) Control block diagram

The following shows a basic control block diagram during torque control.







* When [*Pr. 807* = 2] and [*Pr. 1 Maximum frequency*] is the speed limit, acceleration/deceleration processing is not performed.

(2) Operation

Torque control is exercised to develop torque as set in the torque command.

The motor speed becomes constant when the motor output torque and load torque are balanced.

For torque control, therefore, the speed is determined by the load.

For torque control, the motor gains speed as the motor output torque becomes greater than the motor load. To prevent overspeed, set the speed limit value so that the motor speed does not increase too high. (Speed control is exercised during speed limit and torque control is disabled.)

When speed limit is not set, the speed limit value setting is regarded as 0Hz to disable torque control.

When the actual speed reaches or exceeds the speed limit value, torque control is switched to speed control to prevent overspeed. SL (SL) appears on the operation panel during speed limit operation and the OL signal is output.

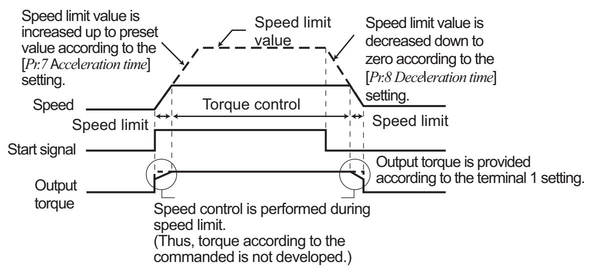
When speed limit operation starts, speed control is enabled internal torque limit ([*Pr. 22 Stall prevention operation level*]) (initial value). In such a case, speed control may not return to torque control. To prevent this, set torque limit to the setting same as torque command.

For example, when torque command is analog input to terminal 1, torque limit be set to external torque limit (terminal 1, 4). (Refer to page 283)

Undervoltage avoidance function ([*Pr. 261* = 11, 12]) of power-failure deceleration stop function becomes invalid under torque control. When [*Pr. 261* = 11 (12)], the inverter operates in the same manner as when [*Pr. 261* = 1 (2)]. (Refer to page 373)

Set linear acceleration/deceleration ([*Pr. 29* = 0 (initial value)) when torque control is performed. When acceleration/deceleration patterns other than the linear acceleration/deceleration are selected, the protective function of the inverter may function. (Refer to page 234)

Performing pre-excitation (LX signal and X13 signal) under torque control (Real sensorless vector control, vector control) may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.

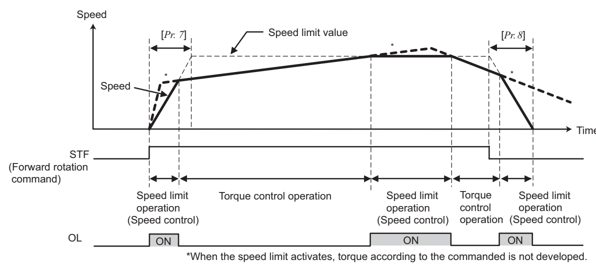


[Example] When [*Pr. 804* = 0]

Torque control is enabled if the actual speed is less than the speed limit value.

When the actual speed reaches or exceeds the speed limit value, speed limit operation starts, torque control is stopped, and speed control (proportional control) starts.

The following shows the operations in response to the analog input command from terminal 1.



1) When STF signal is turned ON, the speed limit value is increased according to the time set in [*Pr. 7*].
2) Speed control operation is performed if the actual speed rises to or above the speed limit value.
3) When the STF signal is turned OFF, the speed limit value is decreased according to the time set in [*Pr. 8*].
4) For torque control, the actual speed becomes constant when the torque command and load torque are balanced.
5) The motor torque developing direction is determined by the combination of the torque command input polarity and start signal as indicated in the following table.

Torque Command Polarity	Torque Developing Direction	
	STF signal ON	STR signal ON
Positive torque command	Forward rotation direction (forward rotation driving/reverse rotation regeneration)	Reverse rotation direction (forward rotation regeneration/reverse rotation driving)
Negative torque command	Reverse rotation direction (forward rotation regeneration/reverse rotation driving)	Forward rotation direction (forward rotation driving/reverse rotation regeneration)

(3) Concept of torque control gains

Normally, it is not necessary to change [*Pr. 824, 834 Torque control P gain*], [*Pr. 825, 835 Torque control integral time*]. Refer to page 306 to make adjustment.

1) Torque control P (proportional) gain

During vector control, [*Pr. 824* = 100%] is equivalent to 2000rad/s.

During Real sensorless vector control, [*Pr. 824* = 100%] is equivalent to 1000rad/s.

2) Torque control integral time

[*Pr. 825* = 5ms] is equivalent to 200rad/s.

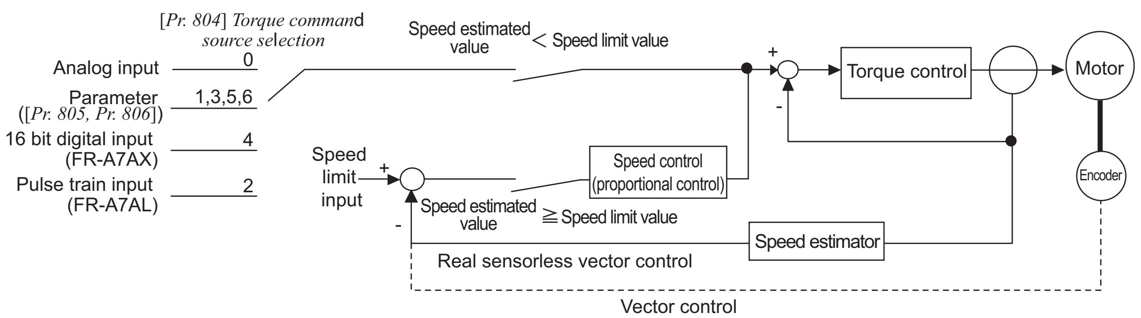
2.10.2 Torque command setting [Pr. 304, 305, 432, 433, 447, 448, 803 to 806] (A700)

Torque command source for torque control can be selected.

[Pr.]	Name	Initial Value	Setting Range	Description	
304	Digital input and analog input compensation enable/disable selection AX	9999	0 to 4, 0 to 14, 9999	Set 4 when inputting 12 bit Torque command value, set 14 when inputting 16 bit Torque command value.	
305	Read timing operation selection AX	0	0	Data is always read regardless of DY signal.	
			1	Data is read only when DY signal is ON.	
			10	Data is always read regardless of DY signal. Filter is ON when reading data.	
432	Pulse train torque command bias AL	0%	0 to 400%	Set torque command value when pulse train is 0.	
433	Pulse train torque command gain AL		0 to 400%	Set torque command value when pulse train is 400kpps.	
447	Digital torque command bias AX	0%	0 to 400%	Set torque command value when input signal is 7FFFH(7FFH).	
448	Digital torque command gain AX	150%	0 to 400%	Set the torque command value when input signal is 0.	
			9999	The input signal is used as the torque command value.	
803	Constant power range torque characteristic selection	0	0	Constant motor output command	Select the torque command in the constant power range by torque command setting.
			1	Torque constant command	
804	Torque command source selection	0	0	Torque command by terminal1 analog input * (Refer to page 43)	
			1	Torque command (-400% to 400%) by parameter setting ([*Pr. 805*] or [*Pr. 806*])	
			2	Torque command by the pulse train input (FR-A7AL).	
			3	Torque command (-400% to 400%) by parameter setting ([*Pr. 805*] or [*Pr. 806*])	Torque command setting using CC-Link communication (FR-A7NC) remote register (-400% to 400%)
			4	12 bit/16 bit digital input (FR-A7AX)	
			5	Torque command by parameter setting ([*Pr. 805*] or [*Pr. 806*]) (Set from other than CC-Link -400% to 400% Set from CC-Link communication -327.68% to 327.67%)	Torque command setting using CC-Link communication (FR-A7NC) remote register (-327.68% to 327.67%)
			6		—
805	Torque command value (RAM)	1000%	600 to 1400%	Writes the torque command value to the RAM. On the assumption that 1000% is 0%, the torque command is set by an offset from 1000%.	
806	Torque command value (RAM,EEPROM)	1000%	600 to 1400%	Writes the torque command value to the RAM and EEPROM. On the assumption that 1000% is 0%, the torque command is set by an offset from 1000%.	

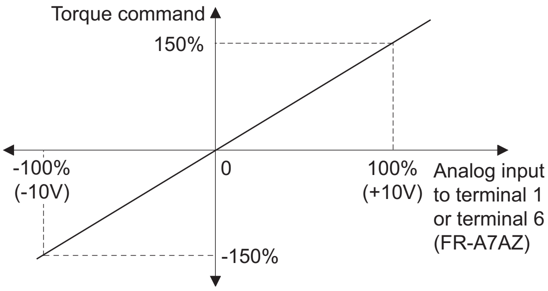
* When FR-A7AZ is installed, torque command from terminal 6 is also available.

(1) Control block diagram



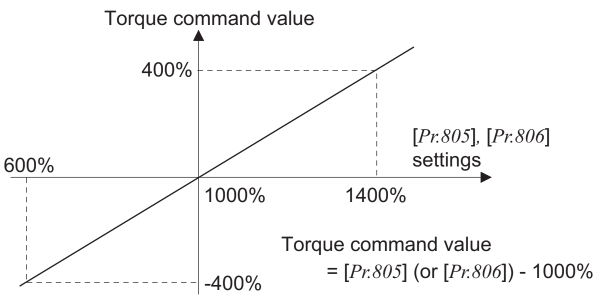
(2) Torque command by analog input (terminal 1 or terminal 6 (FR-A7AZ)) [*Pr. 804* = 0]

Torque command is given by voltage (current) input to terminal 1 or terminal 6 (FR-A7AZ). When torque command is input to terminal 1, set [*Pr. 868 Terminal 1 function assignment* = 3 or 4]. When [*Pr. 804* = 0] and a value other than 3 or 4 is set in [*Pr. 868*], torque command value = 0. (Refer to page 43)
To input torque command to terminal 6 (FR-A7AZ), set [*Pr. 406 High resolution analog input selection* = 3 or 4]. When the setting overlaps with terminal 1, terminal 6 is the torque command, and terminal 1 does not have a function. (Refer to page 43)
Torque command by analog input can be calibrated using calibration parameter [*C16 to C19 (Pr. 919, 920)*] and [*C34 to C37 (Pr. 928, 929)*]. (Refer to page 320)



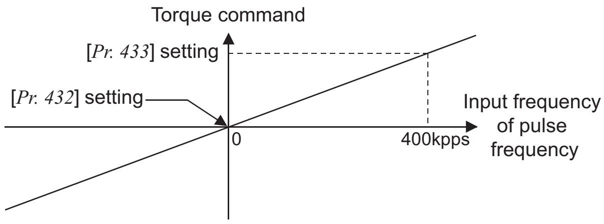
(3) Torque command by parameter [*Pr. 804* = 1, *Pr. 805*, *806*]

Torque command value can be set by setting [*Pr. 805 Torque command value (RAM)*] or [*Pr. 806 Torque command value (RAM, EEPROM)*].
For [*Pr. 805*] or [*Pr. 806*], the setting value 1000% is considered as torque command value 0% and the torque command is set by an offset from 1000%. The relationship between the [*Pr. 805*] or [*Pr. 806*] setting and actual torque command value at this time is shown on below.
When changing the torque command frequently, write to [*Pr. 805*]. Performing frequent parameter write to [*Pr. 806*] will shorten the life of the EEPROM.
When torque command is set in [*Pr. 805 (RAM)*], powering off the inverter will erase the changed parameter values. Therefore, the parameter value available when power is switched ON again is the value set in [*Pr. 806 (EEPROM)*].



(4) Torque command by the pulse train input [Pr. 804=2, Pr.432, 433]

Torque command is given by pulse train input of FR-A7AL (built-in option). The relation between input pulse and torque command value is shown below.



(5) Torque command by using CC-Link communication [*Pr. 804* = (1), 3, 5, 6]

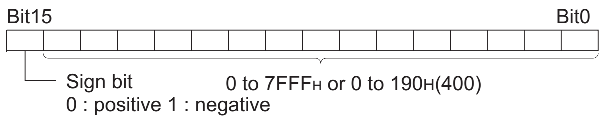
Writing [*Pr. 805*] or [*Pr. 806*] from CC-Link communication or writing to remote register RWw1 or RWwc with the FR-A7NC (communication option) mounted will set the torque command value.
Refer to the table below for torque command setting method and setting increments during CC-Link communication.

[*Pr. 804*] Setting	Torque Command Setting Method During CC-Link Communication	
	Write in [*Pr. 805*] or [*Pr. 806*]	Write in Remote Register (RWw1 or RWwc)
1	○ Setting 600 to 1400 ↓ Torque command value -400% to 400%	×
3	○ Setting 600 to 1400 ↓ Torque command value -400% to 400%	○ Setting 600 to 1400 ↓ Torque command value -400% to 400%
5	○* Setting -32768 to 32767 ↓ Torque command value -327.68% to 327.67%	○ Setting -32768 to 32767 ↓ Torque command value -327.68% to 327.67%
6	○* Setting -32768 to 32767 ↓ Torque command value -327.68% to 327.67%	×

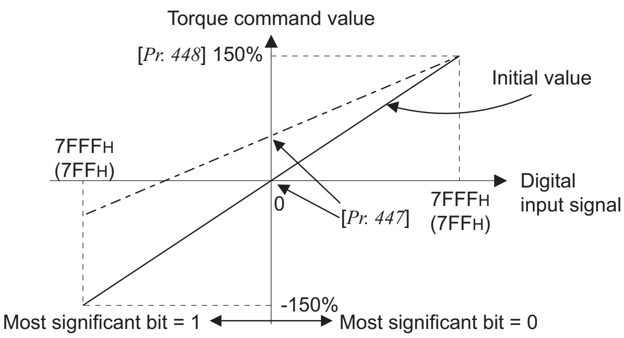
* When the value is set from other than CC-Link communication, setting value 600 to 1400 becomes -400 to 400%.

(6) Torque command by 16 bit digital input [*Pr. 804 = 4, Pr. 304, 305, 447, 448*]

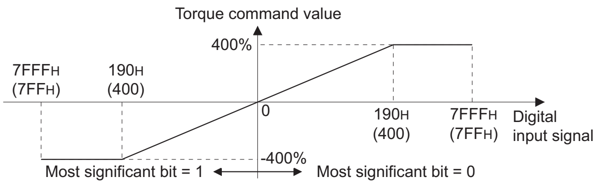
Torque command by 12 bit digital input is given when [*Pr. 304* = 4] and 16 bit digital input is given when [*Pr. 304* = 14] using the FR-A7AX (plug-in option). When [*Pr. 804* = 4] and a value other than 4 or 14 is set in [*Pr. 304*], torque command value = 0.
The digital torque command is input only by binary input. The input signal uses the last 15 (11) bits as torque command and the most significant bit as sign.



Set the torque command value when the input signal is "0" in [*Pr. 447*] and the torque command value when the input signal is 7FFFH (7FFH) in [*Pr. 448*].

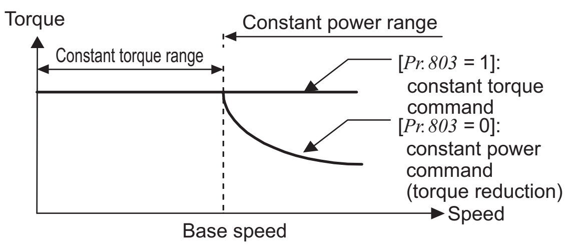


The input signal is used as the torque command value when [*Pr. 448* = 9999].



(7) Torque characteristic in the constant power range [*Pr. 803*].

Due to the motor characteristics, torque is reduced at or above the base frequency. Set "1" in [*Pr. 803 Constant power range torque characteristic selection*] when you want to keep the torque to be constant even at or above the base frequency.



2.10.3 Speed limit [Pr. 807 to Pr. 809, C12 to C15 (Pr. 917, 918), C30 to C33(Pr. 926, 927)) (A700)

Set the speed limit value to prevent overspeed of the motor in case the load torque becomes less than the torque command value, etc during torque control operation.

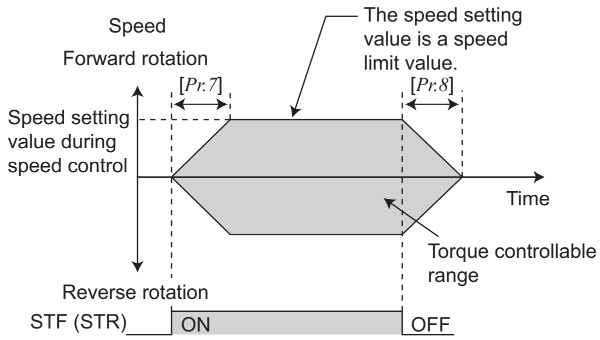
SL (SL) appears on the operation panel during speed limit operation and the OL signal is output.

[Pr.]	Name	Initial value	Setting Range	Description
807	Speed limit selection	0	0	Use the speed command value during speed control as speed limit.
			1	According to [*Pr. 808* and *Pr. 809*], set the speed limit in forward and reverse rotation directions individually.
			2	Forward/reverse rotation speed limit The analog voltage of the terminal 1 input is used to make speed limit.* The speed limit of the forward rotation and reverse rotation is switched according to the polarity
808	Forward rotation speed limit	60Hz	0 to120Hz	Set the speed limit for the forward rotation direction.
809	Reverse rotation speed limit	9999	0 to120Hz	Set the speed limit for the reverse rotation direction.
			9999	As set in [*Pr. 808*] .
C12(917)	Terminal 1 bias frequency (speed)	0Hz	0 to 400Hz	Set the frequency (speed) on the bias side of terminal 1 input.
C13(917)	Terminal 1 bias (speed)	0%	0 to 300%	Set the converted % of the bias side voltage of terminal1 input.
C14(918)	Terminal 1 gain frequency (speed)	60Hz	0 to 400Hz	Set the frequency (speed) of terminal 1 input gain (maximum).
C15(918)	Terminal 1 gain (speed)	100%	0 to 300%	Set the converted % of the gain side voltage of terminal1 input.
C30(926)	Terminal 6 bias frequency (speed) AZ	0Hz	0 to 400Hz	Set the frequency (speed) on the bias side of terminal 6 input.
C31(926)	Terminal 6 bias (speed) AZ	0%	0 to 300%	Set the converted % on the bias side voltage of terminal 6 input.
C32(927)	Terminal 6 gain frequency (speed) AZ	60Hz	0 to 400Hz	Set the frequency (speed) of the (maximum) terminal 6 input gain.
C33(927)	Terminal 6 gain (speed) AZ	100%	0 to 300Hz	Set the converted % on the gain side voltage of terminal 6 input.

* When FR-A7AZ is installed, forward/reverse rotation speed limit using terminal 6 is also available.

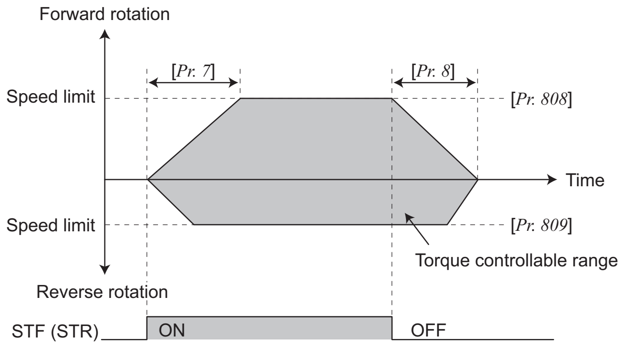
(1) Use the speed command for speed control [*Pr. 807* = 0]

Set the speed limit in the same method as speed setting for speed control.
(speed setting by the PU (FR-DU07/FR-PU04/FR-PU07), multi-speed setting, plug-in options, etc.)
The speed limit level is increased from 0Hz upon turning ON of the start signal according to the acceleration time set in [*Pr. 7 Acceleration time*] and is decreased upon turning OFF of the start signal from the then speed limit level to the DC injection brake operation speed set in [*Pr.10*] to a stop in accordance with the deceleration time set in [*Pr. 8 Deceleration time*].
When the above speed limit command is greater than the [*Pr. 1 Maximum speed*] value, the speed limit value is the [*Pr. 1 Maximum frequency*] value, and when the speed limit command is less than the [*Pr. 2 Minimum speed*] value, the speed limit value is the [*Pr. 2 Minimum frequency*] value. Similarly when the speed limit command is smaller than [*Pr. 13 Starting frequency*], the speed limit value is 0Hz.



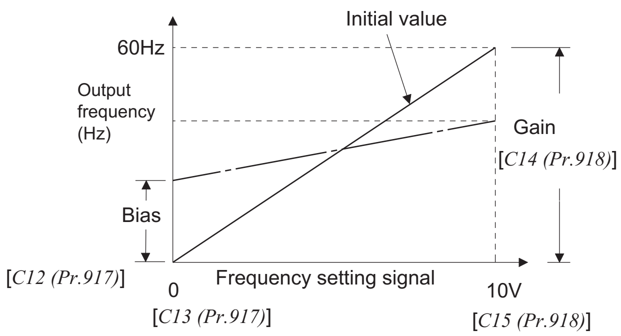
(2) Set the forward rotation and reverse rotation individually. [*Pr. 807* = 1, *Pr. 808, 809*]

Set the speed limit during forward rotation using [*Pr. 808 Forward rotation speed limit*] and the speed limit during reverse rotation using [*Pr. 809 Reverse rotation speed limit*].
The speed during forward and reverse rotation is limited at the setting value of [*Pr. 808*] when [*Pr. 809* = 9999] (initial value).
The speed limit value changes according to acceleration/deceleration time of [*Pr. 7, Pr. 8*].

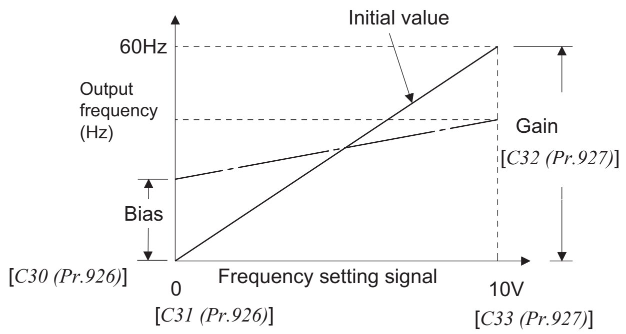


(3) Forward rotation/reverse rotation speed limit [*Pr. 807 = 2, C12 to C15(Pr. 917, 918), C30 to C33(Pr. 926, 927)*]

When making a speed limit using analog input to terminal 1 or terminal 6 (FR-A7AZ), the speed limit of the forward and reverse rotation can be switched according to the polarity of voltage.
Forward/reverse rotation speed limit is valid when [*Pr. 868 Terminal 1 function assignment* = 5]. (Refer to page 43 for details of terminal1 function assignment)
Set [*Pr. 406 High resolution analog input selection* = 5] to limit forward/reverse rotation speed using terminal 6 (FR-A7AZ). When [*Pr. 406* = 5] and [*Pr. 868* = 5], terminal 6 is the forward/reverse speed limit, and terminal 1 does not have a function.
Speed limit by analog terminal input can be calibrated using calibration parameter [*C12* to *15* (*Pr. 917, Pr. 918*)], [*C34* to *37* (*Pr. 928, Pr. 929*)].



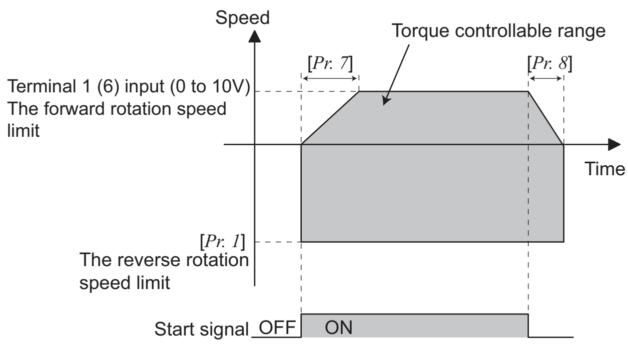
Example of terminal 1 calibration



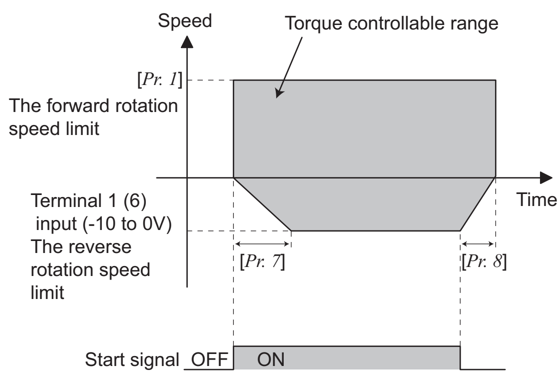
Example of terminal 6 (FR-A7AZ) calibration

For 0 to 10V input, set the forward rotation speed limit. The reverse rotation speed limit at this time is the value of [*Pr. 1 Maximum frequency*]. The speed limit value does not follow acceleration/deceleration time of [*Pr. 7 and Pr. 8*].
For -10 to 0V input, set the reverse rotation speed limit. The forward rotation speed limit at this time is the value of [*Pr. 1 Maximum frequency*] .The forward rotation speed limit does not follow acceleration/ deceleration time of [*Pr. 7, Pr. 8*].
The maximum speed of both the forward and reverse rotations is [*Pr. 1Maximum frequency*].

●When terminal 1 or terminal 6 (FR-A7AZ) input is "0 to 10V"



●When terminal 1 or terminal 6 (FR-A7AZ) input is "-10 to 0V"



2.10.4 Gain adjustment [Pr. 824, 825, 834, 835] A700

Although stable operation is available with the initial value, make adjustment when any of such case as unusual motor and machine vibration noise and overcurrent has occurred.

[Pr.]	Name	Initial Value	Setting Range	Description
824	Torque control P gain 1	100%	0 to 200%	Set the current loop proportional gain.
825	Torque control integral time 1	5ms	0 to 500ms	Set the current loop integral compensation time.
834	Torque control P gain 2	9999	0 to 200%	Set the current loop proportional gain when the RT signal is ON.
			9999	Without torque control P gain 2 function
835	Torque control integral time 2	9999	0 to 500ms	Set the current loop integral compensation time when the RT signal is ON.
			9999	Without torque control integral time 2 function

(1) Adjustment of current loop proportional (P) gain

Set the proportional gain for torque control. For general adjustment, make setting within the range 50 to 200% as a guideline.

Increasing the value improves response to a current command change and reduces current variation with disturbance. However, a too large gain will cause instability, generating harmonic torque pulsation.

(2) Adjustment of current control integral time

Set the integral time of current control during torque control.

A small value enhances the torque response level, but a too small value will cause current fluctuation.

Decreasing the value shortens the time taken to return to the original torque if current variation with disturbance occurs.

(3) Use two gains

When you want to change the gain according to applications, or to switch multiple motors with one inverter, etc., use [*Pr. 834 Torque control P gain 2*] and [*Pr. 835 Torque control integral time 2*].

[*Pr. 834 Torque control P gain 2*] and [*Pr. 835 Torque control P gain 2*] are valid when the RT signal is ON.

(4) Adjustment procedure

Make adjustment when any of unusual motor and machine vibration, noise, current, and overcurrent occurs.

1) Check the conditions and simultaneously change the [*Pr. 824*].
2) If you cannot make proper adjustment, change the [*Pr. 825*] value and repeat step 1).

Adjustment Method	
Set [*Pr. 824*] a little lower and [*Pr. 825*] a little higher. First lower [*Pr. 824*] and check the motor for unusual vibration, noise and overcurrent. If the problem still persists, increase [*Pr. 825*] .	
[*Pr. 824*]	Decrease the value by 10% until just before unusual noise and current are improved, and set about 0.8 to 0.9 of that value. Note that a too low value will produce current ripples, causing the motor to generate sound synchronizing with the cycle of current ripples.
[*Pr. 825*]	Double the current value until just before an unusual noise and current does not occur, and set about 0.8 to 0.9 of that value. Note that taking a too long time will produce current ripples, causing the motor to generate sound synchronizing with the cycle of current ripples.

2.10.5 Troubleshooting (torque control) (A700)

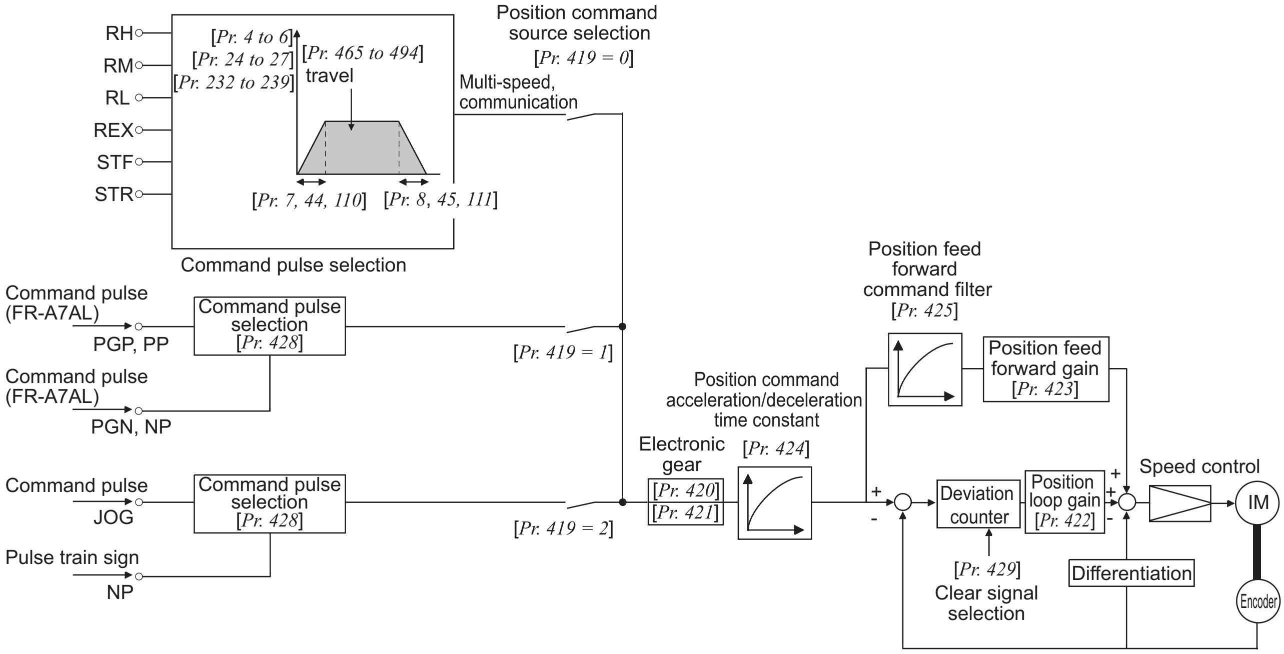
	Case	Cause	Countermeasures
1	Torque control is not exercised normally.	1)The phase sequence of the motor or encoder wiring is wrong. (2) The [*Pr. 800 Control mode selection*] setting is improper. (3)The speed limit value is not input. (4) The torque command varies. (5)The torque command does not match the inverter-recognized value. (6)Torque variation due to the change in the motor temperature.	1) Check the wiring (Refer to page 86) (2)Check the [*Pr. 800*] setting. (Refer to page 252) (3)Set the speed limit value. (If the speed limit value is not input, the motor will not rotate since the speed limit value is regarded as 0Hz.) (4)-1 Check that the command device gives a correct torque command. (4)-2 Decrease [*Pr. 72 PWM frequency selection*]. (4)-3 Increase [*Pr. 826 Torque setting filter 1*]. (5) Recalibrate [*C16Terminal 1 bias command (torque/magnetic flux)* , [*C17 Terminal 1 bias (torque/magnetic flux)*, [*C18 Terminal 1 gain command (torque/magnetic flux)* , [*C19 Terminal 1 gain (torque/magnetic flux)* . (Refer to page 320) (6)Select magnetic flux observer by setting [*Pr. 95 Online auto tuning selection*] . (Refer to page 276)
2	When the torque command is small, the motor rotates in the direction opposite to the start signal.	The offset calibration of the torque command does not match.	Recalibrate [*C16 Terminal 1bias command (torque/magnetic flux)*] and [*C17 Terminal 1bias (torque/magnetic flux)* .] (Refer to page 320)
3	Normal torque control cannot be exercised during acceleration/deceleration. The motor vibrates.	The speed limit is activated. (Since the speed limit value changes with the setting of the acceleration/ deceleration time [*Pr. 7, Pr. 8*] , the speed limit may be activated.)	Reduce the acceleration/deceleration time. Or, set the acceleration/deceleration time to "0". (The speed limit during acceleration/deceleration depends on the speed limit during the constant speed.)
4	Output torque is not linear in response to the torque command.	Insufficient torque.	Return the [*Pr. 854 Excitation ratio*] to the initial value.

2.11 Position control by vector control

2.11.1 Position control (A700)

(1) Control block diagram

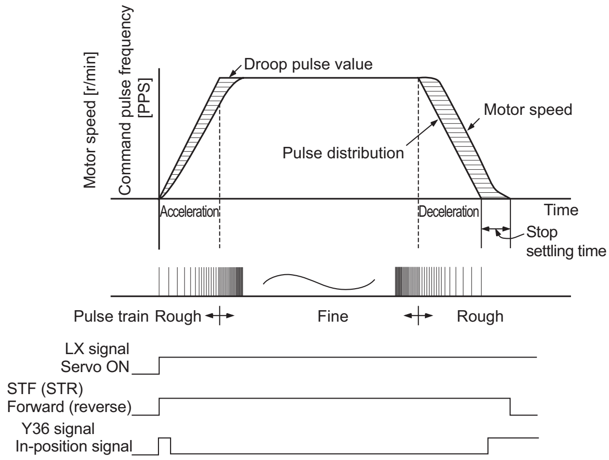
The following shows a basic control block diagram during position control.



(2) Operation

The speed command given to rotate the motor is calculated to zero the difference between the number of internal command pulse train pulses (when [*Pr. 419* = 0], the number of pulses set by parameter ([*Pr. 465 to 494*]) is changed to the command pulses in the inverter) and the number of pulses fed back from the motor end encoder.

1) When a pulse train is input, pulses are accumulated in the deviation counter and these droop pulses act as position control pulses to give the speed command.
2) As soon as the motor starts running under the speed command of the inverter, the encoder generates feed back pulses and the droop of the deviation counter is counted down. The deviation counter maintains a given droop pulse value to keep the motor running.
3) When the command pulse input stops, the droop pulses of the deviation counter decreases, reducing the speed. The motor stops when there are no droop pulses.
4) When the number of droop pulses has fallen below the value set in [*Pr. 426 In-position width*], it is regarded as completion of positioning and the in-position signal (Y36) turns ON.



For conditional position control function by contact input, the terminals STF and STR provide the forward (reverse) command signal. The motor can run only in the direction where the forward (reverse) signal is ON. Turning the STF signal OFF does not run the motor forward and turning the STR signal OFF does not run the motor reverse.

The pulse train is rough during acceleration and fine at the maximum speed. During deceleration the pulse train is rough and at last there are no pulses. The motor stops shortly after the command pulses stop.

This time lag is necessary for maintaining the stop accuracy and called stop settling time.

(3) Concept of position control gains

1) The [*Pr. 422 Position loop gain*] setting is rad/s increments.
Increasing the setting improves response for the position command and also improves servo rigidity at a stop, but oppositely makes an overshoot and vibration more liable to occur. <u>Normally set this parameter within the range about 5 to 50.</u>
2) To cancel all droop pulse, set 100% in [*Pr. 423 Position feed forward gain*].
Feed forward gain is a function designed to cancel a delay caused by the droop pulses of the deviation counter. When a tracking delay for command pulses poses a problem, increase the setting gradually and use this parameter within the range where an overshoot or vibration will not occur.
This function has no effects on servo rigidity at a stop. <u>Normally set 0.</u>

(4) Adjustment procedures

1) Select the speed control using [*Pr. 800 Control method selection*] and perform gain adjustment of speed control.
2) Then, change the control to position control using [*Pr. 800 Control method selection*] and adjust position loop gain.
3) Adjust position loop gain by checking response to the command pulses.

2.11.2 Conditional position feed function by contact input [Pr. 419, 464 to 494] (A700)

Inputting the number of pulses (positions) in the parameters and setting multi-speed and forward (reverse) commands enable position control.

The motor does not return to the home position with this conditional position feed function .

[Pr.]	Name	Initial Value	Setting Range	Description
419	Position command source selection AP AL	0	0	Conditional position control function by contact input. (position command by parameter settings)
			1	Pulse train position command by programmable controller positioning unit (when FR-A7AL installed)
			2	Conditional pulse train position command by inverter pulse train input
464	Digital position control sudden stop deceleration time AP AL	0s	0 to 360.0s	Set the time until the inverter stops when the forward rotation (reverse rotation) command is turned OFF with the position feed forward function.

[Pr.]	Name	Initial Value	Setting Range	Selection Method OFF ×, ON ○ REX	RH	RM	RL	Position Feed Frequency Setting
465	First position feed amount lower 4 digits AP AL	0	0 to 9999	×	○	×	×	High speed [*Pr. 4*]
466	First position feed amount upper 4 digits AP AL	0	0 to 9999					
467	Second position feed amount lower 4 digits AP AL	0	0 to 9999	×	×	○	×	Middle speed [*Pr. 5*]
468	Second position feed amount upper 4 digits AP AL	0	0 to 9999					
469	Third position feed amount lower 4 digits AP AL	0	0 to 9999	×	×	×	○	Low speed [*Pr. 6*]
470	Third position feed amount upper 4 digits AP AL	0	0 to 9999					
471	Fourth position feed amount lower 4 digits AP AL	0	0 to 9999	×	×	○	○	4 speed [*Pr. 24*]
472	Fourth position feed amount upper 4 digits AP AL	0	0 to 9999					
473	Fifth position feed amount lower 4 digits AP AL	0	0 to 9999	×	○	×	○	5 speed [*Pr. 25*]
474	Fifth position feed amount upper 4 digits AP AL	0	0 to 9999					
475	Sixth position feed amount lower 4 digits AP AL	0	0 to 9999	×	○	○	×	6 speed [*Pr. 26*]
476	Sixth position feed amount upper 4 digits AP AL	0	0 to 9999					
477	Seventh position feed amount lower 4 digits AP AL	0	0 to 9999	×	○	○	○	7 speed [*Pr. 27*]
478	Seventh position feed amount upper 4 digits AP AL	0	0 to 9999					

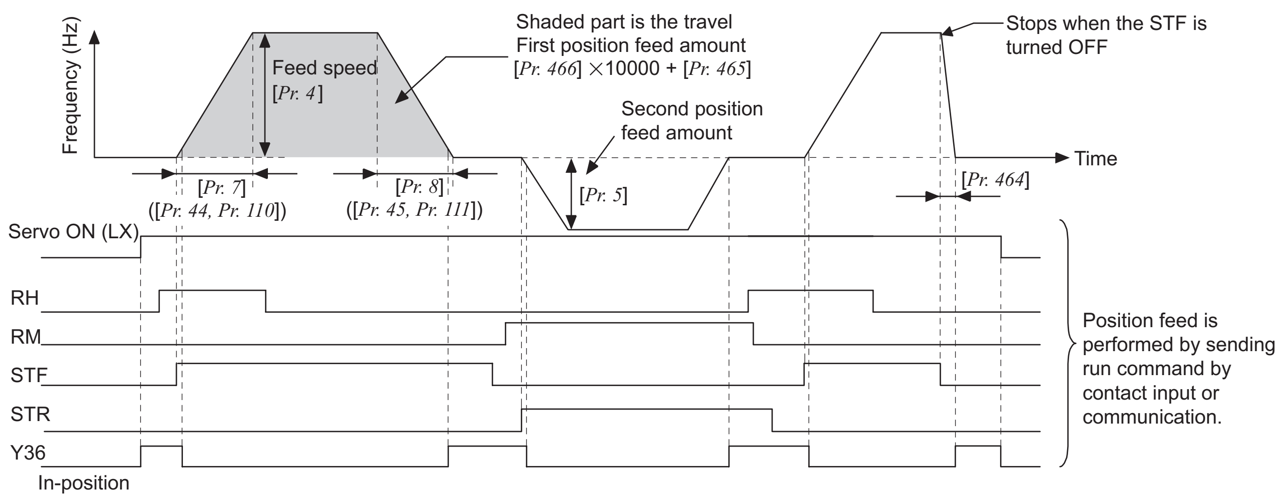
[Pr.]	Name	Initial Value	Setting Range	Description				
479	Eighth position feed amount lower 4 digits AP AL	0	0 to 9999	○	×	×	×	8 speed [*Pr. 232*]
480	Eighth position feed amount upper 4 digits AP AL	0	0 to 9999					
481	Ninth position feed amount lower 4 digits AP AL	0	0 to 9999	○	×	×	○	9 speed [*Pr. 233*]
482	Ninth position feed amount upper 4 digits AP AL	0	0 to 9999					
483	Tenth position feed amount lower 4 digits AP AL	0	0 to 9999	○	×	○	×	10 speed [*Pr. 234*]
484	Tenth position feed amount upper 4 digits AP AL	0	0 to 9999					
485	Eleventh position feed amount lower 4 digits AP AL	0	0 to 9999	○	×	○	○	11 speed [*Pr. 235*]
486	Eleventh position feed amount upper 4 digits AP AL	0	0 to 9999					
487	Twelfth position feed amount lower 4 digits AP AL	0	0 to 9999	○	○	×	×	12 speed [*Pr. 236*]
488	Twelfth position feed amount upper 4 digits AP AL	0	0 to 9999					
489	Thirteenth position feed amount lower 4 digits AP AL	0	0 to 9999	○	○	×	○	13 speed [*Pr. 237*]
490	Thirteenth position feed amount upper 4 digits AP AL	0	0 to 9999					
491	Fourteenth position feed amount lower 4 digits AP AL	0	0 to 9999	○	○	○	×	14 speed [*Pr. 238*]
492	Fourteenth position feed amount upper 4 digits AP AL	0	0 to 9999					
493	Fifteenth position feed amount lower 4 digits AP AL	0	0 to 9999	○	○	○	○	15 speed [*Pr. 239*]
494	Fifteenth position feed amount upper 4 digits AP AL	0	0 to 9999					

(1) Setting of position feed amount by parameter [Pr. 419 = 0, Pr. 465 to 494]

Set [*Pr. 419* = 0] (initial value) and set position feed amount in [*Pr. 465* to *494*].
The feed amount set in each parameter is selected by multi-speed terminal (RH, RM, RL, REX).
Set (encoder resolution × speed × 4 times) for position feed amount.
For example, when stopping the motor after 100 rotations using the SF-V5RU, 2048 (pulse/r) × 100 (speed) × 4 (multiplication) = 819200 (feed amount).
To set 819200 for the first position feed amount, divide the value into upper four digits and lower four digits and set 81 (decimal) in [*Pr. 466*] (upper) and 9200 (decimal) in [*Pr. 465*] (lower).

(2) Position command operation by parameter

Information on multi-speed command (position command) is determined at rising of the forward (reverse) command to perform position control. Therefore, set forward (reverse) command after multi-speed command (position command by RL, RM, RH, and REX signals). Position feed is invalid if the multi-speed command is given after forward (reverse) command.
For deceleration by turning the STF(STR) OFF, use [*Pr. 464 Digital position control sudden stop deceleration time*] to set deceleration time.
Acceleration/deceleration time is 0.1s minimum and 360s maximum.
[*Pr. 20 Acceleration/deceleration reference frequency*] is clamped at a minimum of 16.66Hz (500r/min).
The acceleration/deceleration patterns for position control are all linear acceleration and the setting of [*Pr. 29 Acceleration/deceleration pattern selection*] is invalid.



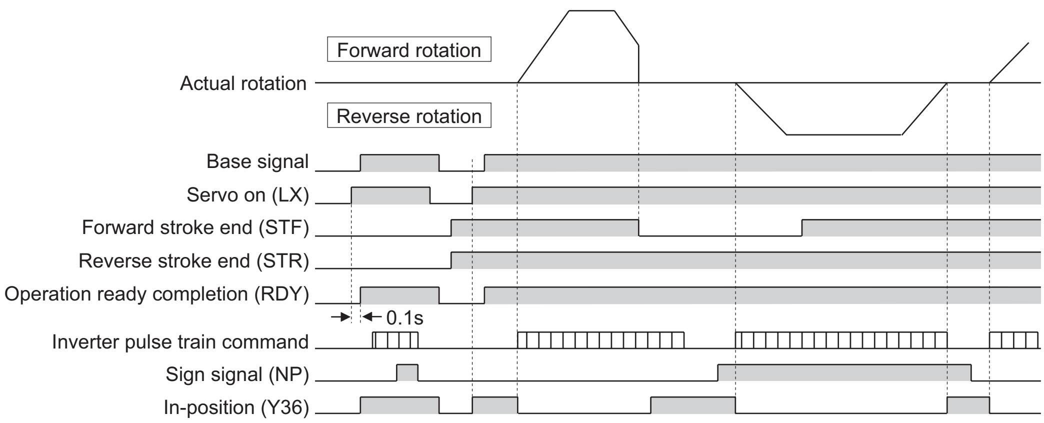
2.11.3 Position control by the inverter pulse train input [Pr. 419, 428 to 430] (A700)

Simple position pulse train command can be input by pulse train input to terminal JOG and sign signal (NP).

[Pr.]	Name	Initial Value	Setting Range	Description	
419	Position command source selection AP AL	0	0	Simple position control function by contact input. (position command by parameter settings)	
			1	Pulse train position command by programmable controller positioning unit (when FR-A7AL installed)	
			2	Simple pulse train position command by inverter pulse train input	
428	Command pulse selection AP AL	0	0 to 2	Pulse train + rotation direction sign	Negative logic
			3 to 5		Positive logic
429	Clear signal selection AP AL	1	0	Deviation counter is cleared at edge of turning ON of the clear signal (CLR) from OFF.	
			1	Deviation counter while the clear signal (CLR) is ON	
430	Pulse monitor selection AP AL	9999	0 to 5	The status of various pulses during running are displayed.	
			9999	Frequency monitor is displayed.	

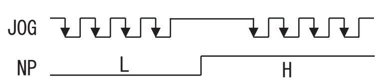
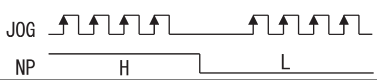
(1) Operation overview [Pr. 419 = 2]

Turning ON the servo on signal (LX) cancels the output shut-off and the operation ready signal (RDY) turns ON after 0.1s. Turning ON the STF (forward stroke end signal) or STR (reverse stroke end signal) runs the motor according to the commanded pulse. When the forward (reverse) stroke end signal turns OFF, the motor does not run in that direction.



(2) Pulse train form type selection (NP signal) [Pr. 428]

1) Set [*Pr. 419* = 2] (simple pulse train position command). In this case, terminal JOG serves as simple position pulse train input terminal regardless of [*Pr. 291 Pulse train I/O selection*].
2) Set "68" in [*Pr. 178 to 189 Input terminal function selection*] to assign simple position pulse train sign (NP).
3) Select command pulse train using [*Pr. 428*].

[Pr. 428] Setting	Command Pulse Train Form		At Forward Rotation	At Reverse Rotation
0 to 2	Negative logic	Pulse train + rotation direction sign		
3 to 5	Positive logic	Pulse train + rotation direction sign		

4) Select vector control, then select position control.

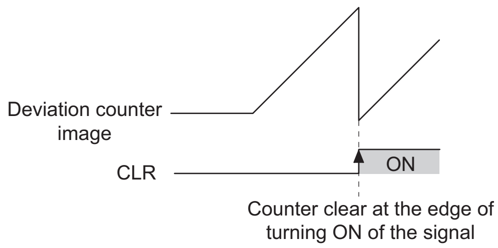
(3) Selection of clear signal (CLR signal) [Pr. 429]

Use this function to make a drooping pulse 0 for home position operation, etc.

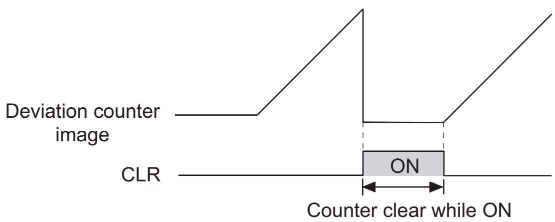
When [*Pr. 429* = 0], the deviation counter is cleared at the edge of turning ON of the clear signal (CLR). The CLR signal turns ON in synchronization with the zero pulse signal of encoder for home position operation, etc. and clears the deviation counter.

When [*Pr. 429* = 1] (initial value), the deviation counter is cleared while the clear signal (CLR) in ON. For the terminal used for CLR signal input, set 69 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function.

● When [*Pr. 429* = 0]



● When [*Pr. 429* = 1] (initial value)



(4) Pulse monitor selection [Pr. 430]

The status of various pulses during running are displayed.

Set [*Pr. 52 DU/PU main display data selection* = 6] to display output frequency monitor.

Count the number of pulses when the servo is ON.

The cumulative pulse value is cleared when the base is shut off or the clear signal (CLR) is turned ON.

[Pr. 430] setting	Description	Display Range	
		FR-DU07	FR-PU04 FR-PU07
0	The cumulative command pulse value is displayed.	Lower 4 digits	Lower 5 digits
1		Upper 4 digits	Upper 5 digits
2	The cumulative feedback pulse value is displayed.	Lower 4 digits	Lower 5 digits
3		Upper 4 digits	Upper 5 digits
4	The droop pulses are displayed.	Lower 4 digits	Lower 5 digits
5		Upper 4 digits	Upper 5 digits
9999	Frequency monitor is displayed. (initial value)		

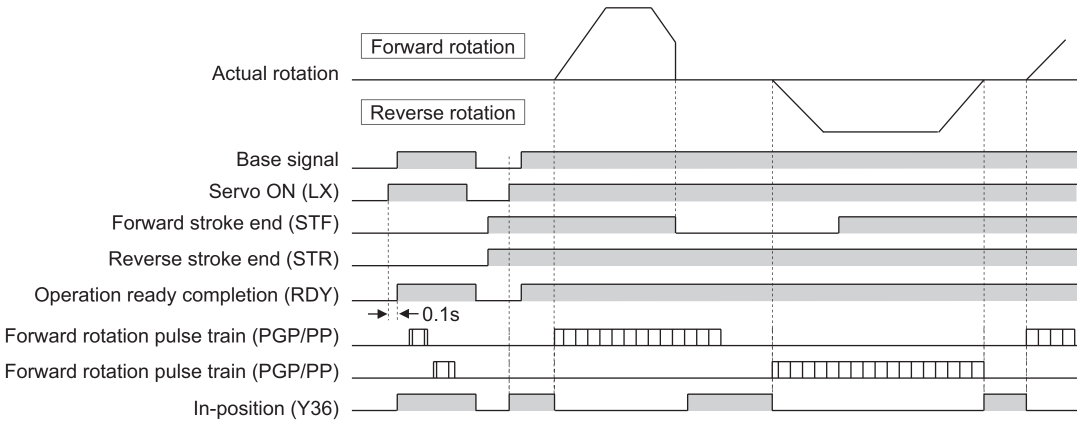
2.11.4 Positioning control by pulse train input of FR-A7AL [Pr.419, 428 to 430] (A700)

The built-in option FR-A7AL enables position control by the programmable controller positioning unit.

[Pr.]	Name	Initial Value	Setting Range	Description	
419	Position command source selection AP AL	0	0	Simple position control function by contact input. (position command by parameter settings)	
			1	Pulse train position command by programmable controller positioning unit (when FR-A7AL installed)	
			2	Simple pulse train position command by inverter pulse train input	
428	Command pulse selection AP AL	0	0	Forward rotation pulse train + reverse rotation pulse train	Negative logic
			1	Pulse train + rotation direction sign	
			2	A-phase pulse train + B-phase pulse train	
			3	Forward rotation pulse train + reverse rotation pulse train	Positive logic
			4	Pulse train + rotation direction sign	
			5	A-phase pulse train + B-phase pulse train	
429	Clear signal selection AP AL	1	0	Deviation counter is cleared at edge of turning ON of the clear signal (CLR) from OFF.	
			1	Deviation counter while the clear signal (CLR) is ON	
430	Pulse monitor selection AP AL	9999	0 to 5	The status of various pulses during running are displayed.	
			9999	Frequency monitor is displayed.	

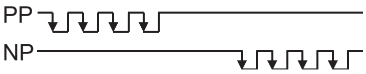
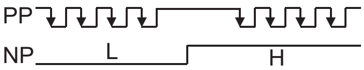
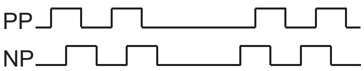
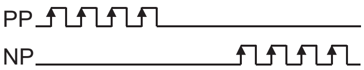
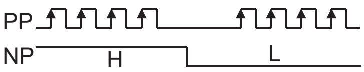
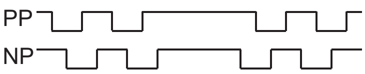
(1) Operation overview [Pr. 419 = 1]

Turning ON the servo ON signal (LX) cancels the output shut-off, and the operation ready signal (RDY) turns ON after 0.1s. Turning ON the STF (forward stroke end signal) or STR (reverse stroke end signal) runs the motor according to the commanded pulse. When the forward (reverse) stroke end signal turns OFF, the motor does not run in that direction.



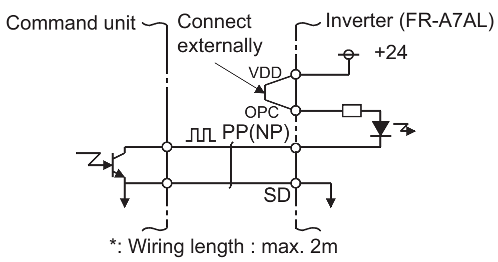
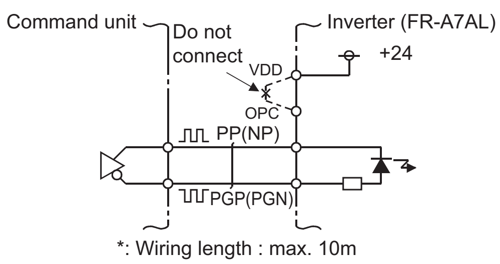
(2) Pulse train form selection (PP, NP signal) [Pr. 428]

Command pulse can be changed according to the positioning unit as in the table below.

	Command Pulse Train Form	At Forward Rotation	At Reverse Rotation	Setting [*Pr. 428*]	Remarks
Negative logic	Forward rotation pulse train Reverse rotation pulse train			0 (factory setting)	QD75D(CW/CWW mode) (Note) If (CW/CWW mode) and (PLS/SIGN mode) are mistaken, the motor runs only in one direction.
	Pulse train + rotation direction sign			1	QD75D (PLS/SIGN mode)
	A phase pulse train B phase pulse train			2	Counted after multiplying by four. Set the pulse train frequency multiplied by four to 500kpps or less with the differential driver type and to 200kpps or less with the open collector type.
Positive logic	Forward rotation pulse train Reverse rotation pulse train			3	
	Pulse train + rotation direction sign			4	
	A phase pulse train B phase pulse train			5	Counted after being multiplied by four. Set the pulse train frequency multiplied by four to 500kpps or less with the differential driver type and to 200kpps or less with the open collector type.

(3) Interface of the positioning unit and inverter

When running the inverter by each positioning unit, interface of the positioning command pulse train need to be matched.

Output Type	Hardware Configuration	Input Pulse Frequency
Open collector		Max. 200kpps
Differential line driver		Max. 500kpps

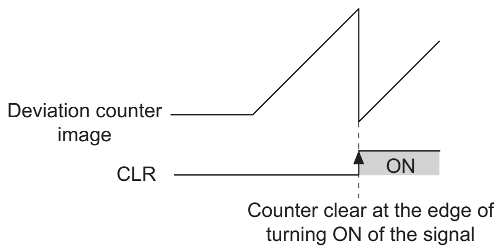
(4) Selection of clear signal (CLR signal) [Pr. 429]

Use this function to make a drooping pulse 0 for home position operation, etc.

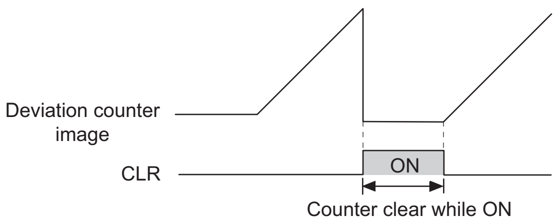
When [*Pr. 429* = 0], the deviation counter is cleared at the edge of turning ON of the clear signal (CLR). The CLR signal turns ON in synchronization with the zero pulse signal of encoder for home position operation, etc. and clears the deviation counter.

When [*Pr. 429* = 1] (initial value), the deviation counter is cleared while the clear signal (CLR) in ON. For the terminal used for CLR signal input, set 69 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function.

● When [*Pr. 429* = 0]



● When [*Pr. 429* = 1] (initial value)



(5) Pulse monitor selection [Pr. 430]

The status of various pulses during running are displayed.

Set [*Pr. 52 DU/PU main display data selection* = 6] to display output frequency monitor.

Count the number of pulses when the servo is ON.

The cumulative pulse value is cleared when the base is shut off or the clear signal (CLR) is turned ON.

[Pr. 430] setting	Description	Display Range	
		FR-DU07	FR-PU04 FR-PU07
0	The cumulative command pulse value is displayed.	Lower 4 digits	Lower 5 digits
1		Upper 4 digits	Upper 5 digits
2	The cumulative feedback pulse value is displayed.	Lower 4 digits	Lower 5 digits
3		Upper 4 digits	Upper 5 digits
4	The droop pulses are displayed.	Lower 4 digits	Lower 5 digits
5		Upper 4 digits	Upper 5 digits
9999	Frequency monitor is displayed. (initial value)		

2.11.5 Setting the electronic gear [Pr. 420, 421, 424] (A700)

Set the ratio of the machine side gear and the motor side gear.

[Pr.]	Name	Initial Value	Setting Range	Description
420	Command pulse scaling factor numerator AP AL	1	0 to 32767*	Set the electric gear. [*Pr. 420*] is a numerator and [*Pr. 421*] is a denominator.
421	Command pulse scaling factor denominator AP AL	1	0 to 32767*	
424	Position command acceleration/deceleration time constant AP AL	0s	0 to 50s	Used when rotation is not smooth at a large electronic gear ratio (about 10 times or more) and low speed.

* When the operation panel (FR-DU07) is used, the maximum setting is 9999. When a parameter unit is used, up to the maximum value within the setting range can be set.

(1) Calculation of the gear ratio [Pr. 420, 421]

The position resolution (travel per pulse ⊿ℓ[mm]) is determined by the travel per motor revolution ⊿ [mm] and the feedback pulses Pf [pulse/rev] of the detector, and is represented by the following expression.

$$\Delta \ell = \frac{\Delta s}{Pf}$$

⊿ℓ :travel per pulse [mm]

⊿s :1[mm]

Pf :number of feedback pulses [pulse/rev] (number of pulses after multiplying the number of encoder pulses by four)

Using the parameters, the travel per command pulse can be set separately to set the travel per command pulse without a fraction.

$$\Delta \ell = \frac{\Delta s}{Pf} \times \frac{[Pr.\ 420]}{[Pr.\ 421]}$$

In addition, the relationship between the motor speed and internal command pulse frequency is as follows:

$$fo \times \frac{[Pr.\ 420]}{[Pr.\ 421]} = Pf \times \frac{No}{60}$$

fo :internal command pulse frequency [pps]
No :motor speed [r/min]

Set the electronic gear in the range of 1/50 to 20. Note that too small a value will decrease the speed command and too large a value will increase the speed ripples.

[Setting example 1]

The travel per pulse is $\Delta \ell$ = 0.01(mm) in a drive system where the ball screw pitch PB = 10(mm) and the reduction ratio 1/n = 1 and the electronic gear ratio is Δs = 10 (mm) when the number of feedback pulses Pf = 4000 (pulse/rev). According to the following formula:

$$\Delta \ell = \frac{\Delta s}{Pf} \times \frac{[Pr.\ 420]}{[Pr.\ 421]}$$

$$\frac{[Pr.\ 420]}{[Pr.\ 421]} = \Delta \ell \times \frac{Pf}{\Delta s}$$

$$= 0.01 \times \frac{4000}{10} \quad \frac{4}{1}$$

Therefore, set [*Pr. 420* = 4], [*Pr. 421* = 1].

[Setting example 2]

Find the internal command pulse frequency of the dedicated motor rated speed. Note that the command pulse scaling factor [*Pr. 420/Pr. 421* = 1] .

Assuming that the number of encoder pulses is 2048 (pulses/rev) (feedback pulse Pf = 2048 × 4),

$$fo = 2048 \times \frac{4}{(\text{multiplication})} \times \frac{No}{60} \times \frac{[Pr.\ 421]}{[Pr.\ 420]}$$

$$= 204800$$

Therefore, the internal command pulse frequency is 204800 (pps).

The relationship between position resolution $\Delta \ell$ and overall accuracy is as follows. Since overall accuracy (positioning accuracy of machine) is the sum of electrical error and mechanical error, normally take measures to prevent the electrical system error from affecting the overall error. As a guideline, refer to the following relationship.

$$\Delta \ell < \left(\frac{1}{5} \text{ to } \frac{1}{10}\right) \times \Delta \varepsilon$$

$\Delta \varepsilon$:positioning accuracy

<Stopping characteristic of motor>

When parameters are used to run the motor, the command pulse frequency and motor speed have the relationship as shown in the chart on page 308, and as the motor speed decreases, pulses are accumulated in the deviation counter of the inverter. These pulses are called droop pulses (ε), and the relationship between command frequency (fo) and position loop gain (Kp: [*Pr. 422*]) is as represented by the following formula.

$$\varepsilon = \frac{fo}{Kp} \text{ [pulse]}$$

$$\varepsilon = \frac{204800}{25} \text{ [pulse] (rated motor speed)}$$
$$= 8192 \text{ [pulse]}$$

When the initial value of Kp is $25s^{-1}$, the droop pulses (ε) are 8192 pulses.

Since the inverter has droop pulses during running, a stop settling time (ts) is needed from when the command has zeroed until the motor stops. Set the operation pattern in consideration of the stop settling time.

$$ts = 3 \times \frac{1}{Kp} \text{ [s]}$$

When the initial value of Kp is $25s^{-1}$, the stop setting time (ts) is 0.12s.

Positioning accuracy $\Delta \varepsilon$ is represented as the following formula.

$\Delta \varepsilon$ =(5 to 10) × $\Delta \ell$[mm]

(2) Position command acceleration/ deceleration time constant [Pr. 424]

When the electronic gear ratio is large (about 10 or more times) and the speed is low, rotation will not be smooth, resulting in pulse-wise rotation. At such a time, set this parameter to smooth the rotation.

When acceleration/deceleration time cannot be provided for the command pulses, a sudden change in command pulse frequency may cause an overshoot or error excess alarm. At such a time, set this parameter to provide acceleration/deceleration time.

Normally set 0.

2.11.6 Setting of positioning adjustment parameter [Pr. 426, 427] A700

[Pr.]	Name	Initial Value	Setting Range	Description
426	In-position width AP AL	100 pulses	0 to 32767 pulses*	When the number of droop pulses has fallen below the setting value, the in-position signal (Y36) turns ON.
427	Excessive level error AP AL	40	0 to 400	A position error excessive (E.OD) occurs when the number of droop pulses exceeds the setting.
			9999	Function invalid

* When the operation panel (FR-DU07) is used, the maximum setting is 9999. When a parameter unit is used, up to the maximum value within the setting range can be set.

(1) In-position width [Pr. 426]

The Y36 signal acts as an in-position signal. When the number of droop pulses has fallen below the setting value, the in-position signal (Y36) turns ON.
For the Y36 signal, assign the function by setting 36 (positive logic) or 136 (negative logic) in any of [*Pr. 190 to 196 Output terminal function selection*] .

(2) Excessive level error [Pr. 427]

When droop pulses exceed the value set in [*Pr. 427*], position error becomes large, and a fault (E.OD) is displayed to stop the inverter. When you decrease the position loop gain [*Pr. 422 Position loop gain*] setting, increase the error excessive level setting.
Also decrease the setting when you want to detect an error slightly earlier under large load.
When [*Pr. 427* = 9999], position error large (E.OD) does not occur regardless of droop pulses.

2.11.7 Gain adjustment [Pr. 422, 423, 425] A700

Easy gain tuning is available as an easy tuning method. Refer to page 286 for easy gain tuning.
If easy gain tuning does not produce any effect, make fine adjustment by using the following parameters.

Set [*Pr. 819 Easy gain tuning* = 0] before setting the parameters below.

[Pr.]	Name	Initial Value	Setting Range	Description
422	Position loop gain AP AL	$25s^{-1}$	0 to $150s^{-1}$	Set the gain of the position loop.
423	Position feed forward gain AP AL	0%	0 to 100%	Function to cancel a delay caused by the droop pulses of the deviation counter.
425	Position feed forward command filter AP AL	0s	0 to 5s	Enters the primary delay filter in response to the feed forward command.

(1) Position loop gain [Pr. 422]

Make adjustment when any of unusual vibration, noise and overcurrent of the motor/machine occurs.
Increasing the setting improves response for the position command and also improves servo rigidity at a stop, but oppositely makes an overshoot and vibration more liable to occur.
Normally set this parameter within the range about 5 to 50.

Phenomenon/ Condition	Adjustment Method
Slow response	Increase the [*Pr. 422*] setting by $3s^{-1}$ until just before an overshoot or instable behavior such as stop-time vibration occurs, and set about 0.8 to 0.9 of that value.
Overshoot, stop-time vibration or other instable behavior occurs.	Decrease the [*Pr. 422*] setting by $3s^{-1}$ until just before an overshoot or instable behavior such as stop-time vibration does not occur, and set about 0.8 to 0.9 of that value.

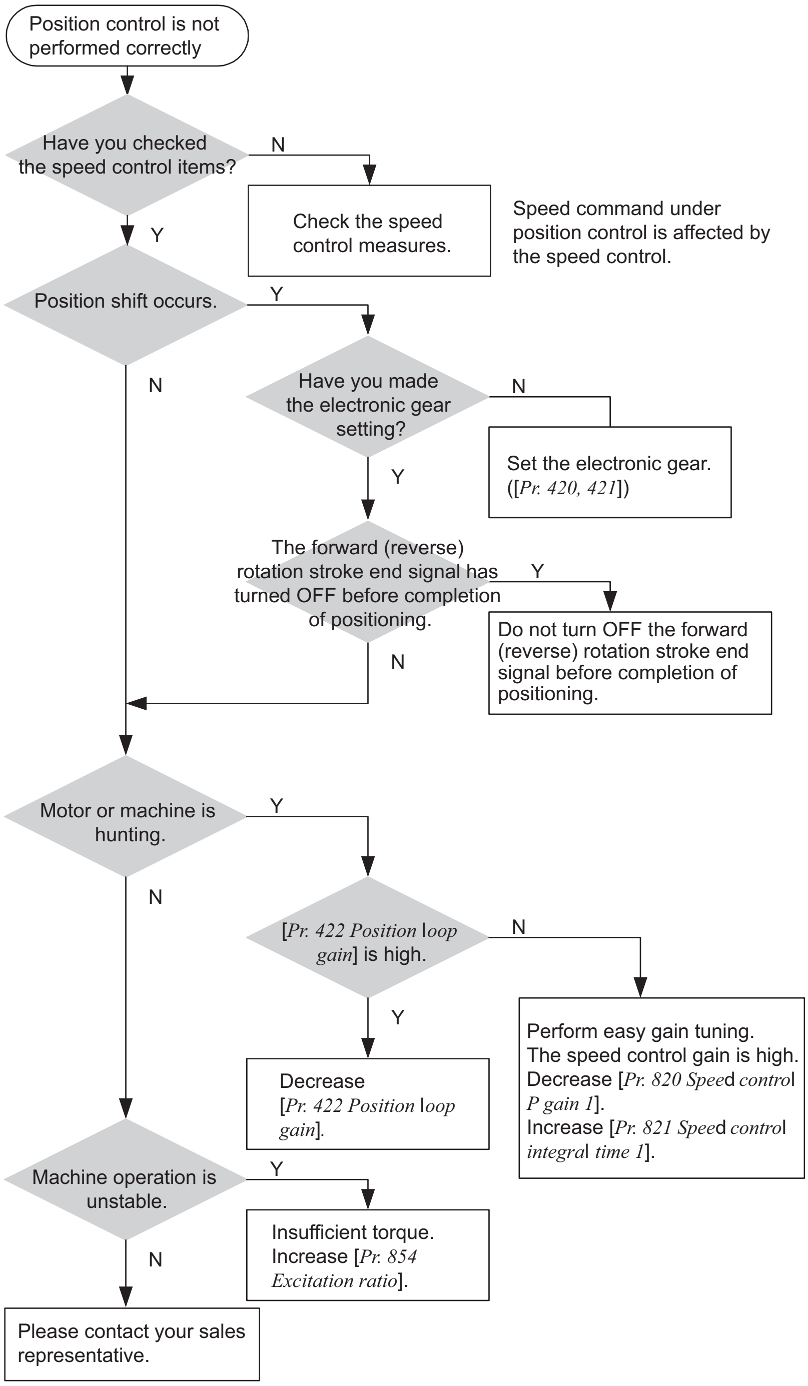
(2) Position feed forward gain [Pr. 423]

This function is designed to cancel a delay caused by the droop pulses of the deviation counter.
When a tracking delay for command pulses poses a problem, increase the setting gradually and use this parameter within the range where an overshoot or vibration will not occur.
This function has no effects on servo rigidity at a stop.
Normally set this parameter to 0.

2.11.8 Troubleshooting (position control) (A700)

	Case	Cause	Countermeasures
1	Motor does not rotate	(1) The phase sequence of the motor or encoder wiring is wrong. (2) [*Pr. 800 The control mode selection*] setting is improper. (3) The servo ON signal or stroke end signal (STF, STR) is not input. (4) Command pulse, position pulse sign (NP) are not correctly input. (5) The [*Pr. 419 Position command source selection*] setting is not correct. (6) When the [*Pr. 419 Position command source selection*] setting is 0, the position feed amount [*Pr. 465 to Pr. 494*] settings are not correct.	(1) Check the wiring (Refer to page 86) (2) Check the [*Pr. 800*] setting. (Refer to page 252) (3) Check that the signals are input correctly. (4)-1 Check that the command pulses are input correctly. (Check the cumulative command pulse value in [*Pr. 430*]) (4)-2 Check the command pulse form and [*Pr. 428 Command pulse selection*] setting. (4)-3 Check that the position pulse sign (NP) is assigned to the input terminal. (inverter pulse input) (5) Check the [*Pr. 419 Position command source selection*]. (6) Check the position feed amount in [*Pr. 465 to Pr. 494*].
2	Position shift occurs.	(1) The command pulses are not input correctly. (2) The command is affected by noise or the encoder feedback signal is compounded with noise.	(1)-1 Check the command pulse form and [*Pr. 428 Command pulse selection*] setting. (1)-2 Check that the command pulses are input correctly. (Check the cumulative command pulse value in [*Pr. 430*]) (1)-3 Check that the position pulse sign (NP) is assigned to the input terminal. (inverter pulse input) (2)-1 Decrease [*Pr. 72 PWM frequency selection*]. (2)-2 Change the earthing (grounding) point of shielded wire. Or leave the cable suspended.
3	Motor or machine hunts.	(1) The position loop gain is high. (2) The speed loop gain is high.	(1) Decrease [*Pr. 422*]. (2)-1 Perform easy gain tuning. (2)-2 Decrease [*Pr. 820*] and increase [*Pr. 821*] .
4	Machine operation is unstable	(1) The acceleration/deceleration time setting has adverse effect.	(1) Decrease the [*Pr. 7, Pr. 8*] value.

(1) Position control is not performed correctly



2.12 Adjustment of Real sensorless vector control, vector control

2.12.1 Bias and gain of torque (magnetic flux) setting voltage (current) [Pr. 241, C16 to C19 (Pr. 919, 920), C34 to C37 (Pr. 928, 929), C38 to C41 (Pr. 932, 933)] A700

You can set the magnitude (slope) of the torque as desired in relation to the torque setting signal (0 to 5VDC, 0 to 10V or 4 to 20mA).
Set [*Pr. 73, Pr. 267*] to switch between 0 to 5VDC, 0 to 10VDC and 4 to 20mA. (Refer to page 217)
In the initial setting status, terminal 1 and terminal 4 used for analog input are respectively set to speed setting auxiliary (speed limit auxiliary) and speed command (speed limit). To use an analog input terminal as torque command, torque limit, and magnetic flux input, set [*Pr. 868 Terminal 1 function assignment*] and [*Pr. 858 Terminal 4 function assignment*] to change functions. (Refer to page 46)
Magnetic flux is valid only during vector control.
To use terminal 6 of FR-A7AZ for torque command or torque limit, set [*Pr. 406 High resolution analog input selection*] and change the function. (Refer to page 46)

[Pr.]	Name	Initial Value	Setting Range	Description	
241*1	Analog input display unit switchover	0	0	Displayed in %	Selects the unit for analog input display.
			1	Displayed in V/mA	
C16(919)	Terminal 1 bias command (torque/ magnetic flux)	0%	0 to 400%	Set the torque (magnetic flux) on the bias side of terminal 1 input.	
C17(919)	Terminal 1 bias (torque/magnetic flux)	0%	0 to 300%	Set the converted % of the bias side voltage of terminal 1 input.	
C18(920)	Terminal 1 gain command (torque/ magnetic flux))	150%	0 to 400%	Set the torque (magnetic flux) of the terminal 1 input gain (maximum).	
C19(920)	Terminal 1 gain (torque/magnetic flux)	100%	0 to 300%	Set the converted % of the gain side voltage of terminal 1 input.	
C34(928)	Terminal 6 bias command (torque) AZ	0%	0 to 400%	Set the torque on the bias side of terminal 6 input.	
C35(928)	Terminal 6 bias (torque) AZ	0%	0 to 300%	Set the converted % of the bias side voltage of terminal 6 input.	
C36(929)	Terminal 6 gain command (torque) AZ	150%	0 to 400%	Set the torque of the terminal 6 input gain (maximum).	
C37(929)	Terminal 6 gain (torque) AZ	100%	0 to 300%	Set the converted % of the gain side voltage of terminal 6 input.	
C38(932)	Terminal 4 bias command (torque/ magnetic flux)	0%	0 to 400%	Set the torque (magnetic flux) on the bias side of terminal 4 input.	
C39(932)	Terminal 4 bias (torque/magnetic flux)	20%	0 to 300%	Set the converted % of the bias side current (voltage) of terminal 4 input.	
C40(933)	Terminal 4 gain command (torque/ magnetic flux)	150%	0 to 400%	Set the torque (magnetic flux) of the terminal 4 input gain (maximum).	
C41(933)	Terminal 4 gain (torque/magnetic flux)	100%	0 to 300%	Set the converted % of the gain side current (voltage) of terminal 4 input.	

*1 The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in [*Pr. 77 Parameter write selection*].

(1) The relationship between analog input terminal and calibration parameter

- Terminal 1 functional calibration parameter

[*Pr. 868*] Setting	Terminal Function	Calibration Parameters	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) setting auxiliary	[*C2(Pr. 902) Terminal 2 frequency setting bias frequency*] [*C3(Pr. 902) Terminal 2 frequency setting bias*] [*C5(Pr. 904) Terminal 4 frequency setting bias frequency*] [*C6(Pr. 904) Terminal 4 frequency setting bias*]	[*Pr. 125 Terminal 2 frequency setting gain frequency*] [*C4(Pr. 903) Terminal 2 frequency setting gain*] [*Pr. 126 Terminal 4 frequency setting gain frequency*] [*C7(Pr. 905) Terminal 4 frequency setting gain*]
1	Magnetic flux command	[*C16(Pr. 919) Terminal 1bias command (torque/magnetic flux)*] [*C17(Pr. 919) Terminal 1bias (torque/magnetic flux)*]	[*C18(Pr. 920) Terminal 1gain command (torque/magnetic flux)*] [*C19(Pr. 920) Terminal 1gain (torque/magnetic flux)*]
2	Regenerative torque limit	[*C16(Pr. 919) Terminal 1bias command (torque/magnetic flux)*] [*C17(Pr. 919) Terminal 1bias (torque/magnetic flux)*]	[*C18(Pr. 920) Terminal 1gain command (torque/magnetic flux)*] [*C19(Pr. 920) Terminal 1gain (torque/magnetic flux)*]
3	Torque command		
4	Stall prevention operation level* /Torque limit/torque command		
5	Forward/reverse rotation speed limit	[*C12(Pr. 917) Terminal 1 bias frequency (speed)*] [*C13(Pr. 917) Terminal 1 bias frequency (speed)*]	[*C14(Pr. 918) Terminal 1 gain frequency (speed)*] [*C15(Pr. 918) Terminal 1 gain (speed)*]
6	Torque bias input	[*C16(Pr. 919) Terminal 1bias command (torque/magnetic flux)*] [*C17(Pr. 919) Terminal 1bias (torque/magnetic flux)*]	[*C18(Pr. 920) Terminal 1gain command (torque/magnetic flux)*] [*C19(Pr. 920) Terminal 1gain (torque/magnetic flux)*]
9999	—	—	—

- Terminal 4 functional calibration parameter

[*Pr. 858*] Setting	Terminal Function	Calibration Parameters	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) indication speed limit	[*C5(Pr. 904) Terminal 4 frequency setting bias frequency*] [*C6(Pr. 904) Terminal 4 frequency setting bias*]	[*Pr. 126 Terminal 4 frequency setting gain frequency*] [*C7(Pr. 905) Terminal 4 frequency setting gain*]
1	Magnetic flux command	[*C38(Pr. 932) Terminal 4 bias command (torque/ magnetic flux)*] [*C39(Pr. 932) Terminal 4 bias (torque/magnetic flux)*]	[*C40(Pr. 933) Terminal 4 gain command (torque/ magnetic flux)*] [*C41(Pr. 933) Terminal 4 gain (torque/magnetic flux)*]
4	Stall prevention operation level* /Torque limit	[*C38(Pr. 932) Terminal 4 bias command (torque/ magnetic flux)*] [*C39(Pr. 932) Terminal 4 bias (torque/magnetic flux)*]	[*C40(Pr. 933) Terminal 4 gain command (torque/ magnetic flux)*] [*C41(Pr. 933) Terminal 4 gain (torque/magnetic flux)*]
9999	—	—	—

—:No function

* Use [*Pr. 148 Stall prevention level at 0V input*] and [*Pr. 149 Stall prevention level at 10V input*] to adjust bias/gain of stall prevention operation level.

- Terminal 6 (FR-A7AZ) functional calibration parameter

[*Pr. 406*] Setting	Terminal Function	Calibration Parameters	
		Bias setting	Gain setting
0	Speed command / speed limit	[*C30 (Pr. 926) Terminal 6 bias frequency (speed)*] [*C31 (Pr. 926) Terminal 6 bias (speed)*]	[*C32 (Pr. 927) Terminal 6 gain frequency (speed)*] [*C33 (Pr. 927) Terminal 6 gain (speed)*]
2	Regenerative torque limit	[*C34 (Pr. 928) Terminal 6 bias command (torque)*] [*C35 (Pr. 928) Terminal 6 bias (torque)*]	[*C36 (Pr. 929) Terminal 6 gain command (torque)*] [*C37 (Pr. 929) Terminal 6 gain (torque)*]
3	Torque command		
4	Stall prevention operation level* / Torque limit / torque command		
5	Forward/reverse rotation speed limit	[*C30 (Pr. 926) Terminal 6 bias frequency (speed)*] [*C31 (Pr. 926) Terminal 6 bias (speed)*]	[*C32 (Pr. 927) Terminal 6 gain frequency (speed)*] [*C33 (Pr. 927) Terminal 6 gain (speed)*]
6	Torque bias input	[*C34 (Pr. 928) Terminal 6 bias command (torque)*] [*C35 (Pr. 928) Terminal 6 bias (torque)*]	[*C36 (Pr. 929) Terminal 6 gain command (torque)*] [*C37 (Pr. 929) Terminal 6 gain (torque)*]
9999 (initial value)	—	—	—

—:No function

* Use [*Pr. 148 Stall prevention level at 0V input*] and [*Pr. 149 Stall prevention level at 10V input*] to adjust bias/gain of stall prevention operation level.

(2) Change the torque at maximum analog input [C18(Pr. 920), C36(Pr. 929), C40(Pr. 933)]

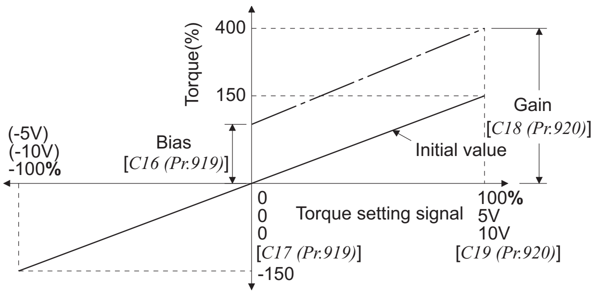
Set [*C18 (Pr. 920)*], [*C36 (Pr. 929)*], [*C40 (Pr. 933)*] when changing only torque setting (gain) of the maximum analog input voltage (current).

(3) Analog input bias/gain calibration [C16 to C19(Pr. 919, 920), C34 to C37(Pr. 928, 929), C38 to C41(Pr. 932, 933)]

The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter to set the torque command and torque limit, e.g. 0 to 5VDC, 0 to 10VDC or 4 to 20mADC, and the torque.

Set the bias torque of the terminal 1 input using [*C16 (Pr. 919)*] . (It is initial value to the torque at 0V)

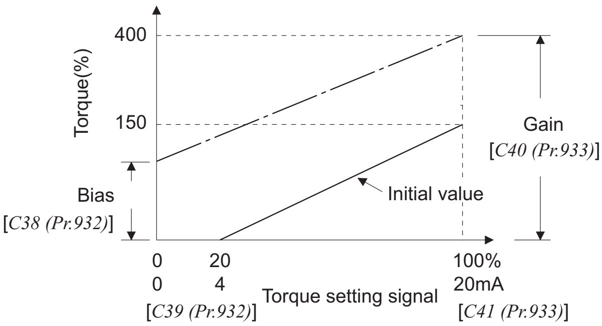
Set the torque in [*C18 (Pr. 920)*] for the torque command voltage set with [*Pr. 73 Analog input selection*]. (Initial value is 10V)



Calibration example of terminal 1

Set the bias torque of the terminal 4 input using [*C38 (Pr. 932)*] . (It is initial value to the torque at 4mA)

Set the torque in [*C40 (Pr. 933)*] for 20mA of the torque command current (4 to 20mA).

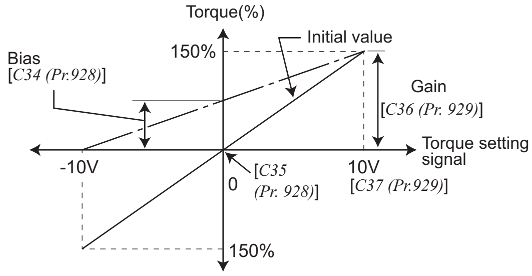


Calibration example of terminal 4

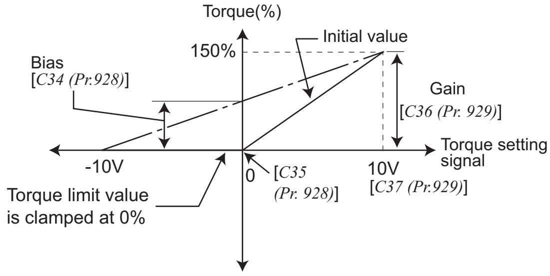
When the voltage/current input specifications were changed using [*Pr. 73 and 267*], be sure to make calibration.

Set [*C34 (Pr. 928)*] for the bias torque of terminal 6 (FR-A7AZ). (Initial value is 0)

Set [*C36 (Pr. 929)*] for the torque of torque command at voltage 10V (Initial value).



Calibration example of terminal 6 (torque command)



Calibration example of terminal 6 ((regenerative) torque limit)

(4) Analog input display unit switchover [*Pr. 241*]

You can change the analog input display unit (%/V/mA) for analog input bias/gain calibration.

Depending on the terminal input specification set in [*Pr. 73*] and [*Pr. 267*], the display units of [*C17 (Pr. 919)*] [*C19(Pr. 920)*], [*C39(Pr. 932)*] and [*C41(Pr. 933)*] change as shown below.

Analog Command (Terminal 1,4) [*Pr. 73, Pr. 267*]	[*Pr. 241* = 0] (Initial Value)	[*Pr. 241* = 1]
0 to 5V input	Displayed in 0 to 100% (displayed in 0.1%)	Displayed in 0 to 5V (0.01V increments)
0 to 10V input	Displayed in 0 to 100% (displayed in 0.1%)	Displayed in 0 to 10V (0.01V increments)
0 to 20mA input	Displayed in 0 to 100% (displayed in 0.1%)	Displayed in 0 to 20mA (0.01mA increments)

2.12.2 Response level of analog input and noise elimination [Pr. 822, 826, 832, 836] (A700)

You can adjust response level and stability of frequency command and torque command at analog input (terminal 1, 2, 4, terminal 6 (FR-A7AZ))

[Pr.]	Name	Initial Value	Setting Range	Description
822	Speed setting filter 1	9999	0 to 5s	Set the time constant of the primary delay filter relative to the external speed command (analog input command).
			9999	[*Pr. 74*] used
826	Torque setting filter 1	9999	0 to 5s	Set the time constant of the primary delay filter relative to the external torque command (analog input command).
			9999	[*Pr. 74*] used
832	Speed setting filter 2	9999	0 to 5s, 9999	Second function of [*Pr. 822*] (valid when RT signal is ON)
836	Torque setting filter 2	9999	0 to 5s, 9999	Second function of [*Pr. 826*] (valid when RT signal is ON)

(1) Time constant of analog speed command input [Pr. 822, 832]

Set the time constant of the primary delay filter relative to the external speed command (analog input command) using [*Pr. 822 Speed setting filter 1*].

Set a large time constant when you want to delay the tracking of the speed command, when the analog input voltage fluctuates, etc.

When you want to change time constant when switching multiple motors with one inverter, etc., use the [*Pr. 832 Speed setting filter 2*].

[*Pr. 832 Speed setting filter 2*] is valid when the RT signal turns ON.

(2) Time constant of analog torque input [Pr. 826, 836]

Set the time constant of the primary delay filter relative to the external torque command (analog input command) using [*Pr. 826 Torque setting filter 1*] during Real sensorless vector control.

Set a large time constant value when you want to delay the tracking of the torque command, when the analog input voltage fluctuates, etc.

When you want to change time constant when switching between two motors with one inverter, etc., use [*Pr. 836 Torque setting filter 2*]. [*Pr. 836 Torque setting filter 2*] is valid when the RT signal turns ON.

2.12.3 Speed detection filter and torque detection filter [Pr. 823, 827, 833, 837] A700

Set the time constant of the primary delay filter relative to the speed feedback signal and torque feedback signal.
Since this function reduces the speed loop response, use it with the initial value.

[Pr.]	Name	Initial Value	Setting Range	Description
823	Speed detection filter 1 AP AL	0.001s	0	Without filter
			0.001 to 0.1s	Set the time constant of the primary delay filter relative to the speed feedback signal.
827	Torque detection filter 1	0s	0	Without filter
			0.001 to 0.1s	Set the time constant of the primary delay filter relative to the torque feedback signal.
833	Speed detection filter 2 AP AL	9999	0 to 0.1s	Second function of [*Pr. 823*] (valid when RT signal is ON)
			9999	Same as the [*Pr. 823*] setting
837	Torque detection filter 2	9999	0 to 0.1s	Second function of [*Pr. 827*] (valid when RT signal is ON)
			9999	Same as the [*Pr. 827*] setting

(1) Stabilize speed detection [Pr. 823, 833]

Since the speed loop response reduces, use it with the initial value.
Increase the setting value gradually and adjust the value to stabilize the speed when speed ripples occur due to high frequency disturbance, etc. A too large value will run the motor unstably.
Speed detection filter is valid only during vector control.

(2) Stabilize the torque detection [Pr. 827, 837]

Since the current loop response reduces, use it with the initial value.
Increase the setting value gradually and adjust the value to stabilize the speed when torque ripples occur due to high frequency disturbance, etc. A too large value will run the motor unstably.

(3) Use multiple primary delay filters

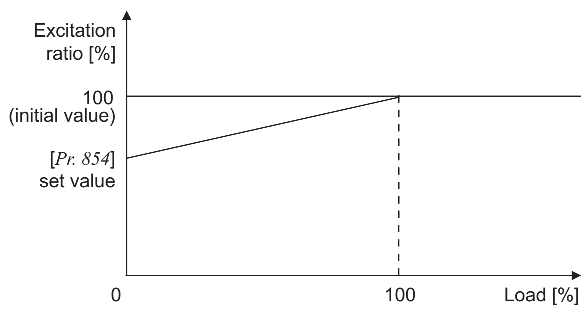
Use [*Pr. 833 and 837*] to change the filter according to applications. [*Pr. 833 and 837*] are valid when the RT signal is ON. Other second function is also valid.

2.12.4 Excitation ratio [Pr. 854] A700

Decrease the excitation ratio when you want to improve efficiency under light load. (Motor magnetic noise decreases.)

[Pr.]	Name	Initial Value	Setting Range	Description
854	Excitation ratio	100%	0 to 100%	Set the excitation ratio under no load.

Note that the rise of output torque becomes slow if excitation ratio is decreased.
This function is appropriate for applications as machine tools which repeat rapid acceleration/deceleration up to high speed.
When 1 (magnetic flux with terminal) is set in [*Pr. 858 Terminal 4 function assignment*] or [*Pr. 868 Terminal 1 function assignment*] , the [*Pr. 854*] setting is invalid.

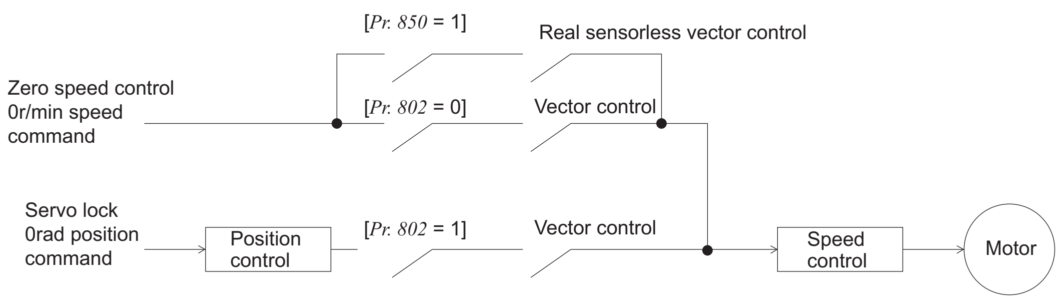


2.12.5 Pre-excitation (zero speed control, servo lock) [Pr. 10, 11, 802, 850] A700

When the start signal (STF, STR) is not input to the inverter (during a stop), turning ON the pre-excitation signal LX enables 0 speed control or servo lock.
At deceleration to stop, either zero speed control or stop with servo lock is selectable even if pre-excitation signal LX is not input.
Zero speed control can be selected during Real sensorless vector control and either zero speed control or servo lock can be selected under vector control.
In DC injection brake operation, DC voltage is directly applied to the motor to prevent the motor shaft from rotating. In zero speed control, vector control is performed to maintain 0r/min. In either control, the motor will not return to the original position if the motor shaft rotates due to external force.
The motor shaft position is maintained with servo rock. The motor will return to the original position if the motor shaft rotates due to external force.

[Pr.]	Name	Initial Value	Setting Range	Description
10	DC injection brake operation frequency	3Hz	0 to 120Hz	Set the operation frequency of the DC injection brake (zero speed control, servo lock).
			9999	Operated at [*Pr. 13*] or less.
11	DC injection brake operation time	0.5s	0	Without DC injection brake (zero speed control, servo lock)
			0.1 to 10s	Set the operation time of the DC injection brake (zero speed control, servo lock).
			8888	Operates when X13 signal is ON
802	Pre-excitation selection AP AL	0	0	Zero speed control
			1	Servo lock
850	Brake operation selection	0	0	DC injection brake operation
			1	Zero speed control

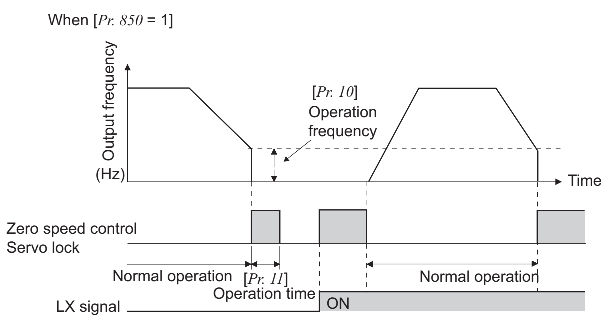
(1) Control block diagram



(2) Operation

When the LX signal is turned ON under Real sensorless vector control or vector control, pre-excitation (zero speed control, servo lock) is performed during a stop.
For the terminal used for LX signal input, set 23 in any of [*Pr. 178 to 189*] to assign the function.
Performing pre-excitation (LX signal and X13 signal) under torque control (Real sensorless vector control) may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.
Although FWD/REV of the operation panel is not lit during pre-excitation, note that voltage is applied to the motor.

When offline auto tuning [*Pr. 96 Auto tuning setting/status* = 1 or 101] is performed during pre-excitation, offline auto tuning is not executed. However, take note that the motor starts rotation.



(3) Brake operation selection [Pr. 850] during Real sensorless vector control

You can select DC injection brake (initial value) or zero speed control for brake operation during Real sensorless vector control.

When [*Pr. 850* = 1], zero speed control is exercised when the frequency reaches or decreases below the frequency set in [*Pr. 10*].

When the X13 signal is ON with [*Pr. 11* = 8888] under Real sensorless vector control, zero speed control is activated regardless of setting of [*Pr. 850 Brake operation selection*].

When restarting from brake operation during Real sensorless vector control, set [*Pr. 850* = 1] (zero speed control). When the setting value is 0 (DC injection brake), it may take about 2s until frequency is actually output from when the start command is input.

(4) Brake operation selection under vector control [*Pr. 802*]

When pre-excitation is performed, select zero speed control or servo lock using [*Pr. 802*] .

Pr. 802 setting	Pre-excitation	Description
0 (initial value)	Zero speed control	Even under load, an attempt is made to maintain 0r/min to keep the motor shaft stopped. Note that if the shaft is overcome and turned by external force, it does not return to the original position. Position control is not exercised and only speed control is carried out to perform operation.
1	Servo lock	Even under load, an attempt is made to maintain the motor shaft position. Note that if the shaft is turned by external force, it returns to the original position after the external force has gone away. Since position control is exercised, you can adjust this position loop gain using [*Pr. 422 Position loop gain*].

(5) Operation frequency setting [Pr. 10].

After the frequency at which the DC injection brake (zero speed control, servo lock) will be operated is set to [*Pr. 10*], the DC voltage is applied (zero speed control, servo lock) to the motor when this frequency is reached during deceleration.

At [*Pr. 10* = 9999] , DC injection brake (zero speed control, servo lock) is operated when the speed has decreased to the frequency set in [*Pr. 13 Start frequency*] .

Performing pre-excitation (zero speed control) under Real sensorless vector may cause motor vibration, etc. at deceleration to stop. To prevent this, set [*Pr. 10 DC injection brake operation frequency*] to 0.5Hz or less.

The initial value of [*Pr. 10*] automatically changes to 0.5Hz during vector control.

(6) Operation time setting (X13 signal) [Pr. 11]

Use [*Pr. 11*] to set the duration period the DC injection brake (zero speed control, servo lock) is applied.

When the motor does not stop due to large inertia (J), increasing the setting produces an effect.

When [*Pr. 11* = 0s], DC injection brake (zero speed control, servo lock) will not operate. (At a stop, the motor coasts.)

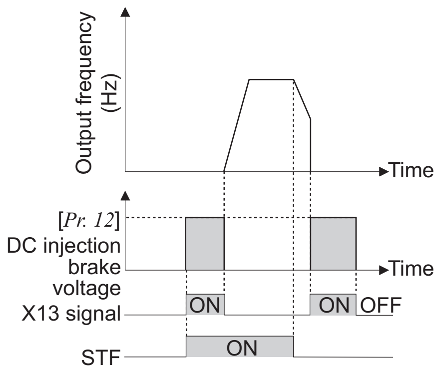
When [*Pr. 11* = 8888], the DC injection brake (zero speed control, servo lock) will operate when the X13 signal is turned ON. Turning the X13 signal ON during operation will operate DC injection brake (zero speed control, servo lock).

For the terminal used for the X13 signal input, set 13 in any of [*Pr. 178 to 189*] to assign the function.

When the X13 signal is ON with [*Pr. 11* = 8888] under Real sensorless vector control, zero speed control is activated regardless of the setting of [*Pr. 850 Brake operation selection*].

Under vector control, zero speed control or servo rock is activated according to the [*Pr. 802*] setting.

[When *Pr. 11* = 8888]



Control Method	Control Mode	[*Pr. 802*]	[*Pr. 850*]	Decelerates to Stop	LX-ON	X13-ON [*Pr. 11* = 8888]
V/F control	—	—	—	DC injection brake	—	DC injection brake
Advanced magnetic flux vector control	—	—	—	DC injection brake	—	DC injection brake
Real sensorless vector control	Speed	—	0	DC injection brake	Zero speed	Zero speed
		—	1	Zero speed		
	Torque	—	0	DC injection brake	Zero speed	Zero speed
		—	1	Zero speed		
Vector control	Speed	0	—	Zero speed	Zero speed	Zero speed
		1	—	Servo lock	Servo lock	Servo lock
	Torque	—	—	Zero speed	Zero speed	Zero speed
	Position	—	—	—	Servo lock	—

2.13 Selection of DC injection brake and regenerative brake

2.13.1 DC injection brake [Pr. 10 to 12] (common)

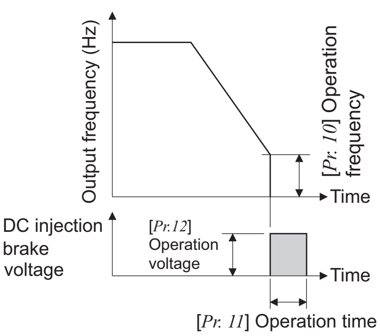
DC injection brake operation is a braking operation which prevents the motor shaft from rotating by directly applying DC voltage to the motor.
When decelerating, the motor run by the inverter to stop, DC injection brake at 3Hz or less is applied. Operation time of this DC injection brake and braking torque (DC injection brake voltage) can be adjusted.

In addition, DC injection brake operation frequency can be adjusted.
Refer to page 325 for brake operation during Real sensorless vector control and vector control.

[Pr.]	Name	Initial Value		Setting Range	Description	Available Inverters A700	F700	E700 D700
10	DC injection brake operation frequency	3Hz		0 to 120Hz	Set the operation frequency of the DC injection brake (zero speed control, servo lock).	○	○	○
				9999	Operated at [*Pr. 13*] or less.			—
11	DC injection brake operation time	0.5s		0	Without DC injection brake (zero speed control, servo lock)	○	○	○
				0.1 to 10s	Set the operation time of the DC injection brake (zero speed control, servo lock).			
				8888	Operates when X13 signal is ON	○	—	—
12	DC injection brake operation voltage	0.1K, 0.2K	6%	0 to 30%	Set the DC injection brake voltage (torque). When 0 is set, DC injection brake is disabled.	○	○	○
		0.4K to 7.5K	4%					
		11K to 55K	2%					
		75K or more	1%					

(1) Operation frequency setting [Pr. 10]

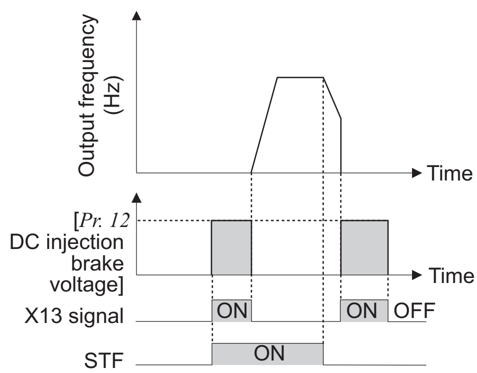
When the DC injection operating frequency is set to [*Pr. 10*] and the output frequency reaches to the set frequency during deceleration, the DC voltage is applied to the motor.
When the output frequency decelerates to the set frequency of [*Pr.13 Starting frequency*] while [*Pr.10* = 9999] in (A700) (F700), DC voltage applies to the motor.



(2) Operation time setting (X13 signal) [Pr. 11]

In [*Pr. 11*], set the time of the DC injection brake.
When the motor does not stop due to large inertia (J), increasing the setting produces an effect.
When [*Pr. 11* = 0s], the DC injection brake is disabled. (At a stop, the motor coasts.)
For (A700), turning ON the X13 signal when [*Pr. 11* = 8888] starts DC injection brake. Turning ON the X13 signal starts DC injection brake even during inverter operation.
For the terminal used for the X13 signal input, set 13 in any of [*Pr. 178 to 189*] to assign the function.
When the X13 signal is ON with [*Pr. 11* = 8888] under Real sensorless vector control, zero speed control is activated regardless of the setting of [*Pr. 850 Brake operation selection*]. (Refer to page 325)

(A700) **[When Pr. 11 = 8888]**



(3) Operation voltage (torque) setting [Pr. 12]

Use [*Pr. 12*] to set the percentage to the power supply voltage. (For A700, this parameter is not used during zero speed control or servo lock.)
When [*Pr. 12* = 0%], the DC injection brake is disabled. (At a stop, the motor coasts.)
Even [*Pr. 12*] setting is set larger, braking torque is limited so that output current is within the inverter rated current.
When using the constant-torque motor (SF-JRCA) and energy saving motor (SF-HR, SF-HRCA), change the [*Pr. 12*] setting as follows:

SF-JRCA: 3.7K or less ...4%, 5.5K to 55K ...2%
SF-HR, SF-HRCA: 3.7K or less...4%, 5.5K, 7.5K...3%, 11K to 55K...2% (30K...1.5%)

For the 5.5K, 7.5K, when the [*Pr. 12*] setting is the following, changing the [*Pr. 71 Applied motor*] setting automatically changes the [*Pr. 12*] setting. Therefore, it is not necessary to change the [*Pr. 12*] setting.

	[Pr. 71] Setting	
	Standard Motor (Initial Value)	Constant-torque Motor
0.1K, 0.2K	6%	4%
0.4K to 3.7K	4%	4%
5.5K, 7.5K	4%	2%
11K to 55K	2%	2%
75K or more	1%	1%

2.13.2 Stop selection, start signal selection [Pr. 250] (common)

Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching OFF of the start signal.
You can also select the operations of the start signals (STF/STR).

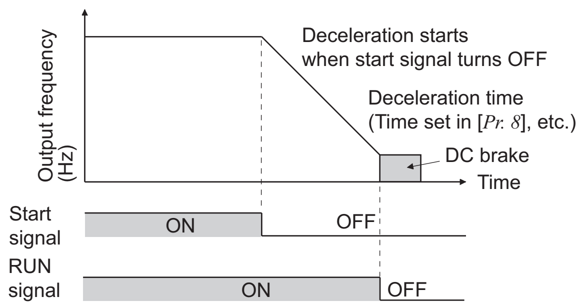
Stop selection is invalid when the following functions are activated.

- •Position control ([*Pr. 419* = 0])
- •Power failure stop function ([*Pr. 261*])
- •PU stop ([*Pr. 75*])
- •Deceleration stop because of fault definition ([*Pr. 875*])
- •Deceleration stop because of communication fault ([*Pr. 502*])
- •JOG operation mode
- •Offline auto tuning (with motor running)
- •Emergency stop by LONWORKS communication

[Pr.]	Name	Initial Value	Setting Range	Description	
				Start signal (STF/STR)	Stop operation
250	Stop selection	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF.
			1000s to 1100s	STF signal: Start signal STR signal: Forward/reverse signal	The motor is coasted to a stop ([*Pr. 250*] - 1000)s after the start signal is turned OFF.
			9999	STF signal: Forward rotation start STR signal: Reverse rotation start	When the start signal is turned OFF, the motor decelerates to stop.
			8888	STF signal: Start signal STR signal: Forward/reverse signal	

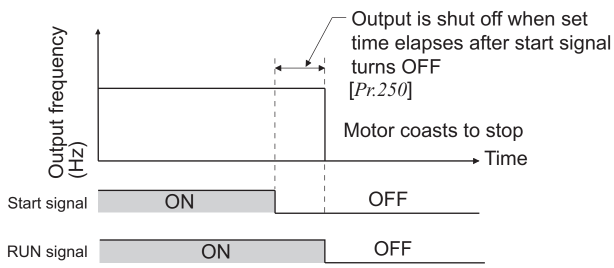
(1) Decelerate the motor to a stop

Set [*Pr. 250* = 9999 or 8888].
The motor decelerates to a stop when the start signal (STF/STR) turns OFF.



(2) Coast the motor to a stop

In [*Pr. 250*] , set the time from when the start signal turns OFF until the output is shut off. When any of 1000 to 1100 is set, the output is shut off after ([*Pr. 250*] - 1000)s.
The output is shut off when the time set in [*Pr. 250*] has elapsed after the start signal had turned OFF. The motor coasts to a stop.
Motor accelerates/decelerates according to the frequency command until output is stopped by start signal OFF. To maintain the output frequency until output is stopped by start signal OFF, do not turn OFF frequency signal and keep it ON.
The RUN signal turns OFF when the output stops.



(3) Start signal selection

STF	STR	[Pr. 250] Setting and Inverter Status	
		0 to 100s, 9999	1000s to 1100s, 8888
OFF	OFF	Stop	Stop
OFF	ON	Reverse rotation	
ON	OFF	Forward rotation	Forward rotation
ON	ON	Stop	Reverse rotation

2.13.3 Selection of regenerative brake and DC feeding [Pr. 30, 70] (common)

When making frequent starts/stops, use the optional high-duty brake resistor (FR-ABR), brake unit (FR-BU2, BU, FR-BU, MT-BU) to increase the regenerative brake duty.
Use a power regeneration common converter (FR-CV) or power regeneration converter (MT-RC) for continuous operation in regeneration status.

Use a high power factor converter (FR-HC, MT-HC) to reduce harmonics, improve the power factor, or continuously use the regeneration mode.
In addition, either DC feeding mode 1 in which operation is performed with DC power (terminal P, N) or DC feeding mode 2 in which operation is performed normally with the AC power (terminal R, S, T) and performed with DC power such as battery at occurrence of power failure can be selected.

● (A700) (F700)

[Pr.]	Name	Initial Value	Setting Range		Description: Regeneration unit	Description: Terminal for power supply to the inverter	Available Inverters: A700	Available Inverters: F700
30	Regenerative function selection	0	0		Built-in brake resistor, without regeneration function, brake unit (FR-BU2, BU, BU type)	R, S, T	○	○
			10			P, N (DC feeding mode 1)	○	—
			20			R, S, T/P, N (DC feeding mode 2)	○	—
			1		High-duty brake resistor, Brake unit (MT-BU5), Power regeneration converter (MT-RC)	R, S, T	○	○
			11			P, N (DC feeding mode 1)	○	—
			21			R, S, T/P, N (DC feeding mode 2)	○	—
			2		High power factor converter (FR-HC, MT-HC), Power regeneration common converter (FR-CV)	P, N	○	○
70	Special regenerative brake duty	0%	55K or less	0 to 30%	Set the %ED of the transistor operation when using a built-in brake resistor and brake unit (MT-BU5).		○	—
			75K or more	0 to 10%				○

● (E700) (D700)

[Pr.]	Name	Initial Value	Setting Range	Description: Regeneration unit
30	Regenerative function selection	0	0	Without regenerative function, Brake resistor (MRS type), Brake unit (FR-BU2) Power regeneration common converter (FR-CV) High power factor converter (FR-HC)
			1	High-duty brake resistor (FR-ABR)
			2	High power factor converter (FR-HC) when automatic restart after instantaneous power failure is selected
70	Special regenerative brake duty	0%	0 to 30%	Brake duty when using the high-duty brake resistor (FR-ABR)

(1) When using a built-in brake resistor (A700)

Set [*Pr. 30* = 0, 10, 20]. The [*Pr. 70*] setting is invalid.
At this time, the regenerative brake duty is as follows.
(The built-in brake resistor is provided for the 7.5K or less.)

Inverter type	Duty
FR-A720-0.4K to 3.7K	3%
FR-A720-5.5K and 7.5K	2%
FR-A740-0.4K to 7.5K	2%
Other than above (without built-in brake resistor)	0%

(F700) (E700) (D700) are not equipped with a built-in brake resistor.

(2) When using brake resistor (MRS type) (E700) (D700)

Set [*Pr. 30* = 0]. [*Pr. 70*] setting becomes invalid.
At this time, the regenerative brake duty is as follows.

Inverter type	Duty
FR-E720-0.4K to 3.7K	3%
FR-E720-5.5K to 15K	2%
FR-E740-0.4K to 15K	2%
FR-D740-0.4K to 15K	2%

(3) When using brake resistor (MYS type)

MYS type brake resistor is available for 200V class 3.7K. At this time, set [*Pr. 30* = 1], [*Pr. 70* = 6%].

(4) When using the high-duty brake resistor (FR-ABR) (22K or less) (A700) (E700) (D700)

Set [*Pr. 30* = 1, 11, 21].
Set [*Pr. 70*] as follows.

Capacity	[Pr. 70] Setting
7.5K or less	10%
11K to 22K	6%

High-duty brake resistor (FR-ABR) cannot be connected to (A700) 30K or more, (E700) (D700) 0.2K or less, or (F700).

(5) When the brake unit (FR-BU2, BU, FR-BU) is used. (common)

Set [*Pr. 30* = 0, 10, 20]. The [*Pr. 70*] setting is invalid.

(6) When using the brake unit (MT-BU5) or power regeneration converter (MT-RC) (75K or more) (A700) (F700)

Set [*Pr. 30* = 1, 11, 21].
Set [*Pr. 70* = 10%] when using the brake unit (MT-BU5).
Set [*Pr. 70* = 0%] when using the regeneration converter (MT-RC).

(7) When using the high power factor converter (FR-HC, MT-HC) or power regeneration common converter (FR-CV) (A700) (F700)

Set [*Pr. 30* = 2]. The [*Pr. 70*] setting is invalid.
Also built-in brake transistor is invalid.
Changing the setting to [*Pr. 30* = 2] causes inverter reset and "Err" to be displayed on the operation panel.
Use any of [*Pr. 178 to 189 input terminal function assignment*] to assign the following signals to the contact input terminals.

(a) X10 signal: FR-HC, MT-HC connection, FR-CV connection (inverter operation enable signal)
To make protective coordination with the FR-HC, MT-HC or FR-CV, use the inverter operation enable signal to shut off the inverter output.
Input the RDY signal of the FR-HC, MT-HC (RDYB signal of the FR-CV).

(b) X11 signal: FR-HC, MT-HC connection (instantaneous power failure detection signal)
When the setting has been made to hold the mode at occurrence of an instantaneous power failure for RS-485 communication operation, use this signal to hold the mode.
Input the Y1 or Y2 signal (instantaneous power failure detection signal) of the FR-HC, MT-HC.

For the terminal used for the X10, X11 signal input, set 10 and 11 in any of [*Pr. 178 to 189*] to assign the function.

(8) When using power regeneration common converter (FR-CV), high power factor converter (FR-HC) (E700) (D700)

Set [*Pr. 30* = 0]. [*Pr. 70*] setting is invalid. Assign inverter operation enable signal (X10) to contact input terminal. Shut off the inverter output by the inverter operation enable signal (X10) to make protective coordination with FR-HC and FR-CV.
Input RDY signal of FR-HC (RDYB signal of FR-CV).
For the terminal to input X10 signal, assign the function by setting "10 (X10)" to any of [*Pr. 178 to 184 Input terminal function selection*].

(9) When automatic restart after instantaneous power failure function is valid while using high power factor converter (FR-HC) (E700) (D700)

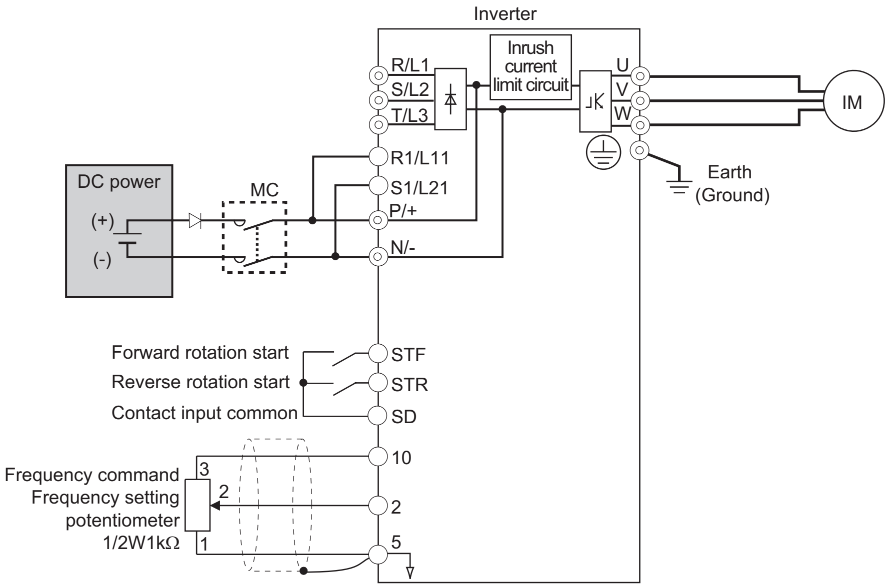
When automatic restart after instantaneous power failure is valid [*Pr. 57 Restart coasting time* ≠ 9999] in FR-HC and inverter, set [*Pr. 30* = 2].
Set [*Pr. 70* = 0% (initial value)].
RDY signal turns ON if FR-HC detects power failure during inverter operation, and motor coasts. If RDY signal is turned OFF after power is restored, inverter detects motor speed (depending on the [*Pr.162 Automatic restart after instantaneous power failure selection*] setting) and restarts after instantaneous power failure. Changing the setting to [*Pr. 30* = 2] causes inverter reset and "Err" to be displayed on the operation panel.

(10) DC feeding mode1 [Pr. 30 = 10, 11] (A700)

Setting [*Pr. 30* = 10, 11] enables DC power supply operation. Built-in brake transistor control is valid.

Leave the AC power supply connection terminals R/L1, S/L2, and T/L3 open and connect the DC power supply to terminals P/+ and N/-. Also, remove jumpers across terminals R/L1 and R/1/L11 and across terminals S/L2 and S1/L21. And connect terminals R1/L11 and S1/L21 to terminal P/+ and N/-.

The diagram below is a connection example.



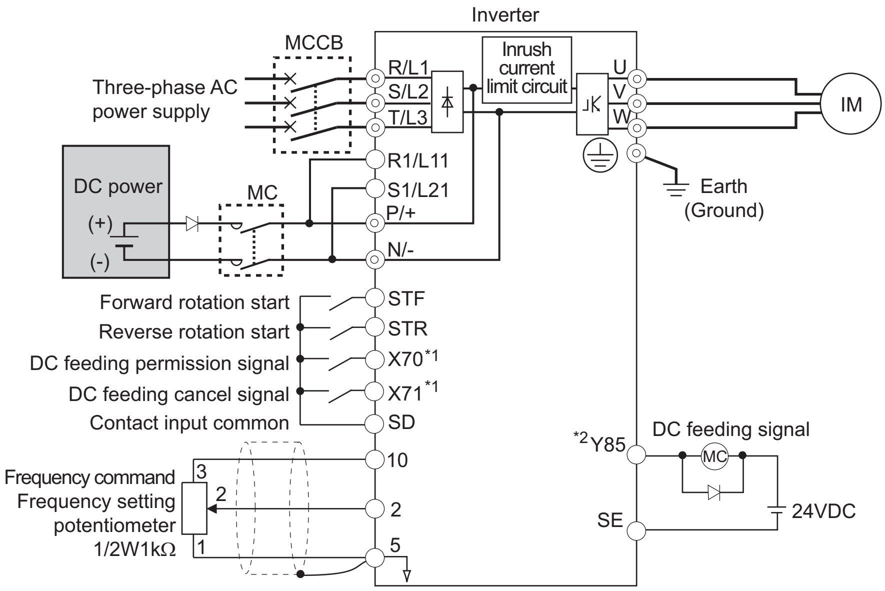
(11) DC feeding mode 2 [Pr. 30 = 20, 21] (A700)

When [*Pr. 30* = 20, 21], operation is performed with AC power normally and with DC power such as battery at power failure. Built-in brake transistor control is valid.

Connect the AC power supply to terminal R/L1, S/L2, and T/L3 and connect the DC power supply to terminal P/+ and N/-. Also, remove jumpers across terminal R/L1 and R/1/L11 and across terminal S/L2 and S1/L21. And connect terminals R1/L11 and S1/L21 to terminal P/+ and N/-.

Turning ON the DC feeding operation permission signal (X70) enables DC power supply operation.

The following shows the connection diagram when switching to a DC power using inverter power failure detection.



*1 Assign the function using [*Pr. 178 to 189 input terminal function selection*].

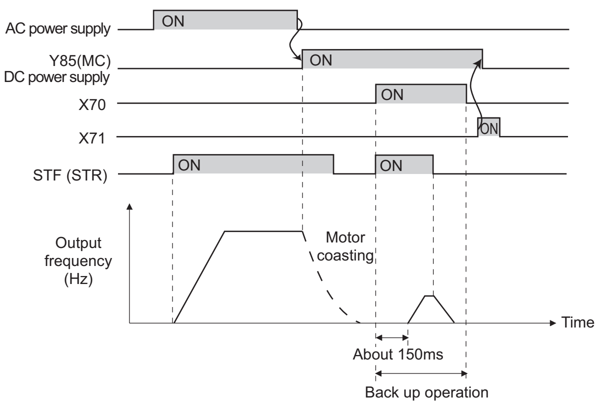
*2 Assign the function using [*Pr. 190 to 196 output terminal function selection*].

2

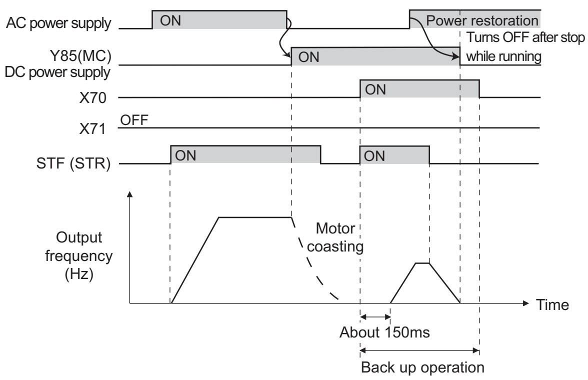
PARAMETER

Signal		Name	Description	Parameter Setting
Input	X70	DC feeding operation permission signal	When performing operation with DC feeding, turn ON the X70 signal. When the inverter output is shut off because of power failure, the inverter starts about 150ms after switching ON X70 signal. (When automatic restart operation is valid, the inverter starts after additional [*Pr. 57*] set time has elapsed.) When the X70 signal turns OFF during inverter operation, output is shutoff ([*Pr. 261* = 0]) or the inverter is decelerated to a stop ([*Pr. 261* ≠ 0]).	Set 70 in any of [*Pr. 178 to 189*].
Input	X71	DC feeding cancel signal	Turn this signal ON to stop DC feeding. When the X71 signal is turned ON during inverter operation with turning ON the X70 signal, output is shutoff ([*Pr. 261* = 0]) or the inverter is decelerated to a stop ([*Pr. 261* ≠ 0]), then the X85 signal turns OFF after the inverter stop. After turning ON of the X71 signal, operation can not be performed even if the X70 signal is turned ON.	Set 71 in any of [*Pr. 178 to 189*].
Output	Y85	DC feeding signal	This signal turns ON during power failure or under voltage of AC power. The signal turns OFF when the X71 signal turns ON or power is restored. The Y85 signal does not turn OFF during inverter operation even if the power is restored and turns OFF after an inverter stop. When the Y85 signal turns ON because of undervoltage, the Y85 signal does not turn OFF even if undervoltage is eliminated. ON/OFF status is retained at an inverter reset.	Set 85 (positive logic) or 185 (negative logic) in any of [*Pr. 190 to 196*] .

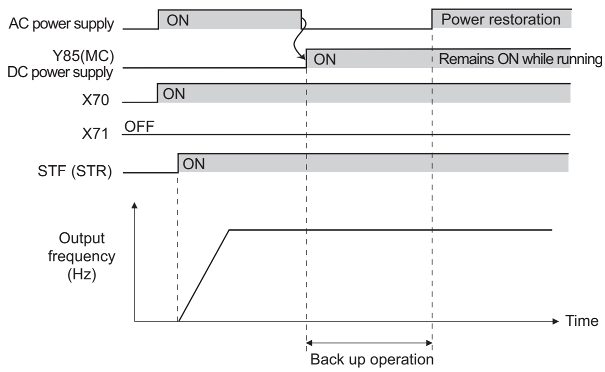
Operation example 1 at power failure



Operation example 2 at power failure (when AC power is restored)



Operation example 3 at power failure (when continuous operation is performed)



(12) Power supply specification at DC feeding

A700

As voltage between P and N becomes 415VDC (830VDC) or more temporarily at regeneration, select DC power supply carefully.

200V class	Rated input DC voltage	283 VDC to 339 VDC
	Permissible fluctuation	240VDC to 373VDC
400V class	Rated input DC voltage	537VDC to 679 VDC
	Permissible fluctuation	457VDC to 740VDC

2.14 Stall prevention operation and regeneration avoidance operation

2.14.1 Overcurrent stall prevention operation [Pr. 22, 23, 48, 49*, 66, 114*, 115*, 148*, 149*, 154*, 156, 157, 277*, 858*, 868*] common

(*[Pr. 114, 115, 858, 868] are not available for F700.)
(*[Pr. 49, 114, 115, 148, 149, 154, 858, 868] are not available for E700 D700.)
(*[Pr. 277] is available for only E700.)

This function monitors the output current and automatically changes the output frequency to prevent the inverter from coming to trip due to overcurrent, overvoltage, etc. It can also limit stall prevention and fast-response current limit operation during acceleration/deceleration, driving or regeneration.
It is invalid under Real sensorless vector control and vector control by A700. (It serve as torque limit and not as stall prevention operation (current limit). Refer to page 283)

- Stall prevention
  If the output current exceeds the stall prevention operation level, the output frequency of the inverter is automatically varied to reduce the output current .
  Also the second stall prevention function can restrict the output frequency range in which the stall prevention function is valid.
  In E700, output current and output torque can be chosen and limited.
- Fast-response current limit
  If the current exceeds the limit value, the output of the inverter is shut off to prevent an overcurrent.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters			
					A700	F700	E700	D700
22	Stall prevention operation level	A700 E700 D700 150% F700 120%	0	Stall prevention operation selection becomes invalid.	○	○	○	○
			A700 0.1 to 400% F700 0.1 to 150% E700 D700 0.1 to 200%	Set the current value at which stall prevention operation will be started.	○	○	○	○
			9999	Analog variable	—	○	—	—
23	Stall prevention operation level compensation factor at double speed	9999	0 to 200%	The stall operation level can be reduced when operating at a high speed above the rated frequency.	○	○	○	○
			9999	Constant according to [*Pr. 22*]				
48	Second stall prevention operation current	A700 E700 D700 150% F700 120%	0	Second stall prevention operation invalid	○	○	○	○
			A700 0.1 to 220% F700 0.1 to 150% E700 D700 0.1 to 200%	The second stall prevention operation level can be set.				
			9999	Same level with [*Pr. 22*]	—	—	○	○
49	Second stall prevention operation frequency	0Hz	0	Second stall prevention operation invalid	○	○	—	—
			0.01 to 400Hz	Set the frequency at which stall prevention operation of [*Pr. 48*] is started.				
			9999	[*Pr. 48*] is valid when the RT signal is ON.				
66	Stall prevention operation reduction starting frequency	60Hz	0 to 400Hz	Set the frequency at which the stall operation level is started to reduce.	○	○	○	○
114	Third stall prevention operation current	150%	0	Third stall prevention operation invalid	○	—	—	—
			0.1 to 220%	The stall prevention operation level can be changed with the X9 signal.				
115	Third stall prevention operation frequency	0Hz	0	Third stall prevention operation invalid	○	—	—	—
			0.01 to 400Hz	Set the frequency at which stall prevention operation starts when the X9 signal is ON.				

[Pr.]	Name	Initial Value	Setting Range	Description		Available Inverters A700	F700	E700	D700
148	Stall prevention level at 0V input	A700 150% F700 120%	A700 0 to 220% F700 0 to 150%	Stall prevention operation level can be changed by the analog signal input to terminal1 and 4 (For F700, input is to terminal 1 only).		○	○	—	—
149	Stall prevention level at 10V input	A700 200% F700 150%	A700 0 to 220% F700 0 to 150%			○	○	—	—
154	Voltage reduction selection during stall prevention operation	1	0	With voltage reduction	You can select whether to use output voltage reduction during stall prevention operation or not.	○	○	—	—
			1	Without voltage reduction					
156	Stall prevention operation selection	0	0 to 31, 100, 101	You can select whether stall prevention operation and fast-response current limit operation will be performed or not.		○	○	○	○
157	OL signal output timer	0s	0 to 25s	Set the output start time of the OL signal output when stall prevention is activated.		○	○	○	○
			9999	Without the OL signal output					
277	Stall prevention operation current switchover	0	0	Output current is the limit level		—	—	○	—
			1	Output torque (torque current) is the limit level					
406	High resolution analog input selection AZ	9999	0, 2 to 6, 9999	When the setting value is "4", stall prevention operation level can be changed by the signal output to terminal 6.		○	—	—	—
858	Terminal 4 function assignment	0	0, 1, 4, 9999	By setting 4, the stall prevention operation level can be changed with a signal to terminal 4.		○	—	—	—
868	Terminal 1 function assignment	0	0 to 6, 9999	By setting 4, the stall prevention operation level can be changed with a signal to terminal 1.		○	—	—	—

(1) Setting of stall prevention operation level [Pr. 22] (common)

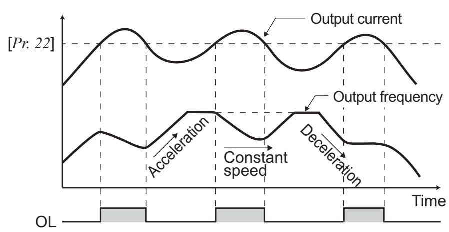
Set in [*Pr. 22*] the percentage of the output current to the rated inverter current at which stall prevention operation will be performed. Normally, set 150% (initial value) for A700 E700 D700, and set 120% (initial value) for F700.

During acceleration, stall prevention operation stops acceleration. During constant speed, it decelerates, and during deceleration, it stops deceleration. If stall prevention operated during deceleration to stop, the inverter would not stop. To prevent this, stall prevention during deceleration becomes invalid after 3s so that motor decelerates to a stop.

When stall prevention operation is performed, the OL signal is output.

If an overload status lasts long, an inverter trip (e.g. electronic thermal O/L relay) (E.THM)) may occur.

When [*Pr. 156*] has been set to activate the fast-response current limit (initial value), the [*Pr. 22*] setting should not be higher than 170%. (140% for F700) If fast-response current limit activates, torque may not be generated.



Stall prevention operation example

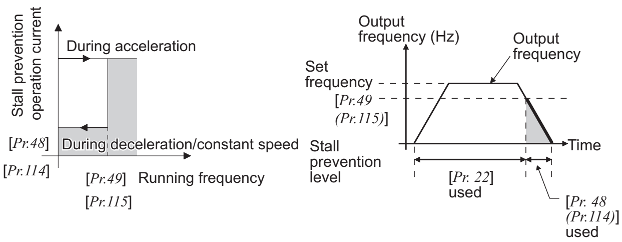
(2) Second, third stall prevention operation level [Pr. 48, 49**, 114* **, 115* **] (*Not available for F700.) (**Not available for E700 D700.) (common)

In A700 F700, [*Pr. 48 Second stall prevention operation current*] is valid when [*Pr. 49 Second stall prevention operation frequency* = 9999] and RT signal is ON. In E700 D700, [*Pr. 48*] is valid when RT signals is ON.

When [*Pr. 49 (115)* ≠ 0] in A700 F700, the stall prevention operation level for output frequency from 0Hz to [*Pr. 49 (115)*] can be set to [*Pr. 48 (114)*]. Note that the operation level follows the [*Pr. 22*] setting during acceleration.

This function can also be used for stop-on-contact or similar operation by decreasing the [*Pr. 48 (114)*] setting to weaken the deceleration torque (stopping torque).

[*Pr. 114 and Pr. 115*] of A700 are valid when the X9 signal is ON. For the terminal used for X9 signal input, set 9 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the X9 signal function.



Operation example when frequency is set in [*Pr.49 (115)*] in A700.

<table>
<tr><th rowspan="2">[Pr. 49] Setting</th><th colspan="2">A700 F700 Stall Prevention Operation Level</th></tr>
<tr><th>RT signal-OFF</th><th>RT signal-ON</th></tr>
<tr><td>0(initial value)</td><td colspan="2">[Pr. 22] (Second stall prevention function is not activated)</td></tr>
<tr><td>0.01 to 400Hz</td><td colspan="2">
<table>
<tr><th></th><th>Output frequency ≤ [Pr. 49]</th><th>[Pr. 49] < Output frequency</th></tr>
<tr><td>Acceleration</td><td colspan="2">[Pr. 22]</td></tr>
<tr><td>Constant speed Deceleration</td><td>[Pr. 48]*1</td><td>[Pr. 22]</td></tr>
</table>
</td></tr>
<tr><td>9999*2</td><td>[Pr. 22]</td><td>[Pr. 48]*3</td></tr>
</table>

*1 The smaller setting of the stall prevention operation levels set in [Pr. 22] and [Pr. 48] has a higher priority. When [Pr. 48 = 0], stall prevention level operates as 0%.

*2 Even when stall prevention operation level is variable by analog input, turning the RT signal ON also switches from analog input level to the stall prevention operation level using [Pr. 48]. (The second stall prevention operation level cannot be input by analog.)

*3 When [Pr. 48 = 0], stall prevention operation is not performed.

*4 When X9 signal is turned ON, the third stall prevention function has precedence.

<table>
<tr><th rowspan="2">[Pr. 115] Setting</th><th colspan="2">A700 Stall Prevention Operation Level</th></tr>
<tr><th>X9 Signal-OFF:</th><th>X9 Signal-ON:</th></tr>
<tr><td>0(initial value)</td><td colspan="2">[Pr. 22] *1(Third stall prevention function is not activated)</td></tr>
<tr><td>0.01 to 400Hz</td><td>[Pr. 22] *1</td><td>
<table>
<tr><th></th><th>Output frequency ≤ [Pr. 115]</th><th>[Pr. 115] < Output frequency</th></tr>
<tr><td>Acceleration</td><td colspan="2">[Pr. 22]*2</td></tr>
<tr><td>Constant speed Deceleration</td><td>[Pr. 114]*3</td><td>[Pr. 22]*3</td></tr>
</table>
</td></tr>
</table>

*1 As set in Second stall prevention operation.

*2 Stall operation level is as set in [Pr. 48] when the RT signal is ON with [Pr. 49 = 9999]. When [Pr. 48 = 0], stall prevention operation is not performed.

*3 The smaller setting of the stall prevention operation levels set in [Pr. 22] and [Pr. 114] has a higher priority. When [Pr. 114 = 0], stall prevention level operates as 0%.

(3) Stall prevention at double speed [Pr. 23, Pr. 66] (common)

During high-speed operation above the rated motor frequency, acceleration may not be made because the motor current does not increase. If operation is performed in a high frequency range, the current at motor lockup becomes smaller than the rated output current of the inverter, and the protective function (OL) is not executed even if the motor is at a stop.

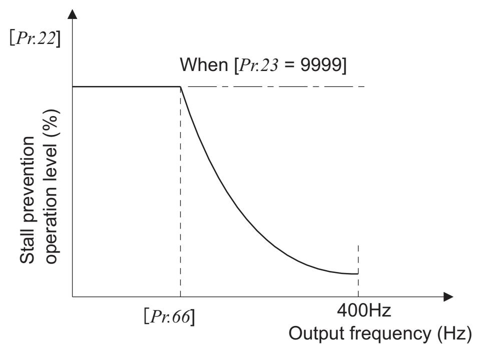
To improve the operating characteristics of the motor in this case, the stall prevention level can be reduced in the high frequency range. This function is effective for performing operation up to the high-speed range on a centrifugal separator etc. Normally, set [Pr. 66 = 60Hz] and [Pr. 23 = 100%].

Setting [Pr. 23 *Stall prevention operation level compensation factor at double speed* = 9999] (initial value) will make the stall prevention operation level constant up to 400Hz with [Pr. 22] setting.

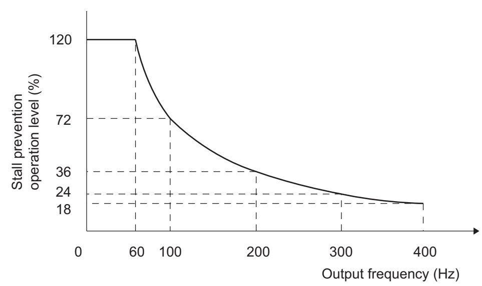
$$\text{Stall prevention operation level at} = A+B\times\left(\frac{[Pr.\,22]-A}{[Pr.\,22]-B}\right)\times\left(\frac{[Pr.\,23]-100}{100}\right)$$

Note that $A = \dfrac{[Pr.\,66](Hz)\times[Pr.\,22](\%)}{\text{Output frequency (Hz)}}$

$B = \dfrac{[Pr.\,66](Hz)\times[Pr.\,22](\%)}{400\ (Hz)}$



[Setting example] [Pr. 22 = 120%], [Pr. 23 = 100%], [Pr. 66 = 60Hz]



(4) Analog variable stall prevention operation level setting [Pr. 22, 148, 149, 406*, 858*, 868*] (*not available for F700) A700 F700

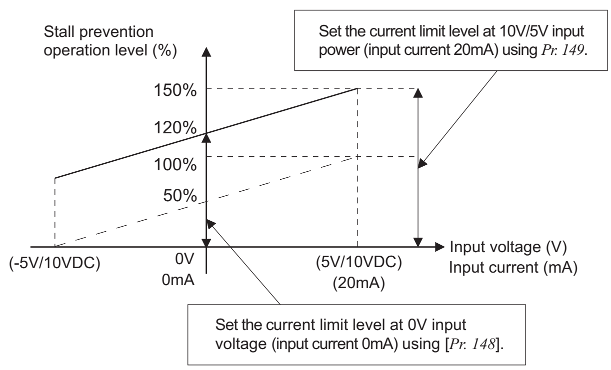
For A700, set [*Pr. 868 Terminal 1 function assignment* = 4] to set stall prevention operation level using terminal 1 (analog input). (Refer to page 46 for terminal1 function assignment)

For F700, set [*Pr. 22 Stall prevention operation level* = 9999] to set stall prevention operation level using terminal 1 (analog input).
At this time, other functions of terminal 1 (auxiliary input, override function, PID control) do not function.
Input 0 to 5V (or 0 to 10V) to the terminal 1. For selection of 5V and 10V, use [*Pr. 73 Analog input selection*]. When [*Pr. 73* = 1] (initial value), 0 to ±10V is input.

For A700, set [*Pr. 858 Terminal 4 function assignment* = 4] to set stall prevention operation level using terminal 4 (analog input). When 4 is set in both [*Pr. 858*] and [*Pr. 868*], function of terminal 1 has higher priority and terminal 4 has no function. (Refer to page 46 for terminal 4 function assignment)
Input 0 to 20mA to terminal 4. Turning ON of AU signal is not necessary. PID control and speed command from terminal 4 do not function even if the AU signal turns ON.

For F700, stall prevention operation level can not be set using terminal 4.

When using A700 with FR-A7AZ, stall prevention operation level can be also set to terminal 6 (analog input). For this, set [*Pr. 406 High resolution analog input selection* = 4]. When [*Pr. 858* = 4] and [*Pr. 868* = 4] while [*Pr. 406 High resolution analog input selection* = 4], terminal 6 is the stall prevention operation level, and terminal 1 and terminal 4 does not have a function.
Set stall prevention operation level at 0V (0mA) input voltage in [*Pr. 148 Stall prevention level at 0V input*] .
Set stall prevention operation level at 10V/5V(20mA) input voltage in [*Pr. 149 Stall prevention level at 10V input*].



(5) Stall prevention operation and limit of fast-response current limit operation [Pr. 156] common

Use [*Pr. 156*] to select whether stall prevention operation or fast-response current limit operation will be performed or not and the operation at OL signal output.
When the load is heavy, or the acceleration/ deceleration time is short, stall prevention is activated and acceleration/deceleration may not be made according to the preset acceleration/deceleration time. Set [*Pr. 156*] and stall prevention operation level to the optimum values.
In vertical lift applications, make setting so that the fast-response current limit is not activated. Torque may not be produced, causing a drop due to gravity.
[Setting example]
Fan/Pump 0
Lifting device/traveling machine 9
(a stop distance at deceleration should not change)

[Pr. 156] Setting	Fast Response Current Limit*1 ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation Continued ●: Operation is not Continued *2
		Acceleration	Constant speed	Deceleration	
0 (initial value)	○	○	○	○	○
1	●	○	○	○	○
2	○	●	○	○	○
3	●	●	○	○	○
4	○	○	●	○	○
5	●	○	●	○	○
6	○	●	●	○	○
7	●	●	●	○	○
8	○	○	○	●	○
9	●	○	○	●	○
10	○	●	○	●	○
11	●	●	○	●	○
12	○	○	●	●	○
13	●	○	●	●	○
14	○	●	●	●	A700 F700 ○ E700 D700 —*3
15	●	●	●	●	—*4
16	○	○	○	○	●
17	●	○	○	○	●
18	○	●	○	○	●
19	●	●	○	○	●
20	○	○	●	○	●
21	●	○	●	○	●
22	○	●	●	○	●
23	●	●	●	○	●

[Pr. 156] Setting		Fast Response Current Limit *1 ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation Continued ●: Operation is not Continued *2
			Acceleration	Constant speed	Deceleration	
24		○	○	○	●	●
25		●	○	○	●	●
26		○	●	○	●	●
27		●	●	○	●	●
28		○	○	●	●	●
29		●	○	●	●	●
30		○	●	●	●	A700 F700 ● E700 D700 — *3
31		●	●	●	●	— *4
100 *5	Power driving	○	○	○	○	○
	Regeneration	●	●	●	●	— *4
101 *5	Power driving	●	○	○	○	○
	Regeneration	●	●	●	●	— *4

*1 During fast-response current limit operation, OL signal is output in A700 F700 but not output in E700 D700.

*2 When "Operation not continued at OL signal output" is selected, the "E.OLT" (stopped by stall prevention) is displayed at OL operation and inverter trips.

*3 Stall prevention does not operate during fast-response current limit operation in E700 D700, so the OL signal and E.OLT are not output. However, OL signal and E.OLT are output when regeneration avoidance function (refer to page 340) is active.

*4 Since both fast-response current limit and stall prevention are not activated, OL signal and E.OLT are not output. However, OL signal and E.OLT are output when regeneration avoidance function (refer to page 340) is active.

*5 The settings "100" and "101" allow operations to be performed in the driving and regeneration modes, respectively. The setting "101" disables the fast-response current limit in the driving mode.

(6) Output voltage reduction during stall prevention operation [Pr. 154] A700 F700

When [*Pr. 154* = 0], the output voltage decreases during stall prevention operation. By making setting to reduce the output voltage, an overcurrent trip can further become difficult to occur.

Use this function where a torque decrease will not pose a problem.

[Pr. 154] Setting	Description
0	Output voltage reduced
1 (initial value)	Output voltage not reduced

(7) Stall prevention operation signal output and output timing adjustment (OL signal) [Pr. 157] common

When the output current exceeds the stall prevention operation level and stall prevention is activated, OL (overcurrent stall) is displayed and the stall prevention operation signal (OL signal) is ON for longer than 100ms. When the output current falls to or below the stall prevention operation level, the output signal turns OFF. When using A700 F700, OL signal is output during fast-response current limit operation. (OL signal is not output during fast-response current limit operation in E700 D700.)

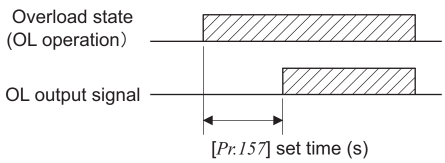
Use [*Pr. 157 OL signal output timer*] to set whether the OL signal is output immediately or output if stall prevention is continuously activated after the preset time.

This operation is also performed when the overvoltage stall prevention operation and regeneration avoidance function oL (overvoltage stall) are performed.

If the frequency has fallen to 0.5Hz* by stall prevention operation and remains for 3s, a fault (E.OLT) appears and trips the inverter.

* 1Hz for E700 D700.

[Pr. 157] Setting	Description
0 (initial value)	Output immediately.
0.1 to 25	Output after the set time (s) has elapsed.
9999	Not output.



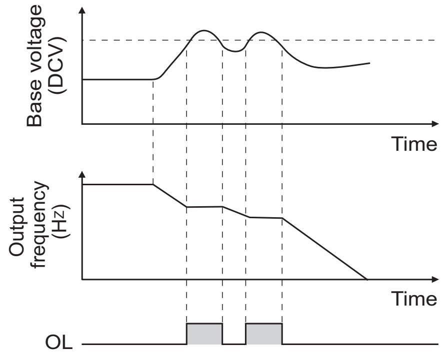
2

PARAMETER

2.14.2 Overvoltage stall prevention operation level (common)

If the regenerative energy of the motor at deceleration becomes excessive and DC bus voltage exceeds the specified value, this function stops the decrease in frequency for 3s maximum to prevent overvoltage trip. As soon as the regenerative energy has reduced, deceleration resumes.

When overvoltage stall prevention is activated, oL (overvoltage stall) appears and the OL signal is output.
Note that a stop distance extends if overvoltage stall prevention operation activates.
Whether to perform overvoltage stall prevention or not is selected using stall prevention operation selection of [*Pr. 156*] (refer to page 338). When stall prevention operation disabled is selected using [*Pr. 156*], overcurrent stall prevention operation is not also operated.



Overvoltage stall prevention operation example

Model			Overvoltage Stall Prevention Operation Start Level	Overvoltage Stall Prevention Operation Cancel Level
(A700)	200V	55K or less	390VDC	385VDC
		75K or more	385VDC	380VDC
	400V	55K or less	780VDC	770VDC
		75K or more	785VDC	780VDC
(F700)	200V	30K or less	390VDC	385VDC
		37K or more	385VDC	380VDC
	400V	55K or less	780VDC	770VDC
		75K or more	785VDC	780VDC
(E700)	200V		400VDC	395VDC
(D700)	400V		780VDC	770VDC

2.14.3 Regeneration avoidance function [Pr. 665*, 882, 883, 884*, 885, 886] (common)

(*[Pr. 665] is not available for (F700).)
(*[Pr. 884] is not available for (E700)(D700).)

This function detects a regeneration status and increases the frequency to avoid the regeneration status.
It is possible to avoid regeneration by automatically increasing the frequency and continue operation if a fan happens to rotate faster than the set speed due to the effect of another fan in the same duct.

[Pr.]	Name	Initial Value		Setting Range	Description	Available Inverters (A700)	(F700)	(E700)(D700)
882	Regeneration avoidance operation selection	0		0	Regeneration avoidance function invalid	○	○	○
				1	Regeneration avoidance function is always valid			
				2	Regeneration avoidance function is valid only during a constant speed operation			
883	Regeneration avoidance operation level	200V class	(A700)(F700) 380VDC (E700)(D700) 400VDC	300 to 800V	Set the bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvoltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the power supply voltage x $\sqrt{2}$.	○	○	○
		400V class	(A700)(F700) 760VDC (E700)(D700) 780VDC					
884	Regeneration avoidance at deceleration detection sensitivity	0		0	Regeneration avoidance by bus voltage change ratio is invalid	○	○	—
				1 to 5	Set sensitivity to detect the bus voltage change ratio. Setting 1 → 5 Detection sensitivity low → high			

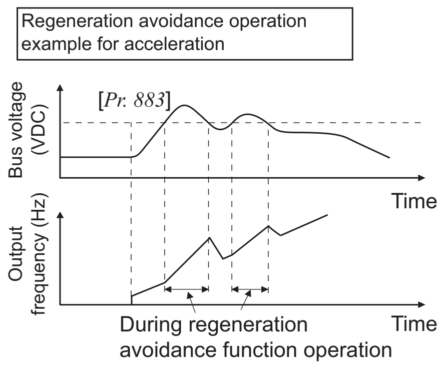
[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	F700	E700 D700
885	Regeneration avoidance compensation frequency limit value	6Hz	0 to 10Hz	Set the limit value of frequency which rises at activation of regeneration avoidance function.	○	○	○
			9999	Frequency limit invalid			
886	Regeneration avoidance voltage gain	100%	0 to 200%	Adjusts responsiveness at activation of regeneration avoidance. A larger setting will improve responsiveness to the bus voltage change. However, the output frequency could become unstable. When the load inertia of the motor is large, decrease the [*Pr. 886*] setting. When vibration is not suppressed by decreasing the [*Pr. 886*] setting, set a smaller value in [*Pr. 665*].	○	○	○
665	Regeneration avoidance frequency gain	100%	0 to 200%		○	—	○

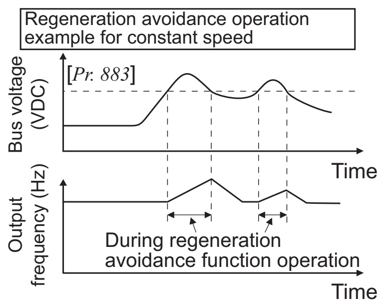
(1) Operation [Pr. 882, 883]

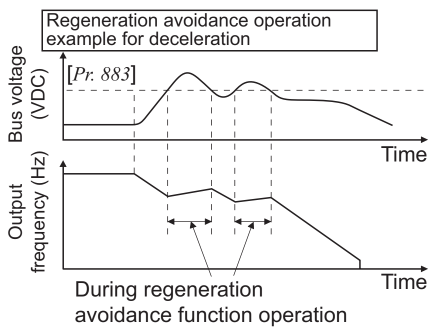
When the regeneration status is serious, the DC bus voltage rises and an overvoltage fault (E. OV1 to 3) may occur. When this bus voltage rise is detected and the bus voltage level reaches or exceeds [*Pr. 883*], increasing the frequency will avoid the regeneration status.

The [*Pr. 883*] setting should be kept higher than the DC bus voltage level at a stop. Otherwise regeneration avoidance function always activates.

Whether regeneration avoidance operation is always activated ([*Pr. 882* = 1]) or activated only at a constant speed ([*Pr. 882* = 2]) can be selected.







While overvoltage stall (oL) is activated only during deceleration and stops the decrease in output frequency, the regeneration avoidance function is always ON ([*Pr. 882* = 1]) or activated only during a constant speed ([*Pr. 882* = 2]) and increases the frequency according to the regeneration amount. When regeneration avoidance function is always ON [*Pr. 882* = 1] is selected, overvoltage stall prevention during deceleration is not operated and regeneration avoidance operation is performed.

When regeneration avoidance operation is activated, oL (overvoltage stall) appears and the OL signal is output. Use [*Pr. 156, Pr. 157*] to select OL signal ON/OFF and output timing (refer to page 338).

When regeneration avoidance operation is performed, stall prevention is also activated at the same time.

When using the regeneration unit (FR-BU2, FR-BU, MT-BU5, FR-CV, FR-HC, MT-HC) and brake resistor (FR-ABR etc.), set [*Pr. 882* = 0] (initial value)" (regeneration avoidance function invalid).

Under vector control operation of A700, unusual noise may be generated from the motor during deceleration when using regeneration avoidance function . To prevent this, make gain adjustment, e.g. by performing easy gain tuning. (Refer to page 286)

2

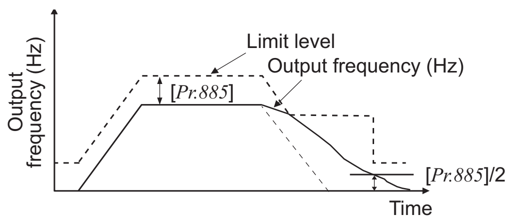
PARAMETER

(2) Regeneration status detection sensitivity [Pr. 884] (*Not available for E700 D700.)

As the regeneration avoidance function cannot respond to an abrupt voltage change by detection of the bus voltage level, the ratio of bus voltage change is detected to stop deceleration if the bus voltage is less than [*Pr. 883 Regeneration avoidance operation level*].
Set that detectable bus voltage change ratio to [*Pr. 884*] as detection sensitivity.
Increasing the setting raises the detection sensitivity.
Too small setting (low detection sensitivity) will disable detection, and too large setting will turn ON the regeneration avoidance function if the bus voltage is varied by an input power change, etc.

(3) Limit of regeneration avoidance operation frequency [Pr. 885]

The output frequency compensated for (increased by) the regeneration avoidance function can be limited.
The frequency is limited to the output frequency (frequency prior to regeneration avoidance operation) + [*Pr. 885 Regeneration avoidance compensation frequency limit value*] during acceleration or constant speed.
If the regeneration avoidance frequency exceeds the limit value during deceleration, the limit value is held until the output frequency falls to 1/2 of [*Pr. 885*].
When the regeneration avoidance frequency has reached [*Pr. 1 Maximum frequency*], it is limited to the maximum frequency.
When [*Pr. 885* = 9999], the frequency setting is invalid.



(4) Regeneration avoidance function adjustment [Pr. 665*, 886] (*Not available for F700.)

If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of [*Pr. 886 Regeneration avoidance voltage gain*]. On the contrary, if sudden regeneration causes an overvoltage alarm, increase the setting.
When the load inertia of the motor is large, decrease the [*Pr. 886*] setting. When vibration is not suppressed by decreasing the [*Pr. 886*] setting, set a smaller value in [*Pr. 665 Regeneration avoidance frequency gain*] .

2.15 Monitor display and monitor output signal

2.15.1 Speed display and speed setting [Pr. 37, 144*, 505*, 811*] (common)

(*[*Pr. 505, 811*] are not available for (F700).)
(*[*Pr. 144, 505, 811*] are not available for (E700)(D700).)

The monitor display and frequency setting of the PU (FR-DU07/FR-PU04/FR-PU07) can be changed to the motor speed and machine speed.

[Pr.]	Name	Initial Value	Setting Range	Description		Available Inverters		
						(A700)	(F700)	(E700) (D700)
37	Speed display	0	0	Frequency display, setting		○	○	○
			(A700)(F700) 1 to 9998 (E700)(D700) 0.01 to 9998	Set the machine speed for [*Pr. 505*]				
144	Speed setting switchover	4	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	Set the number of motor poles when displaying the motor speed.		○	○	—
505	Speed setting reference	60Hz	1 to 120Hz	Set the reference speed for [*Pr. 37*].		○	—	—
811	Set resolution switchover	0	0	Speed setting and running speed monitor increments from the PU, RS-485 communication or communication option.	Torque limit setting increments [*Pr. 22, Pr. 812 to Pr. 817*]	○	—	—
				1r/min	0.1%			
			1	0.1r/min				
			10	1r/min	0.01%			
			11	0.1r/min				

To display the machine speed on (A700), set in [*Pr. 37*] the machine speed for operation with frequency set in [*Pr. 505*]. For (F700)(E700)(D700), set in [*Pr. 37*] the machine speed at 60Hz operation.
For example, when [*Pr. 505* = 60Hz] and [*Pr. 37* = 1000] on (A700), 1000 is displayed on the running speed monitor when the running frequency is 60Hz. When running frequency is 30Hz, 500 is displayed.

To display the motor speed in (E700)(D700), set the motor speed at 60Hz operation. The value displayed in monitor is calculated from the output frequency when slip compensation is performed during Advanced magnetic vector control in (E700) or when slip compensation is performed in (D700).

To display the motor speed in (A700)(F700), set the number of motor poles (one of 2, 4, 6, 8, and 10) or number of motor poles + 100 (102, 104,106,108, or 110). Under V/F control, the output frequency of the inverter is displayed in terms of synchronous speed. Therefore displayed value is a total value of actual speed and motor slip. This display changes to the actual speed (estimated value calculated based on the motor slip) when the Advanced magnetic flux vector control or Real sensorless vector control is selected on (A700), and actual speed from the encoder is displayed when encoder feed back control or vector control is performed.

When [*Pr. 811* = 1, 11] on (A700), the setting increments of speed setting from the PU, speed setting from RS-485 communication or communication options (other than FR-A7ND, FR-A7NL) and running speed monitor is 0.1r/min. Note that parameter setting is in 1r/min increments. (For torque setting increments, refer to page 285.)

When both [*Pr. 37 and Pr. 144*] have been set, their priorities are as given below.

[*Pr. 144* = 102 to 110] > [*Pr. 37* = 1 to 9998] > [*Pr. 144* = 2 to 10]

Refer to [*Pr. 52*] when you want to change the PU main monitor (PU main display). (Refer to page 345)

Since the panel display of the operation panel (FR-DU07) is 4 digits in length, the monitor value of more than 9999 is displayed as ----.

When the running speed monitor is selected, each monitor and setting are determined by the combination of [*Pr. 37*] and [*Pr. 144*] as the tables on the next page. (Units in the bold frame are initial values.)

1) A700 F700

[Pr. 37] Setting	[Pr. 144] Setting	Output Frequency Monitor	Set Frequency Monitor	Running Speed Monitor	Frequency Setting Parameter Setting
0 (initial value)	0	Hz	Hz	r/min*1	Hz
	2 to 10	Hz	Hz	r/min*1	Hz
	102 to 110	r/min*1	r/min *1	r/min*1	r/min*1
1 to 9998	0	Hz	Hz	Machine speed*1	Hz
	2 to 10	Machine speed*1	Machine speed*1	Machine speed*1	Machine speed*1
	102 to 110	Hz	Hz	r/min *1	Hz

*1 Motor speed r/min conversion formula ....frequency × 120/number of motor poles ([*Pr. 144*])
Machine speed conversion formula .... A700 [*Pr. 37*] × frequency/ [*Pr. 505*], F700 [*Pr. 37*] × frequency/ 60Hz
[*Pr. 144*] in the above formula is [*Pr. 144*] -100 when [*Pr. 144* = 102 to 110], and is 4 when [*Pr. 37* = 0] and [*Pr. 144* = 0].

*2 The increments for Hz are 0.01Hz, machine speed are 1m/min, and r/min are 1r/min. For A700, 0.1r/min increments is available according to [*Pr. 811*] setting.

*3 For A700, [*Pr. 505*] is always set as frequency (Hz).

2) E700 D700

[Pr. 37] Setting	Output Frequency Monitor	Set Frequency Monitor	Frequency Setting	Parameter Setting
0 (initial value)	Hz	Hz	Hz	Hz
0.01 to 9998	Machine speed*1	Machine speed*1	Machine speed*1	

*1 Machine speed conversion formula ....[*Pr. 37*] × frequency / 60Hz
*2 The increments for Hz are 0.01Hz, machine speed are 1m/min.

2.15.2 Monitor display selection of the DU/PU, terminal FM/AM, terminal AM0/AM1 (FR-A7AY), terminal DA1 (FR-A7AZ) [Pr. 52, 54, 158*, 170, 171, 268, 306*, 310*, 563, 564, 838*, 891*] (common)

(*[*Pr. 838*] is not available for F700.)
(*[*Pr. 158, 838, 891*] are not available for E700.)
(*[*Pr. 158, 306, 310, 838*] are not available for D700.)

The monitor to be displayed on the main screen of the operation panel (FR-DU07)/parameter unit (FR-PU04/FR-PU07) can be selected.

In addition, signal to be output to terminal FM (pulse train output), AM (analog voltage output), AM0 (FR-A7AY analog voltage output), AM1 (FR-A7AY analog current output), and DA1 (FR-A7AZ bipolar analog voltage output) can be selected.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	F700	E700	D700
52*	DU/PU main display data selection	0 (output frequency)	A700 0, 5 to 14, 17 to 20, 22 to 25, 32 to 35, 50 to 57, 100 F700 0, 5, 6, 8 to 14, 17, 20, 23 to 25, 50 to 57, 100 E700 0, 5, 7 to 12, 14, 20, 23 to 25, 52 to 57, 61, 62, 100 D700 0, 5, 8 to 12, 14, 20, 23 to 25, 52 to 55, 61, 62, 64, 100	Selects the monitor to be displayed on the operation panel and parameter unit. Refer to the table on the next page for monitor description	○	○	○	○
54*	FM terminal function selection	1 (output frequency)	A700 1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53 F700 1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53 E700 1 to 3, 5, 7 to 12, 14, 21, 24, 52, 53, 61, 62 D700 1 to 3, 5, 8 to 12, 14, 21, 24, 52, 53, 61, 62	Select the monitor output to terminal FM.	○	○	○	○
158*	AM terminal function selection			Select the monitor output to terminal AM.	○	○	—	—
306*	Analog output signal selection AY	2 (output current)		Select monitor to be output to terminal AM0 and AM1 of the plug-in option FR-A7AY.	○	○	○	—
310*	Analog meter voltage output selection AY							
838*	DA1 terminal function selection AZ	2 (output current)	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 36, 50, 52, 53	Select the monitor to be output from terminal DA1 of the plug-in option FR-A7AZ.	○	—	—	—
170	Watt-hour meter clear	9999	0	Set 0 to clear the watt-hour meter monitor.	○	○	○	○
			10	Set the maximum value when monitoring from communication to 0 to 9999kWh.				
			9999	Set the maximum value when monitoring from communication to 0 to 65535kWh.				
171	Operation hour meter clear	9999	0, 9999	Set "0" to clear the operation time monitor. Setting 9999 has no effect.	○	○	○	○
268*	Monitor decimal digits selection	9999	0	Displayed as integral value	○	○	○	○
			1	Displayed in 0.1 increments.				
			9999	No function				
563	Energization time carrying-over times	0	0 to 65535 (reading only)	The numbers of cumulative energization time monitor exceeded 65535h is displayed. Reading only	○	○	○	○

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	F700	E700	D700
564	Operating time carrying-over times	0	0 to 65535 (reading only)	The numbers of operation time monitor exceeded 65535h is displayed. Reading only	○	○	○	○
891	Cumulative power monitor digit shifted times	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit Clamps the monitor value at maximum.	○	○	—	○
			9999	No shift Clears the monitor value when it exceeds the maximum value.				

*The above parameters allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0] (initial value).

(1) Monitor description list [Pr. 52, 54, 158*, 306*, 310*, 838*]

(*[*Pr. 838*] is not available for F700.)
(*[*Pr. 158, 838*] are not available for E700.)
(*[*Pr. 158, 306, 310, 838*] are not available for D700.)

Types of Monitor	Increments	[Pr. 52] Setting: DU (Operation panel) LED	[Pr. 52] Setting: PU main monitor	[Pr. 54] (FM) [Pr. 158] (AM) [Pr. 306] [Pr. 310] [Pr. 838] Setting	Full-scale Value	Description	Available Inverters A700	F700	E700	D700
Output frequency	0.01Hz	0/100		1 *14	[*Pr. 55*]	Displays the inverter output frequency	○	○	○	○
Output current	0.01A/ 0.1A *7	0/100		2	[*Pr. 56*]	Displays the inverter output current effective value	○	○	○	○
Output voltage	0.1V	0/100		3	200V class: 400V 400V class: 800V	Displays the inverter output voltage	○	○	○	○
Fault or alarm indication	—	0/100		×	—	Displays 8 past faults individually	○	○	○	○
Frequency setting	0.01Hz	5	*1	5	[*Pr. 55*]	Displays the set frequency	○	○	○	○
Running speed	1(r/min)	6	*1	6 *14	The value converted with the [*Pr. 37*] value from [*Pr. 55*].	Displays the motor speed (according to the [*Pr. 37, Pr. 144*] setting. Running speed is the actual speed detected by the encoder during encoder feedback control and vector control. Refer to page 343 for details.)	○	○	—	—
Motor torque	0.1%	7	*1	7 *15	A700 [*Pr. 866*] E700 Rated torque of applied motor x 2	Displays the motor torque in % on the assumption that the rated motor torque is 100% (displays 0% during V/F control)	○	—	○	—
Converter output voltage	0.1V	8	*1	8	200V class: 400V 400V class: 800V	Displays the DC bus voltage value	○	○	○	○
Regenerative brake duty	0.1%	9	*1	9	[*Pr. 70*]	Brake duty set in [*Pr. 30, Pr. 70*]	○	○	○	○

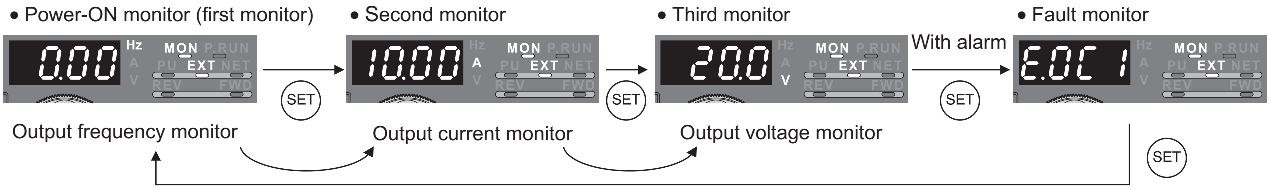
Types of Monitor	Increments	[Pr. 52] Setting: DU (Operation panel) LED	[Pr. 52] Setting: PU main monitor	[Pr. 54] (FM) [Pr. 158] (AM) [Pr. 306] [Pr. 310] [Pr. 838] Setting	Full-scale Value	Description	Available Inverters: A700	F700	E700	D700
Electronic thermal relay function load factor	0.1%	10	*1	10	100%	Displays the motor thermal cumulative value on the assumption that the thermal operation level is 100% *11 *12	○	○	○	○
Output current peak value	0.01A/ 0.1A *7	11	*1	11	[*Pr. 56*]	Retains the peak value of the output current monitor and displays (cleared at every start)	○	○	○	○
Converter output voltage peak value	0.1V	12	*1	12	200V class: 400V 400V class: 800V	Retains the peak value of the DC bus voltage value and displays (cleared at every start)	○	○	○	○
Input power	0.01kW/ 0.1kW *7	13	*1	13	Rated inverter power × 2	Displays the power on the inverter input side	○	○	—	—
Output power	0.01kW/ 0.1kW *7	14	*1	14	Rated inverter power × 2	Displays the power on the inverter output side	○	○	○	○
Load meter	0.1%	17		17 *15	[*Pr. 866*]	Torque current is displayed in % by regarding [*Pr. 56*] setting value as 100% (the motor rated torque is regarded as 100% during Real sensorless control and vector control for A700).	○	○	—	—
Motor excitation current	0.01A/ 0.1A*7	18		18	[*Pr. 56*]	Displays the excitation current of the motor	○	—	—	—
Position pulse*2	—	19		×	—	Displays the number of pulses per rotation of the motor under orientation control or position control	○	—	—	—
Cumulative energization time *4	1h	20		×	—	Displays cumulative energization time since the inverter shipment You can check the numbers of the monitor value exceeded 65535h with [*Pr. 563*].	○	○	○	○
Reference voltage output	—	—		21	—	Terminal FM: when [*Pr. 291* = 0, 1] outputs 1440pulse/s when [*Pr. 291* ≠ 0, 1] outputs 50kpulse/s	○	○	—	—
						Terminal FM: outputs 1440pulse/s	—	○	○	○
						Terminal AM: outputs 10VDC	○	○	—	—
						Terminal AM0: outputs 10VDC (factory setting)	○	○	○	—
						Terminal AM1: outputs 20mADC (factory setting)	○	○	○	—
Orientation status *2	1	22		×	—	Displays only when orientation control is valid (Refer to page 421)	○	—	—	—
Actual operation time *4*5	1h	23		×	—	Displays cumulative inverter running time You can check the numbers of the monitor value exceeded 65535h with [*Pr. 564*]. Use [*Pr. 171*] to clear the value. (Refer to page 351)	○	○	○	○

Types of Monitor	Increments	[Pr. 52] Setting DU (Operation panel) LED	[Pr. 52] Setting PU main monitor	[Pr. 54] (FM) [Pr. 158] (AM) [Pr. 306] [Pr. 310] [Pr. 838] Setting	Full-scale Value	Description	A700	F700	E700	D700
Motor load factor	0.1%	24		24	200%	Displays the output current value in % on the assumption that the inverter rated current value is 100% Monitor value = output current monitor value/rated inverter current ×100 [%]	○	○	○	○
Cumulative power *8	0.01kWh/ 0.1kWh *6*7	25		×	—	Displays cumulative power amount according to the output power monitor Use [*Pr. 170*] to clear the value. (Refer to page 351)	○	○	○	○
Torque command *13	0.1%	32		32 *15	[*Pr. 866*]	Displays torque command value obtained from vector control	○	—	—	—
Torque current command *13	0.1%	33		33 *15	[*Pr. 866*]	Displays the torque current command value	○	—	—	—
Motor output	0.01kW/ 0.1kW *7	34		34 *16	Rated motor capacity	Multiplies the motor speed by the output torque and displays the machine output of the motor shaft end	○	—	—	—
Feedback pulse *3*8	—	35		×	—	Displays the number of pulses fed back from the encoder during one sampling (displays during a stop).	○	—	—	—
Torque monitor (driving/ regenerative polarity switching)	—	—		36 *16 *17	[*Pr. 866*]	Outputs the motor torque in bipolar analog by regarding motor rated torque as 100%. (0% during V/F control)	○	—	—	—
Power saving effect	Variable according to parameters	50		50	Inverter capacity	Displays energy saving effect monitor You can change the monitor to power saving, power saving average value, charge display and % display using parameters. (Refer to page 360 for details)	○	○	—	—
Cumulative saving power *8		51		×	—					
PID set point	0.1%	52		52	100%	Displays the set point, measured value and deviation during PID control (refer to page 402 for details)	○	○	○	○
PID measured value	0.1%	53		53	100%					
PID deviation	0.1%	54		×	—					
Input terminal status	—	55	*1	×	—	Displays the input terminal ON/OFF status on the PU. (Refer to page 350 for the DU display)	○	○	○	○
Output terminal status	—		*1	×	—	Displays the output terminal ON/OFF status on the PU. (Refer to page 350 for the DU display)				
Option input terminal status	—	56	×	×	—	Displays the input terminal ON/OFF status of digital input option (FR-A7AX) on the DU (refer to page 350 for details)	○	○	○	—
Option output terminal status	—	57	×	×	—	Displays the output terminal ON/OFF status of the digital output option (FR-A7AY) or relay output option (FR-A7AR) on the DU (refer to page 350 for details).	○	○	○	—

Types of Monitor	Increments	[Pr. 52] Setting		[Pr. 54] (FM) [Pr. 158] (AM) [Pr. 306] [Pr. 310] [Pr. 838] Setting	Full-scale Value	Description	Available Inverters			
		DU (Operation panel) LED	PU main monitor				A700	F700	E700	D700
Motor thermal load ratio	0.1%	61		61	Thermal operation level (100%)	Displays the motor thermal integrated value (Motor overload shuts off (E.THM) occurs at 100%)	—	—	○	○
Inverter thermal load ratio *12	0.1%	62		62	Thermal operation level (100%)	Displays the transistor thermal heat integrated value. (Inverter overload trip (E.THT) occurs at 100%.)	—	—	○	○
PTC thermistor resistance	0.01kΩ	64		×	—	Displays the PTC thermistor resistance input value to terminal 2 when PTC thermistor protection is valid. (0.10kΩ to 31.5kΩ) (Refer to page 50)	—	—	—	○

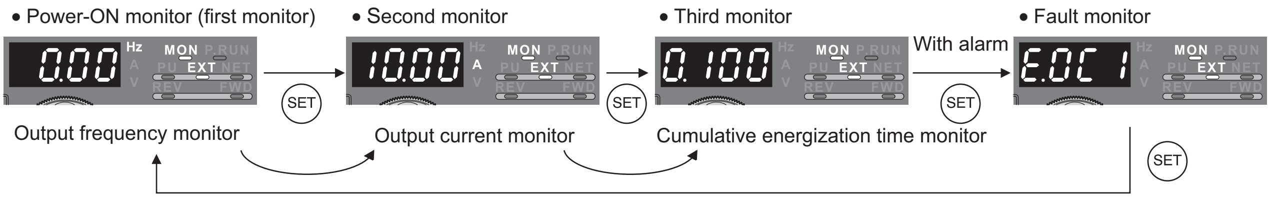
*1 Frequency setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04V/FR-PU07).
*2 Position pulse and orientation status function when used with an option (FR-A7AP). If a value is set without using an option, the display remains 0.
*3 Feedback pulse functions when the option (FR-A7AP) is used and vector control is performed.
*4 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel (FR-DU07) is used, the time is displayed up to 65.53 (65530h) on the assumption that 1h = 0.001, and thereafter, it is added up from 0.
*5 The actual operation time is not added up if the cumulative operation time before power supply-off is less than 1h.
*6 When using the parameter unit (FR-PU04/FR-PU07), kW is displayed.
*7 The setting depends on the inverter capacity. (55K or less/75K or more)
*8 Since the panel display of the operation panel (FR-DU07) is 4 digits in length, the monitor value of more than 9999 is displayed as ----.

*9 By setting [*Pr. 52* = 0], the monitoring of output frequency to alarm display can be selected in sequence by SET.



*10 The monitor set in [*Pr. 52*] is displayed in the third monitor position. (The output voltage monitor is changed.) Note that load meter, motor exciting current, motor load factor are displayed in the second monitor position (output current monitor).

Example: When [*Pr. 52* = 20] (cumulative energization time), the monitor is displayed on the operation panel as described below.



*11 Bigger value between motor thermal and transistor thermal integrated value is displayed.
*12 A value other than 0% may be displayed if surrounding air temperature (fin temperature) is high even during a stop in E700 D700.
*13 Select torque command when using motor rating torque as a reference.
Select torque current command when using motor rating torque current as a reference.
*14 When outputting from terminal DA1 of the built-in option FR-A7AZ (when [*Pr. 838*] is set), + (plus) output at forward rotation and - (minus) output is at reverse rotation.
*15 When outputting from terminal DA1 of the built-in option FR-A7AZ (when [*Pr. 838*] is set), + (plus) voltage is at forward rotation drive / reverse regeneration, and - (minus) voltage is made at reverse drive/ forward regeneration.
*16 When outputting from terminal DA1 of the built-in option FR-A7AZ (when [*Pr. 838*] is set), + (plus) voltage is made at forward / reverse drive, and - (minus) voltage is at forward/ reverse regeneration.
*17 Torque monitor can be set only to [*Pr. 838*].

2

PARAMETER

(2) Displays the set frequency during stop [Pr. 52 = 100]

When [*Pr. 52* = 100], the set frequency monitor is displayed during a stop and the output frequency monitor is displayed during operation. (LED of Hz flickers during stop and is lit during operation.)
When [*Pr. 52* = 100], the set frequency to be output at start is displayed during a stop.
The value of the set frequency is different from what is displayed when [*Pr. 52* = 5] and is calculated considering the maximum/minimum frequency and frequency jump.
The output frequency at error occurrence is displayed during an error and the monitor displayed during MRS is the same as at stop.
During offline auto tuning, the tuning status monitor has priority.

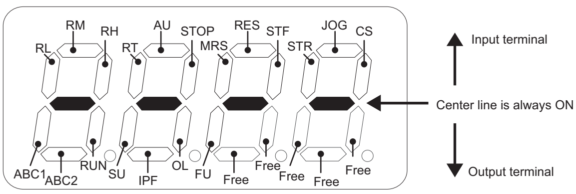
	[Pr. 52] Setting		
	0	100	
	During running/stop	During stop	During running
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Fault or alarm indication	Fault or alarm indication		

(3) I/O terminal monitor [Pr. 52 = 55 to 57] of the operation panel (FR-DU07)

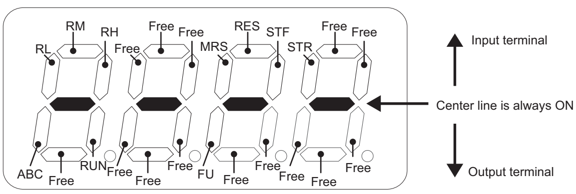
When [*Pr. 52* = 55 to 57] , the I/O terminal status can be monitored on the operation panel (FR-DU07).
The I/O terminal monitor is displayed on the third monitor. The LED is ON when the terminal is ON, and the LED is OFF when the terminal is OFF. The center line of LED is always ON.

On the unit I/O terminal monitor ([*Pr. 52* = 55]), the upper LEDs denote the input terminal status and the lower the output terminal status.

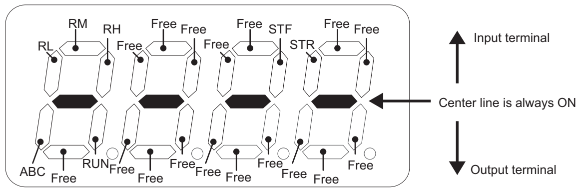
1) A700 F700



2) E700



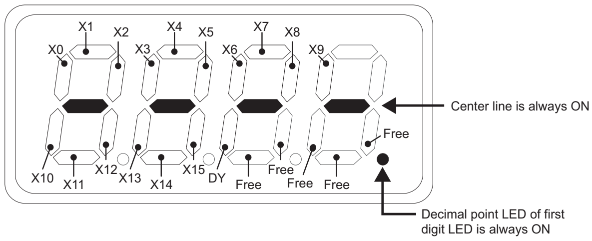
3) D700



On the input option (FR-A7AX) terminal monitor ([*Pr. 52* = 56*], the decimal point LED of the first digit LED is ON.

● A700 F700 E700

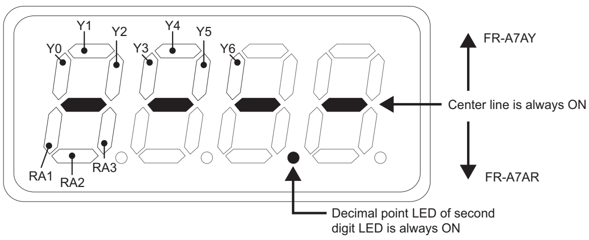
(Built-in options cannot be connected to D700.)



On the output option (FR-A7AY, FR-A7AR) terminal monitor ([*Pr. 52* = 57*], the decimal point LED of the second digit LED is ON.)

● A700 F700 E700

(Built-in options cannot be connected to D700.)



* [*Pr. 52* = 56, 57] can be set even if the option is not mounted. The monitor displays are all OFF status if the option is not mounted.

(4) Cumulative power monitor and clear [Pr. 52 = 25, Pr. 170, 891*] (*[*Pr. 891*] is not available for (E700).)

On the cumulative energization power monitor ([*Pr. 52* = 25]), the output power monitor value is added up and is updated in 1h increments.
The operation panel (FR-PU07), parameter unit (FR-PU04/FR-PU07) and communication (RS-485 communication, communication option) display increments and display ranges are as indicated below.

Operation Panel *1	
Range	Increments
0 to 99.99kWh	0.01kWh
100.0 to 999.9kWh	0.1kWh
1000 to 9999kWh	1kWh

*1 Power is measured in the range 0 to 9999.99kWh, and displayed in 4 digits. When the monitor value exceeds 99.99, a carry occurs, e.g. 100.0, so the value is displayed in 0.1kWh increments.

Parameter Unit *2	
Range	Increments
0 to 999.99kWh	0.01kWh
1000.0 to 9999.9kWh	0.1kWh
10000 to 99999kWh	1kWh

*2 Power is measured in the range 0 to 99999.99.99kWh, and displayed in 5 digits. When the monitor value exceeds 999.99, a carry occurs, e.g. 1000.0, so the value is displayed in 0.1kWh increments.

Communication		
Range		Increments
[Pr. 170 = 10]	[Pr. 170 = 9999]	
0 to 9999kWh	0 to 65535kWh (initial value)	1kWh

The digits of the cumulative power monitor value can be shifted to the right for the number of [*Pr. 891*] setting values. For example, if the cumulative power value is 1278.56kWh when [*Pr. 891* = 2], the PU/DU display is 12.78 (displayed in 100kWh increments) and the communication data is 12.
If the maximum value exceeded at [*Pr. 891* = 0 to 4], the power is clamped at the maximum value, indicating that a digit shift is necessary.
When [*Pr. 891* = 9999], the value returns to 0 if it exceeds the maximum value, then counting restarts.
Writing [*Pr. 170* = 0] clears the cumulative power monitor. If [*Pr. 170* = 0] is written and [*Pr. 170*] is read again, 9999 or 10 is always displayed.

(5) Cumulative energization time and actual operation time monitor [Pr. 52 = 20, 23, Pr. 171, 563, 564]

Cumulative energization time monitor ([*Pr. 52* = 20]) accumulates energization time from shipment of the inverter every one hour.
On the actual operation time monitor ([*Pr. 52* = 23]), the inverter running time is added up every hour. (The actual operation time does not add up if inverter operates for less than one hour.)
If the monitor value exceeds 65535, it is added up from 0. The numbers of cumulative energization time monitor exceeded 65535h can be checked with [*Pr. 563*] and the numbers of actual operation time monitor exceeded 65535h with [*Pr. 564*].
Writing [*Pr. 171* = 0] will clear the actual operation time monitor. (The cumulative energization time monitor can not be cleared.) If [*Pr. 171* = 0] is written and [*Pr. 171*] is read again, "9999" is always displayed. Setting 9999 does not clear the actual operation time meter.

(6) Monitor decimal digits selection [Pr. 268]

As the operation panel (FR-DU07) display is 4 digits long, the decimal places may vary at analog input, etc. The decimal places can be hidden by selecting the decimal digits. In such a case, the decimal digits can be selected by [*Pr. 268*] .
The number of display digits on the cumulative time ([*Pr. 52* = 20]), actual operation time ([*Pr. 52* = 23]), cumulative energization power ([*Pr. 52* = 25]) or cumulative saving power monitor ([*Pr. 52* = 51]) does not change.

[Pr. 268] Setting	Description
9999 (initial value)	No function
0	For the first or second decimal places (0.1 increments or 0.01 increments) of the monitor, numbers in the first decimal place and smaller are rounded to display an integral value (1 increments). The monitor value of 0.99 or less is displayed as 0.
1	When 2 decimal places (0.01 increments) are monitored, the 0.01 decimal place is dropped and the monitor displays the first decimal place (0.1 increments). The monitored digits in 1 increments are displayed.

2.15.3 Reference of terminal FM/AM, terminal AM0/AM1 (FR-A7AY), terminal DA1 (FR-A7AZ) [Pr. 55, 56, 291*, 839*, 866*, 867*] (common)

(*[Pr. 291, 839, 866] are not available for (F700).)
(*[Pr. 291, 839, 866, 867] are not available for (E700)(D700).)

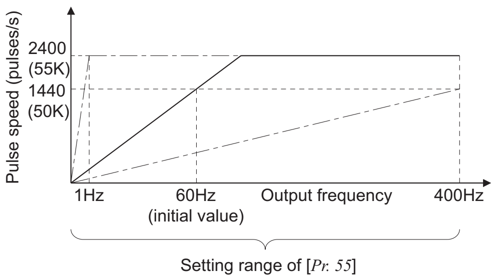
Two types of monitor outputs are available in (A700)(F700): pulse train output from terminal FM and analog voltage output from terminal AM. Analog voltage output (terminal AM0) and analog current output (terminal AM1) become available when the plug-in option FR-A7AY is mounted. Bipolar analog voltage output (terminal DA1) becomes available when the plug-in option FR-A7AZ is mounted to (A700). Terminal FM for pulse output is available for monitor output in (E700)(D700). Analog voltage output (terminal AM0) and analog current output (terminal AM1) become available when the plug-in option FR-A7AY is mounted to (E700). For (A700), pulse train output by voltage output and by open collector output can be selected for terminal FM.
Set the reference of the signal output from terminal FM and AM, AM0, AM1, DA1.

<table>
<tr><th rowspan="2">[Pr.]</th><th rowspan="2">Name</th><th rowspan="2">Initial Value</th><th rowspan="2" colspan="2">Setting Range</th><th rowspan="2" colspan="2">Description</th><th colspan="3">Available Inverters</th></tr>
<tr><th>A700</th><th>F700</th><th>E700 D700</th></tr>
<tr><td>55*</td><td>Frequency monitoring reference</td><td>60Hz</td><td colspan="2">0 to 400Hz</td><td colspan="2">Set the full-scale value to output the output frequency monitor value to terminal FM and AM.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">56*</td><td rowspan="2">Current monitoring reference</td><td rowspan="2">Inverter rated output current</td><td>55K or less</td><td>0 to 500A</td><td rowspan="2" colspan="2">Set the full-scale value to output the output current monitor value to terminal FM and AM.</td><td rowspan="2">○</td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td>75K or more</td><td>0 to 3600A</td></tr>
<tr><td rowspan="8">291</td><td rowspan="8">Pulse train I/O selection</td><td rowspan="8">0</td><td colspan="2" rowspan="2">0</td><td>Pulse train input</td><td>Pulse train output</td><td rowspan="8">○</td><td rowspan="8">—</td><td rowspan="8">—</td></tr>
<tr><td>Terminal JOG</td><td>FM output</td></tr>
<tr><td colspan="2">1</td><td>Pulse train input</td><td>FM output</td></tr>
<tr><td colspan="2">10</td><td>Terminal JOG</td><td>High speed pulse train output (50%Duty)</td></tr>
<tr><td colspan="2">11</td><td>Pulse train input</td><td>High speed pulse train output (50%Duty)</td></tr>
<tr><td colspan="2">20</td><td>Terminal JOG</td><td>High speed pulse train output (ON width is always same)</td></tr>
<tr><td colspan="2">21</td><td>Pulse train input</td><td>High speed pulse train output (ON width is always same)</td></tr>
<tr><td colspan="2">100</td><td>Pulse train input</td><td>High speed pulse train output (ON width is always same)
The inverter outputs the signal input as pulse train as is</td></tr>
<tr><td>839</td><td>DA1 output filter AZ</td><td>0.05s</td><td colspan="2">0 to 5s</td><td colspan="2">Set the output filter for terminal DA1 of built-in option FR-A7AZ.</td><td>○</td><td>—</td><td>—</td></tr>
<tr><td>866*</td><td>Torque monitoring reference</td><td>150%</td><td colspan="2">0 to 400%</td><td colspan="2">Set a full scale value when output torque monitor value is output in analog.</td><td>○</td><td>—</td><td>—</td></tr>
<tr><td>867</td><td>AM output filter</td><td>0.01s</td><td colspan="2">0 to 5s</td><td colspan="2">Set the output filter of terminal AM.</td><td>○</td><td>○</td><td>—</td></tr>
</table>

* The above parameters allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0] (initial value) .

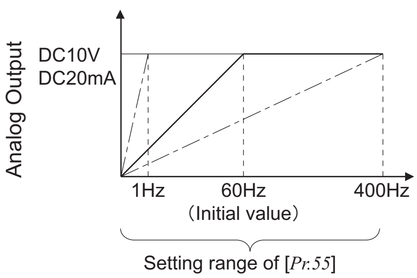
(1) Frequency monitor reference [Pr. 55] common

For the calibration of terminal FM, set the full-scale value of the connected meter when the pulse speed of terminal FM is 1440 pulse/s (50k pulse/s when high speed pulse train output is selected in A700). Set the frequency to be indicated as the full scale value on the frequency meter (1mA analog meter) connected between terminal FM and SD. (For example, 60Hz or 120 Hz.) Pulse speed is proportional to the output frequency of the inverter. The pulse speed and inverter output frequency are proportional to each other. (Maximum pulse train output is 2400 pulse/s (55k pulse/s when high speed pulse train output is selected on A700 .))



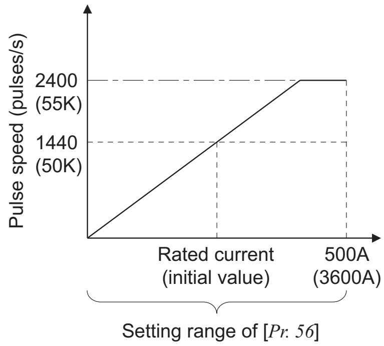
For the calibration of terminal AM, AM0 in A700 F700 and DA1 (only in A700), set the full-scale value of the connected frequency meter when the output voltage of terminal AM, AM1 and DA1 are 10VDC. For the calibration of terminal AM0 of E700, set the full-scale value of the connected frequency meter when the output voltage of terminal AM0 is 10VDC. Set the frequency to be indicated as the full scale value on the meter (10V analog meter) connected between terminal AM and 5 (AM0 and AMC, DA1 and 5). (For example, 60Hz or 120 Hz.) Output voltage is proportional to the frequency. (Maximum output voltage is 10VDC.)

For the calibration of terminal AM1 of A700 F700 E700, set the full-scale value of the connected meter when the output current of the terminal AM1 is 20mADC. Set the frequency to be indicated as the full scale value on the meter (20mA analog meter) connected between terminal AM1 and AMC. (20mADC current meter.) Output voltage is proportional to the frequency. (Maximum output current is 20mADC.)



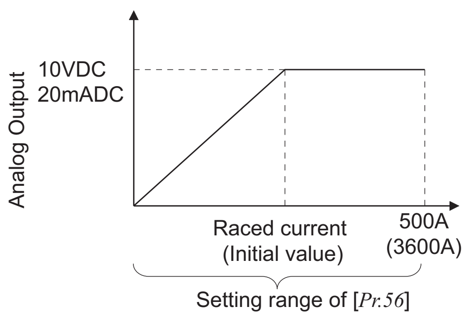
(2) Current monitor reference [Pr. 56] common

For the calibration of terminal FM, set the full-scale value of the connected current meter when the pulse speed of terminal FM is 1440 pulse/s (50k pulse/s when high speed pulse train output is selected in A700). Set the current to be indicated as the full scale value on the meter (1mA analog meter) connected between terminal FM and SD. Pulse speed is proportional to the monitored value of output current. (Maximum pulse train output is 2400 pulse/s (55k pulse/s when high speed pulse train output is selected on A700)).



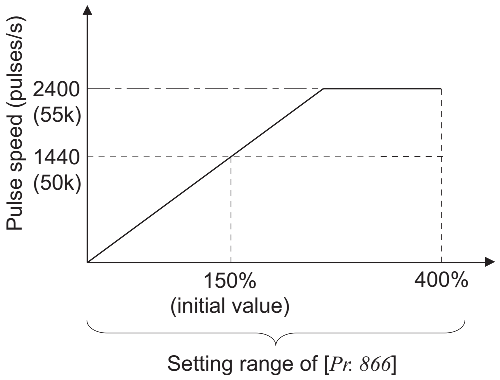
For the calibration of terminal AM, AM0 and DA1 (only in A700), set the full-scale value of the connected current meter when the output voltage of the terminal AM, AM1 and DA1 are 10VDC. For terminal AM0 of E700, set the full-scale value of the connected current meter when the output voltage of the terminal AM0 is 10VDC. Set the current to be indicated as the full scale value on the meter (10V analog meter) connected between terminal AM and 5 (AM0 and AMC, DA1 and 5). Output voltage is proportional to the monitored value of output current. (Maximum output voltage is 10VDC.)

For terminal AM1 of A700 F700 E700, set the full-scale value of the connected current meter when the output current of the terminal AM1 is 20mADC. Set the current to be indicated as the full scale value on the meter (20mA analog meter) connected between terminal AM1 and AMC. Output current is proportional to the monitored value of output current. (Maximum output current is 20mADC.)

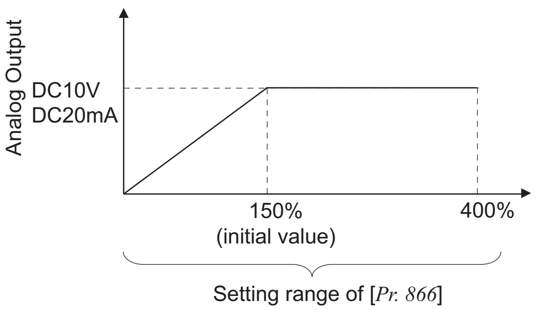


(3) Reference of torque monitor [Pr. 866] (A700)

For the calibration of terminal FM, set the full-scale value of the connected torque meter when the pulse speed of terminal FM is 1440 pulse/s (50k pulse/s when high speed pulse train output is selected in (A700)). Set the torque to be indicated as the full scale value on the torque meter (1mA analog meter) connected between terminal FM and SD. Pulse speed is proportional to the monitored value of torque. (Maximum pulse train output is 2400 pulse/s (55k pulse/s when high speed pulse train output is selected on (A700))).



For the calibration of terminal AM, AM0 and DA1, set the full-scale value of the connected torque meter when the output voltage of the terminal AM, AM0 and DA1 are 10VDC. Set the torque to be indicated as the full scale value on the meter (10V analog meter) connected between terminal AM and 5 (AM0 and AMC, DA1 and 5). Output voltage is proportional to the monitored value of torque.(Maximum output voltage is 10VDC.)
For the calibration of terminal AM1, set the full-scale value of the connected torque meter when the output current of the terminal AM1 is 20mADC. Set the torque to be indicated as the full scale value on the meter (20mA analog meter) connected between terminal AM1 and AMC. Output current is proportional to the monitored value of torque. (Maximum output current is 20mADC.))



(4) Terminal AM response adjustment [Pr. 867] (A700) (F700)

Using [*Pr. 867*], the output voltage response of terminal AM can be adjusted within the range 0 to 5s. Increasing the setting stabilizes the terminal AM output more but reduces the response level. (Setting 0 sets the response level to 4ms)

(5) Terminal DA1 (FR-A7AZ) response adjustment [Pr. 839] (A700)

Using [*Pr. 839*], the output voltage response of terminal DA1 can be adjusted within the range 0 to 5s.
Increasing the setting stabilizes the terminal DA1 output but reduces the response level.
[*Pr. 839 DA1 output filter*] setting plus 5ms at maximum equals to the response time of terminal DA1.

(6) Pulse train output of terminal FM [Pr. 291*] (common) (*Available for only (A700).)

Two types of pulse train can be selected for terminal FM of (A700) according to the [*Pr. 291*] setting. Using [*Pr. 291*], input specifications (pulse train input or contact input) of terminal JOG can be selected. Change the setting value using care not to change input specifications of terminal JOG. (Refer to page 228 for pulse train input.)

For (F700)(E700)(D700), only FM output can be output at terminal FM. (High speed pulse train can not be output.)

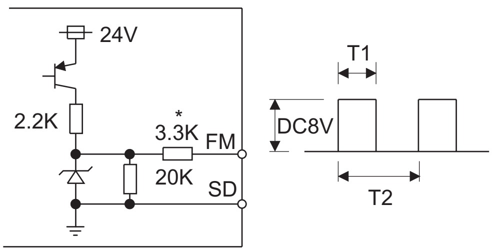
1) FM output (common)

When [*Pr. 291 Pulse train I/O selection* = 0 or 1] on (A700) and using (F700)(E700)(D700), FM output is selected and pulse train of 8VDC maximum, 2400pulse/s is output.

The pulse width can be adjusted by calibration parameter [*C0 (Pr. 900) FM terminal calibration*] using the operation panel and parameter unit.

Output frequency, etc. of the inverter can be commanded by connecting a DC ammeter of full-scale deflection, digital indicator, etc. The initial setting is 1mA full-scale and 1440 pulse/s terminal FM frequency at 60Hz.

FM output circuit



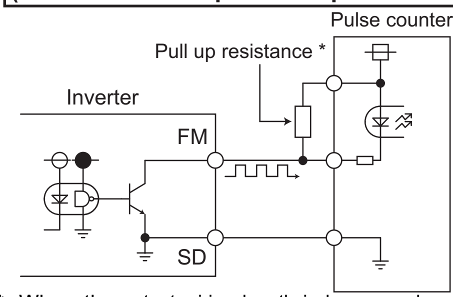
Pulse width T1: Adjust using calibration parameter [*C0*]
Pulse cycle T2: Set with [*Pr. 55*] (frequency monitor)
Set with [*Pr. 56*] (current monitor)
* 4.7K in (E700)(D700)

2) High speed pulse train output (A700)

When [*Pr. 291 Pulse train I/O selection = 10, 11, 20, 21, 100*] on (A700), high speed pulse train is output by open collector output. Maximum 55k pulse/s of pulse train is output.

Two types of pulse width, 50% Duty and fixed ON width, are available. Adjustment by calibration parameter [*C0 (Pr. 900) FM terminal calibration*] can not be performed.

High speed pulse train output circuit (connection example with a pulse counter)



* When the output wiring length is long, a pulse shape is deformed due to the stray capacitances of the wiring and output pulse can not be recognized. If the wiring length is long, connect the open collector output signal and the power supply using an external pull up resistance.
Check specifications of a pulse counter for a resistance value to pull up. Select an appropriate resistance value so that the load current is 80mA or less.

High speed pulse train output specifications

Item	Specifications
Output method	NPN open collector output
Voltage between a collector and emitter	30V (max)
Maximum permissible load current	80mA
Output pulse rate	0 to 55kpps*
Output resolution	3pps (excluding a jitter)

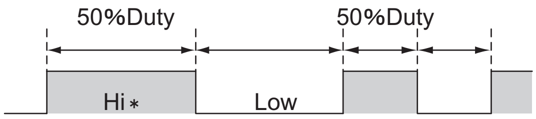
* The output pulse rate is 50kpps when a monitor output value is 100%.

When [*Pr. 291* = 10, 11], pulse cycle is 50% Duty (ON width and OFF width are the same).

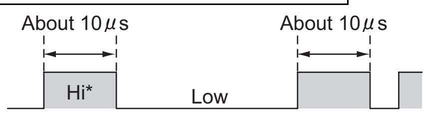
When [*Pr. 291* = 20, 21, 100], fixed ON width of pulse is output (approx. 10μs).

When the setting value is 100, the pulse train from the pulse train input (terminal JOG) is output as is. Use this value for synchronous speed operation of multiple inverters. (Refer to page 567)

Pulse when [Pr. 291 = 10, 11]



Pulse when [Pr. 291 = 20, 21, 100]



* Hi indicates that the open collector output transistor is OFF.

When high speed pulse train output is selected, performing all parameter clear will return the [*Pr. 291*] setting to the initial value 0, changing the terminal FM output from high speed pulse train output to FM output (voltage output).

Disconnect the device connected to terminal FM and perform all parameter clear.

2

PARAMETER

2.15.4 Terminal FM, AM calibration [C0 (Pr. 900), C1 (Pr. 901)*] (common)

(*[*C1 (Pr. 901)*] is not available for (D700).)

By operation panel or parameter unit, terminal FM and terminal AM in (A700)(**F700**) can be calibrated to full scale.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters	
					(A700) (F700) (E700)	(D700)
C0(900)	FM terminal calibration	—	—	Calibrates the scale of the meter connected to terminal FM.	○	○
C1(901)[*1]	AM terminal calibration	—	—	Calibrates the scale of the analog meter connected to terminal AM.	○	—

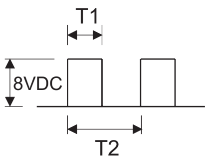
*1 The setting is available for (E700) when it has built-in option FR-A7AY installed.

*2 The above parameters allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0] (initial value).

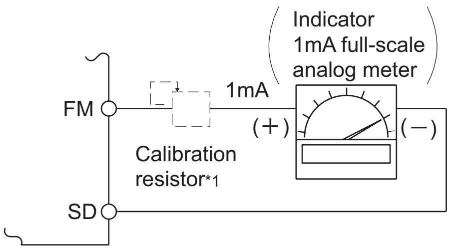
(1) FM terminal calibration [C0(Pr. 900)]

(common)

When using (A700) with [*Pr. 291* = 0, 1] and for (**F700**)(E700)(D700), terminal FM is preset to FM output. By setting the calibration parameter [*C0 (Pr. 900)*], the meter connected to the inverter can be calibrated without using a calibration resistor.

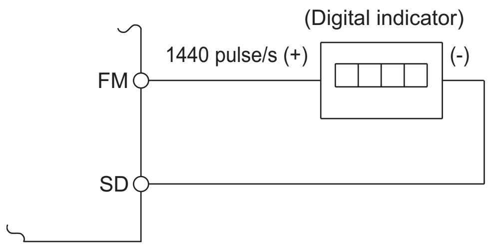


Pulse width T1: Adjust using calibration parameter [*C0 (Pr.900)*]
Pulse cycle T2: Set with [*Pr. 55*] (frequency monitor)
Set with [*Pr. 56*] (current monitor)



*1 It is not necessary when the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) is used for calibration.
Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter.
However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, use this resistor and perform calibration of operation panel or parameter unit.

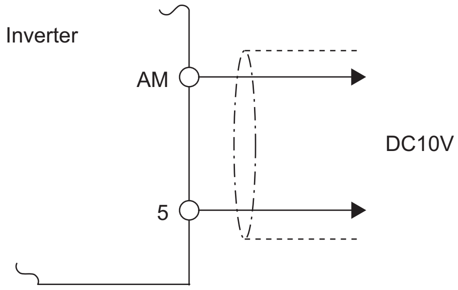
Connect an indicator/frequency meter (moving-coil type DC ammeter 1mA) across terminals FM-SD of the inverter. (Note the polarity. The terminal FM is positive.)
Set the monitor description in [*Pr. 54*] and operate the inverter. (It is not necessary to connect the motor.)
Read [*C0*] and turn  to change the pulse width.
The average value of the output voltage will change, enabling the indicator/frequency meter to be calibrated. When calibrating a monitor output signal, which cannot be adjusted to a 100% value without an actual load and a measurement equipment, set [*Pr. 54* = 21] (reference voltage output) and make calibration. When monitoring the frequency, the FM terminal output is filled to capacity at the initial value if the maximum output frequency reaches or exceeds 100Hz. In this case, the [*Pr. 55*] setting has to be changed to the maximum frequency.
Using the FM output of the terminal FM, a digital display can be provided to connect a digital counter. The monitor value is 1440 pulse/s output at the full-scale value of monitor description list (page 346) (*Pr. 54 FM terminal function selection*). Change the reference value of [*Pr. 55, Pr. 56, Pr. 866*] to change the number of pulses at full scale value. ([*Pr. 866*] is available for only (A700).)



(2) AM terminal calibration [C1(Pr. 901)]

A700 **F700**

Terminal AM is factory-set to provide a 10VDC output in the full-scale status of the corresponding monitor item. Calibration parameter [*C1 (Pr. 901)*] allows the output voltage ratios (gains) to be adjusted according to the meter scale. Note that the maximum output voltage is 10VDC.



Connect a meter/frequency meter (DC voltmeter 10V) to across inverter terminals AM-5. (Note the polarity. The terminal AM is positive.)
Set the monitor description in [*Pr. 158*] and operate the inverter. (It is not necessary to connect the motor.) Read [*C1*] and turn to change the output voltage, enabling the indicator/frequency meter to be calibrated. When calibrating a monitor output signal, which cannot adjust to a 100% value without an actual load and a measurement equipment, set [*Pr. 54* = 21] (reference voltage output) and make calibration. 10VDC is output from the terminal AM.

2.15.5 Signal selection and calibration of terminal AM0, AM1 (FR-A7AY) [Pr. 307 to 309, 311, 312, 323, 324, C0(Pr. 900), C1(Pr.901)] A700 F700 E700

Signal output from terminal AM0 (analog voltage output) and AM1 (analog current output) when the plug-in option FR-A7AY is fitted to the inverter can be selected and calibrated.

[Pr.]	Name	Initial Value	Setting Range	Description	
307	Setting for zero analog output AY	0%	0 to 100%	[*Pr. 309* = 0, 1] : Output signal value for zero analog output When[*Pr. 309* = 10,11]: Analog output value for zero output signal	
308	Setting for maximum analog output AY	100%	0 to 100%	[*Pr. 309* = 0, 1] : Output signal value for maximum analog output [*Pr. 309*=10, 11] : Analog output value for maximum output signal	
309	Voltage/current selection for analog output signal AY	0		Output signal selection, calibration/adjustment method	
				Terminal AM0	Terminal AM1
			0	Signal selection (same signal is output from terminal AM0 and AM1) using [*Pr. 306*] Full-scale calibration using [*C1 (Pr. 901)*] Adjustment of output signal value using [*Pr. 307, Pr. 308*]	
			1	Selection of signal using [*Pr. 310*] Full-scale calibration using [*C0 (Pr. 900)*] Adjustment of output signal value using [*Pr. 311, Pr. 312*]	Selection of signal using [*Pr. 306*] Full-scale calibration using [*C1 (Pr. 901)*] Adjustment of output signal value using [*Pr. 307, Pr. 308*]
			10	Signal selection (same signal is output from terminal AM0 and AM1) using [*Pr. 306*] Full-scale calibration using [*C1 (Pr. 901)*] Adjustment of analog output value using [*Pr. 307, Pr. 308*]	
			11	Selection of signal using [*Pr. 310*] Full-scale calibration using [*C0 (Pr. 900)*] Adjustment of analog output value using [*Pr. 311, Pr. 312*]	Selection of signal using [*Pr. 306*] Full-scale calibration using [*C1 (Pr. 901)*] Adjustment of analog output value using [*Pr. 307, Pr. 308*]
311	Setting for zero analog meter voltage output AY	0%	0 to 100%	[*Pr. 309* = 1]: Output signal value for zero analog output [*Pr. 309* = 11]: Analog output value for zero output signal	
312	Setting for maximum analog meter voltage output AY	100%	0 to 100%	[Pr. 309 = 1] : Output signal value for maximum analog output [*Pr. 309* = 11]: Analog output value for maximum output signal	
323	AM0 0V adjustment AY	1000%	900 to 1100%	The meter connected to terminal AM0 can be adjusted to stop at 0.	
324	AM1 0mA adjustment AY	1000%	900 to 1100%	The meter connected to terminal AM1 can be adjusted to stop at 0.	
C0(900)	FM terminal calibration	—	—	Scale of the connected meter to terminal AM0 can be calibrated.	
C1(901)*	AM terminal calibration	—	—	Scale of the connected meter to terminal AM1 can be calibrated.	

* The setting is available for E700 when it has built-in option FR-A7AY installed.

(1) Analog output signal setting [Pr. 309]

Use [*Pr. 309 Analog output signal voltage/current switchover*] to select whether to output the same signal or different signals from terminal AM0 (analog voltage output) and terminal AM1(analog current output).

When [*Pr. 309 = 0, 10*] , same signal is output from terminal AM0 and AM1, and set the output signal using [*Pr. 306*]. (Refer to page 346 for output signal description.)

When [*Pr. 309* = 1, 11], a different signal is output from each terminal, and set output signal from AM0 using [*Pr. 310*] and from AM1 using [*Pr. 306*]. (Refer to page 346 for output signal description.)

(2) Adjusting the meter needle to stop at 0 [Pr. 323, 324]

If the meter needle does not point to 0 when voltage or current output is 0, use [*Pr. 323 AM0 0V adjustment*] or [*Pr. 324 AM1 0mA adjustment*] to calibrate the meter. Setting a smaller value decreases the analog output and a larger value increases the analog output.

(3) Calibration of analog signal [C0 (Pr. 900), C1 (Pr. 901)]

When outputting the same signal from terminal AM0 and AM1 ([*Pr. 309* = 0, 10]), set [*Pr. 306* = 21] (reference voltage output) and adjust the output at full-scale using [C1 (*Pr. 901*)].

When outputting the same signal from terminal AM0 and AM1 ([*Pr. 309* = 1, 11]) , set [*Pr. 310* = 21] (reference voltage output) for terminal AM0 and [*Pr. 306* = 21] (reference voltage output) for AM1 to adjust the output from these terminals at full-scale using [C0 (*Pr. 900*)] and [C1 (*Pr. 901*)] respectively. Refer to page 356 for details.

Calibrating AM 0 and AM1 without setting 21 in [*Pr. 306*] or [*Pr. 310*] calibrates terminal FM and AM of the inverter. To prevent this, always set 21 before calibrating terminal AM0 and AM1.

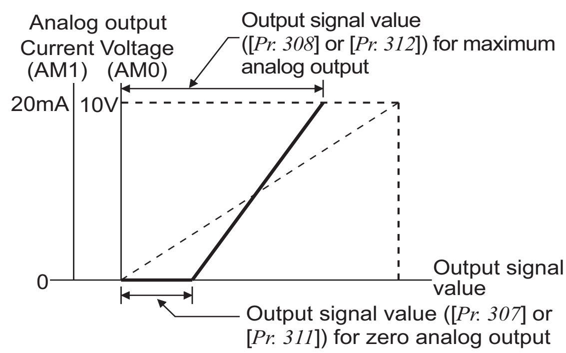
(4) Analog signal adjustment [Pr. 307, 308, 311, 312]

Use [*Pr. 307*] or [*Pr. 311*] to set for zero analog output (meter points 0).

In addition, use [*Pr. 308*] or [*Pr. 312*] to set for maximum analog output (full-scale).

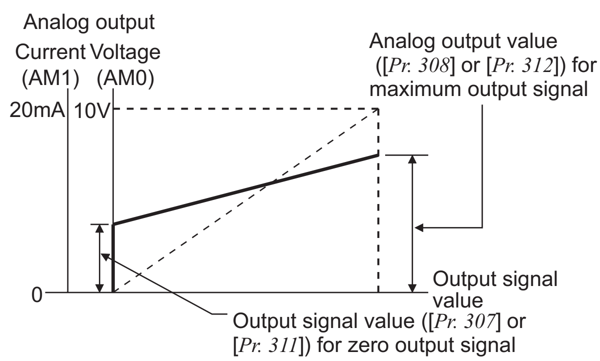
Output signal value can be calibrated when [*Pr. 309* = 0, 1] and analog input value can be adjusted when [*Pr. 309* = 10, 11].

When [Pr. 309 = 0, 1]



* When [*Pr. 307*] ≧ [*Pr. 308*] and [*Pr. 311*] ≧ [*Pr. 312*] are set, the output value at terminal AM0 and AM1 are always zero.

When [Pr. 309 = 10, 11]



* When [*Pr. 307*] ＝[*Pr. 308*] and [*Pr. 311*] ＝[*Pr. 312*] are set, the output value at terminal AM0 and AM1 are always the parameter setting value.

2.15.6 Terminal DA1(FR-A7AZ) calibration [Pr. 857, C0 (Pr. 900)] (A700)

Calibration can be performed for the signal that is output from terminal DA1 (bipolar analog voltage output) when the built-in option FR-A7AZ is installed to the inverter.

[Pr.]	Name	Initial Value	Setting Range	Description
857	DA1-0V adjustment AZ	1000%	900 to 1100%	Adjustment can be made for the meter needle of the meter connected to terminal DA1
CO(900)	FM terminal calibration	—	—	Scale of the connected meter to terminal DA1 can be calibrated.

(1) Adjusting the meter needle to stop at 0 [Pr. 857]

When the meter needle does not point 0 at 0 output voltage, calibrate the meter with [*Pr. 857 DA1-0V adjustment*]
Analog output becomes smaller by making the setting value smaller, and it becomes greater by making the setting value larger.

(2) Calibrating analog signal [CO(Pr. 900)]

For the calibration of terminal DA1, set [*Pr. 838* =21] (Reference voltage output), and perform full scale adjustment by [C0(*Pr. 900*)]. For the adjustment method, refer to page 356.
If calibration is attempted without setting 21 in [*Pr. 838*] (Reference voltage output), calibration is performed for the terminal FM of the inverter.
When using and installing both of FR-A7AZ and FR-A7AY, and [*Pr.309 Analog output signal voltage/current switchover* = 1 or 11] and [*Pr. 310 Analog meter voltage output selection* = 21] are set, the terminal AM0 of FR-A7AY is calibrated by [*C0 (900)*].

2.15.7 Energy saving monitor [Pr. 891 to 899] A700 F700

From the power consumption estimated value during commercial power supply operation, the energy saving effect by use of the inverter can be monitored/output.

[Pr.]	Name	Initial Value	Setting Range		Description
52	DU/PU main display data selection	0 (output frequency)	A700: 0, 5 to 14, 17 to 20, 22 to 25, 32 to 35, 50 to 57, 100 F700: 0, 5, 6, 8 to 14, 17, 20, 23 to 25, 50 to 57, 100		50: Power saving monitor 51: Power saving cumulative monitor
54	FM terminal function selection	1 (output frequency)	A700: 1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53 F700: 1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53		50: Power saving monitor
158	AM terminal function selection				
891	Cumulative power monitor digit shifted times	9999	0 to 4		Set the number of times to shift the cumulative power monitor digit Clamps the monitor value at maximum.
			9999		No shift Clears the monitor value when it exceeds the maximum value.
892	Load factor	100%	30 to 150%		Set the load factor for commercial power-supply operation. Multiplied by the power consumption rate (page *363*) during commercial power supply operation.
893	Energy saving monitor reference (motor capacity)	Inverter rated capacity	55K or less	0.1 to 55kW	Set the motor capacity (pump capacity). Set when calculating power saving rate, power saving rate average value, commercial operation power.
			75K or more	0 to 3600kW	
894	Control selection during commercial power-supply operation	0	0		Discharge damper control (fan)
			1		Inlet damper control (fan)
			2		Valve control (pump)
			3		Commercial power supply drive (fixed value)
895	Power saving rate reference value	9999	0		Consider the value during commercial power-supply operation as 100%
			1		Consider the [*Pr. 893*] setting as 100%.
			9999		No function
896	Power unit cost	9999	0 to 500		Set the power unit cost. Displays the power saving amount charge on the energy saving monitor
			9999		No function
897	Power saving monitor average time	9999	0		Average for 30 minutes
			1 to 1000h		Average for the set time
			9999		No function
898	Power saving cumulative monitor clear	9999	0		Cumulative monitor value clear
			1		Cumulative monitor value hold
			10		Accumulation continued (communication data upper limit 9999)
			9999		Accumulation continued (communication data upper limit 65535)
899	Operation time rate (estimated value)	9999	0 to 100%		Use for calculation of annual power saving amount. Set the annual operation ratio (consider 365 days × 24h as 100%).
			9999		No function

* The above parameters allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0] (initial value) .

(1) Energy saving monitor list

The following items are monitored by the power saving monitor [*Pr. 52, Pr. 54, Pr. 158* = 50].
Only 1) power saving and 3) power saving average value can be output to [*Pr. 54*] (terminal FM) and [*Pr. 158*] (terminal AM)).

<table>
<tr><th rowspan="2"></th><th rowspan="2">Energy saving Monitor Item</th><th rowspan="2">Description and Calculation Formula</th><th rowspan="2">Increments</th><th colspan="4">Parameter Setting</th></tr>
<tr><th>[Pr. 895]</th><th>[Pr. 896]</th><th>[Pr. 897]</th><th>[Pr. 899]</th></tr>
<tr><td>1)</td><td>Power saving</td><td>Difference between the estimated value of power necessary for commercial power supply operation and the input power calculated by the inverter
Power during commercial power supply operation - input power monitor</td><td>0.01kW/ 0.1kW *3</td><td>9999</td><td rowspan="3">—</td><td rowspan="3">9999</td><td rowspan="8">—</td></tr>
<tr><td rowspan="2">2)</td><td rowspan="2">Power saving rate</td><td>Ratio of power saving on the assumption that power during commercial power supply operation is 100%
$\frac{\text{1) Power saving}}{\text{Power during commercial power supply operation}} \times 100$</td><td rowspan="2">0.1%</td><td>0</td></tr>
<tr><td>Ratio of power saving on the assumption that [Pr. 893] is 100%.
$\frac{\text{1) Power saving}}{[Pr.\ 893]} \times 100$</td><td>1</td></tr>
<tr><td>3)</td><td>Average power saving value</td><td>Average value of power saving amount per hour during the set time ([Pr. 897])
$\frac{\Sigma(\text{(1) Power saving} \times \Delta t)}{[Pr.\ 897]} \times 100$</td><td>0.01kWh/ 0.1kWh*3</td><td>9999</td><td rowspan="3">9999</td><td rowspan="4">0 to 1000h</td></tr>
<tr><td rowspan="2">4)</td><td rowspan="2">Average power saving rate</td><td>Average ratio of power saving value on the assumption that the value during commercial power supply operation is 100%
$\frac{\Sigma(\text{(2) Power saving rate} \times \Delta t)}{[Pr.\ 897]} \times 100$</td><td rowspan="2">0.1%</td><td>0</td></tr>
<tr><td>Ratio of power saving average value on the assumption that [Pr. 893] is100%.
$\frac{\text{3) Average power saving value}}{[Pr.\ 893]} \times 100$</td><td>1</td></tr>
<tr><td>5)</td><td>Average power saving amount</td><td>Average power saving value represented in terms of charge
3) Average power saving value × [Pr. 896]</td><td>0.01/0.1*3</td><td>—</td><td>0 to 500</td></tr>
</table>

The following items are monitored by the power saving monitor [*Pr. 52* = 51]. The monitor value of the cumulative monitor can be shifted to the right with [*Pr. 891 Cumulative power monitor digit shifted times*] .

<table>
<tr><th rowspan="2"></th><th rowspan="2">Energy Saving Monitor Item</th><th rowspan="2">Description and Calculation Formula</th><th rowspan="2">Increments</th><th colspan="4">Parameter Setting</th></tr>
<tr><th>[Pr. 895]</th><th>[Pr. 896]</th><th>[Pr. 897]</th><th>[Pr. 899]</th></tr>
<tr><td>6)</td><td>Power saving amount</td><td>Power saving is added up per hour.
$\Sigma(\text{(1) Power saving} \times \Delta t)$</td><td>0.01kWh/ 0.1kWh *1*2*3</td><td>—</td><td>9999</td><td rowspan="4">—</td><td rowspan="2">9999</td></tr>
<tr><td>7)</td><td>Power saving amount charge</td><td>Power saving amount represented in terms of charge
6) Power saving amount × [Pr. 896]</td><td>0.01/0.1 *1*3</td><td>—</td><td>0 to 500</td></tr>
<tr><td>8)</td><td>Annual power saving amount</td><td>Estimated value of annual power saving amount
$\frac{\text{6) Power saving amount}}{\text{Operation time during power saving accumulation}} \times 24 \times 365 \times \frac{[P.899]}{100}$</td><td>0.01kWh/ 0.1kWh *1*2*3</td><td>—</td><td>9999</td><td rowspan="2">0 to 100%</td></tr>
<tr><td>9)</td><td>Annual power saving amount charge</td><td>Annual power saving amount represented in terms of charge
8)Annual power saving amount × [Pr. 896]</td><td>0.01/0.1 *1*3</td><td>—</td><td>0 to 500</td></tr>
</table>

*1 For communication (RS-485 communication, communication option), the display increments are 1. For example, 10.00kWh indicates that communication data is 10.

*2 When using the parameter unit (FR-PU04/FR-PU07), kW is displayed.

*3 The increments vary according to the inverter capacity. (55K or less/75K or more)

*4 Since four digits are displayed on the operation panel (FR-DU07), the value is displayed in 0.1 increments when a monitor value in 0.01 increments exceeds 99.99, then rounded up to 100.0. The maximum display is 9999.

*5 Since five digits are displayed on the parameter unit (FR-PU04/FR-PU07), the value is displayed in 0.1 increments when a monitor value in 0.01 increments exceeds 999.99, then rounded up to 1000.0. The maximum display is 99999.

*6 When [*Pr. 898 Power saving cumulative monitor clear* = 9999], the maximum value of communication (RS-485 communication, communication option) is 65535. The upper limit of 0.01 increments monitor is 655.35 and that of 0.1 increments monitor is 6553.5.

(2) Energy saving instantaneous monitor
1) Power saving,
2)Power saving rate

The power saving monitor 1) calculates power saving effect (difference) to the power consumption (estimated value) during commercial power supply operation and displays on the main monitor.
In the following case, the power saving monitor 1) is 0.

(a) The calculated value of the power saving monitor is negative value.
(b) During DC injection brake operation
(c) The motor is not connected (output current monitor is 0A)

Power saving rate monitor 2) displays the power saving rate on the assumption that the power consumption (estimated value) during commercial power supply operation is 100% by setting [*Pr. 895 Power saving rate reference value* = 0]. In addition, when [*Pr. 895* = 1], the monitor displays the power saving rate on the assumption that the [*Pr. 893 Energy saving monitor reference (motor capacity)*] is 100%.

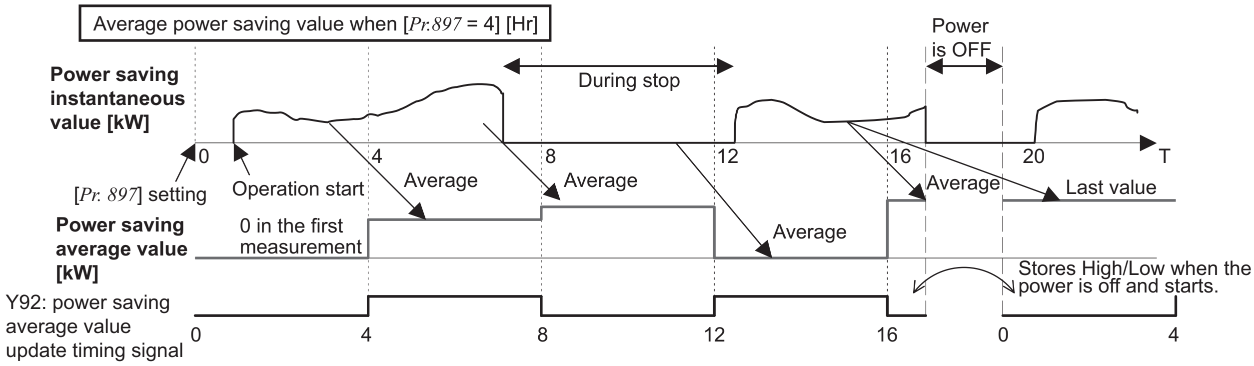
(3) Power saving average value monitor
3) Average power saving value,
4) Average power saving rate
5) Average power saving amount charge

The power saving average value monitor is displayed by setting a value other than 9999 in [*Pr. 897 Power saving monitor average time*].
The power saving average value monitor 3) displays the unit time average value of power saving amount at every averaging.
The average value is updated when the [*Pr. 897*] setting is changed, power is turned ON, or the average time has passed since the inverter is reset.
Power saving average value update timing signal (Y92) is inversed every time the average value is updated.
When 0 or 1 is set in [*Pr. 895 Power saving rate reference value*], power saving average value monitor 4) displays unit time average value of power saving rate 2) at every averaging time.
When charge (unit power value) per 1kWh of power amount is set in [*Pr. 896 Unit power value*], power saving amount average value monitor 5) displays charge (power saving average value 3)× [*Pr. 896*]) to the power saving average value.

(4) Power saving cumulative monitor
6) Power saving amount,
7) Power saving amount charge,
8) Annual power saving amount,
9) Annual power saving amount charge

The power saving cumulative monitor data digit can be shifted to the right by the number set in [*Pr. 891Cumulative power monitor digit shifted time*]. For example, if the cumulative power value is 1278.56kWh when [*Pr. 891* = 2] , the PU/DU display is 12.78 (displayed in 100kWh increments) and the communication data is 12.
If the maximum value exceeded at [*Pr. 891* = 0 to 4], the power is clamped at the maximum value, indicating that a digit shift is necessary. When [*Pr. 891* = 9999], the value returns to 0 if it exceeds the maximum value, then counting restarts.
The other monitors are clamped at the display upper limit.
The power saving cumulative monitor value is stored every hour. Hence, when the power supply is switched OFF within one hour, and switched ON again, the previously stored monitor value is displayed and accumulation starts. (The cumulative monitor value may decrease)
The power saving amount monitor 6) can measure the power amount during a predetermined period. Carry measurement according to the following steps.

i) Write 9999 or 10 in [*Pr. 898 Power saving cumulative monitor clear*].
ii) Write [*Pr. 898* = 0] at measurement start timing to clear the power saving cumulative monitor value and start accumulation of power saving.
iii) Write [*Pr. 898* = 1] at measurement end timing to hold the power saving cumulative monitor value.

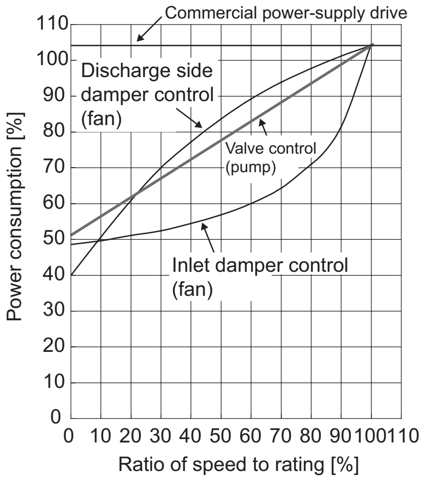


(5) Power estimated value of commercial power supply operation [Pr. 892, Pr. 893, Pr. 894]

Select the commercial power supply operation pattern from among the four patterns of discharge damper control (fan), inlet damper control (fan), valve control (pump) and commercial power supply drive, and set it to [*Pr. 894 Control selection during commercial power-supply operation*] .

Set motor capacity (pump capacity) in [*Pr. 893 Energy saving monitor reference (motor capacity)*].

The power consumption rate (%) during commercial power supply operation is estimated from the operation pattern and the ratio of speed to rating (current output frequency/[*Pr. 3 Base frequency*]) in the following chart.



From the motor capacity set in [*Pr. 893*] and [*Pr. 892 Load factor*] , the power estimated value (kW) during commercial power supply operation is found by the following formula.

Power estimated value (kW) during commercial power supply operation(kW)
$= [\text{Pr. } 893]\text{kW} \times \frac{\text{Power consumption (\%)}}{100} \times \frac{[\text{Pr. } 892]\ (\%)}{100}$

Since the speed does not increase above the power supply frequency in commercial power supply operation, it becomes constant when the output frequency rises to or above [*Pr. 3 Base frequency*].

(6) Annual power saving amount, power charge [*Pr. 899*]

By setting the operation time rate [%] (ratio of time when the motor is actually driven by the inverter during a year) in [*Pr. 899*], the annual energy saving effect can be estimated.
When the operation pattern is predetermined to some degree, the estimated value of the annual power saving amount can be found by measurement of the power saving amount during a given measurement period.
Refer to the following and set the operation time rate.

1) Estimate the average time [h/day] of operation in a day.
2) Find the annual operation days [days/year]. (Monthly average operation days × 12 months)
3) Calculate the annual operation time [h/year] from 1) and 2).

Annual operation time (h/year)
= average time (h/day) × operation days (days/year)

4) Calculate the operation time rate and set it to [*Pr. 899*].

$\text{Operation time rate (\%)} = \frac{\text{Annual operation time (h/year)}}{24\ \text{(h/day)} \times 365\ \text{(days/year)}} \times 100$

[Operation time rate setting example]

When operation is performed for about 21 hours per day and the monthly average operation days are 16 days

Annual operation time = 21 (h/day) × 16 (day/month) × 12 months

= 4032(h/year)

$$\text{Operation time rate} = \frac{4032\ \text{(h/year)}}{24\ \text{(h/day)} \times 365\ \text{(days/year)}} \times 100(\%)$$

= 46.03

Set [*Pr. 899* = 46.03%] .

Calculate the annual power saving amount from [*Pr. 899 Operation time rate (estimated value)*] and power saving average value monitor.

Annual power saving amount (kWh/year)
= Power savings average value during accumulation with [*Pr. 898 = 10 or 9999*] (kW) × 24h × 365days × $\frac{[Pr.899]}{100}$

The annual power saving charge can be monitored by setting the power charge per hour in [*Pr. 896 Power unit cost*].
Calculate the annual power saving charge in the following method.

Annual power saving amount charge
= annual power saving amount (kWh/year)× [*Pr. 896*]

In the regeneration mode, make calculation on the assumption that power saving = power during commercial power supply operation (input power = 0).

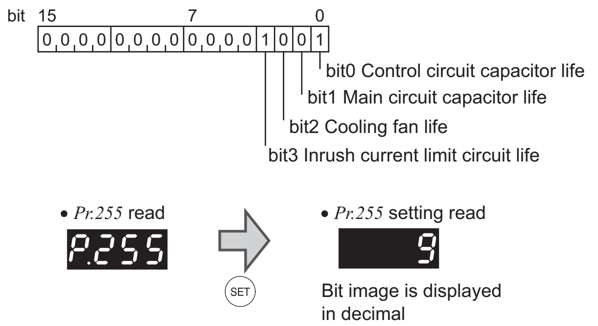
2.15.8 Display of the life of the inverter parts [Pr. 255 to 259] (common)

Degrees of deterioration of main circuit capacitor, control circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed by monitor.
When any part has approached the end of its life, an alarm can be output by self diagnosis to prevent a fault.
(Use the life check of this function as a guideline since the life except the main circuit capacitor is calculated theoretically.)
For the life check of the main circuit capacitor, the alarm signal (Y90) will not be output if a measuring method of (4) is not performed.

[Pr.]	Name	Initial Value	Setting Range	Description
255	Life alarm status display	0	(0 to 15)	Displays whether the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit has reached the life alarm output level or not. Reading only
256	Inrush current limit circuit life display	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. Reading only
257	Control circuit capacitor life display	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. Reading only
258	Main circuit capacitor life display	100%	(0 to 100%)	Displays the deterioration degree of the main circuit capacitor. Reading only The value measured by [*Pr. 259*] is displayed.
259	Main circuit capacitor life measuring	0	0, 1 (2, 3, 8, 9)	Setting 1 and switching the power supply OFF starts the measurement of the main circuit capacitor life. Switch the power supply ON again and check the [*Pr. 259*] setting. Measurement is complete if the setting is 3. Displays the deterioration degree in [*Pr. 258*] .

(1) Life alarm display and signal output (Y90 signal) [Pr. 255]

Whether any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit has reached the life alarm output level or not can be checked by [*Pr. 255 Life alarm status display*] and life alarm signal (Y90).
The life alarm signal (Y90) turns ON when any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit reaches the life alarm output level.
For the terminal to output Y90 signal, assign 90 (positive logic) or 190 (negative logic) to any of (A700)(F700) [*Pr.190 to 196 Output terminal function selection*], (E700)[*Pr.190 to 192 Output terminal function selection*], or (D700)[*Pr.190, 192 Output terminal function selection*].
When using a built-in option (FR-A7AY, FR-A7AR) in (A700)(F700)(E700), the following life signals can be output individually: control circuit capacitor life signal (Y86), main circuit capacitor life signal (Y87), cooling fan life signal (Y88), and inrush current limit circuit life signal (Y89).



[Pr. 255] (Decimal)	Bit (Binary)	Inrush Current Suppression Circuit Life	Cooling Fan Life	Main Circuit Capacitor Life	Control Circuit Capacitor Life
15	1111	○	○	○	○
14	1110	○	○	○	×
13	1101	○	○	×	○
12	1100	○	○	×	×
11	1011	○	×	○	○
10	1010	○	×	○	×
9	1001	○	×	×	○
8	1000	○	×	×	×
7	0111	×	○	○	○
6	0110	×	○	○	×
5	0101	×	○	×	○
4	0100	×	○	×	×
3	0011	×	×	○	○
2	0010	×	×	○	×
1	0001	×	×	×	○
0	0000	×	×	×	×

○: With warnings, ×: Without warnings

(2) Inrush limit circuit life display [Pr. 256]

The life of the inrush current limit circuit (relay, contactor and inrush resistance) is displayed in [*Pr. 259*] .

The number of contact (relay, contactor, thyristor) ON times is counted. It is counted down from 100% (used 0 time and 1,000,000 times left) at every 1% (at every 10,000 times). When the count reaches 10% (used 900,000 times and 100,000 times left), [*Pr. 255*] bit 3 is turned ON and Y90 signal is output to notify the life.

(3) Control circuit capacitor life display [Pr. 257]

The deterioration degree of the control circuit capacitor is displayed in [*Pr. 257*] as a life.

The control circuit capacitor life is calculated from the energization time and temperature according to the operating status, and is counted down from 100%. As soon as the control circuit capacitor life falls below 10%, [*Pr. 255*] bit 0 is turned ON and also an alarm is output to the Y90 signal.

(4) Main circuit capacitor life display [Pr. 258, 259]

The deterioration degree of the main circuit capacitor is displayed in [*Pr. 258*] as a life.

On the assumption that the main circuit capacitor capacitance at factory shipment is 100%, the capacitor life is displayed in [*Pr. 258*] every time measurement is made. When the measured value falls to or below 85%, [*Pr. 255*] bit 1 is turned ON and also an alarm is output to the Y90 signal.

Measure the capacitor capacity according to the following procedure and check the deterioration level of the capacitor capacity.

1) Check that the motor is connected and at a stop.
2) Set [*Pr. 259* = 1] (measuring start)
3) Switch power OFF. The inverter applies DC voltage to the motor to measure the capacitor capacity while the inverter is OFF.
4) After making sure that the power lamp is OFF in (A700)(F700) and LED on the operation panel is OFF in (E700)(D700), switch ON the power supply again.
5) Confirm that [*Pr. 259* = 3] (measurement complete), read [*Pr. 258*], and check the deterioration degree of the main circuit capacitor.

[P.259]	Description	Remarks
0	No measurement	Initial value
1	Measurement start	Measurement starts when the power supply is switched OFF.
2	During measurement	Only displayed and cannot be set
3	Measurement complete	
8	Forced end See (c), (g), (h), (i) below.	
9	Measurement error See (d), (e), (f) below.	

Do not measure in the following conditions. If measured in the following conditions, "forced end" [*Pr. 259*=8] or "measurement error" [*Pr. 259*=9] would occur, or "measurement start" [*Pr. 259*=1] would continues. Even when "measurement complete" [*Pr. 259*=3] appears in the following conditions, the capacitor capacity is not measured correctly.

(A700)(F700)

(a) FR-HC, MT-HC, FR-CV, or a sine wave filter is connected.
(b) Terminal R1/L11, S1/L21 or DC power supply is connected to terminal P/+ and N/-.
(c) Switching power ON during measuring.
(d) The motor is not connected to the inverter.
(e) The motor is running (coasting)
(f) The motor capacity is two rank smaller as compared to the inverter capacity.
(g) The inverter is tripped or a fault occurred when power is OFF.
(h) The inverter output is shut off with the MRS signal.
(i) The start command is given while measuring.

(E700)(D700)

(a) FR-HC or FR-CV is connected.
(b) DC power supply is connected to terminal P/+ and terminal N/-.
(c) Switching power ON during measuring.
(d) The motor is not connected to the inverter.
(e) The motor is running (coasting)
(f) The motor capacity is two rank smaller as compared to the inverter capacity.
(g) The inverter is tripped or a fault occurred when power is OFF.
(h) The inverter output is shut off with the MRS signal.
(i) The start command is given while measuring.
(j) Parameter unit (FR-PU04/FR-PU07) is connected.

(k) Using terminal PC as a power supply.
(l) I/O terminals on the control terminal block (including the I/O terminals of built-in options for E700) are ON (conducted).
(m) A built-in option is installed (only for E700 0.75K or less).

•Turning the power supply ON during measurement before LED turns OFF may cause "during measurement" [*Pr. 259* =2] output to continue. In that case, re-do the operation from 2.

(5) Cooling fan life display

The cooling fan speed of 50% or less is detected and "FN" is displayed on the operation panel and parameter unit (FR-PU04/FR-DU07). As an alarm display, [*Pr. 255*] bit2 is turned ON and also an alarm is output to the Y90 signal.
When the inverter is mounted with two or more cooling fans, the life of even one cooling fan is diagnosed.

2.16 Operation selection at power failure and instantaneous power failure

2.16.1 Automatic restart after instantaneous power failure/flying start [Pr. 30, 57, 58, 96, 162, 163*, 164*, 165, 298*, 299, 611] common

(*[*Pr. 163, 164*] are not available for E700 D700.)
(*[*Pr. 298*] is not available for A700 F700.)

When instantaneous power failure protection (E.IPF) and undervoltage protection (E.UVT) are activated, the inverter output is shut off. (Refer to page 111 for E.IPF and E.UVT)
When automatic restart after instantaneous power failure operation is set with the following conditions, the motor can be restarted if power is restored after an instantaneous power failure or undervoltage. (E.IPF and E.UVT are not activated.)

- when electronic bypass operation is switched to inverter operation
- when power comes back ON after an instantaneous power failure
- when motor is coasting at start

Automatic restart after instantaneous power failure function is invalid when load torque high speed frequency control ([*Pr. 270* = 2, 3]) is set.

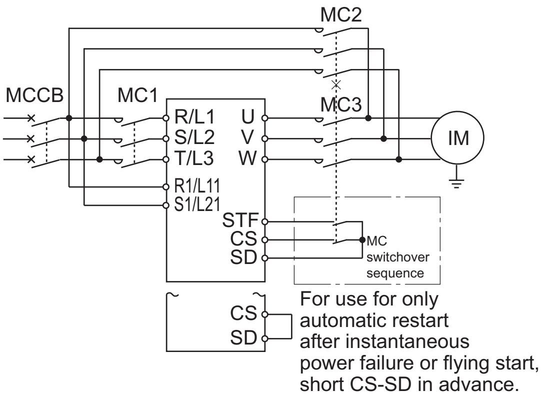
[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	F700	E700	D700
57	Restart coasting time	9999	0	A700 F700 1.5K or less ..... 0.5s 2.2K to 7.5K .... 1s 11K to 55K....... 3.0s 75K or more .... 5.0s of coasting time E700 D700 1.5K or less...... 1s 2.2K to 7.5K..... 2s 11K or more ..... 3.0s of coasting time	○	○	○	○
			55K or less: 0.1 to 5s 75K or more: 0.1 to 30s	Set the waiting time for inverter-triggered restart after an instantaneous power failure.				
			9999	No restart				
58	Restart cushion time	1s	0 to 60s	Set a voltage starting time at restart.	○	○	○	○
96	Auto tuning setting/status	0	0	Offline auto tuning is not performed.	○*	—	○	○
			1	For Advanced magnetic vector control Offline auto tuning (all motor constants) without running the motor. *(Refer to page 268)*	○*	—	○	—
			11	For General-purpose magnetic flux vector control Offline auto tuning (only motor constant (R1)) without turning the motor. *(Refer to page 268)*	—	—	○	○
			21	For V/F control. Offline auto tuning (without running the motor) for automatic restart after instantaneous power failure (with frequency search)	—	—	○	○
			101	For Advanced magnetic vector control Offline auto tuning (all motor constants) by running the motor. *(Refer to page 268)*	○*	—	—	—
162	Automatic restart after instantaneous power failure selection	0	0	With frequency search	○	○	○	○
			1	Without frequency search (reduced voltage system)	○	○	○	○
			2	Encoder detection frequency search	○	—	○	—
			10	Frequency search at every start	○	○	○	○
			11	Reduced voltage at every start	○	○	○	○
			12	Encoder detection frequency search at every start	○	—	○	—

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	F700	E700	D700
163	First cushion time for restart	0s	0 to 20s	Set a voltage starting time at restart. Consider using these parameters according to the load (inertia moment, torque) magnitude.	○	○	○	○
164	First cushion voltage for restart	0%	0 to 100%					
165	Stall prevention operation level for restart	A700 E700 D700 150% F700 120%	A700 0 to 220% E700 D700 0 to 200% F700 0 to 150%	Considers the rated inverter current as 100% and sets the stall prevention operation level during restart operation.	○	○	○	○
298	Frequency search gain	9999	0 to 32767	When offline auto tuning is performed under V/F control, frequency search gain necessary for frequency search for automatic restart after instantaneous power failure is set as well as the motor constants (R1).	—	—	○	○
			9999	Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SFHRCA) constants				
299	Rotation direction detection selection at restarting	A700 E700 D700 0 F700 9999	0	Without rotation direction detection	○	○	○	○
			1	With rotation direction detection				
			9999	When [*Pr. 78* = 0] , the rotation direction is detected. When [*Pr. 78* = 1, 2] the rotation direction is not detected.				
611	Acceleration time at a restart	55K or less: 5s 75K or more: 15s	0 to 3600s, 9999	Set the acceleration time (acceleration slope) at restart. For [*Pr.611*], set the acceleration time to reach [*Pr.20 Acceleration/deceleration reference frequency*] from 0Hz. Acceleration time for restart is the normal acceleration time (e.g. [*Pr. 7*]) when 9999 is set.	○	○	○	○

* These parameters are not used in instantaneous power failure function.

(1) Connection (CS signal) A700 F700

When the automatic restart after instantaneous power failure selection signal (CS) is turned ON, automatic restart operation is enabled. To use automatic restart after instantaneous power failure or flying start function, turn ON CS signal. To operate by switching between bypass and inverter operation, configure a sequence which turns OFF CS signal during bypass operation and turns ON during inverter operation.
When [*Pr. 57* ≠ 9999] (automatic restart operation enabled), the inverter will not operate if used with the CS signal remained OFF.



(2) Automatic restart operation selection [*Pr. 162, Pr. 299*]

1) With frequency search

When [*Pr. 162* = 0, 10] , the inverter smoothly starts by increasing voltage up to the frequency set in [*Pr. 58 Restart cushion time*] after detecting the motor speed upon power restoration.

When performing Real sensorless vector control on A700 , control starts at the detected frequency ([*Pr. 58 Restart cushion time*] is invalid).

Even when the motor is rotating in the opposite direction, the inverter can be restarted smoothly as the direction of rotation is detected.

When selecting frequency search in E700 D700 , perform offline auto tuning.

Whether to make a rotation direction detection or not can be selected using [*Pr. 299 Rotation direction detection selection at restarting*]. When capacities of the motor and inverter differ, set [*Pr. 299* = 0] (without rotation direction detection).

When reverse rotation is detected when [*Pr. 78* = 1] (reverse rotation disabled), the rotation direction is changed to forward rotation after decelerates in reverse rotation when the start command is forward rotation. The inverter will not start when the start command is reverse rotation.

[*Pr. 299*] Setting	[*Pr. 78*] Setting		
	0	1	2
9999	○	×	×
0 (initial value)	×	×	×
1	○	○	○

○: the rotation direction is detected.
×: the rotation direction is not detected.

Speed detection time (frequency search) changes according to the motor speed. (maximum 500ms in A700 F700 , maximum 100ms in E700 D700)

When the inverter capacity is two rank or larger than the motor capacity, the inverter may not start due to overcurrent (OCT) alarm.

If two or more motors are connected to one inverter, the inverter functions abnormally. (The inverter does not start smoothly.)

Since the DC injection brake is operated instantaneously when the speed is detected at a restart, the speed may decrease if the load inertia (J) is small.

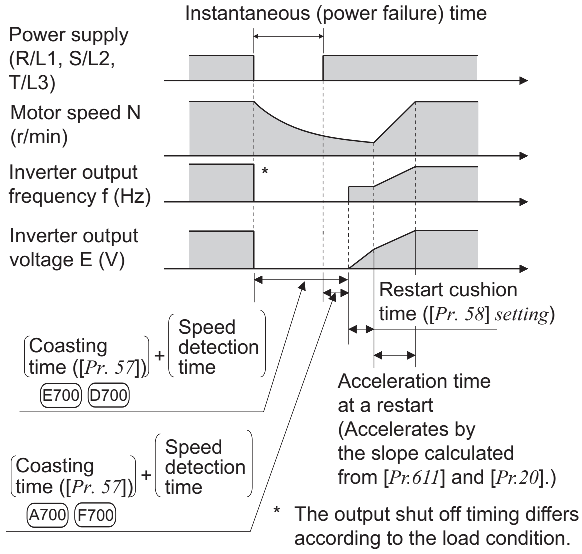
When E700 D700 perform automatic restart after instantaneous power failure in low speed operation (less than 10Hz), E700 D700 restart with the same rotation direction as before the instantaneous power failure and does not detect rotation direction [*Pr. 299 Rotation direction detection selection at restarting* =1].

When result of frequency search is the setting frequency or higher, output frequency is limited to the set frequency.

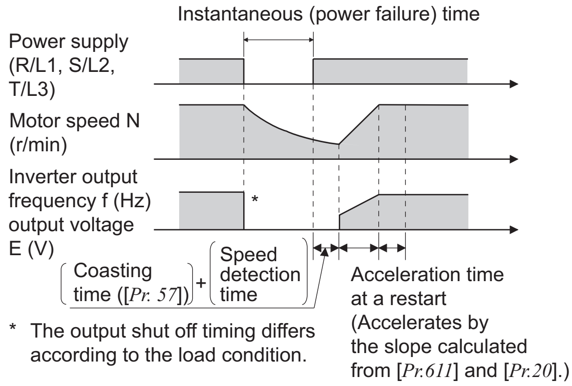
When wiring length is longer than the values in the table below in E700 D700 , select "without frequency search" [*Pr. 162*=1, 11].

Motor capacity	0.1K	0.2K	0.4K or more
Wiring length	20m	50m	100m

V/F control, Advanced magnetic flux vector control, General-purpose magnetic flux vector



Real sensorless vector control



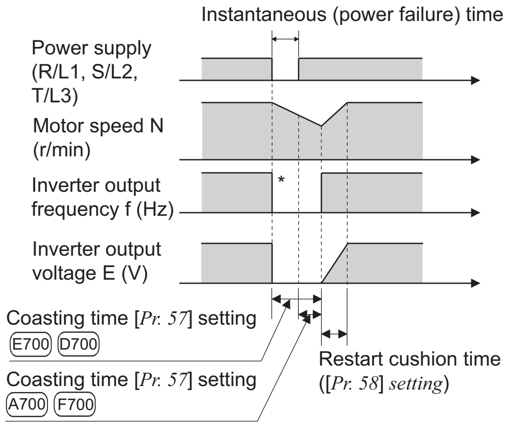
2) Frequency not searched

When [*Pr. 162* = 1, 11], automatic restart operation is performed in a reduced voltage, where the voltage is gradually risen with the output frequency unchanged from prior to an instantaneous power failure independently of the coasting speed of the motor.

When performing Real sensorless vector control on A700 , control starts at the output frequency before instantaneous power failure ([*Pr. 58 Restart cushion time*] is invalid).

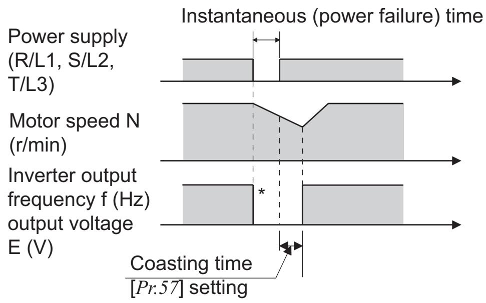
This system stores the output frequency prior to an instantaneous power failure and increases the voltage. Therefore, if the instantaneous power failure time exceeds 0.2s, the inverter starts at [*Pr. 13 Starting frequency*] (initial value = 0.5Hz) since the stored output frequency cannot be retained.

V/F control, Advanced magnetic flux vector control, General-purpose magnetic flux vector



* The output shut off timing differs according to the load condition.

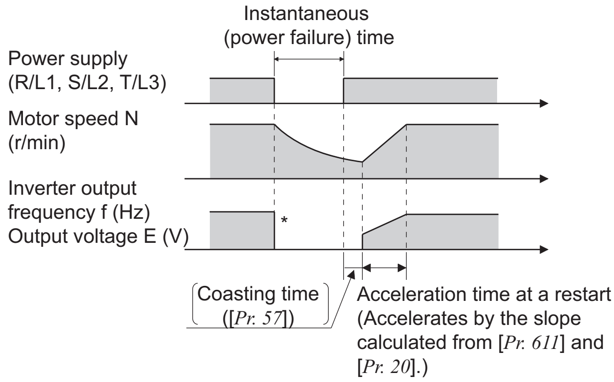
Real sensorless vector control



* The output shut off timing differs according to the load condition.

3) Encoder detection frequency search (A700)
Encoder detection frequency search is valid when the plug-in option FR-A7AP is mounted to (A700) and encoder signal is connected.
When [*Pr. 162* = 2, 12] under encoder feedback control, the motor starts at the motor speed and in the rotation direction detected from the encoder at power restoration.
Encoder detection frequency search is performed regardless of the [*Pr. 162*] setting under vector control.
Executing encoder detection frequency search will make the [*Pr. 58, Pr. 299*] settings invalid.

When encoder feedback control is invalid [*Pr. 162* = 2, 12], frequency search ([*Pr. 162* = 0, 10]) is executed.



* The output shut off timing differs according to the load condition.

4) Restart operation at every start
When [*Pr. 162* = 10, 11, 12] is set, automatic restart operation is also performed every start, in addition to the automatic restart after instantaneous power failure (start after [*Pr. 57*] set time has elapsed). When [*Pr. 162* = 0, 1, 2], automatic restart operation is performed at first start after power ON, but not performed at the second start or later.

5) Automatic restart operation selection by MRS(X10) signal.
When automatic restart operation of high power regeneration common converter (FR-HC) is selected by setting [*Pr. 30* = 2] (Refer to page 331), automatic restart operation is performed at a start after tuning ON → OFF the MRS (X10) signal.

[*Pr.30* = 2]	Operation after turning MRS or X10 signal OFF → ON → OFF
Other than 2	Restarts from [*Pr.13 Start frequency*]
2	Performs automatic restart function and restarts

(3) Restart coasting time [Pr. 57]

Coasting time is the time from when the motor speed is detected until automatic restart control is started. Set [*Pr. 57* = 0] to perform automatic restart operation. The coasting time is automatically set to the value below. Generally this setting will pose no problems.

(A700) (F700)
1.5K or less................. 0.5s
2.2K to 7.5K................ 1s,
11K to 55K.................. 3.0s,
75K or more 5.0s

(E700) (D700)
1.5K or less................. 1s
2.2K to 7.5K................ 2s
11K or more 3s

Operation may not be performed well depending on the magnitude of the load inertia (J) or running frequency. Adjust the coasting time between 0.1s and 5s according to the load specifications.

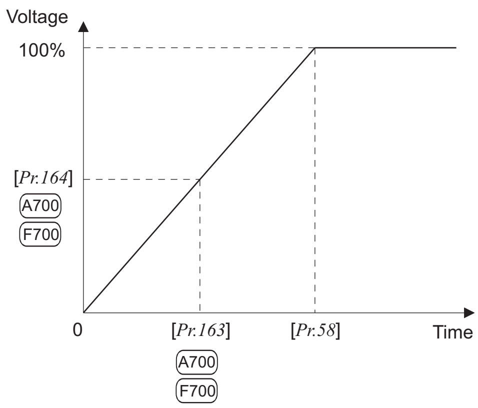
(4) Restart cushion time [Pr. 58]

Cushion time is the length of time taken to raise the voltage appropriate to the detected motor speed (output frequency prior to instantaneous power failure when *Pr. 162* = "1" or "11").

Normally the initial value need not be changed for operation, but adjust it according to the magnitude of the load inertia (J) of the load or torque.

[*Pr. 58 Restart cushion time*] is invalid during encoder feedback control ([*Pr. 162* = 2, 12]), Real sensorless vector control or vector control on A700 .

The SU and FU signals are not output during a restart. These are output after the restart cushion time has elapsed.



(5) Automatic restart operation selection [Pr. 163*, 164*, 165, 611]

(*Not available for E700 D700.)

In A700 F700 , voltage rise time at a restart can be adjusted as shown above using [*Pr.163, 164*]. Using [*Pr. 165*], the stall prevention operation level at a restart can be set.

Acceleration time (acceleration slope) can be set using [*Pr. 611 Acceleration time at a restart*] separately from the acceleration time in normal operation. For [*Pr. 611*], set the acceleration time to reach [*Pr.20 Acceleration/deceleration reference frequency*] from 0Hz. (If the [*Pr. 21 Acceleration/deceleration time increments*] setting is changed, the setting increments of [*Pr. 611*] remain unchanged.)

(6) Frequency search gain *(Pr. 298)*, offline auto tuning *(Pr. 96)* E700 D700

When automatic restart after instantaneous power failure operation (with frequency search) is valid at V/F control, perform offline auto tuning.

Perform offline auto tuning during V/F control in the following order to set *Pr. 298 Frequency search gain* automatically.

(Refer to page 268 during Advanced magnetic flux vector control and General-purpose magnetic flux vector control.)

●Checking the wiring and load

Check the following before performing offline auto tuning.

1) Connect a motor, and select V/F control. Note that the motor should be at a stop at a tuning start.
2) The motor capacity should be equal to or one rank lower than the inverter capacity.(Note that the capacity is 0.1kW or more.)
3) Auto tuning can be performed with load (such as friction and steady load) connected to the motor. Note that tuning is more accurate with smaller load. Tuning accuracy is not affected if the inertia is large.
4) Even when [*Pr.96* =21] (tuning without running motor), the motor may run slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs.
   <u>*Especially fix the motor securely in vertical lift applications.</u> Note that tuning performance is unaffected even if the motor runs slightly.

●Parameter setting

Set the following parameters.

1) [*Pr. 96 Auto tuning setting/status*]
   .... Set 21.
   Tuning is performed without running the motor.
2) [*Pr. 9 Electric thermal*]
   .... Set motor rated current (A).
3) [*Pr. 71 Applied motor*]
   .... Select the setting value from the below table.

Motor		*Pr.71* Setting
Mitsubishi standard motor Mitsubishi high efficiency motor	SF-JR	3
	SF-JR 4P 1.5kW or less	23
	SF-HR	43
	Others	3
Mitsubishi constant-torque motor	SF-JRCA 4P	13
	SF-HRCA	53
	Others (SF-JRC, etc.)	13
Other manufacturer's standard motor	—	3
Other manufacturer's constant torque motor	—	13

2

PARAMETER

●Execution of auto tuning

When performing PU operation, press RUN of the operation panel.

For External operation, turn ON the start command (STF signal or STR signal). Tuning starts. (Excitation noise generates at this time.)

Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed.

During offline auto tuning, the following I/O signals are the only valid signals (in the initial setting.)

Input terminal <Valid signal>	E700 MRS, RES, STF, STR D700 STF, STR
Output terminal	RUN, FM*, ABC

* When terminal FM is assigned to output the output frequency and speed, progress status of offline auto tuning (full scale when ended properly) is output (eight levels for E700, five levels for D700).

It takes approximately 9s to complete the tuning.

• To force tuning to end

Enter signal to terminal MRS or RES, or press STOP RESET during the PU operation mode. In the External operation mode, enter signal to terminal MRS or RES, or turn OFF the starting switch (STR or STR signal) to end the operation.

After tuning is completed, check [Pr.96] setting.

• Ended properly...............3 or 103 is displayed.

• Ended in error ....One of 8, 9, 91, 92, and 92 is displayed.

Error Display	Error Cause	Countermeasure
8	Forced end	Set "21" in *Pr. 96* and perform tuning again.
9	Inverter protective function operation	Make setting again.
91	Current limit (stall prevention) function was activated.	Set acceleration / deceleration time longer. Set "1" in *Pr. 156*.
92	Converter output voltage reached 75% of rated value.	Check for fluctuation of power supply voltage.
93	Calculation error A motor is not connected.	Check the motor wiring and make setting again. Set the rated current of the motor in *Pr . 9*.

When offline auto tuning ends, press STOP RESET of the operation panel during PU operation. For External operation, turn OFF the start signal (STF signal or STR signal) once.

This operation resets the offline auto tuning and the PU's monitor display returns to the normal indication.

(Without this operation, next operation cannot be started.)

When tuning ends in error, auto tuning is not performed properly, so the frequency search gain is not set. Perform inverter reset (*refer to page 57*), and re-do the tuning.

When using the motor corresponding to the following specifications and conditions, reset [*Pr. 9 Electronic thermal O/L relay*] as below after tuning is completed.

(a) When the rated power specifications of the motor is 200/220V(400/440V) 60Hz, set 1.1 times rated motor current value in *Pr. 9*.

(b) When performing motor protection from overheat using a PTC thermistor or motor with temperature detector such as Klixon, set "0" (motor overheat protection by the inverter is invalid) in *Pr.9*.

The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again.

Monitor is displayed on the operation panel and parameter unit (FR-PU04, FR-PU07) during tuning as below.

	Parameter Unit (FR-PU04, FR-PU07)	Operation Panel Indication
Pr. 96 setting	21	21
(1) Setting	READ:List 21 STOP PU	
(2) Tuning in progress	TUNE 22 STF FWD PU	
(3) Normal end	TUNE 23 COMPLETION STF STOP PU	Flickering 
(4) Error end (when inverter protective function operation is activated)	TUNE 9 ERROR STF STOP PU	

2.16.2 Power failure stop mode [Pr. 261, 262 to 266*, Pr. 294*] (common)

(*[Pr. 294] is not available for (F700).)

(*[Pr. 262 to 266, 294] are not available for (E700)(D700).)

When a power failure or undervoltage occurs, the inverter can be decelerated to a stop or can be decelerated and re-accelerated to the set frequency.

[Pr.]	Name	Initial Value	Setting Range	Description		Available Inverters		
						A700	F700	E700 D700
261	Power failure stop selection	0	0	Coasts to stop When undervoltage or power failure occurs, the inverter output is shut off.		○	○	○
			1	Without under voltage avoidance	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	○	○	○
			11	With under voltage avoidance		○	—	—
			2	Without under voltage avoidance	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. If power is restored during a power failure, the inverter accelerates again.	○	○	○
			12	With under voltage avoidance		○	—	—
262	Subtracted frequency at deceleration start	3Hz	0 to 20Hz	Normally operation can be performed with the initial value unchanged. But adjust the frequency according to the magnitude of the load specifications (moment of inertia, torque).		○	○	—
263	Subtraction starting frequency	60Hz	0 to 120Hz	When output frequency ≥ [*Pr. 263*] Decelerate from the speed obtained from output frequency minus [*Pr. 262*]. When output frequency < [*Pr. 263*] Decelerate from output frequency		○	○	—
			9999	Decelerate from the speed obtained from output frequency minus [*Pr. 262*].				
264	Power-failure deceleration time 1	5s	0 to 3600/ 360s*	Set a deceleration slope down to the frequency set in [*Pr. 266*].		○	○	—
265	Power-failure deceleration time 2	9999	0 to 3600/ 360s*	Set a deceleration slope below the frequency set in [*Pr. 266*].		○	○	—
			9999	Same slope as in [*Pr. 264*]				
266	Power failure deceleration time switchover frequency	60Hz	0 to 400Hz	Set the frequency at which the deceleration slope is switched from the [*Pr. 264*] setting to the [*Pr. 265*] setting.		○	○	—
294	UV avoidance voltage gain	100%	0 to 200%	Adjusts the response level during undervoltage avoidance operation. A larger setting will improve responsiveness to the bus voltage change. Since the regeneration amount is large when the inertia is large, decrease the setting value.		○	—	—

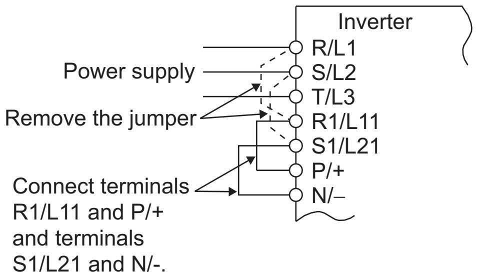
* The setting range is 0 to 3600 and the setting increments is 0.1s when [*Pr. 21 Acceleration/deceleration time increments* = 0] (initial value) and the setting range is 0 to 360s and the setting increments is 0.01s when [*Pr. 21* = 1].

(1) Connection and parameter setting

For A700 F700, remove a jumper across terminals R/L1-R1/L11 and terminals S/L2-S1/L21 and connect terminal R1/L11 to terminal P/+ and terminal S1/L21 to terminal N/-.

When [*Pr. 261* ≠ 0] and an undervoltage or power failure occurs, undervoltage protection (E.UVT) or instantaneous power failure protection (E.IPF) is not provided, but power failure deceleration is made.

If input phase is lost when[*Pr. 872* = 1] (input phase loss protection provided) and [*Pr. 261* ≠ 0], input phase failure protection (E.ILF) is not provided but power-failure deceleration is made.

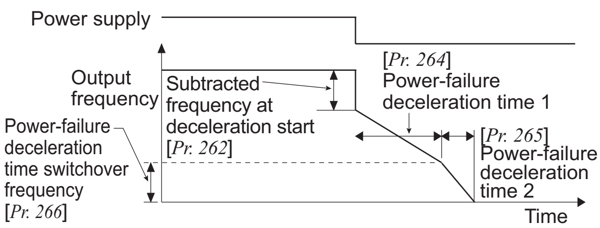


When [*Pr. 261* ≠ 0] in E700 D700, inverter decelerates to a stop at undervoltage and power failure.

(2) Operation outline of deceleration to stop at power failure

If an undervoltage or power failure occurs in A700 F700, the output frequency is dropped by the frequency set in [*Pr. 262 Subtracted frequency at deceleration start*], and deceleration is made for the deceleration time set in [*Pr. 264 Power-failure deceleration time 1*]. (Deceleration time setting is the time taken from the [*Pr. 20 Acceleration/deceleration reference frequency*] to a stop.)

When the frequency is low and enough regeneration energy is not provided, for example, the deceleration time (slope) from [*Pr. 266 Power failure deceleration time switchover frequency*] to a stop can be changed using [*Pr. 265 Power-failure deceleration time 2*] .



When [*Pr. 30 Regenerative function selection* = 2] (FR-HC, MT-HC, FR-CV is used), the power failure deceleration function is invalid.

When the (output frequency - [*Pr. 262*]) at undervoltage or power failure occurrence is negative, the calculation result is regarded as 0Hz (DC injection brake operation is performed without deceleration).

If an undervoltage or power failure occurs in E700 D700, the output frequency is decreased and controlled to decrease to 0Hz by keeping the voltage in the converter section (bus voltage) steady.

Power failure stop function does not operate during a stop or trip.

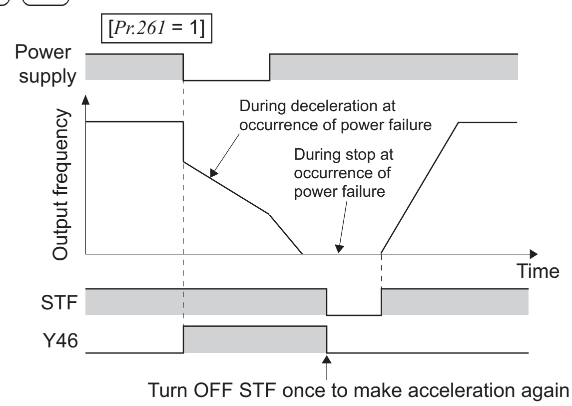
(3) Power failure stop mode [Pr. 261 = 1, 11*] (*not available for F700 E700 D700)

If power is restored during power failure deceleration, deceleration to a stop is continued and the inverter remains stopped. To restart, turn OFF the start signal once, then turn it ON again.

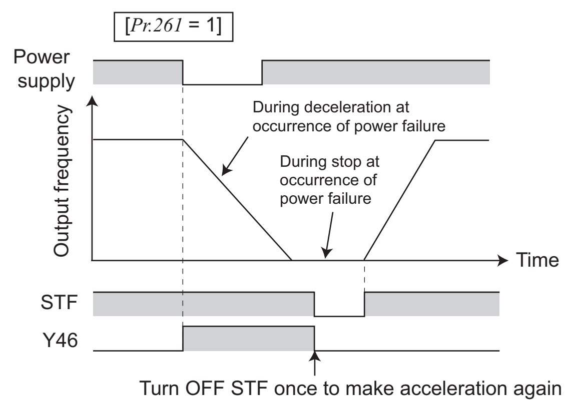
After a power failure stop, the inverter will not start even if the power is turned ON with the start signal (STF/STR) input. After switching ON the power, turn OFF the start signal once and then ON again to make a start.

When automatic restart after instantaneous power failure is selected ([*Pr. 57* ≠ 9999]) , power failure stop function is made invalid and automatic restart operation after instantaneous power failure is performed.

A700 F700



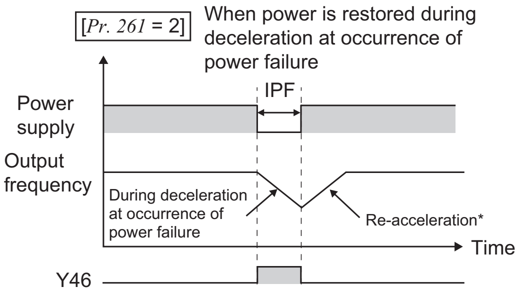
E700 D700



(4) Operation continuation function at instantaneous power failure [Pr. 261 = 2, 12*]

(*not available for (F700) (E700) (D700))

When power is restored during deceleration after a power failure, acceleration is made again up to the set frequency.

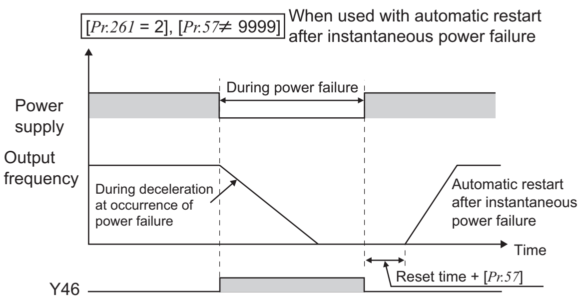


* Acceleration time follows the [*Pr. 7*] ([*Pr. 44*]) setting.

When this function is used in combination with the automatic restart after instantaneous power failure operation, deceleration can be made at a power failure and acceleration can be made again after power restoration. When power is restored after a stop by deceleration at an instantaneous power failure, automatic restart operation is performed if automatic restart after instantaneous power failure has been selected [*Pr. 57* ≠ "9999"]

Keep start signal (STF/STR) ON during instantaneous power failure when using operation continuation function at instantaneous power failure.

When start signal turns OFF during instantaneous power failure, the inverter decelerates by the deceleration time setting. If regeneration energy is insufficient, the motor coasts.



(5) Undervoltage avoidance function [Pr. 261 = 11, 12, Pr. 294] (A700)

When [*Pr. 261* = 11, 12], the deceleration time is automatically adjusted (shortened) to prevent undervoltage from occurring during deceleration at an instantaneous power failure.

Adjust the slope of frequency decrease and response level with [*Pr. 294*]. A larger setting will improve responsiveness to the bus voltage. Since the regeneration amount is large when the inertia is large, decrease the setting value.

Undervoltage avoidance function is invalid during torque control by Real sensorless vector control. When [*Pr. 261* = 11 (12)], the inverter operates in the same manner as when [*Pr. 261* = 1 (2)].

(6) Power failure deceleration signal (Y46 signal)

After deceleration at an instantaneous power failure, inverter can not start even if the start command is given. In this case, check the power failure deceleration signal (Y46).

The Y46 signal is ON during deceleration at an instantaneous power failure or during a stop after deceleration at an instantaneous power failure.

For the Y46 signal, set 46 (positive logic) or 146 (negative logic) in any of [*Pr. 190 to Pr. 196 (output terminal function selection*] to assign the function.

2

PARAMETER

2.17 Alarm function

2.17.1 Retry function [Pr. 65, 67 to 69] (common)

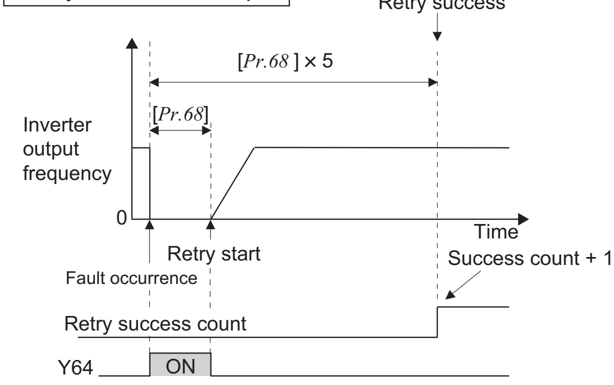
If a fault occurs, the inverter resets itself automatically to restart. You can also select the fault that causes a retry.
When you have selected automatic restart after instantaneous power failure ([*Pr. 57 Restart coasting time* ≠ 9999]), restart operation is performed at the retry operation time which is the same of that of a power failure. (*Refer to page 367* for the restart function.)

[Pr.]	Name	Initial Value	Setting Range		Description
65	Retry selection	0	0 to 5		A fault for retry can be selected. (Refer to the next page)
67	Number of retries at fault occurrence	0	0		No retry function
			1 to 10		Set the number of retries at fault occurrence. A fault output is not provided during retry operation.
			101 to 110		Set the number of retries at fault occurrence. (The setting value of minus 100 is the number of retries.) A fault output is provided during retry operation.
68	Retry waiting time	1s	A700 F700	0 to 10s	Set the waiting time from when an inverter trips until a retry is made.
			E700	0.1 to 360s	
			D700	0.1 to 600s	
69	Retry count display erase	0	0		Clear the number of restarts succeeded by retry.

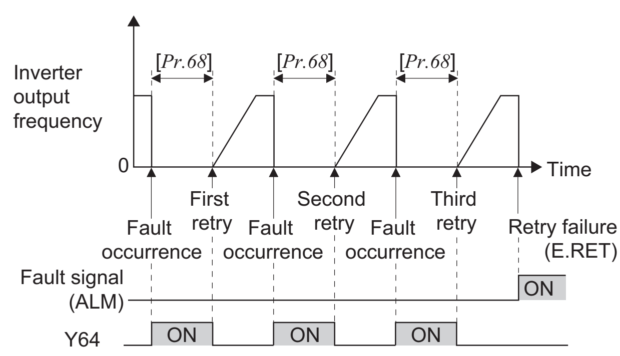
(1) Retry operation [Pr. 67 to 69]

Retry operation automatically resets a fault and restarts the inverter at the starting frequency when the time set in [*Pr. 68 Retry waiting time*] elapses after the inverter is tripped.
Retry operation is performed by setting [*Pr. 67* ≠ 0] .Set the number of retries at fault occurrence in [*Pr. 67 Number of retries at fault occurrence*]. When retries fail consecutively more than the number of times set in [*Pr.67*], a retry count excess fault (E.RET) occurs, and inverter trips. (Refer to retry failure example)
Use [*Pr.68*] to set the waiting time from an inverter trip to a retry in the range of 0 to 10s in A700 F700, 0.1 to 360s in E700, and 0.1 to 600s in D700. (When the setting value is 0s, the actual time is 0.1s.)
Reading [*Pr. 69 Retry count display erase*] provides the cumulative number of successful restart times made by retry. The cumulative count in [*Pr. 69*] is increased by 1 when a retry is regarded as successful after normal operation continues without faults occurring for more than four times longer than the time set in [*Pr. 68*] after a retry start. (After retry is succeeded, cumulative number of retry fail time is cleared.)
Writing 0 in [*Pr. 69*] clears the cumulative count.
During a retry, the Y64 signal is ON. For the Y64 signal, assign the function by setting 64 (positive logic) or 164 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] .

Retry success example



Retry failure example



(2) Retry selection[Pr. 65]

Use [*Pr. 65 Retry selection*] to select the fault to be activated for retries. No retry will be made for the fault not indicated. (*Refer to page 97* for the fault description. ● in the table below indicates the fault items to be selected for retry.

For a retry error, only the description of the first fault is stored.

When an inverter fault is reset by the retry function at the retry time, the accumulated data such as the electronic thermal relay function, regeneration brake duty are not cleared. (Different from the power-ON reset.)

When E.PE (Parameter storage device fault) occurs at power-ON, retry is not performed.

Stay away from the motor and machine when inverter tripped while retry function is selected. The motor starts suddenly (after the reset time has elapsed) after the inverter trip.

Fault for Retry	[Pr. 65] Setting					
	0	1	2	3	4	5
E.OC1	●	●		●	●	●
E.OC2	●	●		●	●	
E.OC3	●	●		●	●	●
E.OV1	●		●	●	●	
E.OV2	●		●	●	●	
E.OV3	●		●	●	●	
E.THM	●					
E.THT	●					
E.IPF*3*4	●				●	
E.UVT*3*4	●				●	
E.BE	●				●	
E.GF	●				●	
E.OHT	●					
E.OLT	●				●	
E.OPT*4	●				●	
E.OP3*1*4	●				●	

Fault for Retry	[Pr. 65] Setting					
	0	1	2	3	4	5
E.PE	●				●	
E.MB1*2*3*4	●				●	
E.MB2*2*3*4	●				●	
E.MB3*2*3*4	●				●	
E.MB4*2*4	●				●	
E.MB5*2*4	●				●	
E.MB6*2*4	●				●	
E.MB7*2*4	●				●	
E.OS*2*3*4	●				●	
E.OSD*2*3*4	●				●	
E.OD*2*3*4	●				●	
E.PTC*3	●					
E.CDO*3	●				●	
E.SER*3*4	●				●	
E.USB*2*4	●				●	
E.ILF	●				●	

*1 E.OP1 appears on F700 E700.

*2 These are not available for F700.

*3 These are not available for E700.

*4 These are not available for D700.

2.17.2 Fault code output selection [Pr. 76] (A700) (F700)

At fault occurrence, its definition can be output as 4 bit digital signal from the open collector output terminal.
The fault code can be read by a programmable controller, etc., and its countermeasure can be shown on a display, etc.

[Pr.]	Name	Initial Value	Setting Range	Description
76	Fault code output selection	0	0	Without fault code output
			1	With fault code output
			2	Fault code output at fault occurrence only

By setting [*Pr. 76* = 1 or 2], the fault code can be output to the output terminals. When an fault occurs, the output terminals SU, IPF, OL, FU output the signal in the right table, independently of the [*Pr. 190 to Pr. 196 Output terminal function selection*] settings. Please be careful when inverter control setting has been made with the output signals of [*Pr. 190 to Pr. 196*] .
When [*Pr. 76* = 2], an fault code is output at only fault occurrence, and during normal operation, the terminals output the signals assigned using [*Pr. 190 to Pr. 196 Output terminal function selection*] .

The following table indicates fault codes to be output.
(0: output transistor OFF, 1: output transistor ON)

Control panel indication (FR-DU07)	Output of output terminals				Fault Code
	SU	IPF	OL	FU	
Normal *1	0	0	0	0	0
E.OC1	0	0	0	1	1
E.OC2	0	0	1	0	2
E.OC3	0	0	1	1	3
E.OV1 to E.OV3	0	1	0	0	4
E.THM	0	1	0	1	5
E.THT	0	1	1	0	6
E.IPF	0	1	1	1	7
E.UVT	1	0	0	0	8
E.FIN	1	0	0	1	9
E.BE	1	0	1	0	A
E.GF	1	0	1	1	B
E.OHT	1	1	0	0	C
E.OLT	1	1	0	1	D
E.OPT	1	1	1	0	E
E.OP3 *2	1	1	1	0	E
Other than the above	1	1	1	1	F

*1 When [*Pr. 76* = 2], the output terminals output the signals assigned to [*Pr. 190 to Pr. 196*] .

*2 E.OP1 appears on (F700).

2.17.3 Motor overheat protection (Electronic thermal O/L relay) [Pr. 9, 51, 875*] common

(*[*Pr. 875*] is not available for F700 E700 D700.)

Set the current of the electronic thermal relay function to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed. Refer to page 50 to protect the motor from overheat using external thermal input (OH signal) and refer to page 50 using PTC thermistor input (PTC signal).

[Pr.]	Name	Initial Value	Setting Range		Description	Available Inverter	
						A700	F700 E700 D700
9	Electronic thermal O/L relay	Rated inverter output current*	55K or less	0 to 500A	Set the rated motor current.	○	○
			75K or more	0 to 3600A			
51	Second electronic thermal O/L relay	9999	55K or less	0 to 500A	Made valid when the RT signal is ON. Set the rated motor current.	○	○
			75K or more	0 to 3600A			
			9999		Second electronic thermal O/L relay invalid		
875	Fault definition	0	0		Normal operation	○	—
			1		The motor decelerates to stop when motor thermal protection is activated.		

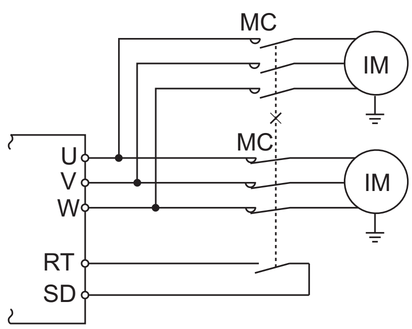
* The 0.4K and 0.75K are set to 85% of the rated inverter current on A700 E700.

(1) Electronic thermal O/L relay [Pr. 9]

This function detects the overload (overheat) of the motor and trips. (Refer to page 111.)
Set the motor type to be used in [*Pr. 71*] and set the rated motor current value (A) in [*Pr. 9*].
(If the motor has both 50Hz and 60Hz rating and the [*Pr. 3 Base frequency*] is set to 60Hz, set the 1.1 times of the 60Hz rated motor current.)
Set [*Pr. 9* = 0] when you do not want to operate the electronic thermal relay function when using the motor with the external thermal relay, etc. (Note that the output transistor protection of the inverter functions (E.THT).)
Since a thermal relay protector is built in a motor dedicated for vector control (SF-V5RU), set [*Pr. 9* = 0] to use the motor.
Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal function. Install an external thermal relay to each motor.
When a difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
Electronic thermal may not operate when the setting value for the electronic thermal is 5% of the inverter's rated current or less.
A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.

(2) Set two different electronic thermal O/L relays [Pr. 51]

Use this function when running two motors of different rated currents individually by a single inverter. (When running two motors together, use external thermal relays.)
Set the rated current of the second motor in [*Pr. 51*].
When the RT signal is ON, thermal protection is provided based on the [*Pr. 51*] setting. The RT signal acts as the second function selection signal and makes the other second functions valid.



[Pr. 450] Second Applied Motor	[Pr. 9] Electronic Thermal O/L Relay	[Pr. 51] Second Electronic Thermal O/L Relay	RT = OFF First motor	RT = OFF Second motor	RT = ON First motor	RT = ON Second motor
9999	0	9999	×	×	×	×
		0	×	×	×	×
		0.01 to 500 (0.1 to 3600)	×	△	×	○
9999	Other than 0	9999	○	×	○	×
		0	○	×	△	×
		0.01 to 500 (0.1 to 3600)	○	△	△	○
Other than 9999	0	9999	×	×	×	×
		0	×	×	×	×
		0.01 to 500 (0.1 to 3600)	×	△	×	○
Other than 9999	Other than 0	9999	○	△	△	○
		0	○	×	△	×
		0.01 to 500 (0.1 to 3600)	○	△	△	○

○ ... Output current value is used to perform integration processing.

△...Output current is assumed as 0A to perform integration processing. (cooling processing)

×.....Electronic thermal relay function is not activated.

(3) Fault definition [Pr. 875] (A700)

When [*Pr. 875* = 0], the inverter immediately shut off output at fault occurrence and outputs faults.

When [*Pr. 875* = 1] and external thermal relay (E.OHT), motor overload (electronic thermal relay function) (E.THM) or PTC thermistor (E.PTC) is activated, turning ON the alarm output 2 signal (ER) starts the motor to decelerate and provides a fault after deceleration to a stop.

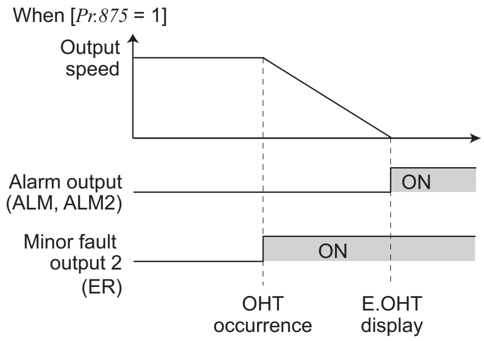
When the ER signal turns ON, decrease load, etc. to allow the inverter to decelerate.

At occurrence of a fault other than E.OHT, E.THM and E.PTC, the inverter trips immediately and a fault signal is output.

Set 97 (positive logic) or 197 (negative logic) in [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign the ER signal to the output terminal.

This function is invalid during vector control.

The value 0 is recommended for the system in which the motor continues running without deceleration due to a large torque on the load side.



2.17.4 Input/output phase loss protection selection [Pr. 251, 872] (common)

You can disable the output phase loss protection function that stops the inverter output if one of the inverter output side (load side) three phases (U, V, W) is lost.

The input phase loss protection function of the inverter input side (R/L1, S/L2, T/L3) can also be valid.

[Pr.]	Name	Initial Value	Setting Range	Description
251	Output phase loss protection selection	1	0	Without output phase loss protection
			1	With output phase loss protection
872	Input phase loss protection selection	(A700)(F700)(D700) 0 (E700) 1	0	Without input phase loss protection
			1	With input phase loss protection

(1) Output phase loss protection selection [Pr. 251]

When [*Pr. 251* = 0], output phase loss protection (E.LF) becomes invalid.

(2) Input phase loss protection selection [Pr. 872]

When [*Pr. 872* = 1], input phase loss protection (E.ILF) is provided if a phase loss of one phase among the three phases is detected for 1s continuously.

Note that if input phase is lost when [*Pr. 261* ≠ 0] in (A700)(F700) (power failure stop function valid), input phase loss protection (E.ILF) is not provided but power-failure deceleration is made.

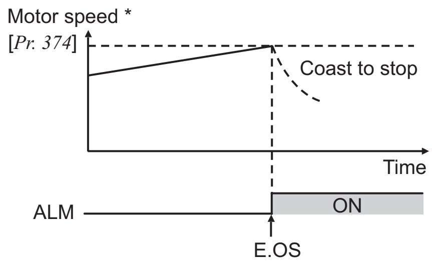
When an input phase loss occurs in the R/L1 and S/L2 phases, input phase loss protection is not provided but the inverter output is shut off.

If the load is light, lost phase cannot be detected in (E700)(D700) because detection is performed based on the fluctuation of bus voltage. It cannot be detected under regenerative load either.

Also, input loss protection (E.ILF) may occur when phase voltage is largely unbalanced among three phases.

2.17.5 Overspeed detection [Pr. 374] (A700)

[Pr.]	Name	Initial Value	Setting Range	Description
374	Overspeed detection level	140Hz	0 to 400Hz	When the motor speed reaches or exceeds the speed set in [*Pr. 374*] during encoder feedback control, Real sensorless vector control, or vector control, over speed (E.OS) occurs and trips the inverter.



* The output frequency and [*Pr. 374*] are compared during Real sensorless vector control.

2.17.6 Encoder signal loss detection [Pr. 376] (A700)

When the encoder signal is lost during encoder feedback control, orientation control, or vector control, signal loss detection (E.ECT) is activated to trip the inverter.

[Pr.]	Name	Initial Value	Setting Range	Description
376	Encoder signal loss detection enable/disable selection AP	0	0	Signal loss detection is invalid
			1	Signal loss detection is valid

2.17.7 Earth (ground) fault detection at start [Pr. 249] (E700) (D700)

You can choose whether to make earth (ground) fault detection at start valid or invalid.

[Pr.]	Name	Initial Value	Setting Range	Description
249	Earth (ground) fault detection at start	0	0	Without earth (ground) fault detection
			1	With earth (ground) fault detection

When [*Pr.249*=1], earth (ground) fault detection is performed at start. Earth (ground) fault detection is performed only after start signal is input to the inverter. Protective function does not operate for the ground (earth) fault, which occurs while inverter is running.
Because the detection is performed at a start, output delays for about 20ms at every start.

If earth (ground) fault is detected when [*Pr.249*=1], output side earth (ground) fault overcurrent (E.GF) is output, and the inverter output is shutoff. (*Refer to page 99*)
If motor capacity is smaller than the inverter capacity in 5.5K or more, ground (earth) fault protection may not operate.

2

PARAMETER

2.18 Misoperation prevention and parameter setting and PU setting

2.18.1 Reset selection/disconnected PU detection/PU stop selection [Pr. 75] common

You can select the reset input acceptance, disconnected PU (FR-DU07/FR-PU04/FR-PU07) connector detection function and PU stop function.

[Pr.]	Name	Initial Value	Setting Range	Description
75	Reset selection/disconnected PU detection/PU stop selection	14	0 to 3, 14 to 17	For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function are set.

* The [*Pr. 75*] value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.

<table>
<tr><th>[Pr. 75] Setting</th><th>Reset Selection</th><th>Disconnected PU Detection</th><th>PU Stop Selection</th></tr>
<tr><td>0</td><td>Reset input normally enabled</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing STOP/RESET decelerates the motor to a stop only in the PU operation mode.</td></tr>
<tr><td>1</td><td>Reset input is enabled only when a fault occurs.</td></tr>
<tr><td>2</td><td>Reset input normally enabled</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>3</td><td>Reset input is enabled only when a fault occurs.</td></tr>
<tr><td>14 (initial value)</td><td>Reset input normally enabled</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing STOP/RESET decelerates the motor to a stop in any of the PU, External and communication operation modes.</td></tr>
<tr><td>15</td><td>Reset input is enabled only when a fault occurs.</td></tr>
<tr><td>16</td><td>Reset input normally enabled</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>17</td><td>Reset input is enabled only when a fault occurs.</td></tr>
</table>

(1) Reset selection

You can select the enable condition of reset function (RES signal, reset command through communication) input.
When [*Pr. 75* = 0, 2, 14, 16] and the reset signal (RES) is input during operation, the motor coasts since the inverter being reset shuts off the output. In addition, the cumulative values of the electronic thermal relay and regenerative brake duty are cleared.
When [*Pr. 75* = 1, 3, 15, 17], a reset can be input only when a fault occurs.
The reset key of the PU is only valid when the inverter is tripped, independently of the [*Pr. 75*] setting.

(2) Disconnected PU detection

Removal or reinstallation of the PU (FR-DU07/FR-PU04/FR-PU07) will not pose a problem. However, if the PU is accidentally removed in the PU operation mode, only resetting the power can stop the motor.
When [*Pr. 75* = 2, 3, 16, 17] and this function detects that the PU (FR-DU07/FR-PU04/FR-PU07) has been disconnected from the inverter for 1s or longer, the inverter provides a fault output (E.PUE) and comes to trip. When the PU has been disconnected since before power-ON, it is not judged as a fault.
When [*Pr. 75* = 0, 1, 14, 15] , operation is continued if the PU is disconnected. Note that the motor decelerates to stop when the PU is disconnected during PU/JOG operation.
When RS-485 communication operation is performed through the PU connector, the reset selection/PU stop selection function is valid but the disconnected PU detection function is invalid.

(3) PU Stop Selection

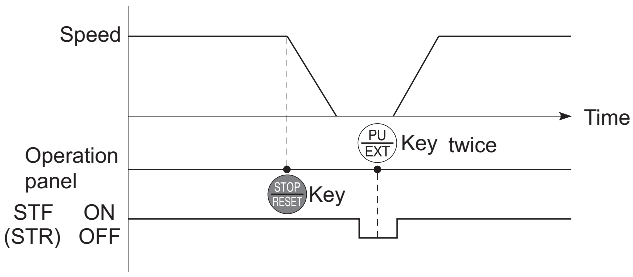
When [*Pr. 75* = 14 to 17], the motor can be stopped by pressing STOP RESET of the PU in any of the PU operation, External operation and Network operation modes. Even if [*Pr. 250 Stop selection* ≠ 9999] is set to select coasting to a stop, the motor will not coast to stop but decelerate to stop by the PU stop function during external operation.
When the inverter is stopped by the PU stop function in other than PU operation mode, PS is displayed on the PU. A fault signal is not provided.

When [*Pr. 75* = 0 to 3], deceleration to stop by STOP RESET is valid only in the PU operation mode.

How to restart the motor (cancel PU stop (PS)) by STOP RESET input from the PU in the External operation mode is shown below.

(a) Operation panel (FR-DU07)

1) After completion of deceleration to a stop, switch OFF the STF or STR signal.
2) Press PU EXT to display PU.
   ....(PS reset)
3) Press PU EXT to return to EXT.
4) Turn ON the STF or STR signal.



Stop/restart example for external operation

(b) Parameter unit (FR-PU04/FR-PU07)

1) After completion of deceleration to a stop, switch OFF the STF or STR signal.
2) Press EXT.
   ....(PS reset)
3) Turn ON the STF or STR signal.

The motor can be restarted by making a reset using a power supply reset or RES signal.

2.18.2 Parameter write disable selection [Pr. 77] (common)

You can select whether write to various parameters can be performed or not. Use this function to prevent parameter values from being rewritten by misoperation.

[Pr.]	Name	Initial Value	Setting Range	Description
77	Parameter write selection	0	0	Write is enabled only during a stop.
			1	Parameter write is not enabled.
			2	Parameter write is enabled in any operation mode regardless of operating status.

* [*Pr. 77*] can be always set independently of the operation mode and operation status.

(1) Write parameters only during stop [Pr. 77 = 0]

Parameters can be written only during a stop in the PU operation mode.
The shaded parameters in the parameter list (page 120) ▭ can always be written, regardless of the operation mode and operation status. However, [*Pr. 72 PWM frequency selection*] and [*Pr. 240 Soft-PWM operation selection*] can be written during operation in the PU operation mode, but cannot be written in the External operation mode.

(2) Disable parameter write [Pr. 77 = 1]

Parameter write is not enabled. (Read is enabled.)
Parameter clear and all parameter clear cannot be performed, either.
The following parameters can be written even when [*Pr. 77* = 1] .

[Pr.]	Name
22	Stall prevention operation level
75	Reset selection/disconnected PU detection/PU stop selection
77	Parameter write selection
79	Operation mode selection
160	User group read selection
296*	Password lock level
297*	Password lock/unlock

* The setting is available for (D700).

(3) Write parameters during operation [Pr. 77 = 2]

Parameters can always be written.
The following parameters cannot be written when the inverter is running even if [*Pr. 77* = 2]. Stop the inverter when changing their parameter settings.

[Pr.]	Name
19 *5	Base frequency voltage
23	Stall prevention operation level compensation factor at double speed
40 *1 *2	RUN key rotation direction selection
48	Second stall prevention operation current
49 *3 *4	Second stall prevention operation frequency
60	Energy saving control selection
61 *2	Reference current
66	Stall prevention operation reduction starting frequency
71	Applied motor
79	Operation mode selection
80	Motor capacity
81 *2 *4	Number of motor poles
82 *2	Motor excitation current
83 *2	Rated motor voltage
84 *2	Rated motor frequency
90, 91 *2 *4, 92 *2 *4, 93 *2 *4, 94 *2 *4	(motor constants)
95 *2 *4	Online auto tuning selection
96 *2	Auto tuning setting/status
100 to 109 *3 *4	(Adjustable 5 points V/F parameter)
135 to 139 *3 *4	(parameter for electronic bypass sequence)
(A700)(F700) 178 to 196 (E700) 178 to 184, 190 to 192 (D700) 178 to 182, 190, 192	(input terminal function selection)
255	Life alarm status display
256	Inrush current limit circuit life display
257	Control circuit capacitor life display
258	Main circuit capacitor life display

[Pr.]	Name
277 *1 *2 *4	Stall prevention operation current switchover
291 *2 *3 *4	Pulse train I/O selection
292 *2 *4	Automatic acceleration/deceleration
293 *2 *4	Acceleration/deceleration individual operation selection
298 *1 *2	Frequency search gain
329 *4	Digital input unit selection Parameter for the plug-in option FR-A7AX
343	Communication error count
450 *2	Second applied motor
451 *2 *3 *4	Second motor control method selection
453 *2 *3 *4	Second motor capacity
454 *2 *3 *4	Number of second motor poles
458 to 462 *2 *3 *4	(second motor constant)
463*2 *3 *4	Second motor auto tuning setting/status
541 *2 *4	Frequency command sign selection (CC-Link) (Parameter for the plug-in option FR-A7NC)
563	Energization time carrying-over times
564	Operating time carrying-over times
574 *2 *3 *4	Second motor online auto tuning
800 *2	Control method selection
819 *2 *3 *4	Easy gain tuning selection
858 *2 *3 *4	Terminal 4 function assignment
859 *2	Torque current
860*2 *3 *4	Second motor torque current
868*2 *3 *4	Terminal 1 function assignment

*1 These are not available for A700.

*2 These are not available for F700.

*3 These are not available for E700.

*4 These are not available for D700.

*5 These parameters can be written while inverter is running in A700 D700.

2.18.3 Reverse rotation prevention selection [Pr. 78] common

This function can prevent reverse rotation fault resulting from the incorrect input of the start signal. Set this parameter when you want to limit the motor rotation to only one direction.
This parameter is valid for all of the reverse rotation and forward rotation keys of the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07), the start signals (STF, STR signals) via external terminals, and the forward and reverse rotation commands through communication.

[Pr.]	Name	Initial Value	Setting Range	Description
78	Reverse rotation prevention selection	0	0	Both forward and reverse rotations enabled
			1	Reverse rotation disabled
			2	Forward rotation disabled

2

PARAMETER

2.18.4 Extended parameter display and user group function [Pr. 160, 172 to 174*] common

(*[Pr. 172 to 174] are not available for D700.)

Parameter which can be read from the operation panel and parameter unit can be restricted.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700 F700 E700	Available Inverters D700
160	A700 F700 E700 User group read selection D700 Extended function display selection	A700 E700 0 F700 D700 9999	9999	Only the simple mode parameters can be displayed.	○	○
			0	The simple mode and extended parameters can be displayed		
			1	Only the parameters registered to the user group can be displayed.		—
172	User group registered display/batch clear	0	(0 to 16)	Displays the number of parameters registered as a user group (Reading only)	○	—
			9999	Batch clear the user group registration		
173*1	User group registration	9999	0 to 999, 9999	Set the parameter numbers to be registered to the user group.	○	—
174*1	User group clear	9999	0 to 999, 9999	Set the parameter numbers to be cleared from the user group.	○	—

*1 The values read from [*Pr. 173, Pr. 174*] are always 9999.

(1) Display of simple mode parameters and extended parameters [Pr. 160]

When [*Pr. 160* = 9999], only the simple mode parameters can be displayed on the control panel (FR-DU07) and parameter unit (FR-PU04/FR-PU-07). (Refer to the parameter list on page 120, for the simple mode parameters.)
When [*Pr. 160* = 0], simple mode parameters and extended parameters can be displayed.
All parameter can be read regardless of [Pr.160] setting when performing parameter read using a communication option in A700 F700 E700.
When reading parameters with RS-484 communication made by RS-485 terminal in A700 F700 or PU connector in E700 D700, all parameters can be read regardless of [*Pr. 160*] setting by setting [*Pr. 550 NET mode operation command source selection*] and [*Pr. 551 PU mode operation command source selection*] as the below table.

Inverters	[Pr. 551]	[Pr. 550]	OP*2
A700	2(PU)*1 3(USB)	1	—
		9999 (auto detect)*1	Invalid
F700	2(PU)*1	1	—
		9999(auto detect)*1	Invalid

Inverters	[Pr. 551]	[Pr. 550]	OP*2
E700	3(USB)	2(PU)	—
	9999 (auto detect)*1	9999(auto detect)*1	Invalid
D700 *3	4(operation panel) 9999(auto detect)*1	—	—

*1 Indicates initial value.
*2 OP indicates a communication option.
*3 Parameter read cannot be performed when read is restricted by the [*Pr. 296 Password lock level*] setting under the NET mode. (Refer to page 387)

[*Pr. 15 Jog frequency*], [*Pr. 16 Jog acceleration/ deceleration time*], and [*Pr. 991 PU contrast adjustment*] are displayed as simple mode parameter when the parameter unit (FR-PU04/FR-PU07) is fitted.

(2) User group function [Pr. 160, 172 to 174] A700 F700 E700

The user group function is designed to display only the parameters necessary for the setting.
Among all parameters, a maximum of 16 parameters can be registered to the user group. When [*Pr. 160* = 1], only parameters registered in the user group can be accessed for reading and writing. (The

parameters not registered in the user group can not be read.)
To register a parameter to the user group, set its parameter number in [*Pr. 173*]. To delete a parameter in the user group, set its parameter number in [*Pr. 174*] . Set [*Pr. 172* = 9999] to batch delete parameters registered.

[*Pr. 77, Pr. 160 and Pr. 991*] can always be read, independently of the user group setting.
[*Pr. 77, Pr. 160, Pr. 172 to Pr. 174*] cannot be registered to the user group.
When [*Pr. 173, Pr. 174*] is read, 9999 is always displayed.
When any value other than 9999 is set in [*Pr. 172*], no function is available.

2.18.5 Password function [Pr. 296, 297] (D700)

Registering 4-digit password can restrict parameter reading/writing.

[Pr.]	Name	Initial Value	Setting Range	Description
296	Password lock level	9999	1 to 6, 101 to 106	Select restriction level of parameter reading/ writing when a password is registered.
			9999	No password lock
297	Password lock/unlock	9999	1000 to 9998	Register a 4-digit password
			(0 to 5)	Displays password unlock error count. (Reading only) (Valid when *Pr. 296* = "101" to "106")
			(9999)	No password lock (Reading only)

(1) Parameter reading/writing restriction level [*Pr. 296*]

Level of reading/writing restriction by PU/NET mode operation command can be selected by [*Pr. 296*].

[*Pr. 296*] Setting	PU Mode Operation Command *3		NET Mode Operation Command *4	
	Read *1	Write *2	Read *1	Write *2
9999	○	○	○	○
1, 101	○	×	○	×
2, 102	○	×	○	○
3, 103	○	○	○	×
4, 104	×	×	×	×
5, 105	×	×	○	○
6, 106	○	○	×	×

○: enabled, ×: disabled

*1 If the parameter reading is restricted by the [*Pr. 160*] setting, those parameters are unavailable for reading even when "○" is indicated.
*2 If the parameter writing is restricted by the [*Pr. 77*] setting, those parameters are unavailable for writing even when "○" is indicated.
*3 Parameter access from unit where parameter is written in PU operation mode (initially set to operation panel, parameter unit) is restricted. (*Refer to page 436* for PU mode operation command source selection)
*4 Parameter access in NET operation mode with RS-485 communication is restricted.

(2) Password lock/unlock [*Pr.296, Pr.297*]

1) Lock
Set parameter reading/writing restriction level by *Pr. 296*. ([*Pr. 296* ≠ 9999])
When the setting is "101 to 106", the number of password unlock errors (0 to 5 times) is displayed when [*Pr. 297*] is read.
(When the [*Pr. 296*] setting is "1 to 6", the number is not displayed.
Write four-digit number (1000 to 9998) in [*Pr.297*] as a password.
(When [*Pr. 296* ="9999"], *Pr.297* cannot be written.)
Once password is registered, parameter reading/ writing is restricted with the restriction level set in [*Pr. 296*] until password unlock.
After registering a password, a read value of [*Pr. 297*] is always "0" to "5". When a password restricted parameter is read/written, LOCd is displayed. Even if a password is registered, parameters which the inverter itself writes, such as inverter parts life, are overwritten occasionally.
Even if a password is registered, [*Pr. 991 PU contrast adjustment*] can be read/written when a parameter unit (FR-PU04/FR-PU07) is connected.

2) Unlock

Enter a password in [*Pr. 297*].
The lock is unlocked when a password is correct.
If a password is incorrect, an error occurs and the lock is not unlocked.
During [*Pr. 296* = "101 to 106"], if password unlock error has occurred 5 times, correct password will not unlock the restriction. (During password lock)

If the password has been forgotten, perform parameter all clear to unlock the parameter restriction. In that case, other parameters are also cleared. (All parameter clear cannot be performed during operation.)

(3) Parameter operation during password lock/unlock

Parameter write is restricted as the following during password lock.

Parameter operation		Unlocked		Password registered	Locked
		[*Pr. 296* = 9999] [*Pr. 297* = 9999]	[*Pr. 296* ≠ 9999] [*Pr. 297* = 9999]	[*Pr. 296* ≠ 9999] [*Pr. 297* = 0 to 4 (Read value)]	[*Pr. 296* = 101 to 106] [*Pr. 297* = 5 (Read value)]
[*Pr. 296*]	Read	○ *1	○	○	○
	Write	○ *1	○ *1	×	×
[*Pr. 297*]	Read	○ *1	○	○	○
	Write	×	○	○	○ *3
Performing parameter clear		○	○	×	×
Performing parameter all clear		○	○	○ *2	○ *2
Performing parameter copy		○	○	×	×

○: enabled, ×: disabled

*1 Reading/writing is unavailable when there is restriction to reading by the [*Pr. 160*] setting.
*2 Unavailable during operation of voltage output.
*3 Correct password will not unlock the restriction.

When [*Pr. 296* = "4, 5, 104, 105"] and using the parameter unit (FR-PU04/FR-PU07), PUJOG operation is unavailable. When writing is restricted from PU mode operation command [*Pr. 296* = 1, 2, 4, 5, 101, 102, 104, 105], switching of operation mode by easy setting mode is unavailable.

2.18.6 Free parameter [Pr. 888, 889] (common)

You can input any number within the setting range 0 to 9999.
For example, the parameter can be used:

- As a unit number when multiple units are used.
- As a pattern number for each operation application when multiple units are used.
- As the year and month of introduction or inspection.

[Pr. *888, Pr. 889*] do not influence the inverter operation.

[Pr.]	Name	Initial Value	Setting Range
888	Free parameter 1	9999	0 to 9999
889	Free parameter 2	9999	0 to 9999

* The above parameters allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0].

2.18.7 Setting from the parameter unit and operation panel [Pr. 40*, 145, 161, 295*, 990, 991] (common)

(*Not available for (A700)(F700).)

Parameter unit (FR-PU04/FR-PU07), operation panel (FR-DU07) can be set.

<table>
<tr><th rowspan="2">[Pr.]</th><th rowspan="2">Name</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2" colspan="2">Description</th><th colspan="2">Available Inverters</th></tr>
<tr><th>A700 F700</th><th>E700 D700</th></tr>
<tr><td rowspan="2">40</td><td rowspan="2">RUN key rotation direction selection</td><td rowspan="2">0</td><td>0</td><td colspan="2">Forward rotation</td><td rowspan="2">—</td><td rowspan="2">○</td></tr>
<tr><td>1</td><td colspan="2">Reverse rotation</td></tr>
<tr><td rowspan="8">145</td><td rowspan="8">PU display language selection</td><td rowspan="8">0</td><td>0</td><td colspan="2">Japanese</td><td rowspan="8">○</td><td rowspan="8">○</td></tr>
<tr><td>1</td><td colspan="2">English</td></tr>
<tr><td>2</td><td colspan="2">German</td></tr>
<tr><td>3</td><td colspan="2">French</td></tr>
<tr><td>4</td><td colspan="2">Spanish</td></tr>
<tr><td>5</td><td colspan="2">Italian</td></tr>
<tr><td>6</td><td colspan="2">Swedish</td></tr>
<tr><td>7</td><td colspan="2">Finnish</td></tr>
<tr><td rowspan="4">161</td><td rowspan="4">Frequency setting/key lock operation selection</td><td rowspan="4">0</td><td>0</td><td>Setting dial frequency setting mode</td><td rowspan="2">Key lock invalid</td><td rowspan="4">○</td><td rowspan="4">○</td></tr>
<tr><td>1</td><td>Setting dial potentiometer mode</td></tr>
<tr><td>10</td><td>Setting dial frequency setting mode</td><td rowspan="2">Key lock valid</td></tr>
<tr><td>11</td><td>Setting dial potentiometer mode</td></tr>
<tr><td rowspan="5">295</td><td rowspan="5">Magnitude of frequency change setting</td><td rowspan="5">0</td><td>0</td><td colspan="2">Function invalid</td><td rowspan="5">—</td><td rowspan="5">○</td></tr>
<tr><td>0.01</td><td colspan="2" rowspan="4">The minimum varying width when the set frequency is changed by the setting dial can be set.</td></tr>
<tr><td>0.10</td></tr>
<tr><td>1.00</td></tr>
<tr><td>10.00</td></tr>
<tr><td rowspan="2">990*1</td><td rowspan="2">PU buzzer control</td><td rowspan="2">1</td><td>0</td><td colspan="2">Without buzzer</td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td>1</td><td colspan="2">With buzzer</td></tr>
<tr><td>991 *1*2</td><td>PU contrast adjustment</td><td>58</td><td>0 to 63</td><td colspan="2">0: Light
↓
63: Dark</td><td>○</td><td>○</td></tr>
</table>

*1 The above parameter allow its setting to be changed during operation in any operation mode even if [*Pr. 77 Parameter write selection* = 0].
*2 This parameter is displayed as simple mode parameter only when the parameter unit (FR-PU04/FR-PU07) is connected.

(1) RUN key rotation direction selection [Pr. 40] (E700)(D700)

Used to choose the direction of rotation by operating (RUN) of the operation panel.

(2) PU display language selection [Pr. 145] (common)

The display language of the parameter unit (FR-PU04/FR-PU07) can be changed to other language using [*Pr. 145*] .

(3) Operation panel frequency setting/key lock operation selection [Pr. 161] (common)

The setting dial of the operation panel (FR-DU07) can be used like a potentiometer and key operation of the operation panel can be invalid by setting [*Pr. 161*]. For details refer to page 214.

(4) Magnitude of frequency change setting [Pr. 295] (E700)(D700)

When setting the set frequency with the setting dial, frequency changes in 0.01Hz increments in the initial status. Setting [*Pr. 295*] increases the magnitude of frequency which changes according to the rotated amount of the setting dial, improving usability.
For example, when "1.00Hz" is set in [*Pr. 295*], one click (one dial gauge) of the setting dial changes the frequency in increments of 1.00Hz→2.00Hz→3.00Hz.
Magnitude of frequency change works only for the set frequency. Magnitude of frequency changes for other parameters which are set in frequency is not changed by *Pr. 295*.
When 10 is set, the setting changes in 10Hz increments. Be cautious for the excess speed (in potentiometer mode)
Minimum increment for the magnitude of change is also determined by [*Pr. 295*] setting when machine speed unit is displayed by [*Pr. 37*] setting. However, setting value may differ since a set machine speed is converted to frequency, then the frequency is converted back to speed.

When the set frequency (speed) is 100 or more, frequency is displayed in 0.1 increments. Therefore, the minimum varying width is 0.1 even when [*Pr. 295* <0.1].
When the set frequency (speed) is 1000 or more, frequency is displayed in 1 increments. Therefore, the minimum varying width is 1 even when [*Pr. 295*<1].

(5) Buzzer control [Pr. 990]

You can select to make the buzzer "beep" when you press key of the operation panel and parameter unit (FR-PU04/FR-PU07) or not by using [*Pr. 990*].

(6) PU contrast adjustment [Pr. 991]

The LCD contrast of the parameter unit (FR-PU04/ FR-PU07) can be adjusted using [*Pr. 991*].
Decreasing the setting value makes contrast light.
The contrast can be adjusted by changing the setting with ▲ ▼ of the parameter unit.

At this time, press WRITE to store the setting.

2.18.8 Setting an operation panel (PA02) for FR-E500 series E700 D700

Operation panel for the FR-E500 series (PA02) can be used by connecting with PU cable.
(PA02 cannot be connected to the inverter body directly.)

[Pr.]	Name	Initial Value	Setting Range	Description
146	Built-in potentiometer switching	1	0	PA02 built-in frequency setting potentiometer valid Frequency setting by the built-in frequency setting potentiometer
			1	PA02 built-in frequency setting potentiometer invalid Digital frequency setting by the ▲/▼ key. Changing frequency continuously by pressing the ▲/▼ key. The value changes while pressing down the ▲/▼ key.
C22(922)	Frequency setting voltage bias frequency (built-in potentiometer)	0Hz	0 to 400Hz	Frequency on the bias side of PA02 built-in frequency setting potentiometer.
C23(922)	Frequency setting voltage bias (built-in potentiometer)	0%	0 to 300%	Converted % of the bias side setting level of PA02 built-in frequency setting potentiometer.
C24(923)	Frequency setting voltage gain frequency (built-in potentiometer)	60Hz	0 to 400Hz	Frequency on the gain side of PA02 built-in frequency setting potentiometer.
C25(923)	Frequency setting voltage gain (built-in potentiometer)	100%	0 to 300%	Converted % of the bias side setting level of PA02 built-in frequency setting potentiometer.

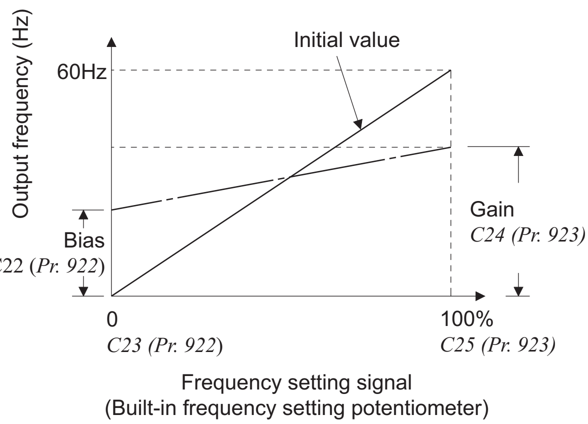
(1) Built-in potentiometer switching [Pr. 146]

Switches the frequency setting method between the PA02 built-in frequency setting potentiometer and digital frequency setting by the ▲/▼ key.

Set [*Pr.146* =0] only when operating by a built-in frequency setting potentiometer of an operation panel for the FR-500 series (PA02). When [*Pr.146* =0], operation may not be available from an inverter's operation panel or by communication.

(2) Bias and gain of the built-in frequency setting potentiometer [C22 (Pr. 922) to C25 (Pr. 923)]

When the operation panel (PA02) for the FR-E500 series is hooked up with the PU cable, the magnitude (slope) of the output frequency to the frequency setting potentiometer of the operation panel can be set as desired.
Adjust the bias of the potentiometer of the operation panel using [*Pr. 922* (C22, C23)] and gain with [*Pr. 923* (C24, C25)].



2.19 Frequency compensation function

2.19.1 Slip compensation [Pr. 245 to 247] common

Motor speed can be kept constant by estimating motor slip from output current under V/F control, Simple magnetic flux vector control (only in F700), and General-purpose magnetic flux vector control (only in E700 D700.)

[Pr.]	Name	Initial Value	Setting Range	Description
245	Rated slip	9999	0.01 to 50%	Used to set the rated motor slip.
			0, 9999	No slip compensation
246	Slip compensation time constant	0.5s	0.01 to 10s	Used to set the slip compensation response time. When the value is made smaller, response will be faster. However, as load inertia is greater, a regenerative overvoltage fault (E.OV1 to 3) is more liable to occur.
247	Constant-power range slip compensation selection	9999	0	Slip compensation is not made in the constant power range (frequency range above the frequency set in ([*Pr. 3*]).
			9999	Slip compensation is made in the constant power range.

Slip compensation is valid when the motor rated slip calculated by the following expression is set in [*Pr. 245*] .
Slip compensation is not made when [*Pr. 245 = 0, 9999*].

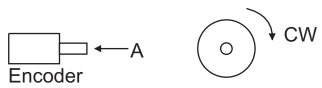
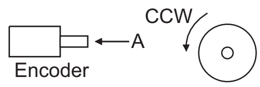
$$\text{Rated slip} = \frac{\text{(Synchronous speed at base frequency)} - \text{Rated speed}}{\text{Synchronous speed at base frequency}} \times 100\ [\%]$$

When performing slip compensation, the output frequency may become greater than the set frequency. Set the [*Pr. 1 Maximum frequency*] value a little higher than the set frequency.

[*Pr.245 to 247*] settings are invalid under Advanced magnetic flux vector control in A700 E700, Real sensorless vector control in A700, and vector control since slip compensation is performed under these controls.
When encoder feedback control is performed by A700, [*Pr. 245 to Pr. 247*] settings are invalid.

2.19.2 Encoder feedback control [Pr. 144, 285, 359, 367 to 369] (A700)

This controls the inverter output frequency so that the motor speed is constant to the load variation by detecting the motor speed with the speed detector (encoder) to feed it back to the inverter under V/F control and Advanced magnetic flux vector control. Slip compensation of [*Pr. 245 to Pr. 247*] is invalid.
Plug-in option FR-A7AP or FR-A7AL is necessary.

[Pr.]	Name	Initial Value	Setting Range	Description
144	Speed setting switchover	4	0, 2, 4, 6, 8, 10, 102 104, 106, 108, 110	Set the number of motor poles when performing encoder feedback control under V/F control.
285	Overspeed detection frequency *1	9999	0 to 30Hz	If (detected frequency) - (output frequency) ≥ *Pr. 285* during encoder feedback control, the inverter fault (E.MBI) is provided.
			9999	Overspeed is not detected.
359	Encoder rotation direction AP AL	1	0	 Clockwise direction as viewed from A is forward rotation
			1	 Counter clockwise direction as viewed from A is forward rotation
367	Speed feedback range AP AL	9999	0 to 400Hz	Set the region of speed feedback control.
			9999	Encoder feedback control is invalid
368	Feedback gain AP AL	1	0 to 100	Set when the rotation is unstable or response is slow.
369	Number of encoder pulses AP AL	1024	0 to 4096	Set the number of pulses of the encoder. Set the number of pulses before multiplied by four.

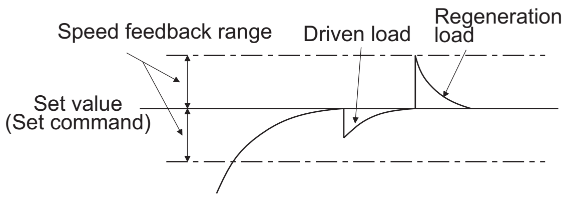
*1 When performing vector control with the FR-A7AP or FR-A7AL, this parameter changes to speed deviation excess detection frequency (*For details, refer to page 294*).

(1) Setting before the operation [*Pr. 144, 359, 369*]

When performing encoder feedback control under V/F control, set the number of motor poles in [*Pr. 144 Speed setting switchover*] according to the motor used.
When [*Pr. 144 = 0, 10, 110*] and run the inverter, fault E1 to E3 occurs.
When [*Pr. 144 = 102, 104, 106, 108*], the value subtracting 100 is set as the number of motor poles.
[*Pr. 144*] is used to change the monitor display increments. Refer to page 343 for details.
When operating Advanced magnetic flux vector control and encoder feedback control together, the [*Pr. 144*] setting is invalid and the [*Pr. 81 Number of motor poles*] setting is valid.
Set the rotation direction of the encoder and number of pulse using [*Pr. 359 Encoder rotation direction*] and [*Pr. 369 Number of encoder pulses*]. Encoder feedback control can not be performed when the setting of encoder rotation direction is wrong. (Inverter operation is enabled.) Encoder rotation direction can be checked with the rotation direction display of the parameter unit.
In encoder feedback control, inverter output is controlled by the encoder at motor side. When performing encoder feedback control by the encoder at machine side by using FR-A7AL, convert the number of encoder pulses at machine side to the number equivalent for the motor side, and set the value to [*Pr. 396 Number of encoder pulses*]. When encoders at motor side and machine side differ, set the same rotation direction as the motor side to [*Pr. 359 Encoder rotation direction*].

(2) Selection of encoder feedback control [*Pr. 367*]

When [*Pr. 367 Speed feedback range ≠ 9999*], encoder feedback control is valid.
Using the set point (frequency at which stable speed operation is performed) as reference, set the higher and lower setting range. Normally, set the frequency converted from the slip amount (r/min) of the rated motor speed (rated load). If the setting is too large, response becomes slow.



[Example]
When the rated speed of the motor (4P) is1740 r/min/60Hz

Slip amount Nsp = Synchronous speed - rated speed
= 1800 - 1740 = 60 (r/min)

Frequency fsp equivalent to the slip amount

$$fsp = \frac{Nsp \times \text{the number of motor poles}}{120} = \frac{60 \times 4}{120} = 2(Hz)$$

Encoder feedback control is not performed during acceleration/deceleration to prevent unstable phenomenon such as hunting and performed when the output frequency once reaches [set frequency] ± [speed feedback range].
If the following conditions occur during encoder feedback control, the inverter operates at the frequency within [set speed] ± [speed feedback range] without coming to trip nor tracking the motor speed.

- The pulse signals are not received from the encoder due to a signal loss or the like.
- The accurate pulse signal from the encoder can not be detected due to induction noise, etc.
- The motor has been forcibly accelerated (regeneration) or decelerated (motor lock or the like) by large external force.

For the motor with brake, use the RUN signal (inverter running) to open the brake. (The brake may not be opened if the FU (output frequency detection) signal is used.)

(3) Feedback gain [*Pr. 368*]

Set [*Pr. 368 Feedback gain*] when the rotation is unstable or response is slow.
If the acceleration/deceleration time is long, feedback response becomes slower. In this case, increase the [*Pr. 368*] setting.

[Pr. 368] Setting	Description
[*Pr. 368*] > 1	Although the response becomes faster, overcurrent or unstable rotation is liable to occur.
1 < [*Pr. 368*]	Although the response become slow, rotation becomes stable.

(4) Overspeed detection [*Pr. 285*]

If (detection frequency) - (output frequency) > [*Pr. 285*] under encoder feedback control, E.MB1 occurs and the inverter output is stopped to prevent malfunction when the accurate pulse signal from the encoder can not be detected.
Overspeed is not detected when [*Pr. 285 = 9999*] .

(5) Switching the control method from the external terminal (RT, X18 signal)

When Advanced magnetic flux vector control, Real sensorless vector control, or vector control is selected and [*Pr. 18 = 12 to 20*], use X18 signal to change to V/F control. When encoder feedback control is valid, turning X18 signal ON to change to V/F control becomes invalid, and encoder feedback control is valid.

<table>
<tr><th colspan="2">Changing First Motor Control Method
([Pr. 80 = Motor capacity], [Pr. 81 = 12, 14, 16, 18, 20])</th></tr>
<tr><th>X18 signal-OFF</th><th>X18 signal-ON</th></tr>
<tr><td>Advanced magnetic flux vector control
with encoder feedback

Real sensorless vector control *1

Vector control *1</td><td>V/F control
with encoder feedback</td></tr>
</table>

*1 Encoder feedback is invalid during Real sensorless vector control and vector control even if set.

Turning RT signal ON changes the control to the second motor control. Note that if encoder feedback control is valid and the second motor is selected ([*Pr. 450 ≠ 9999*]), turning RT signal ON will not start encoder feedback control.
When the second motor is not selected ([*Pr. 450 = 9999*], turning RT signal ON starts encoder feedback control.
When both X18 signal and RT signal are turned ON, RT signal has priority.

<table>
<tr><th>First Motor Control Method Selection
RT Signal-OFF</th><th>Second Motor Control Method
RT Signal-ON</th><th>[Pr. 450]
Setting</th><th>[Pr. 453]
[Pr. 454]
Setting</th><th>[Pr. 451]
Setting</th></tr>
<tr><td rowspan="4">V/F control
with encoder feedback</td><td>V/F control
with encoder feedback</td><td>9999</td><td>—</td><td>—</td></tr>
<tr><td>V/F control
without encoder feedback</td><td rowspan="3">Other than 9999</td><td>9999</td><td>—</td></tr>
<tr><td>Advanced magnetic flux vector control
without encoder feedback</td><td rowspan="2">Other than 9999</td><td>20, 9999</td></tr>
<tr><td>Real sensorless vector control *1</td><td>10 to 12</td></tr>
<tr><td rowspan="4">Advanced magnetic flux vector control
with encoder feedback

Real sensorless vector control *1

Vector control *1</td><td>[Pr. 81 = 2 to 10] Same control as the first motor *1
with encoder feedback
[Pr. 81 = 12 to 20 *2] V/F control
with encoder feedback</td><td>9999</td><td>—</td><td>—</td></tr>
<tr><td>V/F control
without encoder feedback</td><td rowspan="3">Other than 9999</td><td>9999</td><td>—</td></tr>
<tr><td>Advanced magnetic flux vector control
without encoder feedback</td><td rowspan="2">Other than 9999</td><td>20, 9999</td></tr>
<tr><td>Real sensorless vector control *1</td><td>10 to 12</td></tr>
</table>

*1 Encoder feedback is invalid during Real sensorless vector control and vector control even if set.
*2 Turning X18 signal ON selects V/F control. When the X18 signal is not assigned, turning the RT signal ON selects V/F control as the RT signal shares this function.

2.19.3 Droop control [Pr. 286 to 288] (A700) (E700)

Droop control makes the load balanced in proportion to the load torque and provides droop characteristic to the speed under Advanced magnetic flux vector control, Real sensorless vector control (only in (A700)), and vector control (only in (A700)).

This function is effective for balancing the load when using multiple inverters

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	Available Inverters E700
286	Droop gain	0%	0	Normal operation (droop control is invalid)	○	○
			0.1% to 100%	Droop control is valid Set the drooping amount at the rated torque as a percentage with respect to the rated motor frequency.		
287	Droop filter time constant	0.3s	0 to 1s	Set the time constant of the filter applied on the torque current.	○	○
288	Droop function activation selection	0	0 to 5	When the frequency after droop control operation limit and droop compensation is negative, droop compensation reference can be selected.	○	—

[Pr. 288] Setting	Advanced Magnetic Flux Vector Control: Operation limit	Advanced Magnetic Flux Vector Control: When the frequency after compensation is negative	Advanced Magnetic Flux Vector Control: Droop Compensation reference	Real Sensorless Vector Control, Vector Control: Operation limit	Real Sensorless Vector Control, Vector Control: When the frequency after compensation is negative	Real Sensorless Vector Control, Vector Control: Droop compensation reference
0	Not performed during acceleration/ deceleration	Frequency command is limited at 0.5Hz	Rated motor frequency	Not performed during acceleration/ deceleration	Frequency command is limited at 0Hz	Rated motor frequency
1				Always operates	Frequency command is limited at 0Hz	Rated motor frequency
2				Always operates	Under vector control: Frequency command is not limited (rotation direction is inversed) Under Real sensor less vector control: Frequency command is limited at 0Hz	Rated motor frequency
10				Not performed during acceleration/ deceleration	Frequency command is limited at 0Hz	Motor speed
11				Always operates	Frequency command is limited at 0Hz	Motor speed

The output frequency is changed according to the magnitude of torque current under Advanced magnetic flux vector control and Real sensorless vector control.

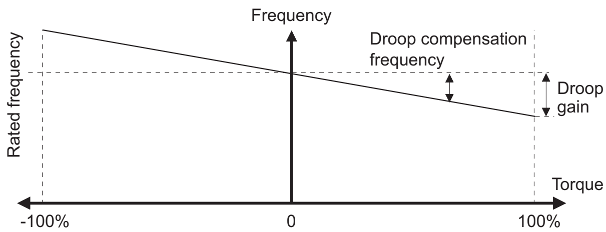
By setting [*Pr. 288*] in (A700), droop control operation under Real sensorless vector control and vector control can be changed.

The drooping amount at the rated torque is set by the droop gain as a percentage using the rated frequency (motor speed when [*Pr. 288 = 10, 11*]) as a reference.

Set the droop gain to about the rated slip of the motor.

$$\text{Rated slip} = \frac{(\text{Synchronous speed at base frequency}) - \text{Rated speed}}{\text{Synchronous speed at base frequency}} \times 100\ [\%]$$

The maximum value of frequency after droop compensation is either 120Hz or [*Pr. 1 Maximum frequency*], whichever is smaller.



When [*Pr. 288 = 0 to 2*] or under Advanced magnetic flux vector control

$$\text{Droop compensation frequency} = \frac{\text{Torque current after filtering}}{\text{Rated value of torque current}} \times \frac{\text{Rated motor frequency} \times \text{Droop gain}}{100}$$

When [*Pr. 288 = 10, 11*]

$$\text{Droop compensation frequency} = \frac{\text{Torque current after filtering}}{\text{Rated value of torque current}} \times \frac{\text{Motor speed} \times \text{Droop gain}}{100}$$

2.20 Other function

2.20.1 Load torque high speed frequency control [Pr. 4, 5, 270 to 274] (A700)

Load torque high speed frequency control is a function which automatically sets the operational maximum frequency according to the load.
More specifically, the magnitude of the load is judged according to the average current at a certain time after starting to perform operation at higher than the preset frequency under light load.
This function is designed to increase speed automatically under light load, for example to minimize the incoming/ outgoing time in a multi-story parking lot.

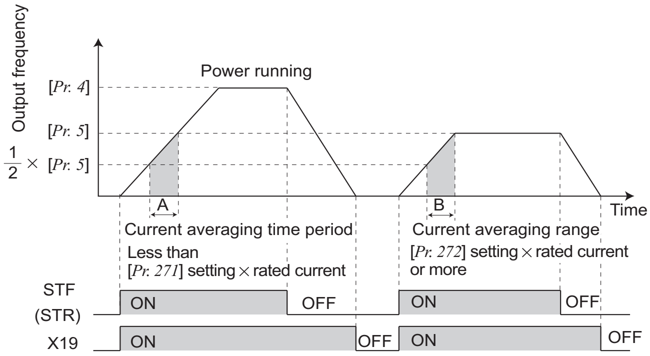
[Pr.]	Name	Initial Value	Setting Range	Description
4	Multi-speed setting (high speed)	60Hz	0 to 400Hz	Set the higher-speed frequency.
5	Multi-speed setting (middle speed)	30Hz	0 to 400Hz	Set the lower-speed frequency.
270	Stop-on contact/load torque high-speed frequency control selection	0	0	Normal operation
			1	Stop-on-contact control (refer to page 396)
			2	Load torque high speed frequency control
			3	Stop-on-contact (refer to page 396) +load torque high speed frequency control
271	High-speed setting maximum current	50%	0 to 220%	Set the upper and lower limits of the current at high and middle speeds.
272	Middle-speed setting minimum current	100%	0 to 220%	
273	Current averaging range	9999	0 to 400Hz	Average current during acceleration from ([*Pr. 273*] × 1/2) Hz to ([*Pr. 273*]) Hz can be achieved.
			9999	Average current during acceleration from ([*Pr. 5*] × 1/2) Hz to ([*Pr. 5*]) Hz is achieved.
274	Current averaging filter time constant	16	1 to 4000	Set the time constant of the primary delay filter relative to the output current. (The time constant [ms] is 0.75 × [*Pr. 274*] and the initial value is 12ms.) A larger setting provides higher stability but poorer response.

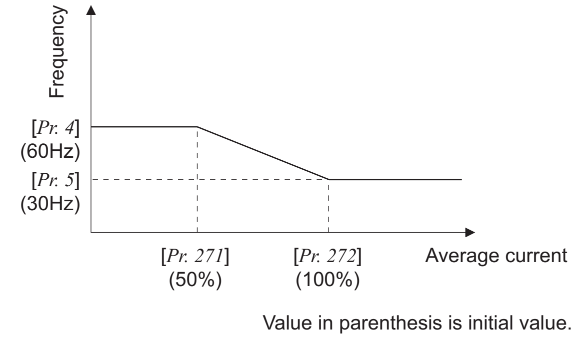
Set [*Pr. 270 Stop-on contact/load torque high-speed frequency control selection = 2 or 3*].
When operating with the load torque high speed frequency function selection signal (X19) ON, the inverter automatically changes the maximum frequency within the setting range of [*Pr. 4 Multi-speed setting (high speed)*] and [*Pr. 5 Multi-speed setting (middle speed)*] according to the magnitude of the average current during the time to accelerate from 1/2 of the frequency set in [*Pr. 5*] to the frequency set in [*Pr. 5*].
When the average current of the current averaging range (refer to A in the chart on the next page) during operation with the X19 signal on is less than the "rated inverter current" × [*Pr. 271*], the maximum frequency automatically becomes the [*Pr. 4*] setting value.
When the average current of the current averaging time period (refer to B in the chart on the next page) during operation with the X19 signal on is higher than the "rated inverter current" × [*Pr. 272*], the maximum frequency automatically becomes the [*Pr. 5*] setting value.
During regeneration load operation, [*Pr. 5*] is the maximum frequency regardless of the average current. When the average current during acceleration is too small, it may be judged as regeneration and the maximum frequency becomes the setting of [*Pr. 5*].
The current averaging range can be set between 1/2 frequency of the [*Pr. 273*] setting value and [*Pr. 273*] set frequency.
When the current averaging range includes the constant power range, the output current may become large in the constant power range.
When the average current value in the current averaging range is small, deceleration time becomes longer as the running frequency increases.
The maximum output frequency is 120Hz. The output frequency is 120Hz even when the setting is above 120Hz.
Set [*Pr. 178 to Pr. 189 (input terminal function selection) = 19*] and assign X19 signal function to the input terminal.
This control can be activated at every start. Fully note that the speed changes every time if the magnitude of the load differs every time.
It is valid in the External operation mode only, and restart after instantaneous power failure function and fast-response current limit function are invalid.
The load torque high speed frequency function is invalid in the following operation conditions.

- PU operation ([*Pr. 79*])
- PU+external operation ([*Pr. 79*])
- JOG operation (JOG signal)
- PID control operation (X14 signal)
- Remote function selection operation ([*Pr.59*])
- Orientation control operation
- Multi-speed setting (RH, RM, and RL signals)
- 16bit digital input (FR-A7AX)

2

PARAMETER





2.20.2 Stop-on contact control function [Pr. 6, 48, 270, 275, 276] (A700) (E700)

To ensure accurate positioning at the upper limit etc. of a lift, stop-on-contact control causes a mechanical brake to be closed while the motor is developing a holding torque to keep the load in contact with a mechanical stopper etc.

This function suppresses vibration which is liable to occur when the load is stopped upon contact in vertical motion applications, ensuring steady precise positioning.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverter A700	Available Inverter E700
6	Multi-speed setting (low speed)	10Hz	0 to 400Hz	Set the output frequency for stop-on-contact control.	○	○
48	Second stall prevention operation current	(A700) 150% (E700) 9999	(A700) 0 to 220% (E700) 0 to 200%	Set the stall prevention operation level for stop-on-contact control. ((A700) The smaller setting value between [*Pr.22 Stall prevention operation level*] and [*Pr.48*] has a priority.)	○	○
			9999	Same level as [*Pr.22 Stall prevention operation level*]	—	○
270	(A700) Stop-on contact/load torque high-speed frequency control selection (E700) Stop-on contact control selection	0	0	Normal operation	○	○
			1	Stop-on-contact control		
			2	Load torque high speed frequency control (refer to page 395)	○	—
			3	Stop-on-contact+load torque high speed frequency control (refer to page 395)		
275	Stop-on contact excitation current low-speed multiplying factor	9999	(A700) 0 to 1000% (E700) 0 to 300%	Set the force (holding torque) for stop-on-contact control. Normally set 130% to 180%. Valid only during Advanced magnetic flux vector control.	○	○
			9999	No compensation.		
276	PWM carrier frequency at stop-on contact	9999	55K or less: 0 to 9 75K or more: 0 to 4	Set a PWM carrier frequency for stop-on-contact control. For Real sensorless vector control, carrier frequency is always 2Hz	○	○
			9999	As set in [*Pr. 72 PWM frequency selection*].		

Confirm that the External operation mode is selected. In (A700), select Real sensorless vector control or Advanced magnetic vector control. This function is not activated during V/F control and vector control.

In (E700), select Advanced magnetic flux vector control or General-purpose magnetic vector control. This function is not activated during V/F control.

In (A700), set [*Pr. 270 Stop-on contact/load torque high-speed frequency control selection*=1 or 3]. In (E700), set [*Pr. 270 Stop-on contact control selection* =1].

Set output frequency during stop-on-contact control in [*Pr. 6 Multi-speed setting (low speed)*]. The frequency should be as low as possible (about 2Hz). If it is set to more than 30Hz, the operating frequency will be 30Hz.

When both the RT and RL signals are switched ON, the inverter enters the stop-on-contact mode, in which operation is performed at the frequency set in [*Pr. 6*] independently of the preceding speed.

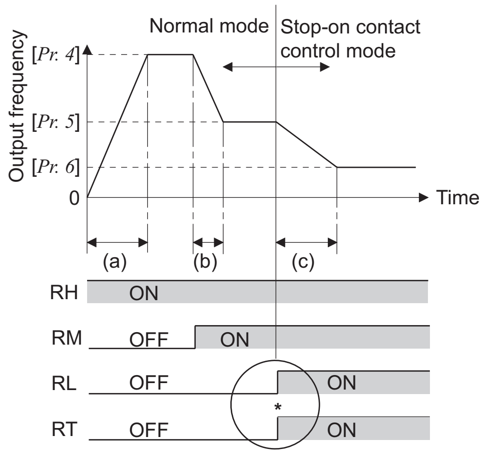
Under Advanced magnetic flux vector control and General-purpose magnetic flux control, increasing the [*Pr. 275*] setting enhances excitation at the low speed and increases torque. Normally set this parameter within the range about 130 to 180%. If the setting is too large, overcurrent fault (E.OC 1 to 3) may occur or the machine may oscillate in a stop-on-contact state.

The stop-on-contact function is different from servo-lock function, and if used to stop or hold a load for an extended period, this function can cause the motor to overheat. After a stop, immediately hold the load by a mechanical brake.

Under the following operating conditions, the stop-on-contact function is invalid:

- PU operation ([*Pr. 79*])
- JOG operation (JOG signal)
- PU +external operation ([*Pr. 79*])
- PID control function operation([*Pr. 128*])
- Remote setting function operation ([*Pr. 59*])
- Start time tuning (only in (A700))
- Orientation control function operation (only in (A700))

When performing stop-on-contact control during encoder feedback control, encoder feedback control is invalid due to a mode shift to the stop-on-contact control mode.



*Goes into stop-on-contact control mode when both RL and RT switch ON.
RL and RT may be switched ON in any order with any time difference

(a):Acceleration time ([*Pr. 7*])
(b):Deceleration time ([*Pr. 8*])
(c):Second deceleration time ([*Pr. 44*])

(A700)

Main Functions	Normal Operation (either RL or RT is OFF or both are OFF)		With Stop-on-contact Control (both RL and RT are ON)	
	Real sensorless vector control	Advanced magnetic flux vector control	Real sensorless vector control	Advanced magnetic flux vector control
Output frequency	Multi-speed 0 to 5V, 0 to 10V 4 to 20mA etc.		[*Pr. 6*] setting	
Stall prevention operation level	—	[*Pr. 22*] setting	—	The setting value of [*Pr. 48*] or [*Pr. 22*], whichever is smaller *
Torque limit level	[*Pr. 22*] setting	—	[*Pr. 22*] setting	—
Excitation current low speed scaling factor	—		—	[*Pr. 275*] (0 to 1000%) is compensated from normal operation
Carrier frequency	[*Pr. 72*] setting		Output frequency is 3Hz or less [*Pr. 276*] setting ([*Pr. 72*] when [*Pr. 276 = 9999*])	
Fast-response current limit	—	Valid	—	Invalid

* When RL and RT are ON, [*Pr. 49 Second stall prevention operation frequency*] is invalid.

2

PARAMETER

E700

Main Functions	Normal Operation (either RL or RT is OFF or both are OFF)	With Stop-on-contact Control (both RL and RT are ON)
	Advanced magnetic flux vector control, General-purpose magnetic flux control.	Advanced magnetic flux vector control, General-purpose magnetic flux control.
Output frequency	Multi-speed 0 to 5V, 0 to 10V 4 to 20mA etc.	[*Pr. 6*] setting
Stall prevention operation level	[*Pr. 22*] setting	[*Pr. 48*] setting (When [*Pr. 48* = 9999], [*Pr. 22*] setting
Excitation current low speed scaling factor	—	[*Pr. 275*] (0 to 300%) is compensated from normal operation
Carrier frequency	[*Pr. 72*] setting	Output frequency is 3Hz or less [*Pr. 276*] setting ([*Pr. 72*] when [*Pr. 276 = 9999*])
Fast-response current limit	Valid	Invalid

Input Signal (○ = ON)					Set Frequency
RH	RM	RL	RT	JOG	
○					[*Pr. 4 Multi-speed setting (high speed)*]
	○				[*Pr. 5 Multi-speed setting (middle speed)*]
		○			[*Pr. 6 Multi-speed setting (low speed)*]
			○		By 0 to 5V (0 to 10V), 4 to 20mA input
				○	[*Pr. 15 Jog frequency*]
○	○				[*Pr. 26 Multi-speed setting (speed 6)*]
○		○			[*Pr. 25 Multi-speed setting (speed 5)*]
○			○		[*Pr. 4 Multi-speed setting (high speed)*]
○				○	[*Pr. 15 Jog frequency*]
	○	○			[*Pr. 24 Multi-speed setting (speed 4)*]
	○		○		[*Pr. 5 Multi-speed setting (middle speed)*]
	○			○	[*Pr. 15 Jog frequency*]
		○	○		[*Pr. 6 Multi-speed setting (low speed)*]
		○		○	[*Pr. 15 Jog frequency*]
			○	○	[*Pr. 15 Jog frequency*]
		○	○	○	[*Pr. 15 Jog frequency*]

Input Signal (○ = ON)					Set Frequency
RH	RM	RL	RT	JOG	
	○		○	○	[*Pr. 15 Jog frequency*]
	○	○		○	[*Pr. 15 Jog frequency*]
	○	○	○		[*Pr. 6 Multi-speed setting (low speed)*]
○			○	○	[*Pr. 15 Jog frequency*]
○		○		○	[*Pr. 15 Jog frequency*]
○		○	○		[*Pr. 6 Multi-speed setting (low speed)*]
○	○			○	[*Pr. 15 Jog frequency*]
○	○		○		[*Pr. 26 Multi-speed setting (speed 6)*]
○	○	○			[*Pr. 27 Multi-speed setting (speed 7)*]
	○	○	○	○	[*Pr. 15 Jog frequency*]
○		○	○	○	[*Pr. 15 Jog frequency*]
○	○		○	○	[*Pr. 15 Jog frequency*]
○	○	○		○	[*Pr. 15 Jog frequency*]
○	○	○	○		[*Pr. 6 Multi-speed setting (low speed)*]
○	○	○	○	○	[*Pr. 15 Jog frequency*]
					By 0 to 5V (0 to 10V), 4 to 20mA input

2.20.3 Brake sequence function [Pr. 278 to 283, 284*, 285*, 292] (A700) (E700)

(*[*Pr. 284, 285*] are not available for (E700).)

This function is used to output from the inverter the mechanical brake operation timing signal in vertical lift and other applications. This function prevents the load from dropping with gravity at a start due to the operation timing error of the mechanical brake or an overcurrent alarm from occurring at a stop, ensuring secure operation.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700	Available Inverters E700
278	Brake opening frequency	3Hz	0 to 30Hz	Set to the rated slip frequency of the motor + about 1.0Hz. Setting is enabled only when [*Pr. 278*] ≤ [*Pr. 282*].	○	○
279	Brake opening current	130%	(A700)0 to 220% (E700)0 to 200%	Generally, set this parameter to about 50 to 90%. If the setting is too low, the load is liable to drop due to gravity at start. Suppose that the rated inverter current is 100%.	○	○
280	Brake opening current detection time	0.3s	0 to 2s	Generally, set this parameter to about 0.1 to 0.3s.	○	○
281	Brake operation time at a start	0.3s	0 to 5s	Set the mechanical delay time until the brake is loosened when [*Pr. 292*=7]. Set the mechanical delay time until the brake is loosened + about 0.1 to 0.2s when [*Pr. 292 = 8*].	○	○
282	Brake operation frequency	6Hz	0 to 30Hz	Set the frequency to activate the mechanical brake by turning OFF the brake opening request signal (BOF). Generally, set this parameter to the [*Pr. 278*] setting + 3 to 4Hz. Setting is enabled only when [*Pr. 282*] ≥ [*Pr. 278*].	○	○
283	Brake operation time at stop	0.3s	0 to 5s	Set the mechanical delay time until the brake is closed + 0.1s when [*Pr. 292 = 7*]. Set the mechanical delay time until the brake is closed + 0.2 to 0.3s when [*Pr. 292 = 8*].	○	○
284	Deceleration detection function selection	0	0	Deceleration is not detected.	○	—
			1	If deceleration is not normal during deceleration operation, the inverter alarm is provided.		
285	Overspeed detection frequency *	9999	0 to 30Hz	If (detected frequency) - (output frequency) ≥ *Pr. 285* during encoder feedback control, the inverter fault (E.MBI) is provided.	○	—
			9999	Overspeed is not detected.		
292	Automatic acceleration/ deceleration	0	0	Normal operation mode	○	○
			1, 11	Shortest acceleration/deceleration mode (refer to page 242)		
			3	Optimum acceleration/deceleration mode (refer to page 243)	○	—
			5, 6	Elevator mode (refer to page 249)		
			7	Brake sequence mode 1	○	○
			8	Brake sequence mode 2		

* When performing vector control with the FR-A7AP or FR-A7AL, this parameter changes to speed deviation excess detection frequency. (For details, refer to page 294.)

(1) Setting of brake sequence function

For A700, select one of Real sensorless vector control, vector control (speed control), and Advanced magnetic flux vector control. For E700, select Advanced magnetic flux vector control or General-purpose magnetic flux control. This function is invalid during V/F control.

The brake sequence function is valid only when the External operation mode, External/PU combined operation mode 1 or Network operation mode is selected. When brake sequence mode is selected, automatic restart after instantaneous power failure is invalid. In addition, set acceleration/deceleration time to 1s or more.

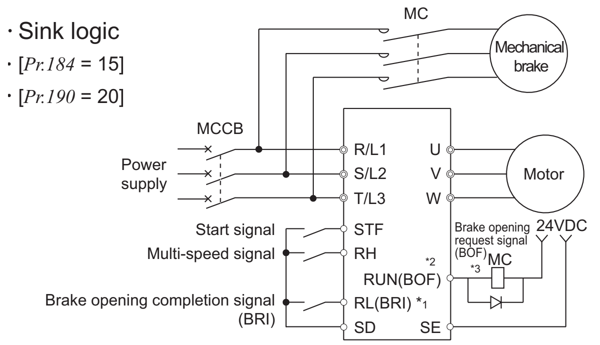
Set [*Pr. 292 = 7 or 8*] (brake sequence mode). To ensure more complete sequence control, it is recommended to set [*Pr. 292 = 7*] (brake opening completion signal input) .

Set [*Pr. 178 to Pr. 189 (input terminal function selection = 15*] and assign the brake opening completion signal (BRI) to the input terminal.

Set "20 (positive logic) or 120 (negative logic)" in any of [*Pr. 190 to Pr. 196 Output terminal function selection*] and assign the brake opening request signal (BOF) to the output terminal.

Even if brake sequence function is selected, inputting the JOG signal (JOG operation), RT signal (second function selection) or X9 signal (third function selection) during an inverter stop will switch to the normal operation and give priority to JOG operation or second and third function selection. Note that JOG and RT signal input is invalid even if JOG signal and RT signal are input during operation by brake sequence function.

When PID control or load torque high speed frequency control is selected, brake sequence function is invalid.



*1 The input signal terminal used differs according to the [*Pr. 178 to Pr. 189*] settings.

*2 The output signal terminal used differs according to the [*Pr. 190 to Pr. 196*] settings.

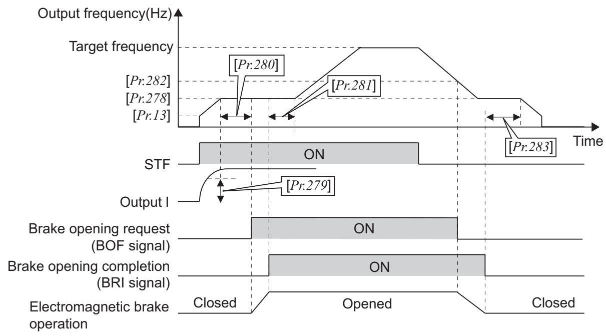
*3 The current should be within the permissible current of transistor in the inverter. (24V 0.1ADC)

(2) With brake opening completion signal input [*Pr. 278 to Pr. 283, Pr. 292 = 7*]

When the start signal is input to the inverter, the inverter starts running. When the output frequency reaches the value set in [*Pr. 278*] and the output current is more than the value set in [*Pr. 279*] , the inverter outputs the brake opening request signal (BOF) after the time set in [*Pr. 280*] has elapsed.

When the time set in [*Pr. 281*] elapses after the brake opening completion signal (BRI) was activated, the inverter increases the output frequency to the set speed.

When the speed has decreased to the frequency set in [*Pr. 282*] during deceleration, the BOF signal is turned OFF. When the time set in [*Pr. 283*] elapses after the electromagnetic brake operation was completed and the BRI signal was turned OFF, the inverter output is switched OFF.

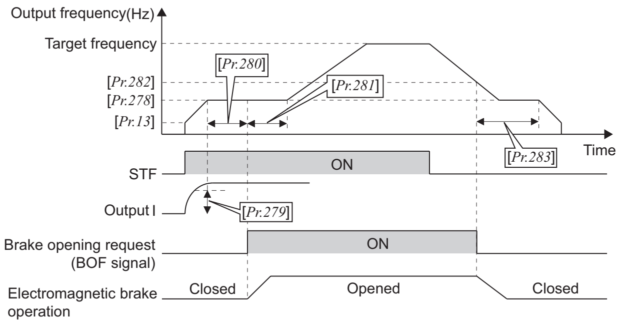


(3) Without brake opening completion signal input [*Pr. 278 to 283, Pr. 292 = 8*]

When the start signal is input to the inverter, the inverter starts running. When the output frequency reaches the value set in [*Pr. 278*] and the output current is more than the value set in [*Pr. 279*] , the inverter outputs the brake opening request signal (BOF) after the time set in [*Pr. 280*] has elapsed.

When the time set in [*Pr. 281*] elapses after the BOF signal is output, the inverter increases the output frequency to the set speed.

When the speed has decreased to the frequency set in [*Pr. 282*] during deceleration, the brake opening request signal (BOF) is turned OFF. When the time set in [*Pr. 283*] has elapsed after the BOF signal is turned OFF, the inverter output is switched OFF.



(4) Protective function [*Pr. 284, Pr. 285*]

If any of the following errors occurs in the brake sequence mode, the inverter results in an alarm, shuts off the output, and turns OFF the brake opening request signal (BOF).

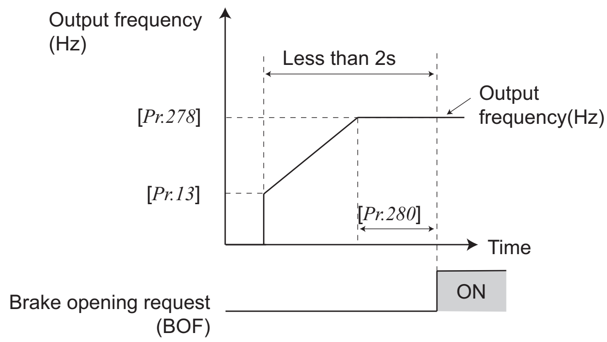
Error Display	Description
E.MB1 *1	During encoder feedback control When (detected frequency) - (output frequency) > [*Pr. 285*] When [*Pr. 285 = 9999*] (overspeed detection function), overspeed is not detected.
E.MB2 *1	When deceleration is not normal during deceleration operation from the set frequency to the frequency set in [*Pr. 282*]. (When [*Pr. 284 = 1*]) (except stall prevention operation)
E.MB3 *1	Brake opening request signal (BOF) turned ON though the motor is at a stop. (gravity drop prevention function)
E.MB4	Although more than 2s have elapsed after the start command (forward or reverse rotation) is input, the brake opening request signal (BOF) does not turn ON.
E.MB5	Although more than 2s have elapsed after the brake opening request signal (BOF) turned ON, the brake opening completion signal (BRI) does not turn ON.
E.MB6	Though the inverter had turned ON the brake opening request signal (BOF), the brake opening completion signal (BRI) turned OFF midway.
E.MB7	Although more than 2s have elapsed after the brake opening request signal (BOF) turned OFF at a stop, the brake opening completion signal (BRI) does not turn OFF.

*1 Not available for E700

*2 Overspeed detection ([*Pr. 285*]) is valid under encoder feedback control (used with the FR-A7AP or FR-A7AL option) even if a value other than 7 or 8 is set in [*Pr. 292*].

*3 A too large setting of [*Pr. 278 Brake opening frequency*] activates stall prevention operation and may cause E.MB4.

*4 When the acceleration time from [*Pr.13 Starting frequency*] to [*Pr.278 Brake opening frequency*] plus [*Pr.280 Brake opening current detection time*] exceeds 2s, E.MB4 occurs.



2.20.4 PID control [Pr. 127 to 134, 575 to 577*] (common)

(*[Pr. 575 to 577] are not available for (E700).)

The inverter can be used to exercise process control, e.g. flow rate, air volume or pressure.
The terminal 2 input signal or parameter setting is used as a set point and the terminal 4 input signal used as a feedback value to constitute a feedback system for PID control.

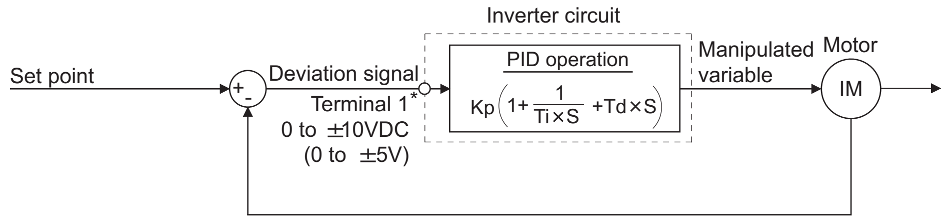
[Pr.]	Name	Initial Value	Setting Range	Description			Available Inverters (A700) (F700)	(E700)	(D700)
127	PID control automatic switchover frequency	9999	0 to 400Hz	Set the frequency at which the control is automatically changed to PID control.			○	○	○
			9999	Without PID automatic switchover function					
128	PID action selection	(A700) (F700) 10 (E700) (D700) 0	0	PID action is not performed			—	○	○
			10	PID reverse action	Deviation value signal input (terminal 1)		○	—	—
			11	PID forward action					
			20	PID reverse action	Measured value (terminal 4) Set value (terminal 2 or [*Pr. 133*])		○	○	○
			21	PID forward action					
			40	PID reverse action	Addition method: fixed	For dancer control set point ([*Pr. 133*]), measured value (terminal 4), main speed (frequency command of the operation mode)(*Refer to page 411*)	—	○	○
			41	PID forward action					
			42	PID reverse action	Addition method: ratio				
			43	PID forward action					
			50	PID reverse action	Deviation value signal input (LONWORKS, CC-Link communication)		○	○	—
			51	PID forward action					
			60	PID reverse action	Measured value and set point input (LONWORKS, CC-Link communication)				
			61	PID forward action					
129 *1	PID proportional band	100%	0.1 to 1000%	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain Kp = 1/proportional band			○	○	○
			9999	No proportional control					
130 *1	PID integral time	1s	0.1 to 3600s	For deviation step input, time (Ti) required for only the integral (I) action to provide the same manipulated variable as that for the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.			○	○	○
			9999	No integral control.					
131	PID upper limit	9999	0 to 100%	Set the upper limit value. If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.			○	○	○
			9999	No function					
132	PID lower limit	9999	0 to 100%	Set the lower limit value. If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.			○	○	○
			9999	No function					
133 *1	PID action set point	9999	0 to 100%	Used to set the set point for PID control.			○	○	○
			9999	Terminal 2 input is the set point.					
134 *1	PID differential time	9999	0.01 to 10.00s	For deviation ramp input, time (Td) required for providing the manipulated variable for the proportional (P) action only. As the differential time increases, greater response is made to a deviation change.			○	○	○
			9999	No differential control.					

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters		
					A700 F700	E700	D700
575	Output interruption detection time	1s	0 to 3600s	If the output frequency after PID operation remains lower than the [*Pr. 576*] setting for longer than the time set in [*Pr. 575*], the inverter stops operation.	○	—	○
			9999	Without output interruption function			
576	Output interruption detection level	0Hz	0 to 400Hz	Set the frequency at which the output suspension processing is performed.			
577	Output interruption cancel level	1000%	900 to 1100%	Level at which the PID output interruption function is canceled Set [*Pr. 577*] -1000%.			

*1 [*Pr. 129, 130, 133, 134*] can be set during operation. These can also be set independently of the operation mode.

(1) PID control basic configuration

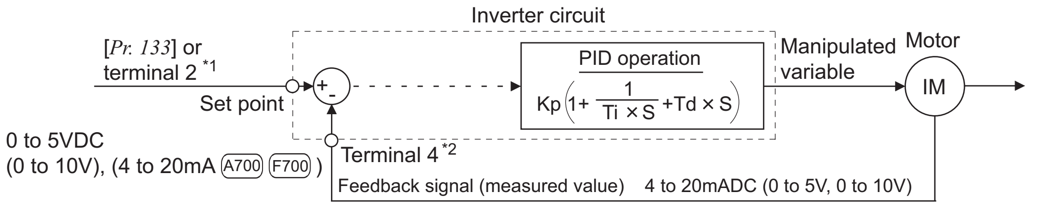
[*Pr. 128 = 10, 11*] Deviation value signal input (A700) (F700)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

* Set [*Pr. 868 Terminal 1 function assignment = 0*]. PID control is invalid when [*Pr. 868≠0*].

[*Pr. 128 = 20, 21*] Measured value input (common)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

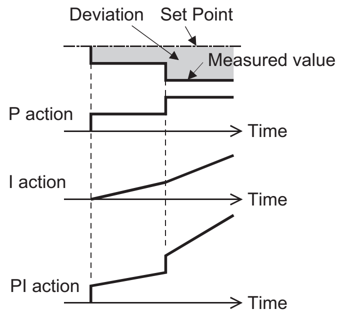
*1 Note that terminal 1 input is added to the set point of terminal 2 input. (Only in (A700)(F700))

*2 Set [*Pr. 858 Terminal 4 function assignment = 0*]. PID control is invalid when [*Pr. 858 ≠ 0*]. (Only in (A700))

(2) PID action overview

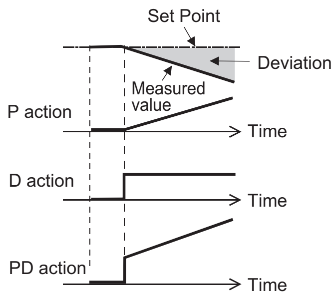
1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.
PI action is the sum of P and I actions.



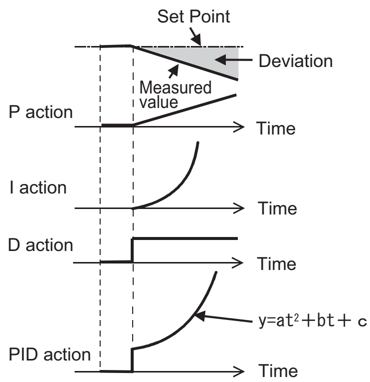
2) PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.
PD action is the sum of P and D actions.



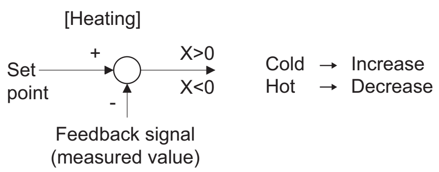
3) PID action

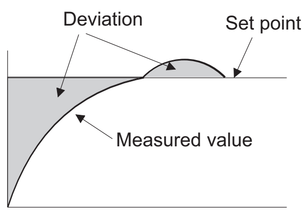
The PI action and PD action are combined to utilize the advantages of both actions for control.
PID action is the sum of P, I and D actions.



4) Reverse action

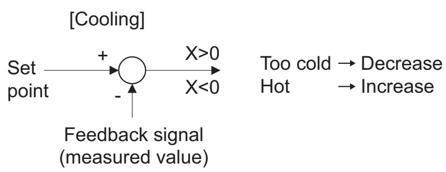
Increases the manipulated variable (output frequency) if deviation X = (set point - measured value) is positive, and decreases the manipulated variable if deviation is negative.

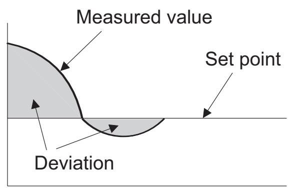




5) Forward action

Increases the manipulated variable (output frequency) if deviation X = (set point - measured value) is negative, and decreases the manipulated variable if deviation is positive.



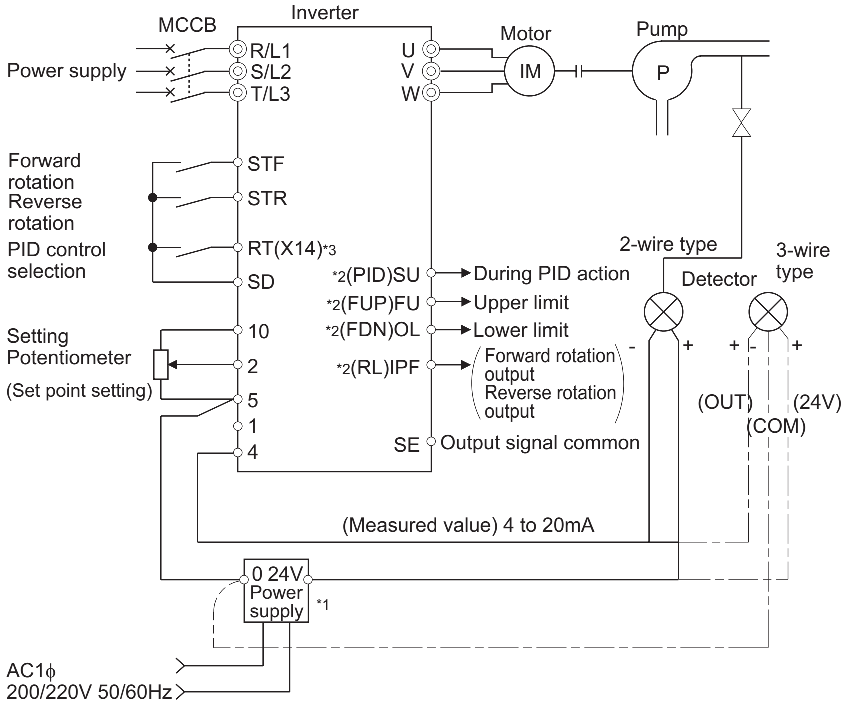


Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	**Negative**
Reverse action	↗	↘
Forward action	↘	↗

(3) Connection diagram (A700)

- Sink logic
- [*Pr. 128 = 20*]
- [*Pr. 183 = 14*]
- [*Pr. 191 = 47*]
- [*Pr. 192 = 16*]
- [*Pr. 193 = 14*]
- [*Pr. 194 = 15*]



*1 The power supply must be selected in accordance with the power specifications of the detector used.

*2 The used output signal terminal changes depending on the [*Pr. 190 to Pr. 196 Output terminal selection*] setting.

*3 The used input signal terminal changes depending on the [*Pr. 178 to Pr. 189 Input terminal selection*] setting.

*4 The AU signal need not be input.

(4) I/O signals and parameter setting

To perform PID control, turn X14 signal ON in (A700)(F700). When this signal is off, PID action is not performed and normal inverter operation is performed. (Note that it is not necessary to turn ON X14 signal when performing PID control with LONWORKS or CC-Link communication.)

Set [*Pr .128* =20, 21, 50, 51, 60, 61] in (E700), and set [*Pr. 128* =20, 21] in (D700), and then turn X14 signal ON. When X14 signal is not assigned, PID control is valid by just setting [*Pr. 128*].

If the multi-speed (RH, RM, RL signal) or JOG operation (JOG signal) is entered with X14 signal ON, PID control stops and multi-speed or JOG operation starts.

Enter the set point across inverter terminals 2 and 5 or in [*Pr. 133*] and enter the measured value signal across inverter terminals 4 and 5. At this time, set [*Pr. 128*] to 20 or 21.

When entering the deviation signal calculated externally in (A700)(F700), enter it across terminals 1 and 5. At this time, set [*Pr. 128*] to 10 or 11.

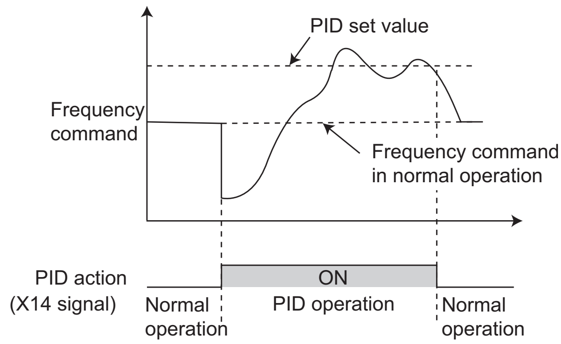
If the setting is as follows, PID control becomes invalid.

- Switchover mode ([*Pr. 79 = 6*])
- Terminal 4 torque command ([*Pr. 858 = 4*])
- Terminal 1 torque command ([*Pr. 868 = 4*])

When PID control is selected, the minimum frequency is the frequency set in [*Pr. 902*] and the maximum frequency is the frequency set in [*Pr. 903*]. ([*Pr.1 Maximum frequency*] and [*Pr. 2 Minimum frequency*] settings are also valid.)

During PID operation, the remote operation function ([*Pr. 59*]) and functions set using [*Pr. 292 Automatic acceleration/deceleration*] are invalid.

When X14 signal switches the control from normal operation to PID control, the frequency command during the normal operation is not retained, and new frequency is calculated with PID by the 0Hz reference.



Operation example of normal operation switching to PID control

A700 F700

	Signal	Terminal Used	Functions	Description	Parameter Setting
Input	X14	According to [*Pr. 178 to Pr. 189*]	PID control selection	Turn ON X14 to perform PID control.	Set 14 in any of [*Pr. 178 to Pr. 189*].
Input	X64	According to [*Pr. 178 to Pr. 189*]	PID forward/ reverse action switchover	By turning ON X64, forward action can be selected for PID reverse action ([*Pr. 128 = 10, 20*]), and reverse action for forward action ([*Pr. 128 = 11, 21*]).	Set 64 in any of [*Pr. 178 to Pr. 189*].
Input	2	2	Set point input	You can input the set point for PID control.	[*Pr. 128 = 20, 21*] [*Pr. 133 = 9999*]
				0 to 5V ....0 to 100%	[*Pr. 73 = 1* *1, *3, 5, 11, 13, 15*]
				0 to 10V ....0 to 100%	[*Pr. 73 = 0, 2, 4, 10, 12, 14*]
				0 to 20mA ....0 to 100%	[*Pr. 73 = 6, 7, 16, 17*]
Input	PU	—	Set point input	Set the set point ([*Pr. 133*]) from the operation panel or parameter unit.	[*Pr. 128 = 20, 21*] [*Pr. 133 = 0 to 100%*]
Input	1	1	Deviation signal input	Input the deviation signal calculated externally.	[*Pr. 128 = 10* *1, *11*]
				-5V to +5V........-100% to +100%	[*Pr. 73 = 2, 3, 5, 7, 12, 13, 15, 17*]
				-10 to +10V......-100 to +100%	[*Pr. 73 = 0, 1* *1, *4, 6, 10, 11, 14, 16*]
Input	4	4	Measured value input	Input the signal from the detector (measured value signal).	[*Pr. 128 = 20, 21*]
				4 to 20mA ....0 to 100%	[*Pr. 267 = 0* *1]
				0 to 5V ....0 to 100%	[*Pr. 267 = 1*]
				0 to 10V ....0 to 100%	[*Pr. 267 = 2*]
Input	Communication *2	—	Deviation value input	Input the deviation value from LONWORKS , CC-Link communication.	[*Pr. 128 = 50, 51*]
			Set point, measured value input	Input the set point and measured value from LONWORKS , CC-Link communication.	[*Pr. 128 = 60, 61*]
Output	FUP	According to [*Pr. 190 to Pr. 196*]	Upper limit output		[*Pr. 128 = 20, 21, 60, 61*] [*Pr. 131 ≠ 9999*] Set 15 or 115 in any of [*Pr. 190 to Pr. 196*] *3
Output	FDN		Lower limit output		[*Pr. 128 = 20, 21, 60, 61*] [*Pr. 132 ≠ 9999*] Set 14 or 114 in any of [*Pr. 190 to Pr. 196*] *3
Output	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	Set 16 or 116 in any of [*Pr. 190 to Pr. 196*] *3
Output	PID		During PID control activated	Turns ON during PID control.	Set 47 or 147 in any of [*Pr. 190 to Pr. 196*] *3
Output	SLEEP		PID output interruption	Turns ON when the PID output interruption function is performed.	[*Pr. 575 ≠ 9999*] Set 70 or 170 in any of [*Pr. 190 to Pr. 196*] *3
Output	SE	SE	Output terminal common	Common terminal for terminals FUP, FDN, RL, PID and SLEEP	

*1 The shaded area indicates the parameter initial value.
*2 For the setting method via LONWORKS communication, refer to the LONWORKS communication option (FR-A7NL) instruction manual.
For the setting method via CC-Link communication, refer to the CC-Link communication option (FR-A7NC) instruction manual.
*3 When 100 or larger value is set in any of [*Pr. 190 to Pr. 196 Output terminal function selection*], the terminal output has negative logic.

E700 D700

Signal		Terminal Used	Function	Description	Parameter Setting
Input	X14	Depending on E700 [*Pr. 178 to 184*] D700 [*Pr. 178 to 182*]	PID control selection	Turn ON X14 signal to perform PID control. *1	Set 14 in any of E700 [*Pr. 178* to *184*] D700 [*Pr. 178* to *182*]
	2	2	Set point input	You can input the set point for PID control.*4	[*Pr. 128* = 20, 21] [*Pr. 133* = 9999]
				0 to 5V ....0 to 100%	*Pr. 73* = 1 *2, 11]
				0 to 10V ....0 to 100%	[*Pr. 73* = 0, 10]
	PU	—	Set point input	Set the set point [*Pr. 133*] from the operation panel.	[*Pr. 128* = 20, 21] [*Pr. 133* = 0 to 100%]
	4	4	Measured value input	Input the signal from the detector (measured value signal).	[*Pr. 128* = 20, 21]
				4 to 20mA ....0 to 100%	[*Pr. 267* = 0 *2]
				0 to 5V ....0 to 100%	[*Pr. 267* = 1]
				0 to 10V ....0 to 100%	[*Pr. 267* = 2]
Output	FUP	Depending on E700 [*Pr. 190 to Pr. 192*] D700 [*Pr. 190, Pr. 192*]	Upper limit output	Output to indicate that the process value signal exceeded the maximum value [*Pr. 131*].	[*Pr. 128* = 20, 21] [*Pr. 131* ≠ 9999] Set 15 or 115 *3 in E700 [*Pr. 190 to Pr. 192*] D700 [*Pr. 190* or *Pr. 192*]
	FDN		Lower limit output	Output when the process value signal falls below the minimum value [*Pr. 132*].	[*Pr. 128* = 20, 21] [*Pr. 132* ≠ 9999] Set 14 or 114 *3 in E700 [*Pr. 190 to Pr. 192*] D700 [*Pr. 190* or *Pr. 192*]
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	Set 16 or 116 *3 in E700 [*Pr. 190 to Pr. 192*] D700 [*Pr. 190* or *Pr. 192*]
	PID		During PID control activated	Turns ON during PID control.	Set 47 or 147 *3 in E700 [*Pr. 190 to Pr. 192*] D700 [*Pr. 190* or *Pr. 192*]
	SLEEP (Only in D700)		PID output interruption	Turns ON when the PID output interruption function is performed.	*Pr. 575* ≠9999] Set 70 or 170 *3 in [*Pr. 190* or *Pr.192*]
	SE	SE	Output terminal common	Common terminal for open collector output terminal.	

*1 When the X14 signal is not assigned, only the [*Pr. 128* ≠ 0] setting makes PID control valid.

*2 The shaded area indicates the parameter initial value.

*3 When 100 or larger value is set in any of *Pr.190 to Pr.192 (output terminal function selection)*, the terminal output has negative logic. *(Refer to page 61 for details)*

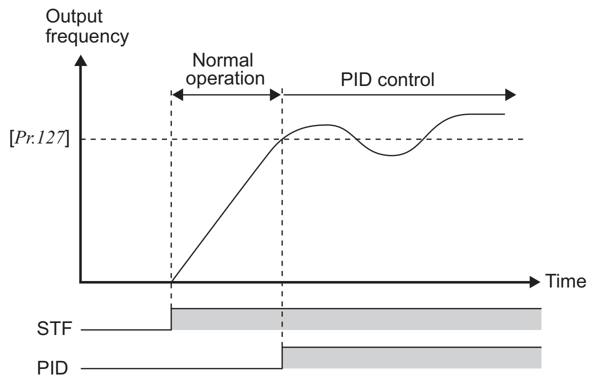
*4 When [*Pr. 561 PTC thermistor protection level* ≠"9999"], terminal 2 is not available for set point input. Use [*Pr. 133*] for set point input. (Only in D700)

*5 Refer to the LONWORKS communication option (FR-A7NL E kit) instruction manual for the setting method from LONWORKS communication.
Refer to the CC-Link communication option (FR-A7NC E kit) instruction manual for the setting method from CC-Link communication. (Only in E700)

(5) PID automatic switchover control [*Pr. 127*]

For a fast system startup at an operation start, the inverter can be started up in normal operation mode only at a start.

When the frequency is set to [*Pr. 127 PID control automatic switchover frequency*] within the range of 0 to 400Hz, the inverter starts up without PID operation from a start until output frequency is reached [*Pr. 127*], and then it shifts to PID control. Once the inverter has entered PID control operation, it continues PID control even if the output frequency falls to or below [*Pr. 127*].



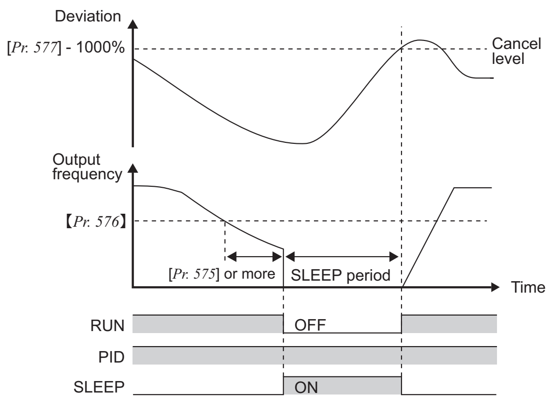
(6) PID output interruption function (SLEEP function) (SLEEP signal) [*Pr. 575 to 577*] (A700)(F700)(D700)

If the output frequency after PID calculation remains lower than the [*Pr. 576 Output interruption detection level*] setting for longer than the time set in [*Pr. 575 Output interruption detection time*], the inverter stops operation. The energy consumption in the inefficient low speed region can be reduced.

When the deviation (= set value - process value) reaches the PID output shutoff cancel level ([*Pr. 577*] setting - 1000%) while the PID output interruption function is on, the PID output interruption function is canceled and PID control operation is resumed automatically.

While the PID output interruption function is on, the PID output interruption signal (SLEEP) is output. At this time, the inverter running signal (RUN) is OFF, and the PID control operating signal (PID) is ON.

Reverse action ([*Pr. 128* = 10])



(7) PID monitor function

The PID control set value, measured value and deviation value can be displayed on the operation panel and output from terminal FM and AM.

Integral value indicating a negative % can be displayed on the deviation monitor. 0% is displayed as 1000. (The deviation monitor cannot be output from the terminal FM and AM.)

For each monitor, set the following value in [*Pr. 52 DU/PU main display screen data selection*] and [*Pr. 54 FM terminal function selection*], [*Pr. 158 AM terminal function selection*(A700)(F700)].

[Pr. 52, 54, 158] Setting	Monitor Description	Terminal FM, AM Full Scale	Remarks
52	PID set point	100%	For deviation input ([*Pr. 128 = 10, 11*]), the monitor values always displayed as 0.
53	PID measured value	100%	
54	PID deviation	—	Value cannot be set to [*Pr. 54, 158*] Displays 1000 when the PID deviation is 0%.

(8) Adjustment procedure

Parameter setting — Adjust the PID control parameters, [*Pr. 127 to 134*] *and* [*Pr. 575 to 577* (A700)(F700)(D700)].

Terminal setting — Set the I/O terminals for PID control ([*Pr. 178 to 189 Input terminal function selection*], [*Pr. 190 to 196 Output terminal function selection*])

Turn on the X14 signal — * When the X14 signal is not assigned in (E700)(D700), only the [*Pr. 128* ≠ 0] setting makes PID control valid.

Operation

(9) Calibration example

(A detector of 4mA at 0℃ and 20mA at 50℃ is used to adjust the room temperature to 25℃ under PID control.
The set point is given across inverter terminals 2-5 (0 to 5V).)

Start

Determination of set point
Determine the set point of what is desired to be adjusted.

…… Set the room temperature to 25℃.
Set [*Pr. 128*] and turn ON the X14 signal to enable PID control.

Conversion of set point into %
Calculate the ratio of the set point to the detector output.

…… Detector specifications
When 0℃→4mA and 50℃→20mA are used, the set point 25℃ is 50% on the assumption that 4mA is 0% and 20mA is 100%.

Make calibration.

…… Make the following calibration* when the target setting input (0 to 5V) and detector output (4 to 20mA) must be calibrated.

Setting of set point
Input a voltage across terminals 2-5 according to the set value %.

…… When the set point is 50%
As the terminal 2 specifications are 0% → 0V and 100% → 5V, input 2.5V to the terminal 2 for the set point of 50%.

Operation
Set the proportional band ([*Pr. 129*]) to a slightly larger value, the integral time ([*Pr. 130*]) to a slightly longer time, and the differential time ([*Pr. 134*]) to "9999" (no function), and turn ON the start signal.

…… When the parameter unit is used for operation, input the set point (0 to 100%) in [*Pr. 133*].
When performing operation, first set the proportional band ([*Pr. 129*]) to a slightly larger value, the integral time ([*Pr. 130*]) to a slightly longer time, and the differential time ([*Pr. 134*]) to "9999" (no function), and while looking at the system operation, decrease the proportional band ([*Pr. 129*]) and increase the integral time ([*Pr. 130*]) .

Is the set point stable?

No →

Parameter adjustment
To stabilize the measured value, change the proportional band ([*Pr. 129*]) to a larger value, the integral time ([*Pr. 130*]) to a slightly longer time, and the differential time ([*Pr. 134*]) to a slightly shorter time.

Yes →

Parameter optimization
While the measured value is stable throughout the operation status, the proportional band ([*Pr. 129*]) may be decreased, the integral time ([*Pr. 130*]) decreased, and the differential time ([*Pr. 134*]) increased.

Adjustment end

*When calibration is required → Using [*Pr. 125, C2 to C4 (Pr.902, 903)*] (terminal 2) or [*Pr. 126, C5 to C7 (Pr.904, 905)*] (terminal 4), calibrate the detector output and target setting input.
Make calibration in the PU mode during an inverter stop.

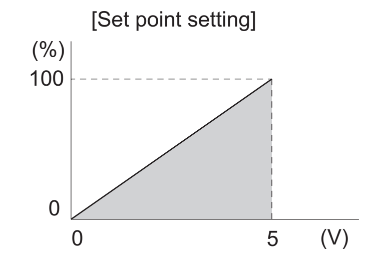
<Set point input calibration>

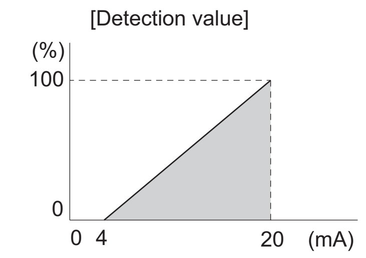
1) Apply the input voltage of 0% set point setting (e.g. 0V) across terminals 2-5.
2) Enter in [*C2 (Pr. 902)*] the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).
3) In [*C3 (Pr. 902)*], set the voltage value at 0%.
4) Apply the voltage of 100% set point (e.g. 5V) across terminals 2-5.
5) Enter in [*Pr. 125*] the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz).
6) In [*C4 (Pr. 903)*], set the voltage value at 100%.

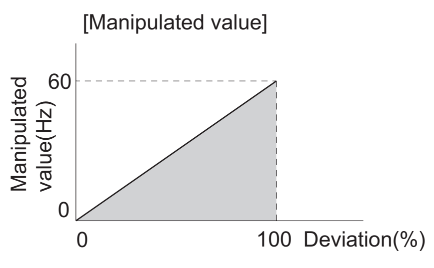
<Detector output calibration>

1) Apply the output current of 0% detector setting (e.g. 4mA) across terminals 4-5.
2) Make calibration using [*C6 (Pr. 904)*].
3) Apply the output current of 100% detector setting (e.g. 20mA) across terminals 4-5.
4) Make calibration using [*C7 (Pr. 905)*] .
5) The frequency set in [*C5 (Pr. 904)*] and [*Pr. 126*] should be the same as set in [*C2 (Pr. 902)*] and [*Pr. 125*].

The results of the above calibration are as shown below:







2.20.5 Dancer control [Pr.44, 45, 128 to 134] (E700) (D700)

Performs PID control by feedback of the position detection of the dancer roller, controlling the dancer roller is in the specified position.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters E700	Available Inverters D700
44	Second acceleration/ deceleration time	3.7K or less: 5s 5.5K, 7.5K: 10s 11K, 15K: 15s	E700 0 to 3600/ 0 to 360s D700 0 to 3600s	This parameter is the acceleration time of the main speed during dancer control. It will not function as second acceleration/ deceleration time.	○	○
45	Second deceleration time	9999	E700 0 to 3600/ 0 to 360s D700 0 to 3600s	This parameter is the deceleration time of the main speed during dancer control. It will not function as second deceleration time.	○	○
			9999			
128	PID action selection	0	0	PID action is not performed	○	○
			20	PID reverse action: Measured value (terminal 4) Set value (terminal 2 or [*Pr. 133*])		
			21	PID forward action: Measured value (terminal 4) Set value (terminal 2 or [*Pr. 133*])		
			40	PID reverse action: Addition method: fixed. For dancer control set point [*Pr. 133*], measured value (terminal 4) main speed (speed command of the operation mode)		
			41	PID forward action: Addition method: fixed. For dancer control set point [*Pr. 133*], measured value (terminal 4) main speed (speed command of the operation mode)		
			42	PID reverse action: Addition method: ratio. For dancer control set point [*Pr. 133*], measured value (terminal 4) main speed (speed command of the operation mode)		
			43	PID forward action: Addition method: ratio. For dancer control set point [*Pr. 133*], measured value (terminal 4) main speed (speed command of the operation mode)		
			50	PID reverse action: Deviation value signal input (LONWORKS, CC-Link communication)	○	—
			51	PID forward action: Deviation value signal input (LONWORKS, CC-Link communication)		
			60	PID reverse action: Set point and measured value input (LONWORKS, CC-Link communication)		
			61	PID forward action: Set point and measured value input (LONWORKS, CC-Link communication)		
129 *1	PID proportional band	100%	0.1 to 1000%	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain Kp = 1/proportional band	○	○
			9999	No proportional control		
130 *1	PID integral time	1s	0.1 to 3600s	When deviation step is input, time (Ti) is the time required for integral (I) action to provide the same manipulated variable as the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.	○	○
			9999	No integral control.		
131	PID upper limit	9999	0 to 100%	Maximum value If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	○	○
			9999	No function		
132	PID lower limit	9999	0 to 100%	Minimum value If the process value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	○	○
			9999	No function		
133 *1	PID action set point	9999	0 to 100%	Used to set the set point for PID control.	○	○
			9999	Always 50%		

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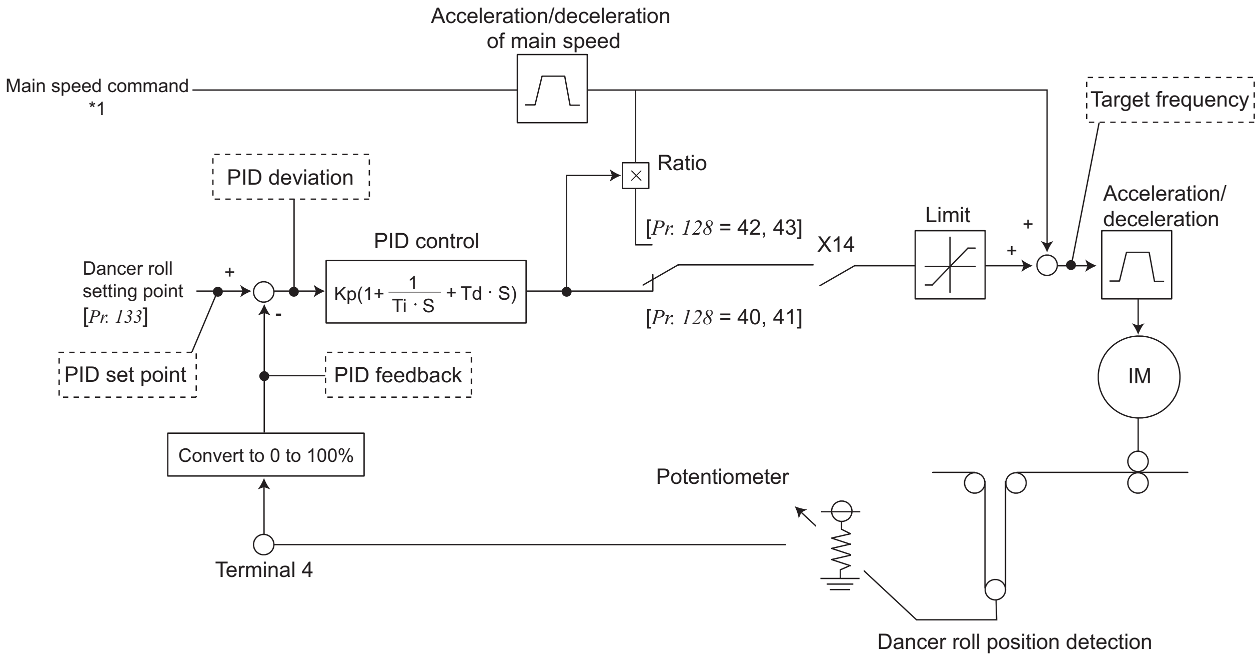
PARAMETER

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters E700	D700
134 *1	PID differential time	9999	0.01 to 10s	For deviation ramp input, time (Td) required for providing only the manipulated variable for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.	○	○
			9999	No differential control.		

*1 [*Pr. 129, Pr. 130, Pr. 133 and Pr. 134*] can be set during operation. These can also be set independently of the operation mode.

(1) Dancer control block diagram



*1 The main speed can be selected from all operation mode such as external (analog voltage input, multi-speed), PU (digital frequency setting), communication (RS-485, CC-Link).

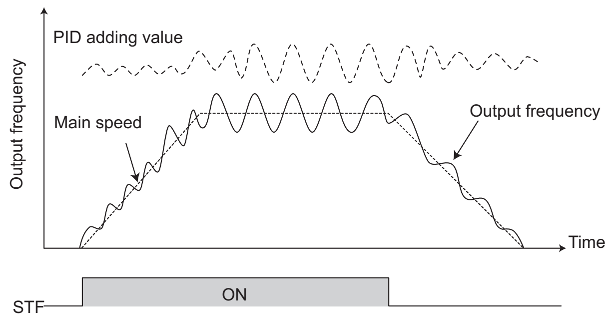
Set point and measured value of PID control

	Input	Input Signal	[*Pr.267*] Setting	Current/Voltage Input Switch
Set point	[Pr.133]	0 to 100%	—	—
Measured value	When measured value is input as current (4 to 20mA)	4mA ..... 0%, 20mA .. 100%	0	Switch : I
	When measured value is input as voltage (0 to ±5V or 0 to ±10V)	0V .... 0%, 5V 100%	1	Switch : V
		0V .... 0%, 10V 100%	2	

(2) Dancer control overview

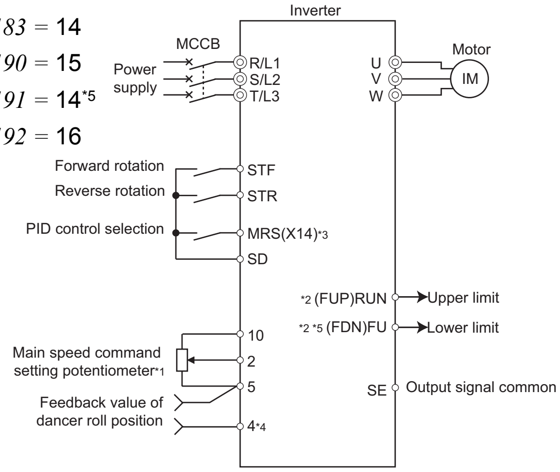
Performs dancer control by setting 40 to 43 in *Pr. 128 PID action selection.* The main speed command is the speed command of each operation mode (External, PU, Network). Performs PID control by the position detection signal of the dancer roller, then the result is added to the main speed command. For acceleration/deceleration of the main speed, set the acceleration time in *Pr. 44 Second acceleration/deceleration time* in *Pr. 45 Second deceleration time*.

* Set 0s normally to *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. When the *Pr. 7 and Pr. 8* setting is large, response of dancer control during acceleration/deceleration is slow.



(3) Connection diagram

•Sink logic
•*Pr. 128* = 41
•*Pr. 183* = 14
•*Pr. 190* = 15
•*Pr. 191* = 14*5
•*Pr. 192* = 16



*1 The main speed command differs according to each operation mode (external, PU, communication)
*2 The used output signal terminal changes depending on the *Pr. 190 to Pr. 192 (output terminal selection)* setting. D700 has only one open collector output terminal.
*3 The used input signal terminal changes depending on the *Pr. 178 to Pr. 184(input terminal selection)* setting.
*4 The AU signal need not be input.
*5 Available only in E700.

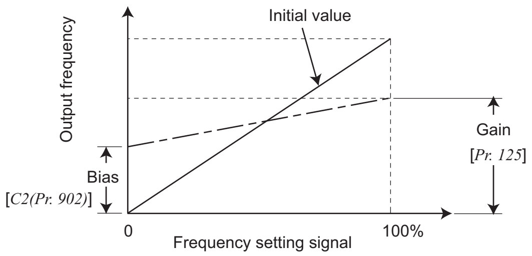
(4) I/O signals and parameter setting

Set "40 to 43" in [*Pr. 128*] to perform dancer control. (Disable PID output interruption function ([*Pr. 575* = 9999]) during dancer control.)
Set "14" in any of [*Pr. 178 to Pr. 184* (*input terminal function selection*)] to assign PID control selection signal (X14) to turn the X14 signal ON.
When the X14 signal is not assigned, only the *Pr. 128* setting makes dancer control valid.
Input the main speed command (External, PU, Network). The main speed command in any operation mode can be input. (Note that terminal 4 can not be used as the main speed command.) (Terminal 2 is not available for speed control when [*Pr. 561 PTC thermistor protection level* ≠ 9999] in D700. Terminal 2 functions as a PTC thermistor input terminal.)
Input the set point using [*Pr. 133*], then input the measured value signal (dancer roller position detection signal) across terminal 4 and 5 of the inverter.
When [*Pr. 128*] = "0" or X14 signal is OFF, normal inverter operation is performed without dancer control.
Turning ON/OFF of bit of the terminal, to which X14 signal is assigned through network as RS-485 communication, enables dancer control.

Signal		Terminal Used	Function	Description	Parameter Setting
Input	X14	Depending on [*Pr. 178* to *Pr. 184*]	PID control selection	Turn ON X14 signal to perform dancer control. *1	Set 14 in any of [*Pr. 178 to Pr. 184*].
	4	4	Measured value input	Input the signal from the dancer roller detector (measured value signal).	[*Pr.128* = 40, 41, 42, 43]
				4 to 20mA... 0 to 100%	[*Pr.267* = 0] *2
				0 to 5V........ 0 to 100%	[*Pr.267* = 1]
				0 to 10V...... 0 to 100%	[*Pr.267* = 2]
Output	FUP	Depending on [*Pr. 190* to *Pr. 192*]	Upper limit output	Output to indicate that the measured value signal exceeded the maximum value [*Pr. 131*].	[*Pr.128* = 40, 41, 42, 43] [*Pr.131* = 9999] Set 15 or 115 in any of [*Pr. 190* to *Pr. 192*]. *3
	FDN		Lower limit output	Output when the measured value signal falls below the minimum value [*Pr. 132*].	[*Pr.128* = 40, 41, 42, 43] [*Pr.132* ≠ 9999] Set 14 or 114 in any of [*Pr. 190* to *Pr. 192*]. *3
	RL		Forward (reverse) rotation direction output	Output is "ON" when the output indication of the parameter unit is forward rotation (FWD) and "OFF" when reverse rotation (REV) or stop (STOP).	Set 16 or 116 in any of [*Pr. 190* to *Pr. 192*]. *3
	PID		During PID control activated	Turns ON during PID control.	Set 47 or 147 in any of [*Pr. 190* to *Pr. 192*]. *3
	SE	SE	Output terminal common	Common terminal for open collector output terminal.	

*1 When the X14 signal is not assigned, only the [*Pr. 128* = 40 to 43] setting makes dancer control valid.
*2 The shaded area indicates the parameter initial value.
*3 When 100 or larger value is set in any of *Pr. 190 to Pr. 192 (output terminal function selection)*, the terminal output has negative logic. *(For details, Refer to page 61)*

(5) Parameter details



When ratio ([*Pr. 128* = "42, 43"]) is selected for addition method, PID control × (ratio of main speed) is added to the main speed. The ratio is determined by the [*Pr. 125 Terminal 2 frequency setting gain frequency*] and [*C2 (Pr. 902) Terminal 2 frequency setting bias frequency*]. The frequency setting signal is set to 0 to 60Hz in the range of 0 to 100% in the initial setting. The ratio is (×100%) when the main speed is 60Hz and (×50%) when 30Hz.

Even when C4 [(*Pr. 903*)] is set to other than 100%, the frequency setting signal is considered as 100%.
Even when [C3 (*Pr. 903*)] is set to other than 0%, the frequency setting signal is considered as 0%.
When [C2 (*Pr .902*)] is set to other than 0Hz, the frequency setting signal is 0% when [C2 (*Pr. 902*)] is less than the set frequency.
Turning X14 signal ON/OFF during operation by assigning X14 signal results in the following operation.

When X14 signal is ON: Uses output frequency unchanged as the main speed command and continues operation by dancer control.
When X14 signal is OFF: Ends dancer control and continues operation at the set frequency.

[*Pr. 128* Setting]	PID Action	Addition Method	Set Point	Measured Value	Main Speed Command
40	Reverse action	Fixed	*Pr. 133*	Terminal 4	Speed command for each operation mode
41	Forward action				
42	Reverse action	Ratio			
43	Forward action				

Action of [*Pr. 129 PID proportional band*], [*Pr. 130 PID integral time*], [*Pr. 131 PID upper limit*], [*Pr. 132 PID lower limit*], [*Pr. 134 PID differential time*] is the same as PID control. For the relationship of controlled variable (%) of PID control and frequency, 0% is equivalent to the set frequency of [*Pr. 902*] and 100% to [*Pr. 903*] .

For the [*Pr. 133 PID action set point*] setting, set frequency of [*Pr. 902*] is equivalent to 0% and [*Pr. 903*] to 100%. When *9999* is set in [*Pr. 133*], 50% is the set point.

*1 PID control stops when RH, RM, RL, and REX signals (for multi-speed operation) or JOG signal is input during normal PID control. However, PID control continues when those signals are input during dancer control since these are treated as speed commands.

*2 The second acceleration/deceleration time set in [*Pr. 44, 45*] is the acceleration/deceleration time for the main speed command during dancer control, and it does not function as second function.

*3 Dancer control (PID control) is invalid when switchover mode is selected with [*Pr. 79*=6].

*4 Speed command to terminal 4 by turning AU signal ON is invalid during dancer control.

*5 Acceleration/deceleration of main speed command follows the frequency increase/decrease made by analog input. Therefore, the following situations may occur:
- SU signal may stay ON even though start signal is switched ON/OFF. (Always in constant speed status)
- When the start signal is OFF, the DC brake does not activate at the frequency set in [*Pr.10*], but at the smaller frequency between [*Pr. 13*] setting or 0.5Hz.
- The value of "speed command + PID control", which is constantly changing, is displayed in the set frequency monitor.

*6 The main speed setting frequency accelerates/decelerates by the [*Pr. 44, 45*] settings. Output frequency accelerates/decelerates by the [*Pr. 7, 8*] settings. Therefore, when the set time in [*Pr.7, 8*] is longer than the set time in [*Pr. 44, 45*], the set time in [*Pr. 7, 8*] is the acceleration/deceleration time of the output frequency.

*7 Integral term is limited by the smaller value between 100% and the PID manipulated variable (%) converted from the linear interpolated [*Pr.1 Maximum frequency*] by [*Pr. 902, 903*].
Although the output frequency is limited by the minimum frequency, the action of the integral term is not limited.

(6) Output signal

PID signal turns ON during dancer control (PID control) or at a stop by PID control (in the status PID operation being performed inside). (The signal is OFF during normal operation.)
For the terminal used for PID signal output, assign the function by setting "47 (positive logic) or 147 (negative logic)" in any of [*Pr. 190 to Pr. 192 (output terminal function selection)*].

(7) PID monitor function

The PID control set point and measured value can be output to the operation panel monitor display and terminal FM.
For each monitor, set the following value in [*Pr. 52 DU/PU main display data selection*] and [*Pr. 54 FM terminal function selection*].

Setting	Monitor Description	Minimum Increments	Terminal FM Full Scale	Remarks
52	PID set point	0.1%	100%	—
53	PID measured value	0.1%	100%	
54	PID deviation value	0.1%	—	Value cannot be set in [*Pr. 54*]. Displays 1000 when the PID deviation is 0%.

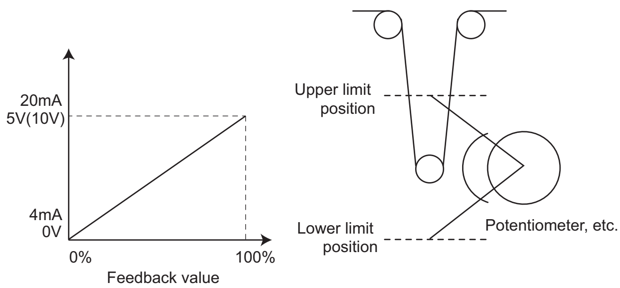
(8) Priorities of main speed command

The priorities of the main speed speed command source when the speed command source is external are as follows.
JOG signal > multi-speed setting signal (RL/RM/RH/REX) > 16 bit digital input (option) E700 > terminal 2
The priorities of the main speed speed command source when "3" is set in [*Pr. 79*] are as follows.
Multi-speed setting signal (RL/RM/RH/REX) > set frequency (digital setting by PU, operation panel)
Terminal 4 can not be selected as the main speed speed command even when AU terminal is turned ON.
Even when a remote operation function is selected by setting [*Pr. 59* ≠ 0], compensation of the remote setting frequency to the main speed is ignored (changes to 0).

(9) Adjustment procedure

● Dancer roll position detection signal adjustment

When terminal 4 input is voltage input, 0V is the lower limit position and 5V(10V) is the upper limit position. When current is input, 4mA is the lower limit position and 20mA is the upper limit position (initial value). When 0 to 7V is output from the potentiometer, it is necessary to calibrate [*C7 (Pr .905)*] at 7V.



(Example) Control at a dancer center position using a 0 to 7V potentiometer

1) After changing the current/voltage input switch to "V", set "2" in [*Pr. 267* = 2] to change terminal 4 input to voltage input.
2) Input 0V to across terminal 4 and 5 to calibrate [*C6 (Pr. 904)*]. (% display displayed at analog calibration is irrelevant to % of the feedback value.)
3) By inputting 7V across terminal 4 to 5, calibrate [*C7(Pr. 905)*] (% display displayed at analog calibration is irrelevant to % of the feedback value.)
4) Set 50% in [*Pr.133*].

2

PARAMETER

2.20.6 Bypass-inverter switchover function [Pr. 57, 58, 135 to 139, 159] A700 F700

The complicated sequence circuit for bypass-inverter switchover is built-in to the inverter. Hence, simply inputting the start, stop or automatic switchover selection signal facilitates the interlock operation of the switchover magnetic contactor.

[Pr.]	Name	Initial Value	Setting Range	Description
57	Restart coasting time	9999	0	1.5K or less .... 0.5s 2.2K to 7.5K .... 1s 11K to 55K .... 3.0s 75K or more .... 5.0s of coasting time
			55K or less: 0.1 to 5s 75K or more: 0.1 to 30s	Set the waiting time for inverter-triggered restart after an instantaneous power failure.
			9999	No restart
58	Restart cushion time	1s	0 to 60s	Set a voltage starting time at restart.
135	Electronic bypass sequence selection	0	0	Without electronic bypass sequence
			1	With electronic bypass sequence
136	MC switchover interlock time	1s	0 to 100s	Set the operation interlock time of MC2 and MC3.
137	Start waiting time	0.5s	0 to 100s	Set the time slightly longer (0.3 to 0.5s or so) than the time from when the ON signal enters MC3 until it actually turns ON.
138	Bypass selection at a fault	0	0	Inverter output is stopped (motor coast) at inverter fault.
			1	Operation is automatically switched to bypass operation at inverter fault (not switched when an external thermal error occurs)
139	Automatic switchover frequency from inverter to bypass operation	9999	0 to 60Hz	Set the frequency to switch the inverter operation to commercial power supply operation. Inverter operation is performed from a start until [*Pr. 139*] is reached, and when the output frequency is at or above [*Pr. 139*], inverter operation is automatically switched to bypass operation.
			9999	Without automatic switchover
159	Automatic switchover ON range between commercial power-supply and inverter operation	9999	0 to 10Hz	Valid during automatic switchover operation ([*Pr. 139* $\neq$ *9999*]) When the frequency command decreases below ([*Pr. 139*] - [*Pr. 159*]) after operation is switched from inverter operation to commercial power supply operation, the inverter automatically switches operation to inverter operation and operates at the frequency of frequency command. When the inverter start command (STF/STR) is turned OFF, operation is switched to inverter operation also.
			9999	Valid during automatic switchover operation ([*Pr. 139* $\neq$ *9999*]) When the inverter start command (STF/STR) is turned OFF after operation is switched from inverter operation to commercial power supply operation, operation is switched to the inverter operation and the motor decelerates to stop.

When the motor is operated at 60Hz (or 50Hz), more efficient operation can be performed by the commercial power supply than by the inverter. When the motor cannot be stopped for a long time for the maintenance/inspection of the inverter, it is recommended to provide the commercial power supply circuit.

To switch between inverter operation and bypass operation, an interlock must be provided to stop the motor once and then start it by the inverter in order to prevent the inverter from resulting in an overcurrent fault.

Using the electronic bypass sequence function that outputs the timing signal for operation of the magnetic contactor, a complicated commercial power supply switchover interlock can be provided by the inverter.

The electronic bypass sequence function is valid only in the external operation or combined operation mode (PU speed command, external operation command [*Pr. 79 = 3*]).

Commercial operation can not be performed with the Mitsubishi vector motor (SF-V5RU).

(1) Connection

1) Main Circuit
Fully note the phase rotation of the power supply.
If the phase rotation of the power supply differs, the rotation direction of the motor is reversed when switching between the inverter operation and bypass operation, causing malfunction such as damage to the machine and motor shaft and overcurrent alarm of the inverter.

- Connect MC1 to the inverter input side.
- Connect MC2 to the bypass operation side.
- Connect MC3 to the inverter output side.
- Be sure to provide mechanical interlocks for MC2 and MC3.

2) Control circuit
Connect the control power supply (terminal R1, S1) in front of input side MC1. If the control power supply is connected behind input side MC1, the electronic bypass sequence function is not executed. In such case, the input side MC1 will not close and the inverter operation will not be performed.

- Remove a jumper across terminal R-R1 and S-S1.
- Control power should be supplied from the front of MC1 and connected to R1 and S1.

3) Input signal (refer to the following table for details)

- CS signal : Input a switchover signal for inverter operation and bypass operation. The inverter operation is selected if closed.
- STF (STR) signal : Input an inverter forward rotation (reverse rotation) start signal.
- MRS signal : Input an operation interlock signal. Both inverter operation and bypass operation are interlocked if opened.

4) Output signal (refer to the next page for details)

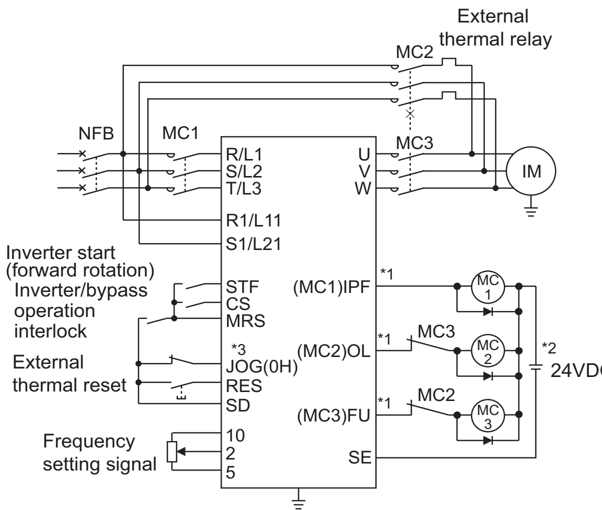
- MC1 signal : Operation timing signal of a magnetic contactor MC1 on the inverter input side is output.
- MC2 signal : Operation timing signal of a magnetic contactor MC2 on the inverter output side is output.
- MC3 signal : Operation timing signal of a magnetic contactor MC3 for bypass operation is output.

5) External thermal relay installation
When using an external thermal relay, connect it to the bypass operation side, not the inverter output side.
When performing low-noise operation of 400V class small capacity inverter with an external thermal relay connected to the output side, the external thermal relay may operate unnecessarily.

- OH signal : Input an external thermal signal.

[**Connection diagram**]

- Sink logic
- [*Pr. 185 = 7*]
- [*Pr. 192 = 17*]
- [*Pr. 193 = 18*]
- [*Pr. 194 = 19*]



Electronic bypass sequence connection diagram

*1 Take caution for the capacity of the sequence output terminal.
The used terminal changes depending on the [*Pr. 190 to Pr. 196 Output terminal function selection*] setting.

Output Terminal Capacity	Output Terminal Permissible Load
Inverter open collector output (RUN, SU, IPF, OL, FU)	24VDC 0.1A
Inverter relay output (A1-C1, B1-C1, A2-B2, B2-C2) Relay output option (FR-A7AR)	230VAC 0.3A 30VDC 0.3A

*2 When connecting a DC power supply, insert a protective diode.
When connecting an AC power supply, connect the relay output option (FR-A7AR) and use a contact output.

*3 The used terminal changes depending on the [*Pr. 180 to Pr. 189 Input terminal function selection*] setting.

Magnetic Contactor	Installation Place	Operation (○: Shorted, ×: Open)		
		During bypass operation	During inverter operation	At an inverter fault occurrence
MC1	Between power supply and inverter input	○	○	× (Shorted by reset)
MC2	Between power supply and motor	○	×	× (Can be selected using [*Pr. 138*], always open when external thermal relay is ON)
MC3	Between inverter output and motor	×	○	×

(2) Operation

1) Input signal function

Signal	Terminal Used	Functions	Operation	MC Operation *6		
				MC1 *5	MC2	MC3
MRS	MRS	Operation enable/ disable selection *1	ON........Bypass-inverter operation enabled	○	—	—
			OFF ......Bypass-inverter operation disabled	○	×	No change
CS	CS	Inverter/electronic bypass switchover *2	ON........Inverter running	○	×	○
			OFF ......Bypass operation	○	○	×
STF (STR)	STF (STR)	Inverter operation command (invalid for bypass operation) *3	ON........Forward rotation (reverse rotation)	○	×	○
			OFF ......Stop	○	×	○
OH	Set 7 in any of [*Pr. 180 to 189*]	External thermal relay input	ON........Motor normal	○	—	—
			OFF ......Motor error	×	×	×
RES	RES	Operating status initialization *4	ON........Initialization	No change	×	No change
			OFF ......Normal operation	○	—	—

*1 Unless the MRS signal is turned ON, neither commercial power supply operation nor inverter operation can be performed.

*2 The CS signal functions only when the MRS signal is ON.

*3 STF (STR) functions only when both the MRS signal and CS signal are ON.

*4 The RES signal enables reset input acceptance selection using [*Pr. 75 Reset selection/disconnected PU detection/PU stop selection*].

*5 MC1 turns OFF when an inverter fault occurs.

*6 MC operation

○ : MC-ON

× : MC-OFF

— : Inverter operation..... MC2 is OFF and MC3 is ON

Bypass operation ..... MC2 is ON and MC3 is OFF

No change : The status before the signal turns ON or OFF is held.

2) Output signal function

Signal	Terminal Used ([Pr. 190 to 196] Setting)	Description
MC1	17	Control signal output of inverter input side magnetic contactor MC1
MC2	18	Control signal output of bypass operation magnetic contactor MC2
MC3	19	Control signal output of inverter output side magnetic contactor MC3

3) When performing bypass operation
Cancel an operation interlock signal (by turning ON MRS signal). When signal CS is OFF, bypass operation is performed.

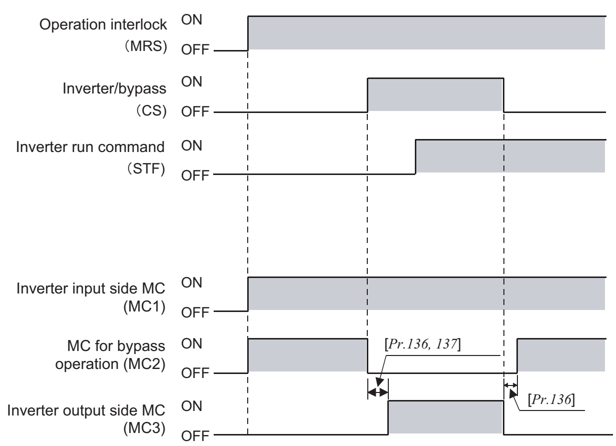
4) When performing inverter operation
Cancel an operation interlock signal (by turning ON MRS signal), and turn ON CS signal. By turning ON/OFF the inverter's start signal (STF (STR)) , perform inverter operation.

5) When switching from inverter operation to bypass operation
Turn ON → OFF CS signal.

6) When switching from bypass operation to inverter operation
Turn OFF → ON CS signal, and turn ON the inverter's start signal (STF (STR)). If an instantaneous power failure function is set at this time, smooth switchover without decreasing the motor speed is performed.

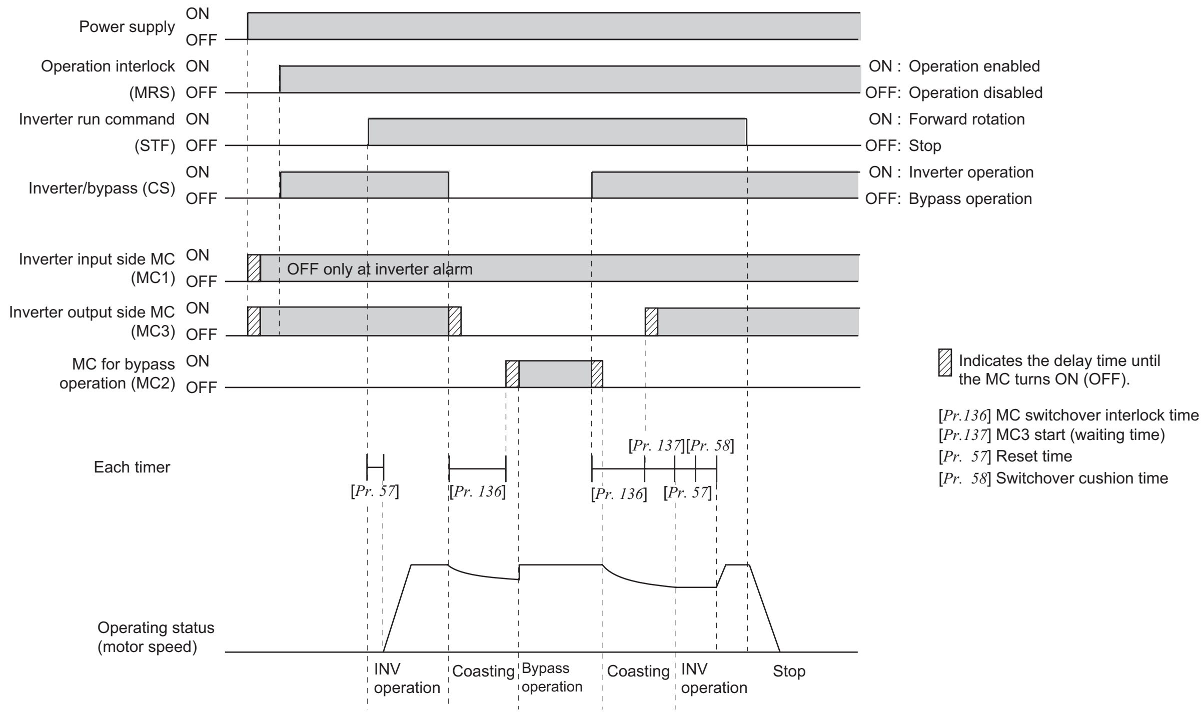
7) When switching to bypass operation at inverter fault
When [*Pr. 138 = 1*], the operation automatically switches to commercial operation if an inverter fault has occurred during inverter operation.

Note that automatic switchover can not be made if E.CPU appears.

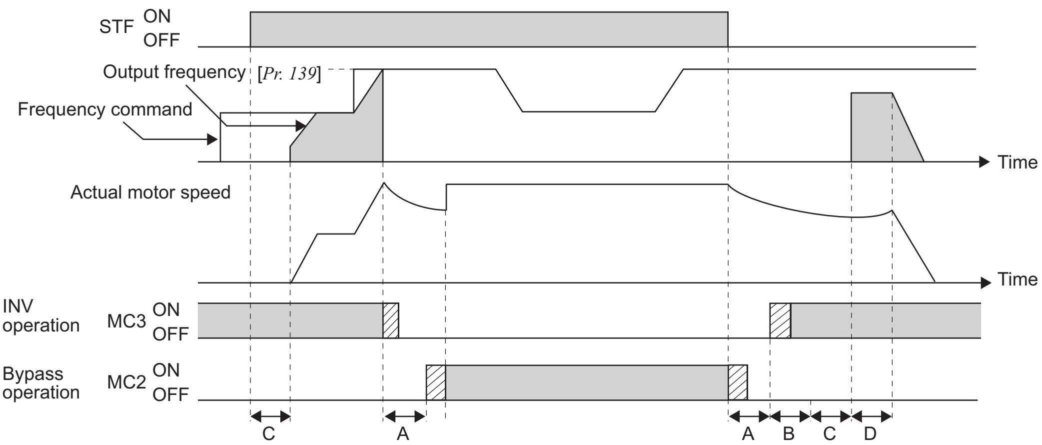


Operation timing example of the MC

• Operation sequence example without automatic switchover sequence ([*Pr. 139 = 9999*])

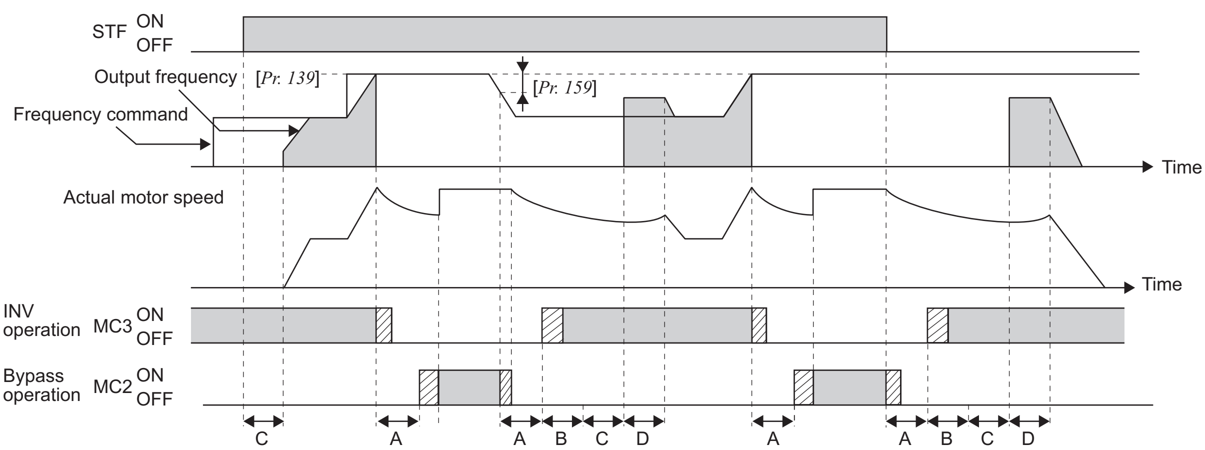


• Operation sequence example with automatic switchover sequence ([*Pr. 139 ≠ 9999*], [*Pr. 159 = 9999*])



A : [*Pr. 136*] MC switchover interlock time
B : [*Pr. 137*] Start waiting time
C : [*Pr. 57*] Restart coasting time
D : [*Pr. 58*] Restart cushion time

• Operation sequence example with automatic switchover sequence ([*Pr. 139≠ 9999*], [*Pr. 159≠ 9999*])



A : [*Pr. 136*] MC switchover interlock time
B : [*Pr. 137*] Start waiting time
C : [*Pr. 57*] Restart coasting time
D : [*Pr. 58*] Restart cushion time

(3) Operating procedure

1) Operating procedure for operation

Operation pattern

Power supply ON
↓
Setting the parameters
↓
Start inverter operation
↓
Constant-speed bypass operation
↓
Deceleration (stop) inverter operation

- [*Pr. 135 = 1*] (open collector output terminal of inverter)
- [*Pr. 136 = 2.0s*]
- [*Pr. 137 = 1.0s*] (Set the time longer than the time from when MC3 actually turns ON until the inverter and motor are connected. If the time is short, a restart may not function properly.)
- [*Pr. 57 = 0.5s*]
- [*Pr. 58 = 0.5s*] (Be sure to set this parameter when bypass operation is switched to inverter operation.)

2) Signal ON/OFF after parameter setting

	MRS	CS	STF	MC1	MC2	MC3	REMARKS
Power-on	OFF (OFF)	OFF (OFF)	OFF (OFF)	OFF→ON (OFF→ON)	OFF (OFF)	OFF→ON (OFF→ON)	External operation mode (PU operation mode)
At start (inverter)	OFF→ON	OFF→ON	OFF→ON	ON	OFF	ON	
At constant speed (bypass)	ON	ON→OFF	ON	ON	OFF→ON	ON→OFF	MC2 turns ON after MC3 turns OFF (coasting status during this period) waiting time 2s
Switched to inverter for deceleration (inverter)	ON	OFF→ON	ON	ON	ON→OFF	OFF→ON	MC3 turns ON after MC2 turns OFF (coasting status during this period) waiting time 4s
Stop	ON	ON	ON→OFF	ON	OFF	ON	

*1 In the operation mode other than External operation or combined operation mode (PU speed command, external operation command [*Pr. 79 = 3*]), MC1 and MC3 turn ON.

*2 When the MRS and CS signals are ON and the STF (STR) signal is OFF, MC3 is ON, but when the motor was coasted to a stop from bypass operation last time, a start is made after the time set in [*Pr. 137*] has elapsed.

*3 Inverter operation can be performed when the MRS, STF (STR) and CS signals turn ON. In any other case (MRS signal - ON), bypass operation is performed.

*4 When the CS signal is turned OFF, the motor switches to bypass operation. However, when the STF (STR) signal is turned OFF, the motor is decelerated to a stop in the inverter operation mode.

*5 When both MC2 and MC3 are OFF and either MC2 or MC3 is then turned ON, there is a waiting time set in [*Pr. 136*].

*6 When the electronic bypass-inverter switchover sequence function (*Pr. 135 = 1*]) and PU operation interlock function ([*Pr. 79 = 7*]) are used simultaneously, the MRS signal is shared by the PU operation external interlock signal unless the X12 signal is assigned. (When the MRS and CS signals turn ON, inverter operation is enabled.)

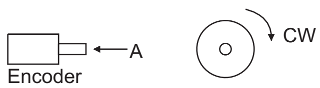
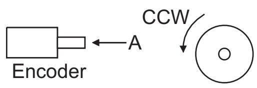
2.20.7 Orientation control [Pr. 350 to 366, 369, 393, 396 to 399] (A700)

This function is used with a position detector (encoder) installed to the spindle of a machine tool, etc. to allow a rotation shaft to be stopped at the specified position (oriented). It requires a plug-in option FR-A7AP or FR-A7AL and valid under V/F control, Advanced magnetic flux vector control, and vector control. Orientation control is invalid when a Real sensorless vector control is selected,.

If the orientation command signal (X22) is turned on during operation after the various parameters have been set, the speed will decelerate to the "orientation switchover speed". After the "orientation stop distance" is calculated, the speed will further decelerate, and the "orientation state" (servo lock) will be entered. The "orientation complete signal" (ORA) will be output when the "orientation complete width" is entered.

[*Pr. 350 Stop position command selection = 9999*] at initial setting, orientation control function is invalid.

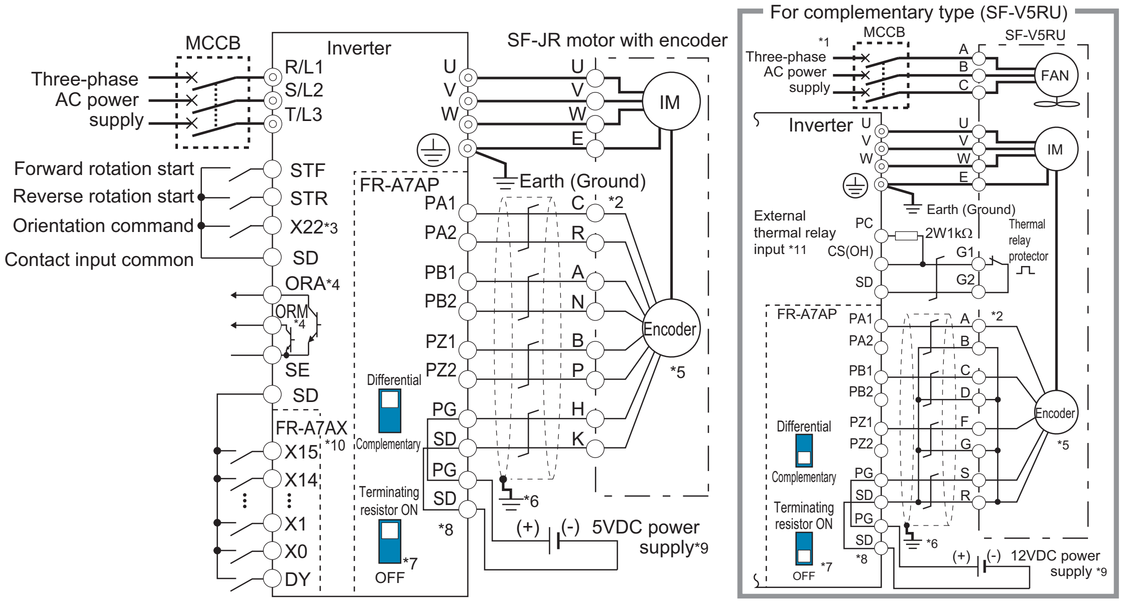
When orientation control is performed, PID control is invalid.

[Pr.]	Name	Initial Value	Setting Range	Description		V/F Control Advanced Magnetic Flux Vector Control	Vector Control
350	Stop position command selection AP AL	9999	0	Internal stop position command ([*Pr.356*])		○	○
			1	External stop position command (FR-A7AX 16-bit data)			
			9999	Orientation control invalid			
351	Orientation speed AP AL	2Hz	0 to 30Hz	Decrease the motor speed to the set value when the orientation command (X22) is given.		○	○
352	Creep speed AP AL	0.5Hz	0 to 10Hz	After the speed reaches the orientation speed, the speed decreases to the creep speed set in [*Pr.352*] as soon as the current position pulse reaches the creep switchover position set in [*Pr.353*].		○	×
353	Creep switchover position AP AL	511	0 to 16383 *			○	×
354	Position loop switchover position AP AL	96	0 to 8191	As soon as the current position pulse reaches the set position loop switchover position, control is changed to position loop.		○	×
355	DC injection brake start position AP AL	5	0 to 255	After changed to position loop, DC injection brake is applied and the motor stops as soon as the current position pulse reaches the set DC injection brake start position.		○	×
356	Internal stop position command AP AL	0	0 to 16383 *	When [*Pr.350 = 0*], the internal position command is activated and the setting value of [*Pr.356*] becomes a stop position.		○	○
357	Orientation in-position zone AP AL	5	0 to 255	Set the in-position zone at a stop of the orientation.		○	○
358	Servo torque selection AP AL	1	0 to 13	Functions at orientation completion can be selected.		○	×
359	Encoder rotation direction AP AL	1	0	 Clockwise direction as viewed from A is forward rotation		○	○
			1	 Counter clockwise direction as viewed from A is forward rotation			
360	16 bit data selection AP AL	0	0	Speed command		○	○
			1	16 bit data is used as external position command as is.	When 1 is set in [*Pr.350* = 1] and the FR-A7AX is mounted, set a stop position using 16-bit data. Stop position command is input as binary regardless of the [*Pr.304*] setting.		
			2 to 127	Set the stop position dividing up to 128 stop positions at regular intervals.			
361	Position shift AP AL	0	0 to 16383 *	Shift the origin using a compensation value without changing the origin of the encoder. The stop position is a position obtained by adding the setting value of [*Pr.361*] to the position command.		○	○

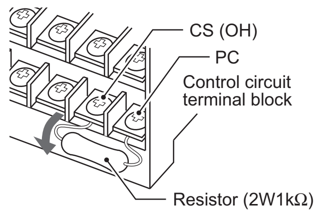
[Pr.]	Name	Initial Value	Setting Range	Description	V/F Control Advanced Magnetic Flux Vector Control	Vector Control
362	Orientation position loop gain AP AL	1	0.1 to 100	When servo torque function is selected using [*Pr.358*], output frequency for generating servo torque increases to the creep speed of [*Pr.352*] gradually according to the slope set in [*Pr.362*]. Although the operation becomes faster when the value is increased, a machine may hunt, etc.	○	○
363	Completion signal output delay time AP AL	0.5s	0 to 5s	The orientation complete signal is output delaying the set time after in-position zone is entered. Also, the signal turns OFF delaying the set time after in-position zone is out.	○	×
364	Encoder stop check time AP AL	0.5s	0 to 5s	Orientation fault signal (ORM) is output when the encoder remains stopped for the set time without orientation completion in the state where orientation complete signal (ORA) is not output even once. ORA signal is also output when the orientation was started once but stopped without completing the orientation before reaching to the set time.	○	×
365	Orientation limit AP AL	9999	0 to 60s	Measure the time taken after passing the creep switchover position and output the orientation fault signal (ORM) if orientation is not completed within the set time.	○	×
366	Recheck time AP AL	9999	0 to 5s	Turning OFF the start signal with orientation command (X22) ON after stopping the motor by orientation control, the present position is checked again after the set time elapses and the orientation complete signal (ORA) or orientation fault signal (ORM) is output.	○	×
			9999	Not checked.		
369	Number of encoder pulses AP AL	1024	0 to 4096	Set the number of pulses of the encoder. Set the number of pulses before multiplied by four.	○	○
393	Orientation selection AP AL	0	0	Orientation is executed from the current rotation direction.	×	○
			1	Orientation is executed from the forward rotation direction.		
			2	Orientation is executed from the reverse rotation direction.		
396	Orientation speed gain (P term) AP AL	60	0 to 1000	Response level during position control loop (servo rigidity) at orientation stop can be adjusted.	×	○
397	Orientation speed integral time AP AL	0.333	0 to 20.0s		×	○
398	Orientation speed gain (D term) AP AL	1	0 to 100.0	Lag/advance compensation gain can be adjusted.	×	○
399	Orientation deceleration ratio AP AL	20	0 to 1000	Make adjustment when the motor rocks at orientation stop or the orientation time is long.	×	○
829	Number of encoder pulses at machine side AL	9999	0 to 4096	Set the number of encoder pulses at machine side. Set the number of pulses before multiplied by four.	○	○
			9999	Orientation control at machine side cannot be performed.		

○ : valid × :invalid

(1) Connection example



*1 For the fan of the 7.5kW or less dedicated motor, the power supply is single phase.
*2 The pin number differs according to the encoder used.
*3 Use [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the function to any of terminal (refer to page 37).
*4 Use [*Pr. 190 to Pr. 196 Output terminal function selection*] to assign the function to any of terminal (refer to page 61).
*5 The encoder should be coupled on the same axis with the motor shaft without any mechanical looseness. Speed ratio should be 1:1.
*6 Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P clip, etc. (refer to page 91).
*7 For the differential line driver, set the terminating resistor selection switch to ON position (initial status) to use (refer to page 86). Note that the terminating resistor switch should be set to OFF position when sharing the same encoder with other unit (NC, etc.) and a terminating resistor is connected to other unit.
For the complementary, set the switch to OFF position.
*8 Refer to page 88 for terminal compatibility of the FR-JCBL, FR-V5CBL, FR-A7AP, and FR-A7AL.
*9 A separate power supply of 5V/12V/15V/24V is necessary according to the encoder power specification.
When performing encoder feedback control and vector control together, an encoder and power supply can be shared.
*10 When a stop position command is input from outside, a plug-in option FR-A7AX is necessary. Refer to page 424 for external stop position command.
*11 Assign OH (external thermal input) signal to the terminal CS.
([*Pr. 186 = 7*])
Connect a 2W1kΩ resistor between the terminal PC and CS (OH).
Install the resistor pushing it against the bottom part of the terminal block so as to avoid a contact with other cables.



(2) Setting I/O signals

Terminal	Terminal Name	Application Explanation
X22	Orientation command input	Used to enter an orientation signal for orientation. For the terminal used for X22 signal input, set 22 in any of [*Pr. 178 to Pr. 189*] to assign the function.
SD	Contact input common	Common terminal for the orientation signal.
ORA	Orientation complete signal output	Switched low if the orientation has stopped within the in-position zone while the start and orientation signals are input. For the terminal used for the ORA signal output, assign the function by setting 27 (positive logic) or 127 (negative logic) in any of [*Pr. 190 to Pr.196*].
ORM	Orientation fault signal output	Switched low if the orientation has not stopped within the in-position zone while the start and orientation signals are input. For the terminal used for the ORM signal output, assign the function by setting 28 (positive logic) or 128 (negative logic) in any of [*Pr.190 to Pr.196*] .
SE	Open collector output common	Common terminal for the ORA and ORM open collector output terminals.

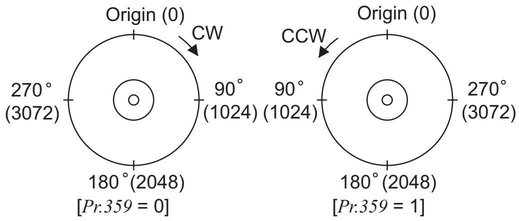
(3) Selecting stop position command [*Pr.350*]

Select either the internal stop position command ([*Pr.356*]) or the external stop position command (16-bit data using the FR-A7AX).

[Pr.350] Setting	Stop Position Command Source
0	Internal stop position command ([*Pr.356*] : 0 to 16383)
1	External stop position command (FR-A7AX) 16-bit data

1) Internal stop position command [*Pr. 350 = 0*]

The value set in [*Pr.356*] is the stop position.
When the number of encoder pulses is 1024p/r, one revolution of the encoder 360° is divided into 4096 positions, i.e. 360°/4096 pulses = 0.0879°/ pulses per address as shown below. The stop positions (addresses) are indicated in parentheses.

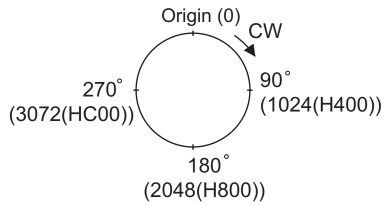


2) External stop position command [*Pr.350 = 1*]

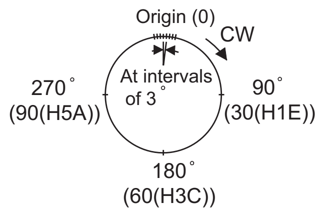
Mount the option FR-A7AX and set a stop position using 16-bit data (binary input).
The value set in [*Pr.360 16 bit data selection*] should be the number of stop positions minus 1.
FR-A7AX parameters ([*Pr.300 to Pr.305*]) are invalid. (Parameters are valid when [*Pr. 360 = 0*].)
Terminal DY (data read timing input signal) is invalid during vector control. (The position data is downloaded at the start of orientation.)

[Pr.360] Setting	Description
0	External position command is invalid. (Speed command or torque command with the FR-A7AX.)
1	Position command direct input The 16-bit digital signal from the FR-A7AX directly serves as stop position command. <Example> When the [*Pr.369 Number of encoder pulses*] setting is 1024, stop position command from 0 to 4095 can be directly input using the FR-A7AX and input digital signal of 2048 (H800) to stop the motor at 180° position. The command more than 4096 is considered as 4095.
2 to 127	Set the stop position command dividing up to 128 stop positions at regular intervals. If the external stop command entered is greater than the setting, the stop positions are the same as those in the maximum external stop command value. <Example> When the number of stop positions is 90 (divided at intervals of 4°), 90 - 1 = 89. Hence, set 89.

[**Example 1**]
[***Pr. 369 = 1024***], [***Pr. 360 = 1***]



[**Example 2**]
120 stop position ([*Pr. 369 = 119*])



* Values in parentheses indicate binary data entered from the terminals. Even if the position pulse monitor ([*Pr. 52 DU/PU main display data selection = 19*]) is selected, the data monitored is not the number of stop positions but is 0 to 65535 pulses.

[Pr.350] Stop Position Command Selection	[Pr.360] 16 Bit Data Selection	Operation		
		Stop position command	16 bit data (FR-A7AX)	Speed command
0 : Internal	0 : Speed command	Internal ([*Pr.356*])	Speed command	16 bit data
	1, 2 to 127 : Position command	Internal ([*Pr.356*])	Invalid	External command (or PU)
1 : External	0 : Speed command	Internal ([*Pr.356*])	Speed command	16 bit data
	1, 2 to 127: Position command	External (Internal when the FR-A7AX is not mounted ([*Pr.356*]))	Position command	External command (or PU)

3) Position shift [*Pr.361*]

Shift the origin using a compensation value without changing the origin of the position detector (encoder). The stop position is a position obtained by adding the setting value of [*Pr.361*] to the position command.

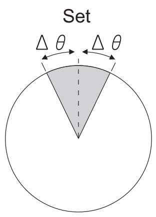
(4) Monitor display change

Monitor	Remarks
Position pulse monitor	When [*Pr.52 = 19*], position pulse monitor is displayed instead of output voltage monitor of the PU. (Displayed only when the FR-A7AP or FR-A7AL is mounted.)
Orientation Status *	When [*Pr.52* = *22*], orientation status is displayed instead of output voltage monitor of the PU. (Displayed only when the FR-A7AP or FR-A7AL is mounted.) 0-Other than orientation operation or orientation speed is not reached 1-Orientation speed is reached 2-Creep speed is reached 3-Position loop is reached 4-Orientation complete 5-Orientatino fault (pulse stop) 6-Orientatino fault (orientation limit) 7-Orientation fault (recheck) 8-Continuous multi-point orientation

* Invalid during vector control. (0 is always displayed.)

(5) Orientation in-position zone [*Pr.357*]

The positioning width for orientation stop can be set. The initial setting of [*Pr.357*] is 5. To change the $\Delta\theta$ value, finely adjust with ±10 increments, and make fine adjustment.
If the position detection value from the encoder enters ± $\Delta\theta$ during orientation stop, the orientation complete signal (ORA) will be output.



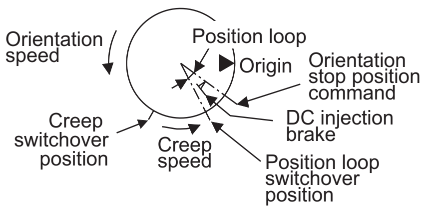
$$\Delta\theta = \frac{360^\circ}{\left(\begin{array}{c}[Pr.369\\ \text{Number of encoder pulses}]\end{array}\right) \times \text{four times}} \times [Pr.\ 357]$$

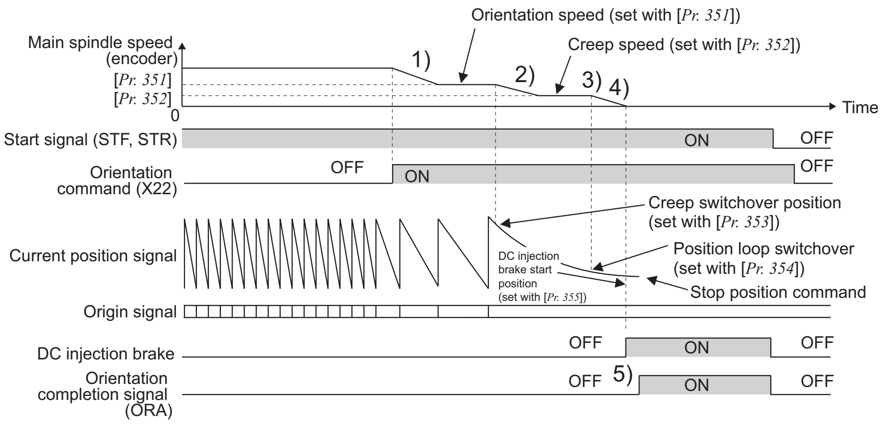
(6) Orientation operation (under V/F control, Advanced magnetic flux vector control)

●Orientation during running

1) When the orientation command (X22) is input, the motor speed decreases to the orientation speed set in [*Pr.351 Orientation speed*]. ([*Pr.351*] initial value : 2Hz)
2) After the speed reaches the orientation speed, the speed decreases to the creep speed set in [*Pr.352 Creep speed*] as soon as the current position pulse reaches the creep switchover position set in [*Pr.353 Creep switchover position*].
([*Pr.352*] initial value : 0.5Hz, [*Pr.353*] initial value : 511)
3) Moreover, as soon as the current position pulse reaches the set position loop switchover position in [*Pr.354 Position loop switchover position*], control is changed to position loop. ([*Pr.354*] initial value : 96)
4) After switching to position loop, the inverter decelerates and stops with DC injection brake as soon as the current position pulse has reached the DC injection brake start position set in [*Pr.355 DC injection brake start position*]. ([*Pr.355*] initial value : 5)
5) When the current position pulse has stopped within the in-position zone set in [*Pr.357 Orientation in-position zone*], the orientation complete signal (ORA) is output after the complete signal output delay time set in [*Pr.363 Completion signal output delay time*] has elapsed. If the current position pulse does not stop within the in-position zone due to external force, etc., the orientation completion signal is turned OFF after the time set in [*Pr.363 Completion signal output delay time*] has elapsed. ([*Pr.357*] initial value : 5)
6) If the orientation is not completed continuously for the time set in [*Pr.365 Orientation limit*] after passing the creep switchover position, the orientation fault signal (ORM) is output.
7) When the current position pulse stops before reaching the in-position zone due to external force after orientation start and orientation complete signal (ORA) is not output, orientation fault signal (ORM) is output after the time set in encoder stop check time set in [*Pr.364 Encoder stop check time*] has elapsed. Moreover, the orientation complete signal (ORA) is turned OFF after the time set in [*Pr.363 Completion signal output delay time*] has elapsed if the current position pulse is outside the in-position zone due to external force, etc. after outputting the orientation complete signal (ORA), and the orientation fault signal (ORM) is output if the orientation has not completed within the time set in [*Pr.364 Encoder stop check time*].
8) When the start signal (STF or STR) is turned OFF with the orientation command on after outputting the orientation complete signal (ORA) and orientation fault signal (ORM), the orientation complete signal (ORM) or orientation fault signal (ORM) is output again after recheck time set in [*Pr.366 Recheck time*] has elapsed.
9) The orientation complete signal (ORA) and orientation fault signal (ORM) are not output when the orientation command is OFF.
10) To terminate orientation, the start signal (STF or STR) must be first switched OFF and then the orientation signal (X22) must be switched OFF. As soon as this orientation signal is switched OFF, orientation control ends. (Depending on the [*Pr. 358 Servo torque selection*] setting, orientation status continues if the orientation signal remains ON even if DC injection brake is released at turning OFF of the start signal. Therefore, the orientation status of the monitor function is not 0.)

[**Action time chart**]





*1 When the orientation command is OFF with the start signal ON, the speed accelerates to the command speed.

*2 If the hunting of the motor shaft occurs, set a larger value in [*Pr.354 Position loop switchover position*] or a smaller value in [*Pr.352 Creep speed*] to prevent it.

*3 DC injection brake operates when orientation stop is made. Release the DC injection brake in a time as short as possible (within several seconds) since continuous operation of the DC injection brake will cause the motor to overheat, leading to burnout.

*4 Since no servo lock function is available after orientation stop, provide a holding mechanism such as mechanical brake or knock pin when secure holding of a main spindle is required.

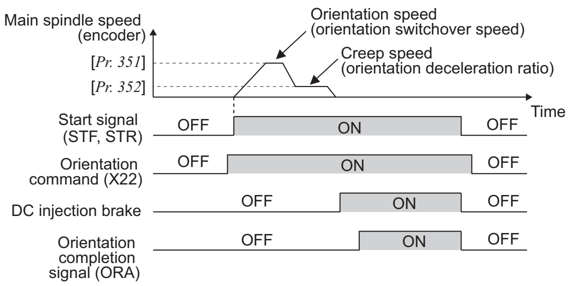
*5 When orientation control is performed, orientation can not be completed if DC injection brake operation is not set in the DC injection brake adjusting (voltage, frequency, speed, time) parameters. Always set the DC injection brake enabled.

*6 When [*Pr.11 DC injection brake operation time = 8888*] (DC injection brake external selection), DC injection brake does not operate if the X13 signal is not turned ON. Note that the DC injection brake is applied under orientation control regardless of the X13 signal status.

●Orientation from stop

After turning on the orientation command (X22), turning ON the start signal will increase the motor speed to the orientation speed set in [*Pr.351 Orientation speed*], then orientation operation same as when "orientation during running" is performed. Note that, DC injection brake is operated if the position signal is within the DC injection brake start position.

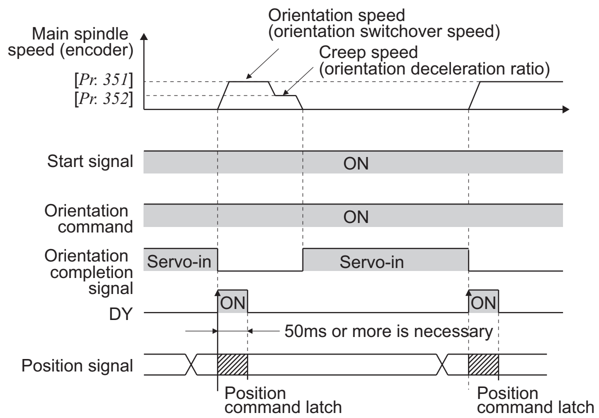
[**Action time chart**]



●Continuous multi-point orientation

Orientation command and orientation with STF/STR ON(orientation in servo in status)

[**Action time chart**]



- Read 16 bit data (position data) at starting up of terminal DY of the plug-in option FR-A7AX. 16 bit data with the FR-A7AX is valid only when terminal DY is ON.
- When the position signal is within the creep switchover position, the speed starts up to the creep speed not to the orientation speed.
- When the position signal is not within the creep switchover position, the speed starts up to the orientation speed.
- The DC injection brake is operated if the position signal is within the DC injection brake start position.

●Servo torque selection [*Pr. 358*]
Valid only under V/F control and Advanced magnetic flux vector control.

Function	[Pr. 358] Setting														Remarks
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
1) Servo torque function selection until output of the orientation complete signal (ORA)	×	○	○	○	○	×	○	×	○	×	○	×	×	○	○ : with servo torque function × : without servo torque function
2) Retry function selection	×	×	×	×	×	×	×	○	×	×	×	○	×	×	○ : with retry function × : without retry function
3) Output frequency is compensated when the motor stops outside the in-position zone	×	×	○	○	×	○	○	×	×	×	×	×	○	○	○ : with frequency compensation × : without frequency compensation
4) DC injection brake and servo torque selection when the motor stops outside of the in-position zone after output of the orientation complete signal (ORA)	○	×	×	×	×	○	○	○	○	○	○	○	○	○	○ : with DC injection brake × : with servo torque
5) End switch selection of the DC injection brake and orientation complete signal (ORA)	○	○	○	×	×	○	○	○	○	×	×	×	×	×	○ : when the start signal (STF, STR) or orientation command is turned OFF × : when the orientation command is turned OFF
6) Completion signal OFF selection when the position pulse stops outside of in-position zone after output of the orientation completion signal (ORA)	○	○	○	○	○	×	×	×	×	×	×	×	×	×	○ : turns OFF the completion signal when the position pulse stops outside of the in-position zone × : completion signal remains ON even if the position pulse stops outside of the completion zone (orientation fault signal (ORM) is not output)

*1 When the orientation command is OFF with the start signal ON, the speed accelerates to the command speed.
*2 When the motor shaft stops outside of the set setting range of stop position, the motor shaft is returned to the stop position by servo torque function (if enough torque is generated).

1) Servo torque function selection until output of the orientation completion signal
   Whether servo torque is available or not is selected using [*Pr. 358 Servo torque selection*]. Servo torque is not generated if the current position pulse is in between the orientation stop position and DC injection brake start position. Although, the shaft is retained by the DC injection brake, servo torque is generated to return the shaft within the width if the shaft rotates out of the width by external force, etc. Once the orientation completion signal (ORA) is output, the motor runs according to the setting made in 4).
2) Retry function selection
   Select retry function using [*Pr. 358 Servo torque selection*]. Note that servo torque function can not be used together. When the motor shaft is not stopped within the in-position zone when the motor stop is checked, orientation operation is performed again by retry function.
   With this retry function, three orientations including the first one are performed. More than three times retry operations are not made. (The orientation fault signal (ORM) is not output during retry operation)
3) Frequency compensation function when the motor stops outside the orientation in-position zone
   When the shaft stops rotation before entering the in-position zone due to external force, etc., output frequency is increased to rotate the shaft to the orientation stop position. The output frequency is gradually increased to the creep speed of [*Pr. 352 Creep speed*].
   Note that retry function can not be used together.
4) DC injection brake and servo torque selection when the position pulse comes off the in-position zone after output of the orientation completion signal (ORA)
   If the position pulse comes off the orientation in-position width, you can select a setting either fixing a shaft with the DC injection brake or returning the motor to the orientation stop position with servo torque.
5) Orientation operation or end switch operation selection
   When ending the orientation operation, turn OFF the start signal (STF or STR), then turn OFF the orientation command (X22). At this time, you can select when to turn OFF the orientation completion signal (ORA) from between at turning OFF of the start signal or turning OFF of the orientation command signal.
6) Selection of completion signal OFF or ON when the motor stops outside of the in-position zone after output of the orientation completion signal (ORA)
   You can select the mode to turn OFF the completion signal or keep the completion signal ON (orientation fault signal (ORM) is not output) when the motor stops outside of the in-position zone.

●Position loop gain [*Pr. 362*]
When servo torque function is selected using [*Pr. 358 Servo torque selection*], output frequency for generating servo torque increases to the creep speed of [*Pr. 352 Creep speed*] gradually according to the slope set in [*Pr. 362 Orientation position loop gain*].
Although the operation becomes faster when the value is increased, a machine may hunt, etc.

(7) Orientation operation explanation (during vector control)

●Setting the rotation direction [*Pr. 393 Orientation selection*]

[Pr. 393] Setting	Rotation direction
0 (initial value)	Orientation is executed from the current rotation direction.
1	Orientation is executed from the forward rotation direction. (If the motor is running in reverse, orientation is executed from the forward rotation direction after deceleration.)
2	Orientation is executed from the reverse rotation direction. (If the motor is running in forward, orientation is executed from the reverse rotation direction after deceleration.)

1) Orientation from the current rotation direction

When the orientation command (X22) is input, the motor speed will decelerate from the running speed to [*Pr. 351 Orientation speed*]. At the same time, the orientation stop position command will be read in. (The stop position command is determined by the setting of [*Pr. 350 and Pr. 360*].

When the orientation switchover speed is reached, the encoder Z phase pulse will be confirmed, and the mode will change from speed control to position control ([*Pr. 362 Orientation position loop gain*]).

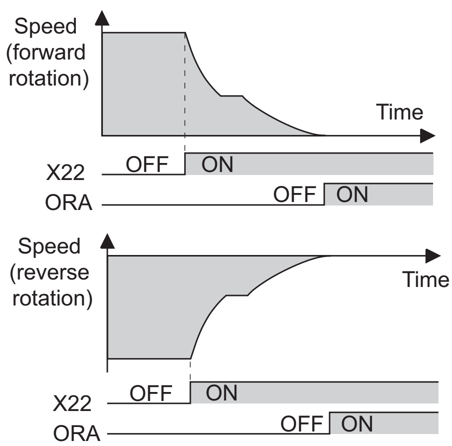
The distance to the orientation stop position is calculated at switching of the control, and the motor decelerates and stops with a set deceleration pattern ([*Pr. 399*]) the orientation (servo lock) state will be entered.

When entered in the [*Pr. 357*] Orientation in-position zone, the orientation completion signal (ORA) will be output.

The zero point position (origin) can be rotated using position shift [*Pr. 361 Position shift*].

If the orientation command (X22) is turned OFF while the start signal is input, the motor will accelerate toward the speed of the current speed command. Thus, to stop, turn the forward rotation (reverse rotation) signal OFF.

If E.ECT (no encoder signal) is displayed causing the inverter to trip when the orient signal (X22) is ON, check for a break in the cable of the Z phase of the encoder.

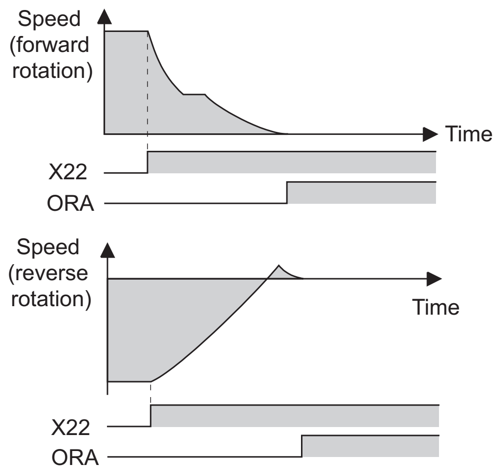


2) Orientation from the forward rotation direction

This method is used to improve the stopping precision and maintain the mechanical precision when the backlash is large.

If the motor is running in the forward rotation direction, it will orientation stop with the same method as "orientation from the current rotation direction".

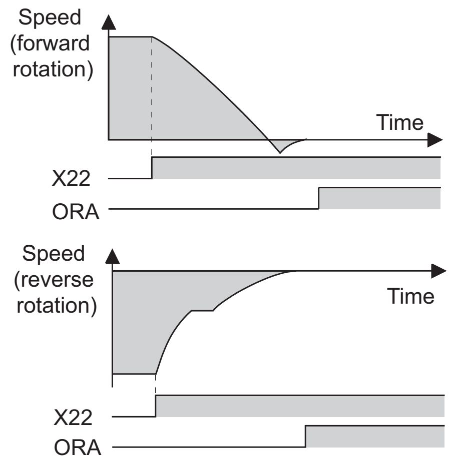
If the motor is running in reverse, it will decelerate, the rotation direction will be changed to forward run, and then orientation stop will be executed.



3) Orientation from the reverse rotation direction

If the motor is running in the reverse rotation direction, it will orientation stop with the same method as "orientation from the current rotation direction".

If the motor is running in forward, it will decelerate, the rotation direction will be changed to reverse run, and then orientation stop will be executed.



●Servo rigidity adjustment [*Pr. 362, Pr. 396 to Pr. 398*]

To increase the servo rigidity [*1] during orientation stop in [*Pr. 396, Pr. 397*], adjust with the following procedures.

1) Increase the [*Pr. 362 Orientation position loop gain*] value to the extent that rocking does not occur during orientation stop [*3].
2) Increase [*Pr. 396, Pr. 397*] at the same rate.
   Generally adjust [*Pr. 396*] in the range from 10 to 100, and [*Pr. 397*] from 0.1 to 1.0s. (Note that these do not need to be set to the same rate.)
   [Example]
   When the [*Pr. 396*] value is multiplied by 1.2, divide the [*Pr. 397*] value by 1.2. If vibration occurs during orientation stop, the scale cannot be raised any higher.
3) [*Pr. 398*] is the lag/advance compensation gain. [*2]
   The limit cycle can be prevented by increasing the value, and the running can be stopped stably. However, the torque in regard to the position deviation will drop, and the motor will stop with deviation.

   [Application of lag/advance control and PI control]
   PI control can be applied by setting [*Pr. 398 = 0*]. Normally, the lag/advance control is selected. When using a machine with a high spindle stationary friction torque and requires a stopping position precision.

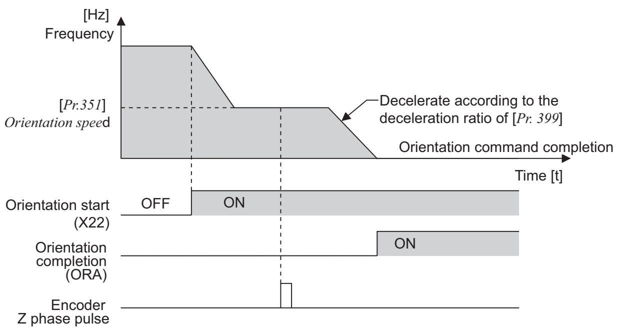
*1 Servo rigidity : This is the response when a position control loop is configured.
When the servo rigidity is raised, the holding force will increase, the running will stabilize, but vibration will occur easily.
When the servo rigidity is lowered, the holding force will drop, and the settling time will increase.

*2 Limit cycle :This is a phenomenon that generates ± continuous vibration centering on the target position.

*3 Rocking : Movement in which return occurs if the stopping position is exceeded.

●Orientation speed [*Pr. 351*]

Set the speed when switching between the speed control mode and the position control mode is performed under orientation operation.
Decreasing the set speed enables stable orientation stop. Note that the orientation time will increase.
When [*Pr. 52 DU/PU main display data selection = 19*], position pulse monitor is displayed on the PU instead of output voltage monitor.



●Orientation deceleration ratio [*Pr. 399*]

Make adjustments as shown below according to the orientation status. Refer to the [*Pr. 396* and *Pr. 397*] details also.
Generally adjust [*Pr. 362*] in the range from 5 to 20 and [*Pr 399*] from 5 to 50.
Orientation stop operation can not be performed and excessive position error alarm occurs. Or, if the motor does forward/reverse reciprocation operation, the parameter setting value for the orientation detector installation direction may be incorrect. Review [*Pr. 393 Orientation selection*] (refer to page 428) and [*Pr. 359 Encoder rotation direction*] (refer to page 421).

Case	Adjustment Procedure			
	[Pr. 396]	[Pr. 397]	[Pr. 362]	[Pr. 399]
Rocking occurs during stopping	3) ↗	3) ↗	2) ↘	1) ↘
The orientation time is long	→	→	2) ↗	1) ↗
Hunting occurs when stopping	2) ↘	2) ↗	1) ↘	→
The servo rigidity during stopping is low	1) ↗	1) ↘	2) ↗	→

*1 ↗ :Increase the parameter setting value.
→ :Do not change the parameter setting value.
↘ :Decrease the parameter setting value.

*2 The numbers 1) 2) and 3) in the table show the order of priority for changing the parameters setting value.

(8) Orientation control at machine side

To simultaneously perform orientation control at machine side with encoder feedback control / vector control using an encoder at machine side and FR-A7AL, set the number of encoder pulses to [*Pr.829 Number of machine end encoder pulses*].
Orientation control to the encoder at machine side is enabled.

[Setting example]
Number of pulses equivalent for the motor side is calculate as below when the number of encoder pulses at machine side is 4000 pulses, and the gear ratio between motor side and machine side is 4:1 (motor rotates four times while machine rotates once).

Number of pulses equivalent for the motor side = 4000 × 1/4 =1000

Thus, set [*Pr. 369* =1000] and [*Pr. 829* =4000] (encoder pulses at machine side.)

2.20.8 PWM carrier frequency and Soft-PWM control [Pr. 72, 240, 260*] common

(* [Pr. 260] is not available for A700 E700.)

You can change the motor sound. Increasing PWM carrier frequency will reduce the motor acoustic noises, but increases EMI and leakage current from the inverter.

[Pr.]	Name	Initial Value	Setting Range		Description	Available Inverters			
						A700	F700	E700	D700
72 *	PWM frequency selection	2	55K or less	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz, 15 indicates 14.5kHz and 25 indicates 2.5kHz. (25 is exclusively for a sine wave filter.)	○	○	○	○
			75K or more	0 to 6, 25					
240 *	Soft-PWM operation selection	1	0		Soft-PWM is invalid	○	○	○	○
			1		When [*Pr. 72 = 0 to 5*] (0 to 4 for the 75K or more), Soft-PWM is valid.				
260	PWM frequency automatic switchover	F700 1 D700 0	0		PWM carrier frequency is constant independently of load. Operate continuously at less than 85% of the inverter rated current when carrier frequency is set 3kHz or more ([*Pr. 72* $\geqq$ *3*]) in F700.	—	○	—	○
			1		Decreases PWM carrier frequency automatically when load increases.				

* The parameters in the table allow its setting to be changed during operation even if [*Pr. 77 Parameter write selection = 0*] (initial value).

(1) PWM carrier frequency changing [*Pr. 72*]

You can change the PWM carrier frequency of the inverter.
Changing PWM carrier frequency is useful for the following purposes:

- •To avoid mechanical or motor resonance
- •To prevent EMI
- •To reduce leakage current by PWM switching

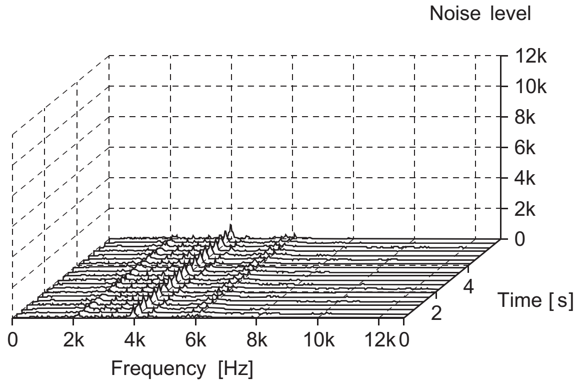
When using an option sine wave filter (MT-BSL/BSC) for the 75K or more, set [*Pr. 72 = 25 (2.5kHz)*]. When [*Pr. 72 = 25*], V/F control is forcibly selected. At this time, perform continuous operation at less than 90% of the rated inverter output current.
When the carrier frequency is set to 3kHz or more ([*Pr. 72* $\geq$ *3*]) to the 75K or more A700 inverter, perform continuous operation at less than 85% of the rated inverter output current.
Carrier frequencies under Real sensorless vector control and vector control by A700 are as shown below.

[Pr. 72] Setting		Carrier Frequency (kHz)
55K or less	75K or more	
0 to 5	0 to 5	2
6 to 9	6	6
10 to 13	—	10
14, 15	—	14

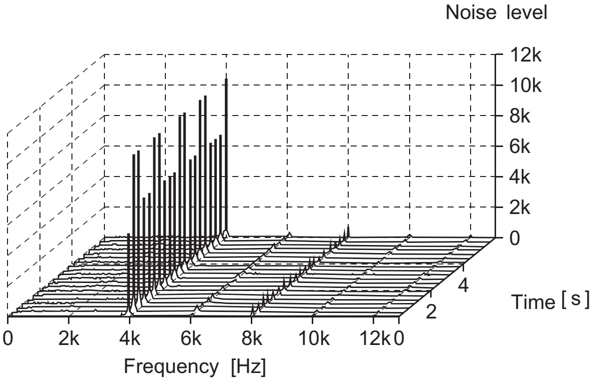
When PWM carrier frequency is set to 1kHz or less ([*Pr. 72* $\leqq$ *1*]), fast-response current limit may function before stall prevention operation due to increased ripple current, and torque may be insufficient. In such case, set fast-response current limit operation invalid using [*Pr. 156 Stall prevention operation selection*] .

(2) Soft-PWM control [*Pr. 240*]

Soft-PWM control is a control method that changes the motor noise from a metallic tone into an unoffending complex tone.



(a) With Soft-PWM
Since the frequency components are dispersed, the sound becomes inoffensive with less metallic noises.



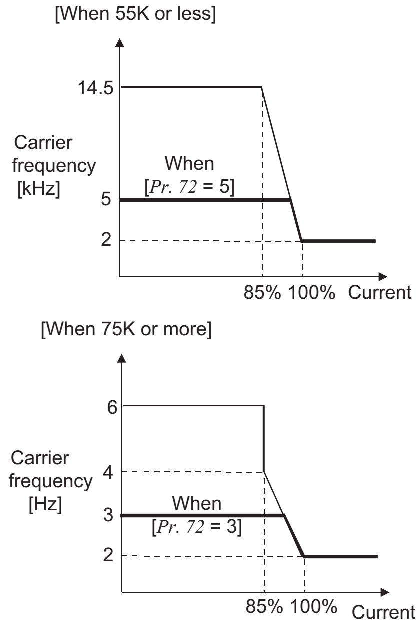
(b) Without Soft-PWM
Since the frequency components are concentrated, metallic noises are generated.

Motor noises data example
(When the motor SF-JR 4P 3.7kW carrier frequency 2kHz is used)

(3) PWM carrier frequency automatic reduction function [*Pr. 260*] (F700)(D700)

When [*Pr. 260 = 1*] (initial value in (F700)) in (F700)(D700), performing continuous operation at the 85% or more of the rated inverter current with the inverter carrier frequency set to 3kHz or more ([*Pr. 72* ≥ *3*]) will automatically reduce the carrier frequency to 2kHz to protect the inverter output transistor. (Although the motor acoustic noises increase, it is not a fault.)

When [*Pr. 260* =0] (initial value in (D700)) in (F700)(D700), the carrier frequency is constant (at the [*Pr.72*] setting) regardless of the load, making the motor sound uniform. For (F700), make sure to operate continuously at less than 85% of the inverter rated current when carrier frequency is set 3kHz or more (less than the rated output current in parenthesis on page 4) for keeping the carrier frequency constant.



(F700)(D700) **Carrier frequency automatic reduction characteristics**

2.20.9 Cooling fan operation selection [Pr. 244] (common)

The operation of built-in cooling fan (in forced cooling inverters) can be controlled. (To confirm which inverters are forced cooling, refer to the specification list on page 2 .)

[Pr.]	Name	Initial Value	Setting Range	Description
244	Cooling fan operation selection	1	0	Operates in power-ON status. Cooling fan ON/OFF control invalid (the cooling fan is always on at power on)
			1	Cooling fan ON/OFF control valid The fan is always ON while the inverter is running. During a stop, the inverter status is monitored and the fan switches ON-OFF according to the temperature.

In either of the following cases, fan operation is regarded as faulty, [FN] is shown on the operation panel, and the fan fault (FAN) and alarm (LF) signals are output.

- [When *Pr. 244 = 0*]
  When the fan comes to a stop with power ON.
- When [*Pr. 244 = 1*]
  When the inverter is running and the fan stops during fan ON command.

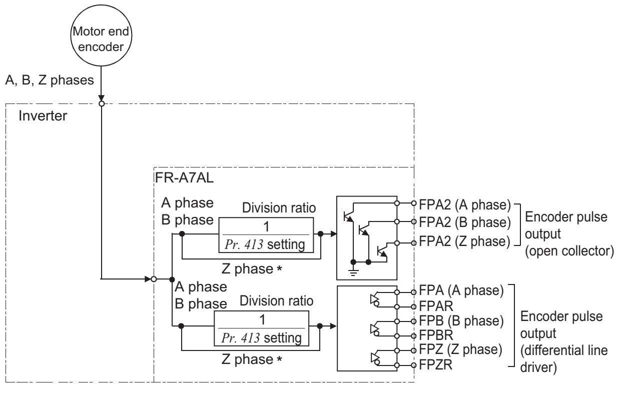
For the terminal used for FAN signal output, set 25 (positive logic) or 125 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*], and for the LF signal, set 98 (positive logic) or 198 (negative logic).

2.20.10 PLG pulse division output [Pr.413] (A700)

Pulse input of encoder connected to the inverter is divided and output from the FR-A7AL terminal.

[Pr.]	Name	Initial Value	Setting Range	Description
413	Encoder pulse division ratio AL	1	1 to 32767	The encoder pulse signal at the motor end can be divided in division ratio set in [*Pr. 413*] and output.

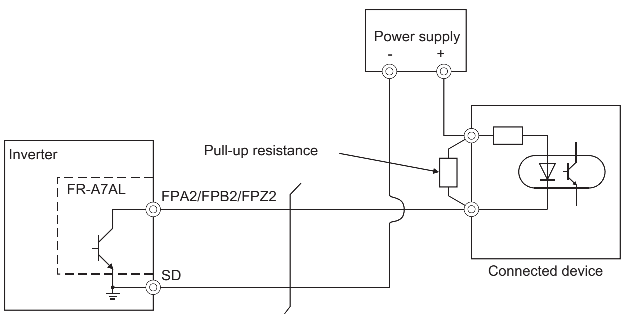
(1) Wiring Example



* Z phase can not be divided.

For open collector output, the signal may become unstable if the input resistance of the connected device is large and the device may detect the signal incorrectly. In this case, adding a pull up resistance as shown below will improve the phenomenon.

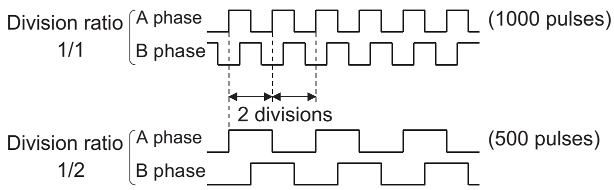
Select a pull-up resistance in consideration of the input current of the connected device so that the open collector output current will not exceed the output permissible load current.



(2) Division waveform by division ratio

Both ON-OFF width is division times. (50% duty)

- Pulse waveform example at 1000 pulse input when [*Pr. 413* = "2"]



Control of forward rotation/reverse rotation by phase difference between A phase and B phase.

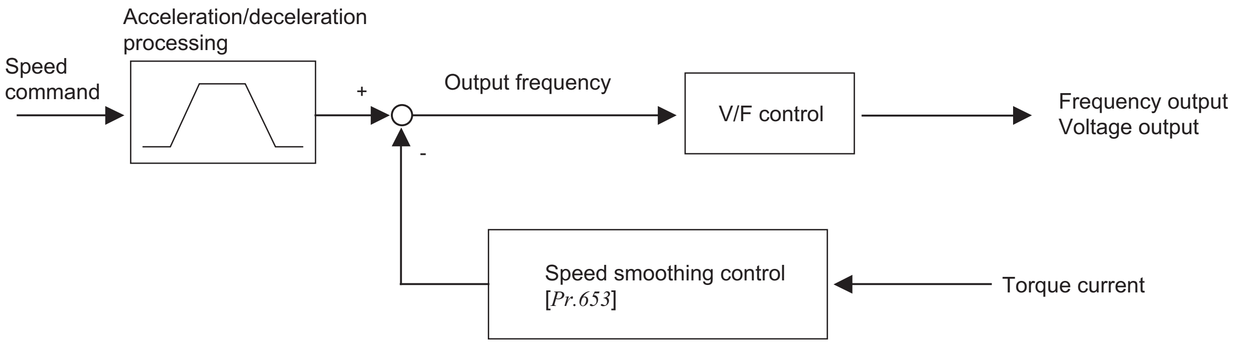
- When A phase is 90° advanced as compared to B phase: forward rotation
- When A phase is 90° behind as compared to B phase: reverse rotation

2.20.11 Speed smoothing control [Pr.653] E700 D700

Vibration due to mechanical resonance influences the inverter control, causing the output current (torque) unstable. In this case, the output current (torque) fluctuation can be reduced to ease vibration by changing the output frequency.

[Pr.]	Name	Initial Value	Setting Range	Description
653	Speed smoothing control	0	0 to 200%	Increase or decrease the value using 100% as reference to check an effect.

(1) Control block diagram



(2) Setting method

If vibration due to mechanical resonance occurs, set 100% in [*Pr. 653*], run the inverter at the frequency which generates maximum vibration and check if the vibration will be reduced or not after several seconds.
If effect is not produced, gradually increase the [*Pr. 653*] setting and check the effect repeatedly until the most effective value is set in [*Pr. 653*].
If vibration becomes large by increasing the [*Pr. 653*] setting, gradually decrease the [*Pr. 653*] setting than 100% to check the effect in a similar manner. (Depending on the machine, vibration may not be reduced enough or an effect may not be produced.)

2

PARAMETER

2.21 Communication operation

2.21.1 Operation mode selection [Pr. 79, 340] common

When power is switched on or when power comes back on after instantaneous power failure, the inverter can be started up in the Network operation mode. After the inverter has started up in the Network operation mode, parameter write and operation can be performed from a program. Set this mode for communication operation using the inverter RS-485 terminals or communication option.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters A700 F700	Available Inverters E700 D700
79	Operation mode selection	0	0 to 4, 6, 7	Select the operation mode. (Refer to page 209)	○	○
340 *1	Communication startup mode selection	0	0	As set in [*Pr. 79*].	○	○
			1	Started in network operation mode. When the setting is 2, it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs.	○	○
			2		○	—
			10	Started in network operation mode. Operation mode can be changed between the PU operation mode and Network operation mode from the operation panel. When the setting is 12, it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs.	○	○
			12		○	—

The above parameters can be changed during a stop in any operation mode.

*1 However, the parameters can be set whenever the communication option is connected. Changed setting value is valid when powering on or resetting the inverter.

(1) Operation mode at power-on [*Pr. 340*]

Depending on the [*Pr. 79*] and [*Pr. 340*] settings, the operation mode at power-ON (reset) changes as described below.

[Pr. 340] Setting	[Pr. 79] Setting	Operation Mode at Power ON or Power Restoration or Reset	Operation Mode Switching
0 (initial value)	0 (initial value)	External operation mode	Switching among the External, PU, and NET operation mode is enabled *2
	1	PU operation mode	PU operation mode fixed
	2	External operation mode	Switching between the External and NET operation mode is enabled Switching to PU operation mode is disabled
	3, 4	External/PU combined operation mode	Operation mode switching is disabled
	6	External operation mode	Switching among the External, PU, and NET operation mode is enabled while running
	7	X12 (MRS) signal ON・・・・External operation mode	Switching among the External, PU, and NET operation mode is enabled *2
		X12 (MRS) signal OFF・・・・External operation mode	Fixed to External operation mode (forcibly switched to external operation mode)
1, 2 *1	0	NET operation mode	Same as when [*Pr. 340 = 0*]
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined operation mode	
	6	NET operation mode	
	7	X12 (MRS) signal ON・・・・NET operation mode	
		X12 (MRS) signal OFF・・・・External operation mode	
10, 12 *1	0	NET operation mode	Switching between the PU and NET operation mode is enabled *3
	1	PU operation mode	Same as when [*Pr. 340 = 0*]
	2	NET operation mode	Fixed to NET operation mode
	3, 4	External/PU combined operation mode	Same as when [*Pr. 340 = 0*]
	6	NET operation mode	Switching between the PU and NET operation mode is enabled while running *3
	7	External operation mode	Same as when [*Pr. 340 = 0*]

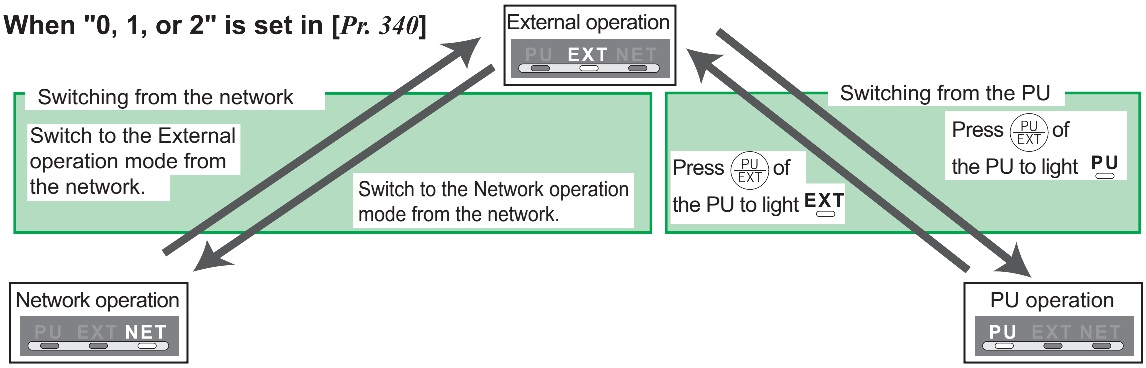
*1 Setting values 2 and 12 for [Pr.340] are available only for A700 F700. These setting values are mainly used in a communication operation with RS-485 terminal. When [*Pr. 57 Restart coasting time ≠ 9999*] (automatic restart after instantaneous power failure is selected) , the inverter will resume the same operation state which was in before after power has been restored from an instantaneous power failure.

*2 The operation mode cannot be switched directly between the PU operation mode and Network operation mode.

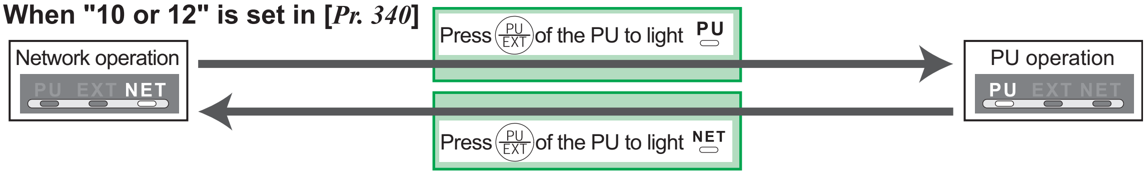
*3 Operation mode can be changed between the PU operation mode and Network operation mode with PU/EXT key of the control panel (PU07) and X65 signal.

(2) Operation mode switching method

When "0, 1, or 2" is set in [*Pr. 340*]



When "10 or 12" is set in [*Pr. 340*]



(3) Switching of operation mode by external signal (X65, X66 signals)

When [*Pr. 79 = any of 0, 2, 6, 7*], the operation mode switching signals (X65, X66) can be used to change the PU or External operation mode to the network operation mode during a stop (during a motor stop or start command OFF). [*Pr. 79 = 6*] (Switch-over mode) can be changed during operation)

The priorities of [*Pr. 79*], [*Pr. 340*] and signals are [*Pr. 79*] > X12 > X66 > X65 > X16 > [*Pr. 340*].

1) When switching between the Network operation mode and PU operation mode

[Pr. 340] Setting	[Pr. 79] Setting		X65 Signal State ON (PU)	X65 Signal State OFF (NET)	Remarks
10, 12	0 (initial value)		PU operation mode *1	NET operation mode *2	Switching to External operation mode is disabled
	1		PU operation mode		PU operation mode fixed
	2		NET operation mode		Fixed to NET operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		PU operation mode *1	NET operation mode *2	Switching operation mode is enabled while running Switching to External operation mode disabled
	7	X12 (MRS) ON	Switching among the External and PU operation mode is enabled *3		Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 NET operation mode when the X66 signal is ON.

*2 PU operation mode is selected when the X16 signal is OFF. PU operation mode is selected when [*Pr. 550 NET mode operation command source selection = 1*] (communication option command source) and the communication option is not fitted.

*3 External operation mode when the X16 signal is ON.

2) When switching between the Network operation mode and External operation mode

[Pr. 340] Setting	[Pr. 79] Setting		X66 signal state ON (NET)	X66 signal state OFF (External)	Remarks
0(initial value), 1, 2	0 (initial value)		NET operation mode *1	External operation mode *2	
	1		PU operation mode		PU operation mode fixed
	2		NET operation mode *1	External operation mode	Switching to PU operation mode is disabled
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		NET operation mode *1	External operation mode *2	Operation mode can be switched with operation continued
	7	X12 (MRS) ON	NET operation mode *1	External operation mode *2	Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 External operation mode is selected when [*Pr. 550 NET mode operation command source selection = 1*] (communication option control source) and the communication option is not fitted.

*2 PU operation mode is selected when the X16 signal is OFF. When the X65 signal has been assigned, the operation mode changes with the ON/OFF state of the X65 signal.

2.21.2 Operation command source and frequency command source [Pr. 338, 339, 550*, 551] (common)

(*[*Pr. 550*] is not available for (D700).)

When the RS-485 terminals or communication option is used, the external operation command and speed command can be valid. Also, the operation command source in the PU operation mode can be selected.

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters (A700)	(F700)	(E700)	(D700)
338	Communication operation command source	0	0	Operation command source communication	○	○	○	○
			1	Operation command source external				
339	Communication speed command source	0	0	Speed command source communication	○	○	○	○
			1	Speed command source external (Frequency setting from communication is invalid, terminal 2 and 1 setting from external is valid)				
			2	Speed command source external (Frequency setting from communication is valid, terminal 2 and 1 setting from external is invalid)				
550 *	NET mode operation command source selection	9999	0	Communication option is valid	○	○	○	—
			1	RS-485 terminals are valid	○	○	—	
			2	PU connector is the command source when NET operation mode.	—	—	○	
			9999	Automatic communication option recognition Normally, the RS-485 terminals are valid. When a communication option is mounted, the communication option is valid.	○	○	○	
551 *	PU mode operation command source selection	(A700) (F700) 2 (E700) (D700) 9999	1	Selects RS-485 terminal as the PU operation mode command source.	○	○	—	—
			2	Selects the PU connector as the PU operation mode command source.		○	○	○
			3	Selects the USB connector as the PU operation mode command source.		—	○	—
			4	Operation panel is the command source when PU operation mode.	—	—	○	○
			9999	USB (E700) / parameter unit (D700) automatic recognition Normally, operation panel is the command source. When the parameter unit is connected to the PU connector, PU is the command source. When USB is connected, USB connector is the command source.	—	—	○	○

The above parameters can be set whenever the communication option is connected.

* [*Pr. 550, Pr. 551*] are always write-enabled. Changed setting value is valid when powering ON or resetting the inverter.

(1) Command source selection for the Network operation mode [*Pr. 550*] (A700) (F700) (E700)

Command source in the Network operation mode can be RS-485 terminal ((A700) (F700))/PU connector ((E700)) or a communication option.

For example, set [*Pr. 550* =1] in (A700) when using RS-485 terminal to write parameters and to send start and frequency commands whether a communication option is connected or not.

In the initial setting, [*Pr.550* =9999] (automatic communication option recognition) is set. When a communication option is installed in that initial setting, parameter write, start and frequency commands cannot be sent using RS-485 terminal ((A700) (F700))/PU connector ((E700)). (Monitoring and parameter read can be performed.)

(2) Command source selection for the PU operation mode [*Pr. 551*]

Any of PU connector, RS-485 terminal ((A700) (F700)), or USB connector ((A700) (E700))can be assigned as the source of control in the PU operation mode. Set [*Pr. 551*=1] when writing parameters and sending start and frequency commands by the communication from RS-485 terminal in the PU operation mode ((A700) (F700)). Set [*Pr. 551*=3] when sending these commands from USB connector ((A700) (E700)).

PU operation mode has priority over other control modes when [*Pr. 550* =1] (NET mode with RS-485 terminal) or [*Pr. 551* =1] (PU mode with RS-485 terminal) in (A700) (F700) and when [*Pr. 550* =2] (NET mode with PU connector) or [*Pr. 551* =2] (PU mode with PU connector) in (E700). Therefore, the operation mode cannot be switched to the Network operation mode when a communication option is not installed.

The initial setting in (E700) (D700) is [*Pr. 551* =9999] (automatic USB/PU connector recognition). Therefore, parameter write, start and frequency commands cannot be sent from an operation panel when using USB or parameter unit. (Monitoring and parameter read can be performed.)

Also, PU connector cannot be the command source for the PU operation mode when RS-485 communication is performed from the PU connector while [*Pr. 551* =9999]. Change to NET mode for changing the command source.

A700 F700

[Pr. 550] Setting	[Pr. 551] Setting	Command Source of Each Operation Location: PU connector	USB connector *3	RS-485 terminals	Communication option	Remarks
0	1	×	×	PU operation mode *1	NET operation mode *2	
	2 (initial value)	PU operation mode	×	×	NET operation mode *2	
	3 *3	×	PU operation mode	×	NET operation mode *2	
1	1	×	×	PU operation mode *1	×	Switching to NET operation mode disabled
	2 (initial value)	PU operation mode	×	NET operation mode	×	
	3 *3	×	PU operation mode	NET operation mode	×	
9999 (initial value)	1	×	×	PU operation mode *1	NET operation mode *2	
	2 (initial value)	PU operation mode	×	×	NET operation mode *2	Communication option fitted
				NET operation mode	×	Communication option not fitted
	3 *3	×	PU operation mode	×	NET operation mode *2	Communication option fitted
				NET operation mode	×	Communication option not fitted

*1 The Modbus-RTU protocol cannot be used in the PU operation mode. When using the Modbus-RTU protocol, set [*Pr. 551 = 2*].
*2 When the communication option is not fitted, the operation mode cannot be switched to the Network operation mode.
*3 This value is not available for F700.

E700 D700

[Pr. 550] Setting *4	[Pr. 551] Setting	Command Source of Each Operation Location: Operation panel	USB connector *4	PU connector: Parameter unit	PU connector: RS-485 terminals	Communication option *4	Remarks
0	2	×	×	PU operation mode	PU operation mode *1	NET operation mode *2	
	3 *4	×	PU operation mode	×	×	NET operation mode *2	
	4	PU operation mode	×	×	×	NET operation mode *2	
	9999 (initial value)	PU operation mode *3	PU operation mode *3	PU operation mode *3	×	NET operation mode *2	
2	2	×	×	PU operation mode	PU operation mode *1	×	Switching to NET operation mode disabled
	3 *4	×	PU operation mode	×	NET operation mode	×	
	4	PU operation mode	×	×	NET operation mode	×	
	9999 (initial value)	PU operation mode *3	PU operation mode *3	PU operation mode *3	NET operation mode	×	
9999 (initial value)	2	×	×	PU operation modes	PU operation mode *1	NET operation mode *2	
	3 *4	×	PU operation mode	×	×	NET operation mode *2	Communication option fitted
					NET operation mode	×	Communication option not fitted
	4	PU operation mode	×	×	×	NET operation mode *2	Communication option fitted
					NET operation mode	×	Communication option not fitted
	9999 (initial value)	PU operation mode *3	PU operation mode *3	PU operation mode *3	×	NET operation mode *2	Communication option fitted
					NET operation mode	×	Communication option not fitted

*1 The Modbus-RTU protocol cannot be used in the PU operation mode. When using the Modbus-RTU protocol, set [*Pr. 551 = 2*].
*2 When the communication option is not fitted, the operation mode cannot be switched to the Network operation mode.
*3 The priorities of command sources for the PU operation mode are: USB connector (E700) > parameter unit (FR-PU04/FR-PU07) > operation panel.
*4 This value is not available for D700.

(3) Controllability through communication

The following table shows whether control can be performed or not in each operation mode. Monitoring and parameter read are available in any operation regardless of the operation mode.

Operation Location	[Pr. 551] Setting	Item		Operation Mode: PU Operation	Operation Mode: External Operation	Operation Mode: External/PU Combined Operation Mode 1 ([Pr. 79 = 3])	Operation Mode: External/PU Combined Operation Mode 2 [Pr. 79 = 4]	NET operation: Not using communication option*6 (A700, F700)	NET operation: Not using communication option*8 (E700, D700)	NET operation: Using communication option*7*11
Control by RS-485 communication from PU connector	2 (PU connector)	Run command (start)		○	×	×	○	×		
		Run command (stop)		○	△*3	△*3	○	△*3		
		Running frequency setting		○	×	○	×	×		
		Parameter write		○*4	×*5	○*4	○*4	×*5		
		Inverter reset		○	○	○	○	○		
	Other than 2	Run command (start)		×	×	×	×	×	○*1	×
		Run command (stop)	A700 F700	△*3	△*3	△*3	△*3	△*3	—	△*3
			E700 D700	×	×	×	×	—	○*1	×
		Running frequency setting		×	×	×	×	×	○*1	×
		Parameter write		×*5	×*5	×*5	×*5	×*5	○*4	×*5
		Inverter reset	A700 F700	○	○	○	○	○	—	○
			E700 D700	×	×	×	×	—	○*2	×
Control by communication from RS-485 terminals *10*11	1 (RS-485 terminals)	Run command (start, stop)		○	×	×	○	×	—	×
		Running frequency setting		○	×	○	×	×	—	×
		Parameter write		○*4	×*5	○*4	○*4	×*5	—	×*5
		Inverter reset		○	○	○	○	○	—	○
	Other than 1	Run command (start, stop)		×	×	×	×	○*1	—	×
		Running frequency setting		×	×	×	×	○*1	—	×
		Parameter write		×*5	×*5	×*5	×*5	○*4	—	×*5
		Inverter reset		×	×	×	×	○*2	—	×
Operation from the USB connector *9*11	3 (USB connector) 9999 (automatic recognition)	Run command (start, stop)		○	×	×	○	×		
		Running frequency setting		○	×	○	×	×		
		Parameter write		○*4	×*5	×*5	×*5	×*5		
		Inverter reset		○	○	○	○	○		
	Other than 3	Run command (start, stop)		×	×	×	×	×		
		Running frequency setting		×	×	×	×	×		
		Parameter write		×*5	×*5	×*5	×*5	×*5		
		Inverter reset		○	○	○	○	○		
Control by communication from communication option *11	—	Run command (start, stop)		×	×	×	×	—		○*1
		Running frequency setting		×	×	×	×	—		○*1
		Parameter write		×*5	×*5	×*5	×*5	—		○*4
		Inverter reset		×	×	×	×	—		○*2
Control circuit external terminals	—	Inverter reset		○	○	○	○	○		
		Run command (start, stop)		×	○	○	×	×*1		
		Frequency setting		×	○	×	○	×*1		

○ enabled, × disabled △some are enabled

*1 As set in [*Pr. 338 Communication operation command source*], [*Pr. 339 communication speed command source*]. (Refer to page 440)
*2 At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.
*3 Enabled only when stopped by the PU. At a PU stop, PS is displayed on the operation panel. As set in [*Pr. 75 PU stop selection*]. (Refer to page 382)
*4 Some parameters may be write-disabled according to the [*Pr. 77 Parameter write selection*] setting and operating status. Refer to page 384)
*5 Some parameters are write-enabled independently of the operation mode and command source presence/absence. When [*Pr. 77 = 2*] , write is enabled. (Refer to the parameter list on page 120) Parameter clear is disabled.
*6 When [*Pr. 550 NET mode operation command source selection = 1*] (RS-485 terminals valid) or [*Pr. 550 NET mode operation command source selection = 9999*] and the communication option is not fitted.
*7 When [*Pr. 550 NET mode operation command source selection = 0*] (communication option is valid) or [*Pr. 550 NET mode operation command source selection = 9999*] and the communication option is fitted.
*8 No communication option is installed when [*Pr.550 NET mode operation command source selection =2*] (PU connector valid) or [*Pr.550 NET mode operation command source selection = 9999*]
*9 Not available for F700.
*10 Not available for E700.
*11 Not available for D700.

(4) Operation at error occurrence

Alarm Description	[Pr. 551] Setting	Operation Mode: PU Operation	External Operation	External/PU Combined Operation Mode 1 ([Pr. 79 = 3])	External/PU Combined Operation Mode 2 ([Pr. 79 = 4])	NET Operation: RS-485 terminals*5 A700 F700	PU connector*7 E700 D700	Communication option*6*10
Inverter fault	—	Stop						
PU disconnection of the PU connector	2 (PU connector) 9999 (automatic recognition)	Stop/continued *1, 4						
	Other than 2	Stop/continued *1						
Communication error of PU connector	2 (PU connector)	Stop/ continued *2	Continued		Stop/continued *2	Continued	—	Continued
	Other than 2	Continued					Stop/ continued *2	Continued
Communication error of RS-485 terminals *9*10	1 (RS-485 terminals)	Stop/ continued *2	Continued		Stop/continued *2	Continued	—	Continued
	Other than 1	Continued				Stop/ continued *2	—	Continued
Communication error of USB connector *8*10	3 (USB connector) 9999 (automatic recognition)	Stop/ continued *2	Continued		Stop/continued *2	Continued		
	Other than 3	Continued						
Communication error of communication option *10	—	Continued						Stop/continued *3

*1 Can be selected using [*Pr. 75 Reset selection/disconnected PU detection/PU stop selection*].
*2 Can be selected using [*Pr. 122 PU communication check time interval*], [*Pr. 336 RS-485 communication check time interval*], and [*Pr. 548 USB communication check time interval*].
*3 As controlled by the communication option.
*4 In the PU Jog operation mode, operation is always stopped when the PU is disconnected. Whether error (E.PUE) occurrence is allowed or not is as set in [*Pr. 75 Reset selection/disconnected PU detection/PU stop selection*].
*5 When [*Pr. 550 NET mode operation command source selection = 1*] (RS-485 terminals valid) or [*Pr. 550 NET mode operation command source selection = 9999*] and the communication option is not fitted.
*6 When [*Pr. 550 NET mode operation command source selection = 0*] (communication option is valid) or [*Pr. 550 NET mode operation command source selection = 9999*] and the communication option is fitted.
*7 No communication option is installed when [*Pr.550 NET mode operation command source selection =2*] (PU connector valid) or [*Pr.550 NET mode operation command source selection = 9999*]
*8 Not available for F700.
*9 Not available for E700.
*10 Not available for D700.

2

PARAMETER

(5) Command source selection for the Network operation mode [*Pr. 338, Pr. 339*]

As command sources, there are operation command sources that control signals related to the inverter start command and function selection and speed command source that controls signals related to frequency setting.
In the Network operation mode, the commands from the external terminals and communication (RS-485 terminals or communication option) are as listed below.
[*Pr. 338*] [*Pr. 339*] settings can be changed while inverter is running when [*Pr. 77 =* 2], but new setting is reflected after a stop. Operation communication command source and communication speed command source, which are previously set, are kept until a stop.

Operation Location Selection			[Pr. 338 Communication operation command source]	0: NET			1: External			Remarks
			[Pr. 339 Communication speed command source]	0: NET	1: External	2: External	0: NET	1: External	2: External	
Fixed function (terminal-equivalent function)			Running frequency from communication	NET	—	NET	NET	—	NET	
			Terminal 2	—	External	—	—	External	—	
			Terminal 4	—	External		—	External		
			Terminal 1	Compensation						
Selective function [*Pr. 178 to Pr. 189*] setting	0	RL	Low speed operation command/remote setting clear/stop-on contact selection 0	NET	External		NET	External		[*Pr. 59 = 0*] (multi-speed) [*Pr. 59 ≠ 0*] (remote) [*Pr. 270 = 1, 3*] (stop-on-contact) *1*3
	1	RM	Middle speed operation command/ remote set deceleration	NET	External		NET	External		
	2	RH	High speed operation command/ remote set acceleration	NET	External		NET	External		
	3	RT	Second function selection/stop-on contact selection 1	NET			External			[*Pr. 270 = 1, 3*] (stop-on-contact) *1*3
	4	AU	Current input selection	—	Combined		—	Combined		
	5	JOG	Jog operation selection	—			External			
	6 *2	CS	Selection of automatic restart after instantaneous power failure	External						
	7	OH	External thermal relay input	External						
	8	REX	Fifteen speed selection	NET	External		NET	External		[*Pr. 59 = 0*] (multi-speed)
	9 *1*2	X9	Third function selection	NET			External			
	10	X10	Inverter operation enable signal	External						
	11 *2	X11	FR-HC connection, instantaneous power failure detection	External						
	12	X12	PU operation external interlock	External						
	13 *1*2	X13	External DC injection brake operation start	NET			External			
	14	X14	PID control valid terminal	NET	External		NET	External		
	15 *1*3	BRI	Brake opening completion signal	NET			External			
	16	X16	PU-external operation switchover	External						
	17 *1*2	X17	Load pattern selection forward rotation reverse rotation boost	NET			External			
	18 *1	X18	V/F switching	NET			External			
	19 *1*2	X19	Load torque high-speed frequency	NET			External			
	20 *1*2	X20	S-pattern acceleration/deceleration C switchover	NET			External			
	22 *1*2	X22	Orientation command	NET			External			
	23 *1*2	LX	Pre-excitation	NET			External			
	24	MRS	Output stop	Combined			External			[*Pr. 79 ≠ 7*]
			PU operation interlock	External						[*Pr. 79 = 7*] When the X12 signal is not assigned
	25 *1	STOP	Start self-holding selection	—			External			
	26 *1*2	MC	Control mode switchover	NET			External			
	27 *1*2	TL	Torque limit selection	NET			External			
	28 *1*2	X28	Start-time tuning start external input	NET			External			
	42 *1*2	X42	Torque bias selection 1	NET			External			
	43 *1*2	X43	Torque bias selection 2	NET			External			
	44 *1*2	X44	P/PI control switchover	NET			External			
	60	STF	Forward rotation command	NET			External			
	61	STR	Reverse rotation command	NET			External			
	62	RES	Reset	External						
	63 *2	PTC	PTC thermistor selection	External						
	64 *2	X64	PID forward rotation action switchover	NET	External		NET	External		
	65	X65	PU-NET operation switchover	External						
	66	X66	NET-external operation switchover	External						
	67	X67	Command source switchover	External						
	68 *1	NP	Conditional position pulse train sign	External						
	69 *1*2	CLR	Conditional position droop pulse clear	External						
	70 *1*2	X70	DC feeding operation permission	NET			External			
	71 *1*2	X71	DC feeding cancel	NET			External			
	74 *1*2	X74	Magnetic flux decay output shutoff signal	NET			External			

External	: Command is valid only from signal of external terminal.
NET	: Command is valid only from communication.
Combined	: Command is valid from either of control terminal or communication.
—	: Command is valid from both control terminal or communication.
Compensation	: Command is valid by signal from external terminal if [*Pr. 28 Multi-speed input compensation selection = 1*].

*1 These are not available for F700.

*2 These are not available for E700 D700.

*3 These are not available for D700.

(6) Command source switchover by external terminal (X67 signal)

In the network operation mode, the command source switching signal (X67) switches start command source and frequency command source. This function is useful when controlling signal input from both of control terminal and communication.
Set 67 in any of [*Pr. 178 to Pr. 189 Input terminal function selection*] to assign the X67 signal to the control terminal.
When X67 signal is OFF, control terminal has the start command source and frequency command source.

The ON/OFF state of the X67 signal is reflected only during a stop. It is reflected after a stop when the terminal is switched during operation.
When the X67 signal is OFF, a reset via communication is disabled.

X67 Signal State	Start Command Source	Frequency Command Source
No signal assignment	According to [*Pr. 338*]	According to [*Pr. 339*]
ON		
OFF	Command from control terminal is the only valid command.	

2.21.3 Initial settings and specifications of RS-485 communication [Pr. 117 to 124, 331 to 337*, 341*, 502*, 549] common

(*[*Pr. 331 to 337, 341*] are not available for E700 D700.)

(*In A700 F700, [*Pr.502*] is available only when a communication option is installed.)

Used to perform required settings for RS-485 communication between the inverter and personal computer.
There are two different communications: communication using the PU connector of the inverter and communication using the RS-485 terminals. (only in A700 F700)
You can perform parameter setting, monitoring, etc. using Mitsubishi inverter protocol or Modbus-RTU protocol.

To make communication between the personal computer and inverter, initialization of the communication specifications must be made to the inverter. Data communication cannot be made if the initial settings are not made or there is any setting error.
<u>Always reset the inverter after making the initial settings of the parameters. After you have changed the communication related parameters, communication cannot be made until the inverter is reset.</u>

[PU connector communication related parameter] common

[Pr.]	Name	Initial Value	Setting Range	Description	
117	PU communication station number	0	A700 F700 0 to 31 E700 D700 0 to 31 (0 to 247)*1	Specifies the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
118	PU communication speed	192	48, 96, 192, 384	Set the communication speed. The setting value × 100 equals the communication speed. For example, the communication speed is 19200bps when the setting value is 192.	
119*2	PU communication stop bit length	1		Stop bit length	Data length
			0	1bit	8bit
			1	2bit	
			10	1bit	7bit
			11	2bit	
120	PU communication parity check	2	0	Without parity check	
			1	With odd parity check	
			2	With even parity check	

<table>
<tr><th>[Pr.]</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">121*3</td><td rowspan="2">Number of PU communication retries</td><td rowspan="2">1</td><td>0 to 10</td><td colspan="4">Set the permissible number of retries at occurrence of a data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to tirp.
Valid only in Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>9999</td><td colspan="4">Even if a communication error occurs, the inverter will not come to trip.</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">A700 F700
9999
E700 D700
0</td><td>0</td><td colspan="4">A700 F700
No PU connector communication
E700 D700
RS485 communication is available. Note that a communication fault would occur if mode is switched to another operation mode with command source (NET mode at initial setting).*5</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="4">Set the interval of communication check time.
If a no-communication state persists for longer than the permissible time, the inverter will come to trip.</td></tr>
<tr><td>9999</td><td colspan="4">No communication check</td></tr>
<tr><td rowspan="2">123*3</td><td rowspan="2">PU communication waiting time setting</td><td rowspan="2">9999</td><td>0 to 150ms</td><td colspan="4">Set the waiting time between data transmission to the inverter and response.</td></tr>
<tr><td>9999</td><td colspan="4">Set with communication data.</td></tr>
<tr><td rowspan="3">124*3</td><td rowspan="3">PU communication CR/LF selection</td><td rowspan="3">1</td><td>0</td><td colspan="4">Without CR/LF</td></tr>
<tr><td>1</td><td colspan="4">With CR</td></tr>
<tr><td>2</td><td colspan="4">With CR/LF</td></tr>
<tr><td rowspan="4">502</td><td rowspan="4">Stop mode selection at communication error</td><td rowspan="4">0</td><td rowspan="2">0, 3*6</td><th>At Fault Occurrence</th><th>Indication</th><th>Fault Output</th><th>At Fault Removal</th></tr>
<tr><td>Coasts to stop</td><td>E.PUE</td><td>Output</td><td>Stop (E.PUE)</td></tr>
<tr><td>1</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Output after stop</td><td>Stop (E.PUE)</td></tr>
<tr><td>2</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Without output</td><td>Automatic restart functions</td></tr>
<tr><td rowspan="2">549</td><td rowspan="2">Protocol selection</td><td rowspan="2">1</td><td>0</td><td colspan="4">Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>1</td><td colspan="4">Modbus-RTU protocol</td></tr>
</table>

*1 When [*Pr.549* = 1] (Modbus-RTU protocol), setting range is the values in parentheses.

*2 For Modbus-RTU protocol, the data length is fixed to 8bit and the stop bit length is [*Pr.120*] setting. *(Refer to page 459)*

*3 Modbus-RTU protocol is invalid.

*4 The Modbus-RTU of A700 F700 is valid for only communication from the RS-485 terminals.

*5 Monitoring and parameter read are available during the communication with [*Pr.122 PU communication check time interval* =0], but inverter outputs fault as soon as operation mode is switched to NET operation mode. When operation mode is the Network operation mode at powering ON, communication error (E.PUE) occurs after first communication. To operate or write parameter using communication, set [*Pr.122* = 9999] or set a large value to [*Pr.122*]. (The setting value depends on the program of the computer.) *(Refer to page 449)*

*6 Setting value 3 is only available in E700.

[RS-485 terminal communication related parameter] A700 F700

[Pr.]	Name	Initial Value	Setting Range	Description
331	RS-485 communication station number	0	0 to 31 (0 to 247) *1	Set the inverter station number. (same specifications as [*Pr. 117*])
332	RS-485 communication speed	96	3, 6, 12, 24, 48, 96, 192, 384	select the communication speed. (same specifications as [*Pr. 118*])
333 *2	RS-485 communication stop bit length	1	0, 1, 10, 11	Select stop bit length and data length. (same specifications as [*Pr. 119*])
334	RS-485 communication parity check selection	2	0, 1, 2	Select the parity check specifications. (same specifications as [*Pr. 120*])
335 *3	RS-485 communication retry count	1	0 to 10, 9999	Set the permissible number of retries at occurrence of a data receive error. (same specifications as [*Pr. 121*])
336 *3	RS-485 communication check time interval	0s	0	RS-485 communication is enabled. However, the inverter will come to trip if operation is changed to NET operation mode.*5
			0.1 to 999.8s	Set the interval of communication check time. (same specifications as [*Pr. 122*])
			9999	No communication check
337 *3	RS-485 communication waiting time setting	9999	0 to 150ms, 9999	Set the waiting time between data transmission to the inverter and response. (same specifications as [*Pr. 123*])
341 *3	RS-485 communication CR/LF selection	1	0, 1, 2	Select presence/absence of CR/LF. (same specifications as [*Pr. 124*])
549	Protocol selection	0	0	Mitsubishi inverter (computer link operation) protocol
			1	Modbus-RTU protocol *4

*1 When [*Pr. 549 = 1*] (Modbus-RTU protocol) is set, the setting range within parenthesis is applied.

*2 For the Modbus-RTU protocol, the data length is fixed to 8 bits and the stop bit depends on the [*Pr. 334*] setting. (Refer to page 459)

*3 The Modbus-RTU protocol becomes invalid.

*4 The Modbus-RTU protocol of A700 F700 is only valid for the communication from the RS-485 terminals.

*5 If communication is made with [*Pr. 336 RS-485 communication check time interval = 0*] (initial value), monitor, parameter read, etc. can be performed, but the inverter results in an alarm as soon as it is switched to the NET operation mode. If the operation mode at power-ON is the Network operation mode, a communication alarm (E.SER) occurs after first communication.
When performing operation or parameter write through communication, set [*Pr. 336 = 9999*] or larger value. (The setting depends on the computer side program.) *(Refer to page 449)*

2.21.4 Communication EEPROM write selection [Pr. 342] (common)

When parameter write is performed from the inverter PU connector, RS-485 terminals, USB communication and communication option, parameters can be written to the RAM.
When changing the parameter values frequently, set [*Pr. 342 = 1*] to write them to the RAM.

The life of the EEPROM will be shorter if parameter write is performed frequently with [*Pr. 342 = 0*] (initial value) (EEPROM, RAM write).
When [*Pr. 342 = 1*] (write to RAM only), powering OFF the inverter will erase the changed parameter values. Therefore, the parameter values available when power is switched ON again are the values stored in EEPROM previously.

[Pr.]	Name	Initial Value	Setting Range	Description
342	Communication EEPROM write selection	0	0	Parameter values written by communication are written to the EEPROM and RAM.
			1	Parameter values written by communication are written to the RAM.

The above parameters can be set whenever the communication option is connected.

2

PARAMETER

2.21.5 Mitsubishi inverter protocol (computer link communication) (common)

You can perform parameter setting, monitor, etc. from the PU connector or RS-485 terminals of the inverter using the Mitsubishi inverter protocol (computer link communication).

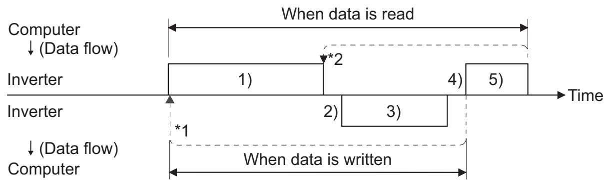
(1) Communication specifications

Item		Description	Related Parameter
Communication protocol		Mitsubishi protocol (computer link)	[Pr. 551]
Conforming standard		EIA-485 (RS-485)	—
Number of connectable devices		1: N (maximum 32 units), setting is 0 to 31 stations	[Pr. 117] [Pr. 331]
Communication speed	PU connector	Selectable from among 4800/9600/19200 and 38400bps	[Pr. 118]
	RS-485 terminals	Selectable from 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400bps	[Pr. 332]
Control procedure		Asynchronous	—
Communication method		Half-duplex	—
Communication specifications	Character system	ASCII (7 bits or 8 bits can be selected)	[Pr. 119] [Pr. 333]
	Start bit	1bit	—
	Stop bit length	1 bit or 2 bits can be selected	[Pr. 119] [Pr. 333]
	Parity check	Check (even, odd) or no check can be selected	[Pr. 120] [Pr. 334]
	Error check	Sum code check	—
	Terminator	CR/LF (presence/absence selectable)	[Pr. 124] [Pr. 341]
Waiting time setting		Selectable between presence and absence	[Pr. 123] [Pr. 337]

(2) Communication procedure

Data communication between the computer and inverter is made in the following procedure.

1) Request data is sent from the computer to the inverter. (The inverter will not send data unless requested.)
2) After waiting for the waiting time
3) The inverter sends return data to the computer in response to the computer request.
4) After waiting for the inverter data processing time
5) Answer from the computer in response to reply data 3) of the inverter is transmitted. (Even if 5) is not sent, subsequent communication is made properly.)



*1 If a data error is detected and a retry must be made, execute retry operation with the user program. The inverter comes to an alarm stop if the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the inverter returns retry data 3) to the computer again. The inverter comes to trip if the number of consecutive data errors reaches or exceeds the parameter setting.

(3) Communication operation presence/absence and data format types

- Data communication between the computer and inverter is made in ASCII code (hexadecimal code).
- Communication operation presence/absence and data format types are as follows:

<table>
<tr><th>No.</th><th colspan="2">Operation</th><th>Run Command</th><th>Operation Frequency</th><th>Multi command*5</th><th>Parameter Write</th><th>Inverter Reset</th><th>Monitor</th><th>Parameter Read</th></tr>
<tr><td>1)</td><td colspan="2">Communication request is sent to the inverter in accordance with the user program in the computer.</td><td>A, A1</td><td>A, A2 *3</td><td>A3</td><td>A, A2 *3</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>2)</td><td colspan="2">Inverter data processing time</td><td>Present</td><td>Present</td><td>Present</td><td>Present</td><td>Present</td><td>Present</td><td>Present</td></tr>
<tr><td rowspan="2">3)</td><td rowspan="2">Reply data from the inverter (Data 1) is checked for error)</td><td>No error *1 (Request accepted)</td><td>C</td><td>C</td><td>C1*4</td><td>C</td><td>C *2</td><td>E, E1, E2, E3 *3</td><td>E, E2 *3</td></tr>
<tr><td>With error (Request rejected)</td><td>D</td><td>D</td><td>D</td><td>D</td><td>D *2</td><td>D</td><td>D</td></tr>
<tr><td>4)</td><td colspan="2">Computer processing delay time</td><td colspan="7">10ms or more</td></tr>
<tr><td rowspan="2">5)</td><td rowspan="2">Answer from computer in response to reply data 3). (Data 3) is checked for error)</td><td>No error *1 (No inverter processing)</td><td>Absent</td><td>Absent</td><td>Absent (C)</td><td>Absent</td><td>Absent</td><td>Absent (C)</td><td>Absent (C)</td></tr>
<tr><td>With error (Inverter outputs 3) again.)</td><td>Absent</td><td>Absent</td><td>F</td><td>Absent</td><td>Absent</td><td>F</td><td>F</td></tr>
</table>

*1 In the communication request data from the computer to the inverter, 10ms or more is also required after "no data error (ACK)". (*Refer to page Refer to page 447)*

*2 Reply from the inverter to the inverter reset request can be selected. *(Refer to page 452)*

*3 When any of "0.01 to 9998" is set in [*Pr.37*] and "01" is set in the instruction code HHF in E700 D700, data format is A2 or E2. In addition, data formats are always A2 and E2 for read or write of [*Pr.37*].

*4 At mode error, and data range error, C1 data contains an error code. *(Refer to page 458)* Except for those errors, the error is returned with data format D.

*5 Multi command is available only in D700.

- Data writing format

Communication request data from the computer to the inverter 1)

<table>
<tr><th rowspan="2">Format</th><th colspan="19">Number of Characters</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th></tr>
<tr><td>A</td><td>ENQ *1</td><td colspan="2">Inverter station number *2</td><td colspan="2">Instruction code</td><td>*3</td><td colspan="4">Data</td><td colspan="2">Sum check</td><td>*4</td><td colspan="6"></td></tr>
<tr><td>A1</td><td>ENQ *1</td><td colspan="2">Inverter station number *2</td><td colspan="2">Instruction code</td><td>*3</td><td colspan="2">Data</td><td colspan="2">Sum check</td><td>*4</td><td colspan="8"></td></tr>
<tr><td>A2</td><td>ENQ *1</td><td colspan="2">Inverter station number *2</td><td colspan="2">Instruction code</td><td>*3</td><td colspan="6">Data</td><td colspan="2">Sum check</td><td>*4</td><td colspan="4"></td></tr>
<tr><td>A3</td><td>ENQ *1</td><td colspan="2">Inverter station number *2</td><td colspan="2">Instruction code</td><td>*3</td><td>Send data type</td><td>Receive data type</td><td colspan="4">Data1</td><td colspan="4">Data2</td><td colspan="2">Sum check</td><td>*4</td></tr>
</table>

Reply data from the inverter to the computer 3) (No data error detected)

<table>
<tr><th rowspan="2">Format</th><th colspan="19">Number of Characters</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th></tr>
<tr><td>C</td><td>ACK *1</td><td colspan="2">Inverter station number *2</td><td>*4</td><td colspan="15"></td></tr>
<tr><td>C1</td><td>STX *1</td><td colspan="2">Inverter station number *2</td><td>Send data type</td><td>Receive data type</td><td>Error code 1</td><td>Error code 2</td><td colspan="4">Data1</td><td colspan="4">Data2</td><td>ETX *1</td><td colspan="2">Sum check</td><td>*4</td></tr>
</table>

2

PARAMETER

Reply data from the inverter to the computer 3) (With data error)

Format	Number of Characters				
	1	2	3	4	5
D	NAK *1	Inverter station number *2		Error code	*4

*1 Indicate a control code

*2 Specify the inverter station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.

*3 Set waiting time. When the [*Pr. 123, 337 (waiting time setting)*] is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

*4 CR, LF code
When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Whether the CR and LF codes will be present or absent can be selected using [*Pr. 124, 341 (CR, LF selection)*].

• Data reading format

Communication request data from the computer to the inverter 1)

Format	Number of Characters								
	1	2	3	4	5	6	7	8	9
B	ENQ *1	Inverter station number *2		Instruction code		*3	Sum check		*4

Reply data from the inverter to the computer 3) (No data error detected)

Format	Number of Characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
E	STX *1	Inverter station number *2		Read data				ETX *1	Sum check		*4		
E1	STX *1	Inverter station number *2		Read data		ETX *1	Sum check		*4				
E2	STX *1	Inverter station number *2		Read data						ETX *1	Sum check		*4

Format	Number of Characters							
	1	2	3	4 to 23	24	25	26	27
E3	STX *1	Inverter station number *2		Read data (Inverter type information)	ETX *1	Sum check		*4

Reply data from the inverter to the computer 3) (With data error)

Format	Number of Characters				
	1	2	3	4	5
D	NAK *1	Inverter station number *2		Error code	*4

Send data from the computer to the inverter 5)

Format	Number of Characters			
	1	2	3	4
C (Without data error)	ACK *1	Inverter station number *2		*4
F (With data error)	NAK *1	Inverter station number *2		*4

*1 Indicate a control code

*2 Specify the inverter station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.

*3 Set waiting time. When the [*Pr. 123, 337 (waiting time setting)*] is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

*4 CR, LF code
When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Whether the CR and LF codes will be present or absent can be selected using [*Pr. 124, 341 (CR, LF selection)*].

(4) Data definitions

1) Control codes

Signal Name	ASCII Code	Description
STX	H02	Start of Text (start of data)
ETX	H03	End of Text (end of data)
ENQ	H05	Enquiry (communication request)
ACK	H06	Acknowledge (no data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (data error detected)

2) Inverter station number
Specify the station number of the inverter which communicates with the computer.

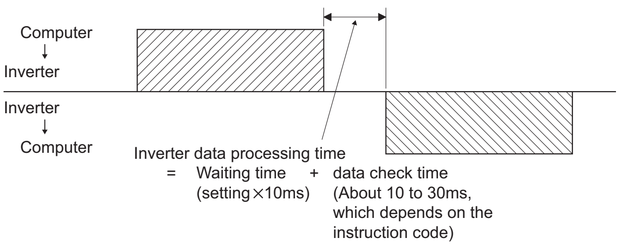
3) Instruction code
Specify the processing request, e.g. operation or monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 452)

4) Data
Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 452)

5) Waiting time
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments. (e.g. 1 = 10ms, 2 = 20ms).

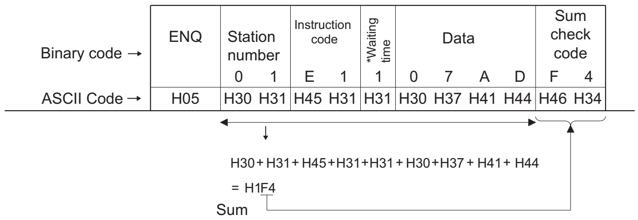
When the [*Pr. 123, Pr. 337 Waiting time setting* $\neq$ *9999*], create the communication request data without waiting time in the data format. (The number of characters decreases by 1.)

The data check time changes depending on the instruction code. (Refer to page 448)



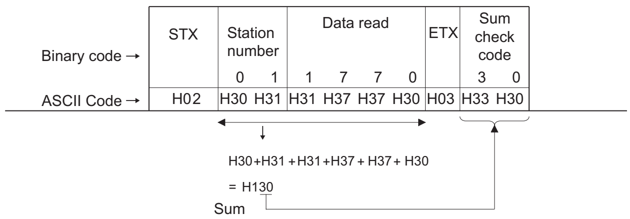
6) Sum check code
The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.

[Example 1] Computer → inverter



* When the [*Pr. 123, 337 Waiting time setting* $\neq$ *9999*], create the communication request data without waiting time in the data format.

[Example 2] Computer → inverter

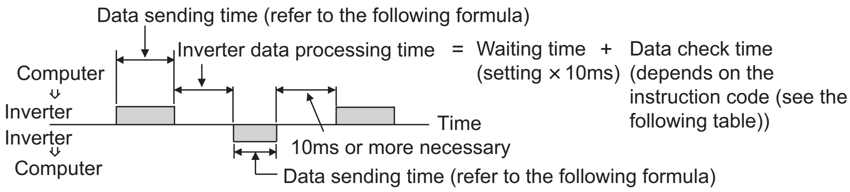


7) Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code.

Error Code	Error Item	Error Description	Inverter Side Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to trip (E. PUE/ E.SER) if error occurs continuously more than the allowable number of retry times.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
H3	Protocol error	The data received by the inverter has a grammatical mistake. Alternatively, data receive is not completed within the predetermined time. CR or LF is not as set in the parameter.	
H4	Framing error	The stop bit length differs from the initial setting.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted the computer link operation mode, operation command source is not selected or inverter operation.	Does not accept received data
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
HD	—	—	—
HE	—	—	—
HF	—	—	—

(5) Response time



[Formula for data sending time]

$$\frac{1}{\text{Communication speed (bps)}} \times \begin{matrix}\text{Number of data}\\ \text{characters}\\ \text{(Refer to page 438)}\end{matrix} \times \begin{matrix}\text{Communication specifications}\\ \text{(total number of bits)}\\ \text{(Refer to the following.)}\end{matrix} = \text{Data send time (s)}$$

●Communication specifications

Name		Number of Bits
Stop bit length		1 bits 2 bits
Data length		7 bits 8 bits
Parity check	Yes	1 bits
	No	0

In addition to the above, 1 start bit is necessary.
Minimum number of total bits 9 bits
Maximum number of total bits12 bits

●Data check time

Item	Check Time
Various monitors, run command, Set frequency (RAM)	< 12ms
Parameter read/write, frequency setting (EEPROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	No answer

(6) Retry count setting [*Pr. 121, 335*]

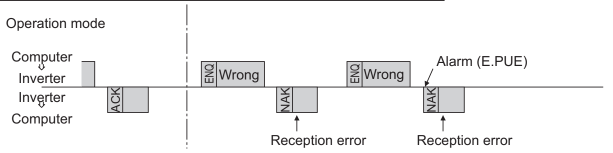
Set the permissible number of retries at data receive error occurrence. (Refer to page 448 for data receive error for retry)

When data receive errors occur consecutively and exceed the permissible number of retries set, an inverter trip (E.PUE) may occur and stops the motor.

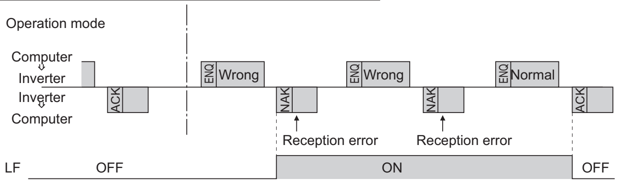
When 9999 is set, an inverter fault is not provided even if data receive error occurs but an alarm output signal (LF) is output.

For the terminal used for the LF signal output, assign the function by setting 98 (positive logic) or 198 (negative logic) in any of [*Pr. 190 to Pr. 196 Output terminal function selection*].

Example: PU connector communication, [*Pr. 121* = 1] (initial value)



Example: PU connector communication, [*Pr. 121* = 9999]



(7) Signal loss detection (RS-485 communication check time interval) [*Pr. 122, 336*]

If a signal loss (communication stop) is detected between the inverter and computer as a result of a signal loss detection, a communication fault (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter trips.

A signal loss detection is made when the setting is any of 0.1 to 999.8s. To make a signal loss detection, it is necessary to send data (control code: refer to page 447) from the computer within the communication check time interval. (The inverter makes communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).

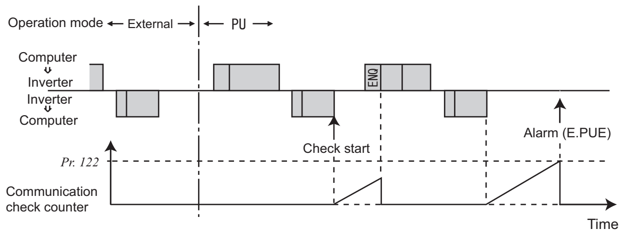
Communication check is started at the first communication in the operation mode having the operation source (PU operation mode for PU connector communication in the default setting or network operation mode for RS-485 terminal communication).

When the setting is 9999, communication check (signal loss detection) is not made. If communication is broken due to signal cable breakage, computer fault etc., the inverter does not detect such a fault. This should be fully noted. It is recommended to set the communication check time interval before starting operation to prevent hazardous conditions.

When the setting is 0 in A700 F700, communication from the PU connector cannot be performed. For communication via the RS-485 terminals, monitor, parameter read, etc. can be performed, but a communication error (E.SER) occurs as soon as the inverter is switched to the network operation mode.

When the setting is 0 (initial value) in E700 D700, communication from RS-485 can be performed, however, communication error (E.PUE) would occur if switched to another operation mode with command source (NET mode at initial setting).

Example: PU connector communication, [*Pr. 122* = 0.1 to 999.8s]



⚠ CAUTION

⚠ **Always set the communication check time interval before starting operation to prevent hazardous conditions. Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter trips (E.PUE).**
The inverter can be coasted to a stop by turning ON its RES signal or by switching power OFF.

⚠ **If communication is broken due to signal cable breakage, computer fault, etc, the inverter does not detect such a fault. This should be fully noted.**

(8) Stop operation selection at occurrence of communication fault *(Pr. 502)* (E700)(D700)

Stop operation when retry count exceeds (Mitsubishi inverter protocol only) or signal loss detection error occurs can be selected.
The fault output indicates fault output signal (ALM signal) or alarm bit output.
When the setting was made to provide a fault output, the fault description is stored into the faults history. (The fault description is written to the faults history when a fault output is provided.)
When no fault output is provided, the fault definition overwrites the fault indication of the faults history temporarily, but is not stored.
After the fault is removed, the fault indication returns to the ordinary monitor, and the faults history returns to the preceding fault indication.
When the [*Pr. 502*] setting is "1 or 2", the deceleration time is the ordinary deceleration time setting ([*Pr. 8, Pr. 44, Pr. 45*]). In addition, acceleration time for restart is the normal acceleration time ([*Pr. 7, Pr. 44*]).
When "2" is set in [*Pr. 502*], run command/speed command at restart follows the command before an fault occurrence.
When "2" is set in [*Pr. 502*] at occurrence of a communication error and the error is removed during deceleration, the inverter accelerates again at that point.

Operation at fault occurrence

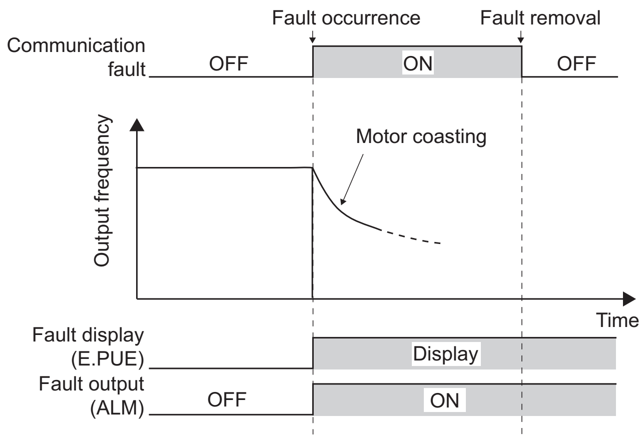
Pr. 502 Setting	Operation	Indication	Fault Output
0 (initial value), 3*	Coasts to stop	E. PUE lit	Provided
1	Decelerates to stop	E. PUE lit after stop	Provided after stop
2			Not provided

Operation at fault removal

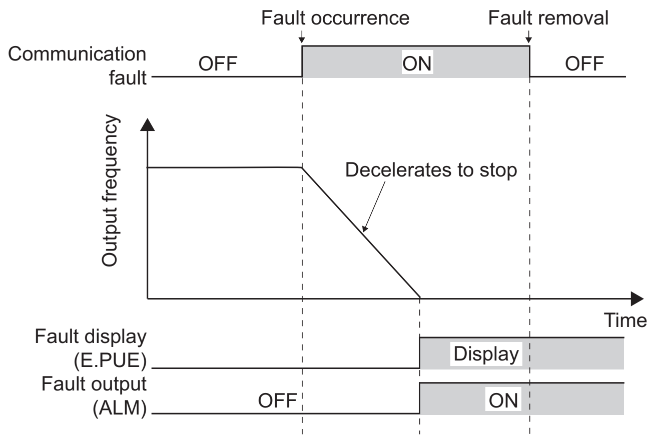
Pr.502 Setting	Operation	Indication	Fault Output
0 (initial value), 3*	Kept stopped	E. PUE	Kept provided
1			
2	Automatic restart functions	Normal display	Not provided

* Setting value 3 is only available in (E700).

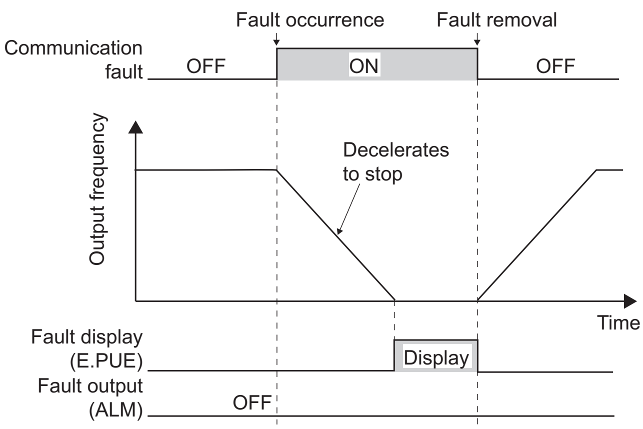
●[*Pr. 502*] setting "0" (initial value)



●[*Pr. 502*] setting "1"



●[*Pr. 502*] setting "2"

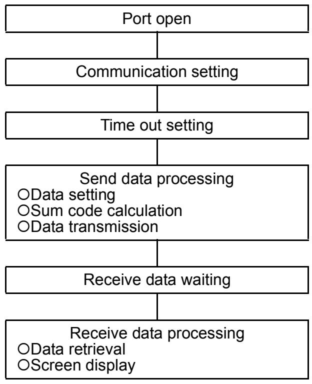


(9) Instructions for the program

1) When data from the computer has any error, the inverter does not accept that data. Hence, in the user program, always insert a retry program for data error.
2) All data communication, e.g. run command or monitoring, are started when the computer gives a communication request. The inverter does not return any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
3) Program example
   When switching the operation mode to NET operation.

Programming example of Microsoft® Visual C++® (Ver.6.0)

General flowchart




```
#include <stdio.h>
#include <windows.h>

void main(void){
    HANDLE          hCom;           //Communication handle
    DCB             hDcb;           //Structure for communication setting
    COMMTIMEOUTS        hTim;       // Structure for time out setting

    char            szTx[0x10];             // Send buffer
    char            szRx[0x10];             // Receive buffer
    char            szCommand[0x10];// Command
    int             nTx,nRx;                // For buffer size storing
    int             nSum;                   // For sum code calculation
    BOOL            bRet;
    int             nRet;
    int             i;

    //**** Opens COM1 port****
    hCom = CreateFile ("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
    if (hCom != NULL) {
        //**** Makes a communication setting of COM1 port****
        GetCommState(hCom,&hDcb);                       // Retrieves current communication information
        hDcb.DCBlength = sizeof(DCB);                   // Structure size setting
        hDcb.BaudRate  = 19200;                         // Communication speed=19200bps
        hDcb.ByteSize  = 8;                             // Data length=8bit
        hDcb.Parity    = 2;                             // Even parity
        hDcb.StopBits  = 2;                             // Stop bit=2bit
        bRet = SetCommState(hCom,&hDcb);                // Sets the changed communication data
        if (bRet == TRUE) {
            //**** Makes a time out setting of COM1 port****
            Get CommTimeouts(hCom,&hTim);               // Obtains the current time out value
            hTim.WriteTotalTimeoutConstant = 1000;      // Write time out 1s
            hTim.ReadTotalTimeoutConstant  = 1000;      // Read time out 1s
            SetCommTimeouts(hCom,&hTim);                // Changed time out value setting
            //**** Sets the command to switch the operation mode of the station 1 inverter to the network operation mode ****
            sprintf(szCommand,"01FB10000");             // Send data (NET operation write)
            nTx = strlen(szCommand);                    //Send data size
            //**** Generates sum code****
            nSum = 0;                                   // Initialization of sum data
            for (i = 0;i < nTx;i++) {
                nSum += szCommand[i];                   // Calculates sum code
                nSum &= (0xff);                         // Masks data
            }

            //**** Generates send data****
            memset(szTx,0,sizeof(szTx));                // Initialization of send buffer
            memset(szRx,0,sizeof(szRx));                // Initialization of receive buffer
            sprintf(szTx,"\5%s%02X",szCommand,nSum);// ENQ code+send data+sum code
            nTx = 1 + nTx + 2;                          // Number of ENQ code+number of send data+number of sum code

            nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
            //**** Sending ****
            if(nRet != 0) {
                nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
            //**** Receiving ****
                if(nRet != 0) {
                    //**** Displays the receive data ****
                    for(i = 0;i < nRx;i++) {
                        printf("%02X ",(BYTE)szRx[i]);// Consol output of receive data
                        // Displays ASCII coder in hexadecimal. Displays 30 when "0"
                    }
                    printf("\n\r");
                }
            }
        }
        CloseHandle(hCom);                              // Close communication port
    }
}
```

(10) Setting items and set data

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Read/ Write</th><th>Instruction Code</th><th>Data Description</th><th>Number of Data Digits *1 (format)</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Operation mode</td><td>Read</td><td>H7B</td><td rowspan="2">H0000: Network operation
H0001: External operation
H0002: PU operation (RS-485 communication operation via PU connector)</td><td>4 digits
(B, E/D)</td></tr>
<tr><td>Write</td><td>HFB</td><td>4 digits
(A, C/D)</td></tr>
<tr><td rowspan="7">2</td><td rowspan="7">Monitor</td><td>Output frequency /speed</td><td>Read</td><td>H6F</td><td>H0000 to HFFFF: Output frequency in 0.01Hz increments
A700 F700
Speed 1r/min increments or 0.1r/min increments
E700 D700
Speed increment 1/0.001 (when [Pr. 37=0.01 to 9998]).
When [Pr. 37] setting is any of 0.01 to 9999 and "01" is set to the instruction code HHF, increment is 0.001, and the data format is E2.
When [Pr. 52=100], monitored values differ during a stop and during a run.
(Refer to page 343 for details)</td><td>4 digits
(B, E/D)
6 digits
(B, E2/D)</td></tr>
<tr><td>Output current</td><td>Read</td><td>H70</td><td>H0000 to HFFFF: Output current (hexadecimal)
0.01A increments (55K or less)/0.1A increments (75K or more)</td><td>4 digits
(B, E/D)</td></tr>
<tr><td>Output voltage</td><td>Read</td><td>H71</td><td>H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments</td><td>4 digits
(B, E/D)</td></tr>
<tr><td>Special monitor</td><td>Read</td><td>H72</td><td>H0000 to HFFFF: Monitor data selected in instruction code HF3</td><td>4 digits
(B, E/D)
6 digits
(B, E2/D)</td></tr>
<tr><td rowspan="2">Special monitor selection No.</td><td>Read</td><td>H73</td><td rowspan="2">H01 to H3C: Monitor selection data
Refer to the special monitor No. table (page 455)</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HF3 *3</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td>Fault description</td><td>Read</td><td>H74 to H77</td><td>H0000 to HFFFF: Two latest fault definitions.
<table><tr><th></th><th>b15 … b8</th><th>b7 … b0</th></tr><tr><td>H74</td><td>Second fault in past</td><td>Latest fault</td></tr><tr><td>H75</td><td>Fourth fault in past</td><td>Third fault in past</td></tr><tr><td>H76</td><td>Sixth fault in past</td><td>Fifth fault in past</td></tr><tr><td>H77</td><td>Eighth fault in past</td><td>Seventh fault in past</td></tr></table>Refer to the fault data table (page 456)</td><td>4 digits
(B, E/D)</td></tr>
<tr><td rowspan="2">3</td><td colspan="2">Run command (expansion)</td><td>Write</td><td>HF9</td><td rowspan="2">Sets control input commands such as the forward rotation signal (STF) and reverse rotation signal (STR). (Refer to page 457 for details)</td><td>4 digits
(A, C/D)</td></tr>
<tr><td colspan="2">Run command</td><td>Write</td><td>HFA</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td rowspan="2">4</td><td colspan="2">Inverter status monitor (expansion)</td><td>Read</td><td>H79</td><td rowspan="2">Monitors the states of the output signals such as forward rotation, reverse rotation and inverter running (RUN). (Refer to page 458 for details)</td><td>4 digits
(B, E/D)</td></tr>
<tr><td colspan="2">Inverter status monitor</td><td>Read</td><td>H7A</td><td>2 digits
(B, E1/D)</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Read/ Write</th><th>Instruction Code</th><th>Data Description</th><th>Number of Data Digits *1 (format)</th></tr>
<tr><td rowspan="4">5</td><td>Set frequency (RAM)</td><td rowspan="2">Read</td><td>H6D</td><td rowspan="2">Reads set frequency/speed from RAM or EEPROM.
H0000 to HFFFF: Set frequency in 0.01Hz increments
A700 F700
Speed 1r/min increments or 0.1r/min increments.
E700 D700
Speed increment is 1/0.001 (when [Pr. 37=0.01 to 9998]).
When [Pr. 37] setting is any of 0.01 to 9999 and "01" is set to the instruction code HHF, increment is 0.001, and the data format is E2.
(Refer to page 343 for details)</td><td rowspan="2">4 digits
(B, E/D)
6 digits
(B, E2/D)</td></tr>
<tr><td>Set frequency (EEPROM)</td><td>H6E</td></tr>
<tr><td>Set frequency (RAM)</td><td rowspan="2">Write</td><td>HED</td><td rowspan="2">Write set frequency/speed to RAM or EEPROM.
H0000 to H9C40 (0 to 400.00Hz) : Frequency 0.01Hz increments
A700 F700
H0000 to H270E (0 to 9998r/min) : Speed 1 r/min increments
H0000 to H8CA0 (0 to 3600.0r/min) : Speed 0.1r/min increments (2, 4poles)
H0000 to H5DC0 (0 to 2400.0r/min) : Speed 0.1 r/min increments (6 poles)
H0000 to H4650 (0 to 1800.0r/min) : Speed 0.1r/min increments (8poles)
H0000 to H2EE0 (0 to 1200.0r/min) : Speed 0.1r/min increments (10poles)
E700 D700
Speed increment is 1/0.001 (when [Pr. 37=0.01 to 9998]).
When a value from 0.01 to 9999 is set to [Pr. 37] and "01" is set to the instruction code HHF, increment is 0.001, and the data format is A2.
(Refer to page 343 for details)
• To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: HED)</td><td rowspan="2">4 digits
(A, C/D)
6 digits
(A2, C/D)</td></tr>
<tr><td>Set frequency (RAM, EEPROM)</td><td>HEE</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Inverter reset</td><td rowspan="2">Write</td><td rowspan="2">HFD</td><td>H9696: Resets the inverter.
• As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.</td><td>4 digits
(A, C/D)</td></tr>
<tr><td>H9966: Resets the inverter.
• When data is sent normally, ACK is returned to the computer and then the inverter is reset.</td><td>4 digits
(A, D)</td></tr>
<tr><td>7</td><td>Fault definition all clear</td><td>Write</td><td>HF4</td><td>H9696: Fault history batch clear</td><td>4 digits
(A, C/D)</td></tr>
<tr><td>8</td><td>Parameter clear
All parameter clear</td><td>Write</td><td>HFC</td><td>All parameters return to the initial values.
Whether to clear communication parameters or not can be selected according to data. (○: Clear, ×: Not clear)
Refer to page 120 for parameter clear, all clear, and communication parameters.
<table><tr><th>Clear Type</th><th>Data</th><th>Communication Pr.</th></tr><tr><td rowspan="2">Parameter clear</td><td>H9696</td><td>○</td></tr><tr><td>H5A5A</td><td>×</td></tr><tr><td rowspan="2">All parameter clear</td><td>H9966</td><td>○</td></tr><tr><td>H55AA</td><td>×</td></tr></table>When clear is executed for H9696 or H9966, communication-related parameter settings also return to the initial values. When resuming operation, set the parameters again.
Executing clear will clear the instruction code HEC, HF3, and HFF settings.
All parameter clear can be performed by H9966 and H55AA during password lock.</td><td>4 digits
(A, C/D)</td></tr>
<tr><td>9</td><td rowspan="2">Parameter</td><td>Read</td><td>H00 to H6B</td><td rowspan="2">Refer to the instruction code (page 120) and write and/or read parameter values as required. *2
When setting [Pr. 100] and later, set link parameter expansion setting.
In E700 D700, data formats for [Pr. 37] read and write are E2 and A2.</td><td>4 digits
(B, E/D)
6 digits
(B, E2/D)</td></tr>
<tr><td>10</td><td>Write</td><td>H80 to HEB</td><td>4 digits
(A, C/D)
6 digits
(A2, C/D)</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">Link parameter expansion setting</td><td>Read</td><td>H7F</td><td rowspan="2">Set any of H00 to H09 to change the parameter settings.
For details of the settings, refer to the instruction code (page 120) .</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HFF *3</td><td>2 digits
(A1, C/D)</td></tr>
</table>

No.	Item		Read/ Write	Instruction Code	Data Description	Number of Data Digits *1 (format)
12	Second parameter changing (instruction code HFF = 1, 9)		Read	H6C	Setting calibration parameter *5 H00: Frequency *6 H01: Parameter-set analog value H02: Analog value input from terminal *5 Refer to the list of calibration parameters below for calibration parameters. *6 The gain frequency can be written using [*P. 125*] (instruction code H99) or [*Pr. 126*] (instruction code H9A) also.	2 digits (B, E1/D)
			Write	HEC *3		2 digits (A1, C/D)
13*4	Multi command		Write/ Read	HF0	Available for writing 2 commands, and monitoring 2 items for reading data (*Refer to page 458* for detail)	10 digits (A3, C1/D)
14*4	Inverter type monitor	Inverter type	Read	H7C	Reading inverter type in ASCII code. "H20" (blank code) is set for blank area Example of FR-D740 H46, H52, H2D, H44, H37, H34, H30, H20.. H20	20 digits (B, E3/D)
		Capacity	Read	H7D	Reading inverter capacity in ASCII code. Data is read in increments of 0.1kW, and rounds down to 0.01kW increments "H20" (blank code) is set for blank area Example 0.4K................. " 4" (H20, H20, H20, H20, H20, H34) 0.75K............... " 7" (H20, H20, H20, H20, H20, H37)	6 digits (B, E2/D)

*1 *Refer to page 438* for data format.
*2 Set 65520 (HFFF0) as a parameter value 8888 and 65535 (HFFFF) as 9999.
*3 For the instruction codes HFF, HEC and HF3, their values are held once written but cleared to zero when an inverter reset or all clear is performed.
*4 Setting is available for only D700.

[Example] When reading the [*C3 (Pr. 902)*] and [*C6 (Pr. 904)*] settings from the inverter of station 0

	Computer Send Data	Inverter Send Data	Description
1)	ENQ 00 FF 0 01 82	ACK 00	Set H01 to the expansion link parameter.
2)	ENQ 00 EC 0 01 7E	ACK 00	Set H01 to second parameter changing.
3)	ENQ 00 5E 0 0F	STX 00 0000 ETX 25	[*C3(Pr. 902)*] is read. 0% is read.
4)	ENQ 00 60 0 FB	STX 00 0000 ETX 25	[*C6(Pr. 904)*] is read. 0% is read.

To read/write [*C3 (Pr. 902)*] and [*C6 (Pr. 904)*] after inverter reset or parameter clear, execute from 1) again.

●List of calibration parameters

[Pr.]	Name	Instruction Code		
		Read	Write	Expansion
C2 (902)	Terminal 2 frequency setting bias frequency	5E	DE	1
C3 (902)	Terminal 2 frequency setting bias	5E	DE	1
125 (903)	Terminal 2 frequency setting gain frequency	5F	DF	1
C4 (903)	Terminal 2 frequency setting gain	5F	DF	1
C5 (904)	Terminal 4 frequency setting bias frequency	60	E0	1
C6 (904)	Terminal 4 frequency setting bias	60	E0	1
126 (905)	Terminal 4 frequency setting gain frequency	61	E1	1
C7 (905)	Terminal 4 frequency setting gain	61	E1	1
C12 (917)	Terminal 1 bias frequency (speed)	11	91	9
C13(917) *1	Terminal 1 bias (speed)	11	91	9

*1 These are not available for F700 E700 D700.
*2 These are not available for A700 F700.

[Pr.]	Name	Instruction Code		
		Read	Write	Expansion
C14 (918) *1	Terminal 1 gain frequency (speed)	12	92	9
C15 (918) *1	Terminal 1 gain (speed)	12	92	9
C16 (919) *1	Terminal 1 bias command (torque/magnetic flux)	13	93	9
C17 (919) *1	Terminal 1 bias (torque/magnetic flux)	13	93	9
C18 (920) *1	Terminal 1 gain command (torque/ magnetic flux)	14	94	9
C19 (920) *1	Terminal 1 gain (torque/magnetic flux)	14	94	9
C22 (922) *2	Frequency setting voltage bias frequency (built-in potentiometer)	16	96	9
C23 (922) *2	Frequency setting voltage bias (built-in potentiometer)	16	96	9
C24 (923) *2	Frequency setting voltage gain frequency (built-in potentiometer)	17	97	9
C25 (923) *2	Frequency setting voltage gain (built-in potentiometer)	17	97	9
C38 (932) *1	Terminal 4 bias command (torque/ magnetic flux)	20	A0	9
C39 (932) *1	Terminal 4 bias (torque/magnetic flux)	20	A0	9
C40 (933) *1	Terminal 4 gain command (torque/ magnetic flux)	21	A1	9
C41 (933) *1	Terminal 4 gain (torque/magnetic flux)	21	A1	9

[Special monitor selection No.]

Refer to page 346 for details of the monitor description

Data	Description		Increments
H01	A700 F700	Output frequency/speed *11	0.01Hz/1
	E700 D700	Output frequency/speed *12	0.01Hz/ 1(0.001)
H02	Output current		0.01A/ 0.1A *1
H03	Output voltage		0.1V
H05	A700 F700	Frequency setting/speed *11	0.01Hz/1
	E700 D700	Frequency setting/speed *12	0.01Hz/ 1(0.001)
H06*9*10	Running speed		1r/min
H07*8*10	Motor torque		0.1%
H08	Converter output voltage		0.1V
H09	Regenerative brake duty		0.1%
H0A	Electronic thermal relay function load factor		0.1%
H0B	Output current peak value		0.01A/0.1A *1
H0C	Converter output voltage peak value		0.1V
H0D*9*10	Input power		0.01kWh/ 0.1kW *1
H0E	Output power		0.01kWh/ 0.1kW *1
H0F	Input terminal status *2		—
H10	Output terminal state *3		—
H11*9*10	Load meter		0.1%
H12*8*9*10	Motor excitation current		0.01A/ 0.1A *1

Data	Description	Increments
H13*8*9*10	Position pulse	—
H14	Cumulative energization time	1h
H16*8*9*10	Orientation status	—
H17	Actual operation time	1h
H18	Motor load factor	0.1%
H19	Cumulative power	1kWh
H20*8*9*10	Torque command	0.1%
H21*8*9*10	Torque current command	0.1
H22*8*9*10	Motor output	0.01kWh/ 0.1kW *1
H23*8*9*10	Feedback pulse	—
H32*9*10	Power saving effect	Variable
H33*9*10	Cumulative saving power	Variable
H34	PID set point	0.1%
H35	PID measured value	0.1%
H36	PID deviation	0.1%
H3A*8*10	Option input terminal status 1 *4	—
H3B*8*10	Option input terminal status 2 *5	—
H3C*8*10	Option output terminal status 2 *6	—
H3D*7*8	Motor thermal load factor	0.1%
H3E*7*8	Inverter thermal load factor	0.1%
H3F*7*8*9	Cumulative power 2	0.01kWh
H40*7*8*9	PTC thermistor resistance	0.01kΩ

*1 The setting depends on the inverter capacity. (55K or less/75K or more)

*2 Input terminal monitor details

A700 F700

b15															b0
—	—	—	—	CS	RES	STOP	MRS	JOG	RH	RM	RL	RT	AU	STR	STF

E700

b15															b0
—	—	—	—	—	RES	—	MRS	—	RH	RM	RL	—	—	STR	STF

D700

b15															b0
—	—	—	—	—	—	—	—	—	RH	RM	RL	—	—	STR	STF

*3 Output terminal monitor details

A700 F700

b15															b0
—	—	—	—	—	—	—	—	—	ABC2	ABC1	FU	OL	IPF	SU	RUN

E700

b15															b0
—	—	—	—	—	—	—	—	—	—	ABC	FU	—	—	—	RUN

D700

b15															b0
—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 Details of option input terminal monitor 1 (input terminal status of FR-A7AX)-all terminals are OFF when an option is not fitted

b15															b0
X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

*5 Details of option input terminal monitor 2 (input terminal status of FR-A7AX)-all terminals are OFF when an option is not fitted

b15															b0
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	DY

*6 Details of option output terminal monitor (output terminal status of FR-A7AY/A7AR)--all terminals are OFF when an option is not fitted.

b15															b0
—	—	—	—	—	—	RA3	RA2	RA1	Y6	Y5	Y4	Y3	Y2	Y1	Y0

*7 These are not available for A700.

*8 These are not available for F700.

*9 These are not available for E700.

*10 These are not available for D700.

*11 Increment is 1 when [*Pr. 37*=1 to 9998] or [*Pr. 144*=2 to 10, 102 to 110] in A700 F700.(*Refer to page 343*)

*12 Data format is in 6 digits (E2) when [*Pr. 37*=0.01 to 9998] and "01" is set to the instruction code HHF in E700 D700.

[Fault data]

Refer to page 97 for details of fault description.

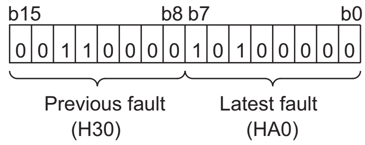
Data	Description
H00	No fault present
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM
H40	E.FIN
H50*3*4	E.IPF
H51*3*4	E.UVT
H52	E.ILF
H60	E.OLT
H70	E.BE
H80	E.GF
H81	E.LF
H90	E.OHT

Data	Description
H91*3	E.PTC
HA0*3*4	E.OPT
HA1*1*4	E.OP1
HA3*2*3*4	E.OP3
HB0	E.PE
HB1	E.PUE
HB2	E.RET
HB3*3*4	E.PE2
HC0	E.CPU
HC1*3*4	E.CTE
HC2*3*4	E.P24
HC4*3	E.CDO
HC5	E.IOH
HC6*3*4	E.SER
HC7	E.AIE
HC8 *2*4	E.USB
HC9 *1*2*3	E.SAF
HD0*2*3*4	E.OS

Data	Description
HD1*2*3*4	E.OSD
HD2*2*3*4	E.ECT
HD3*2*3*4	E.OD
HD5*2*3*4	E.MB1
HD6*2*3*4	E.MB2
HD7*2*3*4	E.MB3
HD8 *2*4	E.MB4
HD9 *2*4	E.MB5
HDA *2*4	E.MB6
HDB *2*4	E.MB7
HDC *2*3*4	E.EP
HF1*4	E. 1
HF2 *2*3*4	E. 2
HF3 *2*3*4	E. 3
HF6*4	E. 6
HF7*3*4	E. 7
HFB *2*3*4	E. 11
HFD*4	E. 13

Fault definition display example (instruction code H74)

For read data H30A0
(Previous fault ...... THT)
(Latest fault ...... OPT)



*1 These are not available for A700.

*2 These are not available for F700.

*3 These are not available for E700.

*4 These are not available for D700.

[Run command]

Item	Instruction Code	Bit Length	Description	Example
Run command	HFA	8bit	b0: AU (current input selection) *1 b1: forward rotation command *5 b2: reverse rotation command *5 b3: RL (low speed command) *1 b4: RM (middle speed command) *1 b5: RH (high speed command) *1 b6: RT (Second function selection) *1 b7: MRS (output stop) *1	[Example 1] H02 Forward rotation b7 ... b0 0 0 0 0 0 0 1 0 [Example 2] H00 Stop b7 ... b0 0 0 0 0 0 0 0 0
Run command (expansion)	HF9	16bit	b0: AU (current input selection) *1 b1: forward rotation command *5 b2: reverse rotation command *5 b3: RL (low speed command) *1 b4: RM (middle speed command) *1 b5: RH (high speed command) *1 b6: RT (Second function selection) *1 b7: MRS (output stop) *1 b8: JOG (JOG operation) *2 *3 *4 b9: CS (selection of automatic restart after instantaneous power failure) *2 *3 *4 b10: STOP (start self-holding) *2 *3 *4 b11: RES (reset) *2 *4 b12: - b13: - b14: - b15: -	[Example 1] H0002 Forward rotation b15 ... b0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 [Example 2] H0800 low speed operation (When [*Pr. 189 RES terminal function selection*] is set to "0") b15 ... b0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

*1 The signal within parentheses is the default setting. Descriptions change according to the [*Pr. 180 to Pr. 184, Pr. 187 Input terminal function selection*].

*2 The signal within parentheses is the default setting. Since Jog operation/automatic restart after instantaneous power failure/ start self-holding/ reset cannot be controlled by the network, bit 8 to bit 11 are invalid in the initial status. When using bit 8 to bit 11, change the signals with [*Pr. 185, Pr. 186, Pr. 188, Pr. 189 Input terminal function selection*]. (Reset can be executed with the instruction code HFD)

*3 These are not available for E700.

*4 These are not available for D700.

*5 When performing RS-485 communication from the PU connector of A700 F700, only forward and reverse rotation can be used. When [*Pr. 551 PU mode operation command source selection* = 2] is set in E700 D700, only forward and reverse rotation can be used.

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[Inverter status monitor]

Item	Instruction Code	Bit Length	Description	Example
Inverter status monitor	H7A	8bit	b0: RUN (inverter running) *1 b1: Forward rotation b2: Reverse rotation b3: SU (up-to-frequency) *1 b4: OL (overload) *1 b5: IPF (instantaneous power failure) *1*2 b6: FU frequency detection *1 b7: ABC1 (fault) *1	[Example 1] H02 ··· During forward rotation b7 … b0 0 0 0 0 0 0 1 0 [Example 2] H80 ··· Stop at fault occurrence b7 … b0 1 0 0 0 0 0 0 0
Inverter status monitor (expansion)	H79	16bit	b0: RUN (inverter running) *1 b1: Forward rotation b2: Reverse rotation b3: SU (up-to-frequency) *1 b4: OL (overload) *1 b5: IPF (instantaneous power failure) *1*2 b6: FU (frequency detection) *1 b7: ABC1 (fault) *1 b8: ABC2 (-) *1*2 b9: - b10: - b11: - b12: - b13: - b14: - b15: Fault occurrence	[Example 1] H0002 ···During forward rotation b15 … b0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 [Example 2] H8080 ···Stop at fault occurrence b15 … b0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0

*1 The signal within parentheses is the default setting. Descriptions change according to the [*Pr. 190 to Pr. 196 Output terminal function selection*].

*2 These are not available for E700 D700.

[Multi command (HF0)] D700

Sending data format from computer to inverter

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A3	ENQ	Inverter station number		Instruction Code (HF0)		Waiting time	Send data type*1	Receive data type*2	Data1*3				Data2 *3				Sum check		CR/LF

Reply data format from inverter to computer (No data error detected)

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C1	STX	Inverter station number		Send data type*1	Receive data type*2	Error code 1 *5	Error code 2 *5	Data1*4				Data2*4				ETX	Sum check		CR/LF

*1 Specify the data type of sending data (from computer to inverter).

*2 Specify the data type of reply data (from inverter to computer).

*3 Combination of data 1 and data 2 for sending

Data Type	Data 1	Data 2	Remarks
0	Run command (expansion)	Set frequency (RAM)	Run command (expansion) is same as instruction code HF9 (*Refer to page 457*)
1	Run command (expansion)	Set frequency (RAM, EEPROM)	The unit of set frequency is always by four digits, even when "0.01 to 9998" is set in [*Pr. 37*] and "01" is set in instruction code HFF.

*4 Combination of data 1 and data 2 for reply

Data Type	Data 1	Data 2	Remarks
0	Inverter status monitor (expansion)	Output frequency (speed)	Inverter status monitor (expansion) is same as instruction code H79 (*Refer to page 457*)
1	Inverter status monitor (expansion)	Special monitor	The unit of speed monitor is always by four digits (rounds down after the decimal point), even when "0.01 to 9998" is set in [*Pr. 37*] and "01" is set in instruction code HFF. Replies the monitor item specified in instruction code HF3 for special monitor.(*Refer to page 455*)

*5 Error code for sending data 1 is set in error code 1, and error code for sending data 2 is set in error code 2.
Mode error (HA), instruction code error (HB), data range error (HC) or no error (HF) is replied.

2.21.6 Modbus-RTU communication [Pr.117*, 118*, 120*, 122*, 331*, 332*, 334*, 343, 502*, 539*, 549] (common)

(*[*Pr. 117, 118, 120, 122, 502*] are not used in (A700) (F700).)
(*[*Pr. 331, 332, 334, 539*] are not available for (E700) (D700).)

Communication operation and parameter setting can be performed using the Modbus-RTU communication protocol from the RS-485 terminal in (A700) (F700) or the PU connector in (E700) (D700).
Set [*Pr. 549 Protocol selection = 1*] to use Modbus RTU protocol.

If a communication option is installed while [*Pr. 550 NET mode operation command source selection* =9999] (initial value) in (A700) (F700), command source (for example, run command) at RS-485 terminal becomes invalid. Change the setting to [*Pr. 550* = 1] in that case. (*Refer to page 436*)
When NET mode command source is at the PU connector in (D700) ([*Pr. 551 PU mode operation command source selection ≠2*]), operation by Modbus RTU communication is available.
When NET mode command source is at the PU connector in (E700) ([*Pr. 550 NET mode operation command source selection = 2 or 9999 (initial value)*], no communication option), operation by Modbus RTU communication is available. (*Refer to page 436*)

[Pr.]	Name	Initial Value	Setting Range	Description	Available Inverters (A700) (F700)	Available Inverters (E700) (D700)
117 / 331	RS-485 communication station number	0	0	No reply to the master [*1]	△[*2] / ○	○ / —
			1 to 247	Specifies the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.		
118 / 332	RS-485 communication speed	96	3, 6, 12, 24, 48, 96, 192, 384	Set the communication speed. The setting value × 100 equals the communication speed. For example, the communication speed is 9600bps when the setting value is 96.	△[*2] / ○	○ / —
120 / 334	RS-485 communication parity check selection	2	0	Without parity check Stop bit length 2bit	△[*2] / ○	○ / —
			1	With odd parity check Stop bit length 1bit		
			2	With even parity check Stop bit length 1bit		
343	Communication error	0	—	Displays the number of communication errors during Modbus-RTU communication.	○	○
122 / 539	Modbus-RTU communication check time interval	(A700)(F700) 9999 (E700)(D700) 0	0	Modbus-RTU communication can be made, but the inverter will come to trip in the NET operation mode.	△[*2] / ○	○ / —
			0 to 999.8s	Set the interval of communication check time.		
			9999	No communication check		
502	Stop mode selection at communication error	0		At Fault Occurrence / Indication / Fault Output / At Fault Removal	△[*2]	○
			(E700) 0, 3 (D700) 0	Coasts to stop / E.PUE / Output / Stop (E.PUE)		
			1	Decelerates to stop / After stop E.PUE / Output after stop / Stop (E.PUE)		
			2	Decelerates to stop / After stop E.PUE / Without output / Automatic restart functions		
549	Protocol selection	0	0	Mitsubishi inverter (computer link operation) protocol	○	○
			1	Modbus-RTU protocol		

*1 When Modbus-RTU communication is performed from the master with address 0 (station 0) set, broadcast communication is selected and the inverter does not send a response message to the master. When response from the inverter is necessary, set [*Pr. 117, 331 RS-485 communication station ≠ 0*] (initial value is 0). Some functions are invalid for broadcast communication.

*2 Not used in Modbus RTU communication.

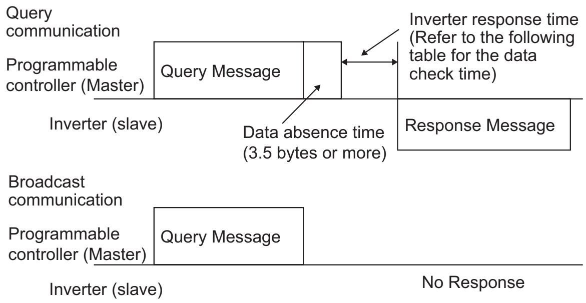
(1) Communication specifications

Item		Description	Related Parameters
Communication protocol		Modbus-RTU protocol	[*Pr. 549*]
Conforming standard		EIA-485(RS-485)	
Number of connectable devices		1:N (maximum 32 units), setting is 0 to 247 stations	[*Pr. 117, 331*]
Communication speed		Can be selected from 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400bps	[*Pr. 118, 332*]
Control procedure		Asynchronous	
Communication method		Half-duplex	
Communication specifications	Character system	Binary (fixed to 8 bits)	
	Start bit	1bit	
	Stop bit length Parity check	Select from the following three types ・No parity, stop bit length 2 bits ・Odd parity, stop bit length 1 bits ・Even parity, stop bit length 1 bit	[*Pr. 120, 334*]
	Error check	CRC code check	
	Terminator	Unavailable	
Waiting time setting		Unavailable	

(2) Overview

The Modbus protocol is the communication protocol developed by Modicon for Programmable controller.
The Modbus protocol performs serial communication between the master and slave using the dedicated message frame. The dedicated message frame has the functions that can perform data read and write. Using the functions, you can read and write the parameter values from the inverter, write the input command of the inverter, and check the operating status. In this product, the inverter data are classified in the holding register area (register addresses 40001 to 49999). By accessing the assigned holding register address, the master can communicate with the inverter which is a slave.
There are two different serial transmission modes: ASCII (American Standard Code for Information Interchange) mode and RTU (Remote Terminal Unit) mode. This product supports only the RTU mode in which 1-byte (8-bit) data is transmitted as-is.
Only the communication protocol is defined by the Modbus protocol, and the physical layer is not stipulated.

(3) Message format



● Data check time

Item	Check Time
Various monitors, run command set frequency (RAM)	A700 F700 < 12ms E700 D700 < 20ms
Parameter read/write, frequency setting (EEPROM)	A700 F700 < 30ms E700 D700 < 50ms
Parameter clear/all clear	< 5s
Reset command	No answer

1) Query
The master sends a message to the slave (= inverter) at the specified address.

2) Normal Response
After receiving the query from the master, the slave executes the requested function and returns the corresponding normal response to the master.

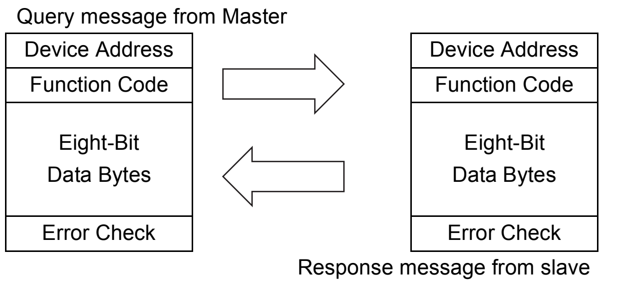
3) Error Response
If an invalid function code, address or data is received, the slave returns it to the master.
When a response description is returned, the error code indicating that the request from the master cannot be executed is added.
No response is returned for the hardware-detected error, frame error and CRC check error.

4) Broadcast
By specifying address 0, the master can send a message to all slaves. All slaves that received the message from the master execute the requested function. In this communication, the slaves do not return a response to the master.
The slave executes the function independently of the inverter station number setting [*Pr. 117, 331*] during broadcast communication.

(4) Message frame (protocol)

● Communication method

Basically, the master sends a query message (question) and the slave returns a response message (response). When communication is normal, Device Address and Function Code are copied, and when communication is abnormal (function code or data code is illegal), bit 7 (= 80h) of Function Code is turned on and the error code is set to Data Bytes.



The message frame consists of the four message fields as shown above.
By adding the no-data time (T1: Start, End) of 3.5 characters to the beginning and end of the message data, the slave recognizes it as one message.

● Protocol details

The four message fields will be explained below.

Start	1) ADDRESS	2) FUNCTION	3) DATA	4) CRC CHECK		End
				L	H	
T1	8bit	8bit	n × 8bit	8bit	8bit	T1

<table>
<tr><th>Message field</th><th>Description</th></tr>
<tr><td>1) ADDRESS field</td><td>The address code is 1 byte long (8 bits) and any of 0 to 247 can be set. Set 0 to send a broadcast message (all-address instruction) or any of 1 to 247 to send a message to each slave.
When the slave responds, it returns the address set from the master.
The value set to [Pr. 117, 331] is the slave address.</td></tr>
<tr><td>2) FUNCTION field</td><td>The function code is 1 byte long (8 bits) and any of 1 to 255 can be set. The master sets the function that it wants to request to the slave, and the slave performs the requested operation. The following table gives the supported function codes. An error response is returned if the set function code is other than those in the following table.
When the slave returns a normal response, it returns the function code set by the master. When the slave returns an error response, it returns H80 + function code.
<table>
<tr><th>Code</th><th>Function Name</th><th>Description</th><th>Broadcast Communication</th></tr>
<tr><td>H03</td><td>Read Holding Register</td><td>Reads the holding register data.</td><td>Disabled</td></tr>
<tr><td>H06</td><td>Preset Single Register</td><td>Writes data to the holding register.</td><td>Enabled</td></tr>
<tr><td>H08</td><td>Diagnostics</td><td>Makes a function diagnosis. (communication check only)</td><td>Disabled</td></tr>
<tr><td>H10</td><td>Preset multiple registers</td><td>Writes data to multiple consecutive holding registers.</td><td>Enabled</td></tr>
<tr><td>H46</td><td>Read Holding Register Access Log</td><td>Reads the number of registers that succeeded in communication last time.</td><td>Disabled</td></tr>
</table>
Table 1: Function code list</td></tr>
<tr><td>3) DATA field</td><td>The format changes depending on the function code. Data includes the byte count, number of bytes, description of access to the holding register, etc.</td></tr>
<tr><td>4) CRC CHECK field</td><td>The received message frame is checked for error. CRC check is performed, and 2byte long data is added to the end of the message. When CRC is added to the message, the low-order byte is added first and is followed by the high-order byte.
The CRC value is calculated by the sending side that adds CRC to the message. The receiving side recalculates CRC during message receiving, and compares the result of that calculation and the actual value received in the CRC CHECK field. If these two values do not match, the result is defined as error.</td></tr>
</table>

(5) Message format types

The message formats corresponding to the function codes in Table 1 above will be explained.

●Read holding register data (H03 or 03)

Can read the description of 1) system environment variables, 2) real-time monitor, 3) faults history, and 4) inverter parameters assigned to the holding register area (refer to the register list (page 468)).

Query message

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8bit)	H03 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	5) Byte Count	6) Data			CRC Check	
(8bit)	H03 (8bit)	(8bit)	H (8bit)	L (8bit)	… (n × 16bit)	L (8bit)	H (8bit)

•Query message setting

Message	Setting Description
1) Slave Address	Set the address to which a message will be sent. Broadcast communication cannot be made (0 is invalid).
2) Function	Set H03.
3) Starting Address	Set the address at which holding register data read will be started. Starting address = Starting register address (decimal) - 40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Points	Number of holding registers from which data will be read. The number of registers from which data can be read is a maximum of 125.

• Description of normal response

Message	Setting Description
5)Byte Count	The setting range is H02 to H14 (2 to 20). Twice greater than the No. of Point specified at 4) is set.
6) Data	The number of data specified at 4) is set. Data are read in order of Hi byte and Lo byte, and set in order of starting address data, starting address + 1 data, starting address + 2 data, ...

[Example] To read the register values of 41004 ([*Pr. 4*]) to 41006 ([*Pr. 6*]) from the slave address 17 (H11).

Query message

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H11 (8bit)	H03 (8bit)	H03 (8bit)	HEB (8bit)	H00 (8bit)	H03 (8bit)	H77 (8bit)	H2B (8bit)

Normal response (Response message)

Slave Address	Function	Byte Count	Data						CRC Check	
H11 (8bit)	H03 (8bit)	H06 (8bit)	H17 (8bit)	H70 (8bit)	H0B (8bit)	HB8 (8bit)	H03 (8bit)	HE8 (8bit)	H2C (8bit)	HE6 (8bit)

Read value
Register 41004 ([Pr. 4]): H1770 (60.00Hz)
Register 41005 ([Pr. 5]): H0BB8 (30.00Hz)
Register 41006 ([Pr. 6]): H03E8 (10.00Hz)

●Write holding register data (H06 or 06)

Can write the description of 1) system environment variables and 4) inverter parameters assigned to the holding register area (refer to the register list (page 468)).

Query message

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8bit)	H06 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8bit)	H06 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

•Query message setting

Message	Setting Description
1) Slave address	Set the address to which a message will be sent. Setting of address 0 enables broadcast communication.
2) Function	Set H06.
3) Register Address	Set the address of the holding register to which data will be written. Register address = Holding register address (decimal) - 40001 For example, setting of register address 0001 writes data to the holding register address 40002.
4) Preset Data	Set the data that will be written to the holding register. The written data is always 2 bytes.

• Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message. For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

[Example] To write 60Hz (H1770) to 40014 (running frequency RAM) at slave address 5 (H05).

Query message

Slave Address	Function	Register Address		Preset Data		CRC Check	
H05 (8bit)	H06 (8bit)	H00 (8bit)	H0D (8bit)	H17 (8bit)	H70 (8bit)	H17 (8bit)	H99 (8bit)

Normal response (Response message)
Same data as the query message

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●Function Diagnosis (H08 or 08)

A communication check can be made since the query message sent is returned unchanged as a response message (function of sub function code H00).

Query message

1) Slave Address	2) Function	3) Sub function		4) Date		CRC Check	
(8bit)	H08 (8bit)	H00 (8bit)	H00 (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	3) Sub function		4) Date		CRC Check	
(8bit)	H08 (8bit)	H00 (8bit)	H00 (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

• Query message setting

Message	Setting Description
1) Slave address	Set the address to which a message will be sent. Broadcast communication cannot be made (0 is invalid).
2) Function	Set H08.
3) Sub function	Set H0000.
4) Data	Any data can be set if it is 2 bytes long. The setting range is H0000 to HFFFF.

• Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message. For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

●Write multiple holding register data (H10 or 16)

You can write data to multiple holding registers.

Query message

1) Slave Address	2) Function	3) Starting Address		4) No. of Registers		5) Byte Count	6) Data			CRC Check	
(8bit)	H10 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	(8bit)	H (8bit)	L (8bit)	… (n × 2 × 8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Registers		CRC Check	
(8bit)	H10 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

•Query message setting

Message	Setting Description
1) Slave address	Set the address to which a message will be sent. Setting of address 0 enables broadcast communication.
2) Function	Set H10.
3) Starting Address	Set the address where holding register data write will be started. Starting address = Starting register address (decimal) - 40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Points	Set the number of holding registers where data will be written. The number of registers where data can be written is a maximum of 125.
5) Byte Count	The setting range is H02 to HFA (0 to 250). Set twice greater than the value specified at 4).
6) Data	Set the data specified by the number specified at 4). The written data are set in order of Hi byte and Lo byte, and arranged in order of the starting address data, starting address + 1 data, starting address + 2 data ...

• Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

Example: To write 0.5s (H05) to 41007 ([*Pr. 7*]) at the slave address 25 (H19) and 1s (H0A) to 41008 ([*Pr. 8*]).

Query message

Slave Address	Function	Starting Address		No. of Points		Byte Count	Data				CRC Check	
H19 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 (8bit)	H02 (8bit)	H04 (8bit)	H00 (8bit)	H05 (8bit)	H00 (8bit)	H0A (8bit)	H86 (8bit)	H3D (8bit)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 (8bit)	H02 (8bit)	H22 (8bit)	H61 (8bit)

●Read Holding Register Access Log (H46 or 70)

A response can be made to a query made by the function code H03, H10.

The starting address of the holding registers that succeeded in access during previous communication and the number of successful registers are returned.

In response to the query for other than the above function code, 0 is returned for the address and number of registers.

Query message

1) Slave Address	2) Function	CRC Check	
(8bit)	H46 (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8bit)	H46 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

•Query message setting

Message	Setting Description
1) Slave address	Set the address to which a message will be sent. Broadcast communication cannot be made (0 is invalid).
2) Function	Set H46.

•Description of normal response

Message	Setting Description
3) Starting Address	The starting address of the holding registers that succeeded in access is returned. Starting address = Starting register address (decimal) - 40001 For example, when the starting address 0001 is returned, the address of the holding register that succeeded in access is 40002.
4) No. of Points	The number of holding registers that succeeded in access is returned.

Example: To read the successful register starting address and successful count from the slave address 25 (H19).

Query message

Slave Address	Function	CRC Check	
H19 (8bit)	H46 (8bit)	H8B (8bit)	HD2 (8bit)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 (8bit)	H02 (8bit)	H22 (8bit)	H61 (8bit)

Success of two registers at starting address 41007 [*Pr. 7*] is returned.

●Error response

An error response is returned if the query message received from the master has an illegal function, address or data.

No response is returned for a parity, CRC, overrun, framing or busy error.

No response message is sent in the case of broadcast communication also.

Error response (Response message)

1) Slave Address	2) Function	3) Exception Code	CRC Check	
(8bit)	H80 + Function (8bit)	(8bit)	L (8bit)	H (8bit)

Message	Setting Description
1) Slave address	Set the address received from the master.
2) Function	Master-requested function code + H80 is set.
3) Exception code	Code in the table below is set.

Error code list

Code	Error Item	Error Description
01	ILLEGAL FUNCTION (Function code illegal)	The set function code in the query message from the master cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS *1 (Address illegal)	The set register address in the query message from the master cannot be handled by the inverter. (No parameter, parameter read disabled, parameter write disabled)
03	ILLEGAL DATA VALUE (Data illegal)	The set data in the query message from the master cannot be handled by the inverter. (Out of parameter write range, mode specified, other error)

*1 An error will not occur in the following cases.

1) Function code H03 (Read holding register data)
When the No. of Points is 1 or more and there is one or more holding registers from which data can be read

2) Function code H10 (Write multiple holding register data)
When the No. of Points is 1 or more and there is 1 or more holding registers to which data can be written

Namely, when the function code H03 or H10 is used to access multiple holding registers, an error will not occur if a non-existing holding register or read disabled or write disabled holding register is accessed.

*2 An error will occur if all accessed holding registers do not exist.

*3 Data read from a non-existing holding register is 0, and data written there is invalid.

• Message data mistake detection

To detect the mistakes of message data from the master, the mistakes are checked for the following errors.

If an error is detected, a trip will not occur.

Error check item

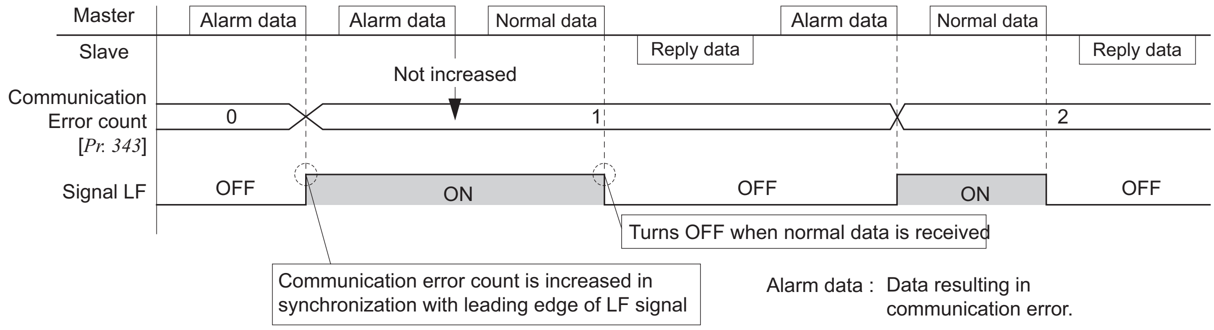
Error Item	Error Description	Inverter Operation
Parity error	The data received by the inverter differs from the specified parity ([*Pr. 120, 334*] setting).	1) [*Pr. 343*] is increased by 1 at error occurrence. 2) The terminal LF is output at error occurrence.
Framing error	The data received by the inverter differs from the specified stop bit length ([*Pr. 120, 334*]).	
Overrun error	The following data was sent from the master before the inverter completes data receiving.	
Message frame error	The message frame data length is checked, and the received data length of less than 4 bytes is regarded as an error.	
CRC check error	A mismatch found by CRC check between the message frame data and calculation result is regarded as an error.	

2

PARAMETER

1) [*Pr. 343 Communication error count*]
You can check the cumulative number of communication errors by reading [*Pr. 343*]. The number of communication errors is temporarily stored into the RAM.
As it is not stored into the EEPROM, performing a power supply reset or inverter reset clears the value to 0.

2) Output signal LF alarm output (communication error warnings)
During a communication error, the alarm signal (LF signal) is output by open collector output.
Assign the used terminal with any of [*Pr. 190 to Pr. 196 Output terminal function selection*].



(6) Modbus registers

●System environment variable

Register	Definition	Read/Write	Remarks
40002	Inverter reset	Write	Any value can be written
40003	Parameter clear	Write	Set H965A as a written value.
40004	All parameter clear	Write	Set H99AA as a written value.
40006	Parameter clear *1	Write	Set H5A96 as a written value.
40007	All parameter clear *1	Write	Set HAA99 as a written value.
40009	Inverter status/control input instruction *2	Read/write	See below.
40010	Operation mode/inverter setting *3	Read/write	See below.
40014	Running frequency (RAM value)	Read/write	According to the [*Pr. 37, Pr. 144*] settings, the frequency and selectable speed are in 1r/min increments.
40015	Running frequency (EEPROM value)	Write	

*1 The communication parameter values are not cleared.
*2 For write, set the data as a control input instruction. For read, data is read as an inverter operating status.
*3 For write, set data as the operation mode setting. For read, data is read as the operation mode status.

<Inverter status/control input instruction>

Bit	Definition	
	Control input instruction	Inverter status
0	Stop command	RUN (inverter running) *2
1	Forward rotation command	Forward running
2	Reverse rotation command	Reverse running
3	RH (high speed command) *1	SU (up-to-frequency) *2
4	RM (middle speed command) *1	OL (overload) *2
5	RL (low speed command) *1	IPF (instantaneous power failure) *2*3*4
6	JOG (Jog operation selection) *1*3*4	FU (frequency detection) *2
7	RT (second function selection) *1	ABC1 (fault) *2
8	AU (current input selection) *1	ABC2 (—) *2*3*4
9	CS (selection of automatic restart after instantaneous power failure) *1*3*4	0
10	MRS output stop *1	0
11	STOP (start self-holding) *1*3*4	0
12	RES (reset) *1*4	0
13	0	0
14	0	0
15	0	Fault occurrence

<Operation mode/inverter setting>

Mode	Read Value	Written Value
EXT	H0000	H0010
PU	H0001	—
EXT JOG	H0002	—
PU JOG*4	H0003	—
NET	H0004	H0014
PU+ EXT	H0005	—

The restrictions depending on the operation mode changes according to the computer link specifications.

*1 The signal within parentheses is the default setting. Descriptions change according to the [*Pr. 180 to Pr. 189 Input terminal function selection*].
Each assigned signal is valid or invalid depending on NET. (Refer to page 440)
*2 The signal within parentheses is the default setting. Descriptions change according to the [*Pr. 190 to Pr. 196 Output terminal function selection*].
*3 These are not available for E700.
*4 These are not available for D700.

●Real time monitor

Refer to page 346 for details of the monitor description.

Register	Description	Increments
40201	Output frequency/speed *11	0.01Hz/1
40202	Output current	0.01A/0.1A *1
40203	Output voltage	0.1V
40205	Frequency setting value/speed	0.01Hz/1
40206 *9*10	Running speed	1r/min
40207 *8*10	Motor torque	0.1
40208	Converter output voltage	0.1V
40209	Regenerative brake duty	0.1%
40210	Electronic thermal relay function load factor	0.1%
40211	Output current peak value	0.01A/0.1A *1
40212	Converter output voltage peak value	0.1V
40213 *9*10	Input power	0.01kW/ 0.1kW *1
40214	Output power	0.01kW/ 0.1kW *1
40215	Input terminal status	—
40216	Output terminal status	—
40217 *9*10	Load meter	0.1%
40218 *8*9*10	Motor excitation current	0.01A/0.1A*1
40219 *8*9*10	Position pulse	—

Register	Description	Increments
40220	Cumulative energization time	1h
40222 *8*9*10	Orientation status	—
40223	Actual operation time	1h
40224	Motor load factor	0.1%
40225	Cumulative power	1kWh
40232 *8*9*10	Torque command	0.1%
40233 *8*9*10	Torque current command	0.1%
40234 *8*9*10	Motor output	0.01kW/ 0.1kW *1
40235 *8*9*10	Feedback pulse	—
40250 *9*10	Power saving effect	Variable
40251 *9*10	Cumulative saving power	Variable
40252	PID set point	0.1%
40253	PID measured value	0.1%
40254	PID deviation	0.1%
40258 *8*10	Option input terminal status 1 *4	—
40259 *8*10	Option input terminal status 2 *5	—
40260 *8*10	Option output terminal status *6	—
40261 *7*8	Motor thermal load factor	0.1%
40262 *7*8	Inverter thermal load factor	0.1%
40263 *7*8*9	Cumulative power 2	0.01kWh
40264 *7*8*9	PTC thermistor resistance	0.01kW

*1 The setting depends on the inverter capacity. (55K or less/75K or more)

*2 Input terminal monitor details

	b15															b0
A700 F700	—	—	—	—	CS	RES	STOP	MRS	JOG	RH	RM	RL	RT	AU	STR	STF
E700	—	—	—	—	—	RES	—	MRS	—	RH	RM	RL	—	—	STR	STF
D700	—	—	—	—	—	—	—	—	—	RH	RM	RL	—	—	STR	STF

*3 Output terminal monitor details

	b15															b0
A700 F700	—	—	—	—	—	—	—	—	—	ABC2	ABC1	FU	OL	IPF	SU	RUN
E700	—	—	—	—	—	—	—	—	—	—	ABC	FU	—	—	—	RUN
D700	—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 Details of option input terminal monitor 1 (input terminal status of FR-A7AX)-all terminals are OFF when an option is not fitted

b15															b0
X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

*5 Details of option input terminal monitor 2 (input terminal status of FR-A7AX)-all terminals are OFF when an option is not fitted

b15															b0
—	—	—	—	—	—	—	-	—	—	—	—	—	—	—	DY

*6 Details of option output terminal monitor (output terminal status of FR-A7AY/A7AR)-all terminals are OFF when an option is not fitted.

b15															b0
—	—	—	—	—	—	RA3	RA2	RA1	Y6	Y5	Y4	Y3	Y2	Y1	Y0

*7 These are not available for A700.

*8 These are not available for F700.

*9 These are not available for E700.

*10 These are not available for D700.

*11 Increment is 1 when [*Pr. 37* =1 to 9998] or [*Pr. 144* =2 to 10, 102 to 110] in A700 F700.

Increment is 1 when [*Pr. 37* =0.01 to 9998] in E700 D700.

- Parameter

[Pr.]	Register	Parameter Name	Read/Write	Remarks
0 to 999	41000 to 41999	Refer to the parameter list (page 120) for the parameter names.	Read/write	The parameter number + 41000 is the register number.
C2 (902)	41902	Terminal 2 frequency setting bias (frequency)	Read/write	
C3 (902)	42092	Terminal 2 frequency setting bias (analog value)	Read/write	Analog value (%) set to [*C3 (902)*] is read.
	43902	Terminal 2 frequency setting bias (terminal analog value)	Read	Analog value (%) of the voltage (current) applied to the terminal 2 is read.
125 (903)	41903	Terminal 2 frequency setting gain (frequency)	Read/write	
C4 (903)	42093	Terminal 2 frequency setting gain (analog value)	Read/write	Analog value (%) set to [*C4 (903)*] is read.
	43903	Terminal 2 frequency setting gain (terminal analog value)	Read	Analog value (%) of the voltage (current) applied to the terminal 2 is read.
C5 (904)	41904	Terminal 4 frequency setting bias (frequency)	Read/write	
C6 (904)	42094	Terminal 4 frequency setting bias (analog value)	Read/write	Analog value (%) set to [*C6 (904)*] is read.
	43904	Terminal 4 frequency setting bias (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to terminal 4 is read.
126 (905)	41905	Terminal 4 frequency setting gain (frequency)	Read/write	
C7 (905)	42095	Terminal 4 frequency setting gain (analog value)	Read/write	Analog value (%) set to [*C7 (905)*] is read.
	43905	Terminal 4 frequency setting gain (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to terminal 4 is read.
C12 (917) *1	41917	Terminal 1 bias frequency (speed)	Read/write	
C13 (917) *1	42107	Terminal 1 bias (speed)	Read/write	Analog value (%) set to [*C13 (917)*] is read.
	43917	Terminal 1 bias (speed) (terminal analog value)	Read	Analog value (%) of the voltage applied to terminal 1 is read.
C14 (918) *1	41918	Terminal 1 gain frequency (speed)	Read/write	
C15 (918)*1	42108	Terminal 1 gain (speed)	Read/write	Analog value (%) set to [*C15 (Pr. 918)*] is read.
	43918	Terminal 1 gain (speed) (terminal analog value)	Read	Analog value (%) of the voltage applied to terminal 1 is read.
C16 (919) *1	41919	Terminal 1 bias command (torque/magnetic flux)	Read/write	
C17(919)*1	42109	Terminal 1 bias (torque/magnetic flux)	Read/write	Analog value (%) set to [*C17 (Pr. 919)*] is read.
	43919	Terminal 1 bias (torque/magnetic flux) (terminal analog value)	Read	Analog value (%) of the voltage applied to terminal 1 is read.
C18 (920) *1	41920	Terminal 1 gain command (torque/magnetic flux)	Read/write	
C19 (920)*1	42110	Terminal 1 gain (torque/magnetic flux)	Read/write	Analog value (%) set to [*C19 (Pr. 920)*] is read.
	43920	Terminal 1 gain (torque/magnetic flux) (terminal analog value)	Read	Analog value (%) of the voltage applied to terminal 1 is read.
C38 (932) *1	41932	Terminal 4 bias command (torque/magnetic flux)	Read/write	
C39 (932) *1	42122	Terminal 4 bias (torque/magnetic flux)	Read/write	Analog value (%) set to [*C39 (Pr. 932)*] is read.
	43932	Terminal 4 bias (torque/magnetic flux) (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4 is read.
C40 (933) *1	41933	Terminal 4 gain command (torque/magnetic flux)	Read/write	
C41 (933) *1	42123	Terminal 4 gain (torque/magnetic flux)	Read/write	Analog value (%) set to [*C41 (Pr. 933)*] is read.
	43933	Terminal 4 gain (torque/magnetic flux) (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4 is read.

*1 These are not available for F700 E700 D700.

*2 These are not available for A700 F700.

●Faults history
Refer to page 97 for details of fault definition.

Register	Definition	Read/write	Remarks
40501	Faults history 1	Read/write	Since data is 2 bytes in length, it is stored as H00○○. The error code can be referred to in the low-order 1 byte. Performing write using the register 40501 batch-clears the faults history. Set any value as data.
40502	Faults history 2	Read	
40503	Faults history 3	Read	
40504	Faults history 4	Read	
40505	Faults history 5	Read	
40506	Faults history 6	Read	
40507	Faults history 7	Read	
40508	Faults history 8	Read	

Alarm code list

Data	Description	Data	Description	Data	Description
H00	No fault present	H91 *3	E.PTC	HD1 *2*3*4	E.OSD
H10	E.OC1	HA0 *3*4	E.OPT	HD2 *2*3*4	E.ECT
H11	E.OC2	HA1 *1*4	E.OP1	HD3*2*3*4	E.OD
H12	E.OC3	HA3 *2*3*4	E.OP3	HD5*2*3*4	E.MB1
H20	E.OV1	HB0	E.PE	HD6*2*3*4	E.MB2
H21	E.OV2	HB1	E.PUE	HD7*2*3*4	E.MB3
H22	E.OV3	HB2	E.RET	HD8 *2*4	E.MB4
H30	E.THT	HB3 *3*4	E.PE2	HD9 *2*4	E.MB5
H31	E.THM	HC0	E.CPU	HDA *2*4	E.MB6
H40	E.FIN	HC1 *3*4	E.CTE	HDB *2*4	E.MB7
H50*3*4	E.IPF	HC2 *3*4	E.P24	HDC *2*3*4	E.EP
H51*3*4	E.UVT	HC4 *3	E.CDO	HF1 *4	E. 1
H52	E.ILF	HC5	E.IOH	HF2 *2*3*4	E. 2
H60	E.OLT	HC6 *3*4	E.SER	HF3 *2*3*4	E. 3
H70	E.BE	HC7	E.AIE	HF6 *4	E. 6
H80	E.GF	HC8 *2*4	E.USB	HF7 *3*4	E. 7
H81	E.LF	HC9 *1*2*3	E.SAF	HFB *2*3*4	E. 11
H90	E.OHT	HD0 *2*3*4	E.OS	HFD *4	E. 13

*1 These are not available for A700.
*2 These are not available for F700.
*3 These are not available for E700.
*4 These are not available for D700.

2

PARAMETER

(7) Signal loss detection [*Pr. 122, 539*]

If a signal loss (communication stop) is detected in the signal loss detection performed between the inverter and computer, communication error (E.SER in A700 F700, E.PUE in E700 D700) occurs, and the inverter output is shut off. (It depends on the [*Pr. 502*] setting in E700 D700.)

A signal loss detection is made when the setting is any of 0.1 to 999.8s. To make a signal loss detection, it is necessary to send data from within the communication check time interval.

When the setting is 9999, communication check (signal loss detection) is not made.

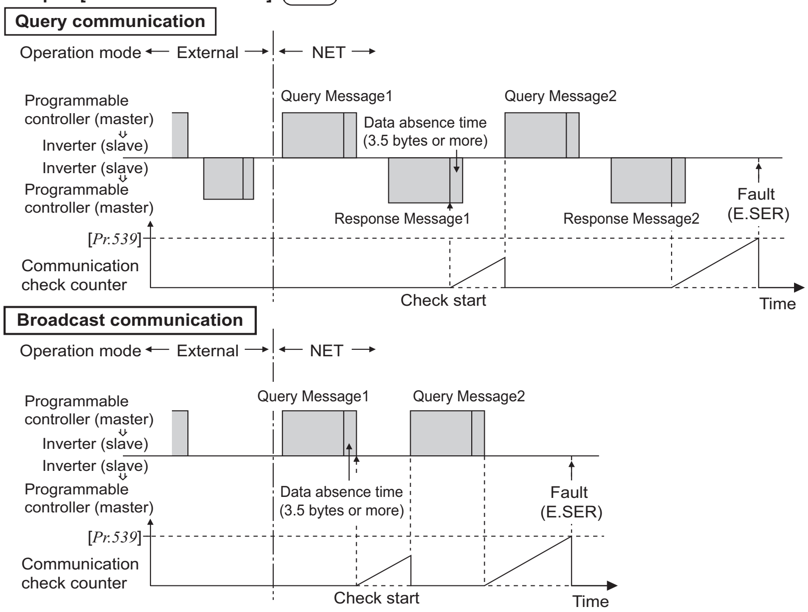
If communication is broken due to signal cable breakage, computer fault etc., the inverter does not detect such a fault. This should be fully noted.

It is recommended to set the communication check time interval before starting operation to prevent hazardous conditions.

When the setting is 0 in A700 F700, monitoring and parameter read are available. However, communication error (E.SER) would occur if operation mode is switched to the Network operation mode.

When the setting is 0 (initial value) in E700 D700, communication from RS-485 can be performed, however, communication error (E.PUE) would occur if switched to another operation mode with command source (NET mode at initial setting).

Example: [*Pr. 539* = 0.1 to 999.8s] A700



2.21.7 USB communication [Pr. 547, 548] (A700) (E700)

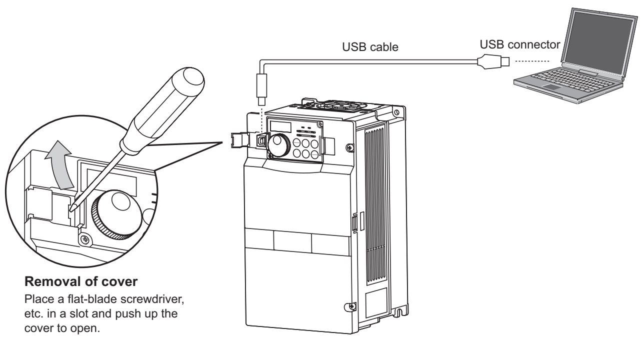
Connect the inverter and PC with USB cable and use FR Configurator to make the inverter setup easily.
A personnel computer and inverter can be easily connected with one USB cable.
Set [*Pr. 551 PU mode operation command source selection =3*] to use USB communication in (A700). *(Refer to page 436 for details)*

Refer to the instruction manual for details of FR Configurator.
It is recommended to fit a ferrite core to the USB cable to reduce the effect of noises from the inverter.

[Pr.]	Name	Initial Value	Setting Range	Description
547	USB communication station number	0	0 to 31	Specifies the inverter station number.
548	USB communication check time interval	9999	0	USB communication is enabled. However, the inverter will come to an alarm stop (E. USB) if operation is changed to PU operation mode.
			0.1 to 999.8s	Set the interval of communication check time. If a no-communication state persists for longer than the permissible time, the inverter will come to trip (E.USB).
			9999	No communication check.

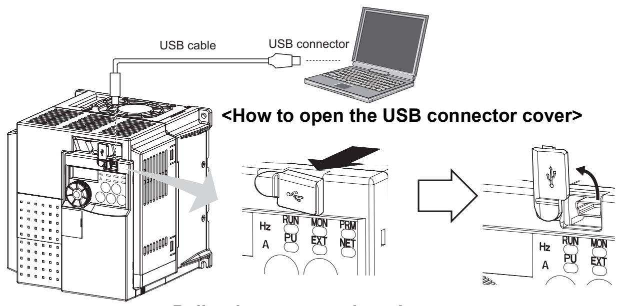
● (A700) USB communication specifications

Interface	Conforms to USB 1.1
Transmission Speed	12Mbps
Wiring Length	Maximum 5m
Connector	USB B connector (B receptacle)
Power Supply	Self-power supply



● (E700) USB communication specifications

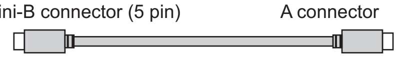
Interface	Conforms to USB1.1
Transmission Speed:	12Mbps
Wiring Length	Maximum 5m
Connector	USB mini B connector (receptacle mini B type)
Power supply	Self-power supply



Pull the cover in the direction of arrow.

Then turn it upward.

● Information on the connection cable for (E700)

Name	Inverter Type	Application/Specifications
USB cable	MR-J3USBCBL3M Cable length 3m	Connector for amplifier mini-B connector (5 pin) / Connector for personal computer A connector 

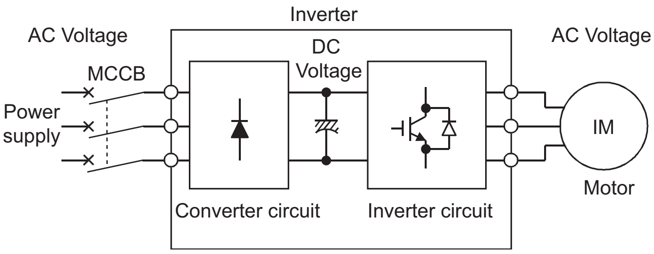
MEMO

3 SELECTION

3.1 Inverter selection

3.1.1 Principle and control method of the inverter common

(1) Principle common



Inverter structure

The inverter rectifies commercial power into a DC Voltage once in the converter circuit and converts it into an AC Voltage of desired frequency in the inverter circuit.
The speed N of the induction motor is expressed by the following formula:

$$N = \frac{120 \times f(\text{frequency})}{P(\text{number of motor poles})} \times (1\text{-}S)\ [\text{r/min}]$$

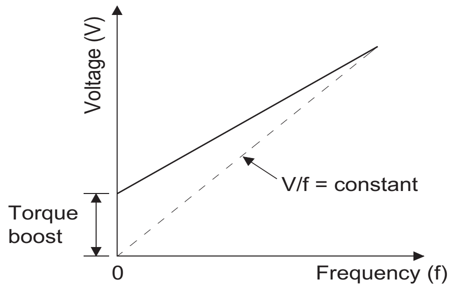
Where S is motor slip

By changing the frequency (f) with the inverter, the motor speed can be changed freely.
Actually, when the frequency (f) is changed, the output voltage (V) is also changed to produce a sufficient motor torque.

(2) Control Method

1) V/F control common

When changing the frequency (f), the inverter controls to make the ratio (V/f) of output frequency (f) to output voltage (V) constant. This method is the basic inverter control method and called V/F control.
In this method, a sufficient torque will not be developed since the actual effective voltage decreases due to a voltage drop in the wiring and motor's primary winding. This phenomenon has greater influence as the speed gets lower. (Low-speed torque will be short)
Hence, a voltage drop is pre-estimated to increase the voltage (torque boost *) as indicated by the continuous line in the figure below to compensate for the torque shortage at low speed.
To make up for this disadvantage, we developed Advanced magnetic flux vector control and Real sensorless vector control.



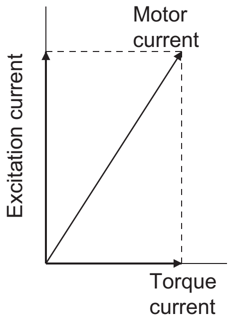
* If the torque boost is too large, the torque is developed sufficiently but an excessive current flows, causing the inverter to be more easily resulting in an overcurrent (OCT) trip.

Comparison between Mitsubishi Inverter Control Method

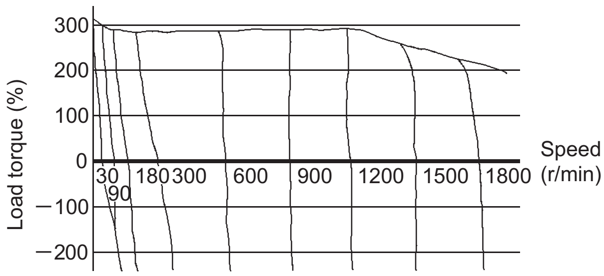
Item	V/F Control	Simple Magnetic Flux Vector Control	General-Purpose Magnetic Flux Vector Control	Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control	Vector Control
Motor used with inverter	Standard motor (Mitsubishi, others)	Standard motor (Mitsubishi, others)	Standard motor (Mitsubishi, others)	Standard motor (Mitsubishi, others)	Standard motor (Mitsubishi, others)	Dedicated motor (Mitsubishi) Standard motor (Mitsubishi, others)
Start several motors at the same time	Enabled	Disabled	Disabled	Disabled	Disabled	Disabled
Auto tuning function	Not necessary	Not necessary	Equipped as standard	Equipped as standard	Equipped as standard	Equipped as standard
Starting torque low speed torque	1Hz: 30% or less 3Hz: 30% 6Hz: 80%	3Hz:120% (when slip compensation is set)	1Hz:150% 3Hz:200% (3.7K or less) (when slip compensation is set)	0.5Hz: 150%	0.3Hz: 200/150% (3.7K or less/5.5K or more)	Dedicated motor 0Hz:150% Standard motor 0Hz:200/150% (3.7k or less/5.5k or more)
Speed detector	Not necessary	Not necessary	Not necessary	Not necessary	Not necessary	Necessary
Speed control range	1 : 10	1 : 15	1 : 60 (driving)	1 : 120 (driving)	1 : 200 (driving)	1 : 1500
Speed variation ratio	2 to 5% Depends on load magnitude	2 to 5% Depends on load magnitude	2 to 5% Depends on load magnitude	1% Not influenced by load	1% Not influenced by load	0.01% Not influenced by load
Torque control	Disabled	Disabled	Disabled	Disabled	Enabled	Enabled
Speed control	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Position control	Disabled	Disabled	Disabled	Disabled	Disabled	Enabled
Control response level	10 to 20rad/s	20 to 30rad/s	20 to 30rad/s	20 to 30rad/s	120rad/s	300rad/s (standard motor)
Applications	Fan, pump, General industrial machines, etc.	Fan, pump, General industrial machines, etc.	General industrial machines, transfer machines, lift applications, etc.	General industrial machines, transfer machines, lift applications, etc	General industrial machines, transfer machines, lift applications, etc.	Transfer machines, lift application line control, etc.
Applicable Inverters	common	F700	E700 D700	A700 E700	A700	A700+A7AP

2) Simple magnetic flux vector control (F700)
This control method divides inverter output current by vector calculation, and compensates for amount of voltage drop which causes torque decrease. Comparing with V/F control, higher torque at low speed range is available.
To compensate the speed variation, use slip compensation ([*Pr. 245 to Pr. 247*]).

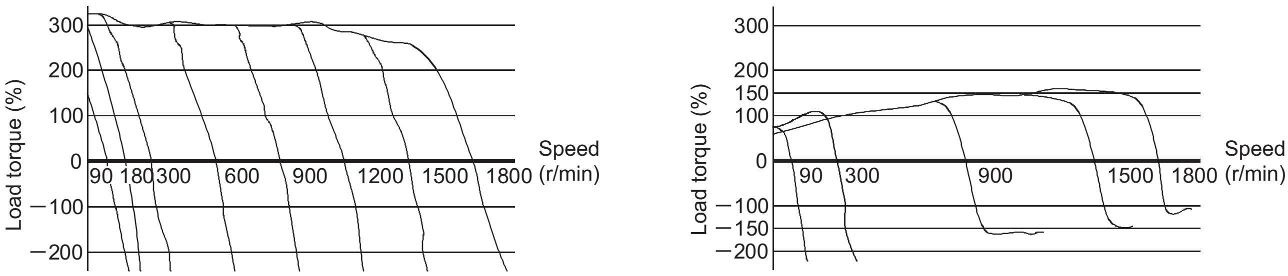
3) General-purpose magnetic flux vector control (E700) (D700)
The output current of the inverter is divided into an exciting current and a torque current by vector operation and the voltage is compensated for to flow a motor current which meets the load torque, thereby improving the low-speed torque. This control method provides a high torque of 200% (3.7K or more) at 6Hz.
If the motor constants vary slightly (when the inverter is used with the another manufacturers motor, for example), this system provides a stable, large, low-speed torque without specific motor constant setting or tuning, achieving high versatility. (Offline auto tuning can be performed to run the motor with the optimum characteristic.)
The output current (motor current) of the inverter is divided into an exciting current (current required to generate a magnetic flux) and a torque current (current proportional to load torque) by vector operation according to each phase of the current relative to the output voltage. (Refer to the figure on the right.)



When the motor current varies due to load fluctuation, the voltage drop of the motor's primary side (including the wiring) also changes, affecting the magnitude of the exciting current.
This voltage drop is found from the motor and primary wiring constants and torque current magnitude, and the output voltage of the inverter is compensated for (increased/decreased) to keep the primary magnetic flux of the motor constant.
Also, the motor speed varies with load fluctuation. You can choose the slip compensation function ([*Pr. 245 to 247*]) which estimates the motor slip from the output current of the inverter to keep the motor speed constant. (The control method is different from Advanced magnetic flux vector control.)
At this time, the torque characteristic is as shown on the below.



Speed-Torque Characteristic Example for General-Purpose Magnetic Flux Vector Control when Slip Compensation Is Selected
(Use of inverter with 0.75kW 4-pole motor)



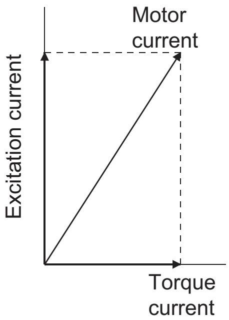
(a) General-purpose magnetic flux vector control **(b) V/F control**

Speed-Torque Characteristic Example for General-Purpose Magnetic Flux Vector Control
(use of inverter with 0.75kW 4-pole motor)

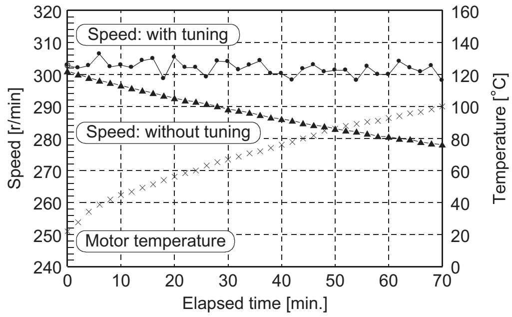
4) Advanced magnetic flux vector control (A700) (E700)

The output current of the inverter is divided into an excitation current and a torque current by vector operation, then the voltage drop causing torque decrease is compensated for and the speed is automatically compensated (slip compensation) to the optimum so that the speed will not change.
The output current of the inverter is divided into an excitation current and a torque current by vector operation and the frequency and voltage are compensated for to flow a motor current which meets a load torque, thereby improving a low speed torque and speed accuracy. This method provides a high (150%) torque at 0.5Hz.

The output current (motor current) of the inverter is divided into an excitation current (current required to generate a magnetic flux) and a torque current (current proportional to load torque) by vector operation according to each phase of the current relative to the output voltage. (Refer to the figure on the right)



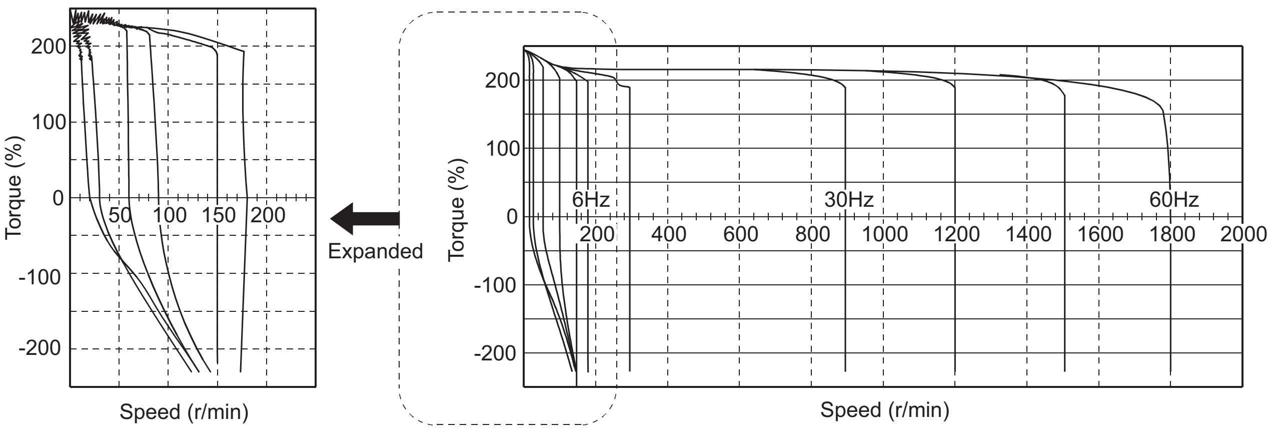
The actual motor speed is estimated from the torque current and the output frequency is compensated for (increased/decreased) to achieve the preset speed. (slip compensation)
When the motor current varies due to load fluctuation, the voltage drop of the motor's primary side (including the wiring) also changes, affecting the magnitude of the excitation current.
This voltage drop is found from the motor and primary wiring constants of the motor and torque current magnitude, and the output voltage of the inverter is compensated for (increased/decreased) to keep the primary magnetic flux of the motor constant.
Also, when the online auto tuning is selected in (A700), the motor is tuned quickly when starting, allowing high-accuracy operation unaffected by motor temperatures and high-torque, stable operation down to an ultra-low speed.
The motor temperature-speed fluctuation characteristic example is shown below.



Motor temperature-speed fluctuation characteristic example

(when the motor SF-JR 4P 3.7kW is used)

(Online auto tuning selected, repeated operation at 90% duty)



Speed-torque characteristic example for Advanced magnetic flux vector control

(online auto tuning selected, inverter used with 3.7kW 4-pole motor)

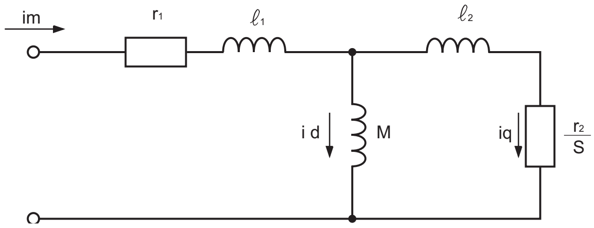
5) Real sensorless vector control (A700)

Real sensorless vector control is a control method which estimates the motor speed from the motor constants, voltage, and current without using an encoder (with a standard motor without encoder). The response and characteristics at nearly zero speed are low as compared to vector control using a motor with encoder.

Real sensorless vector control is the control method which divides the inverter output current into an excitation current and a torque current by vector calculation, and improves low speed torque, speed control range, and speed response by controlling frequency and voltage optimally to flow a motor current which meets the load torque, achieving maximum of 200% (3.7kW or less) high torque at 0.3Hz.

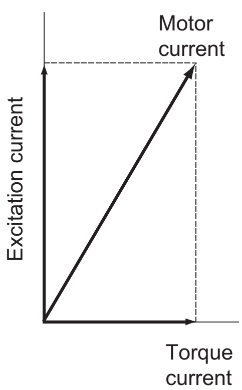
It responds to the load variation quickly (high response) by torque current control, and torque control is also enabled by giving torque command.

To help explain vector control, the fundamental equivalent circuit of an induction motor is shown below:



r1:Primary resistance
r2:Secondary resistance
ℓ1:Primary leakage inductance
ℓ2:Secondary leakage inductance
M:Mutual inductance
S:Slip
id:Excitation current
iq:Torque current
im:Motor current

In the above diagram, currents flowing in the induction motor can be classified into a current id (excitation current) for making a magnetic flux in the motor and a current iq (torque current) for causing the motor to develop a torque. With Real sensorless vector control, inverter controls the motor so that the excitation current and torque current to flow to the optimum by calculating the voltage and output frequency. Control block diagram is shown on the next page.

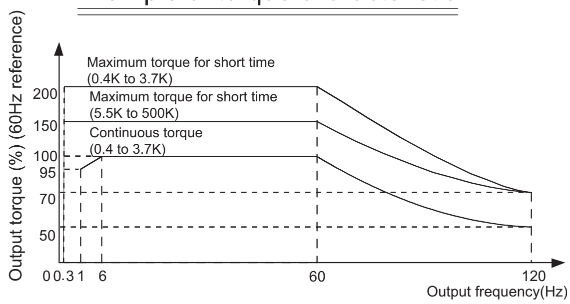


Motor-generated torque TM, slip angular velocity ωs and the motor's secondary magnetic flux Φ can be found by the following calculation:

$$TM \propto \Phi 2 \times iq$$
$$\Phi 2 = M \times id$$
$$\omega s = \frac{r2}{L2} \times \frac{iq}{id}$$

where, L2 = secondary inductance
L2=ℓ2 + M

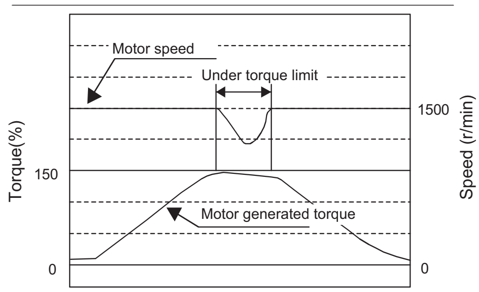
Example of torque characteristic



Torque characteristic

For the motor SF-JR 4P (at 220V input)

Example of torque limit characteristic

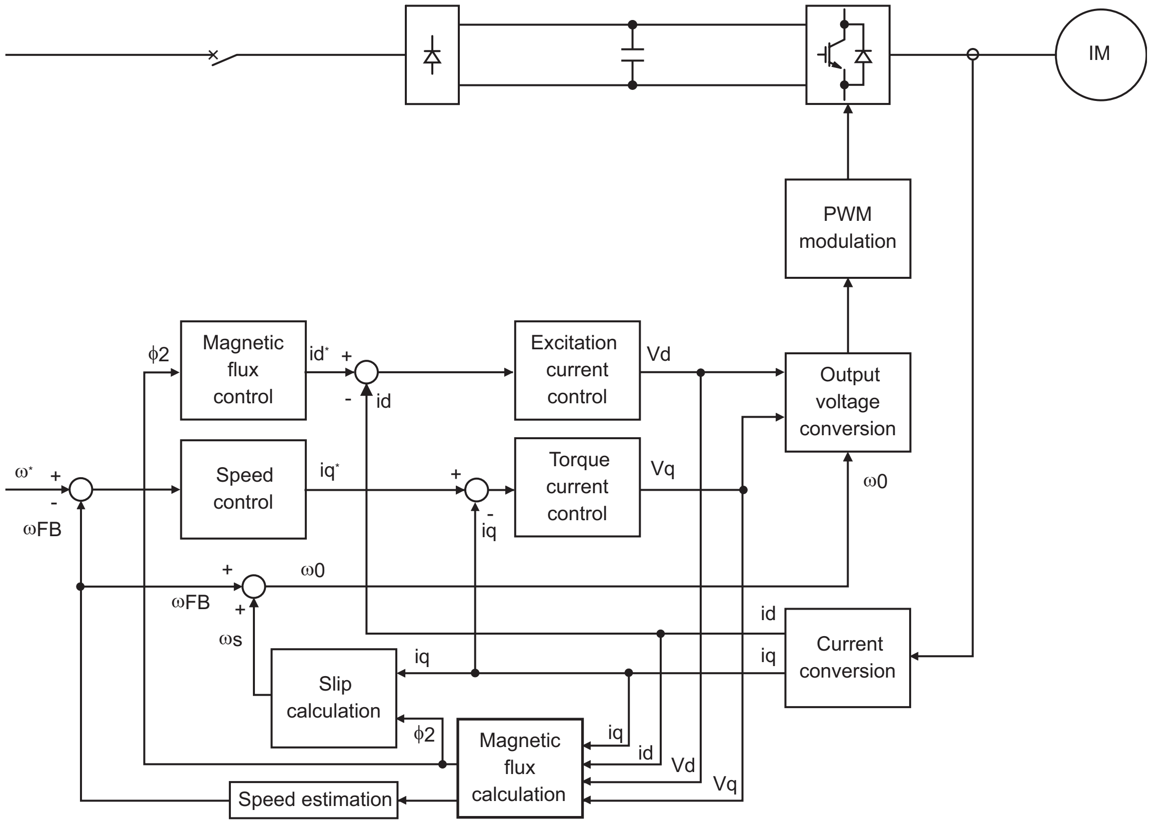


Example of torque limit characteristic

SF-JR 4P 3.7kW motor

Also, when the online auto tuning is selected, the motor is tuned quickly when starting, allowing high-accuracy operation unaffected by motor temperatures and high-torque, stable operation down to an ultra-low speed.

Block diagram of Real sensorless vector control



Since the current control loop is configured same as the vector control with encoder, necessary excitation current (current required to generate magnetic flux) and torque current (current proportional to the load torque) can be calculated separately by using the speed estimated value found by the motor current and output voltage as the speed feedback value.

[Speed control]

Speed control operation is performed to zero the difference between the speed command ω^* and speed estimated value ωFB. At this time, the motor load is found and its result is transferred to the torque current controller as a torque current command iq^*.

[Torque current control]

A voltage (Vq) is calculated for the current (iq) to flow identical to the torque current command (iq*) found by the speed controller.

[Magnetic flux control]

The magnetic flux Φ2 of the motor is derived from the excitation current id. An excitation current command (id*) is calculated for the motor magnetic flux Φ2 to be the predetermined magnetic flux.

[Excitation current control]

A voltage (Vd) is calculated to flow a current id^* which is identical to the excitation current command (id*) found by magnetic flux control.

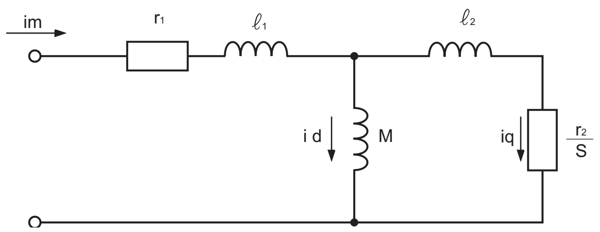
[Output frequency calculation]

Motor slip ωs is calculated on the basis of the torque current value iq and magnetic flux Φ2. Output frequency ω0 is found by adding the slip amount ωs to the speed estimated value ωFB.

The above results are used to make PWM modulation and run the motor.

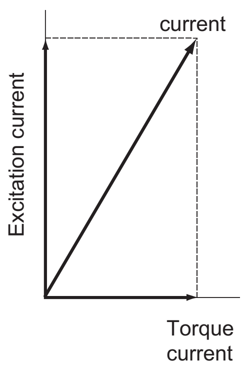
6) Vector control (A700)

This method divides the currents flowing in the motor into a current for making a magnetic flux in the motor and a current for causing the motor to develop a torque, and controls each current separately. Therefore very high response is obtained and torque at low speed can be generated stably.
It is necessary to know the motor speed to perform this control and a motor with an encoder and a plug-in option FR-A7AP or FR-A7AL are required.
It responds to the load variation quickly (high response) by torque current control, and torque control is also enabled by giving torque command.
It has excellent control characteristics and achieves the control characteristics equal to those of DC machines.
To help explain vector control, the fundamental equivalent circuit of an induction motor is shown below:



r1 :Primary resistance
r2 :Secondary resistance
ℓ1:Primary leakage inductance
ℓ2:Secondary leakage inductance
M :Mutual inductance
S :Slip
id :Excitation current
iq :Torque current
im :Motor current

In the above diagram, currents flowing in the induction motor can be classified into a current id (excitation current) for making a magnetic flux in the motor and a current iq (torque current) for causing the motor to develop a torque. With Vector control, inverter controls the motor so that the excitation current and torque current to flow to the optimum by calculating the voltage and output frequency.
Control block diagram is shown on the next page.

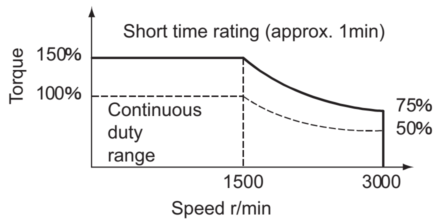


Motor-generated torque TM, slip angular velocity ωs and the motor's secondary magnetic flux $\Phi 2$ can be found by the following calculation:

$$TM \propto \Phi 2 \times iq$$
$$\Phi 2 = M \times id$$
$$\omega s = \frac{r2}{L2} \times \frac{iq}{id}$$

where, L2 = secondary inductance
L2=ℓ2 + M

Vector control requires a dedicated motor with less constants variation and high accuracy encoder (speed detector) to calculate with high accuracy.
Although torque accuracy decreases, vector control can be performed by fitting an encoder to the standard motor.

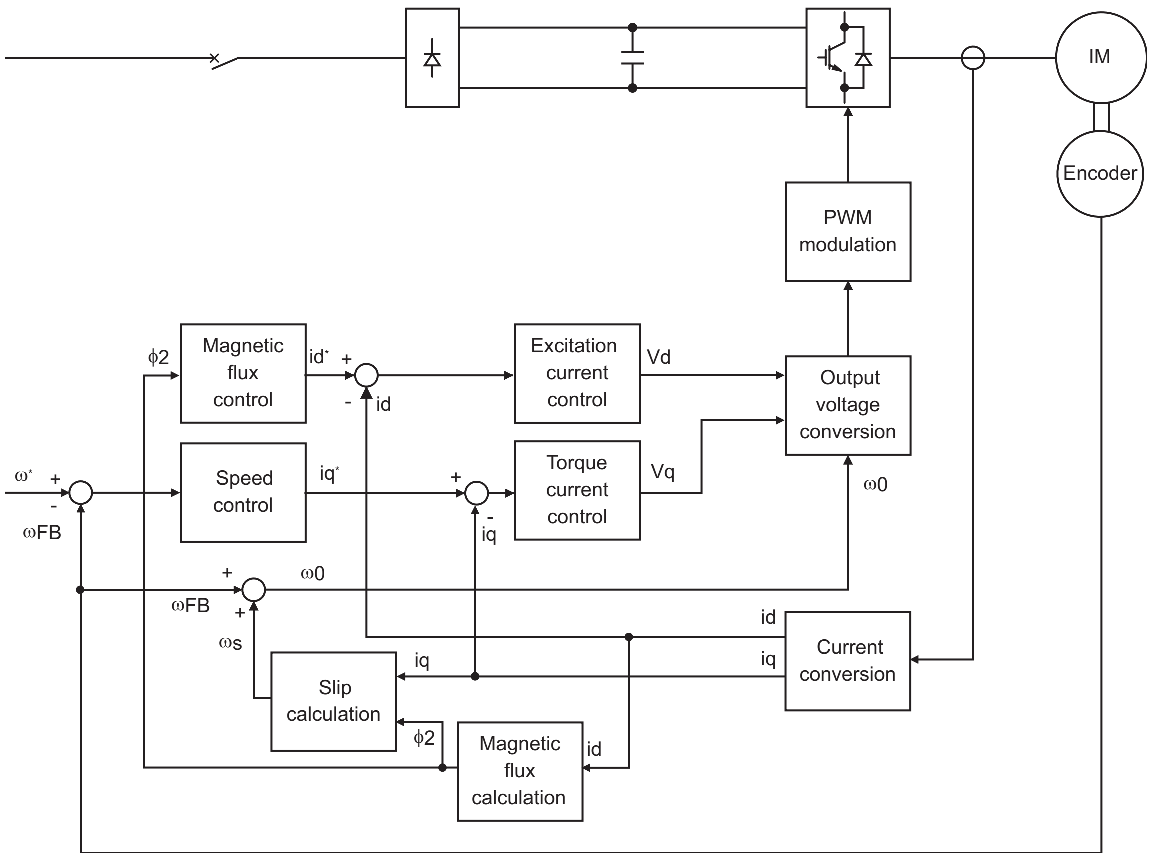


(For dedicated motor 5.5K to 22K)

Output characteristic example of the vector control dedicated motor

When magnetic flux observer is selected, the magnetic flux of the motor is always detected with high accuracy so that an excellent characteristic is provided regardless of the change in the temperature of the motor secondary resistance.

Block diagram of vector control



By detecting the motor speed with an encoder and computing the motor slip, the magnitude of the load can be found.
With the magnitude of the load found, the inverter output current is divided into an excitation current (current required to generate magnetic flux) and torque current (current proportional to the load torque) by vector operation, and frequency and voltage are controlled optimally to flow a current necessary for each.
Since vector control <u>has a current control loop</u>, necessary excitation current and torque current can be calculated separately.

[Speed control]

Speed control operation is performed to zero the difference between the speed command ω^* and actual rotation detection value ωFB by the encoder. At this time, the motor load is found and its result is transferred to the torque current controller as a torque current command iq*.

[Torque current control]

A voltage Vq is calculated to start a current iq which is identical to the torque current command iq* found by speed controller.

[Magnetic flux control]

The magnetic flux Φ2 of the motor is derived from the excitation current id. An excitation current command (id*) is calculated for the motor magnetic flux Φ2 to be the predetermined magnetic flux.

[Excitation current control]

A voltage (Vd) is calculated to start a current id* which is identical to the excitation current command (id*) found by magnetic flux control.

[Output frequency calculation]

Motor slip ωs is calculated on the basis of the torque current value iq and magnetic flux Φ2. The output frequency ω0 is found by adding that slip ωs to the feedback ωFB found by a feedback from the encoder.

The above results are used to make PWM modulation and run the motor.

3.1.2 Rated inverter capacity (common)

Rated capacity of the inverter is calculated based on the rated output current.

Rated inverter capacity (kVA)

$$= \sqrt{3} \times \text{Rated output voltage (V)} \times \text{Rated output current (A)} \times 10^{-3}$$

The rated output current is a current value which the inverter can output continuously at the rated output voltage. The inverter must always be used at no more than this current value.
The overload capacity is defined as the permissible value of a current beyond the rated output current of the inverter.
The overload capacity of the (A700) (E700) (D700) is 150% for one minute and of the (F700) is 120% for one minute.
At a start or for instantaneous overload, the inverter must be used at not more than the overload capacity.
The capacity of the inverter is classified by the rated motor output (kW). This rated capacity applies to the operation of one general-purpose squirrel-cage induction motor of two to six poles especially when there are no limits on acceleration time and starting torque. The suitable capacity must be selected when running a special motor or driving several motors in parallel by one inverter, or when an operation pattern or load torque has been specified.

(1) Operation of one motor (common)

Select the inverter to satisfy the following condition:

Rated inverter output current ≥ rated motor current × 1.1

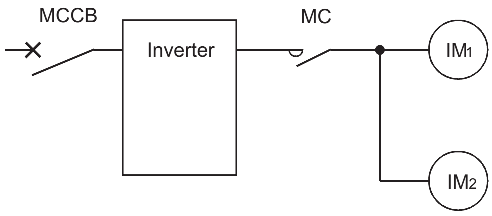
(The current that flows when a standard motor is driven by the inverter is about 1.1 times larger than the current that flows when the motor is run with the commercial power supply.)

*When the inverter is used continuously at rated torque at 50Hz, note the permissible continuous torque of the motor. For more information, refer to the catalog of the corresponding inverter series.

(2) Operation of two or more motors (common)

When two or more motors are connected to one inverter and the output side magnetic contactor is used to start/stop the motors during inverter operation, the inverter capacity selection depends on how to start the motor.

1) Simultaneous start

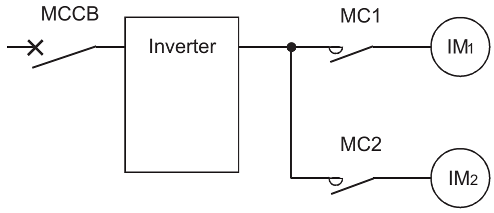


When two or more motors are always switched ON-OFF at the same time, select the inverter to satisfy the following condition:

Rated inverter output current ≥ Sum of rated currents of all motors × 1.1

[Example] Operation of three SF-JR 1.5kW 4-pole motors (rated current 6.0A, starting current 48.4A)
Select the FR-A720-5.5K inverter rated at (6.0A × three motors × 1.1 = 19.8A) or more and having current limit function.

2) Sequential start



When motors are started from the first one
When the current limit function is activated, the frequency changes abruptly. In a sequential start, therefore, the speeds of the motors already started change suddenly.
Therefore, select according to the machine specifications.

• When the fast-response current limit function of the inverter is utilized to minimize the inverter capacity Rated inverter output current ≥ sum of rated currents of all motors × 1.1

• When it is not desired to affect the motors already started (The point is to make selection so that the current limit function is not activated) Rated inverter output current ≥ sum of rated currents of motors already started × 1.1 + Motor starting current of motor started last*
* Motor starting current: Select the inverter so that the starting current of the motor is 6 to 8 times greater than the rated current of the motor.

[Example] Operation of three SF-JR 1.5kW 4-pole motors (rated current 6.0A, starting current 48.4A)

- When the fast-response current limit function of the inverter is utilized to minimize the inverter capacity
  Select the FR-A720-5.5K inverter rated at (6.0A × three motors × 1.1 = 19.8A) or more and having current limit function.
- When it is not desired to affect the motors already started
  Select the FR-A720-18.5K inverter rated at (6.0A × two motors × 1.1+48.4A = 61.1A) or more and having current limit function.

(3) Light motor load (common)

If the load is extremely light as compared to the rated torque of the motor used, the motor current is smaller than the rated current. Hence, cost may be reduced by using an inverter having a smaller rated capacity than the motor capacity. In this case, the following must be noted in determining the rated inverter capacity:
An excitation current (no-load current), 30 to 50% of the rated motor current, flows in a standard motor, even if under no load. For this reason, an inverter with extremely small rated capacity cannot be used.
Under a light load, the ripple factor of the current is higher than that under a rated load even if the effective current value is the same. Since the inverter detects the instantaneous crest value of the motor current to provide protection against overcurrent, the current limit function may be activated at the crest value due to a ripple even if the effective current value is small.
For light-load operation, therefore, it is the best policy to select the inverter capacity which corresponds to the capacity of the motor used.

(4) Special motor (e.g.constant-torque motor dedicated to inverter use)

Special motors are different in motor electrical circuit constants from a standard motor. A motor dedicated to inverter for increased torque at low frequency may be more instable in motor characteristic or be larger in current ripple especially in the low frequency range (about 20Hz or less). When the inverter is used with such a special motor (different in electrical design from the standard motor), select the inverter capacity after fully checking the motor characteristics, noting the following:
1) Choose the inverter capacity one or two ranks higher than the standard.
2) Match the V/F pattern with the motor characteristic using [*Pr. 0*] (torque boost).

(5) For selection of the Simple magnetic flux vector control method (F700)

Select Simple magnetic flux vector control when higher torque than V/F control is necessary in the low speed range.
Simple magnetic flux vector control may be used under the following conditions:
1) The number of motor poles should be any of 2, 4 and 6 poles.
2) Single-motor operation (one motor run by one inverter) should be performed.
3) The wiring length from inverter to motor should be within 30m.

(6) For selection of the General-purpose magnetic flux vector control method (E700)(D700)

Select the General-purpose magnetic flux vector control when you need a large starting torque (3Hz 200% torque (slip compensation is set for 3.7K or less)) for a small capacity or when it is desired to shorten the acceleration time.
When choosing the General-purpose magnetic flux vector control, set the capacity (kW) of the applied motor. (For (E700), set number of motor poles and control method.)
When using a constant-torque motor, select a constant-torque motor in [*Pr. 71 (applied motor selection)*].
When using the General-purpose magnetic flux vector control, there are the following restrictions:
1)Motor of which capacity is equal to or one rank lower than the inverter capacity.
2)Single-motor operation (one motor is run by one inverter).
3)The wiring length from the inverter to the motor should be within 30m. (When the wiring length exceeds 30m, perform offline auto tuning with wires already in place.)
If any of the above conditions are not satisfied, excellent operation characteristics may not be provided.

(7) For selection of the Advanced magnetic flux vector control method (A700)(E700)

Select the Advanced magnetic flux vector control for a load which requires a large starting torque (0.5Hz 150% torque) or a load which requires a 130 to 140% average acceleration torque to decrease the acceleration time.
Advanced magnetic flux vector control may be used under the following conditions:
1) Motor to be used is either Mitsubishi standard motor (SF-JR, SF-HR two-pole, four-pole, six-pole 0.4kW or more) or Mitsubishi constant torque motor (SF-JRCA, SF-HRCA four-pole 0.4kW to 55kW). When using a motor other than the above (other manufacturer's motor, SF-JRC, etc.), perform offline auto tuning without fail.
2) The motor capacity should be equal to or one rank lower than the inverter capacity.
3) Single-motor operation (one motor run by one inverter) should be performed.
4) The wiring length from inverter to motor should be within 30m. (Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m.)

(8) For selection of the Real sensorless vector control (A700)

Select Real sensorless vector control for a load which requires a quick response to the sudden load fluctuation and torque limit during speed control operation.
Real sensorless vector control may be used under the following restriction, conditions.

1) Make sure to perform offline auto tuning before performing Real sensorless vector control.
2) Torque control can not be performed in the low speed regeneration range and at a low speed with light load. In this case, select vector control.

3) Performing pre-excitation (LX signal and X13 signal) under torque control may start the motor running at a low speed even when the start signal (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.
4) Do not switch between the forward rotation command (STF) and reverse rotation command (STR) during operation under torque control. Overcurrent trip (E.OC1 to 3) or opposite rotation deceleration fault (E.11) occurs.
5) For the 0.4K to 3.7K, the speed deviation may become large at 20Hz or less and torque may become insufficient in the low speed range under 11Hz during continuous operation under Real sensorless vector control. In this case, stop once and accelerate again to improve.
6) When the inverter is likely to start during motor coasting under Real sensorless vector control, set to make frequency search of automatic restart after instantaneous power failure valid [*Pr. 57 ≠ 9999, Pr. 162 = 10*].
7) The motor capacity should be equal to or one rank lower than the inverter capacity. (note that the capacity should be 0.4kW or more)
8) Single-motor operation (one motor run by one inverter) should be performed.

(9) For selection of the vector control (A700)

For a load which requires control characteristics equal to those of DC machines and torque control, fit an optional FR-A7AP or FR-A7AL and select vector control.
Vector control may be used under the following restriction, conditions.

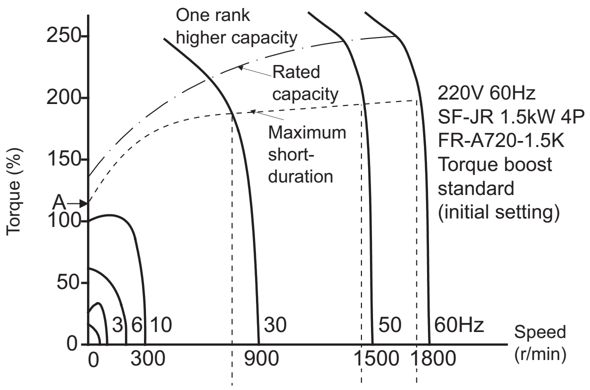
1) Even when motors (other manufacturer's motor, SF-JRC, etc.) other than Mitsubishi standard motor, high efficiency motor (SF-JR, SF-HR0.4kW or more), Mitsubishi constant torque motor (SF-JRCA, SF-HRCA 4-pole 0.4kW to 55kW), vector control dedicated motor (SF-V5RU) are used, using the offline auto tuning function runs the motor with the optimum operating characteristics.
2) The motor capacity should be equal to or one rank lower than the inverter capacity when using a standard motor. (note that the capacity should be 0.4kW or more)
3) For vector control operation, the encoder should be coupled on the same axis with the motor shaft without any mechanical looseness. The speed ratio should be 1:1.
4) Single-motor operation (one motor run by one inverter) should be performed.
5) The wiring length from inverter to motor should be within 30m.
(Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m.)
6) For the vector control dedicated motor, the inverter one or two ranks higher than the motor in capacity needs to be selected depending on the motor capacity.
The table on the right indicates the combinations of the SF-V5RU, SF-THY and inverter capacity.

Voltage	Motor Capacity	Motor Type	Inverter Type
200V class	1.5kW	SF-V5RU1K	FR-A720-2.2K
	2.2kW	SF-V5RU2K	FR-A720-3.7K
	3.7kW	SF-V5RU3K	FR-A720-5.5K
	5.5kW	SF-V5RU5K	FR-A720-7.5K
	7.5kW	SF-V5RU7K	FR-A720-11K
	11kW	SF-V5RU11K	FR-A720-15K
	15kW	SF-V5RU15K	FR-A720-18.5K
	18.5kW	SF-V5RU18K	FR-A720-22K
	22kW	SF-V5RU22K	FR-A720-30K
	30kW	SF-V5RU30K	FR-A720-37K
	37kW	SF-V5RU37K	FR-A720-45K
	45kW	SF-V5RU45K	FR-A720-55K
	55kW	SF-V5RU55K	FR-A720-75K
	75kW	SF-THY	FR-A720-90K
400V class	1.5kW	SF-V5RUH1K	FR-A740-2.2K
	2.2kW	SF-V5RUH2K	FR-A740-2.2K
	3.7kW	SF-V5RUH3K	FR-A740-3.7K
	5.5kW	SF-V5RUH5K	FR-A740-7.5K
	7.5kW	SF-V5RUH7K	FR-A740-11K
	11kW	SF-V5RUH11K	FR-A740-15K
	15kW	SF-V5RUH15K	FR-A740-18.5K
	18.5kW	SF-V5RUH18K	FR-A740-22K
	22kW	SF-V5RUH22K	FR-A740-30K
	30kW	SF-V5RUH30K	FR-A740-37K
	37kW	SF-V5RUH37K	FR-A740-45K
	45kW	SF-V5RUH45K	FR-A740-55K
	55kW	SF-V5RUH55K	FR-A740-75K
	75kW	SF-THY	FR-A740-90K
	90kW		FR-A740-110K
	110kW		FR-A740-132K
	132kW		FR-A740-160K
	160kW		FR-A740-185K
	200kW		FR-A740-220K
	250kW		FR-A740-280K

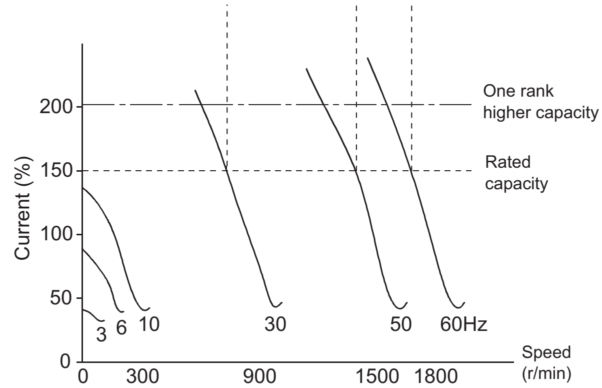
3.1.3 Starting torque and starting current of the motor (common)

When the standard motor is full-voltage started with the commercial power supply, the starting current is generally about 6 to 7 times larger than the rated motor current and the motor starting torque is approximately 150 to 250% of the rated motor torque.
However, the starting and acceleration characteristics of the motor used with the inverter are limited by the overload current rating of the inverter used and are different from those when the motor is full-voltage started with the commercial power supply.
Since the motor is accelerated with the motor starting・acceleration current kept with the overload current rating (150% of the rated output current (120% for (F700))) of the inverter, the starting torque and acceleration torque are smaller than the commercial power supply. Speed-torque and speed-current characteristic examples of the standard motor are as shown in the figure on the right. When the motor is used with the inverter of the corresponding capacity, the torque at the speed corresponding to the intersection of overload current rating (150% of the rated inverter output current (120% for (F700))) and the current characteristics at each frequency is the maximum torque (short-duration rated) generated by the motor. In the example shown on the right, the starting torque at the speed of 0 is 118% (point A).
When the capacity of the inverter used with the motor is increased by one rank, the starting torque and maximum torque increase in proportion to the rise in overload capacity as shown on the right. When the starting torque and acceleration torque are insufficient, it is effective to increase the inverter capacity by one rank.
Changing in proportion to the square of the voltage, the motor-generated torque is influenced by the inverter output voltage.

Since the output voltage of the FR series inverter changes in proportion to the change in input voltage (power supply voltage) of the inverter, the motor speed varies, changing the motor current.



V/F control speed-torque characteristic

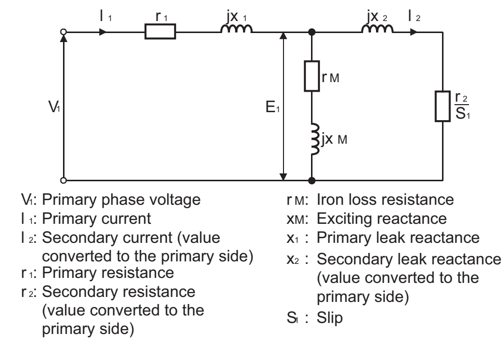


V/F control speed-current characteristic

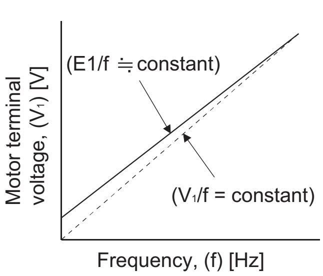
3.1.4 Starting torque boost (common)

The ideal constant-torque characteristic is provided when the ratio of the inverter output voltage (V) to output frequency (f) is as indicated by the broken line in the figure on the right (terminal voltage and frequency) and the torque characteristic in the constant V/f control area is as indicated by the continuous line in the figure on the right (torque characteristic). In the low frequency area, however, since the air gap magnetic flux of the motor, i.e. E_1/f, is reduced by a voltage drop due to the primary resistance (r_1) of the induction motor as shown in the motor equivalent circuit (refer to the figure on the right), the motor torque drops as indicated by the broken line in the figure on the right (torque characteristic).
To prevent the torque reduction at low frequencies, compensate for the voltage drop of the primary resistance to make the inverter output voltage compensation, as indicated by the continuous line in the right figure (torque characteristic). Therefore, the magnetic flux gap becomes constant, and torque characteristic will be closer to the constant torque characteristic on the right (torque characteristic).
The FR series inverters have a function to adjust the inverter output voltage (torque boost). When the starting load torque is large, the primary motor current (I1) is higher than in the equivalent circuit in right figure and E1 is reduced by the voltage drop of the primary resistance (r1).

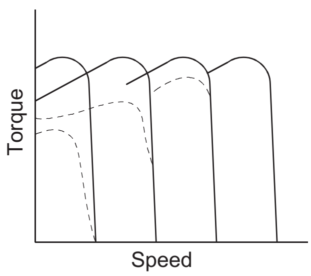
To compensate for this, the torque boost function raises the inverter output voltage.
For details of the torque boost, refer to page 244.



Equivalent circuit of the motor



Terminal voltage and frequency



Torque characteristic

3.1.5 Acceleration/deceleration time of the motor (common)

To suppress the motor starting current within the overload capacity of the inverter, start the motor at a low frequency (initial value 0.5Hz) and increase the frequency gradually. When the motor is decreased from the set frequency, gradually decrease the frequency to prevent the DC bus voltage from being increased excessively by the regenerative energy from the motor. For these reasons, when the motor is accelerated and decelerated by the inverter, the acceleration time and deceleration time between zero and the maximum frequency must be set in advance.

(1) Setting the acceleration time and deceleration time (common)

The acceleration time and deceleration time must be set longer than those found from the torque generated by the inverter-driven motor, the load torque, and the motor and load inertia (J (moment of inertia)).

If the acceleration time setting is too short, the overcurrent protective function (OC1) is activated to stop the inverter. If the deceleration time setting is too short, the overcurrent protective function (OC3) or regenerative overvoltage protective function (OV3) is activated to stop the inverter.

On the contrary, if the acceleration time is too long when the lift is descending, the overcurrent protective function (OC1) or overvoltage protective function (OV1) may be activated.

The acceleration or deceleration time ([*Pr. 7*] or [*Pr. 8*]) value set from the operation panel (parameter unit) is the length of time between zero and the acceleration/deceleration reference frequency ([*Pr. 20*]).

The time required to reach the set frequency can be calculated by proportion as indicated in [Example 1].

The frequency is found from the operating speed and the number of motor poles by using the formula below, with slip ignored:

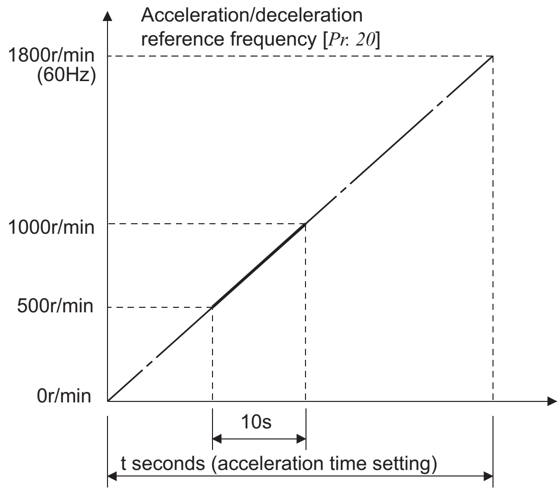
$$\text{Frequency [Hz]} = \frac{\text{Speed [r/min]} \times \text{number of poles}}{120}$$

[Example 1]

When a four-pole motor is accelerated from 500 to 1000 r/min in 10 seconds, acceleration time setting is as follows (assuming that the acceleration/deceleration reference frequency is the factory setting of 60Hz)

$$t = \frac{1800\text{r/min}}{(1000 - 500)\text{r/min}} \times 10\text{s} = 36\text{s}$$

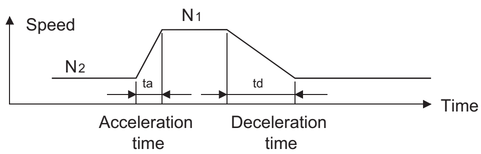
Hence, the acceleration time (*Pr. 7*) is set to 36 seconds.



Acceleration Time Setting

Note : When the acceleration time or deceleration time is set without enough examination, set a long time and check during operation that the OL display on the parameter unit is not lit. When this display is not lit, reduce the set value and make the test again. Repeat this operation until the optimum acceleration or deceleration time is obtained.

(2) Calculation of acceleration and deceleration time (common)



Acceleration/deceleration operation pattern

★ For full information on how to calculate acceleration and deceleration times, refer to any of the following manuals according to the operation pattern:

- Technical note No.30: Capacity selection II (data part)
- Technical note No.31: Capacity selection II (selection part)

3

SELECTION

1) Formula for calculating the acceleration and deceleration times (simple method)

Shortest acceleration time	tas =	$\frac{J_T \times \triangle N}{9.55 \times (T_M \times \alpha a - T_L max)}$ [s]
Shortest deceleration time	tds =	$\frac{J_T \times \triangle N}{9.55 \times (T_M \times \beta + T_L min)}$ [s]

where,

J_T : All J = motorJ_M + loadJ_L (converted to an equivalent JM at the motor shaft) [kg · m^2]

$\triangle$N: Difference between motor speeds before and after acceleration/deceleration $N_1 - N_2$ [r/min]

T_M: Rated motor torque

$$T_M = \frac{9550 \times P}{N} \ [N \cdot m]$$

$T_L$max: Maximum load torque (converted to an equivalent JM at the motor shaft) [N · m]

$T_L$min: Minimum load torque (converted to an equivalent JM at the motor shaft) [N · m]

αa: Acceleration torque coefficient*

β: Brake torque coefficient regenerative braking torque*

P: Rated motor torque [kW]

N: Motor synchronous speed at 60Hz [r/min]

* Refer to the Technical Note No.30 (data part)

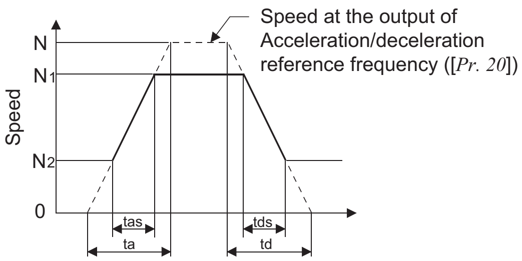
2) Calculation and setting example of the acceleration and deceleration times ([*Pr. 7, Pr. 8*])

Set the time to accelerate/decelerate using acceleration/deceleration reference frequency ([*Pr. 20*]) as reference in acceleration/deceleration time ([*Pr. 7, Pr. 8*]). Use "tas" and "tds" found in 1) to calculate the acceleration and deceleration times ([*Pr. 7, Pr. 8*]) at shortest acceleration/deceleration time as follows:

$$\text{Acceleration time ([Pr. 7])} = \frac{N}{N_1 - N_2} \times \text{tas}$$

$$\text{Acceleration time ([Pr. 8])} = \frac{N}{N_1 - N_2} \times \text{tds}$$

$$N = \frac{120 \times \text{Acceleration/deceleration reference frequency ([Pr. 20])}}{\text{Number of motor poles}}$$



Acceleration time ([*Pr. 7*]) $\geq$ ta

Deceleration time ([*Pr. 8*]) $\geq$ td

When fast response is required, set the smallest value of which the formula is satisfied. And when soft acceleration / deceleration is required, set the required time.

[Example 2] Calculated in the conventional unit system

A conveyor is driven by the SF-JR 2.2kW 4P motor and FR-A720-2.2K inverter (V/F control).
Suppose that
JM = 0.008 [kg·m2],
JL = 0.038 [kg·m2],
TLmax = 9.8 [N·m],
TLmin = 5.88 [N·m], and the acceleration and deceleration times are as short as possible.

JT = 0.008 + 0.038 = 0.046 [kg · m2]

$$\triangle N = N1 - N2 = \frac{120 \times 60}{4} - 0 = 1800[r/min]$$

(When the acceleration/deceleration reference frequency is the initial setting of 60Hz.)

$$TM = \frac{9550 \times 2.2}{1800} = 11.67[N \cdot m]$$

From Technical Note No. 30 (data part) supposing that the torque boost is large,

αa = 1.15

$$tas = \frac{0.046 \times 1800}{9.55 \times (11.67 \times 1.15 - 9.8)} = 2.39[s]$$

β = 1.0

$$tds = \frac{0.046 \times 1800}{9.55 \times (11.67 \times 1.0 + 5.88)} = 0.49[s]$$

When [*Pr. 20 = 60Hz*], acceleration time/deceleration time setting is as follows.

$$\text{Acceleration time ([Pr. 7])} = \frac{1800}{1800 - 0} \times 2.39 = 2.39$$

$$\text{Deceleration time ([Pr. 7])} = \frac{1800}{1800 - 0} \times 0.49 = 0.49$$

Therefore set 2.4s or more for acceleration time, and 0.5s or more for deceleration time.

(3) When there is a limit on acceleration time (common)

When acceleration time exceeds the required value, select either Advanced magnetic flux vector control or Real sensorless vector control, increase torque boost, or select an inverter larger in capacity to increase the inverter current overload capacity at acceleration. Or, select a motor larger in capacity (select an inverter larger in capacity also) to increase the motor acceleration torque.

3.1.6 Deceleration characteristic of the inverter (common)

To shorten the acceleration time, the torque boosts is raised or the inverter capacity or motor capacity is increased. To shorten the deceleration time, add a brake unit or increase the capacity of the built-in brake (increase the inverter capacity).
When the motor is decelerated by the inverter, the inverter gradually lowers the output frequency at a slope of the set deceleration time.
If you try to decelerate the motor in a shorter time than when it is coasted to a stop, the motor runs faster than the synchronous speed of the given frequency. Hence, the motor acts as an induction generator and its rotating energy is partly consumed in the motor winding and partly accumulated in the capacity inside the inverter.
This energy is consumed by the discharge resistor. As a result, it provides braking force for the motor.

[Built-in brake resistor protection] (A700)
Any inverter of 7.5K or less is provided on its rear surface with a discharge resistor for regenerative braking. When the brake resistor is used up to its rating, the temperature rises considerably. The inverter has a protective function to protect this resistor against use beyond its rating.
When this protective function is activated, the built-in brake circuit shut-off to disable the braking action. Therefore, the terminal voltage of the capacity rises to activate the regenerative overvoltage shut-off (OV1 to OV3). Since this protective function returns to the initial state when the inverter is reset, the brake resistor is regarded as cold at the time of restart. Be cautious that operation performed by repeating reset will cause the brake resistor to overheat.

* The brake discharge resistor on the rear surface of the inverter unit will rise to a high temperature. Carefully select the installation place of the inverter.

★ For full information on how to select the brake resistor, brake unit and other braking units, refer to any of the following technical notes according to the operation pattern:

- Technical note No.30 : Capacity selection II (data part)
- Technical note No.31: Capacity selection II (selection part)

(1) Built-in brake resistor (A700)

The built-in brake can provide 100 to 150% of the rated motor torque but must be used within 5s (duty: less than 2 to 3%ED). Select the inverter which satisfies the conditions after finding the permissible duty time, as in the Technical note No.30 (data part).
When a higher brake duty is required, select the external brake resistor or brake unit in accordance with paragraphs 2) or 4). In this case, disconnect the jumper from the built-in brake resistor.

1) The maximum braking torque (% relative to the motor output used with the inverter) value of the built-in brake resistor is shown on page 2. When the braking torque is required is above this value, the inverter capacity must be increased. The addition of the external brake resistor does not increase the braking torque.
2) The regenerative braking duty ([*Pr. 70*]) value of the built-in brake resistor is indicated on page 331. If the duty required is above this value, use the external brake resistor (FR-ABR type) or brake unit (BU type, FR-BU type).

* When further larger braking capability is required, fit the power supply regeneration common converter (FR-CV)

(2) External brake resistor (A700) (E700) (D700)

When the inverter is used in excess of the maximum duty of the built-in brake resistor, the external brake resistor may be installed for 0.4K to 22K. In this case for (A700), the jumper (across terminal PR and PX) on the built-in brake resistor must be disconnected. (0.4 to 7.5kW)

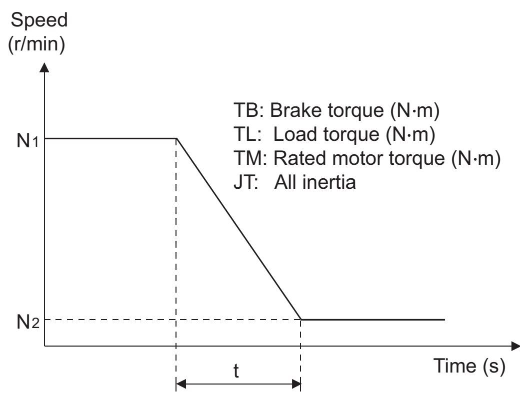
* The (A700) 30K or more and (E700) (D700) 0.2K or less can not use an external brake resistor.

(3) DC injection brake (common)

The DC injection brake is applied during deceleration. Since the braking torque generated by the DC injection brake depends also on the winding resistance of the motor, it cannot be determined uniformly, but an average of more than 50% braking torque is provided in the factory-set state.
In addition, the setting of the DC injection brake time ([*Pr. 11*]), DC injection brake voltage ([*Pr. 12*]), and DC injection brake frequency ([*Pr. 10*]) allows the positioning accuracy to be adjusted according to the load. (Refer to page 328 for details)

(4) Selection of brake unit (common)

The brake unit is used when the brake capability required is greater than that of the built-in brake resistor and external brake resistor. In this case, the capability of the built-in brake resistor is not added to that of the brake unit.
To select the brake unit, determine the required deceleration pattern as shown below.



Deceleration pattern

1) Calculate the brake torque required to decelerate the motor in the determined deceleration pattern:

$$T_B = \frac{J_T \times (N_1 - N_2)}{9.55 \times t} - T_L min\ [N \cdot m]$$

2) Calculate the required brake torque coefficient β as following formula

$$\beta = \frac{T_B}{T_M}$$ TM: rated motor torque to be used

3) From the technical note No.30 (data part), select the brake unit which satisfies the brake torque coefficient β.
4) Using the following formula, find the power W_{MECH} returned from the load, and using the data manual, make sure that the intersection of the deceleration time of t and the permissible brake unit power W_{RS} is below the curve of the brake unit used (refer to Technical note No.30 (data part)). (The motor-compensated power is ignored. For further details, refer to the Technical note No.31 (selection part).
$W_{MECH} = 0.1047 \times T_B \times (N_1+N_2)/2[W]$
5) When using the brake unit frequently (more than 10 times/hour as a guideline), ensure that the value calculated by the following formula is within the permissible continuous power W_{RC} (refer to Technical note No.30 (data part)).

$$W = W_{MECH} \times \frac{\text{Brake operation time}}{\text{1 cycle time}} [W]$$

[Example 3] Calculated in the conventional unit system

To decelerate a 3.7kW 4P motor from 1750 to 0 r/min in two seconds with FR-F720-3.7K.

Assuming that:
Load torque (TL) (reflected to the motor shaft)
: 10% of 3.7kW 4P ≒ 1.96 [N·m]

Load JL (reflected to the motor shaft)
: 10 times greater than 3.7kW 4P ≒ 0.16 [kg·m²]

Rated motor torque (TM) : 19.6 [N·m] on 3.7kW 4P

The brake torque is calculated as follows:

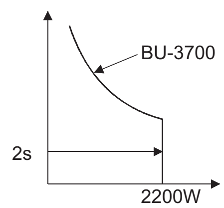
$$T_B = \frac{(0.016 + 0.16) \times (1750 - 0)}{9.55 \times 2} - 1.96 = 14.2[N \cdot m]$$

$$\text{Brake torque coefficient } \beta = \frac{T_B}{T_M} = \frac{14.2}{19.6} = 0.72$$

Since the brake torque coefficient (β) must be 0.72 or higher, select the brake unit combination, in which the brake torque coefficient (β) = 1.2, from the Technical Note No. 30 (Data Part). Hence, the brake unit used in this case is the BU-3700.

$W_{MECH} = 0.1047 \times 14.2 \times (1750 + 0)/2 = 1300[W]$

Since the energy of 2200 [W] is consumed in two seconds, the BU-3700 brake unit can be used according to the Technical note. (1300 [W] < 2200 [W])



[Exercise 4]

It is desired to repeat the start and stop of the load used in Exercise 3 at intervals of 15 seconds.

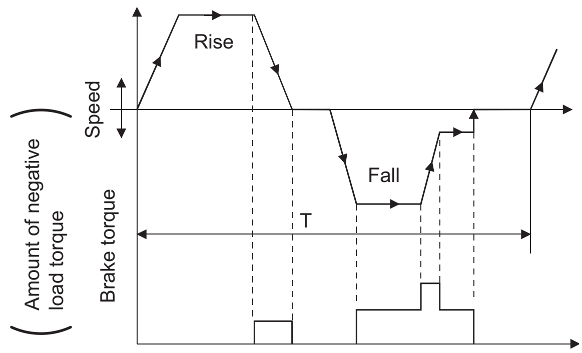
$$W = \frac{1300 \times 2}{15} = 173[W]$$

The BU-3700 can be used because its permissible continuous power is 300W according to the data in the manual. In addition to this calculation, it is also necessary to examine whether the motor may be used repeatedly.

(5) Continuous use of the brake unit (common)

When the motor is used in the brake region, select a brake unit which satisfies the condition that the brake resistor power consumed continuously is not more than the permissible continuous power of the brake unit.

When a negative load is operated repeatedly as shown below, find the power returned from the load in the whole region where the negative load is applied during other than deceleration and check that it is within the permissible continuous power W_{RC} in the data part of Technical note.



Operation pattern of the continuous regenerative duty load

(6) Combination of the brake unit and inverter (common)

A larger brake unit may be required when the repeated use of the brake unit is frequent or a negative load is driven. When a larger brake unit is used, the inverter capacity must also be increased. When higher brake capability is required, select the FR-CV (power supply regeneration common converter).

3.2 Motor characteristics

3.2.1 Characteristics of the induction motor (common)

There are the following relationships between the speed, voltage, frequency, magnetic flux density, torque and other factors of an induction motor:

$$N = \frac{120f}{p}(1-S)$$

$$B = K_1\frac{V}{f}$$

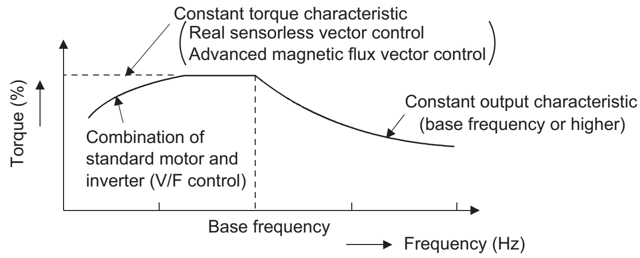
$$T = K_2\frac{V}{f}I \doteqdot K_3\left(\frac{V}{f}\right)^2$$

$$P = K_4TN \doteqdot K_5Tf = K_6VI$$

N: Speed	P:Output
f : Frequency	T : Torque
p : Number of motor poles	V : Terminal voltage
S : Slip	I : Motor current
B : Magnetic flux density	K_1 to K_6 : Constants

When a three-phase standard motor is used, the value of magnetic flux B is maximum at 50Hz and cannot be increased beyond that value. In addition, motor current cannot be flown continuously at more than the rated current value, in principle. To run the standard motor without burnout, V/f must be controlled to be constant or below the constant value.

As indicated by the above formula, making V/f constant causes the motor torque at the rated current to be constant. Therefore, by controlling the voltage and frequency to be kept constant, the torque characteristic is made constant. However, a voltage drop due to the primary impedance cannot be ignored in the low frequency range and the torque lowers as shown below. Refer to page 486.
The Advanced magnetic flux vector control and Real sensorless vector control compensate for a voltage drop due to the primary impedance and therefore provide an ideal constant-torque characteristic.



Motor/torque characteristic

Due to the inverter characteristic, a voltage above the power supply voltage cannot be developed at the frequency of higher than 50Hz or 60Hz or higher. For this reason, the voltage is kept constant, only the frequency is changed, and the torque is inversely proportional to the frequency, i.e. the constant output characteristic is achieved with the voltage kept constant.

3.2.2 Torque generated by a motor driven by an inverter (common)

When the motor is driven with variable voltage/variable frequency power supply, the torque curve is as shown on page 486 (example of 1.5kW). When the inverter is used as a power supply, however, the overload capacity of the inverter suppresses the torque of the motor to be less than the maximum value of the motor. This value is the maximum torque for short time. Hence, the use of a large-capacity inverter raises the overload capacity, leading to the increase in maximum torque for short time. For the values for the standard combinations, refer to the Technical note No.30 (data part).

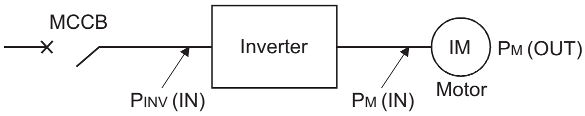
In the low frequency range, the torque value changes according to the V/f pattern of the inverter output and the electrical constant of the motor. Selecting General-purpose magnetic flux vector control, Advanced magnetic flux vector control or Real sensorless vector control minimizes the torque reduction. In the V/F control, the torque boost function ([*Pr. 0*]) also allows the torque to be raise especially in the low frequency range.
Refer to page 486 starting torque boost. For the value increased by the torque boost function, refer to the Technical note No.30 (data part).

3.2.3 Continuous motor output characteristic (common)

When the motor is driven from the inverter, its power factor and efficiency are lower than those of the motor driven with a sine wave (commercial power supply) due to the influence of harmonics included in the inverter output. Therefore, since the motor current increases and the motor temperature rises to generate the same load torque, the motor must be used with its output torque reduced. Because the self-cooling fan of the motor has a less effect, especially at lower than 30Hz, the load torque must be reduced for continuous use.
Refer to the corresponding inverter series catalog for the permissible continuous operation torque of the three rates, 200V/50Hz, 200V/60Hz, 220V/60Hz standard motor driven from the inverter.
When the motor is run continuously with the rated torque down to the low speed range, consider the use of a constant-torque motor.

3.2.4 Efficiency (common)

(1) Finding the overall efficiency



$P_{INV\ (IN)}$: Inverter input power [kW]

$P_{M\ (IN)}$: Motor input power [kW]

$P_{M(OUT)}$: Motor output power [kW]

- Inverter efficiency η INV .... Indicates the efficiency of the inverter itself and is found by the following formula from the inverter input power $P_{INV\ (IN)}$ and the motor input power $P_{M(IN)}$.

$$\eta_{INV} = \frac{P_{M\ (IN)}}{P_{INV\ (IN)}} \times 100\ [\%]$$

- Motor efficiency ηM .... Indicates the efficiency of the motor driven by the inverter and is found by the following formula:

$$\eta_M = \frac{P_{M(OUT)}}{P_{M(IN)}} \times 100[\%]$$

- Overall efficiency ηT.............. Indicates the efficiency of the inverter and motor combined and is found by the following formula:

$$\eta_T = \eta_{INV} \times \eta_M = \frac{P_{M\ (OUT)}}{P_{INV(IN)}} \times 100[\%]$$

(2) Motor efficiency

The motor efficiency in (1) is further developed as indicated by the following formula:

$$\eta_M = \frac{P_{M(OUT)}}{P_{M(IN)}} \times 100 \quad \frac{P_{M(OUT)}}{P_{M(OUT)} + \text{motor loss}} \times 100[\%]$$

Main motor losses are iron loss, stator copper loss and rotor copper loss. When the load torque decreases, the ratio of the above losses to the output power increases, reducing the efficiency. Similarly, if the load torque remains the same, the decrease in output frequency results in reduced efficiency.

The reduction in motor terminal voltage (i.e. inverter output voltage) decreases the motor torque. The increase in motor slip and rotor copper loss decreases the motor efficiency.

3.2.5 Vibration (common)

Since the inverters use a high-carrier frequency sine-wave PWM control, the vibration of the motor is small. As compared to that of the motor driven with the commercial power supply, however, the vibration of the motor installed to a machine may be slightly larger. The possible causes of vibration are as follows.

1) Vibration due to mechanical imbalance of the rotating body including motor rotor and load

Vibration happens by mechanical imbalance, which is caused by rotating body itself or connecting parts with the machine (runner, pulley).

When performing high-speed operation by an inverter, natural frequency of rotating body comes close to the operating frequency, and that increases vibration.

Countermeasure		Effect
Inverter	Set the speed limit by [*Pr. 1 Maximum frequency*].	Vibration is avoided by operating in the frequency less than the vibration enhancing frequency.*1
Inverter	Use the functions set by [*Pr. 31 to 36 Frequency jump*].	Operation at resonance frequency is avoided (resonance point cannot be avoided during acceleration/deceleration).
System	Apply flexible coupling or tire-shaped coupling.	Rotation vibration is absorbed.
System	Strengthen the rigidity of the machine and motor, or place vibration-proof rubber.	Natural frequency at machine side is changed.

*1 Note that operation range is limited.

2) Vibration due to torsional natural vibration consist of motor rotor and load matching the cogging torque frequency (= mechanical resonance with natural vibration).

Harmonic components of the inverter output generates cogging torque, and that cogging torque causes vibration. When torsional natural vibration and cogging torque frequency matches, resonance occurs, applying larger torque to the axis.

Countermeasure		Effect
Inverter	Use the functions set by [*Pr. 31 to 36 Frequency jump*].	Operation at resonance frequency is avoided (resonance point cannot be avoided during acceleration/deceleration).
Inverter	Change [*Pr. 72 PWM frequency selection*] setting.	Resonance is avoided by changing the cogging torque.*2
System	Apply flexible coupling or tire-shaped coupling.	Rotation vibration is absorbed.
System	Strengthen the rigidity of the machine and motor, or place vibration-proof rubber.	Natural frequency at machine side is changed.

*2 Setting PWM frequency higher causes EMI noise and leak current to increase. Setting PWM frequency lower causes acoustic motor noise to increase.

3) Vibration due to complex combination of mechanic element, which includes motor rotor and load, and electric element, which consists of motor and inverter.

Electrical vibration element, which is caused by inverter control and motor slip, and mechanical vibration element, which is caused by load including motor rotor, combines and causes several resonance points. When this happens, large torque is applied to the axis in wide operating frequency range. Physical vibration by mechanical and electrical elements happens as follow: rotation speed of load changes suddenly (decelerates/accelerates) → motor slip amount changes suddenly (increase/decrease) → motor torque occurs (accelerate/decelerate) → continued.

Countermeasure		Effect
Inverter	Set [*Pr. 653 Speed smoothing control*].	Inverter detects torque fluctuation (including motor rotor) in the mechanical system and adjusts inverter's operation frequency so that it will not be affected by the mechanical vibration,. This results in the operation without resonance.
Inverter	Reduce output voltage (adjust [*Pr. 3*] and [*Pr. 19*])	Motor slip is increased to reduce torque fluctuation for the speed fluctuation. In that condition, inverter is less likely to be affected by mechanic vibration, and resonance is avoided.*3
System	Strengthen the rigidity of the machine and motor, or place vibration-proof rubber.	Natural frequency at machine side is changed.

*3 Take caution as output torque and speed may decrease.

Also, when vibration is exceptionally large, inverter's protective function (E.OC 1 to 3 and E.OV 1 to 3) may occur.

In some cases, low vibration motor (refer to page 496) creates desirable effect.

3.3 Operation of various motors

A variety of motors are available; various types of motors classified according to protection types and structure, those provided with equipment such as brakes and speed reducers, and special-purpose motors. When identical to a general-purpose three-phase motor in electrical characteristics, any motor can be run by the inverter without fault.

For motors which have different electrical characteristics, adjustment is required in torque boost function ([*Pr. 0*]) of V/F pattern (Refer to page 486 for Starting Torque Boost), or a dedicated inverter which is matching to the motor characteristics may be required.

When using a motor designed for commercial power supply (50Hz or 60Hz) with the inverter, set the base frequency of the inverter ([*Pr. 3*]) to 50Hz or 60Hz.

3.3.1 Motor types according to protection structure

Motor Protection Structure

Type	Type Code	Protection Code	Remarks
Drip-proof type	SB-JR, SB-TH	IP 22	Available with a standard inverter (Vertical or flange type is also available)
Totally-enclosed fan-cooled type	SF-JR, SF-HR, SF-TH	IP 44	
Totally-enclosed fan-cooled, outdoor type	SF-JRO, SF-HRO, SF-THO	IP 44	
Totally-enclosed fan-cooled, corrosion-proof type	SF-J, SF-TH, CF-J, CF-TH, SF-HJ	IP 44	
Explosion-protected type	XF(E)-NE XF-E, XF-LH	IP 44	Explosion-proof test (Safety test of Ministry of Health, Labour and Welfare) is necessary in combination with the inverter. Refer to page 498 for further information.

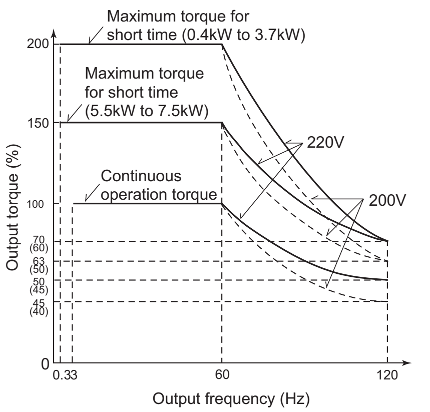
3.3.2 Constant-torque motor

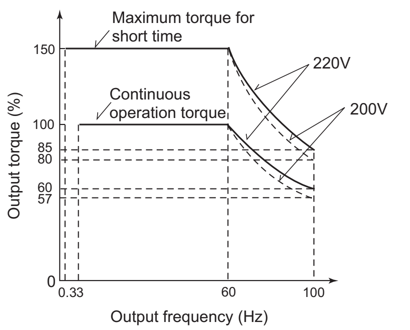
A constant-torque motor is a motor dedicated to inverter operation which can be run continuously without reducing the load torque even in the low speed range. (A700) provides a 100% constant torque from 3 to 60Hz under Real sensorless vector control. (from 10 to 60Hz for 45kW, 55kW)

Inverter has an electronic thermal relay dedicated to Mitsubishi constant motor, therefore external thermal relay is not necessary.

● Continuous use within the rated range (Real sensorless vector control)

SF-HRCA type

<table>
<tr><th>60Hz torque reference
(when inverter is 0.4kW to 7.5kW)</th><th>60Hz torque reference
(when inverter is 11kW to 30kW)</th><th>60Hz torque reference
(when inverter is 37kW to 55kW)</th></tr>
<tr><td>

Values in parenthesis apply to the 0.4kW to 0.75kW</td>
<td>
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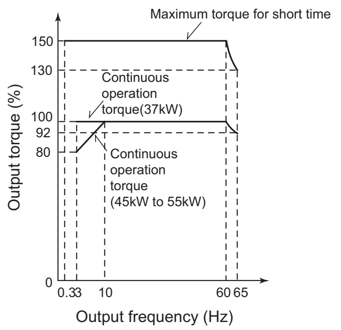
<td>
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Standard Specifications of Constant-Torque Motor (Motor dedicated to magnetic flux vector control)

Output (kW)	Number of poles	Type	Frame Number	Continuous operation torque (N · m)	Insulation	Inverter Power supply	Frequency range	Example of applicable inverter
0.4	4	Totally-enclosed fan-cooled type SF-JRCA	71M	2.12	Class B	200V/50Hz 200V/60Hz 220V/60Hz	3 to 120Hz	FR-A720-0.4K
0.75			80M	3.98				FR-A720-0.75K
1.5			90L	8.0				FR-A720-1.5K
2.2			100L	11.7	Class F			FR-A720-2.2K
3.7			112M	19.6				FR-A720-3.7K
5.5			132S	29.2				FR-A720-5.5K
7.5			132M	39.8				FR-A720-7.5K
11			160M	58.4			3 to 100Hz	FR-A720-11K
15			160L	80				FR-A720-15K
18.5			180M	98.2				FR-A720-18.5K
22			180L	117				FR-A720-22K
30			200L	159			3 to 65Hz	FR-A720-30K
37			200L	196				FR-A720-37K
45			225S	239				FR-A720-45K
55		Totally-enclosed forced cooling type* SE-JRCA-FV	225S	292				FR-A720-55K
75		Totally-enclosed fan-cooled type SF-LHCA	250M	398		400V/50Hz 400V/60Hz 440V/60Hz	6 to 60Hz	FR-A740-75K
90			280S	478				FR-A740-90K
110			280M	584				FR-A740-110K
132			315M	700				FR-A740-132K
150			315M	796				FR-A740-160K
160			315M	849				FR-A740-160K
185			315L	982				FR-A740-220K
200			315L	1061				FR-A740-220K
220			315L	1167				FR-A740-220K
250			355L	1326				FR-A740-280K
280			355L	1486				FR-A740-280K
0.2		Totally-enclosed fan-cooled type SF-HRCA	63M	1.06	Class E	200V/50Hz 200V/60Hz 220V/60Hz	3 to 120Hz (base frequency 60Hz)	FR-A720-0.4K
0.4			71M	2.12				FR-A720-0.4K
0.75			80M	3.98				FR-A720-0.75K
1.5			90L	8.0				FR-A720-1.5K
2.2			100L	11.7				FR-A720-2.2K
3.7			112M	19.6	Class B			FR-A720-3.7K
5.5			132S	29.2				FR-A720-5.5K
7.5			132M	39.8				FR-A720-7.5K
11			160M	58			3 to 100Hz	FR-A720-11K
15			160L	80				FR-A720-15K
18.5			180M	98				FR-A720-18.5K
22			180M	117				FR-A720-22K
30			180L	159	Class F			FR-A720-30K
37			200L	196			3 to 65Hz	FR-A720-37K
45			200L	239				FR-A720-45K
55			225S	292				FR-A720-55K

* Power supply of the forced cooling fan is three-phase 200/200/200V, 50/60/60Hz.

Standard Specifications of Constant-Torque Motor (Motor dedicated to V/F control)

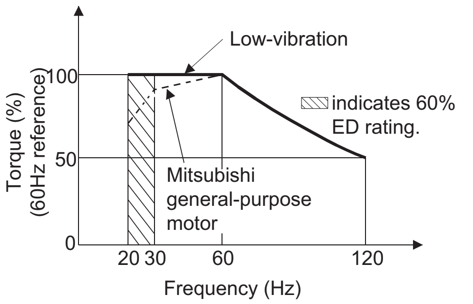
Output (kW)	Number of poles	Type	Frame Number	Continuous operation torque (N · m)	Insulation	Inverter Power supply	Frequency range	Example of applicable inverter
0.4	4	Totally-enclosed fan-cooled type SF-JRC	71M	2.12	Class B	200V/50Hz 200V/60Hz 220V/60Hz	6 to 120Hz (base frequency 60Hz)	FR-A720-0.4K
0.75			80M	3.98				FR-A720-0.75K
1.5			90L	8.0				FR-A720-1.5K
2.2			100L	11.7	Class F			FR-A720-2.2K
3.7			112M	19.6				FR-A720-3.7K
5.5			132S	29.2				FR-A720-5.5K
7.5			132M	39.8				FR-A720-7.5K
11			160L	58			6 to 100Hz	FR-A720-11K
15			180M	80				FR-A720-15K
18.5			180L	98				FR-A720-22K
22			180L	117				FR-A720-30K
30			200L	159			6 to 65Hz	FR-A720-37K
37		Totally-enclosed forced cooling type* SE-JRC-FV	200L	196				FR-A720-45K
45			225S	239				FR-A720-55K

* Power supply of the forced cooling fan is three-phase 200/200/200V, 50/60/60Hz.

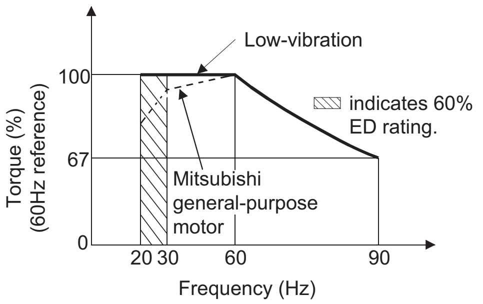
3.3.3 Low-vibration motor

When compared to a general-purpose motor, a low-vibration motor is designed to be insusceptible to time harmonics and space harmonics and is improved in machining accuracy to minimize gap imbalance. Hence, this type of motor has achieved low oscillation of a maximum 5μm full-amplitude and a maximum 1.5G oscillatory acceleration. It is also wider in continuous output range than a general-purpose motor.

· 4-pole motor



· 2-pole motor



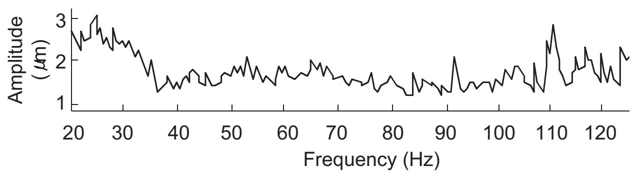
Continuous Rating Range

Standard Specifications of Low-Vibration Motor

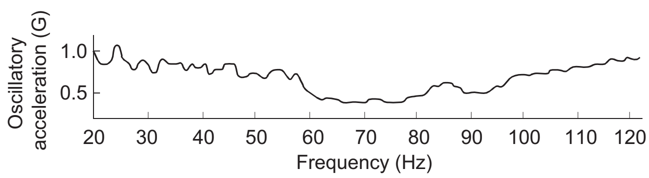
Type	Frame Number	Output (kW)	Number of Poles	Insulation	Power Supply	Frequency Range (Hz)
Totally-enclosed fan-cooled type SF-JRL SF-JRF(V)L	80M	0.75	2	Class F	200V/50Hz 200V/60Hz 220V/60Hz or 400V/50Hz 400V/60Hz 440V/60Hz	20 to 90 Standard frequency 60Hz
	90L	1.5				
	100L	2.2				
	112M	3.7				
Totally-enclosed fan-cooled type SF-JRL SF-JRF(V)L	80M	0.75	4	Class B		20 to 120 Base frequency 60Hz
	90L	1.5		Class F		
	100L	2.2				
	112M	3.7				

*1 Set the torque boost ([*Pr. 0*]) of the minimum value.
*2 Set 0 in Electronic thermal O/L relay ([*Pr. 9*]) and install an external thermal relay.

● Amplitude (Full amplitude)



● Oscillatory acceleration



Oscillation Characteristics (Example of 3.7kW 4P)

3.3.4 Brake motor

When a motor with magnetic brake is operated by the inverter, the power for the brake must be supplied from the primary side of the inverter. (Modifications must be made to a motor with brake where the motor terminals are connected with the brake terminals inside the motor, e.g. a current type brake which operates the brake using a large starting current.)
To stop the motor with the magnetic brake, turn ON the output stop signal (MRS) of the inverter, and at the same time, turn OFF the start input signal (STF or STR). If MRS signal is not used, the braking force will reduce at the time of braking and/or a lock current will flow in the motor, causing the electronic thermal relay to be activated by the current limit function which has been activated for a long time.

Other instructions

1) The brake should be used at a speed of 1800 r/min or less. If the motor running at high speed is brought to a sudden stop, the braking capacity of the electromagnetic brake may be insufficient depending on the value of load J (moment of inertia).
2) When the motor is provided with the NB brake, continuous low-speed operation below 900 r/min may cause noise to be generated due to the looseness of the brake disc, which does not cause a functional problem. This type of motor can be used without fault if operated at low speed for a short duration, e.g. positioning to a stop.
   Setting of factory shipment is AC synchronous OFF connection. For further reduction of the coasting time, DC OFF is available.

3.3.5 Pole changing motor

Since a pole-change motor has difference in rated current from a general-purpose motor, the inverter should be selected after checking the rated motor current. The number of poles must be changed after stopping the motor. If it is changed during rotation, the inverter is brought to a fault as indicated in the table on the right and proper operation cannot be performed.

Switching from high-speed operation to low-speed operation	Overcurrent (OC3) or regenerative overvoltage (OV3) is activated to coast the motor to a stop.
Switching from low-speed operation to high-speed operation	Overcurrent (OC1) is activated to coast the motor to a stop.

3.3.6 Submersible motor

Since its rotor and other parts rotate under water, a water seal type submersible motor is larger in both mechanical loss and rated current than a general-purpose motor. Select the inverter capacity so that its rated output current is more than 1.1 times greater than the rated current of the submersible motor. (An inverter of one rank higher capacity may be required for the motor.)
When large torque is required due to lodged sand etc., an inverter of one rank higher capacity may be selected to raise its overload capacity and the motor capacity may also be increased. Alternatively, the torque boost ([*Pr. 0*]) setting value may be increased.

Other instructions

1) As compared to the one driven by a commercial power supply, the submersible motor driven by an inverter is slightly higher in motor temperature rise. Particularly in a canned system, the increase in can loss causes the submersible motor driven by the inverter to be about 15% higher in temperature than the one driven by a commercial power supply.
2) Protection of submersible motor
   Since the submersible motor may be installed deep in a well, it is difficult to detect its fault from the ground, and its permissible lock time is short. Hence, an appropriate protection relay must be selected to protect the submersible motor.
   Ideally, the installation of a thermal detector, e.g. thermistor, on the motor for the detection of coil temperature ensures safety, which detects faults occurring in a low-speed range (ambient water temperature rise, overload operation). Generally, provide a thermal relay between the inverter and motor, and set zero in electronic thermal O/L relay ([*Pr. 9*]) of the inverter. Set the overload protection of the thermal relay to the rated motor current and set the lock protection to within 5 seconds (3 seconds preferable).
3) When the cable length between the motor and inverter is long, use a large-diameter cable to prevent the motor torque from decreasing due to the voltage drop over the cable.
4) Using an existing submersible motor
   The inverter power supply generates a surge voltage, causing the voltage to rise sharply (dV/dt is large). Therefore when using an installed submersible motor, a high voltage developed by the inverter may burn out the motor if insulation is lower than 10MΩ. Check that the insulation of the submersible motor has not deteriorated.
5) Installation of a leakage current relay
   The installation of a leakage current relay informs of an alarm or an insulation fault of the submersible motor and cable, allowing measures to be taken in advance. Larger in normal leakage current and longer in cable length than a land motor, the submersible motor should be selected with consideration given to a large leakage current.

3.3.7 Explosion-proof motor

The inverter cannot drive commercial power drive pressure-resistant explosion proof motors and safety-increased explosion-proof motors already in place.
To operate an explosion-proof motor by an inverter in Japan, explosion proof certification by the Ministry of Health, Labour and Welfare for the inverter and motor unit is required. Strong cover of the Mitsubishi pressure-resistant explosion-proof motor is utterly unaffected by explosion-proof tests (10 explosion tests + 15 fire explosion tests) By applying Japanese d2G4 standard for the explosion proof structure, the explosion-proof motor can respond to various needs. The inverter used with this motor must be the Mitsubishi FR-B, B3 series inverter dedicated to explosion-proof motor (equivalent to the FR-A700) and must be installed in non-hazardous locations.

(1) Variable torque series (combination with FR-B)*

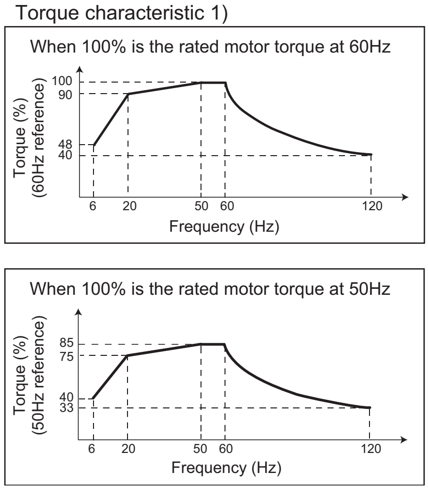
Operate a pressure resistant explosion-proof motor with a FR-B series inverter under V/F control.

Motor Type			Inverter Type	
Type	Output	Torque Characteristic	200V class	400V class
XE-NE	0.2kW			
XE-NE	0.4kW		FR-B-750	FR-B-750
XF-NE	0.75kW			
XF-NE	1.5kW		FR-B-1500	FR-B-1500
XF-NE	2.2kW		FR-B-2200	FR-B-2200
XF-NE	3.7kW		FR-B-3700	FR-B-3700
XF-NE	5.5kW	1)	FR-B-5.5K	FR-B-7.5K
XF-NE	7.5kW		FR-B-7.5K	
XF-E	11kW		FR-B-11K	FR-B-15K
XF-E	15kW		FR-B-15K	
XF-E	22kW		FR-B-22K	FR-B-22K
XF-E	30kW		FR-B-30K	FR-B-37K
XF-E	37kW		FR-B-37K	
XF-E	45kW		FR-B-45K	FR-B-55K
XF-TH	55kW		FR-B-55K	
XF-TH	75kW	2)	FR-B-75K	FR-B-75K
XF-TH	90kW		-	FR-B-90K
XF-TH	110kW		-	FR-B-110K

Motors with 45kW or less have 2-pole, 4-pole, or 6-pole. Note that some motors with 2 or 6 poles are required for the explosion proof test by the Ministry of Health, Labour and Welfare. Please consult your sales representative when placing an order. Motors with 55kW or more have 4 poles. Please consult our sales representative for the motor capacities not mentioned above.

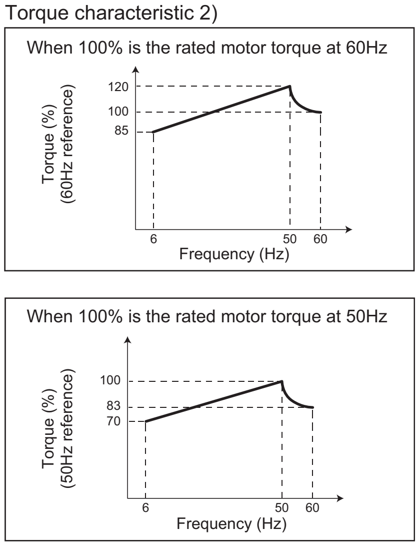
* Above combinations are when Mitsubishi pressure-resistant explosion-proof motor with 4 poles is used.

Torque characteristic 1)



*1 Above graph shows torque characteristic when the maximum frequency is 120Hz. The characteristic differs by the motor frame number.
*2 Continuous operation can be performed in the above mentioned torque range or less.

Torque characteristic 2)



(2) Constant-torque series (combination with FR-B3)

Operate a pressure-resistant explosion-proof motor with a FR-B3 series inverter under Advanced magnetic flux vector control.
Be sure to operate offline auto tuning.

Constant-torque series standard type (combination with FR-B3)

Motor Type			Inverter Type	
Type	Output	Torque Characteristic	200V class	400V class
XE-NECA-2	0.4kW	3)	FR-B3-400	FR-B3-H400
XF-NECA-2	0.75kW		FR-B3-750	FR-B3-H750
XF-NECA-2	1.5kW		FR-B3-1500	FR-B3-H1500
XF-NECA-2	2.2kW		FR-B3-2200	FR-B3-H2200
XF-NECA-2	3.7kW		FR-B3-3700	FR-B3-H3700
XF-NECA-2	5.5kW		FR-B3-5.5K	FR-B3-H5.5K
XF-NECA-2	7.5kW		FR-B3-7.5K	FR-B3-H7.5K
XF-ECA-2	11kW	4)	FR-B3-11K	FR-B3-H11K
XF-ECA-2	15kW		FR-B3-15K	FR-B3-H15K
XF-ECA-2	18.5kW		FR-B3-18.5K	FR-B3-H18.5K
XF-ECA-2	22kW	5)	FR-B3-22K	FR-B3-H22K
XF-ECA-2	30kW		FR-B3-30K	FR-B3-H30K
XF-ECA-2	37kW		FR-B3-37K	FR-B3-H37K

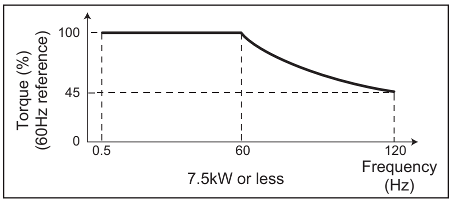
The motor has 4 poles.

Constant-torque series low acoustic noise type (combination with FR-B3-N)

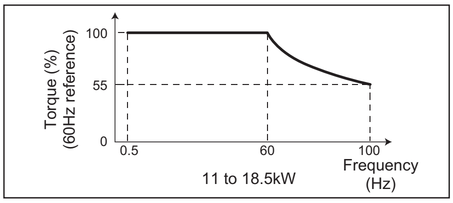
Motor Type			Inverter Type	
Type	Output	Torque Characteristic	200V class	400V class
XE-NECA-1	0.4kW	3)	FR-B3-N400	FR-B3-NH400
XF-NECA-1	0.75kW		FR-B3-N750	FR-B3-NH750
XF-NECA-1	1.5kW		FR-B3-N1500	FR-B3-NH1500
XF-NECA-1	2.2kW		FR-B3-N2200	FR-B3-NH2200
XF-NECA-1	3.7kW		FR-B3-N3700	FR-B3-NH3700
XF-NECA-1	5.5kW		FR-B3-N5.5K	FR-B3-NH5.5K
XF-NECA-1	7.5kW		FR-B3-N7.5K	FR-B3-NH7.5K
XF-ECA-1	11kW	4)	FR-B3-N11K	FR-B3-NH11K
XF-ECA-1	15kW		FR-B3-N15K	FR-B3-NH15K
XF-ECA-1	18.5kW		FR-B3-N18.5K	FR-B3-NH18.5K
XF-ECA-1	22kW	5)	FR-B3-N22K	FR-B3-NH22K
XF-ECA-1	30kW		FR-B3-N30K	FR-B3-NH30K
XF-ECA-1	37kW		FR-B3-N37K	FR-B3-NH37K

The motor has 4 poles.

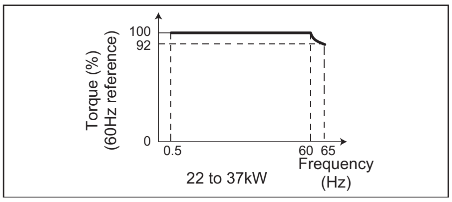
Torque characteristic 3)



Torque characteristic 4)



Torque characteristic 5)



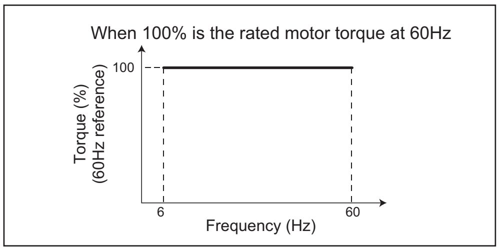
* Above output characteristics are the indoor specifications. When used outside, the maximum frequency for 18.5kW is 65Hz.

(3) Constant-torque series with 60Hz standard (combination with FR-B)

Operate a pressure-resistant explosion-proof motor with a FR-B series inverter under V/F control.

Motor Type			Inverter Type	
Type	Output	Torque Characteristic	200V class	400V class
XF-TH	45kW	6)	FR-B-55K	FR-B-55K
XF-TH	55kW		FR-B-75K	FR-B-75K
XF-TH	75kW		-	FR-B-90K
XF-TH	90kW		-	FR-B-110K

Torque characteristic 6)

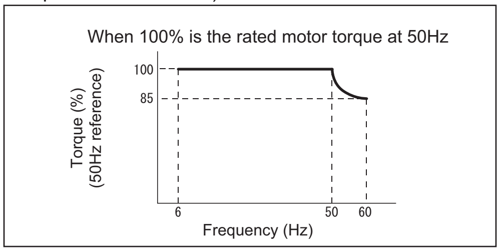


(4) Constant-torque series with 50Hz standard (combination with FR-B)

Operate a pressure-resistant explosion-proof motor with a FR-B series inverter under V/F control.

Motor Type			Inverter Type	
Type	Output	Torque Characteristic	200V class	400V class
XF-TH	37kW	7)	FR-B-55K	FR-B-55K
XF-TH	45kW		FR-B-75K	FR-B-75K
XF-TH	55kW		-	FR-B-90K
XF-TH	75kW		-	FR-B-110K

Torque characteristic 7)



(5) Applicable options

	Name	Type	Availability (Available: ○, Not available: ×)
Plug-in Type	16-bit digital input	FR-A7AX	○
	Digital output, extension analog output	FR-A7AY	○
	Relay output	FR-A7AR	○
	CC-Link communication	FR-A7NC	○
	LONWORKS communication	FR-A7NL	○
	DeviceNet communication	FR-A7ND	○
	PROFIBUS-DP communication	FR-A7NP	○
	Orientation, encoder feedback, Vector control	FR-A7AP	○ *1
Stand-alone	Parameter unit	FR-PU07	○
	Heatsink protrusion attachment	FR-A7CN	○
	Inter compatibility attachment	FR-AAT24, FR-A5AT	○
	AC reactor	FR-HAL	○
	DC reactor	FR-HEL	○
	Line noise filter	FR-BSF01, FR-BLF	○
	High-duty brake resistor	FR-ABR *2	○
	Brake unit, resistor unit	FR-BU2 *3, FR-BR	○
	Power regeneration common converter	FR-CV	× *4
	Power regeneration converter	FR-RC	○
	High power factor converter	FR-HC	× *4

*1 Vector control is not applicable. When using an encoder in explosive area, use an explosion-proof encoder.

*2 High-duty brake resistor (FR-ABR) can be used for 22K or less.
To use, change the following parameters.
(Applies to the products manufactured in September 2008 or later.)
- Set [*Pr. 30* = 1].
- Set [*Pr. 70*] as follow.
  7.5K or less 10%
  11K or more 6%

*3 Motors with frame number 250 or higher can be used in combination with MT-BR.

*4 Explosion-proof test by the Ministry of Health, Labour and Welfare is separately required. For that purpose, inverter needs to be a special model.

3.3.8 Vector control dedicated motor

Vector control dedicated motor is for full-scale vector control, and enables 100% of the continuous operation torque even at a low speed.

Install a plug-in option for encoder feedback control (FR-A7AP or FR-A7AL) in A700

(1) Motor Type

1) Rated speed: 1500r/min (4 poles) (200V, 400V)

Model	Standard type	Rated output (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
		Frame Number	90L	100L	112M	132S	132M	160M	160M	180M	180M	200L	200L	200L	225S
Standard horizontal type*	SF-V5RU(H)□*		●	●	●	●	●	●	●	●	●	●	●	●	●
Flange type*	SF-V5RUF(H)□*		●	●	●	●	●	●	●	●	●	●	●	●	—
Standard horizontal type with brake*	SF-V5RU(H)□B*		●	●	●	●	●	●	●	●	●	●	●	●	●
Flange type with brake*	SF-V5RUF(H)□B*		●	●	●	●	●	●	●	—	—	—	—	—	—

* Type name with H indicates 400V class. For example, when the model is standard horizontal type, use SF-V5RU□ for 200V class, and SF-V5RUH□ for 400V class.

Model	Standard type	Rated output (kW)	75	90	110	132	160	200	250
		Frame Number	250MD	250MD	280MD	280MD	280MD	280L	315H
Standard horizontal type	SF-THY□*	200V	●	—	—	—	—	—	—
		400V	●	●	●	●	●	●	●

* Type of the 200V and 400V is the same.

2) Rated speed: 1000r/min (4 poles), maximum speed: 2000r/min speed ratio 1:2 (200V)

Model	Standard type	Rated output (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
		Frame Number	100L	112M	132S	132M	160M	160L	180M	180L	200L	200L	225S
Standard horizontal type	SF-V5RU□1		●	●	●	●	●	●	●	●	●	●	●
Flange type	SF-V5RUF□1		●	●	●	●	●	●	●	●	●	●	—
Standard horizontal type with brake	SF-V5RU□1B		●	●	●	●	●	●	●	●	●	●	●
Flange type with brake	SF-V5RUF□1B		●	●	●	●	●	●	—	—	—	—	—

* 400V class models with the frame number 250 or higher are available as special products. Consult our sales office.

3) Rated speed: 1000r/min (4 poles), maximum speed: 3000r/min speed ratio 1:3 (200V)

Model	Standard type	Rated output (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30
		Frame Number	112M	132S	132M	160M	160L	180M	180L	200L	200L	225S
Standard horizontal type	SF-V5RU□3		●	●	●	●	●	●	●	●	●	●
Flange type	SF-V5RUF□3		●	●	●	●	●	●	●	●	●	—
Standard horizontal type with brake	SF-V5RU□3B		●	●	●	●	●	●	●	●	●	●
Flange type with brake	SF-V5RUF□3B		●	●	●	●	●	—	—	—	—	—

* 400V class models with the frame number 250 or higher are available as special products. Consult our sales office.

4) Rated speed: 500r/min (4 poles), maximum speed: 2000r/min speed ratio 1:4 (200V)

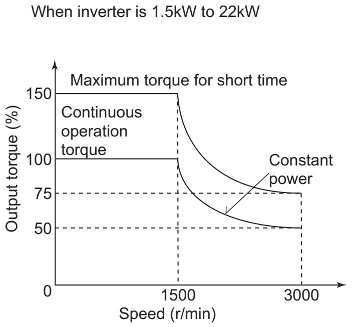
Model	Standard type	Rated output (kW)	1.5	2.2	3.7	5.5	7.5	11	15
		Frame Number	132M	160M	160L	180L	200L	225S	225S
Standard horizontal type	SF-V5RU□4		●	●	●	●	●	●	●
Flange type	SF-V5RUF□4		●	●	●	●	●	—	—
Standard horizontal type with brake	SF-V5RU□4B		●	●	●	●	●	●	●
Flange type with brake	SF-V5RUF□4B		●	●	●	—	—	—	—

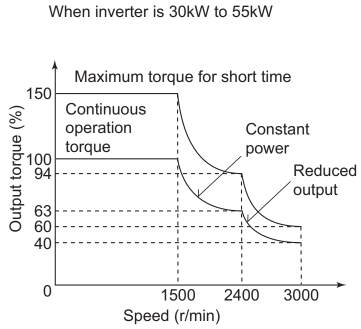
●: Available —: Not available

* 400V class models with the frame number 250 or higher are available as special products. Consult our sales office.

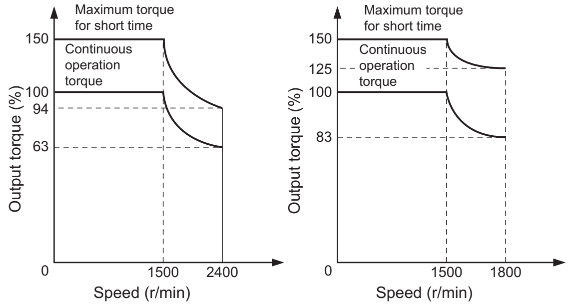
(2) Torque characteristic

SF-V5RU

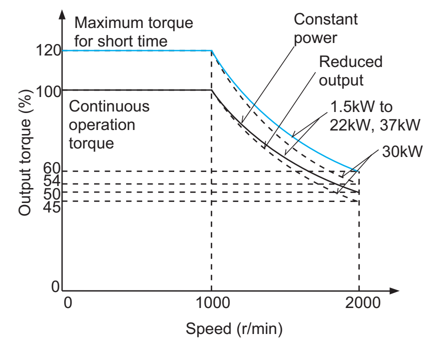
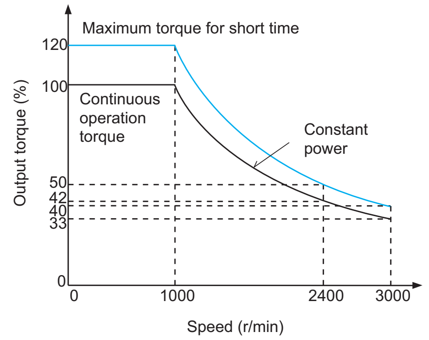
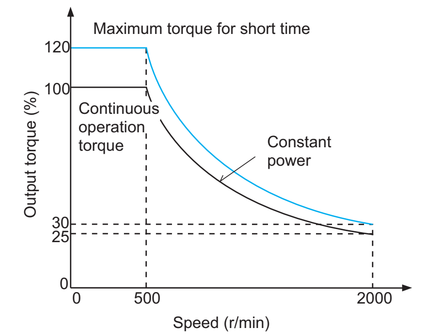




SF-THY



SF-V5RU1, 3, 4

1000r/min torque reference (speed ratio 1:2)	1000r/min torque reference (speed ratio 1:3)	500r/min torque reference (speed ratio 1:4)
(1.5 to 37[kW]) 	(1.5 to 30 [kW]) 	(1.5 to 15[kW]) 

*1 Maximum speed of SF-V5RU-55kW and SF-V5RU1-30kW is 2400 r/min.

*2 Maximum speed of a dedicated motor SF-V5RU-3.7kW or less is 3600 r/min. Consult our sales office when using the motor at the maximum speed.

*3 Maximum speed of the motor with brake is 1800 r/min.

(3) Others

Refer to page 263 for the combination of an inverter and a vector control dedicated motor.
Combination of a standard motor with encoder is also available.
Connect the encoder directly to the backlash-free motor shaft.

3.3.9 Geared motor

Geared motors differ in the continuous-duty speed range according to the lubrication system and manufacturer. Particularly with oil lubrication, continuous operation only in the low speed range can cause gear seizure. When performing high-speed operation beyond 60Hz, please consult the manufacturer.

(1) Mitsubishi standard geared motors

The grease-lubricated GM-S, GM-D and GM-LJ may be used between low speed and high speed of 70 to 120Hz. The oil-lubricated GM-D, GM-LJ and GM-PJ are four-pole motors and may be used between 25Hz and high speed of 60 to 120Hz.

When the motor is inverter-driven, there is no restriction on the permissible number of start times as starting impact is lessened.

* Independent of the magnitude of load inertia, provided that the inverter capacity is equal to the motor capacity at the standard setting of the torque boost.

Available frequency range

Series	Motor capacity 4P (kW)	Insulation class	Frequency Range (Hz)	
			Grease lubrication	Oil lubrication
GM-S	0.1	E	3 to 120[*1]	—
	0.2			
	0.4			
	0.75			
	1.5	B		
	2.2			

Series	Motor capacity 4P (kW)	Insulation class	Frequency Range (Hz)	
			Grease lubrication	Oil lubrication
GM-D	0.4	E	3 to 120[*1]	25 to 120
	0.75			
	1.5	B		
	2.2			
	3.7			
	5.5		—	
	7.5			25 to 115

Series	Motor capacity 4P (kW)	Insulation class	Frequency Range (Hz)	
			Grease lubrication	Oil lubrication
GM-LJ	3.7	F	3 to 85[*1]	25 to 120
	5.5		3 to 75[*1]	
	7.5		3 to 70[*1]	25 to 115
	11		-	25 to 105
	15			25 to 95
	22			25 to 90
	30			25 to 70
	37			

<For special application> Steel line etc.

Series	Motor capacity 4P (kW)	Insulation class	Frequency Range (Hz)	
			Grease lubrication	Oil lubrication
GM-PJ	3.7	F	—	3 to 110
	5.5			
	7.5			3 to 105
	11			3 to 95
	15			3 to 85
	22			3 to 75
	30			3 to 60
	37			
	45			
	55			

*1 If performing continuous operation with inverter frequency 60Hz or more, replace an oil sheet by one year.

*2 For details, refer to a catalog of Mitsubishi standard geared motors.

(2) Built-in brake type geared motor

Refer to page 497 (Motor with Brake). When the brake is used, this type of motor should be used at less than 60Hz because there is restriction on the braking capacity. When a motor with TB brake is continuously operated at low speed, it will generate noise which gives no problem regarding function.

(3) Cyclo speed reducer directly coupled with motor

When the speed reducer is specified as inverter-driven in the purchase order, the motor may be different from the standard one.

If overcurrent trip (OC1) occurs immediately after a start, adjust the torque boost ([*Pr. 0*]).

1) An 1:10 speed range is standard. Consult the manufacturer when the speed reducer is used at more than 60Hz.
2) Lubricant: Frame numbers #208 to #211 are grease-lubricated.
   Frame numbers #84 to #89 of horizontal mounting type are oil-lubricated like the standard ones. For this type, oil used should be of low viscosity within the VG range.
   For frame numbers #84 to #89 of vertical type, the lubrication system must be considered according to the working speed range.
3) Note the starting characteristic at low temperature.
   The loss of the cyclo speed reducer depends on the ambient temperature, input speed, load factor and lubricant. The starting characteristic must be noted under hostile conditions where sudden acceleration is made from the start to 1800 r/min under load at a low temperature. The loss in torque of the oil-lubricated model at the ambient temperature of 0℃ is 15 to 30% of the rated value at 60Hz.

3.3.10 Synchronous motor

Synchronous motor is not available in general.
Synchronous motor may not synchronize to inverter output frequency, and may not start. And even if the motor is started, depending on a load, difference in synchronization may occur.

3.3.11 Single phase motor

It is not recommended to use a single-phase motor with an inverter. The small capacity of the single-phase motor is often rated at 100V and does not match the inverter. The SC, SL, SCL and other motors with capacitors cause an excessive current to flow in the capacitor, resulting in capacitor breakage.

A split-phase-start or repulsion-start motor cannot be used because this will cause the centrifugal switch to be deactivated. (The starting winding will be burned out in a short time.)

3.3.12 Permissible maximum frequency of general-purpose motor

(1) Standard models
Drip-proof protection motor: SB-JR(F, V)
Totally-enclosed fan-cooled motor: SF-JR(F, V)

<table>
<tr><th>Frame Number \ Number of poles</th><th>2</th><th>4</th><th>6</th></tr>
<tr><td>63</td><td rowspan="5">120Hz (*2)
(7200 r/min)</td><td rowspan="7">120Hz
(3600 r/min)</td><td rowspan="10">120Hz
(2400 r/min)</td></tr>
<tr><td>71</td></tr>
<tr><td>80</td></tr>
<tr><td>90</td></tr>
<tr><td>100</td></tr>
<tr><td>112</td><td rowspan="2">90Hz
(5400 r/min)</td></tr>
<tr><td>132</td></tr>
<tr><td>160</td><td>75Hz
(4500 r/min)</td><td rowspan="2">100Hz
(3000 r/min)</td></tr>
<tr><td>180</td><td>65Hz
(3900 r/min)</td></tr>
<tr><td>200</td><td rowspan="2">60Hz
(3600 r/min)</td><td rowspan="2">65Hz
(1950 r/min)</td><td rowspan="2">65Hz
(1300 r/min)</td></tr>
<tr><td>225</td></tr>
</table>

*1 The value in the parentheses indicates synchronous speed.
*2 When a two-pole motor of frame number 90 or 100 is run at 120Hz, noise will exceed 90dB (A).

(2) Other models

<table>
<tr><th colspan="2">Models/ Frame Number \ Number of poles</th><th>2</th><th>4</th><th>6</th></tr>
<tr><td colspan="2">With TB brake</td><td>Not available</td><td>65Hz (except vertical type)</td><td>90Hz (except vertical type)</td></tr>
<tr><td rowspan="5">Outdoor type
Waterproof type</td><td>63 to 132</td><td rowspan="3">65Hz</td><td>120Hz</td><td rowspan="2">120Hz</td></tr>
<tr><td>160</td><td>100Hz</td></tr>
<tr><td>180</td><td rowspan="3">65Hz</td><td>90Hz</td></tr>
<tr><td>200</td><td rowspan="2">60Hz</td><td rowspan="2">65Hz</td></tr>
<tr><td>225</td></tr>
</table>

3.3.13 Inverter-driven 400V motor

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially for a 400V class motor, the surge voltage may deteriorate the insulation. When the 400V class motor is driven by the inverter, consider the following measures:

● Countermeasure

It is recommended to take either of the following measures:

(1) Reinforcing the motor insulation and limiting the PWM carrier frequency according to the wiring length

For a 400V class motor, use an <u>insulation-enhanced motor</u>. Specifically:

1) Specify the "400V class inverter-driven, insulation-enhanced motor".
2) As a dedicated motor such as a constant-torque motor or low-vibration motor, use a "motor dedicated to inverter operation".
3) Set [*Pr. 72 PWM frequency selection*] as indicated below according to the wiring length.

<table>
<tr><th rowspan="2"></th><th colspan="3">Wiring Length</th></tr>
<tr><th>50m or less</th><th>50m to 100m</th><th>More than 100m</th></tr>
<tr><td>[Pr. 72 PWM frequency selection]</td><td>15(14.5kHz) or less</td><td>A700 F700
9(9kHz) or less
E700 D700
8(8kHz) or less</td><td>A700 F700
4(4kHz) or less
E700 D700
2(2kHz) or less</td></tr>
</table>

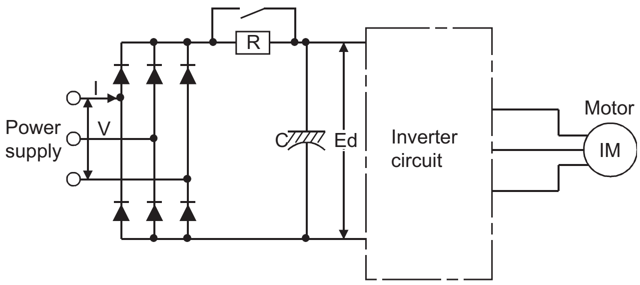
(2) How to suppress surge voltage on the inverter side

Connect the surge voltage suppression filter (FR-ASF-H or FR-BMF-H) to the 55K or less and the sine wave filter (MT-BSL/BSC) to the 75K or more on the inverter output side.

3.4 Power supply of the inverter

3.4.1 Inverter input current and power factor

The converter circuit of the inverter consists of three-phase bridged diodes and capacitor-input smoothing circuit as shown below.



Converter circuit configuration

The capacitance of the DC smoothing capacitor is very large and the input current I from the power supply flows only when the voltage V of the power supply is higher than the terminal voltage Ed of the smoothing capacitor. Hence, the conduction width of the converter circuit is very narrow and the peak (crest) value of the input current is large. The input power factors given in the table on the right assume that the DC voltage does not vary. As shown in the table on the right, if the DC voltage Ed is greater than 1.35 times of the input voltage V under a light load, two pulse currents flow in a half cycle and the power factor falls to 58.7% or less.

Ordinarily, the power factor is represented by a phase difference between voltage and current. When a current having a distorted waveform flows in the inverter input, the power factor is calculated from an apparent power and a three-phase input power found through the three-wattmeter method. The power factor thus calculated is called an overall power factor.

AC power supply current and power factor converter circuit in inverter

Ed	Power Factor	Form Factor	Crest (peak) Factor
Ed > 1.35V	58.7% or less	1.99 or more	2.16 or more
Ed=1.35V	58.7%	1.99	2.16
1.35V > Ed > 1.225V	58.7 to 83.5%	1.99 to 1.27	2.16 to 1.71
Ed=1.225V	83.5%	1.27	1.71
1.225V > Ed	83.5 to 95.3%	1.27 to 1.23	1.71 to 1.28

$$\text{Input current of inverter } I = \frac{\text{Power supply system capacity [kVA]}^{*}}{\sqrt{3} \times V} \text{ [A]}$$

* Refer to page 2.

$$\text{Overall power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}}$$

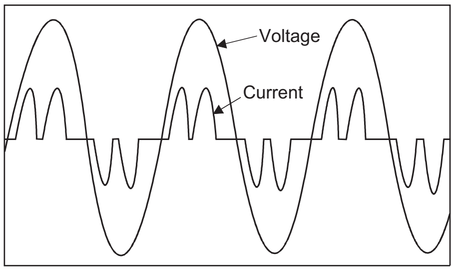
$$= \frac{\text{3-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

(The power factor value measured through three-phase power factor meter which indicates a phase difference between voltage and current is different from the above overall power factor because the current flowing in the inverter is not a sine-wave current.)

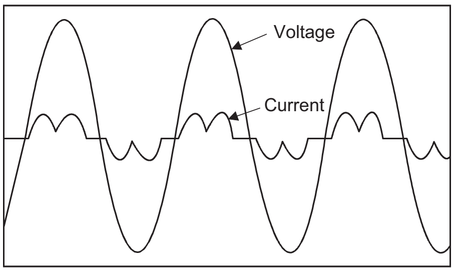
Since the input current has a distorted waveform and the form factor is high (the form factor of a sine wave is 1.11) as described above, the overall input power factor of the inverter may become extremely low depending on the power supply voltage and load factor. The overall input power factor is usually about 75 to 80% for inverters. Accordingly, the input current (effective value) increases.

3.4.2 Improvement of power factor

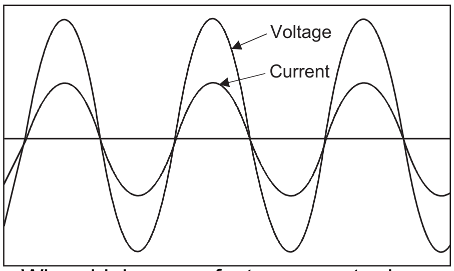
A widespread method of improving the power factor is to insert a reactor in the AC or DC side of the converter in order to smooth the current. (The inverter input power factor is not improved if a power-factor improving power capacitor is inserted in the input circuit. A capacitor must not be inserted in the output circuit. If inserted, the capacitor will be damaged by the harmonic current of the inverter.)
By connecting the optional FR-HAL or FR-HEL power-factor improving reactor to the inverter, the current waveform is improved and the power factor improved as shown in Fig. (b). In addition, the effective value of the input current is reduced.
Use of the high power factor converter (FR-HC) will improve the input current waveform to a sine-waveform, improving the power factor to almost 1 (when the load is 100%).
The inverter input current is influenced by the reactance of the power supply line and that of the input transformer. When the reactance of the line is large, the power factor is higher and the input current is smaller. When the input power factor is higher when the power factor improving reactor is installed, the input current may be smaller than the output current.



(a) Without power-factor improving reactor



(b) With power-factor improving AC reactor



(c) When high power factor converter is used
Inverter input current waveforms

3.4.3 Inrush current

In a PWM inverter which comprises of a capacitor-input filter circuit, an inrush current flows into the large capacity smoothing electrolytic capacitor when the input MCCB is switched ON. This inrush current, which flows only for the capacitor charging time, is extremely large despite its short duration. Since the inrush current is inversely proportional to the impedance of the power supply, the inrush current increases in proportion to the rise in power supply capacity. To suppress the inrush current, an inrush current suppressing resistor of short-duration rating is provided in the converter circuit of the all models.

Avoid switching the inverter power supply ON/OFF frequently. The inrush current occurring frequently at power-ON may deteriorate or short the inrush current suppressing circuit or damage the rectifier circuit, for example.
Especially when the power supply capacity is large, use the optional power factor improving reactor (FR-HAL) in accordance with the selection conditions.

3.4.4 Instantaneous power failure

In A700 F700, if an instantaneous power failure has occurred (15ms or longer), the inverter protective circuit is activated to coast the motor to a stop.(Refer to page 34)
When the power is restored in less than about 50 to 100ms, the instantaneous power failure protective circuit is kept activated and the motor does not restart. When the instantaneous power failure time is approximately 100ms or longer, the inverter is initial-reset at the time of power restoration and the inverter restarts if the start signal remains ON. E700 D700 do not have protection against instantaneous power failure. Inverter output is shutoff when the bus voltage falls below the specified value. If the start signal has been ON when power restores, inverter restarts. If the motor is coasting at this time, a large current may flow in the inverter and activate the current limit function. In this case, the motor is suddenly decelerated, then reaccelerated. To ensure smooth restart of the coasting motor at the time of power restoration, use the automatic restart function after instantaneous power failure.
Use power-failure deceleration stop function to stop the motor at occurrence of a power failure for fail-safe of machine tool, etc.
Use operation continuation function at instantaneous power failure to continue operation without the motor coasting even if an instantaneous power failure occurs during operation.

3.4.5 Power supply voltage variation

The permissible voltage variation range should be within the range from +10% to -15% of the rated voltage. If the power supply voltage rises sharply, the semiconductor devices and electrolytic capacitor may be damaged, adversely affecting the control transformer, magnetic contactor for shorting the inrush current preventing resistor, and the like. In addition, the regenerative brake capability will be reduced, more often resulting in regenerative overvoltage (OV1 to 3).

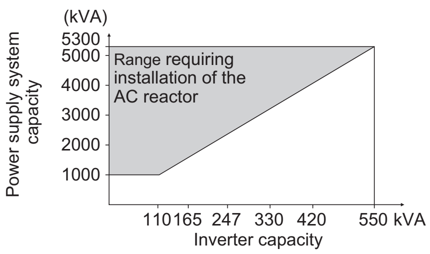
On the contrary, if the voltage is reduced greatly, undervoltage protection (UVT) or undervoltage warning (UV) is activated and operation may not be performed properly. Particularly when the power supply is shared between the inverter and a large-capacity motor requiring a long starting time, the power supply voltage may drop sharply at when starting the motor. For more information on power supply undervoltage, refer to page 111.

3.4.6 Imbalanced power supply voltage

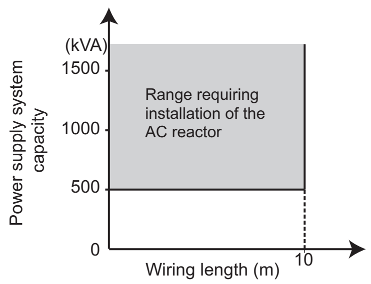
If a small imbalance (about ±3%) occurs in the power supply voltage of the inverter, the inverter input current may be unbalanced greatly. In the worst case, the current may flow only in two phases of the three phases. This takes place when the motor is operated by the inverter under a light load or at low speed. When the current flowing in the load is small, the terminal voltage of the smoothing capacitor only falls slowly, causing the input current not to flow in the phase lowest in AC power supply voltage. This is not a fault and the current is balanced when the load increases or when the motor reaches the high-speed range and the input current increases. To find the input current, average the currents measured at all the three phases.

3.4.7 Coordination with power supply

When the overall impedance of the power supply line is small or when there is a power capacitor switching device in the same power supply line, the peak value of the inverter input current may increase, damaging the converter circuit. To prevent this, the power-factor improving reactor must be used to reduce the current peak value by the current limiting action of the reactor. Insert the power factor improving reactor (FR-HAL).

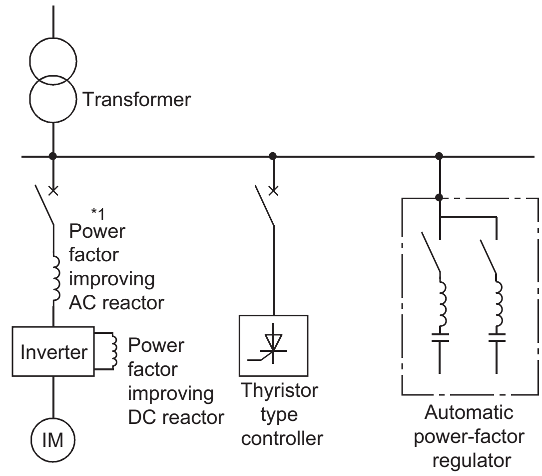


For A700 F700



For E700 D700

- When an automatic power-factor regulator or a thyristor type controller is connected to the power supply line where the inverter is connected (see below)
  If the power supply voltage is distorted by running the above devices, the peak value of the inverter input current may increase, damaging the inverter. When such a condition is expected to occur, insert the power-factor improving reactor in the input circuit as when installing the inverter under the power supply transformer as described above.



Automatic power-factor regulator or a thyristor type controller is connected to the power supply line

*1 Note that using an AC reactor will cause the voltage to drop about 6% = FR-BAL and about 2% = FR-HAL under rated inverter load, reducing the torque.

3 SELECTION

3.5 Inverter-generated harmonics, EMI and leakage current

3.5.1 Differences between EMI and harmonics

Sometimes inverter affects power supply or other peripherals. Confusion of EMI and harmonics may cause a malfunction of the peripheral devices. Countermeasures against EMI and harmonics are different, so different countermeasures for each causes are required. For example, electromagnetic interference produced by a personal computer are distinctly different in their sources, adverse effects etc. from harmonics in a power circuit, and their countermeasures differ greatly.
Their differences will be described below.
Harmonics are defined to have a frequency that is an integral multiple of the fundamental wave and is different from high frequencies. The composition of a single fundamental wave and several harmonics is called a distorted wave.
A distorted wave generally includes harmonics in a high-frequency wave (KHz to MHz order). However, a distorted wave handled as harmonics in a power distribution system is usually of up to about 40th to 50th degrees (to several kHz), and a distorted wave above that value generally assumes an irregular form and must therefore be handled as EMI.

Differences between EMI and harmonics of an inverter and leakage current

Item	EMI	Harmonics	Leakage Currents
Frequency band	High frequency (several 10kHz to 1GHz order)	Normally 40th to 50th degrees or less (up to 3kHz or less)	(several Hz to MHz order)
Source	Inverter circuit	Converter circuit	Inverter circuit
Cause	Transistor switching	Rectifying circuit commutation	Transistor switching
Generated amount	Depends on voltage variation ratio and switching frequency	Depends on current capacity	Depends on switching frequency and voltage
Propagation path	Electric channel, space, induction	Electrical channel	Insulating material
Transmission amount	Distance, wiring route	Line impedance	Capacitance
Affected equipment and influence	Sensor, etc: Mis-detection Radio, wireless equipment : Acoustic noise	Power capacitor : Heat generation Non-utility generator : Heat generation	Earth leakage circuit breaker : Unnecessary operation Thermal relay : Unnecessary operation Output side devices (e.g. CT, meter) : Heat generation
Main countermeasure examples	Change the wiring route Install a EMI filter	Install a reactor	Change detection sensitivity Change switching frequency

3.5.2 Power harmonics and their reduction techniques

Constituted by a power rectifier, the converter circuit of the inverter generates harmonics, distorting the voltage and current waveforms of the input power supply. It is necessary to have a correct understanding of harmonics and take appropriate measures against them when using equipment having a converter circuit in the power supply circuit, e.g. a large-capacity inverter, many inverters, thyristor leonard, thyristor motor or CVCF.
The Japanese harmonic reduction guidelines issued by the Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September 1994 require that the following two main points should be considered as harmonic reduction techniques:

1) Actions taken for faults due to power harmonics (overheating of power capacitors, non-utility generators, etc.)
2) Comply to the Japanese harmonic suppression guidelines

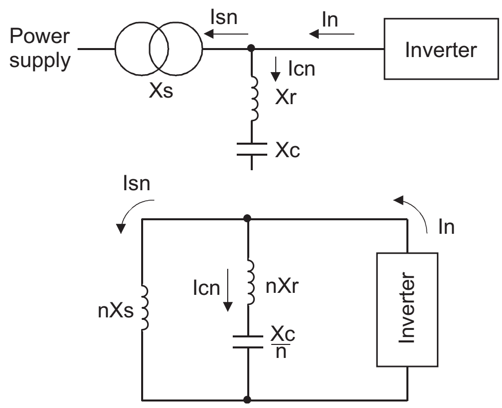
The actions taken to achieve the two points on the left are not always the same, so specific actions must be taken after clarifying their purposes.

(1) Influence on and actions taken for the power supply line

The power supply line to which the inverter is connected with parallel loads such as a power capacitor and a generator. And a harmonic current generated in the inverter is divided into the power supply line and parallel loads according to their impedances. The influence of the harmonic current on the electrical devices (parallel loads) and actions taken against that current will be described below.

1) Power capacitor
   For the maximum working voltages and maximum working currents of power capacitors, JIS-C4902

(high-voltage and special high-voltage power capacitors), JIS-C4901 (low-voltage power capacitors) stipulate their harmonic immunities.
When parallel resonance is produced by harmonics, an excessive current entering the power capacitor may overheat the capacitor and cause dielectric breakdown.
Ordinarily, the power supply impedance is often small enough (the power supply capacity is large) and the power capacitor rarely results in a failure. When a low-voltage power capacitor susceptible to harmonics is used, it is recommended to use the one with a 6% series reactor.
Indicated below is the single-wire diagram and its equivalent circuit where the power capacitor is connected in parallel with the inverter. The harmonic current In generated by the inverter is divided into a harmonic current Isn which flows into the power supply and a harmonic current (Icn) which flows into the capacitor. Icn is found by the following formula:



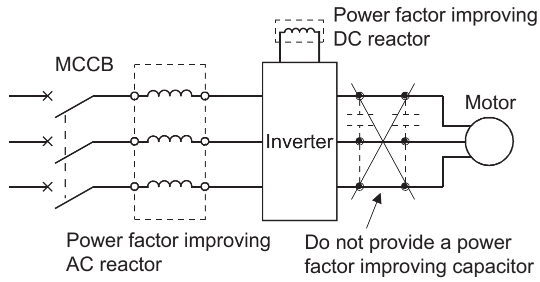
Equivalent circuit regarding the inverter as a harmonic current source

$$Icn = \left(\frac{nXs}{nXs + nXr - Xc/n} \right) \times In$$

Icn	: Harmonic current flowing into the capacitor
Xs	: Power supply impedance
Xr	: Impedance of series reactor
Xc	: Impedance of power capacitor
n	: Harmonic order

If nXs + nXr - Xc/n = 0 in the above formula, resonance occurs and a very large current flows in the power capacitor, burning the capacitor. To prevent this, reduce the capacitor current using the series reactor, or insert the power-factor improving reactor in the inverter input circuit or DC circuit, thereby reducing the harmonic current from the inverter.

* The power-factor improving capacitor and surge suppressor on the inverter output side may be overheated or damaged by the harmonic. Also, since an excessive current flows in the inverter to activate overcurrent protection, do not provide a capacitor and surge suppressor on the inverter output side when the motor is driven by the inverter. To improve the power factor, insert a power factor improving reactor on the inverter's primary side or DC circuit.



Power factor improvement of the inverter

The harmonic immunity of the capacitor is specified in the JIS Standards, e.g. the effective current including the harmonic current found by the formula on the left shall be within 130% of the rated capacitor current, and within 120% for the one with the series reactor.

2) Synchronous generator
When the power is supplied to the inverter by an engine generator or when the inverter is connected to a line where a synchronous generator is running in parallel with the commercial power supply, a harmonic current generated by the inverter is divided between the synchronous generator and commercial power supply line. An induction current develops in the braking winding and field winding of the synchronous generator. If the induction current is too large, heat generated may lead to increased loss (reduced output), overheat, shorter life etc.
In a synchronous generator, assume the loss of harmonic current to be equal to the loss of negative phase-sequence current. In that assumption, adjust the equivalent negative phase-sequence current of the synchronous generator caused by harmonics to be the 15% or less of the permissible negative phase-sequence current provided in JEM1354 (diesel engine driving land synchronous generators).
Equivalent negative phase-sequence current I_2

$$I_2 = \sqrt{\Sigma \left(\sqrt[4]{\frac{n}{2}} In \right)^2}$$

In : Harmonic current
n : Harmonic order

When a synchronous generator is used, loss due to the harmonic current is large. If it exceeds the permissible value of the damper winding, select the large-capacity generator or design the generator which allows the loss due to the harmonics. Alternatively, insertion of a reactor in the inverter input circuit or DC circuit is effective to reduce the harmonic current.

3

SELECTION

(2) Harmonic suppression guideline in Japan

1) Application to the guidelines
Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonic currents.
The three-phase 200V input specifications 3.7kW or less are previously covered by "Harmonic reduction guideline for household appliances and general-purpose products" and other models are covered by "Harmonic reduction guideline for consumers who receive high voltage or special high voltage". However, the general-purpose inverter has been excluded from the target products covered by "Harmonic reduction guideline for household appliances and general-purpose products" in January 2004 and "Harmonic reduction guideline for household appliances and general-purpose products" was repealed on September 6, 2004.
All capacity and all models of general-purpose inverter used by specific consumers are covered by "Harmonic reduction guideline for consumers who receive high voltage or special high voltage".

• Harmonic reduction guideline for consumers receiving power of high voltage or specially high voltage

The upper limit of the outgoing harmonic current per 1kW contract power is determined for the power receiving point of a consumer who receives power of high voltage or specially high voltage.
Note that whether the reduction technique is required or not depends on whether the sum of outgoing harmonic current values of a consumer exceeds the upper limit of the permissible outgoing current determined by the contract power.

2) How to judge whether harmonic reduction technique is required or not at the consumer who receives power of high voltage or especially high voltage
When updating the contract power, a consumer is requested to present a calculation sheet in the format as shown on page 516.
Calculation using the predetermined procedure clarifies whether the reduction technique is required or not. A specific procedure will be described below.

(a) Calculation of rated capacity [kVA]
Used to calculate the 6-pulse equivalent capacity to judge whether the inverter is covered by the <Harmonic reduction guideline for consumers receiving power of high voltage or specially high voltage>.
Independently of whether the inverter has a reactor or not, the rated capacity [kVA] is standardized according to the motor capacity and found by the following formula:

Rated capacity
$=\sqrt{3} \times V \times$ fundamental wave current $\times$ coefficient $\times 10^{-3}$ [kVA]
V : 200V or 400V (input voltage)
Fundamental wave current :
see the table on the following page
Coefficient : 1.0228
Refer to the table for specific calculation results.

★ The above rated capacity is a value used to judge whether the inverter is covered by the harmonic guideline. Therefore, note that these are different from capacities of power supply equipment (such as power transformers) required for use of actual inverters.
The power supply equipment capacity required is 1.3 to 1.6 times greater than the above rated capacity (for specific values, refer to the inverter catalog).

(b) Calculation of 6-pulse equivalent capacity

6 pulses equivalent capacity
= Rated capacity $\times$ Conversion factor Ki [kVA]

Where, conversion factor Ki is as follows:
- Without reactor : 3.4
- With AC reactor : 1.8
- With DC reactor : 1.8
- With AC and DC reactors : 1.4

If the sum of equivalent capacities is higher than the limit found by the above formula, outgoing current of harmonics must be calculated with the following procedure:

Received Power Voltage	Reference Capacity
6.6kV system	50kVA
22kV or 33kV	300kVA
66kV or more system	2000kVA

(c) Conversion of received power voltage into rated current

Rated current converted from received power voltage
= Fundamental wave current $\times$
(200V or 400V inverter power supply voltage/received power voltage) [A]

(d) Calculation of outgoing harmonic current of each degree

Outgoing harmonic current

= Rated current converted from received power voltage $\times$ maximum operation ratio $\times$ harmonic content $\times 10^3$[mA]

Note that the harmonic content is as indicated in the table on the next page.
(If the consumer has a facility to reduce harmonic currents, its effect may be taken into consideration.)

Fundamental wave currents and rated capacities of inverters

Motor Capacity [kW]	Fundamental Wave Current [A]		Rated Capacity [kVA]	
	200V	400V	200V	400V
0.4	1.61	0.81	0.57	
0.75	2.74	1.37	0.97	
1.5	5.50	2.75	1.95	
2.2	7.93	3.96	2.81	
3.7	13.0	6.5	4.61	
5.5	19.1	9.55	6.77	
7.5	25.6	12.8	9.07	
11	36.9	18.5	13.1	
15	49.8	24.9	17.6	
18.5	61.4	30.7	21.8	
22	73.1	36.6	25.9	
30	98.0	49.0	34.7	
37	121	60.4	42.8	
45	147	73.5	52.1	
55	180	89.9	63.7	
75	245	123	87.2	
90	293	147	104	
110	357	179	127	
132	—	216	153	
160	—	258	183	
220	—	355	252	
250	—	403	286	
280	—	450	319	
315	—	506	359	
355	—	571	405	
400	—	643	456	
450	—	723	512	
500	—	804	570	
560	—	900	638	

Harmonic content (Values of the fundamental current is 100%)

(Unit: %)

Circuit components	Degree	5th	7th	11th	13th	17th	19th	23rd	25th
Three-phase bridge (capacitor smoothing)	Without reactor	65	41	8.5	7.7	4.3	3.1	2.6	1.8
	With reactor (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
	With reactor (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
	With reactors (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

(a) If the outgoing harmonic current is higher than the maximum value per 1kW (contract power) × contract power, a harmonic suppression technique is required.

3) Specific calculation example

When a 30kW 400V motor is driven by the FR-A740-30K inverter

Fundamental wave current of the inverter is 49.0A

Rated capacity

$= \sqrt{3} \times V \times$ fundamental wave current $\times$ factor $\times 10^{-3}$

$= \sqrt{3} \times 400 \times 49.0 \times 1.0228 \times 10^{-3}$

= 34.7 [kVA]

6-pulse equivalent capacity

=Rated capacity × conversion factor Ki

=34.7 × 3.4 = 118 [kVA]

Since this value exceeds 50 [kVA], the inverter is covered by the guideline.

Hence, find the outgoing harmonic current in the following procedure:

Rated current converted from received power voltage

= Fundamental wave current × (400V/received voltage)

=49.0 × 400/6600 = 2.97[A]

Outgoing harmonic current

= current Converted from received power voltage × operation ratio × harmonic content × 10^{-3}[mA]

It is derived from the following table.

Assume that the operation ratio is 50%.

Degree	5th	7th	11th	13th	17th	19th	23rd	25th
Outgoing current [mA]	965	609	126	114	63.9	46.0	38.6	26.7
Maximum value of outgoing current [mA/kW]	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70

<u>If the contract power is less than 965/3.5= 276kW, harmonic suppression techniques are required</u>.

4) Harmonic reduction techniques

(a) Reactors for inverter (ACL, DCL)

Install a reactor (ACL) on the AC side of the inverter or a reactor (DCL) on its DC side or both to reduce outgoing harmonic currents.

Generally, installation of the reactor in only one side of the inverter often produces an insufficient suppression effect.

(b) Installation of power factor improving capacitor

When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.

This power factor improving capacitor may be installed in either a high or low voltage side.

(c) Transformer multi-phase operation

When two transformers are used, connecting them with a phase angle difference of 30 degrees as in ⅄ - △ , △ - △ combination will produce an effect corresponding to 12 pulses.

In this case, it is ideal that the harmonic generating equipment of the load of each transformer is the same in model and capacity. If the capacity differs, however, a 12-pulse effect for smaller-capacity equipment can be expected. Therefore, the conversion factor for 6-pulse reference is halved.

(d) AC filter

A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.

The AC filter exhibits an effect on a specific frequency. When there is more than one harmonic current degree, the AC filter must be installed for each degree.

(e) Active filter

This filter detects the current of a circuit generating a harmonic current equivalent to the difference between that current and the fundamental wave current to suppress the harmonic current at the detection point.

As this filter compensates for a whole waveform, a single filter can provide effects on more than one degree of harmonic.

The filter has a protective function. Therefore, if there is an incoming excessive harmonic current, the filter may be short of the harmonic current absorbing effect (i.e. not perform as good) but will not overheat or burn out.

To utilize the performance of the active filter effective, circuit conditions and others must be examined before installing the active filter.

* For further information, refer to the Technical note No.28

Overview of the guideline (excerpt)

Harmonic reduction guideline for consumers who receive high voltage or special high voltage

1. Purpose

This guideline sets forth technological requirements to reduce harmonic currents generated when electric equipments are used by consumers who receive power of high voltage or specially high voltage (hereinafter referred to as the "specific consumers") from commercial power systems (hereinafter referred to as the "system"), after observing the technological standards in accordance with the Electricity Enterprises Act and taking into account the harmonic environment target levels of the systems.

2.Scope

(1) This guideline applies to the specific consumers whose sum of "equivalent capacities" of harmonic generating equipment falls within either of the following:

1) Consumers who receive power from high voltage systems
   6.6kV system 50kVA or more
2) Consumers who receive power from specially high voltage systems
   22kV or 33kV system 300kVA or more
   66kV or more system 2000kVA or more

(2) Equipment covered by (1) shall be all harmonic generating equipment with the exception of the equipment covered by the "Harmonic reduction guideline for household appliances and general-purpose products".

(3) Any new harmonic generating equipment installed or added/renewed is covered by this guideline when the sum of equivalent capacities fall within the value indicated above in (1) after installation, addition or renewal.

3.Reduction of harmonic currents

The maximum outgoing harmonic current values at a specific consumer's receiving shall be values by multiplying the maximum outgoing harmonic current values per 1kW of contract power indicated in the table on the next page by the contract power of the corresponding consumer. If any of these values is exceeded, the necessary countermeasure must be taken.

4.Calculation of outgoing harmonic currents

Outgoing harmonic currents at a receiving point shall be as follows:

(1) Only the magnitude of an outgoing harmonic current is calculated and the 40th or less degree shall be covered by this guideline.

(2) An outgoing harmonic current at a receiving point is found by summing up harmonic currents generated in the rated operating status of individual harmonic generating equipment and multiplying the sum by the maximum operation ratio of the harmonic generating equipment. If the consumer has a facility to reduce harmonic currents, its effect may be taken into consideration.

Overview of the guideline (excerpt)

5.Other references

(1) Contract power

If the "contract power" is not determined at the point of a consumption contract between an electric power company and a consumer or more than one consumer and will be determined later, the contract power shall be as defined below:

1) The contract facility power applies to consumers to whom the "real amount system" of the industrial power of high-voltage power A or less than 500kW contract power is applied.
2) when there are more than one contract power such as time zone-based regulation contract, the largest contract power applies among the contract powers.

(2) Maximum operation ratio of harmonic generating equipment

The "maximum operation ratio of harmonic generating equipment" indicates the ratio of the maximum actual operation capacity (average during 30 minutes) to the sum of capacities of the harmonic generating equipment.

Maximum outgoing harmonic current values per 1kW contract power

(Unit: mA/kW)

Received Power Voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24
66	0.59	0.42	0.27	0.23	0.17	0.16	0.13	0.12
77	0.50	0.36	0.23	0.19	0.15	0.13	0.11	0.10
110	0.35	0.25	0.16	0.13	0.10	0.09	0.07	0.07
154	0.25	0.18	0.11	0.09	0.07	0.06	0.05	0.05
220	0.17	0.12	0.08	0.06	0.05	0.04	0.03	0.03
275	0.14	0.10	0.06	0.05	0.04	0.03	0.03	0.02

Calculation sheet for outgoing harmonic currents from harmonic generating equipment (Part 1)

<Format 1>

Date of Application	
Application No.	
Date of Acceptance	

Customer Name		Business Category		Received Power Voltage	kV	Contract Power	kV

STEP 1 HARMONIC GENERATING EQUIPMENT PARTICULARS										STEP 2 GENERATED HARMONIC CURRENT CALCULATION									
	Harmonic Generating Equipment			Rated Capacity (kVA)	Qty	Total Capacity Pi (kVA)	Circuit Class No.	6-Pulse Conver-sion Factor Ki	6-Pulse Equivalent Capacity [Ki×Pi] (kVA)	Rated Current Value Converted from Received Power Voltage [a×Pi] (mA)	Max. Equipment Operation Ratio (%)	Outgoing Harmonic Current by Degrees (mA)							
No.	Equipment name	Manufacturer	Model									5th	7th	11th	13th	17th	19th	23rd	25th
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
					Sum of 6-pulse equivalent capacities Po					Total									
										Judgment of technique requirement									

<Entry Method>

Step 1

- ☐ Complete the harmonic generating equipment particulars. Enter the circuit class number, etc. according to data.
- ☐ For the equipment whose circuit class number is 10, complete the application <Format 3>.
- ☐ If Po > 50kVA (6kV power received), 300kVA (22, 33kV power received) or 2000kVA (66kV or more power received), proceed to Step 2. (If not, Step 2 need not be completed.)

Step 2

- ☐ When outgoing current > maximum outgoing current value for each degree:
  - ○ If there is in-plant harmonic reduction equipment or suppression technique has been carried out, proceed to Calculation Sheet (Part 2).
  - ○ If not, separate suppression technique will be required.

Maximum Outgoing Harmonic Current Value
(Maximum outgoing harmonic value per kW contract × contract power)

Degree	5th	7th	11th	13th	17th	19th	23rd	25th
Maximum current value (mA)								

* Refer to Technical note No.28 for format-3.

Calculation sheet for outgoing harmonic currents from harmonic generating equipment (Part 2)

<Format 2>

Date of Application	
Application No.	
Date of Acceptance	

Customer Name		Business Category		Received Power Voltage	kV	Contract Power	kV

In-Plant Single-Wire Connection Diagram

Specify the installation position, specifications, electrical constants, etc. of harmonic generating equipment, power receiving transformers, and equipment and the like which reduce (branch) harmonic currents.

Detailed Calculation of Outgoing Harmonic Currents

In consideration of equipment for harmonic current reduction and a suppression effect by branching, specifically describe the process of calculating outgoing harmonic currents at the power receiving point.

Degree	5th	7th	11th	13th	17th	19th	23rd	25th
Outgoing harmonic current in calculation sheet (part 1) (mA)								
Outgoing harmonic current after consideration of reduction effect (mA)								
Maximum outgoing harmonic current value (mA)								
Judgment of suppression technique requirement								

*Note: When it is difficult to complete the in-plant single-wire connection diagram and the detailed calculation of outgoing harmonic currents in this format, separate data may be appended as explanatory information.

<Judgment of suppression technique requirement>

☐ If (outgoing harmonic current after consideration of reduction effect) > (maximum outgoing harmonic current value) for each degree, an additional suppression technique will be required.

How about other than specific consumers?
Japan Electrical Manufacturer's Association established JEM-TR226 for consumers who do not correspond to "Harmonic reduction guideline for consumers who receive high voltage or special high voltage". "Harmonic reduction guideline of the general-purpose inverter (input current of 20A or less)" as a new technical information based on the conventional guideline to raise awareness on overall harmonic suppression.
The purpose of this guideline is that customers take measures against harmonic reduction with the inverter alone to a maximum extent.

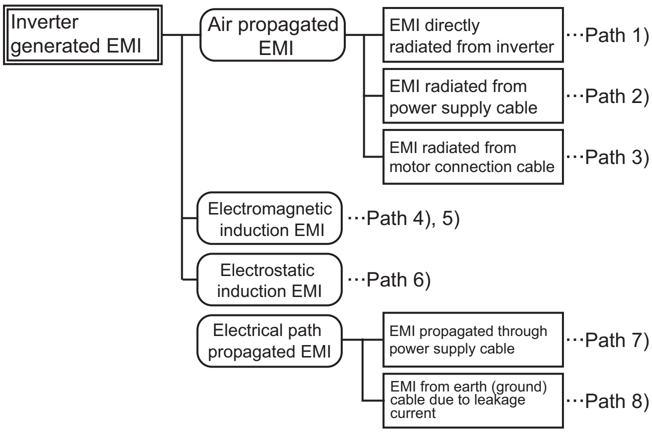
For compliance to "Harmonic reduction guideline of the general-purpose inverter (input current of 20A or less)" for consumers other than specific consumers
Subject models

Input Power	Applicable Motor Capacity	Measures
Single phase 100V	0.75kW or less	Connect the AC reactor or DC reactor recommended in a catalog or an instruction manual.
Single phase 200V	2.2kW or less	
Three phase 200V	3.7kW or less	

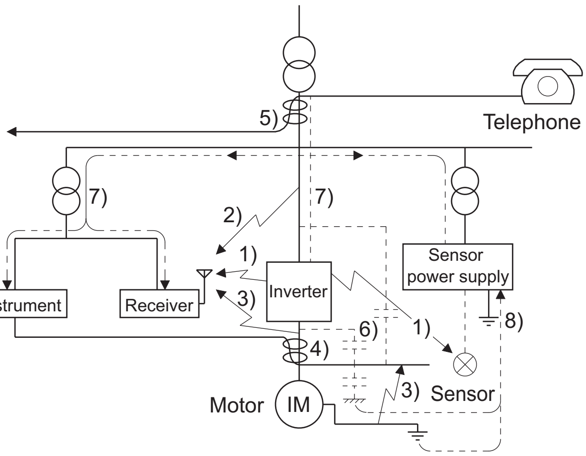
3.5.3 Inverter-generated EMI and their reduction techniques

EMI generated by the inverter is largely classified into EMI radiated by cables connected to the inverter and its main circuit (input, output), magnetic and static induction EMI affecting peripheral device signal lines routed near the main circuit cable and electric path propagation EMI transmitted over the power supply path line.
The EMI types and their paths are shown below.

Influence given to the peripheral devices by high-frequency EMI of the inverter include the malfunctions of computers instrumentation equipment, electronic equipment etc. mainly caused by induction EMI and the malfunctions of radios and nearby switches chiefly caused by radiated EMI.
For details of noise reduction techniques, refer to the Technical note No.21 (Noise and leakage currents).



Types of EMI generated



EMI paths

(1) EMI to electronic equipment

EMI to electronic devices include those transmitted directly over the power supply line and ground cable of the inverter (paths 7 and 8 in the figure above) and those transmitted where the inverter power line and electronic equipment signal line are coupled by electromagnetic induction (paths 4 and 5 in the figure above) or electrostatic induction (path 6 in the figure above).
The power supply line of the electronic devices should be different from the power line where the inverter is connected, protected from EMI incoming from the power supply line by a constant-voltage power supply, insulating transformer, filters etc. and separated from the wiring route. The I/O cables to and from the electronic devices should be separated from the inverter power cables. Basically, keep inverter power cable as far away as possible from cables which must not be subjected to EMI, or run inverter power cable in separate iron shields (ordinarily, iron ducts or metal pipes which should be grounded) to minimize electromagnetic induction and prevent a failure. The best way of grounding the devices is independent equipment must not be grounded jointly.
Especially as a countermeasure against EMI, run the cables in the shortest distance and twist them. Also, grounding should be carried out securely using a large-diameter cable over the shortest distance.

(2) Radio EMI

When the motor is driven from the inverter, high frequency EMI is radiated to the air from the inverter. Like radio-wave EMI, this EMI has a great influence on the frequency band of less than 10MHz and may generate noise when entering into a radio receiver. The radio EMI suppressing methods, radio EMI propagation paths and measurement methods are given below.

1) EMI propagation paths

Major propagation paths of the radio-wave EMI from the source of noise to a receiver affected may be as indicated below:

(a) Direct radiation

EMI radiated directly from the EMI source as an airborne wave and entering the antenna and circuit of the receiver.

(b) Direct transmission

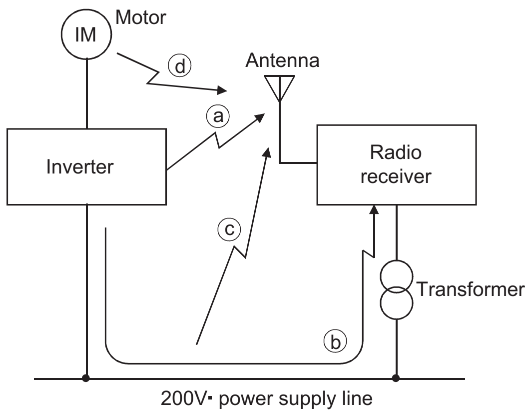
EMI of which current is transmitted through the power supply line and enters the receiver.

(c) Radiation from the power supply line

EMI which leaks to the power supply line is radiated from the distribution line and enters the receiver.

(d) Radiation from the power cables

EMI which is radiated from the wiring between the inverter and motor and enters the receiver.



Radio EMI propagation paths

2) EMI measuring methods

(a) Measurement of EMI terminal voltage

Disturbance wave strength flowing into the power cord of the disturbing device is measured as a disturbance wave voltage on the distribution line where that device is connected.

The measured value is indicated on dB (1μV = 0dB).

(b) Measurement of EMI field strength

The strength of the electric field radiated by the disturbing device to the air is measured with an antenna. The distance of measurement between the devices and antenna is specified as 10m or 3m. The measured value is indicated on dB (1μV/m = 0dB).

(c) Also, disturbing power or the discontinuous EMI (click EMI) of a contact device is measured depending on the EMI type.

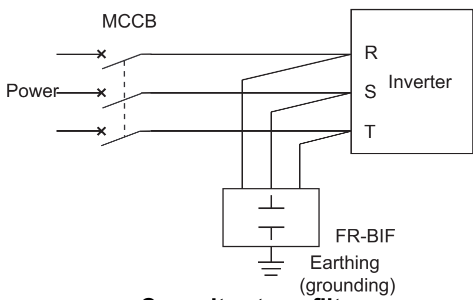
As described above, the evaluation of disturbance wave EMI depends greatly on the difference of its propagation path and the type of EMI measuring method. The most appropriate method for comparing actual harm to the radio receiver by the disturbance wave is to measure the propagation EMI field strength because the receiver is mostly influenced by the propagation paths (a), (c) or (d).

3) Countermeasures against radio EMI

Radio EMI can be reduced by any of the following methods:

(a) Connect the capacitor type filter (FR-BIF) dedicated to FR-series inverters across the inverter input power supply terminals (Phase R, S, T) and securely ground it with the ground cable. This is effective when the wiring distance between the inverter and motor is short.

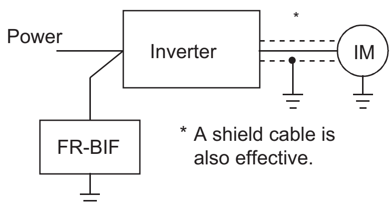
* In this case, one FR-BIF causes an approx. 4mA for the 200V (approx. 8mA for the 400V) leakage current to flow. (equivalent to one phase of the three-phase, three wire, ⅄ connection power supply)



Capacitor type filter

A700 F700 are equipped with a built-in noise filter that is equivalent to a capacitor noise filter. Using the ON/OFF connector, whether to connect to the earth (ground) or not can be selected. (ON/OFF connector is not available for FR-A720-0.4K, 0.75K, and 1.5K. Connector is always in ON status.)

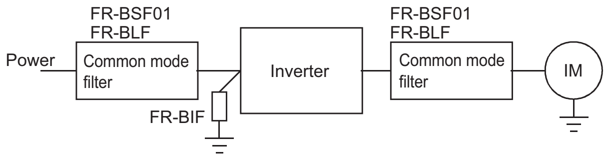
(b) When the wiring distance between the inverter and motor is long, run the cable between the inverter and motor in a grounding conduit.



Grounding conduit

(c) House the inverter in an iron cubicle (without any instrument windows and indicator light windows) and ground the cubicle.

(d) Connect the common mode filter (s) (FR-BSF01, FR-BLF) across either or both the input terminals and output terminals of the inverter and house the inverter and cables in a grounding conduit.
Use the common mode filter (s) together with the capacitor type filter to produce a greater effect.
Built-in EMC filter type of the 55kW or less has a filter corresponding to the common mode filter on the input side.



Capacitor type filter

(Reference)
For example, a radio used in an urban area does not suffer from EMI if it is used more than about 30m away from the inverter and the main circuit wiring to the inverter.

(3) Specific technique examples

1) Techniques and effects
The following levels (estimated values) of effects are expected for the technique examples (on the next page). Use this data for reference when determining the priority of actual techniques.

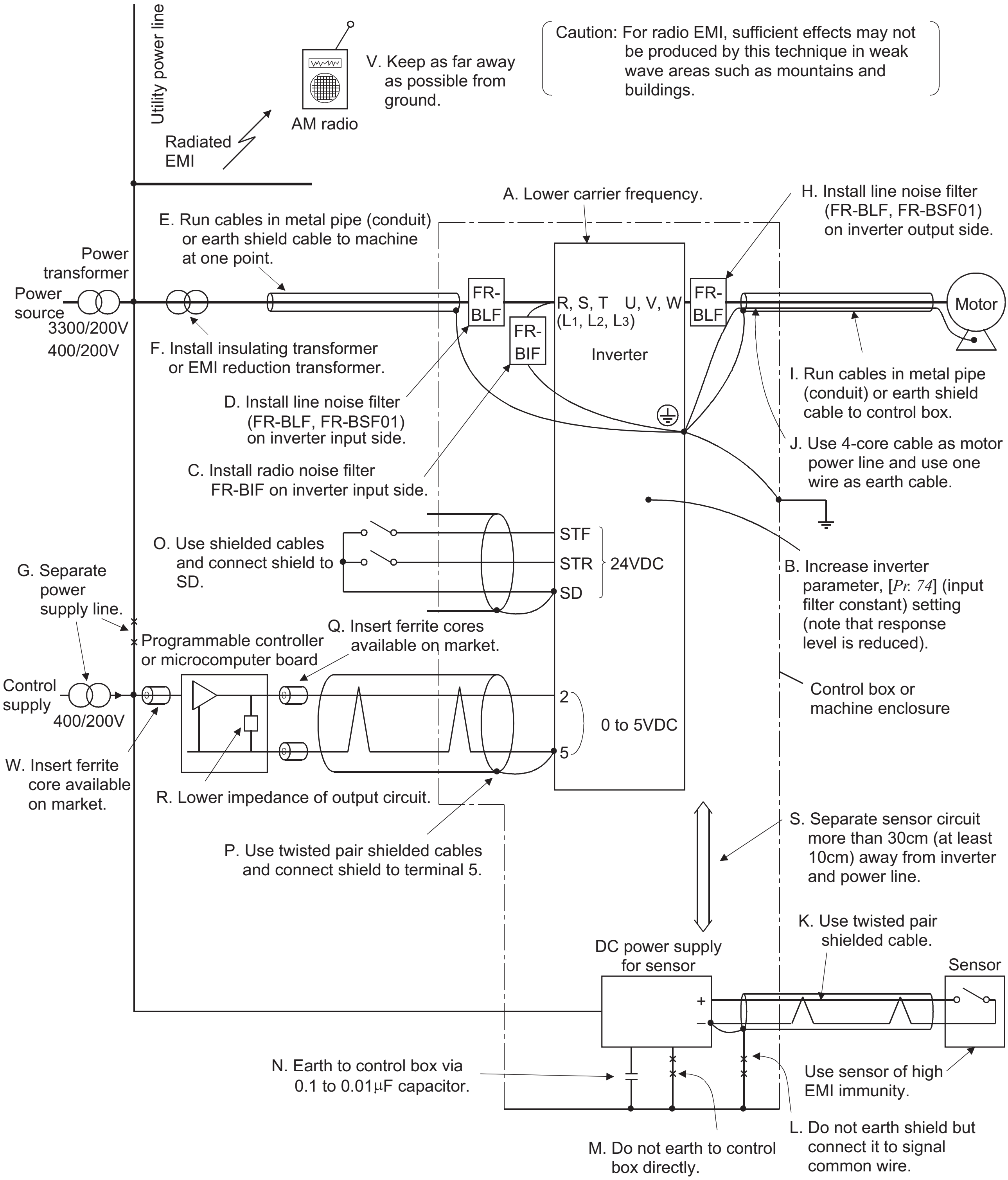
Symbol meanings
◎ : Large effect
○ : Effect produced
△ : Small effect
— : No effect

Effects of EMI reduction techniques

Location	Symbol	Technique	EMI Propagation						
			Air propagated EMI			Electro-magnetic induction interference	Electro-static induction interference	Electrical path propagated EMI	
			Radiation from inverter	Radiation from power cables	Radiation from motor cables			Power cables	Leakage current of ground cable
Inverter	A	Decrease carrier frequency [*Pr. 72*]	◎	◎	◎	◎	◎	◎	◎
	B	Increase input S/W filter constant [*Pr. 74*]	△	△	△	○	△	—	—
Input side	C	Install capacitor type filter FR-BIF (-H)	—	◎	—	—	—	◎	—
	D	Install common mode filter FR-BSF01 or FR-BLF	—	◎	—	—	—	◎	△
	E	Run power supply cables in metal conduit or use shielded cables as power supply cables	—	◎	—	—	—	◎	—
	F	Install insulated transformer or noise reduction transformer	—	△	—	—	—	◎	—
	G	Separate power supply line	—	—	—	—	—	◎	◎
Output side	H	Install common mode filter FR-BSF01 or FR-BLF	—	—	◎	△	△	—	◎
	I	Run output cables in metal conduit or use shielded cables	—	—	◎	○	○	—	—
	J	Use 4-core cable as motor power line and use one wire as ground cable	—	—	△	△	△	—	◎
Connected equipment	K	Use twisted pair shielded cable as sensor signal line	○	○	○	◎	◎	—	—
	L	Connect shield to common of sensor signal	—	—	—	◎	◎	—	◎
	M	Do not earth sensor power unit to control box etc. directly	—	—	—	—	—	△	◎
	N	Earth sensor power unit via capacitor	—	—	—	—	—	△	○
	O	Use twisted pair shielded cables for signal inputs and connect shield to common (input terminal) SD	△	△	△	○	◎	—	△
	P	Use twisted pair shielded cables for speed inputs and connect shield to terminal 5	○	○	○	◎	◎	—	△
	Q	Insert ferrite cores available commercially into speed input cables (output side of mating equipment)	△	△	△	○	—	—	—
	R	Lower impedance of output circuit of mating equipment	△	△	△	○	—	—	—
	S	Separate more than 30cm from inverter and power line	◎	◎	◎	◎	◎	—	—
	T	Do not run cables in parallel or together	△	△	△	◎	◎	—	—
	U	Provide masking shield	○	△	△	△	△	—	—
	V	Keep away from ground	△	○	○	△	△	—	—
	W	Insert ferrite cores available commercially in input side of mating equipment	—	—	—	—	—	○	△

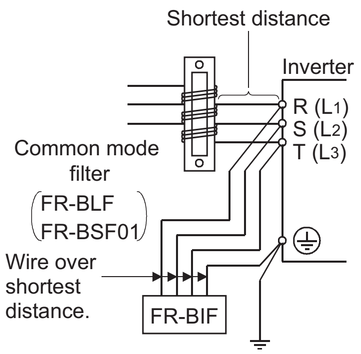
2) Technique examples

The following method will produce some effects with regard to inverter EMI reduction. For effects, see the preceding page.

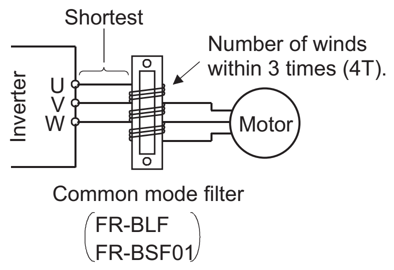


Instructions for installation of noise filters

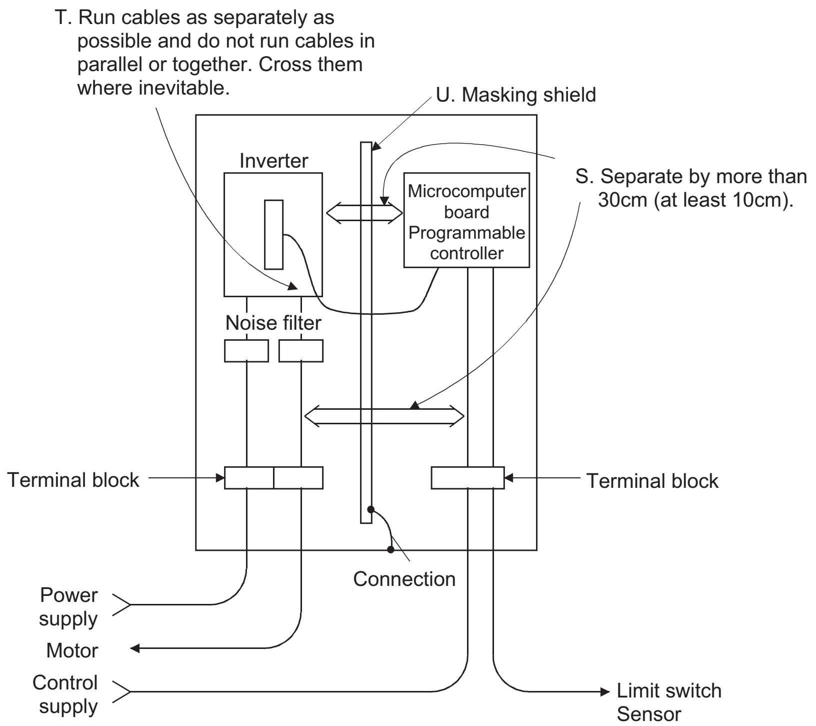
<Installation in inverter input side>



<Installation in inverter output side>

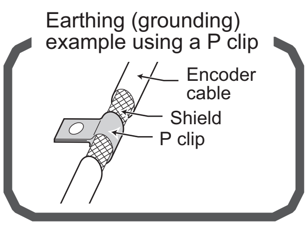


Cable routing in control box



Instructions for encoder cable wiring

• To reduce EMI of the encoder cable, earth (ground) the encoder shielded cable to the enclosure (as near as the inverter) with a P clip or U clip made of metal. To protect the cables from EMI, run them away from any source of noise (e.g. the main circuit and power voltage).



3.5.4 Leakage currents and countermeasures

Due to capacitances existing in the inverter I/O lines and ground, leakage currents flow through them, in addition to the motor current.
These leakage currents are determined by the magnitudes of switching frequency (fc) (carrier frequency) and line-to-line and to-ground capacitances:

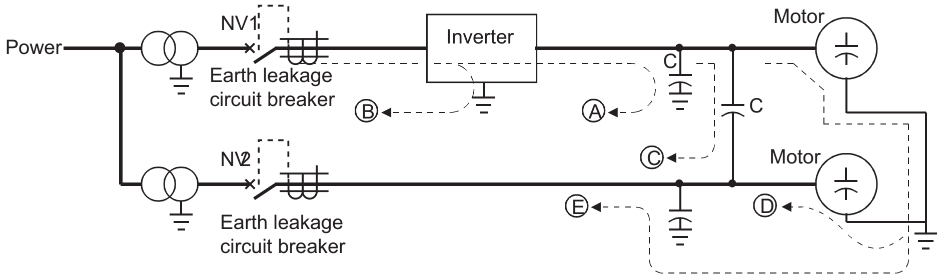
1) When the carrier frequency increases, the leakage current of the inverter increases.
2) If the wiring length is large, the line-to-line and to-ground capacitances increase, increasing the leakage current.

Therefore, independent of the manufacture and inverter type, a low acoustic noise inverter using high-carrier frequency PWM control tends to increase leakage current.

(1) Influence of leakage currents

1) An earth leakage circuit breaker is actuated by to-ground leakage currents
Compared to a case where a motor is driven by a commercial power supply, leakage current produced by inverter operation includes more high-frequency components and to-ground leakage current in this high frequency band are higher than the operating current of the earth leakage circuit breaker, actuating the earth leakage circuit breaker.

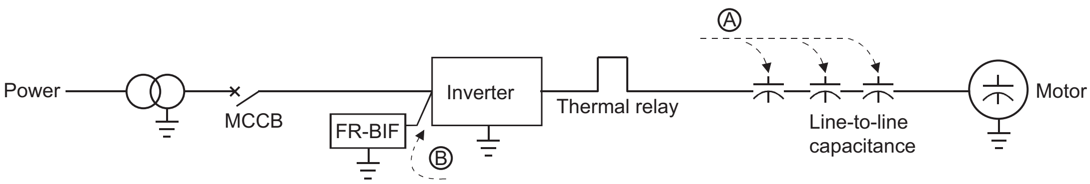
(a) The earth leakage circuit breaker (NV1) is actuated when leakage current flow through to-ground capacitances C in paths A) and B) indicated by dotted lines and exceed the setting of the earth leakage circuit breaker in the same line.
(b) The earth leakage circuit breaker NV2 or NV1 in the other line is actuated when leakage current flows in paths C), D), E), etc. indicated by dotted line.



To-ground leakage current paths

2) External thermal relay is tripped by line-to-line leakage currents
If the wiring distance on the inverter output side is long, line-to-line leakage currents A) may increase the effective value of the current flowing in the thermal relay, operating the thermal relay.

A smaller-capacity model whose rated current is less than several amperes is more liable to be affected by leakage currents.
A leakage current B) may produce a several volts potential at the terminal of the radio noise filter (FR-BIF) but it is not a fault.



(2) Leakage current data

To-ground leakage current example

(Total current measured at 100kHz or less using FFT.)

Carrier Frequency	Leakage Current (mA)
2kHz	90
14.5kHz	210

(running frequency: 60Hz, wiring length: 20m)
(Motor capacity: 3.7kW 4-pole)

* Leakage currents in commercial power supply operation are approximately 1mA.

Line-to-line leakage current example

Total current measured at 100kHz or less using FFT.

Motor Capacity (kW)	200V Class			400V Class		
	Rated current (A)	Leakage current value (A)		Rated current (A)	Leakage current value (A)	
		Wiring length 50m	Wiring length 100m		Wiring length 54m	Wiring length 100m
0.4	1.8	0.31	0.50	1.1	0.62	1.00
0.75	3.2	0.34	0.53	1.9	0.67	1.05
1.5	5.8	0.37	0.56	3.5	0.74	1.12
2.2	8.2	0.40	0.59	4.1	0.80	1.18

(Carrier 14.5kHz)
(Wire used: 3.5⌀ 4-core type cable)

(3) Countermeasure to be taken for unnecessary operation of earth leakage circuit breaker and thermal relay due to earth leakage current

1) Countermeasure to be taken for unnecessary operation of earth leakage circuit breaker

(a) Use an earth leakage circuit breaker (or earth leakage relay) for which high frequency components have been considered.
Use the earth leakage circuit breaker developed for use with an inverter, e.g. Mitsubishi's products designed for harmonic and surge suppression or set a large sensitivity current to prevent unnecessary operation.

(b) Provide dedicated ground cable.
Provide the motor with a dedicated ground cable to divide current, thereby reducing to-ground leakage current.

2) Countermeasure to taken for thermal relay malfunction

(c) Use the electronic thermal relay function built into the inverter.
Inverter detects output current after cutting high frequency components. And thermal relay function is rarely affected by leakage currents.

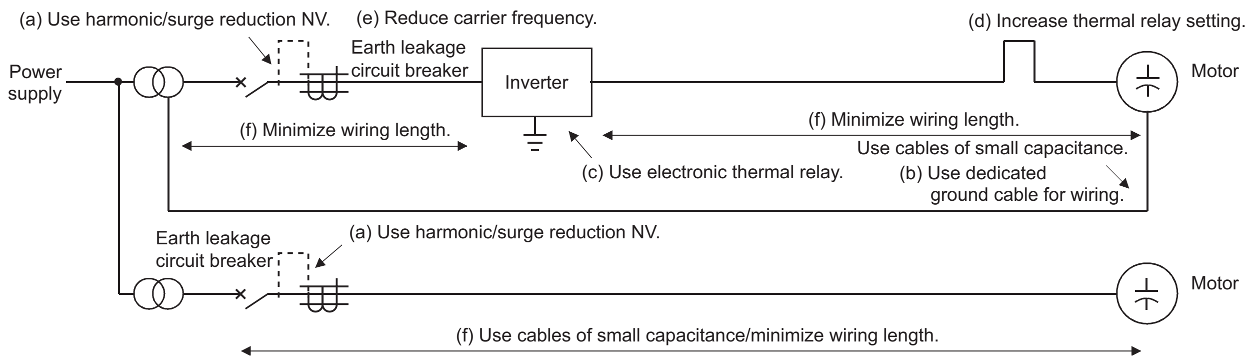
(d) Increase the setting of the external thermal relay.
When the electronic thermal relay cannot be used, e.g. when two or more motors are connected to one inverter and thermal relays are installed individually, increase the setting of each external thermal relay by the equivalence of the leakage current to make them difficult to be actuated.
Motors of 11kW or more capacity rarely have leakage current to make them difficult to be actuated.

3) Countermeasure to be taken for unnecessary operation of earth leakage circuit breaker and thermal relay.

(e) Set the carrier frequency of the inverter to a low value.
Decrease leakage current by setting the carrier frequency of the inverter to a low value using the relevant parameter.
However, it should be noted that the decrease in carrier frequency increases noise during motor running.

(f) Decrease the to-ground and line-to-line capacitances.
Wire cables of smaller capacitances between the inverter power supply side and motor side to minimize the wiring length.

Examples of countermeasure to be taken to prevent unnecessary operation



Effects of countermeasure

Countermeasure marked ◎ are recommended for phenomena occurring due to the influence of leakage current.

No.		Phenomenon	a) Harmonic/ Surge Reduction Breaker	b) Dedicated Ground Cable	c) Use of Electronic Thermal Relay	d) Thermal Relay Setting Change	e) Carrier Frequency Change	f) Reduction of Capacitance
1)	(a)	Operation of circuit breaker in the same line	◎	○	×	×	◎	○
	(b)	Operation of circuit breaker in the other line	◎	○	×	×	◎	○
2)		Thermal relay operation	×	×	○	○	◎	○

Symbol meaning ······ ◎:Adequate effect, ○:Effect produced, × :No effect

3.6 Selection of peripheral devices

The moulded case circuit breakers, magnetic contactors and cables differ with the inverter models.
For specific selection, refer to the corresponding model catalog or manual.

Peripheral device selection list (example A700)

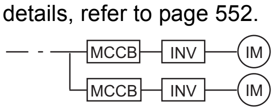
Voltage	Motor Output (kW)*1	Applied Inverter Type	Moulded Case Circuit Breaker (MCCB)*2 or Earth Leakage Circuit Breaker (ELB) — Reactor connection: Without	Moulded Case Circuit Breaker (MCCB)*2 or Earth Leakage Circuit Breaker (ELB) — Reactor connection: With	Magnetic contactor on the Input Side*3 — Reactor connection: Without	Magnetic contactor on the Input Side*3 — Reactor connection: With	Recommended Cable Size (mm²)*4 R, S, T	Recommended Cable Size (mm²)*4 U, V, W
200V class	0.4	FR-A720-0.4K	30AF 5A	30AF 5A	S-N10	S-N10	2	2
	0.75	FR-A720-0.75K	30AF 10A	30AF 10A	S-N10	S-N10	2	2
	1.5	FR-A720-1.5K	30AF 15A	30AF 15A	S-N10	S-N10	2	2
	2.2	FR-A720-2.2K	30AF 20A	30AF 15A	S-N10	S-N10	2	2
	3.7	FR-A720-3.7K	30AF 30A	30AF 30A	S-N20, N21	S-N10	3.5	3.5
	5.5	FR-A720-5.5K	50AF 50A	50AF 40A	S-N25	S-N20, N21	5.5	5.5
	7.5	FR-A720-7.5K	100AF 60A	50AF 50A	S-N25	S-N25	14	8
	11	FR-A720-11K	100AF 75A	100AF 75A	S-N35	S-N35	14	14
	15	FR-A720-15K	225AF 125A	100AF 100A	S-N50	S-N50	22	22
	18.5	FR-A720-18.5K	225AF 150A	225AF 125A	S-N65	S-N50	38	38
	22	FR-A720-22K	225AF 175A	225AF 150A	S-N80	S-N65	38	38
	30	FR-A720-30K	225AF 225A	225AF 175A	S-N95	S-N80	60	60
	37	FR-A720-37K	400AF 250A	225AF 225A	S-N150	S-N125	80	80
	45	FR-A720-45K	400AF 300A	400AF 300A	S-N180	S-N150	100	100
	55	FR-A720-55K	400AF 400A	400AF 350A	S-N220	S-N180	100	100
	75	FR-A720-75K	—	400AF 400A	—	S-N300	125	125
	90	FR-A720-90K	—	400AF 400A	—	S-N300	150	150

Peripheral device selection list (example A700)

Voltage	Motor Output (kW)*1	Applied Inverter Type	Moulded Case Circuit Breaker (MCCB)*2 or Earth Leakage Circuit Breaker (ELB)		Magnetic contactor on the Input Side*3		Recommended Cable Size (mm²)*4	
			Reactor connection		Reactor connection		R, S, T	U, V, W
			Without	With	Without	With		
400V class	0.4	FR-A740-0.4K	30AF 5A	30AF 5A	S-N10	S-N10	2	2
	0.75	FR-A740-0.75K	30AF 5A	30AF 5A	S-N10	S-N10	2	2
	1.5	FR-A740-1.5K	30AF 10A	30AF 10A	S-N10	S-N10	2	2
	2.2	FR-A740-2.2K	30AF 10A	30AF 10A	S-N10	S-N10	2	2
	3.7	FR-A740-3.7K	30AF 20A	30AF 15A	S-N10	S-N10	2	2
	5.5	FR-A740-5.5K	30AF 30A	30AF 20A	S-N20, N21	S-N11, N12	2	2
	7.5	FR-A740-7.5K	30AF 30A	30AF 30A	S-N20, N21	S-N20, N21	3.5	3.5
	11	FR-A740-11K	50AF 50A	50AF 40A	S-N20, N21	S-N20, N21	5.5	5.5
	15	FR-A740-15K	100AF 60A	50AF 50A	S-N25	S-N20, N21	8	8
	18.5	FR-A740-18.5K	100AF 75A	100AF 60A	S-N25	S-N25	14	8
	22	FR-A740-22K	100AF 100A	100AF 75A	S-N35	S-N25	14	14
	30	FR-A740-30K	225AF 125A	100AF 100A	S-N50	S-N50	22	22
	37	FR-A740-37K	225AF 150A	225AF 125A	S-N65	S-N50	22	22
	45	FR-A740-45K	225AF 175A	225AF 150A	S-N80	S-N65	38	38
	55	FR-A740-55K	225AF 200A	225AF 175A	S-N80	S-N80	60	60
	75	FR-A740-75K	—	225AF 225A	—	S-N95	60	60
	90	FR-A740-90K	—	225AF 225A	—	S-N150	60	60
	110	FR-A740-110K	—	225AF 225A	—	S-N180	80	80
	132	FR-A740-132K	—	400AF 400A	—	S-N220	100	100
	150	FR-A740-160K	—	400AF 400A	—	S-N300	125	150
	160	FR-A740-160K	—	400AF 400A	—	S-N300	125	150
	185	FR-A740-185K	—	400AF 400A	—	S-N300	150	150
	220	FR-A740-220K	—	600AF 500A	—	S-N400	2 × 100	2 × 100
	250	FR-A740-250K	—	600AF 600A	—	S-N600	2 × 100	2 × 100
	280	FR-A740-280K	—	600AF 600A	—	S-N600	2 × 125	2 × 125
	315	FR-A740-315K	—	800AF 700A	—	S-N600	2 × 150	2 × 150
	355	FR-A740-355K	—	800AF 800A	—	S-N600	2 × 200	2 × 200
	400	FR-A740-400K	—	1000AF 900A	—	S-N800	2 × 200	2 × 200
	450	FR-A740-450K	—	1000AF 1000A	—	1000A rated product	2 × 250	2 × 250
	500	FR-A740-500K	—	1200AF 1200A	—	1000A rated product	3 × 200	2 × 250

*1 Selections for use of the Mitsubishi 4-pole standard motor with power supply voltage 200VAC (200V class)/ 400VAC (400V class) 50Hz.

*2 Install one MCCB per inverter.
For the use in the United States or Canada, provide the appropriate UL and cUL listed Class RK5, Class T or Class L type fuse or UL489 molded case circuit breaker (MCCB) that is suitable for branch circuit protection. For details, refer to page 552.



*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
When using the MC for emergency stop during motor driving or using on the motor side during commercial-power supply operation, select the class AC-3 rated current for the motor rated current.

*4 Cable
For the 55K or less, the recommended cable size is the cable (HIV cable (600V class 2 vinyl-insulated cable) etc.) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20m or less.
For the 75K or more, the recommended cable size is the cable (e.g. LMFC (heat resistant flexible cross-linked polyethylene insulated cable)) with continuous maximum permissible temperature of 90°C. Assumes that the surrounding air temperature is 50°C or less and wiring is performed in an enclosure.

3.6.1 Moulded case circuit breaker

(1) Protective coordination (Breaking capacity)

The MCCB is used to protect the wiring from damage caused by overload or short-circuit currents. Install the MCCB to shut off any accidental current passing through the inverter input circuit, such as overload or short-circuit thereby minimizing the influence of the accident.
Select the MCCB of which breaking capacity is appropriate for the estimated to the overall impedance of the power supply. (For full information, refer to the Mitsubishi no-fuse breaker technical information)
The master MCCB and inverter MCCB must be fully coordinated for protection. Should a low-impedance short circuit occur, for example, if the transistors in the inverter circuit of the inverter are damaged or the diodes in the converter circuit are broken, the master MCCB may be tripped. Hence, it is necessary to make a pre-check using the operational characteristic curve.
When the overall impedance of the power supply line is small, the peak value of the inverter input power supply increases. Therefore, the current peak value must be reduced by the current limiting action of the power-factor improving reactor.
The power-factor improving reactor must be inserted in the input or DC circuit when the power transformer is large.

(2) Setting the rated current of inverter primary MCCB

The MCCB in the inverter primary circuit is used to protect the inverter primary wiring from overload and short circuit.
Since the inverter has a converter circuit and a large-capacity smoothing electrolytic capacitor, it serves as a capacitor-input rectifier with respect to the power supply and a pulse-shaped current flows in the inverter input circuit to charge the capacitor.
The effective value of the inverter input current varies according to its form factor which is under the influence of the power supply impedance. Hence, the input current is not determined only by the load capacity of the motor and changes under the influence of the reactance of the power supply and wiring. The rated currents of the MCCB listed on the previous page have been selected in relation to the effective value of the inverter input power supply found by using the power supply impedance value on the assumption that the power supply capacity is about 200kVA to 500kVA, with the influence of the temperature rise and other factors such as harmonic components taken into consideration. Select a larger current rating version when an electro-magnetic type MCCB is used because its operational characteristic may change due to harmonic current. By inserting the power-factor currents is improved and the current effective value is reduced.

3.6.2 Magnetic contactor (MC)

(1) Inverter's primary side magnetic contactor (MC)

On the inverter's primary side, it is recommended to provide an MC for the following purposes. Refer to page 34.

1) To release the inverter from the power supply when the inverter protective function is activated or the drive becomes faulty (e.g. emergency stop operation).
   When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, overheat burnout of the brake resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the brake resistor and excess regenerative brake duty.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure. For (A700)(F700), when an instantaneous power failure is 15ms or longer, instantaneous power failure protection is activated to prevent the inverter from automatically restarting when power is restored. When a power failure is longer than about 100ms, the inverter is therefore restarted automatically if the RUN signal is ON.
3) To rest the inverter for an extended period of time
   The control power supply for inverter is always running and consumes a little power. When stopping the inverter for an extended period of time, powering OFF the inverter will save power slightly.
4) To separate the inverter from the power supply to ensure safety of maintenance/inspection work.
   Since the inverter primary MC is used for the above purposes, select the MC which conforms to JEM1038-AC1 class. When making an emergency stop during running, select the MC which conforms to JEM1038-AC3 class to the inverter input side current .

* The MC may be switched ON/OFF to start/stop the inverter. However, since repeated inrush currents at power ON will shorten the life of the converter circuit ((A700) switching life is about 1000,000 times (about 500,000 times for the 200V class 37k or more)), frequent starts and stops must be avoided. Turn ON/OFF the inverter start controlling terminals (STF, STR) to run/stop the inverter.

(2) Inverter secondary side magnetic contactor

Refer to page 37 for details of the turn-ON condition of a magnetic contactor provided between the inverter and motor.

1) Switch between bypass operation and inverter operation.
   In this case, the commercial power supply MC and inverter output circuit MC must be magnetic contactors with electrical and mechanical interlocks and the two MCs must be designed not to turn on at the same time. <u>The transistors will be damaged if the commercial power is applied to the inverter output terminals.</u> Select the MC which has a sufficient capacity for the inverter output current (JEM 1038-AC Class 3 or higher). Take special care so that the inverter is not connected with the commercial power supply by an arc generated when the current is shut off.
2) To use one inverter with several motors by switching the inverter-driven motors from one to another.
   The MC may be switched OFF during stop.
   In a sequential start, select the MC which meets JEM1038-AC Class 3 or higher in consideration of the switching life.

3.6.3 Thermal relay

A thermal relay is generally used to protect a general-purpose motor. The current flowing in the general-purpose motor driven from an inverter is about 10% larger than that flowing in the motor driven when from a commercial power supply.
For this reason, set the thermal relay to 1.1 times greater than the current value for use with the commercial power supply. Note that since the standard motor is designed for use are any of the three ratings of 200V/50Hz, 200V/60Hz and 220V/60Hz, the temperature rise of the motor may exceed the permissible value even when the load current is within the rated value when the motor is continuously run at the rated torque of 50Hz or at low speed. Therefore, select the motor capacity so that the load torque is less than the allowable motor torque as indicated in page 491.
The inverters are incorporated with an electronic thermal relay to protect the motor from overload in the low speed range. Therefore, a thermal relay need not be provided unless:

- Two or more motors are run by one inverter
- A special motor is run. In this case, provide a heat-operated thermal relay.

3.6.4 Cable size and wiring distance

(1) Main circuit cables

Like that of a general power cable, determine the size of the main circuit cables after examining its current capacity, short circuit protection and cable voltage drop.
The effective value of the inverter primary current must be noted because a current larger than the motor current may flow depending on the inverter input power factor (see page 505). If the wiring distance of the cable between the inverter and motor is long, the voltage drop increases, causing a reduction in motor torque and the current to increase. In an extreme case, the motor may overheat. Note that especially when the output frequency is low, the output voltage of the inverter is also low and the rate of voltage drop increases.
Select the cable size so that the voltage drop between the inverter and motor is 2% of the rated voltage.

Voltage drop over wiring distance of 30m

(220V supplied) ...... reference value

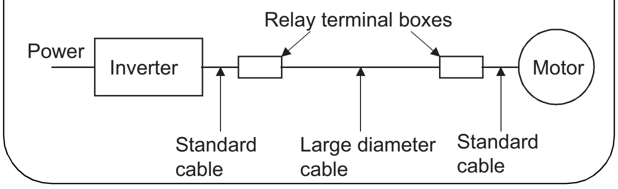
Standard Motor 4P (kW)	Applicable Inverter		Inverter Output Voltage		Standard Applicable Cable		Line Voltage Drop over 30m		
	Type	Current(A)	60Hz(V)	6Hz(V)	Cable diameter (mm^2)	Conductor resistance 20 ℃ (m Ω /m)	Voltage drop (V)	60Hz(%)	6Hz(%)
0.4	FR-A720-0.4K	3	220	34	2	9.24	1.44	0.65	4.2
0.75	FR-A720-0.75K	5	220	34	2	9.24	2.40	1.09	7.1
1.5	FR-A720-1.5K	8	220	30	2	9.24	3.84	1.75	12.8
2.2	FR-A720-2.2K	11	220	30	2	9.24	5.27	2.39	17.5
3.7	FR-A720-3.7K	17.5	220	30	3.5	5.20	4.72	2.14	15.7
5.5	FR-A720-5.5K	24	220	28	5.5	3.33	4.14	1.88	14.7
7.5	FR-A720-7.5K	33	220	28	8	2.31	3.96	1.80	14.1
11	FR-A720-11K	46	220	26	14	1.30	3.11	1.41	12.0
15	FR-A720-15K	61	220	26	22	0.824	2.61	1.19	10.0
18.5	FR-A720-18.5K	76	220	26	38	0.487	1.92	0.87	7.4
22	FR-A720-22K	90	220	26	38	0.487	2.28	1.04	8.8
30	FR-A720-30K	115	220	26	60	0.303	1.81	0.82	7.0
37	FR-A720-37K	145	220	26	80	0.229	1.72	0.78	6.6
45	FR-A720-45K	175	220	26	100	0.180	1.64	0.75	6.3
55	FR-A720-55K	215	220	26	100	0.18	2.00	0.90	7.6
75	FR-A720-75K	288	220	24	125	0.156	2.33	1.05	9.7
90	FR-A720-90K	346	220	24	150	0.136	2.44	1.10	10.1

The line voltage drop can be calculated by the following expression:
Line voltage drop [V]

$$= \frac{\sqrt{3} \times \text{cable resistance [m}\Omega\text{/m]} \times \text{wiring distance[m]} \times \text{current[A]}}{1{,}000}$$

Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

* When it is desired to use a larger-diameter cable but it cannot be connected directly with the motor and inverter terminals, provide relay terminal boxes as shown below:



- Wiring length to the motor
  When the wiring distance between the inverter and motor is long, overcurrent protection may be activated by the influence of the charging current (leakage current) due to the stray capacity of the wiring in addition to the aforementioned voltage drop. (The overall wiring length for connection of multiple motors should be within the value in the table below.)

A700 F700

The [*Pr. 72 PWM frequency selection*] setting	A700	0.4K	0.75K	1.5K or more
	F700	0.75K	1.5K	2.2K or more
2(2kHz) or less		300m	500m	500m
3 to 15 (3kHz to 14.5kHz)		200m	300m	500m

E700 D700

The [*Pr. 72 PWM frequency selection*] setting		0.1K	0.2K	0.4K	0.75K	1.5K	2.2K	3.7K or more
1(1kHz) or less	200V class	200m	200m	300m	500m	500 m	500m	500m
	400V class	-	-	200m	200m	300 m	500m	500m
2 to 15 (2kHz to 14.5kHz)	200V class	30m	100m	200m	300m	500 m	500m	500m
	400V class	-	-	30m	100m	200 m	300m	500m

The wiring length should be 100m maximum for vector control.
When Advanced magnetic flux vector control has been selected, the cable length should be within 30m. A longer cable may cause speed fluctuation at low speed, in addition to reduced torque. Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m.
When driving a 400V class motor by an inverter, serge voltage may occur at the motor terminals because of the

wiring constant. Isolation of the motor may be deteriorated by the surge voltage. In that case, refer to page 504.

(2) Control circuit cable

The cable size of 0.75mm^2 or larger is enough for use with cable other than the main circuit cables, e.g. operation and signal circuits.

3.6.5 Earth leakage circuit breaker (NV)

Since harmonic components are included in the output voltage of an inverter which drives a motor, an earth leakage current flows due to the earth capacity of the electrical path from the inverter to the motor and the stray capacity between the motor winding and iron core. For this reason, the rated sensitivity current of the earth leakage circuit breaker installed in the power supply side of the inverter should be selected as described below:

- Breaker designed for harmonic and surge suppression

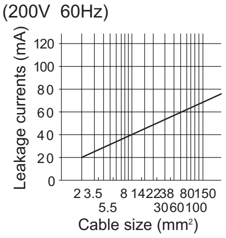
  Rated sensitivity current $I\triangle n \geq 10 \times (Ig_1+Ign+Igi+Ig_2+Igm)$

- Standard breaker

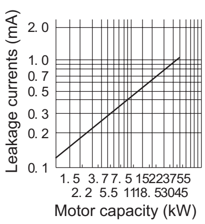
  Rated sensitivity current $I\triangle n \geq 10 \times \{Ig_1+Ign+Igi+3 \times (Ig_2+Igm)\}$

Ig_1, Ig_2	:	Leakage currents in cable path during commercial power supply operation
Ign*	:	Leakage current of noise filter on inverter input side
Igm	:	Leakage currents of motor during commercial power supply operation
Igi	:	Inverter unit leakage current

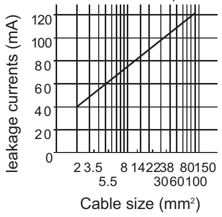
Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(200V 60Hz)



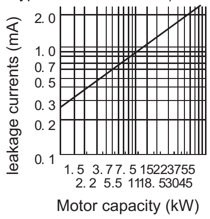
Leakage current example of three-phase induction motor during the commercial power supply operation
(200V 60Hz)



Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(Three-phase three-wire delta connection 400V60Hz)



Leakage current example of three-phase induction motorduring the commercial power supply operation
(Totally-enclosed fan-cooled type motor 400V60Hz)



For "人" connection, the amount of leakage current is appox.1/3 of the above value.

*1 The earth leakage circuit breaker should be installed to the primary (power supply) side of the inverter.

*2 An earth (ground) fault on the secondary side of the inverter can be detected at the running frequency of 120Hz or less.

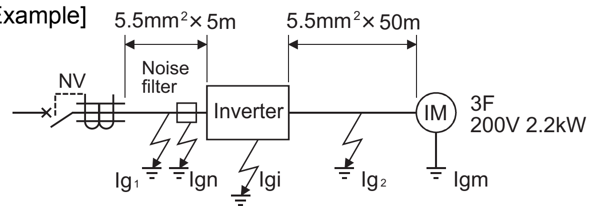
*3 In the 人 connection earthed-neutral system, the sensitivity current is blunt against an earth (ground) fault in the inverter output side.
Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)

*4 When the breaker is installed on the secondary side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is less than the rating.
In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.

*5 General products indicate the following models.
BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F, earth leakage relay (except NV-ZHA), NV with AA neutral wire open-phase protection. The other models are designed for harmonic and surge suppression.
NV-C, NV-S, MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, NV-H

* Note the leakage current value of the noise filter installed on the inverter input side.
(Refer to a catalog for the leakage current value of the filter dedicated to the Mitsubishi inverter)

[Example]



	Breaker Designed for Harmonic and Surge Suppression	Standard Breaker
Leakage current Ig_1	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current Ign	0 (without noise filter)	
Leakage current Igi	1 (without EMC filter) Refer to the table below for the inverter leakage currents	
Leakage current Ig_2	$33 \times \frac{50m}{1000m} = 1.65$	
Motor leakage current Igm	0.18	
Total leakage current Ig	3.00*1	6.65*2
Rated sensitivity current: ($\geq$Ig × 10)	30	100

*1 $Ig_1+Ign+Igi+Ig_2+Igm$ (Unit : mA)

*2 $Ig_1+Ign+Igi+3 \times (Igm_2+Igm)$

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- Inverter leakage currents
  Leak current of an inverter without built-in EMC filter (E700 D700) is 1mA.
  Leak current of A700 F700 is as follow when turning the EMC filter ON/OFF.
  Input power conditions
  (220V class: 220V/60Hz, 400V class: 440V/60Hz, power supply unbalance within 3%)

	Voltage (V)	EMC Filter ON (mA)	EMC Filter OFF (mA)
Phase grounding	200	22 (1)*	1
	400	30	1
Earthed -neutral system	400	1	1

* For the A700 200V class 0.4K and 0.75K, the EMC filter is always valid.
For the F700 200V class 0.75K and 1.5K, the EMC filter is always valid.
The leakage current is 1mA.

(1) Calculation of the continuous leakage current

The value of the leakage current depends on the cable type, cable diameter, cable length from earth leakage circuit breaker to inverter, cable length from inverter to motor, and inverter output frequency. It is roughly calculated from a value for the commercial power supply (50Hz, 60Hz).

1) Leakage current from cables (Ig_1, Ig_2)
   Measure the electrical path length from ground fault interrupter to inverter input terminals and the types and sizes of cables and calculate the leakage current according to the information. (Apply the value for the commercial power supply. Harmonic components can be ignored.)
   Measure the electrical path length from inverter output terminals to the motor and the types and sizes of cables, calculate the leakage current according to this information and multiply the calculated value several times in consideration of the harmonic components. (about three times on average, through it depends on the inverter output frequency)
2) Leakage current from the motor (Igm)
   Determine the capacities and the number of motors, calculate the total leakage current using the in-operation leakage current value in the information and multiply the total value several times in consideration of the harmonic components.
   (about three times on average, through it depends on the inverter output frequency).
3) Leakage current of noise filter on inverter input side (Ign)
   When using the inverter-dedicated radio noise filter (FR-BIF), add approximately 4mA (400V: approx. 8mA) per filter.

   * Leakage currents equivalent to one phase of three phase three wires connection cable.

   (For the calculation of the continuous leakage current, refer to the "Mitsubishi earth leakage circuit breaker technical information".)
4) Leakage current in the inverter (Igi)
   For the A700 200V class 1.5kW or more, all capacities of 400V class, F700 200V class 2.2kW or more, and all capacities of 400V class, the amount of the leakage currents changes by the EMC filter ON/OFF connector.

(2) Selection of the rated sensitivity current

The rated sensitivity current, protective ground resistance value, and continuous leakage current of an electrical path are interrelated. From the standpoint of protection from electric shock, the relationship between the rated sensitivity current and protective ground resistance value is important.
From the standpoint of unnecessary operation prevention, the relationship between the rated sensitivity current and leakage current cannot be ignored.

1) Selection of the rated sensitivity current
   Find the continuous leakage current using the method described in paragraph (1) and use the rated sensitivity current of more than 10 times greater than the continuous leakage current, considering a transient inrush current. Note that when a breaker for harmonic and surge suppression is used with the inverter circuit, the harmonic components are cut. In this case, use the value 10 times greater than the continuous leakage current generated when a commercial power supply is used.
2) Application to legally restricted areas
   In some areas, the rated sensitivity current is specified by the electrical facility standard, occupational safety and health rules and indoor wiring regulations. When installing the earth leakage circuit breaker in such places, select the rated sensitivity current in accordance with these rules and regulations. If the rated sensitivity current selected for a large continuous leakage current cannot satisfy the rules and regulations, take either of the following measures:
   (a) When there are several loads, install an earth leakage current breaker for each motor and inverter.
   (b) Reduce the length of the cable or increase the distance from the ground.
3) Examination from the standpoint of electric shock prevention.
   Electric shock is divided into direct shock and indirect shock. In Japan, protection is generally provided against indirect electric shock. The determination of the rated sensitivity current is related to the contact voltage and the resistance

value of class 3 equipment earthing (protective grounding) and generally there are no restrictions on the rated sensitivity current. Hence, select the rated sensitivity current from among 15, 30, 100, 200 and 500mA, and conduct protective earthing so that the permissible contact voltage is not exceeded.

•200V class ·····	Class D grounding (grounding resistance 100Ω or less)
•400V class ·····	Class C grounding (grounding resistance 10Ω or less)

• When the power transformer is of ⅄ connection neutral point earthing type, use special class C grounding (10Ω or less) because the sensitivity current is blunted with respect to an earth fault on the secondary side of the inverter.

(3) Characteristics and operational instructions for the ground fault interrupter

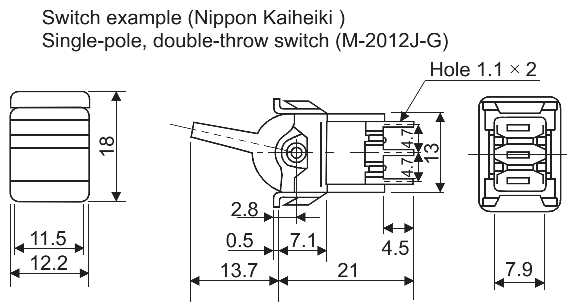
1) When operating the low acoustic noise (high carrier frequency) inverter operation, the leakage current increases in harmonic current component as compared to a conventional inverter, resulting in a larger continuous leakage current. When a recent ground fault interrupter provided with a harmonic eliminating circuit to prevent malfunction is used, selection can be made in the same way as in the conventional inverter (see page 531).
When performing low acoustic noise (high carrier frequency) inverter operation with the ground fault interrupter which is not provided with the harmonic eliminating circuit, a malfunction may occur. Therefore, it is recommended to use the ground fault interrupter provided with the malfunction preventing circuit.
2) Install the groundfault interrupter in the power supply side of the inverter. (Proper operation is not performed if it is installed in the load side)
3) If a ground fault occurs in the power supply side of the inverter, the ground fault interrupter operates properly, posing not problem.
If a ground fault occurs in the load side of the inverter, the sensitivity current of the ground fault interrupter may change depending on the operating status (output frequency) of the inverter. This is mainly because the waveform of the ground fault current is not a sinusoidal wave but an AC non-sinusoidal wave including harmonic and DC components.
4) In Japan installation of an earth leakage circuit breaker is mandated by the "Technological baseline related to electrical equipment, article 41" and "Occupational safety and health rules, articles 333, 334". For full information, refer to the corresponding ordinances.

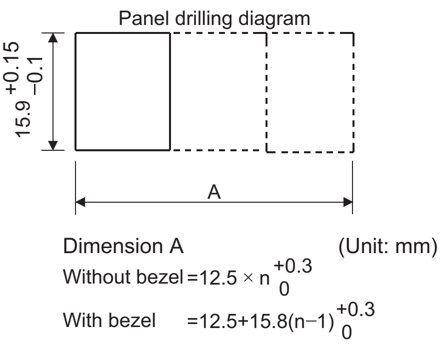
3.6.6 Relays

Relays used in the control circuit, e.g. inputs STF, STR, 10, 2, 5 etc.	Use small-signal relays (twin contact) to prevent a contact fault. Omron: Type G2A, Fuji: Type No. 473, No. 474
Relays used with outputs RUN, SU etc.	Use small relays of 12VDC or 24VDC, 100mA or less.

3.6.7 Start/stop switch

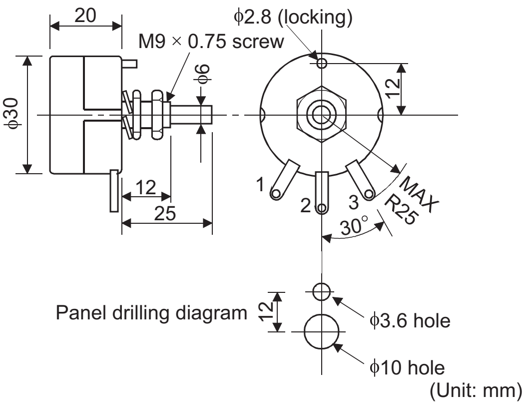
Use a low-current switch to prevent a contact fault.





3.6.8 Frequency setting potentiometer

Type: WA2W 1kΩ
Wire-wound variable resistor 2W1kΩ B characteristics



When frequency setting is not changed frequently, a variable resistor of 1/2W1kΩ may be used.

3.6.9 Frequency meter and calibration resistor

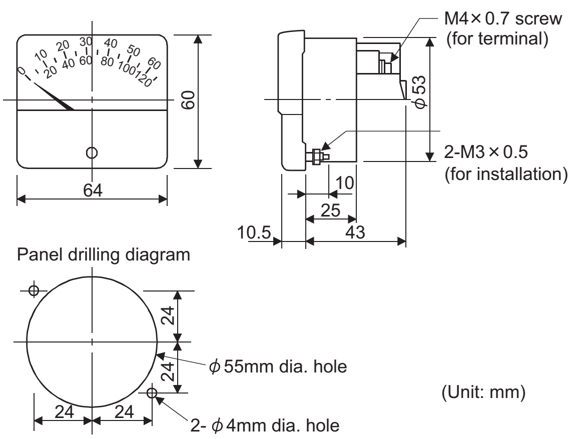
A manual controller with frequency meter (such as the FR-AX) is available. When only a frequency meter is installed separately, use an instrument of the following specifications:

Moving-coil type DC ammeter
Full scale 1mA (internal resistance 300Ωmax.)
Graduations: 60, 120, 240Hz in full scale. Alternatively, graduate in rpm according to the number of poles of the motor used.

Since the frequency meter terminal FM on the inverter develops about 5VDC at the maximum frequency, calibrate the frequency meter using the variable resistor having the following specifications. It is not necessary when calibrating the meter from the operation panel (parameter unit).
Calibration resistor 1/3W or more 10kΩ
The following frequency meter and calibration resistor are available for use.

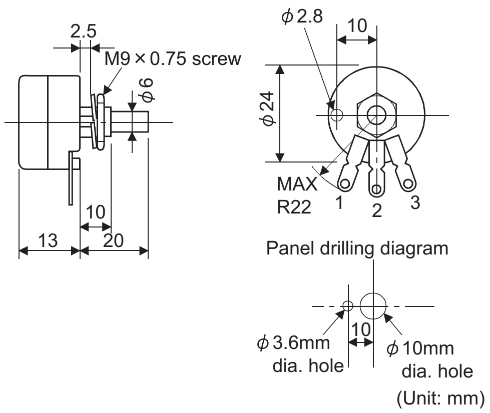
- Analog frequency meter(64mm × 60mm)

Type YM206NRI 1mA
Graduations : 0 to 65, 130Hz double graduations



- Calibration resistor

Type: RV24YN 10kΩ
Deposited carbon variable resistor 1/3W, 10kΩB characteristic



* Not needed when the operation panel (FR-DU07) or parameter unit (FR-PU07) is used for calibration. This resistor is used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. Note that the needle of the frequency meter may not deflect to full-scale when the calibration resistor is connected. In this case, use this resistor and operation panel or parameter unit together.

3.6.10 Twisted/shielded cables

[Example] Twisted cable

Type: KV-2C × 0.3SQ (Optec Dai-Ichi Denko)

Qty. X Size (mm^2)	Finish OD (mm)	Characteristics of a Single Cable				Color
		Structure (wires/mm)	Conductor resistance (Ω/km)	Rated voltage (V)	Permissible temperature (℃)	
2 × 0.3	2 × 1.5	120/0.18	64.4 or less	300	60	Red/white

[Example] Multi-core shielded cable

Type: VCT-S3C × 0.5SQ (Tokiwa Cable)

Qty. X Size (mm^2)	Finish OD (mm)	Characteristics of a Single Cable				Color
		Structure (wires/mm)	—	Rated voltage (V)	—	
3 × 0.3	8.3	200.18	—	600	—	Gray

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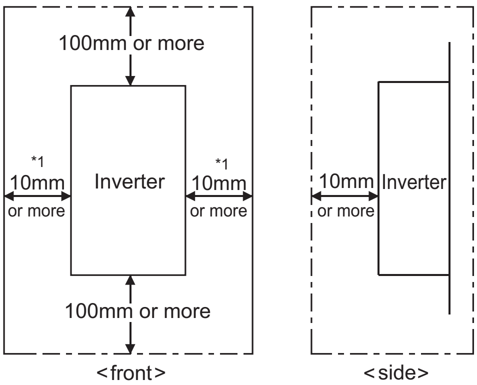
3.6.5 Notes on installation of inverter in an enclosure

(1) Inverter placement

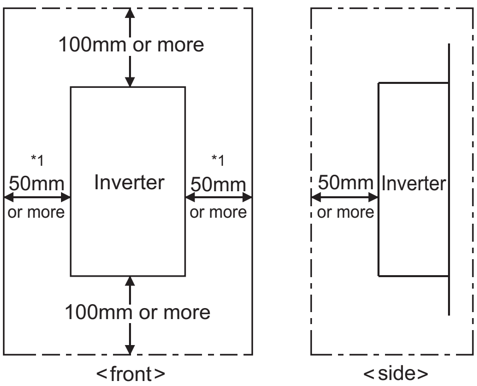
1) Clearances around the inverter

To ensure ease of heat dissipation and maintenance, leave at least the shown clearances around the inverter. At least the following clearances are required under the inverter as a wiring space, and above the inverter as a heat dissipation space.

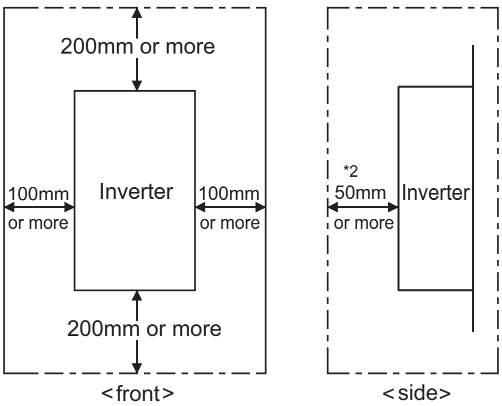
- 3.7K or less



- 5.5K to 55K



- 75K or more



Clearances around the inverter

*1 (E700) (D700) inverters can be installed side-by-side (with 0mm clearance) in the surrounding air temperature of 40°C or less.

*2 For replacing the cooling fan of the FR-A740-160K, FR-F740-185K or more, 300mm of space is necessary in front of the inverter.

2) Inverter mounting orientation

Mount the inverter on a wall as specified. Do not mount it horizontally or any other way.

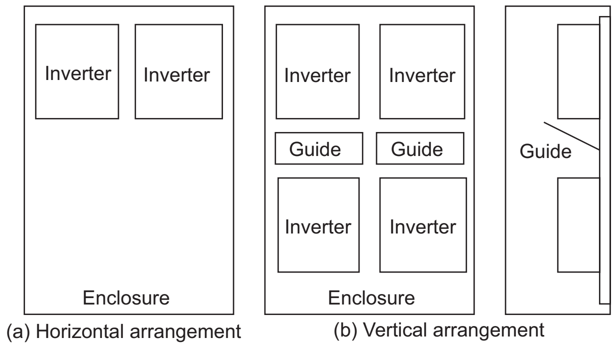
3) Top of the inverter

Heat is blown up from inside the inverter by the small fan built in the unit. Any equipment placed above the inverter should be heat resistant.

The surrounding air temperature should be 50℃ or less at a distance of 50mm from the center bottom and the center of left/right of the inverter.

4) Arrangement of several inverters

When several inverters are placed in the same enclosure, generally arrange them horizontally as shown in the following figure (a). When it is inevitable to arrange them vertically to minimize space, take such measures as to provide guides since heat from the bottom inverters can increase the temperatures in the top inverters, causing inverter failures.

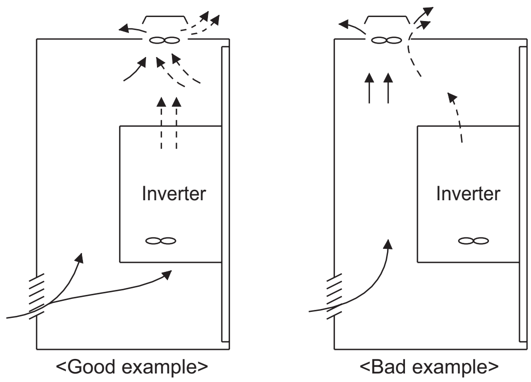


Arrangement of several inverters

When mounting several inverters, fully take caution not to make the surrounding air temperature of the inverter higher than the permissible value by providing ventilation and increasing the panel size.

5) Placement of ventilation fan and inverter

Heat generated in the inverter is blown up from the bottom of the unit as warm air by the cooling fan. When installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the inverter to cool air.)



Placement of ventilation fan and inverter

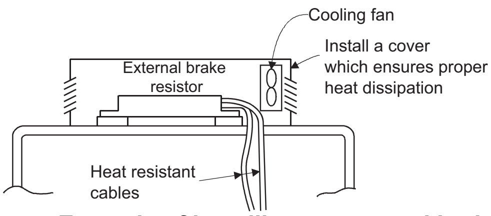
(2) External high-duty brake resistor (FR-ABR type)

1) Installation position

(a) When the A700 7.5K or less is operated in excess of the duty of the built-in brake resistor, disconnect the built-in brake resistor supplied with the inverter and install an external brake resistor.

For the A700 22K or less and E700 D700 0.4K or more, an external brake resistor can be installed.

(b) Since the external brake resistor generates much heat, its surface temperature may exceed 360℃ in an operation pattern using the resistor at high-duty. Hence, install the external brake resistor in consideration of heat dissipation. The inverter and other devices must not be placed above the resistor.

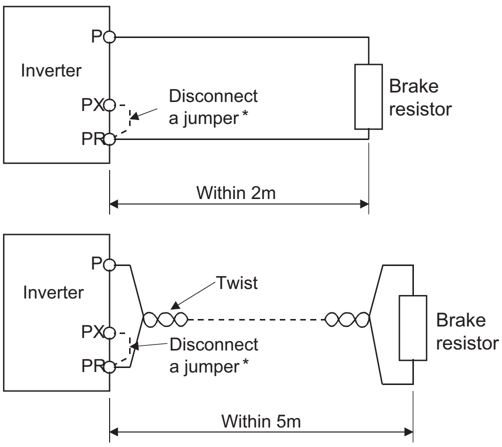


Example of installing an external brake resistor on top of the enclosure

2) Wiring

(a) When wiring the brake resistor, note high DC voltage application and resistor-generated heat.

(b) The wiring distance between the inverter and brake resistor should be as short as possible. If it exceeds 2m, twist the cables. (If twisted, the distance must not exceed 5m)



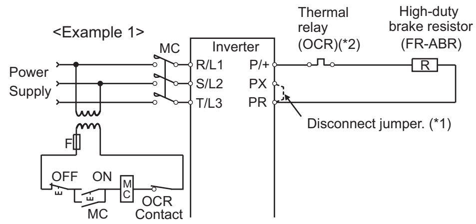
Wiring the brake resistor

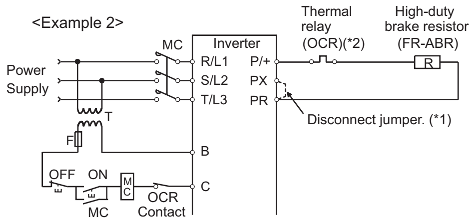
* Since the A700 series 11K or more, E700 D700 series inverter is not provided with the PX terminal, a jumper is not need to be removed.

(c) When wiring the brake resistor, the resistor-generated heat (maximum surface temperature is approximately 360℃) must be taken into consideration.

- Take measures to prevent the cables from making contact with the resistor.
- Use heat-resistant cables (such as glass-braided cables), or cover the cables with silicone tubes. Use cables of 2mm^2 or larger size.

(d) The following sequence is recommended to prevent overheat and burnout of the brake resistor in case the brake transistor is damaged.



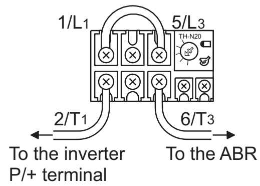


Removing jumpers disables the built-in brake resistor (power is not supplied). Note that the built-in brake resistor is not need to be removed from the inverter. The lead wire of the built-in brake resistor is not need to be removed from the terminal.

*1 Remove the jumper connected across terminal PR-PX of the inverter. Since the A700 series 11K or more, E700 D700 series inverter is not provided with the PX terminal, a jumper is not need to be removed.

*2 Refer to the table below for the type number of each capacity of thermal relay and the diagram below for the connection. (Always install a thermal relay when using a brake resistor whose capacity is 11K or more.)

Power Supply Voltage	High-duty Brake Resistor	Thermal Relay Type (Mitsubishi Product)	Contact Rating
200V	FR-ABR-0.4K	TH-N20CXHZ-0.7A	110VAC 5A, 220VAC 2A (class 11AC) 110VDC 0.5A, 220VDC 0.25A (class 11DC)
	FR-ABR-0.75K	TH-N20CXHZ-1.3A	
	FR-ABR-2.2K	TH-N20CXHZ-2.1A	
	FR-ABR-3.7K	TH-N20CXHZ-3.6A	
	FR-ABR-5.5K	TH-N20CXHZ-5A	
	FR-ABR-7.5K	TH-N20CXHZ-6.6A	
	FR-ABR-11K	TH-N20CXHZ-11A	
	FR-ABR-15K	TH-N20CXHZ-11A	
	FR-ABR-22K	TH-N60-22A	
400V	FR-ABR-H0.4K	TH-N20CXHZ-0.24A	
	FR-ABR-H0.75K	TH-N20CXHZ-0.35A	
	FR-ABR-H1.5K	TH-N20CXHZ-0.9A	
	FR-ABR-H2.2K	TH-N20CXHZ-1.3A	
	FR-ABR-H3.7K	TH-N20CXHZ-2.1A	
	FR-ABR-H5.5K	TH-N20CXHZ-2.5A	
	FR-ABR-H7.5K	TH-N20CXHZ-3.6A	
	FR-ABR-H11K	TH-N20CXHZ-6.6A	
	FR-ABR-H15K	TH-N20CXHZ-6.6A	
	FR-ABR-H22K	TH-N20-9A	



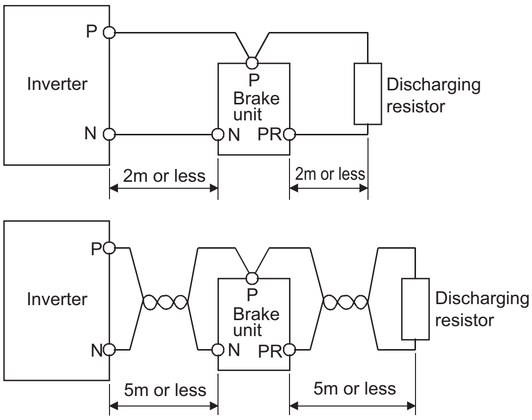
(3) BU type brake unit and discharging resistor

1) Installation position
For the installation position of the discharging resistor, refer to paragraph (2), part 1).

2) Wiring

(a) When wiring the brake unit (BU type) and discharging resistor, note high DC voltage application and discharging resistor-generated heat.

(b) Minimize the cable length between the inverter and brake unit and the discharging resistor and brake unit. If it exceeds 2m, twist the cables. (If twisted, the distance must not exceed 5m)



Wiring the BU brake unit

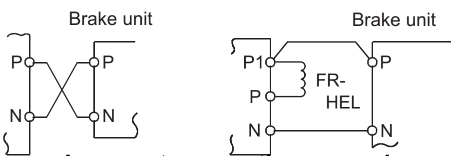
(c) When wiring the discharging resistor, the resistor-generated heat (maximum surface temperature is approximately 150 to 300℃) must be taken into consideration.
- Take measures to prevent the cables from making contact with the resistor.
- Use heat-resistant cables (such as glass-braided cables), or cover the cables with silicone tubes.

(d) Use cables of the size below or larger size.

Cables applicable to the BU brake unit

BU Brake Unit Type		Cable Size
200V	BU-1500, 3700	2mm^2
	BU-7.5K, 15K	3.5mm^2
400V	BU-H7.5K	2mm^2
	BU-H15K, H30K	3.5mm^2

(e) Connect the cables so that the terminal symbols of the brake unit match those of the inverter. When the FR-HEL power-factor improving reactor has been connected, do not connect the brake unit to terminal P1 to protect the brake unit from damage.



Incorrect connection examples

(f) If the transistors in the brake unit become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's input side to configure a circuit so that a current is shut off in case of fault.

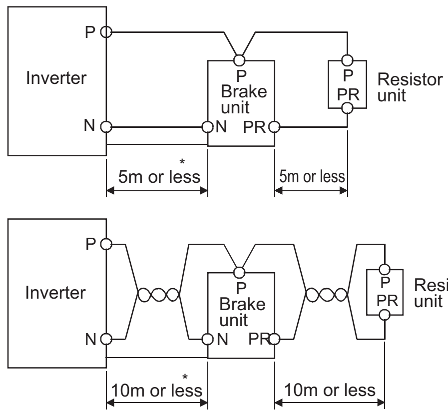
(4) FR-BU2/FR-BU/MT-BU5 brake unit and resistor unit

1) Installation position
Always install the brake unit and resistor unit on a vertical surface in the vertical direction. Installing them in the horizontal direction or on a horizontal surface reduces the heat dissipation effect.
Since the case temperature of the resistor unit rises to or above 100℃ (the temperature rise of the brake resistor of the MT-BU5 is 300K), install the unit in a place where it will not make contact with cables and flammables.

2) Wiring

(a) When wiring the brake unit (FR-BU2/FR-BU/MT-BU5) and resistor unit, note high DC voltage application and resistor unit generated heat.

(b) Minimize the cable length between the inverter and brake unit and the resistor unit and brake unit. Use a twisted cable when the wiring length exceeds 5m.
(Even when the wiring is twisted, the cable length must not exceed 10m.)



* The MT-BU5 is installed within a distance of the supplied cable (P, N, drive signal) reaches the inverter.
Refer to the inverter manual.

Wiring the FR-BU2/FR-BU/MT-BU5 brake unit

(c) Use cables of the size below or larger size.

Cables applicable to the FR-BU/MT-BU5 brake unit

Type		Cable Size
200V	FR-BU-15K, FR-BR-15K	3.5mm^2
	FR-BU-30K, FR-BR-30K	5.5mm^2
	FR-BU-55K, FR-BR-55K	14mm^2
400V	FR-BU-H15K, FR-BR-H15K	3.5mm^2
	FR-BU-H30K, FR-BR-H30K	3.5mm^2
	FR-BU-H55K, FR-BR-H55K	5.5mm^2
	MT-BU5-H75K, MT-BR5-H75K	14mm^2 *
	MT-BU5-H150K, 2 × MT-BR5-H75K	14mm^2 *
	MT-BU5-H220K, 3 × MT-BR5-H75K	14mm^2 *
	MT-BU5-H280K, 4 × MT-BR5-H75K	14mm^2 *
	MT-BU5-H375K, 5 × MT-BR5-H75K	14mm^2 *

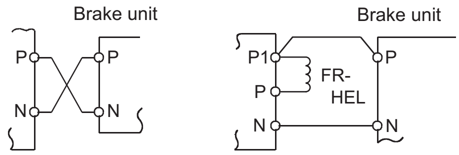
* Per one brake resistor

Cables applicable to the FR-BU2 brake unit

	brake unit Type	Discharging resistor, Resistor unit type	Cable Size
200V class	FR-BU2-1.5K	GZG 300W-50Ω(one)	2mm^2
	FR-BU2-3.7K	GRZG 200-10Ω (three in series)	2mm^2
	FR-BU2-7.5K	GRZG 300-5Ω (four in series)	3.5mm^2
	FR-BU2-15K	GRZG 400-2Ω (six in series) FR-BR-15K	3.5mm^2
	FR-BU2-30K	FR-BR-30K	5.5mm^2
	FR-BU2-55K	FR-BR-55K MT-BR5-55K	14mm^2
400V class	FR-BU2-H7.5K	GRZG 200-10Ω (six in series)	2mm^2
	FR-BU2-H15K	GRZG 300-5Ω (eight in series) FR-BR-H15K	3.5mm^2
	FR-BU2-H30K	GRZG 400-2Ω (twelve in series) FR-BR-H30K	3.5mm^2
	FR-BU2-H55K	FR-BR-H55K	5.5mm^2
	FR-BU2-H75K	MT-BR5-H75K	14mm^2

(d) If the transistors in the brake unit should become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's input side to configure a circuit so that a current is shut off in case of fault.

(e) Connect the cables so that the terminal symbols of the brake unit match those of the inverter. When the FR-HEL power-factor improving reactor has been connected, do not connect the brake unit to terminal P1 to protect the brake unit from damage.



Incorrect connection examples

3) Brake unit operation indications

Brake unit operation indication description (FR-BU)

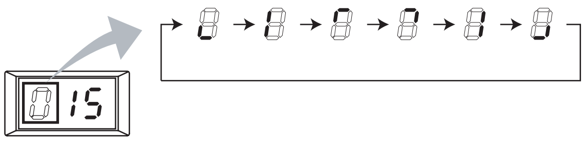
7-Segment LED Indication	Description
(0)	Indicates that the brake unit is switched ON.
to (1 to A)	Indicates %ED during brake operation.
(E)	Indicates a brake transistor failure.
(F)*1	Indicates that the brake is operated in excess of permissible %ED.

*1 When this operation indicator LED is lit to indicate the excess of the permissible %ED, the brake unit stops operating and therefore the "overcurrent", "overvoltage" or other protective function of the inverter is activated. To resume operation, find and remove its cause, then reset the inverter.

*2 By switching OFF the brake unit and making a reset, the cumulative data of the brake duty is cleared. Note that repeating reset many times to perform operation will overheat the resistor unit.

Indication of the brake unit operation (FR-BU2)

When [*Pr.1* = 0] (initial value) in FR-BU2, 3rd digit of the 3-digit LED indicates regeneration status.
Two segments flicker (rotate) at a time during regeneration as shown below and rotate quickly when regeneration amount is large. Another monitor can be also displayed by the setting of [*Pr.1*] in FR-BU2.

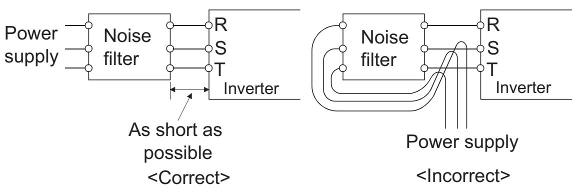


(5) EMI filter

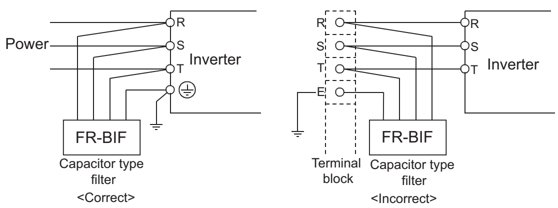
The (A700)(F700) 55K or less has a built-in filter equivalent to common mode filter and capacitor type filter on the input side.

1) Installation position
Since the noise filter produces a greater effect when it is located closer to the source of noise, determine its installation position in consideration of the following:
   (a) When used in the inverter power supply circuit, install the noise filter in a position where the wiring distance from the inverter input terminals is short.
   (b) When used in the inverter output circuit, install the noise filter in a position where the wiring distance from the inverter output terminals is the shortest. (The FR-BIF capacitor type filter cannot be connected to the output circuit.)

2) Wiring
The noise filter cannot produce its effect unless it is wired as indicated below.
The noise filter must be installed as close as possible to the inverter and its wiring distance minimized. In addition, the primary and secondary wirings of the noise filter must not be close to each other or cross each other.
For the selection of the noise filter, see page 518.



Wiring the noise filter



Wiring the FR-BIF

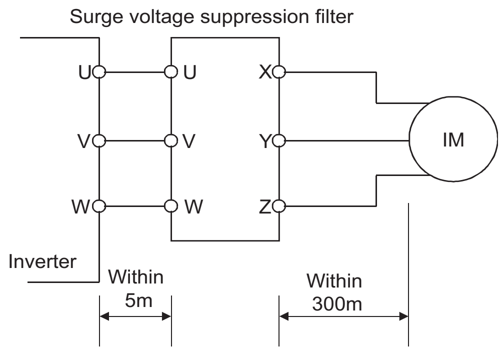
(6) Surge voltage suppression filter (FR-ASF-H, FR-BMF-H)

When a 400V class motor is inverter-driven, a micro surge voltage attributable to wiring constants is generated at the motor terminals and may deteriorate the motor insulation. In such a case, the micro surge voltage can be suppressed to 850V or less by inserting the surge voltage suppression filter (FR-ASF-H) in the secondary side of the inverter.
As surge voltage suppression measures at inverter renewal to 400V non insulation-enhanced motor, small/light FR-BMF-H as compared to the FR-ASF-H can be used.

FR-ASF-H

1) Installation
When energized, the surge voltage suppression filter gets hot. Never install it near flammables or where it can easily make contact with a human body.
To release heat, leave at least 100mm clearances around the filter as an installation space.

2) Wiring
   (a) After checking the terminal symbols of the filter terminal block, connect the cables from the output terminals of the inverter to the filter input terminals (U, V, W) and the cables from the motor terminals to the output terminals (X, Y, Z) of the filter. Incorrect wiring may damage the device.
   As the filter gets hot, avoid wiring the cables near the resistor.
   (b) The wiring length between the inverter output terminals and filter input terminals should be within 5m.
   The wiring length between the filter output terminals and motor input terminals should be within 300m.
   (c) The cable size may be any size if it is as recommended for the inverter.
   (d) The cable type recommended for use is a heat-resistant cable. Note that the temperature of the resistor section of the filter rises about 70 degrees when the filter is switched on. Therefore if the cables may make contact with the resistor, use heat-resistant, glass-braided cables.



Wiring of surge voltage suppression filter

3) Voltage drop
A voltage drop caused by the filter is proportional to the inverter output frequency and output current.
The voltage drop is approximately 30V when the inverter output frequency is 60Hz and the filter is on at the rated current, independent of the capacity.

4) Leakage currents
By connecting the filter, the leakage current slightly increases. When using many filters at the same time, take this into consideration when

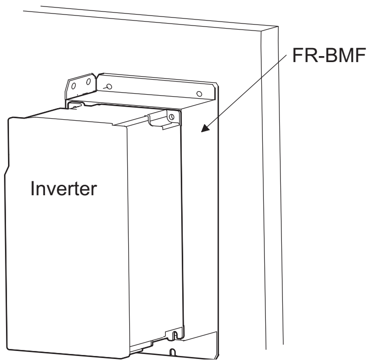
selecting the earth leakage circuit breaker. (As a result of measurement in accordance with the measurement method specified in the New Electrical Appliances Control Rules, the leakage current of the H15K or less is approximately 1mA under the conditions of 60Hz inverter output frequency and 14.5kHz carrier frequency.)

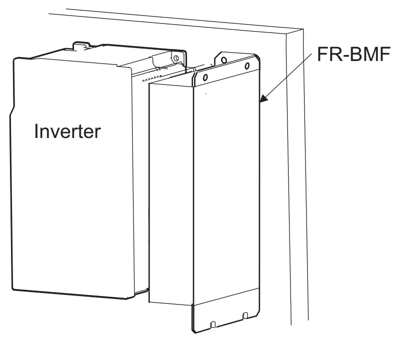
5) Others
Control can be applied to V/F control or Advanced magnetic flux vector control.

FR-BMF-H

1) Installation
   (a) The FR-BMF-H can be installed on the inverter rear side (up to 22K) or on the right side as viewed from the inverter front.
   (b) When installing on the side, leave 10mm or more between the filter and inverter to release heat.
   (c) When using the inverter with the filter pack installed on the side, do not install this combination on moving objects or places that have vibrations (exceeding 1.96m/s^2).
2) Wiring
   (a) Connect the input cable (U, V, W) of the filter to the output terminal (U, V, W) of the inverter and connect the cable from the motor terminal to the output terminal (W, Y, Z) of the filter.
   (b) The wiring length of the filter input connected to the inverter output terminal should not be extended.
   The wiring length between the filter output terminals and motor input terminals should be within 100m.
   (c) The cable size may be any size if it is as recommended for the inverter.

3) Others
The PWM carrier frequency of the inverter should be 2KHz or less.





(7) Sine wave filter

For the A700 F700 75K or more inverter, the motor voltage and current can be made to nearly sine wave shaped by providing a sine wave filter on the output side.
As a result of this, the same characteristic as when the motor is driven with a sine wave current is obtained and the result as below can be expected.

1. Low noise
2. Surge less
3. Motor loss reduction (use of standard motor)

1) Installation
   (a) When connecting capacitors in parallel, leave installation space of 25mm or more.
   (b) The temperature rise of the reactor is equivalent to H class, leave an installation space of 30mm or more between the capacitor.
   Also perform wiring so that the wires do not make contact with the reactor.
   (c) Install a sine wave filter on the inverter side.

2) Wiring
Connecting the capacitor on the primary side (U, V, W) of the reactor may damage the capacitor.

3) Others
   (a) Change to [*Pr. 720* = 25]. (The initial value is 2.)
   The carrier frequency changes to 2.5KHz. (The sine wave filter is designed on condition that the carrier frequency is 2.5KHz. Be sure to change the setting properly.)
   If the inverter is operated with [*Pr. 72* ≠ 25], the inverter and sine wave filter may be damaged.
   (b) The sine wave filter can be used only for 60 Hz or less inverter frequency.
   Note that the filter can not be used for the higher frequency operation than this. (Otherwise the filter loss will increase.)
   (c) Use the inverter with capacity one rank higher.
   If the rated motor current x (1.05 to 1.1) is less than 90% of the inverter rated current, an inverter with same kW with a motor can be used.

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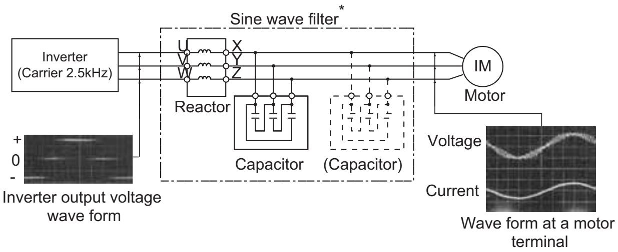
(d) This function is valid for V/F control only. (When [*Pr. 72* = 25], V/F control is automatically selected.)

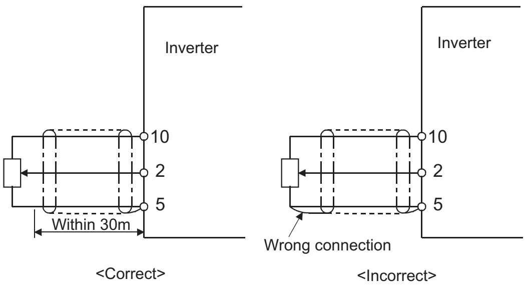
(e) A sine wave filter and MT-HC can not be used together.



(8) Wiring of control circuit

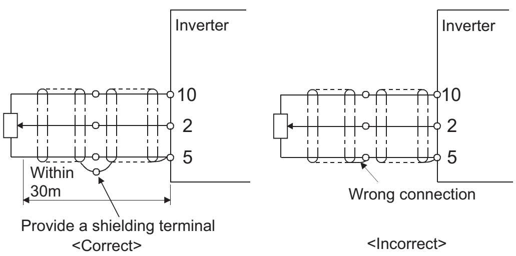
1) Use twisted or shielded cables for connection with the control circuit terminals (10, 2, 5, 1, 4, AM). Do not earth (ground) the shield but connect it as indicated below. (Keep the other end of the shield open)
2) Use twisted or shielded cables for connection with the display (frequency) meter terminals (FM, SD) over a wiring distance of 200m maximum. If the distance exceeds 200m, the display (frequency) meter reading may result in a larger error.
3) Wire the control circuit cables away from the power line over the shortest distance.

[Example 1] Shielded cables



Connecting the shielded cables

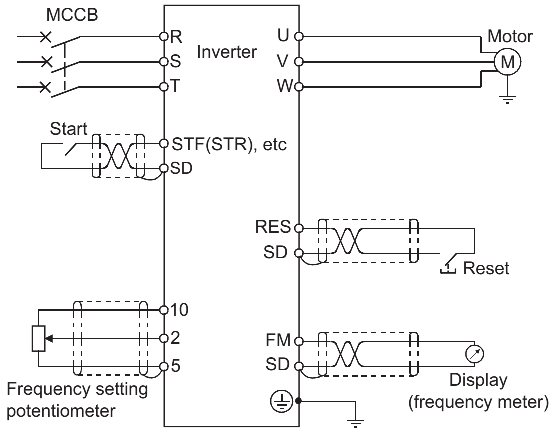
[Example 2] Shielded cables joined



Connecting the shielded cables

(9) Countermeasures against external noise

1) Strengthening the countermeasures against noise
The FR series inverters are sufficiently protected from noise. However, extremely large external noise may cause the inverter to malfunction. When there is such external noise that cannot be eliminated, wire the inverter in accordance with the following figure.

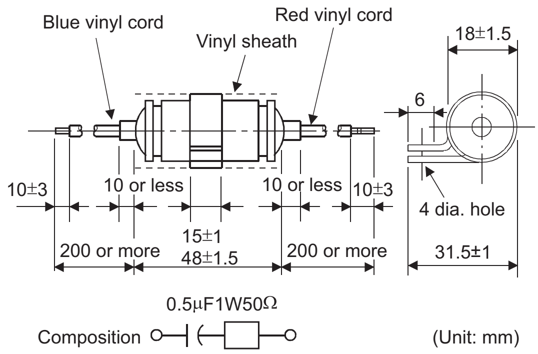


Noise reduction techniques

2) Remote control, etc.
Acting as an antenna, the single lines are susceptible to external noise. Therefore, run the signal lines as far as possible from the power line. If the inverter is controlled 30m or further away from its installation position, it is recommended to use any of the following:
   (a) Speed setting device
   Use the FR-FK motorized speed setter. (For the operation information, see the corresponding manual.)
   (b) External start/stop signal
   Add a relay in the vicinity of the inverter.
   (c) Cable
   Use twisted or twisted shielded cables.
   (d) Surge suppressors
   Install surge suppressors to the coils of the relays, valves etc. around the inverter.

[Example]972A-2003 504 11

(manufactured by MATSUO ELECTRIC CO.,LTD.)



3.7 Enclosure design

When an inverter enclosure is to be designed and manufactured, heat generated by contained equipment, etc., the environment of an operating place, and others must be fully considered to determine the panel structure, size and equipment layout. The inverter unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the inverter in the ambient environment that completely satisfies the equipment specifications.

3.7.1 Inverter installation environment

As the inverter installation environment should satisfy the standard specifications indicated in the following table, operation in any place that does not meet these conditions not only deteriorates the performance and life of the inverter, but also causes a failure. Refer to the following points and take adequate measures.

Environmental standard specifications of inverter

Item	Description
Surrounding air temperature	-10 to +50 ℃ (non-freezing)
Ambient humidity	90% RH maximum (non-condensing)
Atmosphere	Free from corrosive and explosive gases Free from dust and dirt
Maximum altitude	1000m or less
Vibration	5.9m/s^2 {0.6G} or less *

* For the A700 160K or more and F700 185K or more, the vibration is 2.9ms^2 or less

(1) Temperature

The permissible surrounding air temperature of the inverter is between -10 and +50℃. Always operate the inverter within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures so that the surrounding air temperature of the inverter falls within the specified range.

1) Measures against high temperature
   - (a) Use a forced ventilation system or similar cooling system. (Refer to page 549)
   - (b) Install the panel in an air-conditioned electrical room.
   - (c) Block direct sunlight.
   - (d) Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
   - (e) Ventilate the area around the panel well.

2) Measures against low temperature
   - (a) Provide a space heater in the enclosure.
   - (b) Keep the inverter power ON. (Keep the start signal of the inverter OFF.)

3) Sudden temperature changes
   - (a) Select an installation place where temperature does not change suddenly.
   - (b) Avoid installing the inverter near the air outlet of an air conditioner.
   - (c) If temperature changes are caused by opening/closing of a door, install the inverter away from the door.

(2) Humidity

Normally operate the inverter within the 45 to 90% range of the ambient humidity. Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may produce a through-air insulation breakdown. The insulation distance specified in JEM1103 "Control Equipment Insulator" is defined as humidity 45 to 85%.

1) Measures against high humidity
   - (a) Make the panel enclosed, and provide it with a moisture absorber.
   - (b) Take dry air into the enclosure from outside.
   - (c) Provide a space heater in the enclosure.

2) Measures against low humidity
   What is important in this condition is to blow air of proper humidity into the enclosure from outside. It is also important to discharge your body (static electricity) before fitting or inspection of the unit, and keep your body from contact with the parts and patterns.

3) Measures against condensation
   Condensation may occur if temperature in the panel changes suddenly due to frequent power ON/OFF switching or if atmospheric temperature changes suddenly.
   Condensation will cause insulation to be deteriorated and corrosion to occur.
   - (a) Take the measures against high humidity in 1).
   - (b) Keep the inverter power ON (Keep the start signal of the inverter OFF.)

(3) Dust, dirt, oil mist

Dust and dirt will cause such faults as poor contact of contact points, reduced insulation or reduced cooling effect due to moisture absorption of accumulated dust and dirt, and in-panel temperature rise due to clogged filter. In the atmosphere where conductive powder floats, dust and dirt will cause such faults as malfunction, deteriorated insulation and short circuit in a short time.
Since oil mist will cause similar conditions, it is necessary to take adequate measures.
Countermeasures
- (a) Place in a totally enclosed enclosure.
  Take measures if the in-enclosure temperature rises.
  (Refer to page 548, 549.)

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(b) Purge air.
Pump clean air from outside to make the in-panel pressure higher than the outside-air pressure.

(4) Corrosive gas, sea breeze

When the enclosure is installed in places exposed to corrosive gas or sea breeze, the printed circuit board patterns and parts will be corroded and/or contact faults of the relays and switches will occur.
In such places, take the measures given in (a) and (b) in paragraph (3).

(5) Explosive, flammable gases

As the inverter is non-explosion proof, it must be contained in an explosion proof enclosure. In places where explosion may be caused by explosive gas, dust or dirt, an enclosure cannot be used unless it structurally complies with the guidelines and has passed the specified tests. This makes the enclosure itself expensive (including the test charges). The best way is to avoid installation in such places and install the inverter in a non-hazardous place. (refer to page 498)

(6) Highland

Use the inverter at the altitude of within 1000m. If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.

(7) Vibration, impact

The vibration resistance of the inverter is up to 5.9m/s^2 at 10 to 55Hz frequency. Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors.
Especially when impact is imposed repeatedly, caution must be taken as the part mounting pins are likely to break.
Countermeasures

(a) Provide the enclosure with rubber vibration isolators.

(b) Strengthen the structure to prevent the enclosure from resonance.

(c) Install the enclosure away from sources of vibration.

3.7.2 Heat generated by inverter and related devices

Heat generated by inverter/related devices

Capacity (KW)		Inverter Generated Heat [W]														
		Inverter				Power regeneration converter			High power factor converter				Power factor improving reactor		Sine wave filter	
		FR-A700 *1	FR-F700 *1	FR-E700 *2	FR-D700 *2	FR-RC MT-RC	MT-RCL	FR-CV	FR-HC MT-HC	FR-HCL01 MT-HCL01	FR-HCL02 MT-HCL02	FR-HCB MT-HCB	FR-HEL	FR-HAL	MT-BSL	MT-BSC
3 phase 200V class	0.1			14												
	0.2			20												
	0.4	50		32									6	10		
	0.75	70	60	50									7	14		
	1.5	110	100	80									8	20		
	2.2	140	130	100									11	24		
	3.7	190	190	160									13	33		
	5.5	260	260	290									17	40		
	7.5	360	340	380				220	440	65	154		19	46		
	11	520	530	520				315					23	60		
	15	670	580	600		500		460	860	100	218		26	75		
	18.5	770	810										29	74		
	22	940	940					685					34	82		
	30	1050	1370			1020		810	1750	163	316		38	97		
	37	1270	1320					890					47	120		
	45	1610	1490										47	140		
	55	1880	1950			1790		1080	2700	234	473		52	140		
	75	2530	2500										130	170	276	11
	90	3110	2800										130		288	14
	110		3600										160	280		
3 phase 400V class	0.4	50		40	40								6	16		
	0.75	65	50	55	55								7	23		
	1.5	75	80	90	90								8	30		
	2.2	100	90	100	100								11	43		
	3.7	150	140	180	180								13	46		
	5.5	200	180	240	240								17	52		
	7.5	250	220	300	280			130	440	65	154		19	52		
	11	300	310	400				200					23	60		
	15	400	350	500		500		280	860	100	218		26	60		
	18.5	550	440										29	76		
	22	650	520					365					34	74		
	30	800	710			1020		435	1750	163	316		38	91		
	37	1100	930					590					47	97		
	45	1300	1030										47	140		
	55	1550	1320			1790		880	2700	234	473		52	150		
	75	1900	2000			2250	600		2250	142	602	10	130	180	290	10
	90	2400	2400										130			
	110	2500	2900						3300	193	1230	20	140	200	532	14
	132	3000	3000										140			
	150								4500	259	1344	30			437	
	160	4000	3800			4800	1000						170			
	185	4200	4200										230	400		
	220	5000	5100			6600	1600		6600	312	1772	60	240		688	
	250	5500	5500										270			
	280	6500	6400			8400	2100						300	490	885	
	315	7000	7200										360			
	355	8000	8000										360	530		
	400	9000	8600										450			
	450	10500	10200										450			
	500	11500	11500										470			
	560		13200										500	1080		

*1 Heat generation when: output current is inverter rated current, power supply voltage is 220V(in 200V class)/440V (in 400V class), and carrier frequency is 2kHz.

*2 Heat generation when: output current is inverter rated current, power supply voltage is 220V(in 200V class)/440V (in 400V class), and carrier frequency is 14.5kHz.

Heat generated by other equipment

- Capacitor type filter FR-BIF(-H) : 4W or less
- Common mode filter FR-BLF : 4W or less
- Common mode filter FR-BSF01 : 4W or less
- Surge voltage suppression filter FR-ASF-H
  - : 1.5K 75W
  - : 3.7K 129W
  - : 7.5K 216W
  - : 15K 342W
  - : 22K 450W
  - : 37K 670W
  - : 55K 1010W

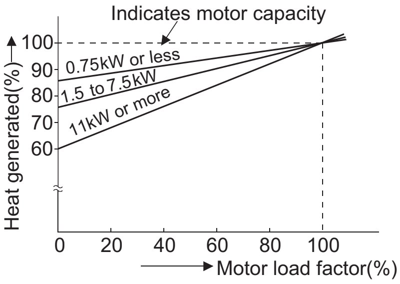
3

SELECTION

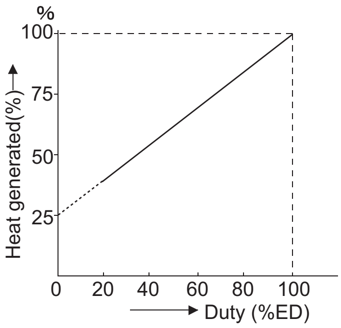
(1) Inverter-generated heat

When the rated output current flows, the inverter generates heat as shown on the preceding page.

1) Reduction according to motor load factor
   At the rated output current, the following figure shows a reduction rate when operating the inverter with a light load.
2) Reduction according to duty
   The ratio of reduction during intermittent operation in a cycle of within five minutes is shown.



Load factor versus heat generated (when motor and inverter have the same rank)



Duty versus heat generated

200V class

Inverter Capacity (kW)		Standby Electricity (W)	
A700	F700	Fan is ON	Fan is OFF
0.4	0.75		9 (without fan)
0.75	1.5		9 (without fan)
1.5	2.2	13	11
2.2	3.7	13	11
3.7	5.5	13	11
5.5	7.5	19	11
7.5	11	19	11
11	15	22	14
15	18.5	25	15
18.5	22	25	15
22	30	27	15

400V class

Inverter Capacity (kW)		Standby Electricity (W)	
A700	F700	Fan is ON	Fan is OFF
0.4	0.75		14 (without fan)
0.75	1.5		14 (without fan)
1.5	2.2		14 (without fan)
2.2	3.7	16	14
3.7	5.5	16	14
5.5	7.5	23	15
7.5	11	23	15
11	15	26	18
15	18.5	26	18
18.5	22	28	18
22	30	28	18

Electricity during standby (at a stop)

(2) Brake unit-generated heat

When a brake unit is used, heat is generated by the brake unit and the brake resistor.

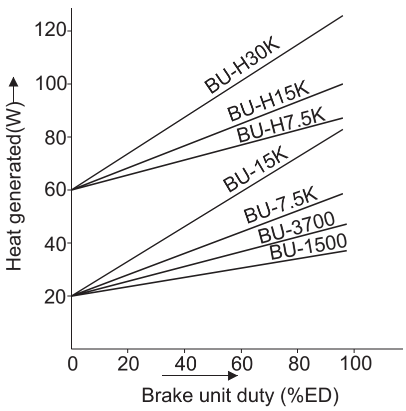
1) Heat generated by the brake unit (excluding that of the brake resistor) is found according to the diagram as shown below.
2) Heat loss of the brake resistor is calculated by the following expression:

$$P[W] = \frac{\sum J \times N^2 \times S}{13700}$$

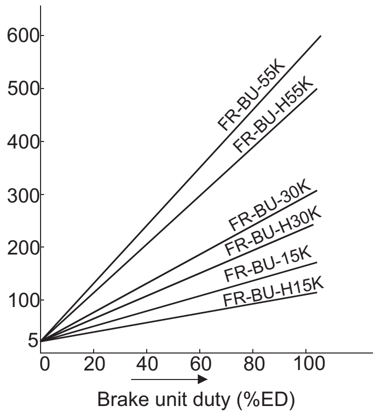
$\sum J$: Overall reflected to motor shaft J_T (including motor J_M) [kg · m^2]

N : Motor speed [r/min]

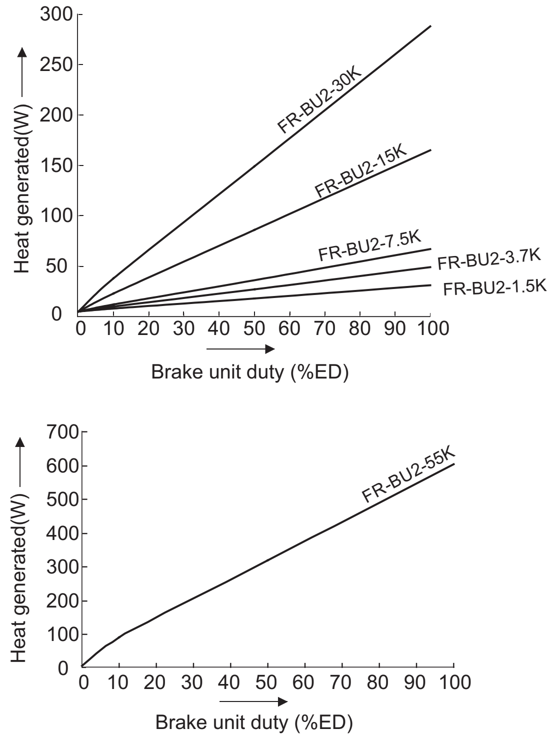
S : Number of deceleration [times/min]



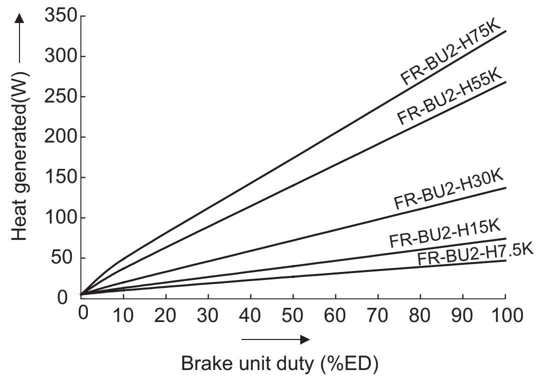
a) BU type



b) FR-BU type



200V class



400V class

c) FR-BU2 type

Brake unit-generated heat

3

SELECTION

3.7.3 Specification of enclosed enclosure

For the inverters, the installation of the semiconductor heat sink and brake resistor outside the enclosure allows heat generated in the enclosure to be greatly reduced to 30% and a compact enclosure to be designed. The following table lists the heat dissipation area and approximate dimensions of the enclosed dust-proof enclosure with respect to the loss (W).

Heat dissipation area of the enclosed dust-proof enclosure (Heat sink outside enclosure) 55kW or less

Inverter Capacity	Enclosed Dust-Proof Type (IP5X)		
	Loss (Rated) (W)	Area required for heat dissipation (m^2)	Approximate box dimensions (mm)
FR-A720-0.4K	Heatsink must not be placed outside		
FR-A720-0.75K			
FR-A720-1.5K	33	0.55	300W × 500H × 250D
FR-A720-2.2K	42	0.7	400W × 500H × 250D
FR-A720-3.7K	57	1.0	500W × 500H × 400D
FR-A720-5.5K	78	1.3	500W × 800H × 400D
FR-A720-7.5K	108	1.8	600W × 800H × 600D
FR-A720-11K	156	2.6	800W × 800H × 600D
FR-A720-15K	201	3.4	800W × 1000H × 600D
FR-A720-18.5K	231	3.9	800W × 1000H × 1000D
FR-A720-22K	282	4.7	800W × 1000H × 1000D
FR-A720-30K	315	5.3	1000W × 1000H × 1000D
FR-A720-37K	381	6.4	1000W × 1500H × 1000D
FR-A720-45K	483	8.1	1500W × 1500H × 1000D
FR-A720-55K	564	9.4	1500W × 1500H × 1000D
FR-A740-0.4K	15	0.3	300W × 500H × 150D
FR-A740-0.75K	20	0.4	300W × 500H × 150D
FR-A740-1.5K	23	0.4	300W × 500H × 150D
FR-A740-2.2K	30	0.5	300W × 500H × 150D
FR-A740-3.7K	45	0.8	400W × 500H × 250D
FR-A740-5.5K	60	1.0	500W × 500H × 400D
FR-A740-7.5K	75	1.3	500W × 800H × 400D
FR-A740-11K	90	1.5	500W × 800H × 400D
FR-A740-15K	120	2.0	500W × 800H × 600D
FR-A740-18.5K	165	2.8	800W × 1000H × 600D
FR-A740-22K	195	3.3	800W × 1000H × 600D
FR-A740-30K	240	4.0	800W × 1000H × 800D
FR-A740-37K	330	5.5	1200W × 1000H × 1000D
FR-A740-45K	390	6.5	1200W × 1000H × 1000D
FR-A740-55K	465	7.8	1200W × 1500H × 1000D

*1 IP5X · · · · · · Type classified by JEM1030 (protective structure of control equipment)

*2 The built-in brake resistor loss is not included.

Heat dissipation area of the enclosed dust-proof enclosure (All units contained in enclosure) 55kW or less

Inverter Capacity	Enclosed Dust-Proof Type (IP5X)		
	Loss (Rated) (W)	Area required for heat dissipation (m^2)	Approximate box dimensions (mm)
FR-A720-0.4K	50	0.9	400W × 600H × 250D
FR-A720-0.75K	70	1.2	550W × 600H × 250D
FR-A720-1.5K	110	1.9	550W × 800H × H400D
FR-A720-2.2K	140	2.4	800W × 800H × 400D
FR-A720-3.7K	190	3.2	900W × 1000H × 600D
FR-A720-5.5K	260	4.4	1200W × 1200H × 600D
FR-A720-7.5K	360	6.0	1400W × 1500H × 600D
FR-A720-11K	520	8.7	2000W × 1500H × 600D
FR-A720-15K	670	11.2	2000W × 1500H × 1000D
FR-A720-18.5K	770	12.9	2000W × 1500H × 1000D
FR-A720-22K	940	15.7	2000W × 2000H × 1000D
FR-A720-30K	1050	17.5	2500W × 2000H × 1000D
FR-A720-37K	1270	21.2	3000W × 2000H × 1000D
FR-A720-45K	1610	26.9	4000W × 2000H × 1200D
FR-A720-55K	1880	31.4	5500W × 2000H × 1200D
FR-A740-0.4K	50	0.84	350W × 600H × 250D
FR-A740-0.75K	65	1.1	550W × 600H × 250D
FR-A740-1.5K	75	1.3	550W × 800H × 400D
FR-A740-2.2K	100	1.7	550W × 800H × 400D
FR-A740-3.7K	150	2.5	800W × 800H × 400D
FR-A740-5.5K	200	3.4	900W × 1000H × 600D
FR-A740-7.5K	250	4.2	1200W × 1000H × 600D
FR-A740-11K	300	5.0	1200W × 1500H × 600D
FR-A740-15K	400	6.7	1200W × 1500H × 600D
FR-A740-18.5K	550	9.2	1800W × 1500H × 1000D
FR-A740-22K	650	10.9	1800W × 1500H × 1000D
FR-A740-30K	800	13.4	1800W × 2000H × 1000D
FR-A740-37K	1100	18.4	3000W × 2000H × 1000D
FR-A740-45K	1300	21.7	3000W × 2000H × 1000D
FR-A740-55K	1550	25.9	3500W × 2000H × 1200D

*3 The values in the above table depend on the operating conditions and surrounding air temperature. (Heat generated by other equipment has not been taken into consideration)

*4 The values in the above table indicate areas effective for heat dissipation.

*5 When the heat sink is installed outside the enclosure, the loss indicates the heat generated by the inverter unit in the enclosure.

3.7.4 Cooling of inverter enclosure

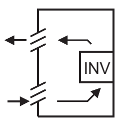
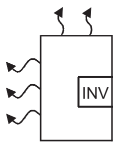
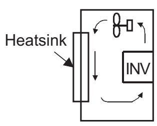
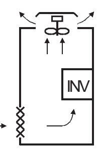
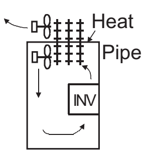
(1) Cooling method

The enclosure housing the inverter must efficiently dissipate heat generated by the inverter and other devices (transformer, lamps, resistors etc.) and heat entering from the outside, e.g. direct sunlight, to keep the temperature inside the enclosure less than the permissible temperature of the equipment in the panel including the inverter.

The cooling systems are classified as follows in terms of the cooling calculation method.

1) Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)
2) Cooling by heatsink (aluminum heatsink, etc.)
3) Cooling by ventilation (forced ventilation type, pipe ventilation type)
4) Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

Cooling system method for inverter enclosure

	Cooling Method	Enclosure Structure	Comment
Natural cooling	Natural ventilation (Enclosed, open type)		Low in cost and generally used, but the enclosure size increases as the inverter capacity increases. For relatively small capacities.
	Natural ventilation (Totally enclosed type)		Being a totally enclosed type, the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the inverter capacity.
Forced cooling	Heatsink cooling		Having restrictions on the heatsink mounting position and area, and designed for relative small capacities.
	Forced ventilation		For general indoor installation. Appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe		Totally enclosed type for enclosure downsizing.

(2) Cooling effect calculation

1) Calculation of heat dissipation energy by natural heat dissipation from enclosure surface:

$W1 = K1 \cdot A \cdot \triangle t$

W1 : Heat dissipation energy per second [W]
A : Effective heat dissipation are [m^2]
$\triangle t$: Temperature difference between inside and outside the enclosure [℃]
K1 : 6 [$W/m^2 \cdot$ ℃]

(a) The effective heat dissipation area does not include constructions, such as a floor and walls, and any surface proximate to the other enclosures.
It does not include the installation areas of vents, heatsinks and heat exchange either.
(b) The temperature in the enclosure should be kept constant by an agitating fan.
(c) Constant K1 is indicated as a reference value because it depends on the enclosure structure, parts layout in the enclosure, and ambient temperature.

2) Calculation of heat dissipation energy from heatsink:

$W2 = N \cdot K2 \cdot \triangle t$

W2 : Heat dissipation energy per second [W]
N : Number of heat sink units [pieces]
$\triangle t$:Temperature difference between inside and outside the enclosure [℃]
K2 :Heat dissipation capability of one heatsink unit [W/℃]

3) Calculation of heat dissipation energy by ventilation:

$$W3 = K3 \cdot \frac{Q}{60} \cdot \triangle t$$

W3 : Heat dissipation energy per second [W]
Q : Air flow [m^3/min]
$\triangle t$: Temperature difference between inside and outside the enclosure [℃]
K3 : 1160 [$J/m^3 \cdot$ ℃]

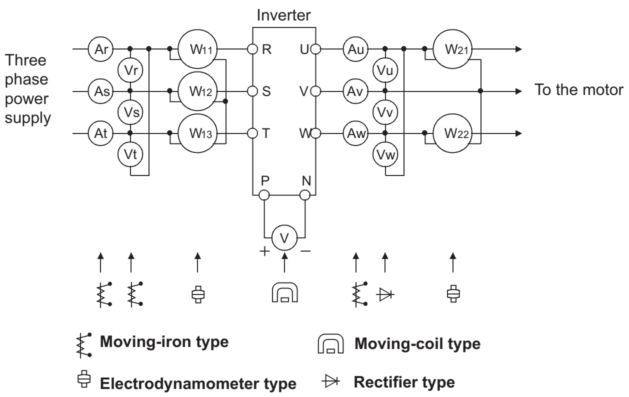
4) Calculation of heat dissipation energy by heat exchange or cooler:

$W4 = K4 \cdot H$

W4 : Heat dissipation energy per second [W]
H : Cooling capability [kcal/h]
K4 : 1.16[Wh/kcal]

3.8 Meters and measurement methods

Since voltages and currents in the primary and secondary side of the inverter include harmonics, different meters indicate different measurement values. When making measurement with the meters designed for commercial frequency, use the following measuring instruments and circuits:



Examples of measuring points and instruments

★ When installing meters etc. on the inverter output side
When the inverter-to-motor wiring length is long, especially in the 400V class, small-capacity models, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating.
When measuring and indicating the output voltage and output current of the inverter, it is recommended to utilize the AM-5 and FM-SD terminal output function of the inverter.

3.8.1 Measurement of powers

Use a digital power meter (designed for inverter) on both the input and output sides of the inverter.

3.8.2 Measurement of voltages and use of PT

(1) Inverter input side

As the input side voltage has a sine wave and it is extremely small in distortion, accurate measurement can be made with an ordinary AC meter.

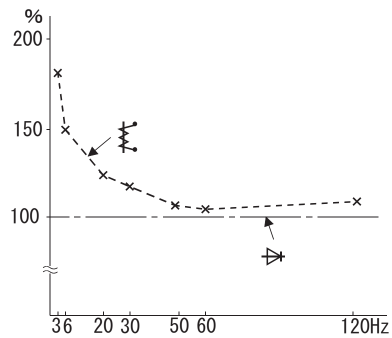
(2) Inverter output side

Since the output side voltage has a PWM-controlled rectangular wave, always use a rectifier type voltmeter. A needle type tester can not be used to measure the output side voltage as it indicates a value much greater than the actual value. A moving iron type meter indicates an effective value which includes harmonics and therefore the value is larger than that of the fundamental wave. The value monitored on the operation panel (parameter unit) is the inverter-controlled voltage itself. Hence, that value is accurate and it is recommended to monitor values (or analog output) using the operation panel (parameter unit). An example of the measurement value difference produced by different measuring meters is shown on the right.

(3) PT

No PT can be used in the output side of the inverter. Use a direct-reading meter. (A PT can be used on the input side of the inverter.)

[Measurement conditions]
Motor 3.7kW 4-pole + inverter 3.7K
Value indicated by rectifier type voltmeter is 100%.

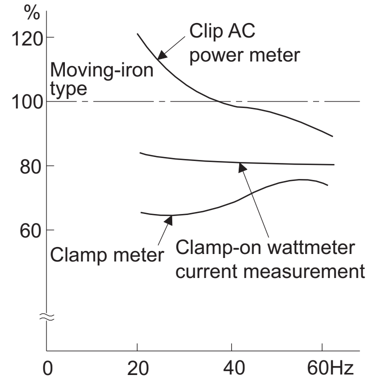


Example of measuring inverter output voltage

3.8.3 Measurement of currents

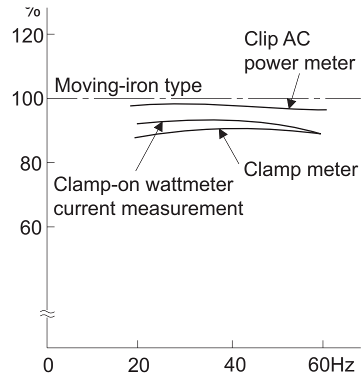
Use a moving-iron type meter on both the input and output sides of the inverter. However, if the carrier frequency exceeds 5kHz, do not use that meter since an overcurrent loss produced in the internal metal parts of the meter will increase and the meter may burn out. In this case, use an approximate-effective value type.
Since current on the inverter input side tends to be unbalanced (refer to page 507), measurement of three phases is recommended. Correct value can not be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output side current should be within 10%.
When a clamp ammeter is used, always use an effective value detection type. A mean value detection type produces a large error and may indicate an extremely smaller value than the actual value. The value monitored on the operation panel (parameter unit) is accurate if the output frequency varies, and it is recommended to monitor values (provide analog output) using the operation panel (parameter unit).
An example of the measurement value difference produced by different measuring meters is shown on the right.

[Measurement conditions]
The reading of the moving-iron type ammeter is 100%.



Example of measuring inverter input current

[Measurement conditions]
Value indicated by moving-iron type ammeter is 100%.



Example of measuring inverter output current

3.8.4 Use of CT and transducer

A CT may be used in both the input and output sides of the inverter, but the one used should have the largest possible VA ability because an error will increase if the frequency gets lower.

When using a transducer, use the effective value calculation type which is immune to harmonics.

3.8.5 Measurement of inverter input power factor

Use the effective power and apparent power to calculate the inverter input power factor (refer to page 505). A power-factor meter can not indicate an exact value.

3.8.6 Measurement of converter output voltage (across terminals P-N)

The output voltage of the converter is developed across terminals P-N and can be measured with a moving-coil type meter (tester). Varying with the power supply voltage, the converter output voltage is approximately 270 to 300V (approximately 540 to 600V for the 400V class) under no load and lowers under load.
When regenerative energy is returned from the motor during deceleration, for example, the converter output voltage rises to nearly 400V (800V for the 400V class) maximum. (When the converter output voltage reaches approximately 400V for the 200V class or approximately 800V for the 400V class, the inverter results in OVT shut-off)

3.8.7 Measurement of inverter output frequency

A pulse train proportional to the output frequency is output across the frequency meter signal output terminal FM-SD of the inverter. This pulse train output can be counted by a frequency counter, or a meter (moving-coil type voltmeter) can be used to read the mean value of the pulse train output voltage. When a meter is used to measure the output frequency, approximately 5VDC is indicated at the maximum frequency.
For detailed specifications of the frequency meter signal output terminal FM, refer to page 78.

3.9 Compliance with standards

The standard models of inverters comply with the UL Standard, cUL Standard and EN Standard.

3.9.1 Compliance with the UL and CSA standards

(conforming standard UL 508C, LSA C22.2 No.14)

About the UL and cUL compliance (common)

The UL (Underwriters Laboratories Inc.) Standard is a safety standard in the U.S.A. UL is a non-profit testing institution established by the U.S. Fire Underwriters' Association and conducts approval tests on industrial products. UL has strictly prescribed the safety standard in an extremely wide range, assuming every possible situation during use of products. The UL mark has extremely high authority and reliability and is mandated by the state laws and city ordinances in many U.S. states.
Canada has a similar standard, the CSA Standard. The standard equivalent to Canada's CSA Standard has been stipulated by the U.S.A. as the cUL Standard, and products approved by this Standard are regarded as approved by the CSA Standard.
Refer to the instruction manual for information on UL and cUL.

C UL US LISTED

cULus mark

[Example] (A700)

(1) Installation

This inverter is UL-listed as a product for use in an enclosure. Design an enclosure so that the inverter surrounding air temperature, humidity and atmosphere satisfy the specifications.

Wiring protection

For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable provincial codes.

For installation in Canada, branch circuit protection must be provided in accordance with the Canada Electrical Code and any applicable provincial codes.
Provide the appropriate UL and cUL listed Class RK5, Class T or Class L type fuse or UL489 molded case circuit breaker (MCCB) that is suitable for branch circuit protection in accordance with the table below.

FR-A720-□□K		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Rated fuse voltage(V)		240V or more														
Fuse maximum allowable rating (A)*	Without power factor improving reactor	15	20	30	40	60	80	150	175	200	225	300	350	400	500	500
	With power factor improving reactor	15	20	20	30	50	70	125	150	200	200	250	300	350	400	500
Molded case circuit breaker (MCCB) Maximum allowable rating (A)*		15	15	20	25	40	60	80	110	150	175	225	250	350	400	500

FR-A720-□□K		75	90
Rated fuse voltage(V)		240V or more	
Fuse maximum allowable rating (A)*	Without power factor improving reactor	—	—
	With power factor improving reactor	600	700
Molded case circuit breaker (MCCB) Maximum allowable rating (A)*		700	800

FR-A740-□□K		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Rated fuse voltage(V)		480V or more														
Fuse maximum allowable rating (A)*	Without power factor improving reactor	6	10	15	20	30	40	70	80	90	110	150	175	200	250	300
	With power factor improving reactor	6	10	10	15	25	35	60	70	90	100	125	150	175	200	250
Molded case circuit breaker (MCCB) Maximum allowable rating (A)*		15	15	15	15	20	30	40	50	70	90	100	125	150	200	250

FR-A740-□□K		75	90	110	132	160	185	220	250	280	315	355	400	450	500
Rated fuse voltage(V)		500V or more													
Fuse maximum allowable rating (A)*	Without power factor improving reactor	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	With power factor improving reactor	300	350	400	500	600	700	800	900	1000	1100	1200	1350	1500	1800
Molded case circuit breaker (MCCB) Maximum allowable rating (A)*		350	450	500	600	800	800	1000	1200	1200	1200	1600	1600	2000	2000

* Maximum allowable rating by US National Electrical Code. Exact size must be chosen for each installation.

(2) Wiring of the power supply and motor

For wiring the input (R/L1, S/L2, T/L3) and output (U, V, W) terminals of the inverter, use the UL-listed copper wires (rated at 75℃) and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

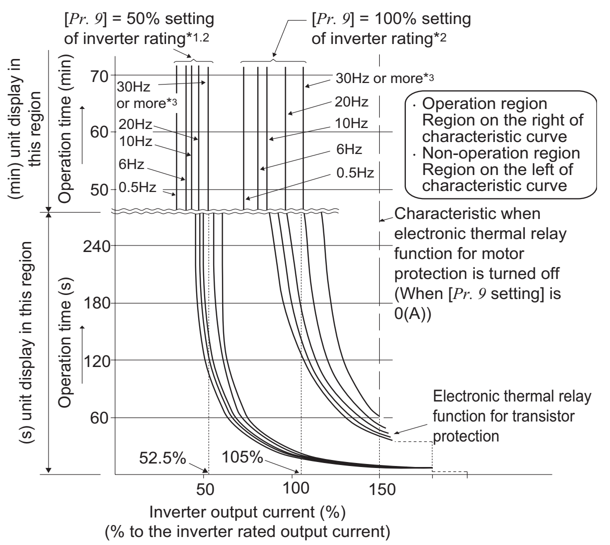
(3) Short circuit ratings

- 200V class
  Suitable for use in a circuit capable of delivering not more than 100kA rms symmetrical amperes maximum, 264 Volts Maximum.
- 400V class
  55K or less
  Suitable for use in a circuit capable of delivering not more than 100kA rms symmetrical amperes maximum, 528 Volts Maximum.
  75K or more
  Suitable for use in a circuit capable of delivering not more than 100kA rms symmetrical amperes maximum, 550 Volts Maximum.

(4) Motor overload protection

This inverter is certified as a motor overload protection device by UL. When using the electronic thermal relay function as motor overload protection, set the rated motor current to [*Pr. 9 Electronic thermal O/L relay*].

Electronic thermal relay function operation characteristic



This function detects the overload (overheat) of the motor and trips. (The operation characteristic is shown above)

- When using a Mitsubishi constant-torque motor

1) Set any of 1, 13 to 18, 50, 53, or 54 in [*Pr. 71*].
   (This provides a 100% continuous torque characteristic in the low-speed range.)
2) Set the rated current of the motor in [*Pr. 9*].

*1 When a value 50% of the inverter rated output current (current value) is set in [*Pr. 9*]
*2 The % value denotes the percentage to the inverter rated output current. It is not the percentage to the rated motor current.
*3 When you set the electronic thermal O/L relay dedicated to the Mitsubishi constant-torque motor, this characteristic curve applies to operation at 6Hz or higher.

Instructions

- Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power OFF.
- When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal function. Install an external thermal relay to each motor.
- When a difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Electronic thermal relay may not function when 5% or less of inverter rated current is set to electronic thermal relay setting.

3.9.2 Compliance with the EU Directives

About the EU Directives

As a part of European integration, common rules for free transfer and commercial activities of people/goods/service within the EU member states are being formed. As one way of this rule making, the EC Committee has compiled 13 directives as the technological uniform standards on health and safety, and each country is legislating in accordance with these directives. Products covered by these directives are obliged to carry the CE mark, and the permission of export to and free movements and sales in the European district is only given to products carrying the CE mark. The following three directives are concerned with drive products:

(1) Machinery Directive

Stipulates the safety of machinery, and fundamentally requires that any machine should not threaten the health and safety of living creatures and the safety of things when it is installed and maintained correctly and operated properly. Since inverters are components designed to control machines/ apparatuses, we understand that inverters are not covered by this directive directly.

(2) EMC Directive A700 F700

We have self-confirmed A700 F700 as products compliant to the EMC Directive (second environment of conforming standard EN61800-3) and place the CE mark on the inverters.

*1 First environment
Environment including residential buildings. Includes buildings directly connected without a transformer to the low voltage power supply network which supplies power to residential buildings.

*2 Second environment
Environment including all buildings except buildings directly connected without a transformer to the low voltage power supply network which supplies power to residential buildings.

Instructions

Set the EMC filter valid and install the inverter and perform wiring according to the following instructions.

- The inverter is equipped with a built-in EMC filter. Set the EMC filter valid. (The filter is invalid when shipped from the factory. (A700 200V class 0.4K, 0.75K and F700 200V class 0.75K and 1.5K are always valid.))
- Connect the inverter to an earthed power supply.
- Install a motor and a control cable written in the EMC Installation Manual (BCN-A21041-204) according to the instruction.
- The cable length between the inverter and the motor is 5m maximum.
- Confirm that the inverter complies with the EMC Directive as the industrial drives application for final installation.

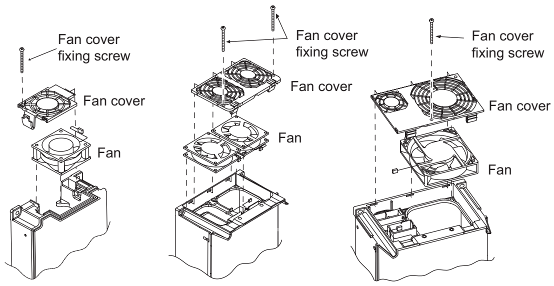
(3) Low Voltage Directive (common)

We have self-confirmed our inverters as products compliant to the Low Voltage Directive (Conforming standard EN 50178 for (A700) (F700) (E700), EN61800-5-1 for (D700)) and place the CE mark on the inverters.

Outline of instructions

- Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth securely.
- Wire the earth (ground) terminal independently. (Do not connect two or more cables to one terminal.)
- Use the cable sizes of earth cable and main circuit under the following conditions.
  - Ambient temperature : 40 ℃ maximum
    If conditions are different from above, select appropriate wire according to EN60204 ANNEX C TABLE 5.
- Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.
  For use as a product compliant with the Low Voltage Directive, use the recommended PVC cable .
- Use the moulded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard. Design notice : Where residual-current-operated protective device (RCD) is used for protection in case of direct or indirect contact, only RCD of Type B is allowed on the supply side of this Electronic Equipment (EE). Otherwise another protective measure shall be applied such as separation of the EE from the environment by double or reinforced insulation or isolation of EE and supply system by a transformer. (Extract from EN51078)
- When using an earth leakage current breaker, use a residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). If not, provide double or reinforced insulation between the inverter and other equipment, or put a transformer between the main power supply and inverter.
- Use the inverter under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earthed-neutral system power supply 400V class only) and pollution degree 2 or lower specified in IEC664.
- To use the inverter of (A700) 30K or more or (F700) 37K or more (IP00) under the conditions of pollution degree 2, install it in the enclosure of IP2X or higher.
- To use the inverter under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
- To use the inverter of (A700) 22K or less, (F700) 30K or less, or (E700) (D700) (IP20) outside of an enclosure in the environment of pollution degree 2, fix a fan cover with fan cover fixing screws enclosed.

[Example] (A700)



- On the input and output of the inverter, use cables of the type and size set forth in EN60204 Appendix C.
- The operating capacity of the relay outputs (terminal symbols A1, B1, C1, A2, B2, C2) should be 30VDC, 0.3A. (Relay outputs are basically isolated from the inverter internal circuit.)
- Control circuit terminals are safely isolated from the main circuit.
- Environment

	Running	In Storage	During Transportation
Ambient Temperature	-10℃ to +50℃	-20℃ to +65℃	-20℃ to +65℃
Humidity	90% RH or less	90% RH or less	90% RH or less
Maximum altitude	1000m	1000m	10000m

Details are given in the "Low Voltage Directive Conformance Guide" (BCN-A21041-203). Please contact your sales representative.

CE mark

3

SELECTION

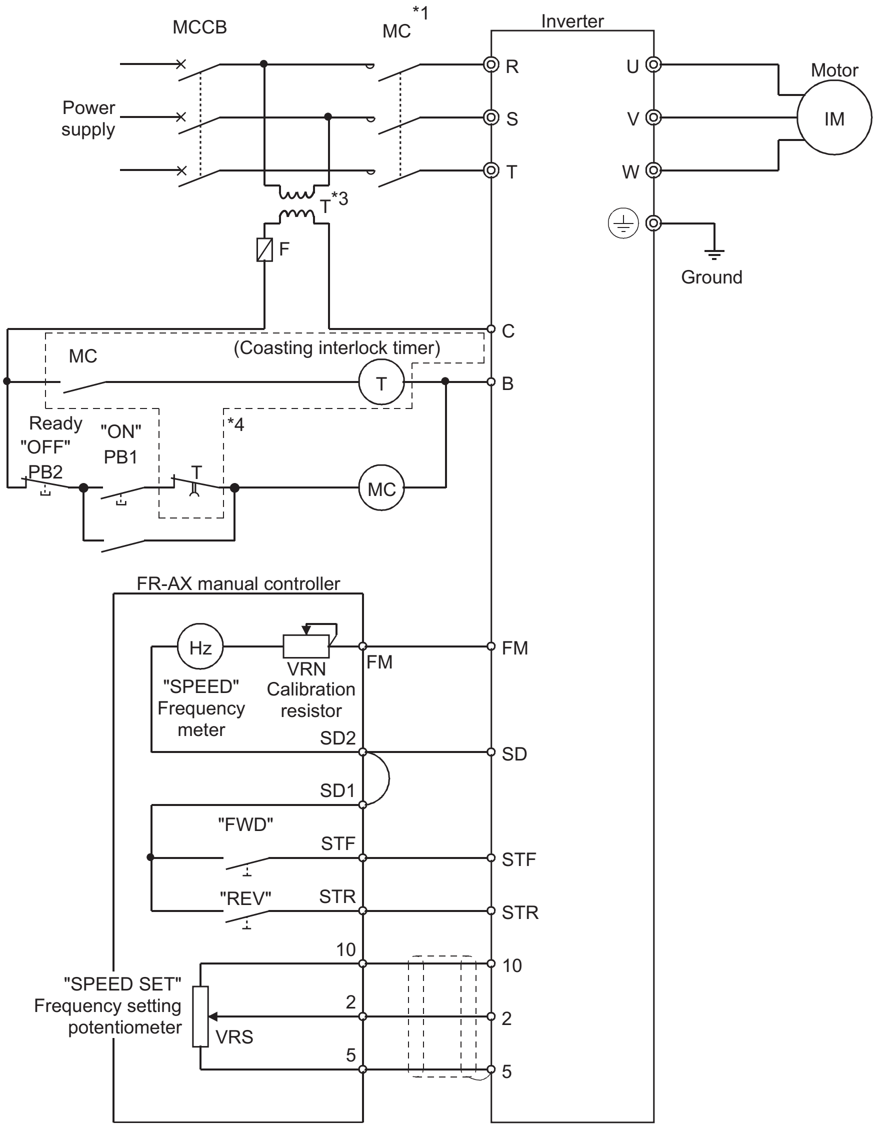
MEMO

4 PRACTICAL CIRCUITS

4.1 Standard connection diagram (common)

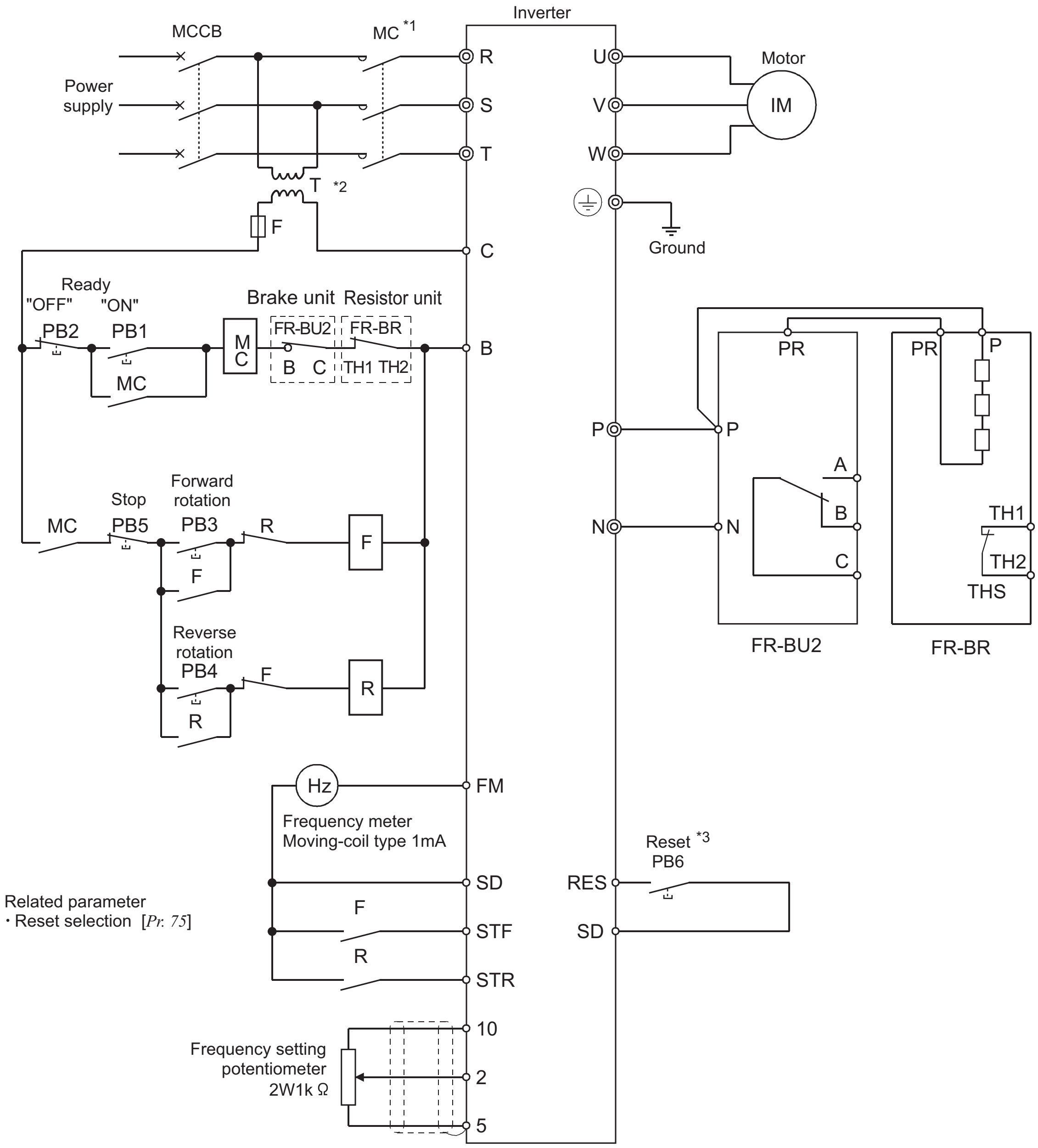
The circuit diagram shown in this chapter are reference circuit diagrams used to activate functions.
When designing actual circuits, examine the operations of the machine and system and the rating, safety interlocks and other devices such as the contactors, relays and other equipment.

4.1.1 The inverter equipped with magnetic contactor on primary side (FR-AX manual controller used) (common)



*1 This magnetic contactor is provided to prevent an automatic restart when power is restored after a power failure. Use the start signal (ON or OFF of STF, STR) to make a start or stop.
*2 The inverter stops when both terminals STF and STR are closed simultaneously.
*3 When the power supply is 400V class, install a step-down transformer.
*4 When the motor shaft inertia is small, for example, this circuit may be omitted by utilizing the current limit function of the inverter.

4.1.2 The inverter equipped with magnetic contactor on primary side (with FR-BU2 type brake unit) (common)



*1 This magnetic contactor is provided to prevent an automatic restart when power is restored after a power failure. Use the start signal (ON or OFF of STF, STR) to make a start or stop.

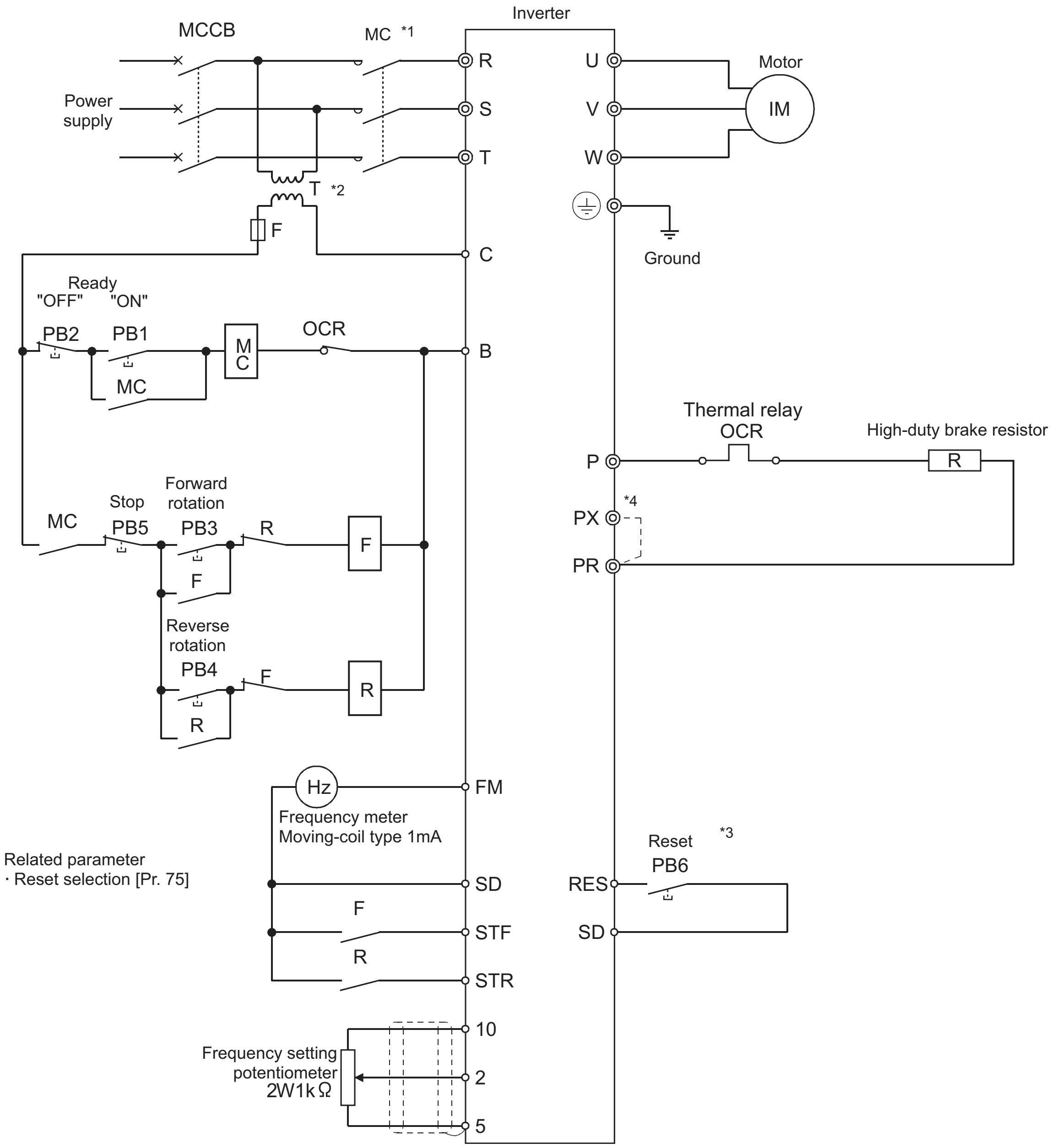
*2 When the power supply is 400V class, install a step-down transformer.

*3 Set [*Pr. 75* = 1] "Reset input is enabled only when the fault occurs" to disable resetting of the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is to prevent the inverter from resulting in a fault if the motor is still coasting when the inverter has returned from the reset status.)

4.1.3 The inverter equipped with magnetic contactor on primary side (with high-duty brake resistor) (A700) (E700) (D700)

(A700) 22K or less

(E700) (D700) 0.4K to 15K



*1 This magnetic contactor is provided to prevent an automatic restart when power is restored after a power failure. Use the start signal (ON or OFF of STF, STR) to make a start or stop.

*2 When the power supply is 400V class, install a step-down transformer.

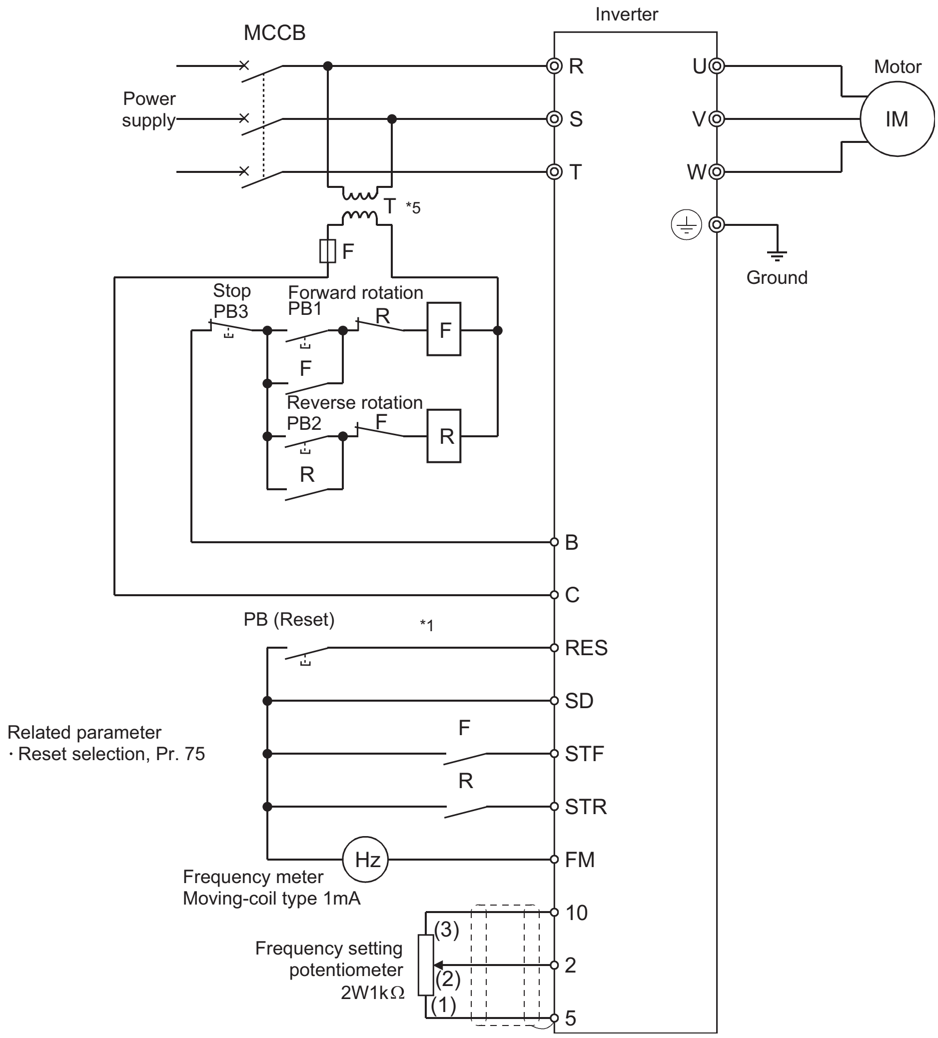
*3 Set [*Pr. 75* = 1] "Reset input is enabled only when the fault occurs" to disable resetting of the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is to prevent the inverter from resulting in an alarm if the motor is still coasting when the inverter has returned from the reset status.)

*4 When using an external brake resistor or brake unit, remove the jumper from across PR-PX.

((A700) 7.5K or less only. Not available for (E700) (D700) .

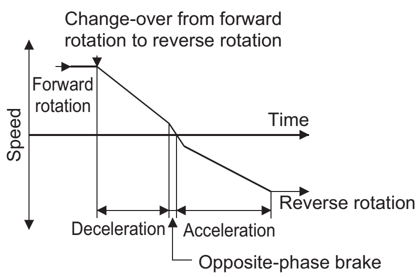
Do not use PR and PX terminals for the (F700) . Do not remove the jumper connected to terminal PR and PX.)

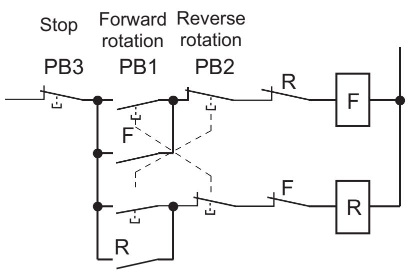
4.1.4 The inverter without magnetic contactor on the primary side (common)



*1 Set [*Pr. 75* = 1] "Reset input is enabled only when the fault occurs" to disable resetting of the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is to prevent the inverter from resulting in an alarm if the motor is still coasting when the inverter has returned from the reset status.)

*2 During operation, switch-over from "forward rotation" to "stop", then to "reverse rotation" is available.
In this case, when the reverse rotation signal is turned ON, the regenerative brake is applied down to the forward rotation frequency of 0.5Hz, the opposite-phase brake is applied at or less than starting frequency and acceleration in reverse rotation is started at that frequency. (DC injection brake is not applied.)





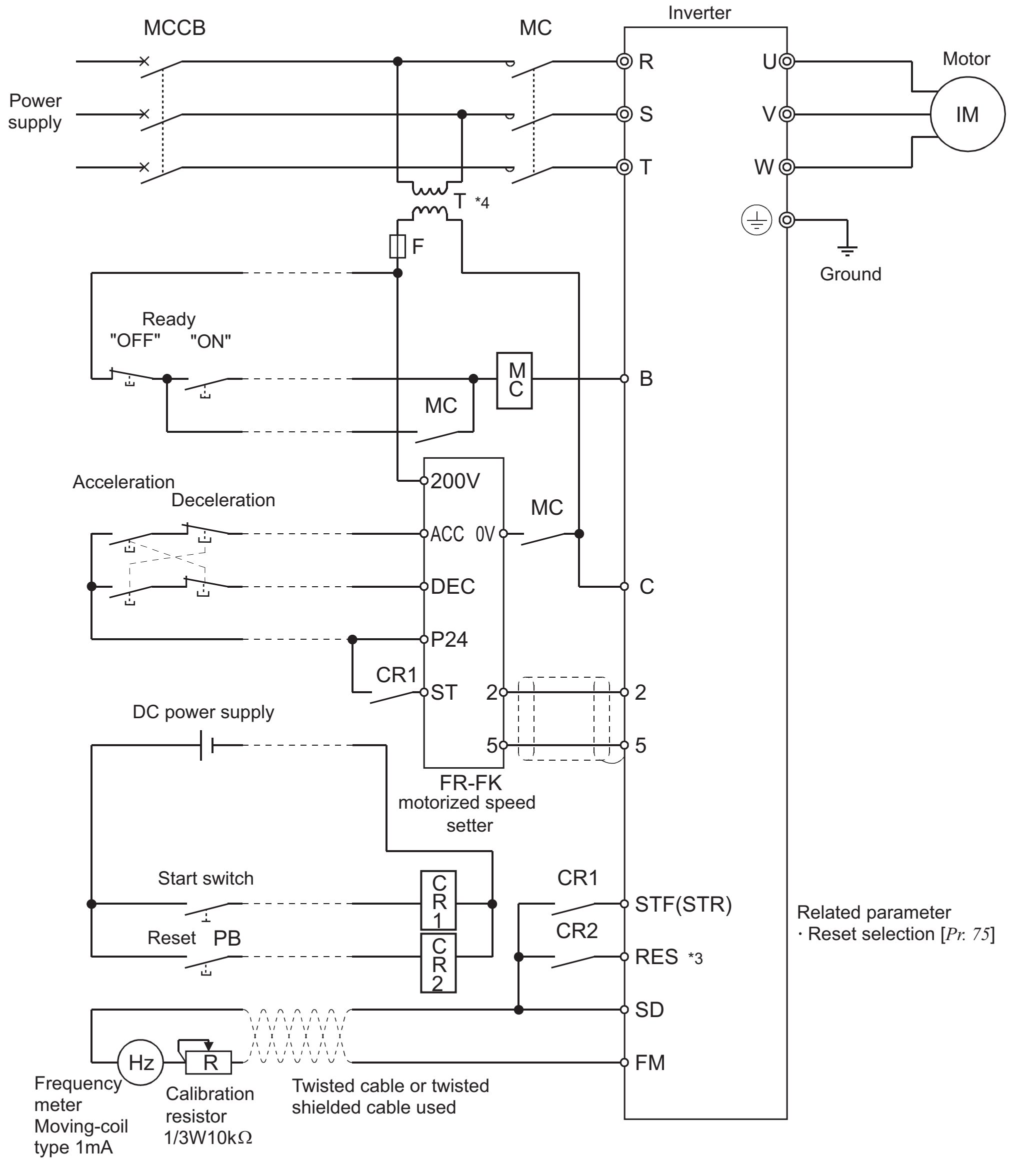
*3 When making "forward rotation" to "reverse rotation" change-over during forward rotation in the above chart, change part of the connection diagram as shown on the above.

*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent the discharging resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharging resistor, and excessive regenerative brake duty, etc.

*5 When the power supply is 400V class, install a step-down transformer.

4.2 Remote operation (common)

4.2.1 Use of the FR-FK motorized speed setter (common)



*1 Separate the signal cable from the power cable. Not doing so can cause the signal line to act as an antenna and be affected more easily by external noise.

*2 The frequency meter connection cable may be increased up to 200m in length. (Install the calibration resistor near the frequency meter.)

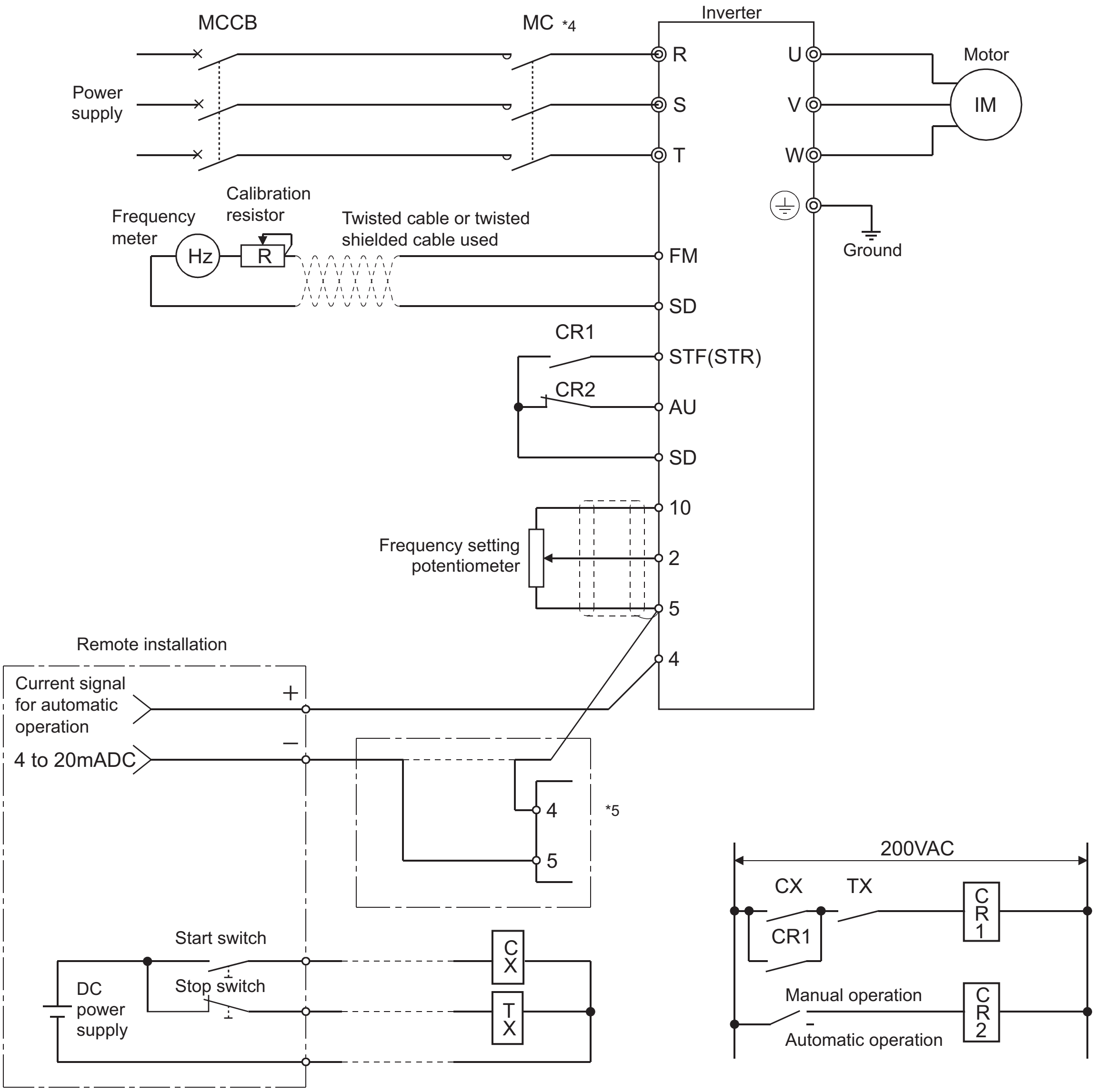
*3 Set [*Pr. 75 = 1*] "Reset input is enabled only when the fault occurs" to disable resetting of the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is to prevent the inverter from resulting in an alarm if the motor is still coasting when the inverter has returned from the reset status.)

*4 When the power supply is 400V class, install a step-down transformer.

*5 When the electric channel length between the inverter and motor is long:

1) As the output voltage of the inverter includes high frequency, continuous leakage current due to the to-ground capacitances in the inverter-to-motor electric channel increases and the earth leakage circuit breaker or earth leakage relay may operate unnecessarily.
   Wire the cables between the inverter and motor over the shortest distance and increase the electric channel-to-ground distance.
2) At a low frequency, the motor torque may decrease due to a voltage drop in the cables. (Refer to page 530)

4.2.2 Automatic operation using 4 to 20mADC current signal (common)



*1 Separate the signal cable from the power cable. Not doing so can cause the signal line to act as an antenna and be affected more easily by external noise.

*2 The frequency meter connection cable may be increased up to 200m in length. (Install the calibration resistor near the frequency meter.)

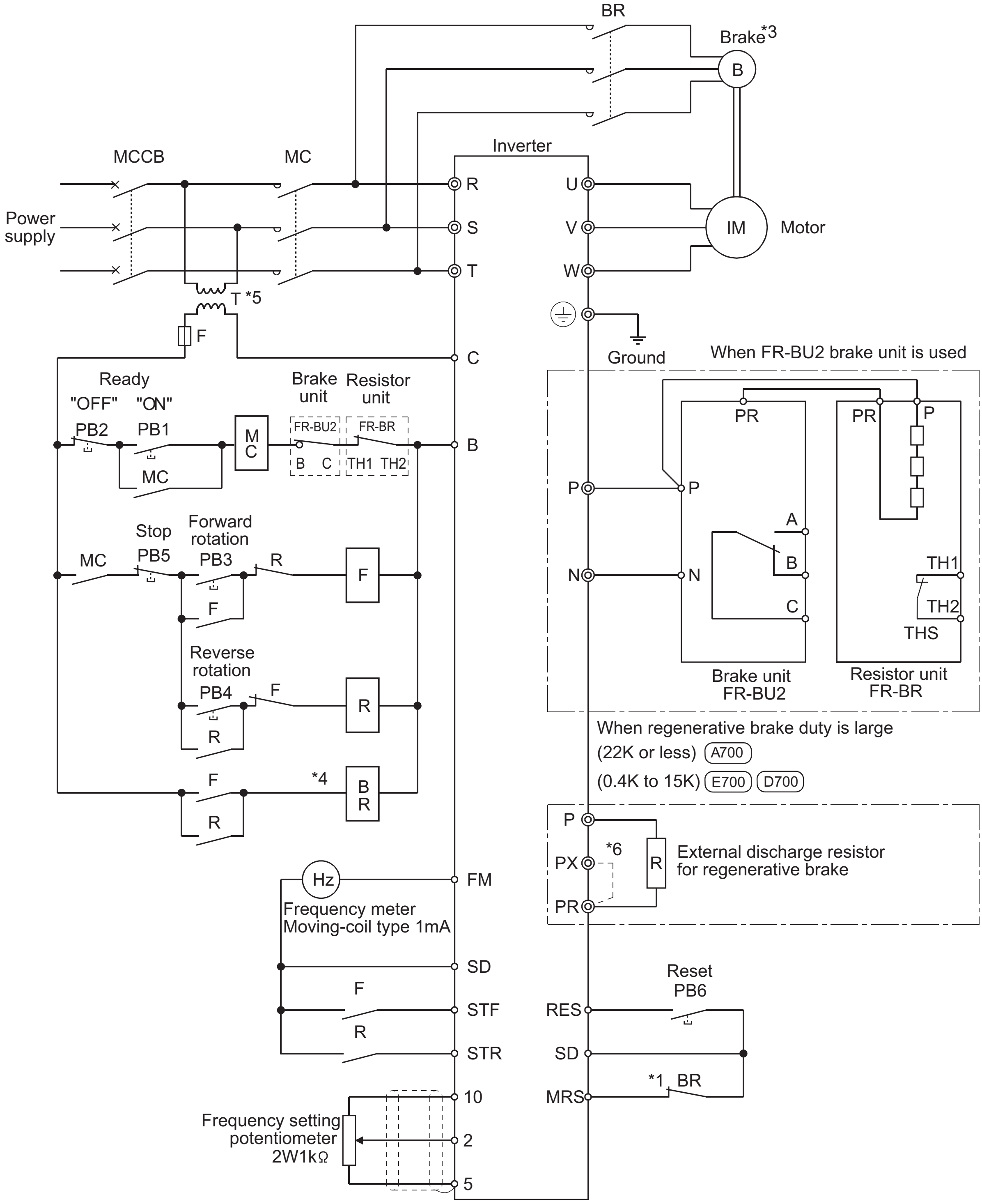
*3 When the electric channel length between the inverter and motor is long:

1) As the output voltage of the inverter includes high frequency, continuous leakage current due to the to-ground capacitances in the inverter-to-motor electric channel increases and the earth leakage circuit breaker or earth leakage relay may operate unnecessarily.
   Wire the cables between the inverter and motor over the shortest distance and increase the electric channel-to-ground distance.
2) At a low frequency, the motor torque may decrease due to a voltage drop in the cables. (Refer to page 530)

*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent discharging resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharging resistor, and excessive regenerative brake duty, etc.

*5 When running two inverters with a 4 to 20mADC current signal at the same time, connect terminals 4-5 in series. Note the power supply capacity of the 4 to 20mADC signal.

4.3 Motor equipped with brake (common)



*1 When stopping the motor equipped with electromagnetic brake, use the output stop terminal signal(MRS) of the inverter. A failure to do so causes a lock current to flow in the motor when the brake is applied, and OCT may occur.

*2 The above caution must also be taken when using any other mechanical brake.

*3 When the motor equipped with a brake is run at or less than 30Hz continuously, the brake disc may rattle but the motor may be used without any problem if it is run at low speed for a short period, for example. in orientation. Also, as there is a limit to the braking capacity, run the motor at no more than 60Hz.

*4 <u>In this circuit, pressing the stop button stops the motor with the electromagnetic brake.</u> For operation of the electromagnetic brake after the motor is decelerated by the inverter, refer to page 576.

*5 When the power supply is 400V class, install a step-down transformer.

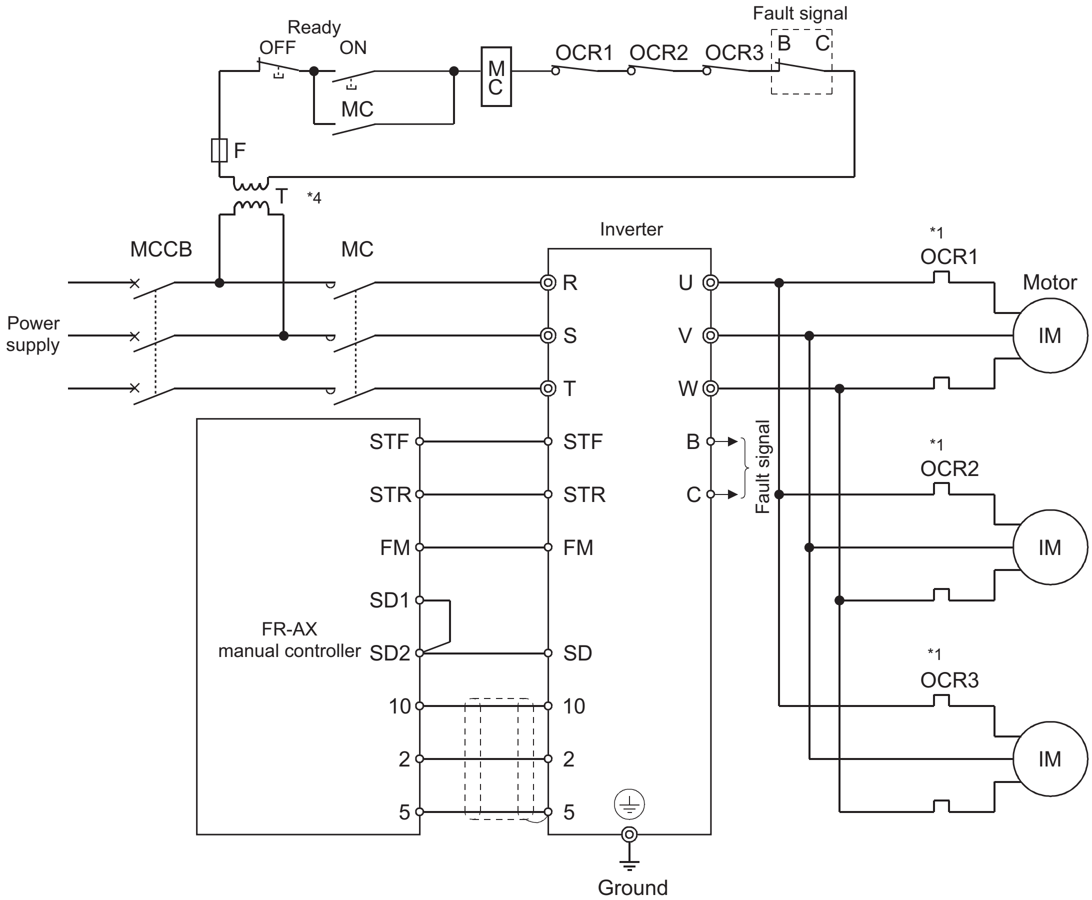
*6 When using an external brake resistor or brake unit, remove the jumper from across PR-PX.

(A700 7.5K or less only. Not available for E700 D700 .

Do not use PR and PX terminals for the F700 . Do not remove the jumper connected to terminal PR and PX.)

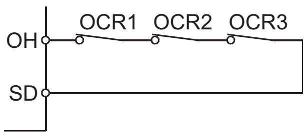
4.4 Parallel motor operation (common)

4.4.1 Motors driven by one inverter (common)



*1 The electronic thermal relay built into the inverter cannot be used. Use an external thermal relay with each motor.
Note that when the capacity is small and the wiring length is large (50m or more), line-to-line leakage currents may operate the thermal relay. Refer to page 524 and take adequate actions.
Set 0 (A) in the electronic thermal relay parameter to switch off the electronic thermal relay.

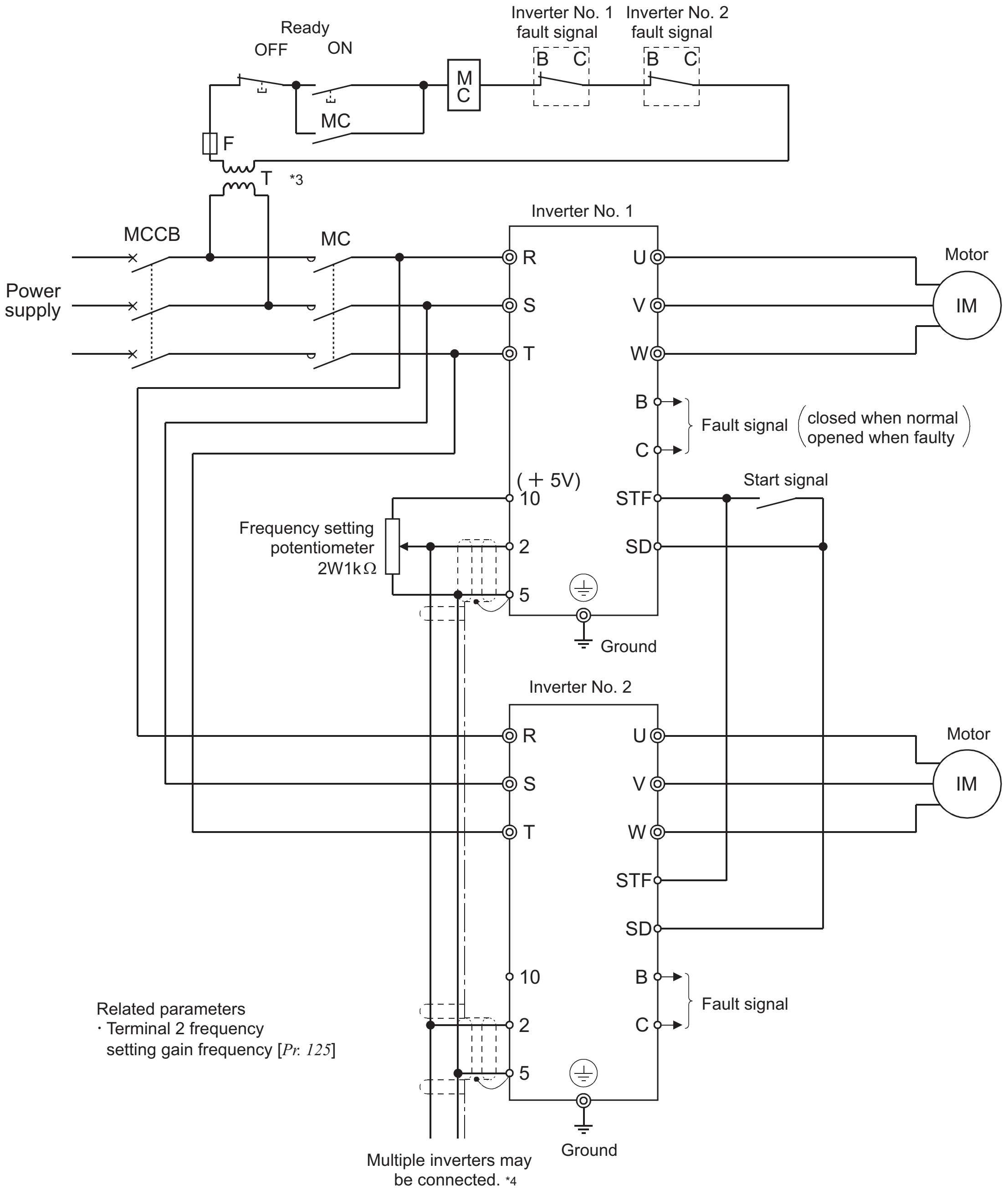
*2 How to stop the inverter without switching off the magnetic contactor (MC) when the external thermal relay is actuated:
Use the external thermal input terminal (OH) to cause the inverter to stop the output. (Refer to page 50 for details)



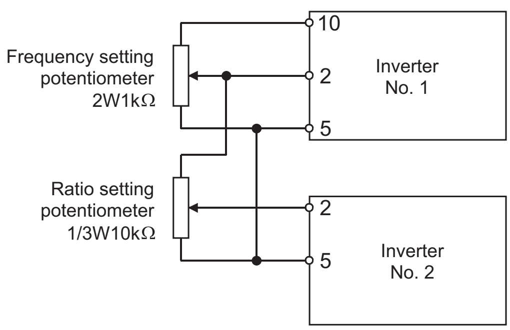
*3 Motor selection
No problem will arise when a specific motor is connected or selected while all motors are at a stop. However, if any of the motors during a stop is direct-on line started by the contactor etc. during inverter operation, the current limit function of the inverter may be activated by the starting current of that motor, leading to a sudden change of the output frequency. In this case, it is recommended to increase the inverter capacity.

*4 Provide a step-down transformer when the power supply is 400V class.

4.4.2 Inverters and motors are in pairs (common)



[Ratio control operation]



The ratio setting potentiometer may be omitted by setting the frequency setting gain/bias function of the inverter.

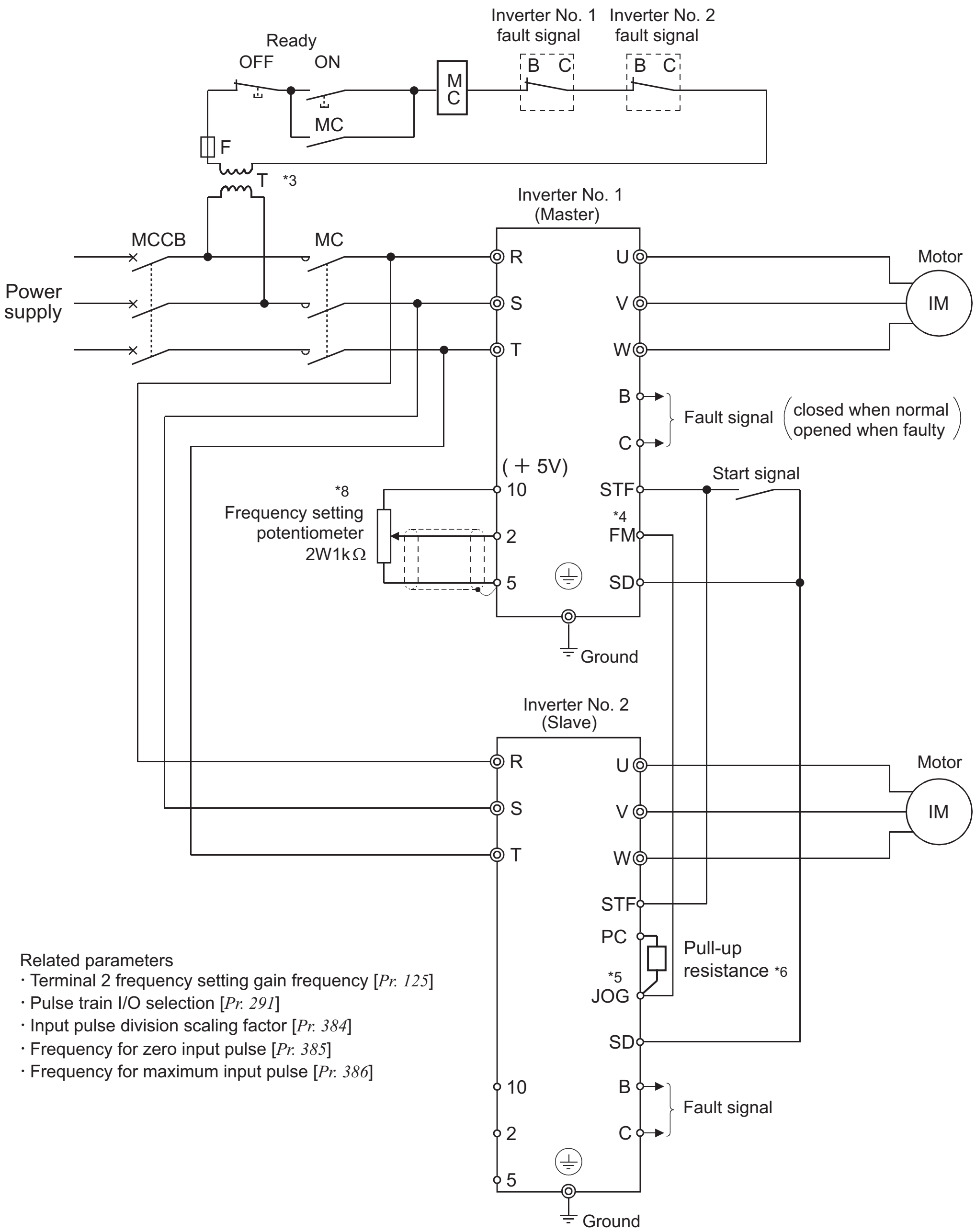
*1 By using the frequency setting gain/bias function of the inverter, you can make adjustment to match the output frequencies of the three inverters corresponding to the common voltage value from the frequency setting potentiometer.

*2 When two or more motors are coupled mechanically, larger load may be applied to one motor, resulting in overload.
Use the method described on page 565.

*3 Provide a step-down transformer when the power supply is 400V class.

*4 Multiple inverters of which total current is within the permissible load current in terminal 10 (+5V) can be connected.
Total of three inverters can be connected using terminal 10E (+10V) and a 1kΩ potentiometer.

4.4.3 Using pulse I/O (A700)



Related parameters
· Terminal 2 frequency setting gain frequency [*Pr. 125*]
· Pulse train I/O selection [*Pr. 291*]
· Input pulse division scaling factor [*Pr. 384*]
· Frequency for zero input pulse [*Pr. 385*]
· Frequency for maximum input pulse [*Pr. 386*]

*1 You can make adjustment to match the output frequency of the inverters regarding [*Pr. 385*, *Pr. 386*]. The ratio can be changed to make adjustment.

*2 When two or more motors are coupled mechanically, larger load may be applied to one motor, resulting in overload. Use the method described on page 565.

*3 When the power supply is 400V class, install a step-down transformer.

*4 Use [*Pr. 291*] to set the FM terminal output to "high speed pulse train output (ON width is always same)". Perform wiring terminal FM on the master side and terminal JOG on the slave side after setting [*Pr. 291*].

*5 Use [*Pr. 291*] to set the JOG terminal input to "pulse train input". In addition, to input the highest pulse train of 50kpulse/s, set [*Pr. 384 = 125*]. *Refer to page 228.*

*6 When the wiring length between FM and JOG is long, input pulse can not be recognized because of a pulse shape deformation due to the stray capacitances of the wiring. When wiring length is long (10m or more of recommended 0.75mm^2 twisted cable), connect terminal JOG and terminal PC using an external pull up resistance. The reference of resistance value to the wiring length is as in the table below.

Wiring Length	Less than 10m	10 to 50m	50 to 100m
Pull up resistance	Not necessary	1kΩ	470Ω
Load current (for reference)	10mA	35mA	65mA

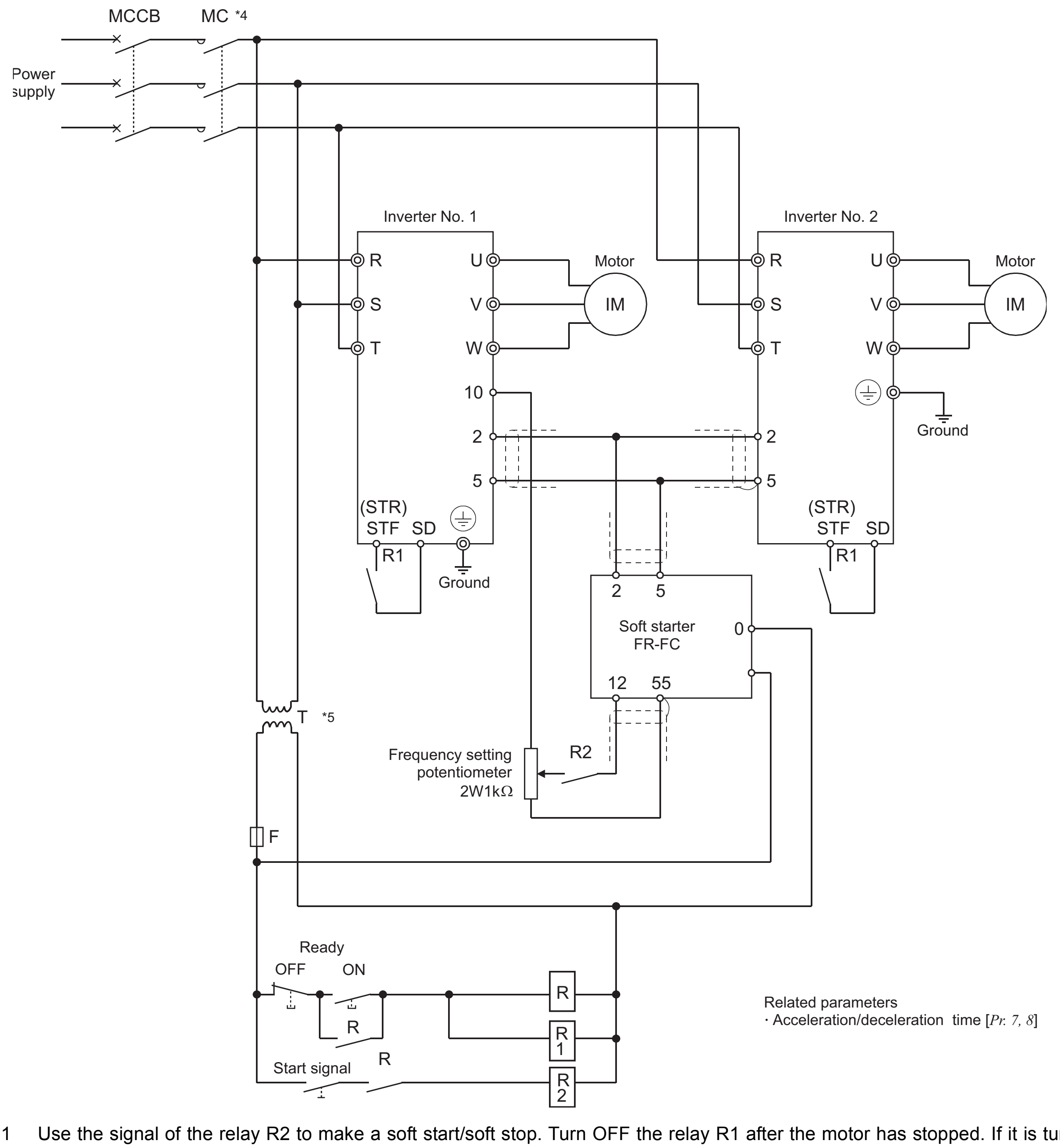
Stray capacitances of the wiring greatly differ according to the cable type and cable laying, the above cable length is not a guaranteed value.
When using a pull up resistance, check the permissible power of the resistor and permissible load current (terminal PC:100mA, high speed pulse train output:85mA) and use them within a permissible range.

*7 A pulse transmission delay in a slave is approximately 1 to 2 μs. When wiring length is long, the delay further increases.

*8 The inverter can be operated by pulse train input as frequency command.

4.4.4 Soft starter is used to soft-start/soft-stop two motors at the same time

common



*1 Use the signal of the relay R2 to make a soft start/soft stop. Turn OFF the relay R1 after the motor has stopped. If it is turned OFF during motor operation, the motor may decelerate at the acceleration/deceleration time in the inverter, resulting in an OVT trip.

*2 The times of acceleration and deceleration made by the FR-FC soft starter are as indicated below at the maximum output voltage. (For the specifications of 90s or longer, contact the manufacturer.)

Standard:	0.15 to 1.3s adjustable	C1-C2 shorted:	0.75 to 7.5s adjustable
C1-C2-C3 shorted:	5 to 50s adjustable	C1-C2-C3-C4 shorted:	10 to 90s adjustable

*3 Set the acceleration/deceleration time of the inverter to the minimum value of 0s.

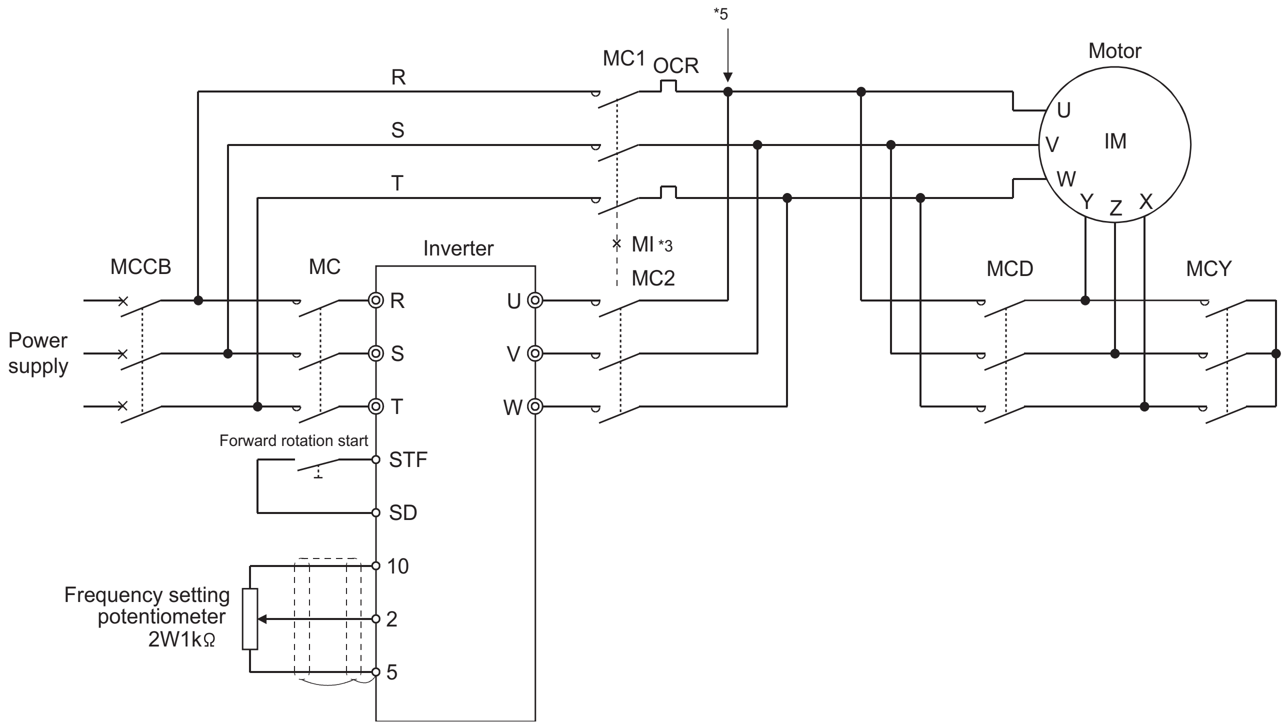
*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent discharging resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharging resistor, and excessive regenerative brake duty, etc.

*5 Provide a control transformer when the power supply is 400V class.

4.5 Inverter - commercial power supply switch-over operation (common)

4.5.1 Star-Delta connection start (common)

When the motor is rotated at full speed of 60Hz (or 50Hz), running the motor by commercial power supply is more efficient than inverter operation. Also, when the motor cannot be stopped for a long time for the maintenance/inspection of the inverter, it is recommended to provide the commercial power supply circuit.



*1 For the control circuit, refer to page 570 and 572.

*2 For inverter operation, turn ON MC2 and MCD simultaneously. (Y-connection operation cannot be performed.)

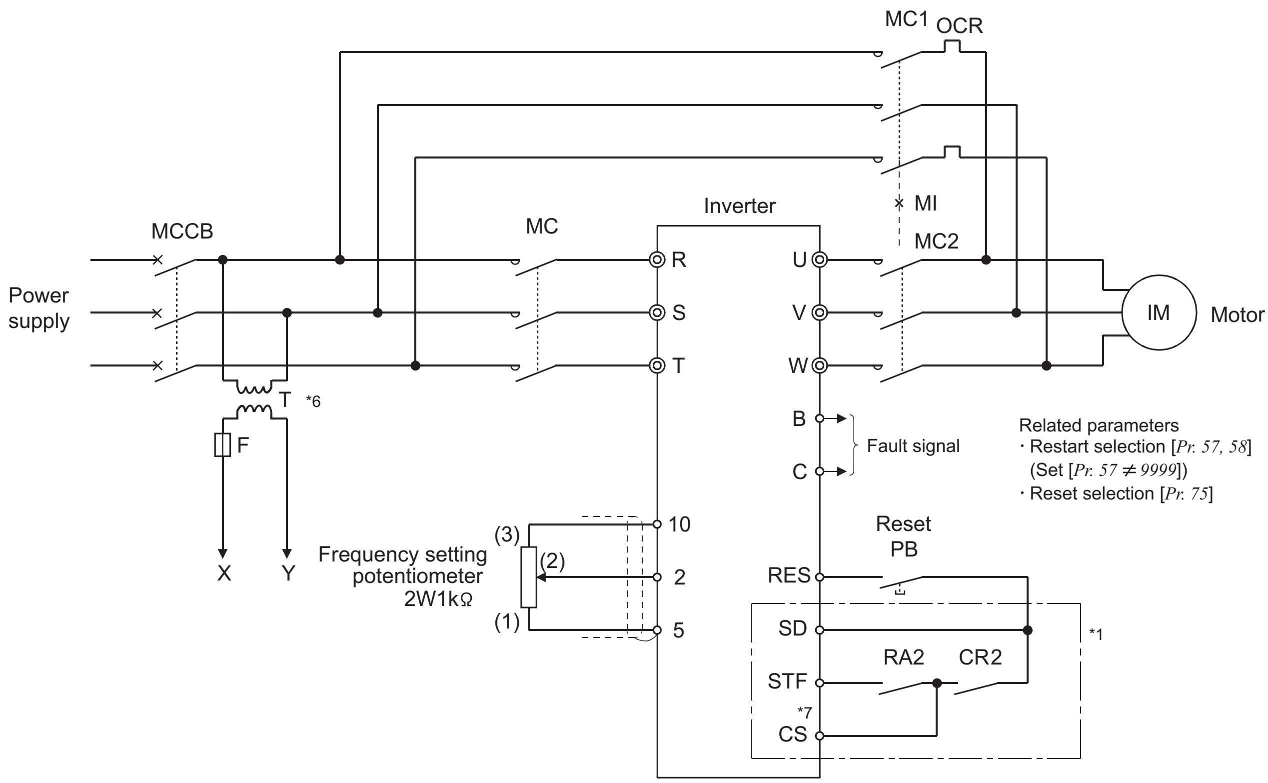
*3 Provide electrical and mechanical interlocks to prevent the MC1 and MC2 from being turned ON at the same time.

*4 In principle, do not turn ON the MC2 to start the inverter while the motor is rotating (coasting). Refer to page 37 for details of the magnetic contactor (MC2) turn-ON conditions.

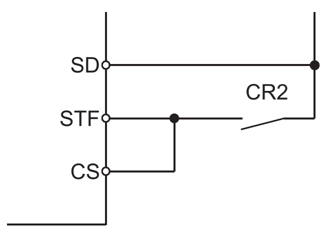
*5 Before making connection, ensure that the phase rotation of the commercial power supply is in R → S → T sequence.

4.5.2 Bypass inverter switch-over operation (common)

Bypass operation can be changed over to inverter operation without stopping the motor.
(Setting [*Pr. 57* ≠ *9999*] will make the restart function valid.)



*1 For (A700) (F700), when coasting the motor to a stop by pressing the stop pushbutton in the inverter mode, modify the circuit as shown below:



*2 By pressing the inverter operation pushbutton, bypass operation can be changed over to inverter operation without stopping the motor.

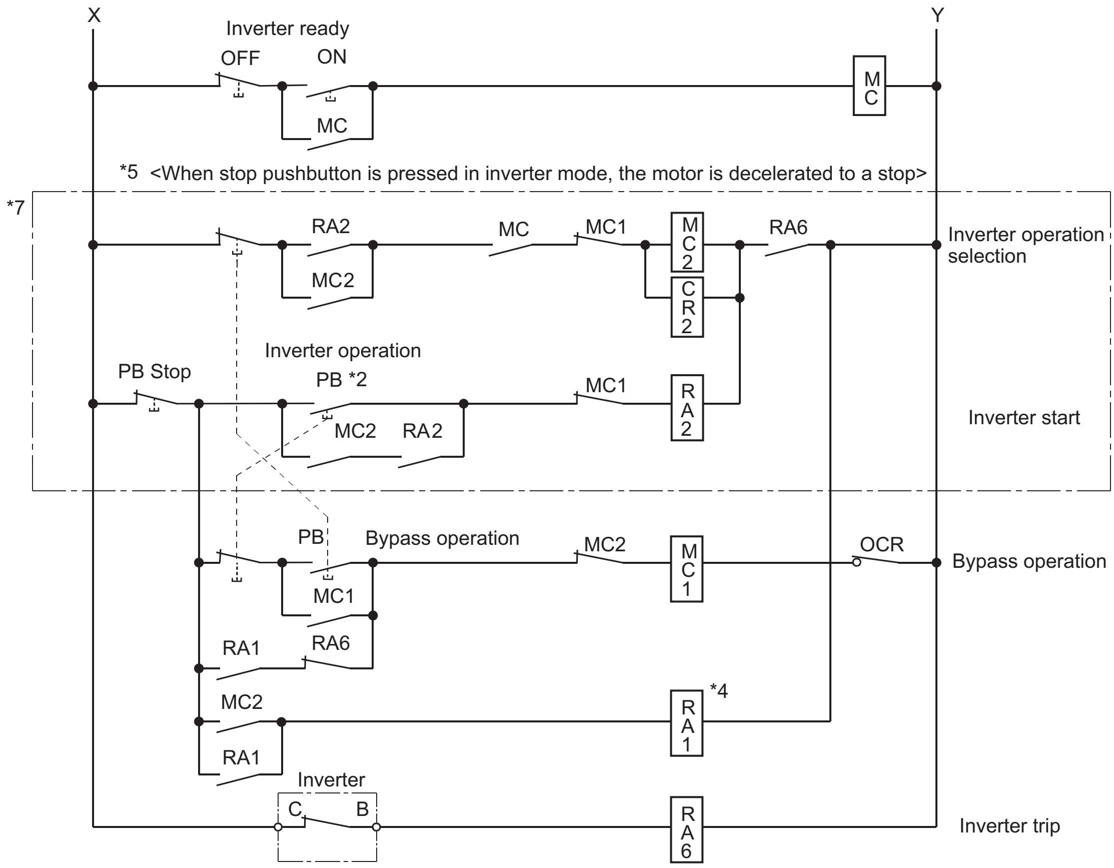
*3 For (A700) (F700), when the inverter is tripped due to an instantaneous power failure (IPF), the motor restarts automatically when power is restored. (Note that when there is no type RD instantaneous power failure relay, the motor is coasted to a stop when the relay or MC turns OFF, and does not restart automatically.)

*4 When an inverter trip occurs, inverter operation is changed over to bypass operation. (When the RA1 marked *4 is removed, bypass backup operation is not performed.)

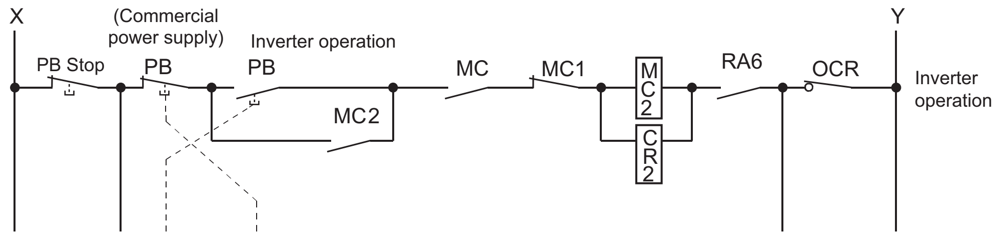
*5 When the stop pushbutton is pressed during inverter operation, the motor is inverter-controlled from deceleration to a stop. (When coating the motor to a stop, modify the circuit portions marked *1 and *7.)

*6 When the power supply is 400V class, install a step-down transformer.

*7 (E700) (D700) do not have CS signal. Assign MRS signal and set the MRS signal logic as normally closed ([*Pr. 17*=2]). Also, set to perform frequency search at every power ON ([*Pr. 162* =10]) for automatic restart after instantaneous power failure.



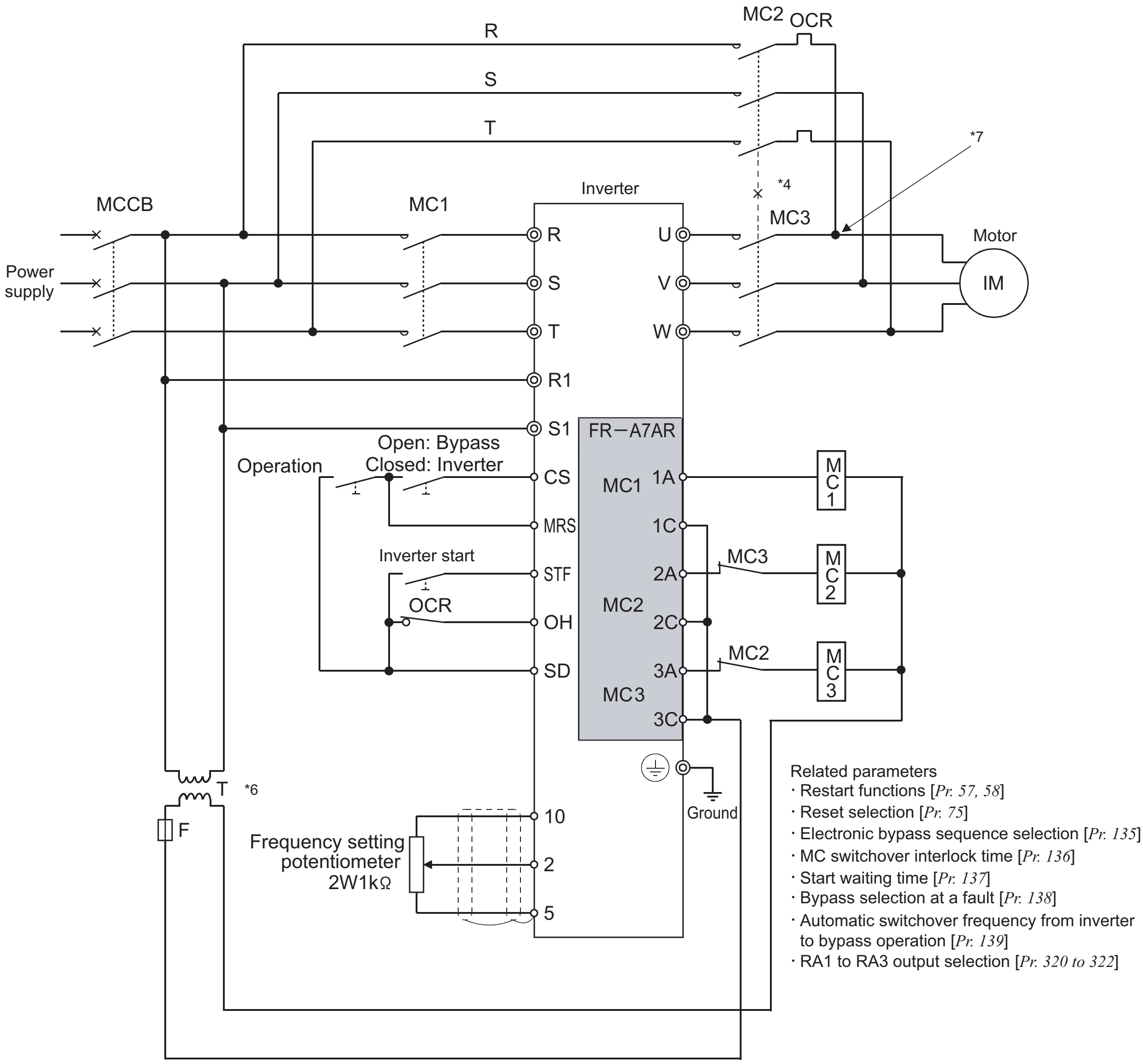
*8 When coasting the motor to a stop by pressing the stop pushbutton in the inverter mode, modify the circuit as shown below:



4 PRACTICAL CIRCUITS

4.5.3 Bypass-inverter switch-over operation [when bypass/inverter switch-over sequence is used] (A700)(F700)

[Relay output inboard option is used]*2



*1 When the inverter protective function is activated, reset the inverter by turning OFF the main breaker once or shorting the inverter reset terminal (RES) and (SD).

*2 Operation may be performed without the inboard option. In this case, however, a 24VDC power supply is required to drive the magnetic contactors.

*3 For switch-over from bypass operation to inverter operation, the motor coasting speed is automatically detected to continue operation without stopping the motor. In this case, note that a value other than 9999 should be set to the function of automatic restart after instantaneous power failure [*Pr. 57, Pr. 58*] of the inverter.

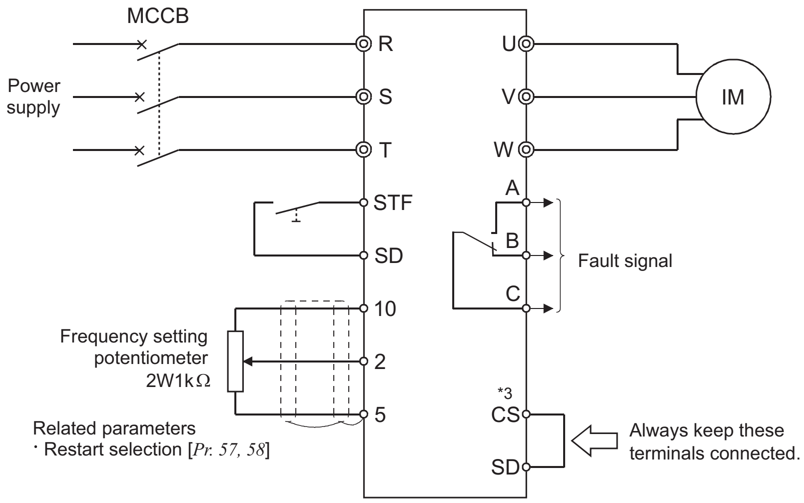
*4 Be sure to provide mechanical interlocks for MC2 and MC3.

*5 When [*Pr. 138 = 1*], the operation automatically switches to bypass operation if an inverter fault has occurred during inverter operation.

*6 When the power supply is 400V class, install a step-down transformer.

*7 Before making connection, ensure that the phase rotation of the commercial power supply is in R → S → T sequence.

4.6 Automatic restart after instantaneous power failure circuit (common)



When [*Pr. 57 ≠ 9999*], shorting terminals CD and SD *3 allows the motor to automatically restarted by the inverter without the motor being stopped when power is restored if an instantaneous power failure occurs during inverter operation.

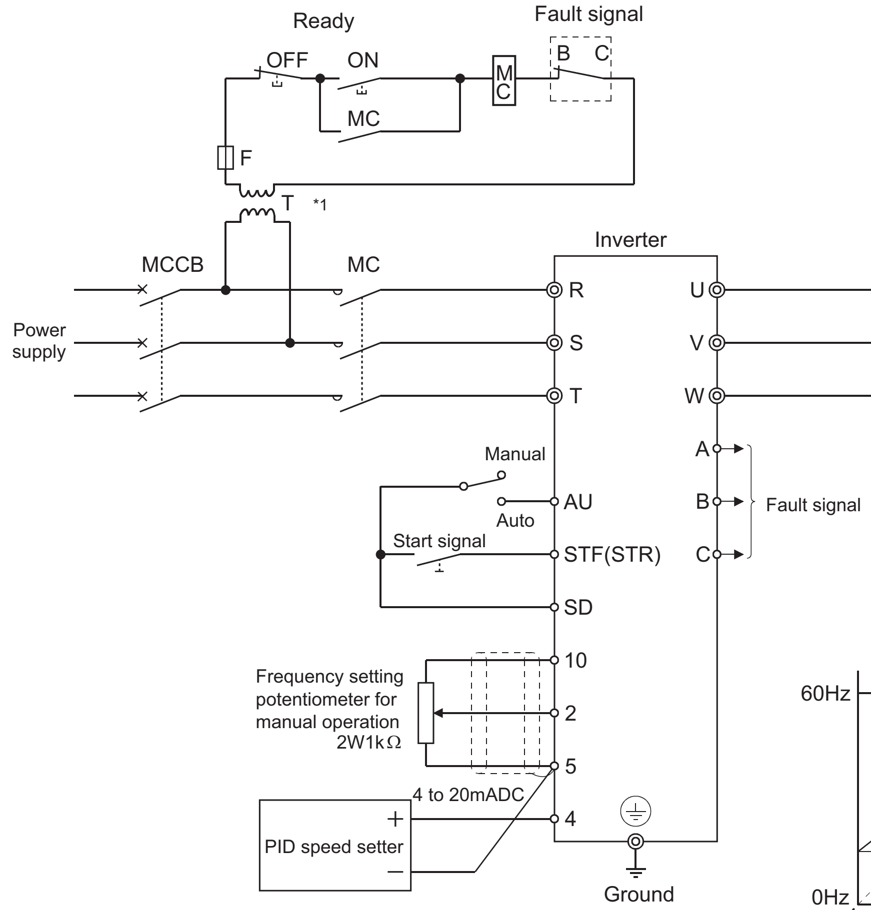
*1 The start signal (STF) must be ON when power is restored. Restart cannot be made if the start signal is turned OFF by the self holding circuit due to a power failure.

*2 Refer to page 367 for other operational details and application instructions.

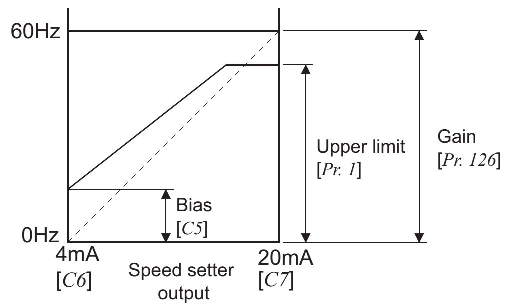
*3 (E700) (D700) do not have CS signal, so the terminal need not to be shorted.

4.7 Automatic operation of fan, pump or the like using speed setter (common)

[Auto-manual switch-over operation]



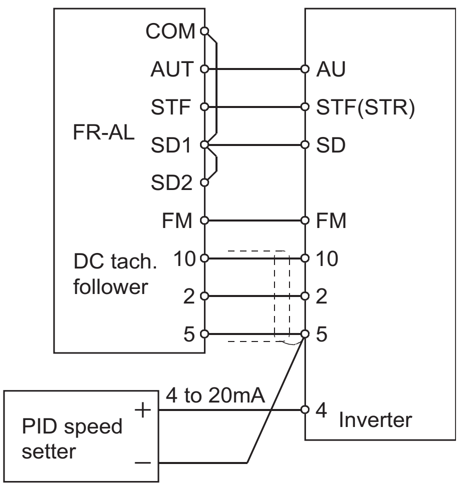
Related parameters
· Frequency setting current bias [*C5, C6(Pr. 904)*]
· Frequency setting current gain [*Pr. 126, C7(Pr. 905)*]



*1 When the power supply is 400V class, install a step-down transformer.

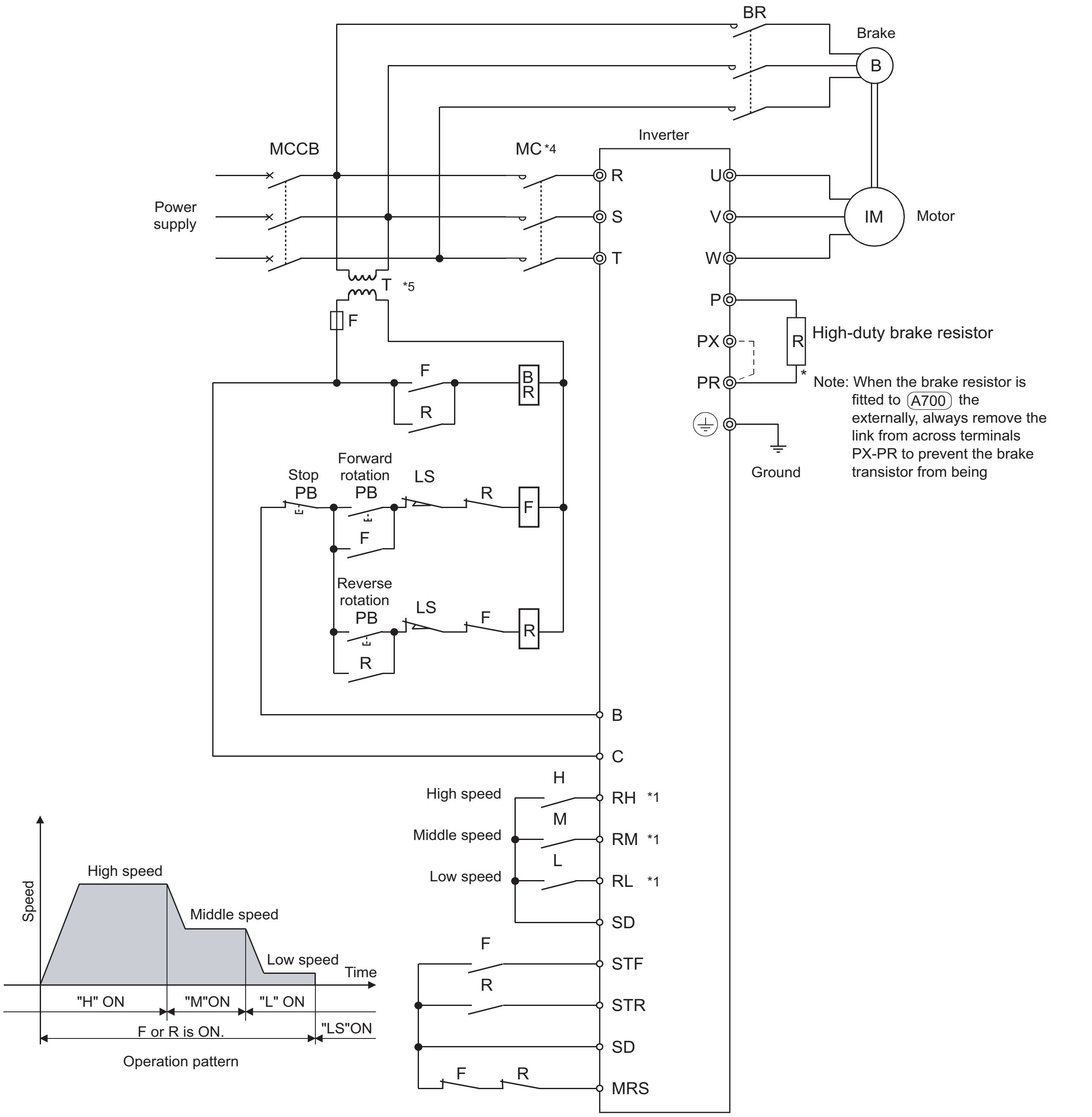
*2 Using the frequency setting gain/bias function of the inverter, you can set the relationship between speed setter output and output frequency as shown above. *Refer to page 217.*

[FR-AL DC tachometer follower]



*3 The FR-AL has the manual-auto change-over, start signal switch and frequency meter.

4.8 Positioning operation (common)



*1 When the speed commands H, M and L are turned on simultaneously, the lower speed has precedence in operation.
[Example] When the speed commands H and L are turned ON simultaneously, the low speed command L is used in operation.
As (D700) do not have many input terminals, speed command can be input to only two terminals.

*2 The (A700) 7.5K or less has a built-in discharging resistor designed for regenerative braking, but in the above diagram it was replaced by a high-duty brake resistor. (A700) the 22K or less, and (E700) (D700) 0.4K to 15K have a built-in brake transistor and a high duty brake resistor can be connected. (For the (F700), an external discharging resistor for regenerative braking can not be used.)

*3 Also refer to the circuit example of the motor equipped with brake. (Refer to page 564)

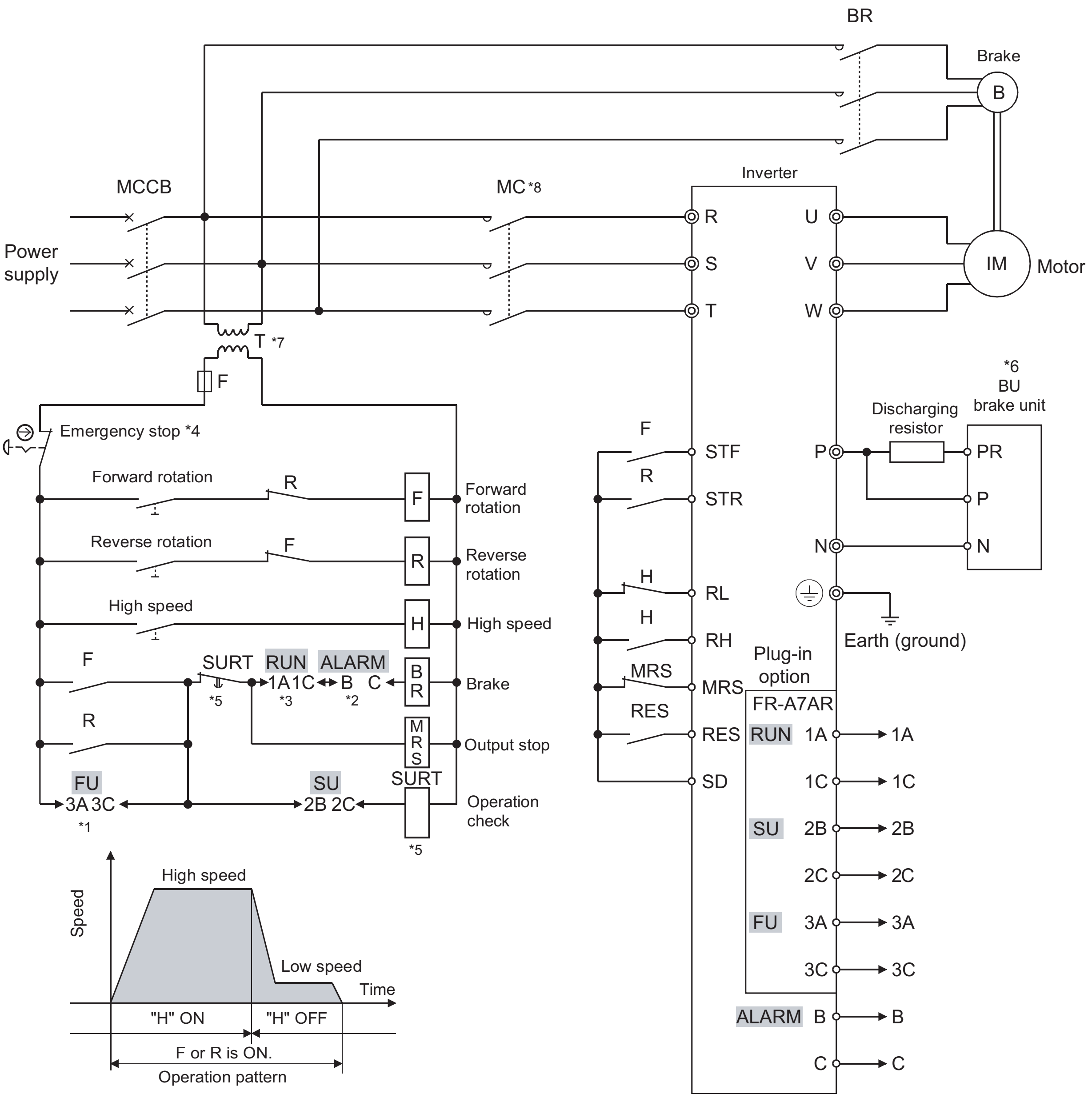
*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent the discharging resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharging resistor, and excessive regenerative brake duty, etc.

*5 When the power supply is 400V class, install a step-down transformer.

*6 In this circuit, pressing the stop button stops the motor with the electromagnetic brake. For operation of the electromagnetic brake after the motor is decelerated by the inverter, refer to page 576.

4.9 Vertical, winding lifter (A700) (E700)

4.9.1 Use of relay output option (A700) (E700)



*1 The brake is opened after terminal MRS is turned OFF by the start signal and the FU signal is then output from the inverter. At a stop, the brake is designed to be closed as soon as the motor has fully decelerated (FU signal).

*2 Connect terminals B-C to the brake circuit to always close the brake when an inverter fault occurs.

*3 The brake should not be opened except when the inverter provides normal output (RUN signal is ON).

*4 Install an emergency stop switch as provision against a failure. In case of an emergency, the motor is stopped by the mechanical brake without relying on the electric braking of the inverter.

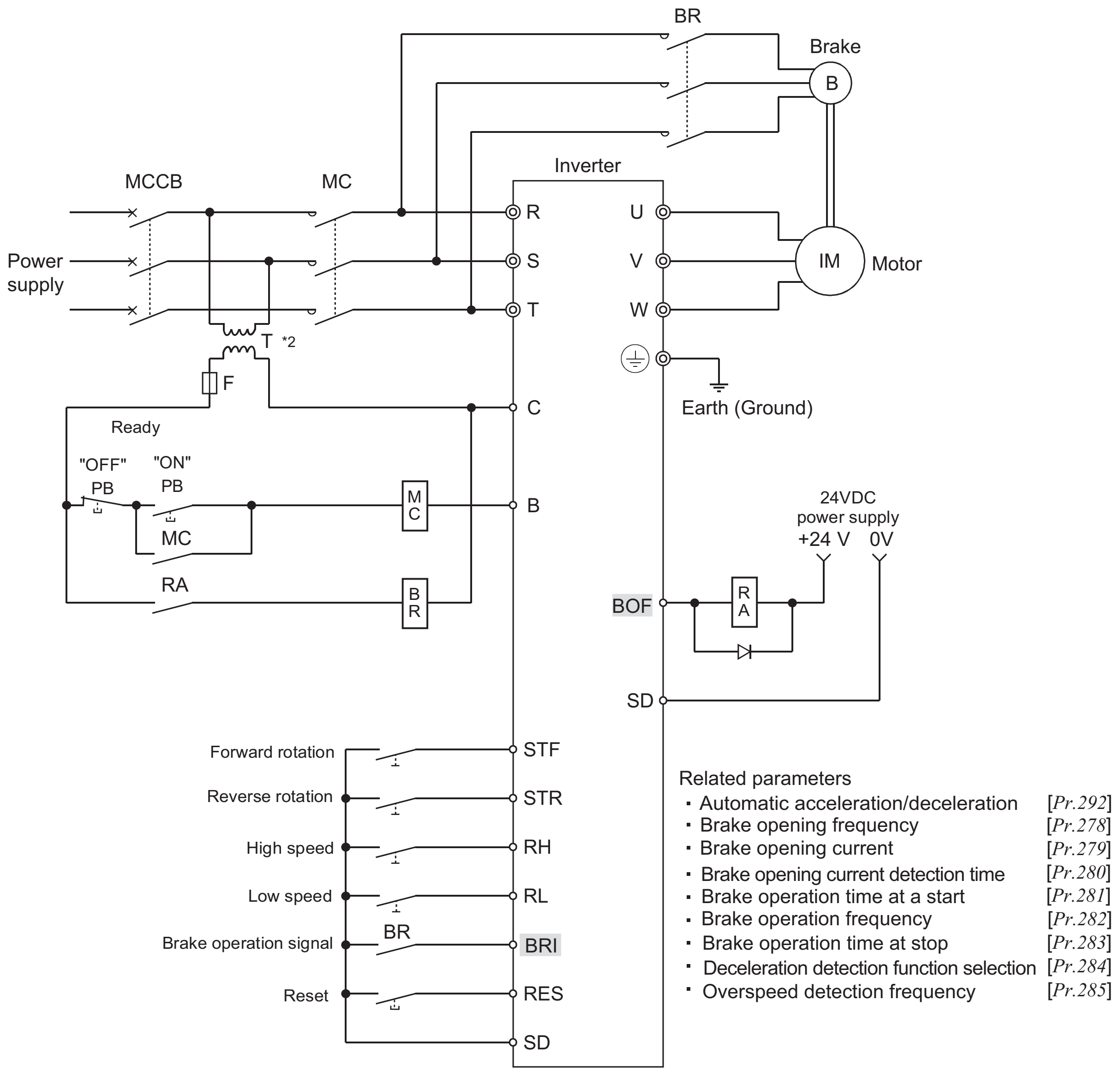
*5 Whether acceleration/deceleration is completed within the given time is checked. If not completed, it is judged that the inverter is faulty and the brake is closed.

*6 (A700) The FR-A700 series 7.5K or less has a built-in brake resistor, but the above diagram shows a case where an external brake is required.

*7 When the power supply is 400V class, install a step-down transformer.

*8 It is recommended to install a magnetic contactor in the primary side to prevent the discharging resistor from overheat/ burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharging resistor, an excessive regenerative brake duty etc.

4.9.2 Use of brake sequence circuit function (A700) (E700)



Related parameters

- Automatic acceleration/deceleration [*Pr.292*]
- Brake opening frequency [*Pr.278*]
- Brake opening current [*Pr.279*]
- Brake opening current detection time [*Pr.280*]
- Brake operation time at a start [*Pr.281*]
- Brake operation frequency [*Pr.282*]
- Brake operation time at stop [*Pr.283*]
- Deceleration detection function selection [*Pr.284*]
- Overspeed detection frequency [*Pr.285*]

- At start: When the start signal is input to the inverter, the output is provided at the starting frequency, and when the given frequency [*Pr. 278*] is reached and the output current exceeds the current set in [*Pr. 279*], the brake opening request signal BOF is output.
  When the given time set in [*Pr. 281*] has elapsed after the brake opening completion signal BRI has been input, the output frequency is raised to the preset speed.
- At stop: When the speed is reduced to the brake operation frequency [*Pr. 282*], the brake opening request signal BOF is turned OFF. When the given time set in [*Pr. 283*] has elapsed after the brake opening completion signal BRI had been turned OFF, the output frequency is switched OFF.

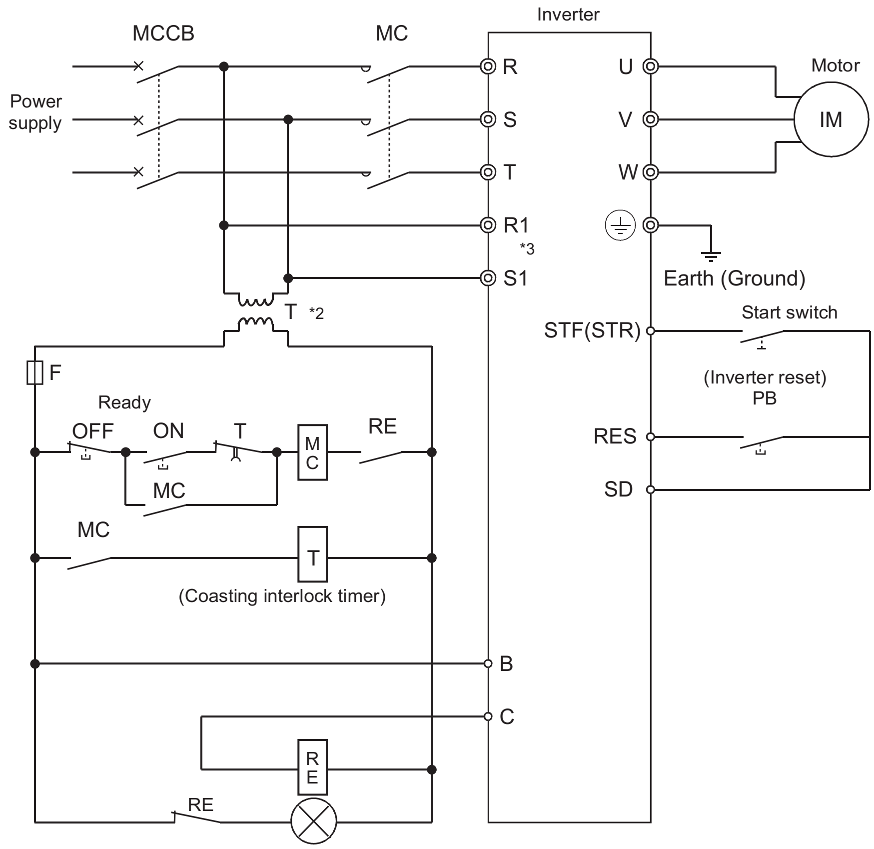
*1 When the motor equipped with a brake is run at or less than 30Hz continuously, the brake disc may rattle but the motor may be used without any problem if it is run at low speed for a short period, e.g. in orientation. Also, as there is a limit to the braking capacity, run the motor at no more than 60Hz.

*2 When the power supply is 400V class, install a step-down transformer.

4.10 Inverter fault output display and failure reset A700 F700

When a fault such as overcurrent, overvoltage, and instantaneous power failure occurs, the inverter outputs the corresponding fault signal. A relay contact is used to output the fault signal and is actuated (turned ON) when a fault occurs. This relay can be deactivated by using the reset terminal RES of the inverter. It may also be reset by switching OFF the inverter power. For details refer to page 57.

A700 When the FR-A700 series 22K or less is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent the brake discharge resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharge resistor, an excessive regenerative brake duty, etc.



*1 Set [*Pr. 75* = 1] "Reset can be made only when a fault occurs" to disable resetting the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is made to prevent the inverter from resulting in an over current alarm if the motor is still coasting when the inverter has returned from the reset status.)
Do not press the inverter reset pushbutton unless required. It is recommended to provide the failure reset pushbutton of the external device and the inverter reset pushbutton individually.

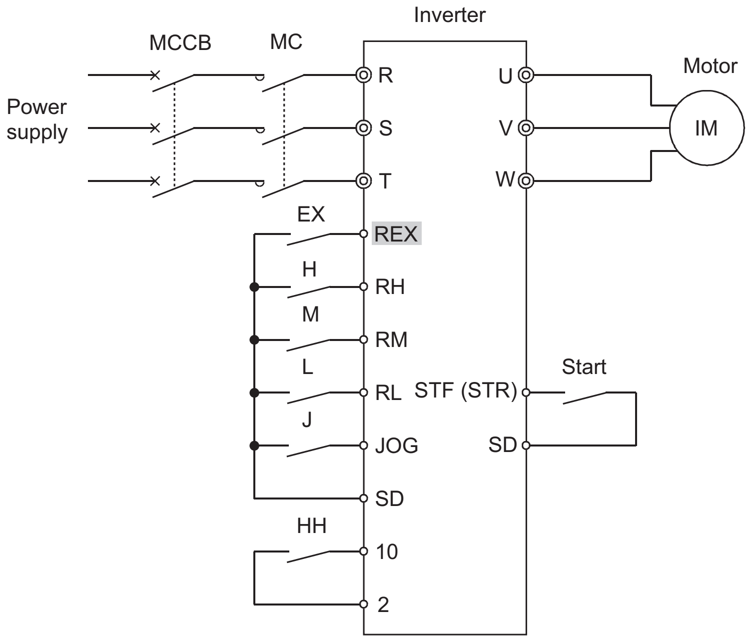
*2 When the power supply is 400V class, install a step-down transformer.

*3 When an alarm indication is held, always remove jumpers or cables from across terminals R-R1 and across S-S1.

4.11 Multi-speed operation application example

A700 F700 E700

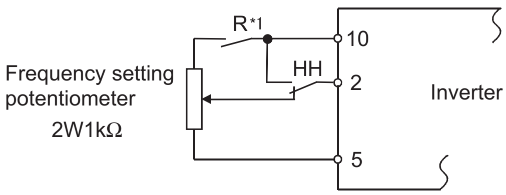
Multi-speed operation of 15-speed is available. The following application gives an example of operation requires more multi-speed operation.



(1) 18 speed operation

Speed	Relay Contacts						Setting
	J	HH	EX	H	M	L	
Lowest speed	OFF	OFF	OFF	OFF	OFF	OFF	[*Pr.* 2]
JOG	ON	—	—	—	—	—	[*Pr.* 15, 16]
Speed 3 (low speed)	OFF	—	OFF	OFF	OFF	ON	[*Pr.* 6]
Speed 2 (middle speed)	OFF	—	OFF	OFF	ON	OFF	[*Pr.* 5]
Speed 1 (high speed)	OFF	—	OFF	ON	OFF	OFF	[*Pr.* 4]
Speed 4	OFF	—	OFF	OFF	ON	ON	[*Pr.* 24]
Speed 5	OFF	—	OFF	ON	OFF	ON	[*Pr.* 25]
Speed 6	OFF	—	OFF	ON	ON	OFF	[*Pr.* 26]
Speed 7	OFF	—	OFF	ON	ON	ON	[*Pr.* 27]
Speed 8	OFF	—	ON	OFF	OFF	OFF	[*Pr.* 232]
Speed 9	OFF	—	ON	OFF	OFF	ON	[*Pr.* 233]
Speed 10	OFF	—	ON	OFF	ON	OFF	[*Pr.* 234]
Speed 11	OFF	—	ON	OFF	ON	ON	[*Pr.* 235]
Speed 12	OFF	—	ON	ON	OFF	OFF	[*Pr.* 236]
Speed 13	OFF	—	ON	ON	OFF	ON	[*Pr.* 237]
Speed 14	OFF	—	ON	ON	ON	OFF	[*Pr.* 238]
Speed 15	OFF	—	ON	ON	ON	ON	[*Pr.* 239]
Highest speed	OFF	ON	OFF	OFF	OFF	OFF	[*Pr.* 125]

(2) To add an external potentiometer to further increase the number of speeds

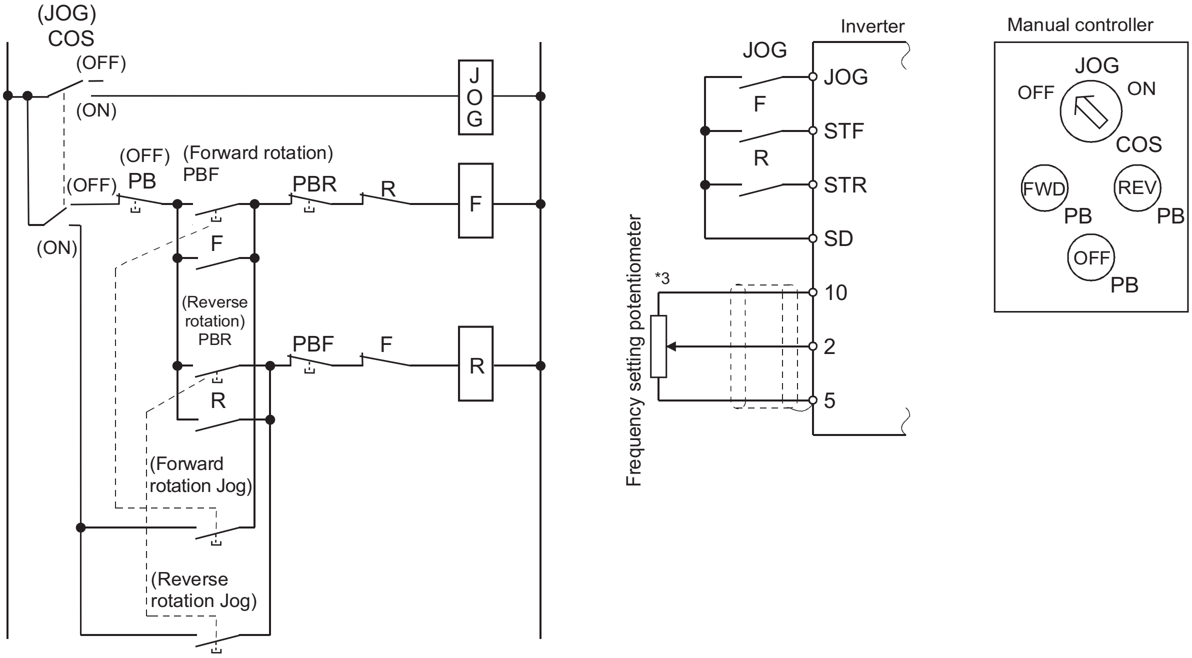


*1 When the relay R turns ON, operation is performed at the frequency set by the frequency setting potentiometer (external potentiometer). In this case, the relays J, HH, EX, H, M and L should all be OFF.

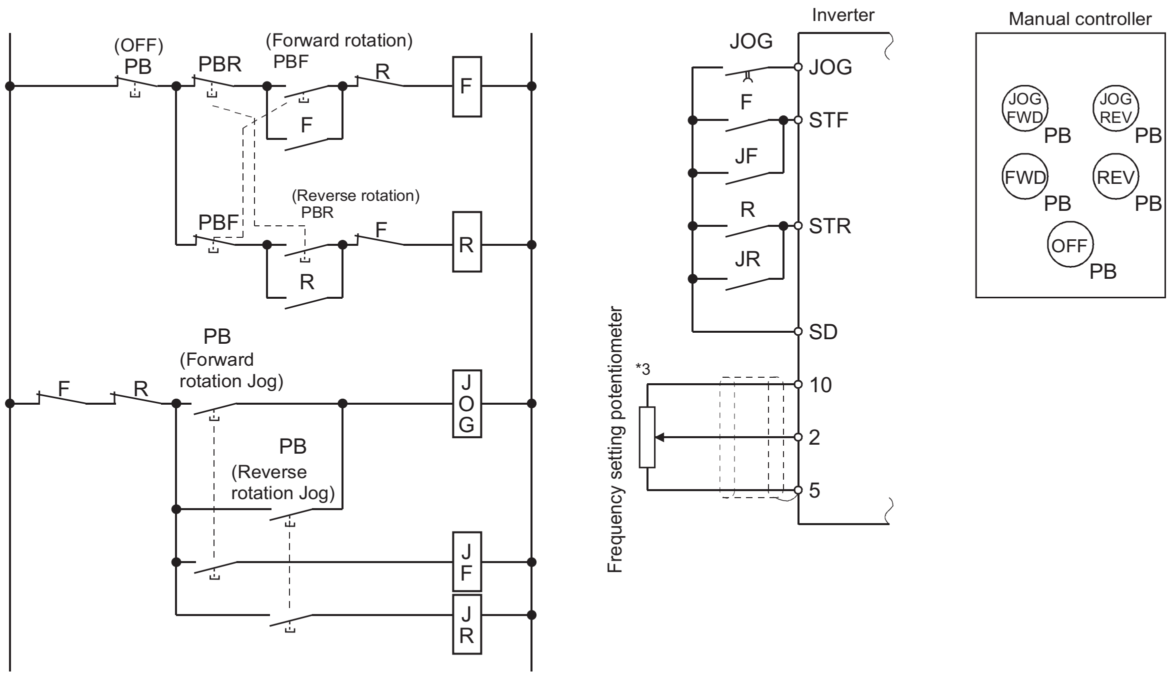
4.12 Jog operation in External operation mode

common

[With Jog mode selection switch]



[With Jog-dedicated pushbutton]

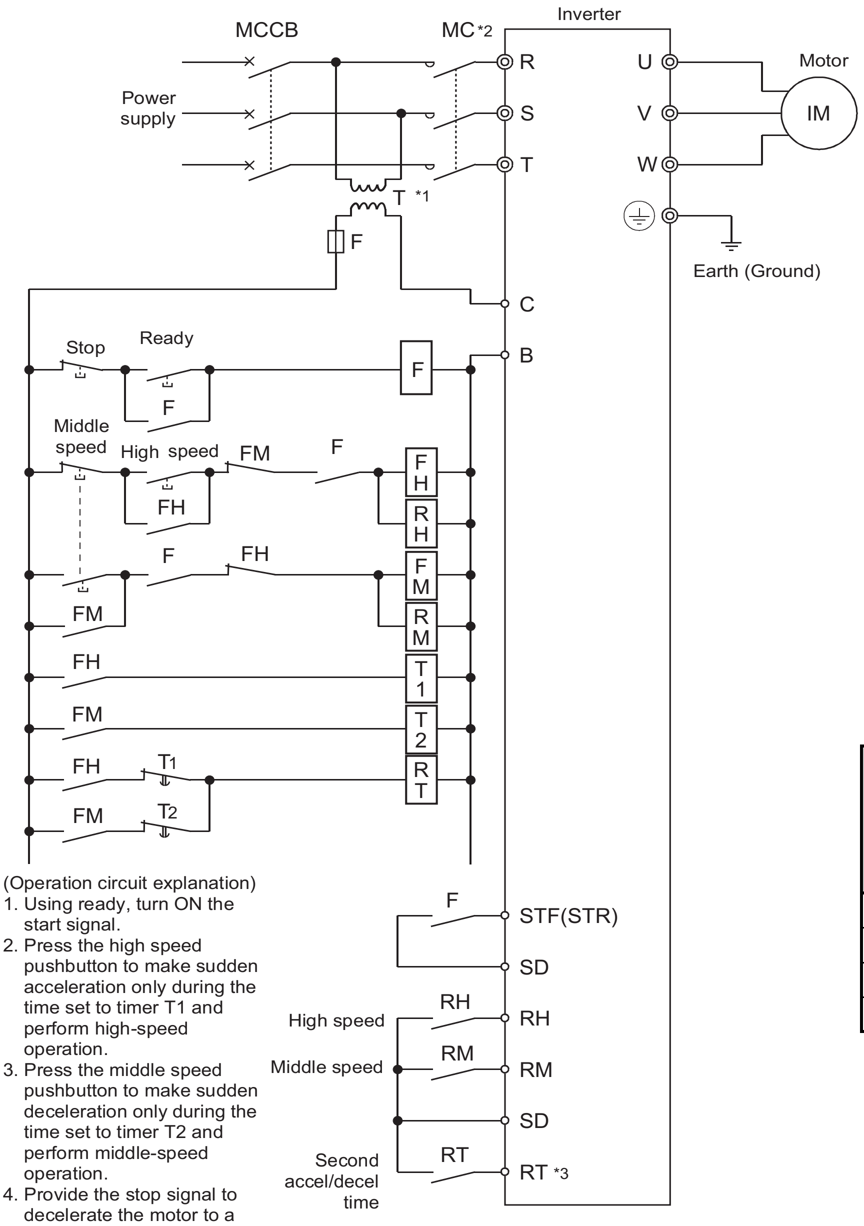


*1 Jog speed setting [*Pr. 15 Jog frequency*]

*2 Acceleration/deceleration time for Jog operation [*Pr. 16 Jog acceleration/deceleration time*]

*3 Potentiometer for constant-speed operation

4.13 Operation using the second acceleration/ deceleration time (common)



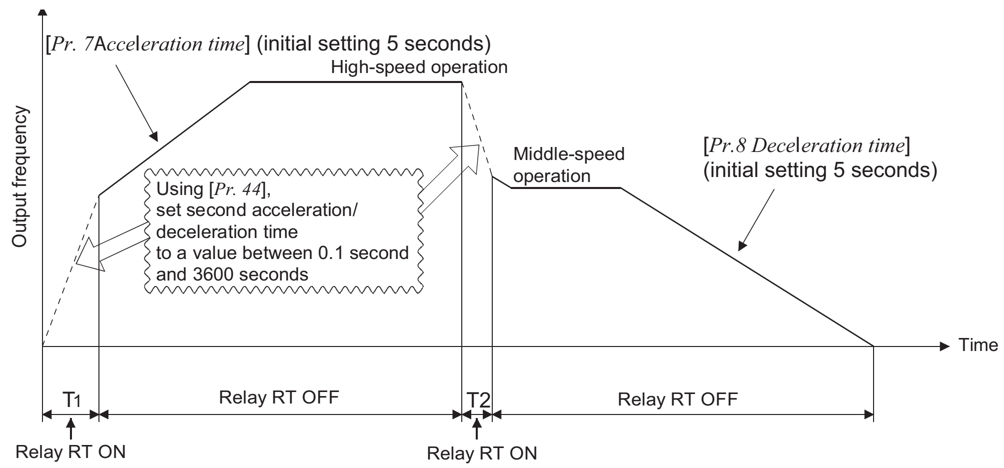
(Operation circuit explanation)
1. Using ready, turn ON the start signal.
2. Press the high speed pushbutton to make sudden acceleration only during the time set to timer T1 and perform high-speed operation.
3. Press the middle speed pushbutton to make sudden deceleration only during the time set to timer T2 and perform middle-speed operation.
4. Provide the stop signal to decelerate the motor to a stop.

* 1 When the power supply is 400V class, install a step-down transformer.

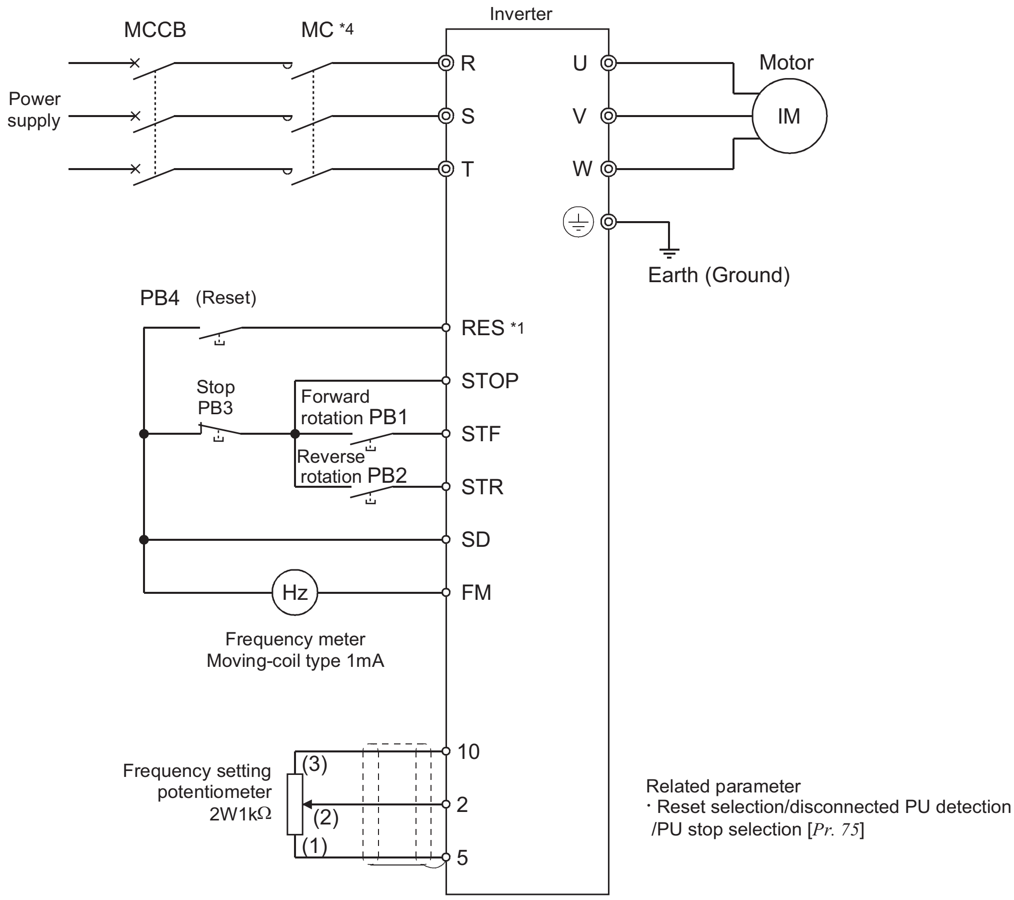
*2 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent the brake discharge resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharge resistor, and excessive regenerative brake duty, etc.

*3 Turning ON-OFF the RT signal changes the manual torque boost and base frequency to the second function, in addition to acceleration and deceleration, as listed below:

Function Name	Parameters Selected by RT signal	
	OFF	ON
Acceleration time	[*Pr. 7*]	[*Pr. 44*]
Deceleration time	[*Pr. 8*]	[*Pr. 45*]
Torque boost	[*Pr. 0*]	[*Pr. 46*]
Base frequency	[*Pr. 3*]	[*Pr. 47*]



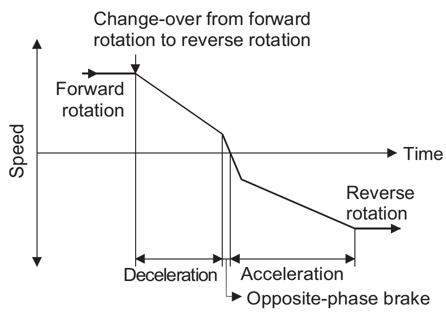
4.14 Start signal (three-wire) holding (common)



*1 Set [*Pr. 75* = 1] "Reset can be made only when a fault occurs" to disable resetting the inverter during normal operation.
(If the inverter is reset during normal operation, the motor coasts to a stop. This setting is made to prevent the inverter from resulting in an alarm if the motor is still coasting when the inverter has returned from the reset status.)

*2 The inverter will stop when both terminals STF and STR are closed simultaneously.

*3 During operation, switch-over from "forward rotation" to "reverse rotation" may be made.
In this case, when the reverse rotation signal is turned ON, the regenerative brake is applied down to the forward rotation frequency of 0.5Hz, the opposite-phase brake is applied at or less than 0.5Hz and acceleration in reverse rotation is started at that frequency. (DC injection brake is not applied.)

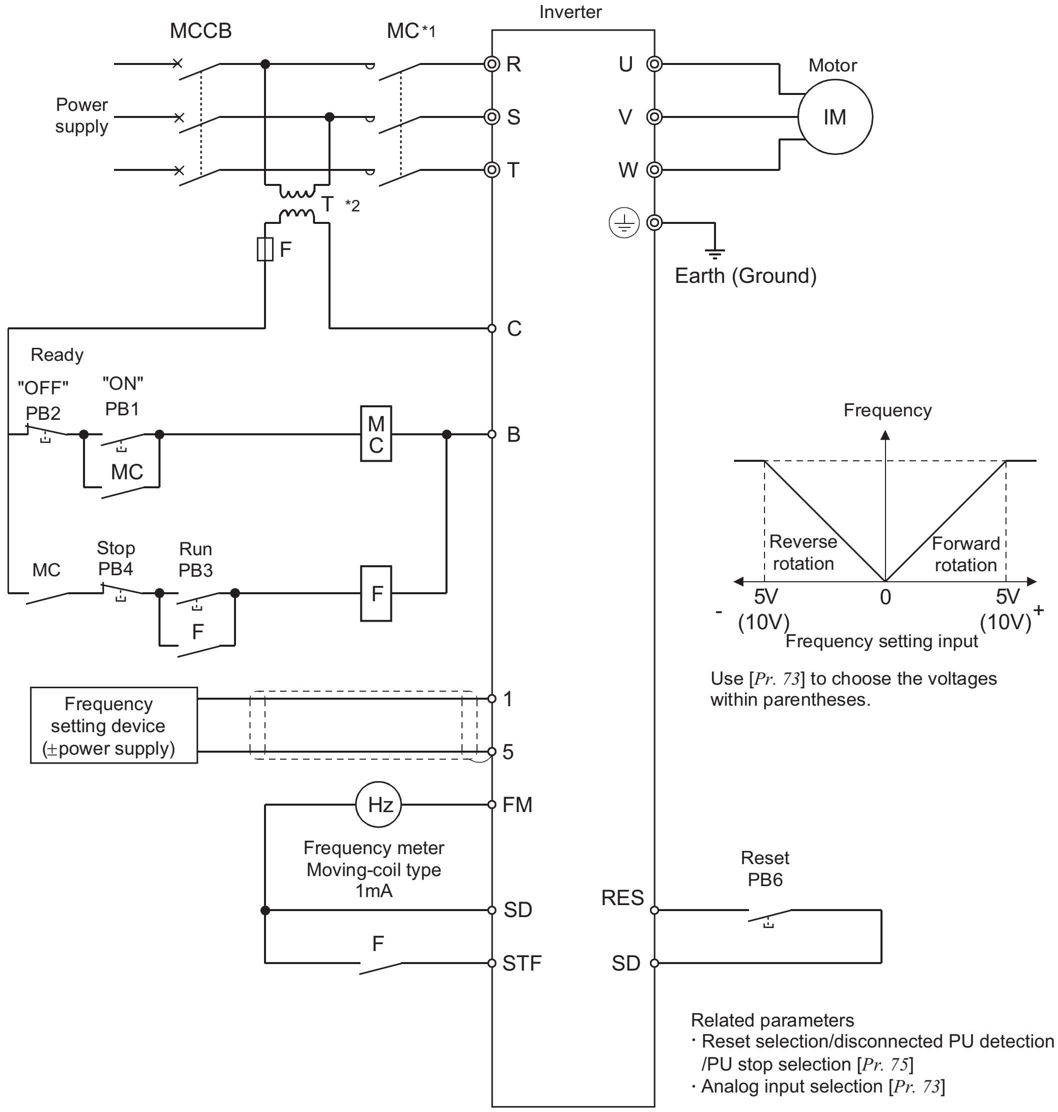


*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, it is recommended to install a magnetic contactor in the primary side to prevent the brake discharge resistor from overheat/burnout if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharge resistor, and excessive regenerative brake duty, etc.

4.15 Reversible operation by analog input

A700 F700

By changing the polarity of the analog input signal to terminal 1 between positive and negative, reversible operation can be performed between forward rotation and reverse rotation.

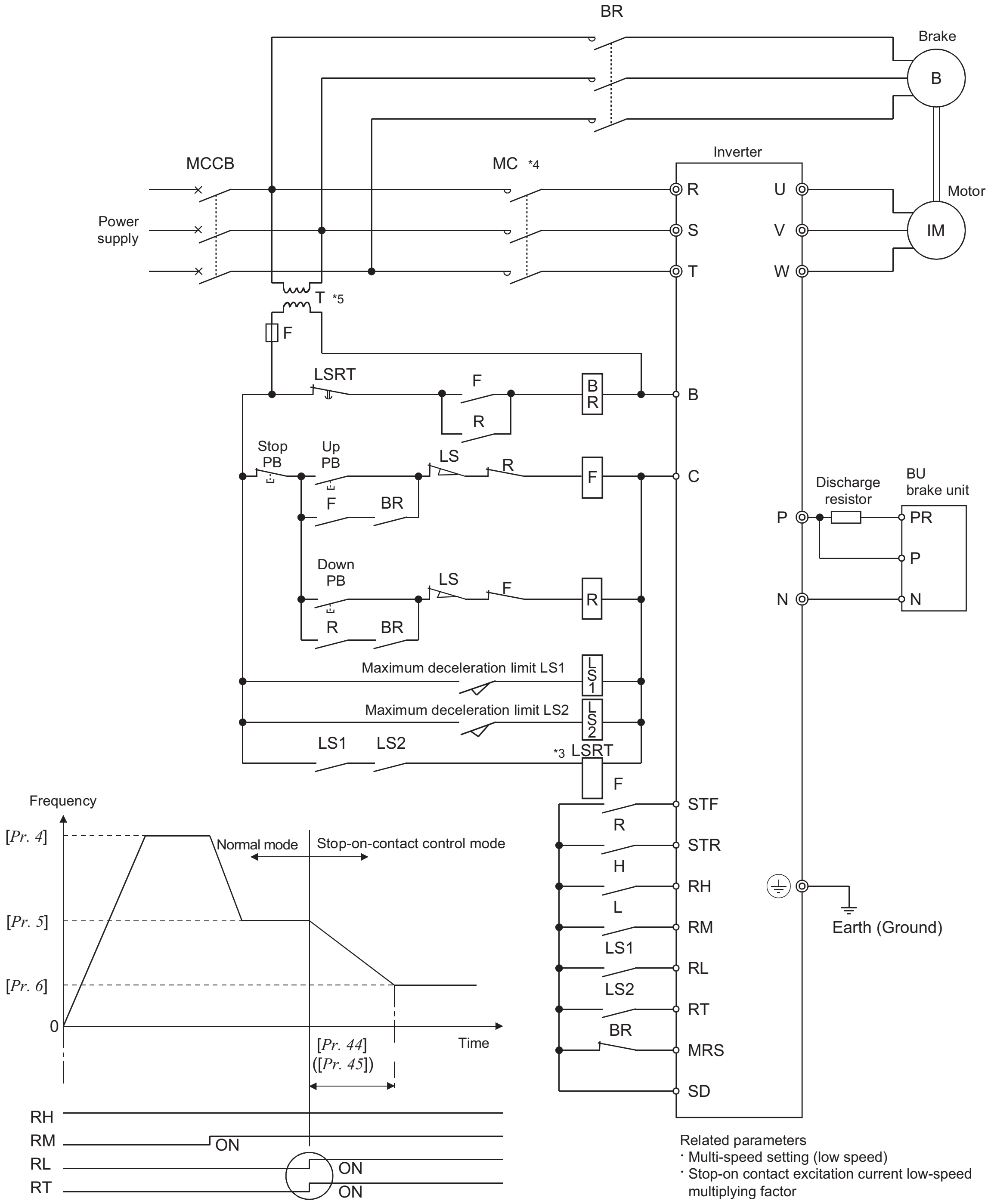


*1 This magnetic contactor is provided to prevent an automatic restart when power is restored after a power failure. Use the start signal (ON or OFF of STF) to make a start or stop.

*2 When the power supply is 400V class, install a step-down transformer.

*3 Set [*Pr. 75* = 1] "Reset can be made only when a fault occurs" to disable resetting the inverter during normal operation. (If the inverter is reset during normal operation, the motor coasts to a stop. This setting is made to prevent the inverter from resulting in an alarm if the motor is still coasting when the inverter has returned from the reset status.)

4.16 Operation using stop-on-contact control function (A700) (E700)



Switched to stop-on-contact control mode when both RL and RT turn ON.
(RL and RT may be turned ON in any sequence and with any delay betweenthem.)

Related parameters

- Multi-speed setting (low speed) [Pr. 6]
- Stop-on contact excitation current low-speed multiplying factor [Pr. 275]
- PWM carrier frequency at stop-on contact [Pr. 276]
- Stop-on contact/load torque high-speed frequency control selection [Pr. 270]
- Second acceleration/deceleration time [Pr. 44]
- Second deceleration time [Pr. 45]

*1 If the setting of the excitation current low-speed multiplying factor at stop-on-contact is too large, an overcurrent (OCT) alarm is liable to occur.

*2 If the setting of the excitation current low speed multiplying factor is too large, the machine may oscillate in a stop-on-contact state.

*3 Unlike the servo lock function, the stop-on-contact function cannot hold the load for a long time. Stop-on-contact operation continued for long time can cause the motor to overheat. After a stop, therefore, immediately use the mechanical brake to hold the load.

*4 When an inverter with a regenerative brake resistor is used for cyclic or heavy duty operation, <u>it is recommended to install a magnetic contactor in the primary side to prevent the brake discharge resistor from overheat/burnout</u> if the regenerative brake transistor is damaged due to the thermal capacity shortage of the discharge resistor, and excessive regenerative brake duty, etc.

*5 When the power supply is 400V class, install a step-down transformer.