

VECTOR INVERTER

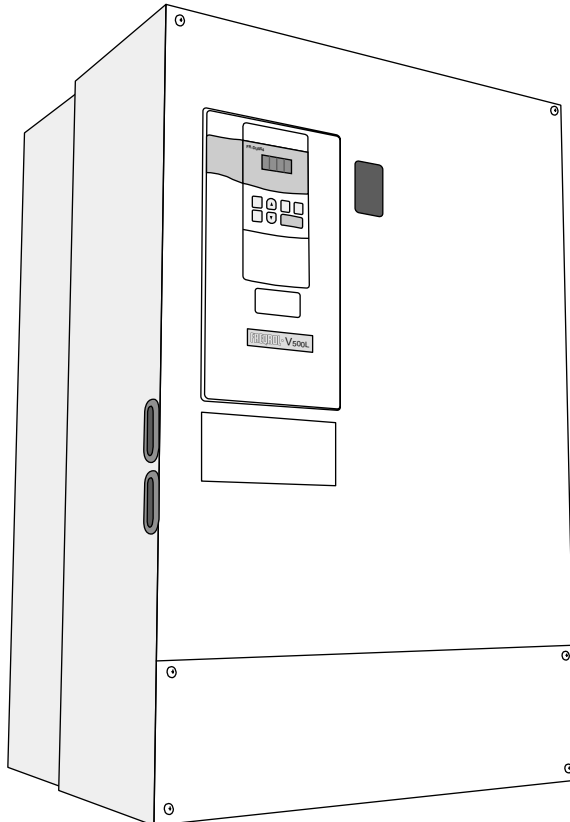
FR-V500L

INSTRUCTION MANUAL (Detailed)

HIGH PRECISION & HIGH
RESPONSE VECTOR INVERTER

FR-V520L-75K (-NA)

FR-V540L-75K to 250K (-NA)



WIRING

1

VECTOR
CONTROL

2

PARAMETERS

3

SPECIFICATIONS

4

Thank you for choosing this Mitsubishi vector inverter. This Instruction Manual (detailed) provides instructions for advanced use of the FR-V500L series inverters. Incorrect handling might cause an unexpected fault. Before using the inverter, always read this Instruction Manual and the Instruction Manual (basic) [IB-T7311] packed with the product carefully to use the equipment to its optimum performance.

This instruction manual uses the International System of Units (SI). The measuring units in the yard and pound system are indicated in parentheses as reference values.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the inverter until you have read through the Instruction Manual (basic) and appended documents carefully and can use the equipment correctly. Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions. In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



WARNING

Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



CAUTION

Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that even the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

1. Electric Shock Prevention



WARNING

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- Even if power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, check that power lamp display is turned off and check for residual voltages with a meter etc. more than 10 minutes after power-off.
- Earth (Ground) the inverter.
- Any person who is involved in wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Perform setting dial and key operations with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.
- Do not change the cooling fan while power is on. It is dangerous to change the cooling fan while power is on.

2. Fire Prevention



CAUTION

- Mount the inverter to incombustible material. Mounting it to or near combustible material can cause a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- Do not connect a resistor directly to the DC terminals P, N. This could cause a fire.

3. Injury Prevention



CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- While power is on and for some time after power-off, do not touch the inverter or brake resistor as they are hot and you may get burnt.

4. Additional Instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

1) Transportation and installation



CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter.
- Do not operate if the inverter is damaged or has parts missing.
- When carrying the inverter, do not hold it by the front cover or setting dial; it may fall off or fail.
- Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments, other conductive bodies, oil or other flammable substances from entering the inverter.
- Do not drop the inverter, or subject it to impact
- Use the inverter under the following environmental conditions:

| | | |
|-------------|---------------------|---|
| Environment | Ambient temperature | -10°C to +50°C (14°F to 122°F) (non-freezing) |
| | Ambient humidity | 90%RH or less (non-condensing) |
| | Storage temperature | -20°C to +65°C* (-4°F to 149°F) |
| | Ambience | Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt) |
| | Altitude, vibration | Maximum 1000m (3280.80feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40feet) up to 2500m (8202.00feet) (91%). 5.9m/s 2 or less (conforming to JIS C 0040) |

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

2) Wiring

CAUTION

- Do not fit capacitive equipment such as power factor correction capacitor, surge suppressor or radio noise filter (option FR-BIF) to the inverter output side.
- The connection orientation of the output cables (terminals U, V, W) to the motor will affect the direction of rotation of the motor.

3) Trial run

CAUTION

- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

4) Operation

WARNING

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The [STOP] key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
- Do not modify the equipment.

CAUTION

- The electronic thermal relay does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power from the inverter may heat/damage the power capacitor and generator.
- When a 400V class motor is inverter-driven, it should be insulation-enhanced or surge voltages suppressed. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation. In addition to the inverter's holding function, install a holding device to ensure safety.

5) Emergency stop

CAUTION

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.

6) Maintenance, inspection and parts replacement

CAUTION

- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

7) Disposing of the inverter

CAUTION

- Treat as industrial waste

8) General Instructions

Many of the diagrams and drawings in this Instruction Manual show the inverter without a cover, or partially open. Never operate the inverter in this manner. Always replace the cover and follow this Instruction Manual when operating the inverter.

CONTENTS

| | | |
|------------|---|-----------|
| 1 | WIRING | 1 |
| 1.1 | Internal block diagram | 2 |
| 1.2 | Main circuit terminal specifications | 3 |
| 1.3 | Connection of stand-alone option units | 4 |
| 1.3.1 | Connection of the MT-BU5 brake unit (option) | 4 |
| 1.3.2 | Connection of the FR-BU brake unit (option) | 5 |
| 1.3.3 | Connection of the MT-HC high power factor converter (option) | 6 |
| 1.3.4 | Connection of the MT-RC power return converter (option) | 7 |
| 1.4 | Control circuit terminal specifications | 8 |
| 1.5 | Precautions for use of the vector inverter | 10 |
| 1.6 | Others | 11 |
| 1.6.1 | Leakage currents and countermeasures | 11 |
| 1.6.2 | Power off and magnetic contactor (MC) | 12 |
| 1.6.3 | Installation of power factor improving reactor | 12 |
| 1.6.4 | Notes on earthing (grounding) | 13 |
| 1.6.5 | Inverter-generated noises and their reduction techniques | 14 |
| 1.6.6 | Power harmonics | 16 |
| 1.6.7 | Japanese harmonic suppression guidelines | 17 |
| 1.6.8 | Inverter-driven 400V class motor | 19 |
| 1.6.9 | Using the PU connector for Computer link | 20 |
| 1.7 | Input terminals | 23 |
| 1.7.1 | Run (start) and stop (STF, STR, STOP) | 23 |
| 1.7.2 | External thermal relay input (OH) | 24 |
| 1.7.3 | Speed setting potentiometer connection (10E, 2 (1), 5) | 24 |
| 1.7.4 | Torque setting input signal and motor-generated torque (terminals 3, 5) | 25 |
| 1.7.5 | Meter connection method and adjustment (DA1, DA2) | 25 |
| 1.7.6 | Common terminals (SD, 5, SE) | 26 |
| 1.7.7 | Signal inputs by contact-less switches | 26 |
| 1.8 | How to use the input signals (assigned terminals DI1 to DI4, STR) (Pr. 180 to Pr. 183, Pr. 187) | 27 |
| 1.8.1 | Multi-speed setting (RL, RM, RH, REX signals): Pr. 180 to Pr. 183, Pr. 187 setting "0, 1, 2, 8" Remote setting (RL, RM, RH signals): Pr. 180 to Pr. 183, Pr. 187 setting "0, 1, 2" | 27 |
| 1.8.2 | Second function selection/second motor switchover (RT signal) : Pr. 180 to Pr. 183, Pr. 187 setting "3" | 27 |
| 1.8.3 | Jog operation (jog signal): Pr. 180 to Pr. 183, Pr. 187 setting "5" | 27 |
| 1.8.4 | Third function selection (X9 signal): Pr. 180 to Pr. 183, Pr. 187 setting "9" | 28 |
| 1.8.5 | MT-HC connection (X10 signal): Pr. 180 to Pr. 183, Pr. 187 setting "10" | 28 |
| 1.8.6 | PU operation external interlock signal (X12 signal): Pr. 180 to Pr. 183, Pr. 187 setting "12" | 28 |
| 1.8.7 | PID control enable terminal: Pr. 180 to Pr. 183, Pr. 187 setting "14" | 28 |
| 1.8.8 | Brake sequence opening signal (BRI signal): Pr. 180 to Pr. 183, Pr. 187 setting "15" | 28 |
| 1.8.9 | PU operation/external operation switchover: Pr. 180 to Pr. 183, Pr. 187 setting "16" | 28 |
| 1.8.10 | S-pattern acceleration/deceleration C switchover terminal (X20 signal) : Pr. 180 to Pr. 183, Pr. 187 setting "20" | 28 |
| 1.8.11 | Orientation command (X22 signal): Pr. 180 to Pr. 183, Pr. 187 setting "22" | 29 |
| 1.8.12 | Pre-excitation/servo on (LX signal): Pr. 180 to Pr. 183, Pr. 187 setting "23" | 29 |
| 1.8.13 | Output stop (MRS signal): Pr. 180 to Pr. 183, Pr. 187 setting "24" | 29 |
| 1.8.14 | Start self-holding selection (STOP signal): Pr. 180 to Pr. 183, Pr. 187 setting "25" | 29 |
| 1.8.15 | Control mode changing (MC signal): Pr. 180 to Pr. 183, Pr. 187 setting "26" | 30 |
| 1.8.16 | Torque restriction selection (TL signal): Pr. 180 to Pr. 183, Pr. 187 setting "27" | 30 |
| 1.8.17 | Torque bias selection 1 (X42 signal): Pr. 180 to Pr. 183, Pr. 187 setting "42" Torque bias selection 2 (X43 signal): Pr. 180 to Pr. 183, Pr. 187 setting "43" | 30 |
| 1.8.18 | P control selection (P/PI control switchover) (X44 signal): Pr. 180 to Pr. 183, Pr. 187 setting "44" | 30 |

| | | |
|-------------|---|-----------|
| 1.9 | How to use the output signals (assigned terminals DO1 to DO3, ABC) (Pr. 190 to Pr. 192, Pr. 195) | 31 |
| 1.10 | Design information to be checked | 33 |
| 1.11 | Using the second motor | 34 |
| 1.11.1 | Wiring diagram (second motor)..... | 34 |
| 1.11.2 | Second motor setting parameters | 34 |
| 1.12 | Using the conventional Mitsubishi motor and other motors | 35 |
| 1.12.1 | Conventional Mitsubishi motor (SF-VH)..... | 35 |
| 1.12.2 | Precautions for and wiring of the motor with PLG | 36 |

2 VECTOR CONTROL **37**

| | | |
|------------|---|-----------|
| 2.1 | What is vector control? | 38 |
| 2.2 | Speed control | 40 |
| 2.2.1 | Outline of speed control | 40 |
| 2.2.2 | Easy gain tuning function block diagram..... | 40 |
| 2.3 | Fine adjustment of gains for speed control | 41 |
| 2.3.1 | Control block diagram | 41 |
| 2.3.2 | Concept of adjustment of manual input speed control gains..... | 42 |
| 2.3.3 | Speed control gain adjustment procedure (Pr. 820, Pr. 821)..... | 42 |
| 2.3.4 | Troubleshooting..... | 43 |
| 2.3.5 | Speed feed forward control, model adaptive speed control (Pr. 828, Pr. 877 to Pr. 881)..... | 45 |
| 2.4 | Torque control | 47 |
| 2.4.1 | Outline of torque control..... | 47 |
| 2.5 | Fine adjustment for torque control | 48 |
| 2.5.1 | Control block diagram | 48 |
| 2.6 | Gain adjustment for torque control | 49 |
| 2.6.1 | Concept of torque control gains | 49 |
| 2.6.2 | Gain adjustment procedure | 49 |
| 2.6.3 | Troubleshooting..... | 50 |
| 2.7 | Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494) | 51 |
| 2.7.1 | Connection diagram | 51 |
| 2.7.2 | Control block diagram | 52 |
| 2.7.3 | Parameter..... | 52 |
| 2.7.4 | Conditional position feed function by contact input (Pr. 419=0) | 54 |
| 2.7.5 | Setting the electronic gear..... | 55 |
| 2.7.6 | In-position width (Pr. 426) | 57 |
| 2.7.7 | Excessive level error (Pr. 427) | 57 |
| 2.7.8 | Pulse monitor selection (Pr. 430) | 57 |
| 2.7.9 | Concept of position control gains | 57 |
| 2.7.10 | Troubleshooting..... | 59 |
| 2.7.11 | Position control is not exercised normally | 60 |

3 PARAMETERS **61**

| | | |
|------------|--|-----------|
| 3.1 | Parameter lists (Japanese version) | 62 |
| 3.2 | Parameter lists (NA version) | 69 |
| 3.3 | At-a-glance guide to functions | 76 |
| 3.4 | Basic functions (Pr. 0 to Pr. 9) | 79 |
| 3.4.1 | Torque boost (Pr. 0) | 79 |
| 3.4.2 | Maximum and minimum speed settings (Pr. 1, Pr. 2)..... | 79 |

| | | |
|-------------|--|------------|
| 3.4.3 | Base frequency, base frequency voltage (Pr. 3, Pr. 19)..... | 80 |
| 3.4.4 | Multi-speed operation (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239) | 80 |
| 3.4.5 | Acceleration and deceleration times (Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45, Pr. 110, Pr. 111) | 81 |
| 3.4.6 | Motor overheat protection (Pr. 9, Pr. 452, Pr. 876) | 83 |
| 3.5 | Standard operation functions (Pr. 10 to Pr. 16) | 85 |
| 3.5.1 | DC injection brake (Pr. 10, Pr.11, Pr. 12, Pr.802)..... | 85 |
| 3.5.2 | Starting speed (Pr. 13)..... | 86 |
| 3.5.3 | Jog operation (Pr. 15, Pr. 16)..... | 87 |
| 3.6 | Operation selection functions 1 (Pr. 17 to Pr. 37)..... | 88 |
| 3.6.1 | Inverter output stop (MRS) (Pr. 17)..... | 88 |
| 3.6.2 | Torque restriction (Pr. 22, Pr. 803, Pr. 810, Pr. 812 to Pr. 817)..... | 89 |
| 3.6.3 | RH, RM, RL signal input compensation (Pr. 28)..... | 90 |
| 3.6.4 | S-pattern acceleration/deceleration curve (Pr. 29, Pr. 140 to Pr. 143, Pr. 380 to Pr. 383) | 91 |
| 3.6.5 | Regenerative brake duty (Pr. 30, Pr. 70)..... | 94 |
| 3.6.6 | Speed jump (Pr. 31 to Pr. 36)..... | 95 |
| 3.6.7 | Speed display (Pr. 37, Pr. 144)..... | 95 |
| 3.7 | Output terminal functions (Pr. 41 to Pr. 50)..... | 97 |
| 3.7.1 | Up-to-speed sensitivity (Pr. 41)..... | 97 |
| 3.7.2 | Speed detection (Pr. 42, Pr. 43, Pr. 50, Pr. 116)..... | 97 |
| 3.8 | Display functions 1 (Pr. 52 to Pr. 56)..... | 99 |
| 3.8.1 | Monitor display/DA1, DA2 terminal function selection (Pr. 52 to Pr. 54, Pr. 158) | 99 |
| 3.8.2 | Monitoring reference (Pr. 55, Pr. 56, Pr. 866)..... | 102 |
| 3.9 | Automatic restart (Pr. 57, Pr. 58) | 103 |
| 3.9.1 | Automatic restart after instantaneous power failure (Pr. 57, Pr. 58, Pr. 162 to Pr. 165)..... | 103 |
| 3.10 | Additional functions (Pr. 59) | 105 |
| 3.10.1 | Remote setting function selection (Pr. 59) | 105 |
| 3.11 | Brake sequence (Pr. 60, Pr. 278 to Pr. 285) | 107 |
| 3.11.1 | Brake sequence function (Pr. 60, Pr. 278 to Pr. 285)..... | 107 |
| 3.12 | Operation selection function 2 (Pr. 65 to Pr. 79)..... | 110 |
| 3.12.1 | Retry function (Pr. 65, Pr. 67 to Pr. 69)..... | 110 |
| 3.12.2 | Applied motor (Pr. 71, Pr. 450)..... | 112 |
| 3.12.3 | PWM carrier frequency selection (Pr. 72, Pr. 240)..... | 113 |
| 3.12.4 | Speed setting signal on/off selection (Pr. 73)..... | 114 |
| 3.12.5 | Reset selection/disconnected PU detection/PU stop selection (Pr. 75)..... | 116 |
| 3.12.6 | Parameter write disable selection (Pr. 77) | 117 |
| 3.12.7 | Reverse rotation prevention selection (Pr. 78)..... | 118 |
| 3.12.8 | Operation mode selection (Pr. 79) | 118 |
| 3.13 | Offline auto tuning (Pr. 80 to Pr. 96)..... | 121 |
| 3.13.1 | Offline auto tuning function (Pr. 9, Pr. 80, Pr. 81, Pr. 83, Pr. 84, Pr. 71, Pr. 96, Pr. 450, Pr. 452)..... | 121 |
| 3.13.2 | Parameters..... | 121 |
| 3.13.3 | Execution of offline auto tuning | 122 |
| 3.13.4 | Utilizing or changing offline auto tuning data for use..... | 124 |
| 3.13.5 | Setting the motor constants directly | 125 |
| 3.13.6 | Direct input + offline auto tuning..... | 126 |
| 3.14 | Online auto tuning (Pr. 95) | 126 |
| 3.14.1 | Online auto tuning selection (Pr. 95, Pr. 9, Pr. 71, Pr. 80, Pr. 81)..... | 126 |
| 3.15 | Communication functions (Pr. 117 to Pr. 124) | 128 |
| 3.15.1 | Computer link operation (RS-485 communication) (Pr. 117 to Pr. 124, Pr. 342) | 128 |
| 3.16 | PID control (Pr. 128 to Pr. 134) | 139 |
| 3.16.1 | PID control (Pr. 128 to Pr. 134)..... | 139 |

| | | |
|-------------|--|------------|
| 3.17 | Current detection (Pr. 150 to Pr. 153) | 145 |
| 3.17.1 | Output current detection function (Pr. 150, Pr. 151)..... | 145 |
| 3.17.2 | Zero current detection (Pr. 152, Pr. 153)..... | 146 |
| 3.18 | Auxiliary functions (Pr. 156, Pr. 157) | 147 |
| 3.18.1 | Stall prevention operation selection (Pr. 156) | 147 |
| 3.18.2 | OL signal output timer (Pr. 157) | 148 |
| 3.19 | Display function 3 (Pr. 160) | 149 |
| 3.19.1 | Extended function display selection (Pr. 160) | 149 |
| 3.20 | Initial monitor (Pr. 171) | 149 |
| 3.20.1 | Actual operation hour meter clear (Pr. 171) | 149 |
| 3.21 | Terminal assignment functions (Pr. 180 to Pr. 195) | 149 |
| 3.21.1 | Input terminal function selection (Pr. 180 to Pr. 183, Pr. 187) | 149 |
| 3.21.2 | Output terminal function selection (Pr. 190 to Pr. 192, Pr. 195)..... | 151 |
| 3.22 | Auxiliary function (Pr. 244) | 153 |
| 3.22.1 | Cooling fan operation selection (Pr. 244)..... | 153 |
| 3.23 | Stop selection function (Pr. 250) | 153 |
| 3.23.1 | Stop selection (Pr. 250)..... | 153 |
| 3.24 | Operation selection function (Pr. 251) | 154 |
| 3.24.1 | Output phase failure protection selection (Pr. 251)..... | 154 |
| 3.25 | Additional function 2 (Pr. 252, Pr. 253) | 155 |
| 3.25.1 | Override bias, gain (Pr. 252, Pr. 253)..... | 155 |
| 3.26 | Power failure stop functions (Pr. 261 to Pr. 266) | 155 |
| 3.26.1 | Power-failure deceleration stop function (Pr. 261 to Pr. 266)..... | 155 |
| 3.27 | Droop (Pr. 286 to Pr. 288) | 157 |
| 3.27.1 | Droop control (Pr. 286 to Pr. 288) | 157 |
| 3.28 | Orientation (Pr. 350 to Pr. 362, Pr. 393 to Pr. 399) | 158 |
| 3.28.1 | Orientation control (Pr. 350, Pr. 351, Pr. 356, Pr. 357, Pr. 360 to Pr. 362, Pr. 393, Pr. 396 to Pr. 399) 158 | |
| 3.29 | Control system function (Pr. 374) | 165 |
| 3.29.1 | Overspeed detection (Pr. 374)..... | 165 |
| 3.30 | Position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494) | 166 |
| 3.30.1 | Position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)..... | 166 |
| 3.31 | Remote Output (Pr. 495 to Pr.497) | 167 |
| 3.31.1 | Remote output function (Pr. 495 to Pr.497)..... | 167 |
| 3.32 | Additional function 3 (Pr. 591) | 168 |
| 3.32.1 | Start holding time (Pr. 591) | 168 |
| 3.33 | Operation selection functions 4 (Pr. 800 to Pr. 809) | 169 |
| 3.33.1 | Control selection (Pr. 800, Pr. 451)..... | 169 |
| 3.33.2 | Torque characteristic selection (Pr. 801)..... | 169 |
| 3.33.3 | Torque command right selection (Pr. 804 to Pr. 806) | 171 |
| 3.33.4 | Speed restriction (Pr. 807 to Pr. 809)..... | 172 |
| 3.34 | Control system functions (Pr. 818 to Pr. 837) | 174 |
| 3.34.1 | Easy gain tuning selection (Pr. 818, Pr. 819)..... | 174 |
| 3.34.2 | Speed loop proportional gain setting (Pr. 820, Pr. 830) | 174 |
| 3.34.3 | Speed control integral time setting (Pr. 821, Pr. 831) | 174 |
| 3.34.4 | Speed setting circuit filter function (Pr. 822, Pr. 832)..... | 174 |
| 3.34.5 | Speed detection filter function (Pr. 823, Pr. 833) | 175 |
| 3.34.6 | Current loop proportional gain setting for vector control (Pr. 824, Pr. 834)..... | 175 |

| | | |
|-------------|--|------------|
| 3.34.7 | Current control integral time setting for vector control (Pr. 825, Pr. 835)..... | 175 |
| 3.34.8 | Torque setting filter function (Pr. 826, Pr. 836) | 175 |
| 3.34.9 | Torque detection filter function (Pr. 827, Pr. 837) | 176 |
| 3.34.10 | Model speed control gain (Pr. 828) | 176 |
| 3.35 | Torque biases (Pr. 840 to Pr. 848) | 176 |
| 3.35.1 | Torque bias function (Pr. 840 to Pr. 848) | 176 |
| 3.36 | Additional functions (Pr. 851 to Pr. 865) | 179 |
| 3.36.1 | Selection of number of PLG pulses (Pr. 851)..... | 179 |
| 3.36.2 | Selection of PLG rotation direction (Pr. 852)..... | 179 |
| 3.36.3 | Excitation ratio (Pr. 854)..... | 180 |
| 3.36.4 | Notch filter (Pr. 862, Pr. 863)..... | 180 |
| 3.36.5 | Torque detection (Pr. 864) | 181 |
| 3.36.6 | Low speed detection (Pr. 865) | 181 |
| 3.37 | Display function (Pr. 867) | 182 |
| 3.37.1 | DA1 output response level adjustment (Pr. 867)..... | 182 |
| 3.38 | Terminal function assignment (Pr. 868)..... | 182 |
| 3.38.1 | No. 1 terminal function assignment (Pr. 868)..... | 182 |
| 3.39 | Protective functions (Pr. 870 to Pr. 874) | 183 |
| 3.39.1 | Speed deviation excessive (Pr. 870, Pr. 871) | 183 |
| 3.39.2 | Speed restriction (Pr. 873) | 184 |
| 3.39.3 | Stop by OLT level prevention (Pr. 874)..... | 184 |
| 3.40 | Operation selection functions 5 (Pr. 875) | 185 |
| 3.40.1 | Fault definition (Pr. 875)..... | 185 |
| 3.41 | Control system function 2 (Pr. 877 to Pr. 881) | 185 |
| 3.41.1 | Speed feed forward control, model adaptive speed control (Pr. 877 to Pr. 881)..... | 185 |
| 3.42 | Maintenance function (Pr. 890 to Pr. 892)..... | 186 |
| 3.42.1 | Maintenance output function (Pr. 890 to Pr. 892)..... | 186 |
| 3.43 | Calibration functions (Pr. 900 to Pr. 920)..... | 187 |
| 3.43.1 | DA1/DA2 terminal calibration (Pr. 900, Pr. 901)..... | 187 |
| 3.43.2 | Biases and gains of speed setting terminals (speed setting No. 2, torque command No.3, multi function No. 1 terminal) (Pr. 902 to Pr. 905, Pr. 917 to Pr. 920)..... | 189 |
| 3.44 | Additional function (Pr. 990) | 192 |
| 3.44.1 | Buzzer control (Pr. 990) | 192 |

4 SPECIFICATIONS 193

| | | |
|------------|---|------------|
| 4.1 | Model specifications..... | 194 |
| 4.2 | Common specifications | 196 |
| 4.3 | Outline dimension drawings | 197 |
| 4.3.1 | Inverter outline dimension drawings..... | 197 |
| 4.3.2 | Operation panel (FR-DU04-1) outline dimension drawings..... | 199 |
| 4.3.3 | Parameter unit (FR-PU04V) outline dimension drawings..... | 199 |
| 4.3.4 | PLG connection cable outline dimension drawings..... | 199 |
| 4.3.5 | Mitsubishi dedicated motor outline dimension drawings (1500r/min series)..... | 202 |

APPENDICES 203

| | | |
|----------|--------------------------------|-----|
| Appendix | Parameter Data Code Lists..... | 204 |
|----------|--------------------------------|-----|

1

WIRING

This chapter describes the basic "wiring" for use of this product.

Always read the instructions and other information before using the equipment.

| | | |
|-------------|---|-----------|
| 1.1 | Internal block diagram | 2 |
| 1.2 | Main circuit terminal specifications | 3 |
| 1.3 | Connection of stand-alone option units | 4 |
| 1.4 | Control circuit terminal specifications..... | 8 |
| 1.5 | Precautions for use of the vector inverter | 10 |
| 1.6 | Others..... | 11 |
| 1.7 | Input terminals | 23 |
| 1.8 | How to use the input signals (assigned terminals DI1 to DI4, STR) (Pr. 180 to Pr. 183, Pr. 187)..... | 27 |
| 1.9 | How to use the output signals (assigned terminals DO1 to DO3, ABC) (Pr. 190 to Pr. 192, Pr. 195) | 31 |
| 1.10 | Design information to be checked | 33 |
| 1.11 | Using the second motor | 34 |
| 1.12 | Using the conventional Mitsubishi motor and other motors..... | 35 |

<Abbreviations>

- DU : Operation panel (FR-DU04-1)
- PU : Operation panel (FR-DU04-1) and parameter unit (FR-PU04V)
- Inverter : Mitsubishi vector inverter FR-V500L series
- Pr. : Parameter number
- PU operation : Operation using the PU (FR-DU04-1/FR-PU04V)
- External operation : Operation using the control circuit signals
- Combined operation : Operation using both the PU (FR-DU04-1/FR-PU04V) and external operation
- Mitsubishi dedicated motor : SF-THY
- Mitsubishi motor with PLG : SF-LHA
- Mitsubishi constant-torque motor : SF-LHCA
- MARATHON constant-torque motor : Blue Max® 2000

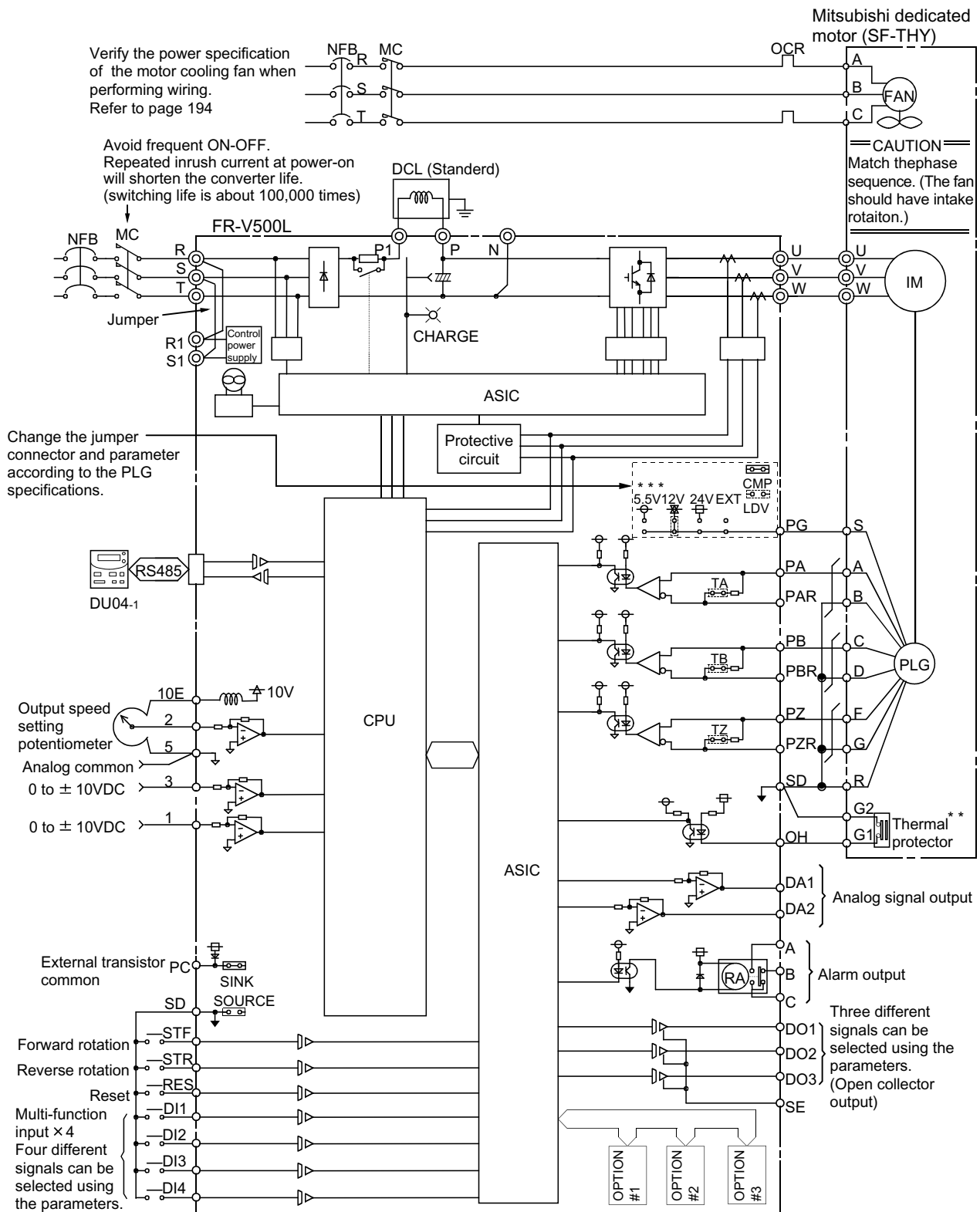
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2

3

4

1.1 Internal block diagram




CAUTION

1. Always earth (ground) the inverter, motor and DCL.
2. **: When using an external thermal relay protection, set "1" (external thermal relay valid) in Pr. 876. (factory setting) (Refer to page 83.)
3. ***: The setting of the PLG power supply jumper connector and output circuit connector when shipped from the factory.

| | Japanese Version | NA Version |
|-----------------------------------|---------------------|--------------------------------|
| PLG power supply jumper connector | 12V | 5V |
| Output circuit jumper connector | Complimentary (CMP) | Differential line driver (LDV) |

1.2 Main circuit terminal specifications

| Terminal Symbol | Terminal Name | Description |
|---|--|---|
| R, S, T | AC power input | Connect to the commercial power supply. Keep these terminals open when using the high power factor converter (MT-HC). |
| U, V, W | Inverter output | Connect a three-phase squirrel-cage motor or the Mitsubishi dedicated motor. |
| R1, S1 | Power supply for control circuit | Connected to the AC power supply terminals R and S. To retain the alarm display and alarm output or when using the high power factor converter (MT-HC), remove the jumpers from terminals R-R1 and S-S1 and apply external power to these terminals. Do not turn off the power supply for control circuit (R1, S1) with the main circuit power (R, S, T) on. Doing so may damage the inverter. The circuit should be configured so that the main circuit power (R, S, T) is also turned off when the power supply for control circuit (R1, S1) is off. 80VA |
| P, N | Brake unit connection | Connect the optional MT-BU5 type brake unit, power return converter (MT-RC) or high power factor converter (MT-HC). |
| P, P1 | Power factor improving DC reactor connection | Connect DC reactor. |
|  | Earth (Ground) | For earthing (grounding) the inverter chassis. Must be earthed (grounded). |

CAUTION

- **The inverter will be damaged if power is applied to the inverter output terminals (U, V, W). Never perform such wiring.**

1.3 Connection of stand-alone option units

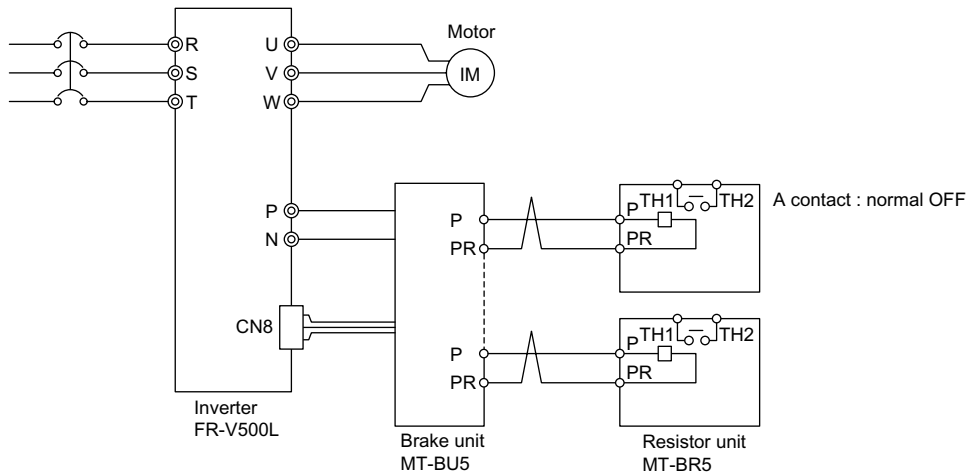
The inverter accepts a variety of stand-alone option units as required.

Incorrect connection will cause inverter damage or accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

1.3.1 Connection of the MT-BU5 brake unit (option)

Connect the BU brake unit correctly as shown below. Incorrect connection will damage the inverter.

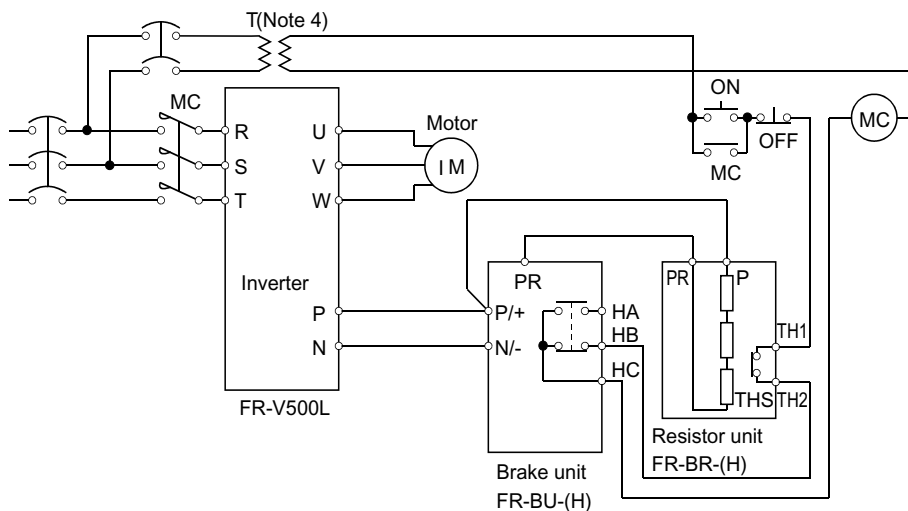
Set "1" in Pr.30 "regenerative function selection". And set the regenerative brake duty in Pr.70 "special regenerative brake duty".



- Note :
1. The wiring distance between the inverter, brake unit and discharge resistor should be used with in the cables which are attached on this unit (because of cable length). Resistor Unit must be installed in Air flow area. If twisted wires are used, the distance should be within 5m.
 2. If the transistors in the brake unit should fail, the resistor will be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off a current in case of failure. Make a sequence circuit with TH1-TH2 (Dry a contact).
 3. The wiring distance between brake unit and resistor should be within 10m with twisted wires. If not twisted wires, within 5m.
 4. The attached cable on this unit should be used for the wiring between brake unit and Inverter. Power cable are connected with P/N terminals. Control cable should be connected to LL connector (CN8) through rubber shield. Cut the rubber shield properly.
 5. P, PR terminals are prepared for number of used Resistor Unit.

1.3.2 Connection of the FR-BU brake unit (option)

Connect the optional FR-BU brake unit as shown below to improve the braking capability during deceleration. Set "1" in Pr.30 "regenerative function selection". And set the regenerative brake duty in Pr.70 "special regenerative brake duty".



- Note :
1. Connect the inverter terminals (P, N) and FR-BU brake unit terminals so that their terminal signals match with each other. (Incorrect connection will damage the inverter.)
 2. The wiring distance between the inverter, brake unit and resistor unit should be within 5m. If twisted wires are used, the distance should be within 10m.
 3. If the transistors in the brake unit should fail, the resistor will be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off a current in case of failure.
 4. For the power supply of 400V class, install a voltage-reducing transformer.

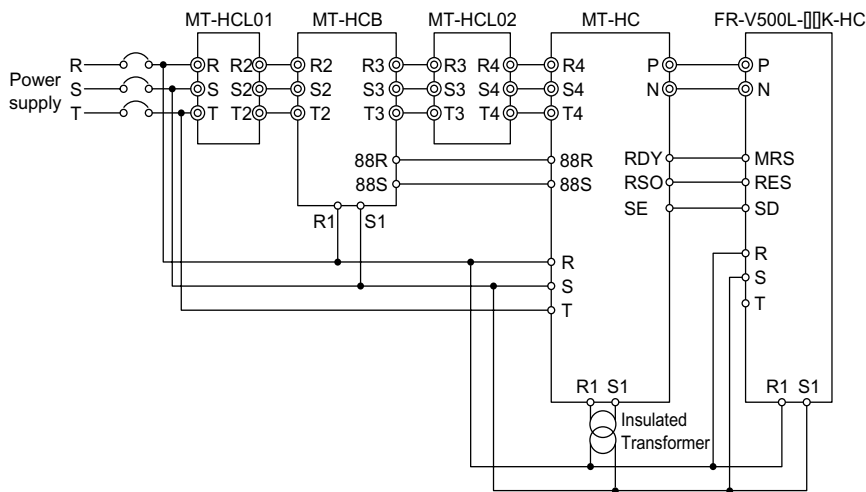
Connection of stand-alone option units

1.3.3 Connection of the MT-HC high power factor converter (option)

When connecting the high power factor converter (MT-HC) to suppress power harmonics, wire as shown below. Wrong connection will damage the high power factor converter and inverter.

After making sure that the wiring is correct, set "2" in Pr. 30 "regenerative function selection".

Inverter must be used "-HC" type Inverter.

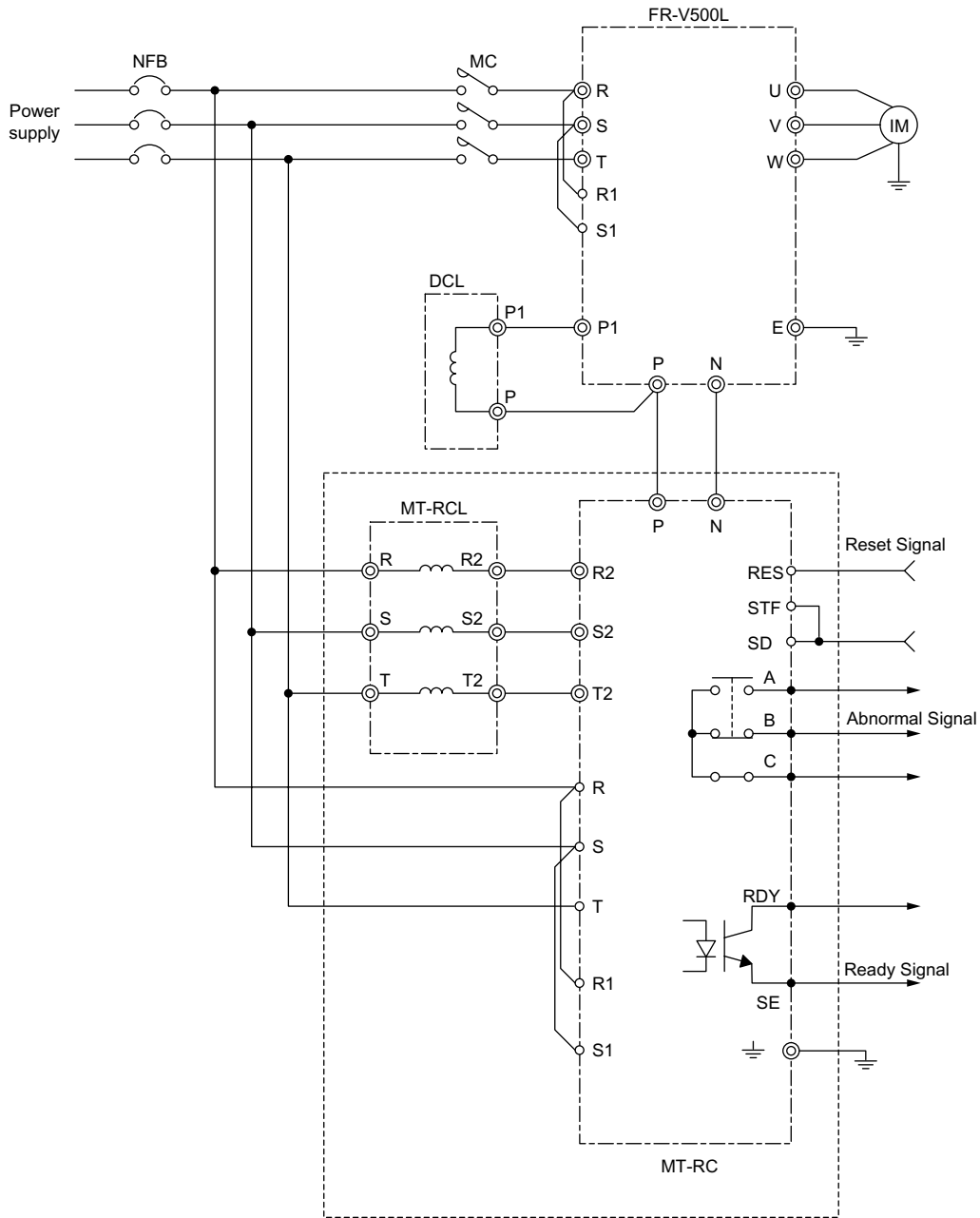


- Note :
1. Remove the jumpers across terminals R-R1 and S-S1 of the inverter and connect the control circuit power supply to terminals R1-S1. The power input terminals R, S, T must be kept open. Accidental connection to these terminals will damage the inverter. Opposite polarity of terminals N, P will also damage the inverter.
 2. Always match the voltage phases of terminals R, S, T and terminals R4, S4, T4 before making connection.
 3. When connecting the MT-HC, use sink logic (factory setting). For source logic, the MT-HC cannot be connected.

1.3.4 Connection of the MT-RC power return converter (option)

(For power coordination, always install the power factor-improving reactor (MT-RCL).)

When connecting the MT-RC power return converter, connect the inverter terminals (P, N) and MT-RC power return converter terminals as shown below so that their signals match with each other. After making sure that the wiring is correct, set "1" in Pr. 30 "regenerative function selection" and "0" in Pr.70 "regenerative power (%)".



Note : How to connect the MT-BAL power factor improving AC reactor (option)
Refer to MT-RC manual.

1.4 Control circuit terminal specifications

| Type | Terminal Symbol | Terminal Name | Description | | Rated Specifications | |
|---------------|-----------------|--|--------------------------------|--|---|--|
| Input signals | Contact input | STF | Forward rotation start | Turn on the STF signal to start forward rotation and turn it off to stop. | Input resistance 4.7kΩ Voltage at opening 21 to 27VDC Current at short-circuited 4 to 6mADC Control by open collector output or 0V contact signal | |
| | | STR | Reverse rotation start | Turn on the STR signal to start reverse rotation and turn it off to stop. The terminal function varies with the input terminal function selection (Pr. 187) setting. Refer to page 149 for details. | | |
| | | DI1 to DI4 | Digital input terminals 1 to 4 | The terminal functions vary with the input terminal function selection (Pr. 180 to Pr. 183) settings. Refer to page 149 for details. | | |
| | | OH | Thermal protector input | Temperature sensor terminal input for motor overheat protection. OHT error occurs when terminals OH and SD are open. | Input resistance 150kΩ Voltage at opening 21 to 27VDC Current at short-circuited 140 to 180mADC Isolate by photocoupler | |
| | | RES | Reset | Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1s, then turn it off. It takes about 1s for reset. | Input resistance 4.7kΩ Voltage at opening 21 to 27VDC Current at short-circuited 4 to 6mADC Control by open collector output or 0V contact signal. | |
| | | SD | Contact input common (sink) | Contact input common terminal. Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE. | — | |
| | Speed setting | 24VDC power supply and external transistor common, contact input common (source) | PC | When connecting a transistor output (open collector output) such as a programmable controller, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by a sneak current. PC-SD can be used as a 24VDC and 0.1A power supply. Note that a sneak current may not be prevented in this case. When source logic has been selected, this terminal serves as a contact input common. | Voltage range 18 to 26 VDC Permissible load current 0.1A | |
| | | | 10E | Speed setting power supply | Used as power supply when connecting volume for speed setting (torque setting) from outside of the inverter. (terminal 5 is a common terminal) | 10VDC±0.4V Permissible load current 10mA |
| | | | 2 | Speed setting (voltage) | By entering 0 to 10VDC, the maximum output speed is reached at 10V and I/O are proportional. | Input resistance 10kΩ±1kΩ Permissible maximum voltage 20VDC |
| | | | 3 | Torque setting terminal | Acts as a torque setting signal for torque control or as a torque restriction signal for speed control or position control. Acts as an input terminal for the external analog-based torque bias function. 0 to ±10VDC input | |
| | | | 1 | Multi-function setting terminal | Since this is a multi-function selection terminal, its function varies with the Pr.868 "No. 1 terminal function assignment" setting. Refer to page 182 for details. 0 to ±10VDC input | |
| | | | 5 | Speed setting common, Analog signal output common | Common terminal for speed setting signal (terminal 2, 1 or 3) or DA1 and DA2. Isolated from terminals SD and SE. Do not earth (ground). | — |


| Type | Terminal Symbol | Terminal Name | Description | Rated Specifications | |
|----------------|-----------------|---------------|---|--|---|
| Input signals | PLG signal | PA | A-phase signal input terminal | Differential line receiver input (AM26LS32 equivalent) or complimentary input | |
| | | PAR | A-phase inverted signal input terminal | Differential line receiver input (AM26LS32 equivalent) | |
| | | PB | B-phase signal input terminal | A-, B- and Z-phase signals are input from the PLG. For the Japanese version, the jumper connector is factory-set to complimentary. Thus, the PLG need not be connected to PAR, PBR, and PZR. | Differential line receiver input (AM26LS32 equivalent) or complimentary input |
| | | PBR | B-phase inverted signal input terminal | For the NA version, the jumper connector is factory-set to differential line driver. Check the phase sequence before connecting. | Differential line receiver input (AM26LS32 equivalent) |
| | | PZ | Z-phase signal input terminal | | Differential line receiver input (AM26LS32 equivalent) or complimentary input |
| | | PZR | Z-phase inverted signal input terminal | | Differential line receiver input (AM26LS32 equivalent) |
| | | PG | PLG power supply terminal (Positive side) | Power supply for PLG. You can switch the power supply between 5, 12 and 24VDC. Can be switched to the external power supply. For the Japanese version, the jumper connector is factory-set to 12VDC. For the NA version, the jumper connector is factory-set to 5VDC. (Refer to the Instruction Manual (basic) for the switchover method.) | 5.5VDC 350mA 12VDC 150mA 24VDC 80mA |
| | | SD | Contact input common (sink), Power supply earth (ground) terminal | Common terminal for contact input or PLG power supply. Isolated from terminals 5 and SE. Do not earth (ground). | Power supply common |
| Output signals | Contact | A, B, C | Alarm output | Switch-over contact output indicating that the output has been stopped by the inverter protective function. 230VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C). The terminal function varies with the output terminal function selection (Pr. 195) setting. Refer to page 151 for details. | Contact output Permissible contact 230VAC 0.3A 30VDC 0.3A |
| | Open collector | DO1 to DO3 | Digital output terminals 1 to 3 | The terminal functions vary with the output terminal function selection (Pr. 190 to Pr. 192) settings. Refer to page 151 for details. | Open collector output Permissible load 24VDC 0.1A |
| | | SE | Open collector output common | Common terminal for terminals DO1, DO2 and DO3. Isolated from terminals SD and 5. | — |
| | Analog | DA1, DA2 | Analog signal output | One selected from monitoring items, such as the speed, is output.* The output signal is proportional to the magnitude of the corresponding monitoring item. | 0 to ±10VDC Permissible load current 1mA Resolution 12 bit load impedance 10kΩ or more |
| | | 5 | Analog signal output common | Common terminal for DA1 and DA2. Isolated from terminals SD and SE. Do not earth (ground). | |
| Communication | RS-485 | — | PU connector | With the PU connector, communication can be made through RS-485. • Conforming standard : EIA Standard RS-485 • Transmission format : Multidrop link system • Communication speed : Maximum. 19200bps • Overall length : 500m (1640.42 feet) | |

* Not output during inverter reset.

1.5 Precautions for use of the vector inverter

The FR-V500L 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) Use insulation-sleeved crimping terminals for the power supply and motor cables.
- (2) Power must not be applied to the output terminals (U, V, W) of the inverter. Otherwise the inverter will be damaged.
- (3) After wiring, wire off-cuts must not be left in the inverter.
Wire off-cuts can cause an alarm, fault or malfunction. Always keep the inverter clean.
When drilling mounting holes in a control box or the like, use care not to allow chips etc. to enter the inverter.
- (4) Wire the cables of the recommended size to make a voltage drop 2% or less.
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 high frequency.
 Refer to Instruction Manual (basic) for the recommended wire sizes.
- (5) The overall wiring length should be 100m (328.08 feet) maximum.
Especially for long distance wiring, the fast-response current restriction function may be reduced or the equipment connected to the secondary 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.
- (6) Electromagnetic wave interference
The input/output (main circuit) of the inverter includes harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install the optional FR-BIF radio noise filter (for use in the input side only) or FR-BLF line noise filter to minimize interference.
- (7) Do not install a power factor correction capacitor, surge suppressor or radio noise filter (FR-BIF option) in the output side of the inverter.
This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is installed, immediately remove it. (When the FR-BIF radio noise filter is connected, switching power off during motor operation may result in E. UVT. In this case, connect the radio noise filter in the primary side of the magnetic contactor.)
- (8) When rewiring after operation, switch power off, wait for more than 10 minutes, and then make sure that the voltage is zero using a tester, etc. For some time after power-off, there is a dangerous voltage in the capacitor.
- (9) A short circuit or earth (ground) fault in 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.
 - Fully check the to-earth (ground) insulation and inter-phase insulation of the inverter secondary side before power-on.
Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance etc.
- (10) Do not use the inverter power supply side magnetic contactor to start/stop the inverter.
Always use the start signal (turn on/off terminals STF, STR-SD) to start/stop the inverter. (Refer to page 12.)
- (11) Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.
Application (contact) of a voltage higher than the permissible voltage to the inverter I/O signal circuits or opposite polarity may damage the I/O devices. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short terminals 10E-5.
- (12) Use of single-phase power supply
Do not use single-phase power input.
- (13) Precautions for use of any motor other than the vector control dedicated motor (SF-THY : Japan, MARATHON Blue Max : NA)
 - a) Vector control cannot be exercised without PLG.
 - b) Connect the PLG directly to the backlash-free motor shaft.
- (14) Since the rated voltage differs from the commercial power supply voltage.

● Capacity (VA) of separate power supply

The capacity is 80VA when separate power is supplied from R1, S1.

1.6 Others

1.6.1 Leakage currents and countermeasures

Leakage currents flow through static capacitances existing in the inverter I/O wiring and motor. Since their values depend on the static capacitances, carrier frequency, etc., take the following measures.

(1) To-earth (ground) leakage currents

Leakage currents may flow not only into the inverter's own line but also into the other lines through the earth (ground) cable, etc.

These leakage currents may operate earth (ground) leakage breakers and earth (ground) leakage relays unnecessarily.

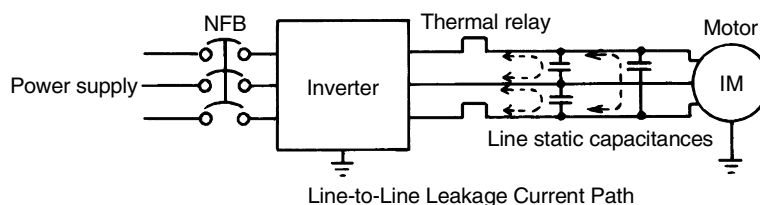
● Countermeasures

- When the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter. Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- Earth (Ground) leakage breakers designed for harmonics and surges can be used in the inverter's own line and other lines to perform operation with the carrier frequency high (with low noise).

(2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacitances between the inverter output cables may operate the external thermal relay unnecessarily.

● Line-to-line leakage current data example (200V class)



*The leakage currents of the 400V class are about twice as large.

● Measures

- Use the electronic thermal relay (Pr. 9) of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.

● Installation and selection of no-fuse breaker

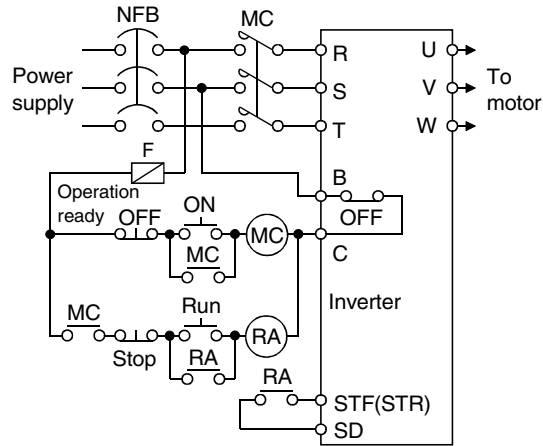
Install a no-fuse breaker (NFB) on the power receiving side to protect the wiring of the inverter primary side. Select the NFB according to the power supply side power factor (which depends on the power supply voltage, output frequency and load). Especially for a completely electromagnetic NFB, one of a slightly large capacity must be selected since its operation characteristic varies with harmonic currents. (Check it in the data of the corresponding breaker.) As an earth (ground) leakage breaker, use the Mitsubishi earth (ground) leakage breaker designed for harmonics and surges (Progressive Super Series).

1.6.2 Power off and magnetic contactor (MC)

CAUTION

- Do not use the inverter power supply side magnetic contactor to start/stop the inverter.
- Do not provide a magnetic contactor on the inverter output side and turn it on-off during operation.
Turning it on during inverter operation can cause a large starting current to flow, resulting in a fault.

As shown on the right, always use the start signal (turn on/off terminals STF, STR-SD) to start/stop the inverter. (Refer to page 23.)



Inverter Start/Stop Circuit Example

(1) Inverter primary side magnetic contactor (MC)

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

(📖 Refer to the Instruction Manual (basic) for selection.)

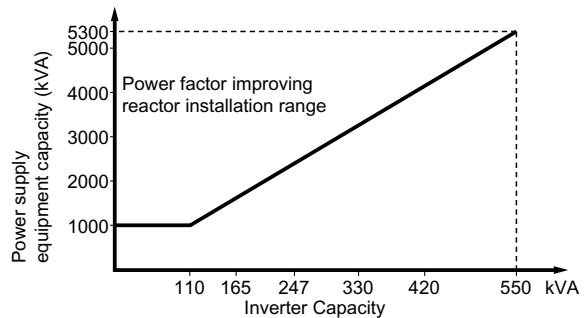
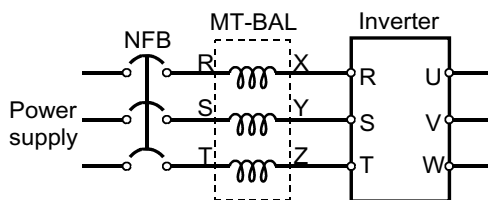
- 1) To release the inverter from the power supply when the inverter protective function is activated or the drive becomes faulty (e.g. emergency stop operation)
When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, over-heat and burnout of the electrical-discharge resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the electrical-discharge 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 safe maintenance and inspection work
Since the MC on the inverter primary side is used for the above purposes, they correspond to the standard duties. Therefore, when making an emergency stop during running, select a JEM1038 class AC3 MC for the inverter input side currents.

REMARKS

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 (switching life is about 100,000 times), frequent starts and stops must be avoided. Turn on/off the inverter start controlling terminals (STF, STR) to run/stop the inverter.

1.6.3 Installation of power factor improving reactor

When the inverter is connected near a large-capacity power transformer or when a power capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install the power factor improving reactor (MT-BAL).



1.6.4 Notes on earthing (grounding)

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be earthed (grounded).
- Use the dedicated earth (ground) terminal to earth (ground) the inverter. (Do not use the screw in the case, chassis, etc.)
- Use the largest possible gauge for the earth (ground) cable. The gauge should be equal to or larger than 38mm². The earthing (grounding) point should be as near as possible to the inverter to minimize the earth (ground) cable length.

For use as a Low Voltage Directive-compliant product, use the PVC cables indicated in the parentheses for earthing (grounding).

- Earth (ground) the motor on the inverter side using one wire of the 4-core cable.
- 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 flow 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):

(a) Where possible, use independent earthing (grounding) for the inverter.

If independent earthing (grounding) (I) is impossible, use joint earthing (grounding) (II) where the inverter is connected with the other equipment at an earthing (grounding) point. Joint earthing (grounding) as in (III) must be avoided as the inverter is connected with the other equipment by a common earth (ground) cable. Also a leakage current including many high frequency components flows in the earth (ground) cables of the inverter and inverter-driven motor. Therefore, they must use the independent earthing (grounding) method and be separated from the earthing (grounding) of equipment sensitive to the aforementioned noises.

In a tall building, it will be a good policy to use the noise malfunction prevention type earthing (grounding) with steel frames and carry out electric shock prevention type earthing (grounding) in the independent earthing (grounding) method.

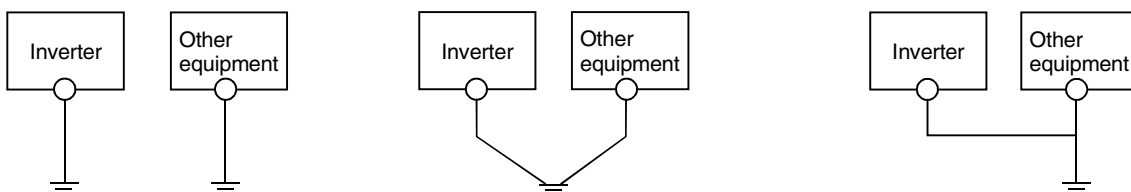
(b) Perform earthing (grounding) work with the earth resistance of less than 10Ω.

(c) Use the thickest possible earth (ground) cable. The earth (ground) cable should be of not less than the size indicated in 38mm².

(d) The earthing (grounding) point should be as near as possible to the inverter to minimize the earth (ground) cable length.

(e) 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.

(f) Use one wire in a 4-core cable with the earth (ground) terminal of the motor and earth (ground) it on the inverter side.



(I) Independent earthing (grounding) ... Best (II) Joint earthing (grounding) ... Good (III) Joint earthing (grounding) ... Not allowed

1.6.5 Inverter-generated noises and their reduction techniques

Some noises enter the inverter to malfunction it and others are radiated by the inverter to malfunction peripheral devices. Though the inverter is designed to be insusceptible to noises, it handles low-level signals, so it requires the following basic techniques. Also, since the inverter chops outputs at high carrier frequency, that could generate noises. If these noises cause peripheral devices to malfunction, measures should be taken to suppress noises. These techniques differ slightly depending on noise propagation paths.

1) Basic techniques

- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted pair shielded cables for the detector connection and control signal cables, and connect the sheathes of the shield cables to terminal SD.
- Earth (Ground) the inverter, motor, etc. at one point.

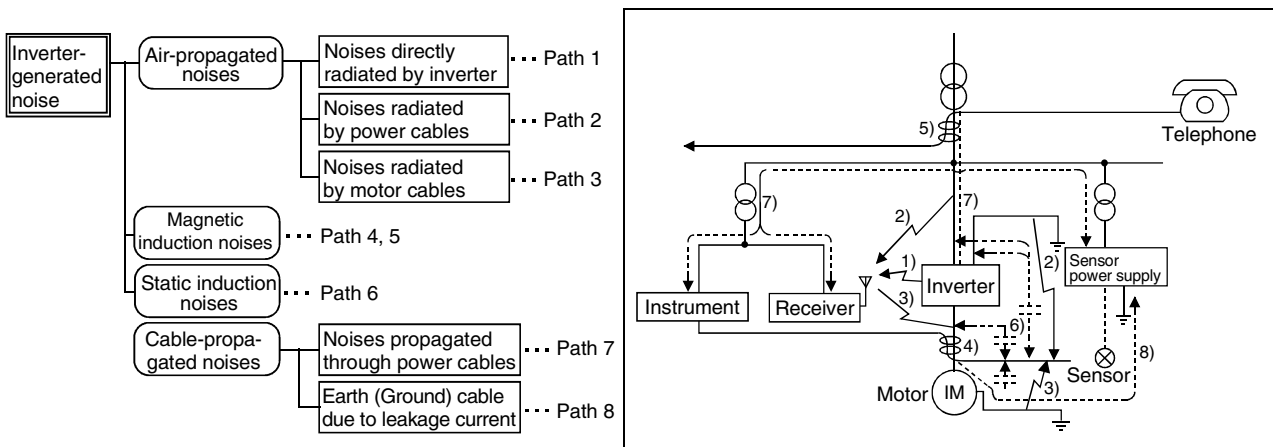
2) Techniques to reduce noises that enter and malfunction the inverter

When devices that generate many noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter and the inverter may be malfunctioned by noises, the following measures must be taken:

- Provide surge suppressors for devices that generate many noises to suppress noises.
- Fit data line filters (page 15) to signal cables.
- Earth (Ground) the shields of the detector connection and control signal cables with cable clamp metal.

3) Techniques to reduce noises that are radiated by the inverter to malfunction peripheral devices

Inverter-generated noises are largely classified into those radiated by the cables connected to the inverter and inverter main circuits (I/O), those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.



- Using shield cables as signal cables, induction noise can be reduced greatly (to 1/10 - 1/100). Induction noise can also be reduced by separating the signal cables from the inverter output cables. (Separation of 30cm (11.8 inches) reduces noise to 1/2-1/3.)

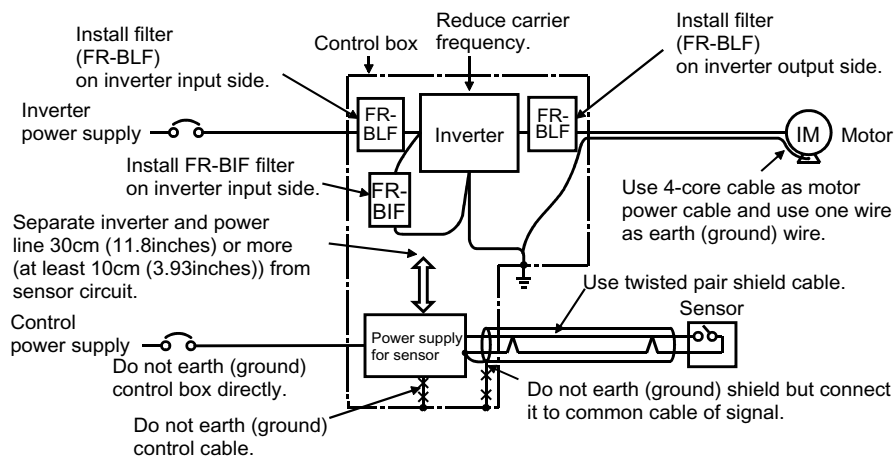
By fitting the FR-BLF on the inverter output side, induction noise to the signal cables can be reduced.

| Noise Propagation Path | Measures |
|------------------------|---|
| 1), 2), 3) | <p>When devices that handle low-level signals and are liable to malfunction due to noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may be malfunctioned by air-propagated noises. The following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter and its I/O cables. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Insert line noise filters into I/O and radio noise filters into input to suppress cable-radiated noises. (5) Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects. |
| 4), 5), 6) | <p>When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to malfunction the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the I/O cables of the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects. |
| 7) | <p>When the power supplies of the peripheral devices are connected to the power supply of the inverter in the same line, inverter-generated noises may flow back through the power supply cables to malfunction the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install the radio noise filter (FR-BIF) to the power cables (input cables) of the inverter. (2) Install the line noise filter (FR-BLF) to the power cables (I/O cables) of the inverter. |
| 8) | <p>When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage currents may flow through the earth (ground) cable of the inverter to malfunction the device. In such a case, disconnection of the earth (ground) cable of the device may cause the device to operate properly.</p> |

● **Data line filters**

Noise entry can be prevented by providing a data line filter for the detector cable etc.

● **Example of noise reduction techniques**



1.6.6 Power harmonics

Power harmonics may be generated from the converter section of the inverter, affecting the power supply equipment, power capacitors, etc. Power harmonics are different in generation source, frequency and transmission path from radio frequency (RF) noise and leakage currents. Take the following measures.

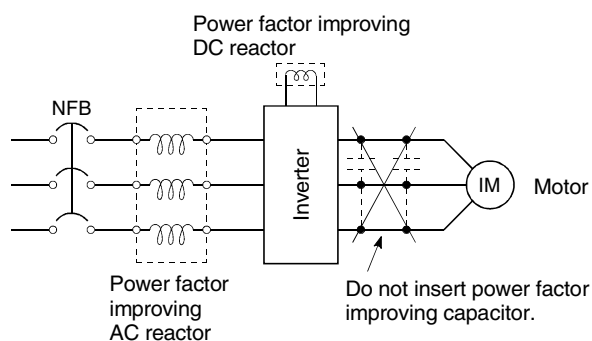
● **The differences between harmonics and RF noises are indicated below:**

| Item | Harmonics | RF Noise |
|-----------------------------|---|--|
| Frequency | Normally 40 to 50th degrees (3kHz or less) | High frequency (several 10kHz to 1GHz order) |
| Environment | To wire paths, power impedance | Across spaces, distance, laying paths |
| Quantitative understanding | Logical computation is possible | Occurs randomly, quantitative understanding is difficult. |
| Generated amount | Approximately proportional to load capacity | According to current fluctuation rate (larger with faster switching) |
| Immunity of affected device | Specified in standards for each device. | Differs according to maker's device specifications. |
| Examples of safeguard | Install a reactor. | Increase the distance. |

● **Safeguard**

The harmonic current generated from the inverter to the power supply differs according to various conditions such as the wiring impedance, whether a power factor improving reactor is used or not, and output frequency and output current on the load side.

For the output frequency and output current, the adequate method is to obtain them under rated load at the maximum operating frequency.



CAUTION

A power factor improving capacitor or surge suppressor on the inverter's output side may overheat or be damaged due to the harmonics of the inverter output. Also, when an overcurrent flows in the inverter, the overcurrent protection is activated. Hence, when the motor is driven by the inverter, do not install a capacitor or surge suppressor on the inverter's output side. To improve the power factor, insert a power factor improving reactor on the inverter's primary side or in the DC circuit.

1.6.7 Japanese harmonic suppression guidelines

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guidelines were established to protect other consumers from these outgoing harmonic currents.

1) "Harmonic suppression guideline for specific consumers"

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or especially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that consumer to take certain suppression measures.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW(1.3HP) Contract Power

| 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 |
| 22kV | 1.8 | 1.3 | 0.82 | 0.69 | 0.53 | 0.47 | 0.39 | 0.36 |
| 33kV | 1.2 | 0.86 | 0.55 | 0.46 | 0.35 | 0.32 | 0.26 | 0.24 |

(1) Application of the harmonic suppression guideline for specific consumers

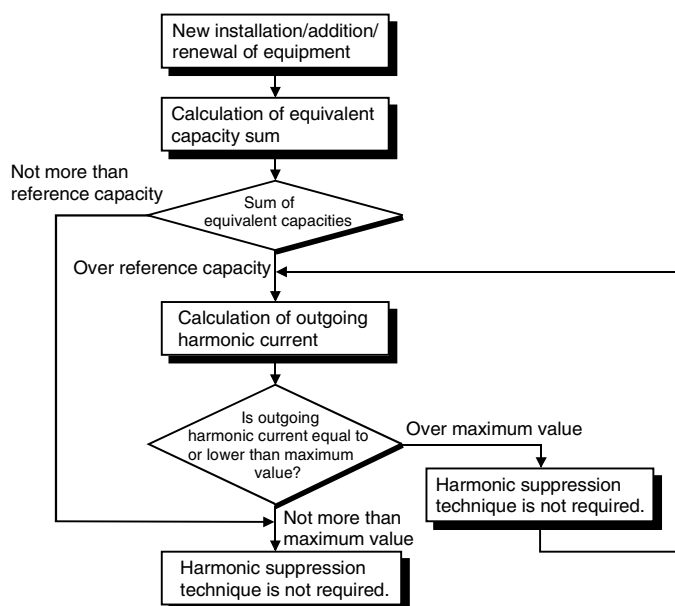


Table 2 Conversion Factors for FR-V500 Series

| Class | Circuit Type | | Conversion Factor Ki |
|-------|--|--|----------------------|
| 3 | 3-phase bridge (Capacitor-smoothed) | Without reactor | K31 = 3.4 |
| | | With reactor (AC side) | K32 = 1.8 |
| | | With reactor (DC side) | K33 = 1.8 |
| | | With reactors (AC, DC sides) | K34 = 1.4 |
| 5 | Self-exciting 3-phase bridge | When high power factor converter is used | K5 = 0 |

Table 3 Equivalent Capacity Limits

| Received Power Voltage | Reference Capacity |
|------------------------|--------------------|
| 6.6kV | 50kVA |
| 22/33kV | 300kVA |
| 66kV or more | 2000kVA |

Table 4 Harmonic Content (Assuming that the fundamental current is 100%)

| Reactor | 5th | 7th | 11th | 13th | 17th | 19th | 23rd | 25th |
|---------------------|-----|------|------|------|------|------|------|------|
| Not used | 65 | 41 | 8.5 | 7.7 | 4.3 | 3.1 | 2.6 | 1.8 |
| Used (AC side) | 38 | 14.5 | 7.4 | 3.4 | 3.2 | 1.9 | 1.7 | 1.3 |
| Used (DC side) | 30 | 13 | 8.4 | 5.0 | 4.7 | 3.2 | 3.0 | 2.2 |
| Used (AC, DC sides) | 28 | 9.1 | 7.2 | 4.1 | 3.2 | 2.4 | 1.6 | 1.4 |

- 1) Calculation of equivalent capacity P0 of harmonic generating equipment
 The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

$$P0 = \sum Ki \times Pi \text{ [kVA]}$$

- Ki: Conversion factor (refer to Table 2)
- Pi: Rated capacity of harmonic generating equipment* [kVA]
- i : Number indicating the conversion circuit type

* Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

- 2) Calculation of outgoing harmonic current
Outgoing harmonic current = fundamental wave current (value converted from received power voltage)
× operation ratio × harmonic content
- Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
 - Harmonic contents: Found in Table 4

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive

| Applied Motor kW (HP) | Rated Current [A] | | Fundamental Wave Current Converted from 6.6kV (mA) | Rated Capacity (kVA) | Outgoing Harmonic Current Converted from 6.6kV (mA) (No reactor, 100% operation ratio) | | | | | | | |
|-----------------------|-------------------|------|--|----------------------|--|-------|-------|-------|-------|------|------|------|
| | 200V | 400V | | | 5th | 7th | 11th | 13th | 17th | 19th | 23rd | 25th |
| 75 | 245 | 123 | 8,200 | 87 | 2,460 | 1,066 | 689 | 410 | 385 | 262 | 246 | 180 |
| 90 | - | 147 | 9,800 | 104 | 2,940 | 1,274 | 823 | 490 | 461 | 314 | 294 | 216 |
| 110 | - | 180 | 11,933 | 127 | 3,580 | 1,551 | 1,002 | 597 | 561 | 382 | 358 | 263 |
| 132 | - | 216 | 14,400 | 153 | 4,320 | 1,872 | 1,210 | 720 | 677 | 461 | 432 | 317 |
| 160 | - | 258 | 17,200 | 183 | 5,160 | 2,236 | 1,445 | 860 | 808 | 550 | 516 | 378 |
| 200 | - | 323 | 21,553 | 229 | 6,460 | 2,799 | 1,809 | 1,077 | 1,012 | 689 | 646 | 474 |
| 220 | - | 355 | 23,667 | 251 | 7,100 | 3,077 | 1,988 | 1,183 | 1,112 | 757 | 710 | 521 |
| 250 | - | 403 | 26,867 | 285 | 8,606 | 3,493 | 2,257 | 1,343 | 1,263 | 860 | 806 | 591 |

- 3) Harmonic suppression technique requirement
 If the outgoing harmonic current is higher than the maximum value per 1kW(1.3HP) contract power × contract power, a harmonic suppression technique is required.

4) Harmonic suppression techniques

| No. | Item | Description |
|-----|--|--|
| 1 | Reactor installation (ACL, DCL) | Install a reactor (ACL) on the AC side of the inverter or a reactor (DCL) on its DC side or both to suppress outgoing harmonic currents. |
| 2 | High power factor converter (MT-HC) | The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (MT-HC) is used with the standard accessory. |
| 3 | Installation of power factor improving capacitor | When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents. |
| 4 | Transformer multi-phase operation | Use two transformers with a phase angle difference of 30° as in λ -delta, delta-delta combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents. |
| 5 | Passive filter (AC filter) | A capacitor and a reactor are used together to reduce impedance at specific frequencies, producing a great effect of absorbing harmonic currents. |
| 6 | Active filter | This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents. |

1.6.8 Inverter-driven 400V class 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:

• **Measures**

It is recommended to take either of the following measures.

(1) Rectifying the motor insulation

For the 400V class motor, use an inverter duty motor. Specifically,

- 1) Specify the "400V class inverter-driven, inverter duty motor".
- 2) For the dedicated motor such as the constant-torque motor or low-vibration motor, use the "inverter-driven, dedicated motor".

CAUTION

- **If the wiring length between the motor and inverter is 40m(131.23feet) or longer, set Pr. 240 to long wiring mode in addition to the above measures to operate the inverter. (Refer to page 113 for Pr. 240 "soft-PWM selection".)**

1.6.9 Using the PU connector for Computer link

(1) When connecting the operation panel or parameter unit using a connection cable

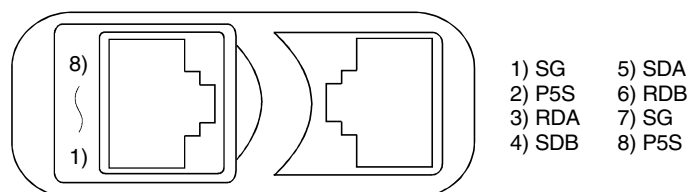
 Refer to the Instruction Manual (basic).

(2) For RS-485 communication

The PU connector can be used to perform communication operation from a personal computer etc. By connecting the PU connector to computers such as a personal computer and Factory Automation computer with a communication cable, you can monitor the inverter operation and read and write parameters using a user program.

<PU connector pin-outs>

Viewed from the inverter (receptacle side) front

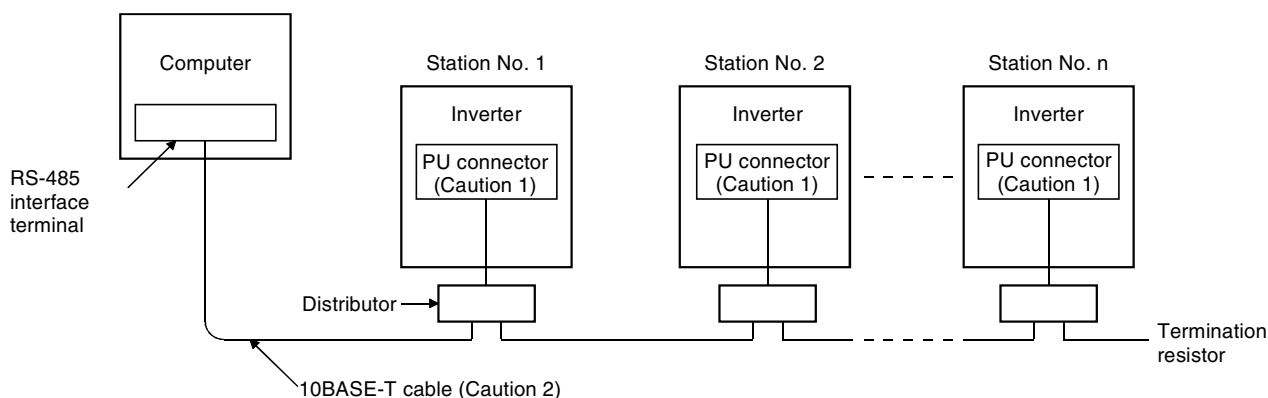


CAUTION

1. Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. Otherwise, the product may be damaged due to electrical specification differences.
2. Pins No. 2 and 8 (P5S) provide power to the operation unit or parameter unit. Do not use these pins for RS-485 communication.

<System configuration example>

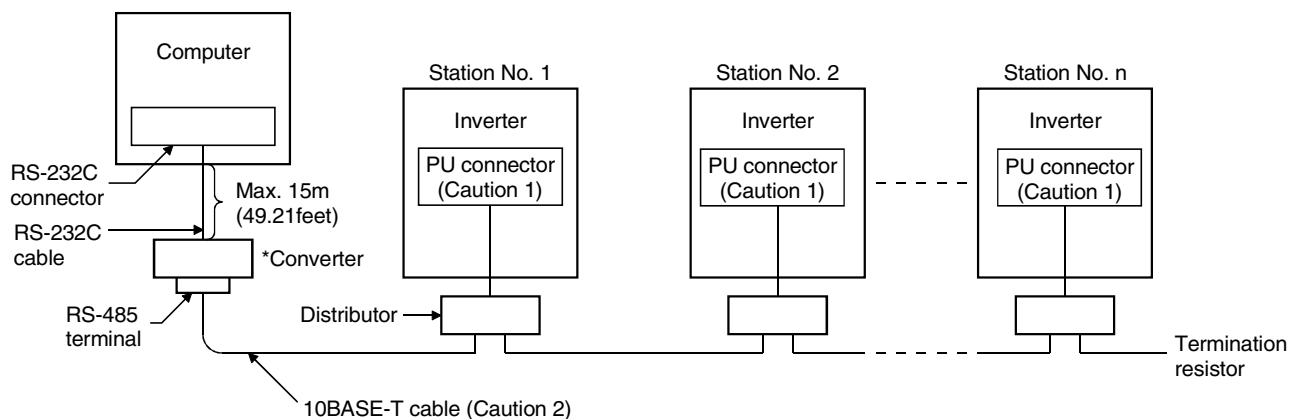
- 1) Using a computer having RS-485 interface with multiple inverters



CAUTION

1. Connector: RJ45 connector
Example: Tyco Electronics Corporation, 5-554720-3
2. Cable : Cable conforming to EIA568 (e.g. 10BASE-T cable)
Example: Mitsubishi Cable Industries, LTD. SGLPEV 0.5mm (0.01 inch) × 4P (twisted pair cable, 4 pairs)
(Do not use pins No. 2 and 8 (P5S).)

2) Using a computer having RS-232C interface with multiple inverters



*Commercially available converter is required. (Caution 3)

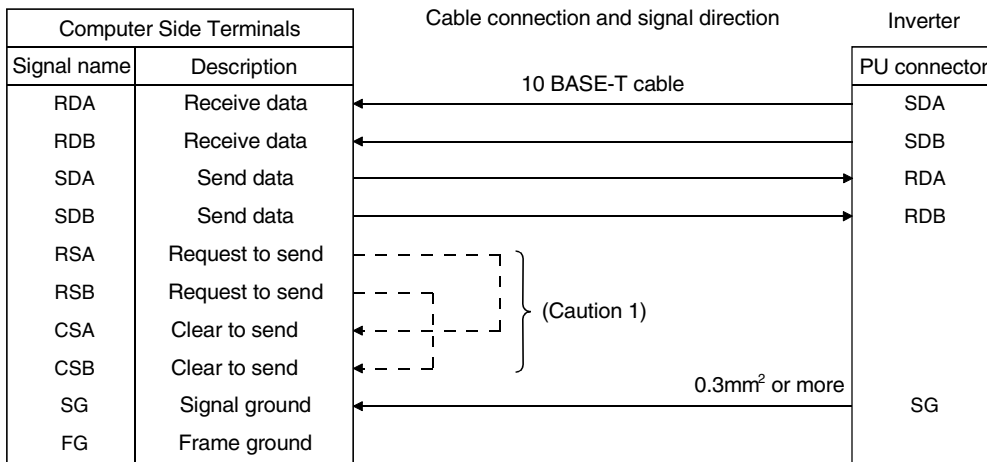
CAUTION

Use the connector, cables and converter that are available on the market.

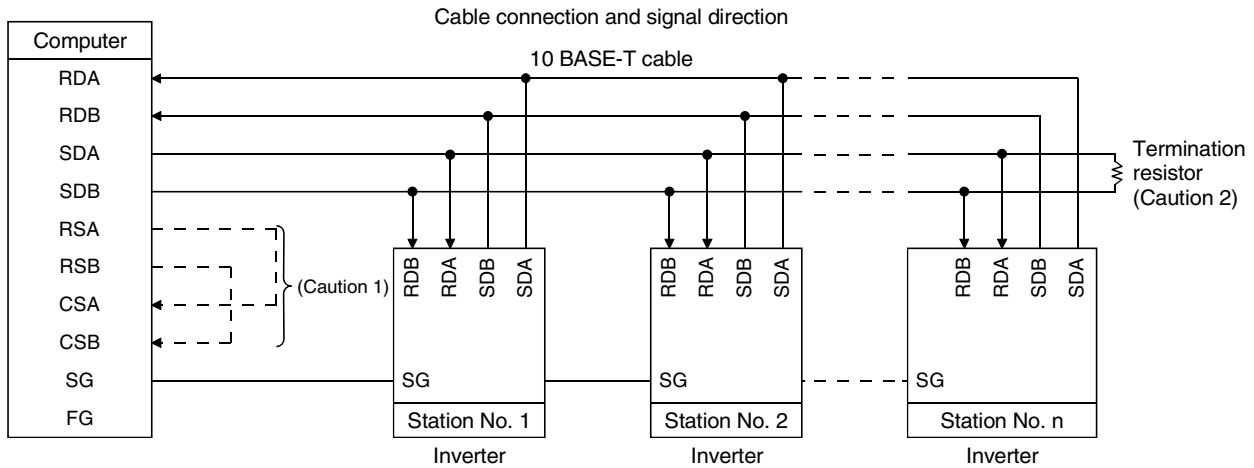
1. **Connector : RJ45 connector**
Example: Tyco Electronics Corporation, 5-554720-3
 2. **Cable : Cable conforming to EIA568 (e.g. 10BASE-T cable)**
Example: Mitsubishi Cable Industries, LTD SGLPEV 0.5mm (0.01 inch) × 4P (twisted pair cable, 4 pairs)
(Do not use pins No. 2 and 8 (P5S).)
 3. **Commercially available converter examples:**
 - 1) **Model: FA-T-RS40**
Converter
Mitsubishi Electric Engineering Co., Ltd.
-

<Wiring method>

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



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



CAUTION

1. **Make connections in accordance with the manual of the computer used. Fully check the terminal numbers of the computer since they vary with the model.**
2. **There may be the influence of reflection depending on the transmission speed and/or transmission distance. If this reflection hinders communication, provide a termination resistor. If the PU connector is used to make a connection, use a distributor since a terminal resistor cannot be fitted. Connect the termination resistor to only the inverter remotest from the computer. (Termination resistor: 100Ω)**

1.7 Input terminals

1.7.1 Run (start) and stop (STF, STR, STOP)

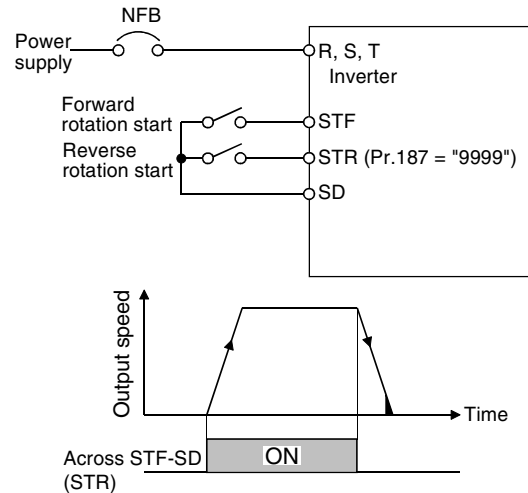
To start and stop the motor, first switch on the input power of the inverter (when there is a magnetic contactor on the input side, use the operation-ready switch to turn on the magnetic contactor), then start the motor with the forward or reverse rotation start signal.

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

A two-wire type connection is shown on the right.

- 1) The 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. Turn on both or turn off the start signal during operation to decelerate the inverter to a stop.
- 2) The speed setting signal may either be given by entering 0 to 10VDC across the speed setting input terminal 2-5 or by setting the required values in Pr. 4 to Pr. 6 "three-speed setting" (high, middle, low speeds). (Refer to page 81 for three-speed operation.)

Two-Wire Type Connection Example



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

A three-wire type connection is shown on the right. Assign the start self-holding signal (STOP) to any of the input terminals.

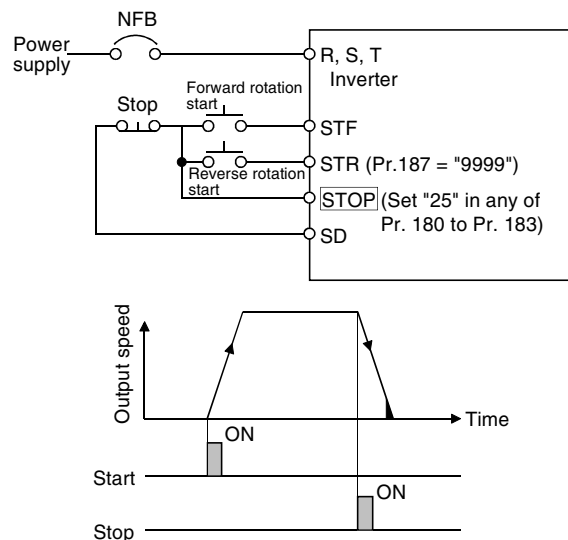
- 1) Short signals STOP-SD to enable the start self-holding function. In this case, the forward/reverse rotation signal functions only as a start signal.

REMARKS

Assign the STOP signal to any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection).

- 2) If the start signal terminals STF (STR)-SD are once shorted, then opened, the start signal is kept on and starts the inverter. To change the rotation direction, short the start signal STR (STF)-SD once, then open it.
- 3) The inverter is decelerated to a stop by opening terminals STOP-SD once. The three-wire connection is shown on the right.
- 4) When terminals JOG-SD are shorted, the STOP signal is invalid and jog signal has precedence.
- 5) If the output stop terminals MRS-SD are shorted, the self-holding function is not deactivated.

Three-Wire Type Connection Example

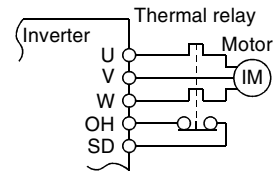


Input terminals

1.7.2 External thermal relay input (OH)

When the external thermal relay or the built-in thermal relay of the motor (thermal protector) is actuated to protect the motor from overheat, the inverter output can be shut off and the corresponding alarm signal can be provided to hold a stop status. If the thermal relay contact resets, the motor cannot be restarted unless the reset terminal RES-SD are shorted for more than 0.1 seconds and then opened or a power-on reset is made.

Therefore, this function can be used as an external emergency stop signal input.

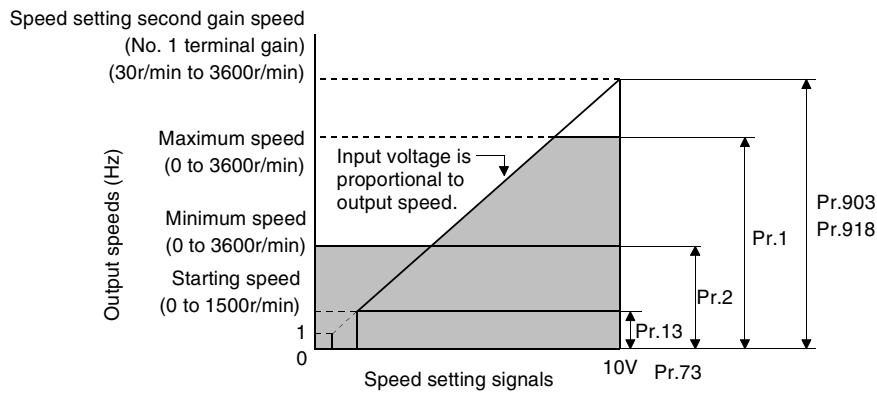


1.7.3 Speed setting potentiometer connection (10E, 2 (1), 5)

As an analog speed setting input signal, a voltage signal can be input.

The relationships between the speed setting input voltages and output speeds are as shown below. The speed setting input signals are proportional to the output speeds. Note that when the input signal is less than the starting speed, the output speed of the inverter is 0r/min.

If the input signal of 10VDC or higher is entered, it cannot exceed Pr. 1 "maximum speed".



Relationships between Speed Setting Inputs and Output Speeds

Related parameters

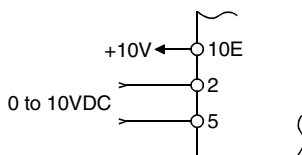
Maximum speed setting Pr. 1 "maximum speed" (Refer to page 79.)

(1) Voltage input (10E, 2, 5)

Enter the speed setting input signal of 0 to 10VDC across the speed setting input terminals 2-5. The maximum output speed is reached when 10V is input across terminals 2-5.

The power supply used may either be the inverter's built-in power supply or an external power supply. For the built-in power supply, terminals 10E-5 provide 10VDC output.

- Use terminal 10E for the built-in power supply.



(2) Multi-function input (1, 5)

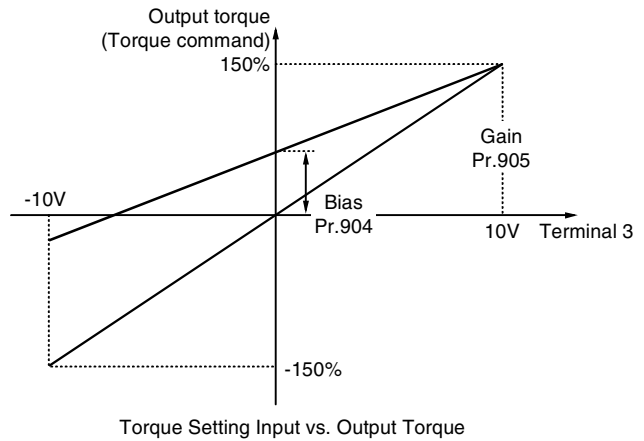
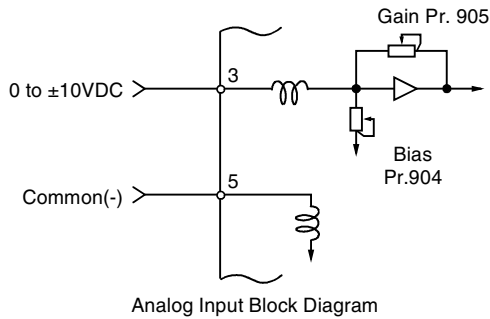
The analog input function can be multi-functioned, e.g. compensation signal may be entered across the main speed setting terminals 2-5 for synchronous operation.

Across auxiliary input terminals 1-5 ... 0 to ± 10 VDC

The function of terminal 1 depends on the setting of Pr. 868 "No. 1 terminal function assignment". Refer to page 182 for details of Pr 868.

1.7.4 Torque setting input signal and motor-generated torque (terminals 3, 5)

Refer to the diagrams shown at below right for the relationship between the torque setting input signal and output voltage. The torque setting input signal is in proportion to the output torque. However, motor-generated torque varies with the motor temperature. The guideline of the output torque accuracy relative to the torque setting input is torque accuracy $\pm 3\%$ (under condition of 75°C (167°F)) when the SF-V5R Mitsubishi inverter motor is used.

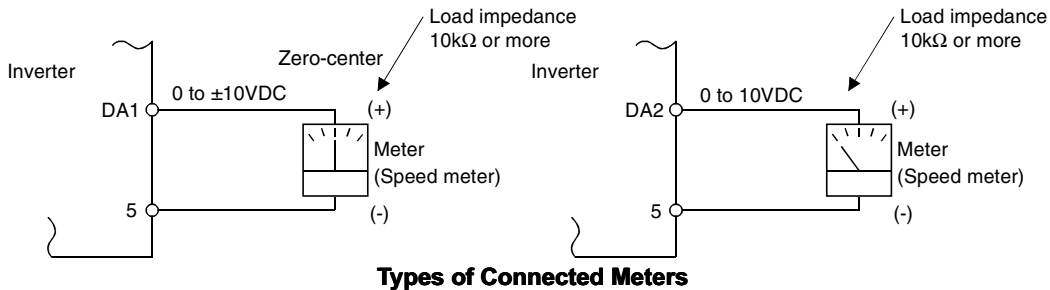


1.7.5 Meter connection method and adjustment (DA1, DA2)

The output speed etc. of the inverter can be displayed by connecting a meter (speed meter) across terminals DA1 (DA2)-5.

The meter can be calibrated from the operation panel or parameter unit. However, if the meter is away from the inverter, the display value will vary with the wiring distance.

The terminals DA1, DA2 are non-isolated from the control circuit of the inverter. Using a shield cable of within 30m (98.42feet) for wiring.



REMARKS

Using Pr. 867 "DA1 output filter", you can function the primary delay filter. (Refer to page 182.)

CAUTION

Refer to page 187 for the meter adjustment procedure.

[Example] To provide a 10V DA1-5 (DA2-5) output of 10V at the inverter output speed of 3000r/min, set "3000" (r/min) in Pr. 55.(factory setting : 1500r/min)

| Parameter No. | Name | Factory Setting | Setting Range |
|---------------|----------------------------|-----------------------------|----------------|
| 55 | Speed monitoring reference | Japanese version: 1500r/min | 0 to 3600r/min |
| | | NA version: 1800r/min | |

CAUTION

Note that when wiring is long, a voltage type meter is susceptible to a voltage drop, induction noise, etc. and may not read correctly.

Input terminals

1.7.6 Common terminals (SD, 5, SE)

Terminals SD, 5 and SE are all common terminals (0V) for I/O terminals and the other common terminals are isolated from each other.

Terminal SD is a common terminal for the contact input terminals (STF, STR, OH, RES, DI1, DI2, DI3 and DI4) and the PLG output signals. When using the terminal SD as a common terminal for the PLG output signals, use a shielded or twisted cable to protect it from external noise.

Terminal 5 is a common terminal for the speed setting analog input signals and analog output signals. Use a shielded or twisted cable to protect it from external noise.

Terminal SE is a common terminal for the open collector output terminals (DO1, DO2, DO3).

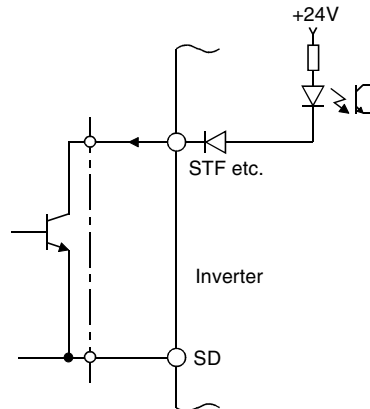
1.7.7 Signal inputs by contact-less switches

If a transistor is used instead of a contacted switch as shown on the right, the input signals of the inverter can control the STF, STR, OH, RES, DI1, DI2, DI3 and DI4 terminals.

Input resistance : 4.7k Ω

Voltage when contacts are open : 21 to 27VDC

When contacts are short-circuited : 4 to 6mADC



External Signal Input by Transistor

REMARKS

- When using an external transistor connected to the external power supply, use terminal PC to prevent a malfunction due to a sneak current.

(Refer to the Instruction Manual (basic) for details.)

- Note that when off, an SSR (solid-state relay) has a relatively large leakage current and it may be accidentally input to the inverter.

1.8 How to use the input signals (assigned terminals DI1 to DI4, STR) (Pr. 180 to Pr. 183, Pr. 187)

These terminals vary in functions with the settings of Pr. 180 to Pr. 183 and Pr. 187.

| Parameter | Factory-Set Value | Factory-Set Signal | Setting Range | |
|---|-------------------|--------------------|--|----------|
| Pr. 180 "DI1 terminal function selection" | 0 | RL | 0 to 3, 5, 8 to 16, 20, 22 to 27, 42 to 44, 9999 (9999 is valid for Pr. 187 only) | Page 149 |
| Pr. 181 "DI2 terminal function selection" | 1 | RM | | |
| Pr. 182 "DI3 terminal function selection" | 2 | RH | | |
| Pr. 183 "DI4 terminal function selection" | 3 | RT | | |
| Pr. 187 "STR terminal function selection" | 9999 | STR | | |

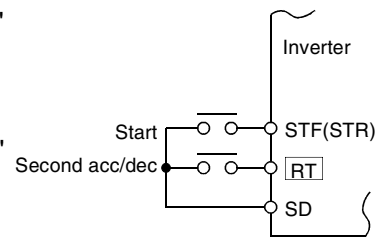
The priorities of the speed commands are in order of jog, multi-speed setting (RH, RM, RL, REX) and PID (X14).

1.8.1 Multi-speed setting (RL, RM, RH, REX signals): Pr. 180 to Pr. 183, Pr. 187 setting "0, 1, 2, 8" Remote setting (RL, RM, RH signals): Pr. 180 to Pr. 183, Pr. 187 setting "0, 1, 2"

- When Pr. 59 = 0, turning on/off the RL, RM, RH and REX signals input as the speed commands enables multi-speed operation (15 speeds). (Refer to page 80 for details. Pr. 59 = 0)
- When Pr. 59 ≠ "0", you can use contact signals to perform continuous variable-speed operation without using analog signals even if the operation panel is away from the control box. (Refer to page 105 for details.)

1.8.2 Second function selection/second motor switchover (RT signal) : Pr. 180 to Pr. 183, Pr. 187 setting "3"

| | |
|---|--|
| Pr. 44 "second acceleration/deceleration time" | Pr. 830 "speed control P gain 2" |
| Pr. 45 "second deceleration time" | Pr. 831 "speed control integral time 2" |
| Pr. 450 "second applied motor" | Pr. 832 "speed setting filter 2" |
| Pr. 451 "second motor control method selection" | Pr. 833 "speed detection filter 2" |
| Pr. 452 "second electronic thermal O/L relay" | Pr. 834 "torque control P gain 2" |
| Pr. 453 "second motor capacity" | Pr. 835 "torque control integral time 2" |
| Pr. 454 "number of second motor poles" | Pr. 836 "torque setting filter 2" |
| | Pr. 837 "torque detection filter 2" |



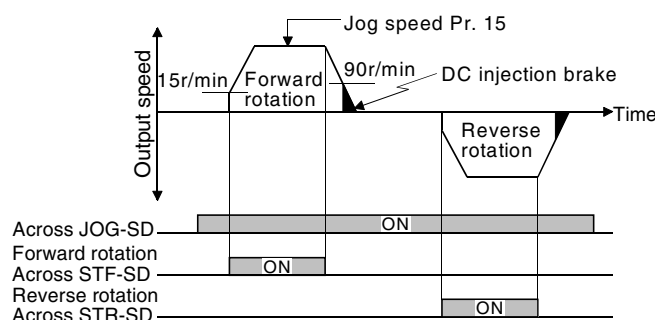
Entering the RT signal enables the second functions (above parameters). However, when Pr. 450 = 9999, it is judged that the second motor functions are not selected, and parameters Pr. 451 and Pr. 453, Pr. 454 are invalid. The second functions other than the above are enabled with the first motor.

1.8.3 Jog operation (jog signal): Pr. 180 to Pr. 183, Pr. 187 setting "5"

(1) Jog operation using external signals

Jog operation can be started/stopped by shorting the jog mode select terminal JOG-SD and shorting/opening the start signal terminal STF or STR-SD. The jog speed and jog acceleration/deceleration time are set in Pr. 15 (factory setting 150r/min, variable between 0 and 1500r/min) and Pr. 16 (factory setting 0.5s, variable between 0 and 3600s (when Pr. 21 = 0)/0 to 360s (when Pr. 21 = 1)), respectively, and their settings can be changed from the operation panel or parameter unit.

The jog signal has higher priority than the multi-speed signals. (external)



How to use the input signals (assigned terminals DI1 to DI4, STR)

1.8.4 Third function selection (X9 signal): Pr. 180 to Pr. 183, Pr. 187 setting "9"

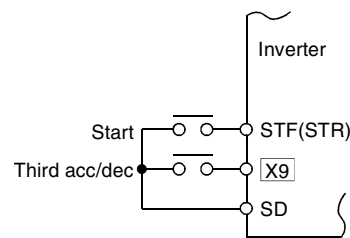
Turn on this "X9 signal" to set:

Pr. 110 "third acceleration/deceleration time"

Pr. 111 "third deceleration time"

Select either the first motor or the second motor according to the RT signal input.

| X9 signal | RT signal | Applied Motor | Other Function |
|-----------|-----------|---------------|-----------------|
| OFF | OFF | First motor | First function |
| OFF | ON | Second motor | Second function |
| ON | OFF | First motor | Third function |
| ON | ON | Second motor | Third function |



1.8.5 MT-HC connection (X10 signal): Pr. 180 to Pr. 183, Pr. 187 setting "10"

- MT-HC connection (inverter operation enable signal)

To provide protective coordination with the high power factor converter (MT-HC) use the inverter operation enable signal to shut off the inverter output. Enter the RDY signal of the high power factor converter.

1.8.6 PU operation external interlock signal (X12 signal): Pr. 180 to Pr. 183, Pr. 187 setting "12"

This function prevents the inverter from being inoperative during operation using an external command if the mode is accidentally left unswitched from the PU operation mode. (Refer to page 116.)

X12 signal on Shift to PU operation mode enabled (output stop during external operation)

X12 signal off Shift to PU operation mode disabled (output stop during external operation)

1.8.7 PID control enable terminal: Pr. 180 to Pr. 183, Pr. 187 setting "14"

Turn the X14 signal on to exercise PID control. When this signal is off, normal inverter operation is performed. Refer to page 139 for details.

Related parameters

Pr. 128 "PID action selection", Pr. 129 "PID proportional band", Pr. 130 "PID integral time", Pr. 131 "upper limit", Pr. 132 "lower limit", Pr. 133 "PID action set point for PU operation", Pr. 134 "PID differential time" (Refer to page 139.)

1.8.8 Brake sequence opening signal (BRI signal): Pr. 180 to Pr. 183, Pr. 187 setting "15"

Used when the method of inputting the mechanical brake opening completion signal to the inverter is used for the brake sequence functions. (Refer to page 107.)

Related parameters

Pr. 60 "intelligent mode selection", Pr. 278 "brake opening speed", Pr. 279 "brake opening current", Pr. 280 "brake opening current detection time", Pr. 281 "brake operation time at start", Pr. 282 "brake operation speed", Pr. 283 "brake operation time at stop", Pr. 284 "deceleration detection function selection", Pr. 285 "overspeed detection speed" (Refer to page 107.)

1.8.9 PU operation/external operation switchover: Pr. 180 to Pr. 183, Pr. 187 setting "16"

You can change the operation mode.

When Pr. 79 "operation mode selection" = "8", turning the X16 signal on shifts the current operation mode to the external operation mode and turning that signal off shifts to the PU operation mode. Refer to page 118 for details.

Related parameters

Pr. 79 "operation mode selection" (Refer to page 118)

1.8.10 S-pattern acceleration/deceleration C switchover terminal (X20 signal) : Pr. 180 to Pr. 183, Pr. 187 setting "20"

When Pr. 29 = "4", you can use the S-pattern acceleration/deceleration C switchover terminal to set the acceleration of S-pattern acceleration/deceleration in the parameter. (Refer to page 91.)

Related parameters

Pr. 29 "acceleration/deceleration pattern", Pr. 380 "acceleration S pattern 1", Pr. 381 "deceleration S pattern 1", Pr. 382 "acceleration S pattern 2", Pr. 383 "deceleration S pattern 2" (Refer to page 91.)

1.8.11 Orientation command (X22 signal): Pr. 180 to Pr. 183, Pr. 187 setting "22"

With the position detector (PLG) fitted to the motor end, you can perform position stop (orientation) control of the rotation shaft. Refer to page 158 for details.

Related parameters

Pr. 350 "stop position command selection", Pr. 351 "orientation switchover speed", Pr. 356 "Internal stop position command", Pr. 357 "orientation in-position zone", Pr. 360 "external position command selection", Pr. 361 "position shift", Pr. 362 "orientation position loop gain", Pr. 393 "orientation selection", Pr. 396 "orientation speed gain (P term)", Pr. 397 "orientation speed integral time", Pr. 398 "orientation speed gain (D term)", Pr. 399 "orientation deceleration ratio" (Refer to page 158.)

1.8.12 Pre-excitation/servo on (LX signal): Pr. 180 to Pr. 183, Pr. 187 setting "23"

● Pre-excitation

When the start signal (STF, STR) is not input to the inverter (during a stop), turning on the pre-excitation terminal LX enables 0 speed control or servo lock. (Refer to page 85 for details.)

● Servo on

Use the LX signal to exercise position control.

Turning on the LX signal switches the servo on and cancels the base circuit shut-off, resulting in a servo lock status. (Refer to page 51 for details.)

Related parameters

Pre-excitation ⇒ Pr. 802 "pre-excitation selection" (Refer to page 85.)

Servo-on ⇒ Pr. 419 "position command right selection", Pr. 420 "command pulse scaling factor numerator", Pr. 421 "command pulse scaling factor denominator", Pr. 422 "position loop gain", Pr. 423 "position feed forward gain", Pr. 424 "position command acceleration/deceleration time constant", Pr. 425 "position feed forward command filter", Pr. 426 "in-position width", Pr. 427 "excessive level error", Pr. 430 "pulse monitor selection", Pr. 464 "digital position control sudden stop deceleration time", Pr. 465 to Pr. 494 (position feed amount) (Refer to page 51.)

1.8.13 Output stop (MRS signal): Pr. 180 to Pr. 183, Pr. 187 setting "24"

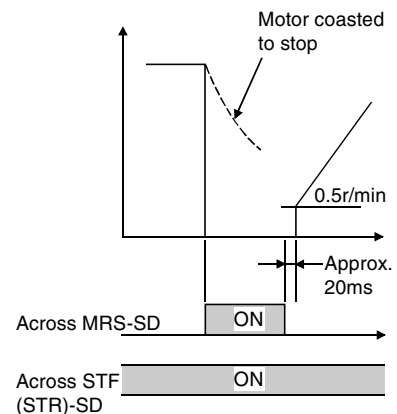
Short the output stop terminals MRS-SD during inverter output to cause the inverter to stop the output immediately.

This function is valid in any mode independently of the control mode.

Open terminals MRS-SD to resume operation in about 20ms.

Terminal MRS may be used as described below.

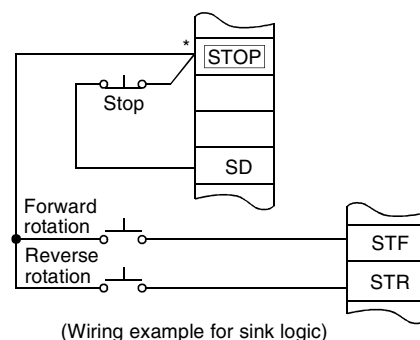
- (1) To stop the motor by mechanical brake (e.g. electromagnetic brake)
Terminals MRS-SD must be shorted when the mechanical brake is operated and be opened before the motor that has stopped restarts.
- (2) To provide interlock to disable operation by the inverter
After terminals MRS-SD have been shorted, the inverter cannot be operated if the start signal is given to the inverter.
- (3) To coast the motor to stop
The motor is decelerated according to the preset deceleration time and is stopped by operating the DC injection brake at the DC injection brake operation speed or less. Using terminal MRS, the motor is coasted to a stop.



1.8.14 Start self-holding selection (STOP signal): Pr. 180 to Pr. 183, Pr. 187 setting "25"

The connection example given here is used to self-hold the start signal (forward rotation, reverse rotation).

* Connected to the STOP signal to disable forward or reverse rotation if forward or reverse rotation and stop are turned on at the same time.



How to use the input signals (assigned terminals DI1 to DI4, STR)

1.8.15 Control mode changing (MC signal): Pr. 180 to Pr. 183, Pr. 187 setting "26"

By setting Pr. 800 "control system selection", change the control mode between speed, torque and position. Refer to page 169 for details.

1.8.16 Torque restriction selection (TL signal): Pr. 180 to Pr. 183, Pr. 187 setting "27"

By setting Pr. 815 "torque restriction level 2", you can change the torque restriction value. Refer to the Instruction Manual (basic) for details.

1.8.17 Torque bias selection 1 (X42 signal): Pr. 180 to Pr. 183, Pr. 187 setting "42" Torque bias selection 2 (X43 signal): Pr. 180 to Pr. 183, Pr. 187 setting "43"

When using the torque bias function, you can combine the on/off of the X42 and X43 signals to select the torque bias amount. Refer to page 176 for details.

Related parameters

Pr. 840 "torque bias selection", Pr. 841 "torque bias 1", Pr. 842 "torque bias 2", Pr. 843 "torque bias 3", Pr. 844 "torque bias filter", Pr. 845 "torque bias operation time", Pr. 846 "torque bias balance compensation", Pr. 847 "fall-time torque bias No. 3 bias", Pr. 848 "fall-time torque bias No. 3 gain" (Refer to page 176.)

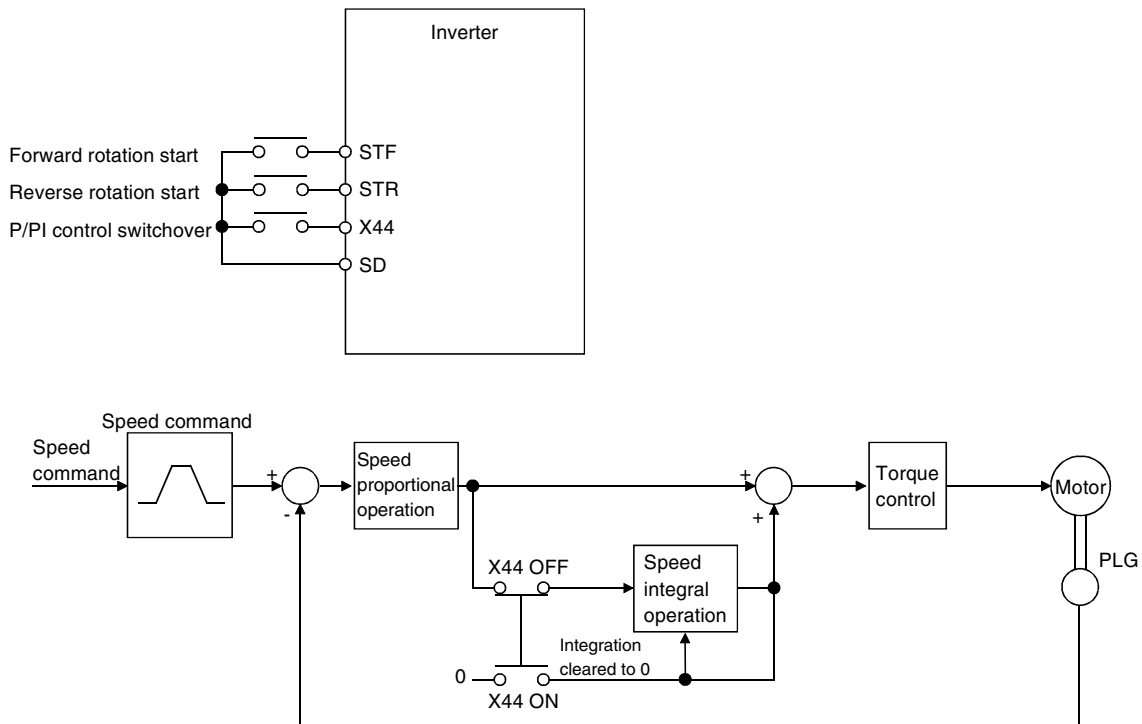
1.8.18 P control selection (P/PI control switchover) (X44 signal): Pr. 180 to Pr. 183, Pr. 187 setting "44"

By turning the X44 signal on/off during operation of the inverter under speed control, you can change between speed P control and speed PI control.

When X44 signal is off: PI control

When X44 signal is on: P control

Since speed deviation occurs according to the load, you can use the machine-coupled device to suppress the hunting of the control system.



1.9 How to use the output signals (assigned terminals DO1 to DO3, ABC) (Pr. 190 to Pr. 192, Pr. 195)

The output terminals DO1, DO2, DO3, ABC vary in functions with the Pr. 190 to Pr. 192 and Pr. 195 settings.

| Parameter | Name | Terminal Symbol | Factory Setting | Factory-Set Terminal Function | Setting Range | Remarks |
|-----------|---------------------------------|-----------------|-----------------|---|----------------|---------------|
| 190 | DO1 terminal function selection | RUN | 0 | Inverter running | 0 to 199, 9999 | Extended mode |
| 191 | DO2 terminal function selection | SU | 1 | Up to speed | 0 to 199, 9999 | |
| 192 | DO3 terminal function selection | IPF | 2 | Instantaneous power failure, undervoltage | 0 to 199, 9999 | |
| 195 | ABC terminal function selection | A, B, C | 99 | Alarm output | 0 to 199, 9999 | |

<Setting>

Refer to the following table for the settings of Pr. 190 to Pr. 192 and Pr. 195.

| Setting | | Signal Name | Function | Operation |
|----------------|----------------|-------------|---|---|
| Positive logic | Negative logic | | | |
| 0 | 100 | RUN | Inverter running | Output when the start command is input. For V/F control, this signal is output during operation when the inverter output speed rises to or above the starting speed. During DC injection brake, 0 speed control or servo lock, this signal is not output. |
| 1 | 101 | SU | Up to speed | Refer to Pr. 41 "up-to-speed sensitivity" (page 97). |
| 2 | 102 | IPF | Instantaneous power failure or undervoltage | Output at occurrence of an instantaneous power failure or undervoltage. |
| 3 | 103 | OL | Overload alarm | Output when torque or speed restriction is activated. For V/F control, this signal is output while the stall prevention function is activated. |
| 4 | 104 | FU | Output speed detection | Refer to Pr. 42, Pr. 43 (speed detection) (page 97). |
| 5 | 105 | FU2 | Second output speed detection | Refer to Pr. 50 "second speed detection" (page 97). |
| 6 | 106 | FU3 | Third output speed detection | Refer to Pr. 116 "third speed detection" (page 97). |
| 7 | 107 | RBP | Regenerative brake prealarm | Output when 85% of the regenerative brake duty set in Pr. 70 is reached. |
| 8 | 108 | THP | Electronic thermal relay prealarm | Output when the electronic thermal relay cumulative value reaches 85% of the preset level. |
| 10 | 110 | PU | PU operation mode | Output when the PU operation mode is selected. |
| 11 | 111 | RY | Inverter operation ready | Output when the inverter can be started by switching the start signal on or while it is running. |
| 12 | 112 | Y12 | Output current detection | Refer to Pr. 150 and 151 (output current detection) (page 145). |
| 13 | 113 | Y13 | Zero current detection | Refer to Pr. 152 and 153 (zero current detection) (page 146). |
| 14 | 114 | FDN | PID lower limit | Refer to Pr. 128 to 134 (PID control) (page 139). |
| 15 | 115 | FUP | PID upper limit | |
| 16 | 116 | RL | PID forward-reverse rotation output | |
| 20 | 120 | BOF | Brake opening request | Refer to Pr. 278 to Pr. 285 (brake sequence function) (page 107). |
| 26 | 126 | FIN | Fin overheat prealarm | Output when the heatsink temperature reaches about 85% of the fin overheat protection activating temperature. |
| 27 | 127 | ORA | Orientation in-position | When orientation is valid |
| 30 | 130 | Y30 | Forward rotation output | For vector control |
| 31 | 131 | Y31 | Reverse rotation output | |

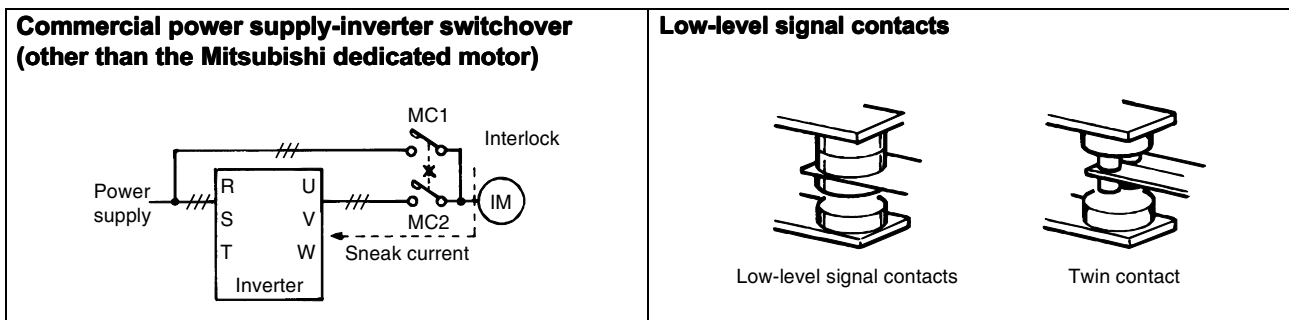
**How to use the output signals (assigned terminals
DO1 to DO3, ABC) (Pr. 190 to Pr. 192, Pr. 195)**

| Setting | | Signal Name | Function | Operation |
|----------------|----------------|-------------|----------------------------|---|
| Positive logic | Negative logic | | | |
| 32 | 132 | Y32 | Regenerative status output | For vector control |
| 33 | 133 | RY2 | Operation ready 2 | Output on completion of pre-excitation. Turned on at an output start when pre-excitation is not made. |
| 34 | 134 | LS | Low speed output | Output when the speed falls to or below any preset low speed. |
| 35 | 135 | TU | Torque detection | Output when the motor torque rises above the predetermined value (Pr.864). (Refer to page 181.) |
| 36 | 136 | Y36 | In-position | Acts as an in-position signal. |
| 37 | 137 | MT | Maintenance timer output | Refer to Pr. 890 to Pr. 892 (maintenance output function) (page 186). |
| 40 | 140 | Y40 | Trace status | Acts as a trace completion signal. |
| 41 | 141 | FB | Speed detection | Output when the motor output speed (feed back value) exceeds the preset speed. Perform in the same way as FU, FU2 and FU3 under V/F control. |
| 42 | 142 | FB2 | Second speed detection | |
| 43 | 143 | FB3 | Third speed detection | |
| 44 | 144 | RUN2 | Inverter running 2 | <ul style="list-style-type: none"> • Output during forward operation or the reverse signal is ON. • Output at deceleration even during forward rotation or the reverse 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)) |
| 96 | 196 | REM | Remote output | Refer to Pr. 495 to Pr.497 (page 167). |
| 97 | 197 | ER | Minor fault output 2 | At occurrence of a major fault, the base circuit is shut off immediately. At occurrence of a minor fault, the base circuit is shut off after deceleration to a stop. |
| 98 | 198 | LF | Minor fault output | Output when a minor fault (fan fault or communication error alarm) occurs. |
| 99 | 199 | ABC | Alarm output | Output when the inverter's protective function is activated to stop the output (major fault). |
| 9999 | — | — | No function | — |

0 to 99: Positive logic, 100 to 199: Negative logic

1.10 Design information to be checked

- 1) When performing commercial power supply-inverter switchover operation for the motor other than the Mitsubishi dedicated motor, securely provide electrical and mechanical interlocks for the MC1 and MC2 used for commercial power supply-inverter switchover.
When the wiring is wrong or there is a commercial power supply-inverter switchover circuit as shown below, the inverter will be damaged by a sneak current from the power supply due to arcs generated at the time of switchover or chattering caused by a sequence error.
- 2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit and also make up a sequence that will not turn on the start signal.
If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.
- 3) When the power supply used with the control circuit is different from the one used with the main circuit, make up a circuit which will switch off the main circuit power supply terminals R, S, T when the control circuit power supply terminals R1, S1 are switched off.
- 4) Since the input signals to the control circuit are on a low level, use two parallel low-level signal contacts or a twin contact for contact inputs to prevent poor contact.
- 5) Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
- 6) Do not apply a voltage directly to the alarm output terminals (A, B, C). Always apply a voltage to these terminals via a relay coil, lamp, etc.
- 7) Fully make sure that the specifications and rating match the system requirements.



1.11 Using the second motor

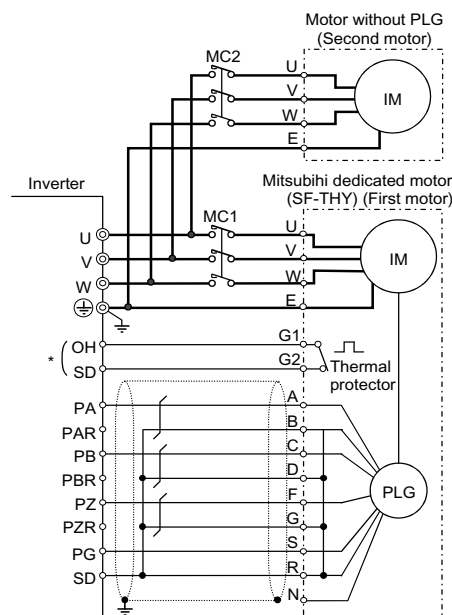
1.11.1 Wiring diagram (second motor)

CAUTION

1. Provide interlocks to prevent the MC1 and MC2 from being turned on simultaneously.
2. For the second motor (motor without PLG), use Pr. 452 "second electronic thermal O/L relay" or provide an external thermal relay.
3. *: Give one external thermal relay signal to across OH-SD.

Related parameters

Second electronic thermal relay setting ⇒ (Pr. 452 "second electronic thermal O/L relay" (Refer to page 83.))



1.11.2 Second motor setting parameters

| Parameter | Name | Factory Setting | Setting Range | | |
|-----------|--|-------------------|---|--|--|
| 450 | Second applied motor | 9999 | 0 | Mitsubishi standard motor (SF-LHA) | Refer to page 112. |
| | | | 10 | Japanese version Mitsubishi constant torque motor (SF-LHCA) | |
| | | | | NA version MARATHON constant torque motor (Blue Max [®] 2000) | |
| | | | | 20 | |
| | | | 30 | Mitsubishi dedicated motor (SF-THY) | |
| 9999 | The second applied motor is made invalid and Pr. 71 "applied motor" is made valid. | | | | |
| 451 | Second motor control method selection | 9999 | 20 | V/F control | The setting is the same as that of control system of Pr. 800 "control system selection". (Caution 1) |
| | | | 9999 | The setting is the same as that of control system of Pr. 800 "control system selection". (Caution 1) | |
| 452 | Second electronic thermal O/L relay | 9999 | Set the rated motor current. 0 to 3600A (Refer to page 83.) 9999 Function invalid | | |
| 453 | Second motor capacity | Inverter capacity | Set the motor capacity. 0 to 3600kW | | Setting can be made when Pr. 450 ≠ "9999" |
| 454 | Number of second motor poles | 4 | Set the number of motor poles. 2, 4, 6P | | |

- Turn on/off the RT signal to switch between the first and second motors using contacts information of the magnetic contactor (MC).
(Use the RT signal after setting it to any of the DI1 to DI4 signals using Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection).)
- Select V/F control for the Pr. 451 setting, vector control with PLG can not be selected.
- By setting values other than "9999" in Pr. 451 when Pr. 450="9999" (factory setting), the control system of the first motor can be changed by switching the RT terminal on and off.
(In this case, turning the RT signal on makes the second function of Pr. 44, Pr. 45, Pr. 452 and Pr. 830 to Pr. 837 valid.)

CAUTION

1. Even when the first motor is under vector control, the second motor is V/F controlled while the RT signal is on independently of the Pr. 451 setting when Pr. 450 ≠ "9999".
2. When switching the second motor (V/F control) to the first motor (position control), switch to the first motor when about 5 seconds elapsed after stopping the second motor.

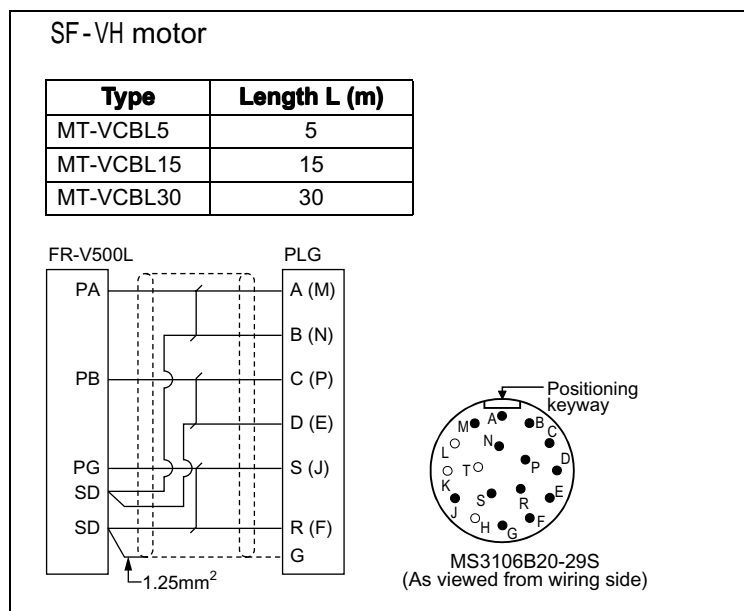
1.12 Using the conventional Mitsubishi motor and other motors

1.12.1 Conventional Mitsubishi motor (SF-VH)

CAUTION

- When using the PLG cable (MT-VCBL) of the conventional Mitsubishi motor for the FR-V500L series, change the size of crimping terminals of the PLG cable from M3 to M3.5.

(1) PLG cable



(2) PLG jumper connector setting

Make PLG setting according to the PLG. (Refer to the Instruction Manual (basic).)

| Item | PLG for SF-VH | PLG for SF-THY (for reference) |
|----------------------|---|--|
| Resolution | 1000 pulse/Rev | 2048 Pulse/Rev |
| Power supply voltage | DC12V±10% | DC12V±10% |
| Current consumption | 100mA | 150mA |
| Output signal form | A, B phases (90° phase shift) | A, B phases (90° phase shift) Z phase: 1 pulse/Rev |
| Output circuit | Complimentary | Complimentary (Constant voltage output matched by emitter fellow) |
| Output voltage | "H" level 10V or more "L" level 1V or less | "H" level -3V or more "L" level 3V or less |

CAUTION

PLG with resolution of 1000 to 4096 pulse/rev is recommended.

⚠ CAUTION

1. Perform the PLG setting correctly. Incorrect setting results in a motor failure.
2. The power supply voltage and output circuit are factory set as follows:

| | Japanese Version | NA Version |
|-----------------------------------|---------------------|--------------------------------|
| PLG power supply jumper connector | 12V | 5V |
| Output circuit jumper connector | Complimentary (CMP) | Differential line driver (LDV) |

Using the conventional Mitsubishi motor and other motors

(3) Parameter setting

Parameters below are extended parameters. Set "1" in Pr. 160 "extended function selection" to read and make setting.

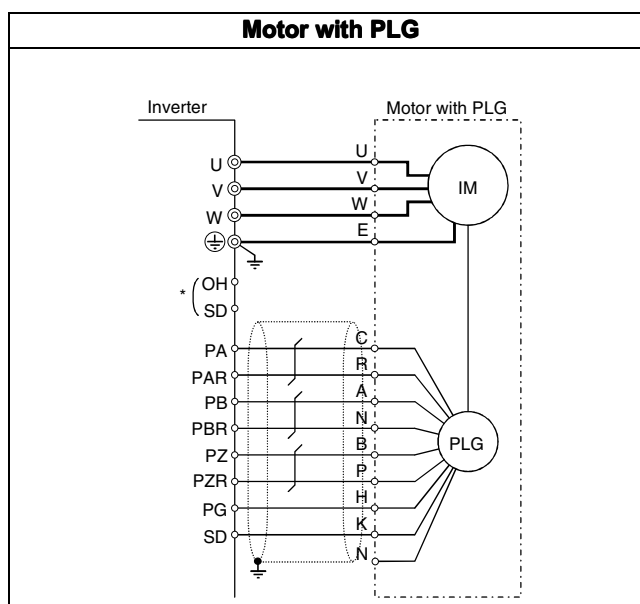
| Parameter | Name | Factory Setting | Setting Range | Refer to |
|-----------|------------------------------|--|--|---|
| 9 | Electronic thermal O/L relay | Japanese Version 0A | 0 to 3600A | 83 |
| | | NA Version rated inverter out- put current | | |
| 71 | Applied motor | Japanese Version 30 | 0, 3 to 8, 10, 13 to 18, 20, 23, 24, 30, 33, 34 | 112 |
| | | NA Version 10 | | |
| 80 | Motor capacity | Inverter capacity | 0 to 3600kW | 121 |
| 81 | Number of motor poles | 4 | 2, 4, 6 | |
| 851 | Number of PLG pulses | Japanese version: 2048 | 0 to 4096 (Number of pulses before multiplied by 4) | Refer to the Instruction Manual (basic) |
| | | NA version: 1024 | | |
| 852 | PLG rotation direction | 1 | 0, 1 | |

CAUTION

- **Pr. 71 setting**
 - SF-THY: "30"
 - SF-VH: "20"
 - SF-LHA: "0"
 - SF-LHCA: "10"(Japanese Version)
 - MARATHON Blue Max[®] 2000: "10"(NA Version)
- **When using motors other than the Mitsubishi dedicated motor (SF-THY) or above motors, perform offline auto tuning. (Refer to page 121.)**

1.12.2 Precautions for and wiring of the motor with PLG

- When the motor used is other than the Mitsubishi dedicated motor, use the offline auto tuning function. (Refer to page 121 for details of offline auto tuning.)
- Set Pr. 800 to select the control method. (Refer to page 169.)
- To protect the motor from overheat, set electronic thermal relay or provide an external thermal relay. (Refer to page 24.)



CAUTION

- *Leave the unused terminals open.
- **When not using an external thermal relay, set "0" in Pr. 876 "thermal protector input". Set Pr. 9 "electronic thermal O/L relay".**
- **Check the power supply specification of PLG and change a jumper connector. (Refer to the Instruction Manual (basic).)**

2

VECTOR CONTROL

This chapter explains the basic "adjustment for vector control" for use of this product.

Always read the instructions and other information before using the equipment.

| | | |
|------------|--|-----------|
| 2.1 | What is vector control? | 38 |
| 2.2 | Speed control | 40 |
| 2.3 | Fine adjustment of gains for speed control..... | 41 |
| 2.4 | Torque control | 47 |
| 2.5 | Fine adjustment for torque control..... | 48 |
| 2.6 | Gain adjustment for torque control..... | 49 |
| 2.7 | Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494) | 51 |

1

2

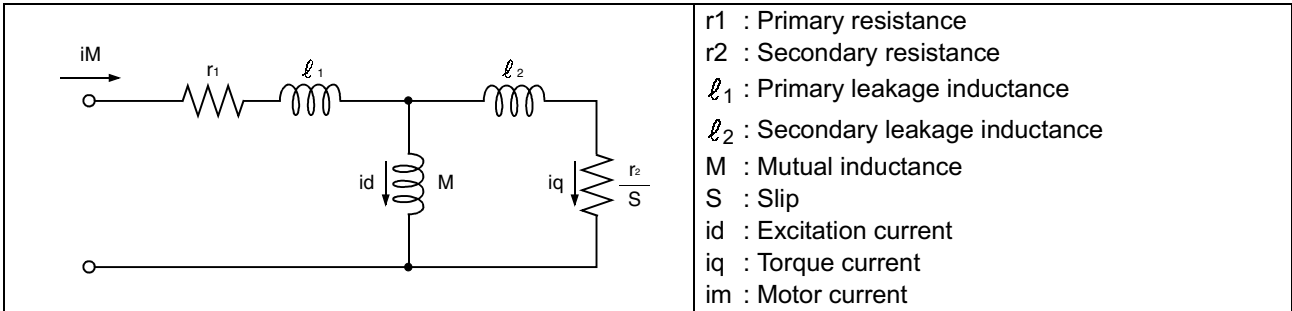
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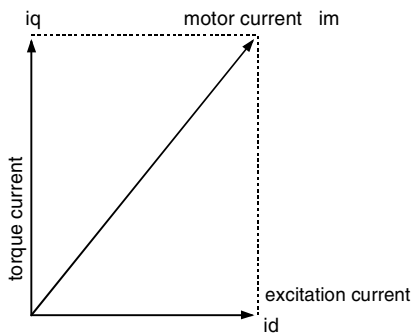
What is vector control?

2.1 What is vector control?

Vector control is one of the control techniques for driving an induction motor. To help explain vector control, the fundamental equivalent circuit of an induction motor is shown below:



In the above diagram, currents flowing in the induction motor can be classified into a current i_d (excitation current) for making a magnetic flux in the motor and a current i_q (torque current) for causing the motor to develop a torque.



In vector control, the voltage and output frequency are calculated to control the motor so that the excitation current and torque current (as shown in the left figure) flow to the optimum as described below:

- (1) The excitation current is controlled to place the internal magnetic flux of the motor in the optimum status.
- (2) Derive the torque command value so that the difference between the motor speed command and the actual speed obtained from the PLG connected to the motor shaft is zero.

Motor-generated torque (T_M), slip angular velocity (ω_s) and the motor's secondary magnetic flux (ϕ_2) can be found by the following calculation:

$$T_M \propto \phi_2 \cdot i_q$$

$$\phi_2 = M \cdot i_d$$

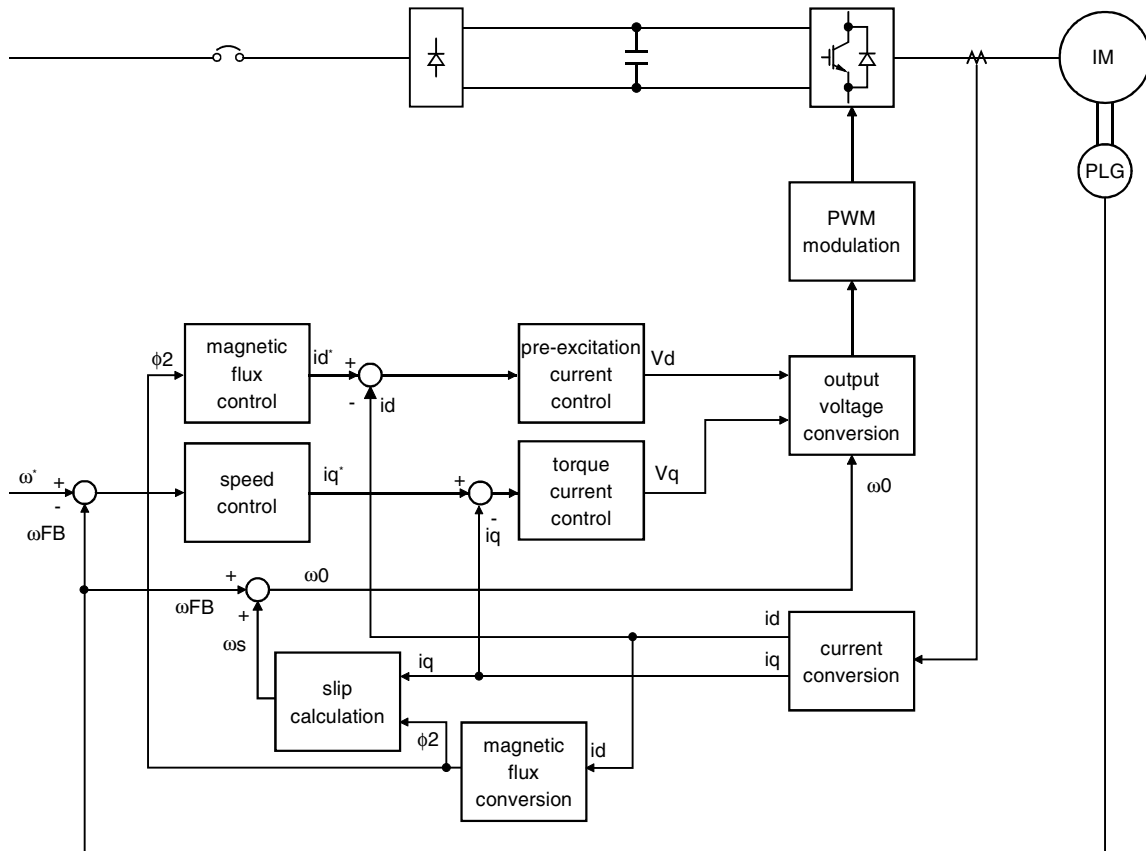
$$\omega_s = \frac{r_2}{L_2} \cdot \frac{i_q}{i_d}$$

where, L_2 = secondary inductance

$$L_2 = l_2 + M$$

Vector control provides the following advantages:

- (1) Excellent control characteristics when compared to V/F control and other control techniques, achieving the control characteristics equal to those of DC machines.
- (2) Applicable to fast-response applications with which induction motors were previously regarded as difficult to use. Applications requiring a wide variable-speed range from extremely low speed to high speed, frequent acceleration/deceleration operations, continuous four-quadrant operations etc.
- (3) Allows torque control.
- (4) Allows servo-lock torque control which generates a torque at zero speed (i.e. status of motor shaft = stopped).



- (1) **Speed control**
Speed control operation is performed to zero the difference between the speed command (ω^*) and actual rotation detection value (ω_{FB}). At this time, the motor load is found and its result is transferred to the torque current controller as a torque current command (i_q^*).
- (2) **Torque current control**
A voltage (V_q) is calculated to start a current (i_q^*) which is identical to the torque current command (i_q) found by the speed controller.
- (3) **Magnetic flux control**
The magnetic flux (ϕ_2) of the motor is derived from the excitation current (i_d). The excitation current command (i_d^*) is calculated to use that motor magnetic flux (ϕ_2) as a predetermined magnetic flux.
- (4) **Excitation current control**
A voltage (V_d) is calculated to start a current (i_d) which is identical to the excitation current command (i_d^*) found by magnetic flux control.
- (5) **Output frequency calculation**
Motor slip (ω_s) is calculated on the basis of the torque current value (i_q) and magnetic flux (ϕ_2). The output frequency (ω_0) is found by adding that slip (ω_s) to the feedback (ω_{FB}) found by a feedback from the PLG.

The above results are used to make PWM modulation and run the motor.

Speed control

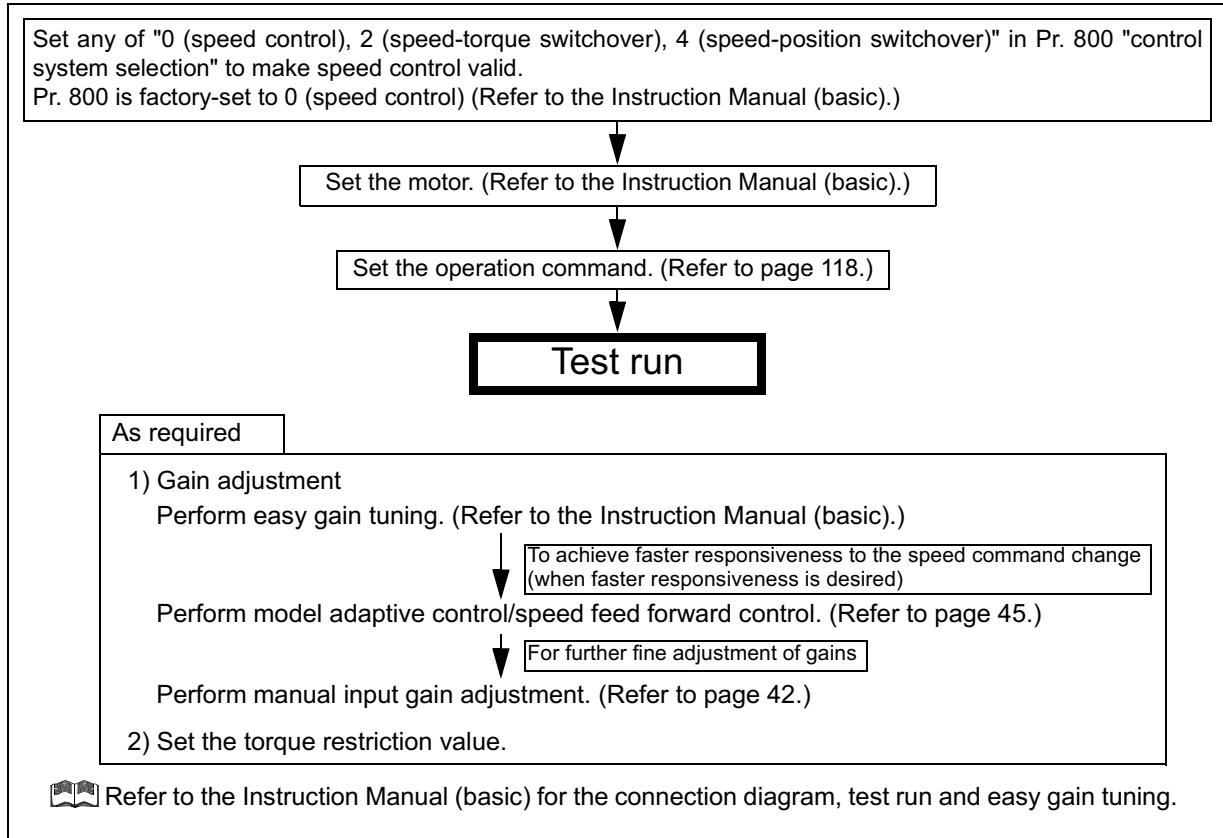
This inverter can control a motor under speed, torque or position control. (As required, set "1" (extended function parameters valid) in Pr. 160 "extended function selection".)

Refer to page 149 for details of Pr. 160 "extended function selection". (Since the factory setting of Pr. 77 is "0", perform parameter write in the PU mode or during a stop.)

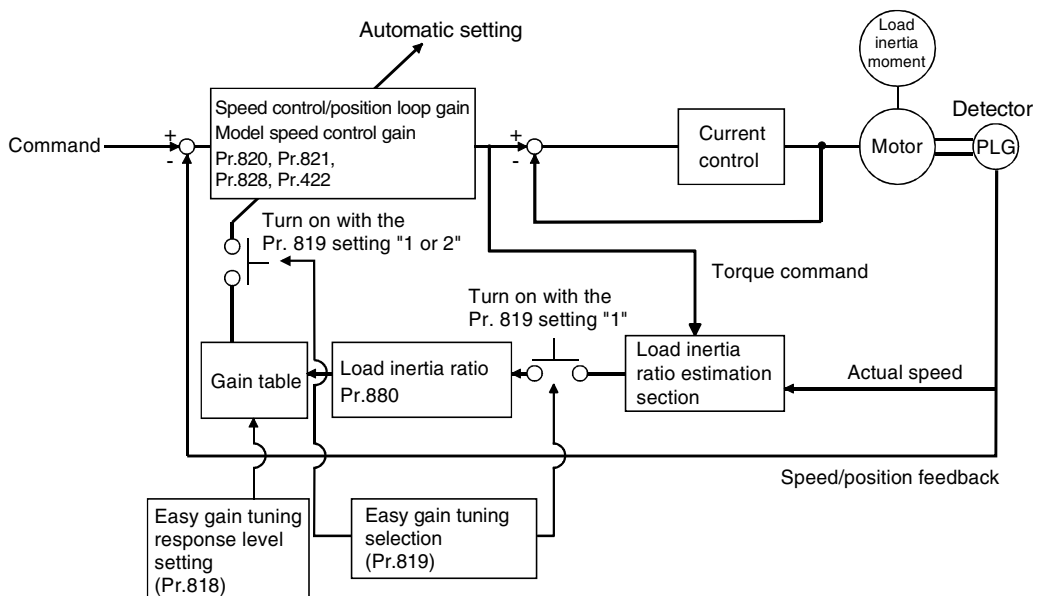
2.2 Speed control

2.2.1 Outline of speed control

The basics of speed control are explained in the Instruction Manual (basic).



2.2.2 Easy gain tuning function block diagram

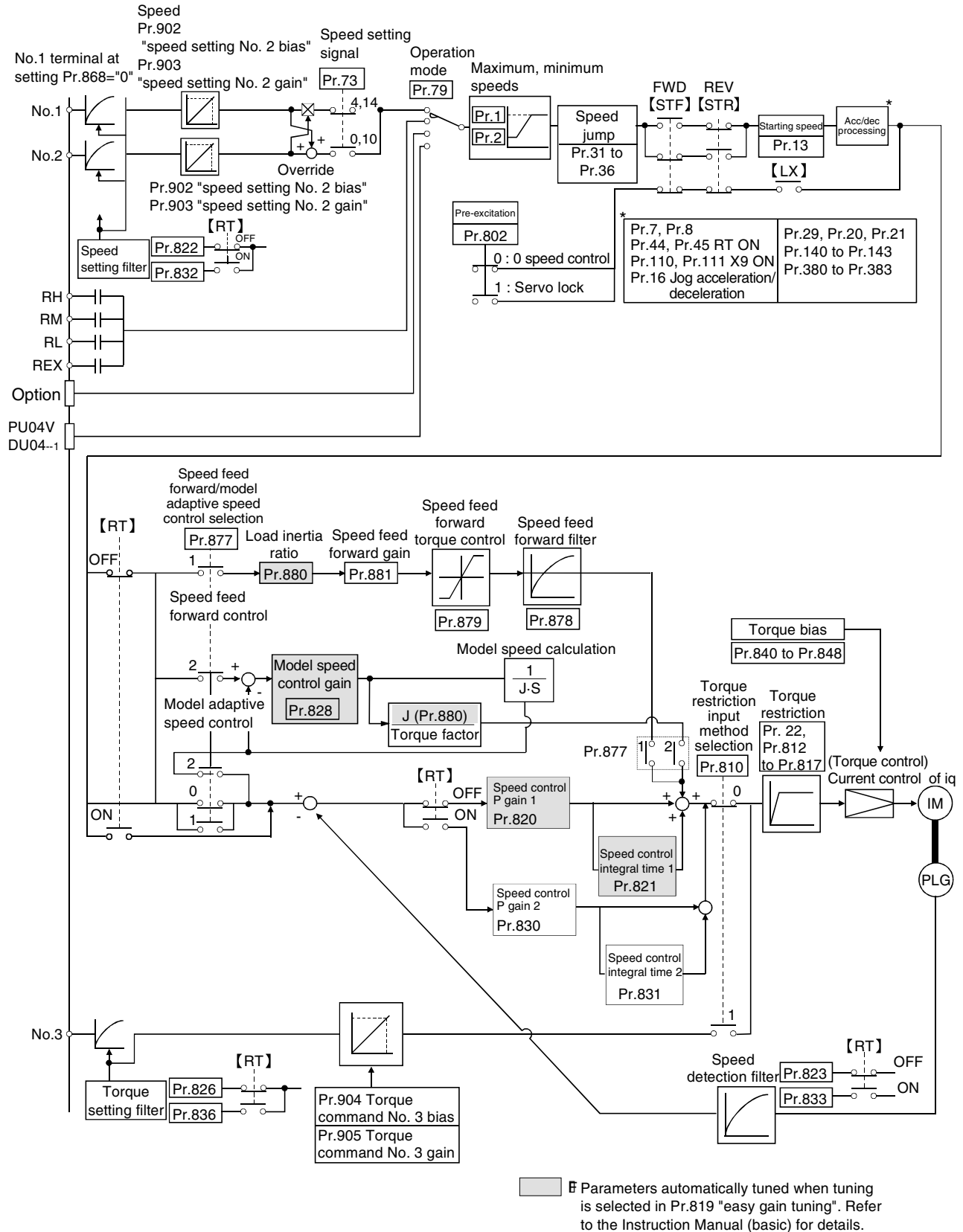


2.3 Fine adjustment of gains for speed control

If easy gain tuning does not provide high accuracy, refer to the next page and make adjustment.

Make adjustment when vibration, noise or any other unfavorable phenomenon occurs due to large load inertia or gear backlash, for example, or when you want to exhibit the best performance that matches the machine.

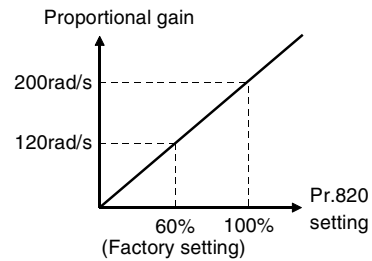
2.3.1 Control block diagram



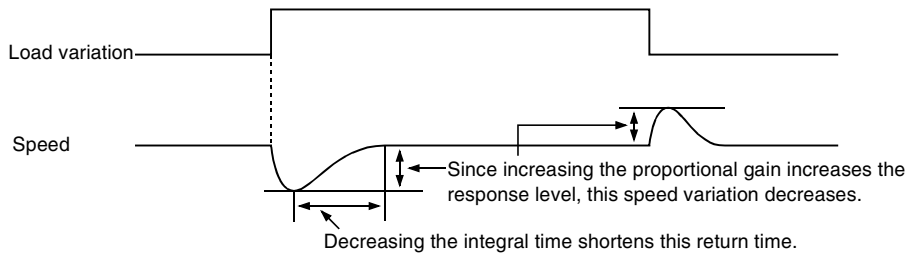
Fine adjustment of gains for speed control

2.3.2 Concept of adjustment of manual input speed control gains

- 1) Speed control P gain 1
 - Pr. 820 = 60% is equivalent to 120rad/s (speed response of the motor alone). (factory setting)
 - Increasing the proportional gain increases the response level. However, a too high gain will produce vibration and/or unusual noise.
- 2) Speed control integral time
 - Pr. 821 = 0.333s (factory setting)
 - Decreasing the integral time shortens the return time taken at a speed change. However, a too short time will generate an overshoot.



When there is load inertia, the actual speed gain is as given below.



Also, when there is load inertia, the actual speed gain decreases as indicated below.

$$\text{Actual speed gain} = \text{speed gain of motor without load} \times \frac{J_M}{J_M + J_L}$$

J_M : Inertia of motor
 J_L : Motor shaft-equivalent load inertia

2.3.3 Speed control gain adjustment procedure (Pr. 820, Pr. 821)

- Set "0" in Pr. 819 "easy gain tuning". (Easy gain tuning is not performed.)
- Refer to the Instruction Manual (basic) for easy gain tuning.
- Refer to the following for manually input gain adjustment.

● Manual input gain adjustment

- Pr. 820 "speed control P (proportional) gain 1", Pr. 830 "speed control P (proportional) gain 2"
- Pr. 821 "speed control integral time 1", Pr. 831 "speed control integral time 2"

Make adjustment when any of such phenomena as unusual machine vibration/noise, low response level and overshoot has occurred.

- 1) First check the conditions and simultaneously change Pr. 820 "speed control P gain 1" value.
- 2) If you cannot make proper adjustment, change Pr. 821 "speed control integral time 1" value and repeat step (1).

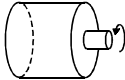




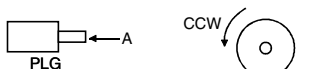
CAUTION

Pr. 830 "speed control P(proportional) gain 2" and Pr. 831 "speed control integral time 2" are made valid when the RT terminal is switched on. Make adjustments in the same way as Pr. 820 and Pr. 821.

| No. | Phenomenon/Condition | Adjustment Method | |
|-----|--|---|---|
| 1 | Large load inertia | Set the Pr. 820 and Pr. 821 values a little higher. | |
| | | Pr. 820 | When a speed rise is slow, increase the value 10% 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 10% 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 5% by 5% until just before vibration/noise is produced, and set about 0.8 to 0.9 of that value. |

| No. | Phenomenon/Condition | Adjustment Method |
|-----|--|--|
| 4 | Long return time (response time) | Set the Pr. 821 value a little lower. |
| | | Decrease the value by half until just before an overshoot or the unstable phenomenon 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 value until just before an overshoot or the unstable phenomenon does not occur, and set about 0.8 to 0.9 of that value. |

2.3.4 Troubleshooting

| | Phenomenon | Cause | Corrective Action | | | | |
|------------------------|--|---|--|-----------------|--|---|---|
| 1 | Motor does not rotate. | (1) The motor or PLG wiring is wrong. | <p>(1) Check the wiring. * Choose V/F control (Pr. 800 = 20) and check the rotation direction of the motor and the speed monitor output from the DA1 output terminal. Check the setting of the Pr. 19 "base frequency voltage" and Pr. 3 "base frequency".</p>  <p>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.)</p> <p>(2) Check the PLG specifications. Check the positions of the 5V/12V/24V/External and differential/complimentary jumper connectors.</p> <p>(3) Check that FWD is displayed when running the motor in the counter-clockwise direction from outside during a stop of the inverter. If REV is displayed, the PLG phase sequence is wrong. Perform the correct wiring or match the Pr. 852 "PLG rotation direction" setting.</p> | | | | |
| | | <p>(2) The PLG specifications (jumper connector setting) are wrong.</p> <p>(3) The PLG wiring is wrong.</p> | <table border="1" style="width: 100%;"> <thead> <tr> <th>Pr. 852 Setting</th> <th>Relationship between the motor and PLG</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>  <p>Forward rotation is clockwise rotation when viewed from A.</p> </td> </tr> <tr> <td style="text-align: center;">1 (factory setting)</td> <td>  <p>Forward rotation is counterclockwise rotation when viewed from A.</p> </td> </tr> </tbody> </table> <p>(4) The Pr. 851 "number of PLG pulses" setting and the number of PLG used are different.</p> <p>(4) The motor will not run if the parameter setting is smaller than the number of PLG pulses used. Set Pr. 851 "number of PLG pulses" correctly.</p> | Pr. 852 Setting | Relationship between the motor and PLG | 0 |  <p>Forward rotation is clockwise rotation when viewed from A.</p> |
| Pr. 852 Setting | Relationship between the motor and PLG | | | | | | |
| 0 |  <p>Forward rotation is clockwise rotation when viewed from A.</p> | | | | | | |
| 1 (factory setting) |  <p>Forward rotation is counterclockwise rotation when viewed from A.</p> | | | | | | |
| 2 | Motor does not run at correct speed. (Speed command does not match actual speed) | <p>(1) The speed command from the command device is incorrect. The speed command is compounded with noise.</p> <p>(2) The speed command value does not match the inverter-recognized value.</p> <p>(3) The number of PLG pulses setting is incorrect.</p> | <p>(1) Check that a correct speed command comes from the command device.</p> <p>(2) Readjust the speed command bias and gain in Pr. 902, Pr. 903, Pr. 917, and Pr. 918.</p> <p>(3) Check the setting of the number of PLG pulses in Pr. 851.</p> | | | | |

Fine adjustment of gains for speed control

| | Phenomenon | Cause | Corrective Action |
|---|---|---|--|
| 3 | Speed does not rise to the speed command. | (1) Insufficient torque. Torque restriction is actuated. (2) Only P (proportional) control is selected. | (1)-1 Increase the torque restriction value. (Refer to the torque restriction of speed control in the Instruction Manual (basic).) (1)-2 Insufficient capacity (2) When the load is heavy, speed deviation will occur under P (proportional) control. Select PI control. |
| 4 | Motor speed is unstable. | (1) The speed command varies. (2) Insufficient torque. (3) The speed control gains do not match the machine. (machine resonance) | (1)-1 Check that a correct speed command comes from the command device. (Take measures against noises.) (1)-2 Increase the speed setting filter in Pr. 822. (2)-1 Increase the torque restriction value. (Refer to the torque restriction of speed control in the Instruction Manual (basic).) (2)-2 Return the excitation ratio in Pr. 854 to the factory setting (100%). (3)-1 Perform easy gain tuning. (3)-2 Adjust Pr. 820 and Pr. 821. (Refer to gain adjustment.) (3)-3 Perform speed feed forward control and model adaptive speed control. |
| 5 | Motor or machine hunts (vibration/noise is produced). | (1) The speed control gain is high. (2) High torque control gain. | (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 Pr. 824. (Refer to page 49.) |
| 6 | Acceleration/ deceleration time does not match the setting. | (1) Insufficient torque. (2) Large load inertia. | (1)-1 Increase the torque restriction value. (Refer to the torque restriction of speed control in the Instruction Manual (basic).) (1)-2 Return the excitation ratio in Pr. 854 to the factory setting. (1)-3 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 and Pr. 821. (Refer to page 42.) (1)-3 Perform speed feed forward control and model adaptive speed control. (2) Change the acceleration/deceleration time to an optimum value. |
| 8 | Speed fluctuates at low speed. | (1) Adverse effect of weak excitation. (2) Low speed control gain. | (1) Return the excitation ratio in Pr. 854 to the factory setting. (2) Increase Pr. 820 "speed control P gain". |

Related parameter reference pages

- Pr. 71 "applied motor" (Refer to page 112.)
- Pr. 800 "control system selection" (Refer to page 169.)
- Pr. 820 "speed control P gain 1" (Refer to page 174.)
- Pr. 821 "speed control integral time 1" (Refer to page 174.)
- Pr. 822 "speed setting filter 1" (Refer to page 174.)
- Pr. 851 "number of PLG pulses" (Refer to the Instruction Manual (basic).)
- Pr. 854 "excitation ratio" (Refer to page 180.)
- Pr. 902 "speed setting No. 2 bias" (Refer to page 189.)
- Pr. 903 "speed setting No. 2 gain" (Refer to page 189.)
- Pr. 917 "No.1 terminal bias (speed)" (Refer to page 189.)
- Pr. 918 "No.1 terminal gain (speed)" (Refer to page 189.)

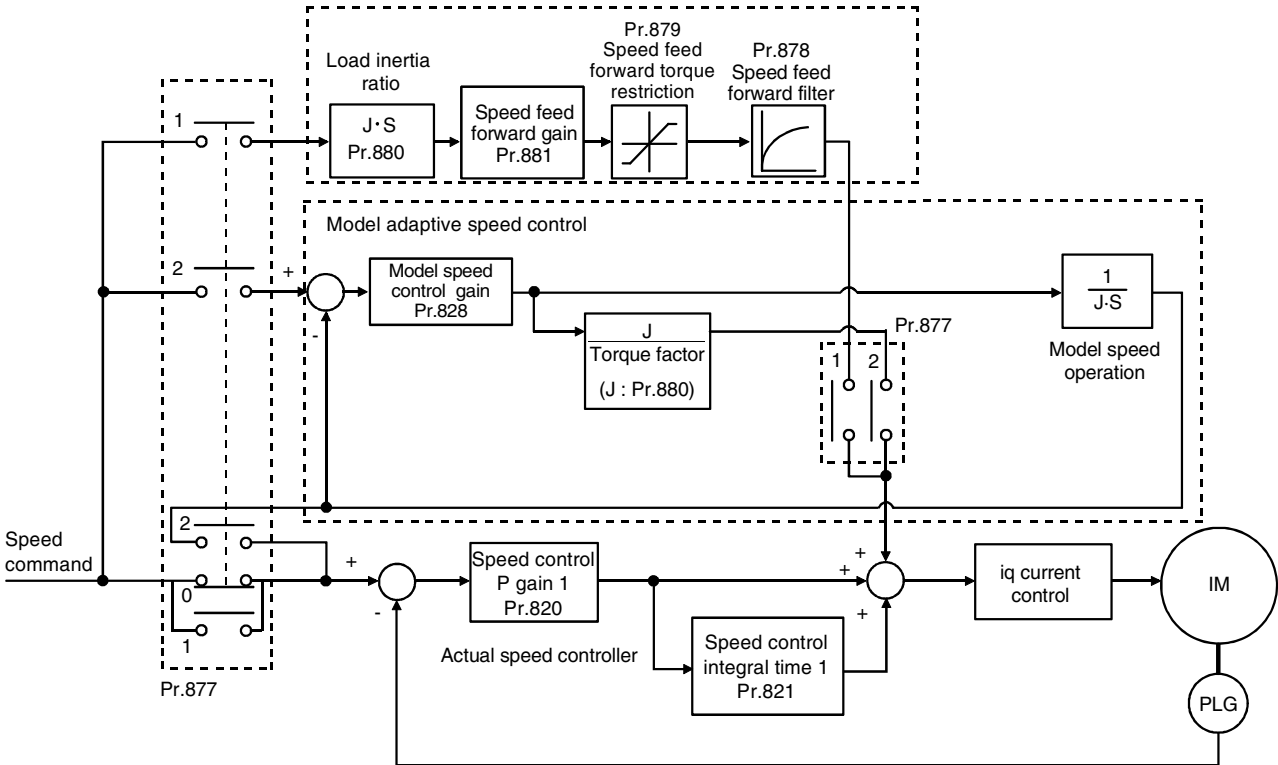
2.3.5 Speed feed forward control, model adaptive speed control (Pr. 828, Pr. 877 to Pr. 881)

By making parameter setting, select the speed feed forward control or model adaptive speed control. The speed feed forward control enhances the track ability of the motor in response to a speed command change. The model adaptive speed control enables individual adjustment of speed track ability and motor disturbance torque response.

| Parameter | Name | Factory Setting | Setting Range |
|-----------|---|-----------------|------------------|
| 828 | Model speed control gain | 60% | 0 to 1000% |
| 877 | Speed feed forward control/model adaptive speed control selection | 0 | 0,1,2 |
| 878 | Speed feed forward filter | 0s | 0 to 1s |
| 879 | Speed feed forward torque restriction | 150% | 0 to 400% |
| 880 | Load inertia ratio | 7 | 0,1 to 200 times |
| 881 | Speed feed forward gain | 0% | 0 to 1000% |

POINT

When model adaptive speed gain is selected, the data obtained from easy gain tuning is used for Pr. 828 "model speed control proportional gain". Perform easy gain tuning also (simultaneously). (Refer to the Instruction Manual (basic).)



Fine adjustment of gains for speed control

| Pr. 877 Setting | Description |
|-----------------|--|
| 0 | Normal speed control is exercised. |
| 1 | Speed feed forward control is exercised. ① Calculate required torque in response to the acceleration/deceleration command for the inertia ratio set in Pr. 880 and generate torque immediately. ② When inertia ratio estimation has been made by easy gain tuning, the inertia ratio estimation result is used as the Pr. 880 setting, from which the speed feed forward is calculated. ③ When the speed feed forward gain is 100%, the calculation result of the speed feed forward in 1) is reflected as-is. ④ 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 restricted using Pr. 879. ⑤ Using Pr. 878, the speed feed forward result can be dulled by the primary delay filter. |
| 2 | Model adaptive speed control is enabled. · At this time, the motor's model speed is calculated to feed back the model side speed controller. This model speed is also used as the actual speed controller command. · The inertia ratio in Pr. 880 is used for calculation of the torque current command value given by the model side speed controller. When inertia ratio estimation has been made by easy gain tuning, Pr. 880 is overwritten by the inertia ratio estimation result, and that value is used to calculate the torque current command value. · 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 iq current 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. |

CAUTION

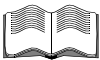
The adequate gain value for the model and actual loop parts are set according to the response setting of easy gain tuning under model adaptive speed control. To increase the response level, Pr. 818 "response setting" needs to be changed (increased).

The following table indicates the relationships between the speed feed forward/model adaptive speed control and easy gain tuning function.

| | Easy Gain Tuning Selection (Pr. 819) Setting | | |
|------------------------------------|--|--|--|
| | 0 | 1 | 2 |
| Load inertia ratio (Pr. 880) | Manual input | Inertia ratio estimation value found by easy gain tuning is displayed. Manual input enabled only during a stop. | Manual input |
| Model speed control gain (Pr. 828) | Manual input | Tuning results are displayed. Write disabled. | Tuning results are displayed. Write disabled. |
| Speed feed forward gain (Pr. 881) | Manual input | Manual input | Manual input |

REMARKS

Calculate the inertia reference of the SF-V5R (H) using the inertia moment J on page 194.



For details of easy gain tuning, refer to the Instruction Manual (basic) for details.

Related parameters

- Pr. 820 "speed control P gain 1" (Refer to page 174.)
- Pr. 821 "speed control integral time 1" (Refer to page 174.)
- Pr. 830 "speed control P gain 2" (Refer to page 174.)
- Pr. 831 "speed control integral time 2" (Refer to page 174.)

2.4 Torque control

2.4.1 Outline of torque control

The basics of torque control are explained in the Instruction Manual (basic).

Set any of "1 (torque control), 2 (speed-torque switchover), 5 (position-torque switchover)" in Pr. 800 "control system selection" to make torque control valid.
(The parameter is factory-set to enable speed control. Set "1" in Pr. 800 to make torque control valid.) (Refer to page 169.)


Set the motor. (Refer to the Instruction Manual (basic).)

Set the torque command. (No. 3 terminal)
When using the parameter or communication to input the torque command, refer to Pr. 804 "torque command right" (page 171).
When giving the torque command from the option (FR-A5NC, FR-V5AH, FR-A5AX, FR-V5AP), refer to the instruction manual of the corresponding option.

Set the speed restriction value. (Refer to the Instruction Manual (basic))

Test run

Set online auto tuning (adaptive magnetic flux observer) as required.

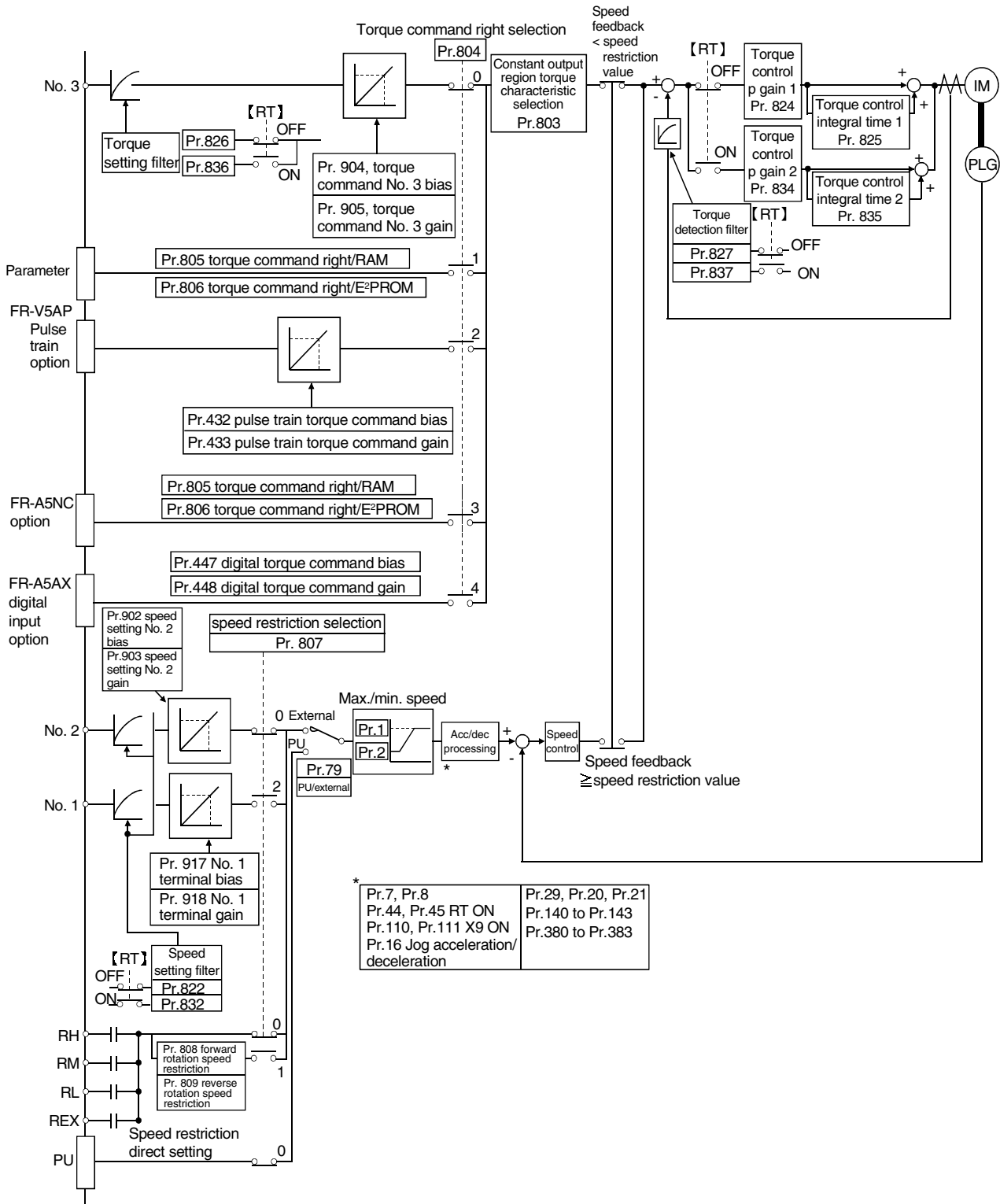
 Refer to the Instruction Manual (basic) for the details of connection diagram, test run, and online auto tuning.

2.5 Fine adjustment for torque control

Current loop gain parameter for adjusting torque control operation state is available with the FR-V500 series. Stable operation is possible with the factory-set parameter.

Refer to the next page and adjust the parameters when torque pulsation or any other unfavorable phenomenon occurs depending on the machine and operating conditions or when you want to exhibit the best performance that matches the machine.

2.5.1 Control block diagram



2.6 Gain adjustment for torque control

When exercising torque control, do not perform easy gain tuning. Easy gain tuning produces no effects. If torque accuracy is necessary, perform online auto tuning. (Refer to the Instruction Manual (basic).)

2.6.1 Concept of torque control gains

- (1) Torque control P gain 1
2000rad/s when Pr. 824 = 100% (factory setting).
- (2) Torque control integral time 1
Pr. 825 = 5ms (factory setting)

2.6.2 Gain adjustment procedure

Refer to the following table for manual input gain adjustment.

CAUTION

Normally, the current loop gains in Pr. 824 and Pr. 825 need not be changed. Fully note that unnecessarily changing the settings of the current loop gains will result in unstable phenomena and/or reduced response level.

● Manual input gain adjustment

Pr. 824 "torque control P gain 1", Pr. 834 "torque control P gain 2"
Pr. 825 "torque control integral time 1", Pr. 835 "torque control integral time 2"

Make adjustment when any of such phenomena as unusual machine vibration/noise and overcurrent has occurred.

- (1) First check the conditions and simultaneously change Pr. 824 "torque control P gain 1" value.
- (2) If you cannot make proper adjustment, change Pr. 825 "torque control integral time 1" value and repeat step (1).

CAUTION

Pr. 834 "torque control P gain 2" and Pr. 835 "torque control integral time 2" are made valid when the RT terminal is switched on. Make adjustments in the same way as Pr. 824 and Pr. 825.

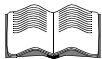
| No. | Phenomenon/Condition | Adjustment Method | |
|-----|---|---|---|
| 1 | <ul style="list-style-type: none"> • Unusual noise generated from motor • Unusual current flowing | Set Pr. 824 a little lower and Pr. 825 a little higher. First lower Pr. 824 and check the motor for unusual vibration/noise and overcurrent. If the problem still persists, increase Pr. 825. | |
| | | Pr. 824 | Decrease the value 10% by 10% until just before the phenomenon on the left is 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 synchronous sound. |
| | | Pr. 825 | Double the value until just before the phenomenon on the left is improved, and set about 0.8 to 0.9 of that value. Note that a too high value will produce current ripples, causing the motor to generate synchronous sound. |
| 2 | Overcurrent occurs. | 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 10% by 10% until just before an overcurrent does not occur, and set about 0.8 to 0.9 of that value. |
| | | Pr. 825 | Double the value until just before the phenomenon on the left is improved, and set about 0.8 to 0.9 of that value. |

2.6.3 Troubleshooting

| | Phenomenon | Cause | Corrective Action |
|---|--|---|--|
| 1 | Torque control is not exercised normally. | (1) The phase sequence of the motor or PLG wiring is wrong. (2) The control mode selection, Pr. 800, setting is improper. (3) The speed restriction value is not input. (4) The torque command varies. (5) Torque variation due to the change in the motor temperature. (6) The torque command does not match the inverter-recognized value. | (1) Check the wiring. (Refer to the Instruction Manual (basic).) (2) Check the Pr. 800 setting. (The factory setting is speed control) (3) Set the speed restriction value. (If the speed restriction value is not input, the motor will not rotate since the speed restriction value is regarded as 0r/min.) (4) Check that the command device gives a correct torque command. · Increase the torque setting filter in Pr. 826. (5) Set the adaptive magnetic flux observer in Pr. 95. (6) Recalibrate the torque command bias and gain in Pr. 904 and Pr. 905. |
| 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 the torque command bias in Pr. 904. |
| 3 | Normal torque control cannot be exercised during acceleration/deceleration. The motor vibrates. | Since the speed restriction value changes with the setting of the acceleration/deceleration time in Pr. 7, Pr. 8, the speed restriction may be activated. (When the speed restriction is activated, torque control cannot be exercised.) | Reduce the acceleration/deceleration time. Alternatively, set the acceleration/deceleration time to 0. (Speed restriction during acceleration/deceleration is speed restriction during constant speed) |
| 4 | Output torque is not linear in response to the torque command. | Insufficient torque. | Return the excitation ratio to the factory setting. |

Related parameter reference pages

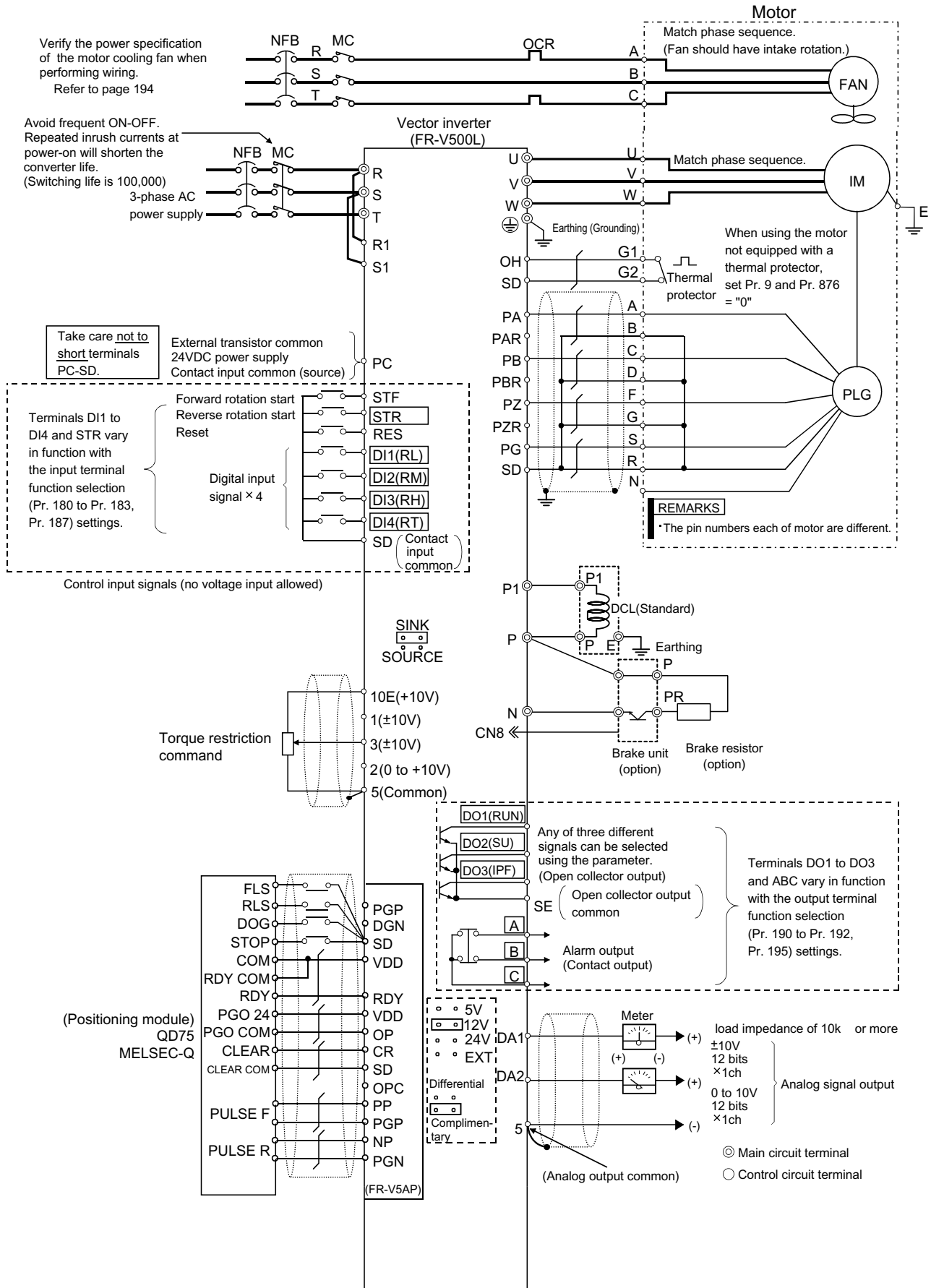
- Pr. 7 "acceleration time" (Refer to page 81.)
- Pr. 8 "deceleration time" (Refer to page 81.)
- Pr. 800 "control system selection" (Refer to page 169.)
- Pr. 802 "pre-excitation selection" (Refer to page 85.)
- Pr. 810 "torque restriction input method selection" (Refer to page 89.)
- Pr. 826 "torque setting filter 1" (Refer to page 175.)
- Pr. 904 "torque command No. 3 bias" (Refer to page 189.)
- Pr. 905 "torque command No. 3 gain" (Refer to page 189.)



For online auto tuning, refer to the Instruction Manual (basic)

2.7 Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

2.7.1 Connection diagram



Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

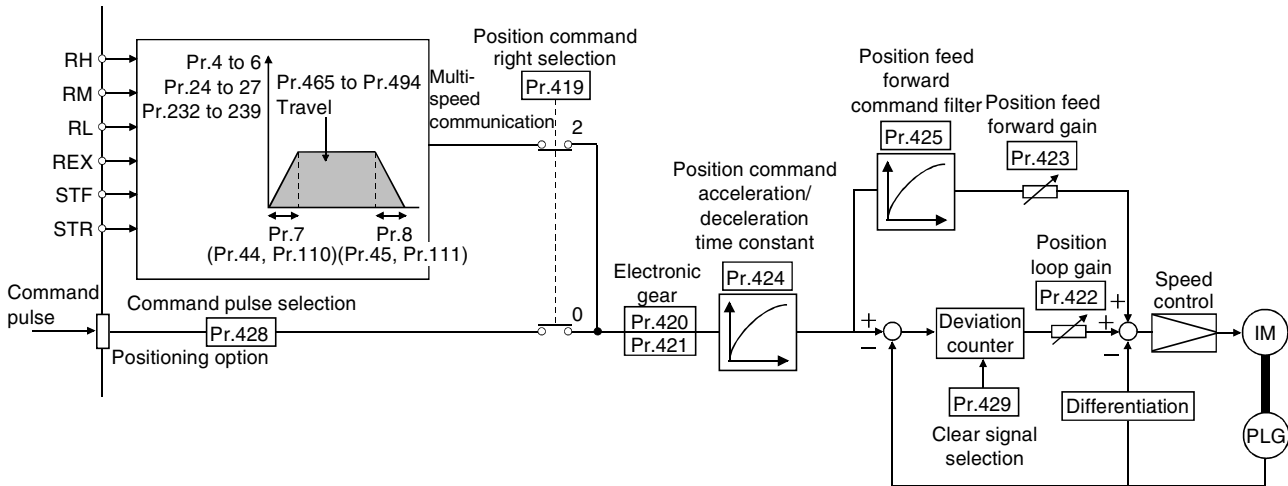
CAUTION

1. *: The setting of the PLG power supply jumper connector and output circuit connector when shipped from the factory.

| | Japanese Version | NA Version |
|-----------------------------------|---------------------|--------------------------------|
| PLG power supply jumper connector | 12V | 5V |
| Output circuit jumper connector | Complimentary (CMP) | Differential line driver (LDV) |

This inverter is allowed to perform position control by setting conditional position feed by contact input or the position control option (FR-V5AP). And the position loop gain that adjusts this position control status is provided for the inverter. It is not used independently but is used with the speed loop parameter to determine the value. Therefore, first adjust the speed loop gain and then adjust the position loop gain parameter.

2.7.2 Control block diagram



2.7.3 Parameter

Set the following parameters when exercising position control with the inverter.

| Parameter | Name | Factory Setting | Setting Range | Description |
|-----------|---|-----------------|-------------------------|---|
| 419 | Position command right selection | 0 | 0, 1 | Set position command input. |
| 420 | Command pulse scaling factor numerator | 1 | 0 to 32767 | Set the electronic gear. |
| 421 | Command pulse scaling factor denominator | 1 | 0 to 32767 | |
| 422 | Position loop gain | 25 | 0 to 150s ⁻¹ | Set the gain of the position loop. |
| 423 | Position feed forward gain | 0% | 0 to 100% | Function to cancel a delay caused by the droop pulses of the deviation counter. |
| 424 | Position command acceleration/ deceleration time constant | 0s | 0 to 50s | |
| 425 | Position feed forward command filter | 0s | 0 to 5s | Enter the primary delay filter in response to the feed forward command. |
| 426 | In-position width | 100 pulses | 0 to 32767 pulses | The in-position signal turns on when the droop pulses become less than the setting. |
| 427 | Excessive level error | 40K | 0 to 400K, 9999 | An error becomes excessive when the droop pulses exceed the setting. |
| 430 | Pulse monitor selection | 9999 | 0 to 5, 9999 | Display the number of pulses. |
| 464 | Digital position control sudden stop deceleration time | 3 | 0 to 360.0s | |

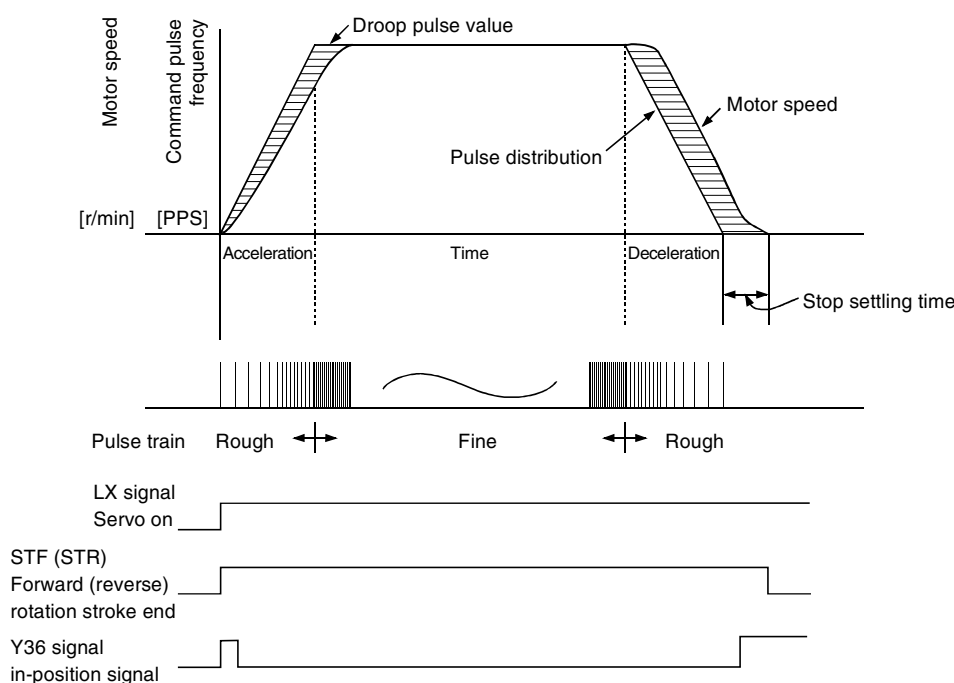
1) Position command right selection (Pr. 419)

| Pr. 419 Setting | Description |
|------------------------|---|
| 0 (factory setting) | Conditional position control function by contact input. (using parameters) |
| 1 | Position command by pulse train input (when the FR-V5AP is fitted). (Refer to the instruction manual of the option for details.) |

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 Pr. 494) is changed to the command pulses in the inverter) and the number of pulses fed back from the motor end PLG.

- 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 decrease, 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 STF and STR terminals provide the forward (reverse) command signal. The motor can run only in the direction where the forward (reverse) signal is on.
- Opening STF-SD disables the forward rotation, and opening STR-SD disables the reverse rotation.
- 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 setting time.

Related parameters

- Servo on (LX) signal ⇒ Set "23" in any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection). (Refer to page 149.)
- In-position signal (Y36) ⇒ Set "36" in any of Pr.190 to Pr.192 and Pr.195 (output terminal function selection). (Refer to page 151.)

Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

2.7.4 Conditional position feed function by contact input (Pr. 419=0)

Inputting the number of pulses (positions) in the parameters and setting multi-speed and forward (reverse) commands enable position control during servo operation. This position feed function does not return to the home position.

1) Setting position command using parameters

Set position command using any two of Pr. 465 to Pr. 494 (position feed amount).

Resolution of encoder speed 4



(When stopping the motor after 100 rotations using the FR-V5R)

2048 (pulse/rev) 100 (speed) 4 = 819200 (feed amount)

Setting the first amount 819200

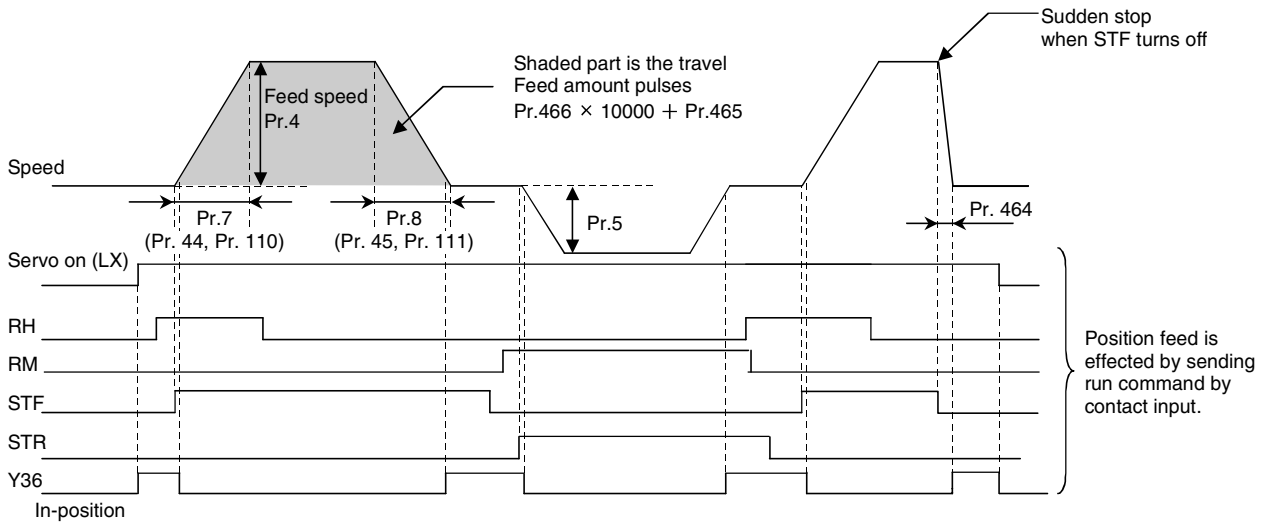
Pr. 466 (upper digits)= Pr. 465 (lower digits)= (decimal numeration)

<Position feed data setting parameters>

- Factory setting : 0
- Setting range : 0 to 9999
- Minimum setting range : 1

| Parameter | Name | Selection Method | | | | Position Feed Speed | |
|-----------|---------------------------------|------------------|-----|-----|-----|---------------------|---------------------|
| | | REX | RH | RM | RL | | |
| 465 | First position feed amount | (lower digits) | OFF | ON | OFF | OFF | High speed, Pr. 4 |
| 466 | | (upper digits) | | | | | |
| 467 | Second position feed amount | (lower digits) | OFF | OFF | ON | OFF | Middle speed, Pr. 5 |
| 468 | | (upper digits) | | | | | |
| 469 | Third position feed amount | (lower digits) | OFF | OFF | OFF | ON | Low speed, Pr. 6 |
| 470 | | (upper digits) | | | | | |
| 471 | Fourth position feed amount | (lower digits) | OFF | OFF | ON | ON | Speed 4, Pr. 24 |
| 472 | | (upper digits) | | | | | |
| 473 | Fifth position feed amount | (lower digits) | OFF | ON | OFF | ON | Speed 5, Pr. 25 |
| 474 | | (upper digits) | | | | | |
| 475 | Sixth position feed amount | (lower digits) | OFF | ON | ON | OFF | Speed 6, Pr. 26 |
| 476 | | (upper digits) | | | | | |
| 477 | Seventh position feed amount | (lower digits) | OFF | ON | ON | ON | Speed 7, Pr. 27 |
| 478 | | (upper digits) | | | | | |
| 479 | Eighth position feed amount | (lower digits) | ON | OFF | OFF | OFF | Speed 8, Pr. 232 |
| 480 | | (upper digits) | | | | | |
| 481 | Ninth position feed amount | (lower digits) | ON | OFF | OFF | ON | Speed 9, Pr. 233 |
| 482 | | (upper digits) | | | | | |
| 483 | Tenth position feed amount | (lower digits) | ON | OFF | ON | OFF | Speed 10, Pr. 234 |
| 484 | | (upper digits) | | | | | |
| 485 | Eleventh position feed amount | (lower digits) | ON | OFF | ON | ON | Speed 11, Pr. 235 |
| 486 | | (upper digits) | | | | | |
| 487 | Twelfth position feed amount | (lower digits) | ON | ON | OFF | OFF | Speed 12, Pr. 236 |
| 488 | | (upper digits) | | | | | |
| 489 | Thirteenth position feed amount | (lower digits) | ON | ON | OFF | ON | Speed 13, Pr. 237 |
| 490 | | (upper digits) | | | | | |
| 491 | Fourteenth position feed amount | (lower digits) | ON | ON | ON | OFF | Speed 14, Pr. 238 |
| 492 | | (upper digits) | | | | | |
| 493 | Fifteenth position feed amount | (lower digits) | ON | ON | ON | ON | Speed 15, Pr. 239 |
| 494 | | (upper digits) | | | | | |

2) Operation by position command using parameters



- Acceleration/deceleration time is 0.1s minimum and 360s maximum.
- Acceleration/deceleration reference speed (Pr. 20) is clamped at a minimum of 500r/min.
- Deceleration time can be set in Pr. 464 "digital position control sudden stop deceleration time".
- At this time, the acceleration/deceleration patterns are all linear acceleration and the setting of Pr. 29 "acceleration/deceleration pattern" is invalid. (Refer to page 91 for Pr. 29.)

CAUTION

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). Position feed is invalid if the multi-speed command is given after forward (reverse) command.

2.7.5 Setting the electronic gear

Adjust the ratio of the machine side gear and the motor side gear.

The position resolution (travel per pulse Δl [mm]) is determined by the travel per motor revolution Δs [mm] and the feedback pulses Pf [pulse/rev] of the detector, and is represented by the following expression.

$$\Delta l = \frac{\Delta s}{Pf}$$

Δl : Travel per pulse [mm]
 Δs : Travel per motor revolution [mm]
 Pf : Number of feedback pulses [pulse/rev]
 (the number of pulses after multiplying the number of PLG pulses by 4)

Using the parameters, the travel per command pulse can be set separately to set the travel per command pulse without a fraction.

$$\Delta l = \frac{\Delta s}{Pf} \times \frac{Pr. 420}{Pr. 421}$$

The relationship between the motor speed and internal command pulse frequency is as follows.

$$f_o \times \frac{Pr. 420}{Pr. 421} = Pf \times \frac{No}{60}$$

f_o : Internal command pulse frequency [pps]
 No : Motor speed [r/min]

CAUTION

Set the electronic gear in the range of 1/50 to 20.

Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

"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 $\Delta s = 10$ (mm) when the number of feedback pulses $Pf = 4000$ (pulse/rev). According to the following expression,

$$\begin{aligned} \Delta \ell &= \frac{\Delta s}{Pf} \times \frac{\text{Pr. 420}}{\text{Pr. 421}} \\ \frac{\text{Pr. 420}}{\text{Pr. 421}} &= \Delta \ell \times \frac{Pf}{\Delta s} \\ &= 0.01 \times \frac{4000}{10} = \frac{4}{1} \end{aligned}$$

Therefore, set "4" in Pr. 420 and "1" in Pr. 421.

"Setting example 2"

Find the internal command pulse frequency of the Mitsubishi dedicated motor rated speed. Note that the command pulse scaling factor $\text{Pr. 420}/\text{Pr. 421} = 1$.

Assuming that the number of PLG pulses is 2048 (pulses/rev) (feedback pulse $Pf = 2048$ 4),

$$\begin{aligned} f_o &= 2048 \times \frac{N_o}{60} \times \frac{\text{Pr. 421}}{\text{Pr. 420}} \times 4 \\ &= 204800 \end{aligned}$$

Therefore, the internal command pulse frequency is 204800 (pps).

<Relationship between position resolution $\Delta \ell$ and overall accuracy>

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.

$$\Delta \ell < \left(\frac{1}{5} \text{ to } \frac{1}{10} \right) \times \Delta \varepsilon \quad \Delta \varepsilon : \text{Positioning accuracy}$$

<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 53, 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 (f_o) and position loop gain (K_p : Pr. 422) is as represented by the following expression.

$$\varepsilon = \frac{f_o}{K_p} \text{ [pulse]} \quad \varepsilon = \frac{204800}{25} \text{ [pulse]} \quad (\text{motor rated speed})$$

When the factory setting of K_p is $25s^{-1}$, the droop pulses (ε) are 8192 pulses.

Since the inverter has droop pulses during running, a stop settling time (t_s) is needed from when the command has zeroed until the motor stops. Set the operation pattern in consideration of the stop settling time.

$$t_s = 3 \times \frac{1}{K_p} \text{ [s]}$$

When the factory setting of K_p is $25s^{-1}$, the stop settling time (t_s) is 0.12s.

The positioning accuracy $\Delta \varepsilon$ is (5 to 10) $\Delta \ell = \Delta \varepsilon$ [mm]

● Position command acceleration/deceleration time constant (Pr. 424)

- 1) 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.
- 2) 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.

2.7.6 In-position width (Pr. 426)

The Y36 terminal signal acts as an in-position signal. The in-position signal turns on when the number of droop pulses becomes less than the setting.

2.7.7 Excessive level error (Pr. 427)

An error becomes excessive when the droop pulses exceed the setting.
When you decreased the position loop gain (Pr. 422) 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. 472="9999", an excessive position error (E.OD) is not output regardless of the droop pulses.

2.7.8 Pulse monitor selection (Pr. 430)

The states of various pulses during operation are displayed in terms of the number of pulses instead of the speed monitor output.

| Pr. 430 | Description | Display Range (FR-DU04-1) | Display Range (FR-PU04V) |
|---------|---|---------------------------|--------------------------|
| 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 monitored. | Lower 4 digits | Lower 5 digits |
| 5 | | Upper 4 digits | Upper 5 digits |
| 9999 | The frequency monitor is displayed. (factory setting) | | |

REMARKS

- 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 is turned on.

2.7.9 Concept of position control gains

Easy gain tuning is available as an easy tuning method. For easy gain tuning, refer to the Instruction Manual (basic). If it does not produce any effect, make fine adjustment by using the following parameters. Set "0" in Pr. 819 "easy gain tuning" before setting the parameters below.

- Pr. 422 "position loop gain" (factory setting $25s^{-1}$)
Make adjustment when any of such phenomena as unusual vibration, noise and overcurrent of the motor/machine occurs.
Increasing the setting improves track ability 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.

| No. | Phenomenon/Condition | Adjustment Method | |
|-----|---|-----------------------------|--|
| 1 | Slow response | Increase the Pr. 422 value. | |
| | | Pr. 422 | Increase the value $3s^{-1}$ by $3s^{-1}$ until just before an overshoot, stop-time vibration or other instable phenomenon occurs, and set about 0.8 to 0.9 of that value. |
| 2 | Overshoot, stop-time vibration or other instable phenomenon occurs. | Decrease the Pr. 422 value. | |
| | | Pr. 824 | Decrease the value $3s^{-1}$ by $3s^{-1}$ until just before an overshoot, stop-time vibration or other instable phenomenon occurs, and set about 0.8 to 0.9 of that value. |

- Pr. 423 "position feed forward gain" (factory setting 0)
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.

Conditional position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

3) Changes in terminal functions by control mode switchover of terminals
The table below lists terminal functions according to control mode

| Classification | Terminal Name | Description | | |
|-----------------------|---------------|----------------------------|---|--|
| | | Position Control | Speed Control/Position Control Switchover (MC:ON/OFF) | Position Control/Torque Control Switchover (MC:ON/OFF) |
| Contact input signal | STF | Forward rotation command * | Forward rotation command | Forward rotation command |
| | STR | Reverse rotation command * | Reverse rotation command | Reverse rotation command |
| | DI1 | ← | ← | ← |
| | DI2 | ← | ← | ← |
| | DI3 | ← | ← | ← |
| Contact output | DI4 | ← | ← | ← |
| | ABC | ← | ← | ← |
| Open collector output | DO1 | ← | ← | ← |
| | DO2 | ← | ← | ← |
| | DO3 | ← | ← | ← |
| Analog input | 2 | Invalid | Speed command/invalid | Invalid/speed command |
| | 1 | Invalid | Speed command/invalid | Invalid/speed command |
| | 3 | Torque restriction input | ← | Torque restriction/torque command |
| Analog output | DA1 | ← | ← | ← |
| | DA2 | ← | ← | ← |

REMARKS

* When exercising position control by pulse train (Pr. 419 = 1, using the FR-V5AP), the STF acts as forward rotation stroke end signal and the STR acts as the reverse rotation stroke end signal. (Refer to the instruction manual of the FR-V5AP for details.)

Related parameters

- DI1 to DI4, STF terminal function selection⇒Pr.180 to Pr.183, Pr.187 (input terminal function selection) (Refer to page 149.)
- DO1 to DO3, ABC terminal function selection⇒Pr.190 to Pr.192, Pr.195 (output terminal function selection) (Refer to page 151.)
- No.1 terminal function selection⇒Pr.868 "No. 1 terminal function assignment". (Refer to page 182.)
- Bias/gain adjustment of No.1, 2, 3 terminals⇒Pr.902 to Pr.905, Pr.917, Pr.918 (bias/gain adjustment) (Refer to page 189.)
- DA1, DA2 terminal function selection⇒Pr.54, Pr.158 (DA1, DA2 function selection) (Refer to page 99.)
- DA1, DA2 terminal calibration⇒Pr.900, Pr.901 (DA1, DA2 terminal calibration) (Refer to page 187.)
- MC signal terminal assignment⇒Set "26" in any two of terminals DI1 to DI4 or STF using Pr.180 to Pr. 183 or Pr.187 (input terminal function selection) (Refer to page 149.)

2.7.10 Troubleshooting

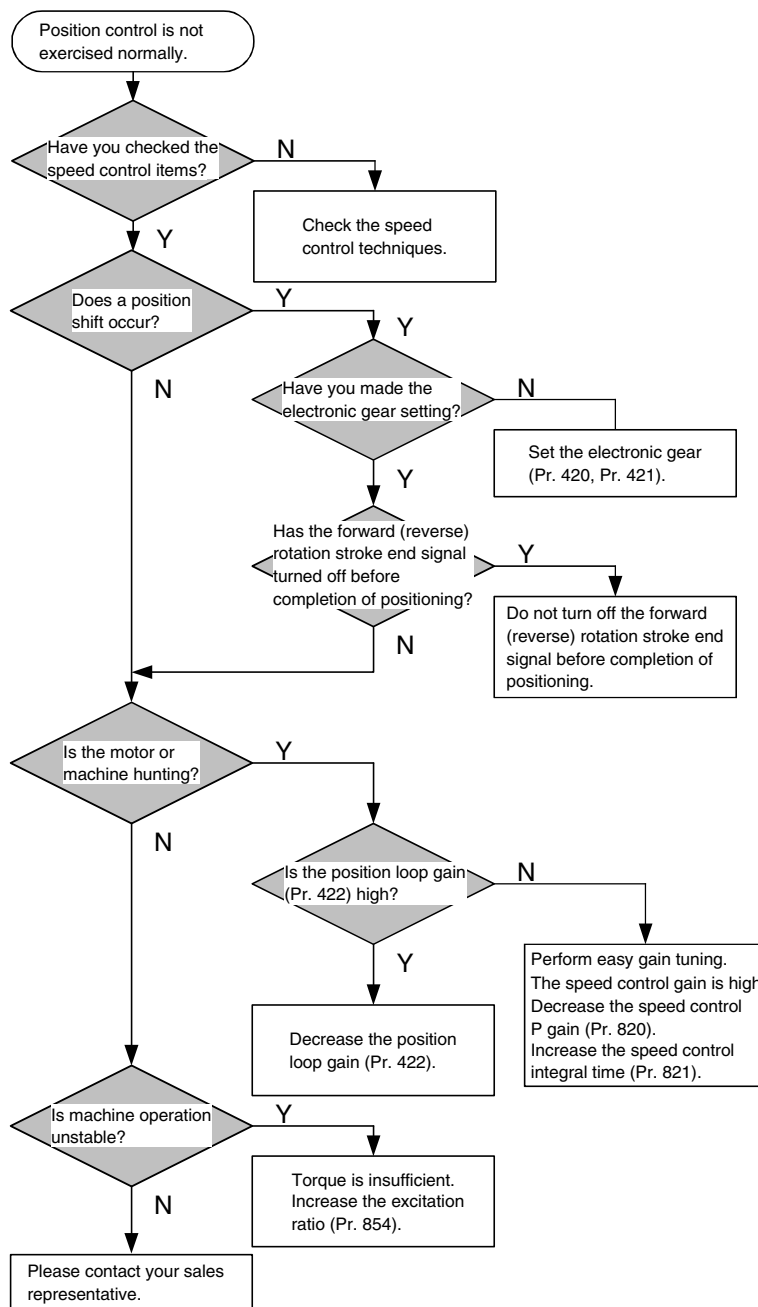
| | Phenomenon | Cause | Corrective Action |
|---|--------------------------------|--|--|
| 1 | Motor does not rotate. | (1) The phase sequence of the motor or PLG wiring is wrong. (2) The control mode selection, Pr. 800, setting is improper. (3) The servo on signal or start signal (STF, STR) is not input. (4) The command pulses are not input correctly. (FR-V5AP) (5) The position command right selection, Pr. 419, setting is not correct. (6) When the position command right selection, Pr. 419, setting is 0, the position feed amount, Pr. 465 to Pr. 494, settings are not correct. | (1) Check the wiring. (Refer to page 51) (2) Check the Pr. 800 setting. (Factory setting is speed control) (3) Check that the signals are input normally. (4)-1 Check that the command pulses are input normally. (Check the cumulative command pulse value in Pr. 430.) (4)-2 Check the command pulse form and command pulse selection, Pr. 428, setting. (5) Check the position command right selection in Pr. 419. (6) Check the position feed amounts 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 PLG feedback is compounded with noise. | (1)-1 Check the command pulse form and command pulse selection, Pr. 428, setting. (1)-2 Check that the command pulses are input normally. (Check the cumulative command pulse value in Pr. 430.) (2)-1 Decrease the PWM carrier frequency in Pr. 72. (2)-2 Change the shielded cable earthing (grounding) place or raise the cable. |
| 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 Pr. 7 and Pr. 8. |

Related parameter reference pages

- Pr. 800 "control system selection" (Refer to page 169.)
- Pr. 802 "pre-excitation selection" (Refer to page 85.)
- Pr. 820 "speed control P gain 1" (Refer to page 174.)
- Pr. 7 "acceleration time" (Refer to page 81.)
- Pr. 8 "deceleration time" (Refer to page 81.)
- Pr. 72 "PWM frequency selection" (Refer to page 113.)
- Pr. 821 "speed control integral time 1" (Refer to page 174.)

2.7.11 Position control is not exercised normally

(1) Position control



REMARKS

The speed command of position control relates to speed control. Refer to the Instruction Manual (basic) for details.

3

PARAMETERS

This chapter explains the "parameters" for use of this product.

Always read the instructions and other information before using the equipment.

The following marks indicate availability of parameters under each control.

speed : Available under speed control

torque : Available under torque control

position : Available under position control

position : Available under position control by parameter settings

1

2

3

4

Parameter lists (Japanese version)

3.1 Parameter lists (Japanese version)

The inverter is factory-set to display only the simple mode parameters.
Set Pr. 160 "extended function selection" as required.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------|-----------------|---------------|--|
| 160 | Extended function selection | 0 | 0 | Accessible to only the simple mode parameters. |
| | | | 1 | Accessible to all parameters. |

CAUTION

- The blacked out parameters in the table below indicate simple mode parameters.
- The shaded parameters in the table allow its setting to be changed during operation even if "0" (factory setting) is set in Pr. 77 (parameter write disable selection).
- *: Accessible when Pr. 77 = 801.

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------|---|------------------------|----------------------------|-----------------|----------|------------------|
| Basic functions | 0 | Torque boost (manual) | 0 to 30% | 0.1% | 1% | 79 | |
| | 1 | Maximum speed | 0 to 3600r/min | 1r/min | 1500r/min | 79 | |
| | 2 | Minimum speed | 0 to 3600r/min | 1r/min | 0r/min | 79 | |
| | 3 | Base frequency | 20 to 200Hz | 0.01Hz | 60Hz | 80 | |
| | 4 | Multi-speed setting (high speed) | 0 to 3600r/min | 1r/min | 1500r/min | 80 | |
| | 5 | Multi-speed setting (middle speed) | 0 to 3600r/min | 1r/min | 750r/min | 80 | |
| | 6 | Multi-speed setting (low speed) | 0 to 3600r/min | 1r/min | 150r/min | 80 | |
| | 7 | Acceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 15s | 81 | |
| | 8 | Deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 15s | 81 | |
| Standard operation functions | 9 | Electronic thermal O/L relay | 0 to 3600A | 0.1A | 0A | 83 | |
| | 10 | DC injection brake operation speed | 0 to 1500r/min, 9999 | 0.1r/min | 15r/min | 85 | |
| | 11 | DC injection brake operation time | 0 to 0.5s | 0.1s | 0.5s | 85 | |
| | 12 | DC injection brake voltage | 0 to 30% | 0.1% | 1% | 85 | |
| | 13 | Starting speed | 0 to 1500r/min | 0.1r/min | 15r/min | 86 | |
| | 15 | Jog speed setting | 0 to 1500r/min | 0.1r/min | 150r/min | 87 | |
| Operation selection functions | 16 | Jog acceleration/deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 0.5s | 87 | |
| | 17 | MRS input selection | 0, 2 | 1 | 0 | 88 | |
| | 19 | Base frequency voltage | 0 to 1000V, 8888, 9999 | 0.1V | 9999 | 80 | |
| | 20 | Acceleration/deceleration reference speed | 1 to 3600r/min | 1r/min | 1500r/min | 81 | |
| | 21 | Acceleration/deceleration time increments | 0, 1 | 1 | 0 | 81 | |
| | 22 | Torque restriction level | 0 to 400% | 0.1% | 150% | 89 | |
| | 24 | Multi-speed setting (speed 4) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 25 | Multi-speed setting (speed 5) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 26 | Multi-speed setting (speed 6) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 27 | Multi-speed setting (speed 7) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 28 | Multi-speed input compensation | 0, 1 | 1 | 0 | 90 | |
| | 29 | Acceleration/deceleration pattern | 0, 1, 2, 3, 4 | 1 | 0 | 91 | |
| | 30 | Regenerative function selection | 0, 1, 2 | 1 | 0 | 94 | |
| | 31 | Speed jump 1A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| 32 | Speed jump 1B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------------------------------|---|---|----------------------------|---------------------------------------|----------|------------------|
| Operation selection functions | 33 | Speed jump 2A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 34 | Speed jump 2B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 35 | Speed jump 3A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 36 | Speed jump 3B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 37 | Speed display | 0, 1 to 9998 | 1 | 0 | 95 | |
| Output terminal functions | 41 | Up-to-speed sensitivity | 0 to 100% | 0.1% | 10% | 97 | |
| | 42 | Speed detection | 0 to 3600r/min | 1r/min | 300r/min | 97 | |
| | 43 | Speed detection for reverse rotation | 0 to 3600r/min, 9999 | 1r/min | 9999 | 97 | |
| Second functions | 44 | Second acceleration/deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 5s | 81 | |
| | 45 | Second deceleration time | 0 to 3600s/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 81 | |
| Output terminal function | 50 | Second speed detection | 0 to 3600r/min | 1r/min | 750r/min | 97 | |
| Display functions | 52 | DU/PU main display data selection | 0, 5 to 12, 17 to 20, 23, 24, 32 to 35, 38, 100 | 1 | 0 | 99 | |
| | 53 | PU level display data selection | 0 to 3, 5 to 12, 17, 18 | 1 | 1 | 99 | |
| | 54 | DA1 terminal function selection | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | 1 | 1 | 99 | |
| | 55 | Speed monitoring reference | 0 to 3600r/min | 1r/min | 1500r/min | 102 | |
| | 56 | Current monitoring reference | 0 to 3600A | 0.1A | Inverter rated output current | 102 | |
| Automatic restart | 57 | Restart coasting time | 0, 0.1 to 30s, 9999 | 0.1s | 9999 | 103 | |
| | 58 | Restart cushion time | 0 to 60s | 0.1s | 1.0s | 103 | |
| Additional function | 59 | Remote setting function selection | 0, 1, 2, 3 | 1 | 0 | 105 | |
| Operation selection functions | 60 | Intelligent mode selection | 0, 7, 8 | 1 | 0 | 107 | |
| | 65 | Retry selection | 0 to 5 | 1 | 0 | 110 | |
| | 67 | Number of retries at alarm occurrence | 0 to 10, 101 to 110 | 1 | 0 | 110 | |
| | 68 | Retry waiting time | 0 to 10s | 0.1s | 1s | 110 | |
| | 69 | Retry count display erasure | 0 | 1 | 0 | 110 | |
| | 70 | Special regenerative brake duty | 0 to 10% | 0.1% | 0% | 94 | |
| | 71 | Applied motor | 0, 3 to 8, 10, 13 to 18, 20, 23, 24, 30, 33, 34 | 1 | 30 | 112 | |
| | 72 | PWM frequency selection | 1 | 1 | 1 | 113 | |
| | 73 | Speed setting signal | 0, 4, 10, 14 | 1 | 0 | 114 | |
| | 75 | Reset selection/disconnected PU detection/PU stop selection | 0 to 3, 14 to 17 | 1 | 14 | 116 | |
| | 77 | Parameter write disable selection | 0, 1, 2 | 1 | 0 | 117 | |
| 78 | Reverse rotation prevention selection | 0, 1, 2 | 1 | 0 | 118 | | |
| 79 | Operation mode selection | 0 to 4, 6 to 8 | 1 | 0 | 118 | | |
| Motor constants | 80 | Motor capacity | 0 to 3600kW | 0.1kW | Inverter capacity | 121 | |
| | 81 | Number of motor poles | 2, 4, 6 | 1 | 4 | 121 | |
| | 82 | Motor excitation current (no load current) * | 0 to , 9999 | | 9999 | 125 | |
| | 83 | Rated motor voltage | 0 to 1000V | 0.1V | 200V (200V class) / 400V (400V class) | 121 | |
| | 84 | Rated motor frequency | 20 to 200Hz | 0.01Hz | 60Hz | 121 | |
| | 90 | Motor constant R1 * | 0 to , 9999 | | 9999 | 125 | |
| | 91 | Motor constant R2 * | 0 to , 9999 | | 9999 | 125 | |
| | 92 | Motor constant L1 * | 0 to , 9999 | | 9999 | 125 | |
| | 93 | Motor constant L2 * | 0 to , 9999 | | 9999 | 125 | |
| | 94 | Motor constant X * | 0 to , 9999 | | 9999 | 125 | |
| 95 | Online auto tuning selection | 0, 1, 2 | 1 | 0 | 126 | | |
| 96 | Auto tuning setting/status | 0, 1, 101 | 1 | 0 | 121 | | |
| Third functions | 110 | Third acceleration/deceleration time | 0 to 3600/0 to 360s | 0.1s/0.01s | 5s | 81 | |
| | 111 | Third deceleration time | 0 to 3600/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 81 | |

Parameter lists (Japanese version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting | |
|---|-----------------------------------|---|---|----------------------------|-----------------|----------|------------------|--|
| Output terminal function | 116 | Third speed detection | 0 to 3600r/min | 1r/min | 1500r/min | 97 | | |
| Communication functions | 117 | Station number | 0 to 31 | 1 | 0 | 128 | | |
| | 118 | Communication speed | 48, 96, 192 | 1 | 192 | 128 | | |
| | 119 | Stop bit length/data length | 0, 1, 10, 11 | 1 | 1 | 128 | | |
| | 120 | Parity check presence/absence | 0, 1, 2 | 1 | 2 | 128 | | |
| | 121 | Number of communication retries | 0 to 10, 9999 | 1 | 1 | 128 | | |
| | 122 | Communication check time interval | 0 to 999.8s, 9999 | 0.1s | 0 | 128 | | |
| | 123 | Waiting time setting | 0 to 150ms, 9999 | 1ms | 9999 | 128 | | |
| PID control | 124 | CR, LF presence/absence selection | 0, 1, 2 | 1 | 1 | 128 | | |
| | 128 | PID action selection | 10, 11, 30, 31 | 1 | 10 | 139 | | |
| | 129 | PID proportional band | 0.1 to 1000%, 9999 | 0.1% | 100% | 139 | | |
| | 130 | PID integral time | 0.1 to 3600s, 9999 | 0.1s | 1s | 139 | | |
| | 131 | Upper limit | 0 to 100%, 9999 | 0.1% | 9999 | 139 | | |
| | 132 | Lower limit | 0 to 100%, 9999 | 0.1% | 9999 | 139 | | |
| Backlash | 133 | PID action set point for PU operation | 0 to 100% | 0.01% | 0% | 139 | | |
| | 134 | PID differential time | 0.01 to 10s, 9999 | 0.01s | 9999 | 139 | | |
| | 140 | Backlash acceleration stopping speed | 0 to 3600r/min | 1r/min | 30r/min | 91 | | |
| | 141 | Backlash acceleration stopping time | 0 to 360s | 0.1s | 0.5s | 91 | | |
| Display functions | 142 | Backlash deceleration stopping speed | 0 to 3600r/min | 1r/min | 30r/min | 91 | | |
| | 143 | Backlash deceleration stopping time | 0 to 360s | 0.1s | 0.5s | 91 | | |
| | 144 | Speed setting switchover | 0, 2, 4, 6, 8, 10 | 1 | 0 | 95 | | |
| Current detection | 145 | Parameter for the option (FR-PU04V). | | | | | | |
| | 150 | Output current detection level | 0 to 200% | 0.1% | 150% | 145 | | |
| | 151 | Output current detection time | 0 to 10s | 0.1s | 0 | 145 | | |
| | 152 | Zero current detection level | 0 to 200.0% | 0.1% | 5.0% | 146 | | |
| Sub functions | 153 | Zero current detection time | 0 to 1s | 0.01s | 0.5s | 146 | | |
| | 156 | Stall prevention operation selection | 0 to 31, 100, 101 | 1 | 1 | 147 | | |
| Display functions | 157 | OL signal output timer | 0 to 25s, 9999 | 0s | 0 | 148 | | |
| | 158 | DA2 terminal function selection | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | 1 | 1 | 99 | | |
| Automatic restart after instantaneous power failure | 160 | Extended function selection | 0, 1 | 1 | 0 | 149 | | |
| | 162 | Automatic restart after instantaneous power failure selection | 0, 1, 10 | 1 | 0 | 103 | | |
| | 163 | First cushion time for restart | 0 to 20s | 0.1s | 0s | 103 | | |
| | 164 | First cushion voltage for restart | 0 to 100% | 0.1% | 0% | 103 | | |
| Maintenance functions | 165 | Restart current restriction level | 0 to 200% | 0.1% | 150% | 103 | | |
| | 168 | Maker setting parameters. Do not make setting. | | | | | | |
| Terminal assignment functions | 169 | Maker setting parameters. Do not make setting. | | | | | | |
| | 171 | Actual operation hour meter clear | 0 | 1 | 0 | 149 | | |
| | 180 | DI1 terminal function selection | 0 to 3, 5, 8 to 16, 20, 22 to 27, 42 to 44, 9999 | 1 | 0 | 149 | | |
| | 181 | DI2 terminal function selection | | 1 | 1 | | | |
| | 182 | DI3 terminal function selection | | 1 | 2 | | | |
| | 183 | DI4 terminal function selection | | 1 | 3 | | | |
| | 187 | STR terminal function selection | | 1 | 9999 | | | |
| | 190 | DO1 terminal function selection | 0 to 8, 10 to 16, 20, 25 to 27, 30 to 37, 40 to 44, 96 to 99, 100 to 108, 110 to 116, 120, 125 to 127, 130 to 137, 140 to 144, 196 to 199, 9999 | 1 | 0 | 151 | | |
| 191 | DO2 terminal function selection | 1 | | 1 | | | | |
| 192 | DO3 terminal function selection | 1 | | 2 | | | | |
| 195 | A,B,C terminal function selection | 1 | | 99 | | | | |
| Multi-speed operation | 232 | Multi-speed setting (speed 8) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |
| | 233 | Multi-speed setting (speed 9) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |
| | 234 | Multi-speed setting (speed 10) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |
| | 235 | Multi-speed setting (speed 11) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |
| | 236 | Multi-speed setting (speed 12) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|------------------------------|---------------|---|---------------------------|----------------------------|-------------------|----------|------------------|
| Multi-speed operation | 237 | Multi-speed setting (speed 13) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 238 | Multi-speed setting (speed 14) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 239 | Multi-speed setting (speed 15) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| Sub functions | 240 | Soft-PWM setting | 0, 1, 10, 11 | 1 | 10 | 113 | |
| | 244 | Cooling fan operation selection | 0, 1 | 1 | 0 | 153 | |
| Stop selection function | 250 | Stop selection | 0 to 100s, 9999 | 0.1s | 9999 | 153 | |
| Operation selection function | 251 | Output phase failure protection selection | 0, 1 | 1 | 1 | 154 | |
| Additional functions | 252 | Override bias | 0 to 200% | 0.1% | 50% | 155 | |
| | 253 | Override gain | 0 to 200% | 0.1% | 150% | 155 | |
| Power failure stop functions | 261 | Power failure stop selection | 0, 1 | 1 | 0 | 155 | |
| | 262 | Subtracted speed at deceleration start | 0 to 600r/min | 1r/min | 90r/min | 155 | |
| | 263 | Subtraction starting speed | 0 to 3600r/min, 9999 | 1r/min | 1500r/min | 155 | |
| | 264 | Power-failure deceleration time 1 | 0 to 3600/0 to 360s | 0.1s/0.01s | 5s | 155 | |
| | 265 | Power-failure deceleration time 2 | 0 to 3600/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 155 | |
| | 266 | Power-failure deceleration time switchover speed | 0 to 3600r/min | 1r/min | 1500r/min | 155 | |
| Brake sequence | 278 | Brake opening speed | 0 to 900r/min | 1r/min | 20r/min | 107 | |
| | 279 | Brake opening current | 0 to 200% | 0.1% | 130% | 107 | |
| | 280 | Brake opening current detection time | 0 to 2s | 0.1s | 0.3s | 107 | |
| | 281 | Brake operation time at start | 0 to 5s | 0.1s | 0.3s | 107 | |
| | 282 | Brake operation speed | 0 to 900r/min | 1r/min | 25r/min | 107 | |
| | 283 | Brake operation time at stop | 0 to 5s | 0.1s | 0.3s | 107 | |
| | 284 | Deceleration detection function selection | 0, 1 | 1 | 0 | 107 | |
| Droop | 285 | Overspeed detection speed | 0 to 900r/min, 9999 | 1r/min | 9999 | 107 | |
| | 286 | Droop gain | 0 to 100.0% | 0.01% | 0% | 157 | |
| | 287 | Droop filter constant | 0.00 to 1.00s | 0.01s | 0.3s | 157 | |
| Additional function | 288 | Droop function activation selection | 0, 1, 2 | 1 | 0 | 157 | |
| | 342 | E ² PROM write presence/absence | 0, 1 | 1 | 0 | 128 | |
| Orientation | 350 | Stop position command selection | 0, 1, 2, 3, 9999 | 1 | 9999 | 158 | |
| | 351 | Orientation switchover speed | 0 to 1000r/min | 1r/min | 200r/min | 158 | |
| | 356 | Internal stop position command | 0 to 16383 | 1 | 0 | 158 | |
| | 357 | In-position zone | 0 to 8192 | 1 | 11 | 158 | |
| | 360 | External position command selection | 0, 1, 2 to 127 | 1 | 0 | 158 | |
| | 361 | Position shift | 0 to 16383 | 1 | 0 | 158 | |
| | 362 | Orientation position loop gain | 0.1 to 100 | 0.1 | 1 | 158 | |
| Control system function | 374 | Overspeed detection level | 0 to 4200r/min | 1r/min | 3450r/min | 165 | |
| S-pattern C | 380 | Acceleration S pattern 1 | 0 to 50% | 1% | 0% | 91 | |
| | 381 | Deceleration S pattern 1 | 0 to 50% | 1% | 0% | 91 | |
| | 382 | Acceleration S pattern 2 | 0 to 50% | 1% | 0% | 91 | |
| | 383 | Deceleration S pattern 2 | 0 to 50% | 1% | 0% | 91 | |
| Orientation | 393 | Orientation selection | 1, 2, 10, 11, 12 | 1 | 0 | 158 | |
| | 396 | Orientation speed gain (P term) | 0 to 1000 | 1 | 60 | 158 | |
| | 397 | Orientation speed integral time | 0 to 20.0s | 0.001 | 0.333 | 158 | |
| | 398 | Orientation speed gain (D term) | 0 to 100.0% | 0.1 | 1 | 158 | |
| | 399 | Orientation deceleration ratio | 0 to 1000 | 1 | 20 | 158 | |
| Position control | 419 | Position command right selection | 0, 1 | 1 | 0 | 52 | |
| | 420 | Command pulse scaling factor numerator | 0 to 32767 | 1 | 1 | 52 | |
| | 421 | Command pulse scaling factor denominator | 0 to 32767 | 1 | 1 | 52 | |
| | 422 | Position loop gain | 0 to 150s ⁻¹ | 1s ⁻¹ | 25s ⁻¹ | 52 | |
| | 423 | Position feed forward gain | 0 to 100% | 1% | 0% | 52 | |
| | 424 | Position command acceleration/ deceleration time constant | 0 to 50s | 0.001s | 0s | 52 | |
| | 425 | Position feed forward command filter | 0 to 5s | 0.001s | 0s | 52 | |

Parameter lists (Japanese version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|---------------------|--|--|---------------------|----------------------------|-------------------|----------|------------------|
| Position control | 426 | In-position width | 0 to 32767 pulses | 1 pulse | 100 pulses | 166 | |
| | 427 | Excessive level error | 0 to 400K, 9999 | 1K | 40K | 166 | |
| | 430 | Pulse monitor selection | 0 to 5, 9999 | 1 | 9999 | 166 | |
| Motor constants | 450 | Second applied motor | 0, 10, 20, 30, 9999 | 1 | 9999 | 112 | |
| | 451 | Second motor control method selection | 20, 9999 | 1 | 9999 | 169 | |
| | 452 | Second electronic thermal O/L relay | 0 to 3600A, 9999 | 0.1A | 9999 | 83 | |
| | 453 | Second motor capacity | 0 to 3600kW | 0.1kW | Inverter capacity | 34 | |
| Position control | 454 | Number of second motor poles | 2, 4, 6 | 1 | 4 | 34 | |
| | 464 | Digital position control sudden stop deceleration time | 0 to 360.0s | 0.1s | 0 | 166 | |
| | 465 | First position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 466 | First position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 467 | Second position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 468 | Second position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 469 | Third position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 470 | Third position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 471 | Fourth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 472 | Fourth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 473 | Fifth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 474 | Fifth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 475 | Sixth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 476 | Sixth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 477 | Seventh position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 478 | Seventh position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 479 | Eighth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 480 | Eighth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 481 | Ninth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 482 | Ninth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 483 | Tenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 484 | Tenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 485 | Eleventh position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| | 486 | Eleventh position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | |
| 487 | Twelfth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 488 | Twelfth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 489 | Thirteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 490 | Thirteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 491 | Fourteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 492 | Fourteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 493 | Fifteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| 494 | Fifteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 166 | | |
| Remote output | 495 | Remote output selection | 0, 1 | 1 | 0 | 166 | |
| | 496 | Remote output data 1 | 0 to 4095 | 1 | 0 | 166 | |
| | 497 | Remote output data 2 | 0 to 4095 | 1 | 0 | 166 | |
| Additional function | 591 | Start holding time | 0 to 10sec, 9999 | 0.1sec | 9999 | 168 | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|----------------------------------|--|----------------------|----------------------------|-----------------|----------|------------------|
| Operation selection functions | 800 | Control system selection | 0 to 5, 20 | 1 | 0 | 169 | |
| | 801 | Torque characteristic selection | 0, 1 | 1 | 1 | 169 | |
| | 802 | Pre-excitation selection | 0, 1 | 1 | 0 | 85 | |
| Operation selection functions | 803 | Constant output region torque characteristic selection | 0, 1 | 1 | 0 | 89 | |
| | 804 | Torque command right selection | 0, 1, 2 | 1 | 0 | 171 | |
| | 805 | Torque command value (RAM) | 600 to 1400% | 1% | 1000% | 171 | |
| | 806 | Torque command value (RAM, E ² PROM) | 600 to 1400% | 1% | 1000% | 171 | |
| | 807 | Speed restriction selection | 0, 1, 2 | 1 | 0 | 172 | |
| | 808 | Forward rotation speed restriction | 0 to 3600r/min | 1r/min | 1500r/min | 172 | |
| | 809 | Reverse rotation speed restriction | 0 to 3600r/min, 9999 | 1r/min | 9999 | 172 | |
| Control system functions | 810 | Torque restriction input method selection | 0, 1 | 1 | 0 | 89 | |
| | 812 | Torque restriction level (regeneration) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 813 | Torque restriction level (3 quadrant) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 814 | Torque restriction level (4 quadrant) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 815 | Torque restriction level 2 | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 816 | Acceleration torque restriction | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 817 | Deceleration torque restriction | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 818 | Easy gain tuning response level setting | 1 to 15 | 1 | 2 | 174 | |
| | 819 | Easy gain tuning selection | 0, 1, 2 | 1 | 0 | 174 | |
| | 820 | Speed control P gain 1 | 0 to 1000% | 1% | 60% | 174 | |
| | 821 | Speed control integral time 1 | 0 to 20s | 0.001s | 0.333s | 174 | |
| | 822 | Speed setting filter 1 | 0 to 5s | 0.001s | 0s | 174 | |
| | 823 | Speed detection filter 1 | 0 to 5s | 0.001s | 0.001s | 175 | |
| | 824 | Torque control P gain 1 | 0 to 200% | 1% | 100% | 175 | |
| | 825 | Torque control integral time 1 | 0 to 500ms | 0.1ms | 5ms | 175 | |
| | 826 | Torque setting filter 1 | 0 to 5s | 0.001s | 0s | 175 | |
| | 827 | Torque detection filter 1 | 0 to 5s | 0.001s | 0s | 175 | |
| | 828 | Model speed control gain | 0 to 1000% | 1% | 60% | 45 | |
| | 830 | Speed control P gain 2 | 0 to 1000%, 9999 | 1% | 9999 | 174 | |
| | 831 | Speed control integral time 2 | 0 to 20s, 9999 | 0.001s | 9999 | 174 | |
| 832 | Speed setting filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 174 | | |
| 833 | Speed detection filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| 834 | Torque control P gain 2 | 0 to 200%, 9999 | 1% | 9999 | 175 | | |
| 835 | Torque control integral time 2 | 0 to 500ms, 9999 | 0.1ms | 9999 | 175 | | |
| 836 | Torque setting filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| 837 | Torque detection filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| Torque biases | 840 | Torque bias selection | 0 to 3, 9999 | 1 | 9999 | 176 | |
| | 841 | Torque bias 1 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 842 | Torque bias 2 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 843 | Torque bias 3 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 844 | Torque bias filter | 0 to 5s, 9999 | 0.001s | 9999 | 176 | |
| | 845 | Torque bias operation time | 0 to 5s, 9999 | 0.01s | 9999 | 176 | |
| | 846 | Torque bias balance compensation | 0 to 10V, 9999 | 0.1V | 9999 | 176 | |
| | 847 | Fall-time torque bias No. 3 bias | 0 to 400%, 9999 | 1% | 9999 | 176 | |
| 848 | Fall-time torque bias No. 3 gain | 0 to 400%, 9999 | 1% | 9999 | 176 | | |
| Additional functions | 849 | Analog input offset adjustment * | 0 to 200% | 0.1% | 100% | 192 | |
| | 851 | Number of PLG pulses | 0 to 4096 | 1 | 2048 | 179 | |
| | 852 | PLG rotation direction | 0, 1 | 1 | 1 | 179 | |
| | 854 | Excitation ratio | 0 to 100% | 1% | 100% | 180 | |
| | 859 | Torque current | 0 to , 9999 | 1 | 9999 | 124 | |
| | 862 | Notch filter frequency | 0 to 60 | 1 | 0 | 180 | |
| | 863 | Notch filter depth | 0 to 3 | 1 | 0 | 180 | |
| | 864 | Torque detection | 0 to 400% | 0.1% | 150% | 181 | |
| 865 | Low speed detection | 0 to 3600r/min | 1r/min | 45r/min | 181 | | |
| Display functions | 866 | Torque monitoring reference | 0 to 400% | 0.1% | 150% | 102 | |
| | 867 | DA1 output filter | 0 to 5s | 0.001s | 0.05s | 182 | |

Parameter lists (Japanese version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------|---|--------------------------|----------------------------|-----------------|----------|------------------|
| Terminal assignment function | 868 | No. 1 terminal function assignment | 0, 1, 2, 5, 9999 | 1 | 0 | 182 | |
| Protective functions | 870 | Speed deviation level | 0 to 1500r/min, 9999 | 1r/min | 9999 | 183 | |
| | 871 | Speed deviation time | 0 to 100s | 0.1s | 12s | 183 | |
| | 873 | Speed restriction | 0 to 3600r/min | 1r/min | 600r/min | 184 | |
| | 874 | OLT level setting | 0 to 200% | 0.1% | 150% | 184 | |
| Operation selection functions | 875 | Fault definition | 0, 1 | 1 | 0 | 185 | |
| | 876 | Thermal relay protector input | 0, 1 | 1 | 1 | 83 | |
| Control system functions | 877 | Speed feed forward control/model adaptive speed control selection | 0, 1, 2 | 1 | 0 | 45 | |
| | 878 | Speed feed forward filter | 0 to 1s | 0.01s | 0s | 45 | |
| | 879 | Speed feed forward torque restriction | 0 to 400% | 0.1% | 150% | 45 | |
| | 880 | Load inertia ratio | 0, 1 to 200 times | 0.1 | 7 | 45 | |
| | 881 | Speed feed forward gain | 0 to 1000% | 1% | 0% | 45 | |
| Maintenance functions | 890 | Maintenance output setting time | 0 to 9998, 9999 | 10hr | 9999 | 186 | |
| | 891 | Maintenance output timer | 0 to 9998 | 10hr | 0 | 186 | |
| | 892 | Maintenance output signal clear | 0 | 1 | 0 | 186 | |
| Calibration functions | 900 | DA1 terminal calibration | | | | 187 | |
| | 901 | DA2 terminal calibration | | | | 187 | |
| | 902 | Speed setting No.2 bias | 0 to 10V, 0 to 3600r/min | 0.1r/min | 0V, 0r/min | 189 | |
| | 903 | Speed setting No.2 gain | 0 to 10V, 0 to 3600r/min | 1r/min | 10V, 1500r/min | 189 | |
| | 904 | Torque command No.3 bias | 0 to 10V, 0 to 400% | 0.1% | 0V, 0% | 189 | |
| | 905 | Torque command No.3 gain | 0 to 10V, 0 to 400% | 0.1% | 10V, 150% | 189 | |
| | 917 | No. 1 terminal bias (speed) | 0 to 10V, 0 to 3600r/min | 0.1r/min | 0V, 0r/min | 189 | |
| | 918 | No. 1 terminal gain (speed) | 0 to 10V, 0 to 3600r/min | 1r/min | 10V, 1500r/min | 189 | |
| | 919 | No. 1 terminal bias (torque/magnetic flux) | 0 to 10V, 0 to 400% | 0.1% | 0V, 0% | 189 | |
| | 920 | No. 1 terminal gain (torque/magnetic flux) | 0 to 10V, 0 to 400% | 0.1% | 10V, 150% | 189 | |
| Additional functions | 990 | Buzzer control | 0, 1 | 1 | 1 | 192 | |
| | 991 | Parameter for the option (FR-PU04V) | | | | | |

3.2 Parameter lists (NA version)

The inverter is factory-set to display only the simple mode parameters.
Set Pr. 160 "extended function selection" as required.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------|-----------------|---------------|--|
| 160 | Extended function selection | 0 | 0 | Accessible to only the simple mode parameters. |
| | | | 1 | Accessible to all parameters. |

CAUTION

- The blacked out parameters in the table below indicate simple mode parameters.
- The shaded parameters in the table allow its setting to be changed during operation even if "0" (factory setting) is set in Pr. 77 (parameter write disable selection).
- *: Accessible when Pr. 77 = 801.

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------|---|------------------------|----------------------------|-------------------------------|----------|------------------|
| Basic functions | 0 | Torque boost (manual) | 0 to 30% | 0.1% | 1% | 79 | |
| | 1 | Maximum speed | 0 to 3600r/min | 1r/min | 1800r/min | 79 | |
| | 2 | Minimum speed | 0 to 3600r/min | 1r/min | 0r/min | 79 | |
| | 3 | Base frequency | 20 to 200Hz | 0.01Hz | 60Hz | 80 | |
| | 4 | Multi-speed setting (high speed) | 0 to 3600r/min | 1r/min | 1800r/min | 80 | |
| | 5 | Multi-speed setting (middle speed) | 0 to 3600r/min | 1r/min | 750r/min | 80 | |
| | 6 | Multi-speed setting (low speed) | 0 to 3600r/min | 1r/min | 150r/min | 80 | |
| | 7 | Acceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 15s | 81 | |
| | 8 | Deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 15s | 81 | |
| | 9 | Electronic thermal O/L relay | 0 to 3600A | 0.1A | Rated inverter output current | 83 | |
| Standard operation functions | 10 | DC injection brake operation speed | 0 to 1500r/min, 9999 | 0.1r/min | 15r/min | 85 | |
| | 11 | DC injection brake operation time | 0 to 0.5s | 0.1s | 0.5s | 85 | |
| | 12 | DC injection brake voltage | 0 to 30% | 0.1% | 1% | 85 | |
| | 13 | Starting speed | 0 to 1500r/min | 0.1r/min | 15r/min | 86 | |
| | 15 | Jog speed setting | 0 to 1500r/min | 0.1r/min | 150r/min | 87 | |
| | 16 | Jog acceleration/deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 0.5s | 87 | |
| Operation selection functions | 17 | MRS input selection | 0, 2 | 1 | 0 | 88 | |
| | 19 | Base frequency voltage | 0 to 1000V, 8888, 9999 | 0.1V | 9999 | 80 | |
| | 20 | Acceleration/deceleration reference speed | 1 to 3600r/min | 1r/min | 1800r/min | 81 | |
| | 21 | Acceleration/deceleration time increments | 0, 1 | 1 | 0 | 81 | |
| | 22 | Torque restriction level | 0 to 400% | 0.1% | 150% | 89 | |
| | 24 | Multi-speed setting (speed 4) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 25 | Multi-speed setting (speed 5) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 26 | Multi-speed setting (speed 6) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 27 | Multi-speed setting (speed 7) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 28 | Multi-speed input compensation | 0, 1 | 1 | 0 | 90 | |

Parameter lists (NA version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------|---|---|----------------------------|---------------------------------------|----------|------------------|
| Operation selection functions | 29 | Acceleration/deceleration pattern | 0, 1, 2, 3, 4 | 1 | 0 | 91 | |
| | 30 | Regenerative function selection | 0, 1, 2 | 1 | 0 | 94 | |
| | 31 | Speed jump 1A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 32 | Speed jump 1B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 33 | Speed jump 2A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 34 | Speed jump 2B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 35 | Speed jump 3A | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 36 | Speed jump 3B | 0 to 3600r/min, 9999 | 1r/min | 9999 | 95 | |
| | 37 | Speed display | 0, 1 to 9998 | 1 | 0 | 95 | |
| Output terminal functions | 41 | Up-to-speed sensitivity | 0 to 100% | 0.1% | 10% | 97 | |
| | 42 | Speed detection | 0 to 3600r/min | 1r/min | 300r/min | 97 | |
| | 43 | Speed detection for reverse rotation | 0 to 3600r/min, 9999 | 1r/min | 9999 | 97 | |
| Second functions | 44 | Second acceleration/deceleration time | 0 to 3600s/0 to 360s | 0.1s/0.01s | 5s | 90 | |
| | 45 | Second deceleration time | 0 to 3600s/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 90 | |
| Output terminal function | 50 | Second speed detection | 0 to 3600r/min | 1r/min | 750r/min | 97 | |
| Display functions | 52 | DU/PU main display data selection | 0, 5 to 12, 17 to 20, 23, 24, 32 to 35, 38, 100 | 1 | 0 | 99 | |
| | 53 | PU level display data selection | 0 to 3, 5 to 12, 17, 18 | 1 | 1 | 99 | |
| | 54 | DA1 terminal function selection | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | 1 | 1 | 99 | |
| | 55 | Speed monitoring reference | 0 to 3600r/min | 1r/min | 1800r/min | 102 | |
| | 56 | Current monitoring reference | 0 to 3600A | 0.1A | Inverter rated output current | 102 | |
| Automatic restart | 57 | Restart coasting time | 0, 0.1 to 30s, 9999 | 0.1s | 9999 | 103 | |
| | 58 | Restart cushion time | 0 to 60s | 0.1s | 1.0s | 103 | |
| Additional function | 59 | Remote setting function selection | 0, 1, 2, 3 | 1 | 0 | 105 | |
| Operation selection functions | 60 | Intelligent mode selection | 0, 7, 8 | 1 | 0 | 107 | |
| | 65 | Retry selection | 0 to 5 | 1 | 0 | 110 | |
| | 67 | Number of retries at alarm occurrence | 0 to 10, 101 to 110 | 1 | 0 | 110 | |
| | 68 | Retry waiting time | 0 to 10s | 0.1s | 1s | 110 | |
| | 69 | Retry count display erasure | 0 | 1 | 0 | 110 | |
| | 70 | Special regenerative brake duty | 0 to 10% | 0.1% | 0% | 94 | |
| | 71 | Applied motor | 0, 3 to 8, 10, 13 to 18, 20,23,24,30, 33, 34 | 1 | 10 | 112 | |
| | 72 | PWM frequency selection | 1 | 1 | 1 | 113 | |
| | 73 | Speed setting signal | 0, 4, 10, 14 | 1 | 0 | 114 | |
| | 75 | Reset selection/disconnected PU detection/PU stop selection | 0 to 3, 14 to 17 | 1 | 14 | 116 | |
| | 77 | Parameter write disable selection | 0, 1, 2 | 1 | 0 | 117 | |
| | 78 | Reverse rotation prevention selection | 0, 1, 2 | 1 | 0 | 118 | |
| | 79 | Operation mode selection | 0 to 4, 6 to 8 | 1 | 0 | 118 | |
| Motor constants | 80 | Motor capacity | 0 to 3600kW | 0.1kW | Motor capacity | 121 | |
| | 81 | Number of motor poles | 2, 4, 6 | 1 | 4 | 121 | |
| | 82 | Motor excitation current (no load current) * | 0 to , 9999 | | 9999 | 124 | |
| | 83 | Rated motor voltage | 0 to 1000V | 0.1V | 200V (200V class) / 400V (400V class) | 121 | |
| | 84 | Rated motor frequency | 20 to 200Hz | 0.01Hz | 60Hz | 121 | |
| | 90 | Motor constant R1 * | 0 to , 9999 | | 9999 | 124 | |
| | 91 | Motor constant R2 * | 0 to , 9999 | | 9999 | 124 | |
| | 92 | Motor constant L1 * | 0 to , 9999 | | 9999 | 124 | |
| | 93 | Motor constant L2 * | 0 to , 9999 | | 9999 | 124 | |
| | 94 | Motor constant X * | 0 to , 9999 | | 9999 | 124 | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting | |
|---|---------------------------------|---|---|----------------------------|-----------------|----------|------------------|--|
| Motor constants | 95 | Online auto tuning selection | 0, 1, 2 | 1 | 0 | 126 | | |
| | 96 | Auto tuning setting/status | 0, 1, 101 | 1 | 0 | 121 | | |
| Third functions | 110 | Third acceleration/deceleration time | 0 to 3600/0 to 360s | 0.1s/0.01s | 5s | 81 | | |
| | 111 | Third deceleration time | 0 to 3600/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 81 | | |
| Output terminal function | 116 | Third speed detection | 0 to 3600r/min | 1r/min | 1800r/min | 97 | | |
| Communication functions | 117 | Station number | 0 to 31 | 1 | 0 | 128 | | |
| | 118 | Communication speed | 48, 96, 192 | 1 | 192 | 128 | | |
| | 119 | Stop bit length/data length | 0, 1, 10, 11 | 1 | 1 | 128 | | |
| | 120 | Parity check presence/absence | 0, 1, 2 | 1 | 2 | 128 | | |
| | 121 | Number of communication retries | 0 to 10, 9999 | 1 | 1 | 128 | | |
| | 122 | Communication check time interval | 0 to 999.8s, 9999 | 0.1s | 9999 | 128 | | |
| | 123 | Waiting time setting | 0 to 150ms, 9999 | 1ms | 9999 | 128 | | |
| PID control | 124 | CR, LF presence/absence selection | 0, 1, 2 | 1 | 1 | 128 | | |
| | 128 | PID action selection | 10, 11, 30, 31 | 1 | 10 | 139 | | |
| | 129 | PID proportional band | 0.1 to 1000%, 9999 | 0.1% | 100% | 139 | | |
| | 130 | PID integral time | 0.1 to 3600s, 9999 | 0.1s | 1s | 139 | | |
| | 131 | Upper limit | 0 to 100%, 9999 | 0.1% | 9999 | 139 | | |
| | 132 | Lower limit | 0 to 100%, 9999 | 0.1% | 9999 | 139 | | |
| | 133 | PID action set point for PU operation | 0 to 100% | 0.01% | 0% | 139 | | |
| Backlash | 134 | PID differential time | 0.01 to 10s, 9999 | 0.01s | 9999 | 139 | | |
| | 140 | Backlash acceleration stopping speed | 0 to 3600r/min | 1r/min | 30r/min | 91 | | |
| | 141 | Backlash acceleration stopping time | 0 to 360s | 0.1s | 0.5s | 91 | | |
| | 142 | Backlash deceleration stopping speed | 0 to 3600r/min | 1r/min | 30r/min | 91 | | |
| Display functions | 143 | Backlash deceleration stopping time | 0 to 360s | 0.1s | 0.5s | 91 | | |
| | 144 | Speed setting switchover | 0, 2, 4, 6, 8, 10 | 1 | 0 | 95 | | |
| Current detection | 145 | Parameter for the option (FR-PU04V). | | | | | | |
| | 150 | Output current detection level | 0 to 200% | 0.1% | 150% | 145 | | |
| | 151 | Output current detection time | 0 to 10s | 0.1s | 0 | 145 | | |
| | 152 | Zero current detection level | 0 to 200.0% | 0.1% | 5.0% | 146 | | |
| Sub functions | 153 | Zero current detection time | 0 to 1s | 0.01s | 0.5s | 146 | | |
| | 156 | Stall prevention operation selection | 0 to 31, 100, 101 | 1 | 1 | 147 | | |
| Display functions | 157 | OL signal output timer | 0 to 25s, 9999 | 0s | 0.1s | 148 | | |
| | 158 | DA2 terminal function selection | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | 1 | 1 | 99 | | |
| Automatic restart after instantaneous power failure | 160 | Extended function selection | 0, 1 | 1 | 0 | 149 | | |
| | 162 | Automatic restart after instantaneous power failure selection | 0, 1, 10 | 1 | 0 | 103 | | |
| | 163 | First cushion time for restart | 0 to 20s | 0.1s | 0s | 103 | | |
| | 164 | First cushion voltage for restart | 0 to 100% | 0.1% | 0% | 103 | | |
| Maintenance functions | 165 | Restart current restriction level | 0 to 200% | 0.1% | 150% | 103 | | |
| | 168 | Maker setting parameters. Do not make setting. | | | | | | |
| Initial monitor | 169 | Maker setting parameters. Do not make setting. | | | | | | |
| Terminal assignment functions | 171 | Actual operation hour meter clear | 0 | 1 | 0 | 149 | | |
| | 180 | DI1 terminal function selection | 0 to 3, 5, 8 to 12, 14 to 16, 20, 22 to 27, 42 to 44, 9999 | 1 | 0 | 149 | | |
| | 181 | DI2 terminal function selection | | 1 | 1 | | | |
| | 182 | DI3 terminal function selection | | 1 | 2 | | | |
| | 183 | DI4 terminal function selection | | 1 | 3 | | | |
| | 187 | STR terminal function selection | | 1 | 9999 | | | |
| | 190 | DO1 terminal function selection | 0 to 8, 10 to 16, 20, 25 to 27, 30 to 37, 40 to 44, 96 to 99, 100 to 108, 110 to 116, 120, 125 to 127, 130 to 137, 140 to 144, 196 to 199, 9999 | 1 | 0 | 151 | | |
| | 191 | DO2 terminal function selection | 1 | 1 | | | | |
| 192 | DO3 terminal function selection | 1 | 2 | | | | | |
| 195 | ABC terminal function selection | 1 | 99 | | | | | |
| Multi-speed operation | 232 | Multi-speed setting (speed 8) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |
| | 233 | Multi-speed setting (speed 9) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | | |

Parameter lists (NA version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|------------------------------|---------------|--|---------------------------|----------------------------|-----------------|----------|------------------|
| Multi-speed operation | 234 | Multi-speed setting (speed 10) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 235 | Multi-speed setting (speed 11) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 236 | Multi-speed setting (speed 12) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 237 | Multi-speed setting (speed 13) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 238 | Multi-speed setting (speed 14) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| | 239 | Multi-speed setting (speed 15) | 0 to 3600r/min, 9999 | 1r/min | 9999 | 80 | |
| Sub functions | 240 | Soft-PWM setting | 0, 1, 10, 11 | 1 | 10 | 113 | |
| | 244 | Cooling fan operation selection | 0, 1 | 1 | 0 | 153 | |
| Stop selection function | 250 | Stop selection | 0 to 100s, 9999 | 0.1s | 9999 | 153 | |
| Operation selection function | 251 | Output phase failure protection selection | 0, 1 | 1 | 1 | 154 | |
| Additional functions | 252 | Override bias | 0 to 200% | 0.1% | 50% | 155 | |
| | 253 | Override gain | 0 to 200% | 0.1% | 150% | 155 | |
| Power failure stop functions | 261 | Power failure stop selection | 0, 1 | 1 | 0 | 155 | |
| | 262 | Subtracted speed at deceleration start | 0 to 600r/min | 1r/min | 90r/min | 155 | |
| | 263 | Subtraction starting speed | 0 to 3600r/min, 9999 | 1r/min | 1800r/min | 155 | |
| | 264 | Power-failure deceleration time 1 | 0 to 3600/0 to 360s | 0.1s/0.01s | 5s | 155 | |
| | 265 | Power-failure deceleration time 2 | 0 to 3600/0 to 360s, 9999 | 0.1s/0.01s | 9999 | 155 | |
| | 266 | Power-failure deceleration time switchover speed | 0 to 3600r/min | 1r/min | 1800r/min | 155 | |
| Brake sequence | 278 | Brake opening speed | 0 to 900r/min | 1r/min | 20r/min | 107 | |
| | 279 | Brake opening current | 0 to 200% | 0.1% | 130% | 107 | |
| | 280 | Brake opening current detection time | 0 to 2s | 0.1s | 0.3s | 107 | |
| | 281 | Brake operation time at start | 0 to 5s | 0.1s | 0.3s | 107 | |
| | 282 | Brake operation speed | 0 to 900r/min | 1r/min | 25r/min | 107 | |
| | 283 | Brake operation time at stop | 0 to 5s | 0.1s | 0.3s | 107 | |
| | 284 | Deceleration detection function selection | 0, 1 | 1 | 0 | 107 | |
| | 285 | Overspeed detection speed | 0 to 900r/min, 9999 | 1r/min | 9999 | 107 | |
| Droop | 286 | Droop gain | 0 to 100.0% | 0.01% | 0% | 157 | |
| | 287 | Droop filter constant | 0.00 to 1.00s | 0.01s | 0.3s | 157 | |
| | 288 | Droop function activation selection | 0, 1, 2 | 1 | 0 | 157 | |
| Additional function | 342 | E ² PROM write presence/absence | 0, 1 | 1 | 0 | 128 | |
| Orientation | 350 | Stop position command selection | 0, 1, 2, 9999 | 1 | 9999 | 158 | |
| | 351 | Orientation switchover speed | 0 to 1000r/min | 1r/min | 200r/min | 158 | |
| | 356 | Internal stop position command | 0 to 16383 | 1 | 0 | 158 | |
| | 357 | Orientation in-position zone | 0 to 8192 | 1 | 11 | 158 | |
| | 360 | External position command selection | 0, 1, 2 to 127 | 1 | 0 | 158 | |
| | 361 | Position shift | 0 to 16383 | 1 | 0 | 158 | |
| | 362 | Orientation position loop gain | 0.1 to 100 | 0.1 | 1 | 158 | |
| Control system function | 374 | Overspeed detection level | 0 to 4200r/min | 1r/min | 4200r/min | 165 | |
| S-pattern C | 380 | Acceleration S pattern 1 | 0 to 50% | 1% | 0% | 91 | |
| | 381 | Deceleration S pattern 1 | 0 to 50% | 1% | 0% | 91 | |
| | 382 | Acceleration S pattern 2 | 0 to 50% | 1% | 0% | 91 | |
| | 383 | Deceleration S pattern 2 | 0 to 50% | 1% | 0% | 91 | |
| Orientation | 393 | Orientation selection | 1, 2, 10, 11, 12 | 1 | 0 | 158 | |
| | 396 | Orientation speed gain (P term) | 0 to 1000 | 1 | 60 | 158 | |
| | 397 | Orientation speed integral time | 0 to 20.0s | 0.001 | 0.333 | 158 | |
| | 398 | Orientation speed gain (D term) | 0 to 100.0% | 0.1 | 1 | 158 | |
| | 399 | Orientation deceleration ratio | 0 to 1000 | 1 | 20 | 158 | |
| Position control | 419 | Position command right selection | 0, 1 | 1 | 0 | 52 | |
| | 420 | Command pulse scaling factor numerator | 0 to 32767 | 1 | 1 | 52 | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|------------------|--|---|-------------------------|----------------------------|-------------------|----------|------------------|
| Position control | 421 | Command pulse scaling factor denominator | 0 to 32767 | 1 | 1 | 52 | |
| | 422 | Position loop gain | 0 to 150s ⁻¹ | 1s ⁻¹ | 25s ⁻¹ | 52 | |
| | 423 | Position feed forward gain | 0 to 100% | 1% | 0% | 52 | |
| | 424 | Position command acceleration/ deceleration time constant | 0 to 50s | 0.001s | 0s | 52 | |
| | 425 | Position feed forward command filter | 0 to 5s | 0.001s | 0s | 52 | |
| | 426 | In-position width | 0 to 32767 pulses | 1 pulse | 100 pulses | 52 | |
| | 427 | Excessive level error | 0 to 400K, 9999 | 1K | 40K | 52 | |
| | 430 | Pulse monitor selection | 0 to 5, 9999 | 1 | 9999 | 52 | |
| Motor constants | 450 | Second applied motor | 0, 10, 20, 30, 9999 | 1 | 9999 | 112 | |
| | 451 | Second motor control method selection | 20, 9999 | 1 | 9999 | 169 | |
| | 452 | Second electronic thermal O/L relay | 0 to 3600A, 9999 | 0.1A | 9999 | 83 | |
| | 453 | Second motor capacity | 0 to 3600kW | 0.1kW | Inverter capacity | 34 | |
| | 454 | Number of second motor poles | 2, 4, 6 | 1 | 4 | 34 | |
| Position control | 464 | Digital position control sudden stop deceleration time | 0 to 360.0s | 0.1s | 0 | 52 | |
| | 465 | First position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 466 | First position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 467 | Second position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 468 | Second position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 469 | Third position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 470 | Third position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 471 | Fourth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 472 | Fourth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 473 | Fifth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 474 | Fifth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 475 | Sixth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 476 | Sixth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 477 | Seventh position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 478 | Seventh position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 479 | Eighth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 480 | Eighth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 481 | Ninth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 482 | Ninth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 483 | Tenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 484 | Tenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 485 | Eleventh position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 486 | Eleventh position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 487 | Twelfth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 488 | Twelfth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| | 489 | Thirteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | |
| 490 | Thirteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | | |
| 491 | Fourteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | | |
| 492 | Fourteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | | |
| 493 | Fifteenth position feed amount lower 4 digits | 0 to 9999 | 1 | 0 | 54 | | |
| 494 | Fifteenth position feed amount upper 4 digits | 0 to 9999 | 1 | 0 | 54 | | |

Parameter lists (NA version)

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|----------------------------------|--|----------------------|----------------------------|-----------------|----------|------------------|
| Remote output | 495 | Remote output selection | 0, 1 | 1 | 0 | 166 | |
| | 496 | Remote output data 1 | 0 to 4095 | 1 | 0 | 166 | |
| | 497 | Remote output data 2 | 0 to 4095 | 1 | 0 | 166 | |
| Additional function | 591 | Start holding time | 0 to 10sec,9999 | 0.1sec | 9999 | 168 | |
| Operation selection functions | 800 | Control system selection | 0 to 5, 20 | 1 | 0 | 169 | |
| | 801 | Torque characteristic selection | 0, 1 | 1 | 1 | 169 | |
| | 802 | Pre-excitation selection | 0, 1 | 1 | 0 | 85 | |
| | 803 | Constant output region torque characteristic selection | 0, 1 | 1 | 0 | 89 | |
| | 804 | Torque command right selection | 0, 1, 2 | 1 | 0 | 171 | |
| | 805 | Torque command value (RAM) | 600 to 1400% | 1% | 1000% | 171 | |
| | 806 | Torque command value (RAM, E ² PROM) | 600 to 1400% | 1% | 1000% | 171 | |
| | 807 | Speed restriction selection | 0, 1, 2 | 1 | 0 | 172 | |
| | 808 | Forward rotation speed restriction | 0 to 3600r/min | 1r/min | 1800r/min | 172 | |
| | 809 | Reverse rotation speed restriction | 0 to 3600r/min, 9999 | 1r/min | 9999 | 172 | |
| Control system functions | 810 | Torque restriction input method selection | 0, 1 | 1 | 0 | 89 | |
| | 812 | Torque restriction level (regeneration) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 813 | Torque restriction level (3rd quadrant) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 814 | Torque restriction level (4th quadrant) | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 815 | Torque restriction level 2 | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 816 | Acceleration torque restriction | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 817 | Deceleration torque restriction | 0 to 400%, 9999 | 0.1% | 9999 | 89 | |
| | 818 | Easy gain tuning response level setting | 1 to 15 | 1 | 2 | 174 | |
| | 819 | Easy gain tuning selection | 0, 1, 2 | 1 | 0 | 174 | |
| | 820 | Speed control P gain 1 | 0 to 1000% | 1% | 60% | 174 | |
| | 821 | Speed control integral time 1 | 0 to 20s | 0.001s | 0.333s | 174 | |
| | 822 | Speed setting filter 1 | 0 to 5s | 0.001s | 0s | 174 | |
| | 823 | Speed detection filter 1 | 0 to 5s | 0.001s | 0.001s | 175 | |
| | 824 | Torque control P gain 1 | 0 to 200% | 1% | 100% | 175 | |
| | 825 | Torque control integral time 1 | 0 to 500ms | 0.1ms | 5ms | 175 | |
| | 826 | Torque setting filter 1 | 0 to 5s | 0.001s | 0s | 175 | |
| | 827 | Torque detection filter 1 | 0 to 5s | 0.001s | 0s | 175 | |
| | 828 | Model speed control gain | 0 to 1000% | 1% | 60% | 176 | |
| | 830 | Speed control P gain 2 | 0 to 1000%, 9999 | 1% | 9999 | 174 | |
| | 831 | Speed control integral time 2 | 0 to 20s, 9999 | 0.001s | 9999 | 174 | |
| 832 | Speed setting filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 174 | | |
| 833 | Speed detection filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| 834 | Torque control P gain 2 | 0 to 200%, 9999 | 1% | 9999 | 175 | | |
| 835 | Torque control integral time 2 | 0 to 500ms, 9999 | 0.1ms | 9999 | 175 | | |
| 836 | Torque setting filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| 837 | Torque detection filter 2 | 0 to 5s, 9999 | 0.001s | 9999 | 175 | | |
| Torque biases | 840 | Torque bias selection | 0 to 3, 9999 | 1 | 9999 | 176 | |
| | 841 | Torque bias 1 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 842 | Torque bias 2 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 843 | Torque bias 3 | 600 to 1400%, 9999 | 1% | 9999 | 176 | |
| | 844 | Torque bias filter | 0 to 5s, 9999 | 0.001s | 9999 | 176 | |
| | 845 | Torque bias operation time | 0 to 5s, 9999 | 0.01s | 9999 | 176 | |
| | 846 | Torque bias balance compensation | 0 to 10V, 9999 | 0.1V | 9999 | 176 | |
| | 847 | Fall-time torque bias No. 3 bias | 0 to 400%, 9999 | 1% | 9999 | 176 | |
| 848 | Fall-time torque bias No. 3 gain | 0 to 400%, 9999 | 1% | 9999 | 176 | | |
| Additional functions | 849 | Analog input offset adjustment * | 0 to 200% | 0.1% | 100% | 192 | |
| | 851 | Number of PLG pulses | 0 to 4096 | 1 | 1024 | 179 | |
| | 852 | PLG rotation direction | 0, 1 | 1 | 1 | 179 | |
| | 854 | Excitation ratio | 0 to 100% | 1% | 100% | 180 | |
| | 859 | Torque current | 0 to , 9999 | 1 | 9999 | 121 | |
| | 862 | Notch filter frequency | 0 to 60 | 1 | 0 | 180 | |
| 863 | Notch filter depth | 0 to 3 | 1 | 0 | 180 | | |

| Function | Parameter No. | Name | Setting Range | Minimum Setting Increments | Factory Setting | Refer To | Customer Setting |
|-------------------------------|---------------|---|--------------------------|----------------------------|-----------------|----------|------------------|
| Additional functions | 864 | Torque detection | 0 to 400% | 0.1% | 150% | 181 | |
| | 865 | Low speed detection | 0 to 3600r/min | 1r/min | 45r/min | 181 | |
| Display functions | 866 | Torque monitoring reference | 0 to 400% | 0.1% | 150% | 102 | |
| | 867 | DA1 output filter | 0 to 5s | 0.001s | 0.05s | 182 | |
| Terminal assignment function | 868 | No. 1 terminal function assignment | 0, 1, 2, 5, 9999 | 1 | 0 | 182 | |
| Protective functions | 870 | Speed deviation level | 0 to 1500r/min, 9999 | 1r/min | 9999 | 183 | |
| | 871 | Speed deviation time | 0 to 100s | 0.1s | 12s | 183 | |
| | 873 | Speed restriction | 0 to 3600r/min | 1r/min | 600r/min | 184 | |
| | 874 | OLT level setting | 0 to 200% | 0.1% | 150% | 184 | |
| Operation selection functions | 875 | Fault definition | 0, 1 | 1 | 0 | 185 | |
| | 876 | Thermal relay protector input | 0, 1 | 1 | 0 | 83 | |
| Control system functions | 877 | Speed feed forward control/model adaptive speed control selection | 0, 1, 2 | 1 | 0 | 185 | |
| | 878 | Speed feed forward filter | 0 to 1s | 0.01s | 0s | 185 | |
| | 879 | Speed feed forward torque restriction | 0 to 400% | 0.1% | 150% | 185 | |
| | 880 | Load inertia ratio | 0, 1 to 200 times | 0.1 | 7 | 45 | |
| | 881 | Speed feed forward gain | 0 to 1000% | 1% | 0% | 45 | |
| Maintenance functions | 890 | Maintenance output setting time | 0 to 9998, 9999 | 10hr | 9999 | 186 | |
| | 891 | Maintenance output timer | 0 to 9998 | 10hr | 0 | 186 | |
| | 892 | Maintenance output signal clear | 0 | 1 | 0 | 186 | |
| Calibration functions | 900 | DA1 terminal calibration | | | | 187 | |
| | 901 | DA2 terminal calibration | | | | 187 | |
| | 902 | Speed setting No.2 bias | 0 to 10V, 0 to 3600r/min | 0.1r/min | 0V, 0r/min | 189 | |
| | 903 | Speed setting No.2 gain | 0 to 10V, 0 to 3600r/min | 1r/min | 10V, 1800r/min | 189 | |
| | 904 | Torque command No.3 bias | 0 to 10V, 0 to 400% | 0.1% | 0V, 0% | 189 | |
| | 905 | Torque command No.3 gain | 0 to 10V, 0 to 400% | 0.1% | 10V, 150% | 189 | |
| | 917 | No. 1 terminal bias (speed) | 0 to 10V, 0 to 3600r/min | 0.1r/min | 0V, 0r/min | 189 | |
| | 918 | No. 1 terminal gain (speed) | 0 to 10V, 0 to 3600r/min | 1r/min | 10V, 1800r/min | 189 | |
| | 919 | No. 1 terminal bias (torque/magnetic flux) | 0 to 10V, 0 to 400% | 0.1% | 0V, 0% | 189 | |
| | 920 | No. 1 terminal gain (torque/magnetic flux) | 0 to 10V, 0 to 400% | 0.1% | 10V, 150% | 189 | |
| Additional functions | 990 | Buzzer control | 0, 1 | 1 | 1 | 192 | |
| | 991 | Parameter for the option (FR-PU04V). | | | | | |

PARAMETERS (NA version)

PARAMETERS

3.3 At-a-glance guide to functions

○....Usable function, ×..... Unusable function

| Category | Function | Pr. number | Terminal | PLG Vector | | |
|-----------------------------------|---|---|--------------------------------|---|--------|----------|
| | | | | Speed | Torque | Position |
| | | | | SF-V5R *Motor with PLG (standard, constant torque)* *: This function can be usable under position control by parameter setting. | | |
| Control | Speed restriction | Pr. 807 to Pr. 809, Pr. 902, Pr. 903, Pr. 917, Pr. 918 | No. 2(1) terminal, multi-speed | × | ○ | × |
| | Torque restriction | Pr. 22, Pr. 803, Pr. 810 to Pr. 817, Pr. 904, Pr. 905, Pr.919, Pr.920 | No. 3(1) terminal | ○ | × | ○ |
| | Offline auto tuning | Pr. 9, Pr. 71, Pr. 80 to Pr. 84, Pr. 90 to Pr. 94, Pr. 96, Pr. 859 | | ○ | ○ | × |
| | Online auto tuning (start-time) Pr.95=1 | Pr. 95 | | ○ | ○ | × |
| | Online auto tuning (adaptive magnetic flux observer) Pr.95=2 | Pr. 95 | | ○ | ○ | ○ |
| | Easy gain tuning | Pr. 818, Pr. 819 | | ○ | × | ○ |
| | Gain adjustment | Pr. 820 to Pr. 827, Pr. 830 to Pr. 837 | | ○ | ○ | ○ |
| | Machine analyzer (notch filter) | Pr. 862, Pr. 863 | | ○ | × | ○ |
| | 0 speed control | Pr. 802 | | ○ | × | ○ |
| | Servo lock | Pr. 802 | | ○ | × | ○ |
| | Variable excitation | Pr. 854 | | ○ | ○ | ○ |
| | Speed feed-forward, model adaptive speed control | Pr. 877 to Pr. 881, Pr. 820, Pr. 821, Pr. 828 | | ○ | × | ○ |
| P/PI switchover | Pr. 180 to Pr. 183, Pr. 187 | X44 signal | ○ | ○ | ○ | |
| Speed feedback filter | Pr. 823, Pr. 833 | | ○ | ○ | ○ | |
| Basic functions | Extended function display | Pr. 160 | | ○ | ○ | ○ |
| | Maximum speed | Pr. 1 | | ○ | ○ | ○ |
| | Minimum speed | Pr. 2 | | ○ | ○ | × |
| | Acceleration time | Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45, Pr. 110, Pr. 111 | | ○ | ○ | × |
| | Acceleration/deceleration pattern | Pr. 29, Pr. 140 to Pr. 143, Pr. 380 to Pr. 383 | | ○ | ○ | × |
| | Jog operation mode | Pr. 15, Pr. 16 | | ○ | ○ | × |
| | PWM frequency selection | Pr. 72, Pr. 240 | | ○ | ○ | ○ |
| | Operation mode (PU/external/combined) | Pr. 79 | | ○ | ○ | × |
| | Switchover mode | Pr. 79 | | ○ | ○ | × |
| | PU operation interlock mode | Pr. 79, Pr. 180 to Pr. 183, Pr. 187 | X12 | ○ | ○ | ○ |
| | Operation mode external signal switchover mode | Pr. 79, Pr. 180 to Pr.183, Pr. 187 | X16 | ○ | ○ | ○ |
| | Start command (2-wire, 3-wire) | Pr. 180 to Pr. 183, Pr. 187 | STOP | ○ | ○ | ○ |
| Parameter write disable selection | Pr. 77 | | ○ | ○ | ○ | |
| Application functions | Starting speed | Pr. 13 | | ○ | ○ | × |
| | DC injection brake | Pr. 10, Pr. 11, Pr. 12 | | ○ | ○ | × |
| | Second, third functions | Pr. 180 to Pr. 183, Pr. 187 | RT, X9 | ○ | ○ | ○ |
| | Multi-speed setting | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 28, Pr. 232 to Pr. 239 | | ○ | ○ | × |
| | Remote setting | Pr. 59 | | ○ | ○ | × |
| | Speed jump | Pr. 31 to Pr. 36 | | ○ | ○ | × |
| | PID control | Pr. 128 to Pr. 134, Pr. 180 to Pr. 183, Pr. 187 | X14 | ○ | × | × |
| | Stop selection | Pr. 250 | | ○ | ○ | × |
| | Power failure stop | Pr. 261 to Pr. 266 | | ○ | ○ | × |
| | PU stop | Pr. 75 | | ○ | ○ | ○ |
| | Reset selection | Pr. 75 | | ○ | ○ | ○ |
| | Forward/reverse rotation prevention | Pr. 78 | | ○ | ○ | ○ |
| | Automatic restart after instantaneous power failure | Pr. 57, Pr. 58 | | ○ | ○ | × |
| | Cooling fan on/off control | Pr. 244 | | ○ | ○ | ○ |
| | Retry function | Pr. 65, Pr. 67, Pr. 68, Pr. 69 | | ○ | ○ | × |
| | Inverter RS485 communication | Pr. 117 to Pr. 124 | | ○ | ○ | ○ |
| | Droop control | Pr. 286 to Pr. 288 | | ○ | × | × |
| Brake sequence | Pr. 60, Pr. 278 to Pr. 285 | | ○ | × | × | |
| Torque bias | Pr. 180 to Pr. 183, Pr. 187, Pr. 840 to Pr. 848, Pr. 904, Pr. 905 | X42, X43 | ○ | × | × | |
| Regenerative function selection | Pr. 30, Pr. 70 | | ○ | ○ | ○ | |

| Category | Function | Pr. number | Terminal | Control Applicable Motor | PLG Vector | | | |
|---|--|---|--|--------------------------------|---|--------|----------|---|
| | | | | | Speed | Torque | Position | |
| | | | | | SF-V5R "Motor with PLG (standard, constant torque)" *: This function can be usable under position control by parameter setting. | | | |
| Application functions | Soft-PWM | Pr. 240 | | | ○ | ○ | ○ | |
| | Torque characteristic selection | Pr. 801 | | | ○ | ○ | ○ | |
| | PLG rotation direction | Pr. 852 | | | ○ | ○ | ○ | |
| | Number of PLG pulses | Pr. 851 | | | ○ | ○ | ○ | |
| | Conditional position control by contact input | Pr. 465 to Pr. 494 | | | × | × | ○ | |
| | Direct display and direct setting of motor constants | Pr. 71, Pr. 82, Pr. 90 to Pr. 94, Pr. 859 | | | ○ | ○ | ○ | |
| | Speed setting/display unit switchover | Pr. 37, Pr. 144, Pr. 81, Pr. 454 | | | ○ | ○ | ○ | |
| Input functions | Electronic gear | Pr. 420, Pr. 421 | | | × | × | ○ | |
| | Multi-function input terminal assignment | Pr. 180 to Pr. 183, Pr. 187 | | | ○ | ○ | ○ | |
| | Analog input assignment/calibration | Pr. 868 / Pr. 902 to Pr. 920 | No. 1, 2, 3 terminals | | ○ | ○ | ○ | |
| | Analog command filter time constant | Pr. 822, Pr. 826, Pr. 832, Pr. 836 | | | ○ | ○ | ○ | |
| | Override, polarity reversible | Pr. 73, Pr. 252, Pr. 253 | | | ○ | ○ | × | |
| Output functions | Output stop | Pr. 17, Pr. 180 to Pr. 183, Pr. 187 | MRS | | ○ | ○ | ○ | |
| | Multi-function output terminal assignment | Pr. 190 to Pr. 192, Pr. 195 | | | ○ | ○ | ○ | |
| | Speed restriction output | Pr. 190 to Pr. 192, Pr. 195 | SL | | × | ○ | × | |
| | Inverter running signal | Pr. 13, Pr.190 to Pr. 192, Pr. 195 | RUN | | ○ | ○ | ○ | |
| | Up-to-speed signal | Pr. 41, Pr. 190 to Pr. 192, Pr. 195 | SU | | ○ | × | × | |
| | Overload alarm signal | Pr. 190 to Pr. 192, Pr. 195 | OL | | | | | |
| | Speed detection signal | Pr. 42, Pr. 43, Pr. 50, Pr. 116, Pr.190 to Pr. 192, Pr. 195 | FU, FU2, FU3 FB, FB2, FB3 | | ○ | × | × | |
| | Regenerative brake prealarm signal | Pr. 190 to Pr. 192, Pr. 195 | RBP | | ○ | ○ | ○ | |
| | Electronic thermal relay prealarm signal | Pr. 190 to Pr. 192, Pr. 195 | THP | | ○ | ○ | ○ | |
| | PU operation mode signal | Pr. 190 to Pr. 192, Pr. 195 | PU | | ○ | ○ | ○ | |
| | Operation ready signal | Pr. 190 to Pr. 192, Pr. 195 | RY | | ○ | ○ | ○ | |
| | Output current detection signal, zero current detection signal | Pr. 150, Pr. 151, Pr. 152, Pr. 153, Pr. 190 to Pr. 192, Pr. 195 | Y12, Y13 | | ○ | ○ | ○ | |
| | Fan fault output signal | Pr. 190 to Pr. 192, Pr. 195 | FAN | | ○ | ○ | ○ | |
| | Fin overheat prealarm signal | Pr. 190 to Pr. 192, Pr. 195 | FIN | | ○ | ○ | ○ | |
| | Forward, reverse rotation output signal | Pr. 190 to Pr. 192, Pr. 195 | Y30, Y31 | | ○ | ○ | ○ | |
| | Regenerative status output signal | Pr. 190 to Pr. 192, Pr. 195 | Y32 | | ○ | ○ | ○ | |
| | Operation ready 2 signal | Pr. 190 to Pr. 192, Pr. 195 | RY2 | | ○ | ○ | ○ | |
| | Low speed detection signal | Pr. 190 to Pr. 192, Pr. 195, Pr. 865 | LS | | ○ | ○ | ○ | |
| | Torque detection signal | Pr. 190 to Pr. 192, Pr. 195, Pr. 864 | TU | | ○ | ○ | ○ | |
| | Maintenance output | Pr. 190 to Pr. 192, Pr. 195, Pr. 890 to Pr. 892 | MT | | ○ | ○ | ○ | |
| | Remote output | Pr. 190 to Pr.192, Pr. 195, Pr. 495 to Pr. 497 | REM | | ○ | ○ | ○ | |
| | Instantaneous power failure (undervoltage) signal | Pr. 190 to Pr. 192, Pr. 195 | IPF | | ○ | ○ | ○ | |
| | Fault definition | Pr. 190 to Pr. 192, Pr. 195, Pr. 875 | ER | | ○ | ○ | × | |
| | Minor fault output signal | Pr. 190 to Pr. 192, Pr. 195 | LF | | ○ | ○ | ○ | |
| | Alarm output signal | Pr. 190 to Pr. 192, Pr. 195 | ABC | | ○ | ○ | ○ | |
| | Monitor functions | DU/PU display data selection | Pr. 52, Pr. 53 | | | ○ | ○ | ○ |
| | | DA1, DA2 output/calibration | Pr. 54 to Pr. 56, Pr. 866, Pr. 158, Pr. 900, Pr. 901 | DA1, DA2 | | ○ | ○ | ○ |
| DA1 output filter | | Pr. 867 | DA1 | | ○ | ○ | ○ | |
| Speed monitor | | Pr. 52 to Pr. 55, Pr.158 | | | ○ | ○ | ○ | |
| Output current monitor/output current peak value monitor | | Pr. 52 to Pr. 54, Pr. 56, Pr. 158 | | | ○ | ○ | ○ | |
| Output voltage monitor | | Pr. 52 to Pr. 54, Pr. 158 | | | ○ | ○ | ○ | |
| Preset speed monitor | | Pr. 52 to Pr. 55, Pr. 158 | | | ○ | ○ | ○ | |
| Output frequency monitor | | Pr. 52 to Pr. 55, Pr. 158 | | | ○ | ○ | ○ | |
| Motor torque monitor | | Pr. 52 to Pr. 54, Pr. 158, Pr. 866 | | | ○ | ○ | ○ | |
| Converter output voltage monitor, converter output voltage peak value monitor | | Pr. 52 to Pr. 54, Pr. 158 | | | ○ | ○ | ○ | |
| Input terminal monitor, output terminal monitor | | — | | | ○ | ○ | ○ | |
| Load meter monitor | | Pr. 52 to Pr. 54, Pr. 158, Pr. 866 | | | ○ | ○ | ○ | |
| Motor excitation current monitor | | Pr. 52 to Pr. 54, Pr. 158, Pr. 56 | | | ○ | ○ | ○ | |
| Cumulative operation time monitor | | Pr. 52 | | | ○ | ○ | ○ | |
| Actual operation time monitor | | Pr. 52, Pr. 171 | | | ○ | ○ | ○ | |
| Motor load factor | | Pr. 52 | | | ○ | ○ | ○ | |
| Orientation status | | Pr. 52 | | | ○ | × | × | |
| Option fitting status monitor | | — | | | ○ | ○ | ○ | |
| Terminal assignment status monitor | | — | | | ○ | ○ | ○ | |
| Motor output monitor | | Pr. 52 | | | ○ | ○ | ○ | |
| Feedback pulse monitor | Pr. 52 | | | ○ | ○ | ○ | | |
| Torque command/torque current command | Pr. 52, Pr. 54, Pr. 158 , Pr. 866 | | | ○ | ○ | ○ | | |

At-a-glance guide to functions

| Category | Function | Pr. number | Terminal | Control | | | |
|---------------------------------|---|---|----------|---|------------|--------|----------|
| | | | | Applicable Motor | PLG Vector | | |
| | | | | | Speed | Torque | Position |
| | | | | SF-V5R "Motor with PLG (standard, constant torque)" *: This function can be usable under position control by parameter setting. | | | |
| Protective functions | Overcurrent protection | — | | ○ | ○ | ○ | |
| | Overvoltage protection | — | | ○ | ○ | ○ | |
| | Electronic thermal O/L relay | Pr. 9 | | ○ | ○ | ○ | |
| | Fin overheat | — | | ○ | ○ | ○ | |
| | Brake transistor alarm | Pr. 30, Pr. 70 | | ○ | ○ | ○ | |
| | Earth (Ground) fault overcurrent protection | — | | ○ | ○ | ○ | |
| | External thermal relay <OHT> | Pr. 876 | OH | ○ | ○ | ○ | |
| | Motor overload (OLT) | Pr. 865, Pr. 874 | | ○ | ○ | ○ | |
| | Option alarm | — | | ○ | ○ | ○ | |
| | Parameter error | — | | ○ | ○ | ○ | |
| | Disconnected PU detection | Pr. 75 | | ○ | ○ | ○ | |
| | Output phase failure protection | Pr. 251 | | ○ | ○ | ○ | |
| | CPU error | — | | ○ | ○ | ○ | |
| | 12/24VDC power supply short circuit protection | — | | ○ | ○ | ○ | |
| | Operation panel power supply short circuit protection | — | | ○ | ○ | ○ | |
| | Overspeed occurrence | Pr. 374 | | ○ | ○ | ○ | |
| | Speed deviation large | Pr. 870, Pr. 871 | | ○ | ○ | ○ | |
| | Encoder no-signal | — | | ○ | ○ | ○ | |
| | Encoder A no-signal | — | | ○ | × | × | |
| Position error large | Pr. 427 | | × | × | ○ | | |
| Output short circuit protection | — | | ○ | ○ | ○ | | |
| Encoder phase error (E. EP) | — | | ○ | ○ | ○ | | |
| PU | PU language changing | Pr. 145 | | ○ | ○ | ○ | |
| | Buzzer control | Pr. 990 | | ○ | ○ | ○ | |
| | PU contrast adjustment | Pr. 991 | | ○ | ○ | ○ | |
| Options | 12-bit digital input "A5AX" | Pr. 300 to Pr. 305, Pr. 329 | | ○ | ○ | × | |
| | Digital setting of torque command "A5AX" | Pr. 447, Pr. 448, Pr. 804 | | × | ○ | × | |
| | Machine end orientation "V5AM" | Pr. 350 to Pr. 369, Pr. 390 to Pr. 396 | | ○ | × | × | |
| | Pulse position control "V5AP" | Pr. 419 to Pr. 431 | | × | × | ○ | |
| | PLG output "V5AY" | Pr. 410 to Pr. 413 | | ○ | ○ | ○ | |
| | Thermistor secondary resistance compensation "V5AX" | Pr. 407, Pr. 925 | | ○ | ○ | ○ | |
| | Extension analog input "V5AX" | Pr. 406 | | ○ | ○ | ○ | |
| | Extension contact input "V5AX" | Pr. 400 to Pr. 405 | | ○ | ○ | ○ | |
| | Digital output "A5AY, V5AY" | Pr. 313 to Pr. 319 / Pr. 410 to Pr. 413 | | ○ | ○ | ○ | |
| | Extension analog output "A5AY" | Pr. 306 to Pr. 312 | | ○ | ○ | ○ | |
| | Relay output "A5AR" | Pr. 320 to Pr. 322, Pr. 330 | | ○ | ○ | ○ | |
| | Pulse train input "A5AP" | Pr. 384 to Pr. 386 | | ○ | ○ | × | |
| | RS485 communication "A5NR" | Pr. 331 to Pr. 342 | | ○ | ○ | ○ | |
| | CC-Link "A5NC" | Pr. 338 to Pr. 342 | | ○ | ○ | ○ | |
| | Profibus-DP "A5NPA" | Pr. 338 to Pr. 342 | | ○ | ○ | ○ | |
| | Device-Net "A5ND" | Pr. 338 to Pr. 342, Pr. 345 to Pr. 348 | | ○ | ○ | ○ | |
| | Modbus Plus "A5NM" | Pr. 338 to Pr. 342 | | ○ | ○ | ○ | |
| | Trace (plug-in option) | Pr. 520 to Pr. 536 | | ○ | ○ | ○ | |

3.4 Basic functions (Pr. 0 to Pr. 9)

3.4.1 Torque boost (Pr. 0)

Use this parameter for V/F control only.

- Motor torque in the low speed region can be adjusted according to the load to increase the starting motor torque.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------|-----------------|---------------|---------------|
| 0 | Torque boost (manual) | 1% | 0 to 30% | Extended mode |

<Setting>

- Increase the setting when the distance between the inverter and motor is long or when the motor torque in the low speed region is insufficient (when the stall prevention protective function is activated), for example.
- Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.

CAUTION

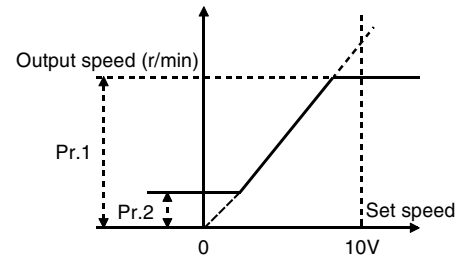
If the setting is too large, the motor may result in overheat or overcurrent trip.

3.4.2 Maximum and minimum speed settings

(Pr. 1 speed torque position , Pr. 2 speed torque)

You can limit the maximum (minimum) speed.

- Speed control
The maximum setting is placed on the running speed.
The minimum setting is placed on the preset speed.
- Torque control
The maximum and minimum settings are made on the speed restriction commands. (Restriction is not placed on the running speed.)
- Position control
The maximum setting is valid for the speed command obtained from the droop pulses. The minimum setting is invalid.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------|--------------------------------|----------------|-------------|
| 1 | Maximum speed | Japanese version: 1500r/min | 0 to 3600r/min | Simple mode |
| | | NA version :1800r/min | | |
| 2 | Minimum speed | 0r/min | 0 to 3600r/min | Simple mode |

<Setting>

● Speed control

- When the upper limit of the output speed is set in Pr. 1, the output speed is clamped at the maximum speed even if the speed command entered is higher than the speed set in Pr.1. (This also applies to the minimum speed setting.)

⚠ CAUTION

⚠ When the Pr. 2 setting is higher than Pr. 13 "starting speed" value, note that the motor will run at the pre-set speed by merely turning the start signal on, even if the command speed has not been entered.

Related parameters

- Starting speed setting ⇒ Pr. 13 "starting speed" (Refer to page 86.)
- Speed restriction command selection for torque control ⇒ Pr. 807 "speed restriction selection" (Refer to page 172.)
- External (example: terminal 2-5 connection) speed setting potentiometer adjustment ⇒ Pr. 902 "speed setting No. 2 bias" (Refer to page 189.),
Pr. 903 "speed setting No. 2 gain" (Refer to page 189.)

Basic functions (Pr. 0 to Pr. 9)

3.4.3 Base frequency, base frequency voltage (Pr. 3, Pr. 19)

Use this parameter for V/F control only.

This parameter matches the inverter outputs (voltage, frequency) to the motor rating.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------|------------------------|---------------------------|--|
| 3 | Base frequency | Japanese version :60Hz | 20 to 200Hz | Extended mode |
| | | NA version :60Hz | | |
| 19 | Base frequency voltage | 9999 | 0 to 1000V, 8888, 9999 | Extended mode 8888: 95% of power supply voltage 9999: Same as power supply voltage |

<Setting>

- Use Pr. 3 to set the base frequency (rated motor frequency).
- If only "50Hz" is given on the motor rating plate as the frequency, always set the "base frequency" to "50Hz". If it remains at "60Hz", the voltage may become too low and torque shortage occurs, resulting in an overload trip.
- Use Pr. 19 to set the base voltage (e.g. rated motor voltage).
The motor whose rated voltage is lower than the power supply voltage of the inverter can be used optimally. This function is useful when a motor rated at 200V is used with a 230V power supply.

REMARKS

If vector control is disabled due to an encoder fault, setting "20" in Pr. 800 "control system selection" enables operation under V/F control. (Refer to page 169.)

Related parameters

Motor setting ⇒ Pr. 71 "applied motor", Pr. 450 "second applied motor" (Refer to page 112.)

3.4.4 Multi-speed operation

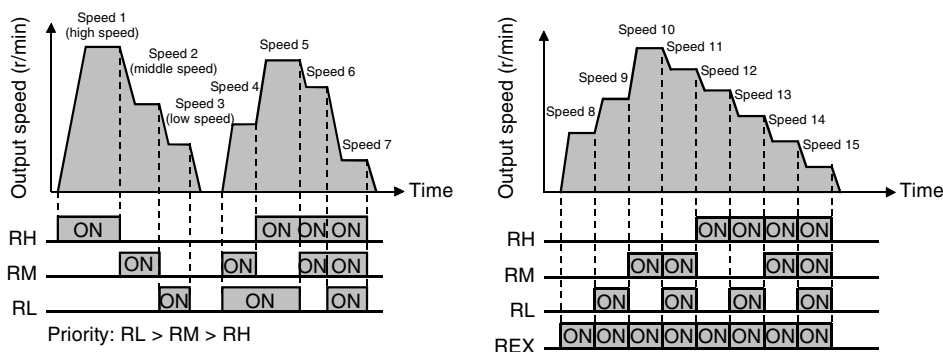
(Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 speed torque position)

Can be used to change between the predetermined running speeds by switching from one terminal to another.

- Any speed can be selected by merely turning on-off the contact signals (RH, RM, RL, REX signals).
- Using these parameters with Pr. 1 "maximum speed" and Pr. 2 "minimum speed" allows the setting of up to 17 speeds.

POINT

- Valid in the external operation mode or in the combined operation mode that is made available by setting "3 or 4" in Pr. 79.
- Valid when "0" is set in Pr. 59.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|------------|--------------------------------------|--------------------------------|----------------------|-------------------|
| 4 | Multi-speed setting (high speed) | Japanese version: 1500r/min | 0 to 3600r/min | Simple mode |
| | | NA version: 1800r/min | | |
| 5 | Multi-speed setting (middle speed) | 750r/min | 0 to 3600r/min | Simple mode |
| 6 | Multi-speed setting (low speed) | 150r/min | 0 to 3600r/min | Simple mode |
| 24 to 27 | Multi-speed setting (speeds 4 to 7) | 9999 | 0 to 3600r/min, 9999 | "9999" No setting |
| 232 to 239 | Multi-speed setting (speeds 8 to 15) | 9999 | 0 to 3600r/min, 9999 | "9999" No setting |

<Setting>

- Set the running speeds in the corresponding parameters. Each speed can be set as desired in the range 0 to 3600r/min during inverter operation. With any multi-speed setting parameter being read, press / to change the setting. In this case, press to store the preset speed. (This is also enabled in the external mode.) Pressing reflects the preset speed.

REMARKS

- Press when the FR-PU04V (option) is used.
- Use Pr. 180 to Pr. 183 and Pr. 187 to assign the terminals used for signals RH, RM, RL, and REX. (*)
*Changing terminal assignment using Pr. 180 to Pr. 183, Pr. 187 may affect the other functions. Check the functions of the corresponding terminals before making setting.
- The priorities of the external terminals for speed commands are as follows.
Jog > pulse train input (option FR-A5AP) > digital setting (option FR-A5AX) > multi-speed operation > PID > No. 2 terminal

CAUTION

- The multi-speed settings override the main speed (across terminals 2-5).
- The multi-speeds can also be set in the PU or external operation mode.
- For 3-speed setting, if two or more speeds are simultaneously selected, priority is given to the preset speed of the lower signal. (RL > RM > RH)
- Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.
- The settings can also be changed during operation.
- When the jog signal is used with multi-speed signals, the jog signal has priority.

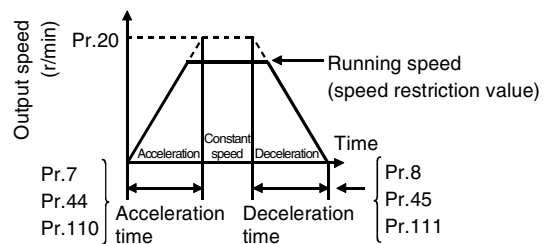
Related parameters

- Maximum, minimum speed setting⇒ Pr. 1 "maximum speed", Pr. 2 "minimum speed" (Refer to page 79.)
- Signal RH, RM, RL, REX terminal assignment⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)
- External operation mode setting⇒ Pr. 79 "operation mode selection" (Refer to page 118.)
- Extended mode/simple mode setting⇒ Pr. 160 "extended function selection" (Refer to page 149.)

3.4.5 Acceleration and deceleration times

(Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45, Pr. 110, Pr. 111)

Set the acceleration/deceleration time of the motor during speed control and position control by parameter setting. Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease. Under torque control, the speed restriction value varies with the acceleration/deceleration time.



Basic functions (Pr. 0 to Pr. 9)

| Parameter | Name | Factory Setting | Setting Range | Remarks | |
|-----------|--|--------------------------------|--------------------|--|---------------|
| 7 | Acceleration time | 15s | 0 to 3600s | Simple mode | |
| | | | 0 to 360s | | |
| 8 | Deceleration time | 15s | 0 to 3600s | Simple mode | |
| | | | 0 to 360s | | |
| 20 | Acceleration/ deceleration reference speed | Japanese version: 1500r/min | 1 to 3600 r/min | Extended mode | |
| | | NA version: 1800r/min | | | |
| 21 | Acceleration/ deceleration time increments | 0 | 0, 1 | 0: 0 to 3600s 1: 0 to 360s | Extended mode |
| 44 | Second acceleration/ deceleration time | 5s | 0 to 3600s | Pr. 21 = 0 | Extended mode |
| | | | 0 to 360s | Pr. 21 = 1 | |
| 45 | Second deceleration time | 9999 | 0 to 3600s | Pr. 21 = 0 | Extended mode |
| | | | 0 to 360s | Pr. 21 = 1 | |
| | | | 9999 | Acceleration time = deceleration time | |
| 110 | Third acceleration/ deceleration time | 5s | 0 to 3600s | Pr. 21 = 0 | Extended mode |
| | | | 0 to 360s | Pr. 21 = 1 | |
| 111 | Third deceleration time | 9999 | 0 to 3600s | Pr. 21 = 0 | Extended mode |
| | | | 0 to 360s | Pr. 21 = 1 | |
| | | | 9999 | Acceleration time = deceleration time | |

<Setting>

- Use Pr. 21 to set the acceleration/deceleration time and minimum setting range.
Value "0" (factory setting) 0 to 3600s (minimum setting increments: 0.1s)
Value "1" 0 to 360s (minimum setting increments: 0.01s)
Changing the Pr. 21 value changes the setting of Pr. 7, Pr. 8, Pr. 44, Pr. 45, Pr. 110 and Pr. 111.

CAUTION

Changing the Pr. 21 setting changes the acceleration/deceleration setting (Pr. 7, Pr. 8, Pr. 16, Pr. 44, Pr. 45, Pr. 110, Pr. 111)

<Example>

When Pr. 21 = "0", setting "5.0" s in Pr. 7 and "1" in Pr. 21 changes the Pr. 7 setting to "0.5" s.

- Use Pr. 7, Pr. 44 and Pr. 110 to set the acceleration time taken to reach the speed set in Pr. 20 from 0r/min.
- Use Pr. 8, Pr. 45 and Pr. 111 to set the deceleration time taken to reach 0r/min from the speed set in Pr. 20.
- Use Pr. 180 to Pr. 183 and Pr. 187 to assign the terminals used to input the RT and X9 signals.

CAUTION

- Pr. 44 and Pr. 45 are valid when the RT signal is on.**
When the RT signal is on, the other second functions (Pr. 450 to Pr. 463, Pr. 815, Pr. 830 to Pr. 837) are also valid.
- Pr. 110 and Pr. 111 are valid when the X9 signal is on.**
When the X9 signal is on, Pr. 820 to Pr. 827 are also valid.
- When both RT and X9 are on, Pr. 110 and Pr. 111 are valid.**
- Switching the RT and X9 signals during operation does not change the acceleration/deceleration time immediately when position control is exercised with the conditional position control function (Pr. 419 = "0") by the contact input.**

REMARKS

- Changing the Pr. 20 "acceleration/deceleration reference speed" setting does not adjust the speed gain setting signal. To adjust the gain, adjust the calibration function (Pr. 903).
- When the setting of Pr. 7, Pr. 8, Pr. 44, Pr. 45, Pr. 110 or Pr. 111 is "0" under V/F control, the acceleration/deceleration time is 0.04s.
- However short the acceleration/deceleration time setting is, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time that is determined by the mechanical system J (inertia moment) and the motor torque.

Related parameters

- Jog acceleration/deceleration time ⇒ Pr. 16 "jog acceleration/deceleration time" (Refer to page 87.)
- RT signal, X9 signal setting ⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)

3.4.6 Motor overheat protection (Pr. 9, Pr. 452, Pr. 876 speed torque position)

When an external thermal relay is not used, protect the motor from overheat by integration processing of the inverter output current. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

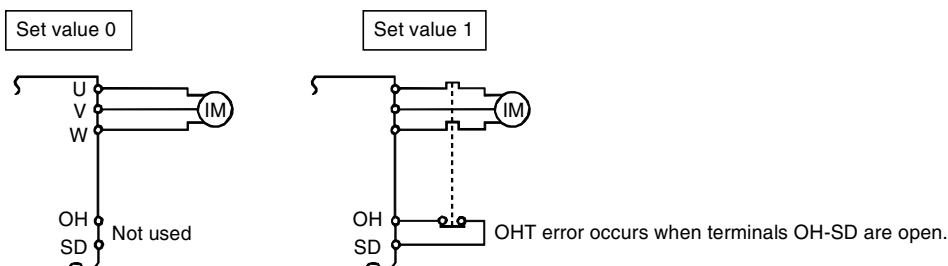
| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------------------------|--|------------------|--|
| 9 | Electronic thermal O/L relay | Japanese version: 0 | 0 to 3600A | Extended mode (NA version: simple mode) |
| | | NA version: Rated inverter output current | | |
| 452 | Second electronic thermal O/L relay | 9999 | 0 to 3600A, 9999 | Extended mode 9999: Without second electronic thermal relay |
| 876 | Thermal relay protector input | Japanese version : 1 | 0, 1 | Extended mode |
| | | NA version : 0 | | |

<Setting>

- When not using an external thermal relay, set the rated current value [A] of the motor in Pr. 9 (Pr. 452) to make the electronic thermal relay valid.
(Normally set the rated current value at 50Hz. When the rated current value of 50Hz is not indicated on the name plate, set the value obtained from multiplying the rated current value of 60Hz by 1.1.)
- Setting "0" in Pr. 9 (Pr. 452) deactivates the electronic thermal relay (motor protective function). (The inverter's output transistor protective function is activated.)
When using the Mitsubishi dedicated motor, set "0" since the thermal protector is on board (outside).
- When using the Mitsubishi constant-torque motor
Set "10" in Pr. 71 "applied motor" to select the 100% continuous torque characteristic in the low speed range.
Set the rated current of the motor in Pr. 9 "electronic thermal O/L relay".
- The electronic thermal relay of the second motor (Pr. 452 "second electronic thermal O/L relay" is made valid by:
Turning on the RT signal; and
Setting other than 9999 in Pr. 450.
(The value set in Pr. 9 is valid when Pr. 452 = 9999.)

• Selection for whether to use an external thermal relay or not (Pr. 876 "thermal relay protector input")

| Pr. 876 Setting | Motor with PLG |
|-----------------|---|
| 0 | When thermal relay etc. is not used (thermal relay protector input invalid) |
| 1 | When thermal relay etc. is used (thermal relay protector input valid) |



CAUTION

- When two or more motors are connected to the inverter under V/F control, they cannot be protected by the electronic thermal relay. 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 will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay. Use an external thermal relay.

REMARKS

- When running two motors with one inverter, you can set the electronic thermal relay of each inverter.

| Pr. 450 "second applied motor" | Pr. 9 "electronic thermal O/L relay" | Pr. 452 "second electronic thermal O/L relay" | First Motor Electronic Thermal Relay | | Second Motor Electronic Thermal Relay | |
|-----------------------------------|---|--|--------------------------------------|---------|---------------------------------------|---------|
| | | | RT = OFF | RT = ON | RT = OFF | RT = ON |
| 9999 | 0 | 9999 | × | × | × | × |
| | | 0 | × | × | × | × |
| | | 0.1 to 3600 | × | × | △ | ○ |
| 9999 | Other than 0 | 9999 | ○ | ○ | × | × |
| | | 0 | ○ | △ | × | × |
| | | 0.1 to 3600 | ○ | △ | △ | ○ |
| Other than 9999 | 0 | 9999 | × | × | × | × |
| | | 0 | × | × | × | × |
| | | 0.1 to 3600 | × | × | △ | ○ |
| Other than 9999 | Other than 0 | 9999 | ○ | △ | △ | ○ |
| | | 0 | ○ | △ | × | × |
| | | 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)

×

- It is valid for controlling one motor with one inverter in two different control systems.
- It is valid for controlling the first motor with an external thermal relay and the second motor with an electronic thermal relay.

Related parameters

- When constant-torque motor is used ⇒ Pr. 71 "applied motor", Pr. 450 "second applied motor" (Refer to page 112.)
- Use of second motor ⇒ Pr. 450 "second applied motor" (Refer to page 112.)
- RT signal setting ⇒ Set "3" in any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection). (Refer to page 149.)

3.5 Standard operation functions (Pr. 10 to Pr. 16)

3.5.1 DC injection brake (Pr. 10, Pr.11 speed torque , Pr. 12, Pr.802 speed position)

By setting the DC injection brake voltage (torque) at a stop, operation time and operation starting speed, the stopping accuracy of positioning operation, etc. or the timing of applying the DC injection brake to stop the motor is adjusted according to the load.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------------------|-----------------|-----------------------|--|
| 10 | DC injection brake operation speed | 15r/min | 0 to 1500 r/min, 9999 | 9999: Operated at or below Pr. 13 value. |
| 11 | DC injection brake operation time | 0.5s | 0 to 0.5s | Extended mode |
| 12 | DC injection brake voltage | 1% | 0 to 30% | |
| 802 | Pre-excitation selection | 0 | 0, 1 | |

<Setting>

- Use Pr. 10 to set the speed at which the DC injection brake application is started.
By setting "9999", the brake is operated at or below the speed set in Pr. 13.
- When stopping the motor by using a STOP key or turning the STF/STR off, the DC injection brake application is started at the speed set in Pr.10. When stopping the motor by setting speed to 0r/min (with PU or Volume), the DC injection brake application is started at the speed set in Pr.13.
- Use Pr. 11 to set the duration period the brake is applied. During this period, DC injection brake operation is exercised.
When this period has elapsed, the motor is coasted to a stop.
- Use Pr. 12 to set the percentage to the power supply voltage. (Use this parameter only during V/F control.)
- When pre-excitation is performed with the LX signal, select zero speed control or servo lock using Pr. 802.
Turning on the LX signal enables the pre-excitation function. (valid only during speed control)

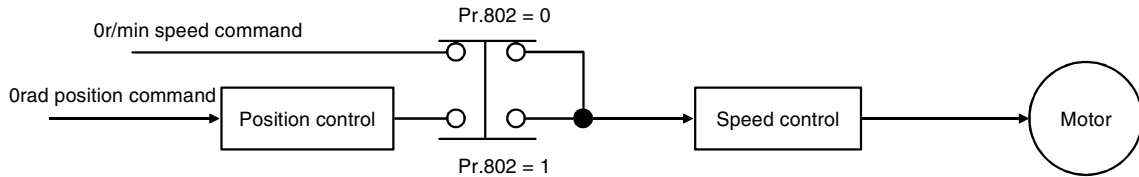
| Parameter | Name | Description |
|-----------|--------------------------|---|
| 802 | Pre-excitation selection | 0: Zero speed control (factory setting) Even under load, an attempt is made to maintain 0r/min to keep the motor shaft stopped. Note that if the shaft is overcome and turned by external 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". |

● The relationship between the DC injection brake operation and pre-excitation operation under each control

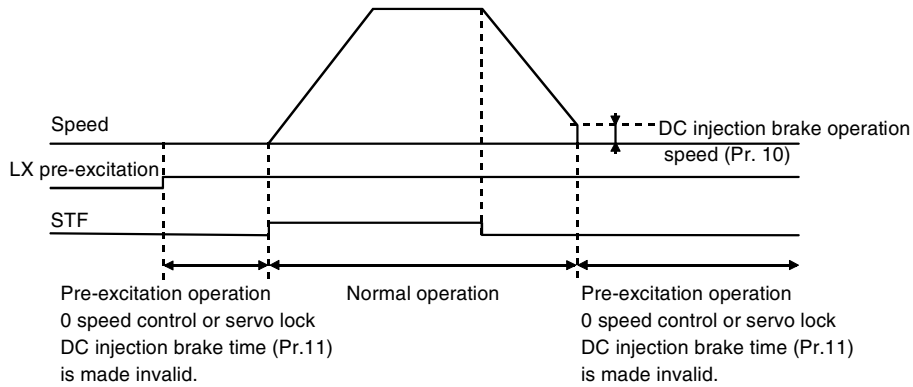
| Control Mode | Operation | | | |
|-----------------------------------|--|--------------------------------------|--------------------------------------|--------------------------------------|
| | LX terminal OFF (Deceleration to stop) | | LX terminal ON | |
| | Pre-excitation selection Pr. 802 = 0 | Pre-excitation selection Pr. 802 = 1 | Pre-excitation selection Pr. 802 = 0 | Pre-excitation selection Pr. 802 = 1 |
| V/F control | DC injection brake | DC injection brake | No operation | No operation |
| Speed control (vector control) | Zero speed control | Servo lock | Zero speed control | Servo lock |
| Position control (vector control) | No operation | No operation | Servo lock | Servo lock |

Standard operation functions (Pr. 10 to Pr. 16)

● The control block diagram during pre-excitation



● Timing chart



* When the LX (pre-excitation) terminal is off, the pre-excitation operation functions for the time set in the DC injection brake operation time (Pr. 11).

⚠ CAUTION

⚠ **Install a mechanical brake.**
After the machine stops fully and the mechanical brake is applied, switch the LX signal (pre-excitation) off.

CAUTION

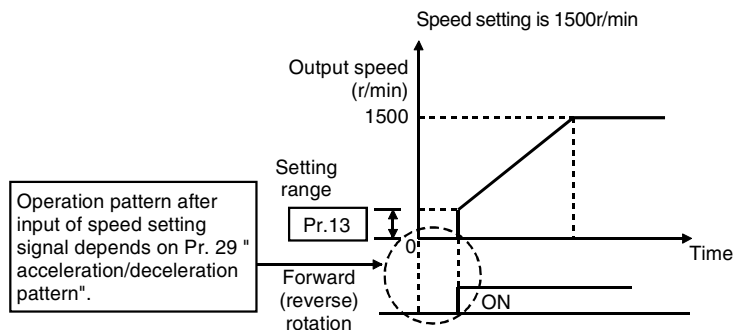
The DC injection brake functions during speed restriction under speed control or torque control, but does not function under position control.

Related parameters

- DC injection brake operation speed when Pr. 10 = 9999 ⇒ Pr. 13 "starting speed"(Refer to page 86.)
- When using constant-torque motor ⇒ Pr. 71 "applied motor", Pr. 450 "second applied motor"(Refer to page 112.)
- Setting control mode ⇒ Pr. 800 "control system selection" (Refer to page 112.)
- LX signal terminal assignment ⇒ Set "23" in any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection). (Refer to page 149.)

3.5.2 Starting speed (Pr. 13 speed torque)

You can set the starting speed at which the start signal is turned on.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|----------------|-----------------|----------------|---------------|
| 13 | Starting speed | 15r/min | 0 to 1500r/min | Extended mode |

CAUTION

- If the speed setting signal is less than the value set in Pr. 13 "starting speed", the operation is either 0 speed or servo lock.
For example, when 150r/min is set in Pr. 13, the motor will start running when the speed setting signal reaches 150r/min.
- When the analog voltage command (example: across 2-5) is used as speed for operation, too low of a setting of the rotation speed at a start may start the motor running by merely entering the start signal although the voltage command is zero. In this case, adjustment can be made using the calibration function, Pr. 902.

⚠ CAUTION

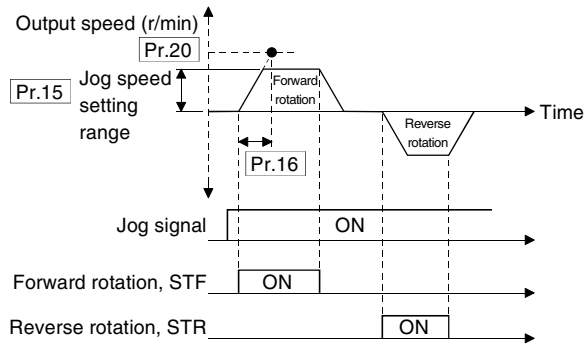
⚠ When the Pr. 13 setting is lower than Pr. 2 "minimum speed" value, note that the motor will start running at the preset speed by merely turning the start signal on, even if the command speed has not been entered.

Related parameters

- Minimum speed setting ⇒ Pr. 2 "minimum speed" (Refer to page 79.)
- Acceleration/deceleration pattern setting ⇒ Pr. 29 "acceleration/deceleration pattern" (Refer to page 91.)
- Adjustment for analog voltage command ⇒ Pr. 902 "speed setting No. 2 bias" (Refer to page 189.)

3.5.3 Jog operation (Pr. 15, Pr. 16 speed torque)

To start/stop jog operation in the external operation mode, choose the jog operation function in input terminal function selection, turn on the jog signal, and turn on/off the start signal (STF, STR). When using the parameter unit (FR-PU04V), choose the jog operation mode and use **FWD** or **REV** to perform jog operation. (When the FR-PU04V is connected, these parameters can be read as the basic parameters.) Perform PU JOG operation using PU (FR-DU04-1, FR-PU04V) in the PU-JOG operation mode. Refer to the Instruction Manual (basic) for details.



- Set the speed and acceleration/deceleration time for jog operation.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|-----------------|----------------|---------------|
| 15 | Jog speed setting | 150r/min | 0 to 1500r/min | Extended mode |
| 16 | Jog acceleration/ deceleration time | 0.5s | 0 to 3600s | |
| | | | 0 to 360s | When Pr. 21=1 |

REMARKS

For the operation method from the operation panel (FR-DU04-1), refer to the Instruction Manual (basic).

CAUTION

- The acceleration time and deceleration time cannot be set separately for jog operation.
- Pr. 15 "jog speed setting" value should be equal to or higher than Pr. 13 "starting speed" setting.
- Assign the jog signal to any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection).
- The priorities of the external terminals for speed commands are:
Jog > multi-speed operation > No. 2 terminal
- During jog operation, the RT and X9 signals cannot be used to switch to the second and third acceleration/deceleration time.
- Under torque control, the jog speed acts as the speed restriction value by turning on the jog signal.
- Jog operation is invalid under position control.

Related parameters

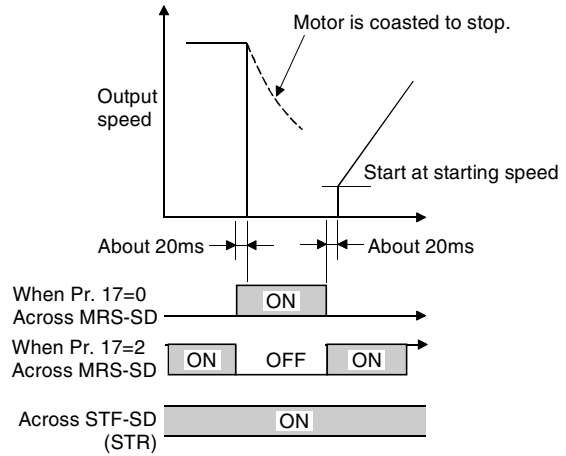
- Jog signal terminal assignment ⇒ Set "5" in any of Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)
- S-shaped acceleration/deceleration pattern A ⇒ Pr. 29 "acceleration/deceleration pattern" (Refer to page 91.)
- Pr. 16 setting range, minimum setting increments condition setting ⇒ Pr. 21 "acceleration/deceleration time increments" (Refer to page 81.)

3.6 Operation selection functions 1 (Pr. 17 to Pr. 37)

3.6.1 Inverter output stop (MRS) (Pr. 17 speed torque position)

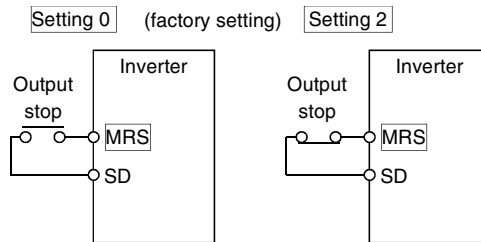
The setting of this parameter needs to be changed to:

- Stop the motor with a mechanical brake (e.g. electromagnetic brake);
- Provide interlocks to prevent the inverter from running if the start signal is input to the inverter; or
- Coast the motor to a stop.



| Parameter | Name | Factory Setting | Setting Range | MRS Signal Specifications | Remarks |
|-----------|---------------------|-----------------|---------------|--|---------------|
| 17 | MRS input selection | 0 | 0 | Output stops when MRS signal turns on. | Extended mode |
| | | | 2 | Output stops when MRS signal turns off. (b contact input specifications) | |

<Wiring example> For sink logic



REMARKS

- Set the MRS signal using the input terminal function selection (Pr. 180 to Pr. 183, Pr. 187).
- The setting cannot be changed during operation.
- Refer to the Instruction Manual (basic) for inverter reset.

CAUTION

- **When Pr. 30 = 2 (MT-HC connection), use the X10 signal.**
- **When the operation mode is the NET mode and Pr. 338 = 0, the MRS signal is used as both the external terminal and communication-based signals, and the output stops when either signal turns on. At the Pr. 17 setting of 2, the output stops when either signal turns off. (Oppositely, at the Pr. 17 setting of 2, both the external terminal and communication-based signals should turn on to make a start.)**

Related parameters

- Starting speed setting ⇒ Pr. 13 "starting speed" (Refer to page 86.)
- MRS signal terminal assignment ⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)

Pr. 19 ➡ Refer to Pr. 3 (page 80)

Pr. 20, Pr. 21 ➡ Refer to Pr. 7, Pr. 8 (page 81)

3.6.2 Torque restriction (Pr. 22 speed position , Pr. 803 speed torque position , Pr. 810 speed position , Pr. 812 to Pr. 817 speed position)

Used to restrict the output torque to the predetermined value during speed control.
For details of the setting method, refer to the torque restriction of the Instruction Manual (basic).

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|-----------------|--------------------|--|
| 22 | Torque restriction level (*1) | 150% | 0 to 400% | When Pr. 810 = 0, 1 quadrant Pr. 22 2 quadrant Pr. 812 3 quadrant Pr. 813 4 quadrant Pr. 814 |
| 803 | Constant output region torque characteristic selection | 0 | 0 | Constant output restriction |
| | | | 1 | Constant torque restriction |
| 810 | Torque restriction input method selection | 0 | 0 | Internal torque restriction Parameter-set torque restriction operation is performed. |
| | | | 1 | External torque restriction Speed restriction based on the analog voltage from the No. 3 terminal |
| 812 | Torque restriction level (regeneration) | 9999 | 0 to 400%, 9999 | Valid in the regeneration mode when Pr. 810 = 0. 9999: Pr. 22 value is used for restriction. |
| 813 | Torque restriction level (3rd quadrant) | 9999 | 0 to 400%, 9999 | Valid in the reverse rotation driving mode when Pr. 810 = 0. 9999: Pr. 22 value is used for restriction. |
| 814 | Torque restriction level (4th quadrant) | 9999 | 0 to 400%, 9999 | Valid in the regeneration mode when Pr. 810 = 0. 9999: Pr. 22 value is used for restriction. |
| 815 | Torque restriction level 2 | 9999 | 0 to 400%, 9999 | When the torque restriction selection (TL) signal is on, Pr. 815 is used as the torque restriction value regardless of Pr. 810. Valid when torque restriction selection (TL) terminal input is provided. 9999: Depending on Pr. 22 setting |
| 816 | Acceleration torque restriction(*2) | 9999 | 0 to 400%, 9999 | Set the torque restriction value during acceleration. 9999: Same torque restriction as at constant speed |
| 817 | Deceleration torque restriction(*2) | 9999 | 0 to 400%, 9999 | Set the torque restriction value during deceleration. 9999: Same torque restriction as at constant speed |

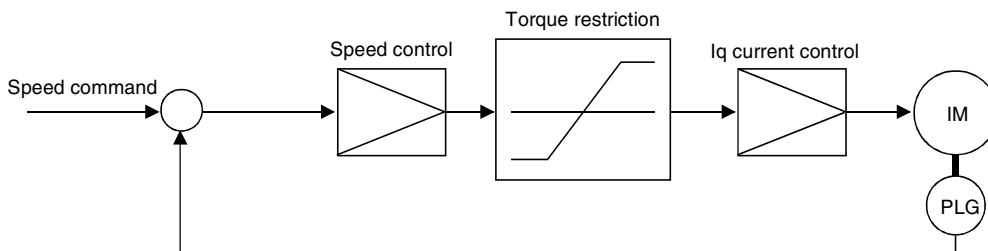
Extended mode

CAUTION

- *1.Output current level (stall prevention function) is activated to prevent the inverter from alarm stop due to overcurrent etc. during V/F control. When "0" is set in Pr. 22, stall prevention function is invalid.
- *2.Pr. 816 "acceleration torque restriction" and Pr. 817 "deceleration torque restriction" are invalid during position control.

<Details>

Torque restriction is activated so that the output torque does not exceed the predetermined value during speed control. The block diagram is shown below. The output of speed control is suppressed within the torque restriction value.



At this time, set Pr. 810 to select the way to make torque restriction.

Operation selection functions 1 (Pr. 17 to Pr. 37)

<Setting>

| Pr. 810 Setting | Torque Restriction Input Method | Operation |
|-----------------|---------------------------------|--|
| 0 | Internal torque restriction | Parameter-set torque restriction operation is performed. Changing the torque restriction parameter value by communication enables torque restriction to be adjusted by communication. |
| 1 | External torque restriction | Torque restriction using the analog voltage from the No. 3 terminal is made valid. |

REMARKS



Refer to the Instruction Manual (basic) for details of the other parameters.

CAUTION

Whether the torque restriction in the constant output range is set to constant torque restriction or constant output restriction in the torque restriction setting depends on the setting of Pr. 803 "constant output range torque characteristic selection".

Related parameters

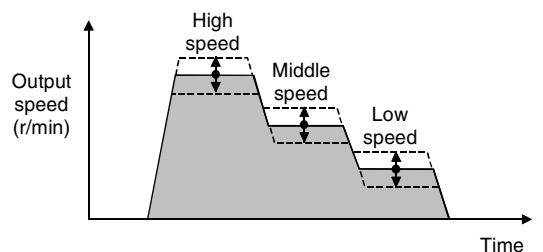
- Torque command bias adjustment ⇒ Pr. 904 "torque command No. 3 bias" (Refer to page 189.)
- Torque command gain adjustment ⇒ Pr. 905 "torque command No. 3 gain" (Refer to page 189.)

Pr. 24 to Pr. 27 ➔ Refer to Pr. 4 to Pr. 6 (page 80)

3.6.3 RH, RM, RL signal input compensation (Pr. 28 speed torque)

By entering 0 to ±10V into terminal 1 (speed setting auxiliary terminal), the speeds of the RH, RM and RL signals (command speeds for multi-speed operation) can be compensated for.

| Parameter | Name | Factory Setting | Setting Range | Description | Remarks |
|-----------|--------------------------------|-----------------|---------------|----------------------|---------------|
| 28 | Multi-speed input compensation | 0 | 0 | Without compensation | Extended mode |
| | | | 1 | With compensation | |



CAUTION

- When "4 or 14" is set in Pr. 73, the compensation signal is input from terminal 2, not from terminal 1. (Override function)
- Since terminal 1 is a multi-function selection terminal, its function varies with the Pr. 868 setting. Set "0" in Pr. 868. Refer to Pr. 902 and Pr. 903 for calibration of the terminal 1.

Related parameters

- Multi-speed setting ⇒ Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 (multi-speed setting) (Refer to page 80.)
- RH, RM, RL signals ⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)
- Speed compensation using terminal 2 ⇒ Pr. 73 "speed setting signal" (Refer to page 114.)
- Function assignment to terminal 1 ⇒ Set "0" in Pr. 868 "No. 1 terminal function assignment" (Refer to page 182.)
- Pr. 59 "remote setting function selection" ⇒ Refer to page 105.
- Calibration of terminal 1 ⇒ Pr. 902 "speed setting No. 2 bias", Pr. 903 "speed setting No. 2 gain" (Refer to page 189)

3.6.4 S-pattern acceleration/deceleration curve (Pr. 29, Pr. 140 to Pr. 143, Pr. 380 to Pr. 383 (speed torque)

When you have changed the preset speed during start, acceleration, deceleration, stop, or operation, you can change the running speed by acceleration/deceleration to make adjustment to reach the preset speed. Set the acceleration/deceleration pattern in Pr. 29 "acceleration/deceleration pattern".

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|----------------|---|
| 29 | Acceleration/ deceleration pattern | 0 | 0 | Linear acceleration/deceleration |
| | | | 1 | S-pattern acceleration/deceleration A |
| | | | 2 | S-pattern acceleration/deceleration B |
| | | | 3 | Backlash compensation acceleration/ deceleration |
| | | | 4 | S-pattern acceleration/deceleration C |
| 140 | Backlash acceleration stopping speed | 30r/min | 0 to 3600r/min | Accessible when Pr. 29 = 3 |
| 141 | Backlash acceleration stopping time | 0.5s | 0 to 360s | |
| 142 | Backlash deceleration stopping speed | 30r/min | 0 to 3600r/min | |
| 143 | Backlash deceleration stopping time | 0.5s | 0 to 360s | |
| 380 | Acceleration S pattern 1 | 0% | 0 to 50% | Accessible when Pr. 29 = 4 |
| 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% | |

Extended mode

Operation selection functions 1 (Pr. 17 to Pr. 37)

<Setting>

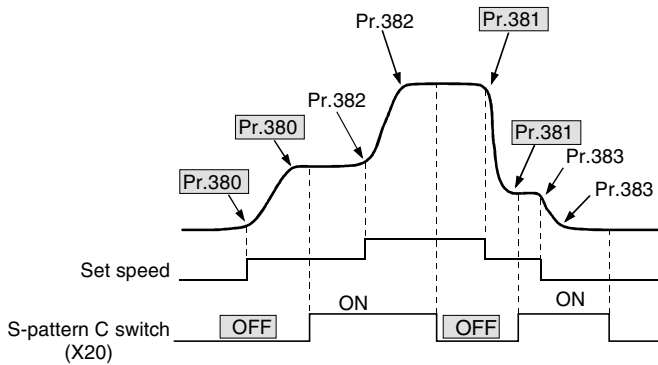
| Pr. 29 Setting | Function | Description | Operation |
|----------------|---|---|---|
| 0 | Linear acceleration/ deceleration (factory setting) | Acceleration/deceleration is made linearly up/down to the preset speed . | <p>[Linear acceleration /deceleration]</p> |
| 1 | S-pattern acceleration/ deceleration A (torque variation technique) | <p>The motor torque is utilized effectively to make fast acceleration/deceleration in a large motor-generated torque area and smooth acceleration/deceleration in a small motor-generated torque area.</p> <p>In this acceleration/deceleration pattern, the base frequency is the inflection point of an S shape, and you can set the acceleration/deceleration time according to the reduction in motor torque in the constant-output operation range at higher than the rated speed.</p> <p>This function is valid for V/F control only. For other than V/F control, linear acceleration/deceleration is made.</p> <p style="text-align: center;">CAUTION</p> <p>As the acceleration/deceleration time, set the time taken to reach Pr. 3 "base frequency", not Pr. 20 "acceleration/deceleration reference speed". Refer to page 80 for details of Pr. 3.</p> | <p>[S-pattern acceleration /deceleration A]</p> |
| 2 | S-pattern acceleration/ deceleration B (shock absorption) | <p>Prevention of cargo collapse on conveyor, etc.</p> <p>This setting always provides S-pattern acceleration/ deceleration from s2 (current speed) to s1 (preset speed), easing an acceleration/deceleration shock and producing an effect on the prevention of cargo collapse, etc.</p> | <p>[S-pattern acceleration /deceleration B]</p> |
| 3 | Backlash compensation acceleration/ deceleration | <p>Backlash compensation for reduction gear, etc.</p> <p>This function stops a speed change temporarily during acceleration/deceleration, reducing a shock generated when a reduction gear backlash is eliminated suddenly. Use Pr. 140 to Pr. 143 to set the stopping times and stopping speed in accordance with the chart on the right. The acceleration/deceleration time is increased by the stopping time.</p> <p>REMARKS</p> <p>Output speed is retained for the time for the starting speed (Pr. 13) and $\Delta s1$ (Pr. 140) time at a start and accelerate again after $\Delta t1$ time has elapsed. Speed reaches or below $-\Delta n$ (Pr. 142) is retained for $\Delta t2$ (Pr. 143) time at a start of deceleration and decelerate again after $\Delta t2$ time has elapsed.</p> | <p>[Backlash compensation function]</p> |
| 4 | S-pattern acceleration/ deceleration C | See next page. | See next page. |

REMARKS

For the acceleration/deceleration time, turning on the RT signal makes Pr. 44 "second acceleration/deceleration time" and Pr. 45 "second deceleration time" valid (turning on the X9 signal makes Pr. 110 and Pr. 111 valid). Refer to page 81.

Pr. 29 = 4 (S-pattern acceleration/deceleration C)

The S-pattern acceleration/deceleration C switch signal (X20) changes an acceleration/deceleration curve.



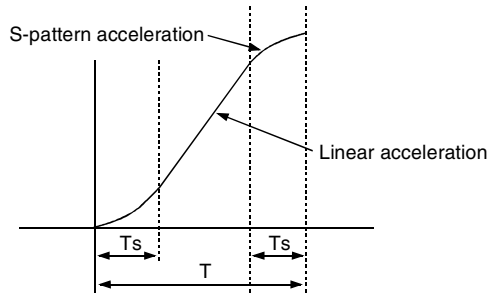
CAUTION

Change the S pattern acceleration/deceleration C switch (X20) after the speed becomes constant. S pattern operation before switching continues even if the X20 is changed during acceleration or deceleration.

| Operation X20 Signal | During Acceleration | During Deceleration |
|-------------------------|------------------------------------|------------------------------------|
| | OFF | Pr. 380 "acceleration S pattern 1" |
| ON | Pr. 382 "acceleration S pattern 2" | Pr. 383 "deceleration S pattern 2" |

As the acceleration/deceleration time during acceleration/deceleration, set the percentage to the acceleration/deceleration time T in Pr. 380 to Pr. 383.

Parameter setting (%) = $T_s / T \times 100\%$



REMARKS

- At a start, the motor starts at Pr. 13 "starting speed" when the start signal turns on.
- If there is a difference between the speed command and speed at a start of deceleration due to torque restriction operation etc., the speed command is matched with the speed to make deceleration.

Related parameters

- Base frequency setting (acceleration/deceleration time setting) ⇒ Pr. 3 "base frequency" (Refer to page 80.)
- X20 signal setting when Pr. 29 = 4 (S-pattern acceleration/deceleration switch) ⇒ Pr. 180 to Pr. 187 (input terminal function selection) (Refer to page 149.)
- Starting speed setting ⇒ Pr. 13 "starting speed" (Refer to page 86.)

Operation selection functions 1 (Pr. 17 to Pr. 37)

3.6.5 Regenerative brake duty (Pr. 30, Pr. 70 speed torque position)

- Use the optional "high power factor converter (MT-HC) or power regeneration converter (MT-RC)" to reduce harmonics, improve the power factor, or continuously use the regenerative mode.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------------------|-----------------|---------------|---|
| 30 | Regenerative function selection | 0 | 0 | No regenerative function |
| | | | 1 | When using the brake unit (MT-BU5), The high power factor converter (MT-RC) |
| | | | 2 | When using the high power factor converter (MT-HC) |
| 70 | Special regenerative brake duty | 0% | 0 to 10% | Extended mode |

<Setting>

- When using the brake unit (MT-BU5)
 - Set "1" in Pr. 30.
 - At this time, set the regenerative brake duty to 10% (Pr.70).
- When using the high power factor converter (MT-RC)
 - Set "1" in Pr. 30.
 - Set "0%" in Pr. 70.
- When using the high power factor converter (MT-HC)
 - Set "2" in Pr. 30.
 - Use any of Pr. 180 to Pr. 186 to assign the following signals to the contact input terminals.
 - X10: MT-HC connection (inverter operation enable signal) (Note3)
To make protective coordination with the high power factor converter (MT-HC), use the inverter operation enable signal to shut off the inverter output. Enter the RDY signal of the high power factor converter.
 - X11: MT-HC connection (instantaneous power failure detection signal)
When the computer link inboard option (FR-A5NR) is used and the setting is made to hold the pre-instantaneous power failure mode, use this signal to hold that mode. Enter the instantaneous power failure detection signal of the high power factor converter.
 - The Pr. 70 setting is made invalid.
Set "10" and "11" in any of Pr. 180 to Pr. 186 to allocate the terminals used to input the X10 and X11signals.

CAUTION

Set "10" and "11" in any of Pr. 180 to Pr. 183 and Pr. 187 to assign the terminals used to input the X10 and X11 signals.

WARNING

 The value set in Pr. 70 must not exceed the setting of the brake resistor used. Otherwise, the resistor can overheat.

REMARKS

- Pr. 70 "regenerative brake duty" indicates the %ED of the built-in brake transistor operation.

Related parameters

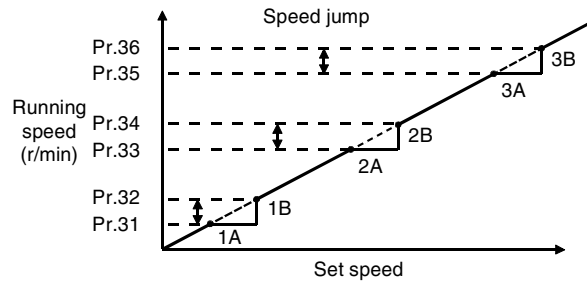
- X10, X11 signal terminal assignment ⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)

CAUTION

Changing the terminal assignment with any of Pr. 180 to 183 and Pr. 187 may affect the other functions. Check the functions of the corresponding terminals before making setting.

3.6.6 Speed jump (Pr. 31 to Pr. 36) speed torque)

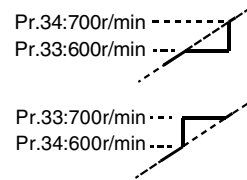
When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonance occurrence speeds to be jumped. Up to three areas may be set, with the jump speeds set to either the top or bottom point of each area. The value set to 1A, 2A or 3A is a jump point and operation is performed at this speed.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------|-----------------|----------------------|---|
| 31 | Speed jump 1A | 9999 | 0 to 3600r/min, 9999 | • 9999: Function invalid • Extended mode |
| 32 | Speed jump 1B | 9999 | 0 to 3600r/min, 9999 | |
| 33 | Speed jump 2A | 9999 | 0 to 3600r/min, 9999 | |
| 34 | Speed jump 2B | 9999 | 0 to 3600r/min, 9999 | |
| 35 | Speed jump 3A | 9999 | 0 to 3600r/min, 9999 | |
| 36 | Speed jump 3B | 9999 | 0 to 3600r/min, 9999 | |

<Setting>

- To fix the speed at 600r/min between Pr. 33 and Pr. 34 (600r/min and 700r/min), set 600r/min in Pr. 33 and 700r/min in Pr. 34.
- To jump to 700r/min between 600r/min and 700r/min, set 700r/min in Pr. 33 and 600r/min in Pr. 34.



CAUTION

During acceleration/deceleration, the running speed within the set area is valid.

REMARKS

If the speed jump setting ranges overlap, a write disable error "Err" appears.

3.6.7 Speed display (Pr. 37, Pr. 144) speed torque position)

The units of the running speed monitor display of the PU (FR-DU04-1/FR-PU04V), the running speed/frequency setting in the PU operation mode, and the parameter setting unit used for frequency setting can be changed from the frequency to the motor speed or machine speed.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--------------------------|-----------------|-------------------|-----------------------|
| 37 | Speed display | 0 | 0 | Output speed |
| | | | 1 to 9998 | Extended mode |
| 144 | Speed setting switchover | 0 | 0, 2, 4, 6, 8, 10 | Number of motor poles |

Operation selection functions 1 (Pr. 17 to Pr. 37)

<Setting>

- To display the machine speed, set in Pr. 37 the machine speed for 1500r/min operation.
- To display the motor frequency, set the number of motor poles (2, 4, 6, 8, 10) in Pr. 144.
- When the running speed monitoring has been selected, the parameter setting unit and the running speed setting in the PU operation mode depend on the combination of the Pr. 37 and Pr. 144 settings as indicated below:

| Pr. 37 | Pr. 144 | Running Speed Monitor | Preset Speed Monitor | Output Frequency Monitor | Running Speed Setting/Pr. Setting |
|-----------|---------|-------------------------|-------------------------|--------------------------|-----------------------------------|
| 0 | 0 | r/min | r/min | Hz Pr. 81, Pr. 454 | r/min |
| | 2 to 10 | Hz Pr. 144 | Hz Pr. 144 | Hz Pr. 144 | Hz Pr. 144 |
| 1 to 9998 | 0 | Machine speed Pr. 37 | Machine speed Pr. 37 | Hz Pr. 81, Pr. 454 | r/min |
| | 2 to 10 | Machine speed Pr. 37 | Machine speed Pr. 37 | Hz Pr. 81, Pr. 454 | Machine speed Pr. 37 |

CAUTION

1. When Pr. 37 and Pr. 144 are combined to select the Hz setting, the number of poles set in Pr. 144 is used to calculate the frequency, independently of the number of motor poles (Pr. 81, Pr. 454) used for control.
Note this when the number of motor poles (Pr. 81, Pr. 454) differs from Pr. 144.
2. When the speed setting has been selected, operation is performed at the synchronous speed.
When 4 poles and 60Hz are set, operation is performed at 1800r/min. For V/F control, the output frequency is 60Hz.
3. To change the PU main monitor (PU main display) or PU level meter (PU level display), refer to Pr. 52 and Pr. 53.
4. As the operation panel display is 4 digits, "-- --" is displayed when the monitored value exceeds "9999".

CAUTION

-  **Make sure that the settings of the running speed and number of motor poles are correct. Otherwise, the motor might run at extremely high speed, damaging the machine.**

Related parameters

- PU main monitor changing ⇒ Pr. 52 "DU/PU main display data selection" (Refer to page 99.)
- PU level meter changing ⇒ Pr. 53 "PU level display data selection" (Refer to page 99.)
- Setting of number of motor poles ⇒ Pr. 81 "number of motor poles", Pr. 454 "number of second motor poles" (Refer to page 121.)

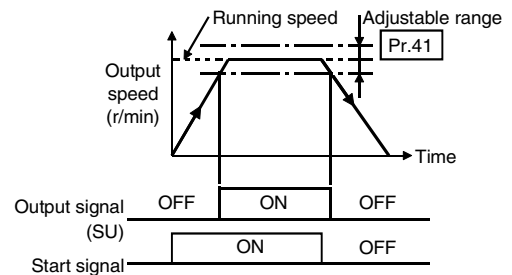
3.7 Output terminal functions (Pr. 41 to Pr. 50)

3.7.1 Up-to-speed sensitivity (Pr. 41 speed)

You can adjust the ON range of the up-to-speed signal (SU) output when the output speed reaches the running speed.

This parameter can be used to confirm that the running speed has been reached and used as the operation start signal etc. for related equipment.

- Under PLG vector control: Actual motor speed (feedback value) is adjusted.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------------|-----------------|---------------|--------------------|
| 41 | Up-to-speed sensitivity | 10% | 0 to 100% | Extended parameter |

REMARKS

- Assign functions to the terminals DO1 to DO3 and ABC to use the SU signal. The SU signal is assigned to the terminal DO2 when shipped from the factory. Use any of Pr. 190 to Pr. 192 and Pr. 195 to change the terminal functions. Changing the terminal assignment with any of Pr. 190 to Pr. 192 and Pr. 195 may affect the other functions. Check the functions of the corresponding terminals before making setting. (Refer to page 151.)
- For V/F control, operation is performed at the speed converted from the output frequency.

Related parameters

- SU signal terminal assignment ⇒ Set "1" in any of Pr. 190 to Pr. 192 and Pr. 195 (output terminal function selection) (Refer to page 151.)

3.7.2 Speed detection (Pr. 42, Pr. 43, Pr. 50, Pr. 116 speed torque position)

When the speed reaches or exceeds the setting, the output speed detection signal (FU, FU2, FU3 signal) or speed detection signal (FB, FB2, FB3 signal) is output.

- This function can be used for electromagnetic brake operation, open signal, etc.
- You can also set speed detection used exclusively for reverse rotation.
- This function is effective for changing the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation, etc.
 - Under PLG vector control: FB signal is the detected speed of the actual motor speed (feedback value)

| Parameter | Name | Factory Setting | Setting Range | Remarks | |
|-----------|--------------------------------------|--|----------------------|---------------------|------------------------------|
| 42 | Speed detection | 300r/min | 0 to 3600r/min | Extended parameters | |
| 43 | Speed detection for reverse rotation | 9999 | 0 to 3600r/min, 9999 | | 9999: Same as Pr. 42 setting |
| 50 | Second speed detection | 750r/min | 0 to 3600r/min | | |
| 116 | Third speed detection | Japanese version: 1500r/min NA version: 1800r/min | 0 to 3600r/min | | |

(1) Signal operation

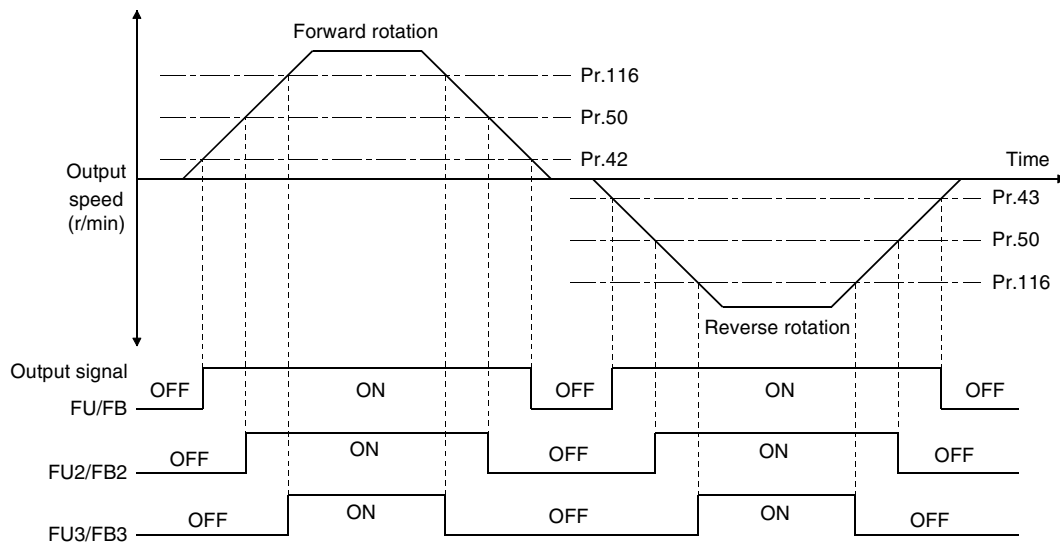
The FU, FU2 and FU3 signals function under speed/V/F control. They do not function under torque/position control.

| | FU | FB |
|------------------|--|--------------------|
| Compared signals | Speed command value | Actual motor speed |
| FU/FB signal | Forward rotation: On when speed is equal to or higher than in Pr. 42 Reverse rotation: On when speed is equal to or higher than in Pr. 43 | |
| FU2/FB2 signal | On when speed is equal to or higher than in Pr. 50 (both forward and reverse) Off when speed is lower than in Pr. 50 (both forward and reverse) | |
| FU3/FB3 signal | On when speed is equal to or higher than in Pr. 116 (both forward and reverse) Off when speed is lower than in Pr. 116 (both forward and reverse) | |

Output terminal functions (Pr. 41 to Pr. 50)

REMARKS

For V/F control, on/off control is exercised at the speed converted from the output frequency. (The detection actions of the FU and FB signals are the same.)



REMARKS

The speed command value indicates the last speed command value given after acceleration/deceleration processing.

CAUTION

- Assign functions to the terminals DO1 to DO3 and ABC to use the FU, FU2, FU3 and FB, FB2, FB3 signals. Use any of Pr. 190 to Pr. 192 and Pr. 195 to change the terminal functions. Changing the terminal assignment with Pr. 190 to Pr. 192 and Pr. 195 may affect the other functions. Check the functions of the corresponding terminals before making setting.
- The speed detection signal turns off when an inverter alarm occurs or when the reset terminal (MRS, RES signal) turns on.
- When any parameter setting is "0", the corresponding signal turns on as soon as the start signal turns on.

Related parameters

- FB, FB2, FB3, FU, FU2, FU3 signal terminal assignment ⇒ Pr. 190 to Pr. 192, Pr. 195 (output terminal function selection) (Refer to page 151.)

Pr. 44, Pr. 45 ➔ Refer to Pr. 7, Pr. 8 (page 81)

Pr. 50 ➔ Refer to Pr. 42, Pr. 43 (page 97)

3.8 Display functions 1 (Pr. 52 to Pr. 56)

3.8.1 Monitor display/DA1, DA2 terminal function selection (Pr. 52 to Pr. 54, Pr. 158 (speed torque position))

During operation, you can select the signals shown on the operation panel (FR-DU04-1)/parameter unit (FR-PU04V) main display screen and on the parameter unit (FR-PU04V) level meter and the signals output to the DA1 and DA2 terminals.

- There are two analog output DA1 and DA2 terminals.
Select the signals using Pr. 54 and Pr. 158.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------------|-----------------|---|---------------|
| 52 | DU/PU main display data selection | 0 | 0, 5 to 12, 17 to 20, 23, 24, 32 to 35, 38, 100 (5 to 12 are invalid for FR-PU04V) | Extended mode |
| 53 | PU level display data selection | 1 | 0 to 3, 5 to 12, 17, 18 | |
| 54 | DA1 terminal function selection | 1 | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | |
| 158 | DA2 terminal function selection | 1 | 1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36 | |

<Setting>

Any of the following signals can be monitored by parameter setting.
The signals marked × cannot be selected for monitoring.

| Signal Type | Display Unit | Parameter Settings | | | | | ± Output | Full-Scale Value of the Level Meter Connected to DA1 and DA2 | Description |
|--------------------------|--------------|--------------------|-----------------|----------------|-----------------------------|-----------------------------|-------------------------------------|---|-------------|
| | | Pr. 52 | Pr. 53 | Pr. 54 | Pr. 158 | | | | |
| | | DU LED | PU main monitor | PU level meter | DA1 terminal 12 bits (±10V) | DA2 terminal 12 bits (+10V) | | | |
| No display | — | × | × | 0 | × | | — | When "0" is set in Pr. 53, the level meter of the parameter unit is not displayed. | |
| Speed | 0.1 r/min | 0/100 | 0/100 | 1 | 1 | ○ | Pr. 55 | Vector control Speed feedback value from PLG | |
| | | | | | | | | V/F control Speed calculated from output frequency | |
| Output current | 0.1A | 0/100 | 0/100 | 2 | 2 | × | Pr. 56 | The output current is displayed as effective value. | |
| Output voltage | 0.1V | 0/100 | 0/100 | 3 | 3 | × | 400V/800V | The output voltage is displayed as effective value. | |
| Alarm display | — | 0/100 | 0/100 | × | × | × | — | — | |
| Set speed | 0.1 r/min | 5 | *2 | 5 | 5 | × | Pr. 55 | Under speed control, the current speed setting is displayed. 0r/min under position control. | |
| Output frequency | 0.01 Hz | 6 | *2 | 6 | 6 | ○ | The frequency converted from Pr. 55 | The output frequency is displayed. | |
| Motor torque | 0.1% | 7 | *2 | 7 | 7 | ○ | Pr. 866 | The output torque is displayed. The ratio to the rated torque is displayed. When the DA1 output monitor is used, a positive voltage is output during forward driving and reverse regeneration and a negative voltage is output during reverse driving and forward regeneration. | |
| Converter output voltage | 0.1V | 8 | *2 | 8 | 8 | × | 400V/800V | DC bus voltage is displayed. | |

Display functions 1 (Pr. 52 to Pr. 56)

| Signal Type | Display Unit | Parameter Settings | | | | | ± Output | Full-Scale Value of the Level Meter Connected to DA1 and DA2 | Description |
|---|-------------------|--------------------|-----------------|----------------|-----------------------------|-----------------------------|-------------------------------|---|-------------|
| | | Pr. 52 | | Pr. 53 | Pr. 54 | Pr. 158 | | | |
| | | DU LED | PU main monitor | PU level meter | DA1 terminal 12 bits (±10V) | DA2 terminal 12 bits (+10V) | | | |
| Regenerative brake duty | 0.1% | 9 | *2 | 9 | 9 | × | Pr. 70 | The brake resistor duty is displayed. | |
| Electronic overcurrent protection load factor | 0.1% | 10 | *2 | 10 | 10 | × | Thermal relay operation level | The thermal relay load factor is displayed. | |
| Output current peak value | 0.01A | 11 | *2 | 11 | 11 | × | Pr. 56 | The peak value of the output voltage is displayed as effective value. | |
| Converter output voltage peak value | 0.1V | 12 | *2 | 12 | 12 | × | 400V/800V | The peak value of DC bus voltage is displayed. | |
| Input terminal status | — | × | *2 | × | × | × | — | — | |
| Output terminal status | — | × | *2 | × | × | × | — | — | |
| Load meter *1 | 0.1% | 17 | 17 | 17 | 17 | ○ | Pr. 866 | The load meter is output. | |
| Motor excitation current | 0.01A | 18 | 18 | 18 | 18 | × | Pr. 56 | Pre-excitation current is displayed. | |
| Position pulse | — | 19 | 19 | × | × | × | — | The position of the motor output shaft is monitored. | |
| Cumulative operation time | 1h | 20 | 20 | × | × | × | — | Cumulative operation time since the inverter shipment (power on time) is displayed. (Minimum increment is Hr) | |
| Reference voltage output | — | × | × | × | 21 | × | — | The voltage of DA1 and DA2 at full-scale is output | |
| Actual operation time | 1h | 23 | 23 | × | × | × | — | The inverter running time is accumulated. (The time during a stop is not accumulated.) It is cleared using Pr. 171 "actual operation hour meter clear". | |
| Motor load factor | 0.1% | 24 | 24 | × | × | × | — | The load factor to the rated motor capacity is displayed. | |
| Torque command*1 | 0.1% | 32 | 32 | × | 32 | ○ | Pr. 866 | The torque command value is displayed. | |
| Torque current command*1 | 0.1% | 33 | 33 | × | 33 | ○ | Pr. 866 | The torque current command value is displayed. | |
| Motor output *1 | 0.01 kW (0.01 HP) | 34 | 34 | × | 34 | ○ | Rated motor current | The machine output of the motor shaft end is displayed. | |
| Feedback pulse | — | 35 | 35 | × | × | × | — | The number of pulses fed back during 1 sampling is displayed. Display range is 0 to 99999 pulses. Sampling time for the following number of PLG pulses are: 1.0s for 1500 pls/rev or less; 0.5s for 1501 to 3200 pls/rev; and 0.25s for 3201 to 4096 pls/rev. | |

| Signal Type | Display Unit | Parameter Settings | | | | | ± Output | Full-Scale Value of the Level Meter Connected to DA1 and DA2 | Description |
|--|--------------|--------------------|-----------------|----------------|-----------------------------|-----------------------------|----------|--|-------------|
| | | Pr. 52 | | Pr. 53 | Pr. 54 | Pr. 158 | | | |
| | | DU LED | PU main monitor | PU level meter | DA1 terminal 12 bits (±10V) | DA2 terminal 12 bits (+10V) | | | |
| Torque monitor (driving/regenerative polarity switchover) *1 | — | × | × | × | 36 | ○ | Pr. 866 | The output torque is monitored. When the DA1 output monitor is used, a positive voltage is output during forward and reverse driving and a negative voltage is output during forward and reverse regeneration. | |
| Trace status | — | 38 | 38 | × | × | × | — | The trace status is displayed. 0: Stop 1: During pre-trigger 2: Waiting for trigger 3: During trace 4: Trace completion 101: During data output 102: Data output completion | |

CAUTION

- *1 When DA1 (Pr. 54) is selected, high response output is available. When DA2 (Pr. 158) is selected, average value is output.
- *2 Select this monitor in "Others" of the FR-PU04V (option).

When "100" is set in Pr. 52, the monitored values during stop and during operation differ as indicated below. (The LED on the left of r/min flickers during stop, and is lit during operation.)

| | Pr.52 | | |
|----------------|----------------------------------|-------------|------------------|
| | 0 | 100 | |
| | During operation/ during stop | During stop | During operation |
| Speed | Speed | Set speed | Speed |
| Output current | Output current | | |
| Output voltage | Output voltage | | |
| Alarm display | Alarm display | | |

REMARKS

- During a reset, the values are the same as at a stop. During offline auto tuning, the tuning status monitor has priority.
- By setting "0" in Pr. 52, the monitoring of output speed to alarm display can be selected in sequence by the SHIFT key.
- *Speed setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04V).
- When Pr. 52 = any of "17, 18 and 24", the output current monitor changes to the set monitored data. When Pr. 52 = any of "19, 20, 23 and 32 to 35, 38", the output voltage monitor changes to the set monitored data.

CAUTION

1. The cumulative operation time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel (FR-DU04-1) is used, more than 9999h is displayed as "----". Use the parameter unit (FR-PU04V) to confirm more than 9999h.
2. The cumulative operation time and actual operation time is not accumulated unless the inverter is run continuously for more than one hour.
3. When the operation panel (FR-DU04-1) is used, the display unit is r/min, V or A only.

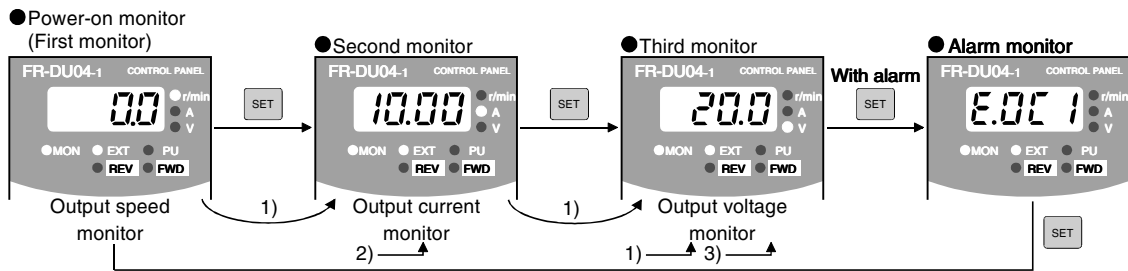
Display functions 1 (Pr. 52 to Pr. 56)

REMARKS

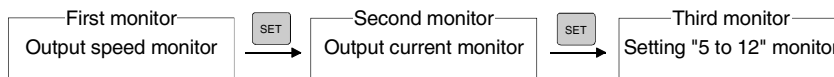
Where to monitor the data set in Pr. 52 varies with the setting.

Factory setting

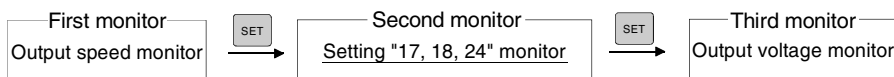
* The monitor displayed at powering on is the first monitor. To set the first monitor, press **SET** for more than 1.5s.



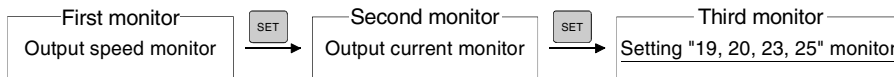
1) Setting is any of "5 to 12" (Displayed in the third monitor position)



2) Setting is any of "17, 18 and 24" (Displayed instead of output current monitor)



3) Setting is any of "19, 20, 23, 25" (Displayed instead of output voltage monitor)

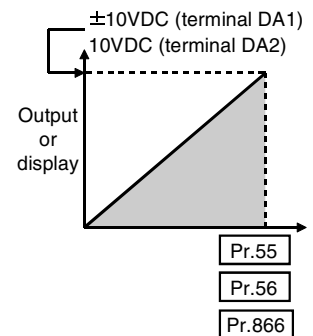


Related parameters

- Speed monitoring reference setting ⇒ Pr. 55 (Refer to page 102.)
- Current monitoring reference setting ⇒ Pr. 56 (Refer to page 102.)
- Torque monitoring reference setting ⇒ Pr. 866 (Refer to page 102.)
- Output filter of terminal DA1 ⇒ Pr. 867 (Refer to page 182.)

3.8.2 Monitoring reference (Pr. 55, Pr. 56, Pr. 866 speed torque position)

Set the value that is referenced when the output speed or output current is selected for the DA1 and DA2 terminals and PU level meter display.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------------|--------------------------------|----------------|---------------|
| 55 | Speed monitoring reference | Japanese version: 1500r/min | 0 to 3600r/min | Extended mode |
| | | NA version: 1800r/min | | |
| 56 | Current monitoring reference | Inverter rated output current | 0 to 3600A | |
| 866 | Torque monitoring reference | 150% | 0 to 400% | |

3.9 Automatic restart (Pr. 57, Pr. 58)

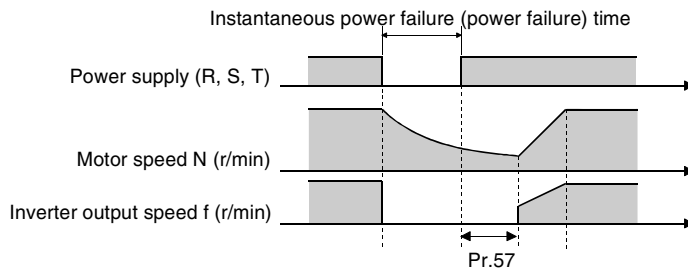
3.9.1 Automatic restart after instantaneous power failure (Pr. 57 speed torque, Pr. 58, Pr. 162 to Pr. 165)

You can restart the inverter without stopping the motor (with the motor coasting) when power is restored after an instantaneous power failure.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|---------------|--------------------------------------|
| 57 | Restart coasting time | 9999 | 0 | Set to 0.1s. |
| | | | 0.1 to 30s | |
| | | | 9999 | 9999: No restart |
| 58 | Restart cushion time | 1.0s | 0 to 60s | |
| 162 | Automatic restart after instantaneous power failure selection | 0 | 0 | 0: With speed search |
| | | | 1 | 1: Without speed search |
| | | | 10 | 10: Speed search initiated per start |
| 163 | First cushion time for restart | 0s | 0 to 20s | Valid for V/F control |
| 164 | First cushion voltage for restart | 0% | 0 to 100% | |
| 165 | Restart current restriction level | 150% | 0 to 200% | |

When vector control is exercised

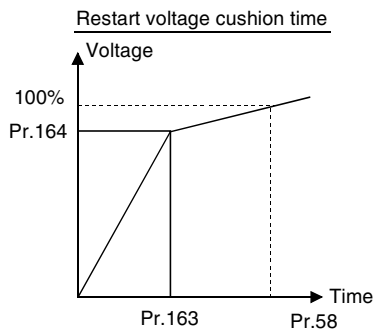
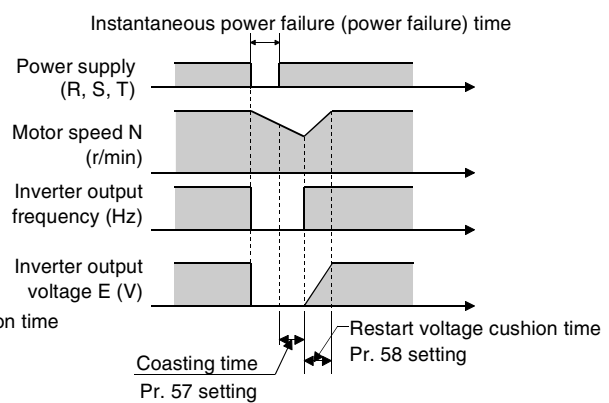
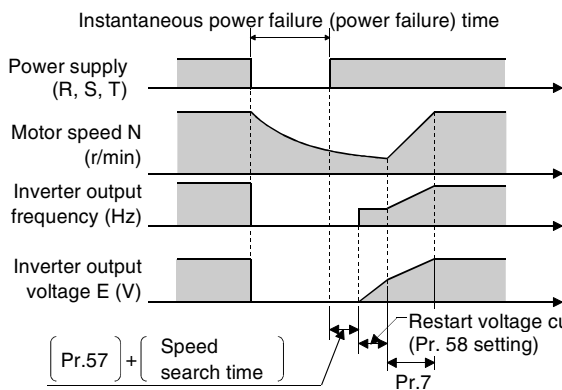
(The Pr. 162 setting "0,1" is invalid under vector control.)



* 0r/min when search speed is 15r/min or less.
Pr.58 is invalid under vector control

Pr. 162 = 0 (with speed search) V/F

Pr. 162 = 1 (without speed search) V/F



<Setting>

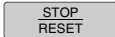
Refer to the above figures and following table to set the corresponding parameters.

| Parameter Number | Setting | Description |
|------------------|------------|---|
| 162 | 0 | With speed search Speed search is made after detection of an instantaneous power failure. |
| | 1 | Without speed search Independently of the motor coasting speed, the output voltage is gradually increased with the speed kept as preset, i.e. a reduced voltage starting system. |
| | 10 | Speed search is made on startup. The motor starts running at the speed detected by the PLG under vector control. |
| 57 | 0 | 0.1s coasting time (5.0s coasting time at V/F control) |
| | 0.1 to 30s | Waiting time for inverter-triggered restart after power is restored from an instantaneous power failure. (Set this time between 0.1s and 5s according to the inertia moment (J) and torque magnitude.) |
| | 9999 | Without restart |
| 58 | 0 to 60s | Normally the motor may be run with the factory settings, but restart or voltage cushion time are adjustable according to the load (inertia moment, torque) magnitude using Pr. 58, Pr. 163, or Pr. 164. Also the output frequency is reduced when the current flow exceeds the Pr. 165 setting. Invalid for vector control. |
| 163 | 0 to 20s | |
| 164 | 0 to 100% | |
| 165 | 0 to 200% | |

CAUTION

1. When restart operation is selected, UVT and IPF among the alarm output signals are not output at occurrence of an instantaneous power failure.
2. When "0" is set in Pr. 162 under V/F control, the DC injection brake is operated instantly on detection of restarting speed. Therefore, if the inertia moment (J) of the load is small, the speed may reduce.
3. When Pr. 162 = "1", the output speed before an instantaneous power failure is stored and output at the time of restart. If the power of the inverter control circuit is lost, the output speed before an instantaneous power failure cannot be stored and the inverter will start at 0r/min.
4. The SU and FU signals are not output during restart but are output after the restart cushion time has elapsed.
5. The restart coasting time in Pr. 57 does not include the speed search time (300ms maximum). There is no delay time due to speed search when speed search is not made or vector control is exercised. (excluding the inverter starting time)
6. V/F control
 - When the inverter capacity is two rank or more larger than the motor capacity when Pr. 162="0" (with speed search), 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.)
 - Recommended settings for Pr. 57 are 5.0s.

⚠ CAUTION

- When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the restart coasting time has elapsed) after occurrence of an instantaneous power failure. Stay away from the motor and machine.
When you have selected automatic restart after instantaneous power failure, apply the supplied CAUTION seals, provided for the Instruction Manual (basic), in easily visible places.
- The motor coasts to a stop as soon as the start signal is turned off or  is pressed during automatic restart cushion time.

Related parameters

- Setting of alarm output signal for executing automatic restart after instantaneous power failure ⇒ Pr. 65 "retry selection" (Refer to page 110.)

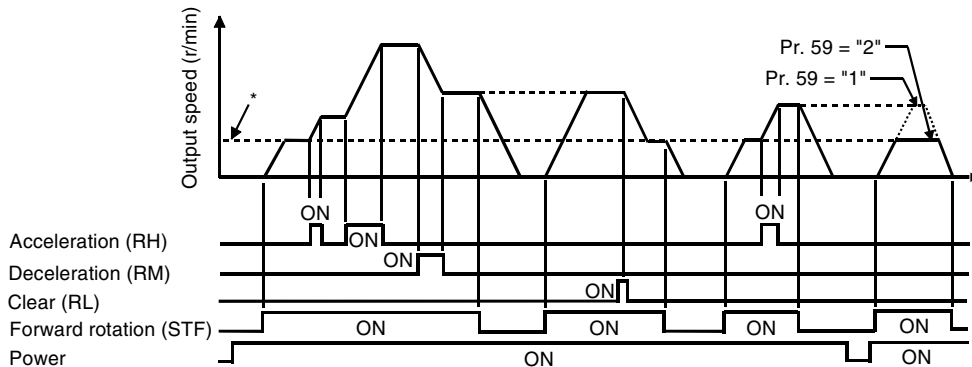
3.10 Additional functions (Pr. 59)

3.10.1 Remote setting function selection (Pr. 59 speed torque)

Even if the operation panel is located away from the control box, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

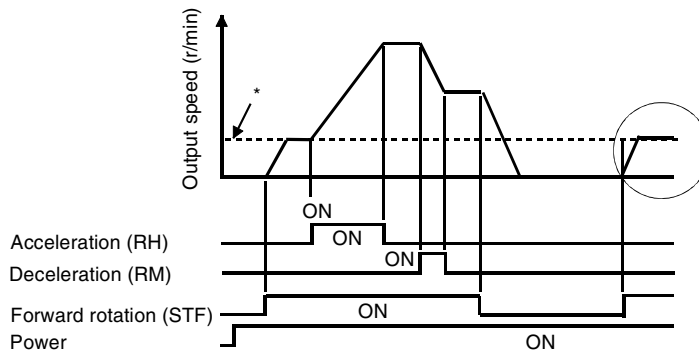
| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------------|-----------------|---------------|---|
| 59 | Remote setting function selection | 0 | 0 | Remote function not activated. |
| | | | 1 | Remote function activated: Stored into E ² PROM. |
| | | | 2 | Remote function activated: Not stored into E ² PROM. |
| | | | 3 | Remote function activated: Not stored into E ² PROM. (Turn on STF (STR) to clear remote setting) |
| | | | | Extended mode |

(1) Pr. 59 = "1" or "2"



*External operation speed or PU operation speed other than multi-speed

(2) Pr. 59 = "3"



*External operation speed or PU operation speed other than multi-speed

REMARKS

- By merely setting this parameter, you can use the acceleration, deceleration and setting clear functions of the motorized speed setter (FR-FK).
- When the remote function is used, the output speed of the inverter can be compensated for as follows:
For external operation, speed set by RH/RM operation plus external analog speed command
For PU operation mode, speed set by RH/RM operation plus DU/PU digital setting speed
- When any value other than 0 is set in Pr. 59, multi-speed operation is invalid. (Refer to page 90.)
- Speed compensation by terminal 1 is made invalid when speed command by terminal 2 is selected.
Set "1" in Pr. 28 "multi-speed input compensation" to enable speed compensation of terminal 1 (Pr. 28 = "0").

<Setting>

Use Pr. 59 to select whether the remote setting function is used or not and whether the speed setting storage function* in the remote setting mode is used or not. When "1" or "2" is set in Pr. 59, the functions of signals RH, RM and RL are changed to acceleration (RH), deceleration (RM) and clear (RL), respectively. Use Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection) to set signals RH, RM and RL.

* Speed setting storage function (Pr. 59 = "1")

This function stores the remotely-set speed (speed set by RH/RM operation) into memory. When power is switched off once, then on, operation is resumed with that output speed value.

<Speed setting storage conditions>

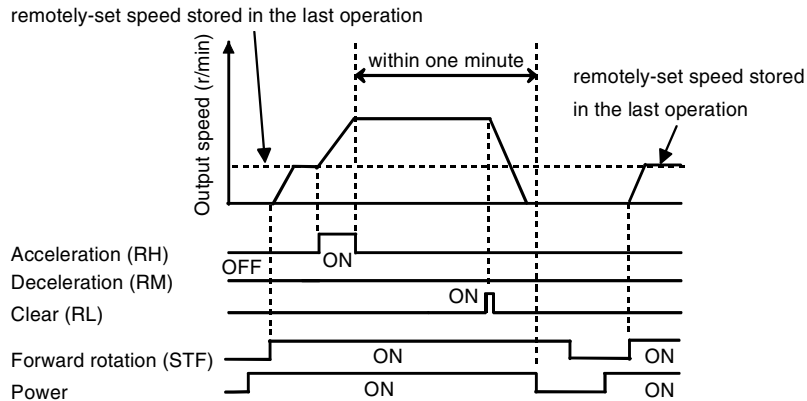
- Speed at which the start signal (STF or STR) turns off
- The remotely-set speed is stored every one minute after one minute has elapsed since turn off (on) of both the RH (acceleration) and RM (deceleration) signals. (The speed is written if the present speed value compared with the past speed value every one minute is different.) (The state of the RL signal dose not affect writing.)

REMARKS

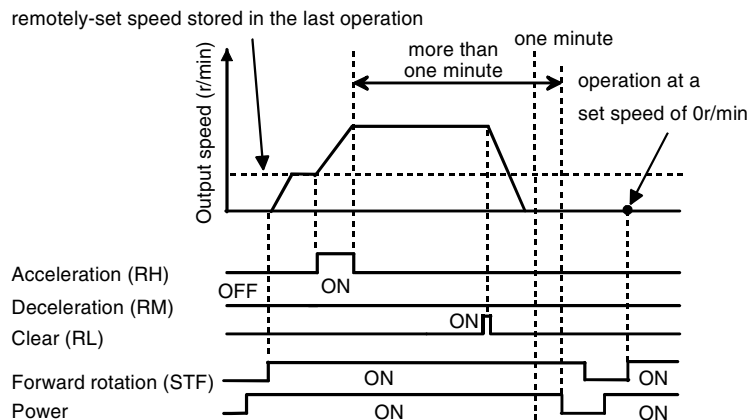
This function is invalid under jog operation and PID control operation.

Setting speed is "0"

Even when the remotely-set speed is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the remotely-set speed stored in the last operation if power is reapplied before one minute has elapsed since turn off (on) of both the RH and RM signals.



When the remotely-set speed is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the speed in the remotely-set speed cleared state if power is reapplied after one minute has elapsed since turn off (on) of both the RH and RM signals .



CAUTION

- **The speed can be varied by RH (acceleration) and RM (deceleration) between 0 and the maximum speed (Pr. 1 setting).**
- **When the acceleration or deceleration signal turns on, the set speed varies according to the slope set in Pr. 44 "second acceleration/deceleration time" or Pr. 45 "second deceleration time". The output speed acceleration/deceleration times are as set in Pr. 7 "acceleration time" and Pr. 8 "deceleration time", respectively. Therefore, the longer preset times are used to vary the actual output speed. (Refer to page 24 for the set speed and output speed.)**
- **If the start signal (STF or STR) is off, turning on the RH (acceleration) or RM (deceleration) signal varies the set speed.**

⚠ CAUTION

⚠ When selecting this function, re-set Pr. 1 "maximum speed" according to the machine.

Related parameters

- RH, RM, RL signal terminal assignment ⇒ Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)
- Maximum speed setting ⇒ Pr. 1 "maximum speed" (Refer to page 79.)
- Output speed acceleration/deceleration time ⇒ Pr. 7 "acceleration time", Pr. 8 "deceleration time" (Refer to page 81.)
- Time setting for acceleration/deceleration ⇒ Pr. 44 "second acceleration/deceleration time", Pr. 45 "second deceleration time" (Refer to page 81.)
- RH, RM, RL signal compensation ⇒ Pr. 28 "multi-speed input compensation" (Refer to page 90.)

3.11 Brake sequence (Pr. 60, Pr. 278 to Pr. 285)

3.11.1 Brake sequence function (Pr. 60, Pr. 278 to Pr. 285 speed)

The inverter automatically sets appropriate parameters for operation.

This function is used to output from the inverter the mechanical brake opening completion signal 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.

POINT

Set "7" or "8" in Pr. 60.

Set any of "0, 2 or 4" in Pr. 800 "control system selection" under external operation and set speed control. (Refer to page 169)

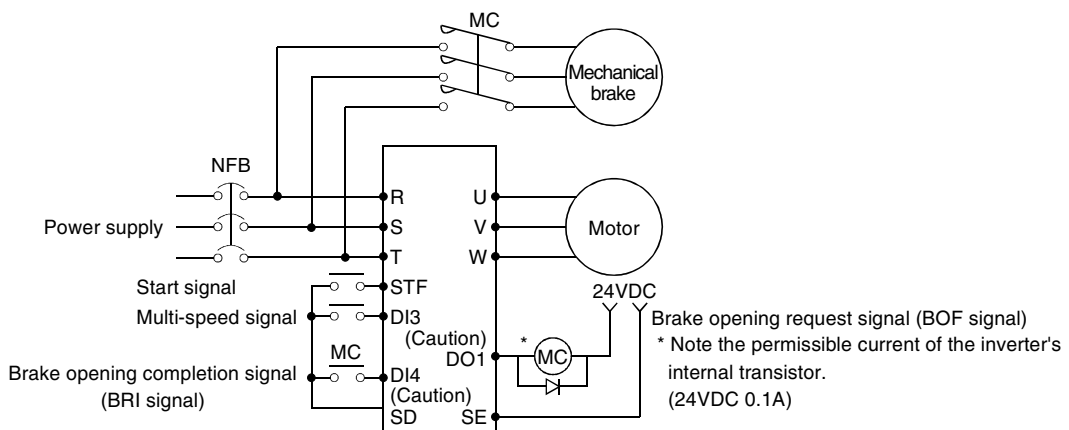
| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|---------------------|---------------|
| 60 | Intelligent mode selection | 0 | 0, 7, 8 | Extended mode |
| 278 | Brake opening speed | 20r/min | 0 to 900r/min | |
| 279 | Brake opening current | 130% | 0 to 200% | |
| 280 | Brake opening current detection time | 0.3s | 0 to 2s | |
| 281 | Brake operation time at start | 0.3s | 0 to 5s | |
| 282 | Brake operation speed | 25r/min | 0 to 900r/min | |
| 283 | Brake operation time at stop | 0.3s | 0 to 5s | |
| 284 | Deceleration detection function selection | 0 | 0, 1 | |
| 285 | Overspeed detection speed | 9999 | 0 to 900r/min, 9999 | |

CAUTION

When brake sequence mode is selected, automatic restart after instantaneous power failure is invalid.

(1) Wiring example

- Sink logic
- Pr.183=15
- Pr.190=20



CAUTION

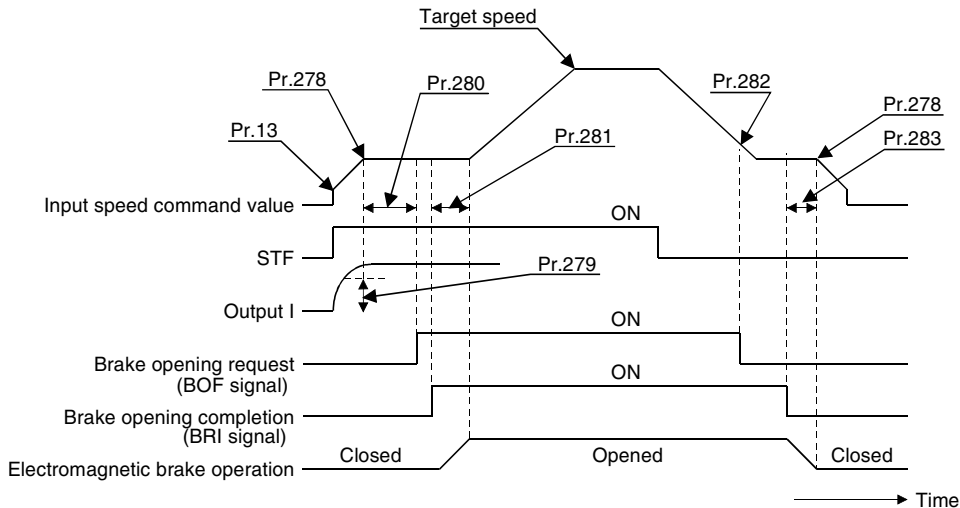
The input signal terminal used differs according to the parameter settings. (Refer to page 109.)

Brake sequence (Pr. 60, Pr. 278 to Pr. 285)

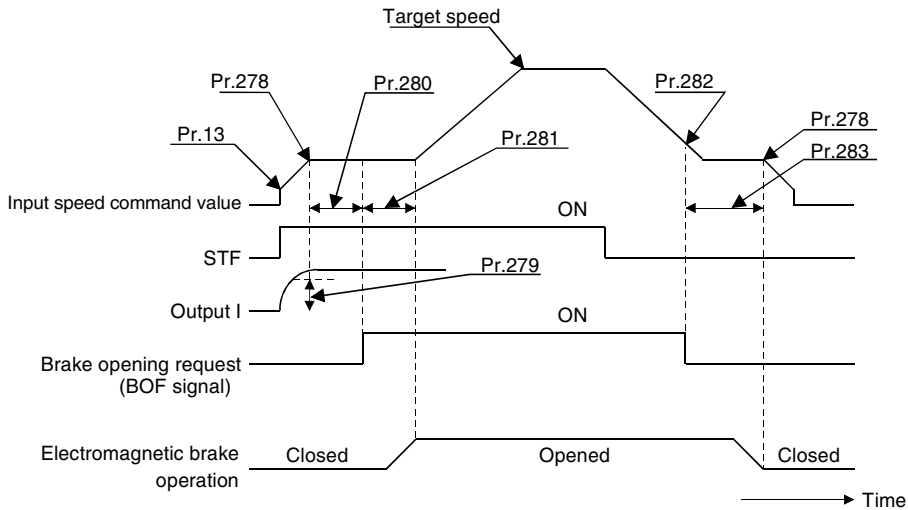
(2) Operation example

- At start: When the start signal is input to the inverter, the inverter starts running. When the internal speed command reaches the value set in Pr. 278 and the output current is not less 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 has elapsed after the brake opening completion signal (BRI) was input, the inverter increases the internal speed command to the set speed.
- At stop: When the speed has decreased to the speed set in Pr. 282, the brake opening request signal (BOF) is turned off. When the time set in Pr. 283 has elapsed after the brake operation confirmation signal (BRI) was input, the inverter output is switched off.
*If Pr. 60 = "8" (mechanical brake opening completion signal not input), this time is the time after the brake opening request signal is output.

1. Pr. 60 = "7" (brake opening completion signal input)



2. Pr. 60 = "8" (mechanical brake opening completion signal not input)



(3) Parameter setting

1. Set speed control in Pr.800 "control system selection". (Refer to page 169.)
2. Set "7 or 8" (brake sequence mode) in Pr. 60.
To ensure more complete sequence control, it is recommended to set "7" (brake opening completion signal input) in Pr. 60.

| Pr. 60 Setting | Operation Mode | Description | |
|----------------|-----------------------|--|---|
| 0 | Normal operation mode | — | |
| 7 | Brake sequence mode | With mechanical brake opening completion signal input | This function causes the inverter to output the mechanical brake operation timing signal for elevating application. |
| 8 | | Without mechanical brake opening completion signal input | For the function details and setting method, refer to Pr. 278 to Pr. 285 (brake sequence function). |

REMARKS

Even if the intelligent operation function has been selected, inputting the jog or RT (second function selection) signal during an inverter stop will switch to the normal operation and give priority to jog operation or second function selection.
After intelligent operation has been started, neither the jog signal nor the RT signal is accepted.

3. Refer to the following table and set the parameters.

| Parameter | Name | Setting Range | Description |
|-----------|---|---------------|---|
| 278 | Brake opening speed | 0 to 900r/min | Set the value higher than the Pr. 13 "starting speed". Setting is enabled only when Pr. 278 ≤ Pr. 282. |
| 279 | Brake opening current | 0 to 200% | Generally, set this parameter to about 50 to 90%. If the setting is too low, the load is liable to drop with gravity at start. Suppose that the rated inverter current is 100%. |
| 280 | Brake opening current detection time | 0 to 2s | Generally, set this parameter to about 0.1 to 0.3s. |
| 281 | Brake operation time at start | 0 to 5s | Pr. 60 = 7: Set the mechanical delay time until the brake is loosened. Pr. 60 = 8: Set the mechanical delay time until the brake is loosened + about 0.1 to 0.2s. |
| 282 | Brake operation speed | 0 to 900r/min | Generally, set the Pr. 278 setting + 1 to 2r/min to this parameter. Setting is enabled only when Pr. 282 ≥ Pr. 278. |
| 283 | Brake operation time at stop | 0 to 5s | Pr. 60 = 7: Set the mechanical delay time until the brake is closed + 0.1s. Pr. 60 = 8: Set the mechanical delay time until the brake is closed + about 0.2 to 0.3s. |
| 284 | Deceleration detection function selection | 0 | Deceleration is not detected. |
| | | 1 | If deceleration is not normal during deceleration operation, the inverter alarm (E.MB2) is provided to shut off the output and turn off the brake opening request signal (BOF). |
| 285 | Overspeed detection speed* | 0 to 900r/min | If (detected speed) - (output speed) > Pr. 285, the inverter alarm (E.MB1) is provided to shut off the output and turn off the brake opening request signal (BOF). |
| | | 9999 | Overspeed is not detected. |

* This function is valid during vector control.

CAUTION

When using this function, set the acceleration/deceleration time to 1s or longer.

(4) Setting terminals

The terminals must be assigned using Pr. 180 to Pr. 183 and Pr. 187 and Pr. 190 to Pr. 192 and Pr. 195.

| Signal | Brake Sequence Mode | |
|--------|---|--|
| | Pr. 60 = 7 (with mechanical brake opening completion signal) | Pr. 60 = 8 (without mechanical brake opening completion signal) |
| BOF | Brake opening request | Brake opening request |
| BRI | Brake opening completion signal | — |

CAUTION

1. The brake opening completion signal (BRI) is a parameter valid when Pr. 60 = 7.
2. Changing the terminal function using any of Pr. 180 to Pr. 183, Pr. 187, Pr. 190 to Pr. 192, and Pr. 195 may affect the other functions. Confirm the functions of the corresponding terminals before making setting. (Refer to page 149.)

Operation selection function 2 (Pr. 65 to Pr. 79)

(5) Protective functions

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 terminal).

On the operation panel (FR-DU04-1) LED or parameter unit (FR-PU04V) screen, the following errors are displayed:

| Error Display | Description |
|---------------|--|
| E.MB1 | (Detected speed) - (output speed) > Pr. 285 during vector control. (Overspeed detection function) |
| E.MB2 | Deceleration is not normal during deceleration operation (Use Pr. 284 to select this function.) (Except stall prevention operation) |
| E.MB3 | Brake opening request signal (BOF) turned on though the motor is at a stop. (Gravity drop prevention function) |
| E.MB4 | More than 2s after the run command (forward or reverse rotation) is input, the brake opening request signal (BOF) does not turn on. |
| E.MB5 | More than 2s after the brake opening request signal 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 | More than 2s after the brake opening request signal (BOF) turned off at a stop, the brake opening completion signal (BRI) does not turn off. |

3.12 Operation selection function 2 (Pr. 65 to Pr. 79)

3.12.1 Retry function (Pr. 65, Pr. 67 to Pr. 69) speed torque

When the inverter output is stopped by the protective function (major fault), this function causes the inverter to automatically reset itself to make a retry. You can select whether retry operation is to be performed or not, alarms reset for retry, number of retries made, and waiting time.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------------------------|-----------------|---------------------------|---------------|
| 65 | Retry selection | 0 | 0 to 5 | Extended mode |
| 67 | Number of retries at alarm occurrence | 0 | 0, 1 to 10, 101 to 110 | |
| 68 | Retry waiting time | 1s | 0 to 10s | |
| 69 | Retry count display erasure | 0 | 0 | |

<Setting>

- Use Pr. 65 to select the protective functions (major faults) to be activated for retries.

| Errors Reset for Retry | | Pr. 65 | | | | | | Remarks |
|---------------------------------|--------------|--------|---|---|---|---|---|---------|
| Error definition | Abbreviation | 0 | 1 | 2 | 3 | 4 | 5 | |
| Acceleration overcurrent | E.OC1 | ● | ● | | ● | ● | ● | |
| Constant-speed overcurrent | E.OC2 | ● | ● | | ● | ● | | |
| Deceleration overcurrent | E.OC3 | ● | ● | | ● | ● | ● | |
| Acceleration overvoltage | E.OV1 | ● | | ● | ● | ● | | |
| Constant-speed overvoltage | E.OV2 | ● | | ● | ● | ● | | |
| Deceleration overvoltage | E.OV3 | ● | | ● | ● | ● | | |
| Motor thermal relay | E.THM | ● | | | | | | |
| Transistor thermal relay | E.THT | ● | | | | | | |
| Instantaneous power failure | E.IPF | ● | | | | ● | | |
| Undervoltage | E.UVT | ● | | | | ● | | |
| Brake transistor | E.BE | ● | | | | ● | | |
| Earth (Ground) fault protection | E.GF | ● | | | | ● | | |
| Output phase failure | E.LF | | | | | | | |
| External thermal relay | E.OHT | ● | | | | | | |
| Stall prevention-triggered stop | E.OLT | ● | | | | ● | | |

| Errors Reset for Retry | | Pr. 65 | | | | | | Remarks |
|-----------------------------------|--------------|--------|---|---|---|---|---|----------------------|
| Error definition | Abbreviation | 0 | 1 | 2 | 3 | 4 | 5 | |
| Option alarm | E.OPT | ● | | | | ● | | |
| Option 1 alarm | E.OP1 | ● | | | | ● | | |
| Option 2 alarm | E.OP2 | ● | | | | ● | | |
| Option 3 alarm | E.OP3 | ● | | | | ● | | |
| Storage device alarm | E.PE | ● | | | | ● | | |
| PU disconnection | E.PUE | | | | | | | |
| Retry count excess | E.RET | | | | | | | |
| CPU error | E.CPU | | | | | | | |
| Fan stop | E.FAN | | | | | | | |
| Fin overheat | E.FIN | | | | | | | |
| Overspeed occurrence | E.OS | ● | | | | ● | | Under vector control |
| Speed deviation large | E.OSD | ● | | | | ● | | Under vector control |
| Encoder no-signal | E.ECT | | | | | | | Under vector control |
| Position error large | E.OD | ● | | | | ● | | Under vector control |
| Encoder A no-signal | E.ECA | | | | | | | Under vector control |
| MB1 | E.MB1 | ● | | | | ● | | Brake sequence |
| MB2 | E.MB2 | ● | | | | ● | | Brake sequence |
| MB3 | E.MB3 | ● | | | | ● | | Brake sequence |
| MB4 | E.MB4 | ● | | | | ● | | Brake sequence |
| MB5 | E.MB5 | ● | | | | ● | | Brake sequence |
| MB6 | E.MB6 | ● | | | | ● | | Brake sequence |
| MB7 | E.MB7 | ● | | | | ● | | Brake sequence |
| P24 short circuit | E.P24 | | | | | | | |
| P12 short circuit | E.P12 | | | | | | | |
| Circuit alarm (P5S short circuit) | E.CTE | | | | | | | |

* ● indicates the errors selected for retry.

- Use Pr. 67 to set the number of retries at alarm occurrence.

| Pr. 67 Setting | Number of Retries | Alarm Signal Output |
|----------------|--------------------|-------------------------|
| 0 | Retry is not made. | — |
| 1 to 10 | 1 to 10 times | Not output every time.* |
| 101 to 110 | 1 to 10 times | Output every time. |

* If the number of retries to be made is exceeded, "E_r E_T" (retry count excess) is displayed.

- Use Pr. 68 to set the waiting time from when an inverter alarm occurs until a retry is made in the range 0 to 10s.
- Reading the Pr. 69 value provides the cumulative number of successful restarts made by retries. Writing "0" erases the cumulative number of times.

CAUTION

- **The cumulative number in Pr. 69 is incremented by "1" when retry operation is regarded as successful, i.e. when normal operation is continued without the protective function (major fault) being activated during a period four times longer than the time set in Pr. 68.**
- **If the protective function (major fault) is activated consecutively within a period four times longer than the above waiting time, the operation panel may show data different from the latest data or the parameter unit (FR-PU04V) may show data different from the first retry data. The data stored as the error reset for retry is only that of the protective function (major fault) activated the first time.**
- **When an inverter alarm is reset by the retry function at the retry time, the accumulated data of the electronic thermal relay, etc. are not cleared. (Different from the power-on reset.)**

⚠ CAUTION

⚠ When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the predetermined time has elapsed) after occurrence of an alarm. When you have selected the retry function, apply the CAUTION seals provided for the Instruction Manual (basic) in easily visible places.

Pr. 70 ➡ Refer to Pr. 30 (page 94)

Operation selection function 2 (Pr. 65 to Pr. 79)

3.12.2 Applied motor (Pr. 71, Pr. 450 speed torque position)

Set the motor used.

When using an other manufacturer's motor, set "3" or "13" in Pr.71 and perform offline auto tuning. Refer to the Instruction Manual (basic) for the motor setting, etc.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|----------------------|----------------------|--|-------------------------------------|
| 71 | Applied motor | Japanese version: 30 | 0, 3 to 8, 10, 13 to 18, 20, 23, 24, 30, 33, 34 | |
| | | NA version: 10 | | |
| 450 | Second applied motor | 9999 | 0, 10, 30, 9999 | 9999 : Second applied motor invalid |

<Setting>

- Refer to the following table and set this parameter according to the motor used.

| Setting | Motor | Control Constants |
|---------|---|---|
| 0 | Mitsubishi standard motor (SF-LHA) | Inverter internal constants |
| 3 | Standard motor (Other manufacturer's motor) | Offline auto tuning |
| 4 | | Offline auto tuning data utilization |
| 5 | | Star connection direct input |
| 6 | | Delta connection direct input |
| 7 | | Star connection direct input + offline auto tuning |
| 8 | | Delta connection direct input + offline auto tuning |
| 10 | Japanese version Mitsubishi constant-torque motor (SF-HRCA) | Inverter internal constants |
| | NA version (only FR-A540L-NA) MARATHON constant-torque motor (Blue Max [®] 2000 : 1) | |
| 13 | Constant-torque motor (Other manufacturer's motor) | Offline auto tuning |
| 14 | | Offline auto tuning data utilization |
| 15 | | Star connection direct input |
| 16 | | Delta connection direct input |
| 17 | | Star connection direct input + offline auto tuning |
| 18 | | Delta connection direct input + offline auto tuning |
| 20 | Mitsubishi SF-VH vector motor | Inverter internal constants |
| 23 | | Offline auto tuning |
| 24 | | Offline auto tuning data utilization |
| 30 | Mitsubishi SF-THY dedicated motor | Inverter internal constants |
| 33 | | Offline auto tuning |
| 34 | | Offline auto tuning data utilization |

CAUTION

- Refer to page 121 for offline auto tuning.
- Refer to page 35 for details of setting conventional Mitsubishi motors and other manufacturer's motors.

CAUTION

 Set this parameter correctly according to the motor used.

REMARKS

- For online auto tuning, refer to the Instruction Manual (basic).

3.12.3 PWM carrier frequency selection (Pr. 72, Pr. 240 speed torque position)

By parameter setting, you can set whether to exercise the Soft-PWM control that changes the motor tone or select with or without long wiring mode.

- Soft-PWM control is a control system that changes the motor noise from a metallic tone into an unoffending tone.
- Surge voltage is suppressed regardless of wiring length in the long wiring mode. (When operating the 400V motor with wiring length of 40m(131.23feet) or longer, select long wiring mode.)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------------|-----------------|---------------|---------------|
| 72 | PWM frequency selection | 1 | 1 | Extended mode |
| 240 | Soft-PWM setting | 10 | 0, 1, 10, 11 | |

<Setting>

| Pr. 72 Setting | Description |
|----------------|-------------|
| 1 | 2.25kHz |

CAUTION

- 1. An increased PWM carrier frequency will decrease the motor sound but increase noise and leakage currents. Therefore, perform the reduction techniques. (Refer to page 11.)**

| Pr. 240 Setting | Description | | Remarks |
|-----------------|-------------|------------------|-------------------------------|
| | Soft-PWM | long wiring mode | |
| 0 | Invalid | Invalid | Carrier frequency is 2.25kHz. |
| 1 | Valid | Invalid | |
| 10 | Invalid | Valid | |
| 11 | Valid | Valid | |

CAUTION

- 1. When long wiring mode is made valid, torque reduces about 5% in the constant output region.**
- 2. The output voltage at rated frequency decreases by about 1.5V maximum (200V class)/about 3.0V maximum (400V class) during V/F control.**
- 3. Use an inverter duty motor for the 400V class. Refer to page 19 for inverter driving of the 400V class motor.**

3.12.4 Speed setting signal on/off selection (Pr. 73 speed torque)

You can select the override function to make main speed setting with the speed setting auxiliary terminal 1. Using Pr. 73, set the input specifications of terminals 1 and 2 and whether to use the override function or not.

POINT

- Set "0" in Pr. 807 "speed restriction selection". (Refer to page 172.)
- Set "0" in Pr. 868 "No.1 terminal function selection". (Refer to page 182.)
- Refer to Pr. 902 "speed setting No. 2 bias", Pr. 903 "speed setting No. 2 gain" for calibration. (Refer to page 189.)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|----------------------|-----------------|---------------|---------------|
| 73 | Speed setting signal | 0 | 0 | Extended mode |
| | | | 4 | |
| | | | 10 | |
| | | | 14 | |

| Pr. 73 Setting | Control Mode | Function | | Terminal 1 (0 to ±10V) | Terminal 2 (0 to 10V) ^{*3} |
|----------------|------------------|-----------------|---------------------|---|-------------------------------------|
| | | Override | Polarity reversible | | |
| 0 | Speed control | × | × | Addition auxiliary ^{*1} Speed command | Main speed setting |
| 4 | | ○ ^{*2} | × | Main speed setting | Override signal |
| 10 | | × | ○ | Addition auxiliary ^{*1} Speed command | Main speed setting |
| 14 | | ○ ^{*2} | ○ | Main speed setting | Override signal |
| 0 | Torque control | × | × | Addition auxiliary Speed restriction | Speed restriction |
| 4 | | ○ ^{*4} | × | Speed restriction | Override signal |
| 10 | | × | × | Addition auxiliary Speed restriction | Speed restriction |
| 14 | | ○ ^{*4} | × | Speed restriction | Override signal |
| 0, 4, 10, 14 | Position control | No function | | No function | No function |

*1:The value of terminal 1 (speed setting auxiliary input) is added to the main speed setting signal of terminal 2.

*2:When override has been selected, terminal 1 is for the main speed setting and terminal 2 for the override signal (50 to 150% at 0 to 10V). (Refer to page 155 for bias/gain adjustment.)

*3:When "30" or "31" is set in Pr. 128, terminal 2 acts as the PID set point function.

*4:When override has been selected, terminal 1 is for speed restriction and terminal 2 is for the override signal.

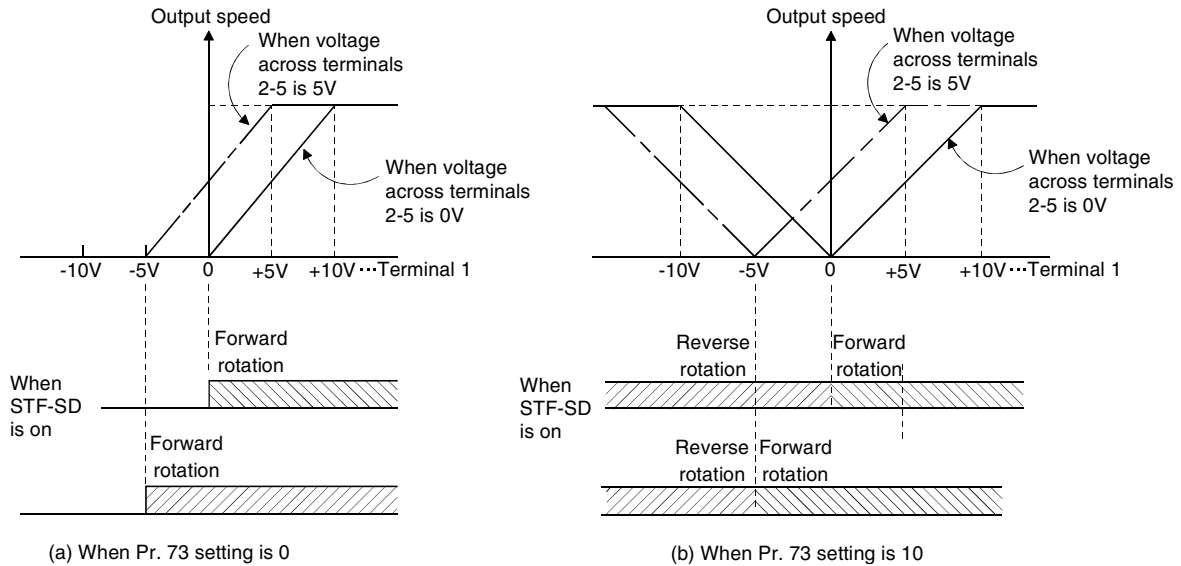
CAUTION

To change the maximum output speed at the input of the maximum speed command voltage, use the speed setting voltage gain, Pr. 903 (Pr. 905).

At this time, the command voltage 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.

- (a) When Pr. 73 "speed setting signal" value is "0"
The voltage across terminals 1-5 is added to the voltage signal (positive) across terminals 2-5. If the result of addition is negative, it is regarded as 0 and the motor comes to a stop.
- (b) When Pr. 73 "speed setting signal" value is "10"
The polarity reversible operation function is selected.
The voltage signal across terminals 1-5 is added to the voltage signal (positive) across terminals 2-5. A positive addition result turns the motor in the forward rotation direction (when the STF terminal turns on), or a negative result turns it in the reverse rotation direction (when the STF terminal turns on). The compensation signal of terminal 1 can also be added to the multi-speed setting.



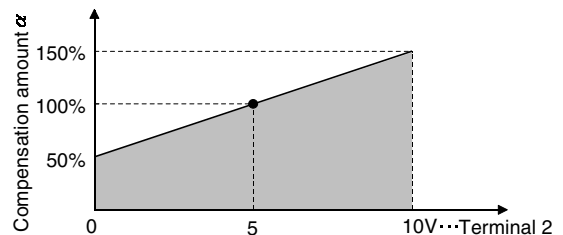
Auxiliary Input Characteristics

- 1) Multi-speed input compensation
By setting 1 in Pr. 28 "multi-speed input compensation selection" (factory setting 0), the speed from the auxiliary input terminal 1 is added when multi-speed operation is performed. (Refer to page 80.)

Inverter Output According to Start Signal and Auxiliary Input Terminal Polarity

| Pr. 73 Setting | Added Command Voltage | Start Signal Input | |
|----------------|-----------------------|--------------------|------------------|
| | | STF-SD | STR-SD |
| 0 | + | Forward rotation | Reverse rotation |
| | - | Stop | Stop |
| 10 | + | Forward rotation | Reverse rotation |
| | - | Reverse rotation | Forward rotation |

- 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.
By setting either "4 or 14" in Pr. 73, override allows the parameter-set multiple speeds and analog input across terminals 1-5 to be varied equally within the range 50% to 150% (The range can be increased with Pr. 252 and Pr. 253) by the analog signal input across terminals 2-5.



Override Setting Signal vs. Compensation Amount

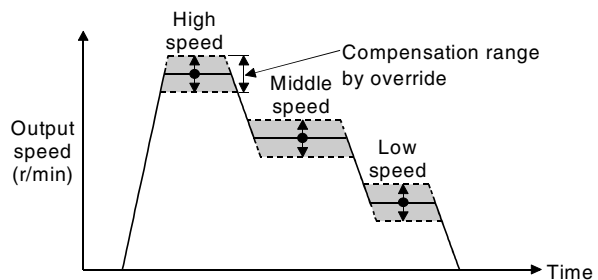
How to find each speed (N)

$$N = N_{pr.} \times \frac{\alpha}{100} \text{ [r/min]}$$

Npr.: Speed setting [r/min]

(Multiple speeds
Analog input across terminals 1-5)

α : Override compensation amount [%]
(Analog input across terminals 2-5)



Multi-speed Override Operation

3.12.5 Reset selection/disconnected PU detection/PU stop selection

(Pr. 75 speed torque position)

You can select the reset input acceptance, PU (FR-DU04-1/FR-PU04V) connector disconnection detection function and PU stop function.

- Reset selection: You can select the reset function input (RES signal) timing.
- Disconnected PU detection: When the disconnection of the PU (FR-DU04-1/FR-PU04V) from the inverter for more than 1s is detected, the inverter outputs an alarm code (E.PUE) and comes to an alarm stop.
- PU stop selection: When an alarm etc. occurs in any operation mode, you can stop the motor from the operation panel by pressing STOP RESET.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|------------------|---------------|
| 75 | Reset selection/disconnected PU detection/PU stop selection | 14 | 0 to 3, 14 to 17 | Extended mode |

<Setting>

| Pr. 75 Setting | Reset Selection | Disconnected PU Detection | PU Stop Selection |
|----------------|--|---|--|
| 0 | Reset input is always enabled. | If the PU is disconnected, operation will be continued as-is. | The PU stop key is invalid. STOP RESET input is valid only in the PU or combined operation mode (Pr. 79 = "4"). |
| 1 | Reset input is enabled only when the protective function is activated. | | |
| 2 | Reset input is always enabled. | When the PU is disconnected, the inverter output is shut off. | STOP RESET input decelerates the motor to a stop in any of the PU, external and communication operation modes. |
| 3 | Reset input is enabled only when the protective function is activated. | | |
| 14 | Reset input is always enabled. | If the PU is disconnected, operation will be continued as-is. | |
| 15 | Reset input is enabled only when the protective function is activated. | | |
| 16 | Reset input is always enabled. | When the PU is disconnected, the inverter output is shut off. | |
| 17 | Reset input is enabled only when the protective function is activated. | | |

(1) Restarting method when stop was made by inputting STOP RESET from the operation panel (Method of restarting from PS indication)

- 1) After the motor has decelerated to a stop, turn off the STF or STR signal.
- 2) Press MODE twice* to display OPNd.

CAUTION

When Pr. 79 = "3", press MODE three times to display PU. Then press ▼ and proceed to 3).

(*For monitor screen)..... Refer to the Instruction Manual (basic) for details of the monitor display provided by pressing MODE.

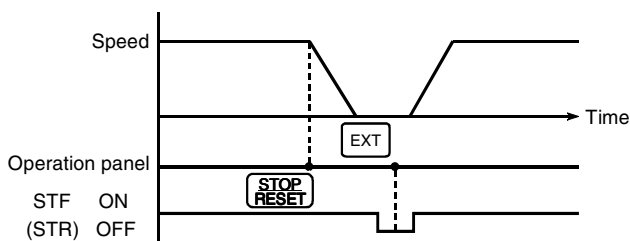
- 3) Press SET.
- 4) Turn on the STF or STR signal.

REMARKS

- When you provide a reset input (RES) during operation, the inverter that is being reset shuts off the output and resets the internal heat integrating value of the electronic thermal relay and the number of retries, and the motor coasts.
- The Pr. 75 value can be set any time. This value does not return to the initial value even if parameter (all) clear is executed.
- When the motor is stopped from the PU, PS and 00 are displayed alternately. An alarm output is not provided.

**(2) Restarting method when stop was made by inputting STOP
RESET from PU**

- 1) After the motor has decelerated to a stop, turn off the STF or STR signal.
- 2) Press EXT.
- (Recovery from PS)
- 3) Turn on the STF or STR signal.



Example of stop and restart during external operation

Alternatively, you can make a restart by making a power-on reset or resetting the inverter using the reset terminal of the inverter.

REMARKS

- When you provide a reset input (RES) during operation, the inverter that is being reset shuts off the output and resets the data of the electronic thermal relay, and the motor coasts.
- To make a restart, confirm that the PU is connected and then reset the inverter.
- The Pr. 75 value can be set any time. This value does not return to the initial value even if parameter (all) clear is executed.
- When the motor is stopped from the PU, PS is displayed. An alarm output is not provided.
- Pr. 250 is made invalid.

⚠ CAUTION

⚠ Do not reset the inverter with the start signal input. Doing so will start the inverter immediately after it has recovered from the error, causing hazard.

3.12.6 Parameter write disable selection (Pr. 77 speed torque position)

You can select between enable and disable for parameter write. This function is used to prevent parameter values from being rewritten by misoperation.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------------|-----------------|---------------|-------------|
| 77 | Parameter write disable selection | 0 | 0, 1, 2 | Simple mode |

<Setting>

| Pr. 77 Setting | Function |
|----------------|---|
| 0 | Write is enabled only during a stop in the PU operation mode.* |
| 1 | Parameter write is disabled.** |
| 2 | Write is enabled even during operation. Write is enabled independently of the operation mode. |

CAUTION

- * The shaded parameters in the parameter list (refer to page 62) always allow setting.
- Even when "2" is set in Pr. 77, the following parameters do not allow writing during operation. Pr. 60, Pr. 71, Pr. 72, Pr. 79, Pr. 80 to Pr. 84, Pr. 90 to Pr. 96, Pr. 180 to Pr. 183, Pr. 187, Pr. 190 to Pr. 192, Pr. 195, Pr. 450, Pr. 451, Pr. 453, Pr. 454, Pr. 800, Pr. 819, Pr. 851, Pr. 852, Pr. 859 and Pr. 868
Stop operation when changing the values of the above parameters.
- By setting "1" in Pr. 77, the following clear operations can be inhibited:
 - Parameter clear
 - Parameter all clear
- Even when "1" is set in Pr. 77, write is allowed for Pr. 22, Pr. 75, Pr. 77 and Pr. 79.

Operation selection function 2 (Pr. 65 to Pr. 79)

3.12.7 Reverse rotation prevention selection (Pr. 78 speed torque position)

This function can prevent any reverse rotation fault resulting from the mis-input of the start signal.

POINT

Used for a machine that runs only in one direction, e.g. fan, pump.
(The setting of this parameter is valid for combined operation, PU operation, external operation and communication operation.)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------------------------|-----------------|---------------|---------------|
| 78 | Reverse rotation prevention selection | 0 | 0, 1, 2 | Extended mode |

<Setting>

| Control Method | Pr. 78 Setting | Start Signal | | Restriction on Analog Reversible | | | | | |
|---|--|---|---------|---|-------|-----------|---------------------|-------------|---|
| | | STF | STR | | | | | | |
| Speed control V/F control | 0 | Valid | Valid | Negative input starts rotation in the direction opposite to that of start signal | | | | | |
| | 1 (reverse rotation lock) | Valid | Invalid | Negative input does not start rotation. | | | | | |
| | 2 (forward rotation lock) | Invalid | Valid | | | | | | |
| Torque control | 0 | Valid | Valid | Negative input starts rotation in the direction opposite to that of start signal | | | | | |
| | 1 (reverse rotation lock) | Valid | Invalid | Negative analog input results as follows. | | | | | |
| | 2 (forward rotation lock) | Invalid | Valid | <table border="1"> <thead> <tr> <th>Speed</th> <th>Operation</th> </tr> </thead> <tbody> <tr> <td>Start speed or less</td> <td>No rotation</td> </tr> <tr> <td>When rotation is in the same direction as that of start signal and speed is higher than starting speed.</td> <td>Torque in the direction opposite to that of start signal is generated.</td> </tr> </tbody> </table> | Speed | Operation | Start speed or less | No rotation | When rotation is in the same direction as that of start signal and speed is higher than starting speed. |
| Speed | Operation | | | | | | | | |
| Start speed or less | No rotation | | | | | | | | |
| When rotation is in the same direction as that of start signal and speed is higher than starting speed. | Torque in the direction opposite to that of start signal is generated. | | | | | | | | |
| Position control | 0 | Functions as a stroke signal and motor does not rotate in the direction where the STF or STR signal does not exist. | | Under position control, analog command is irrelevant to the forward/reverse rotation lock function as it does not function in other than torque restriction setting (absolute value used for operation). | | | | | |
| | 1 (reverse rotation lock) | Motor does not rotate in the reverse rotation direction. | | | | | | | |
| | 2 (forward rotation lock) | Motor does not rotate in the forward rotation direction. | | | | | | | |

3.12.8 Operation mode selection (Pr. 79 speed torque position)

Used to select the operation mode of the inverter.








The inverter can be run from the operation panel or parameter unit (PU operation), with external signals (external operation), or by combination of PU operation and external operation (external/PU combined operation).

The external operation mode is selected at power-on (factory setting).


| Parameter | Name | Factory Setting | Setting Range |
|-----------|--------------------------|-----------------|----------------|
| 79 | Operation mode selection | 0 | 0 to 4, 6 to 8 |

<Setting>

In the following table, operation from the operation panel or parameter unit is abbreviated to PU operation.

| Pr. 79 Setting | Function | | |
|----------------|---|--|---|
| 0 | At power-on, the external operation mode is selected. You can change between the PU operation mode and external operation mode from the operation panel () or parameter unit ( / ). Refer to the fields of settings 1 and 2 for the corresponding modes. | | |
| 1 | Operation mode | Speed command | Start signal |
| | PU operation mode | Setting from the operation panel or FR-PU04V |  ,  |
| 2 | External operation mode | External signal input (across terminals 2(1)-5, multi-speed selection, jog) | External signal input (terminal STF, STR) |
| 3 | External/PU combined operation mode 1 | Digital setting by PU key operation or external signal input (multi-speed setting) | External signal input (terminal STF, STR) |
| 4 | External/PU combined operation mode 2 | External signal input (across terminals 2(1)-5, multi-speed selection, jog) |  ,  |
| 6 | Switchover mode Switchover between PU operation, external operation and computer link operation (when a communication option is used) can be done while running. | | |
| 7 | External operation mode (PU operation interlock) X12 signal ON..... Can be switched to PU operation mode (output stop during external operation) X12 signal OFF Switching to PU operation mode inhibited | | |
| 8 | Operation mode switchover using external signal (disallowed during operation) X16 signal ON..... Switched to external operation mode X16 signal OFF Switched to PU operation mode | | |

REMARKS

- A stop function (PU stop selection) by  of the PU (FR-DU04-1/FR-PU04V) is made valid during the operation other than the PU operation mode. (Refer to page 116)
- Either "3" or "4" may be set to select the PU/external combined operation, and these settings differ in starting method. Refer to page 128 for the computer link operation mode.

(1) Switchover mode

PU operation, external operation and computer link operation (when communication option is used) can be used by switching between them.

| Operation Mode Switching | Switching Operation/Operating Status |
|---|--|
| External operation to PU operation | 1) Change the operation mode to the PU operation mode. •Rotation direction is the same as that of external operation. •Set speed is as set by the potentiometer (speed setting potentiometer). (Note that the setting will disappear when power is switched off or the inverter is reset.) |
| External operation to computer link operation | 1) Mode change command to computer link mode is transmitted from the computer. •Rotation direction is the same as that of external operation. •Set speed is as set by the potentiometer (speed setting potentiometer). (Note that the setting will disappear when power is switched off or the inverter is reset.) |
| PU operation to external operation | 1) Press the external operation key of the parameter unit. •Rotation direction is determined by the external operation input signal. •Set speed is determined by the external speed setting signal. |
| PU operation to computer link operation | 1) Mode change command to computer link mode is transmitted from the computer. •Rotation direction and set speed are the same as those of PU operation. |
| Computer link operation to external operation | 1) Command to change to external mode is transmitted from the computer. •Rotation direction is determined by the external operation input signal. •Set speed is determined by the external speed setting signal. |
| Computer link operation to PU operation | 1) Select the PU operation mode with the operation panel or parameter unit. •Rotation direction and set speed are the same as those of computer link operation. |

Operation selection function 2 (Pr. 65 to Pr. 79)

(2) PU operation interlock

The PU operation interlock function is designed to forcibly change the operation mode to the external operation mode when the X12 signal input turns off. This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from the PU operation mode.

1) Preparation

- Set "7" (PU operation interlock) in Pr. 79.
- Using any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection), allocate the terminal used to input the X12 signal. (Refer to page 149)

REMARKS

Changing the terminal assignment with any of Pr. 180 to 183 and Pr. 187 may affect the other functions. Check the functions of the corresponding terminals before making setting.

2) Function

| X12 Signal | Function/Operation |
|------------|---|
| ON | Output stop during external operation. Operation mode can be switched to the PU operation mode. PU operation allowed. |
| OFF | Forcibly switched to the external operation mode. External operation allowed. Switching to the PU operation mode inhibited. |

<Function/operation changed by switching on-off the X12 signal>

| Operating Condition | | X12 Signal | Operation Mode | Operating Status |
|---------------------|------------------|------------|----------------|--|
| Operation mode | Status | | | |
| PU | During stop | ON→OFF (*) | PU → External | During stop |
| | During operation | ON→OFF (*) | | If external operation speed setting and start signal are entered, operation is performed in that status. |
| External | During stop | OFF→ON | External | During stop |
| | | ON→OFF | | During operation → output stop |
| | During operation | OFF→ON | | Output stop → operation |
| | | ON→OFF | | |

REMARKS

- If the X12 signal is on, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is on.
- * 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 signal is turned off with either of STF and STR on.
- When the X12 signal is off during external operation mode, the operation mode cannot be changed to the PU operation mode. (Change to the PU operation mode after switching the X12 signal on)

(3) Operation mode external signal switching function

1) Preparation

Set "8" (operation mode with signal) in Pr. 79.

Using any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection), allocate the terminal used to input the X16 signal.

REMARKS

Changing the terminal assignment with any of Pr. 180 to 183 and Pr. 187 may affect the other functions. Check the functions of the corresponding terminals before making setting. Refer to page 149 for details.

2) Function

This switching is enabled only during an inverter stop and cannot be achieved during operation.

| X16 Signal | Operation Mode |
|------------|--|
| ON | External operation mode (cannot be changed to the PU operation mode) |
| OFF | PU operation mode (cannot be changed to the external operation mode) |

Related parameters

Pr. 75 "PU stop selection" (Refer to page 116.)

3.13 Offline auto tuning (Pr. 80 to Pr. 96)

3.13.1 Offline auto tuning function

(Pr. 9, Pr. 80, Pr. 81, Pr. 83, Pr. 84, Pr. 71, Pr. 96, Pr. 450, Pr. 452 speed torque position)

If any other manufacturer's motor is used, using the offline auto tuning function runs the motor with the optimum operating characteristics.

- By performing offline auto tuning, the inverter measures the necessary motor constants.
- Offline auto tuning can be performed with an inertia load, e.g. coupling, connected. (As the load is lighter, tuning accuracy is higher. Tuning accuracy does not change if the inertia is large.)
- For the offline auto tuning, you can select either the motor non-rotation mode or rotation mode. The rotation mode has higher tuning accuracy than the non-rotation mode. The rotation mode should be selected for the online auto tuning.
- If any other manufacturer's motor is used, perform offline auto tuning (Pr. 96="101") with motor alone to run the motor before performing online auto tuning. (The motor with inertia load can be connected.)
- Note that it is necessary to perform offline auto tuning (non-rotation mode (Pr. 96="1")) in order for the wiring length resistance to be reflected on the control when the wiring length of the Mitsubishi motor used (SF-THY, SF-VH, MARATHON Blue Max[®] (NA)) is long (30m (98.42 feet) or longer as a reference). (For online auto tuning, refer to the Instruction Manual (basic). For other settings, refer to 35)

CAUTION

1. The motor capacity is equal to or one rank lower than the inverter capacity.
2. Special motors such as high-slip motor and high-speed motor cannot be tuned.
3. Motor runs at up to about the rated speed of the motor.
4. Make sure that the motor is connected. (At a tuning start, the motor should be at a stop.)
5. Tune the motor alone without connecting a load (e.g. frictional stationary load) to the motor. (An inertia load such as a coupling may remain connected.)
6. Use the PLG that is coupled directly to the motor shaft without looseness.
7. Offline auto tuning will not be performed properly if it is performed with a reactor connected between the inverter and motor. Remove it before starting tuning.

REMARKS

- When using the Mitsubishi dedicated motor (SF-THY,SF-VH), Mitsubishi standard motor (SF-LHA with PLG), Mitsubishi constant-torque motor or MARATHON Blue Max (NA version), offline auto tuning is not necessary.
- You can copy the online tuning data (motor constants) to another inverter with the PU (FR-DU04-1/FR-PU04V).
- The offline auto tuning status can be monitored with the PU (FR-DU04-1/FR-PU04V).

3.13.2 Parameters

Set the following parameters.

| Parameter | Name | Setting Range | Factory Setting | Remarks |
|-----------|-------------------------------|---|---|---|
| 71 | Applied motor | Refer to page 112 and set "3 (standard motor)", "13 (constant-torque motor)" "23 (SF-VH)" or "33 (SF-THY)". Electronic thermal characteristics are also changed in accordance with the motor. | | |
| 9 | Electronic thermal O/L relay | 0 to 3600A (Set 0 for use of an external thermal relay.) | Japanese version: 0A | Refer to the motor rating plate and set the rated value. (If two or more rated values are given in the motor rating plate, set the values for 200V/60Hz(400V/60Hz) |
| | | | NA version: Rated inverter output current) | |
| 80 | Motor capacity | 0 to 3600kW | Inverter capacity | |
| 81 | Number of motor poles | 2, 4, 6 | 4 | |
| 83 | Rated motor voltage | 0 to 1000V | 200V/400V | |
| 84 | Rated motor frequency | 20 to 200Hz | Japanese version: 60Hz | |
| | | | NA version: 60Hz | |
| 96 | Auto tuning setting/status | 0, 1, 101 | 0 | 0 : Auto tuning not performed 1 : Tuning performed without motor running 101: Tuning performed with motor running |
| 851 | Number of PLG pulses | 0 to 4096 | Japanese version: 2048 | |
| | | | NA version: 1024 | |
| 852 | PLG rotation direction | 0,1 | 1 | |
| 876 | Thermal relay protector input | 0,1 | Japanese version: 1 | |
| | | | NA version: 0 | |

3.13.3 Execution of offline auto tuning

The following applies to the first motor.

CAUTION

● **Note the following when "101" (offline auto tuning performed with motor running) is set in Pr. 96.**

- Ensure safety when the motor starts running.
- Torque is not enough during tuning.
- The motor may be run at nearly its rated frequency (Pr. 84 setting) without any problem.
- The brake is open.
- When over current alarm (E.OC1, OC2, OC3) occurs, set acceleration time longer using Pr. 7.
- No external force is applied to rotate the motor.

If "1" (tuning performed without motor running) is set in Pr. 96, the motor may run slightly (However, torque is not enough). 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.

**This instruction must be followed especially in vertical lift applications.*

Note that if the motor runs slightly, tuning performance is unaffected.

• During offline auto tuning, only the following I/O signals are valid:

Input signals (STOP, OH, MRS, RT, RES, STF, STR)

Output signals (RUN, OL, IPF, DA1, DA2, A, B, C)

Take extra precaution when designing a sequence where a mechanical brake is opened by the RUN signal.

<Setting>

(1) Parameter setting

- Select Pr. 851 "number of PLG pulses" and Pr. 852 "PLG rotation direction" (Refer to the Instruction Manual (basic).)
- Select Pr. 80 "motor capacity" and Pr. 81 "number of motor poles".
- Refer to the parameter details to set the parameters below.

1) Set "1" or "101" in Pr. 96

• When the setting is "1" tuning performed without motor running

• When the setting is "101" tuning performed with motor running

2) Set Pr. 9 "electronic thermal O/L relay".

When using the external thermal, change the Pr. 9 setting back to "0" after offline auto tuning. The electronic thermal function is made invalid. Set "0" in Pr. 876 if the external thermal relay is not used.

3) Set the rated motor voltage (V) in Pr. 83.

4) Set the rated motor frequency (Hz) in Pr. 84.

5) Select the motor in Pr. 71.

Example

• Mitsubishi standard motor Pr. 71 = "3"

• Mitsubishi constant torque motor (Japanese Version) Pr. 71 = "13"

• SF-VH Pr. 71 = "23"

• SF-THY Pr. 71 = "33"

CAUTION

For the setting value, set the motor rating plate value. When using a motor having several rated values, e.g. a standard motor, set a value for 200V/60Hz, 400V/60Hz or 575V/60Hz.

(2) Tuning command

After setting the above parameters, press **FWD** or **REV**.

(For external operation, turn on the run command (STF, STR).)

REMARKS


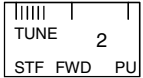


- To force tuning to end, use the MRS or RES signal or press **STOP RESET**. (The start signal may also be turned off to end.)
- Excitation noise is produced during tuning.
- When executing offline auto tuning, input the run command after switching on the main circuit power (R, S, T) of the inverter.

(3) Monitoring during execution

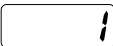
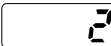
When the parameter unit (FR-PU04V) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown on the next page. When the operation panel (FR-DU04-1) is used, the same value as on the PU is only displayed.

When Pr.96=1

- Parameter unit (FR-PU04V) main monitor

| | 1. Setting | 2. Tuning in progress | 3. Completion | 4. Error-activated end (for inverter trip) |
|---------|---|---|--|---|
| Display |  |  |  |  |

- Operation panel (FR-DU04-1) display

| | 1. Setting | 2. Tuning in progress | 3. Completion | 4. Error-activated end (for inverter trip) |
|-----------------|---|---|--|---|
| Displayed value |  |  |  |  |


REMARKS

- Offline auto tuning time (factory setting)
 - 1: No-rotation mode: Approximate. 25s
 - 2: Rotation mode: Approximate. 40s

(Offline auto tuning time varies with the acceleration and deceleration time settings as indicated below.
Offline auto tuning time = acceleration time + deceleration time + approximate. 30s)

(4) Ending the offline auto tuning

- Confirm the Pr. 96 value.
 - Normal end: "3" or "103" is displayed.
 - Error end: "9", "91", "92" or "93" is displayed.
 - Forced end: "8" is displayed.
- When tuning ended normally


For PU operation, press . For external operation, turn off the start signal (STF or STR) 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.) (Refer to the Instruction Manual (basic) for inverter reset.)
- When tuning was ended due to an error

Offline auto tuning did not end normally. (The motor constants have not been set.) Reset the inverter and start tuning all over again.
- Error display definitions

| Error Display | Error Cause | Remedy |
|---------------|--|--|
| 9 | Inverter trip | Make setting again. |
| 91 | Current limit (stall prevention) function was activated. | Increase acceleration/deceleration time. Set "1" in Pr. 156. |
| 92 | Converter output voltage reached 75% of rated value. | Check for fluctuation of power supply voltage. |
| 93 | Calculation error | Check the motor wiring and make setting again. |

No connection with motor will also result in "93" error.

- When tuning was ended forcibly

Tuning is ended forcibly by pressing  or turning off the start signal (STF or STR) during tuning. In this case, offline auto tuning has not ended properly. (The motor constants have not been set.) Perform an inverter reset and restart tuning.

REMARKS

1. 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.
2. An instantaneous power failure occurring during tuning will result in a tuning error. After power is restored, the inverter goes into the ordinary operation mode. Therefore, when STF (STR) is on, the motor runs in the forward (reverse) rotation.
3. Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
4. The set speed monitor displayed during the offline auto tuning is 0r/min.

⚠ CAUTION

- ⚠ Note that the motor may start running suddenly.**
- ⚠ When the offline auto tuning in the rotation mode is used in vertical lift application, e.g. a lifter, it may drop due to insufficient torque.**

3.13.4 Utilizing or changing offline auto tuning data for use

<Setting the motor constants as desired>

The motor constants (Pr. 90 to Pr. 94) may be set as desired in either of two ways; the data measured in the offline auto tuning are read and utilized or changed, or the motor constants are set without the offline auto tuning data being used.

<Operating procedure>

1. Set the following value in Pr. 71 (Pr. 450):
 - Mitsubishi standard motor Pr. 71 = "4"
 - Mitsubishi constant-torque motor..... Pr. 71 = "14"
 - SF-VH..... Pr. 71 = "24"
 - SF-THY..... Pr. 71 = "34"
2. Set "801" in Pr. 77.
 (The parameter values of Pr. 82 "motor excitation current" and Pr. 90 to Pr. 94 (motor constants) can be displayed. Though the parameter values of other than Pr. 82 and Pr. 90 to Pr. 94 can also be displayed, they are parameters for manufacturer setting and their values should not be changed.)
3. In the parameter setting mode, read the following parameters and set desired values.

| Parameter Number | Name | Setting Range | Setting Increments | Factory Setting |
|------------------|--|-----------------|--------------------|-----------------|
| 82 | Motor excitation current (no load current) | 0 to ****, 9999 | 1 | 9999 |
| 90 | Motor constant R1 | 0 to ****, 9999 | 1 | 9999 |
| 91 | Motor constant R2 | 0 to ****, 9999 | 1 | 9999 |
| 92 | Motor constant L1 | 0 to ****, 9999 | 1 | 9999 |
| 93 | Motor constant L2 | 0 to ****, 9999 | 1 | 9999 |
| 94 | Motor constant x | 0 to ****, 9999 | 1 | 9999 |
| 859 | Torque current | 0 to ****, 9999 | 1 | 9999 |

REMARKS

When "0" (factory setting) is set in Pr. 684 "tuning data increment switchover", the motor constants are set in "internal variable increment". When "1" is set in Pr. 684, the motor constants are set in "mH, mΩ, A". (can be set when Pr.77 = "801")

4. Return the Pr. 77 setting to the original value.

REMARKS

1. Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).
2. Set "3 (standard motor), "13" (constant-torque motor) or "23" SF-VH in Pr. 71 to use the constants measured in the offline auto tuning. Set "4, 14 or 24" in Pr. 71 and change the motor constants to change the values measured in the offline auto tuning.
3. 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 is displayed "2516", set 2642, i.e. 2516 × 1.05=2641.8, in Pr. 90. (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.)
4. When "1" is set in Pr. 96, the last values of Pr. 82, Pr. 92, and Pr. 93 remain unchanged.

3.13.5 Setting the motor constants directly

Offline auto tuning is not used.

The Pr. 92 and Pr. 93 motor constants may either be entered in [mΩ] or in [mH]. Before starting operation, confirm which motor constant unit is used. (Refer to page 121.)

- To enter the Pr. 92 and Pr. 93 motor constants in [mΩ]

<Operating procedure>

1. After checking that the input motor constants are those for star connection or delta connection, set the Pr. 71 value as indicated below (When direct input is selected and offline auto tuning is performed, set "7, 8, 17 or 18") in Pr. 71. (Refer to page 126.)

| | | Star Connection Motor | Delta Connection Motor |
|---------|-----------------------|-----------------------|------------------------|
| Pr. 71 | Standard motor | 5 | 6 |
| Setting | Constant-torque motor | 15 | 16 |

2. Set "801" in Pr. 77.

(The parameter values of the motor constants (Pr. 90 to Pr. 94) can be displayed. Though the parameter values of other than Pr. 90 to Pr. 94 can also be displayed, they are parameters for manufacturer setting and their values should not be changed.)

3. In the parameter setting mode, read the following parameters and set desired values.

I_q =Torque, I_{100} =Rated current, I_0 =No load current

$$I_q = \sqrt{I_{100}^2 - I_0^2}$$

| Parameter Number | Name | Setting Range | Setting Increments | Factory Setting |
|------------------|--|------------------|--------------------|-----------------|
| 82 | Motor excitation current (no load current) | 0 to 3600A | 0.1A | 9999 |
| 90 | Motor constant r1 | 0 to 400mΩ, 9999 | 0.01mΩ | 9999 |
| 91 | Motor constant r2 | 0 to 400mΩ, 9999 | 0.01mΩ | 9999 |
| 92 | Motor constant x1 | 0 to 400mΩ, 9999 | 0.1mΩ | 9999 |
| 93 | Motor constant x2 | 0 to 400mΩ, 9999 | 0.1mΩ | 9999 |
| 94 | Motor constant xm | 0 to 100Ω, 9999 | 0.01Ω | 9999 |
| 859 | Torque current | 0 to 3600A | 0.1A | 9999 |

4. Return the Pr. 77 setting to the original value.

5. Set Pr. 83 and Pr. 84.

| Parameter Number | Name | Setting Range | Setting Increments | Factory Setting |
|------------------|-----------------------|---------------|--------------------|-----------------|
| 83 | Rated motor voltage | 0 to 1000V | 0.1V | 200V/400V |
| 84 | Rated motor frequency | 20 to 200Hz | 0.01Hz | 60Hz |

CAUTION

1. Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).
2. If "star connection" is mistaken for "delta connection" or vice versa during setting of Pr. 71, control cannot be exercised properly.

- To enter the Pr. 92 and Pr. 93 motor constants in [mH]

<Operating procedure>

1. After checking that the input motor constants are those for star connection or delta connection, set the Pr. 71 value as indicated below.

| | | |
|-------------------|-----------------------|----|
| Pr. 71 Setting | Standard motor | 0 |
| | Constant-torque motor | 10 |
| | SF-VH | 20 |
| | SF-THY | 30 |

2. Set "801" in Pr. 77.

(The parameter values of the motor constants (Pr. 90 to Pr. 94) can be displayed. Though the parameter values of other than Pr. 90 to Pr. 94 can also be displayed, they are parameters for manufacturer setting and their values should not be changed.)

Online auto tuning (Pr. 95)

3. In the parameter setting mode, read the following parameters and set desired values.

| Parameter Number | Name | Setting Range | Setting Increments | Factory Setting |
|------------------|--|------------------|--------------------|-----------------|
| 82 | Motor excitation current (no load current) | 0 to 3600A | 0.1A | 9999 |
| 90 | Motor constant R1 | 0 to 400mΩ, 9999 | 0.01mΩ | 9999 |
| 91 | Motor constant R2 | 0 to 400mΩ, 9999 | 0.01mΩ | 9999 |
| 92 | Motor constant L1 | 0 to 400mH, 9999 | 0.01mH | 9999 |
| 93 | Motor constant L2 | 0 to 400mH, 9999 | 0.01mH | 9999 |
| 94 | Motor constant x | 0 to 100%, 9999 | 0.01% | 9999 |
| 859 | Torque current | 0 to 3600A | 0.1A | 9999 |

4. Return the Pr. 77 setting to the original value.

5. Refer to the following table and set Pr. 83 and Pr. 84.

| Parameter Number | Name | Setting Range | Setting Increments | Factory Setting |
|------------------|-----------------------|---------------|--------------------|-----------------|
| 83 | Rated motor voltage | 0 to 1000V | 0.1V | 200V/400V |
| 84 | Rated motor frequency | 20 to 200Hz | 0.01Hz | 60Hz |

CAUTION

Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).

3.13.6 Direct input + offline auto tuning

Perform offline auto tuning after directly inputting the motor constants.

1. Set Pr. 71.

| Pr. 71 Setting | Description | |
|----------------|---|-----------------------|
| 7 | Star connection direct input + offline auto tuning | General-purpose motor |
| 8 | Delta connection direct input + offline auto tuning | |
| 17 | Star connection direct input + offline auto tuning | Constant-torque motor |
| 18 | Delta connection direct input + offline auto tuning | |

2. Set the motor constants (Refer to page 125).

3. Set Pr. 96 to perform offline auto tuning (Refer to page 122).

3.14 Online auto tuning (Pr. 95)

- Excellent torque accuracy is provided by temperature compensation even if the secondary resistance value of the motor varies with the rise in the motor temperature.

3.14.1 Online auto tuning selection (Pr. 95, Pr. 9, Pr. 71, Pr. 80, Pr.

81 speed torque position)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------------|--|-------------------------------------|--|
| 95 | Online auto tuning selection | 0 | 0, 1, 2 | 0: Online auto tuning not performed 1: Start-time tuning (at start-up) 2: Adaptive magnetic flux observer (normal) |
| 9 | Electronic thermal O/L relay | Japanese version: 0A | 0 to 3600A | Used as rated motor current and electronic thermal relay parameters. (Refer to page 83) |
| | | NA version: Rated inverter output current | | |
| 71 | Applied motor | Japanese version: 30 | Refer to page 112 and make setting. | |
| | | NA version: 10 | | |
| 80 | Motor capacity | Inverter capacity | 0.4 to 3600kW | (Down to one rank lower of the inverter capacity) |
| 81 | Number of motor poles | 4 | 2, 4, 6 | |

(1) Pr. 95="1" (start-time tuning)

The current at a start is detected to compensate for the secondary resistance of the motor so that excellent characteristics are provided regardless of the change in value of the secondary resistance of the motor with the rise of the motor temperature.

CAUTION

1. **Perform offline auto tuning in the mode with rotation before performing online auto tuning of the start-time tuning.
For offline auto tuning, refer to page 121.**
2. **For using start-time tuning in vertical lift applications, examine the utilization of a brake sequence for the brake opening timing at a start. 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 gravity drop.**

(2) Pr. 95 = "2" (normal tuning)/adaptive magnetic flux observer

This function is effective for torque accuracy improvement when using the motor with PLG.

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 detected with high accuracy so that excellent characteristics are provided regardless of the change in the temperature of the secondary resistance.

Set "2" when exercising PLG vector control.

CAUTION

1. **For the SF-THY, SF-VH, SF-LHA (with PLG), SF-LHCA (with PLG), MARATHON Blue Max®, 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 (98.43feet) or longer as reference).)
For offline auto tuning, refer to page 121.**

REMARKS

1. Online auto tuning of the start-time tuning is not enabled when the starting conditions of the inverter are not satisfied, e.g. the MRS is input, the preset speed is less than the starting speed (Pr. 13), during inverter error, etc.
2. Online auto tuning of the start-time tuning does not operate during deceleration or at a restart during DC brake operation.
3. Invalid for jog operation.
4. The RUN signal is not output during online auto tuning of the start-time tuning. The RUN signal turns on at a start.
5. If the period from an inverter stop to a restart is within 4s, online auto tuning of the start-time tuning is performed but the tuning results are not reflected.
6. Automatic restart after instantaneous power failure overrides when automatic restart after instantaneous power failure is selected.
7. Zero current detection and output current detection are valid during online auto tuning.

CAUTION

Refer to the Instruction Manual (basic) for details.

Pr. 96 ➡ Refer to page 121.

Pr. 110, Pr. 111 ➡ Refer to Pr. 7 (page 81).

Pr. 116 ➡ Refer to Pr. 42 (page 97).

3.15 Communication functions (Pr. 117 to Pr. 124)

3.15.1 Computer link operation (RS-485 communication)

(Pr. 117 to Pr. 124, Pr. 342 speed torque position)

Used to perform required settings for communication between the inverter and personal computer. Using the inverter setup software (FR-SW1-SETUP-WE) enables efficient parameter setting, monitoring, etc.

- Communication operation can be performed from the PU connector of the inverter by RS-485 communication.

<Communication specifications>

| | | | |
|--------------------------------------|-------------------------|---|--|
| Conforming standard | | RS-485 Standard | |
| Number of inverters connected | | 1: N (max. 32 inverters) | |
| Communication speed | | Selected among 19200, 9600 and 4800bps | |
| Control protocol | | Asynchronous system | |
| Communication method | | Half-duplex system | |
| Communication specifications | Character system | ASCII (7 bits/8 bits) selectable | |
| | Stop bit length | Selectable between 1 bit and 2 bits. | |
| | Terminator | CR/LF (presence/absence selectable) | |
| | Check system | Parity check | Selectable between presence (even/odd) and absence |
| | | Sum check | Presence |
| Waiting time setting | | Selectable between presence and absence | |

- For the data codes of the parameters, refer to the data code list in Appendices (page 204).

REMARKS

For computer link operation, set 65520 (HFFF0) as "8888" and 65535 (HFFFF) as "9999".

<Setting>

To make communication between the personal computer and inverter, the initial settings 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.

CAUTION

Always reset the inverter after making the initial settings of the parameters. Communication is disabled unless the inverter is reset after the communication-related parameter values have been changed.

| Parameter Number | Name | Factory Setting | Setting | Description | |
|------------------|--|---------------------|---------------|---|------------------------|
| 117 | Station number | 0 | 0 to 31 | Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer. | |
| 118 | Communication speed | 192 | 48 | 4800bps | |
| | | | 96 | 9600bps | |
| | | | 192 | 19200bps | |
| 119 | Stop bit length/ data length | 1 | 8 bits | 0 | Stop bit length 1 bit |
| | | | | 1 | Stop bit length 2 bits |
| | | | 7 bits | 10 | Stop bit length 1 bit |
| | | | | 11 | Stop bit length 2 bits |
| 120 | Parity check presence/ absence | 2 | 0 | Absent | |
| | | | 1 | Odd parity present | |
| | | | 2 | Even parity present | |
| 121 | Number of communication retries | 1 | 0 to 10 | Set the permissible number of retries at occurrence of data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop (E. PUE). | |
| | | | 9999 (65535) | If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RESET input. During a communication error (H0 to H5), the minor fault signal (LF) is given to the open collector output. Allocate the used terminal with any of Pr. 190 to Pr. 192 and Pr. 195 (output terminal function selection). | |
| 122* | Communication check time interval | Japanese version: 0 | 0 | No communication | |
| | | NA version: 9999 | 0.1 to 999.8s | Set the communication check time [s] interval. If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop (E. PUE). | |
| 123 | Waiting time setting | 9999 | 0 to 150ms | Set the waiting time between data transmission to the inverter and response. | |
| | | | 9999 | Set with communication data. | |
| 124 | CR/LF instruction presence/ absence | 1 | 0 | Without CR/LF | |
| | | | 1 | With CR | |
| | | | 2 | With CR/LF | |
| 342** | E ² PROM write presence/ absence | 0 | 0 | Parameter values written from the computer are written to the E ² PROM. | |
| | | | 1 | Parameter values written from the computer are written to the RAM. | |

* When making communication, set any value other than 0 in Pr. 122 "communication check time interval".

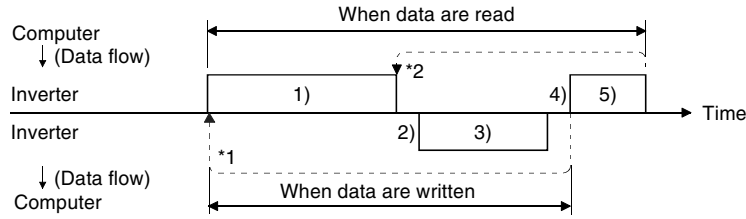
** When write to RAM has been set, powering off the inverter will erase the changed parameter values. Therefore, the parameter values available when power is switched on again are the values stored in E²PROM previously. When changing the parameter values frequently, set "1" in Pr. 342 to write them to the RAM.

The setting of Pr. 342 "E²PROM write presence/absence" is valid for computer link communication operation only.

<Computer programming>

(1) Communication procedure

Data communication between the computer and inverter is made in the following procedure.



- *1 If a retry must be made at occurrence of a data error, 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 an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

(2) Communication operation presence/absence and data format types

Communication operation presence/absence and data format types are as follows.

| No. | Operation | Run Command | Running Speed | Parameter Write | Inverter Reset | Monitoring | Parameter Read | |
|-----|--|---|---------------|-----------------|----------------|------------|----------------|---|
| 1) | Communication request is sent to the inverter in accordance with the user program of the computer. | A' | A | A | A | B | B | |
| 2) | Inverter data processing time | Present | Present | Present | Absent | Present | Present | |
| 3) | Reply data from the inverter (Data 1 is checked for error) | No error* (Request accepted) | C | C | C | Absent | E E' | E |
| | | With error (Request rejected) | D | D | D | Absent | F | F |
| 4) | Computer processing delay time | Absent | Absent | Absent | Absent | Absent | Absent | |
| 5) | Answer from computer in response to reply data 3 (Data 3 is checked for error) | No error* (Inverter performs no processing) | Absent | Absent | Absent | Absent | G | G |
| | | With error (Inverter re-outputs 3) | Absent | Absent | Absent | Absent | H | H |

* 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 132.)

(3) Data format

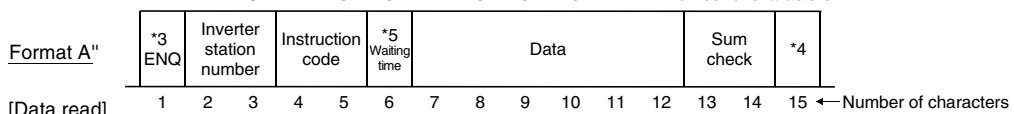
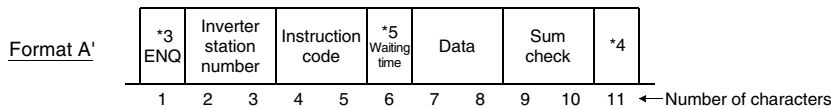
Data are used in hexadecimal.

Data are automatically converted into ASCII for communication between the computer and inverter.

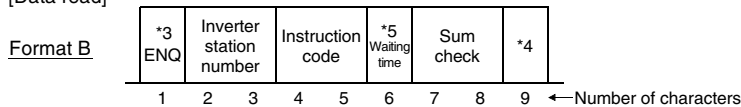
Data format types

1) Communication request data from the computer to the inverter

[Data write]



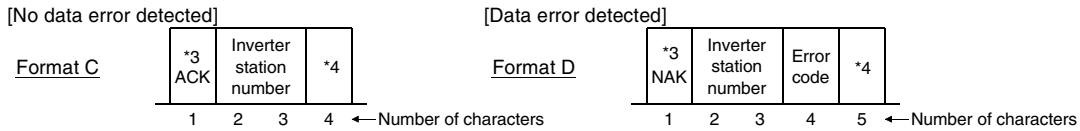
[Data read]



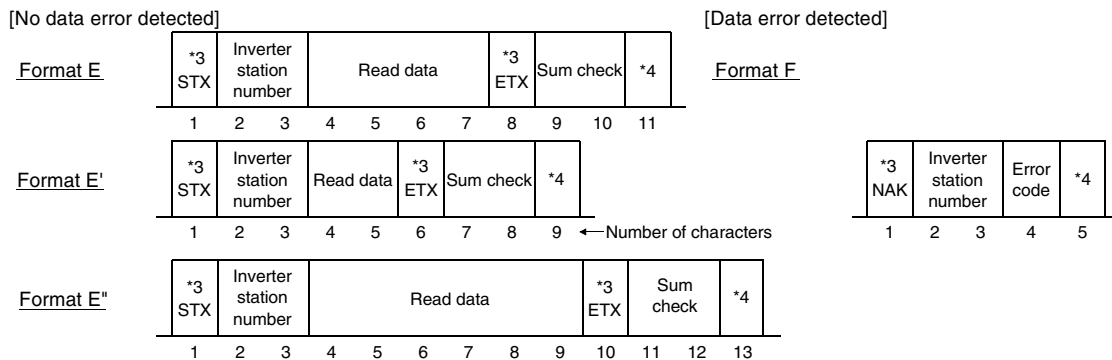
CAUTION

1. Specify the inverter station numbers between H00 and H1F (stations 0 and 31) in hexadecimal.
2. *3 indicates the control code.
3. *4 indicates the CR or 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 from the inverter according to the computer.
Also, the presence and absence of the CR and LF codes can be selected using Pr. 124.
4. *5: When the Pr. 123 "waiting time setting" setting is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

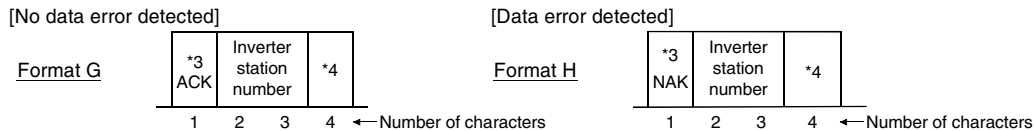
2) Reply data from the inverter to the computer during data write



3) Reply data from the inverter to the computer during data read



4) Send data from the computer to the inverter during data read



(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 codes as appropriate. (Refer to page 204.)

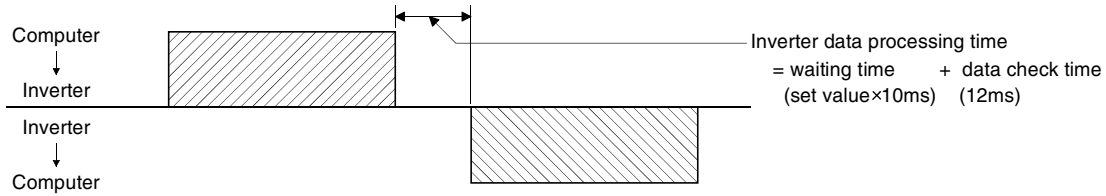
4) Data

Indicates the data such as speed 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 204.)

5) Waiting time

Specify the waiting time between the receipt of data by the inverter from the computer and the transmission of reply data from the inverter. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments. (Example: 1 = 10ms, 2 = 20ms)

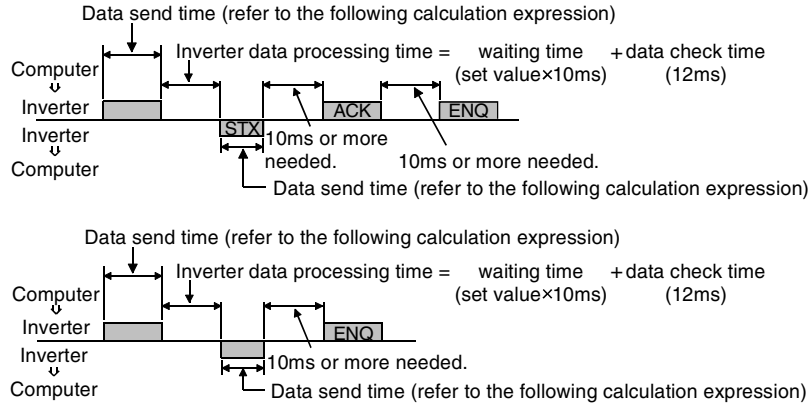
Communication functions (Pr. 117 to Pr. 124)



CAUTION

When the Pr. 123 "waiting time setting" setting is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

6) Response time



[Data send time calculation expression]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters} \times \text{Communication specifications} = \text{Data send time (s)}$$

(Refer to page 130) (Total number of bits) (See below)

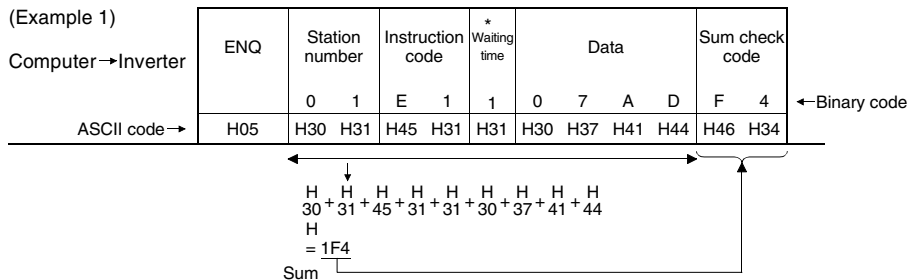
• Communication specifications

| Name | Number of Bits |
|-----------------|------------------|
| Stop bit length | 1 bit 2 bits |
| Data length | 7 bits 8 bits |
| Parity check | Yes 1bit No 0 |

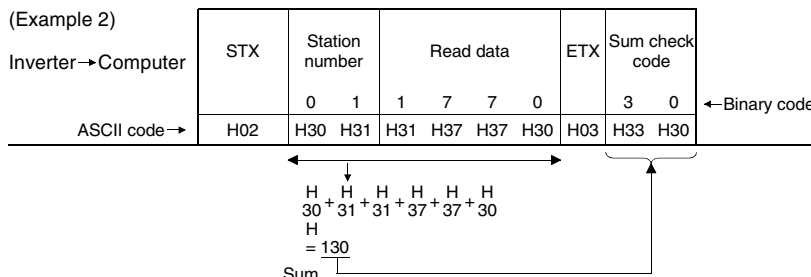
1 start bit is needed in addition to the bits in the left table.
Minimum total number of bits.....9 bits
Maximum total number of bits.....12 bits

7) 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.



*: When the Pr. 123 "waiting time setting" setting is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)



8) 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. (Refer to page 137.)

CAUTION

- 1. When the data from the computer has an error, the inverter does not accept that data.**
- 2. Any data communication, e.g. run command or monitoring, is started when the computer gives a communication request. Without the computer's command, the inverter does not return any data. For monitoring, etc. therefore, design the program to cause the computer to provide a data read request as required.**
- 3. Data for link parameter expansion setting differs as indicated below between access to Pr. 0 to Pr. 99 values and access to Pr. 100 to Pr. 905.**

| | | Instruction Code | Data |
|----------------------------------|-------|------------------|--|
| Link parameter expansion setting | Read | H7F | H00: Pr. 0 to Pr. 96 values are accessible. H01: Pr. 110 to Pr. 158, Pr.900 to Pr.905 values are accessible. H02: Pr. 160 to Pr. 195 and Pr. 232 to Pr. 288 values are accessible. H03: Pr. 300 to Pr. 399 values are accessible. |
| | Write | HFF | H04: Pr. 400 to Pr. 496 values are accessible. H05: Pr. 500 to Pr. 538 values are accessible. H06: Pr. 684 to Pr. 690 values are accessible. H08: Pr. 800 to Pr. 892 values are accessible. H09: Pr. 917 to Pr. 991 values are accessible. |

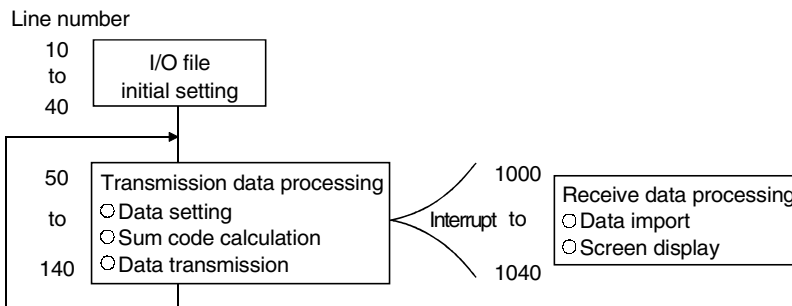
(5) Instructions for the program

- 1) When data from the computer has any error, the inverter does not accept that error. Hence, in the user program, always insert a retry program for data error.
- 2) Since any data communication, such as operation command or monitoring, is always requested by the computer, the inverter will not return 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 the operation mode is switched to communication operation

Communication functions (Pr. 117 to Pr. 124)

| | |
|--|--|
| 10 OPEN "COM1:9600,E,8,2,HD" AS #1 | : Initial setting of I/O file |
| 20 COMST1,1,1:COMST1,2,1 | : Communication file opening |
| 30 ON COM(1)GOSUB REC | : Circuit control signal (RS, ER) ON/OFF setting |
| 40 COM(1)ON | : Interrupt definition at data receive |
| 50 D\$= "01FB10002" | : Interrupt enable |
| 60 S=0 | : Transmission data setting |
| 70 FOR I=1 TO LEN(D\$) | |
| 80 A\$=MID\$(D\$,I,1) | |
| 90 A=ASC(A\$) | : Sum code calculation |
| 100 S=S+A | |
| 110 NEXTI | |
| 120 D\$=CHR\$(&H5)+D\$+RIGHT\$(HEX\$(S),2) | : Addition of control and sum codes |
| 130 PRINT#1,D\$ | : Data transmission |
| 140 GOTO 50 | |
| 1000 REC | : Interrupt data receive |
| 1010 IF LOC(1)=0 THEN RETURN | : Interrupt occurrence at data receive |
| 1020 PRINT "RECEIVE DATA" | |
| 1030 PRINT INPUT\$(LOC(1),#1) | |
| 1040 RETURN | |

General flowchart



⚠ CAUTION

- ⚠ When the inverter's communication time interval is not set, interlocks are provided to disable operation to prevent hazard. Always set the communication check time interval before starting operation.
- ⚠ 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 will come to an alarm stop (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.

<Setting items and set data>

After completion of parameter setting, set the instruction codes and data and start communication from the computer to allow various types of operation control and monitoring.

| No. | Item | Instruction Code | Description | Number of Data Digits |
|-----|----------------|------------------|---|-----------------------|
| 1 | Operation mode | Read H7B | H0000: Communication option operation H0001: External operation H0002: Communication operation (PU connector) | 4 digits |
| | | Write HFB | H0000: Communication option operation H0001: External operation H0002: Communication operation (PU connector) | |

Communication functions (Pr. 117 to Pr. 124)

| No. | Item | Instruction Code | Description | Number of Data Digits | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|---------------------------------------|----------------------|---|------------------------|------------------------|----------------------|-------------|-------------------|-------|---|---|---|---|----------|---|---|---|---|-------|---|---|---|---|-------|---|---|---|---|----------|
| 4 | Run command | HFA | <table style="margin-left: 20px;"> <tr> <td style="text-align: center;">b7</td> <td style="text-align: center;">b0</td> </tr> <tr> <td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td> </tr> </table> <p>(For example 1) [Example 1] H02...Forward rotation [Example 2] H00...Stop</p> <p>b0: _____ b1: Forward rotation (STF) b2: Reverse rotation (STR) b3: _____ b4: _____ b5: _____ b6: _____ b7: _____</p> | b7 | b0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 digits | | | | | | | | | | | | | | | |
| b7 | b0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Inverter status monitor | H7A | <table style="margin-left: 20px;"> <tr> <td style="text-align: center;">b7</td> <td style="text-align: center;">b0</td> </tr> <tr> <td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td> </tr> </table> <p>(For example 1) [Example 1] H02.....During forward rotation [Example 2] H80.....Stop due to alarm occurrence</p> <p>b0: Inverter running (RUN) b1: Forward rotation b2: Reverse rotation b3: DO1* b4: DO2* b5: DO3* b6: Speed detection (FB) b7: Alarm occurrence*</p> <p>* Output data varies with the settings of Pr. 190 to Pr. 192 and Pr. 195.</p> | b7 | b0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 digits | | | | | | | | | | | | | | | |
| b7 | b0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Set speed write (E ² PROM) | HEE | HFF=0 H0000 to H1C20: 1r/min increments (hexadecimal) (4 digits) | 4 digits (6 digits) | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Set speed write (RAM) | HED | HFF=1 H0000 to H11940: 0.1r/min increments (hexadecimal) (6 digits) To change the running speed consecutively, write data to the inverter RAM. (Instruction code: HED) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Set speed (E ² PROM) read | H6E | HFF = 0 H0000 to H1C20: 1r/min increments (hexadecimal) (4 digits) | 4 digits (6 digits) | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Set speed (RAM) read | H6D | HFF = 1 H0000 to 11940: 0.1r/min increments (hexadecimal) (6 digits) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Inverter reset | HFD | H9696: Resets the inverter. As the inverter is reset at start of communication by the computer, the inverter cannot send reply data back to the computer. | 4 digits | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Parameter all clear | HFC | <p>All parameters return to the factory settings. Any of four different clear operations is performed according to the data.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th style="text-align: center;">Pr. Data</th> <th style="text-align: center;">Communi- cation Pr.</th> <th style="text-align: center;">Calibra- tion Pr.</th> <th style="text-align: center;">Other Pr. *</th> <th style="text-align: center;">HEC HF3 HFF</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">H9696</td> <td style="text-align: center;">○</td> <td style="text-align: center;">×</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">H9966</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">H5A5A</td> <td style="text-align: center;">×</td> <td style="text-align: center;">×</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">H55AA</td> <td style="text-align: center;">×</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </tbody> </table> <p>When parameter all clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again. *Pr. 75 is not cleared.</p> | Pr. Data | Communi- cation Pr. | Calibra- tion Pr. | Other Pr. * | HEC HF3 HFF | H9696 | ○ | × | ○ | ○ | H9966 | ○ | ○ | ○ | ○ | H5A5A | × | × | ○ | ○ | H55AA | × | ○ | ○ | ○ | 4 digits |
| Pr. Data | Communi- cation Pr. | Calibra- tion Pr. | Other Pr. * | HEC HF3 HFF | | | | | | | | | | | | | | | | | | | | | | | | | |
| H9696 | ○ | × | ○ | ○ | | | | | | | | | | | | | | | | | | | | | | | | | |
| H9966 | ○ | ○ | ○ | ○ | | | | | | | | | | | | | | | | | | | | | | | | | |
| H5A5A | × | × | ○ | ○ | | | | | | | | | | | | | | | | | | | | | | | | | |
| H55AA | × | ○ | ○ | ○ | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Parameter write | H80 to HFD | Refer to the data list (page 204) and write and/or read parameter values as required. | 4 digits | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | Parameter read | H00 to H7B | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Item | Instruction Code | Description | Number of Data Digits |
|-----|---------------------------------------|------------------|--|-----------------------|
| 12 | Link parameter expansion setting | Read H7F | H00: Pr. 0 to Pr. 96 values are accessible. H01: Pr. 110 to Pr. 158, Pr.900 to Pr.905 values are accessible. H02: Pr. 160 to Pr. 195 and Pr. 232 to Pr. 288 values are accessible. H03: Pr. 300 to Pr. 399 values are accessible. H04: Pr. 400 to Pr. 496 values are accessible. H05: Pr. 500 to Pr. 538 values are accessible. H06: Pr. 684 to Pr. 690 values are accessible. H08: Pr. 800 to Pr. 892 values are accessible. H09: Pr. 917 to Pr. 991 values are accessible. | 2 digits |
| | | Write HFF | CAUTION When the instruction code "HFF" was rewritten, increments of the speed monitor , write and read is changed. HFF = "0"1r/min increments HFF = "1"0.1r/min increments HFF = more than "2"1r/min increments | |
| 13 | Second parameter changing (Code FF=1) | Read H6C | When reading/setting the bias/gain (data code H5E to H61, HDE to HE1) parameters H00: Speed/torque H01: Analog | 2 digits |
| | | Write HEC | H02: Analog value of terminal (When written, the data value is any 4-digit value.) | |

REMARKS

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.

<Error code list>

The corresponding error code in the following list is displayed if an error is detected in any communication request data from the computer.

| Error Code | Error Item | Error Definition | Inverter Side Operation |
|------------|------------------------|--|---|
| H0 | Computer NAK error | The number of errors consecutively detected in communication request data from the computer is greater than the allowed number of retry times. | Brought to an alarm stop (E. PUE) 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 | Data received by the inverter is in the wrong protocol, data receive is not completed within the given time, or CR and LF are not as set in the parameter. | |
| H4 | Framing error | The stop bit length differs from the initial setting. | |
| H5 | Overrun | New data has been set 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 receive data but is not brought to alarm stop. |
| H8 | — | — | — |
| H9 | — | — | — |
| HA | Mode error | Parameter write was attempted in other than the computer link operation mode or during inverter operation. | Does not accept or receive data but is not brought to alarm stop. |
| HB | Instruction code error | The specified command does not exist. | |
| HC | Data range error | Invalid data has been specified for parameter, running frequency write, etc. | |
| HD | — | — | — |
| HE | — | — | — |
| HF | — | — | — |

(6) Communication specifications for RS-485 communication

| Operation Location | Item | Operation Mode | | |
|--|-----------------------|---|----------------------------------|---|
| | | Communication operation from PU connector | External operation | Computer link operation (When plug-in option is used) |
| On-computer user program from PU connector | Run command (start) | Enable | Disable | Disable |
| | Running speed setting | Enable | Enable (Combined operation mode) | Disable |
| | Monitoring | Enable | Enable | Enable |
| | Parameter write | Enable (*4) | Disable (*4) | Disable (*4) |
| | Parameter read | Enable | Enable | Enable |
| | Inverter reset | Enable (*2) | Enable (*2) | Enable (*2) |
| | Stop command (*3) | Enable | Enable | Enable |
| On-computer user program from plug-in option | Run command | Disable | Disable | Enable (*1) |
| | Running speed setting | Disable | Disable | Enable (*1) |
| | Monitoring | Enable | Enable | Enable |
| | Parameter write | Disable (*4) | Disable (*4) | Enable (*4) |
| | Parameter read | Enable | Enable | Enable |
| | Inverter reset | Disable | Disable | Enable (*2) |
| | Stop command (*3) | Disable | Disable | Enable |
| Control circuit terminal | Inverter reset | Enable | Enable | Enable |
| | Run command | Disable | Enable | Enable (*1) |
| | Speed setting | Disable | Enable | Enable (*1) |

(*1) As set in the Pr.79 external/PU combined mode.

(*2) At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.

(*3) As set in Pr. 75.

(*4) As set in Pr. 77.

(7) Operation at alarm occurrence

| Alarm Location | State | Operation Mode | | | |
|---|--------------------|--|--------------------|---|-----------|
| | | Communication operation (PU connector) | External operation | Computer link operation (When plug-in option is used) | |
| Inverter fault | Inverter operation | Stop | Stop | Stop | |
| | Communication | PU connector | Continued | Continued | Continued |
| | | Plug-in option | Continued | Continued | Continued |
| Communication error (Communication from PU connector) | Inverter operation | Stop/continued (*5) | Continued | Continued | |
| | Communication | PU connector | Stop | Stop | Stop |
| | | Plug-in option | Continued | Continued | Continued |

*5: Can be selected using the parameter (factory-set to Continued).

(8) Communication error

| Alarm Location | Error Message |
|--|---------------|
| Communication error (Error in communication from PU connector) | E.PUE |

3.16 PID control (Pr. 128 to Pr. 134)

3.16.1 PID control (Pr. 128 to Pr. 134 speed)

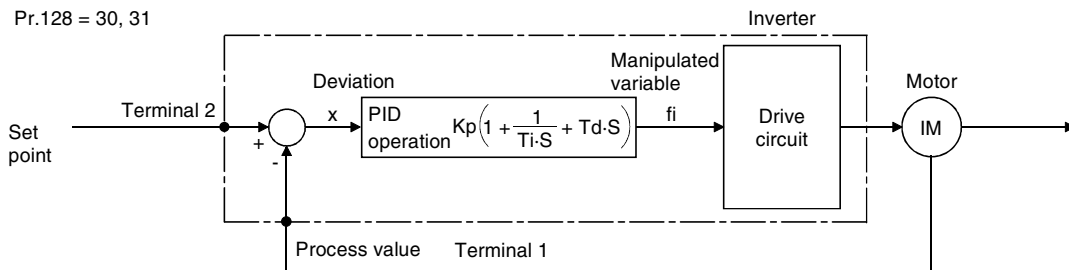
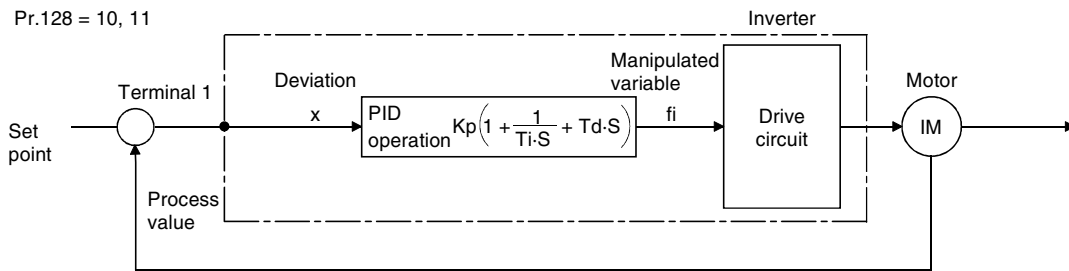
The inverter can be used to exercise process control, e.g. flow rate, air volume or pressure.

- The voltage input signal (0 to ±10V) is used as a feedback value to constitute a feedback system for PID control.

| Parameter Number | Name | Factory Setting | Setting Range | Remarks |
|------------------|---------------------------------------|-----------------|----------------------|-------------------------------|
| 128 | PID action selection | 10 | 10, 11, 30, 31 | |
| 129 | PID proportional band | 100% | 0.1 to 1000%, 9999 | 9999: No proportional control |
| 130 | PID integral time | 1s | 0.1 to 3600s, 9999 | 9999: No integral control |
| 131 | Upper limit | 9999 | 0 to 100%, 9999 | 9999: Function invalid |
| 132 | Lower limit | 9999 | 0 to 100%, 9999 | 9999: Function invalid |
| 133 | PID action set point for PU operation | 0% | 0 to 100% | |
| 134 | PID differential time | 9999 | 0.01 to 10.00s, 9999 | 9999: No differential control |

<Setting>

(1) Basic PID control configuration



Kp: Proportional constant Ti: Integral time S: Operator Td: Differential time

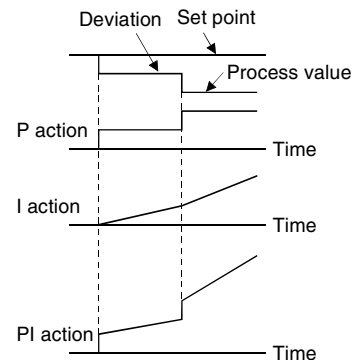
(2) PID action overview

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.

[Operation example for stepped changes of process value]

CAUTION
PI action is the sum of P and I actions.



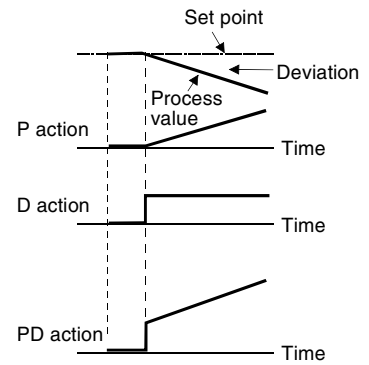
PID control (Pr. 128 to Pr. 134)

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.

[Operation example for proportional changes of process value]

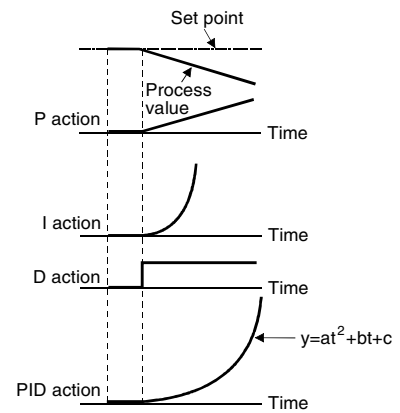
CAUTION
PD action is the sum of P and D actions.



3) PID action

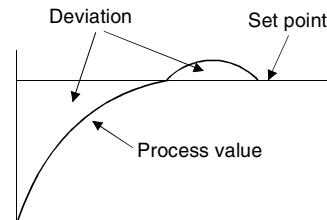
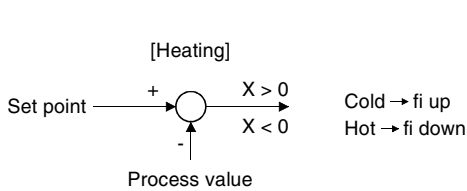
The PI action and PD action are combined to utilize the advantages of both actions for control.

CAUTION
The PID action is the sum of P and I and D actions.



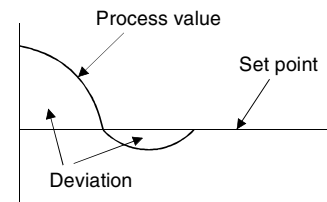
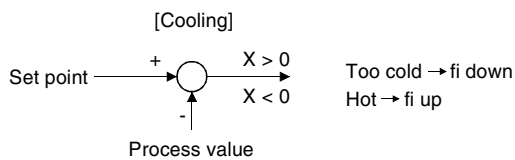
4) Reverse action

Increases the manipulated variable (output speed) if deviation X (set point - process value) is positive, and decreases the manipulated variable if deviation is negative.



5) Forward action

Increases the manipulated variable (output speed) if deviation X (set point - process value) is negative, and decreases the manipulated variable if deviation is positive.



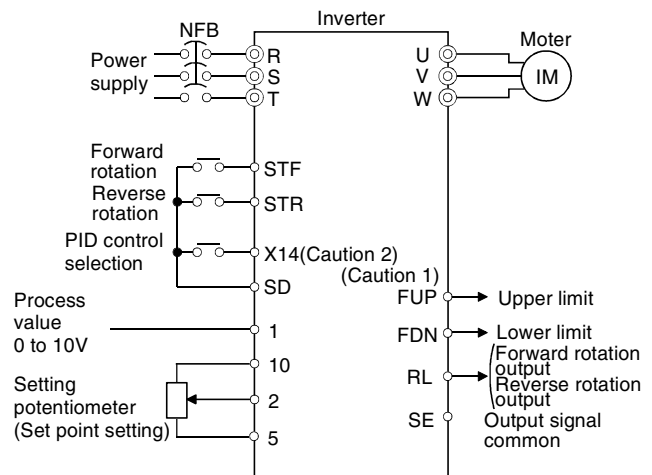
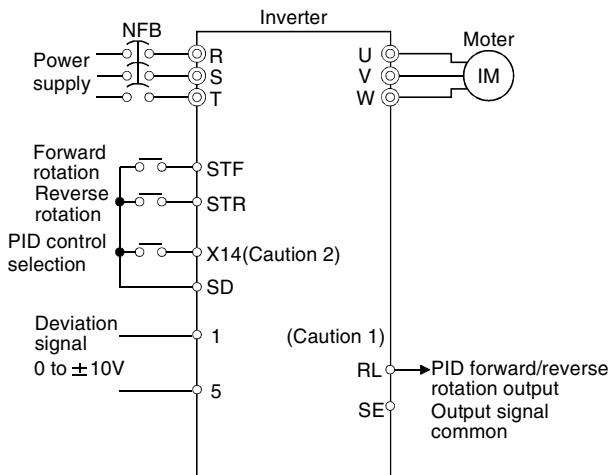
Relationships between deviation and manipulated variable (output speed)

| | Deviation | |
|----------------|-----------|----------|
| | Positive | Negative |
| Reverse Action | ↗ | ↘ |
| Forward Action | ↘ | ↗ |

(3) Wiring example

Pr.128 = 10, 11

Pr.128 = 30, 31



CAUTION

1. Set "16" to the output signal terminal used (Pr. 190 to Pr. 192, Pr. 195). (Refer to page 151.)
2. Set "14" to the input signal terminal used (Pr. 180 to Pr. 183, Pr. 187). (Refer to page 149.)

(4) I/O signals

| Signal | Terminal Used | Function | Description | Remarks | | |
|--------|---------------|---|---|--|--|--|
| Input | X14 | Depending on Pr. 180 to 183, Pr. 187 | PID control selection | Turn on X14 to select PID control. | Set any of 10, 11, 30 and 31 in Pr. 128. | |
| | 1 | 1 | Deviation signal input | Enter the deviation signal of the 0 to ±10V signal calculated externally. | When Pr. 128 = 10, 11 | Refer to Pr. 917 and Pr. 918 (page 189) for calibration. |
| | | | Process value input | Enter the 0 to 10V process value signal from the detector. | When Pr. 128 = 30, 31 | |
| | 2 | 2 | Set point input | Enter the set point for PID control. | When Pr. 128 = 30, 31 | Refer to Pr. 902 and Pr. 903 (page 189) for calibration. |
| 5 | 5 | Common terminal to the PID control setting signal (terminal 2, 1) | Isolated from terminals SD and SE. Do not earth (ground). | | | |
| Output | RL | | PID forward/reverse rotation 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). | (When Pr. 128 = 10, 11, 30, 31) | Open collector output |
| | FUP | Depending on Pr. 190 to 192, Pr. 195 | Upper limit output | Output to indicate that the process value signal exceeded the upper limit value. | When Pr. 128 = 30, 31 | |
| | | | Lower limit output | Output to indicate that the process value signal exceeded the lower limit value. | | |
| | SE | SE | Output terminal common | Common terminal for terminal RL | | |

- To start PID control, turn on the X14 signal. When this signal is off, normal inverter operation is performed without the PID action being done.
- When entering the externally calculated deviation signal, enter it across terminals 1-5. At this time, set "10" or "11" in Pr. 128.
- Enter the set point across inverter terminals 2-5 or into Pr. 133 and enter the process value signal across inverter terminals 1-5. At this time, set "30" or "31" in Pr. 128.

| Item | Entry Method | Description | |
|------------------|----------------------|---|--|
| Deviation signal | Across terminals 1-5 | Set -10V as -100% Set 0V as 0% and +10V as +100%.* | When 10 or 11 is set in Pr. 128, terminal 1 gives the deviation input signal independently of the Pr. 868 setting. |
| Set point | Across terminals 2-5 | Set 0V as 0% and 10V as +100%.* | When 30 or 31 is set in Pr. 128, terminal 1 gives the process value input signal independently of the Pr. 868 setting. |
| | Pr.133 | Set the set point (%) in Pr. 133. | |
| Process value | Across terminals 1-5 | Set 0V as 0% and +10V as +100%.* | |

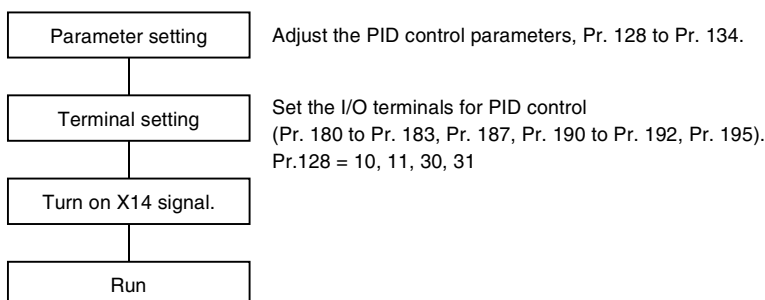
*: The value changes by calibration

(5) Parameter setting

| Parameter Number | Setting | Name | Description | |
|------------------|----------------|---------------------------------------|---|---|
| 128 | 10 | PID action selection | For heating, pressure control, etc. | Deviation value signal input (No. 1 terminal) |
| | 11 | | For cooling, etc. | PID reverse action |
| | 30 | | For heating, pressure control, etc. | Process value input (No. 1 terminal) |
| | 31 | | For cooling, etc. | PID forward action |
| 129 | 0.1 to 1000% | PID proportional band | If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the process value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain $K_p = 1/\text{proportional band}$ | |
| | 9999 | | No proportional control | |
| 130 | 0.1 to 3600s | PID integral time | Time 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 | 0 to 100% | Upper limit | Set the upper limit value. If the feedback value exceeds the setting, the FUP signal is output. (Process value of 0V is equivalent to 0% and 10V to 100%.)* | |
| | 9999 | | No function | |
| 132 | 0 to 100% | Lower limit | Set the lower limit value. (If the process value goes out of the setting range, an alarm can be output. In this case, the process value of 0V is equivalent to 0% and 10V to 100%.)* | |
| | 9999 | | No function | |
| 133 | 0 to 100% | PID action set point for PU operation | Only valid for the PU command in the PU operation or PU/external combined mode. For external operation, the voltage across terminals 2-5 is the set point. (Pr. 902 value is equivalent to 0% and Pr. 903 value to 100%.) | |
| 134 | 0.01 to 10.00s | PID differential time | Time required for only the differential (D) action to provide the same manipulated variable as that for the proportional (P) action. As the differential time increases, greater response is made to a deviation change. | |
| | 9999 | | No differential control. | |

*: The value changes by calibration

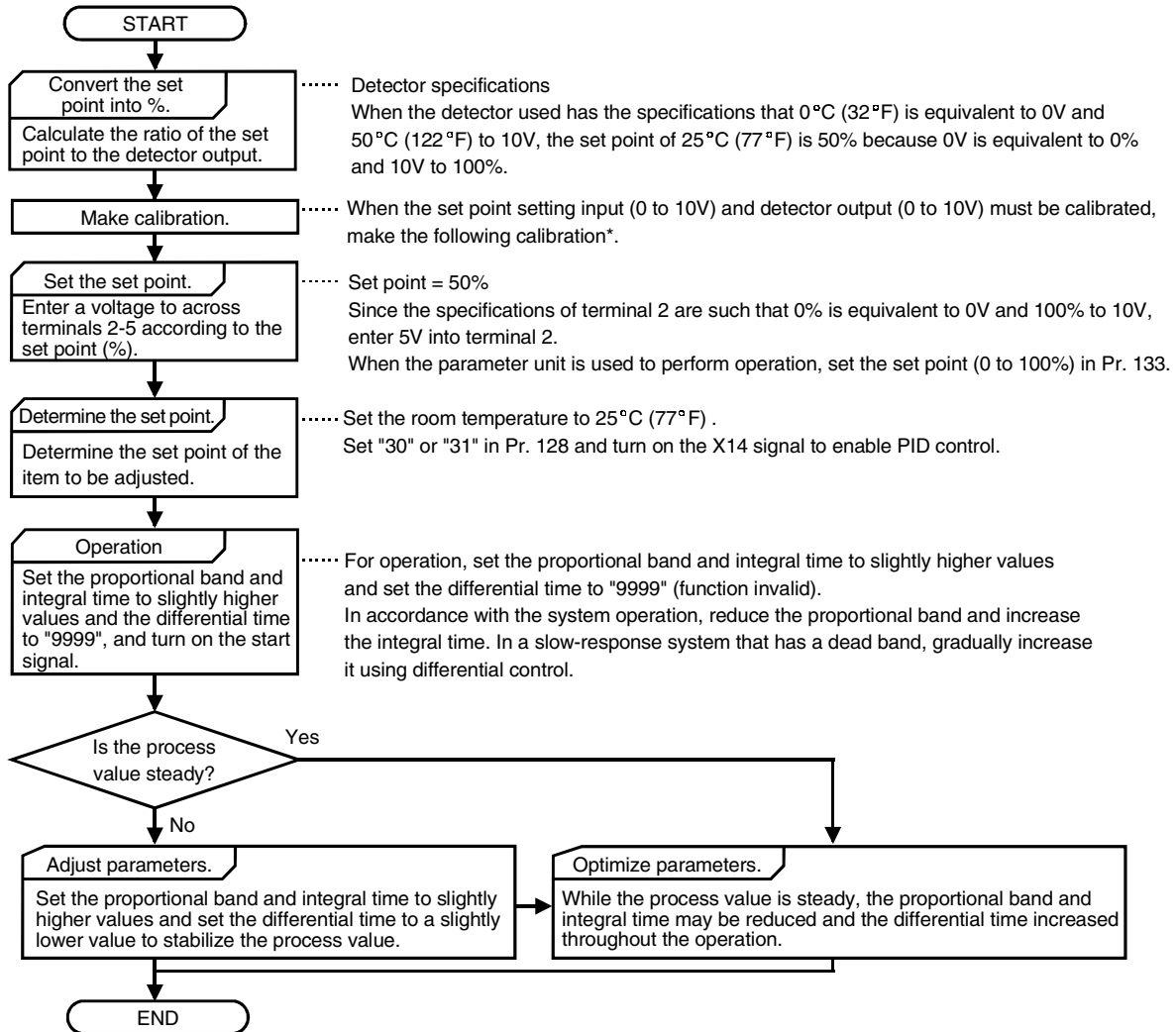
(6) Adjustment procedure



(7) Adjustment example

(A detector of 0V at 0°C (32°F) and 10V at 50°C (122°F) is used to adjust the room temperature to 25°C (77°F) under PID control.

The set point is given to across inverter terminals 2-5 (0 to 10V.)



* Calibration is required → Calibrate the set point setting input and detector output using Pr. 902, Pr. 903, Pr. 917 and Pr. 918. Make calibration in the PU mode during inverter stop.

(8) Calibration example

<Set point input calibration>

1. Apply the input voltage of 0% set point setting (e.g. 0V) to across terminals 2-5.
2. Make calibration using Pr. 902. At this time, enter the speed output by the inverter at the deviation of 0% (e.g. 0r/min).
3. Apply the voltage of 100% set point setting (e.g. 10V) to across terminals 2-5.
4. Make calibration using Pr. 903. At this time, enter the speed output by the inverter at the deviation of 100% (e.g. 1500r/min).

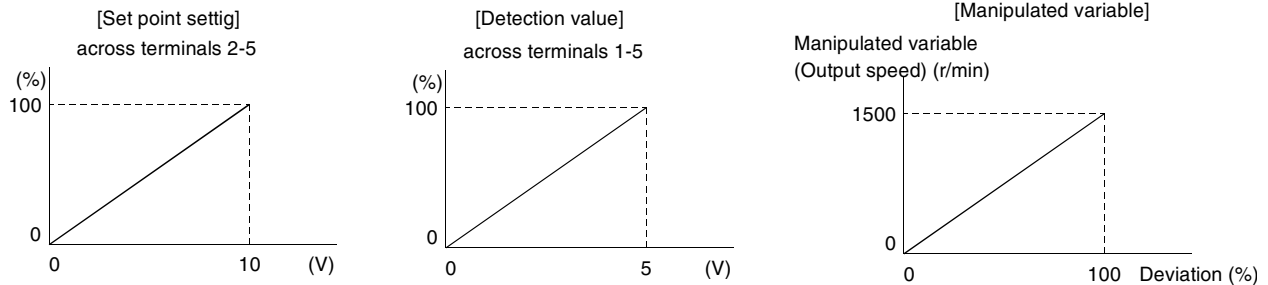
<Detector output calibration>

1. Apply the output current of 0% detector setting (e.g. 0V) to across terminals 1-5.
2. Make calibration using Pr. 917.
3. Apply the output current of 100% detector setting (e.g. 5V) to across terminals 1-5.
4. Make calibration using Pr. 918.

CAUTION

The frequencies set in Pr. 917 and Pr. 918 should be the same as set in Pr. 902 and Pr. 903.

The results of the above calibration are as shown below:



CAUTION

1. If the multi-speed (RH, RM, RL) signal or jog operation (jog) signal is entered with the X14 signal on, PID control is stopped and multi-speed or jog operation is started.
2. When "6" (switchover mode) is selected for Pr. 79, PID is made invalid.
3. When "1" (online auto tuning) is selected for Pr. 95, PID control is made invalid.
4. Changing the terminal function using any of Pr. 180 to 183 and Pr. 187 and Pr. 190 to 192 and Pr. 195 may affect the other functions. Confirm the functions of the corresponding terminals before making setting.
5. When PID control is selected, the minimum speed is as set in Pr. 902 and the maximum speed is as set in Pr. 903.
(Pr. 1 "maximum speed" and Pr. 2 "minimum speed" settings are also valid.)

Related parameters

- Pr. 73 "speed setting signal" (Refer to page 114.)
- Pr. 79 "operation mode selection" (Refer to page 118.)
- Pr. 180 to Pr. 183, Pr. 187 (input terminal function selection) (Refer to page 149.)
- Pr. 191 to Pr. 192, Pr. 195 (output terminal function selection) (Refer to page 151.)
- Pr. 902, Pr. 903, Pr. 917, Pr. 918 (Speed setting terminal bias/gain) (Refer to page 182.)

Pr. 140 to Pr. 143 ➔ Refer to Pr. 29 (page 91)

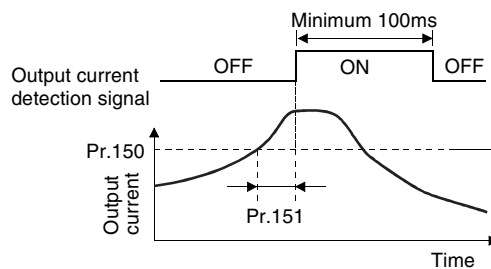
Pr. 144 ➔ Refer to Pr. 37 (page 95)

3.17 Current detection (Pr. 150 to Pr. 153)

3.17.1 Output current detection function (Pr. 150, Pr. 151 speed torque position)

- 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 output terminal.
(Use any of Pr. 190 to Pr. 192 and Pr. 195 to assign the terminal used for Y12 signal output.)

| Parameter | Name | Factory Setting | Setting Range |
|-----------|--------------------------------|-----------------|---------------|
| 150 | Output current detection level | 150% | 0 to 200.0% |
| 151 | Output current detection time | 0 | 0 to 10s |



<Setting>

Refer to the following table and set the parameters.

| Parameter | Description |
|-----------|---|
| 150 | Set the output current detection level. 100% is the rated inverter current. |
| 151 | Set the output current detection time. Set the time from when the output current has risen above the setting until the output current detection signal (Y12) is output. |

CAUTION

1. Once turned on, the output current detection signal is held on for at least 100ms.
2. This function is also valid during execution of the online or offline auto tuning.
3. Changing the terminal function using any of Pr. 190 to 192 and Pr. 195 may affect the other functions. Confirm the functions of the corresponding terminals before making setting.
4. When "0" is set in Pr. 151, the output current detection time is about 50ms.

Related parameters

- Y12 signal terminal assignment ⇒ Pr. 190 to Pr. 192, Pr. 195 (output terminal function selection) (Refer to page 151.)

3.17.2 Zero current detection (Pr. 152, Pr. 153) speed torque position

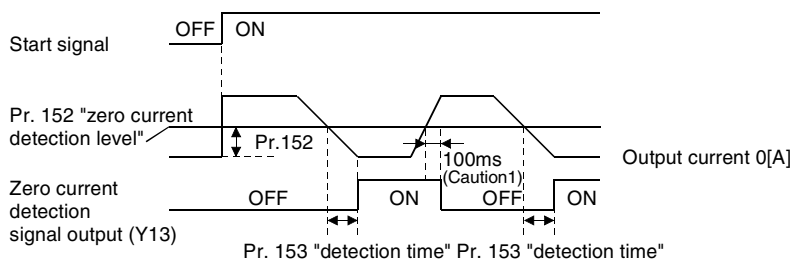
When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop to occur when the inverter is used in vertical lift application.

To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".

- 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 output terminal.

(Use any of Pr. 190 to Pr. 192 and Pr. 195 to assign the terminal used for Y13 signal output.)

| Parameter | Name | Factory Setting | Setting Range |
|-----------|------------------------------|-----------------|---------------|
| 152 | Zero current detection level | 5.0% | 0 to 200.0% |
| 153 | Zero current detection time | 0.5s | 0 to 1s |



<Setting>

Refer to the following table and set the parameters.

| Parameter | Description |
|-----------|--|
| 152 | Set the zero current detection level. Set this parameter to define the percentage of the rated current at which the zero current will be detected. |
| 153 | Set the current detection time. Set this parameter to define the period from when the output current drops below the Pr. 152 value until the zero current detection signal (Y13) is output. |

CAUTION

1. If the current rises above the preset detection level and the condition is not satisfied, the zero current detection signal is held on for about 100ms.
2. This function is also valid during execution of the online auto tuning.
3. Changing the terminal function using any of Pr. 190 to 192 and Pr. 195 may affect the other functions. Confirm the functions of the corresponding terminals before making setting.
4. When "0 to 0.04" is set in Pr. 153, the zero current detection time is about 50ms.

⚠ CAUTION

- ⚠ 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.
- ⚠ 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.

Related parameters

- Y13 signal terminal assignment ⇒ Pr. 190 to Pr. 192, Pr. 195 (output terminal function selection) (Refer to page 151.)

3.18 Auxiliary functions (Pr. 156, Pr. 157)

3.18.1 Stall prevention operation selection (Pr. 156 speed torque position)

Make setting to disable stall prevention activated by overcurrent and/or to prevent the inverter from resulting in an overcurrent trip if an excessive current flows due to sudden load fluctuation or running inverter output side ON-OFF (to disable fast-response current restriction that limits the current). An OL signal output delay can be set in Pr. 157.

- Stall prevention (only during V/F control)
Automatically change the output speed of the inverter to reduce the amount of current when the current flow exceeds the current restriction value.
- High response current restriction
Shut off the output of the inverter to prevent overcurrent when the current flows exceeds the current restriction value.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--------------------------------------|-----------------|-------------------|---------------|
| 156 | Stall prevention operation selection | 1 | 0 to 31, 100, 101 | Extended mode |

| Setting | Fast-Response Current Restriction ○ : Activated ● : Not activated | Stall Prevention ○ : Activated | | | OL Signal Output ○ : Operation continued ● : Operation not continued (Caution1) |
|---------|---|-----------------------------------|----------------|--------------|---|
| | | Acceleration | Constant speed | Deceleration | |
| 0 | ○ | ○ | ○ | ○ | ○ |
| 1 | ● | ○ | ○ | ○ | ○ |
| 2 | ○ | ● | ○ | ○ | ○ |
| 3 | ● | ● | ○ | ○ | ○ |
| 4 | ○ | ○ | ● | ○ | ○ |
| 5 | ● | ○ | ● | ○ | ○ |
| 6 | ○ | ● | ● | ○ | ○ |
| 7 | ● | ● | ● | ○ | ○ |
| 8 | ○ | ○ | ○ | ● | ○ |
| 9 | ● | ○ | ○ | ● | ○ |
| 10 | ○ | ● | ○ | ● | ○ |
| 11 | ● | ● | ○ | ● | ○ |
| 12 | ○ | ○ | ● | ● | ○ |
| 13 | ● | ○ | ● | ● | ○ |
| 14 | ○ | ● | ● | ● | ○ |
| 15 | ● | ● | ● | ● | ○ |
| 16 | ○ | ○ | ○ | ○ | ● |
| 17 | ● | ○ | ○ | ○ | ● |
| 18 | ○ | ● | ○ | ○ | ● |
| 19 | ● | ● | ○ | ○ | ● |
| 20 | ○ | ○ | ● | ○ | ● |
| 21 | ● | ○ | ● | ○ | ● |
| 22 | ○ | ● | ● | ○ | ● |
| 23 | ● | ● | ● | ○ | ● |

| Setting | Fast-Response Current Restriction ○ : Activated ● : Not activated | Stall Prevention ○ : Activated | | | OL Signal Output ○ : Operation continued ● : Operation not continued (Caution1) |
|----------------|---|-----------------------------------|----------------|--------------|---|
| | | Acceleration | Constant speed | Deceleration | |
| 24 | ○ | ○ | ○ | ● | ● |
| 25 | ● | ○ | ○ | ● | ● |
| 26 | ○ | ● | ○ | ● | ● |
| 27 | ● | ● | ○ | ● | ● |
| 28 | ○ | ○ | ● | ● | ● |
| 29 | ● | ○ | ● | ● | ● |
| 30 | ○ | ● | ● | ● | ● |
| 31 | ● | ● | ● | ● | ● |
| 100 | Driving | ○ | ○ | ○ | ○ |
| | Regenerative | ● | ● | ● | ○ |
| 101(Caution 3) | Driving | ● | ○ | ○ | ○ |
| | Regenerative | ● | ● | ● | ○ |

CAUTION

1. When "Operation not continued for OL signal output" is selected, the "E. OLT" alarm code (stopped by stall prevention) is displayed and operation stopped. (Alarm stop display "E. OLT")
2. For the lift application, make setting to disable fast-response current restriction. Otherwise the torque may not be generated, resulting in the lift drop with gravity.
3. When the setting value is "101", fast-response current restriction at driving is well disabled compared to when "100" is set.

⚠ CAUTION

⚠ Always perform test operation.

Stall prevention operation performed during acceleration may increase the acceleration time.

Stall prevention operation performed during constant speed may cause sudden speed changes.

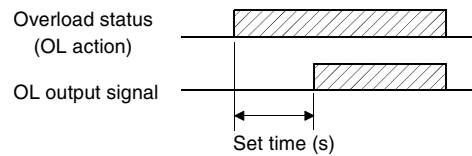
Stall prevention operation performed during deceleration may increase the deceleration time, increasing the deceleration distance.

3.18.2 OL signal output timer (Pr. 157 speed torque position)

Use this parameter to set whether the overload alarm signal (OL signal) is output immediately or a preset period of time after occurrence of an overload status.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------|-----------------|----------------|------------------------|
| 157 | OL signal output timer | 0.1s | 0 to 25s, 9999 | 9999: No signal output |

- V/F control On when stall prevention operation level is exceeded.
- Speed control On when torque restriction is activated.
- Torque control On when speed restriction is activated.
- Position control ... On when torque restriction is activated.



<Setting>

Refer to the following table and set the parameter.

| Pr. 157 Setting | Description |
|-----------------|--|
| 0 | Output immediately. |
| 0.1 to 25 | Output after the set time (s) has elapsed. |
| 9999 | Overload alarm signal is not output. |

Related parameters

- OL signal terminal assignment ⇒ Set 3 in any of Pr. 190 to Pr. 192, Pr. 195 (output terminal function selection). (Refer to page 151.)

Pr.158 ➡ Refer to Pr. 54 (page 151).

3.19 Display function 3 (Pr. 160)

3.19.1 Extended function display selection (Pr. 160 speed torque position)

Used to display the extended function parameters.

- Refer to page 62 for the extended function parameter list.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------------|-----------------|---------------|---|
| 160 | Extended function selection | 0 | 0 | Only the simple mode parameters are accessible. |
| | | | 1 | All parameters are accessible. |

Pr. 162 to Pr. 165 → Refer to Pr. 57 (page 103).

3.20 Initial monitor (Pr. 171)

3.20.1 Actual operation hour meter clear (Pr. 171 speed torque position)

You can clear the actual operation hour of the monitoring function.

| Parameter | Name | Factory Setting | Setting Range |
|-----------|-----------------------------------|-----------------|---------------|
| 171 | Actual operation hour meter clear | 0 | 0 |

<Setting>

Write "0" in the corresponding parameter to clear the actual operation hour.

REMARKS

The actual operation time is the value monitored by setting "23" in Pr. 52.

Related parameters

- Pr. 52 "DU/PU main display data selection" (Refer to page 99.)

3.21 Terminal assignment functions (Pr. 180 to Pr. 195)

3.21.1 Input terminal function selection

(Pr. 180 to Pr. 183, Pr. 187 speed torque position)

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

| Parameter | Name | Terminal Symbol | Factory-Set Value | Factory-Set Terminal Function | Setting Range | Remarks |
|-----------|---------------------------------|-----------------|-------------------|---|--|-------------------|
| 180 | DI1 terminal function selection | DI1 | 0 | Low speed operation command (RL) | 0 to 3, 5, 8 to 12, 14 to 16, 20, 22 to 27, 42 to 44, 9999 | 9999: No function |
| 181 | DI2 terminal function selection | DI2 | 1 | Middle speed operation command (RM) | | |
| 182 | DI3 terminal function selection | DI3 | 2 | High speed operation command (RH) | | |
| 183 | DI4 terminal function selection | DI4 | 3 | Second function/ second motor switchover (RT) | | |
| 187 | STR terminal function selection | STR | 9999 | Reverse rotation command (STR) | | 9999: STR |

Terminal assignment functions (Pr. 180 to Pr. 195)

<Setting>

Refer to the following table and set the parameters.

| Setting | Signal Name | Functions | | Related Parameters | Response Time |
|---------|-------------|---|--------------------------------|--|---------------|
| 0 | RL | Pr. 59 = 0 | Low speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | Within 20ms |
| | | Pr. 59 = 1, 2 * | Remote setting (setting clear) | | |
| 1 | RM | Pr. 59 = 0 | Middle speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | |
| | | Pr. 59 = 1, 2, 3 * | Remote setting (deceleration) | | |
| 2 | RH | Pr. 59 = 0 | High speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | |
| | | Pr. 59 = 1, 2, 3* | Remote setting (acceleration) | | |
| 3 | RT | Second function selection | | Pr. 44 to Pr. 50, Pr. 450 to Pr. 457, Pr. 463 | |
| 5 | JOG | Jog operation selection | | Pr. 15, Pr. 16 | |
| 8 | REX | 15-speed selection (combination with three speeds RL, RM, RH) | | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | |
| 9 | X9 | Third function | | Pr. 110, Pr. 111, Pr. 116 | |
| 10 | X10 | FR-HC connection, FR-CV connection (inverter operation enable) | | Pr. 30, Pr. 70 | Within 2ms |
| 11 | X11 | FR-HC connection (instantaneous power failure detection) (only when FR-A5NR option is fitted) | | Pr. 30, Pr. 70 | Within 20ms |
| 12 | X12 | PU operation external interlock signal | | Pr. 79 | |
| 14 | X14 | PID control enable terminal | | Pr. 128 to Pr. 134 | |
| 15 | BRI | Brake sequence opening completion signal | | Pr. 278 to Pr. 285 | |
| 16 | X16 | PU/external operation switchover | | Pr. 79 | |
| 20 | X20 | S-pattern acceleration/deceleration C switchover | | Pr. 29, Pr. 380 to Pr. 383 | |
| 22 | X22 | Orientation command (Caution 4) | | Pr. 350 to Pr. 369 | |
| 23 | LX | Pre-excitation/servo on (Caution 5) | | Pr. 802 | |
| 24 | MRS | Output stop | | Pr. 17 | |
| 25 | STOP | Start self-holding selection | | — | |
| 26 | MC | Control mode changing | | — | |
| 27 | TL | Torque restriction selection | | Pr. 815 | |
| 42 | X42 | Torque bias selection 1 | | — | |
| 43 | X43 | Torque bias selection 2 | | — | |
| 44 | X44 | P control selection (P/PI control switchover) | | — | |
| 9999 | STR | Reverse rotation start | | STR terminal (Pr. 187) only (Note) DI1 to DI4 functions are made invalid. | — |

* When Pr. 59 = "1, 2, or 3", the functions of the RL, RM, RH and RT signals change as listed above.

CAUTION

1. One signal can be assigned to two or more terminals. In this case, the terminal inputs are ORed.
2. The speed command priorities are higher in order of jog, multi-speed setting (RH, RM, RL, REX) and PID (X14).
3. Use common terminals to assign multi-speeds (7 speeds) and remote setting. They 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.)
4. The FR-A5AX (12-bit digital input) is needed to externally input a stop position under orientation control.
5. Made valid under vector control.

3.21.2 Output terminal function selection

(Pr. 190 to Pr. 192, Pr. 195 speed torque position)

You can change the functions of the open collector output terminal and contact output terminal.

| Parameter | Name | Factory-Set Value | Factory-Set Signal Function | Setting Range | Remarks |
|-----------|---------------------------------|-------------------|---|---|---------------|
| 190 | DO1 terminal function selection | 0 | RUN (Inverter running) | 0 to 8, 10 to 16, 20, 26, 27, 30 to 37, 40 to 44, 96 to 99, 100 to 108, 110 to 116, 120, 125 to 127, 130 to 137, 140 to 144, 196 to 199, 9999 | Extended mode |
| 191 | DO2 terminal function selection | 1 | SU (Up to speed) | | |
| 192 | DO3 terminal function selection | 2 | IPF (Instantaneous power failure/ undervoltage) | | |
| 195 | ABC terminal function selection | 99 | A, B, C (Alarm output) | | |

<Setting>

Refer to the following table and set the parameters.

| Setting | | Signal Name | Function | Operation | Related Parameters | Response Time |
|----------------|----------------|-------------|---|--|--|---------------|
| Positive logic | Negative logic | | | | | |
| 0 | 100 | RUN | Inverter running | This signal is output during operation when the inverter output speed rises to or above the starting speed. During DC injection brake, 0 speed control or servo lock, this signal is not output. However, LX is output as ON under position control. | — | Within 20ms |
| 1 | 101 | SU | Up to speed | Refer to Pr. 41 "up-to-speed sensitivity" (page 97). (Caution 1) | — | — |
| 2 | 102 | IPF | Instantaneous power failure or undervoltage | Output at occurrence of an instantaneous power failure or undervoltage. | — | — |
| 3 | 103 | OL | Overload alarm | Output when torque or speed restriction is activated. For V/F control, this signal is output while the stall prevention function is activated. | Pr. 22, Pr. 806, Pr. 807, Pr. 812 to Pr. 817 | — |
| 4 | 104 | FU | Output speed detection | Refer to Pr. 42, Pr. 43, Pr. 50 and Pr. 116 (speed detection) (page 97). | — | Within 20ms |
| 5 | 105 | FU2 | Second output speed detection | | | |
| 6 | 106 | FU3 | Third output speed detection | | | |
| 7 | 107 | RBP | Regenerative brake prealarm | Output when 85% of the regenerative brake duty set in Pr. 70 is reached. | Pr. 70 | — |
| 8 | 108 | THP | Electronic thermal relay prealarm | Output when the electronic thermal relay cumulative value reaches 85% of the preset level. | Pr. 9 | — |
| 10 | 110 | PU | PU operation mode | Output when the PU operation mode is selected. | — | Within 20ms |
| 11 | 111 | RY | Inverter operation ready | Output when the inverter can be started by switching the start signal on or while it is running. | | |
| 12 | 112 | Y12 | Output current detection | Refer to Pr. 150 and Pr. 151 (output current detection). | Pr. 150, Pr. 151 | — |
| 13 | 113 | Y13 | Zero current detection | Refer to Pr. 152 and Pr. 153 (zero current detection). | Pr. 152, Pr. 153 | — |
| 14 | 114 | FDN | PID lower limit | Refer to Pr. 128 to Pr. 134 (PID control). | Pr. 128 to Pr. 134 | Within 20ms |
| 15 | 115 | FUP | PID upper limit | | | |
| 16 | 116 | RL | PID forward-reverse rotation output | | | |
| 20 | 120 | BOF | Brake opening request | Refer to Pr. 278 to Pr. 285 (brake sequence function). | Pr. 278 to Pr. 285 | — |



Terminal assignment functions (Pr. 180 to Pr. 195)

| Setting | | Signal Name | Function | Operation | Related Parameters | Response Time | |
|----------------|----------------|-------------|----------------------------|---|---------------------------|---------------|-------------|
| Positive logic | Negative logic | | | | | | |
| 26 | 126 | FIN | Fin overheat prealarm | Output when the heatsink temperature reaches about 85% of the fin overheat protection activating temperature. | — | — | |
| 27 | 127 | ORA | Orientation in-position | When orientation is valid (Refer to page 158) | | | |
| 30 | 130 | Y30 | Forward rotation output | On: Forward rotation under vector control Off: Other controls | | | Within 20ms |
| 31 | 131 | Y31 | Reverse rotation output | On: Reverse rotation under vector control Off: Other controls | | | |
| 32 | 132 | Y32 | Regenerative status output | On: Regeneration under vector control Off: Other controls (include stop, pre-excitation) | | | |
| 33 | 133 | RY2 | Operation ready 2 | Output on completion of pre-excitation. Turned on at an output start when pre-excitation is not made. | Pr. 802 | — | |
| 34 | 134 | LS | Low speed output | Output when the speed falls to or below any preset low speed. | Pr. 865 | | |
| 35 | 135 | TU | Torque detection | Output when the motor torque rises above the predetermined value. | Pr. 864 | | |
| 36 | 136 | Y36 | In-position | Output when positioning is completed under position control. | — | Within 20ms | |
| 37 | 137 | MT | Maintenance timer output | When Pr. 891 ≥ Pr. 890, the MT output signal turns on and the warning indication MT appears. | Pr. 890, Pr. 891 | — | |
| 40 | 140 | Y40 | Trace status | Refer to the instruction manual of the trace option. | — | | |
| 41 | 141 | FB | Speed detection | Output when the inverter output speed rises to or above the preset speed. Refer to Pr. 42, Pr.43, Pr. 50, and Pr. 116 (speed detection) (page 97). | — | Within 20ms | |
| 42 | 142 | FB2 | Second speed detection | | | | |
| 43 | 143 | FB3 | Third speed detection | | | | |
| 44 | 144 | RUN2 | Inverter running 2 | <ul style="list-style-type: none"> Output during forward operation or the reverse signal is ON. Output at deceleration even during forward rotation or the reverse 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)) | — | — | |
| 96 | 196 | REM | Remote output | You can use the on/off of signals instead of the remote output function of the PLC. | Pr. 495, Pr. 496, Pr. 497 | Within 20ms | |
| 97 | 197 | ER | Minor fault output 2 | At occurrence of a major fault, the base circuit is shut off immediately. At occurrence of a minor fault, the base circuit is shut off after deceleration to a stop. | Pr. 875 | | |
| 98 | 198 | LF | Minor fault output | Output when a minor fault (fan fault or communication error alarm) occurs. | Pr. 121, Pr. 244 | | |
| 99 | 199 | ABC | Alarm output | Output when the inverter's protective function is activated to stop the output (major fault). | — | | |
| 9999 | — | — | No function | — | — | — | |

0 to 99: Positive logic

100 to 199: Negative logic

CAUTION

- Note that when the speed setting is varied using an analog signal or / of the operation panel, the output of the SU (up to speed) 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".)
- The same function may be set to more than one terminal.
- Pr. 190 to Pr. 192 and Pr. 195 do not function if the values set are other than the above.

Pr.232 to Pr.239 ➡ Refer to Pr. 4 (page 80).

Pr.240 ➡ Refer to Pr. 72 (page 113).

3.22 Auxiliary function (Pr. 244)

3.22.1 Cooling fan operation selection (Pr. 244 speed torque position)

You can control the operation of the cooling fan built in the inverter.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------------------|-----------------|---------------|---------------|
| 244 | Cooling fan operation selection | 0 | 0, 1 | Extended mode |

<Setting>

| Setting | Description |
|---------|---|
| 0 | Operated with power on (independently of whether the inverter is running or at a stop). |
| 1 | Cooling fan on-off control valid (The cooling 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 temperature.) |

3.23 Stop selection function (Pr. 250)

3.23.1 Stop selection (Pr. 250 speed torque)

Used to select the stopping method (deceleration to a stop or coasting) when the start signal (STF/STR) turns off.

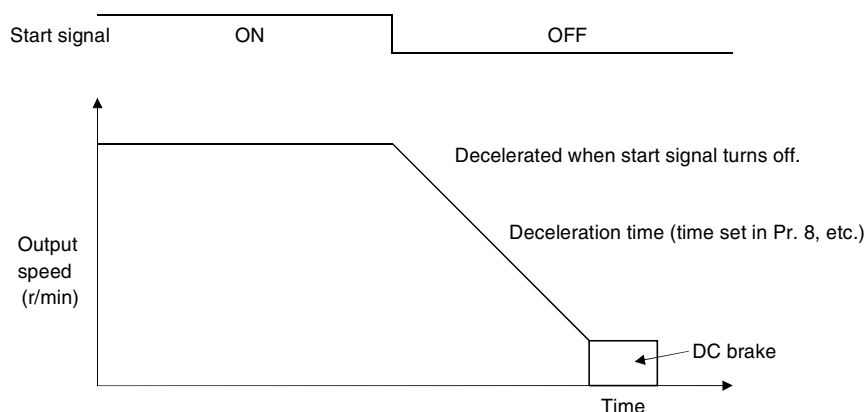
This function is valid for V/F control, speed control, and torque control only.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|----------------|-----------------|-----------------|---------------|
| 250 | Stop selection | 9999 | 0 to 100s, 9999 | Extended mode |

Operation selection function (Pr. 251)

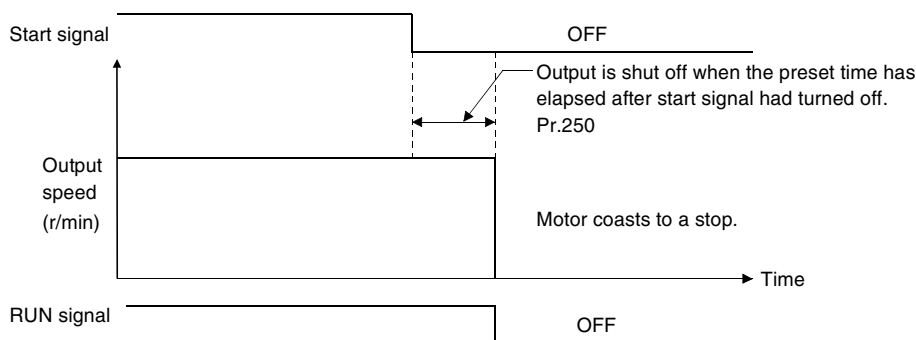
(1) Pr. 250 = "9999"

When the start signal turns off, the motor is decelerated to a stop.



(2) Pr. 250 = other than "9999" (Output is shut off after preset time)

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.



CAUTION

1. The RUN signal turns off when the output stops.
2. When the start signal is turned on again during motor coasting, the motor starts at 0Hz.
3. The output speed becomes the speed restriction value during torque control.

3.24 Operation selection function (Pr. 251)

3.24.1 Output phase failure protection selection (Pr. 251 speed torque position)

You can disable the output phase failure protection (E.LF) function that will stop the inverter output if any of the three phases (U, V, W) on the inverter output side (load side) opens.

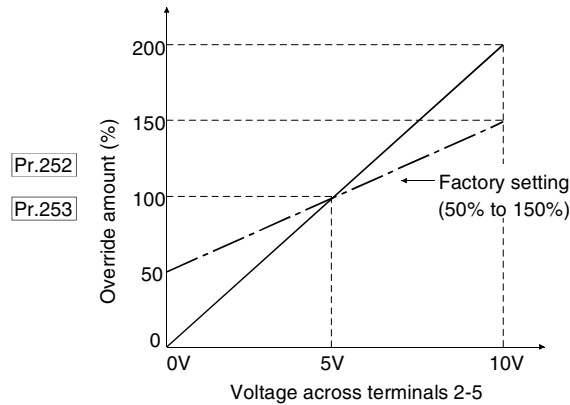
| Parameter | Name | Setting Range | Minimum Setting Increments | Factory Setting | Description | Remarks |
|-----------|---|---------------|----------------------------|-----------------|---|---------------|
| 251 | Output phase failure protection selection | 0, 1 | 1 | 1 | 0: Without output phase failure protection 1: With output phase failure protection | Extended mode |

3.25 Additional function 2 (Pr. 252, Pr. 253)

3.25.1 Override bias, gain (Pr. 252, Pr. 253 speed torque)

When override is selected in Pr. 73 "speed setting signal", the override range of 50% to 150% can be increased (to between 0% and 200%) as desired.

| Parameter | Name | Setting Range | Minimum Setting Increments | Factory Setting | Remarks |
|-----------|---------------|---------------|----------------------------|-----------------|---------------|
| 252 | Override bias | 0 to 200% | 0.1% | 50% | Extended mode |
| 253 | Override gain | 0 to 200% | 0.1% | 150% | |



Related parameters

- ⇒ Pr. 73 "speed setting signal" (Refer to page 114.)

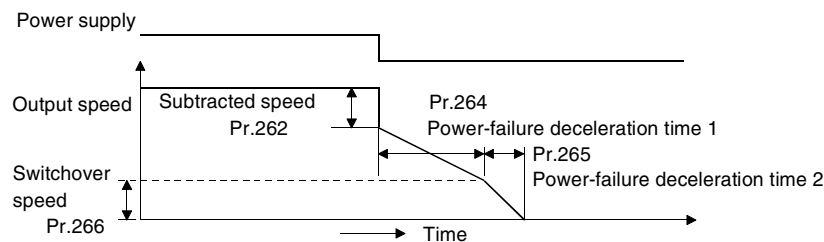
3.26 Power failure stop functions (Pr. 261 to Pr. 266)

3.26.1 Power-failure deceleration stop function (Pr. 261 to Pr. 266 speed torque)

When a power failure or undervoltage occurs, the inverter can be decelerated to a stop.

- Remove the jumpers from across terminals R-R1 and S-S1, and connect terminal R1 to terminal P and terminal S1 to terminal N.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|--------------------------------|---------------------------|---------------|
| 261 | Power failure stop selection | 0 | 0, 1 | Extended mode |
| 262 | Subtracted speed at deceleration start | 90r/min | 0 to 600r/min | |
| 263 | Subtraction starting speed | Japanese version: 1500r/min | 0 to 3600r/min, 9999 | |
| | | NA version:1800r/min | | |
| 264 | Power-failure deceleration time 1 | 5s | 0 to 3600/0 to 360s | |
| 265 | Power-failure deceleration time 2 | 9999 | 0 to 3600/0 to 360s, 9999 | |
| 266 | Power-failure deceleration time switchover speed | Japanese version: 1500r/min | 0 to 3600r/min | |
| | | NA version:1800r/min | | |



<Setting>

| Parameter | | Setting | Description |
|-----------|------------|----------------|---|
| 261 | | 0 | Coasting to stop When undervoltage or power failure occurs, the inverter output is shut off. |
| | | 1 | When undervoltage or power failure occurs, the inverter is decelerated to a stop. |
| 262 | | 0 to 600r/min | Normally, operation can be performed with the factory setting unchanged, but the speed can be adjusted within the range 0 to 600r/min according to the load specifications (inertia moment, torque). |
| 263 | | 0 to 3600r/min | If the output speed at occurrence of undervoltage or power failure is equal to or greater than the speed set in Pr. 263, deceleration starts at the value found by subtracting the speed set in Pr. 262 from the output speed at that time. If the output speed at occurrence of undervoltage or power failure is less than the speed set in Pr. 263, the inverter is decelerated to a stop, starting at the output speed at that time. |
| | | 9999 | The inverter is decelerated to a stop, starting at the value found by subtracting the speed set in Pr. 262 from the output speed at occurrence of undervoltage or power failure. |
| 264 | Pr. 21 = 0 | 0 to 3600s | Set a deceleration slope down to the speed set in Pr. 266. Set the slope in terms of time required for deceleration from the speed set in Pr. 20 to 0r/min. |
| | Pr. 21 = 1 | 0 to 360s | |
| 265 | Pr. 21 = 0 | 0 to 3600s | Set a deceleration slope below the speed set in Pr. 266. Set the slope in terms of time required for deceleration from the speed set in Pr. 20 to 0r/min. |
| | Pr. 21 = 1 | 0 to 360s | |
| | | 9999 | Same slope as in Pr. 264. |
| 266 | | 0 to 3600r/min | Set the speed at which the deceleration slope is switched from the Pr. 264 setting to the Pr. 265 setting. |

CAUTION

1. **This function is invalid when the automatic restart after instantaneous power failure function is activated.**
2. **For the output speed at occurrence of undervoltage or power failure, the calculation result is regarded as 0r/min if the speed set in Pr. 262 is negative.**
3. **The power failure stop function is not activated if a power failure occurs during a stop or error.**
4. **If power is restored during deceleration, the inverter is kept decelerated to a stop. To restart, turn off the start signal once, then turn it on again.**
5. **This function is not activated when the high power factor converter or power regeneration common converter is used (Pr. 30 = 2).**

⚠ CAUTION

**⚠ If power-failure deceleration operation is set, some loads may cause the inverter to trip and the motor to coast.
The motor will coast if enough regenerative energy is given from the motor.**

Related parameters

- ⇒ Pr. 12 "DC injection brake voltage" (Refer to page 85.)
- ⇒ Pr. 20 "acceleration/deceleration reference speed", Pr. 21 "acceleration/deceleration time increments" (Refer to page 81.)

Pr.278 to Pr.285 ➡ Refer to Pr.60 (page 107).

3.27 Droop (Pr. 286 to Pr. 288)

3.27.1 Droop control (Pr. 286 to Pr. 288 speed)

This function is designed to balance the load in proportion to the load torque to provide the speed drooping characteristic.

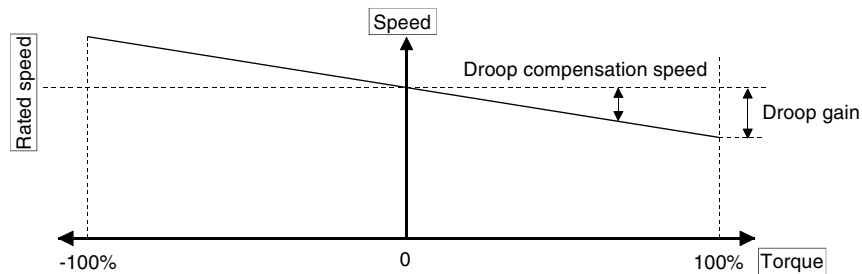
This function is effective for balancing the load when using multiple inverters

- The speed command is varied according to the magnitude of the motor load (load meter of the inverter). The drooping amount at the rated torque is set by the droop gain as a percentage using the rated speed as a reference.

$$\text{Droop compensation speed} = \frac{\text{Amount of torque current after filtering}}{100\% \text{ torque amount current}} \times \frac{\text{Rated speed} \times \text{droop gain}}{100}$$

- Droop control is made valid when Pr. 286 is other than "0".

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------------------------|-----------------|---------------|---|
| 286 | Droop gain | 0% | 0 to 100% | The drooping amount at the rated torque is set by the droop gain as a percentage using the rated speed as a reference. When the setting value is "0", the function will be invalid. |
| 287 | Droop filter constant | 0.3s | 0.00 to 1.00s | Set the time constant of the primary delay filter applied to the torque current. |
| 288 | Droop function activation selection | 0 | 0 | Droop control is not exercised during acceleration/deceleration. |
| | | | 1 | Droop control is always exercised during operation. (speed command after droop is zero limited) |
| | | | 2 | Droop control is always exercised during operation (speed command after droop is not zero limited) |



Pr. 342 ➔ Refer to Pr. 117 (page 128).

3.28 Orientation (Pr. 350 to Pr. 362, Pr. 393 to Pr. 399)

3.28.1 Orientation control (Pr. 350, Pr. 351, Pr. 356, Pr. 357, Pr. 360 to Pr. 362, Pr. 393, Pr. 396 to Pr. 399 speed)

Orientation is a function that stops a motor shaft at a preset position using the motor built-in position detector (PLG). Install the option (FR-V5AM or FR-A5AP, T-PLG50) on the inverter to perform stop position command control with a position detector (PLG) fitted to the machine. Refer to the instruction manual of the option for details.

Pr. 350 "stop position command selection" is factory-set to "9999" to make the orientation control function invalid.

| Parameter No. | Name | Setting Range | Factory Setting | Remarks |
|---------------|-------------------------------------|------------------|-----------------|---------------|
| 350 | Stop position command selection | 0, 1, 2, 9999 | 9999 | Extended mode |
| 351 | Orientation switchover speed | 0 to 1000r/min | 200r/min | |
| 356 | Internal stop position command | 0 to 16383 | 0 | |
| 357 | Orientation in-position zone | 0 to 8192 | 11 | |
| 360 | External position command selection | 0, 1, 2 to 127 | 0 | |
| 361 | Position shift | 0 to 16383 | 0 | |
| 362 | Orientation position loop gain | 0.1 to 100 | 10 | |
| 393 | Orientation selection | 1, 2, 10, 11, 12 | 0 | |
| 396 | Orientation speed gain (P term) | 0 to 1000 | 60 | |
| 397 | Orientation speed integral time | 0 to 20.0s | 0.333 | |
| 398 | Orientation speed gain (D term) | 0 to 100.0% | 1 | |
| 399 | Orientation deceleration ratio | 0 to 1000 | 20 | |

REMARKS

Check the Pr. 851 and Pr. 852 settings. (Refer to the Instruction Manual (basic).)

<Settings>

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.

(1) Setting I/O Signals

| | | | |
|--------|-----------------------------|------------|--|
| Input | Orientation command | X22 signal | Orientation control is valid with the signal on. Set "22" in any of Pr. 180 to Pr.183 or Pr. 187 (input terminal function selection). (Refer to page 149.) |
| Output | Orientation complete signal | ORA signal | Switched low if the orientation has stopped within the in-position zone while the start and orientation signals are input. Open collector output Permissible load 24VDC, 0.1A Set 27 in any of Pr.190 to Pr. 192 or Pr. 195 (output terminal function selection). (Refer to page 151.) |

(2) Selecting stop position command (Pr. 350 "stop position command selection")

Select either the internal stop position command (Pr. 356) or the external stop position command (6/12/16-bit data).

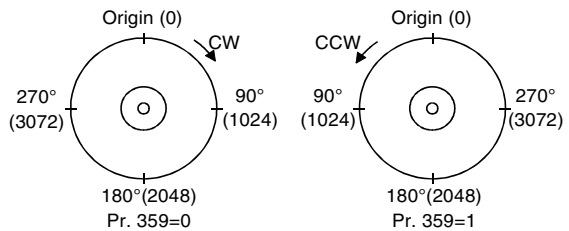
| Pr. 350 Setting | Type of Command |
|---------------------------|--|
| 0 | Internal stop position command (Pr. 356:0 to 16383) |
| 1 | External stop position command (FR-V5AX) 6-bit data |
| 2 | External stop position command (FR-A5AX) 12-bit data |
| 3 | External stop position command (FR-V5AH) 16-bit data |
| 9999 (factory setting) | Orientation control invalid |

(1) Internal stop position command (Pr. 350="0")

The value set in Pr. 356 is the stop position.

When the number of PLG pulses is 1024p/r, one revolution of the PLG (360°) is divided into 4096 positions, i.e. $360^\circ/4096$ pulses = 0.0879°/pulses per address, as shown on the right.

The stop positions (addresses) are indicated in parentheses.



(2)-1 External stop position command (Pr. 350="1")

(Pr. 360 "external position command selection" (factory setting: 0))

Mount the option FR-V5AX and set a stop position using 6-bit data (binary input).

- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

| Pr. 360 Setting | Description |
|-----------------|--|
| 0 | External position command is made invalid (multi-function input with the FR-V5AX) |
| 1 | Set 64 stop positions at regular intervals |
| 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. Note that the stop command greater than the 64 stop positions can not be entered if the number of stop positions are 65 to 128. <Example> When the number of stop positions is 20 (divided at intervals of 18°), $20 - 1 = 19$. Hence, set "19". |

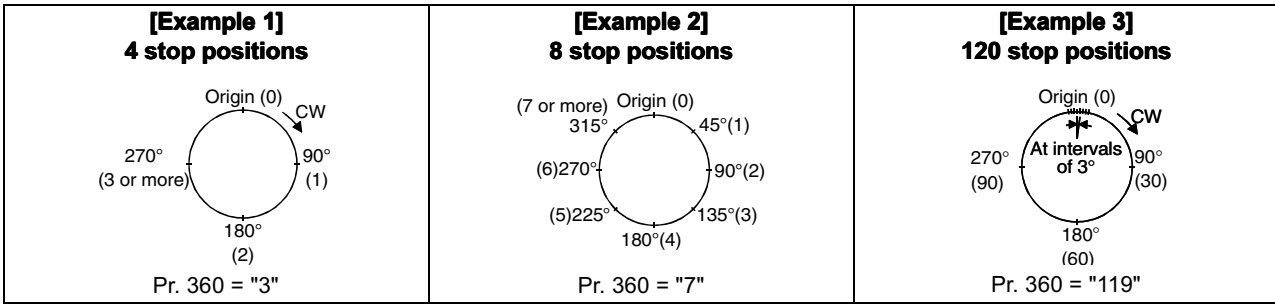
| | | |
|---|---|--|
| <p>[Example 1] 4 stop positions</p> | <p>[Example 2] 8 stop positions</p> | <p>[Example 3] 120 stop positions</p> <p>The external stop command can not be entered.</p> |
|---|---|--|

(2)-2 External stop position command (Pr. 350="2")

Mount the option FR-A5AX and set a stop position using 12-bit data (binary input).

- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

| Pr. 360 Setting | Description |
|-----------------|--|
| 0 | External position command is made invalid (speed command with the FR-A5AX) |
| 1 | Set 4096 stop positions at regular intervals |
| 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. <Examples> When the number of stop positions is 90 (divided at intervals of 4°), $90 - 1 = 89$. Hence, set "89". |



CAUTION

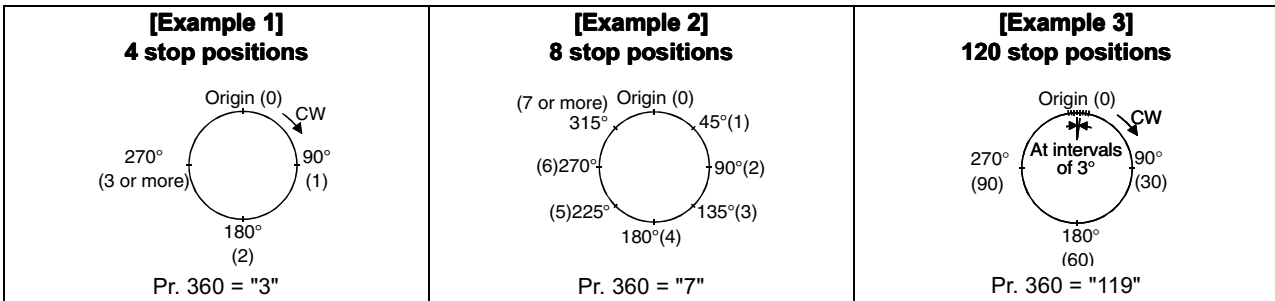
- Values in parentheses indicate binary data entered from the terminals. If the position pulse monitoring (Pr. 52 "DU/PU main display screen data selection" = 19) is selected, the data monitored is not the number of stop positions but is 0 to 4095 pulses.
- When any of "1 to 127" is set in Pr. 360, parameters (Pr. 300 to Pr. 305) of the FR-A5AX are made invalid. (Parameters are valid when Pr. 360="0".)
- Terminal DY (Data read timing input signal) is made invalid. (The position data is downloaded at the start of orientation.)
- When the option is not fitted or Pr. 360="0", the stop position is 0 even if the external stop position command is selected with the Pr. 350 setting.

(2)-3 External stop position command (Pr. 350="3")

Mount the option FR-V5AH and set a stop position using 16-bit data (binary input).

- The value set in Pr. 360 "external position command selection" should be the number of stop positions less 1.

| Pr. 360 Setting | Description |
|-----------------|--|
| 0 | External position command is made invalid (speed command or torque command with the FR-V5AH) |
| 1 | Set 65536 stop positions at regular intervals |
| 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". |



CAUTION

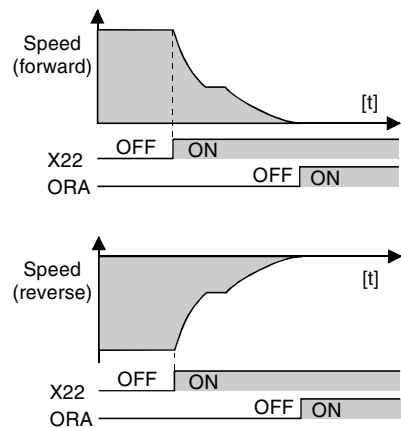
- Values in parentheses indicate binary data entered from the input terminals. If the position pulse monitoring (Pr. 52 "DU/PU main display screen data selection" = 19) is selected, the data monitored is not the number of stop positions but is 0 to 65535 pulses.
- When any of "1 to 127" is set in Pr. 360, parameters (Pr. 300 to Pr. 305) of the FR-V5AH are made invalid. (Parameters are valid when Pr. 360="0".)
- Terminal DY (Data read timing input signal) is made invalid. (The position data is downloaded at the start of orientation.)
- When the option is not fitted or Pr. 360="0", the stop position is 0 even if the external stop position command is selected with the Pr. 350 setting.

(3) Setting the rotation direction (Pr. 393 "orientation selection")

| Pr. 393 setting | Rotation Direction | Type | Remarks |
|------------------------|------------------------------|--|--|
| 0 (factory setting) | Pre-orientation | Motor end orientation | Orientation is executed from the current rotation direction. |
| 1 | Forward rotation orientation | | 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 | Reverse rotation orientation | | 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.) |
| 10 | Pre-orientation | Machine end orientation (when the FR-V5AM or FR-A5AP is used) | Refer to the instruction manual of the option for details. |
| 11 | Forward rotation orientation | | |
| 12 | Reverse rotation orientation | | |

(1) Orientation from the current rotation direction

- When the orientation command (terminal X22) is input, the motor speed will decelerate from the running speed to Pr. 351 "orientation switchover speed". At the same time, the orientation stop position command will be read in. (The stop position command is determined by the settings of Pr.350 and Pr.360. Refer to the diagram on the right.)
- When the orientation switchover speed is reached, the PLG Z phase pulse will be confirmed, and the mode will change from speed control to position control (orientation position loop gain parameter (Pr. 362)).
- When the control is changed, the distance to the orientation stop position will be calculated. The motor will decelerate and stop with a set deceleration pattern (Pr. 399), and the orientation (servo lock) state will be entered.
- When entered in the Pr. 357 in-position zone is entered, the orientation complete signal (terminal ORA) will be output.
- The zero point position (origin) can be moved using position shift (Pr. 361).



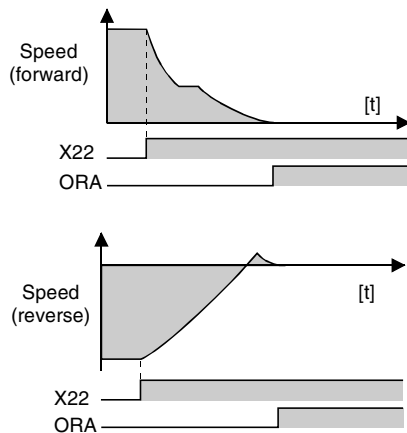
⚠ WARNING

⚠ If the orientation command (terminal 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.

(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.

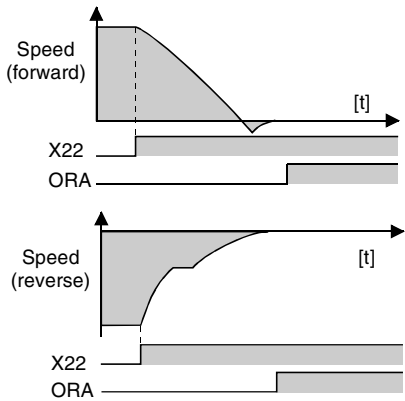
If the motor is running in the forward rotation direction, it will orientation stop with the same method as "orientation from the current rotation direction". If the motor is running in reverse, it will decelerate, the rotation direction will be changed to forward run, and then orientation stop will be executed.



Orientation (Pr. 350 to Pr. 362, Pr. 393 to Pr. 399)

(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.



CAUTION

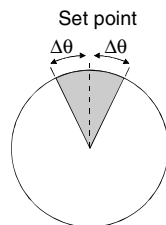
1. The PLG should be coupled with the motor shaft or the spindle oriented with a speed ratio of 1 to 1 without any mechanical looseness.
2. To ensure correct positioning, the PLG must be set in the proper rotation direction and the A and B phases connected correctly.
3. The orientation may not be completed if the pulse signal is not given from the PLG during orientation due to an open cable, etc.
4. To terminate orientation, the start signal (STF or STR) must be first switched off and the orientation signal (X22) must be switched off. As soon as this orientation signal is switched off, orientation control ends.
5. For orientation control, set correct values in Pr. 350 "stop position command selection" and Pr. 360 "external position command selection"
If the values set are incorrect, proper orientation control will not be performed.
6. When orientation control is exercised, PID control is invalid.

REMARKS

If "E.ECT" (no encoder signal) is displayed causing the inverter to trip when the orient signal (X22) is ON, check for an open cable of the Z phase of the encoder.

- Pr. 357 "orientation in-position zone" (factory setting:11)
- The positioning width for orientation stop can be set. The factory setting of Pr. 357 is "11". To change the $\Delta\theta$ value, finely adjust with ± 10 increments, and make fine adjustment.
- If the position detection value from the PLG enters $\pm\Delta\theta$ during orientation stop, the orientation complete signal (ORA) will be output.

Example of operation



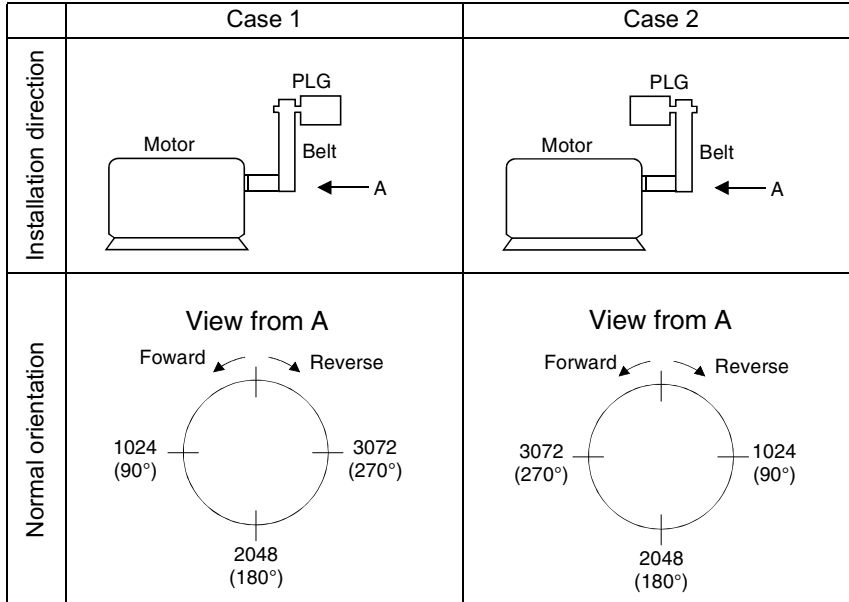
$$\Delta\theta = \frac{360^\circ}{\text{Pr.851 number of PLG pulses} \times 4} \times \text{Pr.357}$$

CAUTION

This setting is used to judge the ON/OFF of the orientation complete signal, and does not determine the orientation stop precision.

(4) Fine adjustment of the orientation stop position (Pr. 361 "position shift" (factory setting: 0))

The orientation stop position will deviate by the value set x 360° / Pr. 851 "number of PLG pulses" x 4.
 Finely adjust the position by changing this setting value in 10 increments.
 The orientation stop position will differ according to the direction that the PLG is installed in.
 (Refer to the drawings below.)



(5) Adjustment of the servo rigidity

- Pr. 396 "orientation speed gain (P term)" (factory setting: 60)
 - Pr. 397 "orientation speed integral time" (factory setting: 0.333)
 - Pr. 398 "orientation speed gain (D term)" (factory setting: 1)
 - Pr. 362 "orientation position loop gain" (factory setting: 10)
- To increase the servo rigidity*1 during orientation stop in Pr. 396 or 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.
 - 2) Increase Pr. 396 and 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 provided 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.

POINT

Application of lag/advance control and PI control
 PI control can be applied by setting Pr. 398 to 0. Normally, the lag/advance control is selected. Use PI control in the following cases.
 When using a machine with a high spindle stationary friction torque and requires a stopping position precision.

REMARKS

*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 setting 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 (Pr. 350 to Pr. 362, Pr. 393 to Pr. 399)


- Pr. 399 "orientation deceleration ratio" (factory setting: 20)
- 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.

| Phenomenon | 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) ↗ | → |

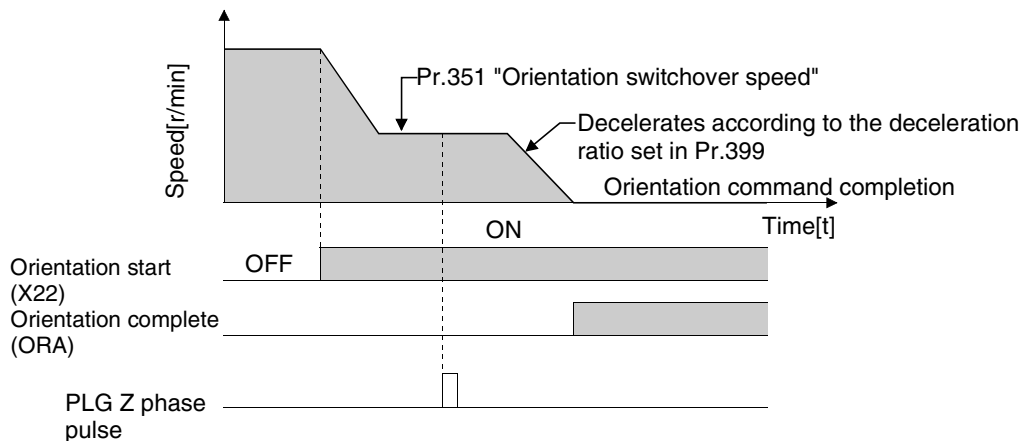
REMARKS

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.

CAUTION

If orientation stop is not possible and the 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 161.) and Pr. 852 "PLG rotation direction" (Refer to the Instruction Manual (basic).)

- Pr. 351 "orientation switchover speed" (factory setting: 200)
Set the speed when switching between the speed control mode and the position control mode under orientation operation. Decreasing the set speed enables stable orientation stop. Note that the orientation time will increase.



REMARKS

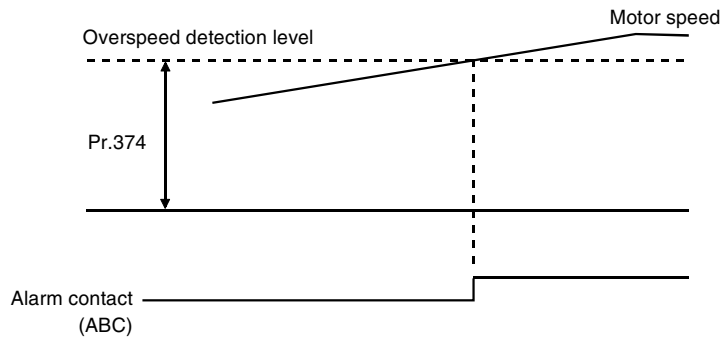
When "19" is set in Pr. 52 "DU/PU main display data selection", position pulse monitor is displayed instead of PU output voltage monitor.

3.29 Control system function (Pr. 374)

3.29.1 Overspeed detection (Pr. 374 speed torque position)

- Excess of the motor speed over the overspeed detection level results in E.OS, stopping the output. This function is enabled only under speed control, torque control or position control.

| Parameter | Name | Setting Range | Factory Setting | Remarks |
|-----------|---------------------------|----------------|--------------------------------|---------------|
| 374 | Overspeed detection level | 0 to 4200r/min | Japanese version: 3450r/min | Extended mode |
| | | | NA version: 4200r/min | |



REMARKS

This function is enabled under speed control, torque control or position control.

Pr. 380 to Pr. 383 ➔ Refer to Pr. 29 (page 91).

3.30 Position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494)

3.30.1 Position control (Pr. 419 to Pr. 430, Pr. 464 to Pr. 494 position)

| Parameter | Name | Setting Range | Factory Setting |
|-----------|--|-------------------------|-------------------|
| 419 | Position command right selection | 0, 1 | 0 |
| 420 | Command pulse scaling factor numerator | 0 to 32767 | 1 |
| 421 | Command pulse scaling factor denominator | 0 to 32767 | 1 |
| 422 | Position loop gain | 0 to 150s ⁻¹ | 25s ⁻¹ |
| 423 | Position feed forward gain | 0 to 100% | 0% |
| 424 | Position command acceleration/deceleration time constant | 0 to 50s | 0s |
| 425 | Position feed forward command filter | 0 to 5s | 0s |
| 426 | In-position width | 0 to 32767 pulses | 100 pulses |
| 427 | Excessive level error | 0 to 400K, 9999 | 40K |
| 430 | Pulse monitor selection | 0 to 5, 9999 | 9999 |
| 464 | Digital position control sudden stop deceleration time | 0 to 360.0s | 0 |

| Parameter | Name | Setting Range | Factory Setting | Selection Method | | | | Positioning Speed |
|-----------|--|---------------|-----------------|------------------|-----|-----|-----|---------------------|
| | | | | REX | RH | RM | RL | |
| 465 | First position feed amount lower 4 digits | 0 to 9999 | 0 | OFF | ON | OFF | OFF | High speed, Pr. 4 |
| 466 | First position feed amount upper 4 digits | | | OFF | OFF | ON | OFF | Middle speed, Pr. 5 |
| 467 | Second position feed amount lower 4 digits | | | OFF | OFF | OFF | ON | Low speed, Pr. 6 |
| 468 | Second position feed amount upper 4 digits | | | OFF | OFF | ON | ON | Speed 4, Pr. 24 |
| 469 | Third position feed amount lower 4 digits | | | OFF | ON | OFF | ON | Speed 5, Pr. 25 |
| 470 | Third position feed amount upper 4 digits | | | OFF | ON | ON | OFF | Speed 6, Pr. 26 |
| 471 | Fourth position feed amount lower 4 digits | | | OFF | ON | ON | ON | Speed 7, Pr. 27 |
| 472 | Fourth position feed amount upper 4 digits | | | ON | OFF | OFF | OFF | Speed 8, Pr. 232 |
| 473 | Fifth position feed amount lower 4 digits | | | ON | OFF | OFF | ON | Speed 9, Pr. 233 |
| 474 | Fifth position feed amount upper 4 digits | | | ON | OFF | ON | OFF | Speed 10, Pr. 234 |
| 475 | Sixth position feed amount lower 4 digits | | | ON | OFF | ON | ON | Speed 11, Pr. 235 |
| 476 | Sixth position feed amount upper 4 digits | | | ON | ON | OFF | OFF | Speed 12, Pr. 236 |
| 477 | Seventh position feed amount lower 4 digits | | | ON | ON | OFF | ON | Speed 13, Pr. 237 |
| 478 | Seventh position feed amount upper 4 digits | | | ON | ON | ON | OFF | Speed 14, Pr. 238 |
| 479 | Eighth position feed amount lower 4 digits | | | ON | ON | ON | ON | Speed 15, Pr. 239 |
| 480 | Eighth position feed amount upper 4 digits | | | | | | | |
| 481 | Ninth position feed amount lower 4 digits | | | | | | | |
| 482 | Ninth position feed amount upper 4 digits | | | | | | | |
| 483 | Tenth position feed amount lower 4 digits | | | | | | | |
| 484 | Tenth position feed amount upper 4 digits | | | | | | | |
| 485 | Eleventh position feed amount lower 4 digits | | | | | | | |
| 486 | Eleventh position feed amount upper 4 digits | | | | | | | |
| 487 | Twelfth position feed amount lower 4 digits | | | | | | | |
| 488 | Twelfth position feed amount upper 4 digits | | | | | | | |
| 489 | Thirteenth position feed amount lower 4 digits | | | | | | | |
| 490 | Thirteenth position feed amount upper 4 digits | | | | | | | |
| 491 | Fourteenth position feed amount lower 4 digits | | | | | | | |
| 492 | Fourteenth position feed amount upper 4 digits | | | | | | | |
| 493 | Fifteenth position feed amount lower 4 digits | | | | | | | |
| 494 | Fifteenth position feed amount upper 4 digits | | | | | | | |

Refer to page 51 for details of position control.

Pr. 450 ➔ Refer to Pr. 71 (page 112).

Pr. 451 ➔ Refer to Pr. 800 (page 169).

Pr. 452 ➔ Refer to Pr. 9 (page 83).

Pr. 453, Pr. 454 ➔ Refer to page 34.

Pr. 464 to Pr. 494 ➔ Refer to page 51.

3.31 Remote Output (Pr. 495 to Pr.497)

3.31.1 Remote output function (Pr. 495 to Pr.497 speed torque position)

You can utilize the on/off of the inverter's output signals instead of the remote output function of the programmable controller.(Use Pr. 190 to Pr. 192 and Pr. 195 to set the output signals. Refer to page 151.)

| Parameter | Name | Factory Setting | Setting Range | Description | Remarks |
|-----------|-------------------------|-----------------|---------------|---|---------------|
| 495 | Remote output selection | 0 | 0 | Remote output data cleared at power failure | Extended mode |
| | | | 1 | Remote output data held at power failure | |
| 496 | Remote output data 1 | 0 | 0 to 4095 | Refer to the following diagram. | |
| 497 | Remote output data 2 | 0 | 0 to 4095 | | |

<Remote output data>

Pr. 496

| b11 | | | | | | b0 | | | | | |
|-----|------------|------------|------------|---|---|-----|---|---|-----|-----|-----|
| * | DO13 ** | DO12 ** | DO11 ** | * | * | ABC | * | * | DO3 | DO2 | DO1 |

*: As desired (always 0 when read)

**DO11 to DO13 are available only when the extension output option (FR-V5AY) is fitted.

Pr. 497

| b11 | | | | | | b0 | | | | | |
|-----|-------------|------------|------------|------------|----------|----------|----------|----------|----------|----------|----------|
| * | RA0 **** | RA3 *** | RA2 *** | RA1 *** | Y6 ** | Y5 ** | Y4 ** | Y3 ** | Y2 ** | Y1 ** | Y0 ** |

*: As desired (always 0 when read)

** :Y0 to Y6 are available only when the extension output option (FR-A5AY) is fitted.

***:RA1 to RA3 are available only when the extension output option (FR-A5AR) is fitted.

****:RA0 is available only when the extension output option (FR-A5NR) is fitted.

(1) Operation

By setting 1 in the corresponding bit of Pr. 496, the output terminal that has been set to 96 (positive logic) or 196 (negative logic) in any of Pr. 190 to Pr. 192 and Pr. 195 turns on (off for negative logic). By setting 0, the output terminal turns off (on for negative logic).

If a power failure occurs at the Pr. 495 setting of 0, the output data are cleared to zero after power recovery and the output terminals turn on/off in accordance with the positive/negative logic settings of Pr. 190 to Pr. 192 and Pr. 195.

When the Pr. 495 setting is 1, the remote output data at occurrence of a power failure are stored into E²PROM to make the output data at power recovery the same as those at a power failure, and the on/off states of the output terminals are also made the same as those at a power failure. (They are not stored at an inverter reset.)

If the terminals of remote output and non-remote output are mixed using Pr. 190 to Pr. 192 and Pr. 195, the terminal to which remote output is not assigned will not turn on/off even if 0/1 is set in the corresponding bit of the remote output data (Pr. 496), and that terminal turns on/off with respect to the selected function.

(2) Others

Setting Pr. 496, Pr. 497 with the PU/DU, by computer link through the PU connector, or by communication through the communication option allows the on/off control of the remote output terminals.

Pr. 496, Pr. 497 is always accessible by making access to RAM only. When the inverter is reset, therefore, the Pr. 496, Pr. 497 setting changes to 0. When Pr. 495 = 1, however, that setting is the same as at a power failure.

If you change the Pr. 495 setting of 1 to 0 with the Pr. 496 and Pr. 497 value stored in E²PROM at occurrence of a power failure, the Pr. 496 and Pr. 497 value stored changes to 0.

CAUTION

When Pr. 495 = 1, take such a step as to connect R1, S1 and P, N to ensure that control power will be retained to some degree. If you do not take such a step, the output signals provided after power-on are not guaranteed.

Related parameters

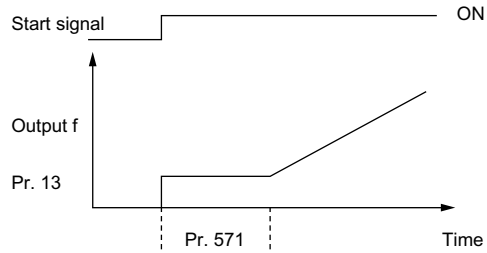
- Pr. 190 to Pr. 192, Pr. 195 (output terminal function selection) (Refer to page 151.)

3.32 Additional function 3 (Pr. 591)

3.32.1 Start holding time (Pr. 591 speed)

| Parameter | Name | Factory Setting | Setting Range |
|-----------|--------------------|-----------------|----------------|
| 591 | start holding time | 9999 | 0 to 10s, 9999 |

- The output frequency will be held at the start frequency for the time set in Pr. 571. This setting is invalid when Pr. 571 is set to 9999. This function is enabled only V/F control or speed control.



3.33 Operation selection functions 4 (Pr. 800 to Pr. 809)

3.33.1 Control selection (Pr. 800, Pr. 451 speed torque position)

Used to select the control method.

- Setting Pr. 800 (Pr. 451) control system selection enables the following combination using the MC signal (mode changing). Use terminal RT to switch to the second motor, control method selection.

| Parameter | Name | Factory Setting | Setting Range |
|-----------|---------------------------------------|-----------------|---------------|
| 800 | Control system selection | 0 | 0 to 5, 20 |
| 451 | Second motor control method selection | 9999 | 20, 9999 |

- Select the inverter control system such as speed control, torque control or position control.

| Pr. 800 Setting | Control System | Control Method | Remarks |
|------------------------|--------------------|--|---|
| 0 (factory setting) | PLG vector control | Speed control | Factory setting |
| 1 | | Torque control | — |
| 2 | | Speed control-torque control switchover | MC ON: Torque control MC OFF: Speed control |
| 3 | | Position control | — |
| 4 | | Speed control-position control switchover | MC ON: Position control MC OFF: Speed control |
| 5 | | Position control-torque control switchover | MC ON: Torque control MC OFF: Position control |
| 20 | V/F control | Speed control | — |

Related parameters

MC signal terminal assignment ⇒ Set "26" in any of Pr. 180 to Pr. 183 and Pr. 187 (input terminal function selection). (Refer to page 149.)

3.33.2 Torque characteristic selection (Pr. 801 speed torque position)

When using the motor with PLG, you can select the torque characteristic.

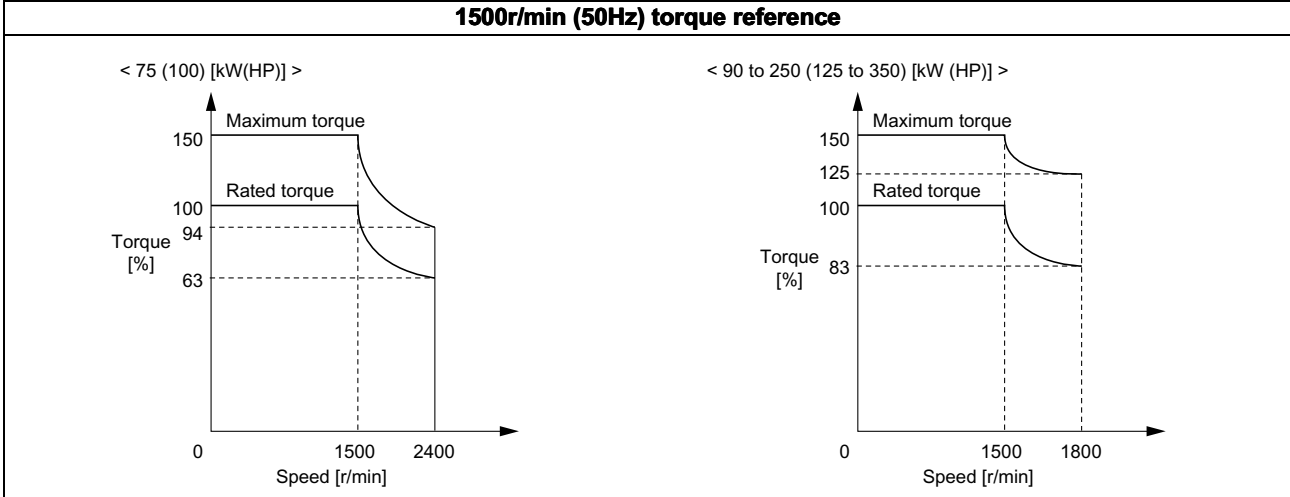
| Parameter | Name | Factory Setting | Setting Range | |
|-----------|---------------------------------|-----------------|--------------------------|------------------------------|
| | | | Dedicated motor (SF-THY) | Motor with PLG (e.g. SF-LHA) |
| 801 | Torque characteristic selection | 1 | 0 | Cyclic operation mode |
| | | | 1 | Continuous operation mode |

CAUTION

- **Whether the motor used is a Mitsubishi dedicated motor or motor with PLG is judged by the setting of Pr. 71 "applied motor". Refer to page 112.**
- **Usually, operate in the continuous operation mode (setting value : 1)
Torque at a low speed is not sufficient in the cyclic operation mode (setting value : 0).
Note this when changing the setting.**

● Mitsubishi dedicated motor torque characteristic

Torque characteristic available when the inverter and motor of the same capacity are used and the rated voltage is input



| Continuous operation mode setting and Cyclic operation mode setting | |
|--|---|
| Continuous operation mode setting | Cyclic operation mode setting |
| <p>This continuous mode is the inverter mode that inverter output voltage at rating load and rating speed is set to rating voltage of the motor. As there is little voltage difference between the input voltage and motor rating voltage, the inverter voltage might be limited to maximum voltage. So the torque characteristic will be bad or the inverter might have over current.</p> | <p>This cycle mode is the inverter mode that output voltage at rating load and rating speed is set to about 80% of motor voltage. At this mode the torque characteristic will be improved. As the output current of the motor increase, the motor will not be able to be used continuously.</p> |

Pr. 802 ➔ Refer to Pr. 10 to Pr. 12 (page 85).

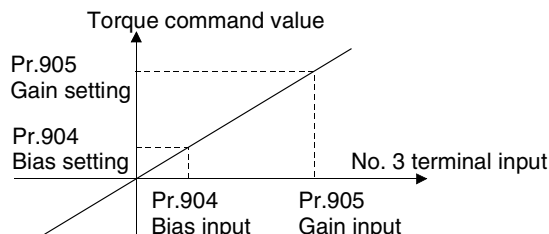
Pr. 803 ➔ Refer to Pr. 22 (page 89).

3.33.3 Torque command right selection (Pr. 804 to Pr. 806 torque)

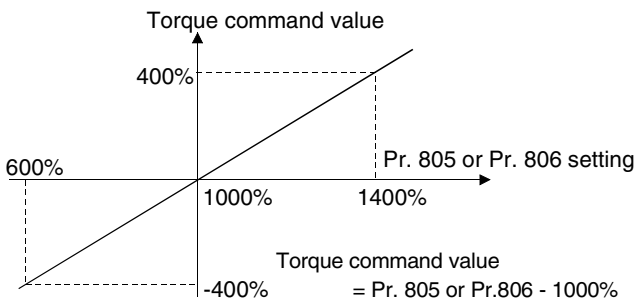
When you selected torque control, you can choose the torque command.

| Parameter | Name | Factory Setting | Setting Range | |
|-----------|---|-----------------|---------------|--|
| | | | | |
| 804 | Torque command right selection | 0 | 0 | No. 3 terminal analog input |
| | | | 1 | Digital input from parameter Pr. 805 or Pr. 806 setting (-400% to 400%) |
| | | | 2 | Torque command using pulse train command (FR-V5AP) Refer to the instruction manual of the option "FR-V5AP" for details. |
| | | | 3 | Torque command by using CC-Link (FR-A5NC) Refer to the instruction manual of the option "FR-A5NC" for details. |
| | | | 4 | Torque command from the option (digital) (FR-V5AH, FR-A5AX) Refer to the instruction manual of the option "FR-V5AH, FR-A5AX" for details. |
| 805 | Torque command value (RAM) | 1000% | 600 to 1400% | |
| 806 | Torque command value (RAM, E ² PROM) | 1000% | 600 to 1400% | |

- (1) No. 3 terminal calibration (Pr. 804 = 0)
The torque command value for the analog input of the No. 3 terminal varies with Pr. 904 and Pr. 905 as shown on the right.



- (2) Digital input from parameter (Pr. 804 = 1)
Digital setting of the torque command can be made by writing the torque command value to Pr. 805 or Pr. 806 by communication. The torque command can also be specified by parameter direct setting. In this case, set the speed restriction value to an appropriate value to prevent acceleration. The relationship between the Pr. 805 or Pr. 806 setting and actual torque command value at this time is shown on the right. On the assumption that 1000% is 0%, the torque command is indicated by an offset from 1000%.



CAUTION

- For the command given by the torque setting command E²PROM (RYE), the set torque (RWW1) is reflected on the torque command value of the inverter when the torque setting command E²PROM (RYE) changes from off to on.
For the command given by the torque setting command RAM (RYD), the set torque (RWW1) is reflected on the inverter while the torque setting command RAM (RYD) is on.
- When writing the torque command value by communication (Pr. 804 = 1, Pr. 804 = 3), there is a restriction on the number of write times to E²PROM. When the value is changed often, write it to RAM. (When Pr. 804 = 1, set "1" in Pr. 342 "E²PROM write presence/absence" to select write to RAM.)

3.33.4 Speed restriction (Pr. 807 to Pr. 809 torque)

When you selected torque control, set the speed restriction value to prevent the load torque from becoming less than the torque command value, resulting in motor overspeed.

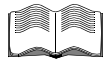
| Parameter | Name | Factory Setting | Setting Range |
|-----------|------------------------------------|-----------------------------|----------------------|
| 807 | Speed restriction selection | 0 | 0, 1, 2 |
| 808 | Forward rotation speed restriction | Japanese version: 1500r/min | 0 to 3600r/min |
| | | NA version: 1800r/min | |
| 809 | Reverse rotation speed restriction | 9999 | 0 to 3600r/min, 9999 |

<Settings>

Set the speed restriction value to prevent the load torque from becoming less than the torque command value, resulting in motor overspeed. Select the speed restriction input method using Pr. 807.

| Pr. 807 Setting | Speed Restriction Input Method | Operation |
|------------------------|---|---|
| 0 (factory setting) | Same method as in speed setting for speed control | <ul style="list-style-type: none"> • Speed setting from the operation panel • External analog command (terminal 1, 2) • Multi-speed command • Option (FR-V5AX etc.) • For both PU and external operations, speed restriction changes according to the acceleration/deceleration time. |
| 1 | Pr. 808 Forward rotation speed restriction Pr. 809 Reverse rotation speed restriction | According to the rotation direction, set the speed restrictions in forward and reverse rotation directions individually. When the reverse rotation speed restriction is 9999, the setting is the same as that of the torque restriction in the forward rotation direction. |
| 2 | Forward/reverse rotation speed restriction (analog polarity switchover speed restriction) (No. 1 terminal analog input) | The analog voltage of the No. 1 terminal input is used to make speed restriction. For 0 to 10V input, set the forward rotation speed restriction. (The reverse rotation speed restriction is Pr. 1 "maximum speed" .) For -10 to 0V input, set the reverse rotation speed restriction. (The forward rotation speed restriction is Pr. 1 "maximum speed".) The maximum speed of both the forward and reverse rotation is Pr. 1 "maximum speed". When No. 1 terminal input is selected, set "5" in Pr. 868 "No. 1 terminal function assignment". (Refer to page 182.) |

(1) When Pr. 807 = 0

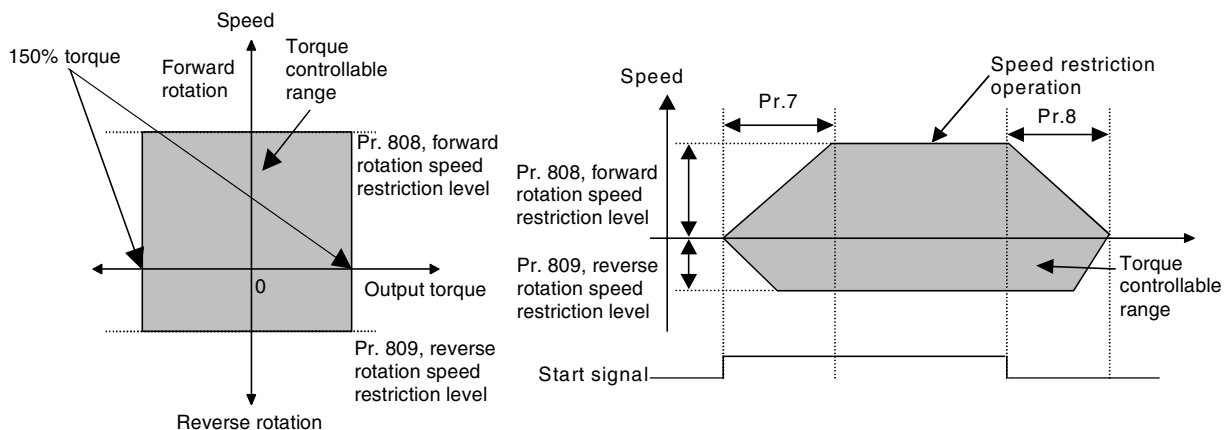


Refer to the Instruction Manual (basic).

(2) When Pr. 807 = 1

| Parameter | Name | Factory Setting | Setting Range |
|-----------|------------------------------------|-----------------------------|----------------------|
| 808 | Forward rotation speed restriction | Japanese version: 1500r/min | 0 to 3600r/min |
| | | NA version: 1800r/min | |
| 809 | Reverse rotation speed restriction | 9999 | 0 to 3600r/min, 9999 |

Using the parameters, set the forward rotation and reverse rotation speed restriction levels individually.



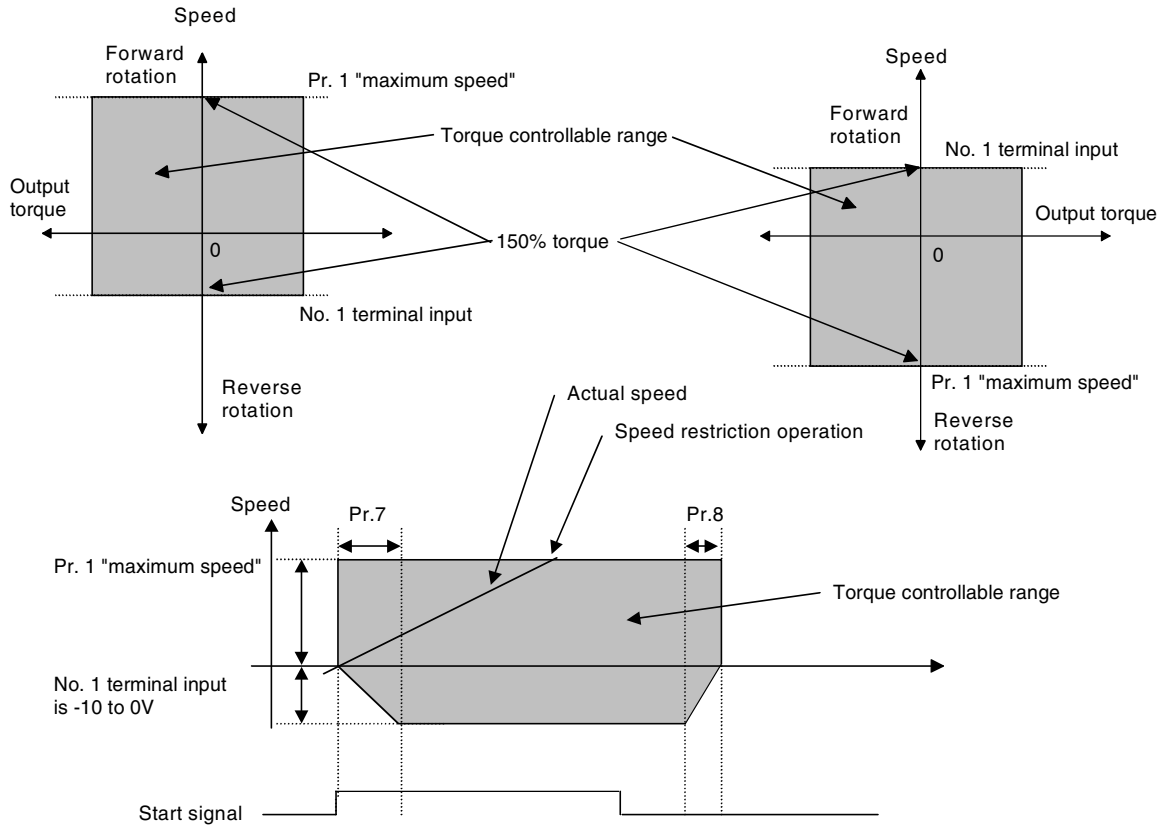
(3) When Pr. 807 = 2

Using the analog input of the No. 1 terminal, set the forward rotation and reverse rotation speed restriction levels.

At this time, the speed restriction made on the analog input is as shown below.

1) When No. 1 terminal input is -10 to 0V
Reverse rotation speed restriction

2) When No. 1 terminal input is 0V to 10V
Forward rotation speed restriction



Related parameters

- Selection of No.1 terminal function ⇒ Pr. 868 "No. 1 terminal function assignment" (Refer to page 182.)
- Speed restriction during acceleration/deceleration ⇒ Pr. 7 "acceleration time", Pr. 8 "deceleration time" (Refer to page 81.)
- DC injection brake operation level ⇒ Pr. 10 "DC injection brake operation speed" (Refer to page 85.)
- Speed restriction level maximum setting ⇒ Pr. 1 "maximum speed" (Refer to page 79.)

CAUTION

When speed ≥ speed restriction, torque control is switched to speed control.

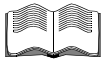
Pr. 810, Pr. 812 to Pr. 817 ➔ Refer to Pr. 22 (page 89)

3.34 Control system functions (Pr. 818 to Pr. 837)

3.34.1 Easy gain tuning selection (Pr. 818, Pr. 819 speed position)

The ratio of load inertia to motor inertia (load inertia moment ratio) is estimated in real time from the torque command and speed during motor operation, and this value is used to automatically set the optimum gain for speed/position control, reducing the time and effort of making gain adjustment.

| Parameter | Name | Factory Setting | Setting Range | |
|-----------|---|-----------------|---------------|----------------------|
| 818 | Easy gain tuning response level setting | 2 | 1 to 15 | |
| 819 | Easy gain tuning selection | 0 | 0 | No tuning |
| | | | 1 | With load estimation |
| | | | 2 | Manual load input |



Refer to the Instruction Manual (basic) for details.

Related parameters

- Adjusted gains ⇒ 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"
- Adjusted load inertia ratio ⇒ Pr. 880 "load inertia ratio"

3.34.2 Speed loop proportional gain setting (Pr. 820, Pr. 830 speed position)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|-----------------|------------------|---------------|
| 820 | Speed control P gain 1 (when RT signal is off) | 60% | 0 to 1000% | Extended mode |
| 830 | Speed control P gain 2 (when RT signal is on) | 9999 | 0 to 1000%, 9999 | |

- Set the proportional gain of the speed loop.
Increasing the gain enhances the speed response level and decreases the speed fluctuation relative to disturbance, but a too large gain will produce vibration and/or sound.
- Pr. 820 "speed control P gain 1" and Pr. 830 "speed control P gain 2" are 0 to 1000% in the setting range and 60% in the factory setting. For general adjustment, set them within the range of 20 to 200%.

REMARKS

- The response level will be worse when the coupling is loose.
- When performing positioning, increase the setting to enhance accuracy.
- Decrease the setting when there is gear backlash, etc.

3.34.3 Speed control integral time setting (Pr. 821, Pr. 831 speed position)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|----------------|---------------|
| 821 | Speed control integral time 1 (when RT signal is off) | 0.333s | 0 to 20s | Extended mode |
| 831 | Speed control integral time 2 (when RT signal is on) | 9999 | 0 to 20s, 9999 | |

- Set the integral compensation time of the speed loop.
If speed fluctuation occurs relative to disturbance, decreasing the value shortens the recovery time, but a too small value will cause a speed overshoot.
A large value improves stability but increases the recovery time (response time) and may cause an undershoot.

3.34.4 Speed setting circuit filter function (Pr. 822, Pr. 832 speed position)

Set the time constant of the primary delay filter relative to the external speed command (analog input command).

Set a large time constant when you want to delay the tracking of the speed command or when the analog input voltage is unstable.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|---------------------|---------------|---------------|
| 822 | Speed setting filter 1 (when RT signal is off) | 0s (without filter) | 0 to 5s | Extended mode |
| 832 | Speed setting filter 2 (when RT signal is on) | 9999 | 0 to 5s, 9999 | |

3.34.5 Speed detection filter function (Pr. 823, Pr. 833 speed torque position)

- Set the time constant of the primary delay filter relative to the speed feedback signal. Since this function reduces the speed loop response, use it with the factory setting. Set the time constant when speed ripples occur due to harmonic disturbance. Note that a too large value will run the motor unstably.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|-----------------|-----------------|-----------------------------------|
| 823 | Speed detection filter 1 (when RT signal is off) | 0.001s | 0 to 0.1s | 0: without filter |
| 833 | Speed detection filter 2 (when RT signal is on) | 9999 | 0 to 0.1s, 9999 | 9999: same as the Pr. 823 setting |

REMARKS

When speed ripples are large, setting this parameter Pr. 823 or Pr. 833 ensures stability.

3.34.6 Current loop proportional gain setting for vector control (Pr. 824, Pr. 834 speed torque position)

- Set the current loop proportional gain for vector control. Increasing the gain enhances the torque response level, but a too large gain will cause instability, generating harmonic torque pulsation.
- Pr. 824 "torque control P gain 1" and Pr. 834 "torque control P gain 2" are 0 to 200% in the setting range and 100% in the factory setting. For general adjustment, set them within the range 50 to 200%.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|-----------------|-----------------|---------------|
| 824 | Torque control P gain 1 (when RT signal is off) | 100% | 0 to 200% | Extended mode |
| 834 | Torque control P gain 2 (when RT signal is on) | 9999 | 0 to 200%, 9999 | |

REMARKS

The factory setting ensures fully stable operation. For general adjustment, make setting within the range 50 to 200% as a guideline.

3.34.7 Current control integral time setting for vector control (Pr. 825, Pr. 835 speed torque position)

- Set the current loop integral compensation time for vector control.
- A small value enhances the torque response level, but a too small value will cause current fluctuation.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|-----------------|------------------|---------------|
| 825 | Torque control integral time 1 (when RT signal is off) | 5ms | 0 to 500ms | Extended mode |
| 835 | Torque control integral time 2 (when RT signal is on) | 9999 | 0 to 500ms, 9999 | |

REMARKS

The factory setting ensures fully stable operation.

3.34.8 Torque setting filter function (Pr. 826, Pr. 836 speed torque position)

- Set the time constant of the primary delay filter relative to the external torque command (analog input command). Set a large time constant value when you want to delay the tracking of the torque command, the analog input voltage fluctuates, etc.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---|---------------------|---------------|---------------|
| 826 | Torque setting filter 1 (when RT signal is off) | 0s (without filter) | 0 to 5s | Extended mode |
| 836 | Torque setting filter 2 (when RT signal is on) | 9999 | 0 to 5s, 9999 | |

(1) Parameter details

1) Pr. 840 "torque bias selection"

Select the setting method of the torque bias amount.

| Pr. 840 Setting | Description |
|-----------------|--|
| 0 | Set the torque bias amount based on the contact signals (DI1 to DI4) in Pr. 841 to Pr. 843. |
| 1 | To raise the cage when the motor runs in forward rotation direction. Set the No. 3 terminal-based torque bias amount as desired in Pr. 904 and Pr. 905. |
| 2 | To raise the cage when the motor runs in reverse rotation direction. Set the No. 3 terminal-based torque bias amount as desired in Pr. 904 and Pr. 905. |
| 3 | The No. 3 terminal-based torque bias amount can be set automatically in Pr. 904, Pr. 905 and Pr. 846 according to the load. |
| 9999 | No torque bias |

<Operation diagrams>

- When Pr. 840 = 0

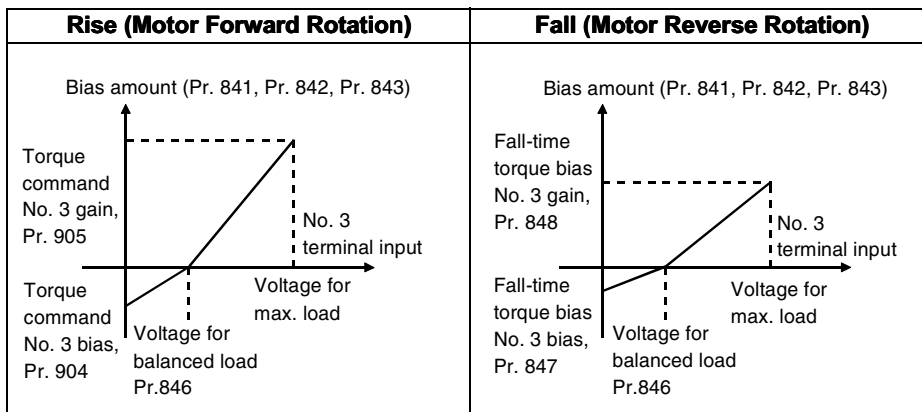
Set the torque bias values (Pr. 841 to Pr. 843) in the following table according to the combination of the contact signals (DI1 to DI4).

| Torque Bias Selection 1 (X42 Terminal) | Torque Bias Selection 2 (X43 Terminal) | Torque Bias (Pr. 841 to Pr. 843) |
|--|--|---|
| OFF | OFF | No selection |
| ON | OFF | Pr.841 1000 to 1400%: Positive value 600 to 999%: Negative value |
| OFF | ON | Pr.842 1000 to 1400%: Positive value 600 to 999%: Negative value |
| ON | ON | Pr.843 1000 to 1400%: Positive value 600 to 999%: Negative value |

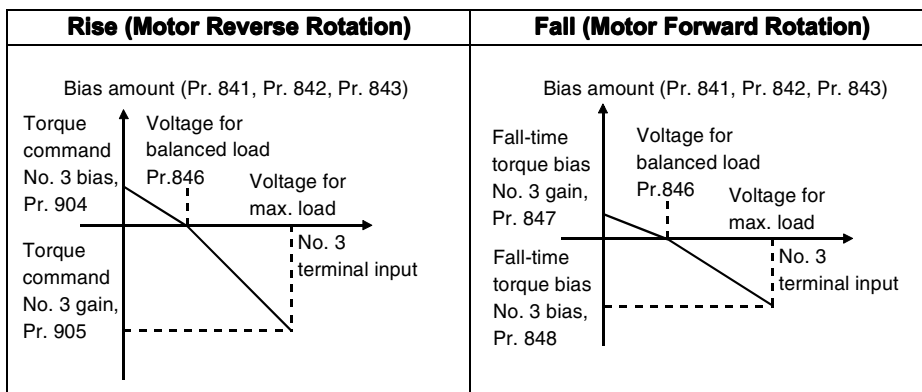
(Example) 25% when Pr. 841 = 1025, -25% when Pr. 842 = 975, -75% when Pr. 843 = 925

- When Pr. 840 = 1

Calculate the torque bias from the analog input value of the No. 3 terminal as shown below and set the gain and bias (Pr. 904, Pr. 905) of the torque command.



- When Pr. 840 = 2

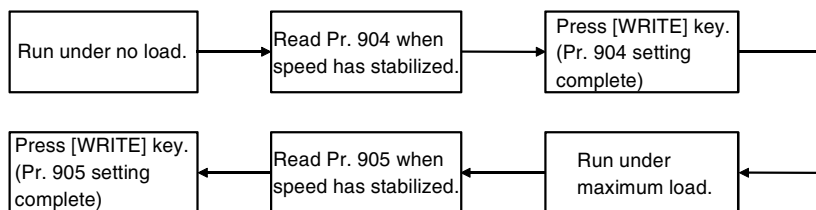


Torque biases (Pr. 840 to Pr. 848)

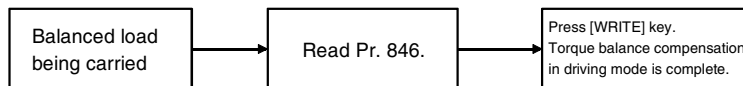
- When Pr. 840 = 3

Pr. 904 "torque command No. 3 bias", Pr. 905 "torque command No. 3 gain" and Pr. 846 "torque bias balance compensation" can be set automatically according to the load.

Pr. 904, Pr. 905 settings



Pr. 846 setting



CAUTION

When starting torque bias operation after completion of automatic setting, set "1 or 2" in Pr. 840.

- 2) Pr. 841 "torque bias 1", Pr. 842 "torque bias 2", Pr. 843 "torque bias 3"

On the assumption that the rated torque is 100%, the torque bias setting of 1000% is the center value of torque and the bias value is "0".

| Setting | Description |
|---------------|--|
| 600 to 999% | Negative torque bias amount (-400% to -1%) |
| 1000 to 1400% | Positive torque bias amount (0% to 400%) |
| 9999 | Without torque bias setting |

- 3) Pr. 844 "torque bias filter"

You can make a torque rise gentler. At this time, the torque rises according to the time constant of the primary delay filter.

| Setting | Description |
|---------|-----------------------------------|
| 0 to 5s | Time until torque rises. |
| 9999 | Same operation as when 0s is set. |

- 4) Pr. 845 "torque bias operation time"

Set the time for output torque be maintained with the torque bias command value alone.

| Setting | Description |
|---------|---|
| 0 to 5s | Time for maintaining torque equivalent to the torque bias amount. |
| 9999 | Same operation as when 0s is set. |

- 5) Pr. 846 "torque bias balance compensation"

Set the voltage of the torque bias analog input value input to the No. 3 terminal to compensate for the balance of the torque bias amount.

| Setting | Description |
|----------|--------------------------------------|
| 0 to 10V | Set the voltage under balanced load. |
| 9999 | Same operation as when 0V is set. |

- 6) Pr. 847 "fall-time torque bias No. 3 bias"

Set the torque bias amount at a fall time (when the motor runs in the reverse rotation direction).

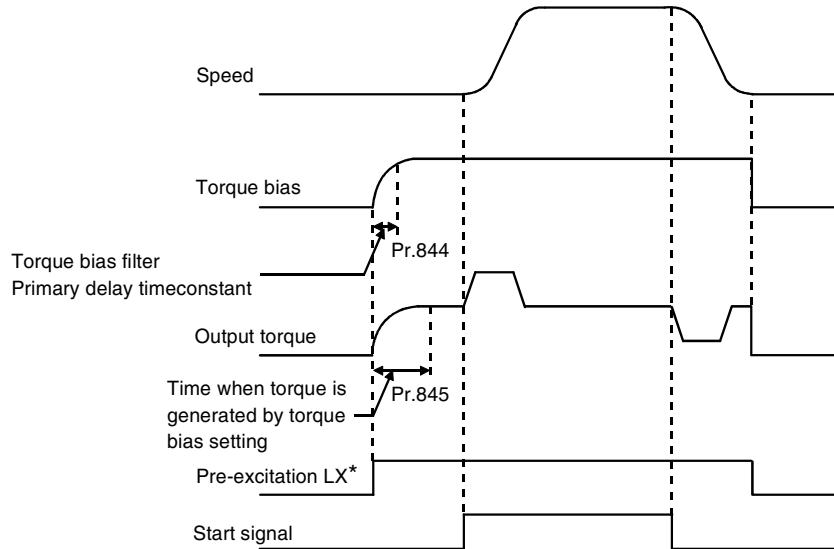
| Setting | Description |
|-----------|---|
| 0 to 400% | Set the bias value of the torque command. |
| 9999 | Same as at a rise time (Pr. 904). |

- 7) Pr. 848 "fall-time torque bias No. 3 gain"

Set the torque bias amount at a fall time.

| Setting | Description |
|-----------|---|
| 0 to 400% | Set the gain value of the torque command. |
| 9999 | Same as at a rise time (Pr. 905). |

(2) Torque bias operation



*When pre-excitation is not made, the torque bias functions simultaneously with the start signal.

Pr. 849 Refer to Pr. 902, Pr.903 (page 189)

3.36 Additional functions (Pr. 851 to Pr. 865)

3.36.1 Selection of number of PLG pulses (Pr. 851 speed torque position)

Set the number of pulses of the PLG fitted to the motor. (number of pulses before multiplied by 4)

| Parameter | Name | Factory Setting | Setting Range |
|-----------|----------------------|------------------------|---------------|
| 851 | Number of PLG pulses | Japanese version: 2048 | 0 to 4096 |
| | | NA version: 1024 | |

Refer to the Instruction Manual (basic) for details.

3.36.2 Selection of PLG rotation direction (Pr. 852 speed torque position)

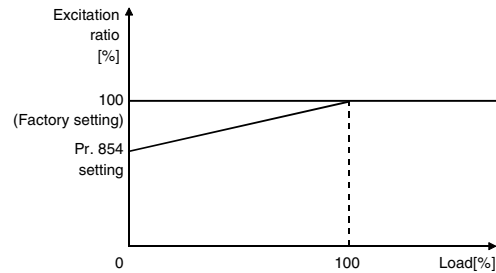
You can set the rotation direction of the PLG.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------|-----------------|---------------|---------------|
| 852 | PLG rotation direction | 1 | 0, 1 | Extended mode |

Refer to the Instruction Manual (basic) for details.

3.36.3 Excitation ratio (Pr. 854 speed torque position)

- Decrease the excitation ratio when you want to improve efficiency under light load. (motor magnetic noise decreases) 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.



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------|-----------------|---------------|---------------|
| 854 | Excitation ratio | 100% | 0 to 100% | Extended mode |

Pr. 859 ➔ Refer to page 121

3.36.4 Notch filter (Pr. 862, Pr. 863 speed position)

You can reduce the response level of speed control in the resonance frequency band of the mechanical system to avoid mechanical resonance.

| Parameter | Name | Setting Range | Increments | Factory Setting | Remarks |
|-----------|------------------------|---------------|------------|-----------------|---------------------|
| 862 | Notch filter frequency | 0 to 60 | 1 | 0 | 0: Function invalid |
| 863 | Notch filter depth | 0 to 3 | 1 | 0 | Extended mode |

●Pr. 862 "notch filter frequency"

| | | | | | | | |
|----|---------|----|------|----|------|----|------|
| 0 | invalid | 16 | 70.3 | 31 | 36.3 | 46 | 24.5 |
| 1 | 1125.0 | 17 | 66.2 | 32 | 35.2 | 47 | 23.9 |
| 2 | 562.5 | 18 | 62.5 | 33 | 34.1 | 48 | 23.4 |
| 3 | 375.0 | 19 | 59.2 | 34 | 33.1 | 49 | 23.0 |
| 4 | 281.3 | 20 | 56.3 | 35 | 32.1 | 50 | 22.5 |
| 5 | 225.0 | 21 | 53.6 | 36 | 31.3 | 51 | 22.1 |
| 6 | 187.5 | 22 | 51.1 | 37 | 30.4 | 52 | 21.6 |
| 7 | 160.7 | 23 | 48.9 | 38 | 29.6 | 53 | 21.2 |
| 8 | 140.6 | 24 | 46.9 | 39 | 28.8 | 54 | 20.8 |
| 9 | 125.0 | 25 | 45.0 | 40 | 28.1 | 55 | 20.5 |
| 10 | 112.5 | 26 | 43.3 | 41 | 27.4 | 56 | 20.1 |
| 11 | 102.3 | 27 | 41.7 | 42 | 26.8 | 57 | 19.7 |
| 12 | 93.8 | 28 | 40.2 | 43 | 26.2 | 58 | 19.4 |
| 13 | 86.5 | 29 | 38.8 | 44 | 25.6 | 59 | 19.1 |
| 14 | 80.4 | 30 | 37.5 | 45 | 25.0 | 60 | 18.8 |
| 15 | 75.0 | | | | | | |

●Pr. 863 "notch filter depth"

| Pr. 863 Setting | Depth (Gain) |
|-----------------|---------------|
| 0 | deep (-40dB) |
| 1 | ↑ (-14dB) |
| 2 | ↓ (-8dB) |
| 3 | sharow (-4dB) |

CAUTION

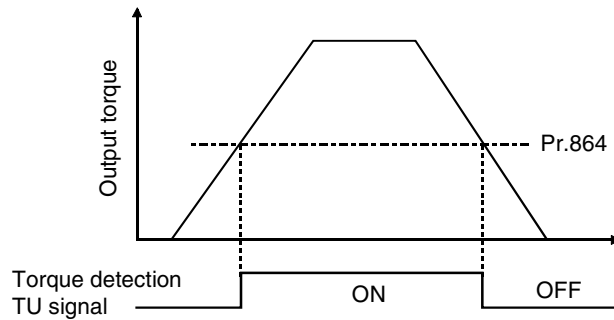
- If you do not know the machine resonance frequency, decrease notch frequency gradually from the highest value. The point at which the smallest vibration is generated is the notch frequency setting.
- The notch filter with deeper depth has an effect on minimizing mechanical resonance. However, large vibration may be generated adversely due to substantial phase delay.
- Machine characteristic can be obtained beforehand with machine analyzer by setup software. Necessary notch frequency can be determined from this.

3.36.5 Torque detection (Pr. 864 speed torque position)

This function outputs a signal if the motor torque rises to or above the Pr. 864 setting. The signal is used as operation and open signal for an electromagnetic brake.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------|-----------------|---------------|---------------|
| 864 | Torque detection | 150% | 0 to 400% | Extended mode |

The signal turns on when the output torque rises to or above the detection torque value set in Pr. 864. It turns off when the torque falls below the detection torque value.



Related parameters

TU signal terminal assignment ⇒ Set "35" in any of Pr. 190 to Pr. 192 and Pr. 195 (output terminal function selection). (Refer to page 151.)

3.36.6 Low speed detection (Pr. 865 speed torque position)

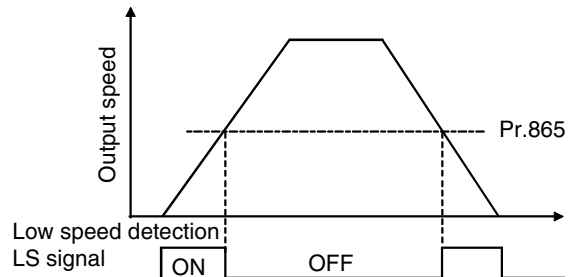
This function outputs a signal if the speed falls to or below the Pr. 865 setting.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------|-----------------|----------------|---------------|
| 865 | Low speed detection | 45r/min | 0 to 3600r/min | Extended mode |

<Operation>

The signal is output during inverter operation under the following conditions.

- (1) Vector control
 Motor speed ≤ Pr. 865 ... ON
 Motor speed > Pr. 865 ... OFF
- (2) V/F control
 Output speed ≤ Pr. 865 speed equivalent ... ON
 Output speed > Pr. 865 speed equivalent ... OFF



REMARKS

When "0" is set, low speed detection (LS signal) is output under position control only.

Related parameters

LS signal terminal assignment ⇒ Set "34" in any of Pr. 190 to Pr. 192 and Pr. 195 (output terminal function selection). (Refer to page 151.)

Pr. 866 ➔ Refer to Pr. 55 (page 102)

3.37 Display function (Pr. 867)

3.37.1 DA1 output response level adjustment (Pr. 867 speed torque position)

You can adjust the response level of the output voltage of the output signal DA1.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------|-----------------|---------------|---------------|
| 867 | DA1 output filter | 0.05s | 0 to 5s | Extended mode |

3.38 Terminal function assignment (Pr. 868)

3.38.1 No. 1 terminal function assignment (Pr. 868 speed torque position)

The No. 1 terminal can be multi-functioned.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------------------------|-----------------|------------------|---------------|
| 868 | No. 1 terminal function assignment | 0 | 0, 1, 2, 5, 9999 | Extended mode |

<No1. terminal function according to control>

| Pr. 868 Setting | No. 1 Terminal Function under Speed Control | No. 1 Terminal Function under Torque Control | No. 1 Terminal Function under Position Control | Bias/Gain Setting | Remarks |
|------------------------|---|---|--|--|---------------------------------------|
| 0 (factory setting) | Speed setting auxiliary * | Speed restriction auxiliary | No function | Pr. 902 "speed setting No. 2 bias" Pr. 903 "speed setting No. 2 gain" | |
| 1 | Magnetic flux command | Magnetic flux command | Magnetic flux command | Pr. 919 "No.1 terminal bias (torque/magnetic flux)" Pr. 920 "No.1 terminal gain (torque/magnetic flux)" | |
| 2 | Regenerative torque restriction | No function | Regenerative torque restriction | Pr. 919 "No.1 terminal bias (torque/magnetic flux)" Pr. 920 "No.1 terminal gain (torque/magnetic flux)" | Setting can be made when Pr. 810 = 1. |
| 5 | No function | Forward/reverse rotation speed restriction (analog polarity switchover speed restriction) | No function | Pr. 917 "No.1 terminal bias (speed)" Pr. 918 "No1. terminal gain (speed)" | |
| 9999 | No function | No function | No function | No function | No function |

* The function is changed to main speed according to the Pr.73 setting with which override, polarity reversible function, etc. can be selected. (Refer to page 114.)

REMARKS

Refer to page 189 for bias/gain settings.

<Detailed operation>

The following table indicates the functional combinations of the No. 1, No. 2 and No. 3 terminals. Basically, the analog multiple functions are assigned to the No. 1 terminal alone and only one function may be selected for the multi-function analog input.

| Control Method | No. 2 Terminal Speed Command/ Speed Restriction/ PID Set Point | No. 3 Terminal Torque Restriction/ Torque Command/ Torque Bias | No. 1 Terminal Multi-function | Remarks |
|---|---|---|--|-------------------------------------|
| Speed control | Speed command | No function (Pr. 810 = 0, Pr. 840=9999) | Speed auxiliary setting (Reversible operation also possible) | Factory-set status |
| | | Torque restriction (Pr. 810 = 1) | Magnetic flux command | |
| | | | Speed auxiliary setting (Reversible operation also possible) | |
| | | | Magnetic flux command | |
| Torque bias (Pr. 810=0, Pr. 840=1,2,3) | Speed setting auxiliary | | | |
| | Magnetic flux command | | | |
| Torque control | Speed restriction | Torque command | Speed restriction auxiliary input | |
| | No function | | Forward/reverse rotation speed restriction (analog polarity switchover speed restriction) | Setting can be made when Pr. 807=2. |
| Position control | No function | No function (Pr. 810 = 0) | No function | |
| | | Torque restriction (Pr. 810 = 1) | Magnetic flux command | |
| | | | No function | |
| | | | Magnetic flux command | |
| | | Regenerative torque restriction | Setting can be made when Pr. 810=1. | |

When the PID control function is selected, the No. 2 terminal is used for the PID set point. For PID control, refer to page 139.

When the torque bias function is selected, the No. 3 terminal is used for the torque bias input.

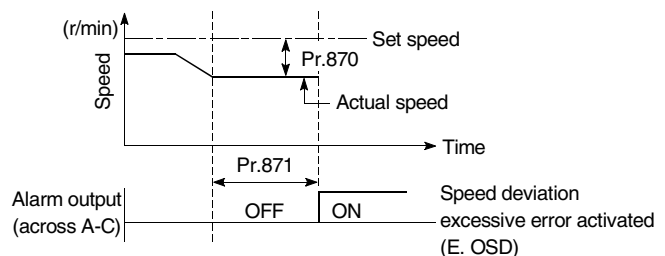
REMARKS

Magnetic flux command is a function used to command magnetic flux (strength of magnetic flux) from the external analog (No.1) terminal. In addition to torque command "No.3 terminal", the inverter can control torque using magnetic flux as a command. For example, the characteristic of motor torque is that output torque is constant independently of the output speed when exercising line feed/tension constant control on a winder, unwinder, etc. Constant output control by variable magnetic flux, equivalent to field excitation control of the DC shunt motor, can be exercised.

3.39 Protective functions (Pr. 870 to Pr. 874)

3.39.1 Speed deviation excessive (Pr. 870, Pr. 871 speed)

- If the difference (absolute value) between the speed command value and actual speed exceeds the Pr. 870 "speed deviation level" setting for longer than the time set in Pr. 871 "speed deviation time", speed deviation excessive occurs and error "E. OSD" appears, resulting in a stop.



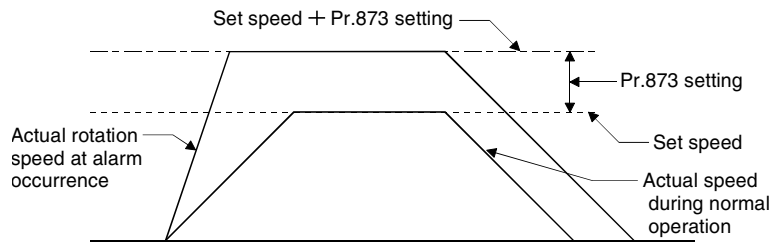
| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-----------------------|-----------------|----------------------|--------------|
| 870 | Speed deviation level | 9999 | 0 to 1500r/min, 9999 | 9999:Invalid |
| 871 | Speed deviation time | 12s | 0 to 100s | - |

REMARKS

1. Set these parameters when a speed difference will pose a problem.
2. This function is activated only under vector control.
3. When the motor with PLG is driven, setting the Pr. 851 "number of PLG pulses" value that is different from the actual number of PLG pulses may make control unstable, resulting in "E. OSD" (even if Pr. 870 = 9999).

3.39.2 Speed restriction (Pr. 873 speed)

This function prevents the motor from overrunning when the setting of number of PLG pulses and the actual number differ. When the setting of number of PLG pulses is smaller than the actual number, the motor may increase its speed. To prevent this, restrict the output speed with the synchronous speed obtained by adding the set speed and Pr.873 setting. (*)



| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------|-----------------|----------------|---------------|
| 873 | Speed restriction | 600r/min | 0 to 3600r/min | Extended mode |

CAUTION

*** When the setting of number of the PLG pulses is smaller than the actual number, selecting automatic restart after instantaneous power failure function (set a value other than "9999" in Pr. 57) restrict the output speed with the synchronous speed obtained by adding the maximum speed (Pr. 1) and Pr. 873 setting.**

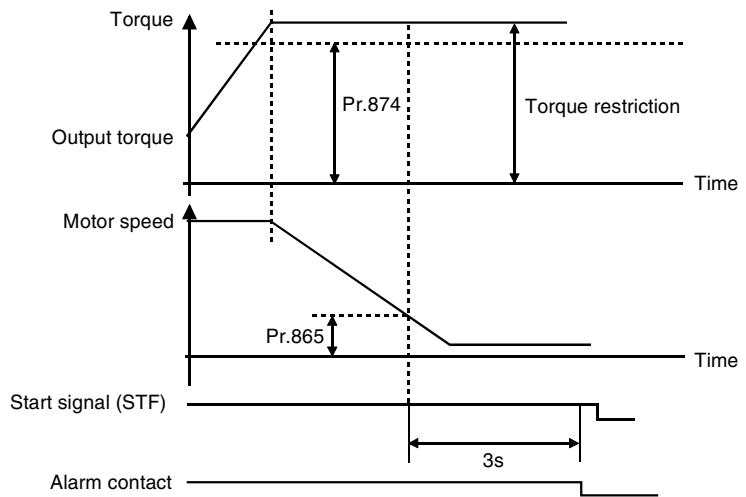
3.39.3 Stop by OLT level prevention (Pr. 874 speed position)

This function can make an alarm stop if the torque restriction is activated to stall the motor.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|-------------------|-----------------|---------------|---------------|
| 874 | OLT level setting | 150% | 0 to 200% | Extended mode |

(1) Speed control, position control

The motor stalls if the torque restriction 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 for 3s, it is regarded as a stop effected by stall prevention and E. OLT is output, resulting in an alarm stop.



If torque restriction is activated and speed falls below Pr. 865 setting, OLT alarm does not occur when output torque at this time is lower than Pr. 874.

(2) V/F control

If the stall prevention function is activated and the output frequency is kept reduced to 0Hz for 3s, OLT will cause an alarm stop.

In this case, this function is activated regardless of Pr. 874.

(3) Torque control

This alarm is not activated.

Related parameters

- Low speed detection ⇒ Pr. 865 "low speed detection" (Refer to page 181.)

3.40 Operation selection functions 5 (Pr. 875)

3.40.1 Fault definition (Pr. 875 speed torque)

With the alarm definitions classified into major and minor faults, the base circuit is shut off immediately at occurrence of a major fault, or after deceleration to a stop at occurrence of a minor fault.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|------------------|-----------------|---------------|---------------|
| 875 | Fault definition | 0 | 0, 1 | Extended mode |

1) Pr. 875 = 0: Normal operation

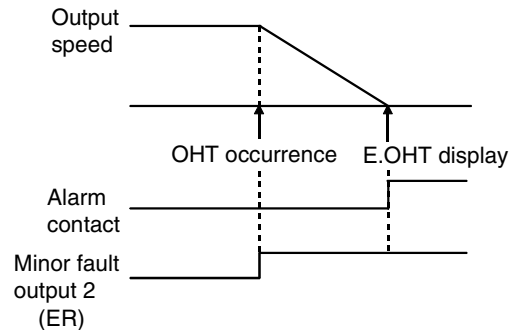
At occurrence of any alarm, the base circuit is shut off immediately. At this time, the alarm output also turns on.

2) Pr. 875 = 1: Fault definition

At occurrence of OHT or THM alarm, the motor is decelerated to a stop. At this time, minor fault output 2 (ER) signal turns on and the base circuit is shut off when the DC brake operation starts after deceleration.

When the ER signal turns on, the electronic thermal relay is activated and the inverter decelerates to a stop. Decrease load, etc. to allow the inverter to decelerate.

At occurrence of an alarm other than OHT or THM, the base circuit is shut off immediately.



CAUTION

**This function is invalid during position 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.**

Pr.876 ➡ Refer to Pr.9 (page 83).

3.41 Control system function 2 (Pr. 877 to Pr. 881)

3.41.1 Speed feed forward control, model adaptive speed control

(Pr. 877 to Pr. 881 speed position)

By making parameter setting, select the speed feed forward control or model adaptive speed control.

The speed feed forward control enhances the track ability of the motor in response to a speed command change.

The model adaptive speed control enables individual adjustment of speed track ability and motor disturbance torque response.

| Parameter | Name | Factory Setting | Setting Range |
|-----------|---|-----------------|-------------------|
| 877 | Speed feed forward control/model adaptive speed control selection | 0 | 0, 1, 2 |
| 878 | Speed feed forward filter | 0s | 0 to 1s |
| 879 | Speed feed forward torque restriction | 150% | 0 to 400% |
| 880 | Load inertia ratio | 7 | 0, 1 to 200 times |
| 881 | Speed feed forward gain | 0% | 0 to 1000% |

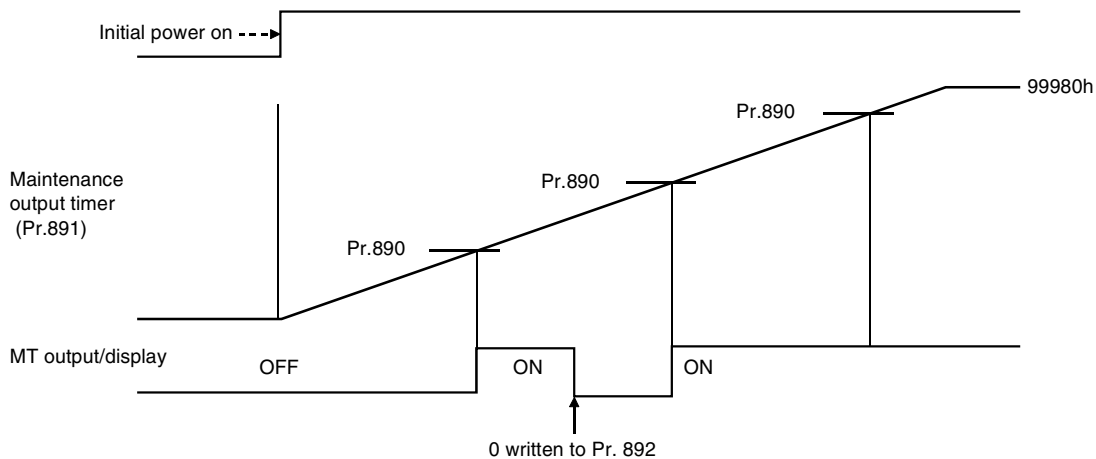
Refer to page 43 for details.

3.42 Maintenance function (Pr. 890 to Pr. 892)

3.42.1 Maintenance output function (Pr. 890 to Pr. 892 speed torque position)

When the cumulative operation time (Pr. 891 "maintenance output timer") of the inverter has elapsed the time set in Pr. 890 "maintenance output setting time", the maintenance output (MT) signal is output and an alarm is displayed on the PU (FR-DU04-1/FR-PU04V). A repetition signal output and alarm display at specified intervals can be set using Pr. 890 "maintenance output setting time". (usable for a capacitor life alarm, etc.)

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|---------------------------------|-----------------|-----------------|------------------------|
| 890 | Maintenance output setting time | 9999 | 0 to 9998, 9999 | 9999: Function invalid |
| 891 | Maintenance output timer | 0 | 0 to 9998 | Extended mode |
| 892 | Maintenance output signal clear | 0 | 0 | |



- The maintenance output timer count displayed on the FR-DU04-1 is clamped at 9998 (99980h).
- Writing 0 to Pr. 892 enables the maintenance (MT) output/display to be turned off. (This is designed to turn it off only when the user intends to turn it off.)
- When the Pr. 891 setting is less than the Pr. 890 value, the maintenance output turns off.

1) Pr. 891 "Maintenance output timer"

The cumulative operation time of the inverter is counted every 1hr and the stored time in E²PROM is output in 10hrs increment.

REMARKS

- The time is counted regardless of the Pr. 890 "maintenance output setting time" value.
- The timer can be cleared by setting "0" in Pr. 891 when Pr. 77="801". Make sure that the Pr. 77 value is reset to the original value.

2) Setting the MT signal

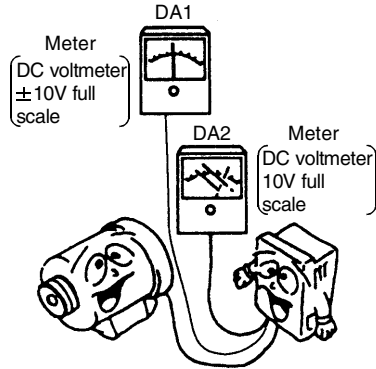
Set "37" (maintenance output signal) in Pr. 190 to Pr. 192 or Pr. 195 (output terminal function selection) to set the MT signal. (Refer to page 151)

3.43 Calibration functions (Pr. 900 to Pr. 920)

3.43.1 DA1/DA2 terminal calibration (Pr. 900, Pr. 901 speed torque position)

Pr. 900 "DA1 terminal calibration"

Pr. 901 "DA2 terminal calibration"



- When the item to be monitored is selected and set in Pr. 54 "DA1 terminal function selection" or Pr. 158 "DA2 terminal function selection", the inverter is factory-set to provide a 10VDC output in the full-scale status of the corresponding monitor item as described in the section of Pr. 54 and Pr. 158. These parameters allow the output voltage ratios (gains) to be adjusted according to the meter scale. Note that the maximum output voltage is 10VDC. (Terminal DA1 can also provide a -10VDC output.) (Refer to page 99 for Pr. 54 and Pr. 158.)

CAUTION
DA1 and DA2 output voltage even at an alarm stop.

(1) Calibration of DA1 terminal

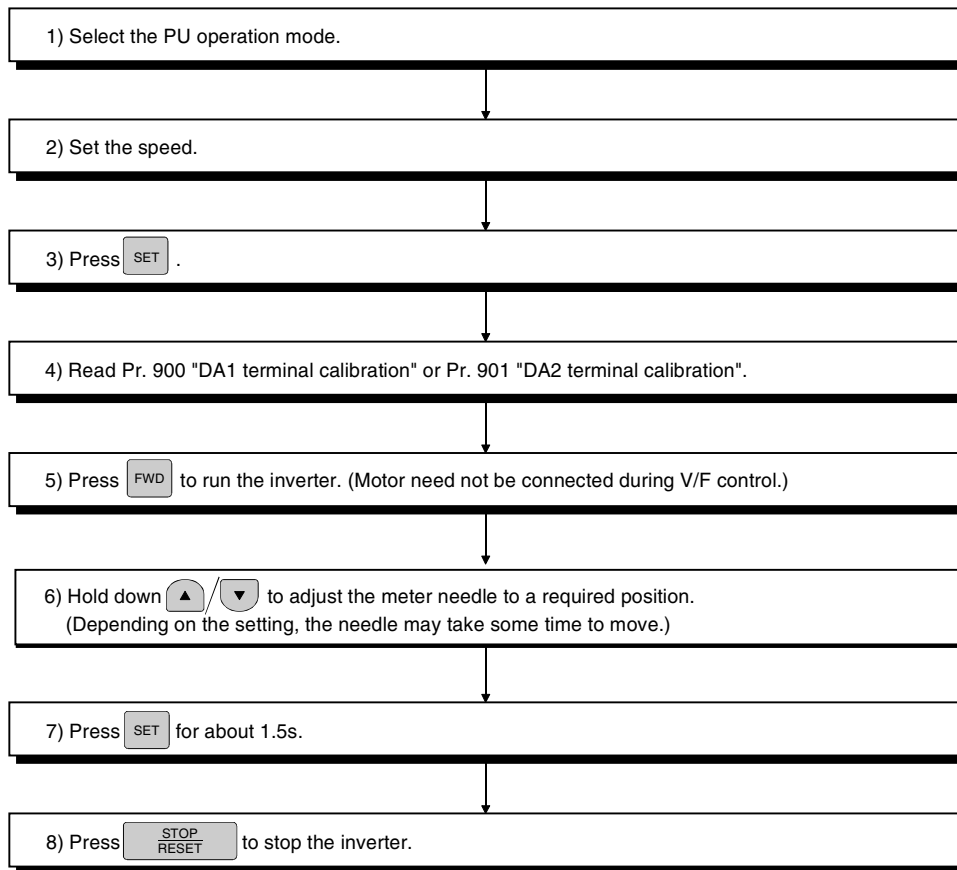
- 1) Connect a meter (speed meter) across inverter terminals DA1-5. (Note the polarity. DA1 is positive.)
- 2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
- 3) Set any of "1 to 3, 5 to 12, 17, 18, 21, 32 to 34 and 36" in Pr. 54.
 When the speed, inverter output current etc. has been selected as the output signal, preset in Pr. 55, Pr. 56 or Pr. 866 the speed, current value or torque at which the output signal is 1500r/min.
 At this 1500r/min or rated current, the meter is normally deflected to full scale.
- 4) When outputting the item that cannot achieve a 100% value easily by operation, e.g. output current, set "21" (reference voltage output) in Pr. 158 and perform the following operation. After that, set "2" (output current, for example) in Pr. 158.

(2) Calibration of terminal DA2

- 1) Connect a 0-10VDC meter (speed meter) to across inverter terminals DA2-5. (Note the polarity. DA2 is positive.)
- 2) Set any of "1 to 3, 5 to 12, 17, 18, 21, 32 to 34, 36" in Pr. 158.
 When the speed, inverter output current or the like has been selected as the output signal, preset in Pr. 55, Pr. 56 or Pr. 866 the speed, current value or torque at which the output signal is 10V.
- 3) When outputting the item that cannot achieve a 100% value easily by operation, e.g. output current, set "21" (reference voltage output) in Pr. 158 and perform the following operation. After that, set "2" (output current, for example) in Pr. 158.

<Operation procedure>

- When operation panel (FR-DU04-1) is used



REMARKS

Calibration can also be made for external operation. Set the speed in the external operation mode and make calibration as in steps 4) to 8).

CAUTION

1. Calibration can be made even during operation.
2. Refer to the FR-PU04V instruction manual for the operation procedure using the parameter unit (FR-PU04V).

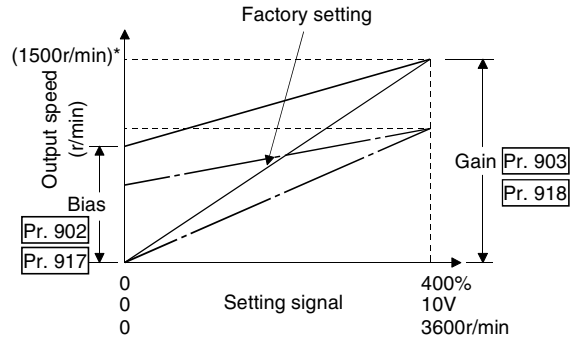
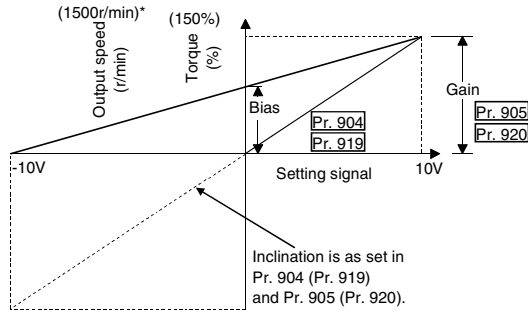
Related parameters

- Pr. 54 "DA1 terminal function selection" (Refer to page 99.)
- Pr. 55 "speed monitoring reference" (Refer to page 102.)
- Pr. 56 "current monitoring reference" (Refer to page 102.)
- Pr. 158 "DA2 terminal function selection" (Refer to page 99.)

3.43.2 Biases and gains of speed setting terminals
(speed setting No. 2, torque command No.3, multi function No. 1 terminal)
(Pr. 902 to Pr. 905, Pr. 917 to Pr. 920 speed torque position)

The "bias" and "gain" functions are designed to adjust the relationships between the externally input 0-10V setting input signal and output speed to set the output speed.

- Using Pr. 902, set the bias speed at 0V.



*: The output speed is 1800r/min for the NA version.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|--|---|----------------------------|---------------|
| 902 | Speed setting No. 2 bias | 0V 0r/min | 0 to 10V 0 to 3600r/min | Extended mode |
| 903 | Speed setting No. 2 gain | 10V Japanese version: 1500r/min NA version: 1800r/min | 0 to 10V 0 to 3600r/min | |
| 904 | Torque command No. 3 bias | 0V 0% | 0 to 10V 0 to 400% | |
| 905 | Torque command No. 3 gain | 10V 150% | 0 to 10V 0 to 400% | |
| 917 | No. 1 terminal bias (speed) | 0V 0r/min | 0 to 10V 0 to 3600r/min | |
| 918 | No. 1 terminal gain (speed) | 10V Japanese version: 1500r/min NA version: 1800r/min | 0 to 10V 0 to 3600r/min | |
| 919 | No. 1 terminal bias (torque/magnetic flux) | 0V 0% | 0 to 10V 0 to 400% | |
| 920 | No. 1 terminal gain (torque/magnetic flux) | 10V 150% | 0 to 10V 0 to 400% | |

| Parameter | Calibration Terminal | Speed Command/Speed Restriction (Pr. 807, Pr. 868, Pr. 73) | | | Forward/Reverse Rotation Speed Restriction | Torque | | | Magnetic Flux | PID Control | | |
|-----------|----------------------------------|--|--------------------|------------------|--|-----------------------|------------------------------|--------------------------|---------------|-----------------------|-----------|-----------|
| | | Speed (main speed+auxiliary) | Compensation input | Override | | Magnetic flux command | Torque restriction (Pr. 810) | Torque command (Pr. 804) | | Torque bias (Pr. 840) | Deviation | Set point |
| 902 | No. 2 terminal (+No. 1 terminal) | ● | ● | ● | | | | | | | | |
| 903 | | | | (No. 1 terminal) | | | | | | ● | | |
| 904 | No. 3 terminal | | | | | ● | ● | ● | | | | |
| 905 | | | | | | | | | | | | |
| 917 | No. 1 terminal | | | | ● | | | | | ● | | ● |
| 918 | | | | | (Pr. 868) | | | | | | | |
| 919 | | | | | | ● | | | | | | |
| 920 | | | | | | ● | | | ● | | | |

<Setting>



There are three methods to adjust the speed setting voltage bias and gain.

- 1) Method to adjust any point by application of voltage to across terminals 2-5
- 2) Method to adjust any point without application of voltage to across terminals 2-5
- 3) Method that does not adjust the bias voltage

Pr. 903 "speed setting No. 2 gain"

(You can also adjust Pr. 902 to Pr. 905 and Pr. 917 to Pr. 920 in the similar manner.)

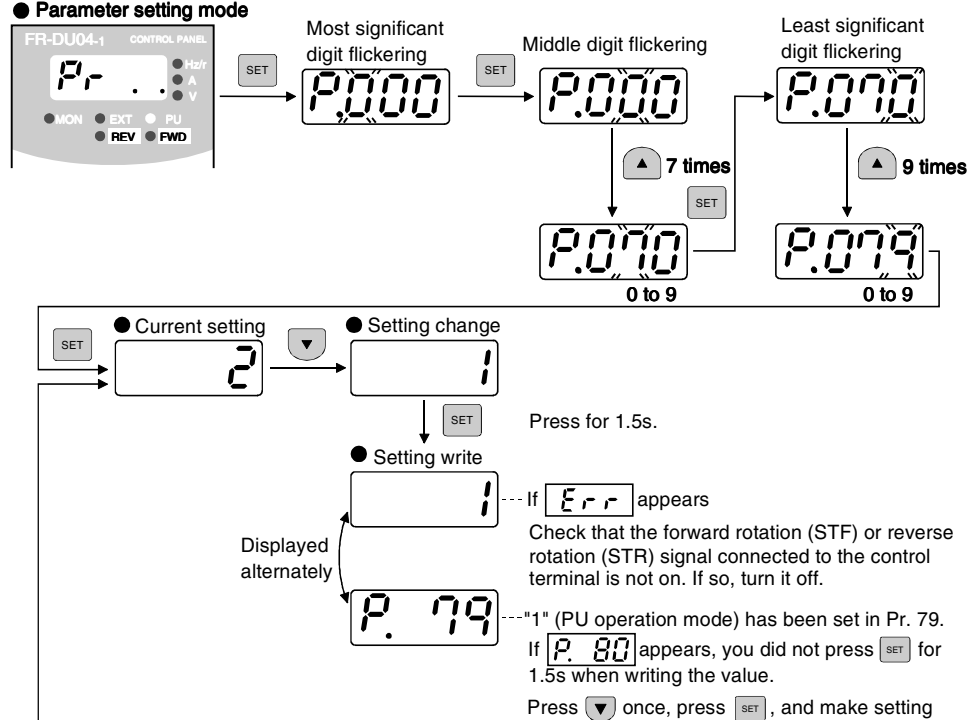
<Adjustment procedure> Using the speed setting signal from the operation panel (FR-DU04-1) to make speed setting

| | |
|---|---|
| <p>(1) Power on (Monitoring mode)</p>  | <p>(2) Choose the PU operation mode.</p> <p>1. Press MODE to make sure that the inverter is in the PU operation mode. (For monitoring displays, refer to the Instruction Manual (basic).)</p> <p>● Operation mode (PU operation mode)</p>  |
|---|---|

2. Set "1" (PU operation mode) in Pr. 79 "operation mode selection".
 Example: To change the external operation mode (Pr. 79 = 2) to the PU operation mode (Pr. 79 = 1)

As in the procedure in 1), press **MODE** to choose the "parameter setting mode".

● **Parameter setting mode**



● **Current setting** ● **Setting change**

● **Setting write**

Displayed alternately

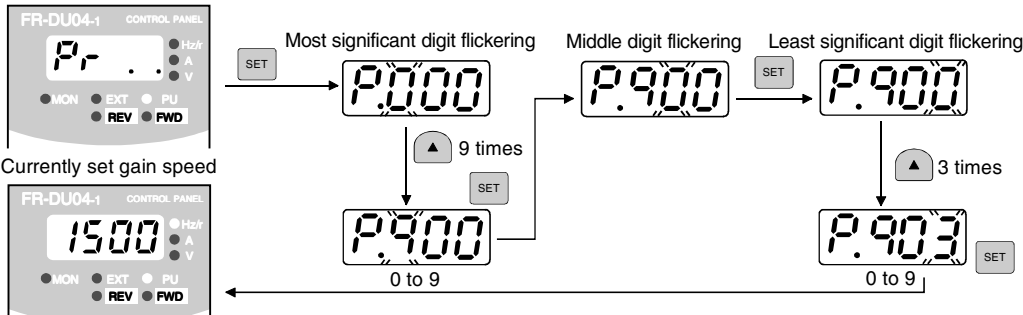
If **Err** appears
 Check that the forward rotation (STF) or reverse rotation (STR) signal connected to the control terminal is not on. If so, turn it off.

If **P. 80** appears, you did not press **SET** for 1.5s when writing the value.
 Press **▼** once, press **SET**, and make setting one more time.

(3) Read Pr. 903 to display the currently set gain speed. (You can also adjust Pr. 902, Pr. 904 and Pr. 905 in a similar manner.)

● **Parameter setting mode**

As in the procedure in (2)-1), press **MODE** to choose the "parameter setting mode".



● **Parameter setting mode**

As in the procedure in (2)-1), press **MODE** to choose the "parameter setting mode".

● **Parameter setting mode**

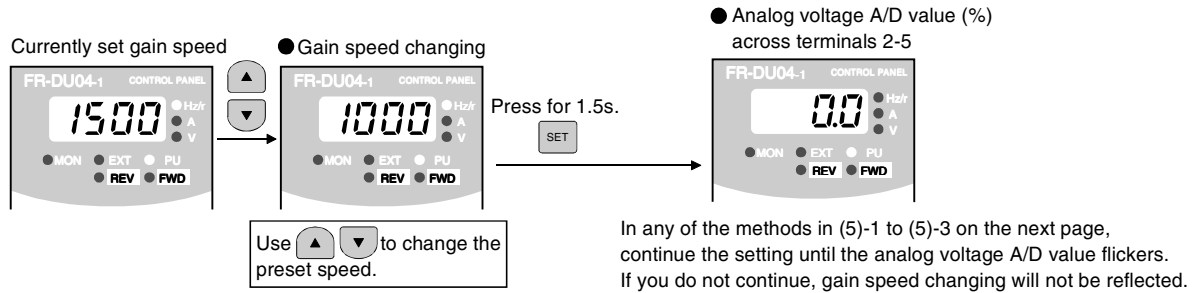
Most significant digit flickering Middle digit flickering Least significant digit flickering

Currently set gain speed

● **Parameter setting mode**

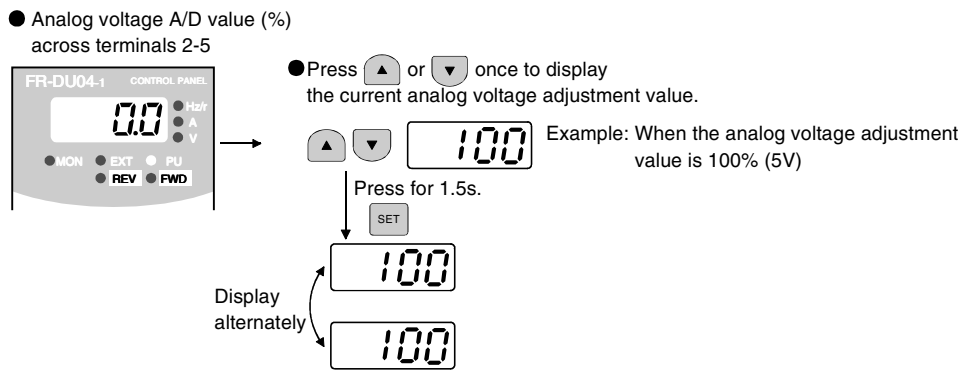
Most significant digit flickering Middle digit flickering Least significant digit flickering

(4) Set the gain speed in Pr. 903 and display the analog voltage A/D value across terminals 2-5 in %.
(To change to 1000r/min)

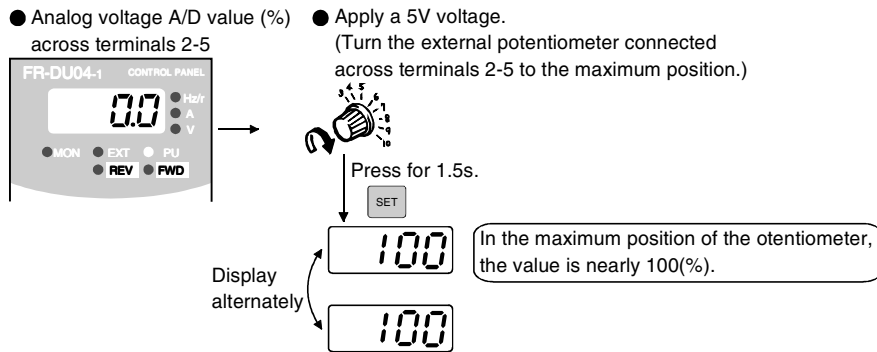


- (1) When not adjusting the gain voltage To (5)-1
- (2) When adjusting any point by application of voltage To (5)-2
- (3) When adjusting any point without application of voltage To (5)-3

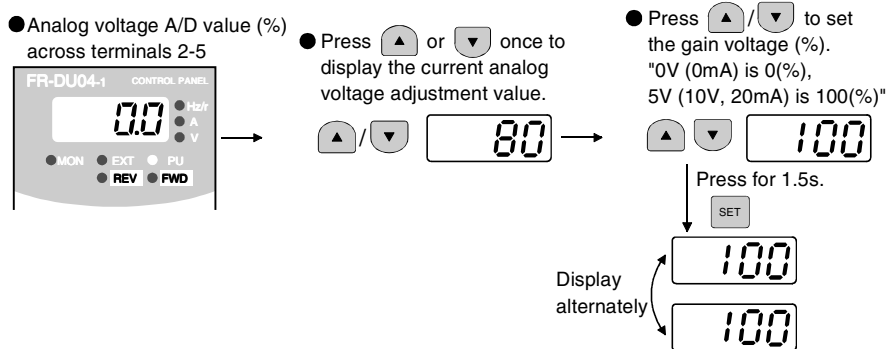
(5)-1 Method to adjust only the gain speed and not to adjust the voltage



(5)-2 Method to adjust any point by application of voltage to across terminals 2-5 (e.g. from external potentiometer)(Current: across terminals 4-5) (when 5V is applied)



(5)-3 Method to adjust any point without application of voltage to across terminals 2-5
(To change from 4V (80%) to 5V (100%))



(6) Pressing the SET key shifts to the next parameter.

(7) Re-set the Pr. 79 "operation mode selection" value according to the operation mode being used.

Additional function (Pr. 990)

CAUTION

1. Changing the Pr. 903 or Pr. 905 (gain adjustment) value will not change the Pr. 20 value. The input of terminal 1 (speed setting auxiliary input) is added to the speed setting signal.
2. For the operation procedure using the parameter unit (FR-PU04V), refer to the FR-PU04V instruction manual.

⚠ CAUTION

⚠ Take care when setting any value other than "0" as the bias speed at 0V. If a speed command is not given, merely turning on the start signal will start the motor at the preset speed.

Related parameters

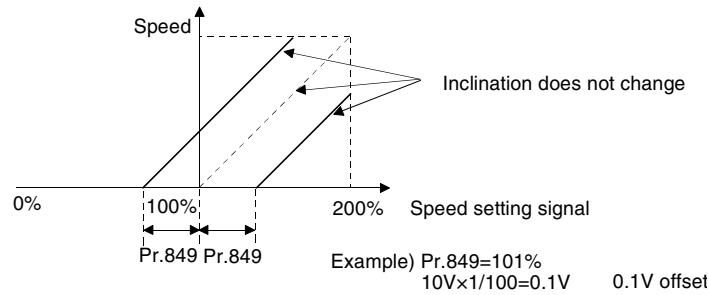
- Pr. 20 "acceleration/deceleration reference speed" (Refer to page 81.)
- Pr. 79 "operation mode selection" (Refer to page 118.)

● Analog input offset adjustment

When speed command by analog input is set, the range where the motor remains stop is created to prevent malfunction at very slow speed.

| Parameter | Name | Factory setting | Setting Range | Remarks |
|-----------|--------------------------------|-----------------|---------------|------------|
| 849 | Analog input offset adjustment | 100% | 0 to 200% | Pr. 77=801 |

Setting Pr. 849 provides speed command by analog input (No. 2 terminal or No. 6 terminal (FR-V5AX)) with offset and avoids speed command to be given due to noise under 0 speed command.



3.44 Additional function (Pr. 990)

3.44.1 Buzzer control (Pr. 990 speed torque position)

You can make the buzzer "beep" when you press any key of the operation panel or parameter unit.

| Parameter | Name | Factory Setting | Setting Range | Remarks |
|-----------|----------------|-----------------|---------------|---|
| 990 | Buzzer control | 1 | 0, 1 | 0: Without beep, 1: With beep Extended mode |

4

SPECIFICATIONS

This chapter explains the "specifications" for use of this product. Always read this instructions before use.

| | | |
|------------|---|------------|
| 4.1 | Model specifications | 194 |
| 4.2 | Common specifications | 196 |
| 4.3 | Outline dimension drawings | 197 |

1

2

3

4

4.1 Model specifications

● **200V class (for use with the Mitsubishi dedicated motor [SF-THY (1500r/min series)])**

| | | | | |
|--|--|--|---|--|
| Inverter | Type FR-V520L-□□K (-NA) | | 75K | |
| | Applicable motor capacity (kW (HP)) | | 75 (100) | |
| | Output | Rated capacity (kVA) (Caution 1) | 114 | |
| | | Rated current (A) | 330 | |
| | | Overload current rating (Caution 2) | 150%60s, 200%0.5s (inverse-time characteristics.) | |
| | Power supply | Voltage | Three-phase 200 to 230V 50/60Hz | |
| | | Rated input AC voltage, frequency | Three-phase 200 to 230V 50/60Hz | |
| | | Permissible AC voltage fluctuation | 170 to 253V 50/60Hz | |
| | | Permissible frequency fluctuation | ±5% | |
| | | Power supply capacity (kVA) (Caution 4) | 330 | |
| Protective structure (JEM 1030) | | Open type (IP00) | | |
| Cooling system | | Forced aircooling | | |
| Approximate. mass (kg(lb)) | | 77 | | |
| Mitsubishi dedicated motor | Motor type | | SF-THY | |
| | Rated output (kW (HP)) | | 75 | |
| | Rated torque (N·m) | | 477 | |
| | Maximum torque 150% 60s (N·m) | | 715 | |
| | Rated speed (r/min) | | 1500 | |
| | Maximum speed (r/min) | | 2400 | |
| | Frame No. | | 250MD | |
| | Inertia moment J (X10⁻⁴kg·m²) | | 1.1 | |
| | | | 90dB | |
| | Cooling fan | Voltage | Three-phase 200V/50Hz, 200V/60Hz, 220V/60Hz | |
| Input (W) | | 750 | | |

CAUTION

1. The rated output capacity indicated assumes that the output voltage is 200V.
2. The overload current rating indicated in % is the ratio of the overload current to the rated output current of the inverter. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
3. The short-time rating is 5s.
4. The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
5. If the motor is one rank lower in capacity than the inverter, it can be used by setting Pr. 80 "motor capacity" and Pr. 81 "number of motor poles". Other manufacturers' motors and special motors can be used by performing online auto tuning.

● 400V class (for use with the Mitsubishi dedicated motor [SF-THV (1500r/min series)])

| | | 75K | 90K | 110K | 132K | 160K | 200K | 250K | | |
|--|--|--|----------|---|-----------|-----------|-----------|-----------|-----------|-----|
| Inverter | Type FR-V540L-□□K (-NA) | | 75K | 90K | 110K | 132K | 160K | 200K | 250K | |
| | Applicable motor capacity (kW (HP)) | | 75 (100) | 90 (125) | 110 (150) | 132 (200) | 160 (250) | 220 (300) | 250 (350) | |
| | Output | Rated capacity (kVA) (Caution 1) | | 114 | 135 | 166 | 187 | 229 | 350 | |
| | | Rated current (A) | | 165 | 195 | 240 | 270 | 330 | 415 | 505 |
| | | Overload current rating (Caution 2) | | 150%60s, 200%0.5s (inverse-time characteristics.) | | | | | | |
| | Power supply | Voltage | | Three-phase 380 to 480V 50/60Hz | | | | | | |
| | | Rated input AC voltage, frequency | | Three-phase 380 to 480V 50/60Hz | | | | | | |
| | | Permissible AC voltage fluctuation | | 323 to 528V 50/60Hz | | | | | | |
| | | Permissible frequency fluctuation | | ±5% | | | | | | |
| | | Power supply capacity (kVA) (Caution 4) | | 114 | 135 | 166 | 187 | 229 | 288 | 350 |
| Protective structure (JEM 1030) | | Open type (IP00) | | | | | | | | |
| Cooling system | | Forced aircooling | | | | | | | | |
| Approximate. mass (kg (lbs)) | | 75 (165) | | 120 (265) | | 220 (485) | | 235 (518) | | |
| Mitsubishi dedicated motor | Motor type | | SF-THV | | | | | | | |
| | Rated output (kW (HP)) | | 75 | 90 | 110 | 132 | 160 | 200 | 250 | |
| | Rated torque (N·m) | | 477 | 572 | 700 | 840 | 1018 | 1273 | 1591 | |
| | Maximum torque 150% 60s (N·m) | | 715 | 858 | 1050 | 1260 | 1527 | 1909 | 2386 | |
| | Rated speed (r/min) | | 1500 | | | | | | | |
| | Maximum speed (r/min) | | 2400 | 1800 | | | | | | |
| | Frame No. | | 250MD | 250MD | 280MD | 280MD | 280MD | 280L | 315H | |
| | Inertia moment J (X10⁻⁴kg·m²) | | 1.1 | 1.7 | 2.3 | 2.3 | 4.0 | 3.8 | 5.0 | |
| | | | 90dB | | | 95dB | | | | |
| | Cooling fan | Voltage | | Three-phase 200V/50Hz, 200V/60Hz, 220V/60Hz | | | | | | |
| Input (W) | | 50Hz | 400 | 400 | 400 | 400 | 400 | 750 | 750 | |
| | | 60Hz | 750 | 750 | 750 | 750 | 750 | 1500 | 1500 | |

CAUTION

1. The rated output capacity indicated assumes that the output voltage is 400V.
2. The overload current rating indicated in % is the ratio of the overload current to the rated output current of the inverter. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
3. The short-time rating is 5s.
4. The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
5. If the motor is one rank lower in capacity than the inverter, it can be used by setting Pr. 80 "motor capacity" and Pr. 81 "number of motor poles". Other manufacturers' motors and special motors can be used by performing online auto tuning.

4.2 Common specifications

| | | | | | | | |
|--|---|--|---|---|--|--|--|
| Inverter | Control specifications | Control system | | Soft-PWM control or high carrier frequency sine-wave PWM control can be selected. | | | |
| | | Control mode | | Vector control, or V/F control can be selected. | | | |
| | | Speed setting resolution | Analog input | 0.03% of the maximum set speed | | | |
| | | Acceleration/deceleration time | Digital input | 0.003% to the maximum setting (minimum setting 0.1r/min) | | | |
| | | Acceleration/deceleration pattern | | 0 to 3600 s (0.1 s increments) | | | |
| | | Torque restriction level | | Linear, S pattern (3 types) or backlash compensation acceleration/deceleration can be selected. | | | |
| | | Torque restriction level | | Torque restriction value can be set (0 to 400% variable) | | | |
| | Input signals | Analog setting signal | Terminal No. | Setting Range | Speed Control | Torque Control | |
| | | | 2 | 0 to 10V (resolution 0.03%) | Main speed setting | Speed restriction | |
| | | | 1 | 0 to ±10V (resolution 0.05%) | Auxiliary speed setting/magnetic flux command/regenerative torque restriction | Speed restriction compensation/magnetic flux command/forward/reverse rotation speed restriction (analog polarity switchover speed restriction) | |
| | | Option (FR-V5AX) | 6 | 0 to ±10V (resolution 0.003%) | Main speed setting (at this time, terminal 2 is invalid)/torque restriction | Speed restriction (at this time, terminal 2 is invalid)/Torque command (at this time, terminal 3 is invalid) | |
| | | Contact signal | 3 fixed function terminals | | Forward rotation command, alarm reset, external thermal relay | | |
| | | | 5 function terminals | | Selection can be made from reverse rotation command, multi-speed setting (max. 15 speeds), remote setting, jog operation (Caution 1), second function selection, third function selection, output stop, start signal self-holding, pre-excitation, control mode switchover, torque restriction selection, S pattern switchover, PID control terminal, orientation command, break opening completion signal, PU operation/external operation switchover, torque bias selection 1, torque bias selection 2, P control selection, servo on, HC connection, and PU/external interlock. | | |
| | Option (FR-V5AX) | 6 multi-function terminals | | Selection can be made from inverter running, inverter running 2, up to speed, instantaneous power failure (undervoltage), speed detection, second speed detection, third speed detection, PU operation mode, overload alarm, regenerative brake prealarm, electronic thermal relay prealarm, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, operation ready, operation ready 2, brake opening request, heatsink overheat prealarm, orientation in-position, forward rotation output, reverse rotation output, low speed output, torque detection, regenerative status output, minor fault output, minor fault output 2, alarm output, maintenance timer output, remote output, output speed detection, second (third) output speed detection, in-position and trace status. | | | |
| | Output signals | Contact signal | 1 changeover contact (230VAC 0.3A, 30VDC 0.3A) | | Selection can be made from speed, output current, output voltage, preset speed, output frequency, motor torque, converter output voltage, regenerative brake duty, electronic overcurrent protection load factor, output current peak value, converter output voltage peak value, input terminal status (Caution 3), output terminal status (Caution 4), load meter, motor exciting current, position pulse, cumulative operation time, actual operation time, motor load factor, torque command, torque current command, feedback pulse, motor output, trace status. | | |
| Open collector signal | | 3 multi-function terminals | | | | | |
| Option (FR-V5AY) | | 3 multi-function terminals | | | | | |
| Option (FR-V5AM) | | 1 multi-function terminal | | | | | |
| Option (FR-A5AY) | | 7 multi-function terminals | | | | | |
| Analog output | 0 to ±10V 12 bits 1CH 0 to 10V 12 bits 1CH | | Selection can be made from speed, output current, output voltage, preset speed, output frequency, motor torque, converter output voltage, regenerative brake duty, electronic overcurrent protection load factor, output current peak value, converter output voltage peak value, load meter, motor exciting current, motor output, reference voltage output, torque command, torque current command and torque monitoring. | | | | |
| Option (FR-A5AY) | 0 to 10V 10 bits 1CH 0 to 20mA 10 bits 1CH | | | | | | |
| PLG pulse output option (FR-V5AY) | A phase, B phase, Z phase (A and B phases can be divided) Open collector/differential line driver. | | | | | | |
| Operational functions | | Maximum/minimum speed setting, speed jump, external thermal relay input selection, polarity reversible operation, override function, automatic restart operation after instantaneous power failure, forward/reverse rotation prevention, operation mode selection, offline auto tuning function, online auto tuning function, easy gain tuning, computer link operation, remote setting, brake sequence, second function, third function, multi-speed operation, coasting to stop, power failure stop, PID control, speed feed forward, model adaptive speed control, master/slave, torque bias, 12-bit digital command (FR-A5AX option), 16-bit digital command (FR-A5AH option), pulse train input (FR-A5AP option), motor thermistor interface (FR-V5AX option) | | | | | |
| Display | Parameter unit (FR-DU04-i/FR-PU04V) | | Selection can be made from speed, output current, output voltage, preset speed, output frequency, motor torque, converter output voltage, regenerative brake duty, electronic overcurrent protection load factor, output current peak value, converter output voltage peak value, input terminal status (Caution 3), output terminal status (Caution 4), load meter, motor exciting current, position pulse, cumulative operation time, actual operation time, motor load factor, torque command, torque current command, feedback pulse, motor output, trace status. | | | | |
| | Alarm definition | | Alarm definition is displayed when protective function is activated. 8 past alarm definitions are stored. (Only 4 alarm definitions are displayed on the operation panel.) | | | | |
| Protective functions | | Overcurrent shut-off (acceleration, deceleration, constant speed), regenerative overvoltage shut-off (acceleration, deceleration, constant speed), undervoltage, instantaneous power failure, overload shut-off (electronic thermal relay), earth (ground) fault current, power output short circuit (12/24VDC/operation panel), stall prevention, external thermal relay, heatsink overheat, option alarm, parameter error, PU disconnection, encoder no-signal, speed deviation large, overspeed, position error large, CPU error, encoder phase error, output phase failure, retry count excess, brake sequence error, main circuit error. | | | | | |
| Environment | Ambient temperature | | -10C to +50°C (14°F to 122°F) (non-freezing) | | | | |
| | Ambient humidity | | 90%RH or less (non-condensing) | | | | |
| | Storage temperature (Caution 2) | | -20 to +65°C (-4°F to 149°F) | | | | |
| | Atmosphere | | Indoor use. (No corrosive gas, flammable gas, oil mist, dust and dirt) | | | | |
| Altitude, vibration | | Maximum 1,000m (3280.80feet) above sea level, 5.9m/s ² or less (compliant with JIS C 0040) | | | | | |

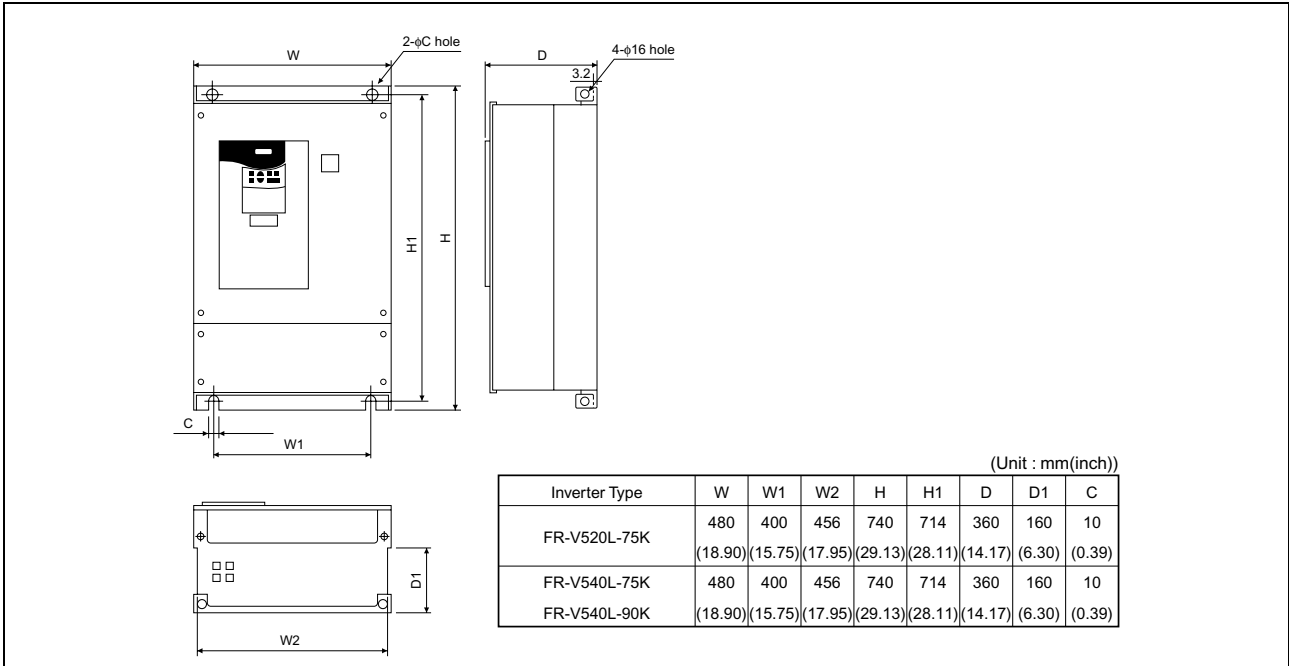
CAUTION

1. Jog operation may also be performed from the operation panel (FR-DU04-1) or the parameter unit (FR-PU04V).
2. Temperature applicable for a short period in transit, etc.
3. Not provided for the operation panel (FR-DU04-1).

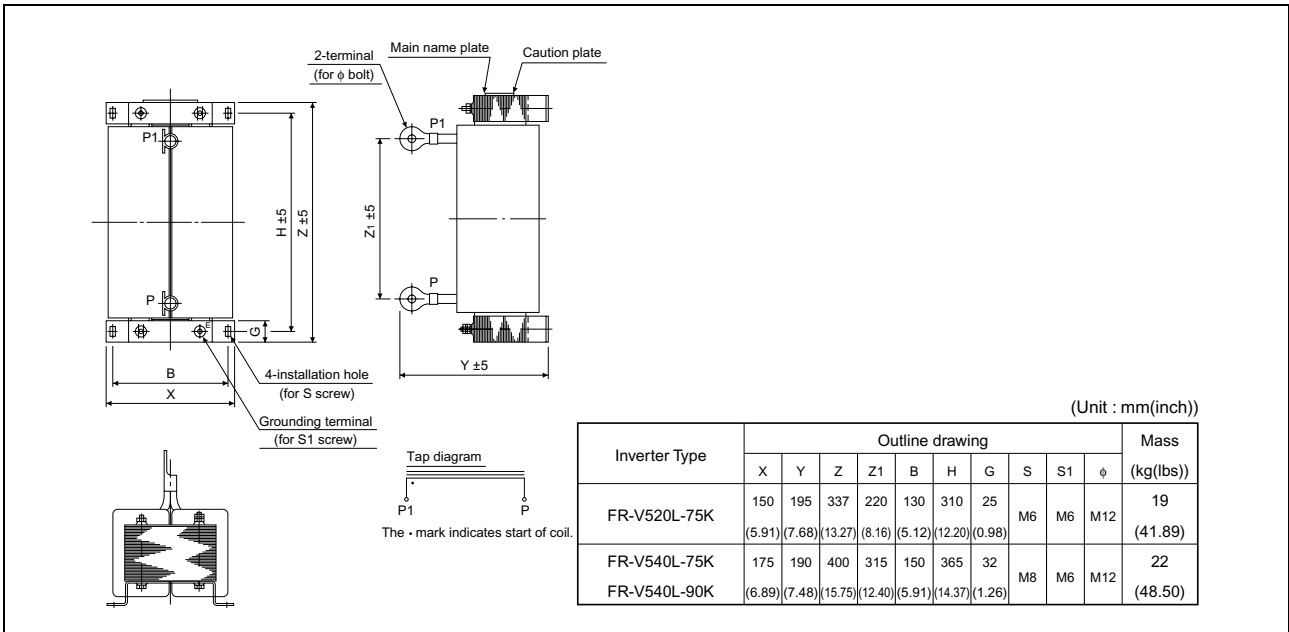
4.3 Outline dimension drawings

4.3.1 Inverter outline dimension drawings

● FR-V540L-75K, 90K / FR-V520L-75K

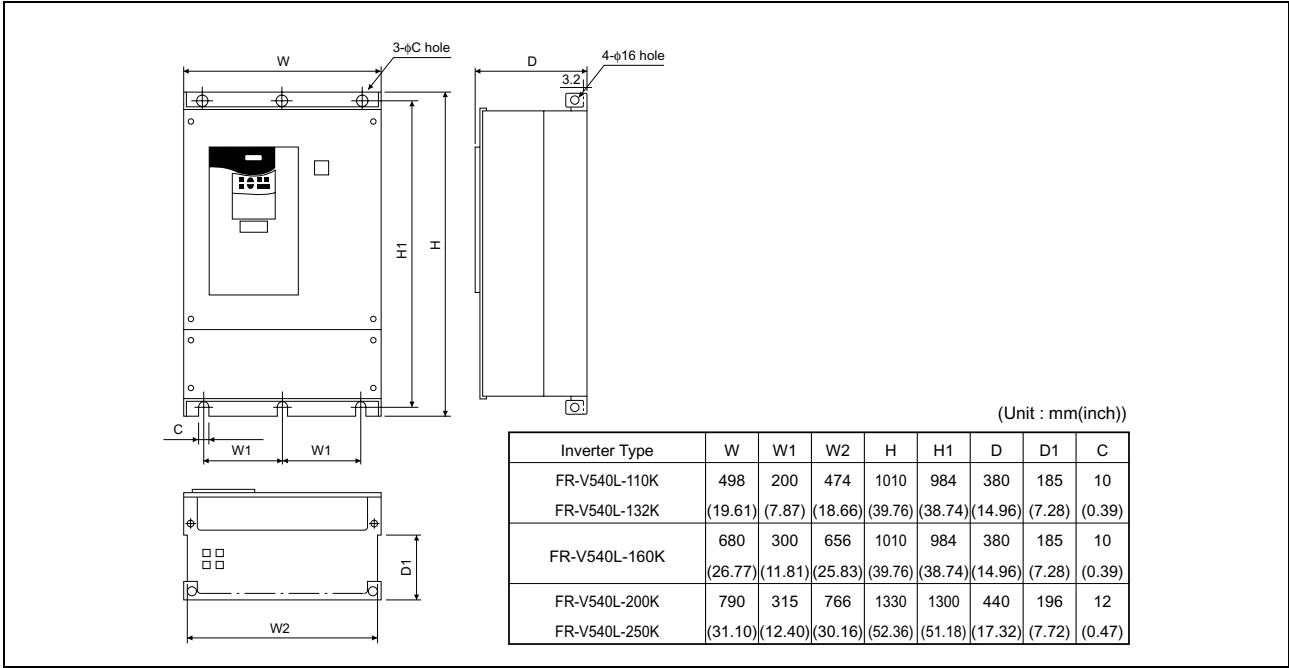


● DC reactor

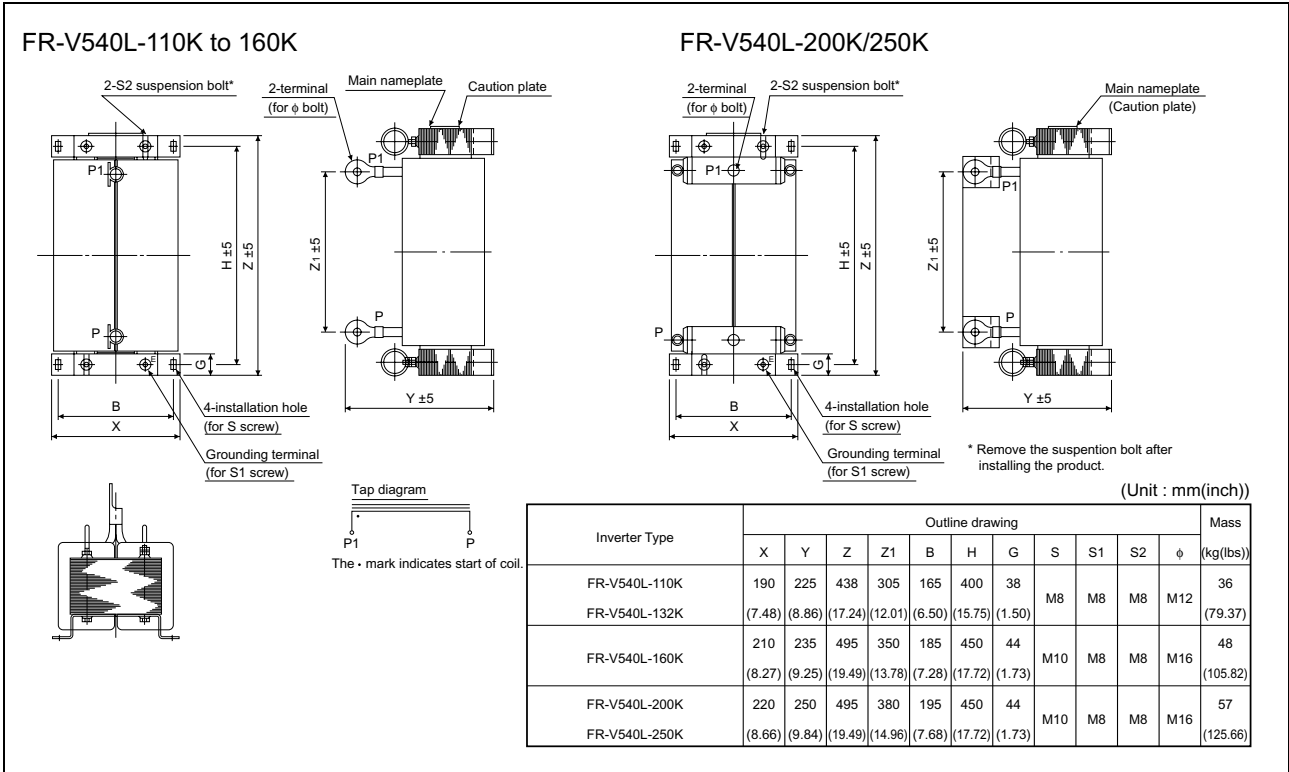


Outline dimension drawings

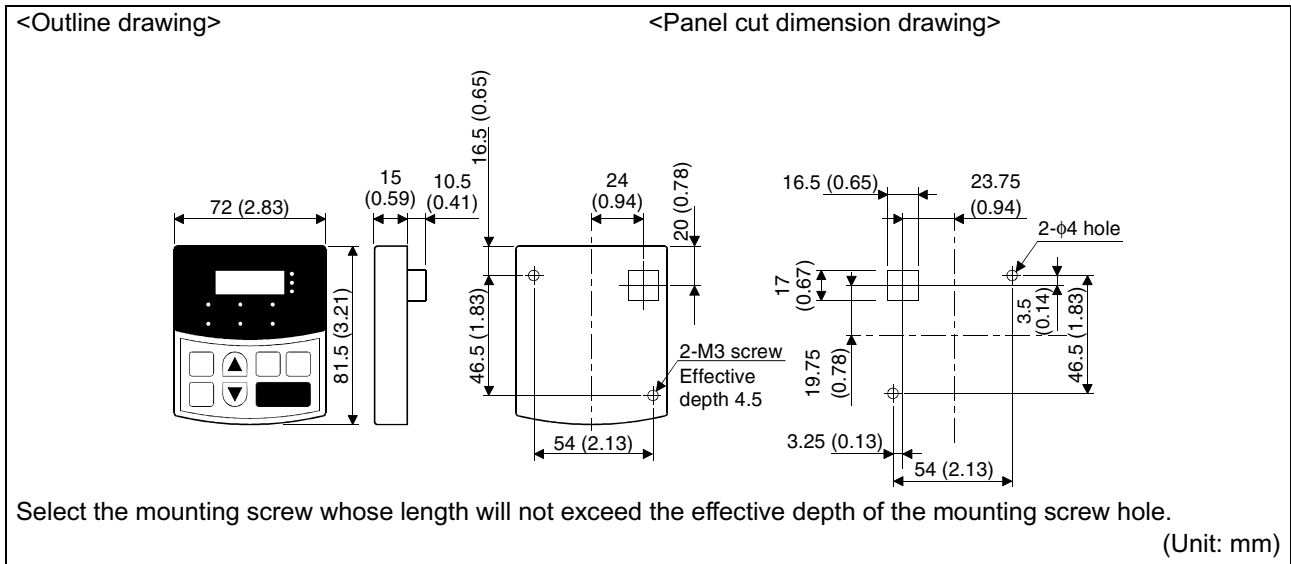
●FR-V540L-110K, 132K, 160K, 200K, 250K



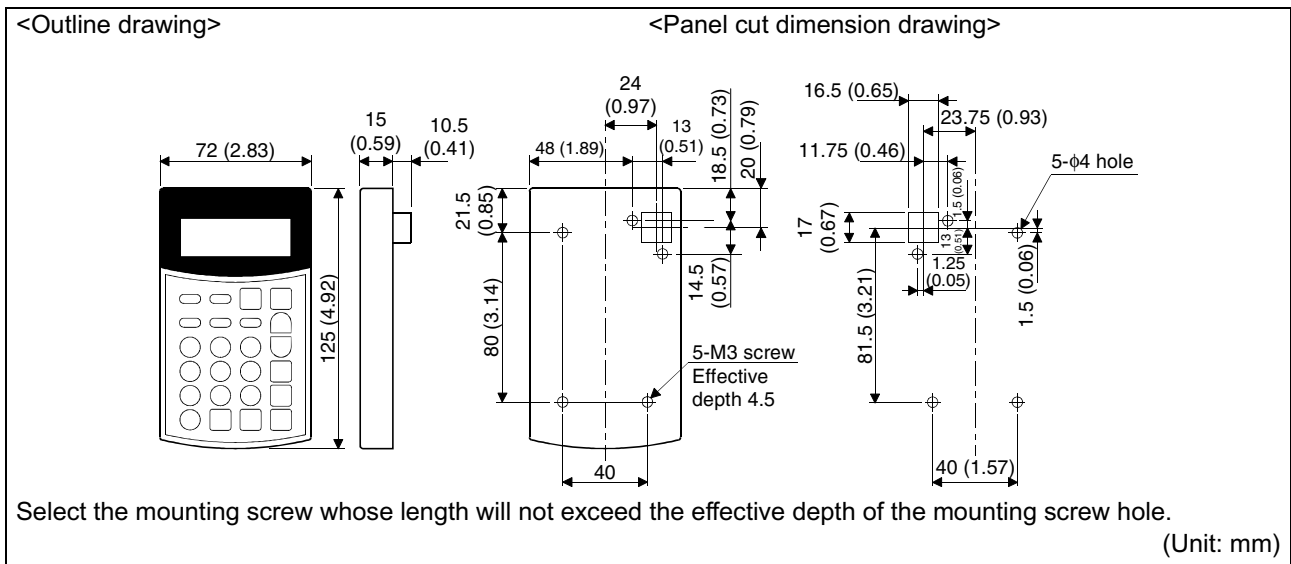
● DC reactor



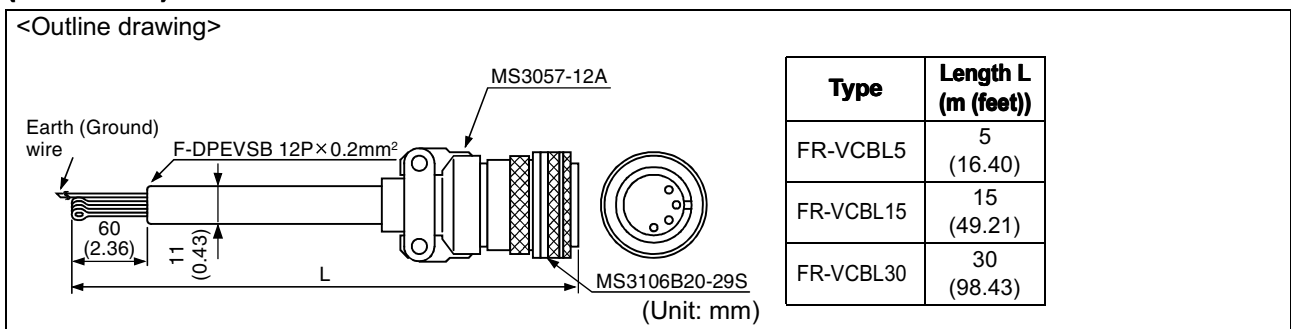
4.3.2 Operation panel (FR-DU04-1) outline dimension drawings



4.3.3 Parameter unit (FR-PU04V) outline dimension drawings



4.3.4 PLG connection cable outline dimension drawings (FR-V5CBL)



Outline dimension drawings

(MT-VCBL)

<Outline drawing>

| Type | Length L (m) |
|------------|--------------|
| MT-VCBL5 | 5 |
| MT-VCBL15 | 15 |
| MT-VCBL30 | 30 |
| MT-VCBL50 | 50 |
| MT-VCBL100 | 100 |

For the MT-VCBL, change the crimping terminal size from M3 to M3.5.

(Unit: mm)

(1) Cable selection specifications

| Wiring Distance | PLG Cable for Options | Cable Specification | |
|---------------------------|--|----------------------------------|-----------------------------|
| | | Wiring 0.2mm ² Cables | Using larger gauge cable |
| 5m (16.4feet) or less | FR-V5CBL5 | 2 parallels or more | 0.4mm ² or more |
| 10m (32.8feet) or less | FR-V5CBL15 | 2 parallels or more | |
| 15m (49.21feet) or less | | 4 parallels or more | 0.75mm ² or more |
| 20m (65.62feet) or less | FR-V5CBL30 | 4 parallels or more | |
| 30m (98.43feet) or less | | 6 parallels or more | |
| 50m (164.04feet) or less | Available on request, please consult us. | 6 parallels or more | 1.25mm ² or more |
| 100m (328.08feet) or less | | | |

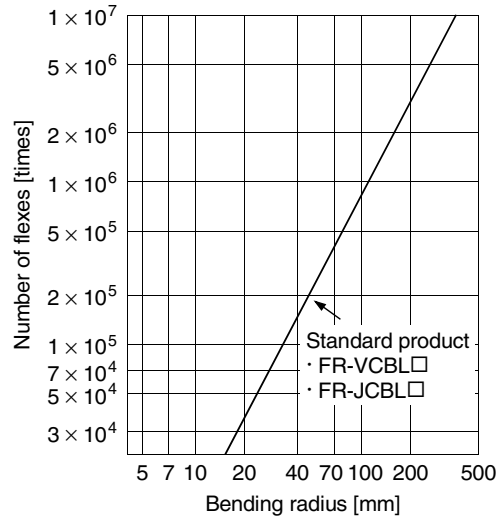
If connection cables are not available, make cables according to the table above.
 For the pin arrangement for the FR-VCBL/FR-JCBL, refer to page 35.

(2) PLG connector (Manufactured by Japan Aviation Electronics Industries) for reference

| Straight Plug MS3106B20-29S | Angle Plug MS3108B20-29S |
|-----------------------------|--|
| | <p>Note This angle type connector is not optional. Please obtain it separately.</p> |
| Cable Clamp MS3057-12A | |
| | |

(3) Cable stresses

- (1) The way of clamping the cable must be fully considered so that flexing stress and cable's own weight stress are not applied to the cable connection.
- (2) In any application where the motor moves, do not subject the cable to excessive stress.
- (3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or trampled over by workers or vehicles.
- (4) The reference value of PLG cable flexing life is shown on the right.
When mounting the PLG on a machine where the motor will move, the flexing radius should be as large as possible.



CAUTION
This graph shows calculated values and not guaranteed values.

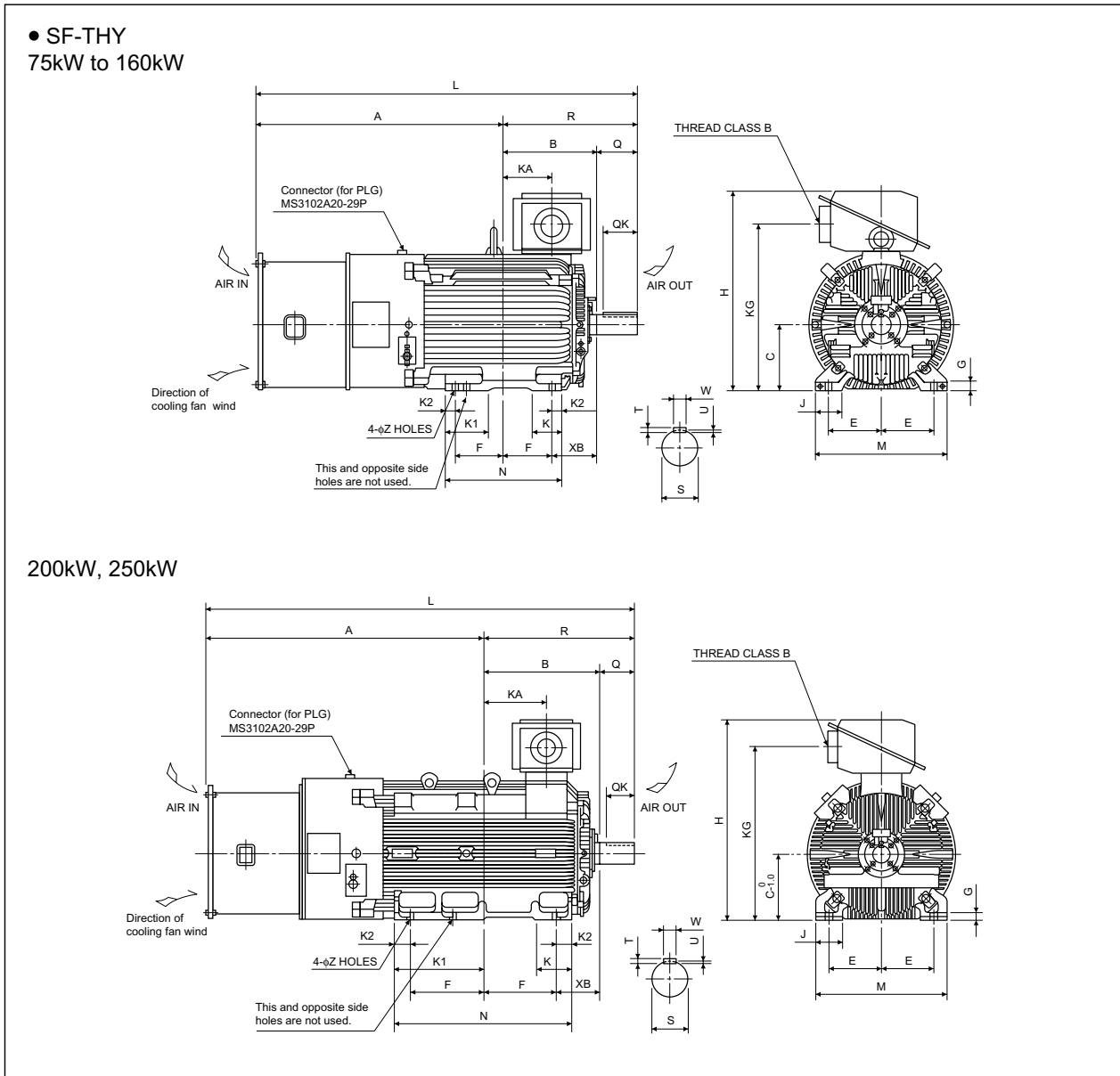
Outline dimension drawings

4.3.5 Mitsubishi dedicated motor outline dimension drawings (1500r/min series)

Install the motor on the floor and use it with the shaft horizontal.

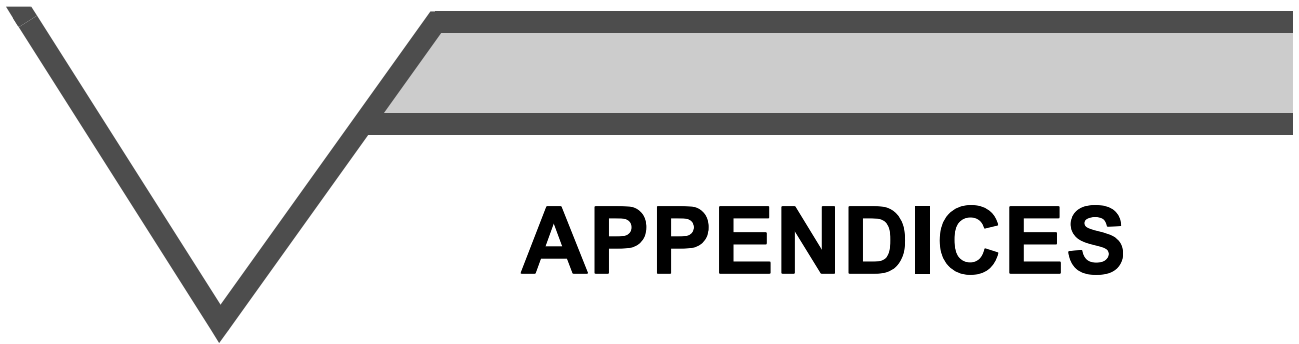
Leave an enough clearance between the fan suction port and wall to ensure adequate cooling.

For the flange type and brake motors, refer to the separately available outline dimension drawings.



Motor size

| Output (kW) | Frame No. | Mass (kg) | Dimensions | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|-----------|-----------|------------|-------|-----|-----|-------|-------|----|-----|-----|-----|-----|----|------|-----|-----|-------|----|-----|-------|-----|-----|-----|-------|----|----|-----|
| | | | A | B | C | D | E | F | G | H | J | K | K1 | K2 | L | M | N | R | Z | XB | KA | KG | Q | QK | S | W | T | U |
| 75 | 250MD | 610 | 988.5 | 340.5 | 250 | 557 | 203 | 174.5 | 30 | 775 | 100 | 130 | 168 | 50 | 1471 | 486 | 449 | 482.5 | 24 | 168 | 157.5 | 635 | 140 | 110 | φ75m6 | 20 | 12 | 7.5 |
| 90 | 250MD | 660 | 988.5 | 340.5 | 250 | 557 | 203 | 174.5 | 30 | 775 | 100 | 130 | 168 | 50 | 1471 | 486 | 449 | 482.5 | 24 | 168 | 157.5 | 635 | 140 | 110 | φ75m6 | 20 | 12 | 7.5 |
| 110 | 280MD | 870 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 499 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | φ85m6 | 22 | 14 | 9 |
| 132 | 280MD | 890 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 499 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | φ85m6 | 22 | 14 | 9 |
| 160 | 280MD | 920 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 499 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | φ85m6 | 22 | 14 | 9 |
| 200 | 280L | 1170 | 1210.5 | 416.5 | 280 | 652 | 228.5 | 228.5 | 30 | 885 | 110 | 160 | 160 | 75 | 1799 | 560 | 607 | 588.5 | 24 | 190 | 214.5 | 745 | 170 | 140 | φ85m6 | 22 | 14 | 9 |
| 250 | 315H | 1630 | 1343 | 565 | 315 | 717 | 254 | 355 | 35 | 965 | 130 | 175 | 428 | 80 | 2084 | 636 | 870 | 741 | 28 | 216 | 306 | 825 | 170 | 140 | φ95m6 | 25 | 14 | 9 |



APPENDICES

This chapter provides the "appendices" for use of this product. Always read this instructions before use.

Appendix Parameter Data Code Lists.....204

Appendix Parameter Data Code Lists

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|-------------------------------|---|---|-----------------|-------|---|
| | | | Read | Write | |
| Basic functions | 0 | Torque boost (manual) | 00 | 80 | 0 |
| | 1 | Maximum speed (simple mode) | 01 | 81 | 0 |
| | 2 | Minimum speed (simple mode) | 02 | 82 | 0 |
| | 3 | Base frequency | 03 | 83 | 0 |
| | 4 | Multi-speed setting (high speed) (simple mode) | 04 | 84 | 0 |
| | 5 | Multi-speed setting (middle speed) (simple mode) | 05 | 85 | 0 |
| | 6 | Multi-speed setting (low speed) (simple mode) | 06 | 86 | 0 |
| | 7 | Acceleration time (simple mode) | 07 | 87 | 0 |
| | 8 | Deceleration time (simple mode) | 08 | 88 | 0 |
| Standard operation functions | 9 | Electronic thermal O/L relay (*) | 09 | 89 | 0 |
| | 10 | DC injection brake operation speed | 0A | 8A | 0 |
| | 11 | DC injection brake operation time | 0B | 8B | 0 |
| | 12 | DC injection brake voltage | 0C | 8C | 0 |
| | 13 | Starting speed | 0D | 8D | 0 |
| | 15 | Jog speed setting | 0F | 8F | 0 |
| Operation selection functions | 16 | Jog acceleration/deceleration time | 10 | 90 | 0 |
| | 17 | MRS input selection | 11 | 91 | 0 |
| | 19 | Base frequency voltage | 13 | 93 | 0 |
| | 20 | Acceleration/deceleration reference speed | 14 | 94 | 0 |
| | 21 | Acceleration/deceleration time increments | 15 | 95 | 0 |
| | 22 | Torque restriction level | 16 | 96 | 0 |
| | 24 | Multi-speed setting (speed 4) | 18 | 98 | 0 |
| | 25 | Multi-speed setting (speed 5) | 19 | 99 | 0 |
| | 26 | Multi-speed setting (speed 6) | 1A | 9A | 0 |
| | 27 | Multi-speed setting (speed 7) | 1B | 9B | 0 |
| | 28 | Multi-speed input compensation | 1C | 9C | 0 |
| | 29 | Acceleration/deceleration pattern | 1D | 9D | 0 |
| | 30 | Regenerative function selection | 1E | 9E | 0 |
| | 31 | Speed jump 1A | 1F | 9F | 0 |
| | 32 | Speed jump 1B | 20 | A0 | 0 |
| | 33 | Speed jump 2A | 21 | A1 | 0 |
| | Output terminal functions | 34 | Speed jump 2B | 22 | A2 |
| 35 | | Speed jump 3A | 23 | A3 | 0 |
| 36 | | Speed jump 3B | 24 | A4 | 0 |
| Second functions | 37 | Speed display | 25 | A5 | 0 |
| | 41 | Up-to-speed sensitivity | 29 | A9 | 0 |
| Terminal assignment functions | 42 | Speed detection | 2A | AA | 0 |
| | 43 | Speed detection for reverse rotation | 2B | AB | 0 |
| Display functions | 44 | Second acceleration/deceleration time | 2C | AC | 0 |
| | 45 | Second deceleration time | 2D | AD | 0 |
| Automatic restart | 50 | Second speed detection | 32 | B2 | 0 |
| | 52 | DU/PU main display data selection | 34 | B4 | 0 |
| | 53 | PU level display data selection | 35 | B5 | 0 |
| | 54 | DA1 terminal function selection | 36 | B6 | 0 |
| Additional function | 55 | Speed monitoring reference | 37 | B7 | 0 |
| | 56 | Current monitoring reference | 38 | B8 | 0 |
| Operation selection functions | 57 | Restart coasting time | 39 | B9 | 0 |
| | 58 | Restart cushion time | 3A | BA | 0 |
| | 59 | Remote setting function selection | 3B | BB | 0 |
| | 60 | Intelligent mode selection | 3C | BC | 0 |
| | 65 | Retry selection | 41 | C1 | 0 |
| | 67 | Number of retries at alarm occurrence | 43 | C3 | 0 |
| | 68 | Retry waiting time | 44 | C4 | 0 |
| | 69 | Retry count display erasure | 45 | C5 | 0 |
| | 70 | Special regenerative brake duty | 46 | C6 | 0 |
| | 71 | Applied motor (*) | 47 | C7 | 0 |
| | 72 | PWM frequency selection (simple mode) | 48 | C8 | 0 |
| | 73 | Speed setting signal | 49 | C9 | 0 |
| | 75 | Reset selection/disconnected PU detection/PU stop selection | 4B | CB | 0 |
| 77 | Parameter write disable selection (simple mode) | 4D | CD (Caution) | 0 | |
| 78 | Reverse rotation prevention selection | 4E | CE | 0 | |
| 79 | Operation mode selection (simple mode) | 4F | CF (Caution) | 0 | |

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|---|---------------|---|------------|-------|---|
| | | | Read | Write | |
| Motor constants | 80 | Motor capacity (*) | 50 | D0 | 0 |
| | 81 | Number of motor poles (*) | 51 | D1 | 0 |
| | 82 | Motor excitation current (no load current) | 52 | D2 | 0 |
| | 83 | Rated motor voltage (*) | 53 | D3 | 0 |
| | 84 | Rated motor frequency (*) | 54 | D4 | 0 |
| | 90 | Motor constant R1 | 5A | DA | 0 |
| | 91 | Motor constant R2 | 5B | DB | 0 |
| | 92 | Motor constant L1 | 5C | DC | 0 |
| | 93 | Motor constant L2 | 5D | DD | 0 |
| | 94 | Motor constant X | 5E | DE | 0 |
| Third functions | 95 | Online auto tuning selection (simple mode) | 5F | DF | 0 |
| | 96 | Auto tuning setting/status (*) | 60 | E0 | 0 |
| Third functions | 110 | Third acceleration/deceleration time | 0A | 8A | 1 |
| | 111 | Third deceleration time | 0B | 8B | 1 |
| Terminal assignment functions | 116 | Third speed detection | 10 | 90 | 1 |
| Communication functions | 117 | Station number | 11 | 91 | 1 |
| | 118 | Communication speed | 12 | 92 | 1 |
| | 119 | Stop bit length/data length | 13 | 93 | 1 |
| | 120 | Parity check presence/absence | 14 | 94 | 1 |
| | 121 | Number of communication retries | 15 | 95 | 1 |
| | 122 | Communication check time interval | 16 | 96 | 1 |
| | 123 | Waiting time setting | 17 | 97 | 1 |
| PID control | 124 | CR, LF presence/absence selection | 18 | 98 | 1 |
| | 128 | PID action selection | 1C | 9C | 1 |
| | 129 | PID proportional band | 1D | 9D | 1 |
| | 130 | PID integral time | 1E | 9E | 1 |
| | 131 | Upper limit | 1F | 9F | 1 |
| | 132 | Lower limit | 20 | A0 | 1 |
| Backlash | 133 | PID action set point for PU operation | 21 | A1 | 1 |
| | 134 | PID differential time | 22 | A2 | 1 |
| | 140 | Backlash acceleration stopping speed | 28 | A8 | 1 |
| | 141 | Backlash acceleration stopping time | 29 | A9 | 1 |
| Display functions | 142 | Backlash deceleration stopping speed | 2A | AA | 1 |
| | 143 | Backlash deceleration stopping time | 2B | AB | 1 |
| | 144 | Speed setting switchover | 2C | AC | 1 |
| Current detection | 145 | Parameter unit language changing | 2D | AD | 1 |
| | 150 | Output current detection level | 32 | B2 | 1 |
| | 151 | Output current detection time | 33 | B3 | 1 |
| | 152 | Zero current detection level | 34 | B4 | 1 |
| Sub functions | 153 | Zero current detection time | 35 | B5 | 1 |
| | 156 | Stall prevention operation selection | 38 | B8 | 1 |
| Display functions | 157 | OL signal output timer | 39 | B9 | 1 |
| | 158 | DA2 terminal function selection | 3A | BA | 1 |
| | 160 | Extended function selection (simple mode) | 00 | 80 | 2 |
| Automatic restart after instantaneous power failure | 162 | Automatic restart after instantaneous power failure selection | 02 | 82 | 2 |
| | 163 | First cushion time for restart | 03 | 83 | 2 |
| | 164 | First cushion voltage for restart | 04 | 84 | 2 |
| | 165 | Restart current restriction level | 05 | 85 | 2 |
| Initial monitor | 171 | Actual operation hour meter clear | 0B | 8B | 2 |
| Terminal assignment functions | 180 | DI1 terminal function selection | 14 | 94 | 2 |
| | 181 | DI2 terminal function selection | 15 | 95 | 2 |
| | 182 | DI3 terminal function selection | 16 | 96 | 2 |
| | 183 | DI4 terminal function selection | 17 | 97 | 2 |
| | 187 | STR terminal function selection | 1B | 9B | 2 |
| | 190 | DO1 terminal function selection | 1E | 9E | 2 |
| | 191 | DO2 terminal function selection | 1F | 9F | 2 |
| | 192 | DO3 terminal function selection | 20 | A0 | 2 |
| Multi-speed operation | 195 | A, B, C terminal function selection | 23 | A3 | 2 |
| | 232 | Multi-speed setting (speed 8) | 28 | A8 | 2 |
| | 233 | Multi-speed setting (speed 9) | 29 | A9 | 2 |
| | 234 | Multi-speed setting (speed 10) | 2A | AA | 2 |
| | 235 | Multi-speed setting (speed 11) | 2B | AB | 2 |
| | 236 | Multi-speed setting (speed 12) | 2C | AC | 2 |
| | 237 | Multi-speed setting (speed 13) | 2D | AD | 2 |
| Sub functions | 238 | Multi-speed setting (speed 14) | 2E | AE | 2 |
| | 239 | Multi-speed setting (speed 15) | 2F | AF | 2 |
| Sub functions | 240 | Soft-PWM setting | 30 | B0 | 2 |
| | 244 | Cooling fan operation selection | 34 | B4 | 2 |

Parameter Data Code Lists

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|------------------------------|---------------|--|------------|-------|---|
| | | | Read | Write | |
| Stop selection function | 250 | Stop selection | 3A | BA | 2 |
| Operation selection function | 251 | Output phase failure protection selection | 3B | BB | 2 |
| Additional functions | 252 | Override bias | 3C | BC | 2 |
| | 253 | Override gain | 3D | BD | 2 |
| Power failure stop functions | 261 | Power failure stop selection | 45 | C5 | 2 |
| | 262 | Subtracted speed at deceleration start | 46 | C6 | 2 |
| | 263 | Subtraction starting speed | 47 | C7 | 2 |
| | 264 | Power-failure deceleration time 1 | 48 | C8 | 2 |
| | 265 | Power-failure deceleration time 2 | 49 | C9 | 2 |
| | 266 | Power-failure deceleration time switchover speed | 4A | CA | 2 |
| Brake sequence | 278 | Brake opening speed | 56 | D6 | 2 |
| | 279 | Brake opening current | 57 | D7 | 2 |
| | 280 | Brake opening current detection time | 58 | D8 | 2 |
| | 281 | Brake operation time at start | 59 | D9 | 2 |
| | 282 | Brake operation speed | 5A | DA | 2 |
| | 283 | Brake operation time at stop | 5B | DB | 2 |
| | 284 | Deceleration detection function selection | 5C | DC | 2 |
| | 285 | Overspeed detection speed | 5D | DD | 2 |
| Droop | 286 | Droop gain | 5E | DE | 2 |
| | 287 | Droop filter constant | 5F | DF | 2 |
| | 288 | Droop function activation selection | 60 | E0 | 2 |
| Digital input | 300 | BCD input bias | 00 | 80 | 3 |
| | 301 | BCD input gain | 01 | 81 | 3 |
| | 302 | Binary input bias | 02 | 82 | 3 |
| | 303 | Binary input gain | 03 | 83 | 3 |
| | 304 | Digital input and analog compensation input enable/disable selection | 04 | 84 | 3 |
| | 305 | Read timing operation selection | 05 | 85 | 3 |
| Analog output | 306 | Analog output signal selection | 06 | 86 | 3 |
| | 307 | Setting for zero analog output | 07 | 87 | 3 |
| | 308 | Setting for maximum analog output | 08 | 88 | 3 |
| | 309 | Analog output signal voltage/current switchover | 09 | 89 | 3 |
| | 310 | Analog meter voltage output selection | 0A | 8A | 3 |
| | 311 | Setting for zero analog meter voltage output | 0B | 8B | 3 |
| | 312 | Setting for maximum analog meter voltage output | 0C | 8C | 3 |
| Digital output | 313 | Y0 output selection | 0D | 8D | 3 |
| | 314 | Y1 output selection | 0E | 8E | 3 |
| | 315 | Y2 output selection | 0F | 8F | 3 |
| | 316 | Y3 output selection | 10 | 90 | 3 |
| | 317 | Y4 output selection | 11 | 91 | 3 |
| | 318 | Y5 output selection | 12 | 92 | 3 |
| | 319 | Y6 output selection | 13 | 93 | 3 |
| Relay output | 320 | RA1 output selection | 14 | 94 | 3 |
| | 321 | RA2 output selection | 15 | 95 | 3 |
| | 322 | RA3 output selection | 16 | 96 | 3 |
| Digital input | 329 | Digital input unit selection | 1D | 9D | 3 |
| Relay output | 330 | RA0 output selection | 1E | 9E | 3 |
| Communication | 331 | Station number | 1F | 9F | 3 |
| | 332 | Communication speed | 20 | A0 | 3 |
| | 333 | Stop bit length | 21 | A1 | 3 |
| | 334 | Parity check presence/absence | 22 | A2 | 3 |
| | 335 | Number of communication retries | 23 | A3 | 3 |
| | 336 | Communication check time interval | 24 | A4 | 3 |
| | 337 | Waiting time setting | 25 | A5 | 3 |
| | 338 | Operation control command source | 26 | A6 | 3 |
| | 339 | Speed command source | 27 | A7 | 3 |
| | 340 | Link startup mode selection | 28 | A8 | 3 |
| | 341 | CR/LF presence/absence selection | 29 | A9 | 3 |
| | 342 | E ² PROM write presence/absence | 2A | AA | 3 |
| | 345 | DeviceNet address (lower) | 2D | AD | 3 |
| | 346 | DeviceNet baud rate (lower) | 2E | AE | 3 |
| | 347 | DeviceNet address (higher) | 2F | AF | 3 |
| | 348 | DeviceNet baud rate (higher) | 30 | B0 | 3 |

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|-------------------------|---------------|--|------------|-------|---|
| | | | Read | Write | |
| Orientation | 350 | Stop position command selection | 32 | B2 | 3 |
| | 351 | Orientation switchover speed | 33 | B3 | 3 |
| | 356 | Internal stop position command | 38 | B8 | 3 |
| | 357 | In-position zone | 39 | B9 | 3 |
| | 359 | Orientation PLG rotation direction | 3B | BB | 3 |
| | 360 | External position command selection | 3C | BC | 3 |
| | 361 | Position shift | 3D | BD | 3 |
| | 362 | Orientation position loop gain | 3E | BE | 3 |
| Control system function | 369 | Number of orientation PLG pulses | 45 | C5 | 3 |
| S-pattern C | 374 | Overspeed detection level | 4A | CA | 3 |
| | 380 | Acceleration S pattern 1 | 50 | D0 | 3 |
| | 381 | Deceleration S pattern 1 | 51 | D1 | 3 |
| | 382 | Acceleration S pattern 2 | 52 | D2 | 3 |
| Pulse train input | 383 | Deceleration S pattern 2 | 53 | D3 | 3 |
| | 384 | Input pulse division scaling factor | 54 | D4 | 3 |
| | 385 | Speed for zero input pulse | 55 | D5 | 3 |
| Orientation | 386 | Speed for maximum input pulse | 56 | D6 | 3 |
| | 393 | Orientation selection | 5D | DD | 3 |
| | 394 | Number of machine side gear teeth | 5E | DE | 3 |
| | 395 | Number of motor side gear teeth | 5F | DF | 3 |
| | 396 | Orientation speed gain (P term) | 60 | E0 | 3 |
| | 397 | Orientation speed integral time | 61 | E1 | 3 |
| | 398 | Orientation speed gain (D term) | 62 | E2 | 3 |
| Extension inputs | 399 | Orientation deceleration ratio | 63 | E3 | 3 |
| | 400 | DI11 terminal function selection | 00 | 80 | 4 |
| | 401 | DI12 terminal function selection | 01 | 81 | 4 |
| | 402 | DI13 terminal function selection | 02 | 82 | 4 |
| | 403 | DI14 terminal function selection | 03 | 83 | 4 |
| | 404 | DI15 terminal function selection | 04 | 84 | 4 |
| | 405 | DI16 terminal function selection | 05 | 85 | 4 |
| | 406 | High resolution analog input selection | 06 | 86 | 4 |
| Extension outputs | 407 | Motor temperature detection filter | 07 | 87 | 4 |
| | 410 | DO11 terminal function selection | 0A | 8A | 4 |
| | 411 | DO12 terminal function selection | 0B | 8V | 4 |
| | 412 | DO13 terminal function selection | 0C | 8C | 4 |
| Position control | 413 | PLG pulse output division ratio | 0D | 8D | 4 |
| | 419 | Position command right selection | 13 | 93 | 4 |
| | 420 | Command pulse scaling factor numerator | 14 | 94 | 4 |
| | 421 | Command pulse scaling factor denominator | 15 | 95 | 4 |
| | 422 | Position loop gain | 16 | 96 | 4 |
| | 423 | Position feed forward gain | 17 | 97 | 4 |
| | 424 | Position command acceleration/deceleration time constant | 18 | 98 | 4 |
| | 425 | Position feed forward command filter | 19 | 99 | 4 |
| | 426 | In-position width | 1A | 9A | 4 |
| | 427 | Excessive level error | 1B | 9B | 4 |
| | 428 | Command pulse selection | 1C | 9C | 4 |
| Torque command | 429 | Clear signal selection | 1D | 9D | 4 |
| | 430 | Pulse monitor selection | 1E | 9E | 4 |
| Position control | 432 | Pulse train torque command bias | 20 | A0 | 4 |
| | 433 | Pulse train torque command gain | 21 | A1 | 4 |
| | 434 | IP address 1 | 22 | A2 | 4 |
| | 435 | IP address 2 | 23 | A3 | 4 |
| | 436 | IP address 3 | 24 | A4 | 4 |
| | 437 | IP address 4 | 25 | A5 | 4 |
| | 438 | Sub-net mask 1 | 26 | A6 | 4 |
| | 439 | Sub-net mask 2 | 27 | A7 | 4 |
| | 440 | Sub-net mask 3 | 28 | A8 | 4 |
| | 441 | Sub-net mask 4 | 29 | A9 | 4 |
| | 442 | Gateway address 1 | 2A | AA | 4 |
| | 443 | Gateway address 2 | 2B | AB | 4 |
| | 444 | Gateway address 3 | 2C | AC | 4 |
| | 445 | Gateway address 4 | 2D | AD | 4 |
| Torque command | 446 | Password | 2E | AE | 4 |
| | 447 | Digital torque command bias | 2F | AF | 4 |
| | 448 | Digital torque command gain | 30 | B0 | 4 |

Parameter Data Code Lists

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|---------------------|--|--|------------|-------|---|
| | | | Read | Write | |
| Motor constants | 450 | Second applied motor | 32 | B2 | 4 |
| | 451 | Second motor control method selection | 33 | B3 | 4 |
| | 452 | Second electronic thermal O/L relay | 34 | B4 | 4 |
| | 453 | Second motor capacity | 35 | B5 | 4 |
| | 454 | Number of second motor poles | 36 | B6 | 4 |
| | 464 | Digital position control sudden stop deceleration time | 40 | C0 | 4 |
| | 465 | First position feed amount lower 4 digits | 41 | C1 | 4 |
| | 466 | First position feed amount upper 4 digits | 42 | C2 | 4 |
| | 467 | Second position feed amount lower 4 digits | 43 | C3 | 4 |
| | 468 | Second position feed amount upper 4 digits | 44 | C4 | 4 |
| | 469 | Third position feed amount lower 4 digits | 45 | C5 | 4 |
| | 470 | Third position feed amount upper 4 digits | 46 | C6 | 4 |
| | 471 | Fourth position feed amount lower 4 digits | 47 | C7 | 4 |
| | 472 | Fourth position feed amount upper 4 digits | 48 | C8 | 4 |
| | 473 | Fifth position feed amount lower 4 digits | 49 | C9 | 4 |
| | 474 | Fifth position feed amount upper 4 digits | 4A | CA | 4 |
| | 475 | Sixth position feed amount lower 4 digits | 4B | CB | 4 |
| | 476 | Sixth position feed amount upper 4 digits | 4C | CC | 4 |
| | 477 | Seventh position feed amount lower 4 digits | 4D | CD | 4 |
| | 478 | Seventh position feed amount upper 4 digits | 4E | CE | 4 |
| | 479 | Eighth position feed amount lower 4 digits | 4F | CF | 4 |
| | 480 | Eighth position feed amount upper 4 digits | 50 | D0 | 4 |
| | 481 | Ninth position feed amount lower 4 digits | 51 | D1 | 4 |
| | 482 | Ninth position feed amount upper 4 digits | 52 | D2 | 4 |
| | 483 | Tenth position feed amount lower 4 digits | 53 | D3 | 4 |
| | 484 | Tenth position feed amount upper 4 digits | 54 | D4 | 4 |
| | 485 | Eleventh position feed amount lower 4 digits | 55 | D5 | 4 |
| | 486 | Eleventh position feed amount upper 4 digits | 56 | D6 | 4 |
| | 487 | Twelfth position feed amount lower 4 digits | 57 | D7 | 4 |
| | 488 | Twelfth position feed amount upper 4 digits | 58 | D8 | 4 |
| 489 | Thirteenth position feed amount lower 4 digits | 59 | D9 | 4 | |
| 490 | Thirteenth position feed amount upper 4 digits | 5A | DA | 4 | |
| 491 | Fourteenth position feed amount lower 4 digits | 5B | DB | 4 | |
| 492 | Fourteenth position feed amount upper 4 digits | 5C | DC | 4 | |
| 493 | Fifteenth position feed amount lower 4 digits | 5D | DD | 4 | |
| 494 | Fifteenth position feed amount upper 4 digits | 5E | DE | 4 | |
| 495 | Remote output selection | 5F | DF | 4 | |
| 496 | Remote output data 1 | 60 | E0 | 4 | |
| 497 | Remote output data 2 | 61 | E1 | 4 | |
| Communication | 499 | Action selection at SSCNET communication interruption | 63 | E3 | 4 |
| | 500 | Communication error recognition waiting time | 00 | 80 | 5 |
| | 501 | Communication error occurrence count display | 01 | 81 | 5 |
| | 502 | Communication error-time stop mode selection | 02 | 82 | 5 |
| Trace | 520 | Trace data CH1 | 14 | 94 | 5 |
| | 521 | Trace data CH2 | 15 | 95 | 5 |
| | 522 | Trace data CH3 | 16 | 96 | 5 |
| | 523 | Trace data CH4 | 17 | 97 | 5 |
| | 524 | Trace data CH5 | 18 | 98 | 5 |
| | 525 | Trace data CH6 | 19 | 99 | 5 |
| | 526 | Trace data CH7 | 1A | 9A | 5 |
| | 527 | Trace data CH8 | 1B | 9B | 5 |
| | 528 | Trace data CH9 | 1C | 9C | 5 |
| | 529 | Trace data CH10 | 1D | 9D | 5 |
| | 530 | Sampling period | 1E | 9E | 5 |
| | 531 | Sampling count selection | 1F | 9F | 5 |
| | 532 | Trigger source selection 1 | 20 | A0 | 5 |
| | 533 | Trigger source selection 2 | 21 | A1 | 5 |
| | 534 | Trigger level | 22 | A2 | 5 |
| | 535 | Trigger slope selection | 23 | A3 | 5 |
| | 536 | Pre-trigger | 24 | A4 | 5 |
| 537 | Trace data D/A output selection | 25 | A5 | 5 | |
| 538 | Trace start/stop selection | 26 | A6 | 5 | |
| Additional function | 591 | Start holding time | 5D | BD | 5 |

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|-------------------------------|----------------------------------|--|------------|-------|---|
| | | | Read | Write | |
| Operation selection functions | 800 | Control system selection (simple mode) | 00 | 80 | 8 |
| | 801 | Torque characteristic selection | 01 | 81 | 8 |
| | 802 | Pre-excitation selection | 02 | 82 | 8 |
| | 803 | Constant output region torque characteristic selection | 03 | 83 | 8 |
| | 804 | Torque command right selection | 04 | 84 | 8 |
| | 805 | Torque command value (RAM) | 05 | 85 | 8 |
| | 806 | Torque command value (RAM, E ² PROM) | 06 | 86 | 8 |
| | 807 | Speed restriction selection | 07 | 87 | 8 |
| | 808 | Forward rotation speed restriction | 08 | 88 | 8 |
| | 809 | Reverse rotation speed restriction | 09 | 89 | 8 |
| Control system functions | 810 | Torque restriction input method selection | 0A | 8A | 8 |
| | 812 | Torque restriction level (regeneration) | 0C | 8C | 8 |
| | 813 | Torque restriction level (3 quadrant) | 0D | 8D | 8 |
| | 814 | Torque restriction level (4 quadrant) | 0E | 8E | 8 |
| | 815 | Torque restriction level 2 | 0F | 8F | 8 |
| | 816 | Acceleration torque restriction | 10 | 90 | 8 |
| | 817 | Deceleration torque restriction | 11 | 91 | 8 |
| | 818 | Easy gain tuning response level setting (simple mode) | 12 | 92 | 8 |
| | 819 | Easy gain tuning selection (simple mode) | 13 | 93 | 8 |
| | 820 | Speed control P gain 1 | 14 | 94 | 8 |
| | 821 | Speed control integral time 1 | 15 | 95 | 8 |
| | 822 | Speed setting filter 1 | 16 | 96 | 8 |
| | 823 | Speed detection filter 1 | 17 | 97 | 8 |
| | 824 | Torque control P gain 1 | 18 | 98 | 8 |
| | 825 | Torque control integral time 1 | 19 | 99 | 8 |
| | 826 | Torque setting filter 1 | 1A | 9A | 8 |
| | 827 | Torque detection filter 1 | 1B | 9B | 8 |
| | 828 | Model speed control gain | 1C | 9C | 8 |
| | 830 | Speed control P gain 2 | 1E | 9E | 8 |
| | 831 | Speed control integral time 2 | 1F | 9F | 8 |
| | 832 | Speed setting filter 2 | 20 | A0 | 8 |
| | 833 | Speed detection filter 2 | 21 | A1 | 8 |
| | 834 | Torque control P gain 2 | 22 | A2 | 8 |
| | 835 | Torque control integral time 2 | 23 | A3 | 8 |
| | 836 | Torque setting filter 2 | 24 | A4 | 8 |
| 837 | Torque detection filter 2 | 25 | A5 | 8 | |
| Torque biases | 840 | Torque bias selection | 28 | A8 | 8 |
| | 841 | Torque bias 1 | 29 | A9 | 8 |
| | 842 | Torque bias 2 | 2A | AA | 8 |
| | 843 | Torque bias 3 | 2B | AB | 8 |
| | 844 | Torque bias filter | 2C | AC | 8 |
| | 845 | Torque bias operation time | 2D | AD | 8 |
| | 846 | Torque bias balance compensation | 2E | AE | 8 |
| | 847 | Fall-time torque bias No. 3 bias | 2F | AF | 8 |
| 848 | Fall-time torque bias No. 3 gain | 30 | B0 | 8 | |
| 849 | Analog input offset adjustment | 31 | B1 | 8 | |
| Additional functions | 851 | Number of PLG pulses | 33 | B3 | 8 |
| | 852 | PLG rotation direction | 34 | B4 | 8 |
| | 854 | Excitation ratio | 36 | B6 | 8 |
| | 859 | Torque current | 3B | BB | 8 |
| | 862 | Notch filter frequency | 3E | BE | 8 |
| | 863 | Notch filter depth | 3F | BF | 8 |
| | 864 | Torque detection | 40 | C0 | 8 |
| 865 | Low speed detection | 41 | C1 | 8 | |
| Display functions | 866 | Torque monitoring reference | 42 | C2 | 8 |
| | 867 | DA1 output filter | 43 | C3 | 8 |
| Terminal assignment function | 868 | No. 1 terminal function assignment | 44 | C4 | 8 |
| Protective functions | 870 | Speed deviation level | 46 | C6 | 8 |
| | 871 | Speed deviation time | 47 | C7 | 8 |
| | 873 | Speed restriction | 49 | C9 | 8 |
| | 874 | OLT level setting | 4A | CA | 8 |
| Operation selection functions | 875 | Fault definition | 4B | CB | 8 |
| | 876 | Thermal relay protector input | 4C | CC | 8 |

Parameter Data Code Lists

| Function | Parameter No. | Name (*: Simple mode for NA version) | Data Codes | | Link Parameter Expansion Setting (Data code 7F/FF) |
|--------------------------|------------------------------|---|------------|-------|---|
| | | | Read | Write | |
| Control system functions | 877 | Speed feed forward/model adaptive speed control selection | 4D | CD | 8 |
| | 878 | Speed feed forward filter | 4E | CE | 8 |
| | 879 | Speed feed forward torque restriction | 4F | CF | 8 |
| | 880 | Load inertia ratio | 50 | D0 | 8 |
| | 881 | Speed feed forward gain | 51 | D1 | 8 |
| Maintenance functions | 890 | Maintenance output setting time | 5A | DA | 8 |
| | 891 | Maintenance output timer | 5B | DB | 8 |
| | 892 | Maintenance output signal clear | 5C | DC | 8 |
| Calibration functions | 900 | DA1 terminal calibration | 5C | DC | 1 |
| | 901 | DA2 terminal calibration | 5D | DD | 1 |
| | 902 | Speed setting No. 2 bias | 5E | DE | 1 |
| | 903 | Speed setting No. 2 gain | 5F | DF | 1 |
| | 904 | Torque command No. 3 bias | 60 | E0 | 1 |
| | 905 | Torque command No. 3 gain | 61 | E1 | 1 |
| | 917 | No. 1 terminal bias (speed) | 11 | 91 | 9 |
| | 918 | No. 1 terminal gain (speed) | 12 | 92 | 9 |
| | 919 | No. 1 terminal bias (torque/magnetic flux) | 13 | 93 | 9 |
| | 920 | No. 1 terminal gain (torque/magnetic flux) | 13 | 94 | 9 |
| | 925 | Motor temperature detection calibration | 19 | 99 | 9 |
| | 926 | No. 6 terminal bias (speed) | 1A | 9A | 9 |
| | 927 | No. 6 terminal gain (speed) | 1B | 9B | 9 |
| 928 | No. 6 terminal bias (torque) | 1C | 9C | 9 | |
| 929 | No. 6 terminal gain (torque) | 1D | 9D | 9 | |
| Additional functions | 990 | Buzzer control | 5A | DA | 9 |
| | 991 | Parameter for the option (FR-PU04V) | 5B | DB | 9 |

CAUTION

Note that read and write of the Pr. 77 and Pr. 79 values are enabled for computer link operation that uses the PU connector, but write is disabled for computer link operation that uses the option (FR-A5NR).

MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

| Print Date | *Manual Number | Revision |
|------------|----------------|---------------|
| Nov., 2002 | IB-T7312 | First edition |
| | | |