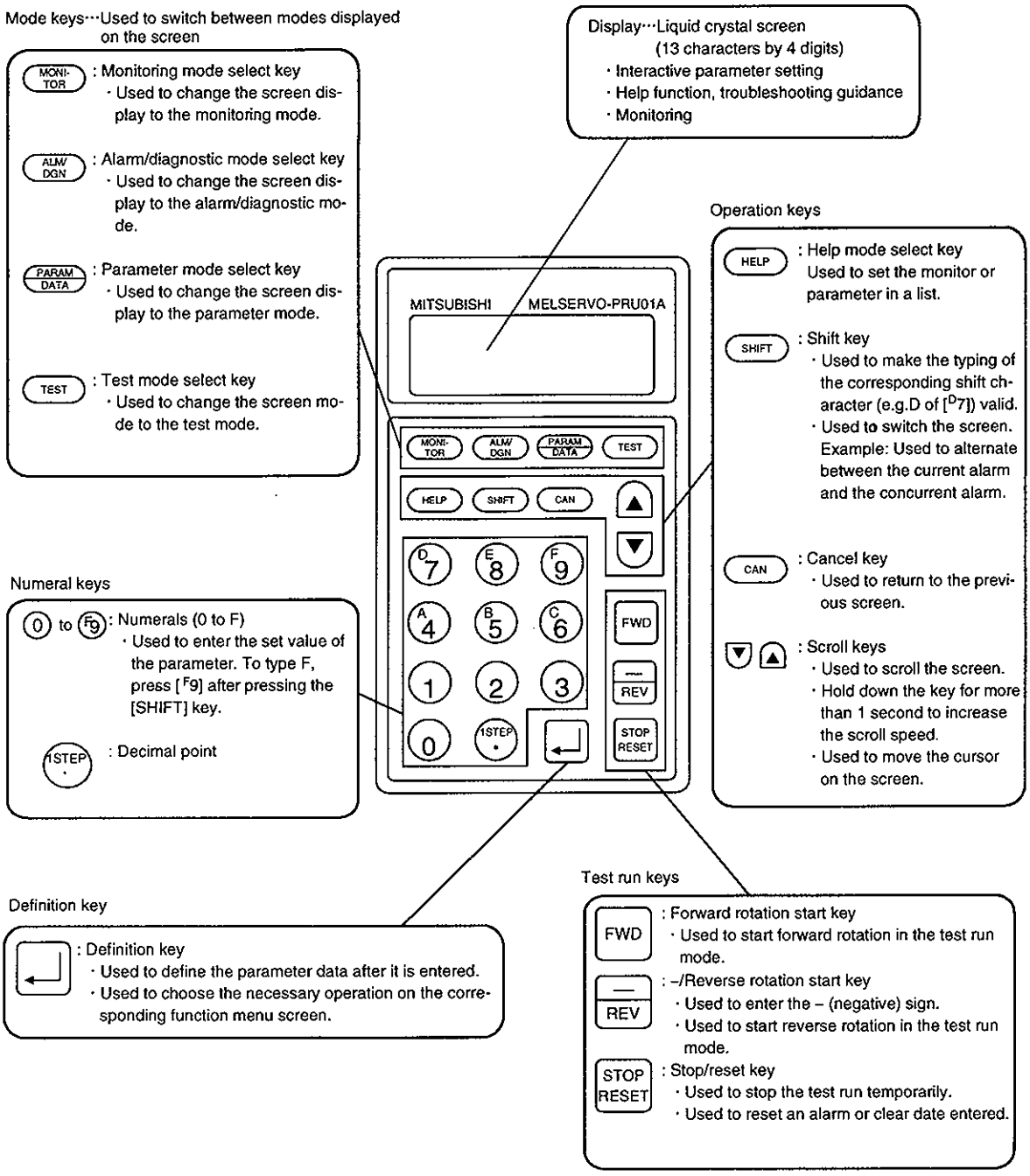
CONTENTS

7. PARAMETER UNIT AND DISPLAY SECTION

7.1 Parameter Unit Keys

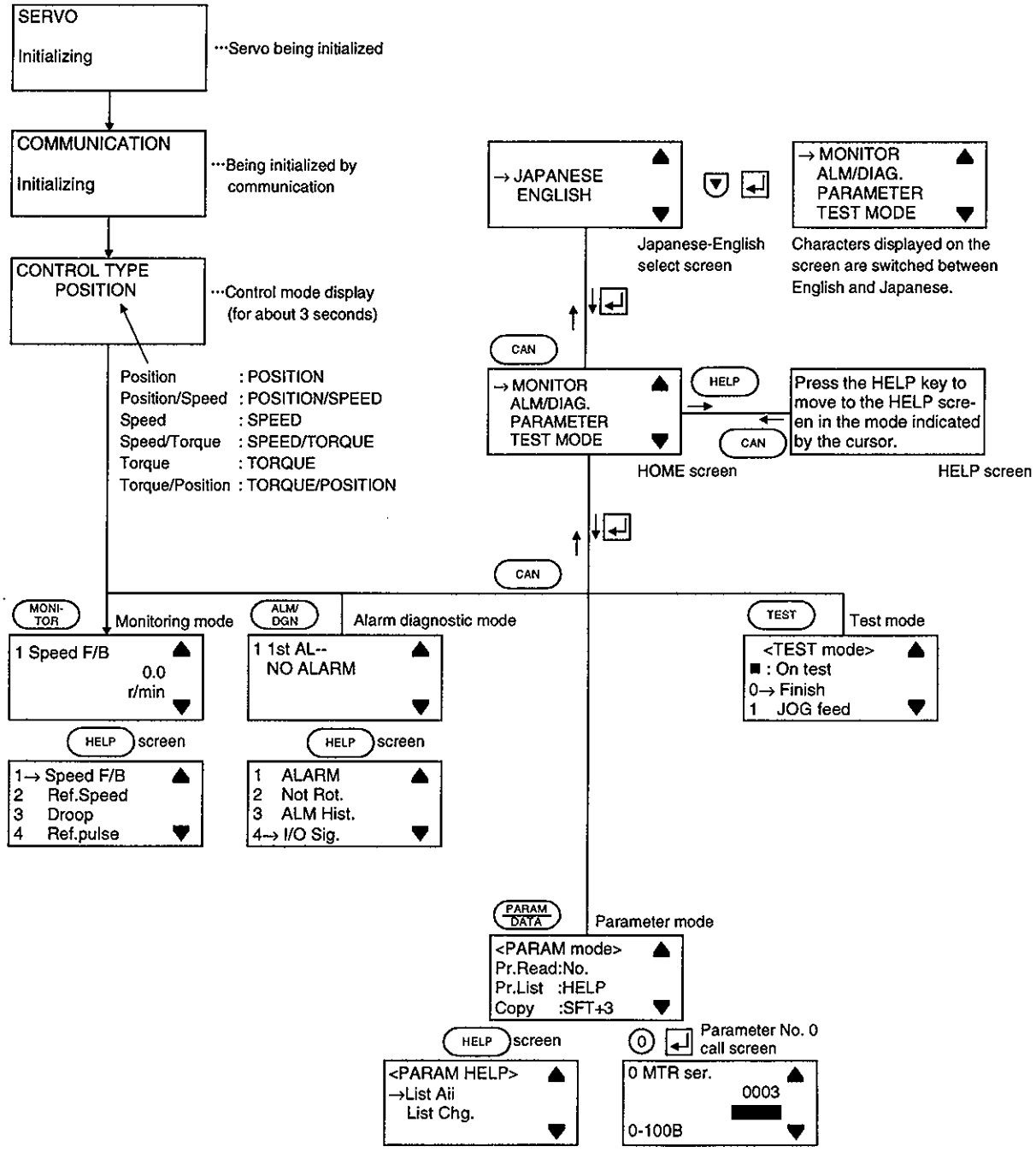
The MR-PRU01A parameter unit is used to set data, perform test operation, set parameters, monitor the operating status, and display alarm definition.

MR-PRU01A Structure



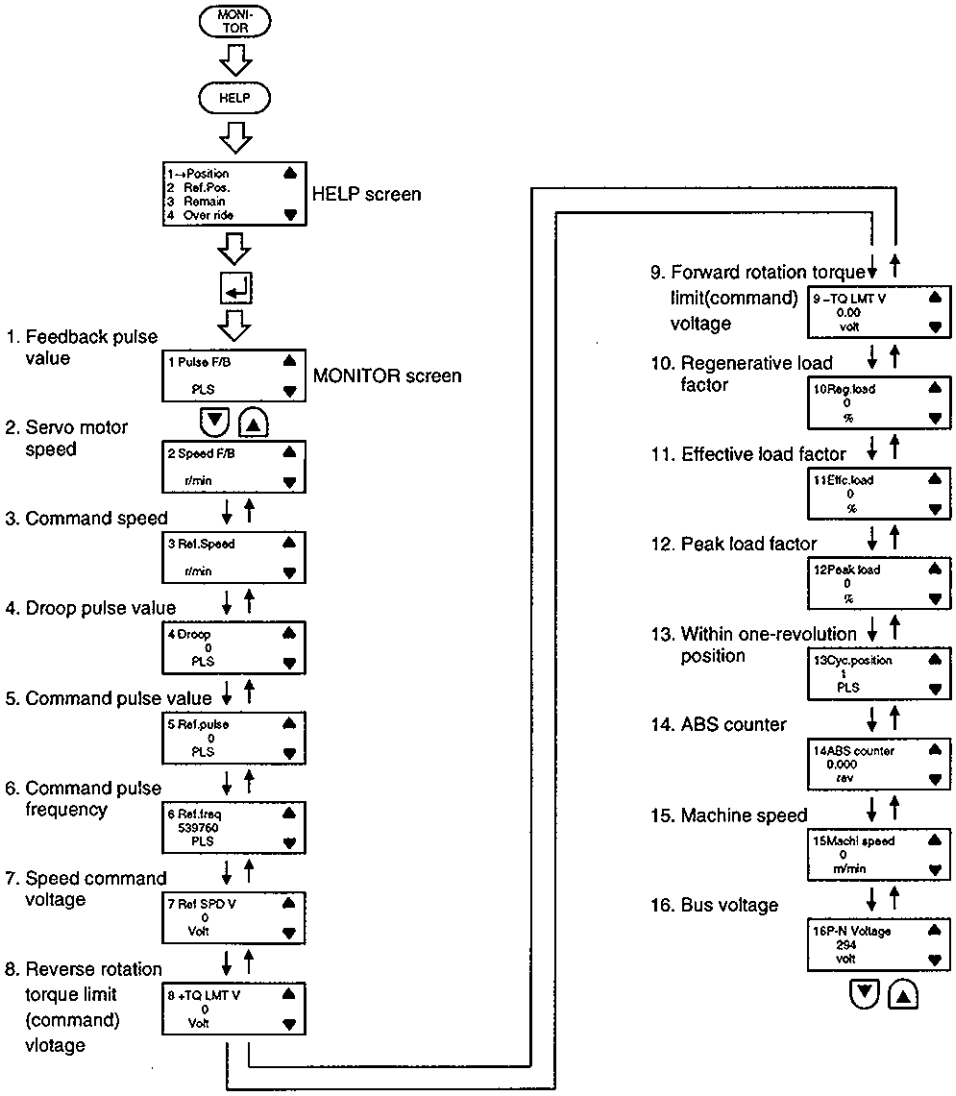
7.2 Operation of the Parameter Unit

(1) Outline of display sequence

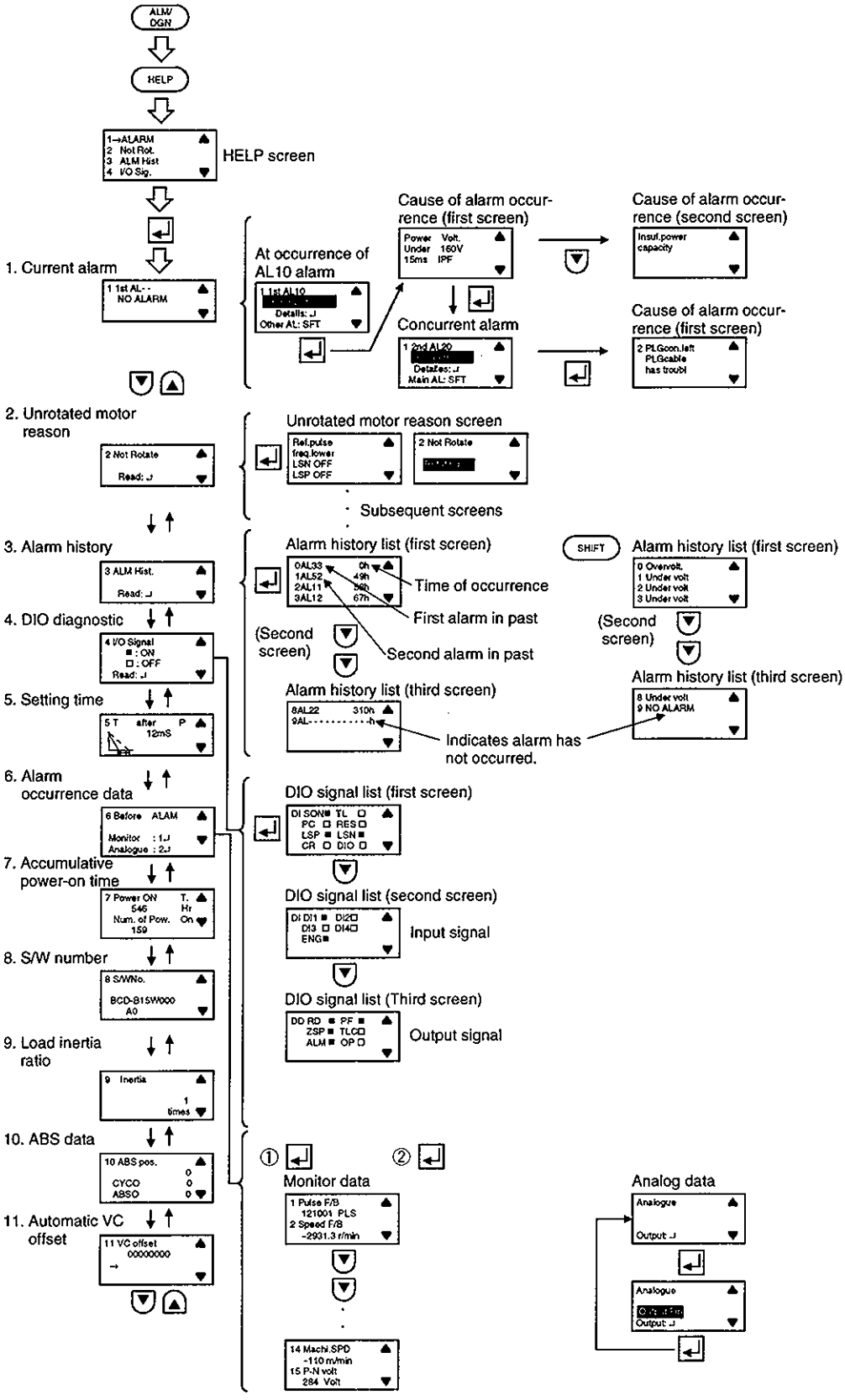


The displays and operation procedure in each mode are given on the following pages. Refer to them.

(2) Monitoring mode

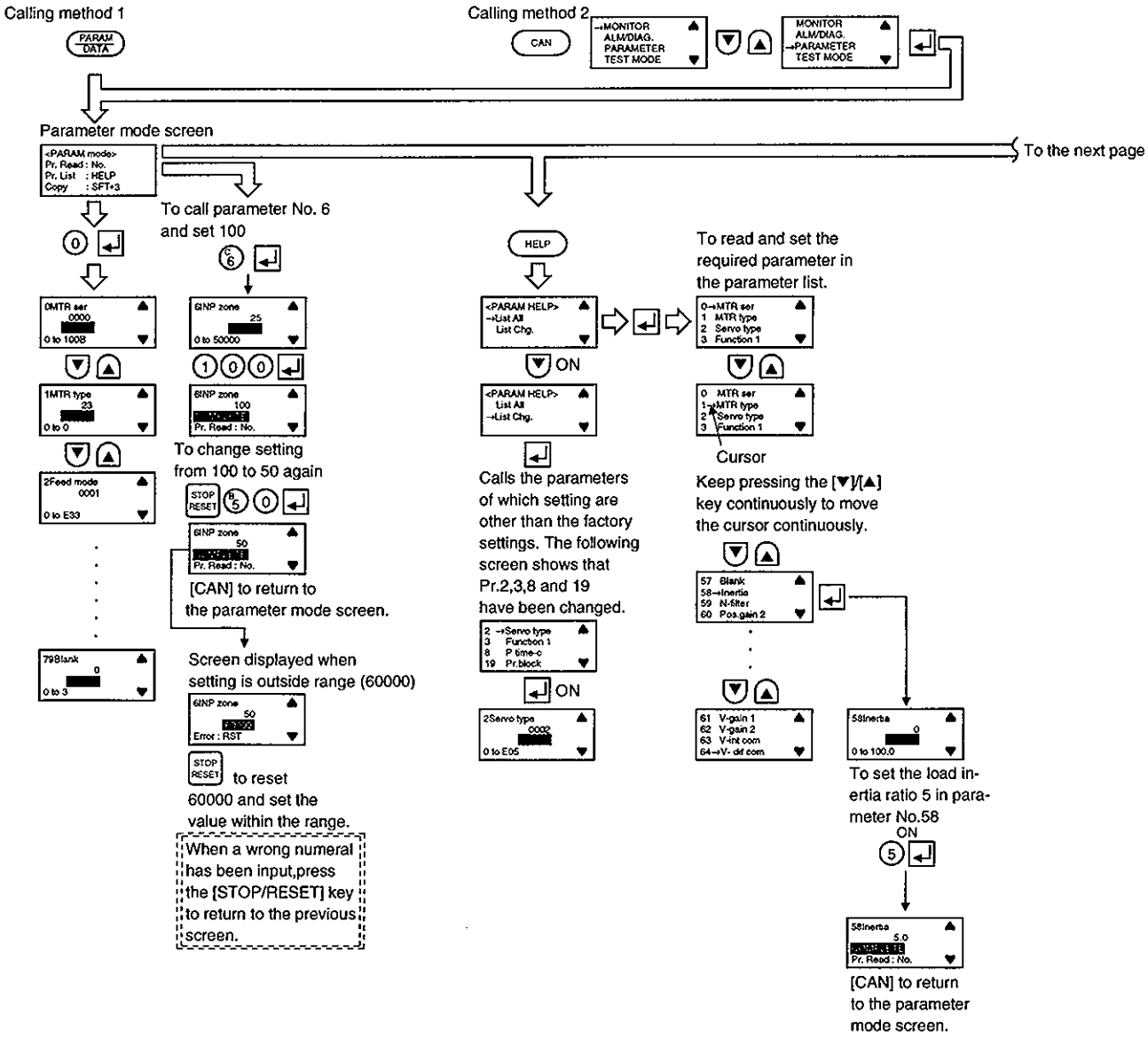


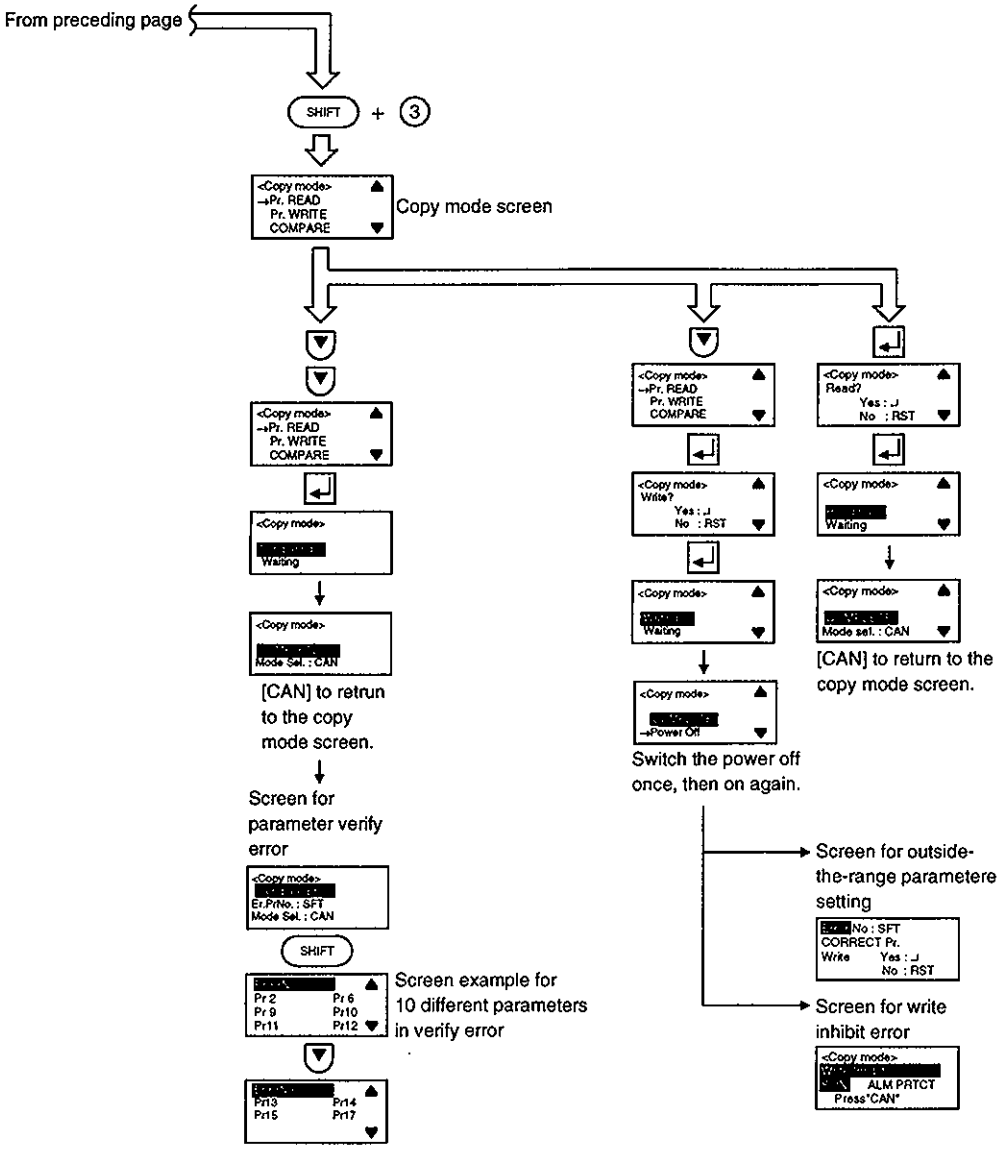
(3) Alarm mode



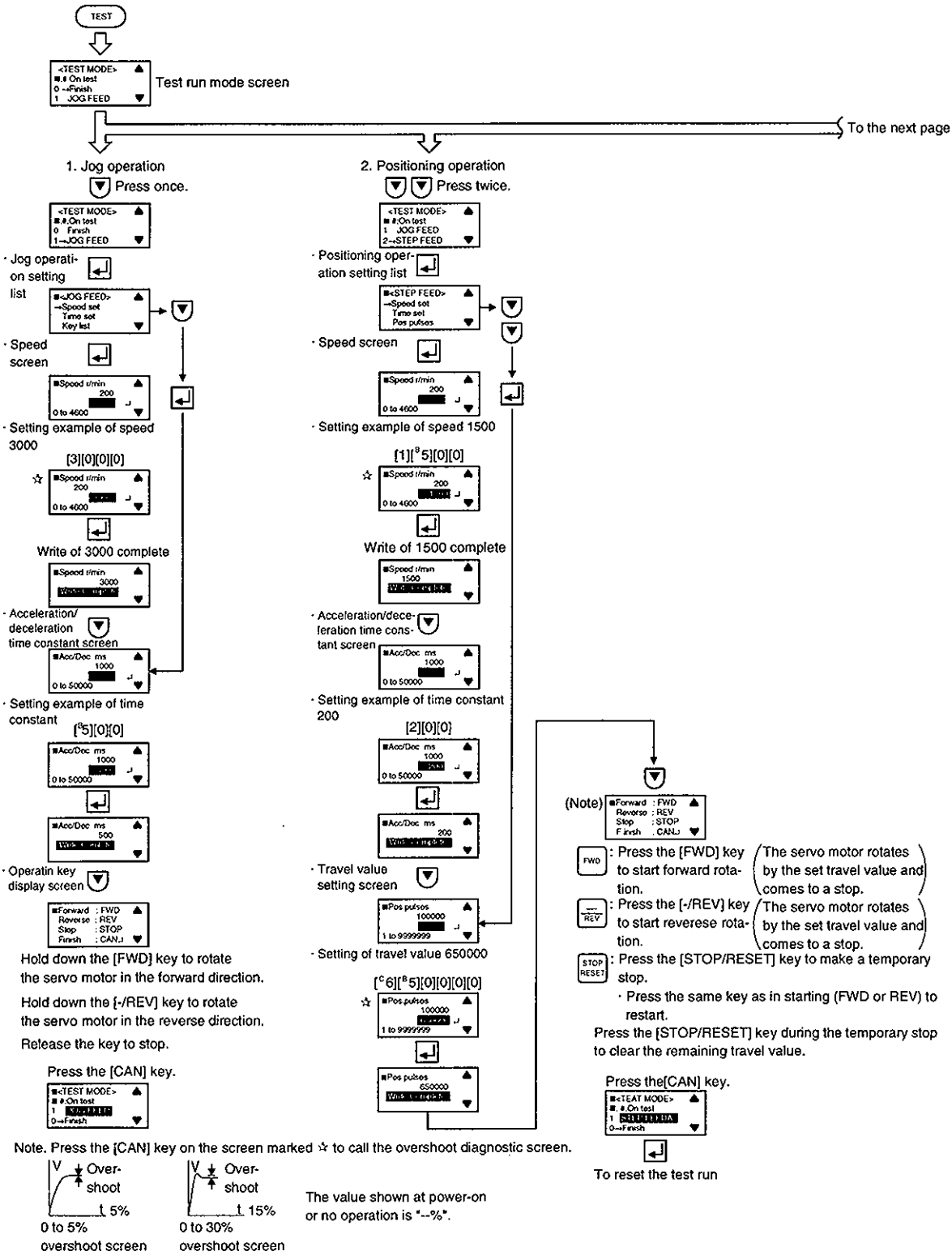
For details of the monitor screens, refer to Section 7.4.

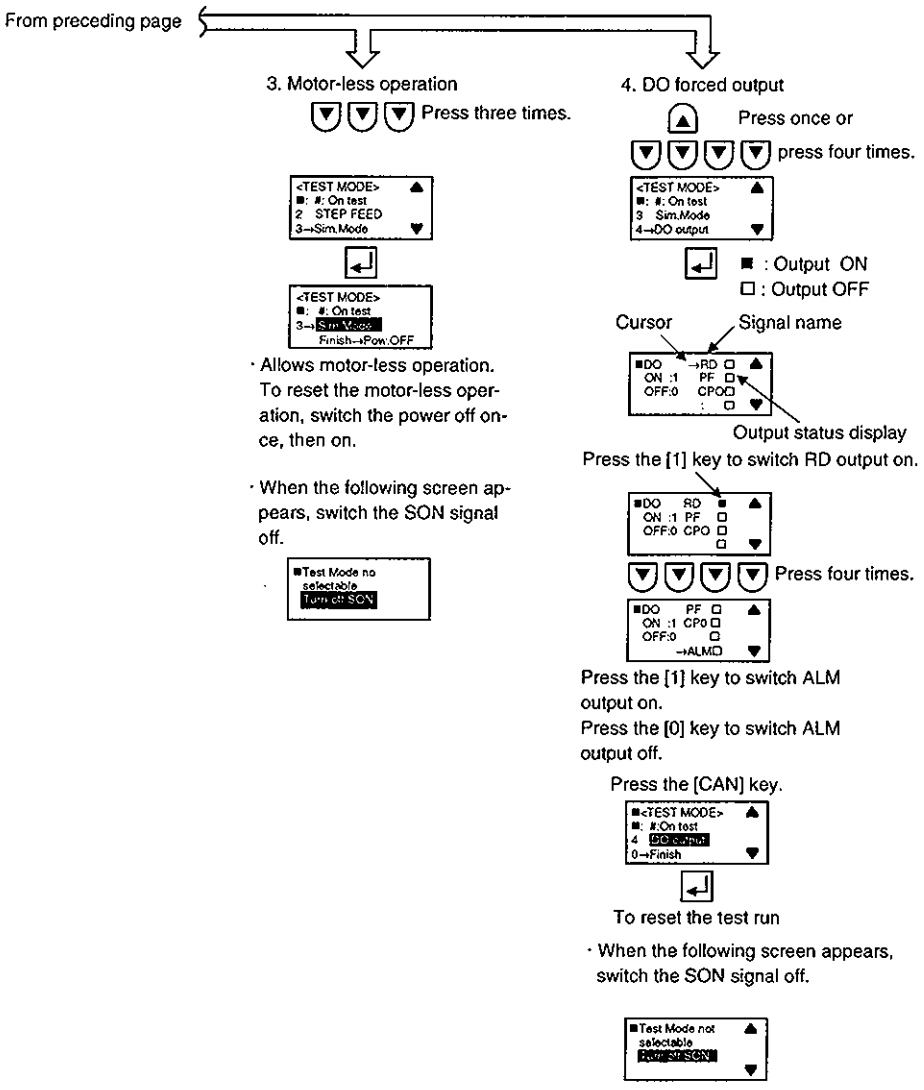
(4) Parameter mode




From preceding page
SHIFT + 3
<Copy mode>
→Pr. READ
Pr. WRITE
COMPARE
Copy mode screen
Waiting
Mode Sel. : CAN
[CAN] to retrun to the copy mode screen.
Screen for parameter verify error
Er.P/No. : SFT
Mode Sel. : CAN
SHIFT
Pr 2 Pr 6
Pr 9 Pr10
Pr11 Pr12
Screen example for 10 different parameters in verify error
Pr13 Pr14
Pr15 Pr17
Write?
Yes : ⊿
No : RST
→Power Off
Switch the power off once, then on again.
Read?
Yes : ⊿
No : RST
[CAN] to return to the copy mode screen.
Screen for outside-the-range parametere setting
No : SFT
CORRECT Pr.
Write Yes : ⊿
No : RST
Screen for write inhibit error
ALM PRTCT
Press"CAN"

(5) Test run mode




From preceding page
3. Motor-less operation
Press three times.
<TEST MODE>
■: #: On test
2 STEP FEED
3→Sim.Mode
<TEST MODE>
■: #: On test
3→Sim.Mode
Finish→Pow.OFF
· Allows motor-less operation. To reset the motor-less operation, switch the power off once, then on.
· When the following screen appears, switch the SON signal off.
■Test Mode no selectable
Turn off SON
4. DO forced output
Press once or
press four times.
<TEST MODE>
■: #: On test
3 Sim.Mode
4→DO output
■ : Output ON
□ : Output OFF
Cursor
Signal name
■DO →RD □
ON :1 PF □
OFF:0 CPO□
Output status display
Press the [1] key to switch RD output on.
■DO RD ■
ON :1 PF □
OFF:0 CPO □
Press four times.
■DO PF □
ON :1 CPO□
OFF:0 □
→ALM□
Press the [1] key to switch ALM output on.
Press the [0] key to switch ALM output off.
Press the [CAN] key.
■<TEST MODE>
■: #:On test
4 DO output
0→Finish
To reset the test run
· When the following screen appears, switch the SON signal off.
■Test Mode not selectable
Turn off SON

7.3 Status Display

The running servo status can be shown on the parameter unit display and servo amplifier display.

Status Display	Parameter Unit Indication	Unit	Description	Indication Range	
				Servo amplifier display	Parameter Unit
Feedback pulse value	Pulse F/B	pulse	Feedback pulses from the servo motor encoder are counted and displayed. When the value exceeds ±9999999, it starts with 0. Press "RESET" to reset the value to "0".	-99999 to 99999	-9999999 to 9999999
Servo motor speed	Speed F/B	r/min	The speed of the servo motor is displayed. Reverse rotation is indicated by "-".	-4600.0 to 4600.0	-4600.0 to 4600.0
Command speed	Ref. speed	r/min	Command speed input to the servo amplifier is shown. For the internal speed command, the value set in the selected parameter is displayed.	-4600.0 to 4600.0	-4600.0 to 4600.0
Droop pulse value	Droop	pulse	The pulse value of the deviation counter is displayed. Reverse rotation pulse value is indicated by "-".	-9999 to 9999	-9999999 to 9999999
Command pulse value	Ref. pulse	pulse	Position command input pulses are counted and displayed. Since the value displayed is not yet multiplied by the electronic gear, it may not match the indication of the feedback pulse value. When the value exceeds ±9999999, it returns to 0. Press "RESET" to reset the value to "0".	-9999 to 9999	-9999999 to 9999999
Command pulse frequency	Ref. freq	kpps	Position command input pulse frequency is displayed. The value displayed is not yet multiplied by the electronic gear. Reverse rotation pulse value is indicated by "-".	-400 to 400	-400 to 400
Speed command voltage	Ref SPDV	V	(1) Position control mode, torque control mode Analog speed limit (VC) voltage is displayed. (2) Speed control mode Analog speed command (VC) voltage is displayed.	-10.00 to +10.00	-10.00 to +10.00
Reverse rotation analog torque command voltage	+ TQ LMTV	V	(1) Position control mode, speed control mode Reverse rotation analog torque limit (TLAP) voltage is displayed. Indication range: 0.00 to +10.00V (2) Torque control mode Reverse rotation analog torque command (TLAP) voltage is displayed. Indication range: 0.00 to +8.00V	Refer to the Description column.	Refer to the Description column.
Forward rotation analog torque command voltage	- TQ LMTV	V	(1) Position control mode, speed control mode Forward rotation analog torque limit (TLAP) voltage is displayed. Indication range: 0.00 to -10.00V (2) Torque control mode Forward rotation analog torque command (TLAP) voltage is displayed. Indication range: 0.00 to -8.00V	Refer to the Description column.	Refer to the Description column.
Regenerative load factor	Reg. load	%	The percentage of regenerative power to the permissible regenerative value is displayed.	0 to 100	0 to 100
Effective load factor	Effc. load	%	Continuous effective load torque is displayed. The effective value is displayed relative to the rated torque of 100%.	0 to 320	0 to 320

Status Display	Parameter Unit Indication	Unit	Description	Indication Range	
				Servo Amplifier Display	Parameter Unit
Peak load factor	Peak load	%	Maximum generated torque is displayed. The peak value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 320	0 to 320
Within one-revolution position	Cyc. pos	pulse	The position within one revolution is displayed in terms of encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses. As the servo amplifier display shows data in four digits, it shows the four lower digits of the actual position within one revolution.	Servo motor with resolution of 8192 pulses: 0 to 8191 Servo motor with resolution of 16384 pulses: 0 to 16383	Servo motor with resolution of 8192 pulses: 0 to 8191 Servo motor with resolution of 16384 pulses: 0 to 16383
ABS counter	ABS Count	rev	Moving distance from the home position in the absolute position detection system is displayed in the counter value of the absolute position encoder. As the servo amplifier display shows data in four digits, it shows the four lower digits of the actual counter value.	-32768 to 32767	-32768 to 32767
Machine speed	Machi. SPD	mm/min m/s	Speed multiplied by the machine speed conversion constant (parameter No. 45) is displayed. The unit can be changed with parameter No. 43.	-	0 to 999.000
Bus voltage	P/N Volt	V	The voltage (across P-N) of the main circuit converter is displayed.	0 to 400	0 to 400

7.4 Alarm/Diagnosis

The servo motor failing to rotate or any abnormality occurring during operation is indicated by the corresponding alarm code. The alarm may also be confirmed on the servo amplifier display, parameter unit or digital display.

(1) Servo amplifier display

When abnormality occurs, its definition is indicated by the corresponding number. For definitions, refer to Section 10.1.

(2) Parameter unit

When abnormality occurs, its definition can be confirmed as listed below.

a) Alarm/diagnosis list

No.	Name	Parameter Unit Display	Description
1	Current alarm	1stAL	The currently occurring alarm number, concurrent alarm, cause of alarm occurrence, etc. are displayed. When alarm occurs, the current alarm overrides the others in any display mode.
2	Unrotated motor reason	Not Rotate	When the servo motor does not rotate, the reason why it does not operate can be displayed.
3	Alarm history	ALM Hist.	The history of alarms from the most recent one to 9th preceding one is displayed with alarm numbers and energization time up to alarm occurrence. All past alarms can be cleared. (For full information, refer to Chapter 10.3)
4	DIO signal	I/O Sig.	The ON-OFF states of the external input signals are displayed.
5	Setting time	T after F	The time from when the position command becomes 0 to when the in-position signal is output is displayed.
6	Alarm occurrence data	Before ALM	Monitored values (16 different values) at the occurrence of alarm are displayed. Further, as soon as an alarm occurs, the status at that time can be output to the analog monitor.
7	Accumulative power-on time	Power ON T.	Accumulative power-on time after shipment from our factory is displayed.
8	S/W number	S/W No.	For management by the manufacturer.
9	Ratio of load inertia moment to motor inertia moment	Inertia	The ratio of load inertia converted into the equivalent value at the servo motor shaft to the rotor inertia of the servo motor itself is estimated and displayed.
10	ABS data	ABS data	Absolute position data (ABC in-position) ····· Present position relative to the home position of 0 1-revolution data (CYSO) ····· Position within 1 revolution Multi-revolution data (ABS0) ····· Number of revolutions with the reference point defined as zero. (Refer to Section 5.9.1)
11	Automatic VC offset	VC offset	If the motor shaft is not stopped at the analog speed command (VC) of 0V in the speed control mode, the offset voltage is automatically tuned to stop the motor shaft.

b) Unrotated motor reason

○: Relevant, \: Irrelevant

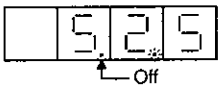
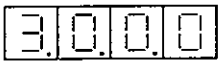
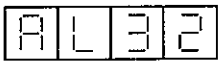
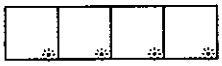
No.	Parameter Unit Display	Description	Control Mode		
			Position	Speed	Torque
1	SON off	Servo on (SON) signal is off.	○	○	○
2	Alarm	Alarm has occurred.	○	○	○
3	RES on	Reset (RES) signal is on.	○	○	○
4	EMG off	Emergency stop (EMG) signal is off.	○	○	○
5	LSP on	Forward rotation stroke end (LSP) signal is off.	○	○	
6	LSN off	Reverse rotation stroke end (LSN) signal is off.	○	○	
7	Ref. Pulse freq. lower	Command pulse frequency is less than 1kpps or command pulses are not input.	○		
8	DI3,DI4 on	DI3 and DI4 are both on.		○	○
9	DI3,DI4 off	DI3 and DI4 are both off.		○	○
10	Ext. torq limit low	When the analog torque limit (TLAP, TLAN) is made valid, the servo motor speed is not more than 5r/min.	○	○	
11	Torq limit (Pr) lower	When the internal torque limit (parameter No. 40, 54) is made valid, the servo motor speed is not more than 5r/min.	○	○	
12	Ext. speed ref. lower	When the analog speed command (VC) is made valid, the preset speed is not more than 1r/min.		○	
13	Ref. Speed □ lower (1 to 7 in □)	When the internal speed command (parameter No. 9 to 11, 30 to 33) is made valid, the preset speed is not more than 1r/min.		○	
14	Ref. Torq. lower	Servo motor speed is not more than the speed limit and not more than 5r/min.			○
15	Ext. speed limit low	When the analog speed limit (VC) is made valid, the preset speed is not more than 5r/min and its speed has been reached.			○
16	Speed limit □ lower (1 to 7 in □)	When the internal speed limit (parameter No. 9 to 11, 30 to 33) is made valid, the preset speed is not more than 5r/min and its speed has been reached.			○
17	Test mode	The motor does not operate because the FWD (forward rotation) or REV (reverse rotation) key of the parameter unit is not pressed in test operation.	○	○	○

7.5 Servo Amplifier Display

The status display and alarm can also be shown on the servo amplifier display.

7.5.1 Display examples

The servo amplifier display shows the four lower digits of the data to be displayed.

Item	Data	4-Digit Display of Servo Amplifier
Speed command voltage	−5.25	 The decimal points are lit as shown on the left to indicate the value of negative polarity. At this time, the actual decimal point is turned off.
Motor speed	3000r/min	
Alarm/warning occurrence	Overcurrent alarm	 If a warning has occurred, the original status display is restored by removing its cause. If an alarm has occurred, its indication is held until the alarm is reset or power is switched off once.
	Watchdog alarm	 The decimal points in all four digits are lit to indicate the watchdog alarm.
Test operation indication		 The decimal point in the lowest digit of the display flickers.
Indication for 2 seconds after power-on or CS1 position changing	Present position set with CS1	

7.5.2 Selection of display data

The status display data can be selected by setting parameter No. 18 and rotary switch CS1.

(1) Parameter setting

Servo amplifier display
(Valid when rotary switch CS1 is in position 0)

0: Servo motor speed	8: Forward rotation torque limit voltage
1: Command speed	9: Regenerative load factor
2: Command remaining distance	A: Effective load factor
3: Droop pulse value	B: Peak load factor
4: Command pulse value	C: Within-1-revolution position
5: Command pulse frequency	D: ABS counter
6: Speed command voltage	E: Bus voltage
7: Reverse rotation torque limit volitage	AF: Blank

Automatic switching to servo amplifier display
- 0: automatic
  - Changed as follows according to the control mode of the servo:
  - Position control mode : feedback pulse value
  - Speed control mode : servo motor speed
  - Torque control mode : effective load factor
- 1: manual
  - The data set in the first digit is displayed.

Parameter unit status display at power-on

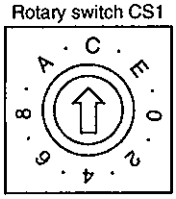
0: Servo motor speed	8: Forward rotation torque limit voltage
1: Command speed	9: Regenerative load factor
2: Command remaining distance	A: Effective load factor
3: Droop pulse value	B: Peak load factor
4: Command pulse value	C: Within-1-revolution position
5: Command pulse frequency	D: ABS counter
6: Speed command voltage	E: Machine speed
7: Reverse rotation torque limit voltage	F: Bus voltage

Automatic switching of parameter unit status display at power-on
- 0: automatic
  - Changed as follows according to the control mode of the servo:
  - Position control mode : feedback pulse value
  - Speed control mode : servo motor speed
  - Torque control mode : effective load factor
- 1: manual
  - The data set in the third digit is displayed.

(2) Setting of rotary switch CS1

You can select the status display by setting the rotary switch CS1 of the servo amplifier. Setting of "0" shows the status set in the first digit of parameter No. 18.

Rotary switch CS1



CS1 Setting	Code	Status Display		
		Position Control Mode	Speed Control Mode	Torque Control Mode
0		Parameter No. 18 setting		
1	Fr	Servo motor speed	Servo motor speed	Servo motor speed
2	Cr	Command speed	Command speed	Command speed
3	E	Droop pulse value		
4	P	Command pulse value		
5	PA	Command pulse frequency		
	F		Speed command voltage	Torque limit voltage
6	UP	Reverse rotation torque limit voltage	Reverse rotation torque limit voltage	Reverse rotation torque limit voltage
7	Un	Forward rotation torque limit voltage	Forward rotation torque limit voltage	Forward rotation torque limit voltage
8	Ld	Regenerative load factor	Regenerative load factor	Regenerative load factor
9	JA	Effective load factor	Effective load factor	Effective load factor
A	Jb	Peak load factor	Peak load factor	Peak load factor
B	Cy	Within-one-revolution position	Within-one-revolution position	Within-one-revolution position
C	Pn	Bus voltage	Bus voltage	Bus voltage

7.6 Test Operation Mode

> **CAUTION**
> - The test operation mode is designed to confirm servo operation. It is not designed to confirm machine operation. Do not use this mode with the machine.
> - If an operation fault occurs, use emergency stop (EMG) to make a stop.

The parameter unit can be used to run the servo motor. For the way of operating the parameter unit, refer to Section 7.2.
When a servo motor with electromagnetic brake is used with the machine to prevent the servo motor from starting in a brake operating status, always make up a sequence circuit which will operate the brake with the electromagnetic brake signal (ZSP) of the servo amplifier.

7.6.1 Jog operation

Jog operation can be performed with no command given from the external command device.

(1) Operation

Connect EMG-SG to perform jog operation, and connect VDD-VIN to use the internal power supply.
Hold down the "FWD" or "REV" key to rotate the servo motor. Release it to stop. The operating conditions can be changed with the parameter unit. The initial conditions and setting ranges of operation are listed below:

Item	Initial Value	Setting Range
Speed [r/min]	200	0 to instantaneous permissible speed
(Note) Acceleration/deceleration time constant [ms]	1000	0 to 50000

Note: The acceleration time constant indicates the time required for the servo motor to attain the rated speed from a stop (0r/min), and the deceleration time constant indicates the time required for the servo motor to stop from the rated speed.

How to use the keys is listed below:

Key	Description
"FWD"	Press to start CCW rotation. Release to stop.
"REV"	Press to start CW rotation. Release to stop.

If the parameter unit cable is disconnected during jog operation, the servo motor is decelerated to a stop.

(2) Status display

The status display can be monitored during jog operation. At this time, the "FWD", "REV" and "STOP" keys are valid.

7.6.2 Positioning operation

Positioning operation can be performed once, with no command given from the external command device.

(1) Operation

Connect EMG-SG to perform positioning operation, and connect VDD-VIN to use the internal power supply.

By pressing the "FWD" or "REV" key, the servo motor rotates and the machine moves the preset distance and stops. The operating conditions can be changed with the parameter unit. The initial conditions and setting ranges of operation are listed below:

Item	Initial Value	Setting Range
Moving distance [pulse]	100000	0 to 9999999
Speed [r/min]	200	0 to instantaneous permissible speed
(Note) Acceleration/deceleration time constant [ms]	1000	0 to 50000

Note: The acceleration time constant indicates the time required for the servo motor to attain the rated speed from a stop (0r/min), and the deceleration time constant indicates the time required for the servo motor to stop from the rated speed.

How to use the keys is listed below:

Key	Description
"FWD"	Press to start positioning operation in the CCW direction.
"REV"	Press to start positioning operation in the CW direction.
"STOP"	Press during operation to make a temporary stop. Press the "STOP" key again to erase the remaining distance. To resume operation, press the key that was used to start operation.

If the parameter unit cable is disconnected during positioning operation, the servo motor is decelerated to a stop.

(2) Status display

The status display can be monitored during positioning operation. At this time, the "FWD", "REV" and "STOP" keys are valid.

7.6.3 Motorless operation

Without the servo motor being connected, the output signals can be provided and the status display monitored in response to external input signals as if the servo motor is actually running. This function can be used for the sequence check of the host programmable controller or the like.

(1) Operation

After turning off SON-SG, choose motorless operation. Then, perform external operation as in ordinary operation.

(2) Status display

The status display can be monitored during motorless operation.

(3) Termination of motorless operation

Switch power off to end motorless operation.

7.6.4 DO forced output

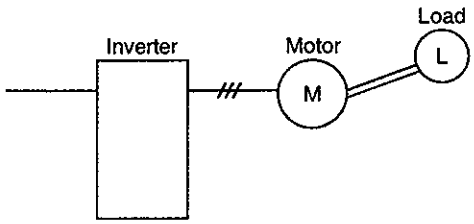
Each output signal can be turned on/off independently of the input signals and servo status. This function can be used for servo wiring check, etc.

8. ADJUSTMENT

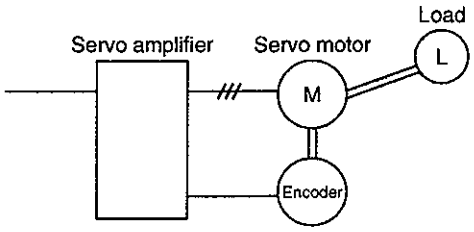
8.1 What Is Gain Adjustment?

8.1.1 Difference between servo amplifier and other drives

Besides the servo amplifier, there are other motor drives such as an inverter and stepping driver. Among these drives, the servo amplifier requires gain adjustment.
The inverter and stepping driver are in an open loop (actual motor speed and position are not detected on the driver side).

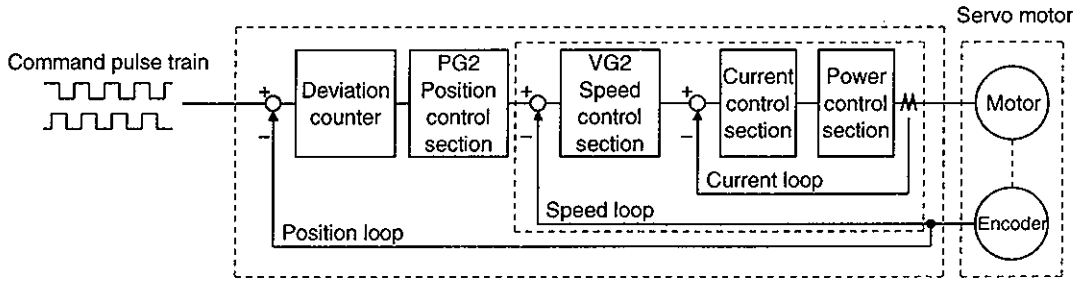


On the other hand, the servo amplifier always detects the positions and speeds of the motor and machine using the servo motor encoder, and exercises control to match the position and speed commands with the actual motor (machine) position and speed. In the servo system, adjustment is needed because:



(1) Response changes according to the inertia moment of the machine;
(2) Vibration occurs due to the resonance point, etc. peculiar to the machine; and
(3) Operation delay and accuracy specification differ between machines and response should satisfy this specification.

8.1.2 Basics of the servo system



A general servo system configuration is shown above. The servo control system consists of three loops: current loop, speed loop and position loop. Among these three loops, the response of the inside loop must be increased 4 to 6 times higher. If this condition is not satisfied, vibration will be generated. If the condition further worsens, hunting will occur.

(1) Current loop

For the MELSERVO, the response level of the current loop is factory-set to a high value and need not be adjusted. If the motor is installed to the machine, the response of the current loop will hardly vary.

(2) Speed loop

Response will vary according to the inertia moment of the machine. When the load inertia moment increases, the response of the speed loop will reduce. Use the speed loop gain (VG2) to compensate for the reduction of the response level.

$$\text{Speed loop response } f_V[\text{rad/s}] = \frac{\text{Amplifier gain setting VG2[rad/s]}}{1+m}$$

m: Load inertia moment ratio $\left[=\frac{J_L}{J_M}\right]$

J_L = load inertia moment

J_M = servo motor shaft inertia moment

(3) Position loop

The response level will not vary according to machine conditions.

Position loop response f_P[rad/s] = amplifier gain setting PG2[rad/s]

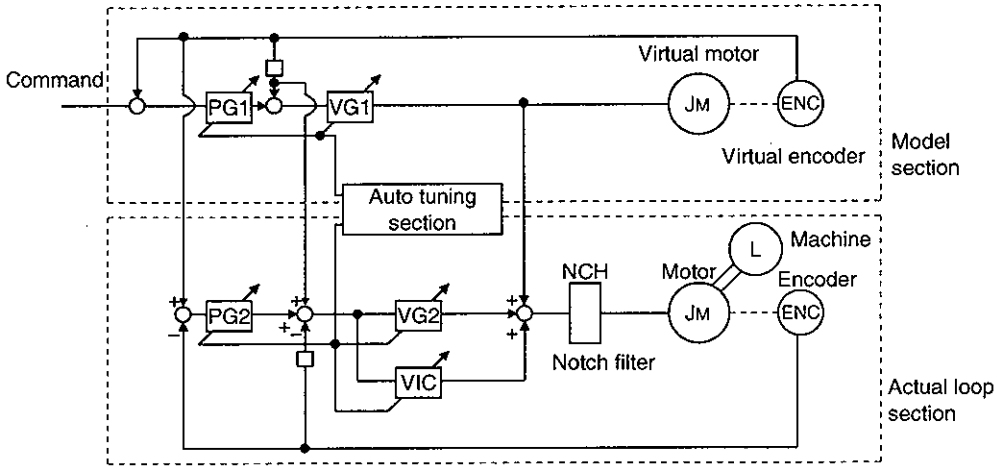
When the motor is installed to the machine, the gain must be adjusted to satisfy $f_V = 4$ to $6f_P$ according to the load inertia moment ratio m.

8.2 Gain adjustment

8.2.1 Parameters required for gain adjustment

Parameter No.	Symbol	Name
No.7	PG1	Position loop gain 1
No.20	OP1	Function selection (Auto tuning)
No.59	NCH	Machine resonance suppression filter.
No.58	GD2	Ratio of load inertia moment to motor inertia moment
No.60	PG2	Position loop gain 2
No.61	VG1	Speed loop gain 1
No.62	VG2	Speed loop gain 2
No.63	VIC	Speed integral compensation

8.2.2 Block diagram



The block diagram of the Servo Amplifier servo control section is shown above. (The current loop is omitted.)

(1) Actual loop section

A control loop designed to control the actual motor and acts to control the servo system stably in response to the load torque of the machine.

(2) Model section

Acts to provide the ideal operation values to the current loop in response to the command.

(3) Auto tuning section

Judges the load inertia moment of the machine fitted with the actual motor from the operation error of the motor to change each control gain in real time.

The gains changed by auto tuning are PG1, VG1, PG2, VG2 and VIC.

8.2.3 What is auto tuning?

The load inertia moment is estimated from the angular speed (ω) and torque (T) in accordance with the equation of motion (8.1) used for motor acceleration/deceleration. In actuality, the acceleration/deceleration characteristics of the model and those of the actual motor are compared to estimate the inertia moment of the load in real time.

$$J\frac{d\omega}{dt}=T \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (8.1)$$

J : Inertia moment
ω : Angular speed
T : Torque

Real-time auto tuning is performed in the following procedure:

(1) When the motor makes acceleration/deceleration, load inertia moment JL is estimated in the above method to calculate the load inertia moment ratio (GD2).

(2) Each gain (PG1, VG1, PG2, VG2, VIC) to the calculated load inertia moment ratio (GD2) is changed according to the response level set in parameter No.20. Note that these gains have been patterned beforehand to satisfy the aforementioned stabilization condition.

8.3 Gain Adjustment by Auto Tuning

8.3.1 Adjustment method

The Servo Amplifier is factory-set to make auto tuning valid (parameter No. 20:□0□1).
The initial settings provide sufficient tuning for general machines. Higher-level tuning can be provided by adjusting the response setting (third digit of parameter No. 20) according to machine rigidity.
The following table lists guidelines for response setting to drive systems. Choose slow response when using a reduction gear having backlash:

Main Drive System		Fast Response	Middle Response	Slow Response
Ballscrew	Direct coupling	←	→	
	With reduction gear	←	→	
Rack & pinion	Direct coupling		←	→
	With reduction gear		←	→
Timing belt	Direct coupling		←	→
	With reduction gear		←	→
Chain	Direct coupling		←	→
	With reduction gear		←	→

The following is how to adjust the response setting to machine phenomena:

(Note) Actual Machine Operation	Ideal Machine Operation	Parameter No.3 Setting
Settling time is long	Reduce settling time.	Increase response setting.
Large overshoot at stop	Reduce overshoot.	Decrease response setting. Set machine selection setting to "large friction".
Gear sound generated from machine	Reduce gear sound.	Decrease response setting.

Note: Settling time indicates time from zero command pulse to servo motor stop.

8.3.2 Valid conditions

> **POINT**
>
> • If the acceleration/deceleration time is long or the motor speed used is only low speed, the valid conditions of auto tuning are not satisfied. Therefore, it may result in false tuning.
> In this case, after performing operation which satisfies the auto tuning conditions, set parameter No. 20 to "auto tuning not executed".

This section provides constraints on the operation pattern to enable excellent auto tuning. If the conditions in this section cannot be satisfied, normal auto tuning may not be performed. In this case, after executing auto tuning in operation which satisfies the conditions given in this section, make auto tuning invalid to disallow the gain setting from being changed.

(1) Set the acceleration time (time until the preset speed is reached) to 5s or less and the acceleration/deceleration current to 50% or more.

(2) Perform operation several times until the cumulative acceleration/deceleration time is 1s or more.

(3) Set the servo motor speed to 500r/min or more.

8.4 Manual Gain Adjustment

On some machines, gain adjustment may not be made by auto tuning or excellent gain setting may not be made if gain adjustment is performed by auto tuning. In this case, adjust the gains manually. Use any of the methods given in this section to adjust the gains.

8.4.1 When machine rigidity is low

(1) Machine condition

Because of low machine rigidity, the response setting of auto tuning is set to slow response and it takes too much time to reach the target position.
When the machine or motor shaft is moved lightly at a stop, it moves easily.

(2) Adjustment procedure

(a) Adjustment 1

1) Execute auto tuning with the response setting of the level at which machine will not vibrate. Set 0101 in parameter No.20.

2) Set "Not executed" auto tuning in parameter No.20.

3) Gradually decrease the speed integral compensation VIC (parameter No.63) setting.

(b) Adjustment 2

1) Perform auto tuning with the response setting of slow response.
Set 0101 in parameter No.20.

2) Set the machine resonance suppression filter (parameter No. 59) in order from higher to lower frequencies.

3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.

4) If the machine condition does not become excellent after the above adjustment, reduce the setting of speed integral compensation as in Adjustment 1.

8.4.2 When the machine vibrates due to machine resonance frequency

(1) Machine condition

The servo motor shaft is oscillating at high frequency (100Hz or more).
The servo motor shaft motion cannot be confirmed visually. However, if the machine generates large noise and vibrates, make Adjustment 1.
If higher "response setting" of auto tuning increases vibration, make Adjustment 2.

(2) Adjustment procedure

(a) Adjustment 1

1) Perform auto tuning with the response setting of slow response.
   Set 0101 in parameter No.20.
2) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No.59).
3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
4) Decrease the machine resonance suppression filter gradually and repeat step 3).
   The optimum value is provided at the point where vibration is minimum.
5) To further shorten the settling time, gradually increase the response setting in parameter No.20 and repeat steps 1) to 4).

(b) Adjustment 2

1) Choose the response setting of slow response.
   Set 0101 in parameter No.20.
2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.58).
   If an exact machine inertia moment ratio is unknown, enter an approximate value.
   When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No.58 value.

Parameter No.	Symbol	Name
No.7	PG1	Position loop gain 1
No.60	PG2	Position loop gain 2
No.61	VG1	Speed loop gain 1
No.62	VG2	Speed loop gain 2
No.63	VIC	Speed integral compensation

3) Set parameter No. 20 to □□□2 (auto tuning not executed).
4) Decrease the speed loop gain 2 (parameter No. 62) to a value about 100 to 200 smaller than the automatically set value.
5) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No.59).
6) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
7) Decrease the machine resonance suppression filter gradually and repeat step 6).
   The optimum value is provided at the point where vibration is minimum.
8) When there is no machine resonance, check the operating status and gradually increase the speed loop gain 2 (parameter No.62) and repeat steps 5) to 7).
   Set the value about 50 to 100 smaller than the value at which gear sound begins to be generated.
   Make this gain a little smaller if there is variation in the machine because a timing belt or the like is used..
9) To further shorten the settling time, gradually increase the response setting of parameter No.20 and repeat steps 1) to 5).

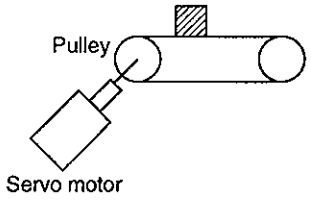
8.4.3 Load inertia moment is 20 or more times

(1) Machine condition

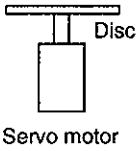
The machine inertia moment is 20 times or more and the servo motor oscillates at low frequency (5Hz or more). At this time, servo motor shaft vibration can be confirmed visually.

This adjustment method is valid for the following machines:

1) Machine in which a timing belt is driven without reduction gear



2) Machine in which a disc is rotated without reduction gear



3) Machine of which ballscrew lead is long

(2) Adjustment procedure

1) Choose the response setting of slow response.
   Set 0101 in parameter No.20.
2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.58).
   If an exact machine inertia moment ratio is unknown, enter an approximate value.
   When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No.58 value.

Parameter No.	Symbol	Name
No.7	PG1	Position loop gain 1
No.60	PG2	Position loop gain 2
No.61	VG1	Speed loop gain 1
No.62	VG2	Speed loop gain 2
No.63	VIC	Speed integral compensation

3) Set parameter No. 20 to □□□2 (auto tuning not executed).
4) Alternate a start and a stop several times and check whether the machine does not vibrate.
5) If vibration still persists, repeat steps 1) and 4).
6) If vibration still persists, make (a) Adjustment 1 and (b)Adjustment 2 in paragraph (2) of Section 8.4.2.
7) If you want to further increase the response, set parameter No. 20 to "auto tuning executed" (first digit) with operation at a stop, and increase the response setting (third digit). After that, set the parameter to "auto tuning not executed" (first digit).
   For example, after setting parameter No. 20 to "□2□1", set it to "□2□2".
8) Reducing the speed loop's integral time constant (parameter No. 63) may improve the performance. However, making it too small may generate vibration.

8.4.4 When shortening the settling time

(1) Machine condition

The settling time will be increased by the gains provided by auto tuning.

(2) Adjustment procedure

a) Choose the response setting of slow response.
Set 0101 in parameter No.20.

b) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.

c) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.58).
If an exact machine inertia moment ratio is unknown, enter an approximate value.
When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the parameter No.58 value.

Parameter No.	Symbol	Name
No.7	PG1	Position loop gain 1
No.60	PG2	Position loop gain 2
No.61	VG1	Speed loop gain 1
No.62	VG2	Speed loop gain 2
No.63	VIC	Speed integral compensation

d) Set □□□2 in parameter No.20 to make auto tuning invalid.
Make the parameter No.7, 60 to 63 settings manually adjustable.

e) Check the operating status and adjust the following parameter values:

Parameter No.	Symbol	Name	Description
No.7	PG1	Position loop gain 1	Higher setting shortens the settling time but is liable to cause overshooting.
No.60	PG2	Position loop gain 2	
No.61	VG1	Speed loop gain 1	Higher setting improves the servo response level but is liable to cause vibration.
No.62	VG2	Speed loop gain 2	
No.63	VIC	Speed integral compensation	Lower setting keeps the speed constant to load disturbance and increases holding force at a stop (servo rigidity) but is liable to cause overshooting.

Make adjustment by gradually increasing the parameter No.7, 60 to 62 settings at the same ratio and reducing the speed integral compensation (parameter No.63). The optimum value is provided at the point just before vibration increases. Use of the machine resonance filter (parameter No.59) may increase the limit point. However, note that the setting increased up to the limit point may cause resonance due to the machine's variations and changes with time.

8.4.5 When the same gain is used for two or more axes

(1) Machine condition

To perform interpolation operation with two or more axes of servo amplifiers, the position loop gains of the axes are set to the same value.

(2) Adjustment procedure

a) To adjust the gains of each axis, adjust the gains of all axes in the adjustment procedures in Sections 8.4.1 to 8.4.5.

b) Set □□□0 or □□□2 in parameter No.20.
□□□0: Interpolation control ····· The following parameter values change at the next start/stop.

Parameter No.	Symbol	Name
No.7	PG1	Position loop gain 1
No.60	PG2	Position loop gain 2
No.63	VIC	Speed integral compensation

□2□□: No auto tuning ····· Make auto tuning invalid and set each gain manually.

c) Match position loop gain 1 to the minimum value of each axis to make the gains of all axes equal.

9. INSPECTION

⚠ WARNING	• Before starting maintenance and/or inspection, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock. • Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.

POINT
• Do not test the servo amplifier with a megger (measure insulation resistance), or it may become faulty. • Do not disassemble and/or repair the equipment on customer side.

9.1 Inspection

It is recommended to make the following checks periodically:

1) Check for loose terminal block screws. Retighten any loose screws.
2) Check the servo motor bearings, brake section, etc. for unusual noise.
3) Check the cables and the like for scratches and cracks. Perform periodic inspection according to operating conditions.
4) Check the servo motor shaft and coupling for misalignment.

9.2 Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. Also when using the servo motor in the atmosphere having much oil mist, dust, etc., clean and inspect every three months.
For parts replacement, please contact your sales representative.

Part Name		Life Guideline
Servo amplifier	Smoothing capacitor	10 years
	Relay	100,000 times
	Cooling fan	10,000 to 30,000 hours (2 to 3 years)
	Absolute position battery	10,000 hours
Servo motor	Bearings	20,000 to 30,000 hours
	Encoder	20,000 to 30,000 hours
	Oil seal, V ring	5,000 hours
	Cooling fan	20,000 hours

(1) Smoothing capacitor

Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment.

(2) Relays

Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life at cumulative 100,000 switching times (switching life), which depends on the power supply capacity.

(3) Servo amplifier cooling fan

The cooling fan bearings reach the end of their life in 10,000 to 35,000 hours. Normally, therefore, the fan must be changed in a few years of continuous operation as a guideline.
It must also be changed if unusual noise or vibration is found during inspection.

(4) Servo motor bearings

When the servo motor is run at rated speed under rated load, change the bearings in 20,000 to 30,000 hours as a guideline. This differs on the operating conditions. The bearings must also be changed if unusual noise or vibration is found during inspection.

(5) Servo motor oil seal, V ring

Must be changed in 5,000 hours of operation at rated speed as a guideline. This differs on the operating conditions. These parts must also be changed if oil leakage, etc. is found during inspection.

(6) Servo motor cooling fan (HA-LH11K2 or more)

The design life of the cooling fan is 20,000 hours. Change the cooling fan periodically.

10. TROUBLESHOOTING

10.1 Trouble at Start-Up

> ⚠CAUTION • Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

> POINT
> • If the servo motor is inoperative, refer to the "unrotated motor reason" screen (Section 7.4 (2)) and take corrective action.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-Up Sequence	Fault	Investigation	Possible Cause	Refer To
1	Power on	· LED is not lit. · LED flickers.	Not improved if connectors CN1, CN2, CN3,CN4,CN11 andCN12 are disconnected.	1) Power supply voltage fault 2) Servo amplifier is faulty.	
			Improved when connectors CN1 and CN11 are disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1) Power supply of encoder cabling is shorted. 2) Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply is shorted.	
		Alarm occurs.	Refer to Section 10.2 and remove cause.		Section 10.2
2	Switch on servo-on signal.	Alarm occurs.	Refer to Section 10.2 and remove cause.		Section 10.2
		Servo motor shaft is not servo-locked (is free).	Check the display to see if the servo amplifier is ready to operate.	1) Servo on signal is not input. (Wiring mistake) 2) 24VDC power is not supplied to COM.	Section 7.4
3	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure: 1) Increase the auto tuning response level. 2) Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 8
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	Make gain adjustment in the following procedure: If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 8
4	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	

10.2 When Alarm or Warning Has Occurred

10.2.1 Alarms and Warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to Section 10.2.2 or 10.2.3 and take the appropriate action.
A 3-bit (RD, PF, ZSP) alarm code can be output by setting □□□1 in parameter No. 44. When you are using the MR-H-D01 option card, a 4-bit (D000, D001, D002, D003) alarm code can be output by setting □□□1 in parameter No. 71.

	Indication	(Note1) Alarm Code			(Note1) MR-H-D01 Alarm Code				Function Name	Parameter Unit Screen Display	Alarm Deactivation		
		ZSP	PF	RD	DO03	DO02	DO01	DO00			Power OFF→ ON	Parameter unit "RES"	Alarm reset (RES) signal
Alarm codes	AL10	0	1	0	0	0	1	0	Under voltage	Under volt	○	○	○
	AL12	0	0	0	0	0	0	0	Memory alarm 1	Memory er 1	○		
	AL13	0	0	0	0	0	0	0	Clock alarm	OSC err	○		
	AL14	0	0	0	0	0	0	0	Watchdog	Watch dog	○		
	AL15	0	0	0	0	0	0	0	Memory alarm 2	Memory er 2	○		
	AL16	1	1	0	0	1	1	0	Encoder alarm 1	PLG err 1	○		
	AL17	0	0	0	0	0	0	0	Board alarm	Board err	○		
	AL19	0	0	0	0	0	0	0	Memory alarm 3	Memory er 3	○		
	AL1A	1	1	0	0	1	1	0	Motor combination error	Motor err.	○		
	AL20	1	1	0	0	1	1	0	Encoder alarm 2	PLG err 2	○		
	AL24	1	0	0	1	1	0	0	Ground fault	Grounded	○	○	○
	AL25	1	1	0	1	1	1	0	Absolute position erase	ABS lost	○		
	AL30	0	0	1	0	0	0	1	Regenerative alarm	Reg. err	○		
	AL31	1	0	1	0	1	0	1	Over speed	Over speed	○	○	○
	AL32	1	0	0	0	1	0	0	Over current	Over curr	○	○	○
	AL33	0	0	1	1	0	0	1	Over voltage	Over volt	○	○	○
	AL35	1	0	1	1	1	0	1	Command pulse frequency alarm	Ref. f err	○	○	○
	AL37	0	0	0	1	0	0	0	Parameter alarm	Pr. err	○		
	AL42	1	1	0	0	1	1	0	Feedback alarm	Pos. err	○	○	○
	AL45	0	1	1	0	0	1	1	Main circuit device overheat	Fin heat	○	○	○
	AL46	0	1	1	0	0	1	1	Servo motor overheat	Motor heat	○	○	○
	AL50	0	1	1	0	0	1	1	Over load 1	Over load 1	○ (Note2)	○ (Note2)	○ (Note2)
	AL51	0	1	1	0	0	1	1	Over load 2	Over load 2	○ (Note2)	○ (Note2)	○ (Note2)
	AL52	1	0	1	0	1	0	1	Error excessive	Over droop	○	○	○
	AL73				1	1	0	1	Auxiliary pulse frequency alarm	OpRef. f er	○	○	○
	AL74				1	1	1	1	Option memory alarm 1	OpMemo. er 1	○		
	AL75				1	1	1	1	Option memory alarm 2	OpMemo. er 2	○	○	○
	AL8E	0	0	0	0	0	0	0	RS-232C alarm	RS232 err	○	○	○
Warning codes	AL92								Open battery cable warning	BTT cable	Removing the cause of occurrence deactivates the alarm automatically.		
	AL96								Zero setting error	ZERO set er			
	AL9F								Battery warning	BTT volt			
	ALE0								Excessive regenerative load warning	OR warning			
	ALE1								Over load warning	OL warning			
	ALE3								Absolute position counter warning	ABS warning			
	ALE5								ABS time-out warning	ABS timeout			
	ALE6								Servo emergency stop	EMG stop			
	ALE9								Main circuit off warning	Main P-off			
	ALEA								ABS servo on warning	SON timeout			

Note 1. 0: Any terminal-SG OFF (open)
1: Any terminal-SG ON (short)
2. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.

10.2.2 Remedies for alarms

> **⚠CAUTION** • When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.

> **POINT**
>
> • When any of the following alarms has occurred, always remove its cause and allow about 30 minutes for cooling before resuming operation. If operation is resumed by switching control circuit power off, then on to reset the alarm, the servo amplifier, servo motor and regenerative brake option may become faulty.
> · Regenerative alarm (AL30)
> · Overload 1 (AL50)
> · Overload 2 (AL51)
> • The alarms can be deactivated by switching power off, then on, by pressing the "RES" key of the parameter unit or by turning on the reset signal (RES). Refer to Section 10.2.1 for details.

When an alarm occurs, the trouble signal (ALM) switches off and the dynamic brake operates to stop the servo motor. At this time, the display shows the corresponding alarm number.
Remove the cause of the alarm in accordance with this section. The optional Parameter Unit may be used to refer to the cause.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 10	Undervoltage	Power supply voltage dropped. 160V or less	Under volt	Power Volt under 160V 15 ms IPF	1. Power supply voltage is low.	Review the power supply.
				Power Volt under 160V 15ms IPF	2. Power failed instantaneously. In case of MR-H700AN or less : 15ms or less In case of MR-HIIKAN or more : 10ms or less	
				Insuf. Power capacity	3. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
					4. Power switched on within 5s after it had switched off.	
					5. Faulty parts in the servo amplifier Checking method Alarm (AL 10) occurs if power is switched on after all connectors are disconnected.	Change the Servo amplifier.
AL 12	Memory alarm 1	RAM, ROM memory fault	Memory er 1	Board error	Faulty parts in the servo amplifier Checking method Alarm (any of AL 12 to 15) occurs if power is switched on after all connectors are disconnected.	Change the Servo amplifier.
AL 13	Clock alarm	Printed board fault	OSC err			
AL 14	Watch dog	CPU fault	Watch dog			
AL 15	Memory alarm 2	EEPROM fault	Memory er 2			
AL 16	Encoder alarm	Communication error occurred between encoder and servo amplifier.	PLG err 1	PLG con. left	1. Encode connector disconnected.	Connect correctly.
				PLG trouble	2. Encoder faulty.	Change the servo motor.
				PLG cable has trouble	3. Encoder cable faulty (wire breakage or short)	Repair or change the cable.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 17	Board alarm	CPU/parts fault	Board err	Board error	Faulty parts in the servo amplifier Checking method Alarm (AL 17 or AL 19) occurs if power is switched on after all connectors have been disconnected.	Change the servo amplifier.
AL 19	Memory alarm 3	Flash ROM fault	Memory alarm 3	Board error		
AL 1A	Motor combination erase	Motor combination error	Motor err.	Motor err.	When using HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, improper motor was connected with servo amplifier.	Use correct combination.
AL 20	Encoder alarm 2	Communication error occurred between encoder and servo amplifier.	PLG err 2	PLG con. left	1. Encoder connector disconnected.	Connect correctly.
				PLG cable has trouble	2. Encoder cable faulty (wire breakage or short)	Repair or change the cable.
AL 24	Ground fault	Ground fault occurred at the servo motor outputs (U,V and W phases) of the servo amplififer.	Grounded	UVW ground fault	1. Power input cable and servo motor output cable are making contact at the main circuit terminal block (TE1).	Connect correctly.
					2. Servo motor power cable insulation deteriorated.	Change the cable.
AL 25	Absolute position erase	Absolute position data in error	ABS lost	Power trset after 2-3 min. pow. on	1. Reduced voltage of super capacitor in encoder	After alarm has occurred, hold power on for a few minutes, and switch it off once, then on again. Make home position return again.
				BTT life time over	2. Battery voltage low	Change battery. Make home position return again.
				BTT cable has trouble	3. Battery cable or battery is faulty.	
AL 30	Regenerative alarm	Permissible regenerative power of the built-in regenerative brake resistor or regenerative brake option is exceeded.	Reg. err	Pr. 2 mis setting	1. Wrong setting of parameter No. 2	Set correctly.
				Reg. Resist. missing	2. Built-in regenerative brake resistor or regenerative brake option is not connected.	connect correctly.
				Reg. Load exceeded	3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative brake option to be exceeded. Checking method Call the status display and check the regenerative load ratio.	1. Reduce the frequency of positioning. 2. Use the regenerative brake option of larger capacity. 3. Reduce the load.
					Power supply voltage is abnormal. 260V or more	Review power supply
		Regenerative transistor fault		Reg. Tr. damaged	5. Regenerative transistor faulty. Checking method 1) The regenerative brake option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.	Change the servo amplifier.
				Reg. Resist has trouble	6. Built-in regenerative brake resistor or regenerative brake option faulty.	Change servo amplifier or regenerative brake option.
		Cooling fan stop			7. Unusual overheat due to cooling fan stop	1. Change the servo amplifier or cooling fan. 2. Reduce ambient temperature.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 31	Over speed	Speed has exceeded the instantaneous permissible speed.	Over speed	Ref/ pulse f exceeded	1. Input command pulse frequency exceeded the permissible instantaneous speed frequency.	Set command pulses correctly.
				Acc. time-C shortage	2. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/decelerati on time constant.
				Over shoot by unstable	3. Servo system is instable to cause overshoot.	1. Re-set servo gain to proper value. 2 If servo gain cannot be set to proper value: 1) Reduce load inertia moment ratio; or 2) Reexamine acceleration/ deceleration time constant.
				Pr. 1 missetting	4. Parameter No. 1 setting error.	Set correctly.
				E-gear rate too large	5. Electronic gear ratio too high.	Set correctly.
				PLG trouble	6. Encoder faulty.	Change the servo motor.
AL 32	Over current	Current that flew is higher than the permissible current of the servo amplifier.	Over curr.	UVW short circuit	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring.
				IPM dameged	2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (AL 32) occurs if power is switched on after U, V and W are disconnected.	Change the servo amplifier
				UVW fault	3. Ground fault occurred in servo amplifier output phases U, V and W.	Correct the wiring.
				Ext. noise	4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
AL 33	Over voltage	Converter bus voltage exceeded 400V.	Over volt.	Reg. Resist. Has trouble	1. Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected.	1. Change lead. 2. Connect correctly.
				Reg. Tr. damaged	2. Regenerative transistor faulty.	
				Reg. Resist has trouble	3. Wire breakage of built-in regenerative brake resistor or regenerative brake option	1. For wire breakage of built-in regenerative brake resistor, change servo amplifier. 2. For wire breakage of regenerative brake option, change regenerative brake option.
				Power volt exceeded	4. Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Add regenerative brake option or increase capacity.
					5. Power supply voltage high.	Review the power supply.
AL 35	command pulse frequency alarm	Input pulse frequency is too high.	Ref. f err	Ref. pulse f exceeded	1. Command pulse frequency too high.	Change the command pulse frequency to a proper value.
				Ref. pulse has noise	2. Noise entered the command pulse.	Take action against noise.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 37	Parameter alarm	Parameter setting is wrong.	Pr. err	Pr. Data destroyed	1. Servo amplifier fault caused the parameter setting to be rewritten.	Change the servo amplifier.
				Pr. □ □ err.	2. Parameter data mis-setting	Set parameter correctly.
AL 42	Feedback alarm	Encoder signal is faulty.	Pos. err	PLG trouble	Encoder faulty.	Change the servo motor.
AL 45	Main circuit device overheat	Main circuit device overheat	Fin heat	Over load	1. Servo amplifier faulty.	Change the servo amplifier.
				Amb. Temp. over 55°c	2. The power supply was turned on and off continuously by overloaded status.	The drive method is reviewed.
				Amp. Cooling trouble	3. Air cooling fan of servo amplifier stops.	The cooling method is reviewed.
AL 46	Servo motor overheat	Servo motor temperature rise actuated the thermal protector.	Motor overheat	Motor amb. Over	1. Ambient temperature of servo motor is over 40℃.	Review environment so that ambient temperature is 0 to 40°C.
				40°C Over load	2. Servo motor is overloaded.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
				PLG-TH trouble	3. Thermal protector in encoder is faulty.	Change servo motor.
				Motor cool trouble	4. Air cooling fan of the servo motor stops.	Change servo motor.
AL 50	Over load 1	Load exceeded overload protection characteristic of servo amplifier. Load ratio 300%: 2.5s or more Load ratio 200%: 100s or more	Over load 1	E-thermal tripped	1. Servo amplifier is used in excess of its continuous output current.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
				Mot. Vibrat. By unstabl	2. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
				Machine locked	3. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
				UVW miswire	4. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
				PLG trouble	5. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 51	Over load 2	Machine collision or the like caused max. output current to flow successively for several seconds. Servo motor locked: 1s or more	Over load 2	Machine locked	1. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
				UVW miswire	2. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
				Mot. Vibrat by unstabl	3. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
				Dc-bus low	4. The bus voltage of the unit has decreased.	Change the servo amplifier.
				PLG trouble	5. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.
AL 52	Error excessive	Droop pulse value of the deviation counter exceeded 80k pulses.	Error excessive	Acc. Time-C shortage	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/decele-ration time constant.
				Start torque missing	2. Torque limit value (parameter No.40) is too small.	Increase the torque limit value.
					3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Review the power supply capacity. 2. Use servo motor which provides larger output.
				Pr. 7 shortage	4. Position control gain 1 (parameter No.7) value is small.	Increase set value and adjust to ensure proper operation.
				Machine locked	5. The bus voltage of the unit due to the breakdown.	Change servo amplifier.
				Rotated by ext. force	6. Servo motor shaft was rotated by external force.	1. When torque is limited, increase the limit value. 2. Reduce load. 3. Use servo motor that provides larger output.
				DC-bus low	7. Machine struck something.	1. Review operation pattern. 2. install limit switches.
				PLG trouble	8. Encoder faulty.	Change the servo motor
					9. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 73	Auxiliary pulse frequency alarm	Input pulse frequency of manual pulse generator connected to option card is too high.	OpRef. fer	Op. board AUX pulse exceeded	Pulse input command frequency exceeded 600kpps.	Use at 600keeps or less.
AL 74	Option memory alarm 1	Option card RAM fault	OpMemo. er 1	Op. board error	MR-H-D01 option card faulty.	Change the option card.
AL 75	Option memory alarm 2	Option card EEP-ROM fault	OpMemo. er 1	Op. board error		
AL 8E	RS-232C alarm	Serial communication error occurred between servo amplifier and communication device (parameter unit, personal computer or similar device).	RS232 err	RS232 comm. error	1. Encoder cable faulty. (write breakage or short)	Repair or change the cable.
					2. Telecommunications equipment faulty.	Change the telecommunication equipment.

10.2.3 Remedies for warnings

Occurrence of any of ALE6, ALE9 and ALEA will result in a servo off status.
If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed.
Eliminate the cause of the warning according to this section. Use the operation parameter unit to refer to the cause of warning.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 92	Open battery cable warning	Absolute position detection system battery voltage is low.	BTT cable	BTT cable has troubl BTT voltage low	1. Battery cable is open.	Repair cable or changed.
					2. battery voltage dropped to 2.8V or less.	Change battery.
AL 96	Zero setting error	1. In incremental system: Zeroing could not be made. 2. In absolute position detection system: Zero setting could not be made.	ZERO set er	Ref. P input after CR on Out of inposition	Droop pulses remaining are greater than the in-position range setting.	Remove the cause of droop pulse occurrence
AL 9F	Battery warning	Voltage of battery for absolute position detection system reduced.	BTT volt	BTT voltage low	Battery voltage fell to 3.2V or less.	Change the battery.
AL E0	Excessive regenera-tive load warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative brake resistor or regenerative brake option.	OR warning	Reg. Load over 85% of alarm	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative brake resistor or regenerative brake option. Checking method Call the status display and check regenerative load ratio.	1. Reduce frequency of positioning. 2. Change regenerative brake option for the one with larger capacity. 3. Reduce load.
AL E1	Over load warning	There is a possibility that overload alarm 1 or 2 may occur.	OL warning	Load over 85% of alarm	Load increased to 85% or more of overload alarm 1 or 2 occurrence level. Cause, checking method Refer to AL 50, 51.	Refer to AL 50, AL 51.
AL E3	Absolute position counter warning	Absolute position encoder pulses faulty.	ABS warning	PLG trouble by noise	1. Noise entered the encoder.	Take noise suppression measures.
					2. Encoder faulty.	Change servo motor.
AL E5	ABS time-out warning		ABS timeout	ABS I/O miswiring PC ladder prog. miss	1. PC lader program wrong.	Contact the program.
					2. DI4 · TLC signal mis-wiring	Connect properly.
AL E6	Servo emergency stop	EMG-SG are open.	EMG stop	EMG off	External emergency stop was made valid. (EMG-SG opened.)	Ensure safety and deactivate emergency stop.
AL E9	Main circuit off warning	Servo was switched on with main circuit power off.	Main P-off	Main power down while SON-on		Switch on main circuit power.
AL EA	ABS servo on warning	Servo on signal (SON) turned on more than 1s after servo amplifier had entered absolute position data transfer mode.	SON timeout	PC larder program wrong. SON-on mis-wriing.	1. PC ladder program wrong.	1. Correct the program.
					2. SON signal mis-wiring.	2. Connect properly.

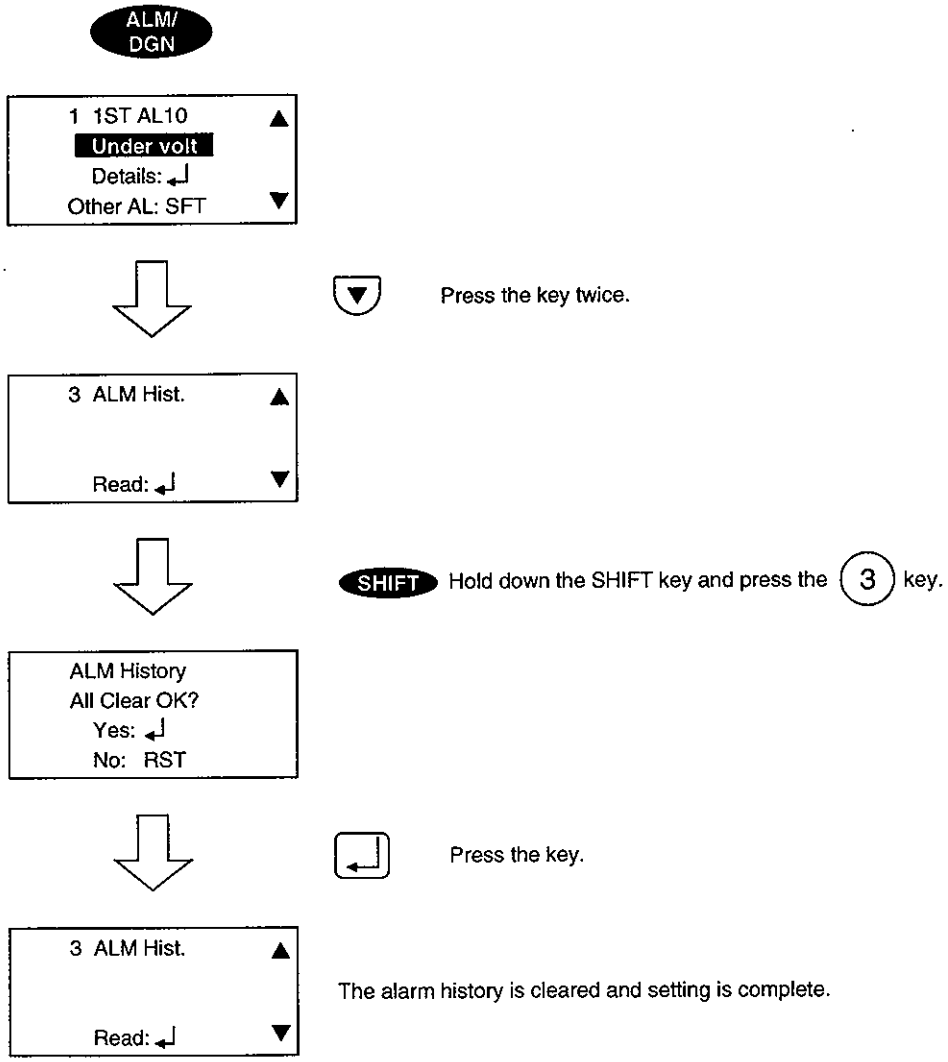
10.2.4 RS-232C communication error

When a communication fault occurs between the servo amplifier and parameter unit, any of the following errors is displayed on the screen of the parameter unit . In this case, switch the power off, take the corresponding action, and switch the power on.

Screen display	Error Definition	Cause	Corrective Action
COMMUNICATION ERROR	A fault occurred in communication between the servo amplifier and parameter unit during servo operation.	1. Parameter unit cable or communication cable connection fault 2. Parameter unit cable or communication cable open	1. Connect properly. 2. Change the cable.
SERVO CPU ERROR	Communication cannot be made at power-on between the servo amplifier and parameter unit.	3. Servo amplifier faulty. 4. Parameter unit faulty.	3. Change the servo amplifier. 4. Change the parameter unit.
PRU MEMORY ERROR	Parameters cannot be copied from the servo amplifier to the parameter unit.	Memory (EEPROM) in the parameter unit faulty.	Change the parameter unit.

10.3 Clearing the Alarm History

The parameter unit can be used to confirm an alarm history. The servo amplifier stores one current alarm and nine past alarms which occurred since it had been switched on first. Before starting operation, clear the alarm history so that you can control alarms which may occur during the operation.



11. SPECIFICATIONS

11.1 Standard specifications

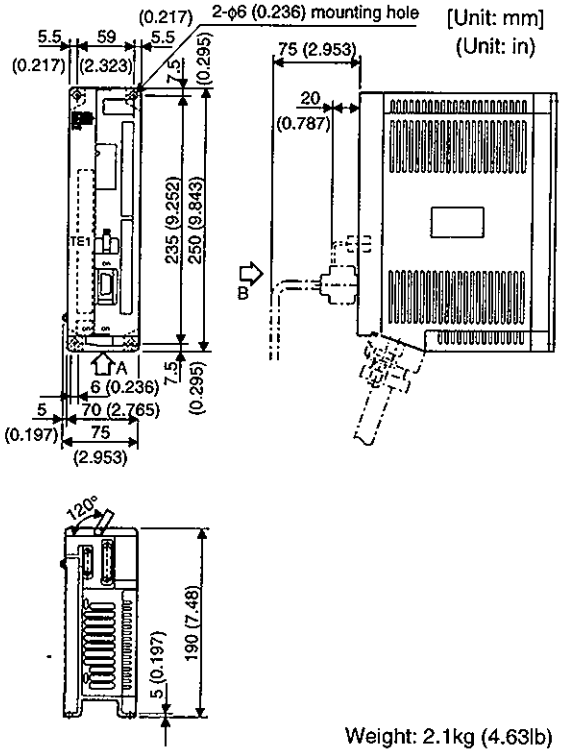
(1) Servo amplifier

Item \ Servo amplifier MR-H□AN		10	20	40	60	100	200	350	500	700	11K	15K	22K
Power supply	Voltage/frequency	3-phase 200 to 230VAC, 50/60Hz								3-phase 200 to 220VAC, 50Hz 3-phase 200 to 230VAC, 60Hz			
	Permissible voltage fluctuation	3-phase 170 to 253VAC, 50/60Hz								3-phase 170 to 242VAC, 50Hz 3-phase 170 to 253VAC, 60Hz			
	Permissible frequency fluctuation	Within ±5%											
	Power supply capacity	Given in Section 12.2											
System		Sine-wave PWM control, current control system											
Dynamic brake		Built-in									Option		
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder fault protection, regenerative fault protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection											
Speed frequency response		250Hz or more											
Torque limit input		0 to ±10VDC/max. current (individual commands for forward rotation and reverse rotation, input impedance 10 to 12kΩ)											
Speed control specifications	Speed control range	1:5000 (1:2000 for external analog speed setting)											
	Speed command input	0 to ±10VDC (CCW direction for +, CW direction for –, input impedance 10 to 12kΩ)											
	Speed variation ratio	–0.03% max. (load variation 0 to 100%) ±0.02% max. (power variation ±10%) ±0.2% max. (ambient temperature 25±10°C) for external speed setting only											
Position control specifications	Max. input pulse frequency	400kpps (for differential receiver) · 200kpps (for open collector)											
	Command pulse multiplying factor	Electronic gear A/B times A · B:1 to 50000 1/50<A/B<50											
	In-position range setting	1 to ±50000 pulse											
	Error excessive	±80k pulse											
Torque control specifications	Torque command input	0 to ±8VDC (reverse rotation driving/forward rotation regenerative mode for + forward rotation driving/reverse rotation regenerative modefor –, input impedance 10 to 12kΩ)											
	Torque linearity	±3% or less											
	Tension control	Used with the LE tension control unit											
Absolute position detection specifications		Given in Chapter 5											
Structure		Open (IP00)											
Environment	Ambient temperature	0 to +55 [°C] (non-freezing)											
		32 to +131 [°F] (non-freezing)											
	Ambient humidity	90%RH or less (non-condensing)											
	storage temperature	–20 to +65 [°C] (non-freezing)											
		–4 to +149 [°F] (non-freezing)											
	storage humidity	90%RH or less (non-condensing)											
	Ambient	Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt											
	Altitud	Max. 1000m (3280ft) above sea level											
	Vibration	5.9 [m/s^2] {0.6G} or less											
		19.4 [ft/s^2] or less											
Weight	[kg]	2.1	2.1	2.1	2.1	2.4	4.4	4.4	7.0	12.0	21	27	30
	[lb]	4.63	4.63	4.63	4.63	5.291	9.7	9.7	15.432	26.455	46.297	59.525	66.139

11.2 Outline Dimensional Drawings

11.2.1 Servo amplifiers

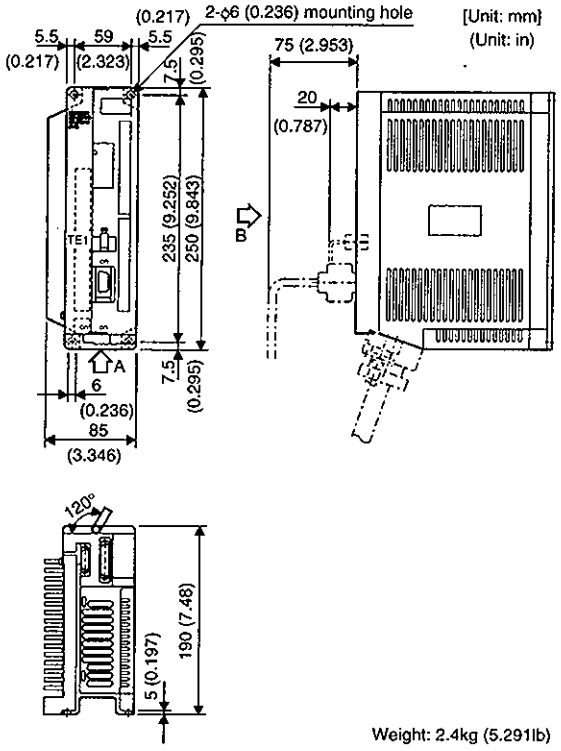
MR-H10AN(-UE) to MR-H60AN(-UE)



Weight: 2.1kg (4.63lb)

Terminal block TE1	
MR-HDAN	MR-HDAN-UE
Terminal screw: M4	Terminal screw: M4
P C N R S T R1 S1 U V W ⏚	P C N L1 L2 L3 L11 L21 U V W (Note) Chassis ⏚ Note: Keep it open.

MR-H100AN(-UE)

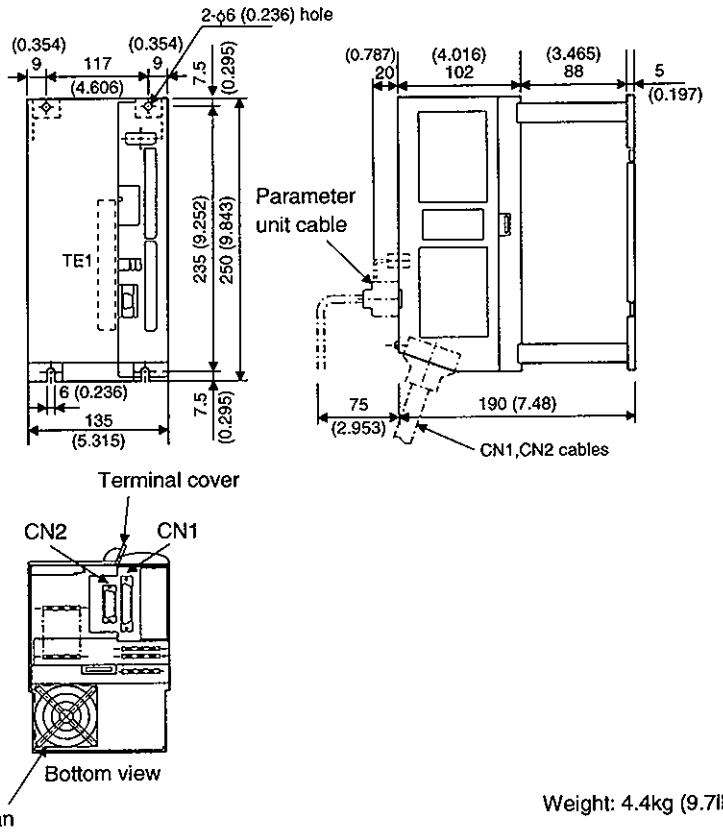


Weight: 2.4kg (5.291lb)

Terminal block TE1	
MR-HDAN	MR-HDAN-UE
Terminal screw: M4	Terminal screw: M4
P C N R S T R1 S1 U V W ⏚	P C N L1 L2 L3 L11 L21 U V W (Note) Chassis ⏚ Note: Keep it open.

MR-H200AN(-UE) · MR-H350AN(-UE)

[Unit: mm]
(Unit: in)

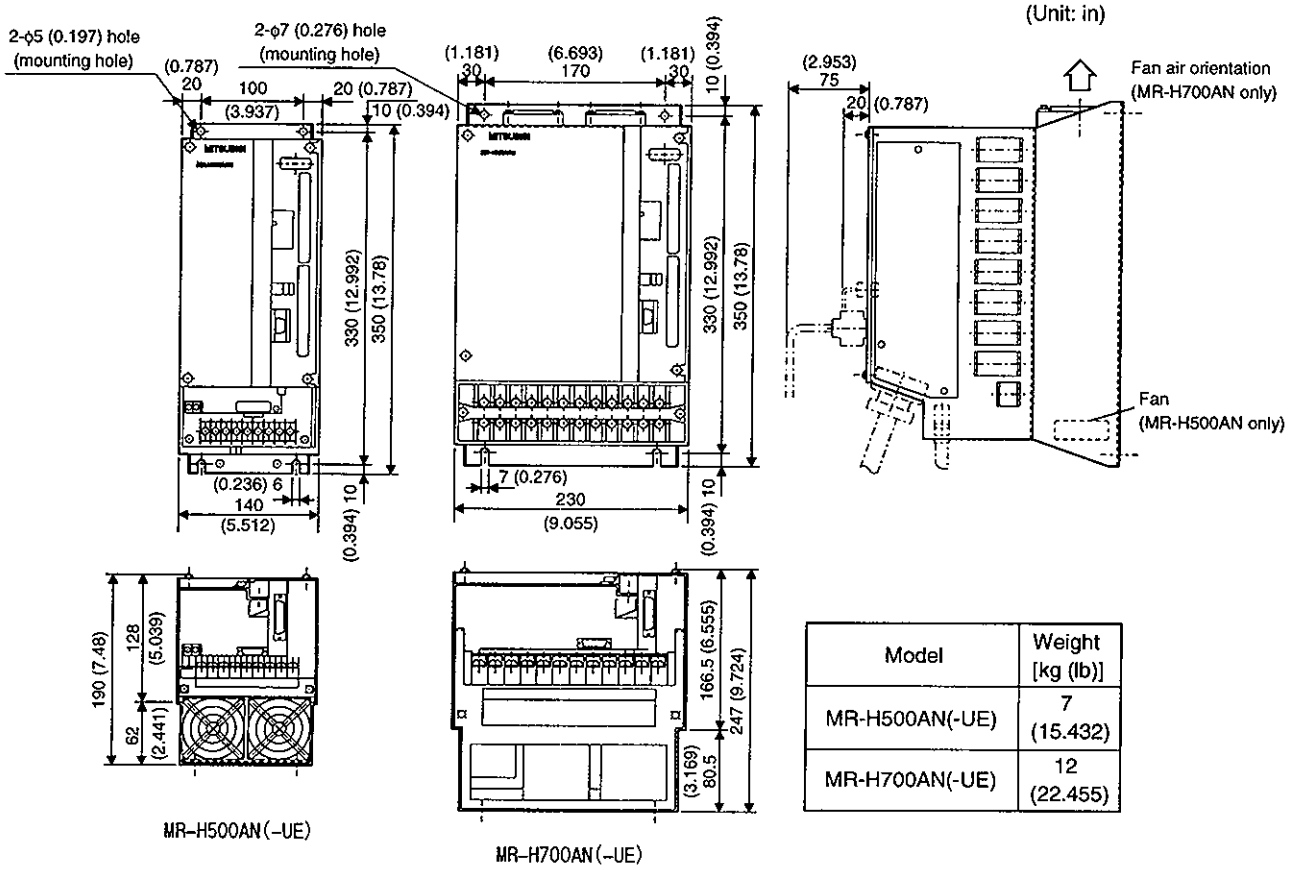


Terminal block TE1	
MR-H□AN	MR-H□AN-UE
Terminal screw: M4	Terminal screw: M4
P C N R S T R1 S1 U V W ⏚	P C N L1 L2 L3 L11 L21 U V W (Note) Chassis Note: Keep it open.

Weight: 4.4kg (9.7lb)

MR-H500AN(-UE) · MR-H700AN(-UE)

[Unit: mm]
(Unit: in)



Model	Weight [kg (lb)]
MR-H500AN(-UE)	7 (15.432)
MR-H700AN(-UE)	12 (22.455)

Terminal block signal arrangement

• MR-H500AN

TE2

R1	S1

GND ◎

Terminal screw: M3.5 Terminal screw: M4

TE1

P	C	N	R	S	T	U	V	W

Terminal screw: M4

• MR-H500AN-UE

TE2

L11	L21

PE

Terminal screw: M4

TE1

P	C	N	L1	L2	L3	U	V	W

Terminal screw: M4

• MR-H700AN

TE1

P	C	N	R	S	T	R1	S1	U	V	W	⏚

Terminal screw: M5

• MR-H700AN-UE

TE1

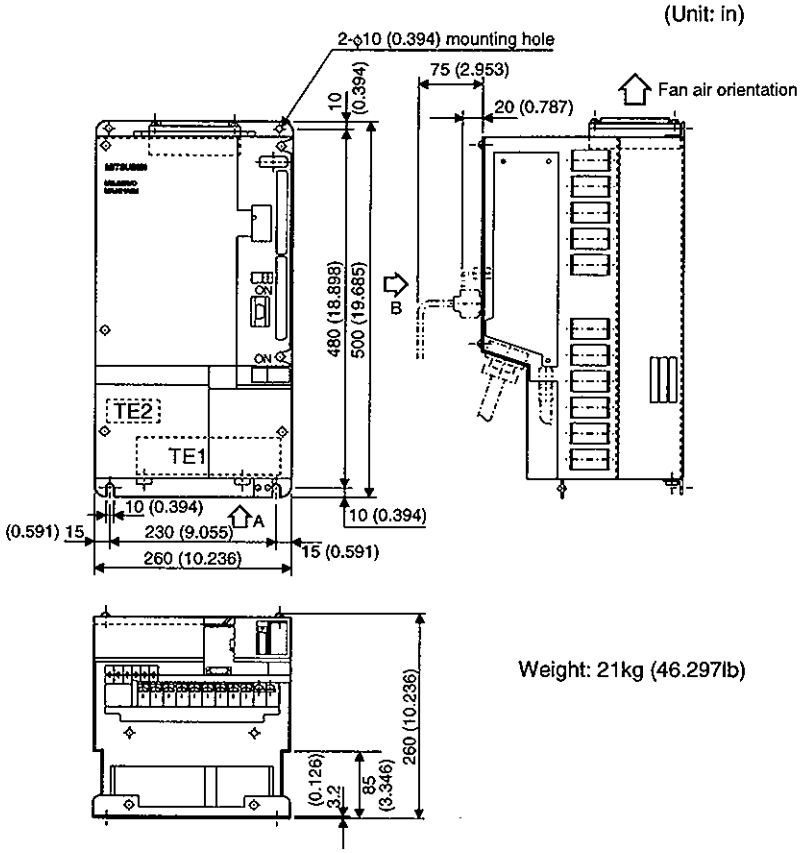
P	C	N	L1	L2	L3	L11	L21	U	V	W	◎

Terminal screw: M5

PE

MR-H11KAN(-UE)

[Unit: mm]
(Unit: in)



Weight: 21kg (46.297lb)

Terminal block signal arrangement

- MR-H11KAN

TE2

R1	S1		MS1	MS2	

Terminal screw: M4

TE1

R	S	T	U	V	W	P	C	N	⏚

Terminal screw: M5

- MR-H11KAN-UE

TE2

L11	L21		MS1	MS2	

Terminal screw: M4

TE1

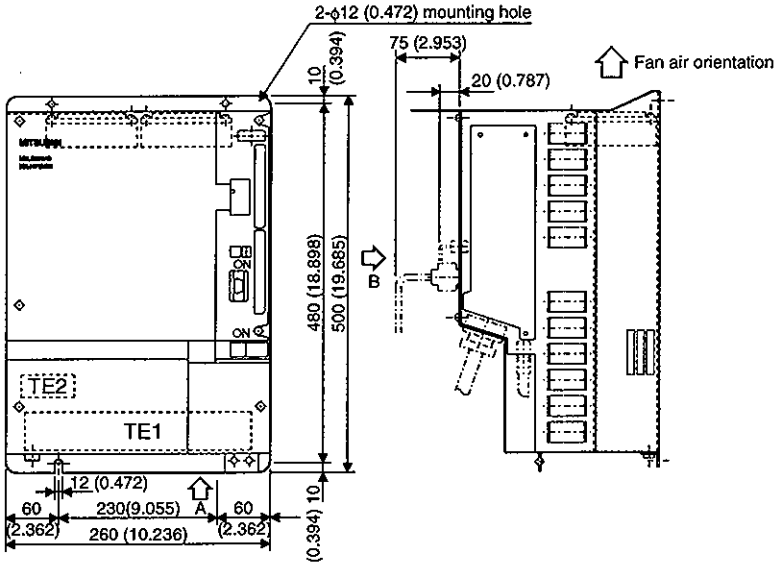
L1	L2	L3	U	V	W	P	C	N	

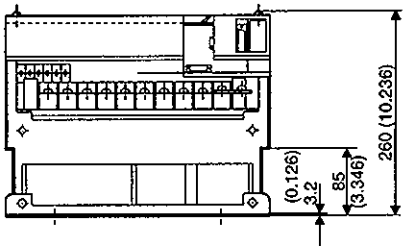
Terminal screw: M5

PE

MR-H15KAN(-UE) · MR-H22KAN(-UE)

[Unit: mm]
(Unit: in)





Model	Weight [kg (lb)]
MR-H15KAN(-UE)	27 (59.525)
MR-H22KAN(-UE)	30 (66.139)

Terminal block signal arrangement

• MR-H15KAN · MR-H22KAN

TE2

R1	S1		MS1	MS2	

Terminal screw: M4

TE1

R	S	T	U	V	W	P	C	N	⏚

Terminal screw: M6(MR-H15KAN)
M8(MR-H22KAN)

• MR-H15KAN-UE · MR-H22KAN-UE

TE2

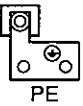
L11	L21		MS1	MS2	

Terminal screw: M4

TE1

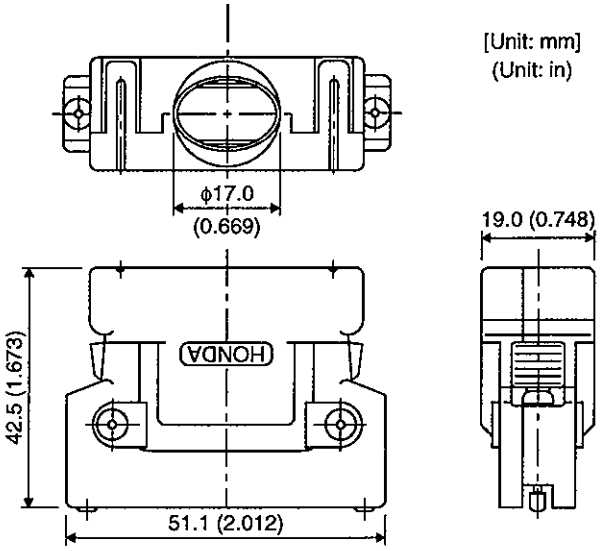
L1	L2	L3	U	V	W	P	C	N	⏚

Terminal screw: M6(MR-H15KAN)
M8(MR-H22KAN)



11.2.2 Connectors

(1) Servo amplifier side connector
<Honda Tsushin Kogyo make>

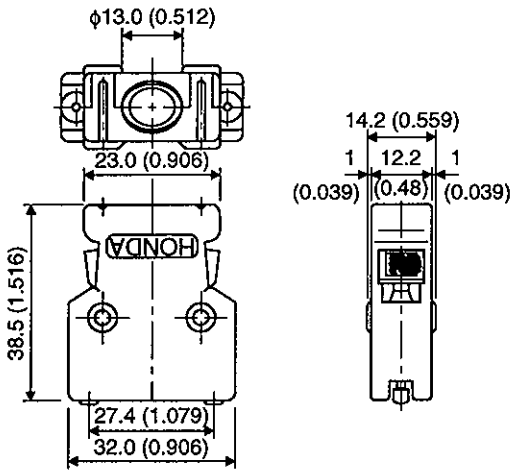


Number of Pins	Model	
	Connector	Case
50	PCR-S50FS (soldering type)	PCR-LS50LA1
	PCR-S50F (insulation displacement type)	

Crimping terminal: FHAT-002A

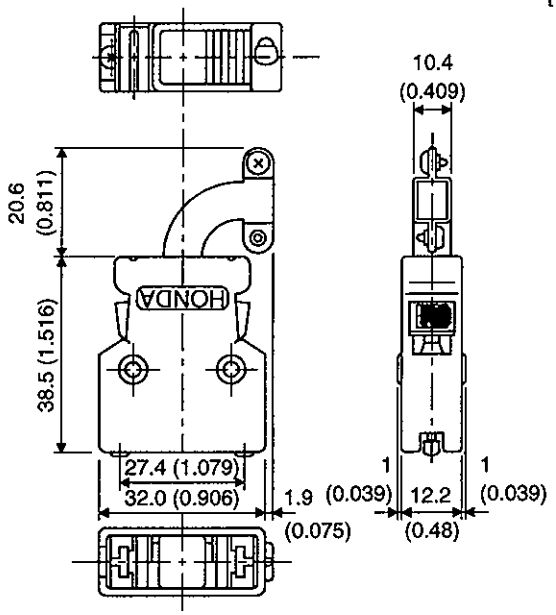
Note: PCR-S50F is not an option and is to be supplied by the customer.

PCR-LS20LA1



PCR-LS20LA1W

[Unit: mm]
(Unit: in)



Number of Pins	Model	
	Connector	Case
50	PCR-S20FS (soldering type)	PCR-LS20LA1
	PCR-S20F (insulation displacement type)	PCR-LS20LA1W

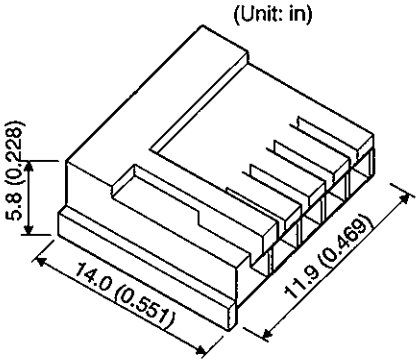
Crimping terminal: FHAT-002A

Note: PCR-S20F and PCR-LS20LA1W are not options and are to be supplied by the customer.

<Nippon AMP make>

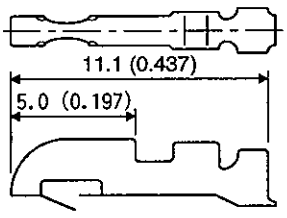
· Housing Model: 171822-4

[Unit: mm]
(Unit: in)



· Contactor Model: 170262-2 (chain type)
170204-2 (loose type)

[Unit: mm]
(Unit: in)

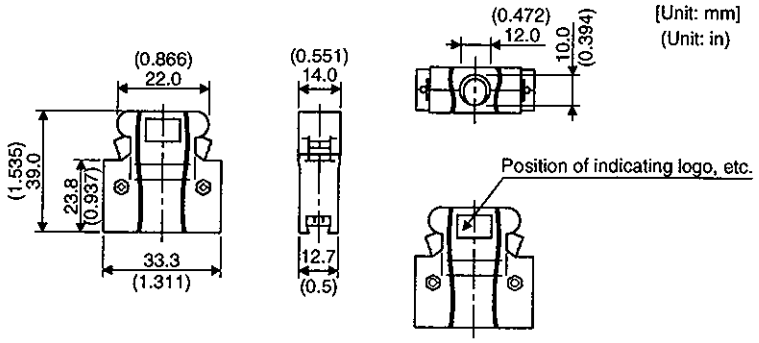


Applicable wire range
AWG: 30-26
(0.05 to 0.15mm²)
Contactor caulking hand tool
Model: 722561-1

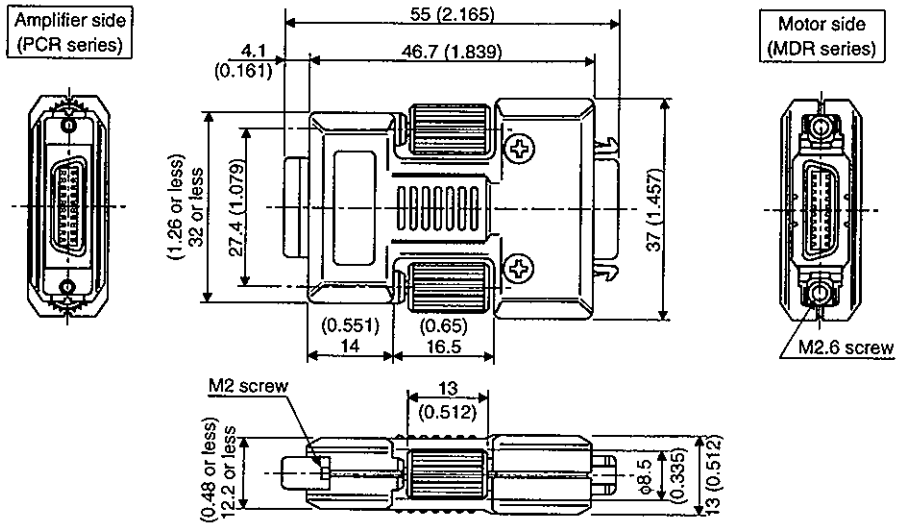
(2) Connector for conversion connector

Signal connector

<Sumitomo Three M make>



(3) MR-HCN2 conversion connector



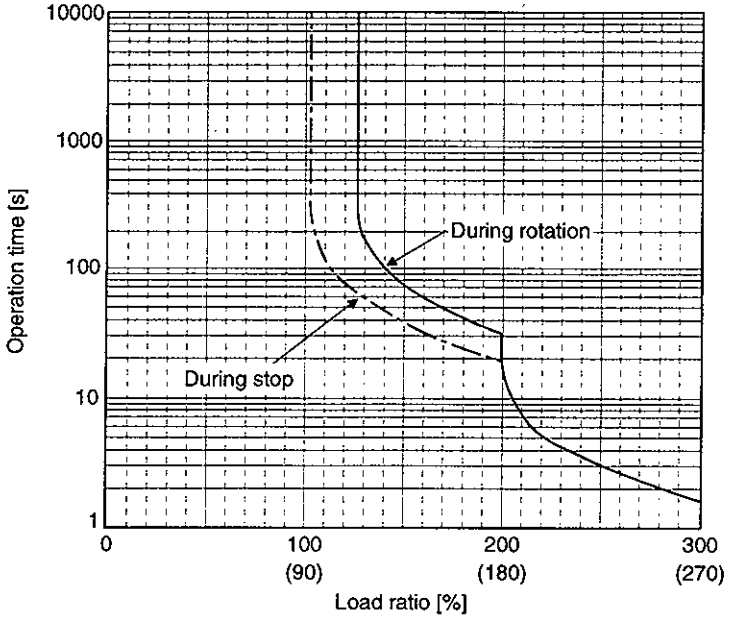
12. CHARACTERISTICS

12.1 Overload Protection Characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. Overload 1 alarm (AL 50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. Overload 2 alarm (AL 51) occurs if the maximum current flew continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.
If load is applied at stop(during servo lock), 70% of the rated torque must not be exceeded.

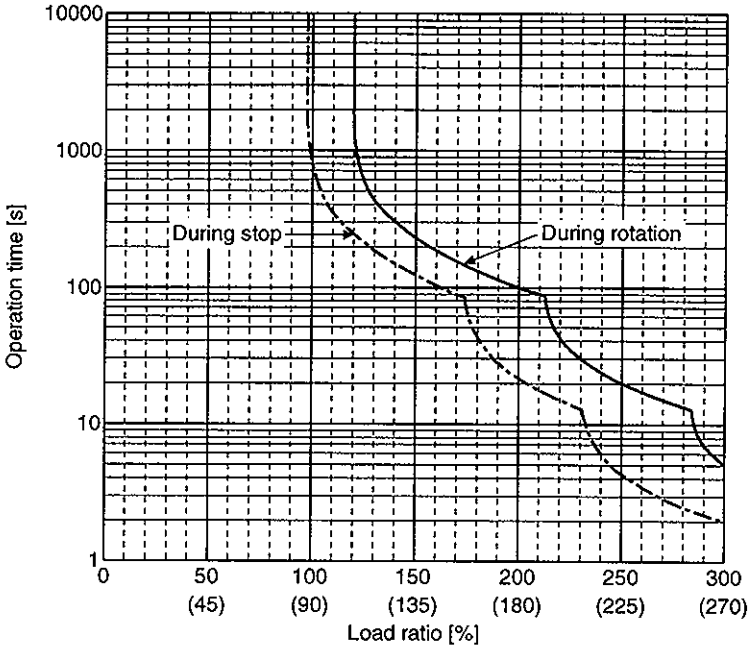
HA-LH serise
(11kW or more)

Note: Values within parentheses in the graph are those in the low acoustic noise mode.



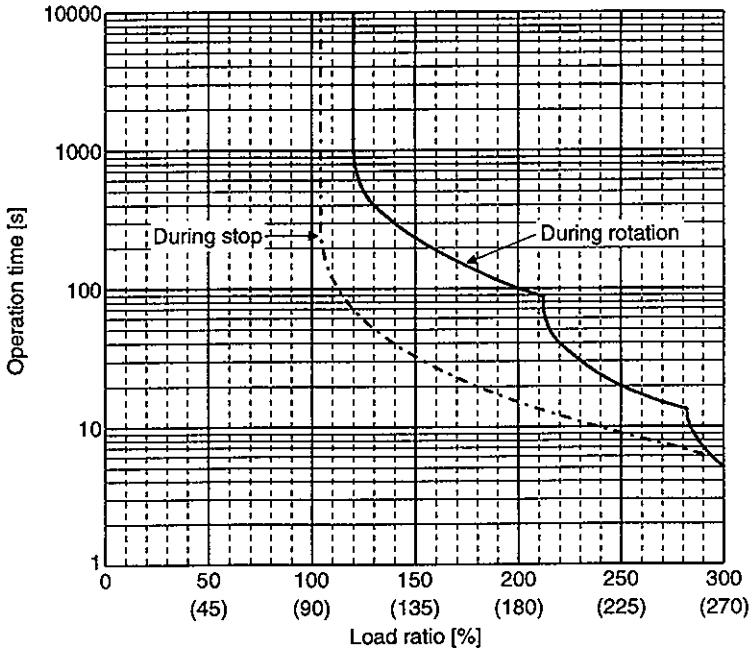
HC-MF serise
HC-SF serise
HC-RF serise
HC-UF serise

Note: Values within parentheses in the graph are those in the low acoustic noise mode.



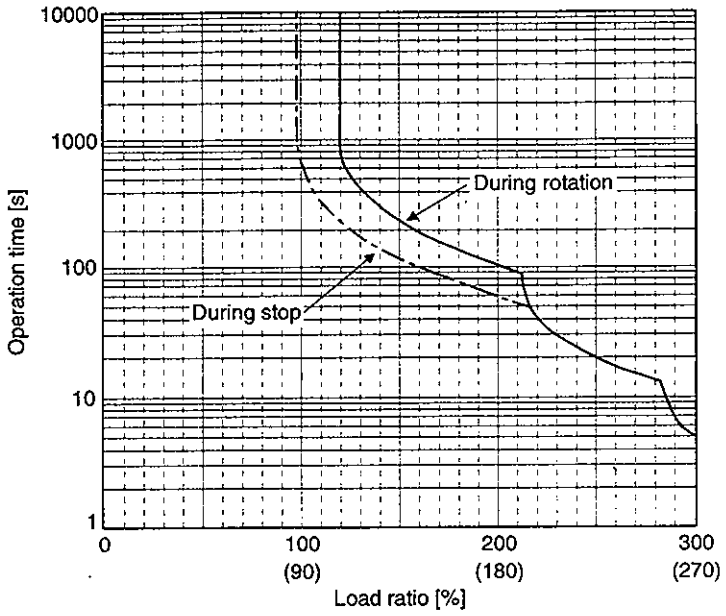
HC-FF serise
(200W or less)

Note: Values within parentheses in the graph are those in the low acoustic noise mode.



HC-FF serise
(300W or more)

Note: Values within parentheses in the graph are those in the low acoustic noise mode.



12.2 Power Supply Equipment Capacity and Generated Loss

(1) Amount of heat generated by the servo amplifier

Table 12.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 12.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and zero torque according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Table 12.1 Power Supply Capacity and Generated Heat Per Servo Amplifier at Rated Output

Servo Amplifier	Servo Motor	Power Supply Capacity [kVA]	Servo Amplifier-Generated Heat [W]		Area Required for Heat Dissipation	
			At rated torque	With servo off	[m^2]	[ft^2]
MR-H10AN	HA-FF053 · 13	0.3	40	30	0.8	8.6
	HC-UF13	0.3	40	30	0.8	8.6
MR-H20AN	HC-MF053 · 13	0.3	40	30	0.8	8.6
	HA-FF23	0.5	40	30	0.8	8.6
MR-H40AN	HC-MF23	0.5	40	30	0.8	8.6
	HA-FF33	0.7	50	30	0.9	9.7
	HA-FF43	0.9	50	30	0.9	9.7
	HC-UF23	0.5	40	30	0.8	8.6
MR-H60AN	HC-MF43	0.9	55	30	1.0	10.8
	HA-FF63	1.1	55	30	1.0	10.8
	HA-SF52 · 53	1.0	55	30	1.0	10.8
	HC-UF43	0.9	55	30	1.0	10.8
MR-H100AN	HC-MF73	1.3	65	30	1.2	12.9
	HC-SF81	1.5	65	30	1.2	12.9
	HC-SF102 · 103	1.7	65	30	1.2	12.9
	HC-UF72 · 73	1.3	65	30	1.2	12.9
MR-H200AN	HC-SF121	2.1	105	35	2.0	21.5
	HC-SF152 · 153	2.5	105	35	2.0	21.5
	HC-SF201 · 202 · 203	3.5	105	35	2.0	21.5
	HC-RF103	1.7	105	35	2.0	21.5
	HC-RF153	2.5	105	35	2.0	21.5
	HC-UF152	2.5	105	35	2.0	21.5
MR-H350AN	HC-SF301	4.8	145	35	2.7	29.1
	HC-SF352 · 353	5.5	145	35	2.7	29.1
	HC-RF203	3.5	135	35	2.5	26.9
	HC-UF202	3.5	145	35	2.7	29.1
MR-H500AN	HC-SF502	7.5	210	40	4.0	43.1
	HC-RF353	5.5	145	35	2.7	29.1
	HC-RF503	7.5	210	40	4.0	43.1
	HC-UF352	5.5	210	40	4.0	43.1
	HC-UF502	7.5	210	40	4.0	43.1
MR-H700AN	HC-SF702	10.0	320	45	6.0	64.6
MR-H11KAN	HA-LH11K2	16	540	57	10.0	107.6
MR-H15KAN	HA-LH15K2	22	660	68	13.0	139.9
MR-H22KAN	HA-LH22K2	33	870	82	16.0	172.2

Note: 1. Sufficient heat-related capacity (kVA) values are indicated in Table for the power supply. However, since instantaneous power 2 to 2.5 times higher than the rated will be required for servo motor acceleration, use a power supply with small voltage fluctuation which will provide the voltage within the permissible voltage fluctuation at the terminals of the servo amplifier. Note that the power supply capacity will vary according to the power supply impedance.

2. Refer to Table for the current capacity of the power supply.
3. When using multi-axes, add the power capacity per axis.
4. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative brake option, use Equation 13.1 in Section 13.1.2.

(2) Heat dissipation area for enclosed servo amplifier

An enclosure or control box for the servo amplifier should be designed to operate at the ambient temperature of 40°C (104°F) within a temperature rise of 10°C (50°F). (With a 5°C (41°F) safety margin, the system should operate within a maximum 55°C (131°F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 12.1:

$$A = \frac{P}{K \cdot \Delta T} \quad \cdots\cdots (12.1)$$

where, A : Heat dissipation area [m^2]
P : Loss generated in the control box [W]
ΔT : Difference between internal and ambient temperatures [°C]
K : Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with Equation 12.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 12.1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the enclosure is directly installed on an insulated wall, that extra amount must be added to the enclosure's surface area.

The required heat dissipation area will vary wit the conditions in the enclosure. If convection in the enclosure is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the enclosure and the use of a fan should be considered.

Table 12.1 lists the enclosure dissipation area for each servo amplifier when the servo amplifier is operated at the ambient temperature of 40°C (104°F) under rated load.

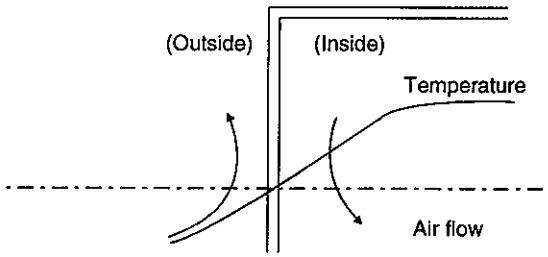


Fig. 12.1 Temperature Distribution in Enclosure

When air flows along the outer wall of the enclosure, effective heat exchange will be possible, because the temperature slope inside and outside the enclosure will be steeper.

(3) Fitting of the servo amplifier (MR-H200AN or more)

When mounted with the heat sink outside mounting attachment (option), the servo amplifier can dissipate generated loss directly to the outside of a control box. This method can reduce the heat dissipation area of the control box since 45 to 55% of the generated loss given in Table 12.1 is dissipated to the outside of the enclosure. For details of the heat sink outside mounting attachment, refer to Section 13.1.9.

12.3 Dynamic Brake Characteristics

When an alarm, emergency stop or power failure occurs, the dynamic brake is operated to bring the servo motor to a sudden stop. Fig. 12.2 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 12.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant t varies with the servo motor and machine operation speeds. (Refer to Fig. 12.3 and Table 12.5.)

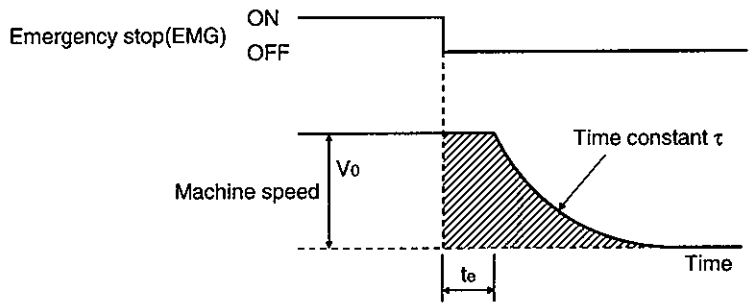
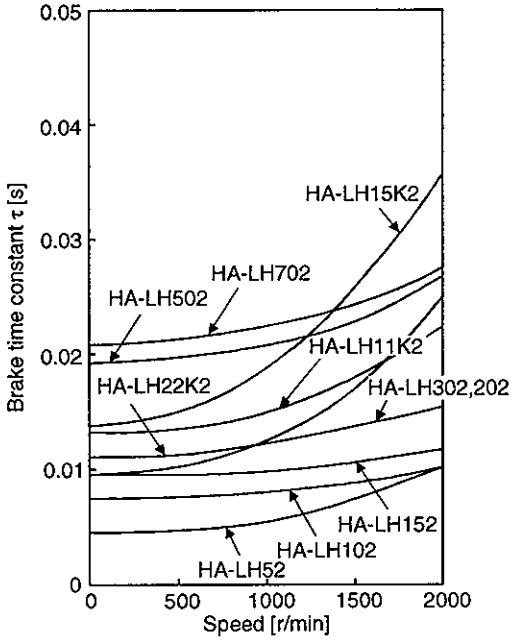


Fig. 12.2 Dynamic Brake Operation Diagram

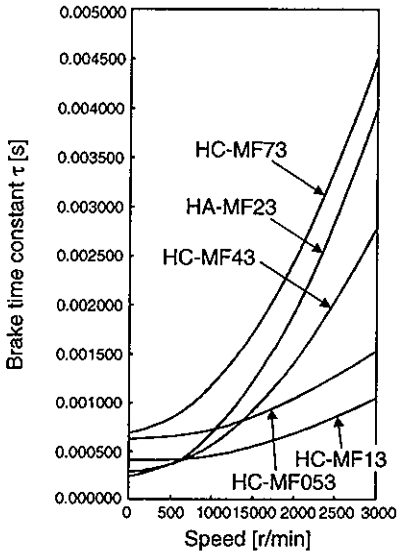
$$Lmax = \frac{V0}{60} \cdot \left\{ te + \tau \left[1 + \frac{JL}{JM} \right] \right\} \quad \cdots\cdots (12.2)$$

L max : Maximum coasting distance ····· [mm][in]
V0 : Machine rapid feedrate ····· [mm/min][in/min]
JM : Servo motor inertial moment ····· [kg · cm²][oz · in²]
JL : Load inertia moment converted into equivalent value on servo motor shaft ····· [kg · cm²][oz · in²]
τ : Brake time constant (Fig. 12.3 · Table 12.4) ····· [s]
te : Delay time of control section (Fig. 12.2) ····· [s]
(There is internal relay delay time of about 30ms.)

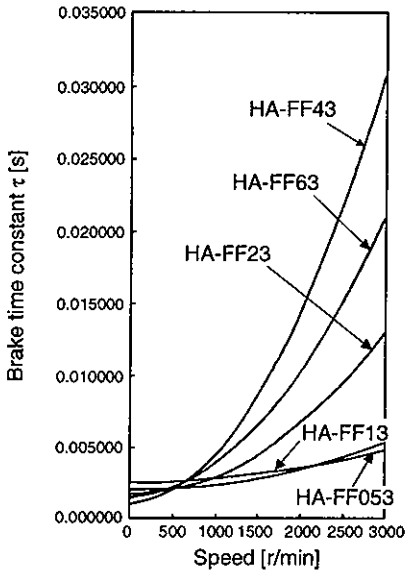


a. HA-LH Series

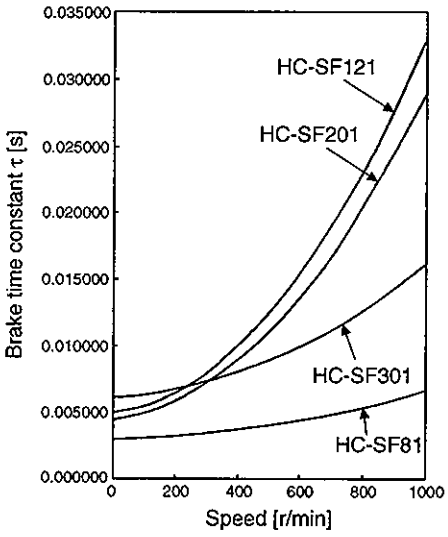
Fig. 12.3 Dynamic Brake Time Constant 1



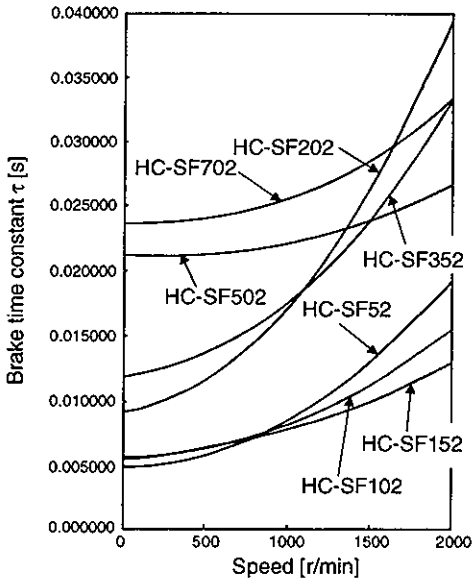
b. HC-MF Series



c. HA-FF Series

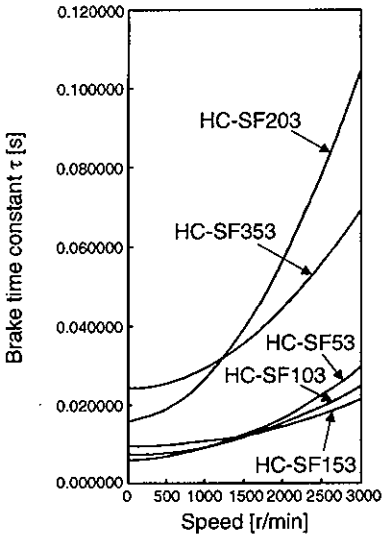


d. HC-SF1000r/min Series

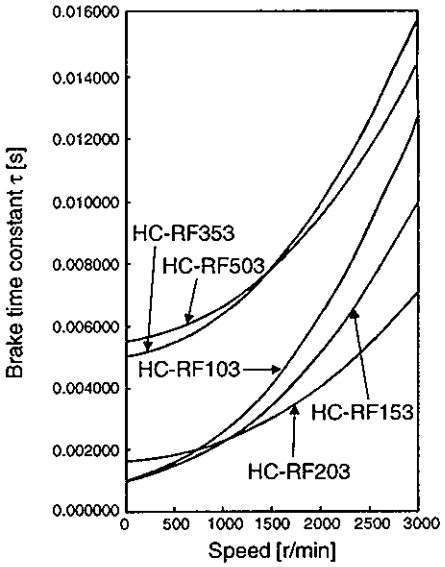


e. HC-SF2000r/min Series

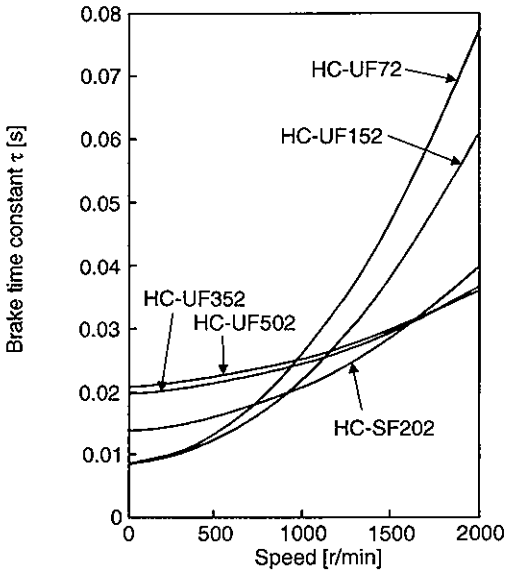
Fig. 12.4 Dynamic Brake Time Constant 2



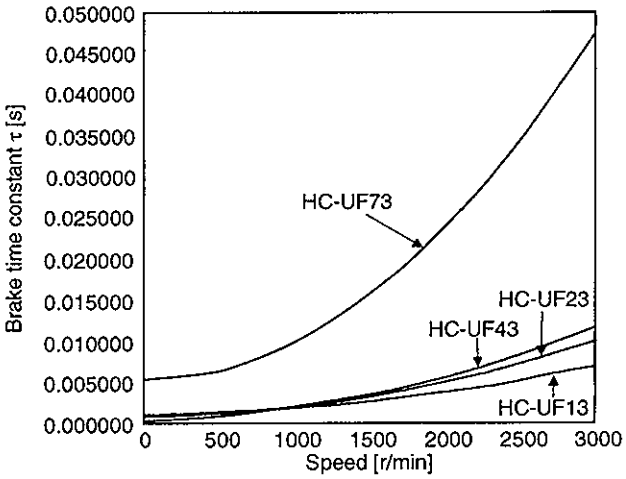
f. HC-SF3000r/min Series



g. HC-RF Series



h. HC-UF2000r/min Series



i. HC-UF3000r/min Series

Fig. 12.5 Dynamic Brake Time Constant 3

[Dynamic brake's permissible load inertia moment]

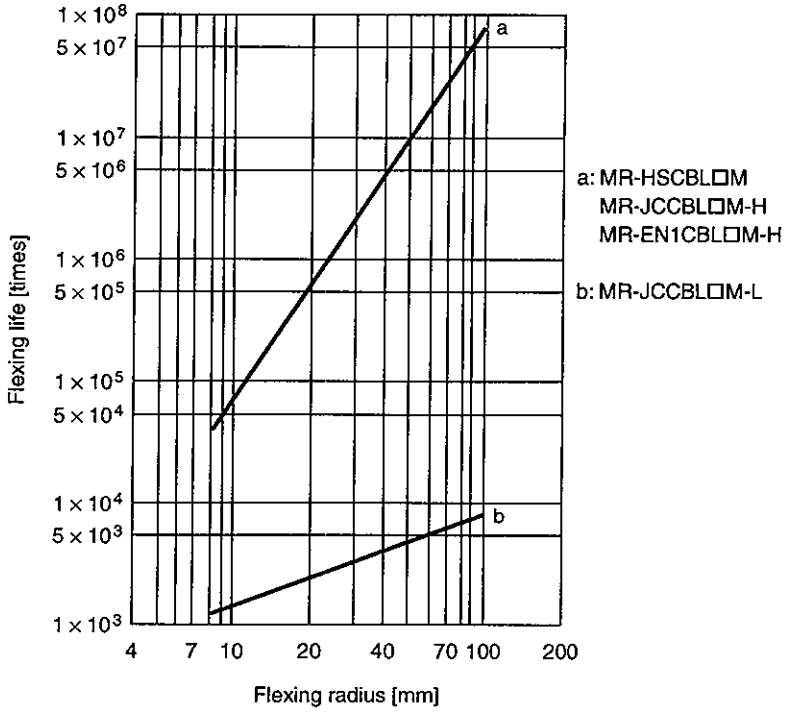
If the dynamic brake is operated at the load inertia moment above the corresponding value indicated in the following list, the brake resistor in the servo amplifier (external brake resistor for 11kW or more) may burn out. If the value is exceeded, contact us.

Servo Amplifier	JL/JM
MR-H10□N to MR-H100□N	30 times
MR-H200□N	20 times
MR-H350□N to MR-H700□N	10 times (Note)
MR-H11K□N to MR-H22K□N	30 times

Note: 15 times for the HC-SF series.

12.4 Encoder Cable Flexing Life

The flexing life of the cables is shown below. This graph gives calculated values. Since they are not guaranteed values, provide a little allowance for these values.



13. OPTIONS AND AUXILIARY EQUIPMENT

> **⚠WARNING** • Before connecting any option or auxiliary equipment, make sure that the charge lamp is off more than 10 minutes after power-off, then confirm the voltage with a tester or the like. Otherwise, you may get an electric shock.

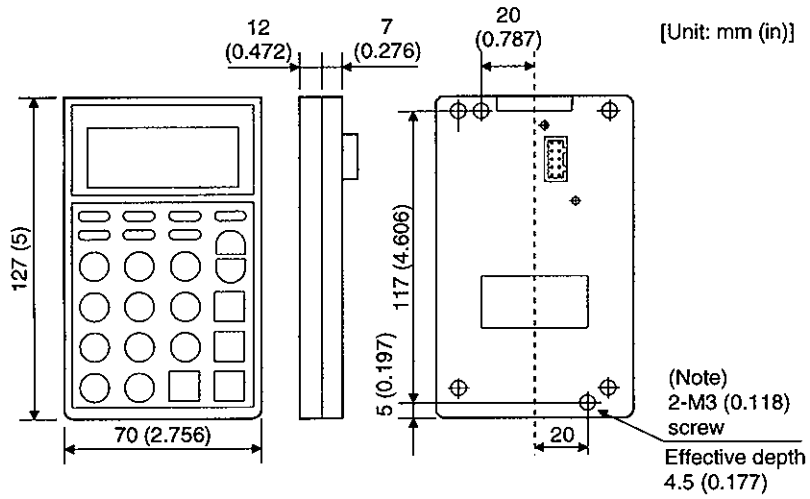
> **⚠CAUTION** • Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.

13.1 Options

13.1.1 Parameter unit

One parameter unit (MR-PRU01A) is required to use the MR-H-AN. It displays parameter settings, test operation and alarms. Use it with the parameter unit cable (MR-PRUCBL□M).

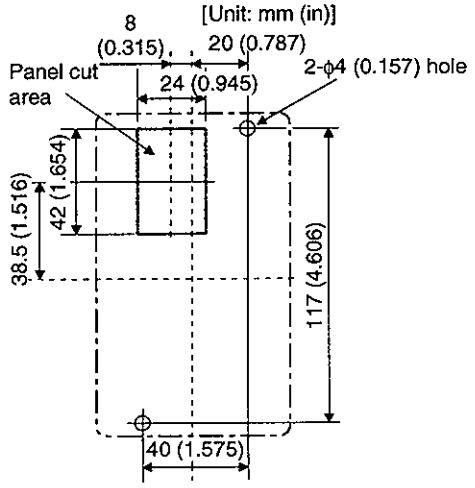
(1) Outline drawing



Note: The length of the mounting screw selected should not exceed the effective depth of the parameter unit mounting screw.

(2) Panel cutting dimensions

The following dimensions assume that the parameter unit is installed on a panel or the like.



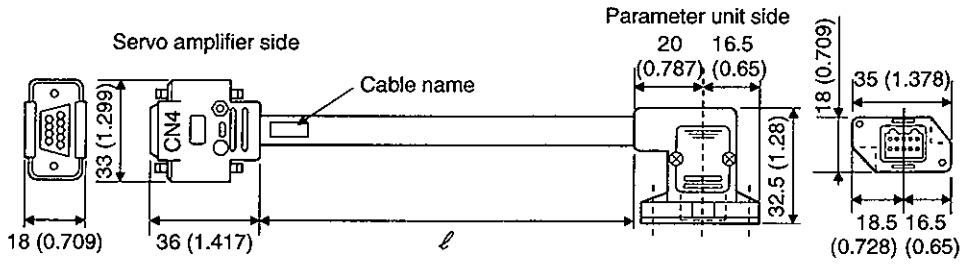
(3) Parameter unit cable

Used for connection of the parameter unit and MR-H-AN.

Model: MR-PRUCBL□M

Symbol	Cable Length [m (ft)]
1	1 (3.281)
3	3 (9.843)
5	5 (16.404)

[Unit: mm (in)]



13.1.2 Regenerative brake options

> ⚠CAUTION • The specified combinations of regenerative brake options and servo amplifiers may only be used. Otherwise, a fire may occur.

(1) Combination and regenerative power

The regenerative power values listed below are not the permissible power values of the resistors.

Servo Amplifier	Regenerative Power [W]					
	Built-in Regenerative Brake Resistor	MR-RB013 [52Ω]	MR-RB033 [52Ω]	MR-RB32 [40Ω]	MR-RB34 [26Ω]	(Note) MR-RB54 [26Ω]
MR-H10AN	None	10	30			
MR-H20AN	None	10	30			
MR-H40AN	50			300		
MR-H60AN	50			300		
MR-H100AN	80			300		
MR-H200AN	80				300	500

Note: Always install a cooling fan.

Servo Amplifier	Regenerative Power [W]				
	Built-in Regenerative Brake Resistor	MR-RB30 [13Ω]	MR-RB31 [6.7Ω]	MR-RB50 [13Ω]	(Note) MR-RB51 [6.7Ω]
MR-H350AN	130	300		500	
MR-H500AN	130	300		500	
MR-H700AN	170		300		500

Note: Always install a cooling fan.

Servo Amplifier	Regenerative Power [W]			
	(Note) External Regenerative Brake Resistor (Accessory)	MR-RB65 [8Ω]	MR-RB66 [5Ω]	MR-RB67 [4Ω]
MR-H11KAN	500 (800)	500 (800)		
MR-H15KAN	850 (1300)		850 (1300)	
MR-H22KAN	850 (1300)			850 (1300)

Note: Values in parentheses assume the installation of a cooling fan.

(2) Selection of the regenerative brake option

(a) Simple selection method

In horizontal motion applications, select the regenerative brake option as described below:

When the servo motor is run without load in the regenerative mode from the running speed to a stop, the permissible duty is as indicated in Section 5.1 of the separately available Servo Motor Instruction Manual. For the servo motor with a load, the permissible duty changes according to the inertia moment of the load and can be calculated by the following formula:

$$\text{Permissible duty} = \frac{\text{permissible duty for servo motor with no load (value indicated in Section 5.1 of the Servo Motor Instruction Manual)}}{(m+1)} \times \left(\frac{\text{ratedspeed}}{\text{running speed}}\right)^2 \text{[times/min]}$$

where m = load inertia moment/servo motor inertia moment

From the permissible duty, find whether the regenerative brake option is required or not.

Permissible duty < number of positioning times [times/min]

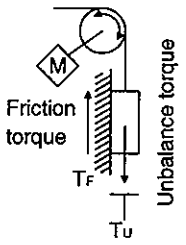
Select the regenerative brake option out of the combinations in (1) in this section.

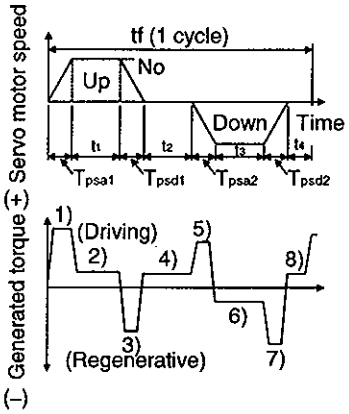
(b) To make selection according to regenerative energy

Use the following method when regeneration occurs continuously in vertical motion applications or when it is desired to make an in-depth selection of the regenerative brake option:

1) Regenerative energy calculation

Use the following table to calculate the regenerative energy.





Formulas for Calculating Torque and Energy in Operation

Regenerative Power	Torque Applied To Servo Motor [N □ m]	Energy [J]
1)	$T_1 = \frac{(J_L + J_M) \cdot No}{9.55 \times 10^4} \cdot \frac{1}{T_{Psd1}} + T_U + T_F$	$E_1 = \frac{0.1047}{2} \cdot No \cdot T_1 \cdot T_{Psa1}$
2)	$T_2 = T_U + T_F$	$E_2 = 0.1047 \cdot No \cdot T_2 \cdot t_1$
3)	$T_3 = \frac{(J_L + J_M) \cdot No}{9.55 \times 10^4} \cdot \frac{1}{T_{Psd1}} + T_U + T_F$	$E_3 = \frac{0.1047}{2} \cdot No \cdot T_3 \cdot T_{Psd1}$
4), 8)	$T_4 = T_U$	$E_4 \geq 0$ (No regeneration)
5)	$T_5 = \frac{(J_L + J_M) \cdot No}{9.55 \times 10^4} \cdot \frac{1}{T_{Psa2}} - T_U + T_F$	$E_5 = \frac{0.1047}{2} \cdot No \cdot T_5 \cdot T_{Psa2}$
6)	$T_6 = T_U + T_F$	$E_6 = 0.1047 \cdot No \cdot T_6 \cdot t_3$
7)	$T_7 = \frac{(J_L + J_M) \cdot No}{9.55 \times 10^4} \cdot \frac{1}{T_{Psd2}} - T_U + T_F$	$E7 = \frac{0.1047}{2} \cdot No \cdot T_7 \cdot T_{Psd2}$
Sum total of regenerative energies	Sum total of negative energies in 1) to 8)	

2) Losses of servo motor and servo amplifier in regenerative mode

The following table lists the efficiencies and other data of the servo motor and servo amplifier in the regenerative mode.

Servo Amplifier	Inverse Efficiency [%]	Capacitor Charging [J]
MR-H10AN	55	9
MR-H20AN	70	9
MR-H40AN	85	9
MR-H60AN	85	9
MR-H100AN	80	15
MR-H200AN	85	25

Servo Amplifier	Inverse Efficiency [%]	Capacitor Charging [J]
MR-H350AN	90	30
MR-H500AN	90	45
MR-H700AN	90	70
MR-H11KAN	90	120
MR-H15KAN	90	180
MR-H22KAN	90	250

Inverse efficiency (η) :Efficiency including some efficiencies of the servo motor and servo amplifier when rated (regenerative) torque is generated at rated speed. Since the efficiency varies with the speed and generated torque, allow for about 10%.

Capacitor charging (Ec) :Energy charged into the electrolytic capacitor in the servo amplifier.

Subtract the capacitor charging from the result of multiplying the sum total of regenerative energies by the inverse efficiency to calculate the energy consumed by the regenerative brake option.

$$ER\,[J] = \eta \cdot Es - Ec$$

Calculate the power consumption of the regenerative brake option on the basis of single-cycle operation period tf [s] to select the necessary regenerative brake option.

$$PR\,[W] = ER/tf \quad \cdots\cdots (13.1)$$

(3) Parameter setting

When using the regenerative brake option, set parameter No.2 according to the regenerative brake option used.

Parameter No. 2

Regenerative brake option selection
0: Set 0 when the servo amplifier of less than 11kW capacity has no external option or when the servo amplifier of 11kW or more uses the supplied regenerative brake resistor or regenerative brake option
1:FR-RC,FR-BU model brake unit
2:MR-RB013
3:MR-RB033
5:MR-RB32
6:MR-RB34
7:MR-RB54
8:MR-RB30
9:MR-RB50
B:MR-RB31
C:MR-RB51
E: When the servo amplifier is 11kW or more and the supplied regenerative brake resistor or regenerative brake option is cooled by a fan to increase its capability

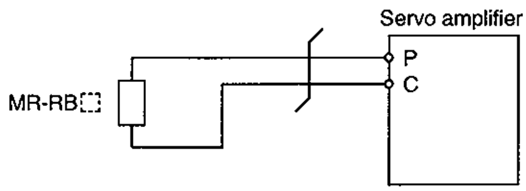
(4) Connection of the regenerative brake option

The regenerative brake option will generate heat of about 100°C. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use fire-retarding cables and keep them clear of the regenerative brake option body.

Always use twisted cables of max. 5m (16.404ft) length for connection with the servo amplifier.

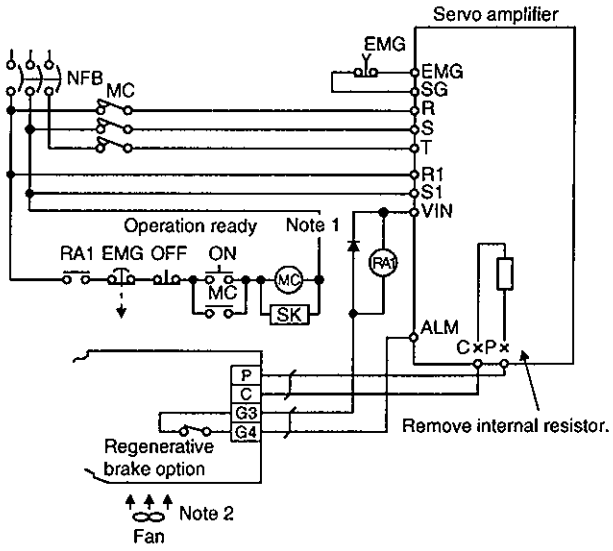
(a) MR-H10AN · MR-H20AN

This servo amplifier does not have the built-in regenerative brake resistor.



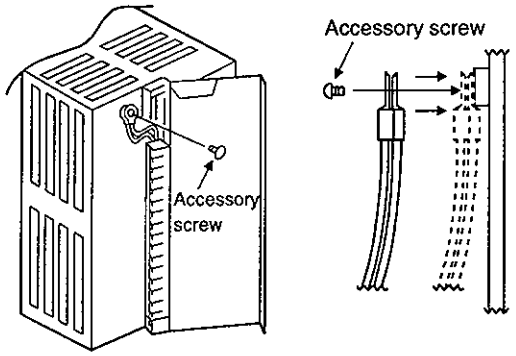
(b) MR-H40AN to MR-H700AN

When any of the MR-RB50 to MR-RB54 is used, the regenerative brake option must be forcibly cooled by the cooling fan.



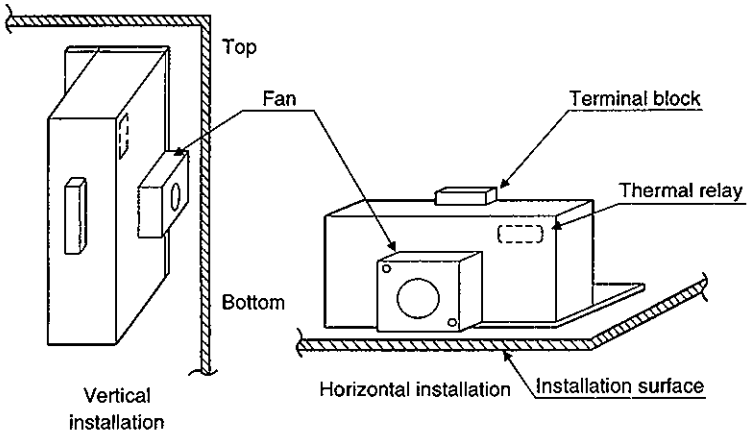
Note: When the MR-RB5□ is used, cool it forcibly by the cooling fan (1.0m^2 /min, about □92).

When the regenerative brake option is used, disconnect the cables from the regenerative brake resistor terminals (across C-P) in the servo amplifier and fix them to the area provided at the opposite side on the front cover as shown in the figure below.

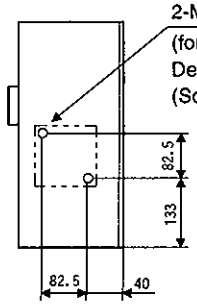


For the MR-RB50, MR-RB51 or MR-RB54, install the cooling fan as shown.

[Unit : mm(in)]



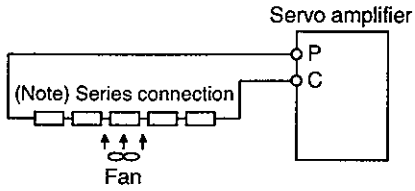
Fan installation screw hole dimensions



Recommended fan:
Toyo Denki's TL396A or equivalent

(C) MR-H11KAN to MR-H22KAN(when using the supplied regenerative brake resistor)

When using the regenerative brake resistors supplied to the servo amplifier, the specified number of resistors (4 or 5 resistors) must be connected in series. If they are connected in parallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative brake resistors burn. Install the resistors at intervals of about 70mm. Cool the resistors with fans to increase the regenerative capability.

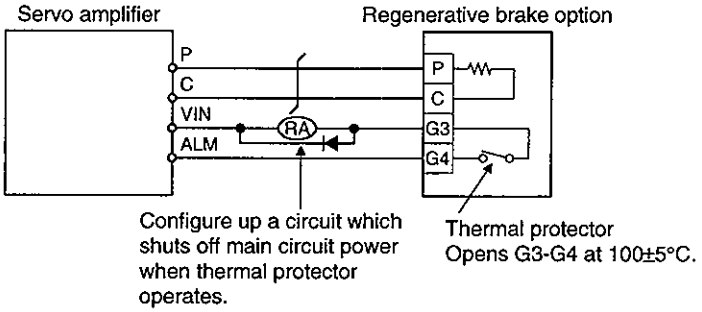


Note: The number of resistors connected in series depends on the resistor type.

Servo Amplifier	Regenerative Brake Resistor	Regenerative Power (W)		Resistance (Ω)	Number Of Resistors
MR-H11KAN	GRZG400-2Ω	600	800	8	4
MR-H15KAN	GRZG400-1Ω	600	1300	5	5
MR-H22KAN	GRZG400-0.8Ω	600	1300	4	5

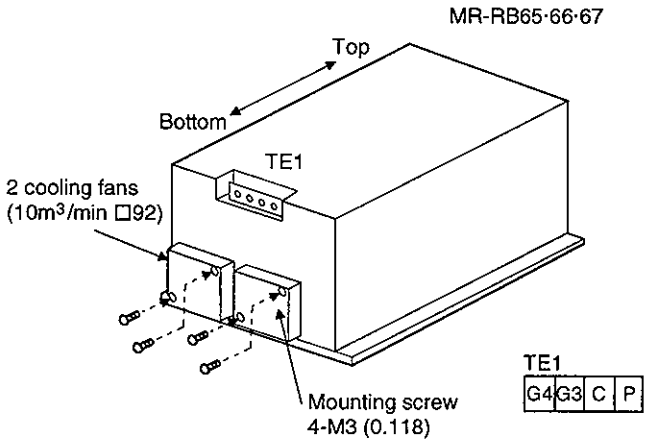
(D) MR-H11KAN-P90 to MR-H22KAN-P90 (when using the regenerative brake option)

Cooling the regenerative brake option with fans improves regenerative capability.



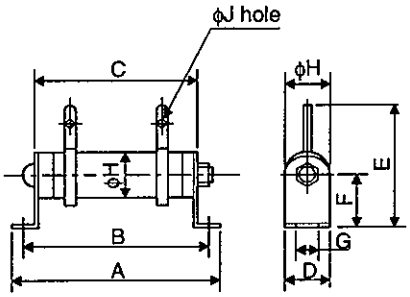
Servo Amplifier	Regenerative Brake Option Model	Resistor (Ω)	Regenerative Power	
			Without Fans	With Fans
MR-H11KAN	MR-RB65	8	500	800
MR-H15KAN	MR-RB66	5	850	1300
MR-H22KAN	MR-RB67	4	850	1300

When using fans, install them using the mounting holes provided in the bottom of the regenerative brake option.



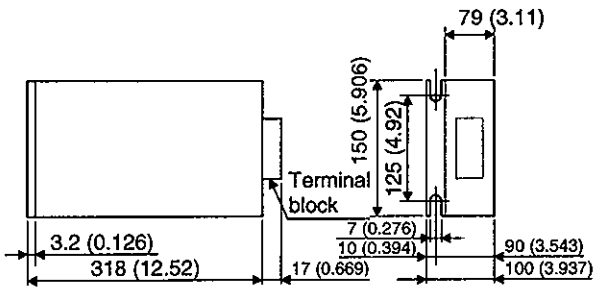
(5) Outline dimension drawings

MR-RB013 · MR-RB033



Regenerative Brake Option	Variable Dimensions [mm(in)]									Weight [kg(lb)]
	A	B	C	D	E	F	G	H	J	
MR-RB013	110 (4.331)	101 (3.979)	85 (3.346)	18 (0.709)	35 (1.378)	16 (0.63)	4.5 (0.177)	18 (0.709)	3.2 (0.126)	0.1 (0.22)
MR-RB033	192 (7.559)	173 (6.811)	152 (5.984)	26 (1.024)	54 (2.126)	22 (0.866)	6 (0.236)	26 (1.024)	3.2 (0.126)	0.2 (0.441)

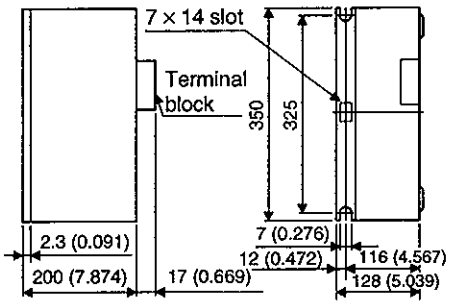
MR-RB30 · MR-RB31 · MR-RB32 · MR-RB34



[Unit : mm(in)]

Regenerative Brake Option	Weight [kg(lb)]
MR-RB30	2.9 (6.393)
MR-RB31	
MR-RB32	
MR-RB34	

MR-RB50 · MR-RB51 · MR-RB54



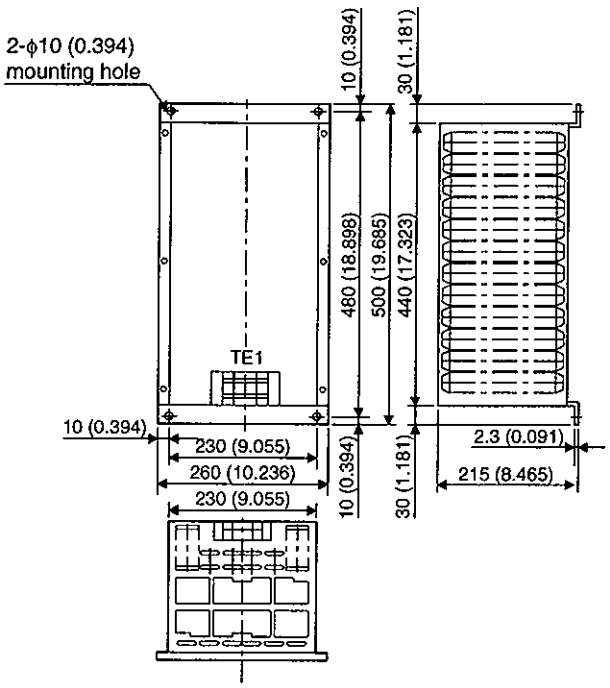
[Unit : mm(in)]

Regenerative Brake Option	Weight [kg(lb)]
MR-RB50	5.6 (12.346)
MR-RB51	
MR-RB54	

MR-RB65 · MR-RB66 · MR-RB67

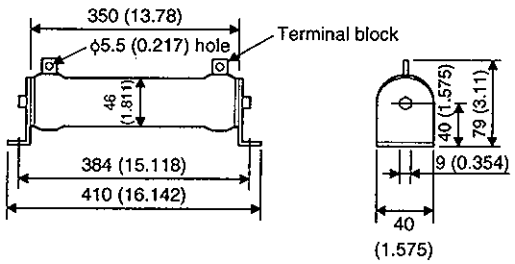
[Unit : mm(in)]

Regenerative Brake Option	Weight [kg(lb)]
MR-RB65	10(22.046)
MR-RB66	11(24.251)
MR-RB67	11(24.251)



GRZG400-2Ω · GRZG400-1Ω · GRZG400-0.8Ω (standard accessories)

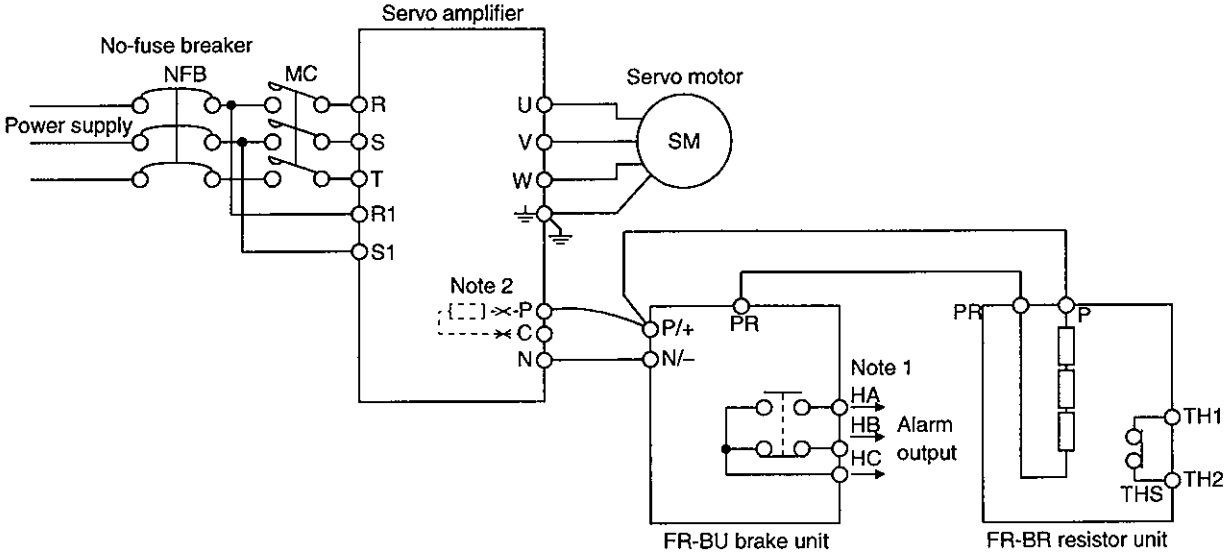
[Unit : mm(in)]



13.1.3 Brake unit

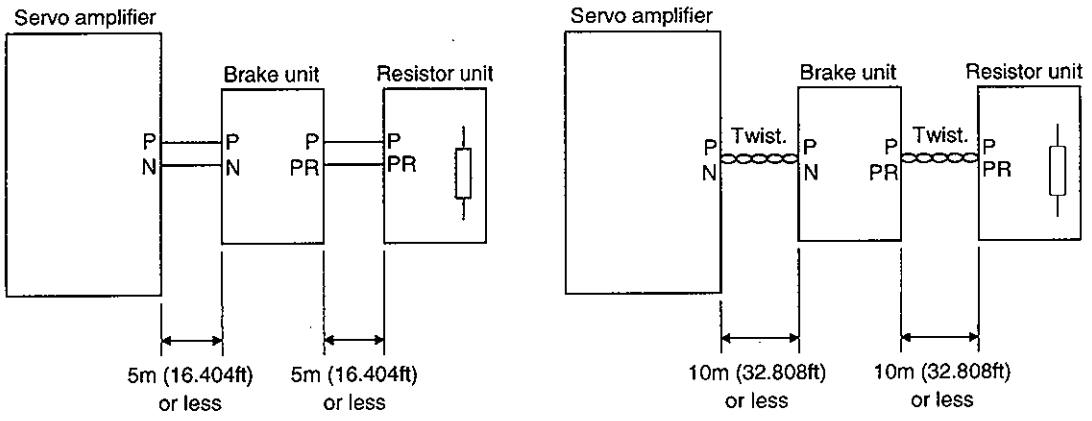
The brake unit is the integration of the regenerative control and resistor and is connected to the bus (across P-N) of the servo amplifier. As compared to the MR-RB regenerative brake option, the brake unit can return larger power. Hence, use the this brake unit when the MR-RB cannot provide sufficient regenerative brake capability.

(1) Connection example for use of brake unit



Note 1. Make up the external sequence to switch the power off when an alarm occurs or when the thermal relay is actuated.
2. The cables of the resistor in the amplifier across P-C must be disconnected.

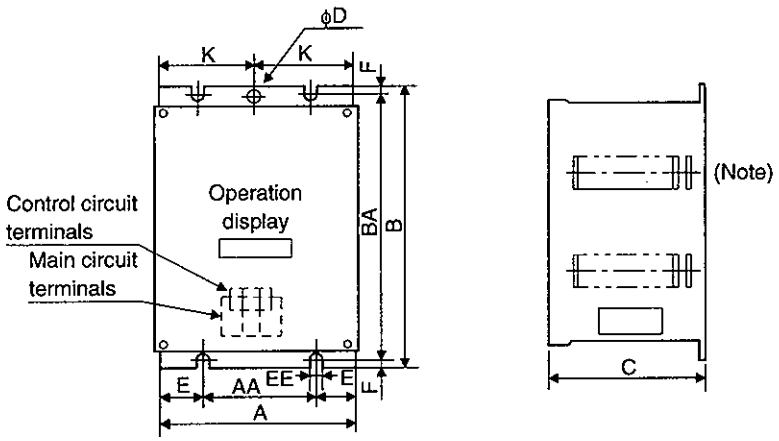
The cables between the servo amplifier and brake unit and between the resistor unit and brake unit should be as short as possible. The cables longer than 5m should be twisted. (If twisted, the cables must not be longer than 10m.)
The cable size should be equal to or larger than the recommended size. See the brake unit instruction manual. You cannot connect one set of brake unit to two servo amplifiers or two sets of brake units to one servo amplifier.



(2) Outside dimensions

· Brake unit (FR-BU)

[Unit : mm(in)]

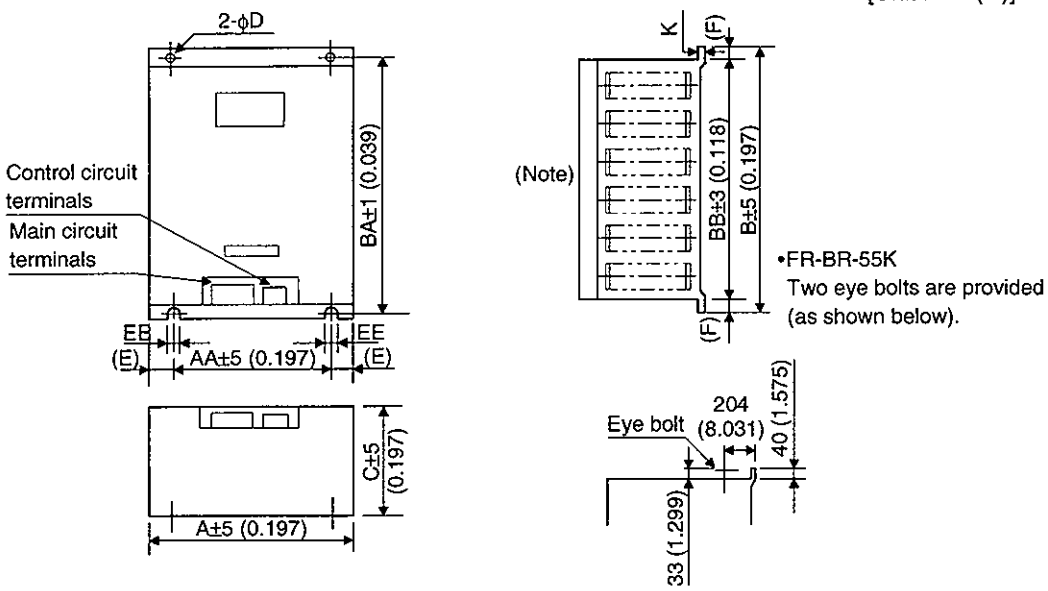


Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

Brake Unit Model	A	AA	B	BA	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-BU-15K	100 (3.937)	60 (2.362)	240 (9.446)	225 (10.039)	128 (5.039)	6 (0.236)	18.5 (0.728)	6 (0.236)	48.5 (1.909)	7.5 (0.295)	2.4 (5.291)
FR-BU-30K	160 (6.299)	90 (3.543)	240 (9.446)	225 (10.039)	128 (5.039)	6 (0.236)	33.5 (1.319)	6 (0.236)	78.5 (3.091)	7.5 (0.295)	3.2 (7.055)
FR-BU-55K	265 (10.433)	145 (5.709)	240 (9.446)	225 (10.039)	128 (5.039)		58.5 (2.303)	6 (0.236)		7.5 (0.295)	5.8 (12.787)

· Resistor unit (FR-BR)

[Unit : mm(in)]



Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

Resistor Unit Model	A	AA	B	BA	BB	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-BR-15K	170 (6.693)	100 (3.937)	450 (17.717)	432 (17.008)	410 (16.142)	220 (8.661)	6 (0.236)	35 (1.378)	6 (0.236)	1.6 (0.063)	20 (0.787)	15 (66.139)
FR-BR-30K	340 (11.389)	270 (10.63)	600 (23.622)	582 (22.913)	560 (22.047)	220 (8.661)	10 (0.394)	35 (1.378)	10 (0.394)	2 (0.079)	20 (0.787)	30 (33.069)
FR-BR-55K	480 (18.898)	410 (16.142)	700 (27.559)	670 (26.378)	620 (24.409)	450 (17.717)	12 (0.472)	35 (1.378)	12 (0.472)	3.2 (0.126)	40 (1.575)	70 (154.323)

POINT

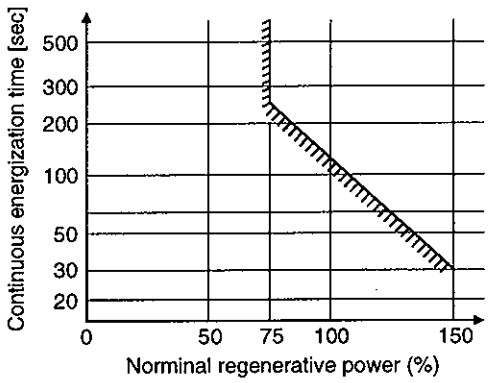
- The brake unit and resistor unit of other than 200V class are not applicable to the servo amplifier.
- The brake unit and resistor unit of the same capacity must be combined. The units of different capacities may result in damage.
- The brake unit and resistor unit must be installed on a vertical surface in the vertical direction. If they are installed in the horizontal direction or on a horizontal surface, a heat dissipation effect reduces.
- The temperature of the resistor unit casing rises to higher than 100°C. Do not cause cables and combustibles to make contact with the casing.

13.1.4 Power return converter

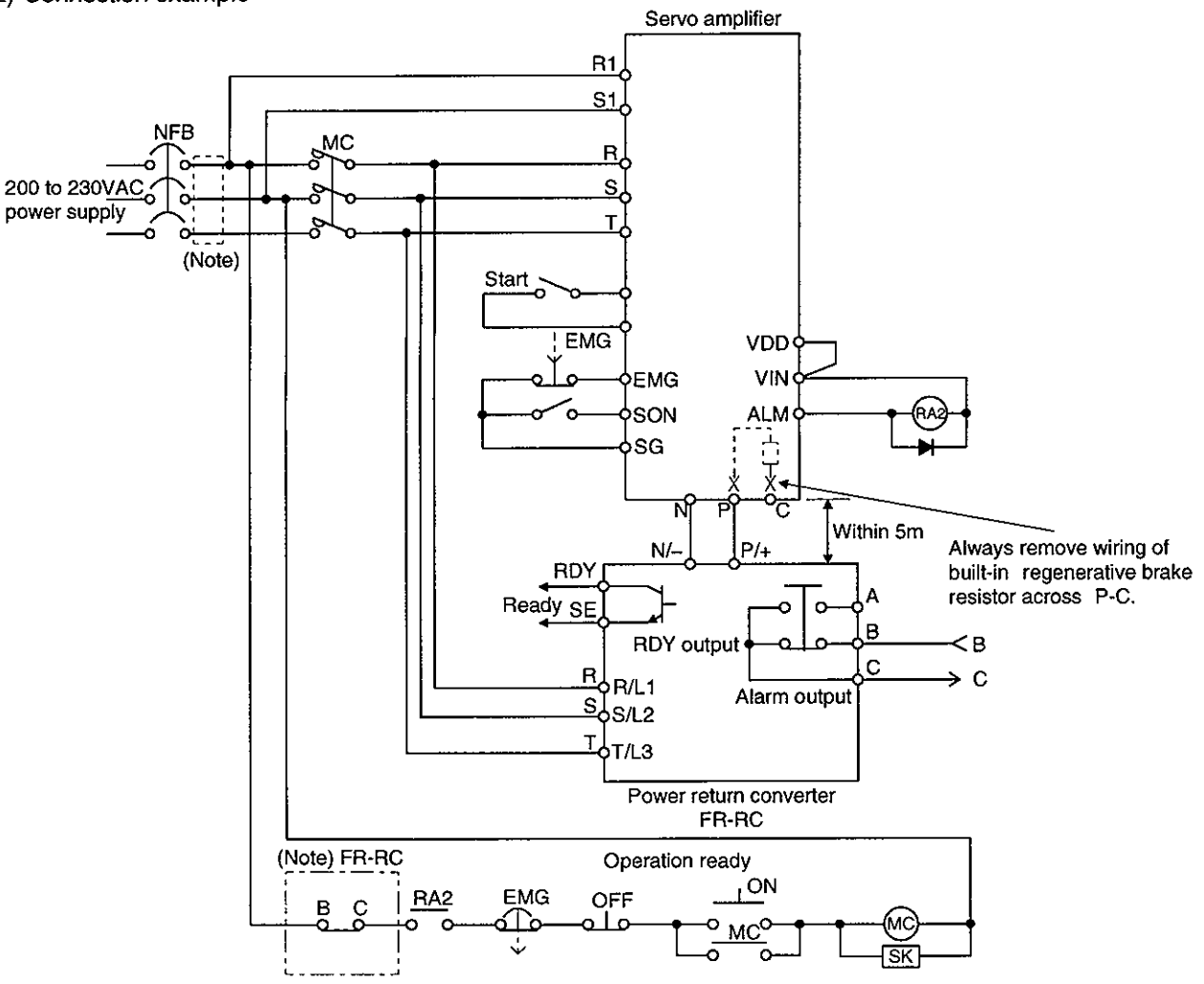
(1) Selection

The characteristics in the figure are common to all units of the FR-RC. The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the MR-H350AN or more.

Model	Nominal Regenerative Power (kW)	Servo Amplifier
FR-RC15	15	MR-H350AN to MR-H700AN
FR-RC30	30	MR-H11KAN MR-H15KAN
FR-RC55	55	MR-H22KAN



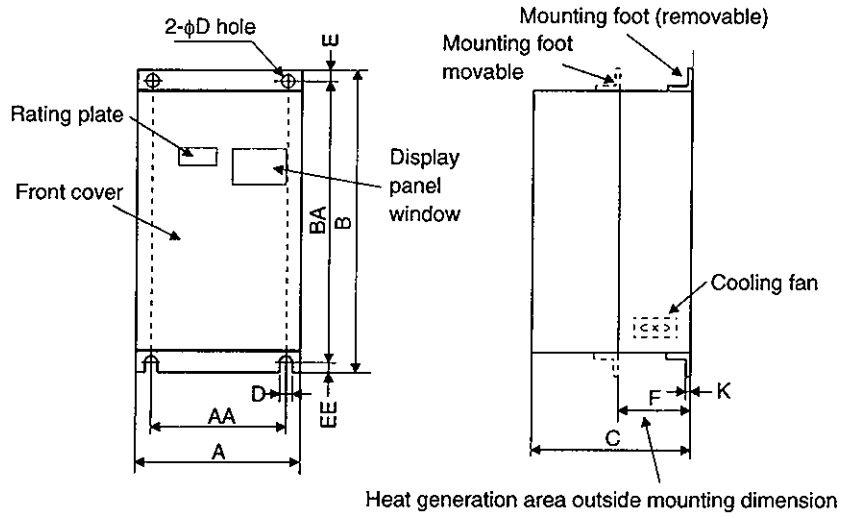
(2) Connection example



Note: To improve the input power factor or when connecting two or more FR-RC's to the same power transformer, install the power factor improving reactor (FR-BAL) in the dotted area.

(3) Outside dimensions of the power return converters

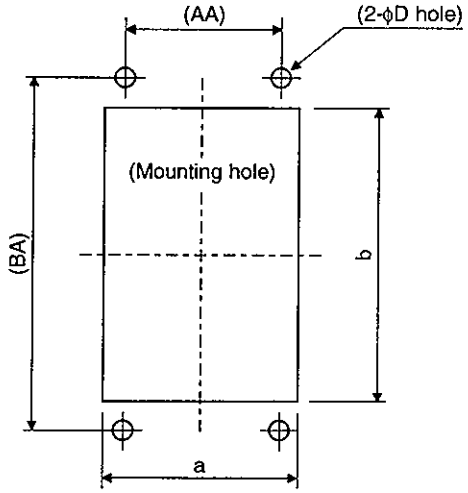
[Unit : mm(in)]



Model	A	AA	B	BA	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-RC-15K	270 (10.630)	200 (7.874)	450 (17.717)	432 (17.008)	195 (7.677)	10 (0.394)	10 (0.394)	8 (0.315)	3.2 (0.126)	87 (3.425)	19 (41.888)
FR-RC-30K	340 (13.386)	270 (10.630)	600 (23.622)	582 (22.913)	195 (7.677)	10 (0.394)	10 (0.394)	8 (0.315)	3.2 (0.126)	90 (3.543)	31 (68.343)
FR-RC-55K	480 (18.898)	410 (16.142)	700 (27.559)	670 (26.378)	250 (9.843)	12 (0.472)	15 (0.591)	15 (0.591)	3.2 (0.126)	135 (5.315)	55 (121.254)

(4) Mounting hole machining dimensions

When the power return converter is fitted to a totally enclosed type box, mount the heat generating area of the converter outside the box to provide heat generation measures. At this time, the mounting hole having the following dimensions is machined in the box.



[Unit : mm(in)]

Model	A	B	D
FR-RC-15K	260 (10.236)	412 (16.220)	10 (0.394)
FR-RC-30K	330 (12.992)	562 (22.126)	10 (0.394)
FR-RC-55K	470 (18.504)	662 (26.063)	12 (0.472)

13.1.5 External dynamic brake

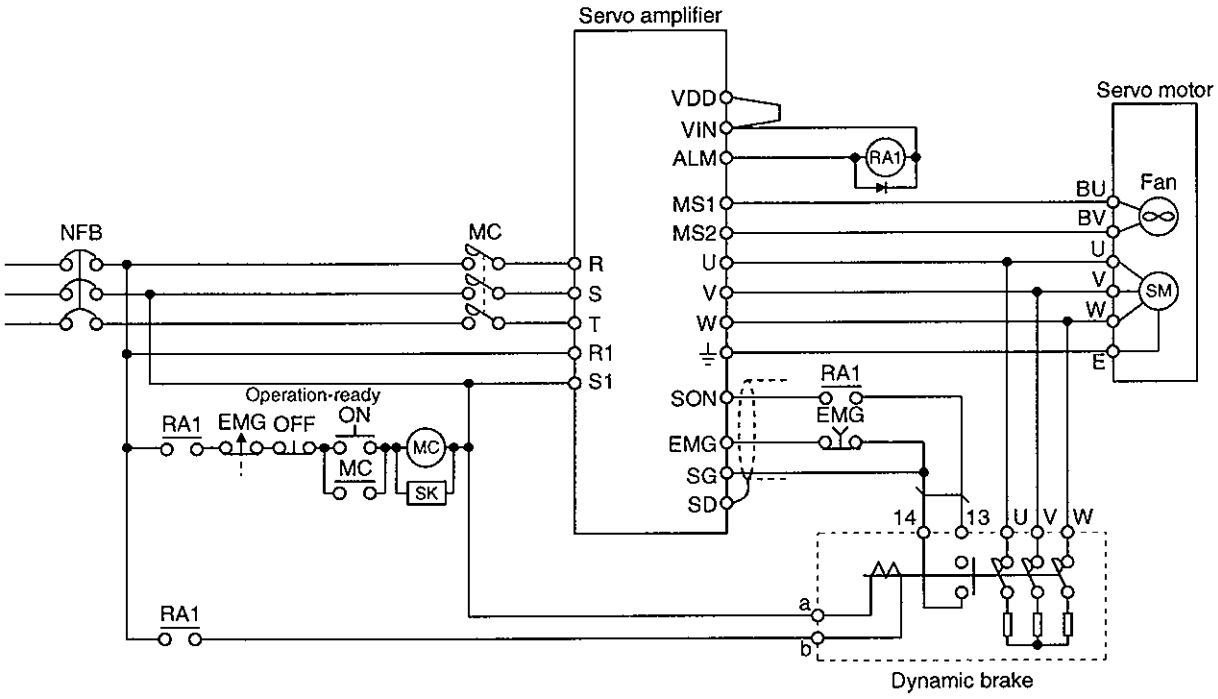
(1) Selection of dynamic brake

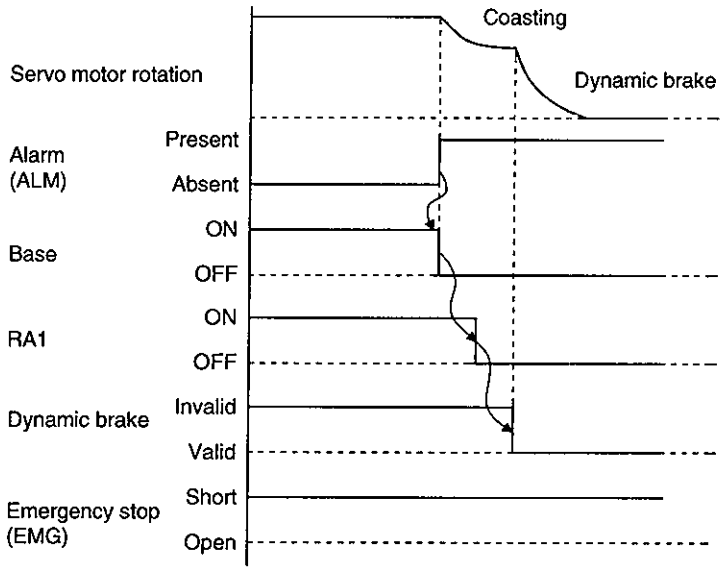
The dynamic brake is designed to bring the motor to a sudden stop when a power failure occurs or the protective circuit is activated. This brake is contained in the servo amplifier of 7kW or less but is not included in the servo amplifier of 11kW or more. When this brake is required, refer to the following table and place a purchase order Set □1□□ in parameter No.3.

Note that when the inertia moment of the load is large, the built-in brake in the servo amplifier of 7kWor less may be used. (Refer to Section 12.3)

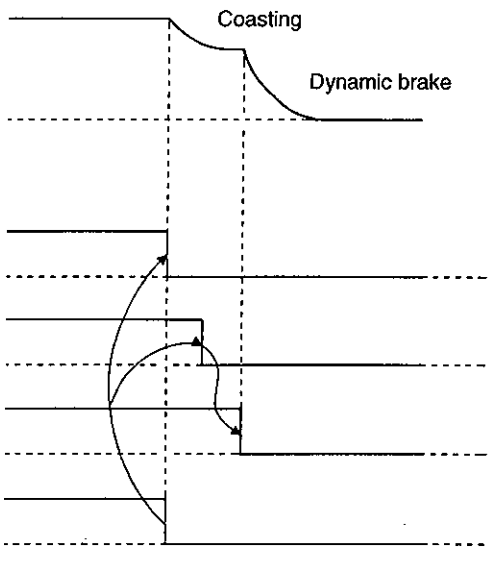
Servo Amplifier	Dynamic Brake
MR-H11KAN	DBU-11K
MR-H15KAN	DBU-15K
MR-H22KAN	DBU-22K

(2) Connection example





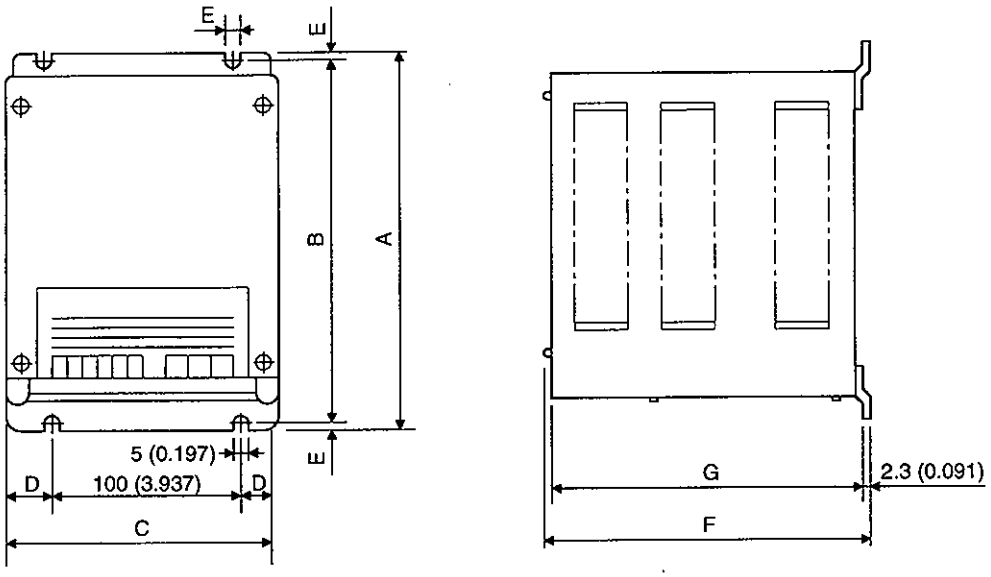
a. Timing chart at alarm (ALM) occurrence



b. Timing chart at emergency stop (EMG) validity

(3) Outline dimension drawing

[Unit: mm (in)]



Terminal block

E (GND)		a	b	13	14

Screw: M3.5

U	V	W

Screw: M4

Model	A	B	C	D	E	F	G	Approx. Weight [kg(lb)]	Connection Wire[mm^2]
DBU-11K	200 (7.874)	290 (11.417)	140 (5.512)	20 (0.787)	5 (0.197)	170 (6.693)	163.5 (6.437)	2 (4.409)	5.5 (AWG10)
DBU-15K DBU-22K	250 (9.843)	238 (9.370)	150 (5.906)	25 (0.984)	6 (0.236)	235 (9.252)	228 (8.976)	6 (13.228)	5.5 (AWG10)

POINT

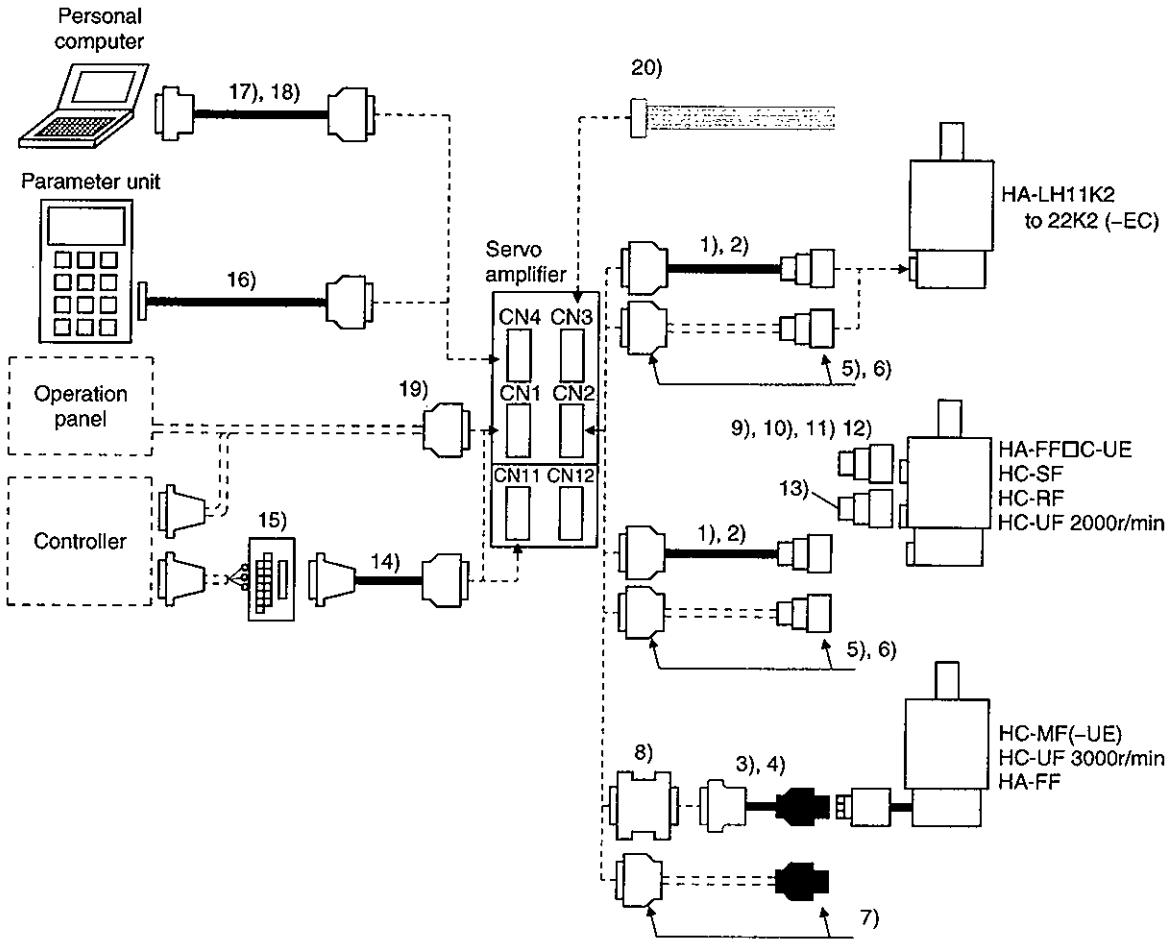
- Configure up a sequence which switches off the contact of the brake unit after (or as soon as) it has turned off the servo on signal at a power failure or failure.
- For the braking time taken when the dynamic brake is operated, refer to Section 12.3.
- The brake unit is rated for a short duration. Do not use it for high duty.

13.1.6 Cables and connectors

(1) Cable make-up

The following cables are used for connection with the servo motor and other models.

When using the HC-UF-S1 (IP65-compatible product including the connector section), contact Mitsubishi for the encoder cables.



No.	Product Name	Model	Description		Application
1)	Encoder cable	MR-HSCBL□M Refer to (2) in this section.	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector (Japan Aviation Electronics Industry make) Plug: MS3106B20-29S Cable clamp: MS-3057-12A	Long flexing life
2)	Encoder cable	MR-EN1CBL□M-H Refer to (2) in this section.	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector (DDK make) Plug: MS3106A20-29S(D190) Cable clamp: CE3057-12A-3(D265) Back shell: CE02-20BS-S	Long flexing life IP65 compliant
3)	Standard encoder cable	MR-JCCBL□M-L Refer to (2) in this section.	Servo amplifier side connector (3M make or equivalent) Connector: 10120-3000VE Shell kit: 10320-52F0-008	Encoder side connector (3M make or equivalent) Housing: 1-172161-9 Connector pin: 170359-1	Standard flexing life
4)	Long flexing life encoder cable	MR-JCCBL□M-H Refer to (2) in this section.			Long flexing life
5)	Encoder connector set	MR-JSCNS	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector (Japan Aviation Electronics Industry make) Plug: MS3106B20-29S Cable clamp: MS3057-12A	
6)	Encoder connector set	MR-EN1CNS	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector Plug: MS3106A20-29S(D190) Cable clamp: CE3057-12A-3(D265) Back shell: CE02-20BS-S	
7)	Encoder connector set	MR-HCNM	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector (3M make or equivalent) Housing: 1-172161-9 Pin: 170359-1 Cable clamp: MTI-0002 (Toa Denki Kogyo make)	

No.	Product Name	Model	Description	Application
8)	Conversion connector	MR-HCN2	Servo amplifier side  Encoder cable side	
9)	Power connector set	MR-PWCNF	 Plug: CE05-6A14S-2SD-B (Daiichi Denshi Kogyo make) Cable connector: YS014-9 to 11 (Daiwa Dengyo make)	IP65 compliant Must be used for compliance with the EN Standard.
10)	Power connector set	MR-PWCNS1	 Daiichi Denshi Kogyo make Plug: CE05-6A22-23SD-B-BSS Cable clamp: CE3057-12A-2(D265)	
11)	Power connector set	MR-PWCNS2	 Daiichi Denshi Kogyo make Plug: CE05-6A22-10SD-B-BSS Cable clamp: CE3057-16A-2(D265)	
12)	Power connector set	MR-PWCNS3	 Daiichi Denshi Kogyo make Plug: CE05-6A32-17SD-B-BSS Cable clamp: CE3057-20A-1(D265)	
13)	Brake connector set	MR-BKCN	 Plug: MS3106A10SL-4S(D190) (Daiichi Denshi Kogyo make) Cable connector: YS010-5 to 8 (Daiwa Dengyo make)	
14)	Junction terminal block cable	MR-HTBL□M Refer to Section 13.1.7.	Junction terminal block side connector (Izumi Denki make) Connector: JE1S-501 Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S50FS Cable: PCR-LS50LA 	
15)	Junction terminal block	MR-TB50	Refer to Section 13.1.7.	
16)	Parameter unit cable	MR-PRUCBL□M Refer to Section 13.1.1.		
17)	Communication cable	MR-HPC98CBL3M Refer to (3) in this section.	Servo amplifier side connector (Japan Aviation Electronics Industry make) Connector: DE-9PF-N Case: DE-C1-J6-S6 Personal computer side connector (Japan Aviation Electronics Industry make) Connector: DE-25PF-N Case: DB-C2-J9 	For connection with PC-98 personal computer

No.	Product Name	Model	Description		Application
18)	Communica-tion cable	MR-HPCATCBL3M Refer to (3) in this section.	Servo amplifier side connector (Japan Aviation Electronics Industry make) Connector: DE-9PF-N Case: DE-C1-J6-S6	Personal computer side connector (Japan Aviation Electronics Industry make) Connector: DE-9SF-N Case: DE-C1-J6-S6 	For connection with PC-AT-compatible personal computer
19)	Connector set	MR-HCN1		Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S50FS Cable: PCR-LS50LA	
20)	CN3 cable	MR-H3CBL1M		Servo amplifier side connector (AMP make) Housing: 171822-4	

(2) Encoder cable

⚠CAUTION	• If you have fabricated the encoder cable, connect it correctly. Otherwise, misoperation or explosion may occur.

POINT
• The encoder cable is not oil-proof. • Refer to Section 12.4 for the flexing life of the encoder cables.

Generally use the encoder cable available as our options. If the required length is not found in the options, fabricate the cable on the customer side.

(a) Selection

The following table lists the encoder cables for use with the servo motors. Choose the appropriate encoder cable according to your operating conditions. The connector sets are also available for your fabrication.

Servo Motor Model	Standard Encoder Cable				Connector Set	
	(Note 1) Model	Use For EN/UL Standard	Long Flexing Life	IP65 Compliance	Model	IP65 Compliance
HA-LH HA-LH-EC HA-FF□C-UE (Note 2) HC-SF HC-RF HC-UF2000r/min	MR-HSCBL□M	○	○		MR-JSCNS	
	MR-EN1CBL□M-H	○	○	○	MR-EN1CNS	○
HC-MF HC-MF-UE HA-FF HC-UF3000r/min	MR-JCCBL□M-L	○			MR-J2CNM MR-HCNM	
	MR-JCCBL□M-H	○	○			

Note: 1 □ indicates the cable length: 2, 5, 10, 20, 30, 40, 50 (m).

2 If the IP65-compliant option is used with the HA-FF□C-UE, the protection system (IP54) of the servo motor is not improved.

3 Not oil-proof.

(b) MR-HSCBL□M (long flexing life product)

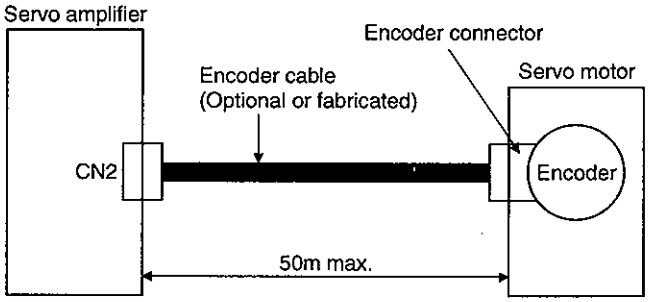
1) Explanation of model name

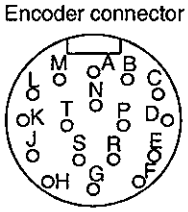
Model: MR-HSCBL□M

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30
40	40
50	50

2) Connection diagram

Refer to Section 3.3.1 for the servo amplifier side pin assignment.

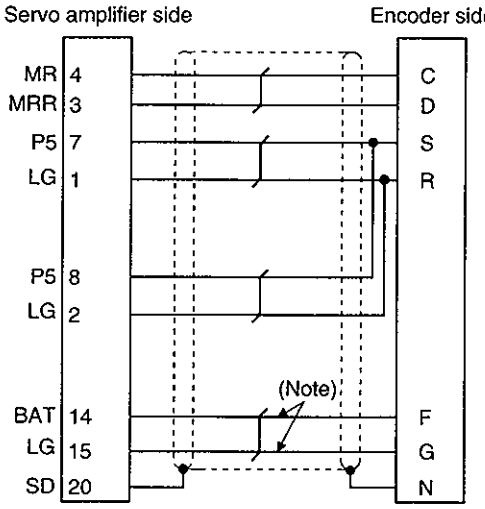




Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	—
F	BAT
G	LG
H	—
J	—

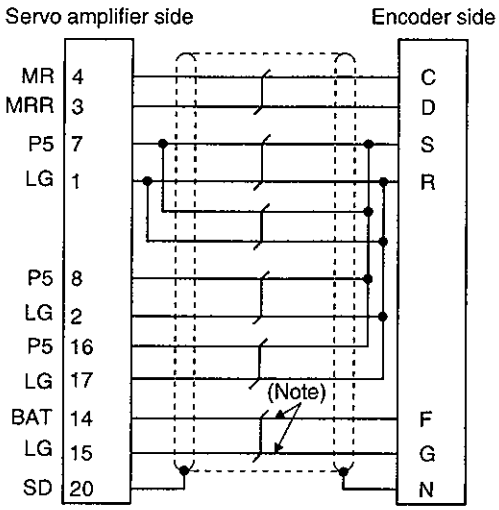
Pin	Signal
K	—
L	—
M	CNT
N	SHD
P	—
R	LG
S	P5
T	—

MR-HSCBL2M
MR-HSCBL5M



(10m or less)

MR-HSCBL10M to MR-HSCBL50M



(10m to 50m)

Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

When fabricating an encoder cable, use the recommended wires given in Section 13.2.1 and the MR-JSCNS connector set for encoder cable fabrication, and fabricate an encoder cable as shown in the following wiring diagram. Referring to this wiring diagram, you can fabricate an encoder cable of up to 50m length including the length of the encoder cable supplied to the servo motor.

(c) MR-EN1CBL□M-H (long flexing life product)

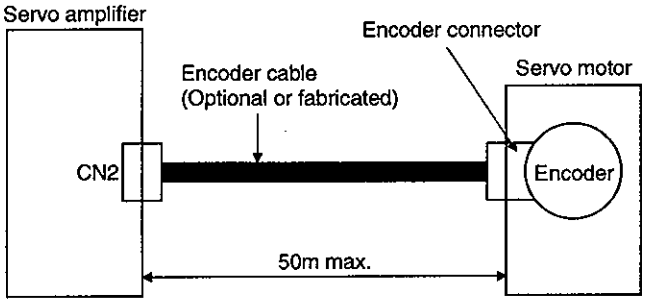
1) Explanation of model name

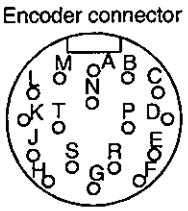
Model: MR-EN1CBL□M-H

Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30
40	40
50	50

2) Connection diagram

Refer to Section 3.3.1 for the servo amplifier side pin assignment.

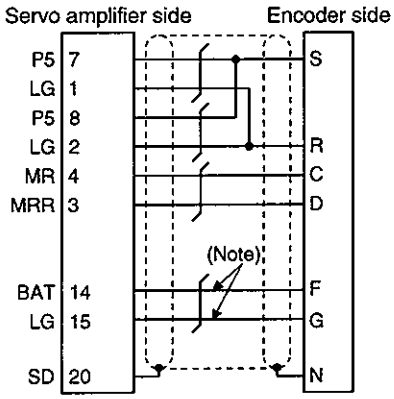




Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	—
F	BAT
G	LG
H	—
J	—

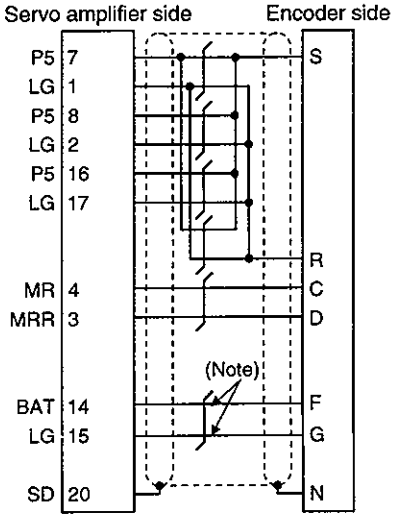
Pin	Signal
K	—
L	—
M	CNT
N	SHD
P	—
R	LG
S	P5
T	—

MR-EN1CBL2M-H
MR-EN1CBL5M-H



AWG24 used
(less than 10m)

MR-EN1CBL10M-H to MR-EN1CBL50M-H



AWG24 used
(10m to 50m)

Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

When fabricating an encoder cable, use the recommended wires given in Section 13.2.1 and the MR-ENICNS connector set for encoder cable fabrication, and fabricate an encoder cable as shown in the following wiring diagram. Referring to this wiring diagram, you can fabricate an encoder cable of up to 50m length including the length of the encoder cable supplied to the servo motor.

(d) MR-JCCBL□M-L · MR-JCCBL□M-H

1) Explanation of model name

Model: MR-JCCBL□M-□

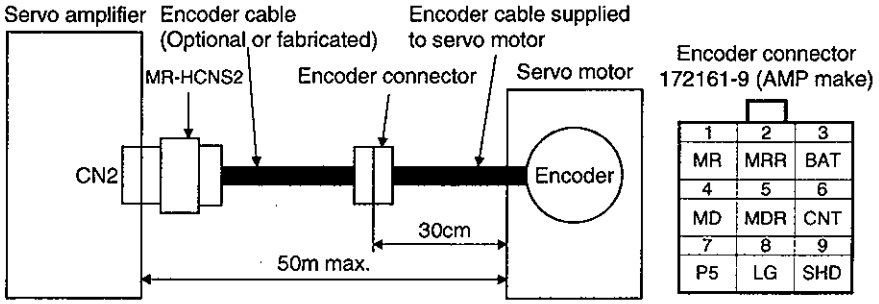
Symbol	Specifications
L	Standard flexing life
H	Long flexing life

Symbol	(Note) Cable Length [m]
2	2
5	5
10	10
20	20
30	30
40	40
50	50

Note: MR-JCCBL□M-H has no 40 and 50m sizes.

2) Connection diagram

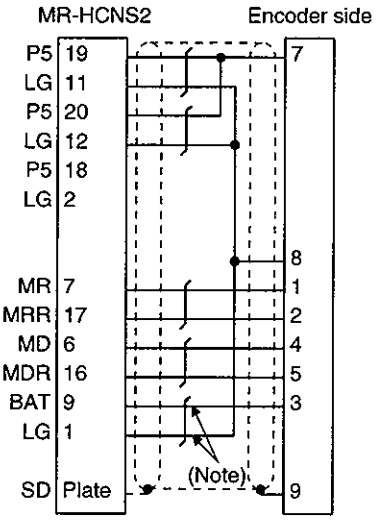
Refer to Section 3.3.1 for the servo amplifier side pin assignment.



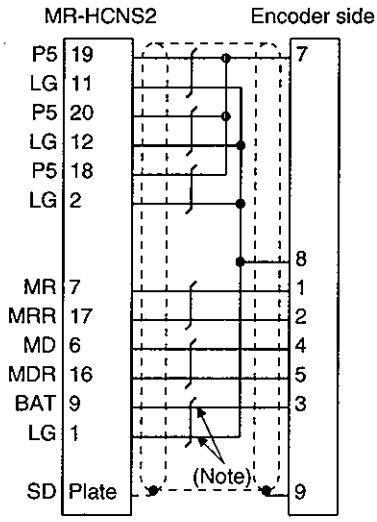
Encoder connector 172161-9 (AMP make)

1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	CNT
7	8	9
P5	LG	SHD

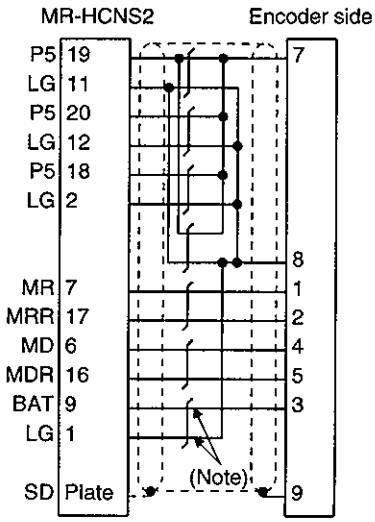
MR-JCCBL2M-L
MR-JCCBL5M-L
MR-JCCBL2M-H
MR-JCCBL5M-H



MR-JCCBL10M-L to MR-JCCBL30M-L



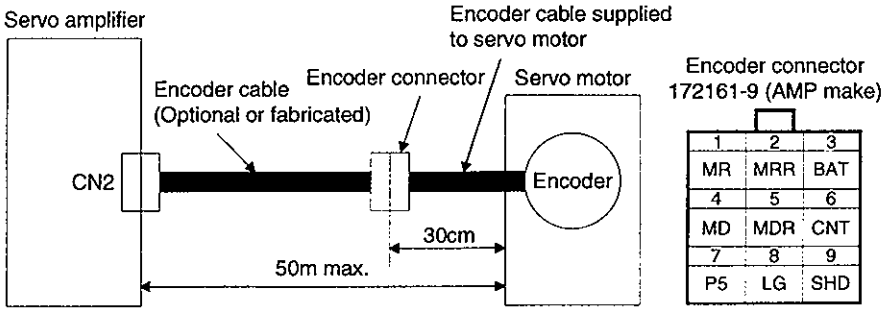
MR-JCCBL10M-H to MR-JCCBL50M-H



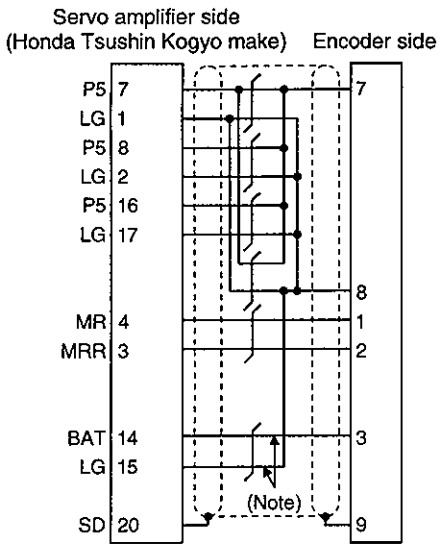
Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

(e) When using MR-HCNM

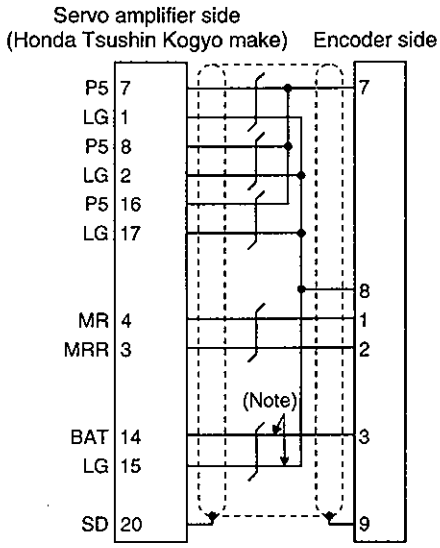
Refer to Section 3.3.1 for the servo amplifier side pin assignment. Use the recommended wires given in Section 13.2.1 and fabricate the encoder cable in accordance with the connection diagram shown below. In this connection, an up to 50m long encoder cable including the encoder cable supplied to the servo motor can be fabricated.



When using AWG24



When using AWG22



Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

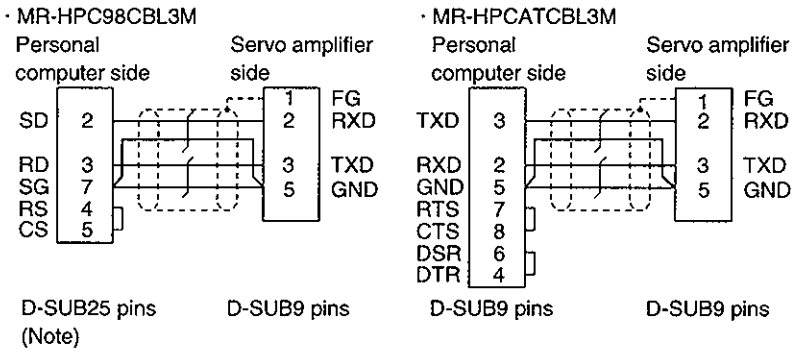
(3) Communication cable

POINT
• This cable may not be used with some personal computers. After fully examining the signals of the RS-232C connector, refer to this section and fabricate the cable.

Select the communication cable according to the shape of the RS-232C connector of the personal computer used. When fabricating the cable, refer to the connection diagram in this section.
The following must be observed in fabrication:

- Always use a shielded, multi-core cable and connect the shield with FG securely.
- The optional communication cable is 3m (10 ft) long. When the cable is fabricated, its maximum length is 15m (49 ft) in offices of good environment with minimal noise.

Connection diagram

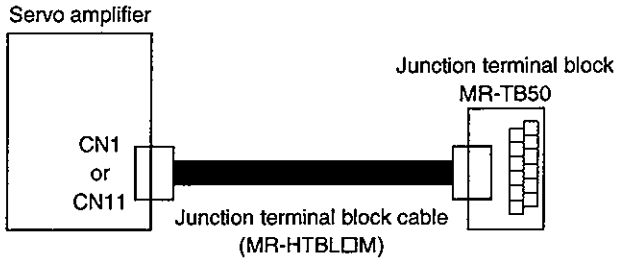


Note: The PC98 Notes having the connector of half-pitch 14 pins are also available.
Confirm the shape of the RS-232C connector of the personal computer used.

13.1.7 Junction terminal block (MR-TB50)

(1) How to use the junction terminal block

Always use the junction terminal block (MR-TB50) with the junction terminal block cable (MR-HTBL□M) as a set. A connection example is shown below:



Ground the junction terminal block cable on the junction terminal block side with the standard accessory cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to (3), Section 13.2.6

(2) Terminal block labels

Use the following label among the terminal block labels attached to the junction terminal block:

(a) For CN1

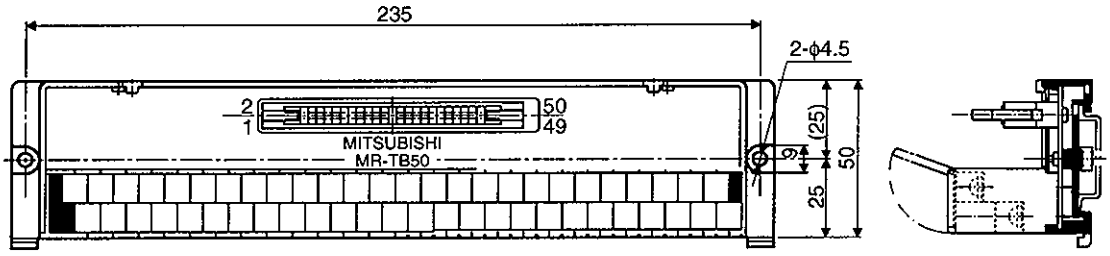
VDD	CR	PPO	NPO	SG	SG	PC	LSP	TL	PF	ALM	DI0	DI2	DI4	P15R	LA	LB	LZ	FPA	PPB	N15R	LG	TLA	PPR	NPR
RD	SG	SG	VDD	VIN	SON	RES	LSN	ZSP	TLC	EMG	DI1	DI3	LG	OP	LAR	LBR	LZR	LG	LG	VC	TLAP	PP	NP	SD

(b) For CN11 (when using MR-H-D01 option card)

	DI 9	DI 18	DI 19	SG	SG	DI 4	DI 10	DI 3	DO 12	DO 14	DI 12	DI 14	DI 16		DO 0	DO 2	DO 4	DO 8	DO 9		DI 21	DO 7	DI 1	DI 8
DO 15	SG	SG	VDD	VIND	DI 2	DI 5	DI 11	DO 11	DO 13	DI 17	DI 13	DI 15	DI 6	DO 10	DO 1	DO 3	DO 5	DI 22	DI 23	DI 20	DO 6	DI 0	DI 7	SD

(3) Outline drawing

[Unit: mm]



Terminal screw: M3.5
Applicable wire: 2mm^2
Crimping terminal width: 7.2mm max.

(4) Junction terminal block cable (MR-HTBL□M)

(a) Explanation of model name

Model: MR-HTBL□M

Symbol	Cable Length [m]
05	0.5
1	1

(b) Connection diagram

PCR-S50FS (servo amplifier side) — JE1S-501 (Junction terminal side)

Signal Name For CN11	Signal Name For CN1	Pin No.		Pin No.
	VDD	22		1
DO15	RD	49		2
DI09	CR	37		3
SG	SG	17		4
DI18	PPO	18		5
SG	SG	47		6
DI19	NPO	19		7
VDD	VDD	21		8
SG	SG	16		9
VIND	VIN	20		10
SG	SG	40		11
DI02	SON	12		12
DI04	JFS	14		13
DI05	STP	15		14
DI10	LSP	38		15
DI11	LSN	39		16
DI03	DEC	13		17
			Empty — Empty	
DO11	CPO	23		18
			Empty — Empty	
DO12	PF	24		19
			Empty — Empty	
DO13	ZP	25		20
			Empty — Empty	
DO14	ALM	48		21
			Empty — Empty	
OD17	EMG	46		22
			Empty — Empty	
DI12	DI0	41		23
DO12	DI1	42		24
DI14	DI2	43		25
DI15	ST1	44		26
DI16	ST2	45		27
			Empty — Empty	
DI06	LG	34		28
	P15R	1		29
DO10	OP	33		30
DO00	LA	4		31
DO01	LAR	5		32
DO02	LB	6		33
DO03	LBR	7		34
DO04	LZ	8		35
DO05	LZR	9		36
DO08	FPA	31		37
DI22	LG	28		38
DO09	FPB	32		39
DI23	LG	30		40
	N15R	26		41
DI20	OVR	2		42
DI21	LG	3		43
DO06	TLAP	27		44
DO07	TLAN	29		45
DI00	PP	10		46
DI01	PPR	11		47
DI07	NP	35		48
DI08	NPR	36		49
SD	SD	50		50

13.1.8 Servo Configuration Software

The Servo Configuration software uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

(1) Specifications

Item	Description
Communication signal	Conforms to RS-232C.
Baudrate	9600bps
Monitor	Batch display, high-speed display, graph display
Alarm	Alarm display, alarm history, data display at alarm occurrence
Diagnostic	External I/O signal display, function device display, cumulative power-on time display, software number display, tuning data display, ABS data display
Parameters	Data setting, list display, change list display, detailed information display
Test operation	Jog operation, positioning operation, motor-less operation, output signal forced output
File operation	Data read, save, print
Others	help display

Note: On some personal computers, this software may not run properly.

(2) System configuration

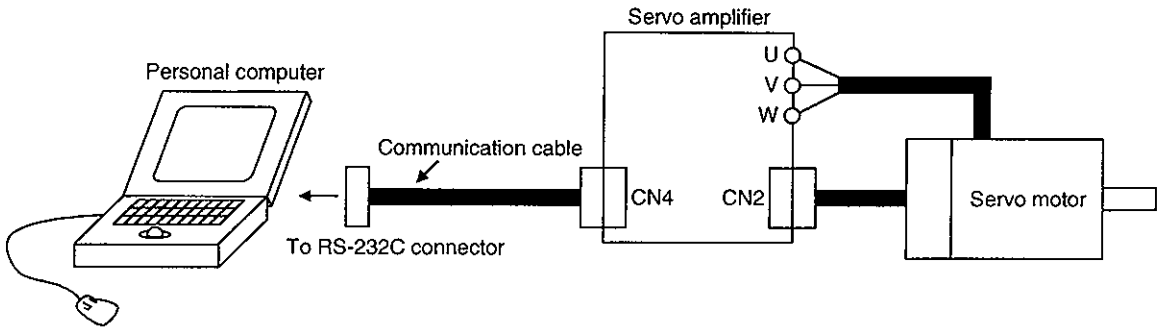
(a) Components

To use this software, the following components are required in addition to the servo amplifier and servo motor:

Model	Description
Personal computer	Which contains a 80386 or higher CPU and on which Windows 3.1· 95 runs (80486 or higher recommended).Memory: 8MB or more, hard disk: 1MB or more, serial port used.
OS	Windows 3.1· 95
Display	640×400 or more color or 16-scale monochrome display which can be used with Windows 3.1· 95.
Keyboard	Which can be connected to the personal computer.
Mouse	Which can be used with Windows 3.1· 95. Note that a serial mouse is not used.
Printer	Which can be used with Windows 3.1· 95.
Communication cable	MR-HPC98CBL3M·MR-HPCATCBL3M When these cannot be used, refer to Section 13.1.6(3) and fabricate.

Note: Windows is a registered trademark of Microsoft Corporation.

(b) Configuration diagram

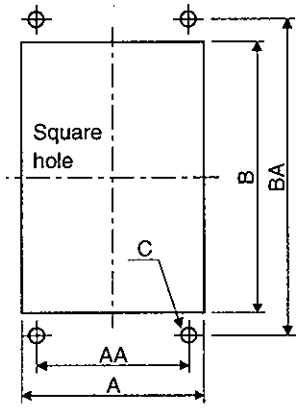


13.1.9 Heat sink outside mounting attachment (MR-ACN)

Use the heat sink outside mounting attachment to mount the heat generation area of the servo amplifier in the outside of the control box to dissipate servo amplifier-generated heat to the outside of the box and reduce the amount of heat generated in the box, thereby allowing a compact control box to be designed.
In the control box, machine a hole having the panel cut dimensions, fit the heat sink outside mounting attachment to the servo amplifier with the fitting screws (4 screws supplied), and install the servo amplifier to the control box.
The environment outside the control box when using the heat sink outside mounting attachment should be within the range of the servo amplifier operating environment conditions.

(1) Panel cut dimensions

(a) MR-ACN350 to MR-ACN700

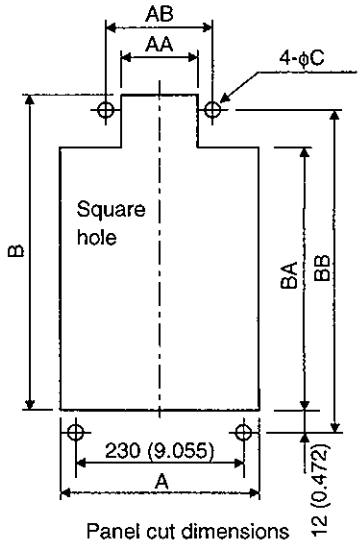


Panel cut dimensions

[Unit: mm (in)]

Model	AA	BA	A	B	C	Servo Amplifier
MR-ACN350	117 (4.606)	280 (11.024)	131 (5.157)	265 (10.433)	4-5M	MR-H200AN MR-H350AN
MR-ACN500	100 (3.937)	370 (14.567)	134 (5.276)	355 (13.976)	4-5M	MR-H500AN
MR-ACN700	170 (6.693)	380 (14.961)	222 (8.740)	360 (14.173)	4-5M	MR-H700AN

(b) MR-ACN11K, MR-ACN22K



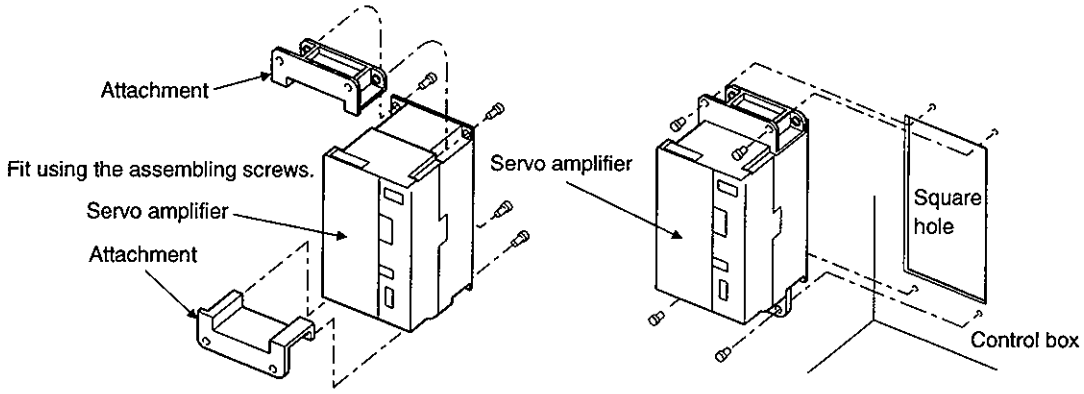
Panel cut dimensions

[Unit: mm (in)]

Model	A	AA	AB	B	BA	BB	C	Servo Amplifier
MR-ACN11K	250 (9.843)	190 (7.480)	230 (9.055)	553 (21.772)	483 (19.016)	523 (20.591)	4-M8	MR-H11KAN
MR-ACN22K	340 (13.386)	284 (11.181)	308 (12.126)	556 (21.890)	483 (19.016)	483 (20.709)	4-M10	MR-H15KAN MR-H22KAN

(1) Fitting method

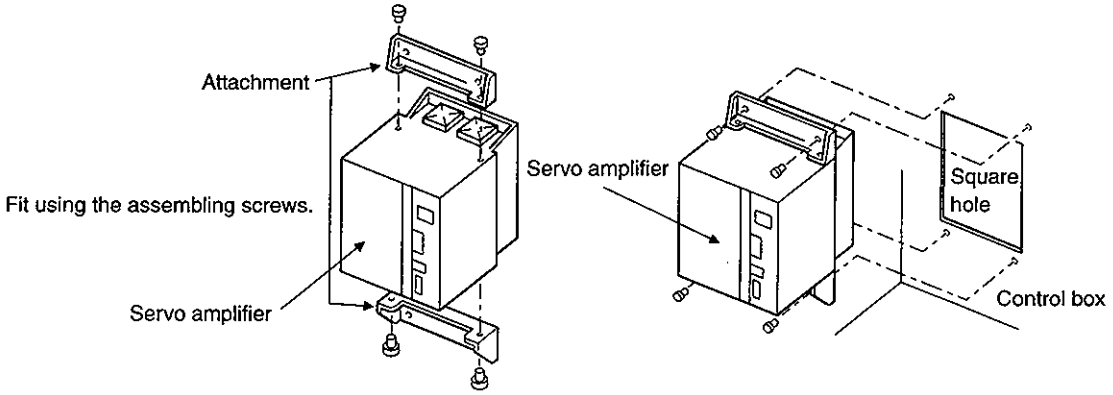
(a) MR-ACN350 (for MR-H200AN, MR-H350AN)



a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

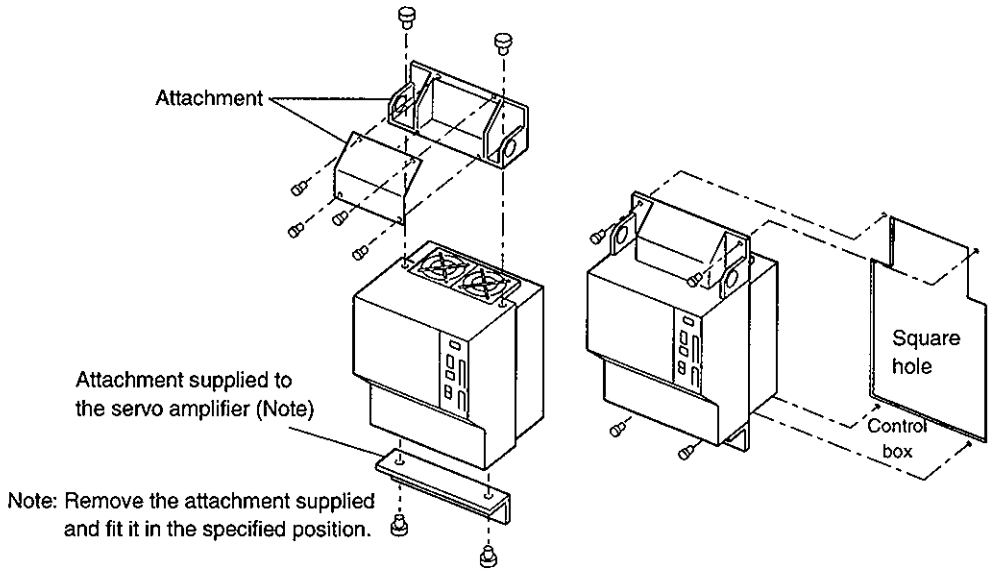
(b) MR-ACN500 (for MR-H500AN), MR-ACN700 (for MR-H700AN)



a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

(c) MR-ACN11K (for MR-H11KAN), MR-ACN22K (for MR-H15KAN, MR-H22KAN)



a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

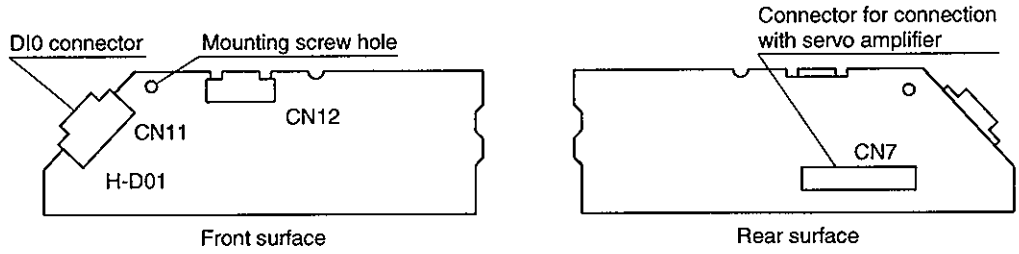
13.1.10 MR-H-D01 option card

Used for alarm code output, etc. See Chapter 3 for the connection and usage.

(1) Specifications

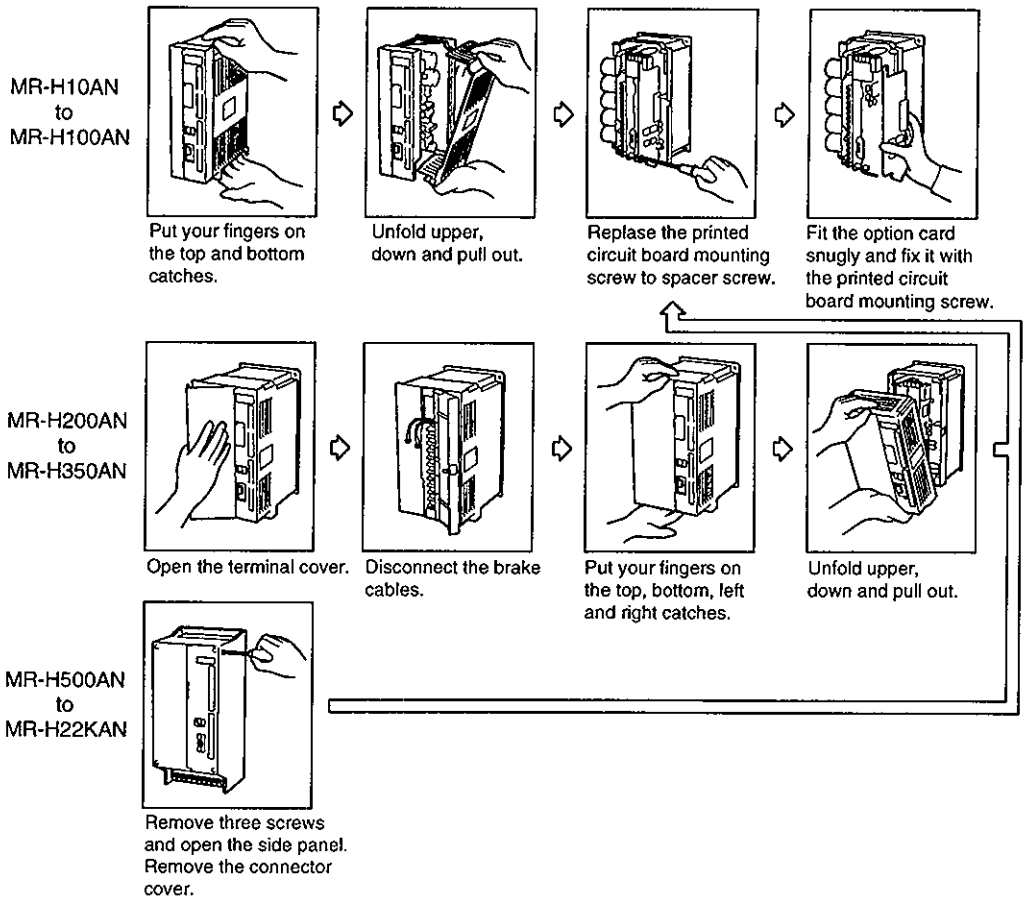
Item		Specifications
Function		Extra digital I/O, point table expansion memory
Digital input		24 points, photocoupler isolated, 24VDC, 5mA
Digital output		16 points, open collector, 24VDC, 50mA max.
Pulse train input	System	Forward/reverse rotation pulse train, 2-phase pulse train, signed pulse train
	Frequency	Differential 400kpps, open collector 200kpps

(2) Part names



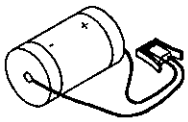
(3) Installation to servo amplifier

> **POINT**
>
> The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:
> - Ground human body and work bench.
> - Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.



13.1.11 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



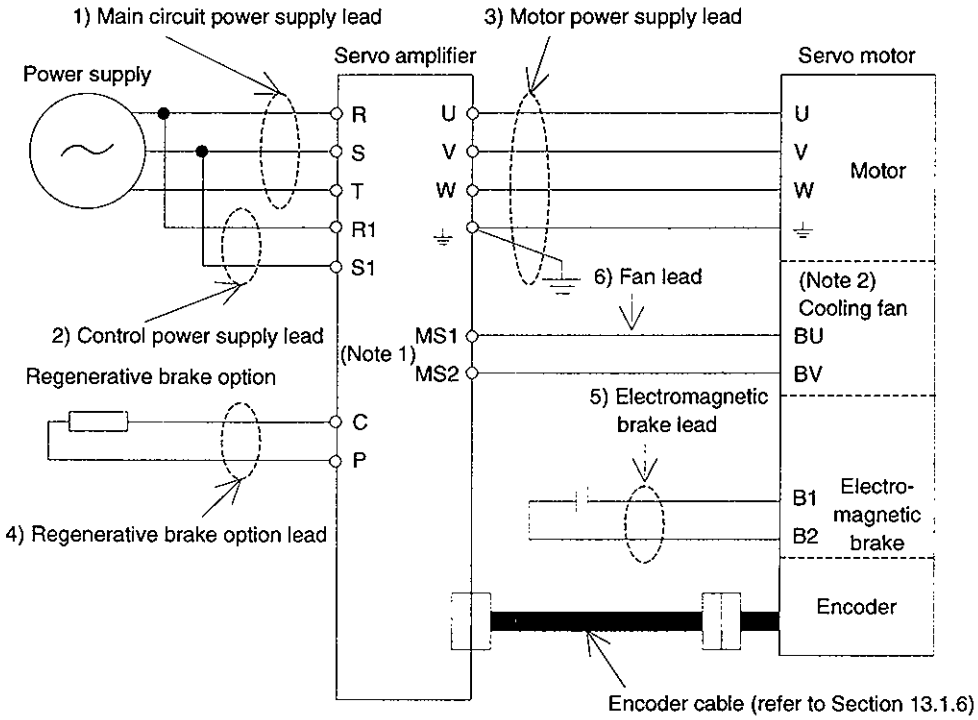
13.2 Auxiliary Equipment

Always use the devices indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL Standard, use the products which conform to the corresponding standard.

13.2.1 Recommended wires

(1) Wires for power supply wiring

The following diagram shows the wires used for wiring. Use the wires given in this paragraph or equivalent.



Note: 1. Provided for the 11kW and more servo amplifiers.
2. Provided for the HA-LH11K2 to 22K2 servo motors.

The following table lists wire sizes. The wires used assume that they are 600V vinyl wires and the wiring distance is 30m max. If the wiring distance is over 30m, choose the wire size in consideration of voltage drop.

The servo motor side connection method depends on the type and capacity of the servo motor. Refer to Section 3.8.

The crimping terminals used with the U, V and W wires for MR-H11KAN should be those of Japan Crimping Terminal's 22-S5 or equivalent.

Tale 13.1 Recommended Wires

Servo Amplifier	Wires [mm2]					
	1) R · S · T	2) R1 · S1	3) U · V · W · ⏚	4) P · C	5) B1 · B2	6) BU · BV
MR-H10AN	2	1.25	1.25	2	1.25	
MR-H20AN						
MR-H40AN						
MR-H60AN						
MR-H100AN			2			
MR-H200AN	3.5		3.5			
MR-H350AN	5.5		(Note) 5.5			
MR-H500AN			5.5			
MR-H700AN	8		8	3.5		2
MR-H11KAN	14		22	5.5		
MR-H15KAN	22		30			
MR-H22KAN	50		60			

Note. 3.5mm² for use of the HC-RF203 servo motor.

Use the following wires to wire the brake unit (FR-BU) and power return converter (FR-RC):

Model	Wire [mm2]
FR-BU-15K	3.5
FR-BU-30K	5.5
FR-BU-55K	14
FR-RC-15K	14

(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent:

Table 13.2 Wires for Standard Encoder cables

Wire Model	Core Size (mm²)	Number of Cores	Finishing OD [mm] (Note 1)	Core insulation Sheath Outline d (mm) (Note 2)	Cable Type	Cable Model
UL20276AWG28 7pair(BLAC)	0.08	14 (7 pairs)	5.6	0.9 to 1.27	Standard encoder cable	MR-JCCBL2M-L to MR-JCCBL10M-L
					Communication cable	MR-HPC98CBL□M MR-HPCATCBL□M
UL20276AWG22 6pair(BLAC)	0.3	14 (7 pairs)	8.2 (8.7)	0.9 to 1.27	Standard encoder cable	MR-JCCBL20M-L MR-JCCBL30ML

Note 1: Value in parentheses is max. OD.

2: d is as shown below:

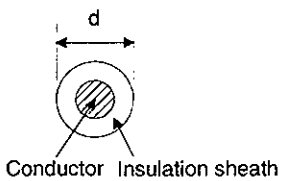


Table 13.3 Wires for Long Flexing Life Encoder Cables

(Note) Junkosha's Wire Model	Core Size [mm^2]	Number of Cores	Finishing OD [mm]	Characteristics of 1 Core		Cable Type	Cable Model
				Structure [Number of wires/mm]	Conductor resistance [Ω/km]		
A14B2339	0.2	8 (4 pairs)	7.2	40/0.08	105 min.	Long flexing life encoder cable	MR-HSCBL5M MR-JCCBL5M-H MR-JHSCBL5M-H
A14B2343	0.2	12 (6 pairs)	7.9	40/0.08	105 min..		MR-HSCBL10M or more MR-JCCBL10M-H or more MR-JHSCBL10M-H or more

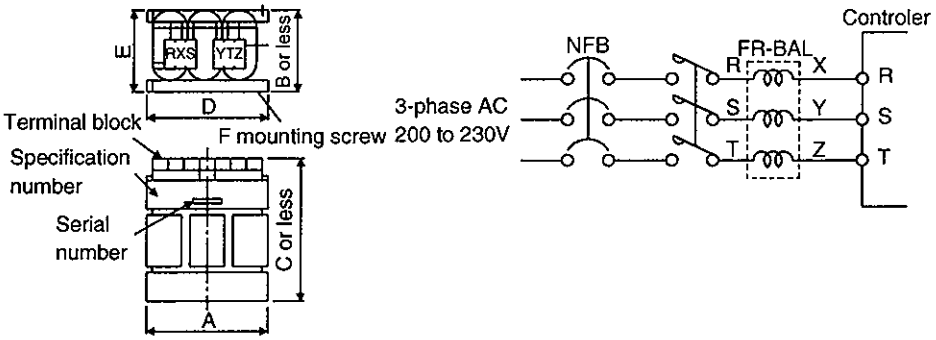
Note: purchase from Toa Electric industry

13.2.2 No-fuse breakers, magnetic contactors

Always use one no-fuse breaker and one magnetic contactor with one servo amplifier.

Servo Amplifier	No-Fuse Breaker	Magnetic Contactor
MR-H10AN	Model NF30 5A	S-N10
MR-H20AN	Model NF30 10A	S-N10
MR-H40AN	Model NF30 10A	S-N10
MR-H60AN	Model NF30 10A	S-N10
MR-H100AN	Model NF30 15A	S-N10
MR-H200AN	Model NF30 20A	S-N18
MR-H350AN	Model NF50 30A	S-N25
MR-H500AN	Model NF50 05A	S-N35
MR-H700AN	Model NF100 75A	S-N50
MR-H11KAN	Model NF100 100A	S-N65
MR-H15KAN	Model NF225 125A	S-N95
MR-H22KAN	Model NF225 175A	S-N125

13.2.3 Power factor improving reactors



Servo Amplifier	Model	dimensions [mm (in)]						Approx. Weight [kg (lb)]
		A	B	C	D	E	F	
MR-H10AN MR-H20AN	FR-BAL-0.4K	135 (5.315)	64 (2.520)	120 (4.724)	120 (4.724)	45 (1.772)	M4	2 (4.409)
MR-H40AN	FR-BAL-0.75K	135 (5.315)	74 (2.913)	120 (4.724)	120 (4.724)	57 (2.244)	M4	3 (6.614)
MR-H60AN	FR-BAL-1.5K	160 (6.299)	76 (2.992)	145 (5.709)	145 (5.709)	55 (2.165)	M4	4 (8.818)
MR-H100AN	FR-BAL-2.2K	160 (6.299)	96 (3.780)	145 (5.709)	145 (5.709)	75 (2.953)	M4	6 (13.228)
MR-H200AN	FR-BAL-3.7K	220 (8.661)	95 (3.740)	200 (7.874)	200 (7.874)	70 (2.756)	M5	8.5 (18.739)
MR-H350AN	FR-BAL-7.5K	220 (8.661)	125 (4.921)	205 (8.071)	200 (7.874)	100 (3.937)	M5	14.5 (31.967)
MR-H500AN	FR-BAL-11K	280 (11.024)	140 (5.512)	245 (9.646)	255 (10.039)	100 (3.937)	M6	19 (41.888)
MR-H700AN MR-H11KAN	FR-BAL-15K	295 (11.614)	156 (6.142)	280 (11.024)	270 (10.630)	110 (4.331)	M6	27 (59.525)
MR-H15KAN	FR-BAL-22K	290 (11.417)	200 (7.874)	300 (11.811)	240 (9.449)	170 (6.693)	M8	35 (77.162)
MR-H22KAN	FR-BAL-30K	290 (11.417)	220 (8.661)	300 (11.811)	240 (9.449)	190 (7.480)	M8	43 (94.799)

13.2.4 Relays

The following relays should be used with the interfaces:

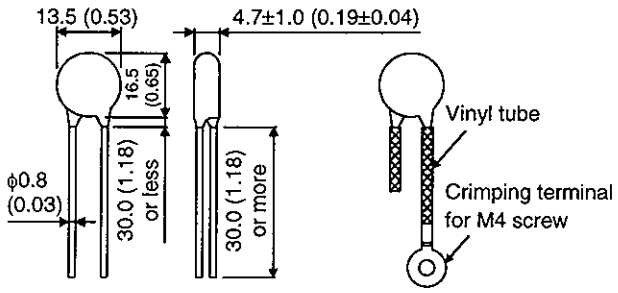
Interface	Selection Example
Relay used especially for switching on-off analog input command and input command (interface DI-1) signals	To prevent defective contacts , use a relay for small signal (twin contacts). (Ex.) OMRON : type G2A , MY
Relay used for digital output signals (interface DO-1)	Small relay with 12VDC or 24VDC of 40mA or less (Ex.) OMRON : type MY

13.2.5 Surge absorbers

A surge absorber is required for the electromagnetic brake. Use the following surge absorber or equivalent. Insulate the wiring as shown in the diagram.

Maximum Rating					Maximum Limit Voltage		Static Capacity (Reference value)	Varistor Voltage Rating (Range) V1mA
Permissible circuit voltage		Surge immunity	Energy immunity	Rated power				
AC[Vma]	DC[V]	[A]	[J]	[W]	[A]	[V]	[pF]	[V]
140	180	(Note) 500/time	5	0.4	25	360	300	220 (198 to 242)

Note: 1 time = 8 × 20μs



13.2.6 Noise reduction techniques

Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral devices to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required.

Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices malfunction due to noises produced by the servo amplifier, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

(1) General reduction techniques

- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the servo amplifier, servo motor, etc. together at one point (refer to Section 3.10).

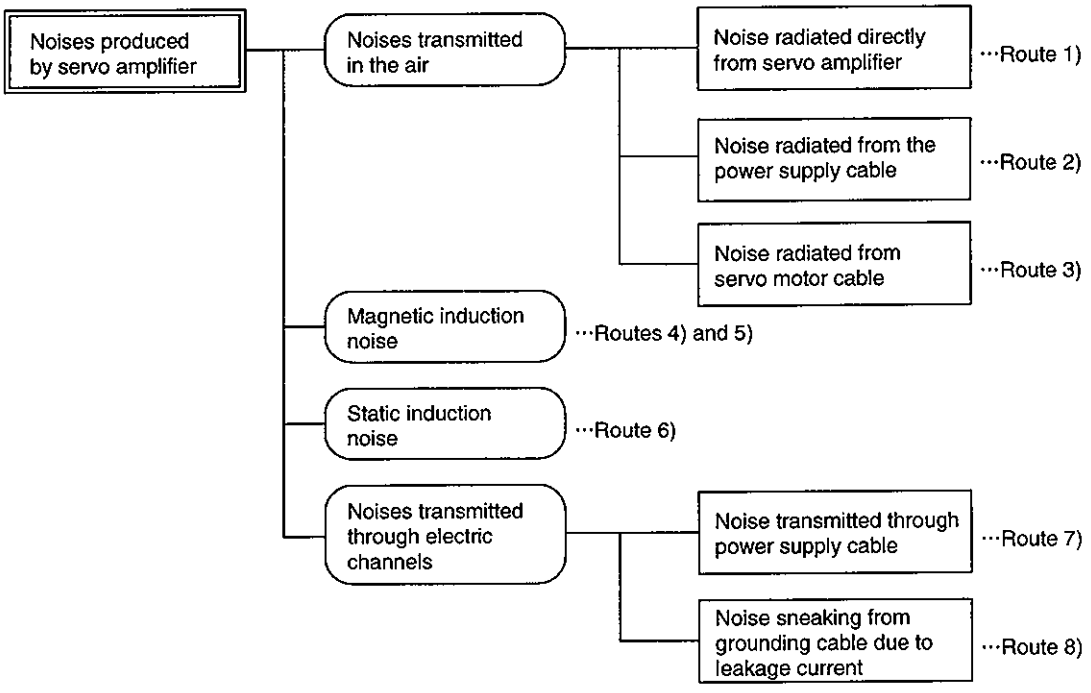
(2) Reduction techniques for external noises that cause the servo amplifier to malfunction

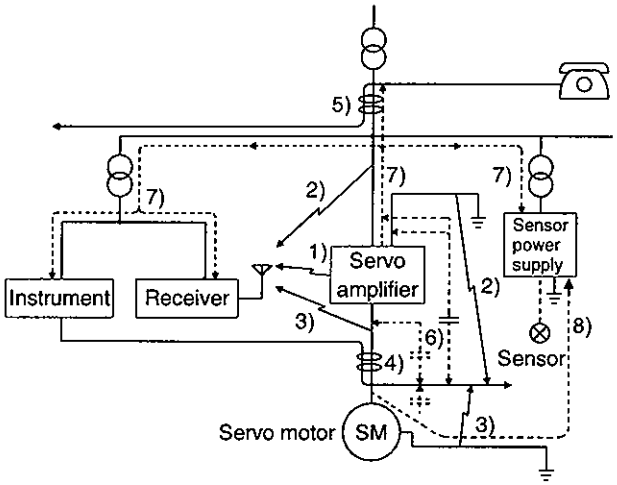
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.

(3) Techniques for noises radiated by the servo amplifier that cause peripheral devices to malfunction

Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.





Noise Transmission Route	Suppression Techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line. (5) Use shielded wires for signal and power cables or put cables in separate metal conduits.
4) 5) 6)	When the power lines and the signal cables are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Use shielded wires for signal and power cables or put the cables in separate metal conduits.
7)	When the power supply of peripheral devices is connected to the power supply of the servo amplifier system, noises produced by the servo amplifier may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. (1) Insert the radio noise filter (FR-BIF) on the power supply cables of the servo amplifier. (2) Insert the line noise filter (FR-BLF·FR-BSF01) on the power cables of the servo amplifier.
8)	When a closed loop circuit is formed by the ground cables of the peripheral device and servo amplifier, a leakage current may flow through to malfunction the peripheral device. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

(1) Data line filter

Noise can be prevented by installing a data line filter onto the encoder cable, etc.

Example: Data line filter: ZCAT3035-1330 [TDK]

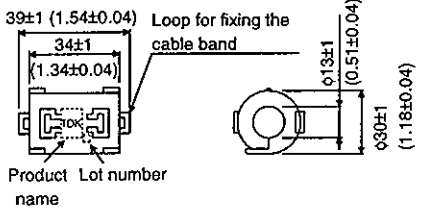
ESD-SR-25 [Tokin]

Impedance specifications (ZCAT3035-1330)

Impedance[Ω]	
10 to 100MHZ	100 to 500MHZ
80	150

The above impedances are reference values and not guaranteed values.

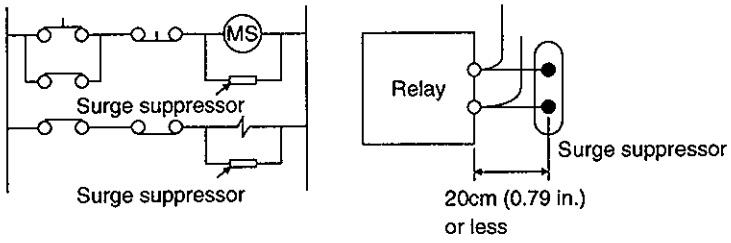
[Unit: mm (in)]



Outline drawing (ZCAT3035-1330)

(2) Surge suppressor

The recommended surge suppressor for installation to an AC relay, AC valve, AC electromagnetic brake or the like near the servo amplifier is shown below. Use this product or equivalent.

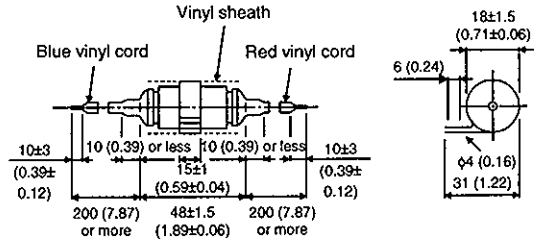


(Ex.) 972A.2003 50411

(Matsuo Electric Co.,Ltd.-200VAC rating)

Rated Voltage AC[V]	C [μF]	R [Ω]	Test Voltage AC[V]
200	0.5	50 (1W)	Across T-C 1000(1~5s)

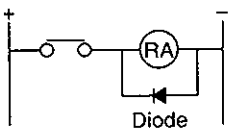
Outline Drawing [Unit: mm] ([Unit: in.])



Note that a diode should be installed to a DC relay, DC valve or the like.

Maximum voltage: Not less than 4 times the drive voltage of the relay or the like

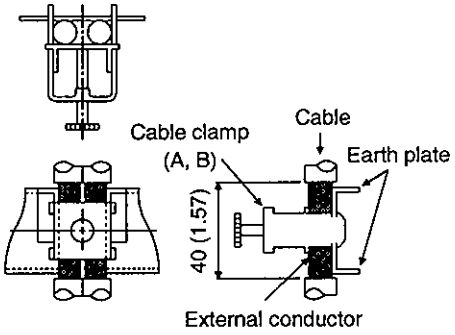
Maximum current: Not less than twice the drive current of the relay or the like



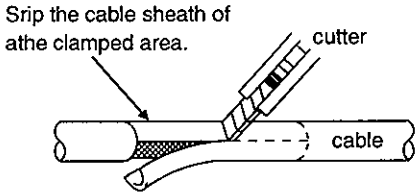
(3) Cable clamp fitting (AERSBAN-□SET)

Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below. Install the earth plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The clamp comes as a set with the earth plate.

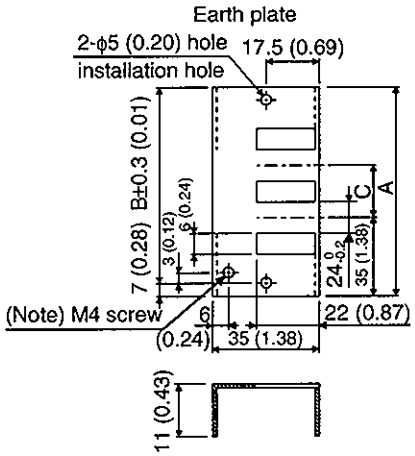


Clamp section diagram

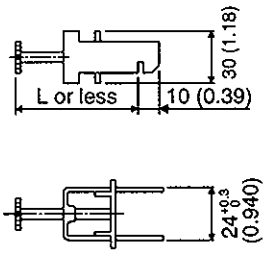


· Outline drawing

[Unit: mm (in)]



Clamp section diagram



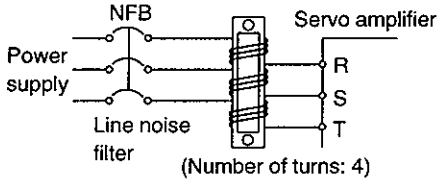
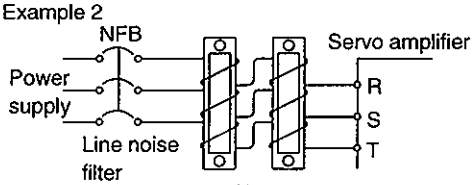
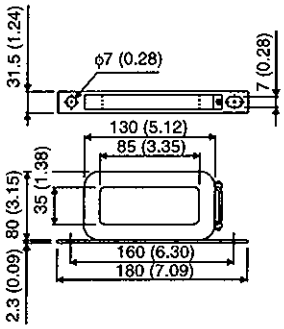
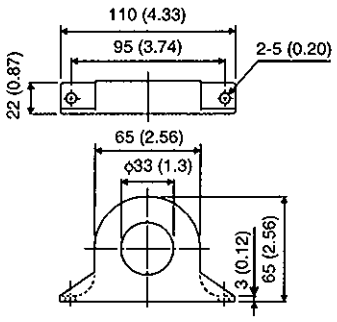
Note: Screw hole for grounding. Connect it to the earth plate of the control box.

Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

Clamp Fitting	L
A	70 (2.76)
B	45 (1.77)

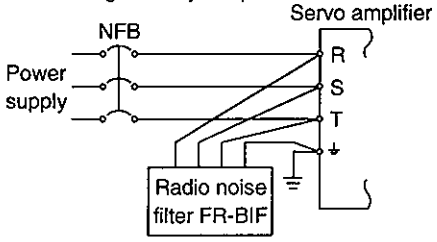
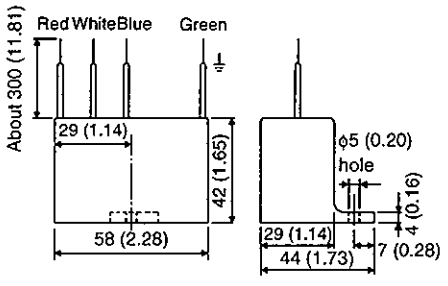
(4) Line noise filter (FR-BLF, FR-BSF01)

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5MHz to 5MHz band.

Connection Diagram	Outline Drawing [Unit: mm] ([Unit: in.])
· Wind the three-phase wires by the equal number of times in the same direction, and connect the filter to the power supply side and output side of the servo amplifier. · The effect of the filter on the power supply side is higher as the number of winds is larger. The number of turns is generally four. On the output side, the number of turns must be four or less. Note 1: Do not wind the grounding wire together with the three-phase wires. The filter effect will decrease. Use special caution when a four-core cable is used. Use a separate wire for grounding. Note 2: If the wires are too thick to be wound, use two or more filters and the number of turns should be as mentioned above. Example 1  (Number of turns: 4) Example 2  Two filters are used (Total number of turns: 4)	FR-BLF (MR-H350AN or more)  FR-BSF01 (for MR-H200AN or less) 

(5) Radio noise filter (FR-BIF)

This filter is effective in suppressing noises radiated from the power supply side of the servo amplifier especially in 10MHz and lower radio frequency bands. The FR-BIF is designed for the input only.

Connection Diagram	Outline Drawing (Unit: mm) ([Unit: in.])
Make the connection cables as short as possible. Grounding is always required.  	Leakage current: 4mA 

13.2.7 Leakage current breaker

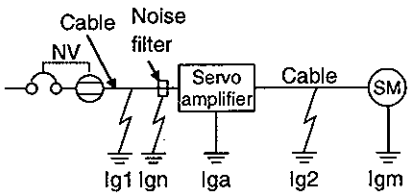
(1) Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor which is run with a commercial power supply.

Select a leakage current breaker according to the following formula, and ground the servo amplifier, servo motor, etc. securely.

Make the input and output cables as short as possible, and also make the grounding cable as long as possible (about 30cm (11.8 in)) to minimize leakage currents.

Rated sensitivity current ≥ 10 · {Ig1+Ign+Iga+K · (Ig2+Igm)} [mA] · · · · · (13.2)



K: Constant considering the harmonic contents

Leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SF NV-CF	1
General models	NV-CA NV-CS NV-SS	3

Ig1: Leakage current on the electric channel from the leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 13.1.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 13.1.)

Ign: Leakage current when a filter is connected to the input side (4.4mA per one FR-BIF)

Iga: Leakage current of the servo amplifier (Found from Table 13.4.)

Igm: Leakage current of the servo motor (Found from Table 13.3.)

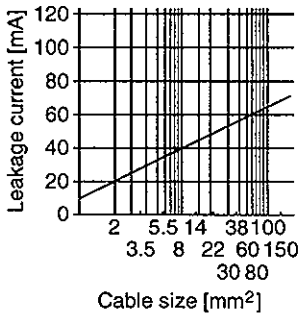


Fig.13.1 Leakage Current Example (Ig1,Ig2)for CV Cable Run in Metal Conduit

Table 13.4 Servo Motor's Leakage Current Example (Igm)

Servo Motor Output [kW]	Leakage Current [mA]
0.05 to 0.5	0.1
0.6 to 1.0	0.1
1.2 to 2.2	0.2
3 to 3.5	0.3
4.5	0.3
5	0.5
7	0.7
11	1.0
15	1.3
22	2.3

Table 13.5 Servo Amplifier's Leakage Current Example (Iga)

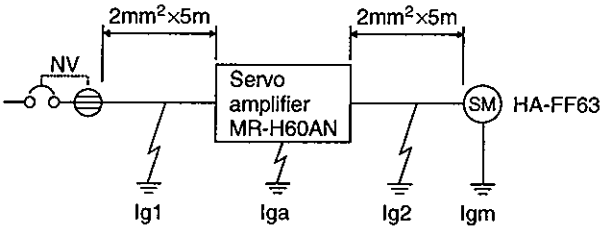
Servo Amplifier Capacity [kW]	Leakage Current [mA]
All series	2

Table 13.6Leakage Circuit Breaker Selection Example

Servo Amplifier	Rated Sensitivity Current of Leakage Circuit Breaker
MR-H10AN to MR-H350AN	15mA
MR-H500AN	30mA
MR-H700AN	50mA
MR-H11KAN to MR-H22KAN	100mA

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions:



Use a leakage current breaker generally available.
Find the terms of Equation (13.2) from the diagram:

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (13.2):

$$Ig \geq 10 \cdot \{0.1+0+0.1+3 \cdot (0.1+0.1)\}$$

$$\geq 8.0 \text{ [mA]}$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 8.0[mA] or more. A leakage current breaker having Ig of 15[mA] is used with the NV-CA/CS/SS series.

13.2.8 Setting potentiometers for analog inputs

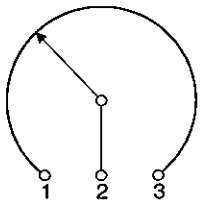
The following variable resistors are available for use with analog inputs such as override and analog torque commands:

(1) Single-revolution type

WA2WYA2SEBK2KΩ (Japan Resistor make)

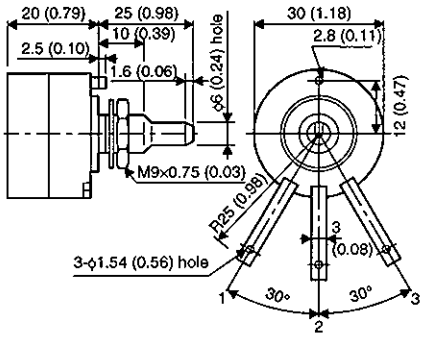
Rated Power	Resistance	Resistance Tolerance	dielectric Strength (for 1 minute)	Insulation Resistance	Mechanical Rotary Angle	Rotary Torque
2W	2kΩ	±10%	700V A.C	100MΩor more	300°±5°	10 to 100g-cm or less

connection diagram



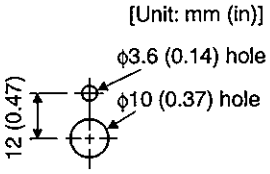
Outline dimension drawing

[Unit: mm (in)]



Panel hole machining diagram

[Unit: mm (in)]

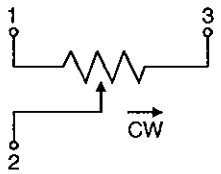


(2) Multi-revolution type

RRS10(M)2KΩ (Japan Resistor make)

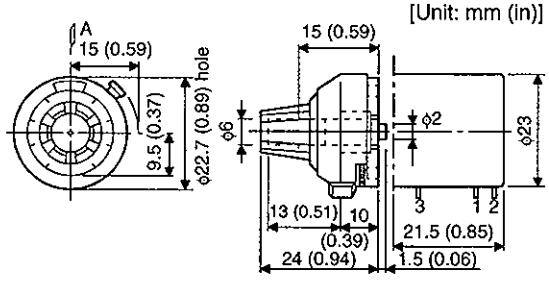
Rated Power	Resistance	Resistance Tolerance	dielectric Strength (for 1 minute)	Insulation Resistance	Mechanical Rotary Angle	Rotary Torque
1W	2kΩ	±10%	700V A.C	1000MΩ or more	3600° $^{+10°}_{-0°}$	100g-cm or less

connection diagram



Outline dimension drawing

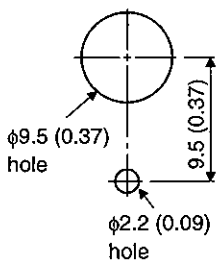
[Unit: mm (in)]



Panel hole machining diagram

[Unit: mm (in)]

Panel thickness: 2 to 6 (0.08 to 0.24)



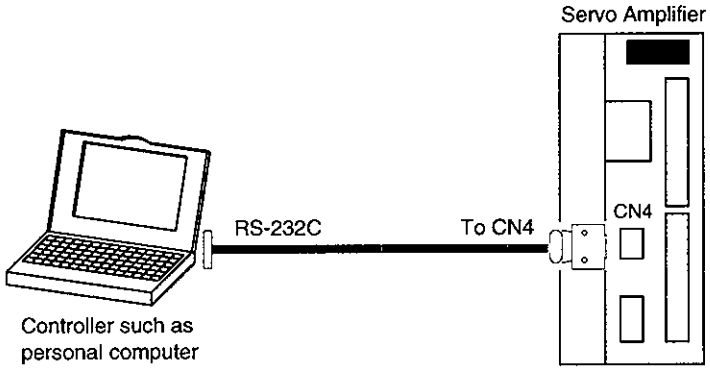
14. RS-232C COMMUNICATION FUNCTIONS

Servo Amplifier has the RS-232C serial communication functions. These functions can be used to perform servo operation, parameter changing, monitor function, etc.

14.1 Configuration

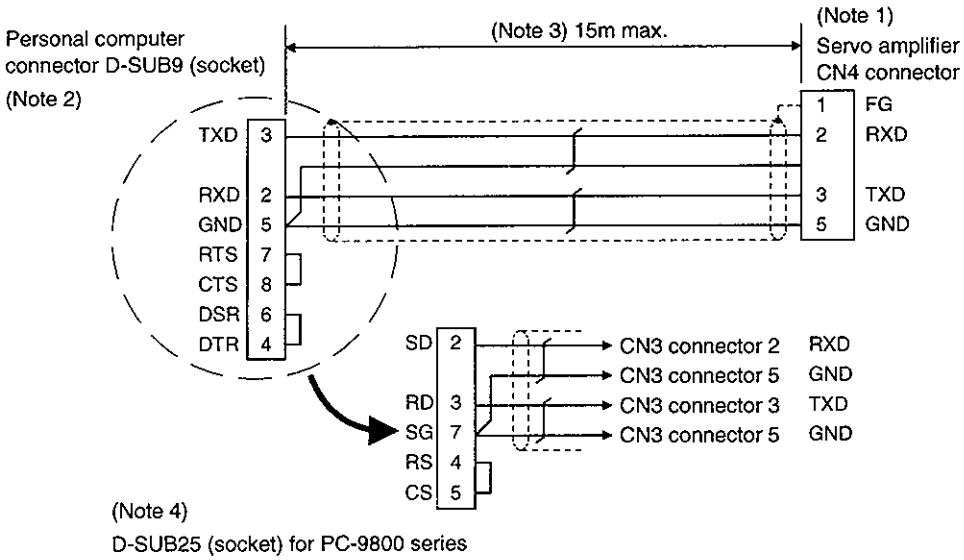
(1) Outline

A single axis of servo amplifier is operated.



(2) Cable connection diagram

Wire as shown below. The communication cable for connection with the personal computer (MR-HPCATCBL3M · MR-HPC98CBL3M) is available. (Refer to Section 13.1.6.)

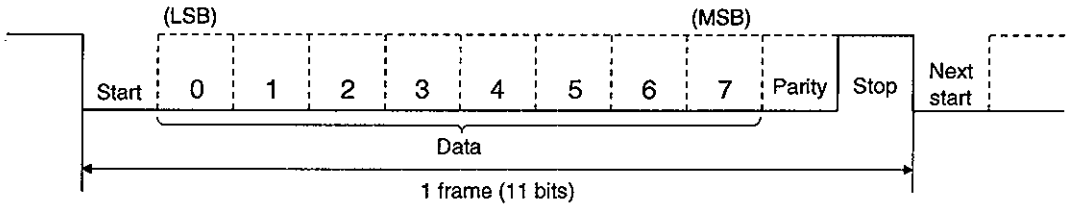


Note: 1. Honda Tsushin's CN3 connector
Connector: DE-9PF-N
Shell kit: DE-C1-J6-S6
2. For the PC-AT compatible controller series.
3. 15m max. in environment of little noise.
4. The PC-9800 series also has the half-pitch type.

14.2 Communication Specifications

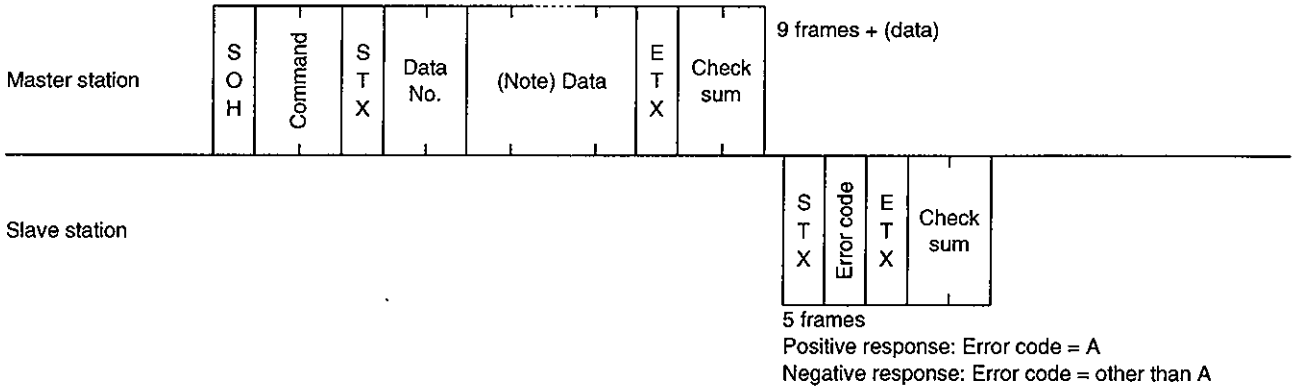
Servo Amplifier is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (servo amplifier) is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

Item	Description
Baudrate	4800/9600/19200 asynchronous system
Transfer code	Start bit : 1 bit Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system



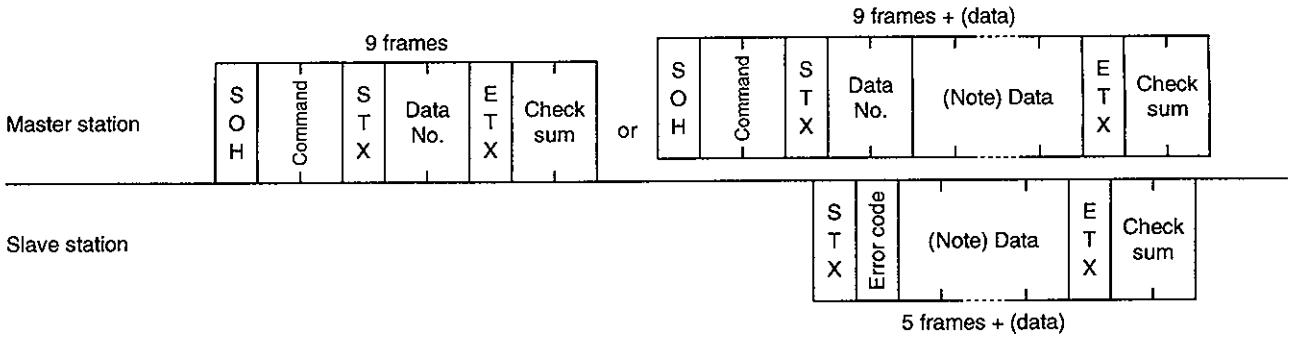
14.3 Protocol

(1) Transmission of data from master station to slave station



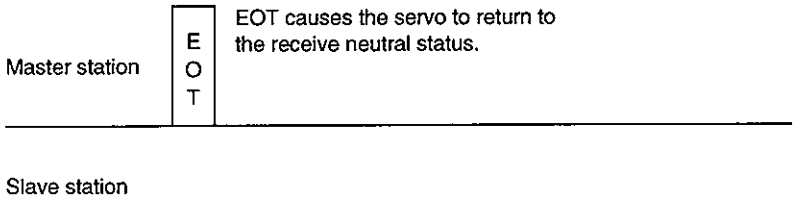
Note: Refer to (4) in this section for the number of data frames.

(2) Transmission of data request from master station to slave station



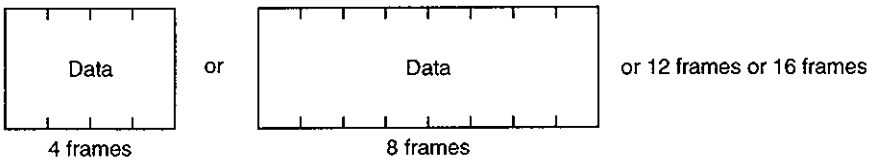
Note: Refer to (4) in this section for the number of data frames.

(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



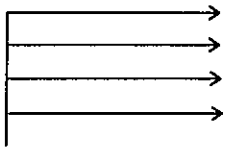
14.4 Character Codes

(1) Control codes

Code Name	Hexadecimal (ASCII code)	Description	Personal Computer Terminal Key Operation (General)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data

JIS8 unit codes are used.



b8	0	0	0	0	0	0	0	0
b7	0	0	0	0	1	1	1	1
b6	0	0	1	1	0	0	1	1
b5	0	1	0	1	0	1	0	1

b8~b5	b4	b3	b2	b1
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

C / R	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC_1	!	1	A	Q	a	q
2	STX	DC_2	"	2	B	R	b	r
3	ETX	DC_3	#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	I	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	|
13			-	=	M	]	m	}
14			.	>	N	^	n	¯
15			/	?	O	_	o	DEL

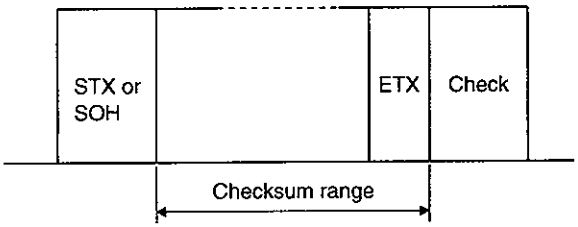
14.5 Error Codes

Error codes are used in the following cases and an error code of single-code length is transmitted.
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station.

Error Code		Error Name	Description	Remarks
Servo normal	Servo alarm			
[A]	[a]	Normal operation	Data transmitted was processed properly.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	Character not existing in the specifications was transmitted.	
[E]	[e]	Command error	Command not existing in the specifications was transmitted.	
[F]	[f]	Data No. error	Data No. not existing in the specifications was transmitted.	
[J]	[j]	External reset ON	Reset (RES) turned on.	Special response

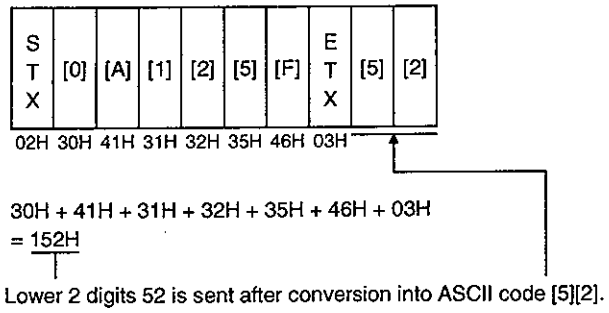
14.6 Checksum

Checksum range



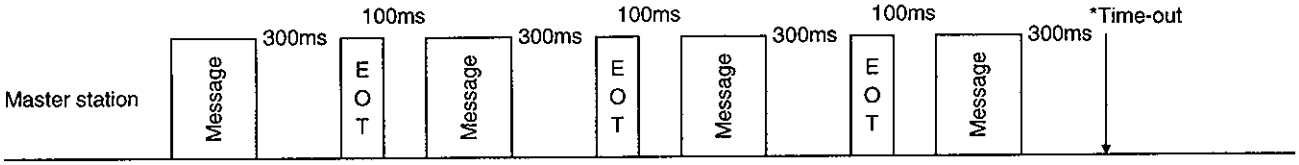
The checksum is sent as a JIS8-coded hexadecimal code representing the lower two digits of the sum of JIS8-coded hexadecimal values up to ETX, with the exception of the first control code (STX or SOH).

(Example)



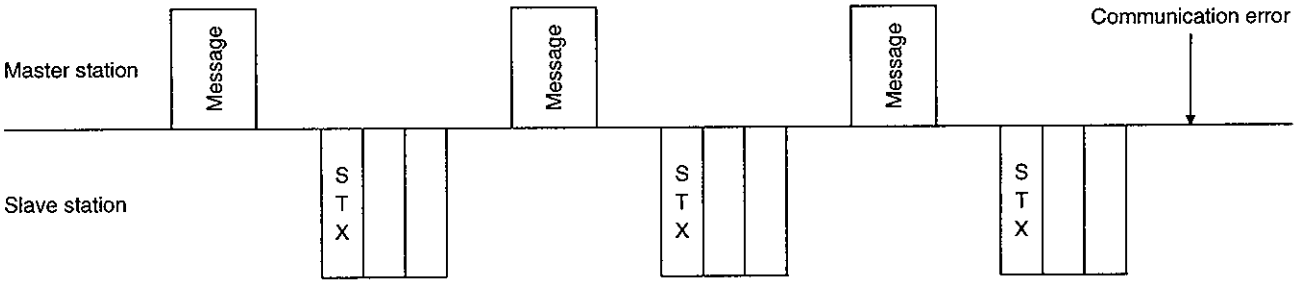
14.7 Time-Out Operation

The master station transmits EOT when the slave station does not start reply operation (STX is not received) 300[ms] after the master station has ended communication operation. 100[ms] after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above operation three times. (Communication error)



14.8 Retry Operation

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [I], [b] to [i]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (Retry operation). A communication error occurs if the above operation is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry operation is performed three times.

14.9 Initialization

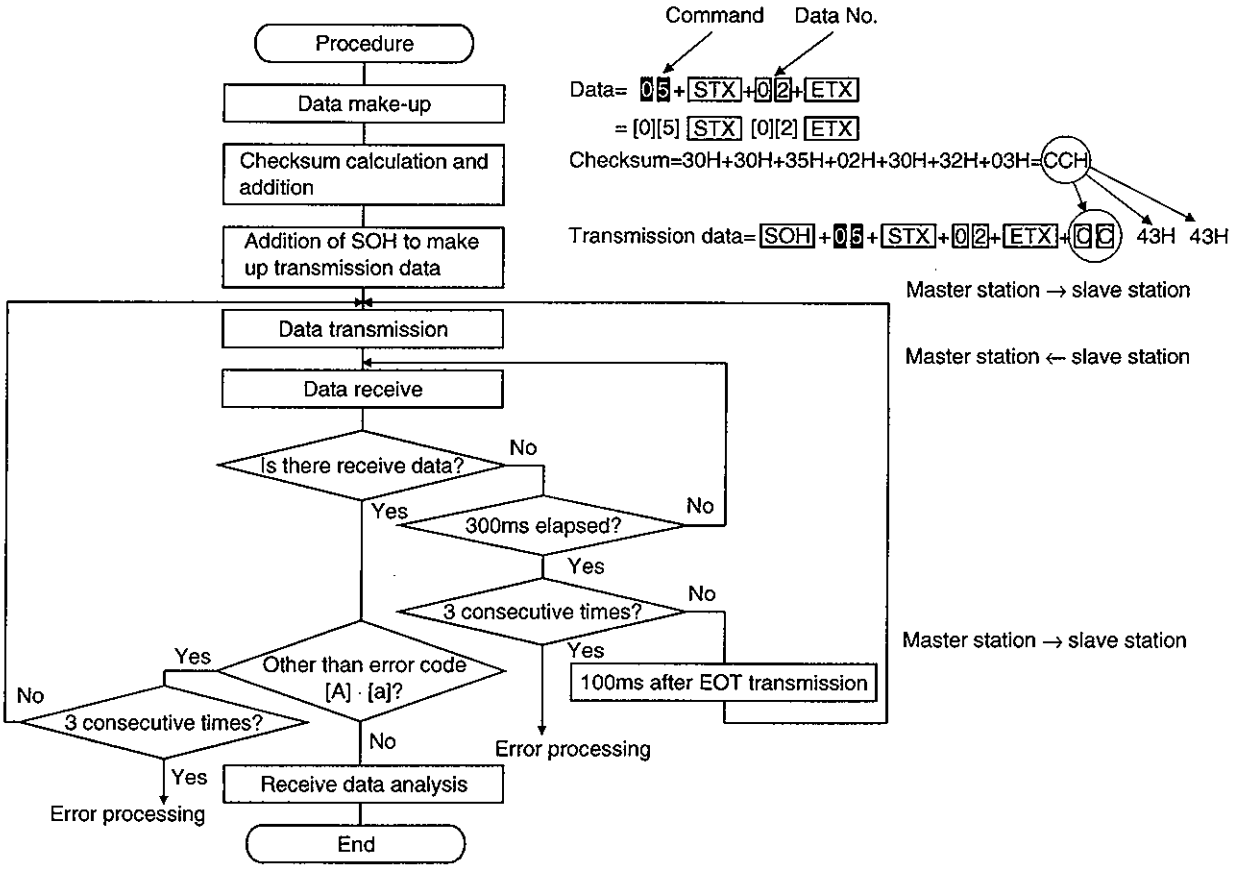
After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after:

1) 1s or more time has elapsed after the slave station is switched on; and
2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

14.10 Communication Procedure Example

The following example reads the setting of parameter No. 2:

Data Item	Value	Description
Command	05	Read command
Data No.	02	Parameter No.2



14.11 Command and Data No. List

14.11.1 Read commands

(1) Status display (Command [0][1])

Command	Data No.	Description	Display Item	Frame Length
[0][1]	[0][0]	Status display name and unit	Feedback pulse value	16
[0][1]	[0][1]		Servo motor speed	16
[0][1]	[0][2]		Command speed	16
[0][1]	[0][3]		Droop pulse	16
[0][1]	[0][4]		Command pulse value	16
[0][1]	[0][5]		Command pulse frequency	16
[0][1]	[0][6]		Speed command voltage	16
[0][1]	[0][7]		Reverse rotation torque limit command voltage	16
[0][1]	[8][8]		Forward rotation torque limit command voltage	16
[0][1]	[0[9]		Regenerative load factor	16
[0][1]	[0][A]		Effective load factor	16
[0][1]	[0][B]		Peak load factor	16
[0][1]	[0][C]		Within one-revolution position	16
[0][1]	[0][D]		ABS counter	16
[0][1]	[0][E]		Machine speed	16
[0][1]	[0][F]		Bus voltage	16
[0][1]	[8][0]	Status display data value and processing information	Feedback pulse value	12
[0][1]	[8][1]		Servo motor speed	12
[0][1]	[8][2]		Command speed	12
[0][1]	[8][3]		Droop pulse	12
[0][1]	[8][4]		Command pulse value	12
[0][1]	[8][5]		Command pulse frequency	12
[0][1]	[8][6]		Speed command voltage	12
[0][1]	[8][7]		Reverse rotation torque limit command voltage	12
[0][1]	[8][8]		Forward rotation torque limit command voltage	12
[0][1]	[8][9]		Regenerative load factor	12
[0][1]	[8][A]		Effective load factor	12
[0][1]	[8][B]		Peak load ratio	12
[0][1]	[8][C]		Within one-revolution position	12
[0][1]	[8][D]		ABS counter	12
[0][1]	[8][E]		Machine speed	12
[0][1]	[8][F]		Bus voltage	12

(2) Parameter (Command [0][5] to [0][8])

Command	Data No.	Description	Frame Length
[0][5]	[0][0]~ [4][F]	Present value of the corresponding parameter (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	8
[0][6]	[0][0]~ [4][F]	Upper limit value of the corresponding parameter setting range (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	8
[0][7]	[0][0]~ [4][F]	Lower limit value of the corresponding parameter setting range (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	8
[0][8]	[0][0]~ [4][F]	Name of the corresponding parameter (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	12

(3) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm Occurrence Sequence	Frame Length
[3][3]	[1][0]	Alarm number in alarm history	most recent alarm	4
[3][3]	[1][1]		first alarm in past	4
[3][3]	[1][2]		second alarm in past	4
[3][3]	[1][3]		third alarm in past	4
[3][3]	[1][4]		fourth alarm in past	4
[3][3]	[1][5]		fifth alarm in past	4
[3][3]	[1][6]		sixth alarm in past	4
[3][3]	[1][7]		seventh alarm in past	4
[3][3]	[1][8]		eighth alarm in past	4
[3][3]	[1][9]		ninth alarm in past	4
[3][3]	[2][0]	Alarm occurrence time in alarm history	most recent alarm	8
[3][3]	[2][1]		first alarm in past	8
[3][3]	[2][2]		second alarm in past	8
[3][3]	[2][3]		third alarm in past	8
[3][3]	[2][4]		fourth alarm in past	8
[3][3]	[2][5]		fifth alarm in past	8
[3][3]	[2][6]		sixth alarm in past	8
[3][3]	[2][7]		seventh alarm in past	8
[3][3]	[2][8]		eighth alarm in past	8
[3][3]	[2][9]		ninth alarm in past	8
[3][3]	[3][0]	Alarm occurrence name	most recent alarm	12
[3][3]	[3][1]		first alarm in past	12
[3][3]	[3][2]		second alarm in past	12
[3][3]	[3][3]		third alarm in past	12
[3][3]	[3][4]		fourth alarm in past	12
[3][3]	[3][5]		fifth alarm in pas	12
[3][3]	[3][6]		sixth alarm in past	12
[3][3]	[3][7]		seventh alarm in past	12
[3][3]	[3][8]		eighth alarm in past	12
[3][3]	[3][9]		ninth alarm in past	12

(4) Current alarm (Command [0][2] · [3][5])

Command	Data No.	Description	Frame Length
[0][2]	[0][0]	Current alarm number	4
[0][2]	[0][1]	Current alarm name	12
[0][2]	[0][8]	Concurrent alarm number	4
[0][2]	[0][9]	Concurrent alarm name	12

Command	Data No.	Description	Status Display Item	Frame Length
[3][5]	[0][0]	Status display name and unit at alarm occurrence	Feedback pulse value	16
[3][5]	[0][1]		Servo motor speed	16
[3][5]	[0][2]		Command speed	16
[3][5]	[0][3]		Droop pulse	16
[3][5]	[0][4]		Command pulse value	16
[3][5]	[0][5]		Command pulse frequency	16
[3][5]	[0][6]		Speed command voltage	16
[3][5]	[0][7]		Reverse rotation torque limit command voltage	16
[3][5]	[0][8]		Forward rotation torque limit command voltage	16
[3][5]	[0][9]		Regenerative load factor	16
[3][5]	[0][A]		Effective load factor	16
[3][5]	[0][B]		Peak load factor	16
[3][5]	[0][C]		Within one-revolution position	16
[3][5]	[0][D]		ABS counter	16
[3][5]	[0][E]		Machine speed	16
[3][5]	[0][F]		Bus voltage	16
[3][5]	[8][0]	Status display data value and processing information at alarm occurrence	Feedback pulse value	12
[3][5]	[8][1]		Servo motor speed	12
[3][5]	[8][2]		Command speed	12
[3][5]	[8][3]		Droop pulse	12
[3][5]	[8][4]		Command pulse value	12
[3][5]	[8][5]		Command pulse frequency	12
[3][5]	[8][6]		Speed command voltage	12
[3][5]	[8][7]		Reverse rotation torque limit command voltage	12
[3][5]	[8][8]		Forward rotation torque limit command voltage	12
[3][5]	[8][9]		Regenerative load factor	12
[3][5]	[8][A]		Effective load factor	12
[3][5]	[8][B]		Peak load factor	12
[3][5]	[8][C]		Within one-revolution position	12
[3][5]	[8][D]		ABS counter	12
[3][5]	[8][E]		Machine speed	12
[3][5]	[8][F]		Bus voltage	12

(5) External I/O signals (command [3][4])

Command	Data No.	Description	Signal	Frame Length
[3][4]	[1][1]	External input signal ON/OFF status	SON	4
[3][4]	[1][2]		TL	4
[3][4]	[1][3]		PC	4
[3][4]	[1][4]		RES	4
[3][4]	[1][5]		LSP	4
[3][4]	[1][6]		LSN	4
[3][4]	[1][7]		CR	4
[3][4]	[1][8]		DI0	4
[3][4]	[1][9]		DI1	4
[3][4]	[1][A]		DI2	4
[3][4]	[1][B]		DI3	4
[3][4]	[1][C]		DI4	4
[3][4]	[1][E]	MR-H-D01 external input signal ON/OFF status	DI00	4
[3][4]	[1][F]		DI01	4
[3][4]	[2][0]		DI02	4
[3][4]	[2][1]		DI03	4
[3][4]	[2][2]		DI04	4
[3][4]	[2][3]		DI05	4
[3][4]	[2][4]		DI06	4
[3][4]	[2][5]		DI07	4
[3][4]	[2][6]		DI08	4
[3][4]	[2][7]		DI09	4
[3][4]	[2][8]		DI10	4
[3][4]	[2][9]		DI11	4
[3][4]	[2][A]		DI12	4
[3][4]	[2][B]		DI13	4
[3][4]	[2][C]		DI14	4
[3][4]	[2][D]		DI15	4
[3][4]	[2][E]		DI16	4
[3][4]	[2][F]		DI17	4
[3][4]	[3][0]		DI18	4
[3][4]	[3][1]		DI19	4
[3][4]	[3][2]		DI20	4
[3][4]	[3][3]		DI21	4
[3][4]	[3][4]		DI22	4
[3][4]	[3][5]		DI23	4
[3][4]	[9][1]	External output signal ON/OFF status	RD	4
[3][4]	[9][2]		PF	4
[3][4]	[9][3]		ZSP	4
[3][4]	[9][4]		TLC	4
[3][4]	[9][5]		ALM	4
[3][4]	[9][6]		OP	4
[3][4]	[9][7]	MR-H-D01 external output signal ON/OFF status	DO00	4
[3][4]	[9][8]		DO01	4
[3][4]	[9][9]		DO02	4
[3][4]	[9][A]		DO03	4
[3][4]	[9][B]		DO04	4
[3][4]	[9][C]		DO05	4
[3][4]	[9][D]		DO06	4
[3][4]	[9][E]		DO07	4
[3][4]	[9][F]		DO08	4

Command	Data No.	Description	Signal	Frame Length
[3][4]	[A][0]	MR-H-D01 external output signal ON/OFF status	DO09	4
[3][4]	[A][1]		DO10	4
[3][4]	[A][2]		DO11	4
[3][4]	[A][3]		DO12	4
[3][4]	[A][4]		DO13	4
[3][4]	[A][5]		DO14	4
[3][4]	[A][6]		DO15	4

14.11.2 Write commands

(1) Japanese-English switch-over (command [8][0])

Command	Data No.	Description	Setting Range	Frame Length
[8][0]	[0][0]	Japanese-English switch-over 0000: Japanese 0001: English	0000 · 0001	4

(2) Status display (command [8][1])

Command	Data No.	Description	Setting Range	Frame Length
[8][1]	[0][0]	Status display data clear	1EA5	4

(3) Alarm (command [8][2])

Command	Data No.	Description	Setting Range	Frame Length
[8][2]	[0][0]	Alarm clear	1EA5	4
[8][2]	[2][0]	Alarm history clear	1EA5	4
[8][2]	[5][0]	Analog output of data before alarm occurrence	1EA5	4

(4) Parameter (command [8][4])

Command	Data No.	Description	Setting Range	Frame Length
[8][4]	[0][0]~ [4][F]	Each parameter write (The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.)	Depends on the parameter.	8

(5) Operation mode selection (command [8][B])

Command	Data No.	Description	Setting Range	Frame Length
[8][B]	[0][0]	Operation mode changing 0000: Exit from test operation mode 0001: Jog operation 0002: Positioning operation 0003: Motor-less operation 0004: DO forced output (output signal forced output)	0000 to 0004	4

(6) DO forced output (command [8][B])

Command	Data No.	Description	Signal	Setting Range	Frame Length
[8][B]	[8][1]	DO forced output 0000:OFF 0001:ON	RD	0000 · 0001	4
[8][B]	[8][2]		PF	0000 · 0001	4
[8][B]	[8][3]		ZSP	0000 · 0001	4
[8][B]	[8][4]		TLC	0000 · 0001	4
[8][B]	[8][5]		ALM	0000 · 0001	4
[8][B]	[8][6]	MR-H-D01 DO forced output 0000:OFF 0001:ON	DO00	0000 · 0001	4
[8][B]	[8][7]		DO01	0000 · 0001	4
[8][B]	[8][8]		DO02	0000 · 0001	4
[8][B]	[8][9]		DO03	0000 · 0001	4
[8][B]	[8][A]		DO04	0000 · 0001	4
[8][B]	[8][B]		DO05	0000 · 0001	4
[8][B]	[8][C]		DO06	0000 · 0001	4
[8][B]	[8][D]		DO07	0000 · 0001	4
[8][B]	[8][E]		DO08	0000 · 0001	4
[8][B]	[8][F]		DO09	0000 · 0001	4
[8][B]	[9][0]		DO10	0000 · 0001	4
[8][B]	[9][1]		DO11	0000 · 0001	4
[8][B]	[9][2]		DO12	0000 · 0001	4
[8][B]	[9][3]		DO13	0000 · 0001	4
[8][B]	[9][4]		DO14	0000 · 0001	4
[8][B]	[9][5]		DO15	0000 · 0001	4

(7) External input signal disable (command [9][0])

Command	Data No.	Description	Setting Range	Frame Length
[9][0]	[0][0]	Turns off the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN, independently of the external ON/OFF statuses.	1EA5	4
[9][0]	[0][1]	Disables only the external input signals (DI) with the exception of EMG, LSP and LSN.	1EA5	4
[9][0]	[0][2]	Disables only the external analog input signals.	1EA5	4
[9][0]	[0][3]	Changes the external output signals (DO) into the value of command [8][B] or command [A][0] + data No. [0][1].	1EA5	4
[9][0]	[1][0]	Enables the disabled external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.	1EA5	4
[9][0]	[1][1]	Enables the disabled external input signals (DI) with the exception of EMG, LSP and LSN.	1EA5	4
[9][0]	[1][2]	Enables the disabled external analog input signals.	1EA5	4
[9][0]	[1][3]	Enables the disabled external output signals (DO).	1EA5	4

(8) Forced ON/OFF of external I/O signals (DIO) [A][0])

Command	Data No.	Description	Setting Range	Frame Length
[A][0]	[0][0]	Forces the external output signals (DO) to turn on/off.	00000000 to FFFFFFFF	8
[A][0]	[0][1]	Forces the external input signals (DI) to turn on/off with the exception of EMG, LSP and LSN.	00000000 to FFFFFFFF	8
[A][0]	[0][2]	Forces the external output signals (DO) of the MR-H-D01 option card to turn on/off.	00000000 to FFFFFFFF	8
[A][0]	[0][3]	Forces the external input signals (DI) of the MR-H-D01 option card to turn on/off.	00000000 to FFFFFFFF	8

(9) Data for test operation mode (command [A][0])

Command	Data No.	Description	Setting Range	Frame Length
[A][0]	[1][0]	Writes the speed of the test operation mode (jog operation, positioning operation).	0000 to 7FFF	4
[A][0]	[1][1]	Writes the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	00000000 to 7FFFFFFF	8
[A][0]	[1][2]	Clears the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	1EA5	4
[A][0]	[1][3]	Writes the moving distance (in pulses) of the test operation mode (jog operation, positioning operation).	80000000 to 7FFFFFFF	8
[A][0]	[1][5]	Temporary stop command of the test operation mode (jog operation, positioning operation)	1EA5	4

14.12 Detailed Explanations of Commands

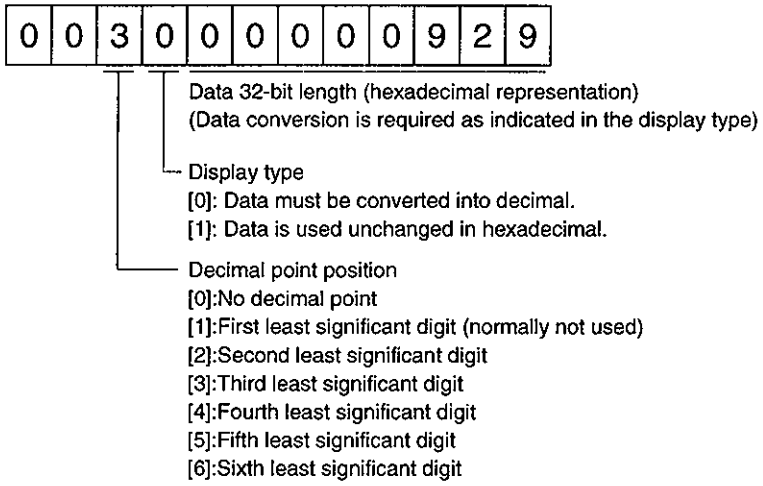
14.12.1 Data processing

When the master station transmits a command + data No. or a command + data No. + data to a slave station, the servo amplifier returns a reply or data according to the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed according to the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing the read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

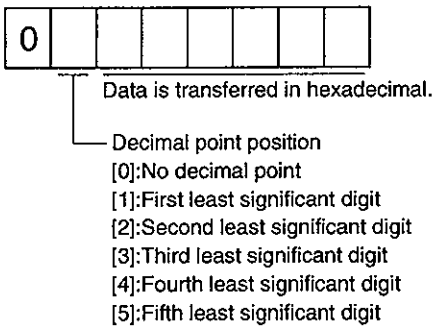


Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(2) Writing the processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.



By way of example, here is described how to process the set data when a value of "15.5" is sent.
Since the decimal point position is the second digit, the decimal point position data is "2".
As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.
155→9B
Hence, "0200009B" is transmitted.

14.12.2 Status display

(1) Reading the status display name and unit

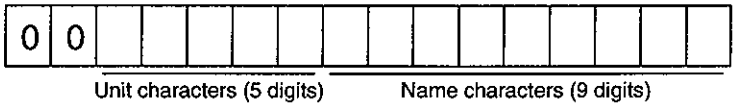
Read the status display name and unit.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read, [0][0] to [0][F]. (Refer to Section 14.11.1.)

(b) Reply

The slave station sends back the status display name and unit requested.



(2) Status display data read

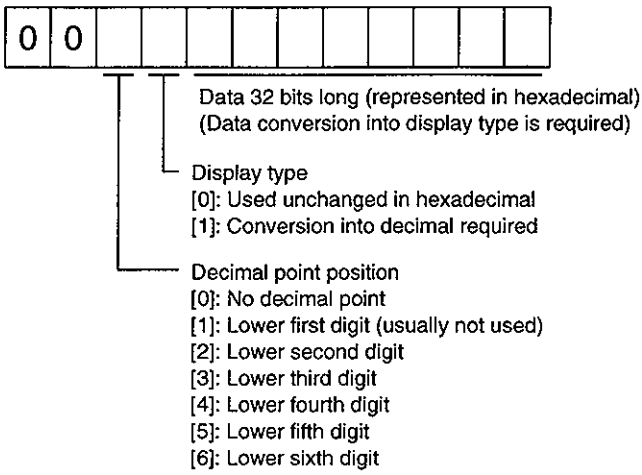
Read the status display data and processing information.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read. Refer to Section 14.11.1.

(b) Reply

The slave station sends back the status display data requested.



(3) Status display data clear

The cumulative feedback pulse data of the status display is cleared. Send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to zero.

Command	Data No.	Data
[8][1]	[0][0]	[1][E][A][5]

For example, after sending command [0][1] and data No. [8][0] and receiving the status display data, send command [8][1], data No. [0][0] and data [1EA5] to clear the cumulative feedback pulse value to zero.

14.12.3 Parameters

(1) Reading the name

Read the parameter name.

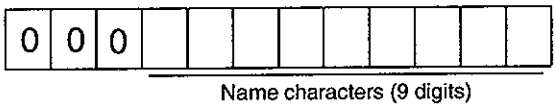
(a) Transmission

Transmit command [0][8] and the data No. corresponding to the parameter No., [0][0] to [4][F]. (Refer to Section 14.11.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the name of the parameter No. requested.



(2) Reading the setting

Read the parameter setting.

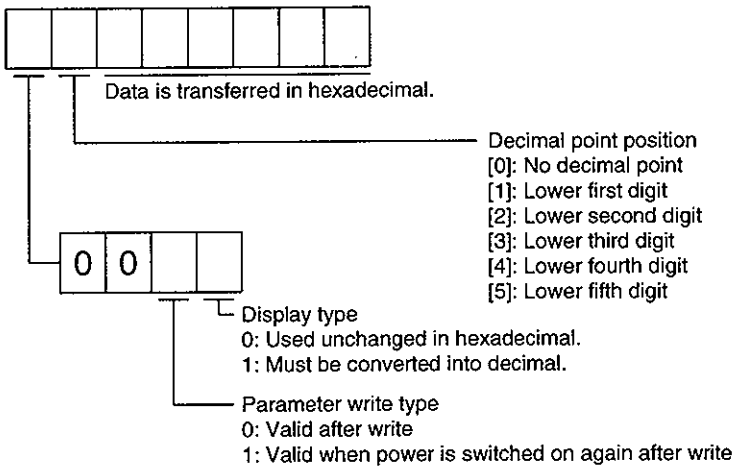
(a) Transmission

Transmit command [0][5] and the data No. corresponding to the parameter No., [0][0] to [4][F]. (Refer to Section 14.11.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "1200270F" means 999.9 (decimal display format) and data "0003ABC" means 3ABC (hexadecimal display format).

When the display type is "0" (hexadecimal) and the decimal point position is other than 0, the display type is a special hexadecimal display format and "F" of the data value is handled as a blank. Data "01FFF053" means 053 (special hexadecimal display format).

"000000" is transferred when the parameter that was read is the one inaccessible for write/reference in the parameter write disable setting of parameter No. 19.

(3) Reading the setting range

Read the parameter setting range.

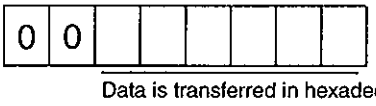
(a) Transmission

When reading the upper limit value, transmit command [0][6] and the data No. corresponding to the parameter No., [0][0] to [F][F]. When reading the lower limit value, transmit command [0][7] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to Section 14.11.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "10FFFFEC" means -20.

(4) Parameter write

Write the parameter setting into EEP-ROM of the servo amplifier.

Parameter settings may be written up to 100,000 times. Write the value within the setting enabled range. For the setting enabled range, refer to Section 6.1 or read the setting range by performing operation in (3) of this section.

Transmit command [8][4], the data No. , and the set data.

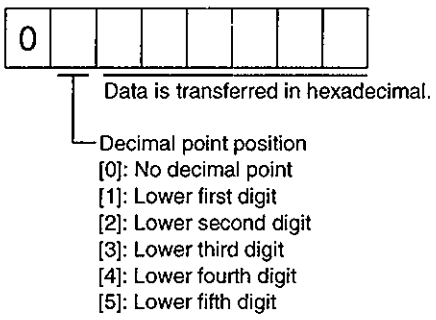
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.

Write the data after making sure that it is within the upper/lower limit value range.

Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Set Data
[8][4]	[0][0] to [3][5]	See below.



14.12.4 External I/O signal status (DIO diagnosis)

(1) Reading the external input signal ON/OFF status

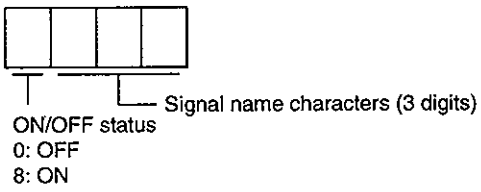
Read the ON/OFF status of the external input signal. When the master station transmits the data No. to the slave station, the slave station sends back the corresponding ON/OFF status to the master station.

(a) Transmission

Transmit command [3][4] and the data No. corresponding to the input signal to be read. (Refer to Section 14.11.1.)

(b) Reply

The slave station sends back the ON/OFF status of the input signal requested.



(2) Reading the external output signal ON/OFF status

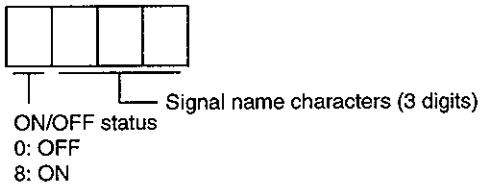
Read the ON/OFF status of the external output signal. When the master station transmits the data No. to the slave station, the slave station sends back the corresponding ON/OFF status to the master station.

(a) Transmission

Transmit command [3][4] and the data No. corresponding to the output signal to be read. (Refer to Section 14.11.1.)

(b) Reply

The slave station sends back the ON/OFF status of the output signal requested.



14.12.5 External output signal ON/OFF (DO forced output)

In the test operation mode, any output signal can be turned on/off independently of its status. Using command [9][0], disable the output signals in advance.

(1) Choosing DO forced output in test operation mode

Transmit command [8][B] + data No. [0][0] + data "0004" to choose DO forced output.

0	0	0	4

Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal ON/OFF

(a) Turning the output signal ON/OFF signal-by-signal

Transmit command [8][B] + data No. corresponding to the output signal, [8][1] to [9][5], and the data which means ON/OFF.

0	0	0	

ON/OFF command
0: OFF
1: ON

(b) Turning all output signals ON/OFF at once

Transmit the following communication commands:

Command	Data No.	Setting Data	Output Signals
[A][0]	[0][1]	See below.	Signals of connector CN1
[A][0]	[0][3]		Signals of connector CN11

Command of each bit is sent to the slave station in hexadecimal.

Assignment of CN1 output signals

bit	Signal Name
0	RD
1	PF
2	ZSP
3	TLC
4	ALM
5	OP
6	
7	
8	
9	
10	

bit	Signal Name
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	

bit	Signal Name
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	

Assignment of CN11 (MR-H-D01 option card) output signals

bit	Signal Name
0	DO00
1	DO01
2	DO02
3	DO03
4	DO04
5	DO05
6	DO06
7	DO07
8	DO08
9	DO09
10	DO10

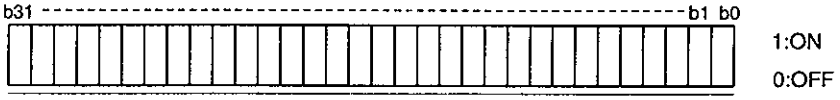
bit	Signal Name
11	DO11
12	DO12
13	DO13
14	DO14
15	DO15
16	
17	
18	
19	
20	
21	

bit	Signal Name
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	

14.12.6 External input signal ON/OFF

With the exception of EMG, LSP and LSN, the input signals can be turned on/off independently of their statuses. Using command [9][0], disable the external input signals in advance. When you want to keep the signals on, turn them on every time data is transmitted.

Command	Data No.	Setting Data	Output Signals
[A][0]	[0][0]	See below.	Signals of connector CN1
[A][0]	[0][2]		Signals of connector CN11



Command of each bit is sent to the slave station in hexadecimal.

Assignment of CN1 input signals

bit	Signal Name
0	SON
1	TL
2	PC
3	RES
4	
5	
6	CR
7	DI0
8	DI1
9	DI2
10	DI3

bit	Signal Name
11	DI4
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	

bit	Signal Name
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	

Assignment of CN11 (MR-H-D01 option card) input signals

bit	Signal Name
0	DI00
1	DI01
2	DI02
3	DI03
4	DI04
5	DI05
6	DI06
7	DI07
8	DI08
9	DI09
10	DI10

bit	Signal Name
11	DI11
12	DI12
13	DI13
14	DI14
15	DI15
16	DI16
17	DI17
18	DI18
19	DI19
20	DI20
21	DI21

bit	Signal Name
22	DI22
23	DI23
24	
25	
26	
27	
28	
29	
30	
31	

14.12.7 Disable/enable of external I/O signals (DIO)

Inputs can be disabled independently of the external I/O signal ON/OFF. When inputs are disabled, the input signals are recognized as follows. Among the external input signals, EMG, LSP and LSN cannot be disabled.

Signal	Status
External input signals (DI)	OFF
External analog input signals	0V
Pulse train inputs	None

(1) Disabling/enabling the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][0]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Disabling/enabling only the external input signals (DI) with the exception of EMG, LSP and LSN.
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][1]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][1]	1EA5

(3) Disabling/enabling only the external analog input signals.
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][2]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][2]	1EA5

(4) Disabling/enabling the external output signals (DO)
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][3]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][3]	1EA5

14.12.8 Test operation mode

(1) Instructions for test operation mode

The test operation mode must be executed in the following procedure. If communication is interrupted for longer than 0.5s during test operation, the servo amplifier causes the motor to be decelerated to a stop and servo-locked. To prevent this, continue communication without a break, e.g. monitor the status display.

1) Turn off all external input signals.

2) Disable the external input signals.

Command	Data No.	Data
[9][0]	[0][0]	1EA5

3) Choose the test operation mode.

Command	Data No.	Transmission Data	Selection of Test Operation Mode
[8][B]	[0][0]	0000	Test operation mode cancel
[8][B]	[0][0]	0001	Jog operation
[8][B]	[0][0]	0002	Positioning operation
[8][B]	[0][0]	0003	Motor-less operation
[8][B]	[0][0]	0004	DO forced output

4) Set the data needed for test operation.

5) Start.

6) Continue communication using the status display or other command.

To terminate the test operation mode, complete the corresponding operation and:

1) Clear the test operation acceleration/deceleration time constant.

Command	Data No.	Data
[A][0]	[1][2]	1EA5

2) Cancel the test operation mode.

Command	Data No.	Data
[8][B]	[0][0]	0000

3) Enable the disabled external input signals.

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Jog operation

Transmit the following communication commands:

(a) Setting of jog operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.

(b) Start

Turn on the external I/O signals SON and DI3/DI4 by using command [A][0] + data No. [0][0] or command [A][0] + data No. [0][1].

Item	Command	Data No.	Data
Forward rotation start	[A][0]	[0][0]	00000401: Turns on SON and DI3.
Reverse rotation start	[A][0]	[0][0]	00000801: Turns on SON and DI4.

(3) Positioning operation

Transmit the following communication commands:

(a) Setting of positioning operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.
Moving distance	[A][0]	[1][3]	Write the moving distance [pulse] in hexadecimal.

(b) Start

Turn on the external I/O signals SON and DI3/DI4 by using command [A][0] + data No. [0][0].

Item	Command	Data No.	Data
Forward rotation start	[A][0]	[0][0]	00000401: Turns on SON and DI3.
Reverse rotation start	[A][0]	[0][0]	00000801: Turns on SON and DI4.

(c) Temporary stop

A temporary stop can be made during positioning operation.

Command	Data No.	Data
[A][0]	[1][5]	1EA5

Retransmit the same communication commands as at the start time to resume operation.

To stop positioning operation after a temporary stop, retransmit the temporary stop communication command. The remaining moving distance is then cleared.

14.12.9 Alarm history

The alarm numbers, occurrence times and name of No.0 (last alarm) to No.9 (ten alarm in the past) are read.

(1) Alarm No. read

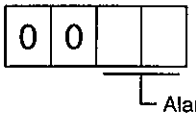
Read the alarm No. which occurred in the past.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][9]. Refer to Section 14.11.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.



For example, "0032" means AL32 and "00FF" means AL_ (no alarm).

(2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

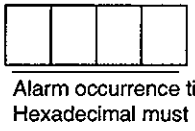
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No. [2][0] to [2][9].

Refer to Section 8.11.1.

(b) Reply



For example, data "01F5" means that the alarm occurred 501 hours after start of operation.

(3) Reading the alarm name

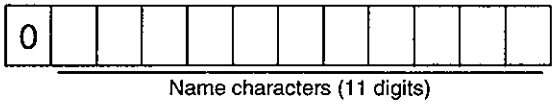
Read the name of the past alarm.

(a) Transmission

Transmit command [3][3] + data No. [3][0] to [3][9]. (Refer to Section 14.11.1.)

(b) Reply

The slave station sends back the alarm name corresponding to the data No.



(4) Alarm history clear

Erase the alarm history. Transmit the following communication command:

Command	Data No.	Data
[8][2]	[2][0]	1EA5

14.12.10 Current alarm

(1) Current alarm No. read

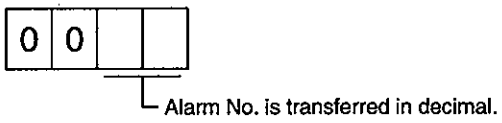
Read the alarm No. which is occurring currently.

(a) Transmission

Send command [0][2] and data No. [0][0].

(b) Reply

The slave station sends back the alarm currently occurring.



For example, "0032" means AL32 and "00FF" means AL_ (no alarm).

(2) Reading the concurrent alarm No.

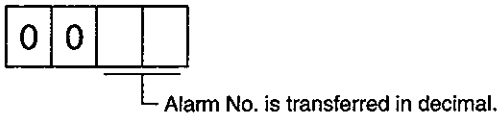
Read the concurrent alarm No.

(a) Transmission

Transmit command [0][2] + data No. [0][8].

(b) Reply

The slave station sends back the concurrent alarm.



(3) Reading the current alarm name

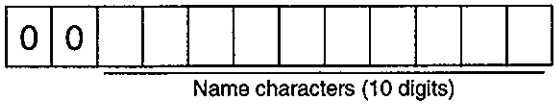
Read the name of the current alarm.

(a) Transmission

Transmit command [0][2] + data No. [0][0].

(b) Reply

The slave station sends back the current alarm.



(4) Reading the concurrent alarm name

Read the concurrent alarm name.

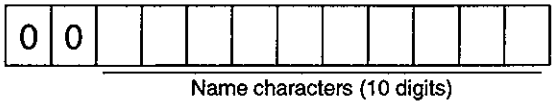
(a) Transmission

Transmit command [0][2] + data No. [0][9].

Command	Data No.
[0][2]	[0][9]

(b) Reply

The slave station sends back the concurrent alarm.



(5) Read of the status display at alarm occurrence

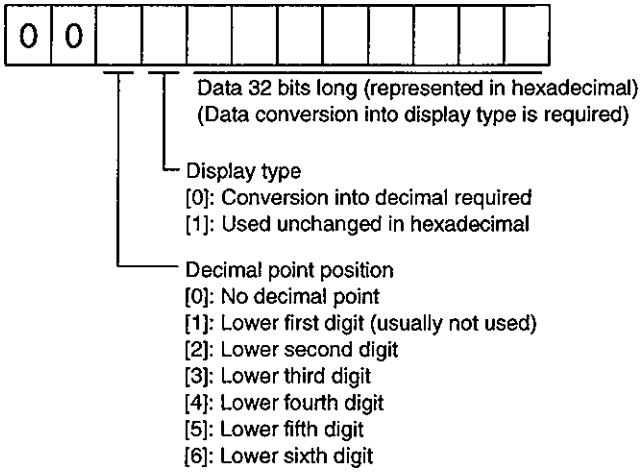
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

Send command [3][5] and any of data No. [8][0] to [8][F] corresponding to the status display item to be read. Refer to Section 14.11.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.



(6) Current alarm clear

As by the entry of the RES signal, reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Transmission

Command	Data No.	Data
[8][2]	[0][0]	1EA5

(7) Analog output of data before alarm occurrence

The status display at the time of alarm occurrence is output to pins 4, 3 of CN3 as an analog signal. Use parameter No. 46 to set the output item.

Transmit the following communication command:

Command	Data No.	Data
[8][2]	[2][0]	1EA5

14.12.11 Selection between Japanese and English

The characters representing the names of the status displays, parameters, etc. may be displayed in either Japanese or English.
Transmit the following communication command:

Command	Data No.	Data
[8][0]	[0][0]	0000: Japanese 0001: English

15. COMPLIANCE WITH THE EUROPEAN EC DIRECTIVES AND UL/C-UL STANDARD

15.1 Compliance With EC Directives

15.1.1 What are EC directives?

The EC Directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the Machinery Directive (effective in January, 1995), EMC Directive (effective in January, 1996) and Low Voltage Directive (effective in January, 1997) of the EC Directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies to machines and equipment into which servo amplifiers have been installed.
The servo amplifiers do not function independently but are designed for use with machines and equipment. Therefore, the CE marking does not apply to the servo amplifiers but applies to the machines and equipment into which the servo amplifiers are installed.
This servo amplifier conforms to the standards related to the Low Voltage Directive to facilitate CE marking on machines and equipment into which the servo amplifiers will be installed. To ensure ease of compliance with the EMC Directive, Mitsubishi Electric prepared the "EMC INSTALLATION GUIDELINES" (IB(NA)67310) which provides servo amplifier installation, control box making and other procedures. Please contact your sales representative.

15.1.2 For compliance

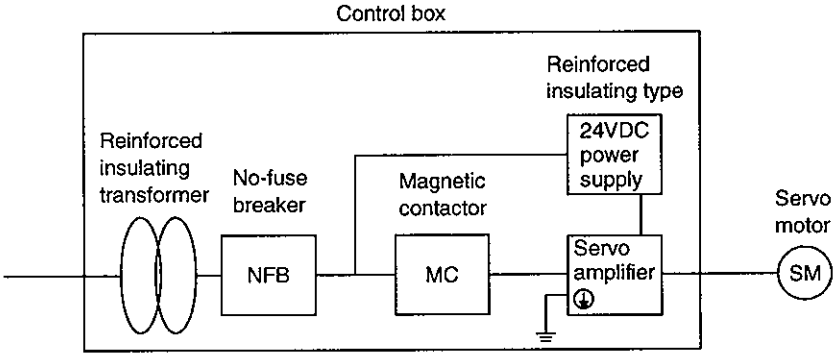
(1) Servo amplifiers and servo motors used

Use the servo amplifiers and servo motors which comply with the EN Standard.

Servo amplifier series: MR-H□AN-UE
Servo motor series : HC-MF□-UE
HA-FF□C-UE
HC-SF□
HC-RF□
HC-UF□
HC-LH□-EC

The handling, performance, specifications and other information of the EN Standard-compliant models are the same as those of the standard models unless otherwise specified.

(2) Structure



(3) Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC664. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

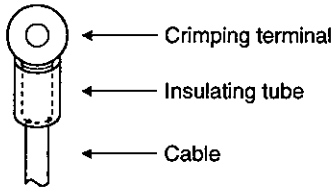
(4) Power supply

(a) Operate the servo amplifier to meet the requirements of the overvoltage category II set forth in IEC664. For this purpose, a reinforced insulating transformer conforming to the IEC or EN Standard should be used in the power input section.

(b) When supplying interface power from external, use a 24VDC power supply which has been insulation-reinforced in I/O.

(5) Wiring

(a) The cables to be connected to the terminal block of the servo amplifier must have crimping terminals provided with insulating tubes to prevent contact with adjacent terminals.



(b) Use a fixed terminal block to connect the power supply lead of the servo motor to the servo amplifier. Do not connect cables directly.

(c) Use the servo motor side power connector which complies with the EN Standard. The EN Standard-compliant power connector sets are available from us as options.

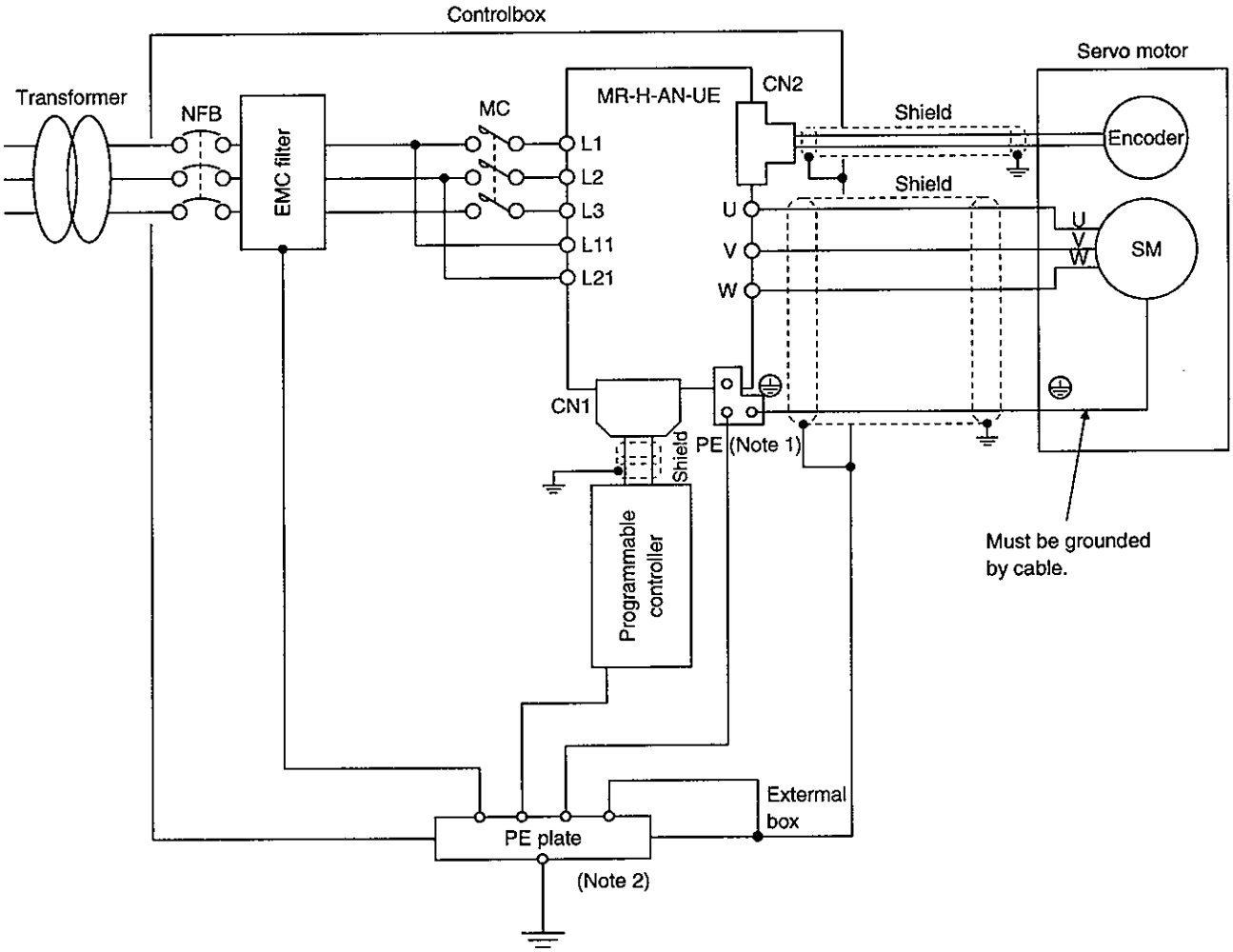
(6) Noise reduction techniques

Use the EMC filter for noise reduction. The radio noise filter (FR-BIF) is not required.

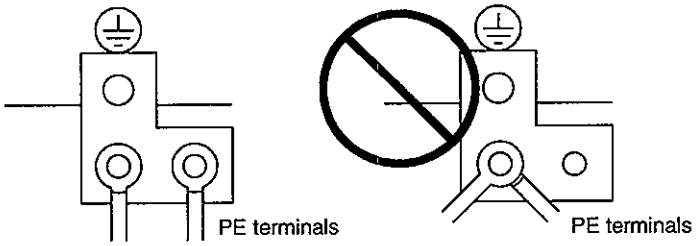
(7) Grounding

> **⚠ WARNING**
> • Securely ground the servo amplifier and servo motor.
> • To prevent an electric shock, the protective earth (PE) terminal (marked ⏚) of the servo amplifier must be connected to the protective earth (PE) of the control box.

The servo amplifier switches the power transistor to supply power to the servo motor. Depending on the routing of the wiring and ground cables, the servo amplifier may be affected by the switching noises (due to di/dt and dv/dt) of the transistor.
To prevent such a fault, refer to the following diagram and use the thickest possible ground cables ($3.5mm^2$ or larger preferable), such as flat mesh copper cables, to securely ground the servo amplifier and servo motor.
Even when a leakage current breaker is used, always earth the protective earth (PE) terminal of the servo amplifier to prevent an electric shock.



Note: 1. Do not connect two ground cables to the same protective earth (PE) terminal as shown at right below. Always connect cables to the terminals one-to-one as shown at left:



2. For the grounding of the control box, refer to EN60204.

(8) Cables, No-Fuse Breakers, Magnetic Contactors, Power Factor Improving Reactors

Always use the EN/IEC Standard compliant products specified in this section or their equivalent products compliant with the EN/IEC Standard.

Servo Amplifier	(Note 4) No-Fuse Breaker	(Note 4) Magnetic Contactor	(Note 1) Cables [mm^2]					Power Factor Improving Reactor FR-BAL
			L1 · L2 · L3	(Note 2) U · V · W ⏚	L11 · L21	(Note 3) P · C	Electro-magnetic Brake	
MR-H10AN-UE	Type NF30 5A	S-N10	2	1.25	2	2	1.25	FR-BAL-0.4K
MR-H20AN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-0.4K
MR-H40AN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-0.75K
MR-H60AN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-1.5K
MR-H100AN-UE	Type NF30 15A	S-N10	2	2	2	2		FR-BAL-2.2K
MR-H200AN-UE	Type NF30 20A	S-N18	3.5	3.5	2	2		FR-BAL-3.7K
MR-H350AN-UE	Type NF50 30A	S-N25	5.5	(Note5) 5.5	2	2		FR-BAL-7.5K
MR-H500AN-UE	Type NF50 50A	S-N35	5.5	5.5	2	2		FR-BAL-11K
MR-H700AN-UE	Type NF100 75A	S-K50	8	8	2	3.5		FR-BAL-15K
MR-H11KAN-UE	Type NF100 100A	S-K65	14	22	2	5.5		FR-BAL-15K
MR-H15KAN-UE	Type NF225 125A	S-K95	22	30	2	5.5		FR-BAL-22K
MR-H22KAN-UE	Type NF225 175A	S-K125	50	60	2	5.5		FR-BAL-30K

Note: 1. Cables are based on the 600V vinyl cables.

The cable sizes listed above conform to EN60204 under the following conditions:

- Ambient temperature 40°C
- PVC (polyvinyl chloride) sheath
- Run on wall surface or in open cable tray

When the cables in compliance with EN60204 are to be used under the conditions other than the above, refer to Table 5 and Appendix C in EN60204.

2. The values assume that the distance between the servo motor and servo amplifier is 30m max.
3. The cables for connection of the regenerative brake option (P · C) should be twisted for wiring.
4. Use the no-fuse breaker and magnetic contactor of the above type or capacity in conformity with the EN/IEC Standard or equivalent.
5. 3.5mm^2 for use of the HC-RF203 servo motor.

(9) Performing EMC tests

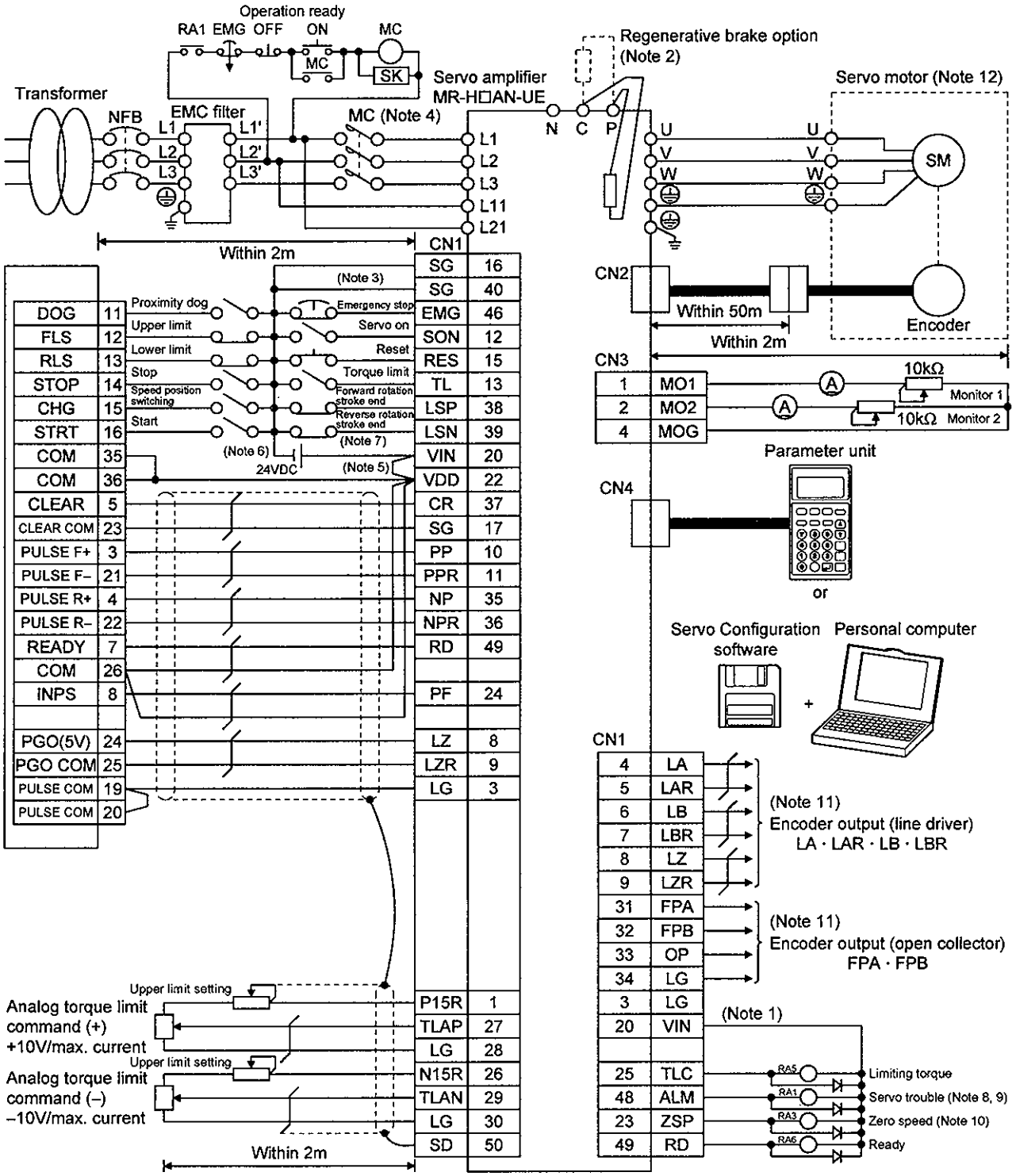
When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

For the way of dealing with the EMC Directive on servo amplifiers, refer to the "EMC INSTALLATION GUIDELINES".

15.1.3 Standard connection examples

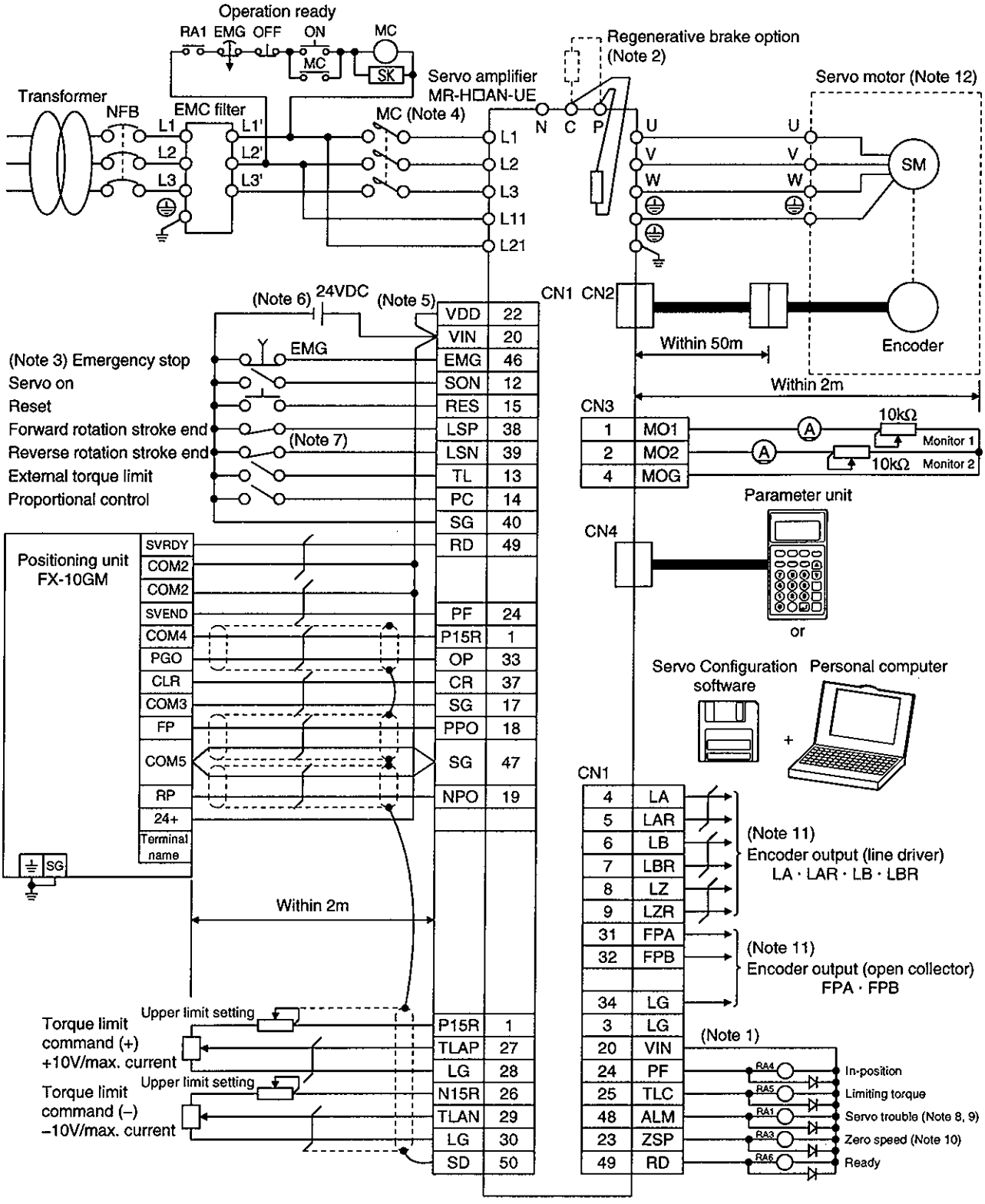
(1) Position control mode

(a) AD75 (A1SD75)



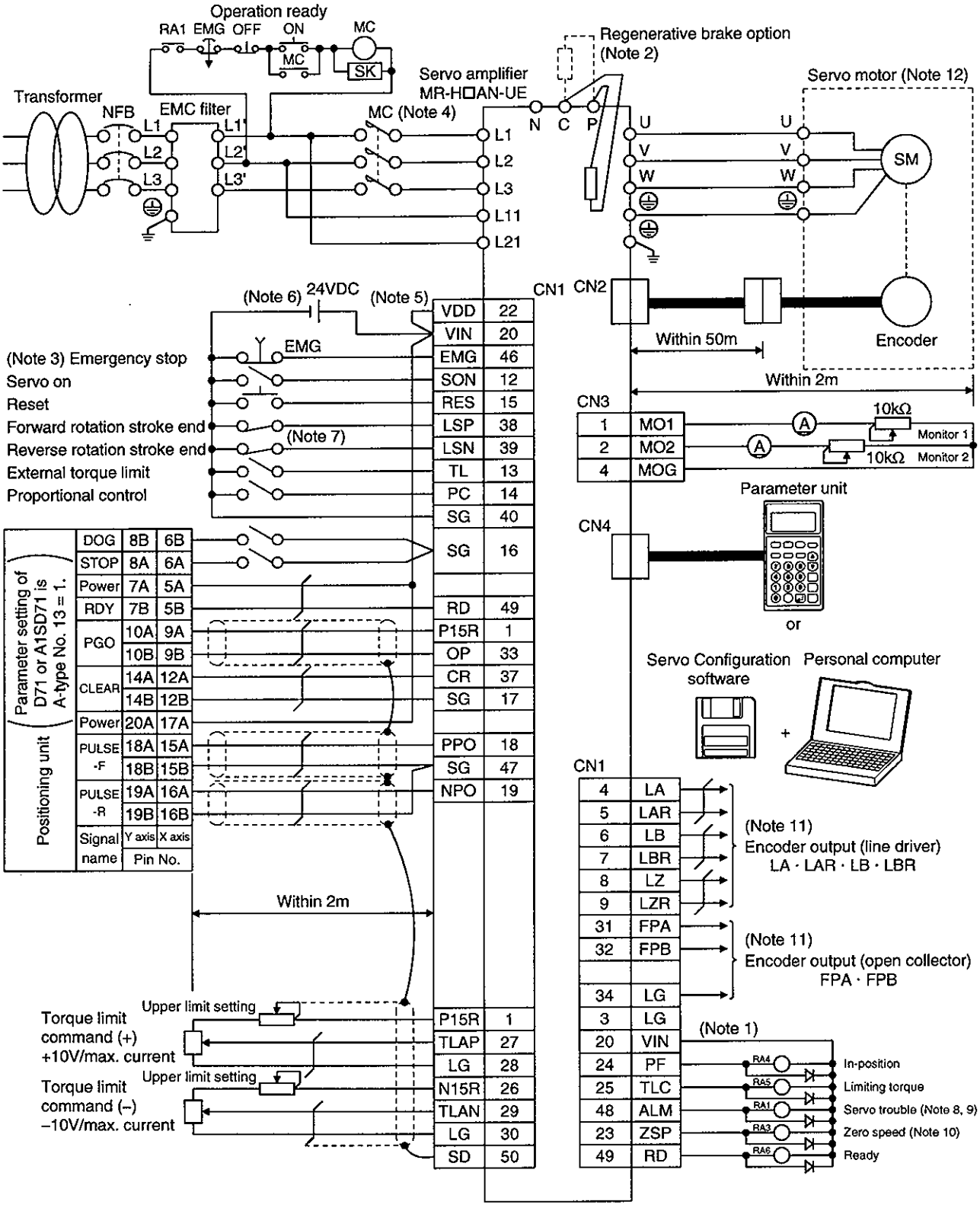
For the notes, refer to page 15-8.

(b) FX-10GM



For the notes, refer to page 15-8.

(c) AD71 (A1SD71)



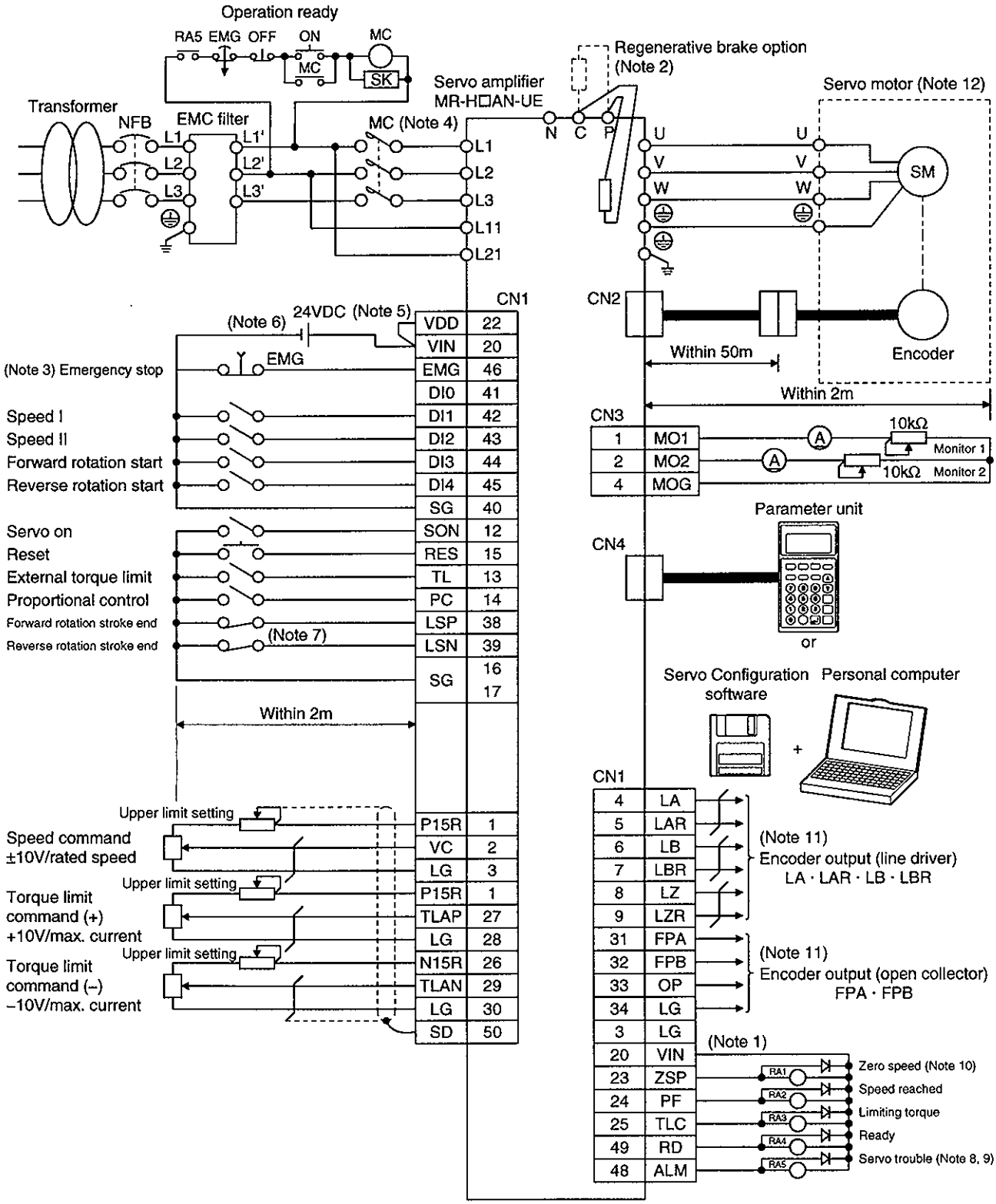
For the notes, refer to page 15-8.

Note: 1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
2. Connect the regenerative brake option across terminals P-C after removing the lead of the built-in regenerative brake resistor from P-C.
3. The emergency stop switch must be installed.
4. Configure up the power circuit which switches off the magnetic contactor after detection of an alarm.
5. The MR-H□AN-UE does not contain an internal power supply for interface. Always connect an external power supply across VIN-SG. At this time, also connect VDD-VIN. When using the MR-H-D01 option card, also connect VDD-VIND externally.
6. Use a 24VDC power supply which is enhanced in I/O insulation.
7. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG.
8. ALM-SG are connected in a normal status, i.e. when there is no alarm.
9. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
10. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
11. The following encoder pulses are output:
(a) Division ratio setting
Output pulses = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF-UE · HA-FF□C-UE HC-UF3000 r/min	2048
HC-SF · HC-RF HC-UF2000 r/min HA-LH-EC	4096

(b) Output pulse setting
Output pulses = (1 to 32768)/4 [pulse/rev]
12. Connection for the HC-MF-UE series. For connection of the other motor, refer to Section 3.8.

(2) Speed control mode



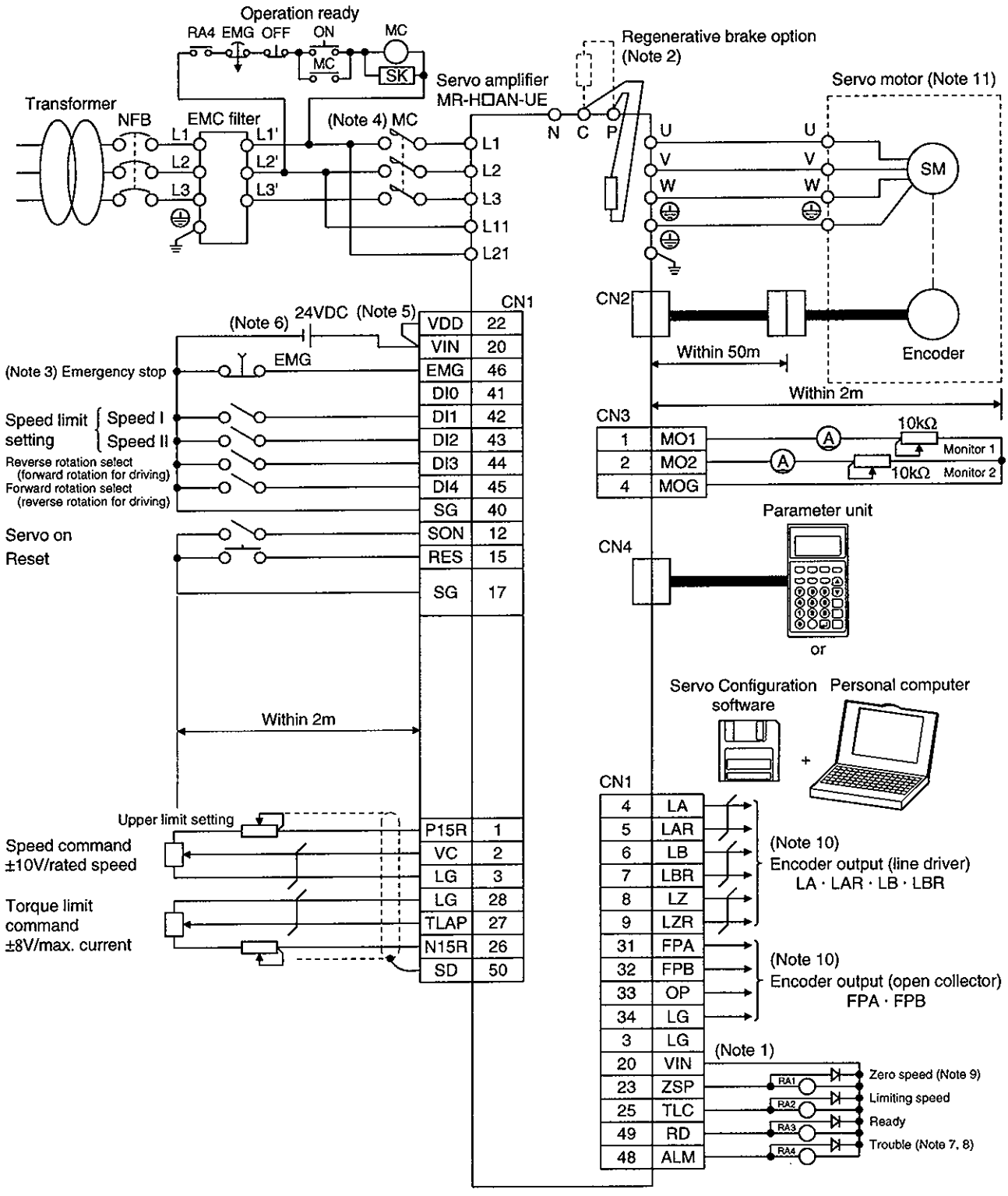
For the notes, refer to the next page.

Note: 1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
2. Connect the regenerative brake option across terminals P-C after removing the lead of the built-in regenerative brake resistor from P-C.
3. The emergency stop switch must be installed.
4. Configure up the power circuit which switches off the magnetic contactor after detection of an alarm.
5. The MR-H□AN-UE does not contain an internal power supply for interface. Always connect an external power supply across VIN-SG. At this time, also connect VDD-VIN. When using the MR-H-D01 option card, also connect VDD-VIND externally.
6. Use a 24VDC power supply which is enhanced in I/O insulation.
7. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG.
8. ALM-SG are connected in a normal status, i.e. when there is no alarm.
9. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
10. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
11. The following encoder pulses are output:
(a) Division ratio setting
Output pulses = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF-UE · HA-FF□C-UE HC-UF3000 r/min	2048
HC-SF · HC-RF HC-UF2000 r/min HA-LH-EC	4096

(b) Output pulse setting
Output pulses = (1 to 32768)/4 [pulse/rev]
12. Connection for the HC-MF-UE series. For connection of the other motor, refer to Section 3.8.

(3) Standard connection example in torque control operation mode



For the notes, refer to the next page.

Note: 1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
2. Connect the regenerative brake option across terminals P-C after removing the lead of the built-in regenerative brake resistor from P-C.
3. The emergency stop switch must be installed.
4. Configure up the power circuit which switches off the magnetic contactor after detection of an alarm.
5. The MR-H□AN-UE does not contain an internal power supply for interface. Always connect an external power supply across VIN-SG. At this time, also connect VDD-VIN. When using the MR-H-D01 option card, also connect VDD-VIND externally.
6. Use a 24VDC power supply which is enhanced in I/O insulation.
7. ALM-SG are connected in a normal status, i.e. when there is no alarm.
8. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
9. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
10. The following encoder pulses are output:
(a) Division ratio setting
Output pulses = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF-UE · HA-FF□C-UE HC-UF3000 r/min	2048
HC-SF · HC-RF HC-UF2000 r/min HA-LH-EC	4096

(b) Output pulse setting
Output pulses = (1 to 32768)/4 [pulse/rev]
11. Connection for the HC-MF-UE series. For connection of the other motor, refer to Section 3.8.

15.2 Conformance With UL/C-UL Standard

15.2.1 Servo amplifier and servo motor used

Use the UL/C-UL Standard-compliant model of servo amplifier and servo motor. The 11kW and higher servo amplifiers will be certified by the UL/C-UL Standard soon, and the UL/C-UL Standard-compliant models of the HA-LH702 to HA-LH22K2 will be released soon.

Servo amplifier series : MR-H10AN-UE to MR-H700AN-UE
Servo motor series : HC-MF□-UE
HA-FF□C-UE
HC-SF□
HC-RF□
HC-UF□

Unless otherwise specified, the handling, performance, specifications, etc. of the UL/C-UL Standard-compliant models are the same as those of the standard models.
When using the options and auxiliary equipment, use those which conform to the UL/C-UL Standard.
To comply with the UL/C-UL Standard, strictly observe the following:

15.2.2 Installation

Install a fan of 100CFM air flow 10.16[cm] (4[in]) above the servo amplifier or provide cooling of at least equivalent capability to ensure that the ambient temperature conforms to the environment conditions.

15.2.3 Power supply capacity

(1) Short circuit rating

This servo amplifier conforms to the circuit whose peak current is limited to 5000A or less. Having been subjected to the short-circuit tests of the UL in the alternating-current circuit, the servo amplifier conforms to the above circuit.

(2) Capacitor discharge time

The capacitor discharge time exceeds 1 minute. To ensure safety, do not touch the charging section for 10 minutes after power-off.

15.2.4 Wires

Always use the wires specified in this section.

Servo Amplifier	(Note 1) Wire[mm^2]				
	L1 · L2 · L3	(Note 2) U · V · W · ⏚	L11 · L21	(Note 3) P · C	Electromagnetic Brake
MR-H10AN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	1.25(AWG 16)
MR-H20AN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H40AN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H60AN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H100AN-UE	2(AWG 14)	2(AWG 14)	2(AWG 14)	2(AWG 14)	
MR-H200AN-UE	3.5(AWG 12)	3.5(AWG 12)	2(AWG 14)	2(AWG 14)	
MR-H350AN-UE	5.5(AWG 10)	(Note 4) 5.5(AWG 10)	2(AWG 14)	2(AWG 14)	
MR-H500AN-UE	5.5(AWG 10)	5.5(AWG 10)	2(AWG 14)	2(AWG 14)	
MR-H700AN-UE	8(AWG 8)	8(AWG 8)	2(AWG 14)	3.5(AWG 12)	

Note: 1. The wires are based on 600V vinyl cables.
2. The values assume that the distance between the servo motor and servo amplifier is 30m max.
3. Twist the regenerative brake option (P · C) cables.
4. 3.5mm^2 (AWG12) for use of the HC-RF203 servo motor.

15.2.5 Crimping terminals and crimping tools

When connecting the wires to the terminal block, always use AMP's crimping terminals specified in this section or UL Standard-compliant products.
For symbols a to e in the list, refer to the table at right.

Servo Amplifier	Crimping Terminals, Crimping Tools			
	L1 · L2 · L3	U · V · W · ⏚	L11 · L21	P · C
MR-H10AN-UE	a	a	a	a
MR-H20AN-UE	a	a	a	a
MR-H40AN-UE	a	a	a	a
MR-H60AN-UE	a	a	a	a
MR-H100AN-UE	a	a	a	a
MR-H200AN-UE	b	b	a	a
MR-H350AN-UE	b	b	a	a
MR-H500AN-UE	b	b	c	a
MR-H700AN-UE	e	e	d	d

Symbol	(Note) Type	
	Crimping Terminals	Crimping Tools
a	32959	47387
b	32968	59239
c	32957	47387
d	171517-1	59239
e	322128	59974-1 (body) 48752-0 (dies)
f	52042	69040 (body) 69066 (head) 48859 (dies)
g	322153	59974-1 (body) 48753-0 (dies)

Note: AMP make

15.2.6 Fuses

When using a fuse, it must be the one specified in this section or its equivalent compliant with the UL/C-UL Standard.

Servo Amplifier	Fuse			
	Type (Maker)	Class	Current [A]	Voltage
MR-H10AN-UE	NON-10(Buss) or OT10(Gould)	K5	10	250VAC
MR-H20AN-UE	NON-10(Buss) or OT10(Gould)	K5	10	
MR-H40AN-UE	NON-15(Buss) or OT15(Gould)	K5	15	
MR-H60AN-UE	NON-20(Buss) or OT20(Gould)	K5	20	
MR-H100AN-UE	NON-25(Buss) or OT25(Gould)	K5	25	
MR-H200AN-UE	NON-40(Buss) or OT40(Gould)	K5	40	
MR-H350AN-UE	NON-70(Buss) or OT70(Gould)	K5 or H	70	
MR-H500AN-UE	NON-125(Buss) or OT125(Gould)	K5 or H	125	
MR-H700AN-UE	NON-150(Buss) or OT150(Gould)	K5 or H	150	

15.2.7 Terminal block tightening torque

The following torques are recommended to tighten screws to the terminal blocks. For the screw size of each terminal block, refer to Section 11.2.

Screw size		M3.5	M4	M5	M6
Recommended tightening torque value	[N·cm]	0.8	1.2	2.0	2.5
	[lb·in]	8	11	20	24

15.2.8 Standard connection example

Same as in Section 15.1.3.

15.3 Signals

15.3.1 Main circuit terminal block

Note that the power supply symbols of the MR-H□AN-UE given on the terminal block are different from those of the standard models. What the symbols R, S, T, R1 and S1 used in other than this chapter indicate are the same as what L1, L2, L3, L11 and L21 indicate.

Signal Name	Power Supply Symbols	
	MR-H□AN	MR-H□AN-UE
Main circuit power supply	R · S · T	L1 · L2 · L3
Control circuit power supply	R1 · S1	L11 · L21

The position and signal arrangement of the terminal block depend on the servo amplifier capacity. Refer to Section 13.2.1.

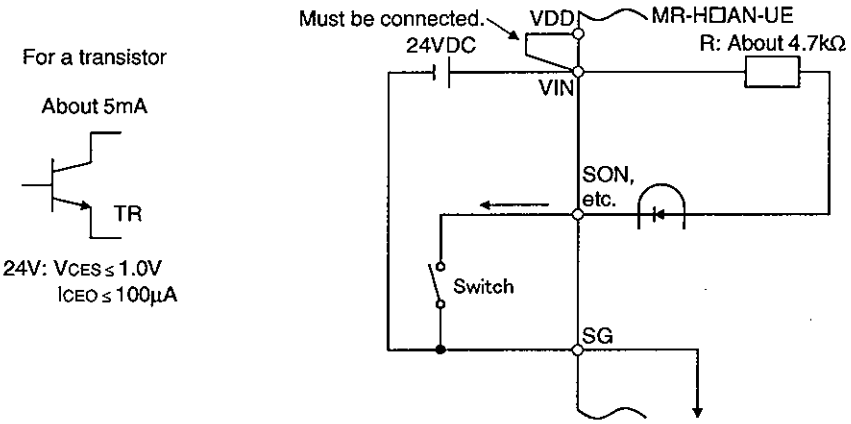
Symbol	Signal	Description
L1, L2, L3	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to L1, L2, L3. For MR-H700□AN-UE or more, the voltage of 50Hz power is 200 to 220V.
U, V, W	Servo motor output	Servo motor power output terminals Connect to the servo motor power supply terminals (U, V, W).
L11, L21	Control circuit power supply	Control circuit power input terminals L11 and L21 should be in phase with L1 and L2, respectively. Connect a single-phase 200 to 230VAC, 50/60Hz power supply. For MR-H700□AN-UE or more, the voltage of 50Hz power is 200 to 220V.
P, C, D	Regenerative brake	Regenerative brake option connection terminals In the MR-H-400AN-UE to MR-H700AN-UE, the built-in regenerative brake resistor is factory-connected across P-C. When using the regenerative brake option, brake unit or power return converter, always connect it after removing the wiring of the built-in regenerative brake resistor connected across P-C. For MR-H11KAN-UE or more, always connect the supplied regenerative brake resistor across P-C.
MS1 · MS2	Servo motor fan	Servo motor fan power supply terminals Connect to the cooling fan which is built in the HA-LH11K2-EC to HA-LH22K2-EC servo motors. Provided for the servo amplifiers of MR-H11KAN-UE or more.
⏚	Grounding	Ground terminal Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.

15.3.2 Interfaces

(1) Digital input interface DI-1

Always use an external power supply.

Provide a signal using a relay or open collector transistor.

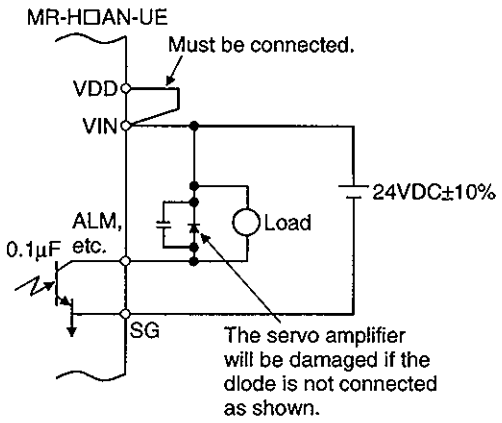


(2) Digital output interface DO-1

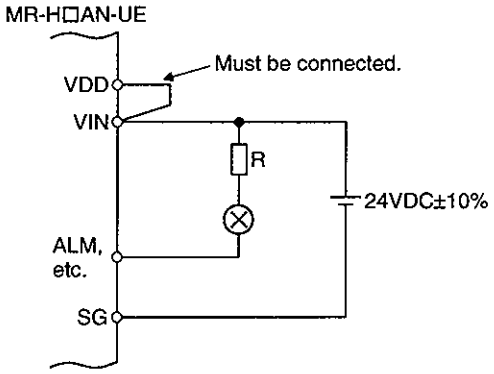
Always use an external power supply.

Can drive a lamp, relay or photocoupler. Provide absorbers (D, C) for an inductive load or an inrush current suppressing resister (R) for a lamp load. (Permissible current: 50mA or less, inrush current: 100mA or less)

· Inductive load



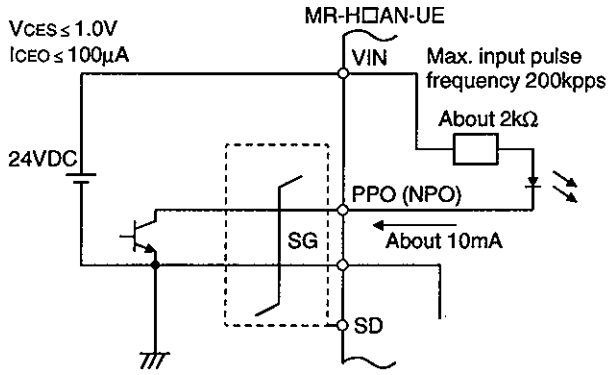
· Lamp load



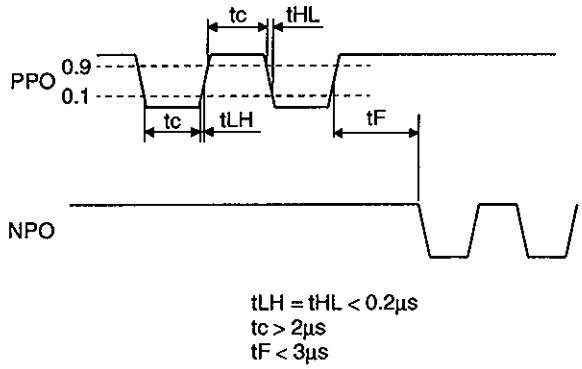
(3) Pulse train input interface DI-2

(a) Open collector system

· Interface example



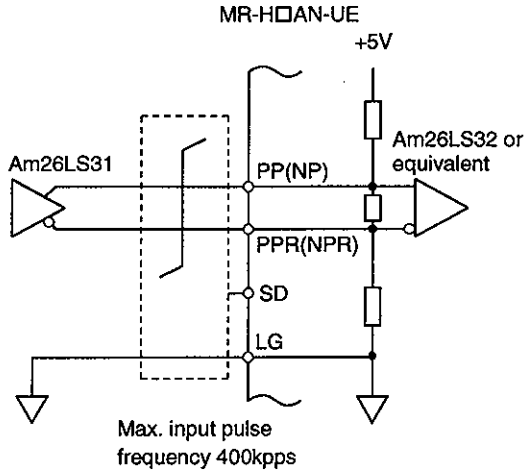
· Input pulse conditions



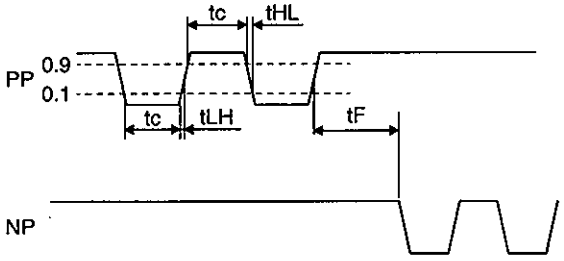
tLH = tHL < 0.2μs
tc > 2μs
tF < 3μs

(b) Differential line driver system

· Interface example



· Input pulse conditions



tLH = tHL < 0.1μs
tc > 1μs
tF < 3μs

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision
Sep.,1998	SH(NA)3190-A	First edition
Sep.,1999	SH(NA)3190-B	Sentences of compliance with the European EC Directives changed. Section 1.3.1 : Rating plate changed. Section 1.3.2 : Model number addition Section 1.4 : Note for servo amplifier and servo motor combinations changed. Section 1.5.1 : Section 3.6 (4) in detailed description column changed to Section 3.6.2 (6). Section 1.5.2 : Main circuit terminal's abbreviation TE2 added. Section 1.5.3 : Main circuit terminal's abbreviation TE2 added. Section 2.4 : Sentence in (2) modified. Chapter 3 : Sentence in WARNING changed. Section 3.1.1(1) : Sentence in Note 4 changed. Section 3.1.2 : Analog speed command of 10V in connection diagram changed to 0 to ±10V. Sentence in Note 4 changed. Section 3.1.3 : Sentence in Note 4 changed. Section 3.2 : Figure change Section 3.3.1 : Sentence deleted. POINT added. Section 3.3.1 : Sentences in Note changed and added. Section 3.3.2 (1) : Sentences in Function/Application modified. Section 3.3.2 (4) : Connections and waveforms added. Section 3.4.1 (1)(a) : Reverse rotation pulse train added. Section 3.4.2 (3) : 3.4.1 (1) for torque limit value changed to 3.4.1 (2). Section 3.4.3 (1)(a) : Sentences added, Note deleted. Section 3.4.2 (2)(a) : Sentence addition Section 3.6.2 (2) : Figure change Section 3.6.2 (4) : Figure change Section 3.7.1 : External dynamic brake added. Sentences added to Note. Section 3.7.2 : Addition of reference to Sections 13.1.2 to 13.1.4 for terminal explanation Section 4.2.2 (7) : Sentence addition Section 4.2.3 (7) : Sentence addition Section 4.2.4 (6) : Sentence addition Section 5.2 (3) : □□□1 in parameter setting changed to 1□□□. Section 5.4 : RA4 deleted. Section 5.5 : Section 3.2.1 (1)(a) changed to Section 3.3.2. Section 5.6 (4)(c) : MR-PRU deleted. Section 7.2 changed to Section 5.9. Section 5.9 changed to Section 5.10. Section 5.8.2 : Changed to MELSEC FX2(N)-32MT (FX2(N)-1PG). Section 5.8.2 (1)(a) : FX2-32MT (FX2-1PG) added. Section 5.8.2 (1)(b) : FX2N-32MT (FX2N-1PG) added. Section 5.8.2 (2)(b) : T204 ABS data waiting timer added and M58 and M59 for checksum comparison added to Device list. Section 5.8.2 (2)(c) : Changed to 1PG home position address set in X-axis ABS data transfer program. Section 5.8.2 (2)(c) : ABS check error added to X-axis ABS data transfer program. Section 5.8.2 (2)(c) : ABS data waiting timer added to X-axis ABS data transfer program. Section 5.9.1 : Section 3.2 changed to Section 7.2. Section 5.10.1 (1) : Section 12.2.2 changed to Section 10.2.2. Section 6.1.2 (1) : Option parameters No. 65 to No. 79 added.

Print Data	*Manual Number	Revision
		Section 6.1.2 (1) : Section 6.2.4 changed to Section 6.2.4 and Refer to Section 13.1 deleted in parameter No. 21. Section 6.1.2 (1) : Sentence for function selection changed in parameter No. 41. Section 6.2.1 (2) : Addition of setting for use of AD75P. Section 6.2.1 : CDV value changed to 50000. Section 7.6.1 (1) : Note addition. Section 8.3.2 : POINT added to valid conditions. Section 8.4.2 (2)(b) : 5) to 7) added to Adjustment 2. Section 8.4.3 (2) : 3), 7) and 8) added to Adjustment procedure. Chapter 9 : CAUTION changed to WARNING. Section 10.2.1 : Sentences modified, table modified, Note 2 added. Section 10.2.2 : Addition of "Refer to Section 9.2.1 for details" to POINT. Section 10.2.2 : Part of description of Alarm No. 50 deleted. Section 10.2.2 : Addition made to description of Alarm No. 50. Section 10.2.3 : Sentences modified. Section 12.1 : Sentence addition. Section 13.1.2 (2) 1) :Sentence modified to Section 5.1 of separately available Servo Motor Instruction Manual. Section 13.1.2 (4) 2) : Note 1 and 3 deleted. Section 13.1.4 (2) : Connection example modified. Section 13.1.6 (1) : Sentence added. HA-FF added to the figure. Section 13.1.6 (1) : 3) Connector type name in table changed. Section 13.1.6 (2)(b) : Encoder connector and signals changed in 2) Connection diagram. Section 13.1.6 (2)(c) : Encoder connector and signals changed in 2) Connection diagram. Section 13.1.6 (2)(d) : Encoder connector "CONT" changed to "CNT" in 2) Connection diagram. Section 13.1.6 (2)(e) : Encoder connector "CONT" changed to "CNT" in (e) When using MR-HCNM. Section 13.1.7 (1) : Section 15.2.6 changed to Section 13.2.6. Section 13.1.7 (2) : Changed to Terminal block. Sentences changed. Section 13.2.1 (1) : Note added to the wire size in 3) of MR-H350AN. Section 14.1 (2) :Cable connection diagram modification, Note 4 addition. Section 14.1.1 (1) :Status display table change. Section 14.1.1 (2) :Data No. changed to [4][F], contents modified. Section 14.1.1 (3) :Alarm history table change. Section 14.1.1 (4) :Current alarm table change. Section 14.1.1 (5) :External output signal table change. Section 14.1.1 (4) :Data No. changed to [4][F], contents modified. Section 14.1.1 (6) :DO forced output table contents changed. Detailed description of commands added. External input signal ON/OFF sentence addition. Section 14.12.6 (1) : Table addition Section 14.12.6 (2) : Sentence modification Section 14.12.6 (3) :(a)Sentence addition Section 14.12.6 (4) : Sentence addition Section 14.12.9 (1) :(b)Example deleted, sentence added. Section 14.12.10 (1) :(b)Example deleted, sentence added. Section 15.2.7 : Table modification