MITSUBISHI

General-Purpose AC Servo

MELSERVO-**H** Series

**General-Purpose Interface
MR-H□BN
Servo Amplifier
Instruction Manual**

MITSUBISHI ELECTRIC B

● Safety Instructions ●

(Always read these instructions before using the equipment.)

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

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions,, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions,, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols:

⊘ : Indicates what must not be done. For example, "No Fire" is indicated by ⊗.
● : Indicates what must be done. For example, grounding is indicated by ⏚.

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this installation guide, always keep it accessible to the operator.

1. To prevent electric shock, note the following:

⚠ CAUTION

* Before wiring or inspection, switch power off and wait for more than 10 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.

* Connect the servo amplifier and servo motor to ground.

* Any person who is involved in wiring and inspection should be fully competent to do the work.

* Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.

* Operate the switches with dry hand to prevent an electric shock.

* The cables should not be damaged, stressed loaded,, or pinched. Otherwise, you may get an electric shock.

* During power-on or operation, do not open the front cover. You may get an electric shock.

* Do not operate the servo amplifier with the front cover removed. High-voltage terminals and charging area are exposed and you may get an electric shock.

* Except for wiring or periodic inspection, do not remove the front cover even if the power is off. The servo amplifier is charged and you may get an electric shock.

2. To prevent fire, note the following:

⚠ CAUTION

* Do not install the servo amplifier, servo motor and regenerative brake resistor on or near combustibles. Otherwise a fire may cause.

* When the servo amplifier has become faulty, switch off the main servo amplifier power side. Continuous flow of a large current may cause a fire.

* When a regenerative brake resistor is used, use an alarm signal to switch main power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor, causing a fire.

3. To prevent injury, note the follow

⚠ CAUTION

* Only the voltage specified in the Instruction Manual should be applied to each terminal,, Otherwise,, a burst,, damage, etc. may occur.

* Connect the terminals correctly to prevent a burst,, damage,, etc.

* Ensure that polarity (+, −) is correct. Otherwise, a burst, damage, etc. may occur.

* During power-on or for some time after power-off, do not touch the servo amplifier fins, regenerative brake resistor, servo motor, etc. Their temperatures may be high and you may get burnt.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a fault, injury, electric shock, etc.

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their weights.
- Use the eye-bolt of the servo motor to only transport the servo motor and do not use it to transport in the condition to have installed a servo motor on the machine.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the servo amplifier. The servo amplifier may drop.
- Install the servo amplifier in a load-bearing place in accordance with the Instruction Manual.
- Do not climb or stand on servo equipment. Do not put heavy objects on equipment.
- The servo amplifier and servo motor must be installed in the specified direction.
- Leave specified clearances between the servo amplifier and control enclosure walls or other equipment.
- Do not install or operate the servo amplifier and servo motor which has been damaged or has any parts missing.
- Do not block the intake/exhaust port of the servo motor which has a cooling fan.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier.
- Do not drop or strike servo amplifier or servo motor. Isolate from all impact loads.
- Use the servo amplifier and servo motor under the following environmental conditions:

| Environment		Conditions			
		Servo Amplifier	Servo Motor		
Ambient temperature	[°C]	0 to +55 (non-freezing)	0 to +40 (non-freezing)		
	[°F]	32 to 131 (non-freezing)	32 to 104 (non-freezing)		
Ambient humidity		90%RH or less (non-condensing)	80%RH or less (non-condensing)		
Storage temperature	[°C]	−20 to +65 (non-freezing)	−15 to +70 (non-freezing)		
	[°F]	−4 to 149 (non-freezing)	5 to 158 (non-freezing)		
Storage humidity		90%RH or less (non-condensing)			
Ambience		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt			
Altitude		Max. 1000m (3280 ft) above sea level			
Vibration	$[m/s^2]$	5.9 {0.6G} or less	HC-MF Series HA-FF Series HC-UF 13 to 73	X · Y : 49 {5G}	
			HC-SF81 HC-SF52 to 152 HC-SF53 to 153 HC-UF 72 · 152	X · Y : 24.5 {2.5G}	
			HC-SF121 · 201 HC-SF202 · 352 HC-SF203 · 353 HC-UF202	X : 24.5 {2.5G} Y : 49 {5G}	
			HC-SF301	X : 24.5 {2.5G} Y : 29.4 {3G}	
	$[ft/s^2]$	19.4 or less	HC-MF Series HA-FF Series HC-UF 13 to 73	X · Y : 64	
			HC-SF81 HC-SF52 to 152 HC-SF53 to 153 HC-UF 72 · 152	X : 32 Y : 80	
			HC-SF121 · 201 HC-SF202 · 352 HC-SF203 · 353 HC-UF202	X : 64 Y : 161	
			HC-SF301	X : 38 Y : 96	

⚠ CAUTION

- Securely attach the servo motor to the machine. If attach insecurely, the servo motor may come off during operation.

- The servo motor with reduction gear must be installed in the specified direction to prevent oil leakage.

- For safety of personnel, always cover rotating and moving parts.

- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.

- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.

- When the equipment has been stored for an extended period of time, consult Mitsubishi.

(2) Wiring

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate..

- Do not install a power capacitor, surge absorber or radio noise filter (FR-BIF option) between the servo motor and servo amplifier.

- Connect the output terminals (U, V, W) correctly. Otherwise, the servo motor will operate improperly.

- Do not connect AC power directly to the servo motor. Otherwise, a fault may occur.

- The surge absorbing diode installed on the DC output signal relay must be wired in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.

Servo
Amplifier

VIN
(24VDC)

Control
output
signal

RA
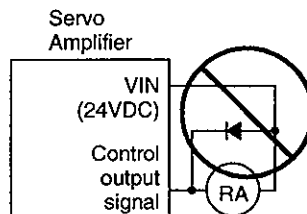
(3) Test run adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.

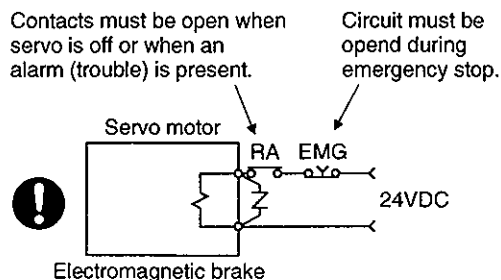- The parameter settings must not be changed excessively. Operation will be insatiable.

(4) Usage

⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.

- Any person who is involved in disassembly and repair should be fully competent to do the work.

- The STOP key of the parameter unit is only valid for test run. Provide an emergency stop key independently of the STOP key.

- Before resetting an alarm, make sure that the run signal is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.

- Do not modify the equipment.

- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo amplifier.

- Use the servo amplifier with the specified servo motor.

- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.

- For such reasons as service life and mechanical structure (e.g. where a ballscrew and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may take place at the occur due to a power failure or a product fault, use a servo motor with electromagnetic brake or an external brake mechanism for the purpose of prevention.

- Configure the electromagnetic brake circuit so that it is activated not only by the servo amplifier signals but also by an external emergency stop signal.

Contacts must be open when servo is off or when an alarm (trouble) is present.

Circuit must be opend during emergency stop.

Servo motor

RA   EMG

24VDC

Electromagnetic brake

- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.

- When power is restored after an instantaneous power failure, keep away from the machine because the machine may be restarted suddenly (design the machine so that it is secured against hazard if restarted).

(6) Maintenance, inspection and parts replacement

⚠ CAUTION
• With age, the electrolytic capacitor will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment. Please consult our sales representative.

(7) Disposal

⚠ CAUTION
• Dispose of the product as general industrial waste.

(8) General instruction

• To illustrate details, the equipment in the diagrams of this Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Instruction Manual.

COMPLIANCE WITH EC DIRECTIVES

Use the servo amplifier and servo motor compliant with the EN Standard.

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 other EMC Directive guidelines on the servo amplifier, refer to the "EMC INSTALLATION GUIDELINES" (IB (NA) 67303).

CONFORMANCE WITH UL/C-UL STANDARD

Use the servo amplifier and servo motor compliant with the UL/C-UL Standard.

Also refer to Chapter 15 and take proper steps.

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4

Optional Servo Motor Instruction Manual CONTENTS

The rough table of contents of the optional MELSERVO Servo Motor Instruction Manual is introduced here for your reference. Note that the contents of the Servo Motor Instruction Manual are not included in the Servo Amplifier Instruction Manual.

1. INTRODUCTION

2. INSTALLATION

3. CONNECTORS USED FOR SERVO MOTOR WIRING

4. INSPECTION

5. SPECIFICATIONS

6. CHARACTERISTICS

7. OUTLINE DIMENSION DRAWINGS

About the Manuals

This Instruction Manual and the MELSERVO Servo Motor Instruction Manual are required if you use the SSC-NET compatible AC servo MELSERVO-H-BN for the first time. Always purchase them and use the MELSERVO-H-BN safely.

Relevant manuals

Manual Name	Manual No.
MELSERVO-H Series TO USE THE AC SERVO SAFELY	IB(NA)67367
MELSERVO Servo Motor Instruction Manual	SH(NA)3181
EMC Installation Guidelines	IB(NA)67310

1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The Mitsubishi MELSERVO-H-BN series SSC-NET-compatible AC servo is the all-digital, intelligent AC servo which has been wholly digitized in servo control. It is connected with a motion controller, machine controller or similar device via a CPU bus and the servo amplifier reads position data directly to perform operation.

Data from a command unit controls the speed and rotation direction of the servo motor and executes precision positioning (16384 pulses/rev resolution for the HC-SF series servo motor).

A torque limit is imposed on the servo amplifier by the clamp circuit to protect the power transistor in the main circuit from overcurrent due to sudden acceleration/deceleration or overload. The torque limit value can be changed to any value with an external analog input or the parameter.

Also having the RS-232C serial communication function, the MELSERVO-H-AN allows a personal computer or similar device to be used for parameter setting, test operation status indication and monitoring etc.

The HC-MF, HA-FF, HC-SF, HC-RF and HC-UF series servo motors are equipped with an absolute position encoder as standard. Simply adding a battery to the servo amplifier configures up an absolute position detection system, and merely setting a home position once makes zeroing unnecessary at power-on, alarm occurrence or the like.

1.2 Function Block Diagram

The function block diagram of the MELSERVO-H-BN is shown on the next page.

1. FUNCTIONS AND CONFIGURATION

Regenerative brake option

MR-H-BN

Power supply
3-phase
200VAC to
230VAC

NFB MC R DS RA P N C

Servo motor

U U
V V
W W

SM

CHARGE lamp

Fan
(MR-H200BN or more)

Current detector

Dynamic brake

Regenerative brake transistor

Control power supply

B1
B2

Electro-magnetic brake
(Note)

MS1 BU
MS2 BV

Regenerative brake

Base amplifier

Voltage level detection

Overcurrent protection

Current detection

CN2

Encoder

CPU counter memory

Pulse input

Model position control

Model speed control

Virtual motor

Virtual encoder

Model position

Model speed

Model torque

Actual position control

Actual speed control

Current control

MR-BAT

CN5

Optional battery
(for absolute position)

A/D

Interface control

RS-232C D/A 12bit

CN1 CN1A CN1B CN4 CN3

Analog 2CH

Controller or servo amplifier

Servo amplifier or termination connector

Analog monitor 2CH

Parameter unit

Note: For 11kW or more

1.3 Model Name Make-Up

1.3.1 Name plate

- Model
- Capacity
- Applicable power supply
- Rated output current
- Serial number

1.3.2 Model

MR-H □ B □ □ □

Series

Compliant Standards

Symbol	Compliant Standards
None	Standard model (in Japan)
-UE	EN Standard, UL/C-UL Standard (Note)

Note: The 11kW and higher servo amplifiers will be certified by the UL/C-UL Standard.

Optional feature

Symbol	Optional feature
None	Standard feature
-P90	This symbol is affixed to indicate that the 11kW or higher servo amplifier does not need the external regenerative resistor equipped as standard because the regenerative brake option (MR-RB65 to 67), brake unit (FR-BU) or power return converter (FR-RC) is purchased.

Corresponding servo motors

Symbol	HA-MH • HA-FH HA-SH • HA-LH HA-UH	HC-MF • HA-FF HC-SF • HC-RF HC-UF
None	O	
N	O	O

SSC-NET compatible AC servo

Rated output

Symbol	Rated output [kW]	Symbol	Rated output [kW]
10	0.1	350	3.5
20	0.2	500	5
40	0.4	700	7
60	0.6	11K	11
100	1	15K	15
200	2	22K	22

1.4 Combination with Servo Motor

The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the models with electromagnetic brakes, the models with reduction gear, the EN Standard-compliant models and the UL/C-UL Standard-compliant models. For combination with the HA-MH, HA-FH, HA-SH and HA-UH series servo motors, refer to parameter No. 3 in Section 6.1.2 (2).
Consult us when using a servo motor which is equipped with a high resolution encoder of 32768 pulses/rev or 131072 pulses/rev.

Servo Amplifier	Servo Motors								
	HC-MF□	HA-FF□	(Note 2) HC-SF□			HC-RF□	(Note 1) HC-UF□		HA-LH□
			1000r/min	2000r/min	3000r/min		2000r/min	3000r/min	
MR-H10BN		053·13						13	
MR-H20BN	053·13	23							
MR-H40BN	23	33·43						23	
MR-H60BN	43	63		52	53			43	52
MR-H100BN	73		81	102	103		72	73	
MR-H200BN			121·201	152·202	153·203	103·153	152		102·152
MR-H350BN			301	352	353	203	202		202
MR-H500BN				502		353·503	352·502		302·502
MR-H700BN				702					702
MR-H11KBN									11K2
MR-H15KBN									15K2
MR-H22KBN									22K2

Note: 1. The HC-UF73 . HC-SF 203 . HC-SF 353 may not be connected depending on the production timing of the servo amplifier. Please contact us.
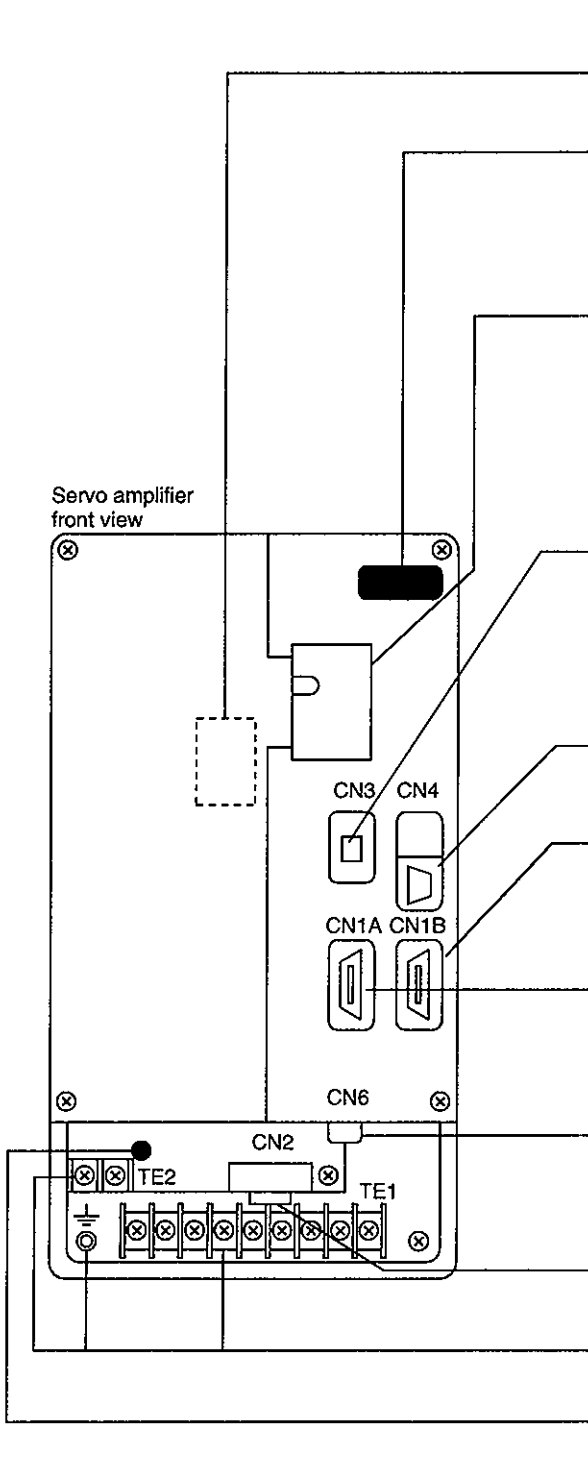
1.5 Parts Identification
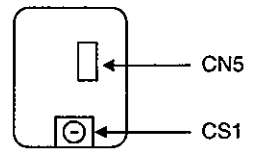
1.5.1 MR-H350BN or less

Name/Application	Refer to
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3 Chapter 10
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Switch window • CN5:Connector for connection of the battery for absolute position detection • CS1:Axis select switch	Chapter 5 Section 3.7
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.4(3) Section 6.2.1
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 3.3.1 Chapter 14
Bus cable connector (CN1A) Used to connect a bus cable which links with a controller or preceding-axis servo amplifier.	Section 3.3.1
Bus cable connector (CN1B) Used to connect a bus cable which links with a subsequent axis servo amplifier or termination connector.	Section 3.3.1
I/O signal connector (CN6) Connect the CN6 connector which comes standard. The CN6 connector is shorted between EM1-EM2. When making up an emergency stop circuit externally, open EM1-EM2 and connect an external emergency stop switch across them.	Section 3.3.1
Encoder connector (CN2) Connector for connection of the servo motor encoder.	Section 13.1.6
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section 3.5.2

Servo amplifier front view

CN3 CN4

CN1A CN1B

CN2 CN6

1. FUNCTIONS AND CONFIGURATION

1.5.2 MR-H500BN • MR-H700BN

Servo amplifier
front view

Name/Application	Refer to
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3 Chapter 10
Switch window • CN5:Connector for connection of the battery for absolute position detection • CN1:Axis select switch CN5 CS1	Chapter 5 Section 3.7
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.4(3) Section 6.2.1
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 3.3.1 Chapter 14
Bus cable connector (CN1B) Used to connect a bus cable which links with a subsequent axis servo amplifier or termination controller.	Section 3.3.1
Bus cable connector (CN1A) Used to connect a bus cable which links with a controller or preceding-axis servo amplifier.	Section 3.3.1
I/O signal connector (CN6) Connect the CN6 connector which comes standard. The CN6 connector is shorted between EM1-EM2. When making up an emergency stop circuit externally, open EM1-EM2 and connect an external emergency stop switch across them.	Section 3.3.1
Encoder connector (CN2) Connector for connection of the servo motor encoder.	Section 13.1.6
Main circuit terminal block (TE1, TE2⏚) Used to connect the input power supply and servo motor.	Section 3.5.2
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	

1. FUNCTIONS AND CONFIGURATION

1.5.3 MR-H11KBN or more

Servo amplifier
front view

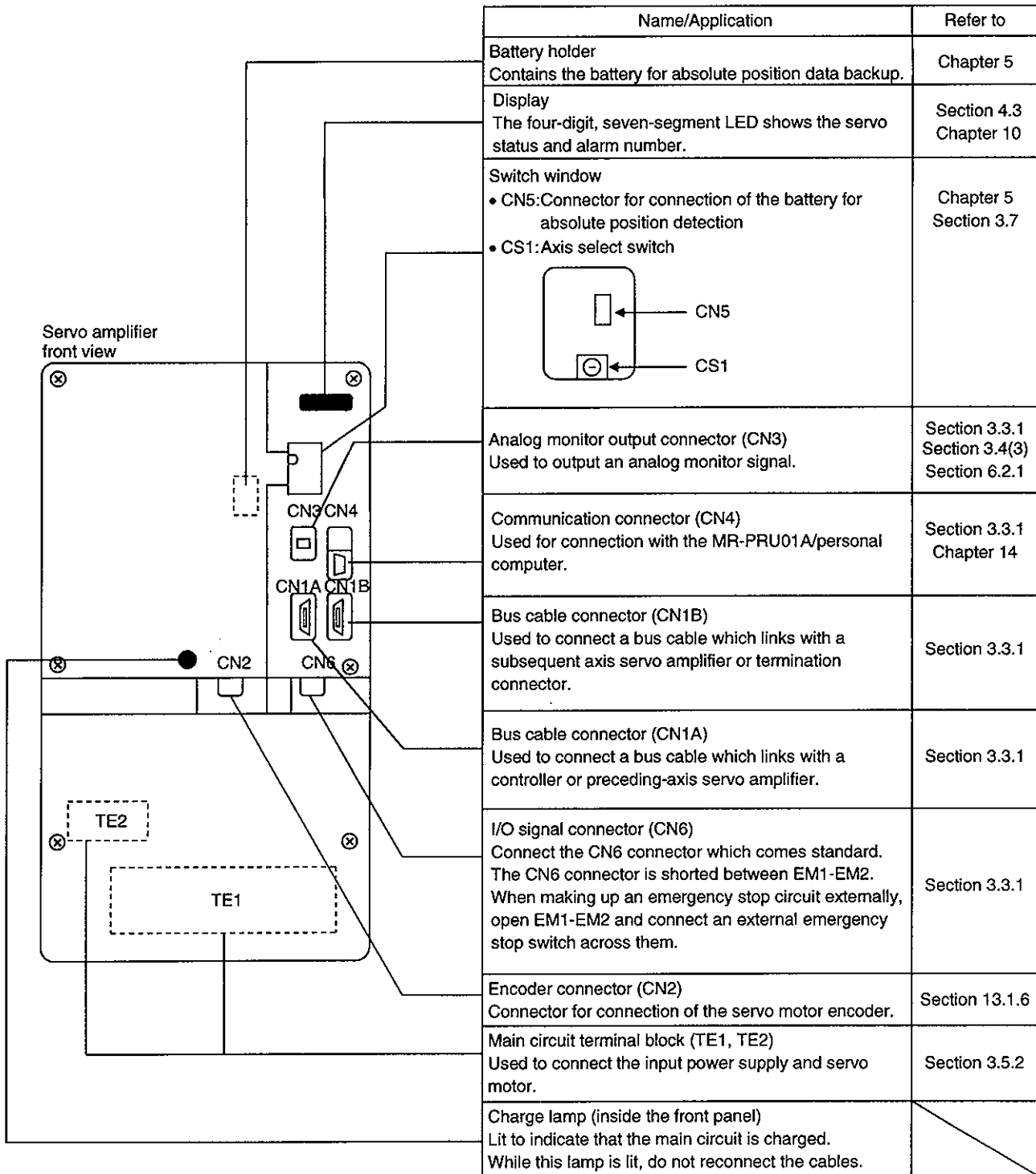| Name/Application	Refer to
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3 Chapter 10
Switch window • CN5:Connector for connection of the battery for absolute position detection • CS1:Axis select switch	Chapter 5 Section 3.7
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.4(3) Section 6.2.1
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 3.3.1 Chapter 14
Bus cable connector (CN1B) Used to connect a bus cable which links with a subsequent axis servo amplifier or termination connector.	Section 3.3.1
Bus cable connector (CN1A) Used to connect a bus cable which links with a controller or preceding-axis servo amplifier.	Section 3.3.1
I/O signal connector (CN6) Connect the CN6 connector which comes standard. The CN6 connector is shorted between EM1-EM2. When making up an emergency stop circuit externally, open EM1-EM2 and connect an external emergency stop switch across them.	Section 3.3.1
Encoder connector (CN2) Connector for connection of the servo motor encoder.	Section 13.1.6
Main circuit terminal block (TE1, TE2) Used to connect the input power supply and servo motor.	Section 3.5.2
Charge lamp (inside the front panel) Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	

CN5

CS1

CN3 CN4

CN1A CN1B

CN2   CN6

TE2

TE1

1.6 Servo System with Auxiliary Equipment

(Note 2)
Power supply
3-phase
200 to 230V

Analog meter

Regenerative
brake option

Servo amplifier
MR-H□BN

No-fuse breaker
(NFB) or fuse

Parameter unit

Magnetic
contactor
(MC)

CHARGE

Servo
Configuration
software

or

Personal
computer

+

The parameter unit or Servo
Configuration software is required for
parameter setting.

P
C
N
R
S
T
R1
S1
U
V
W

CN3   CN4   To CN3

To CN4

CN1A   CN1B   To CN1B

Subsequent axis servo
amplifier
or
termination connector

To CN1A

Servo system controller
or
preceding axis servo amplifier

CN2   CN6

Ground

To CN2

(Note 1)
MR-HCN2

To CN6

External emergency
stop switch or the like

Servo motor

Note: 1. Required when using the HC-MF, HA-FF or HC-UF3000r/min servo motor.
2. Depends on the servo amplifier capacity. Refer to Section 11.1.

2. INSTALLATION

⚠ CAUTION	• Stacking in excess of the limited number of products is not allowed. • Install the equipment to incombustibles. Installing them directly or close to combustibles will led to a fire. • Install the equipment in a load-bearing place in accordance with this Instruction Manual. • Do not get on or put heavy load on the equipment to prevent injury. • Use the equipment within the specified environmental condition range. • Provide an adequate protection to prevent screws, metallic detritus and other conductive matter or oil and other combustible matter from entering the servo amplifier. • Do not block the intake/exhaust ports of the servo amplifier. Otherwise, a fault may occur. • Do not subject the servo amplifier to drop impact or shock loads as they are precision equipment. • Do not install or operate a faulty servo amplifier. • When the product has been stored for an extended period of time, consult Mitsubishi.

2.1 Environmental conditions

| Environment	Conditions
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
Altitude	Max. 1000m (3280 ft) above sea level
Vibration	5.9 [m/s^2] {0.6G} or less
	19.4 [ft/s^2] or less

2.2 Installation direction and clearances

⚠ CAUTION	• Do not hold the front cover to transport the servo amplifier. The controller may drop. • The equipment must be installed in the specified direction. Otherwise, a fault may occur. • Leave specified clearances between the servo amplifier and control box inside walls or other equipment.

(1) Installation of one servo amplifier
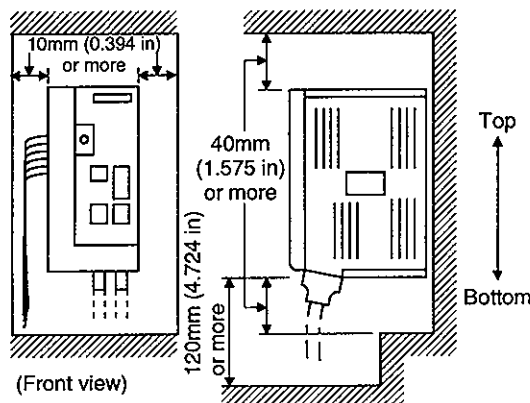
(2) Installation of two or more servo amplifiers

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box, and install a fan to prevent the internal temperature of the control box from exceeding the environmental conditions.

Reserve an at least 10mm (0.394 in.) clearance between the servo amplifiers. For the MR-H10BN to MR-H60BN, reserve an at least 15mm (0.591 in.) clearance as a wiring space.

(3) Others

When using heat generating equipment such as the regenerative brake option, install them with full consideration of heat generation so that the servo amplifier is not affected.

Install the servo amplifier on a perpendicular wall in the correct vertical direction.

2.3 Keep out foreign materials

(1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.

(2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box or a fan installed on the ceiling.

(3) When installing the control box in a place where there are toxic gas, dirt and dust, provide positive pressure in the control box by forcing in clean air to prevent such materials from entering the control box.

2.4 Cable stress

(1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.

(2) In any application where the servo motor moves, the cables should be free from excessive stress.
For use in any application where the servo motor moves, run the cables so that their flexing portions fall within the flex life range of the encoder cable.
Fix the encoder cable and power cable of the servo motor.

(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.

(4) For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to Section 12.4 for the flexing life.
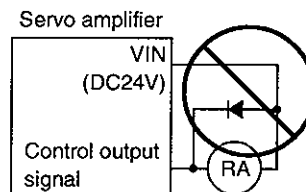
3. SIGNALS AND WIRING

⚠ WARNING	• Any person who is involved in wiring should be fully competent to do the work. • Before starting wiring, make sure that the charge lamp is off and the voltage is safe in the tester or the like more than 10 minutes after power-off. Otherwise, you may get an electric shock. • Ground the servo amplifier and the servo motor securely. • Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock. • The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, you may get an electric shock.

⚠ CAUTION	• Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate, resulting in injury. • Connect cables to correct terminals to prevent a burst, fault, etc. • Ensure that polarity (+, −) is correct. Otherwise, a burst, damage, etc. may occur. • The surge absorbing diode installed to the DC relay designed for control output should be fitted in the specified direction. Otherwise, the signal is not output due to a fault, disabling the emergency stop and other protective circuits. • Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier. • Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) with the power line of the servo motor. • When using the regenerative brake resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative brake resistor, causing a fire. • Do not modify the equipment.

POINT
• The signals of the same name are connected inside the servo amplifier.

3.1 Connection example of control signal system

```
┌─────────────────────────────────────────────────────────────────────────┐
│ POINT                                                                     │
├─────────────────────────────────────────────────────────────────────────┤
│ • Refer to Section 3.5 for the power line connection and to Section 3.6 for│
│   connection with the servo motor.                                        │
└─────────────────────────────────────────────────────────────────────────┘
```
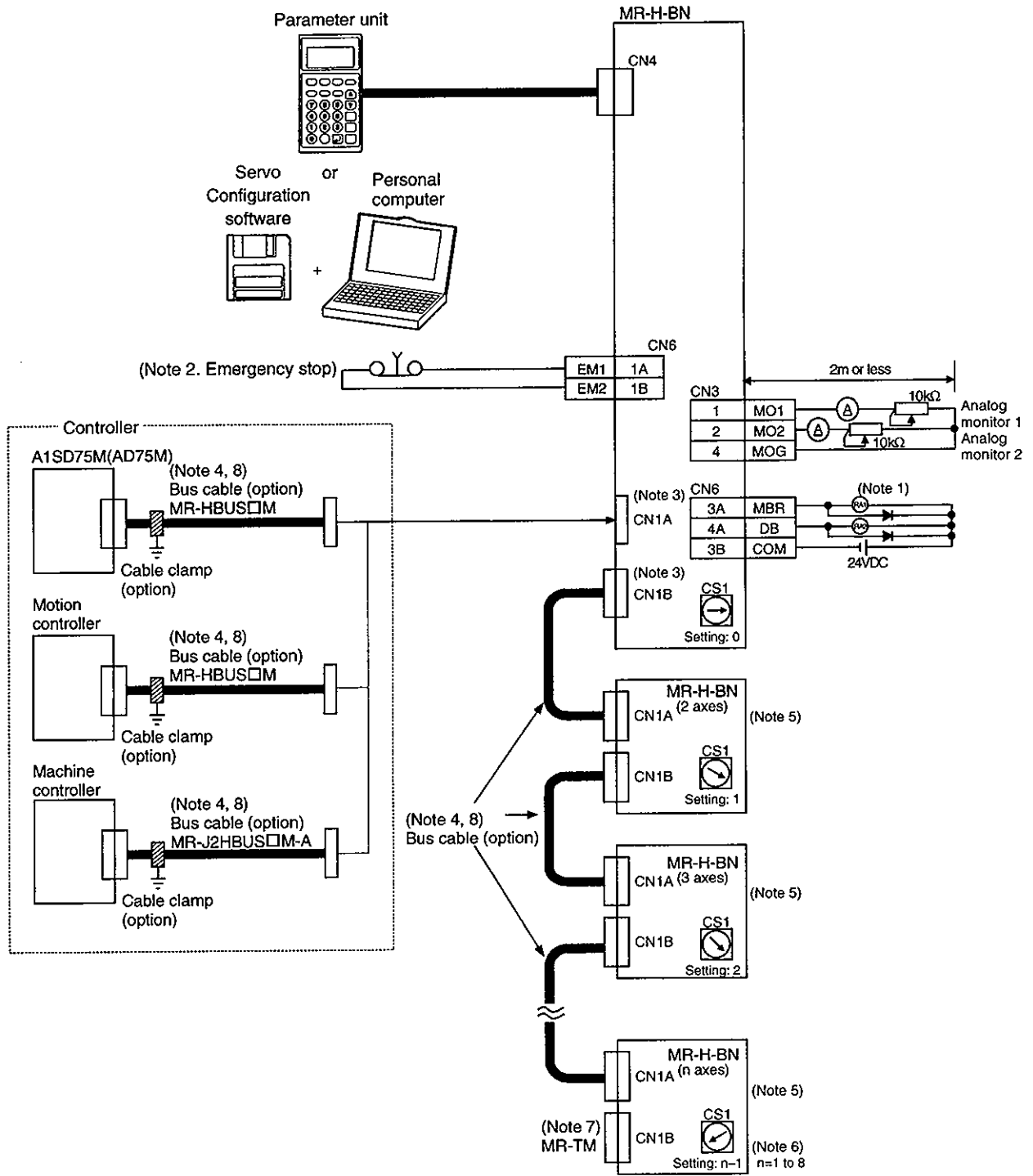
Note 1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.

    2. Always install the emergency stop switch. Connect the emergency stop switch after removing the wiring across EM1-EM2 of the CN6 connector supplied as standard.

    3. CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a fault.

    4. Use the bus cable at the overall distance of 30m or less. In addition, to improve noise immunity, it is recommended to use a cable clamp and data line filters (three or four filters connected in series) near the connector outlet.

    5. The wiring of the second and subsequent axes is omitted.

    6. Up to eight axes (n = 1 to 8) may be connected. The MR-J-B/MR-J2-B servo may be connected on the same bus.

    7. Always insert the termination connector (MR-TM) into CN1B of the servo amplifier located at the termination.

    8. The bus cable used with the SSC-NET depends on the preceding or subsequent controller or servo amplifier connected. Refer to the following table and choose the bus cable.

	MR-H-BN	MR-J-B	MR-J2-B
A1SD75M(AD75M)	MR-HBUS☐M	MR-HBUS☐M	MR-J2HBUS☐M-A
Motion controller	MR-HBUS☐M	MR-HBUS☐M	MR-J2HBUS☐M-A
Model W	MR-J2HBUS☐M-A	MR-J2HBUS☐M-A	MR-J2HBUS☐M
MR-H-BN	MR-HBUS☐M	MR-HBUS☐M	MR-J2HBUS☐M-A
MR-J-B	MR-HBUS☐M	MR-HBUS☐M	MR-J2HBUS☐M-A
MR-J2-B	MR-J2HBUS☐M-A	MR-J2HBUS☐M-A	MR-J2HBUS☐M

3.2 Common Line

The following diagram shows the power supply and its common line.
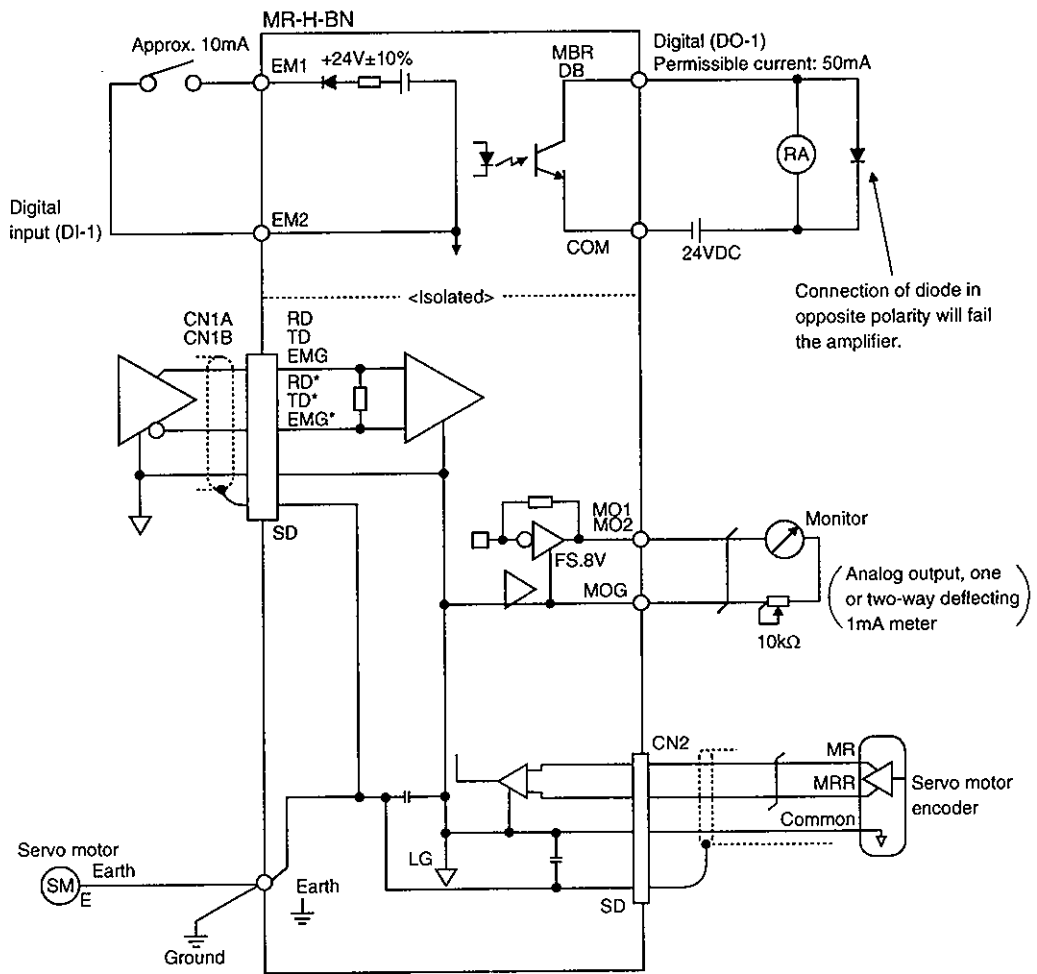
3. SIGNALS AND WIRING

3.3 I/O Signals

3.3.1 Connectors and signal layouts

POINT
• The signal layouts of the connectors are views from the wiring section of the cable connectors.

MR-H-BN

CN3

CN4
(For parameter unit)

CN1A
(For connection
of preceding axis)

CN1B
(For connection of
subsequent axis)

CN2
(Refer to
Section 13.1.6.)

CN6
(For electromagnetic brake/
emergency stop signal)
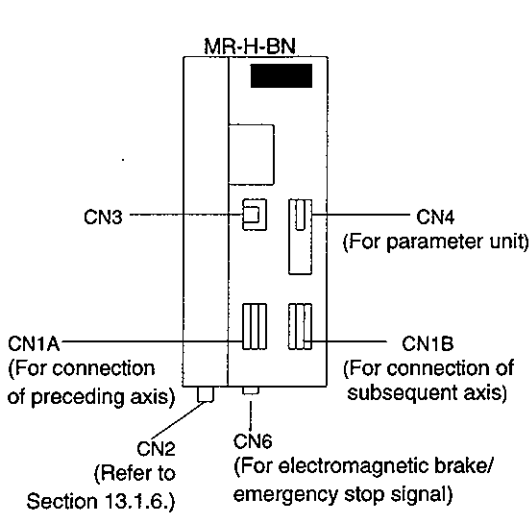
CN2 (for encoder signals)
Model PCR-S20FS (Honda Tsushin make)
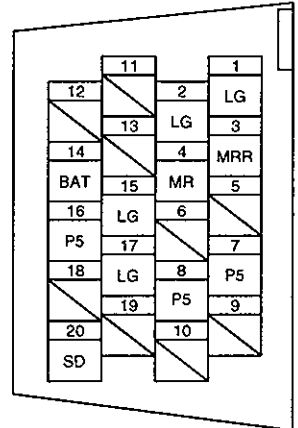
CN1A
Model PCR-S20FS (Honda Tsushin make)
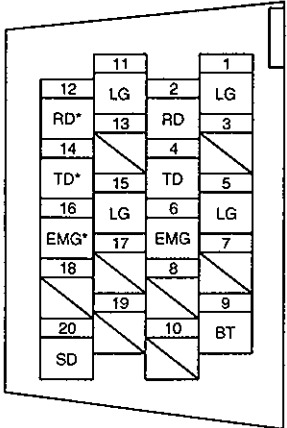
CN1B
Model PCR-S20FS (Honda Tsushin make)
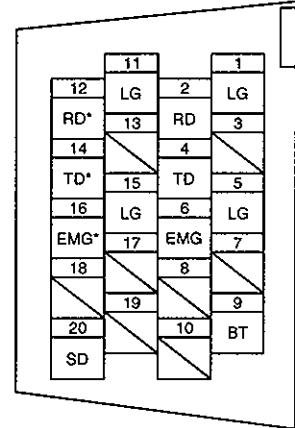
CN6
Model FCN-3610P008 (Fujitsu make)

4A	4B
DB	
3A	3B
MBR	COM
2A	2B
1A	1B
EM1	EM2

CN3
Model 171822-4 (AMP make)

(M01) 1
(M02) 2

(M0G) 4
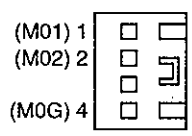
CN6 connector (EM1-EM2 shorted) supplied as standard

3- 5

3.3.2 Signal explanations

For the I/O interfaces (symbols in I/O column in the table), refer to Section 3.4.

(1) CN3

Signal Name	Symbol	Pin No.	Description	I/O Division
Analog monitor 1	MO1	1	Used to output the data set in parameter No. 17 to across MO1-MOG in terms of voltage.	Analog output
Analog monitor 2	MO2	2	Used to output the data set in parameter No. 17 to across MO2-MOG in terms of voltage.	Analog output
Monitor common	MOG	4	Common terminal for MO1 and MO2. Connected with LG inside the servo amplifier.	

(2) CN6

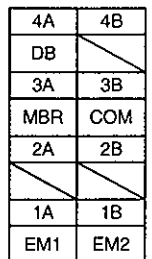| Signal Name	Symbol	Pin No.	Description	I/O Division
Emergency stop	EM1	1A	Emergency stop input terminal. Opening EM1-EM2 results in an emergency stop status, in which the servo system is switched off and the dynamic brake operates to make a sudden stop. Short EM1-EM2 in the emergency stop status to exit the emergency stop status.	DI-1
Emergency stop common	EM2	1B	Common terminal for the emergency stop signal (EM1).	
Magnetic brake interlock	MBR	3A	Magnetic brake interlock output terminal. MBR-SG are disconnected at servo-off or alarm.	DO-1
External dynamic brake	DB	4A	External dynamic brake output terminal. DB-SG are disconnected when the dynamic brake operates.	DO-1
Common	COM	3B	Common terminal for MBR and DB output signals.	

3.4 Interfaces

This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in Sections 3.3.2.
Refer to this section and connect the interfaces with the external equipment.

(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor.
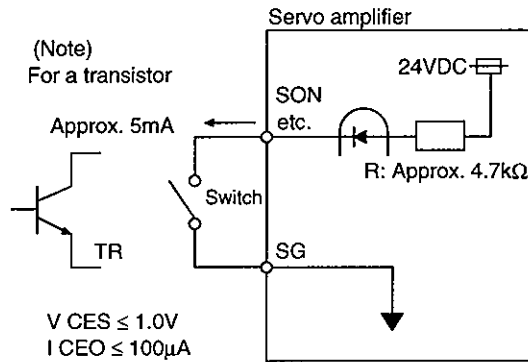
(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Provide a diode (D) for an inductive load, or an inrush current suppressing resister (R) for a lamp load. (Permissible current: 40mA or less, inrush current: 100mA or less)

(a) Inductive load

(b) Lamp load

(3) Analog output

Output ±10V
Max. 1mA

Servo amplifier

MO1
(MO2)

10kΩ

Reading in
one or both
directions
1mA meter

(A)
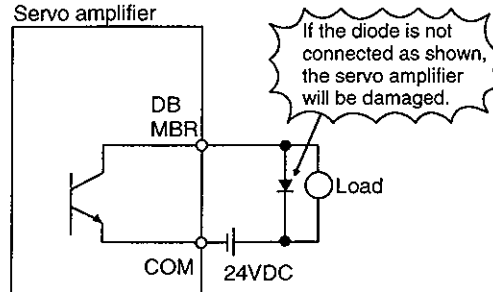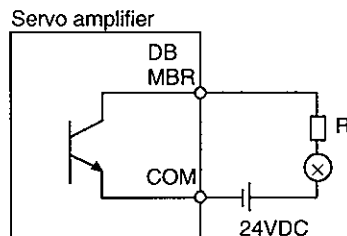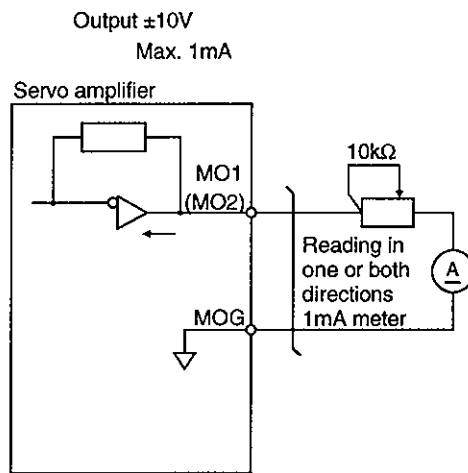
MOG

3.5 Power Line Circuit

	⚠ CAUTION	• When the servo amplifier has become faulty, switch power off on the amplifier power side. Continuous flow of a large current may cause a fire. • Use the trouble signal to switch power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor, causing a fire.

3.5.1 Connection example
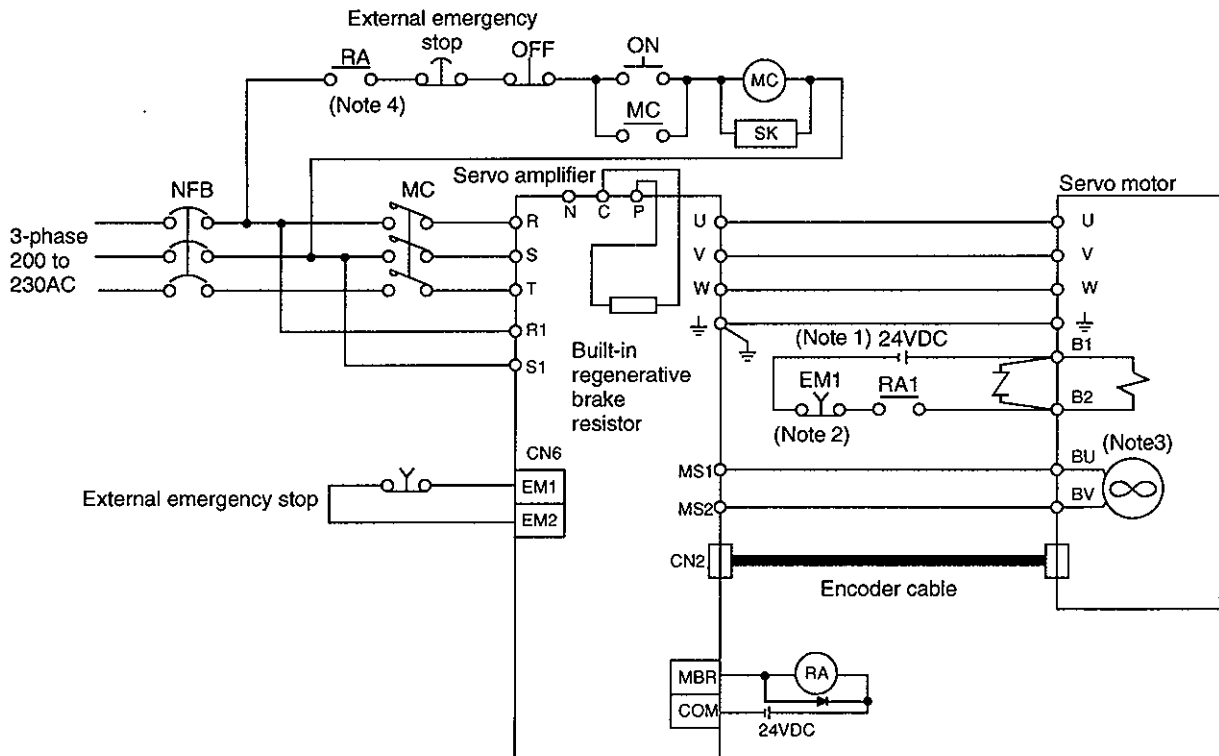
Note: 1. The interface 24VDC power supply (VDD) of the servo amplifier cannot be used. Always prepare a power supply dedicated to electromagnetic brake. The power supply connected to the lead (blue) of the electromagnetic brake should be wired independently of polarity.

2. When the usage is as described in Section 3.9.2 (2), do not connect the EMG switch.

3. For HA-LH11K2 or more.

4. Configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.

3.5.2 Terminal explanations

The arrangement and signal layout of the terminal block change with the servo amplifier capacity. Refer to Section 13.2.1.

Symbol	Signal	Description
R, S, T	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to R, S, T. For MR-H700BN 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).
R₁, S₁	Control circuit power supply	Control circuit power input terminals R₁ and S₁ should be in phase with R and S, respectively. Connect a single-phase 200 to 230VAC, 50/60Hz power supply. For MR-H700BN or more, the voltage of 50Hz power is 200 to 220V.
P, C, D	Regenerative brake	Regenerative brake option connection terminals The MR-H400BN to MR-H700BN are factory-connected with a built-in regenerative brake resistor. When using the regenerative brake option, brake unit or power return converter, always connect the wiring of the built-in regenerative brake resistor connected across P-C. For the MR-H11KBN or more, always connect the standard-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 to HA-LH22K2 servo motors. Provided for the servo amplifiers of MR-H11KBN or more.
⏚	Grounding	Ground terminal Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.

3.5.3 Power-on sequence

(1) Power-on procedure

1) Always wire the power supply as shown in above Section 3.5.1 using the magnetic contactor with the main circuit power supply. Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply L₁₁, L₂₁ simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.

3) The servo amplifier can accept the servo-on command about 1 second after the main circuit power supply is switched on.

(2) Timing chart
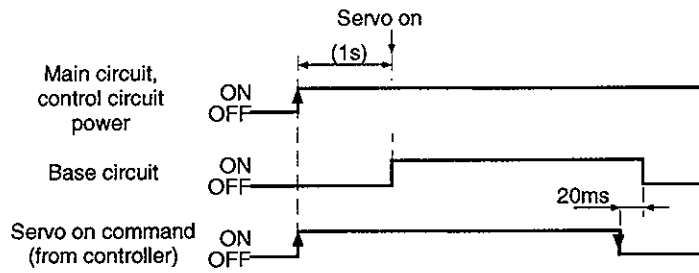
(3) Emergency stop

⚠ CAUTION	• Install an emergency stop circuit externally to ensure that operation can be stopped and power shut off immediately.

Configure up a circuit which shuts off main circuit power as soon as EM1-EM2 are opened at an emergency stop. When EM1-EM2 are opened, the dynamic brake operates to bring the servo motor to a sudden stop. At this time, "emergency stop warning" (E6) appears on the display.

During ordinary operation, do not use the external emergency stop signal to alternate stop and run.
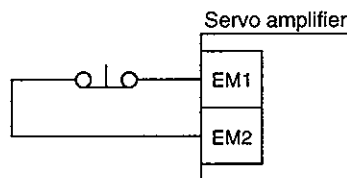
3.6 Connection of Servo Amplifier and Servo Motor

3.6.1 Connection instructions

⚠ **WARNING** • Insulate the connections of the power supply terminals to prevent an electric shock.

⚠ **CAUTION**
- Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and servo motor. Otherwise, the servo motor will operate improperly.
- Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur.

(1) Wind an insulation tape around the connection several times. For the EN Standard-compliant model, connect via a fixed terminal block.
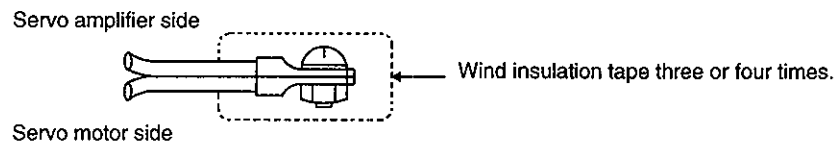
(2) For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal of the servo amplifier and connect the ground cable of the servo amplifier to the earth via the protective earth of the control box.
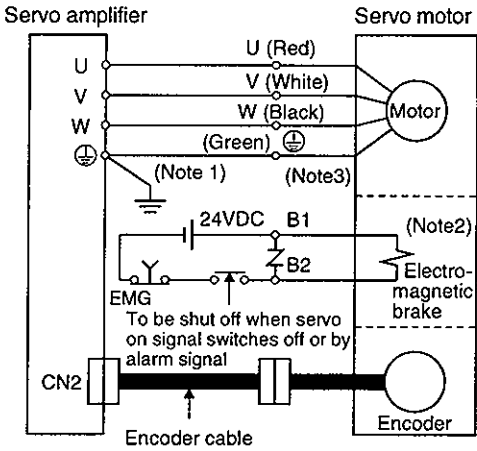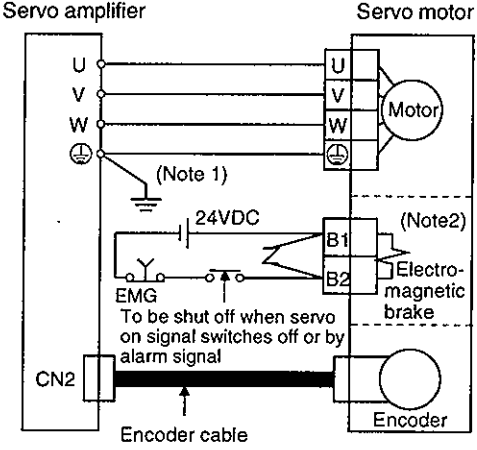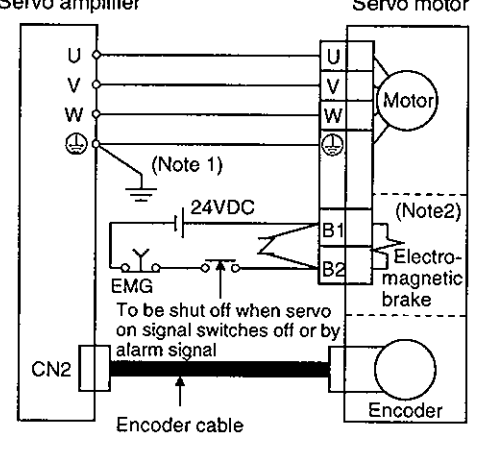
(3) Supply exclusive 24VDC power to the brake lead of the servo motor with electromagnetic brake.

The connection method differs according to the series and capacity of the servo motor and whether or not the servo motor has the electromagnetic brake. Perform wiring in accordance with this section.

3.6.2 Connection diagram

The following table lists wiring methods according to the servo motor types. Use the connection diagram which conforms to the servo motor used. For cables required for wiring, refer to Section 13.2.1. For encoder cable connection, refer to Section 13.1.2.

Servo Motor	Connection Diagram
HA-LH11K2 to HA-LH22K2 HC-MF053(B)(-UE) to HC-MF73(B)(-UE) HA-FF053(B) to HA-FF63(B) HC-UF13(B) to HC-UF73(P)	 Note: 1. To prevent an electric shock, always connect the earth terminal of the servo amplifier to the earth of the control box. 2. This circuit applies to the servo motor with electromagnetic brake. 3. For the HA-FF series, connect the ground cable to the earth terminal of the servo motor. 4. The HA-LH11K2 to HA-LH22K2 are equipped with a cooling fan. For wiring, refer to Section 3.6.4.
HA-FF053C(B)-UE to HA-FF63C(B)-UE HC-SF121(B) to HC-SF301(B) HC-SF202(B) to HC-SF702(B) HC-SF203 (B) · HC-SF353(B) HC-UF202(B) to HC-SF502(B)	 Note: 1. To prevent an electric shock, always connect the earth terminal of the servo amplifier to the earth of the control box. 2. This circuit applies to the servo motor with electromagnetic brake.
HC-SF52(B) to HC-SF152(B) HC-RF103(B) to HC-RF503(B) HC-UF72(B) · HC-UF152(B)	 Note: 1. To prevent an electric shock, always connect the earth terminal of the servo amplifier to the earth of the control box. 2. This circuit applies to the servo motor with electromagnetic brake.

3.6.3 Details of the servo motor side

(1) HC-MF□(B)(-UE) series

Power supply lead
4-AWG19 0.3m
With end-insulated round crimping terminal 1.25-4
Red   : U phase
White   : V phase
Black   : W phase
Green/Yellow: Earth

Encoder cable 0.3m
With connector 172169-9
(AMP make)

Brake cable
2-0.3² 0.3m
With end-insulated round crimping
terminal 1.25-4

Encoder connector signal arrangement

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

(2) HA-FF□(B) series

Earth terminal, M3 screw

Encoder cable 0.3m
With connector 172169-9
(AMP make)

Power supply cable
VCTF3-1.25² 0.5m
With end-insulated round
crimping terminal 1.25-4
Red   : U phase
White : V phase
Black : W phase

Brake cable
VCTF2-0.5² 0.5m
With end-insulated round crimping
terminal 1.25-4

Encoder connector signal arrangement

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

(3) HA-FF□C-UE series

Encoder connector

Power supply connector

Brake connector

Servo Motor	Connector		
	For power supply	For encoder	For brake
HA-FF053C(B)-UE to HA-FF63C(B)-UE	CE05-2A14S-2PD-B	MS3102A20-29P	MS3102E10SL-4P

Power supply connector
signal arrangement
CE05-2A14S-2PD-B
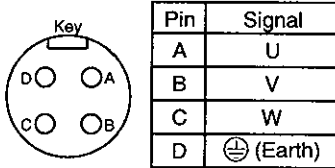
Pin	Signal
A	U
B	V
C	W
D	⊕ (Earth)

Encoder connector signal
arrangement
MS3102A20-29P

Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	CNT
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
J			
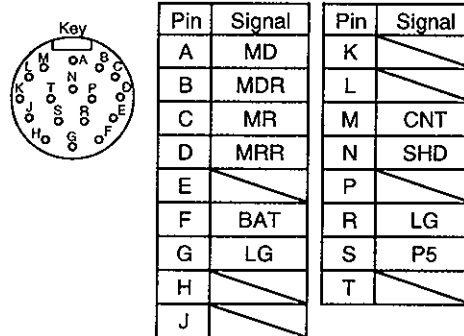
Brake connector signal
arrangement
MS3102E10SL-4P
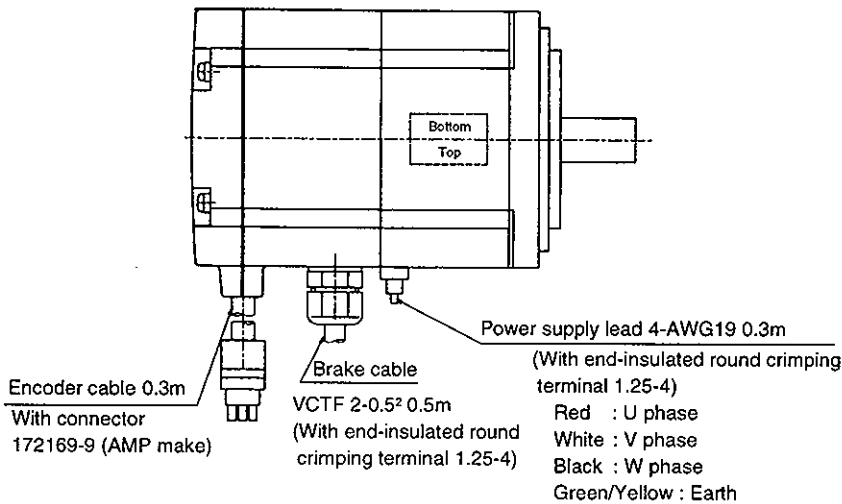
Pin	Signal
A	(Note) B1
B	(Note) B2

Note: 24VDC without
polarity.

(4) HC-UF□(B) 3000r/min series

Bottom
Top

Encoder cable 0.3m
With connector
172169-9 (AMP make)

Brake cable
VCTF 2-0.5² 0.5m
(With end-insulated round
crimping terminal 1.25-4)

Power supply lead 4-AWG19 0.3m
(With end-insulated round crimping
terminal 1.25-4)
Red   : U phase
White : V phase
Black : W phase
Green/Yellow : Earth

Encoder connector
signal arrangement

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

(5) HC-SF□(B) · HC-RF□(B) · HC-UF□(B)2000 r/min series
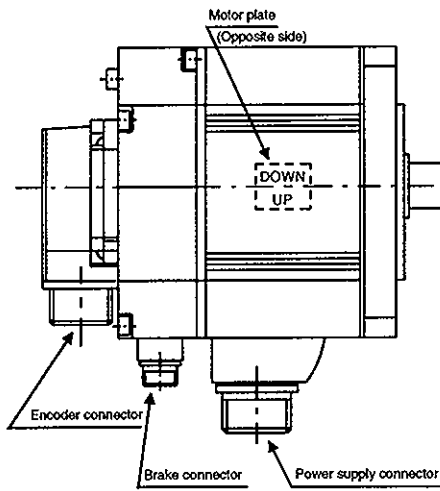
Servo Motor	Connectors		
	For power supply	For encoder	Electromagnetic Brake Connector
HC-SF81(B) HC-SF52(B) to 152(B) HC-SF53(B) to 153(B)	CE05-2A22-23PD-B	MS3102A20-29P	The connector for power is shared.
HC-SF121(B) to 301(B) HC-SF202(B) to 502(B) HC-SF203(B) · 353(B)	CE05-2A24-10PD-B		MS3102A10SL-4P
HC-SF702(B)	CE05-2A32-17PD-B		
HC-RF103(B) to 203 (B)	CE05-2A22-23PD-B		The connector for power is shared.
HC-RF353(B) · 503(B)	CE05-2A24-10PD-B		
HC-UF72(B) · 152(B)	CE05-2A22-23PD-B		
HC-UF202(B) to 502(B)	CE05-2A24-10PD-B		MS3102A10SL-4P

Power supply connector signal arrangement

CE05-2A22-23PD-B
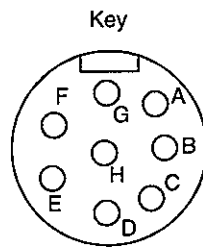
Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	
F	
G	(Note) B1
H	(Note) B2

Note:24VDC,without polarity

CE05-2A24-10PD-B
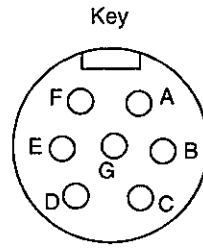
Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	(Note) B1
F	(Note) B2
G	

Note:24VDC,without polarity

CE05—2A32—17PD—B
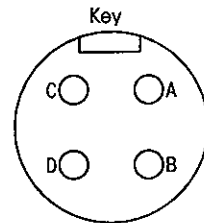
Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

Encoder connector signal arrangement
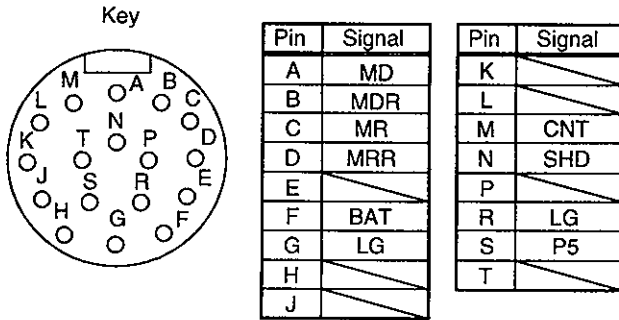
MS3102A20-29P

Electromagnetic brake connector signal pin-outs

MS3102E10SL-4P
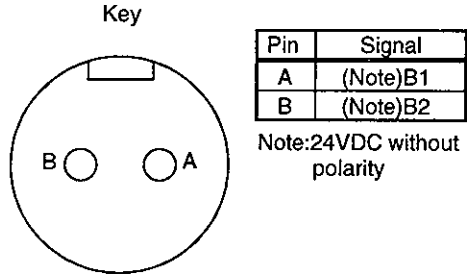
Key

Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	CNT
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
J			

Key

Pin	Signal
A	(Note)B1
B	(Note)B2

Note:24VDC without polarity

(6) HA-LH11K2(-EC) to HA-LH22K2(-EC)

Terminal block

Encoder connector
MS3102A20-29P

Encoder connector signal arrangement

MS3102A20-29P

Key

Pin	Signal	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	CNT
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
J			
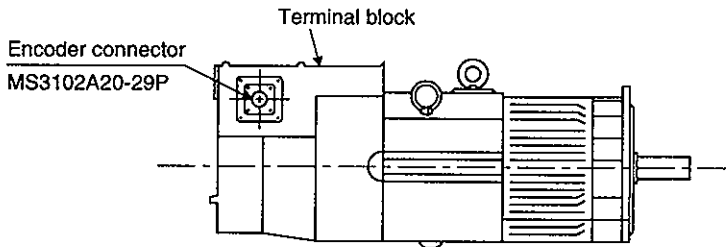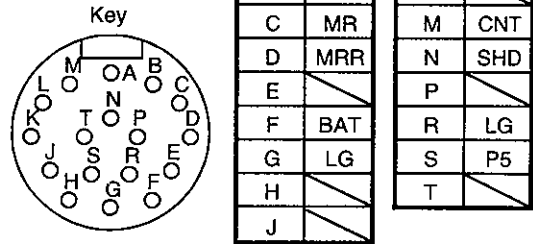
(a) Terminal box of HA-LH11K2 to HA-LH22K2

146   [Unit: mm]

Cooling fan lead (BU,BV)
Round crimping terminal 1.25-4

Ground terminal M5 screw

209

⌀44

Encoder connector
MS3102A20-29P

3 power supply leads (U, V, W) with round crimping terminals
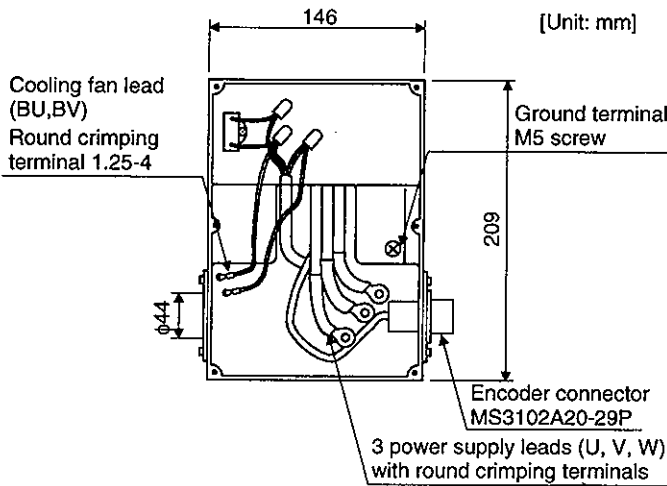
Power supply connection screw size

Servo Motor	Power supply connection screw size
HA-LH11K2	8-6
HA-LH15K2 · 22K2	14-6

(b) Terminal box of HA-LH11K2-EC to HA-LH22K2-EC

[Unit: mm]

Signal arrangement of terminal block

U	V	W	BU	BV

Protective earth (PE) M5 screw

Terminal box

Encoder connector MS3102A20-29P
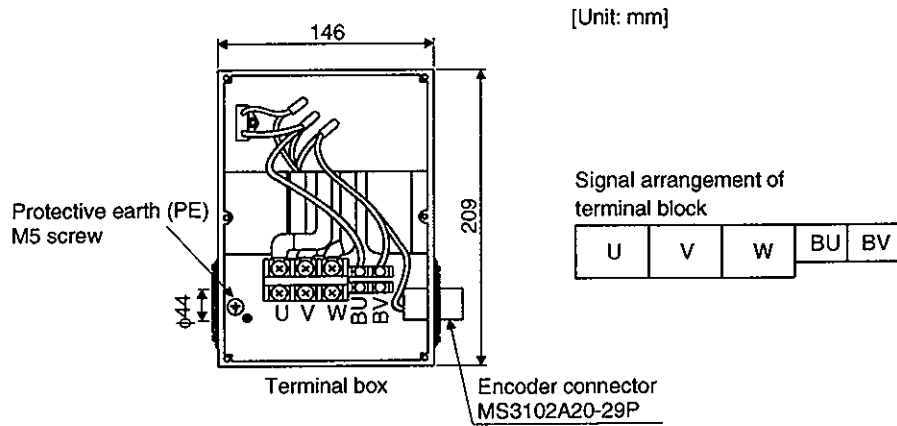
Servo Motor	Power Supply Connection Screw Size	Fan Connection Screw Size
HA-LH11K2-EC	M6	M4
HA-LH15K2-EC · LH22K2-EC	M8	M4

3.6.4 Servo motor fan (HA-LH11K2 to HA-LH22K2)

The 11kW or more of the HA-LH series are of totally-enclosed, force-cooled type. When performing operation, supply power to the cooling fan terminals (BU, BV) to operate the cooling fan. (Single-phase 200V, 35W)
Connect the fan terminals (BU, BV) of the servo motor to the cooling fan power terminals MS1, MS2 of the servo amplifier.
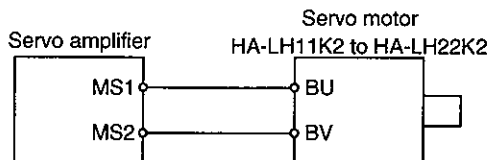
3.7 Control Axis Selection

Use the axis select switch (CS1) to set the control axis number for the servo. The control axis number set to CS1 should be the same as the one set to the servo system controller. If the same numbers are set to different control axes in a single communication system, the system will not operate properly. The control axes may be set independently of the bus cable connection sequence.
Set the switch to "F" when executing the test operation mode using the parameter unit or Servo Configuration software.

Axis select switch (CS1)
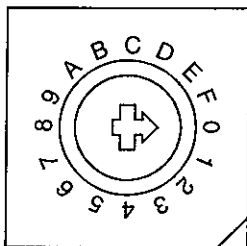
No.	Description
0	Axis 1
1	Axis 2
2	Axis 3
3	Axis 4
4	Axis 5
5	Axis 6
6	Axis 7
7	Axis 8
8	Not used
9	Not used
A	Not used
B	Not used
C	Not used
D	Not used
E	Not used
F	Test operation mode

3.8 Alarm Occurrence Timing Chart

> ⚠ **CAUTION**
> • When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. Switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply off, then on.

However, the alarm cannot be reset unless its cause of occurrence is removed.
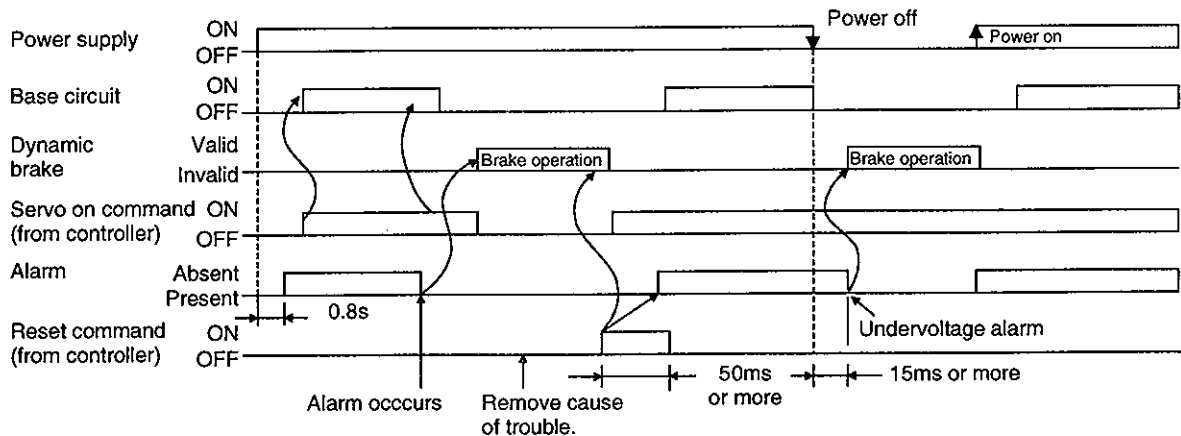
(1) Precautions for alarm occurrence

1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching control circuit power off, then on to reset the overcurrent (32), overload 1 (50) or overload 2 (51) alarm after its occurrence, without removing its cause, the servo amplifier and servo motor may become faulty due to temperature rise. Securely remove the cause of the alarm and also allow about 30 minutes for cooling before resuming operation.

2) Regenerative alarm

If operation is repeated by switching control circuit power off, then on to reset the regenerative (30) alarm after its occurrence, the external regenerative brake resistor will generate heat, resulting in an accident.

3) Instantaneous power failure

If a power failure continues 15ms or longer, the undervoltage (10) alarm will occur. If the power failure still persists for 20ms or longer, the control circuit is switched off. The alarm is deactivated when power is restored in this status.

4) Incremental system

When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a return to home position.

3.9 Servo Motor with Electromagnetic Brake

<table>
<tr>
<td rowspan="2">⚠CAUTION</td>
<td>● For such reasons as service life and mechanical structure (e.g. where a ballscrew and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.
● Configure the electromagnetic brake operation circuit so that it is activated not only by the servo amplifier signals but also by an external emergency stop signal.</td>
</tr>
<tr>
<td>Contacts must be open when servo is off or when an alarm (trouble) is present.   Circuit must be opend during emergency stop.

Servo motor RA EM1
❗   24VDC
Electromagnetic brake</td>
</tr>
</table>
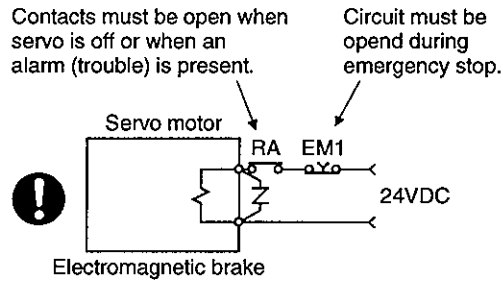
Use a servo motor with electromagnetic brake which is designed to prevent a load drop on a vertical shaft or which ensures double safety at an emergency stop.

3.9.1 Wiring instructions

(1) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.

(2) The brake will operate when the power (24VDC) switches off.

(3) The electromagnetic brake has no polarity. When connecting a power supply, wire it independently of polarity.

3.9.2 Operation of electromagnetic brake

(1) Electromagnetic brake operates when alarm occurs, emergency stop is valid, or SON signal is off

(a) Setting

Set □0□□ (initial value) in parameter No. 24.

(b) Timing chart

1) When alarm occurred   2) When emergency stop is valid   3) When SON signal is off (servo is off)
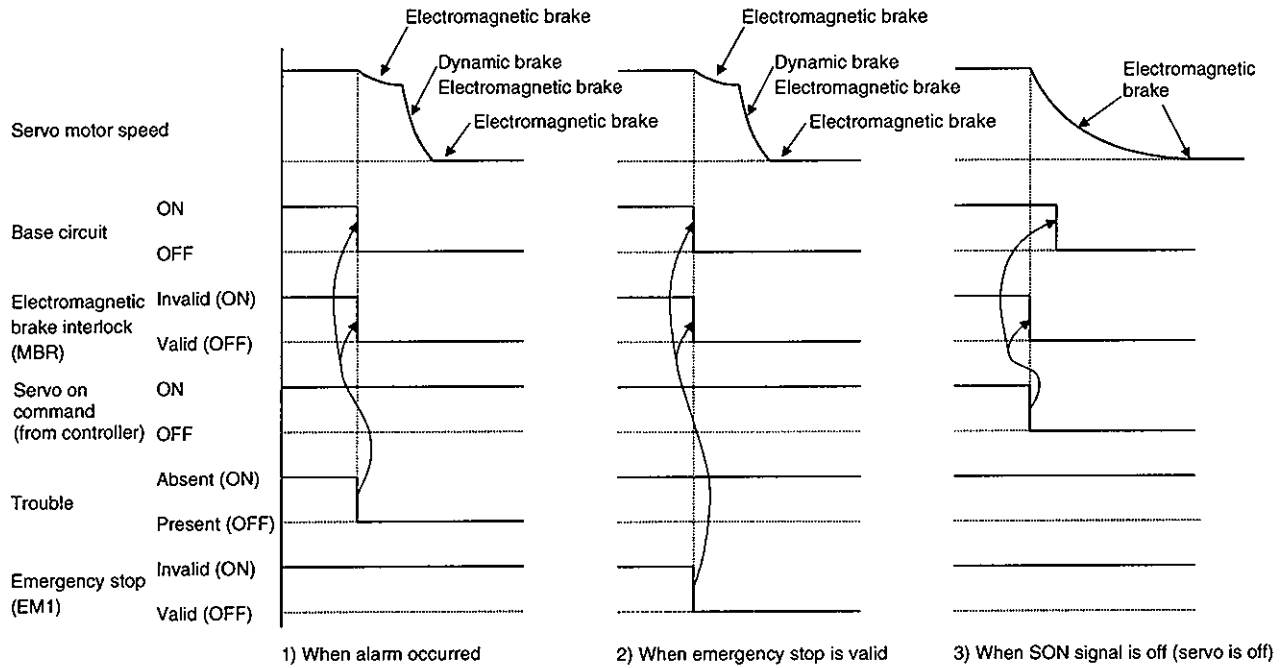
(2) Electromagnetic brake operates under the condition in (1) of this section and at zero speed

    (a) Setting

        1) Set 1□□□ in parameter No. 24.

        2) In parameter No. 21, set a time delay (Tb) between electromagnetic brake operation and base circuit shut-off.

        3) In this usage, do not install the EMG switch marked (Note 2) in the connection example of Section 3.5.1.

    (b) Timing chart

        1) Timing chart for servo on and reset

Servo on (SON) signal OFF
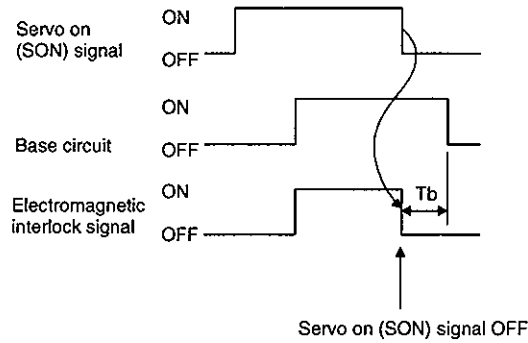
        2) Timing chart for alarm occurrence or emergency stop validity

Alarm occurrence or emergency stop validity

3- 23
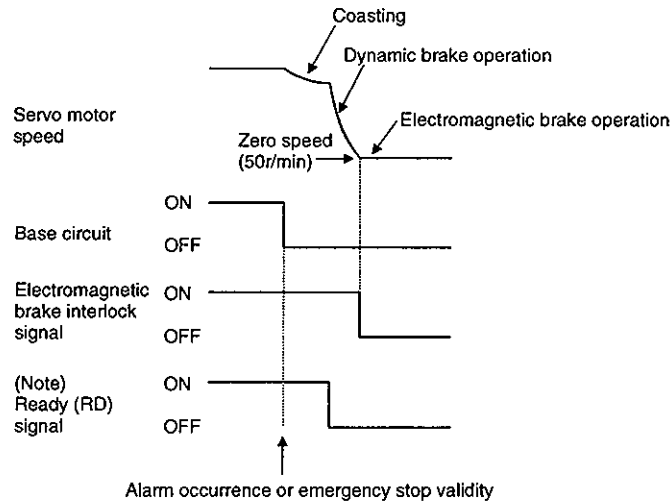
3.10 Grounding

⚠️ **WARNING** • Ground the servo amplifier and servo motor securely.

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cablerouting, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.

To conform to the EMC Directive, refer to the EMC INSTALLATION GUIDELINES (IB(NA)67303).
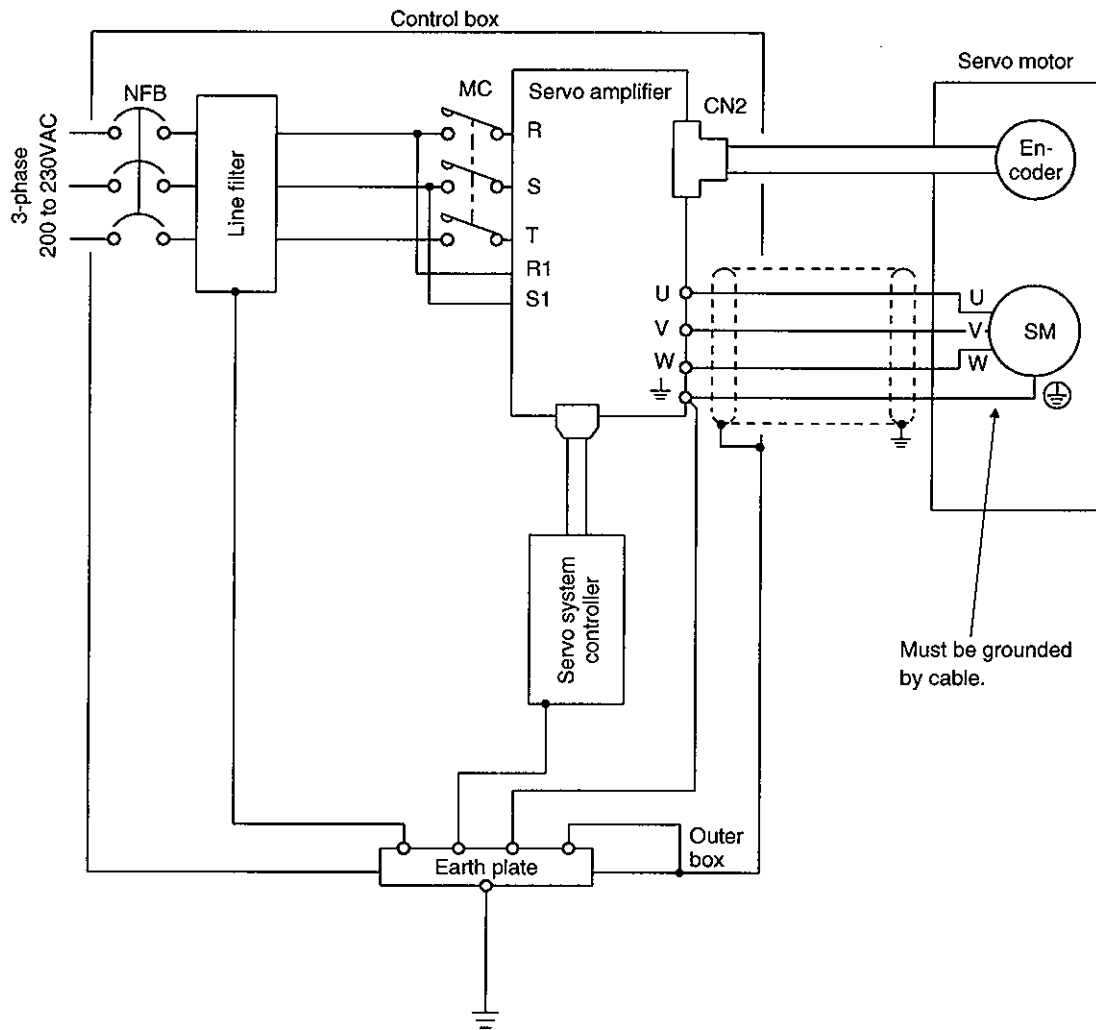
4. OPERATION AND DISPLAY

4.1 When Switching Power On for the First Time

Before starting operation, check the following:

(1) Wiring
   (a) A correct power supply is connected to the power input terminals (R, S, T) of the servo amplifier.
   (b) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W).
   (c) The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals (R, S, T).
   (d) The servo amplifier and servo motor are grounded securely.
   (e) When the regenerative brake option is used, twisted cables should have been used. Also, the leads of the built-in the regenerative brake resistor should have been removed.
   (f) A voltage in excess of 24VDC is not applied to the signal pins of connector CN6.
   (g) The wiring cables are free from excessive force.
   (h) The bus cable from the servo system controller or preceding axis is connected to CN1A. Also, the bus cable to the subsequent-axis servo amplifier or the termination connector (MR-TM) is connected to CN1B.

(2) Environment
   Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

(3) Machine
   (a) The screws in the servo motor installation part and shaft-to-machine connection are tight.
   (b) The servo motor and the machine connected with the servo motor can be operated.

(4) Axis setting
   The axis number of the servo amplifier matches the axis number set to the servo system controller.

4.2 Start Up

⚠ WARNING	• Do not operate the switches with wet hands. You may get an electric shock. • Do not operate the controller with the front cover removed. High-voltage terminals and charging area exposed and you may get an electric shock. • During power-on or operation, do not open the front cover. you may get an electric shock.

⚠ CAUTION	• Before starting operation, check the parameters. Some machines may perform unexpected operation. • During power-on or soon after power-off, do not touch the servo amplifier heat sink, regenerative brake resistor, servo motor, etc. as they may be at high temperatures. You may get burnt.

Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

(1) Power on

When the main and control circuit power supplies are switched on, "feedback pulse value" appears on the parameter unit. "d1" (for the first axis) appears on the servo amplifier display.

In the absolute position detection system, first power-on results in the absolute position lost (25) alarm and the servo system cannot be switched on. This is not a failure and takes place due to the uncharged capacitor in the encoder.

The alarm can be deactivated by keeping power on for a few minutes in the alarm status and then switching power off once and on again.

Also in the absolute position detection system, if power is switched on at the servo motor speed of 500r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(2) Test operation

Make sure that the servo motor operates by performing jog operation in the "test operation mode" from the parameter unit. Refer to Section 7.2(5).

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 6 for the parameter definitions and to Sections 6.4(4) for the setting method.

Parameter setting example

Parameter	Name	Setting	Description
No.1	Amplifier setting	□□□1 └── Used in the absolute position detection system.	
No.2	Servo type	□1□0 ┬─ └── Regenerative brake option is not used. └──── External dynamic brake is used.	
No.7	Rotation direction setting	0	Increase in positioning address rotates the motor in the CCW direction.
No.8	Auto tuning	□□□1 └── Used .	
No.9	Servo response	□□□1 └── Slow response (initial value) is selected.	

After setting the above parameters, switch power off once. Then switch power on again to make the set parameter values valid.

(4) Servo on

Switch the servo on in the following procedure:

1) Switch on main circuit/control power.

2) The controller transmits the servo on command.

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Zeroing

Always perform zeroing before starting positioning operation.

(6) Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop.

When the servo motor is equipped with an electromagnetic brake, refer to Section 3.9.2.

	Operation/Command	Stopping Condition
Servo system controller	Servo off command	The base circuit is shut off and the servo motor coasts.
	Emergency stop command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to an emergency stop. Alarm "E7" occurs.
Servo amplifier	Alarm occurrence	The base circuit is shut off and the dynamic brake operates to bring the servo motor to an emergency stop.
	Emergency stop signal (EM1) OFF	The base circuit is shut off and the dynamic brake operates to bring the servo motor to an emergency stop. Alarm "E6" occurs.

4.3 Servo Amplifier Display

On the servo amplifier display (2-digit, 7-segment display), check the status of communication with the servo system controller at power-on, check the axis number, and diagnose a fault at occurrence of an alarm.

(1) Display sequence

Servo amplifier power ON

|A b| Waiting for servo system controller power to switch ON

Servo system ocntroller power ON

|A C|
|A d| Initial data communication with servo system controller
|A E|

During emergency stop

|b 1| Ready OFF/servo OFF   (Note)

Ready ON

|E n| or |E b|

Emergency stop reset

(Note) |C 1| Ready ON/servo OFF

When alarm occurs, alarm code appears.

Servo ON

(Note) |d 1| Ready ON/servo ON

Ordinary operation

Servo systm controller power OFF

|A A|

Servo systm controller power ON

|b 1| |C 1| |d 1| Note: The right-hand segments of b-1, c1 and d1 indicate the axis number. (Axis 1 in this example)

(2) Indication list

Set the parameters in accordance with the machine structure and specifications. Refer to Chapter 6 for the parameters and refer to Section 7.2 (4) for the way of setting them.

Indication		Status	Description
	AA	Initializing	The servo amplifier was switched on when power to the servo system controller is off.
	Ab	Initializing	• Power to the servo system controller was switched off during power-on of the servo amplifier. • The axis No. set to the servo system controller does not match the axis No. set with the axis setting switch (CS1) of the servo amplifier. • A servo amplifier fault occurred or an error took place in communication with the servo system controller. In this case, the indication changes: "Ab" → "AC" → "Ad" → "Ab" • The servo system controller is faulty.
	AC	Initializing	Communication started between the servo system controller and servo amplifier.
	Ad	Initializing	The servo system controller received the initial parameters.
	AE	Initialize completion	
(Note 1)	b#	Ready OFF	The servo system controller received the ready off signal.
(Note 1)	d#	Servo ON	The servo system controller received the servo on signal.
(Note 1)	C#	Servo OFF	The servo system controller received the servo off signal.
(Note 2)	**	Alarm • Warning	The alarm No./warning No. that occurred is displayed. (Refer to Section 10.1.)
	00	CPU error	
	b0.	Test operation mode	JOG operation, positioning operation, programmed operation, DO forced output
(Note 1)	b#.	Test operation mode	Motor-less operation

Note: 1. # denotes any of numerals 0 to 8 and what it means is listed below:
2. ** indicates the warning/alarm No.

#	Description
0	Set to the test operation mode.
1	First axis
2	Second axis
3	Third axis
4	Fourth axis
5	Fifth axis
6	Sixth axis
7	Seventh axis
8	Eighth axis

5. ABSOLUTE POSITION DETECTION SYSTEM

5.1 Outline

5.1.1 Features

An absolute position detection system can be configured up by simply fitting an absolute position data backup battery and setting parameters.

For ordinary operation, the encoder consists of an encoder designated to detect a position within one revolution and a cumulative revolution counter designated to detect the number of revolutions, as shown below.
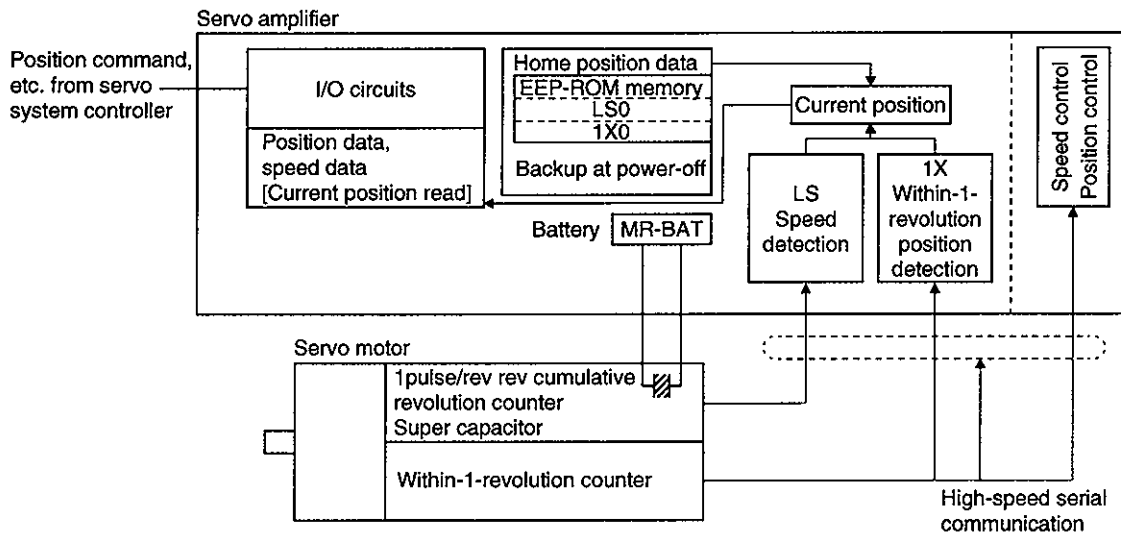
The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the servo amplifier power is on or off. Therefore, once the home position is defined at the time of machine installation, zeroing is not needed when power is switched on thereafter.

If a power failure or a fault occurs, restoration is easy.

Also, the absolute position data, which is battery-backed by the super capacitor in the encoder, can be retained within the specified period (cumulative revolution counter value retaining time) if the cable is unplugged or broken.

5.1.2 Restrictions

You cannot configure up the absolute position detection system in a stroke-less coordinate system such as rotary-axis or endless-length positioning. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, choose incremental in parameter No.1.

5.2 Composition

Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal + 3.6V) Type: MR-BAT or A6BAT
Maximum revolution range	Home position ± 32767 rev.
(Note 1) Maximum speed at power failure	500r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
(Note 3) Data holding time during battery replacement	2 hours at delivery, 1 hour in 5 years after delivery
Battery storage period	5 years from date of manufacture

Note: 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.
2. Time to hold data by a battery with power off.
3. Period during which data can be held by the super capacitor in the encoder after power-off, with the battery voltage low or the battery removed, or during which data can be held with the encoder cable disconnected. Battery replacement should be finished within this period.
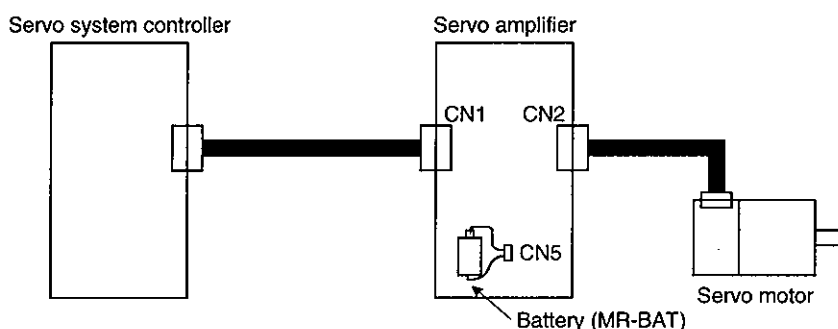
(1) Battery installation procedure

⚠ WARNING	• Before starting battery installation procedure, 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.

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.

1) Open the terminal block cover and switch window. (When the model used is the MR-H500AN or more, also remove the front panel.)
2) Install the battery in the battery holder.
3) Install the battery connector into CN5 until it clicks.
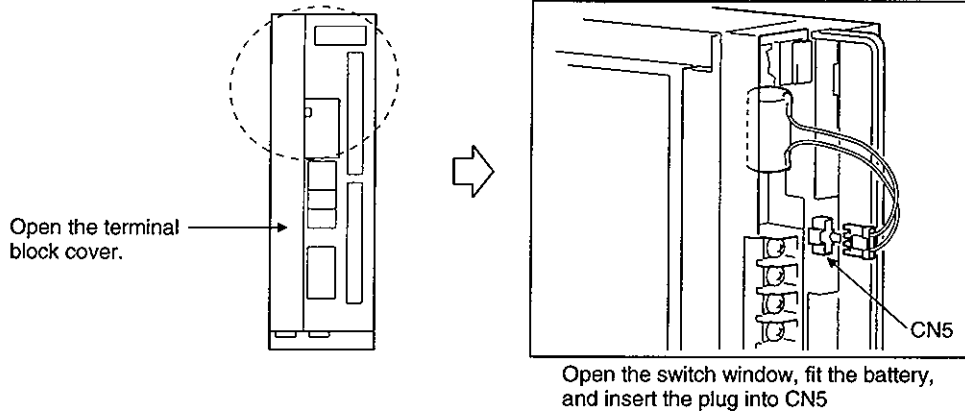
(a) MR-H10BN to MR-H350BN

Open the terminal block cover.

Open the switch window, fit the battery, and insert the plug into CN5

CN5

(b) MR-H500BN,MR-H700BN

Remove two screws and open the front panel.

Front panel

Open the switch window, fit the battery, and insert the plug into CN5

CN5

(C) MR-H11KBN to MR-H22KBN

Remove four screws and open the front panel and terminal block panel.

Front panel

Terminal block panel

Open the switch window, fit the battery, and insert the plug into CN5.

CN5
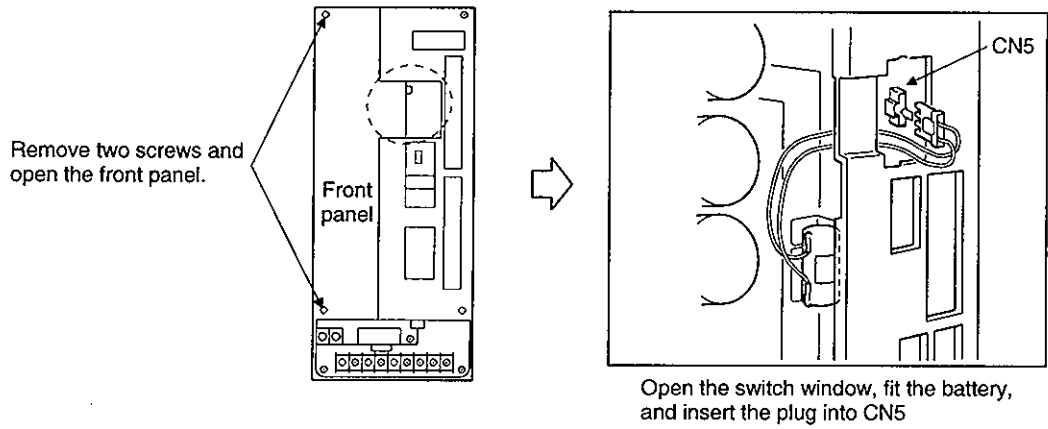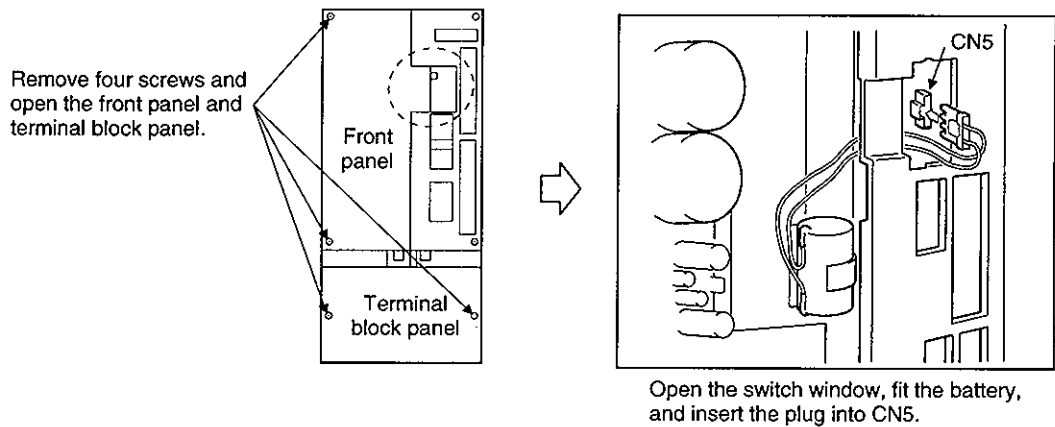
(2) Parameter setting

Set □□□1 in parameter No.1 to make the absolute position detection system valid.

Parameter No. 1

0	0	0	1

Selection of absolute position detection system
0: Incremental system
1: Absolute position detection system

5.3 Confirmation of Absolute Position Detection Data

5.3.1 Using the parameter unit

You can confirm the absolute position data on the "absolute position data" screen in the alarm diagnostic mode. For the operation method, refer to Section 7.2 (3).

```
10 ABS pos.    ▲
        49152
CYC0     1024
ABS0       25 ▼
```

— Absolute position
/ Indicates the distance from the home position \
/ to the present position.
| Display range : –9999999999 to 9999999999 |
\ Unit   : Pulses   /

— Home position within-one-revolution counter data
/ Indicates the home position data (within-one-revolution \
/ counter value) stored in the nonvolatile memory in the |
| servo amplifier |
| Display range : 0 to 8191 |
| : 0 to 16383 |
\ Unit   : Pulse /

— Home position accumulative revolution counter data
/ Indicates the accumulative revolution counter data \
/ stored in the nonvolatile memory in the servo amplifer. |
| Display range :32768 to 32767 |
\ Unit   : Turns /

5.3.2 Using the Servo Configuration software

You can confirm the absolute position data with Servo Configuration software.
Choose "Diagnostics" and "Absolute Encoder Data" to open the absolute position data display screen.
(1) Choosing "Diagnostics" in the menu opens the sub-menu as shown below:
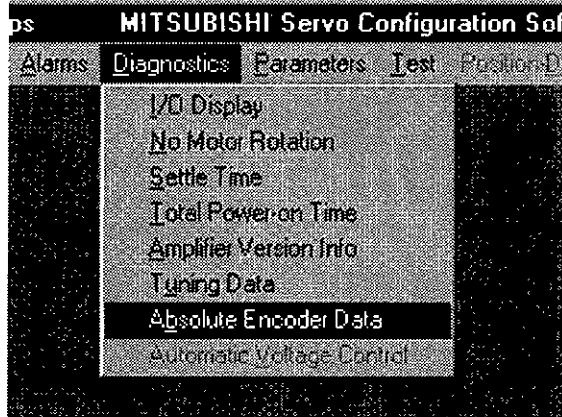
(2) By choosing "Absolute Encoder Data" in the sub-menu, the Absolute Encoder Data display window
appears.
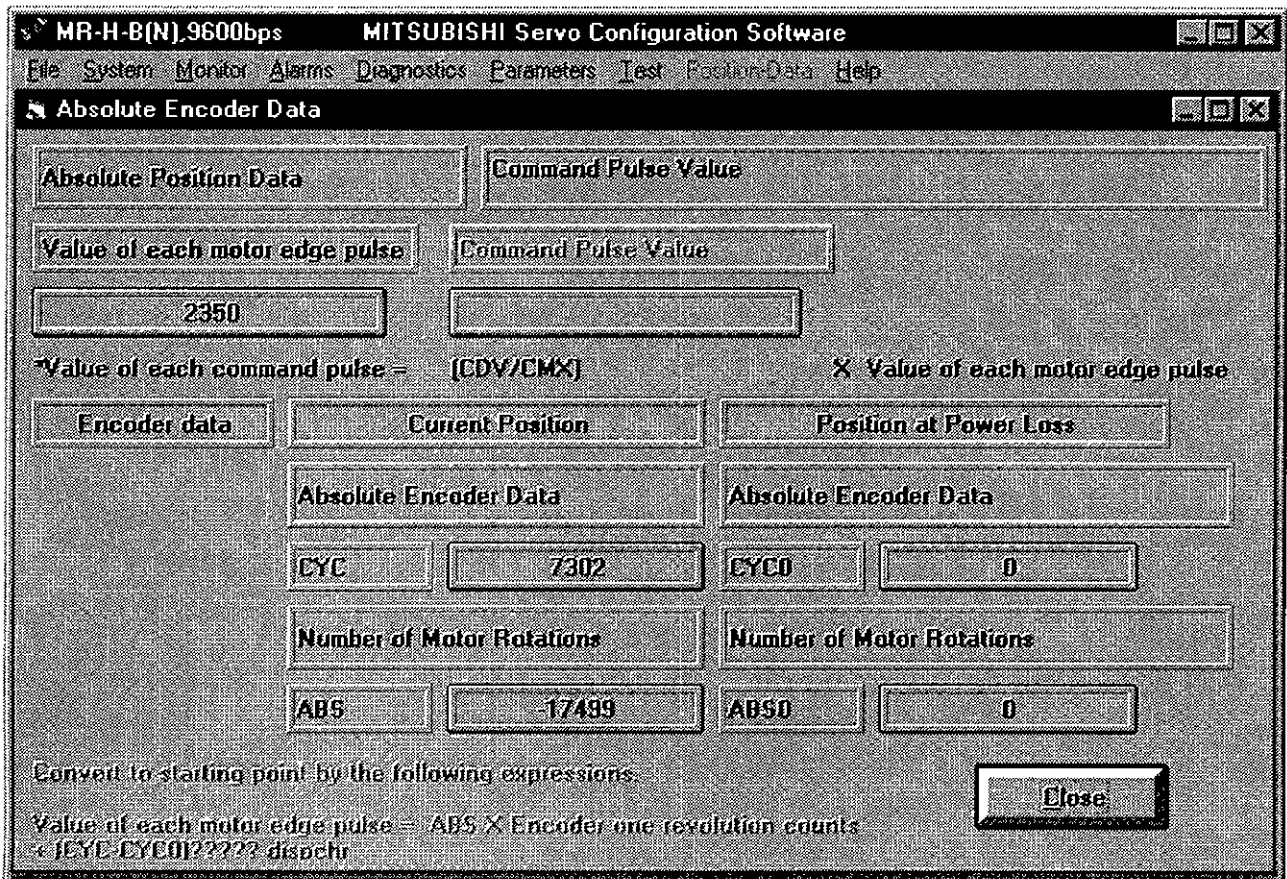
(3) Press the "Close" button to close the Absolute Encoder Data display window.

6. PARAMETERS

⚠ CAUTION	• Never adjust or change the parameter values extremely as it will make operation instable.

POINT
• Connection with the servo system controller sets the parameters to the initial values of the servo system controller.

6.1 Parameter List

6.1.1 Parameter write inhibit

POINT
• When setting the parameter values from the servo system controller, the parameter No. 40 setting need not be changed.

In the MR-H-BN SSC-NET-compatible AC servo amplifier, the parameters are classified into the basic parameters (No. 0 to 11), adjustment parameters (No. 12 to 26) and expansion parameters (No. 27 to 40) according to the safety levels and frequencies of use. The values of the basic parameters may be set/changed by the customer, but those of the adjustment and expansion parameters cannot. When in-depth adjustment such as gain adjustment is required, change the parameter No. 40 value to make all parameters accessible. Parameter No. 40 is made valid by switching power off, then on after setting its value.

Setting	Operation from Controller	Operation from Parameter Unit
0000 (initial value)	Parameters No. 1 to 39	Parameters No. 1 to 11, 40
000A	Parameters No. 1 to 39	Parameter No. 40
000E	Parameters No. 1 to 39	Parameters No. 1 to 40

6.1.2 Lists

POINTS
• For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.
• When using the HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, the values of parameters No. 3, 4, 5 and 6 need not be set. They are automatically judged by simply connecting the servo motor. At this time, the settings of these parameters are ignored.

For details of the parameters, refer to the corresponding items.
The values of the parameters marked "O" in the Controller column of the table can be set/changed from the servo system controller.

(1) Item list

Classifi-cation	No.	Code	Name and Controller Screen Display	Parameter Unit Display	Con-troller	Initial Value	Unit	Customer Setting
Basic parameters	1	*AMS	AMP. SETTING	1 AMP sel.	O	0000		
	2	*REG	RESISTANCE	2 R. resist	O	0001		
	3	*MTY	MOTOR TYPE	3 MTR type	O	(Note)		
	4	*MCA	MOTOR CAPACITY	4 MTR cap.	O	(Note)		
	5	*MTR	ROTATION SPEED (R)	5 MTR speed	O	2		
	6	*FPB	FEED BACK PULS (N)	6 PLG type	O	0		
	7	*POL	SPIN DIRECTION	7 Direction	O	0		
	8	ATU	AUTO-TUNING	8 Auto tun.	O	1		
	9	RSP	SERVO RESPONSE SET	9 Response	O	0001		
	10	TLP	Forward rotation torque limit	10 TQ limit+		300	%	
	11	TLN	Reverse rotation torque limit	11 TQ limit-		300	%	
Adjustment parameters	12	DG2	LOAD INERTIA RATIO	12 Inertia	O	3.0	×0.1	
	13	PG1	POS. LOOP GAIN 1	13 Pos. gain 1	O	70	rad/s	
	14	VG1	VEL. LOOP GAIN 1	14 V-gain 1	O	1200	rad/s	
	15	PG2	POS. LOOP GAIN 2	15 Pos. gain 2	O	25	rad/s	
	16	VG2	VEL. LOOP GAIN 2	16 V-gain 2	O	600	rad/s	
	17	VIC	VEL. INTGRL COMPS.	17 V-int com	O	20	ms	
	18	NCH	NOTCH FILTER	18 N-filter	O	0		
	19	FFC	FEED FORWAR GAIN	19 FF gain	O	0	%	
	20	INP	IN-POSITION RANGE	20 INP zone	O	100	pulse	
	21	MBR	SOLENOID BRAKE OUT	21 BRKtiming	O	100	ms	
	22	MOD	MON. OUT MODE	22 Moni. sel.	O	0001		
	23	*OP1	OPTIONAL FUNC. 1 (CARRIER FREQ. SEL)	23 Function1	O	0000		
	24	*OP2	OPTIONAL FUNC. 2 (W/O MOTOR OPE. SEL)	24 Function2	O	0000		
	25	*OP3	For manufacturer setting	25 Function3		0000		
	26	OP4	For manufacturer setting	26 Function4		0000		
Expansion parameters	27	MO1	MON. OUT 1 OFFSET	27 MO 1offset	O	0	mV	
	28	MO2	MON. OUT 2 OFFSET	28 MO 2offset	O	0	mV	
	29	MOA	BEFORE-ALARM DATA	29 ALM memo	O	0001		
	30	ZSP	ZERO SPEED	30 Zero SPD	O	50	r/min	
	31	ERZ	EX. ERROR ALARM LVL	31 AL52level	O	80	kpulse	
	32		OPTIONAL FUNC. 5	32 Function5	O	0000		
	33	OP6	For manufacturer setting	33 Function6		0000		
	34	VPI	PI-PID SWITCHING POSITION DROOP	34 PID droop	O	0	pulse	
	35	TTT	For manufacturer setting	35 Torq. com	O	0		
	36	VDC	VEL. DIFF. COMPS.	36 V-dif com	O	980		
	37		Spare	37 blank				
	38		Spare	38 blank				
	39		Spare	39 blank				
	40	*BLK	Parameter write disable	40 Pr. block		0000		

Note: Depends on the servo amplifier capacity.
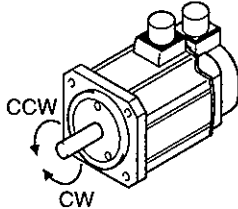
(2) Details list

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Basic parameters	1	*AMS	**Amplifier setting** Used to select the absolute position detection system. ` 0 │ 0 │ 0 │ ▢ ` ↳ Select of the absolute position detection system 0: Used in incremental system. 1: Used in absolute position detection system.	O	0000		0000 to 0001h
	2	*REG	**Regenerative brake resistor** Used to select the regenerative brake option and external dynamic brake. ` 0 │ ▢ │ 0 │ ▢ ` Select the regenerative brake option. 0: Set 0 when the servo amplifier of 7kW or less capacity has no external option or when the servo amplifier of 11kW or more uses the supplied regenerative brake resistor or regenerative brake option without a fan. 1: FR-RC, FR-BU 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. The parameter error will occur if the option used is not the one to be combined with the servo amplifier. Select the external dynamic brake. 0: Without the external dynamic brake 1: With the external dynamic brake	O	0001		0000 to 010Eh
	3	*MTY	**Motor type** Set this parameter value according to the motor used. When using the HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, this parameter value need not be set since it is automatically judged by merely connecting the motor encoder and servo amplifier. At this time, this parameter value is not changed but use it as it is. <table><tr><th>Setting</th><th>Servo Motor Series</th></tr><tr><td>0000</td><td>HA-SH</td></tr><tr><td>0001</td><td>HA-LH</td></tr><tr><td>0002</td><td>HA-UH</td></tr><tr><td>0003</td><td>HA-FH</td></tr><tr><td>0005</td><td>HA-MH</td></tr></table>	O			0000 to 0003 · 0005

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Basic parameters	4	*MCA	Motor capacity Used to set the output capacity of the servo motor. Set this parameter value properly according to the motor used. When using the HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, this parameter value need not be set since it is automatically judged by merely connecting the motor encoder and servo amplifier. At this time, this parameter value is not changed but use it as it is.	O	(Note)		5 to 2200

<table>
<tr><th>Servo Motor</th><th>Capacity [W]</th><th>Setting</th><th>Servo Motor</th><th>Capacity [W]</th><th>Setting</th></tr>
<tr><td>HA-MH13</td><td>100</td><td>10</td><td>HA-SH103</td><td>1000</td><td>100</td></tr>
<tr><td>HA-MH23</td><td>200</td><td>20</td><td>HA-SH153</td><td>1500</td><td>150</td></tr>
<tr><td>HA-MH43</td><td>400</td><td>40</td><td>HA-SH203</td><td>2000</td><td>200</td></tr>
<tr><td>HA-MH73</td><td>750</td><td>70</td><td>HA-SH353</td><td>3500</td><td>350</td></tr>
<tr><td>HA-FH053</td><td>50</td><td>5</td><td>HA-LH52</td><td>500</td><td>50</td></tr>
<tr><td>HA-FH13</td><td>100</td><td>10</td><td>HA-LH102</td><td>1000</td><td>100</td></tr>
<tr><td>HA-FH23</td><td>200</td><td>20</td><td>HA-LH152</td><td>1500</td><td>150</td></tr>
<tr><td>HA-FH33</td><td>300</td><td>30</td><td>HA-LH202</td><td>2000</td><td>200</td></tr>
<tr><td>HA-FH43</td><td>400</td><td>40</td><td>HA-LH302</td><td>3000</td><td>300</td></tr>
<tr><td>HA-FH63</td><td>600</td><td>60</td><td>HA-LH502</td><td>5000</td><td>500</td></tr>
<tr><td>HA-SH81</td><td>850</td><td>80</td><td>HA-LH702</td><td>7000</td><td>700</td></tr>
<tr><td>HA-SH121</td><td>1200</td><td>120</td><td>HA-LH11K2</td><td>11000</td><td>1100</td></tr>
<tr><td>HA-SH201</td><td>2000</td><td>200</td><td>HA-LH15K2</td><td>15000</td><td>1500</td></tr>
<tr><td>HA-SH301</td><td>3000</td><td>300</td><td>HA-LH22K2</td><td>22000</td><td>2200</td></tr>
<tr><td>HA-SH52</td><td>500</td><td>50</td><td>HA-UH32</td><td>300</td><td>30</td></tr>
<tr><td>HA-SH102</td><td>1000</td><td>100</td><td>HA-UH52</td><td>500</td><td>50</td></tr>
<tr><td>HA-SH152</td><td>1500</td><td>150</td><td>HA-UH102</td><td>1000</td><td>100</td></tr>
<tr><td>HA-SH202</td><td>2000</td><td>200</td><td>HA-UH152</td><td>1500</td><td>150</td></tr>
<tr><td>HA-SH352</td><td>3500</td><td>350</td><td>HA-UH222</td><td>2200</td><td>220</td></tr>
<tr><td>HA-SH502</td><td>5000</td><td>500</td><td>HA-UH352</td><td>3500</td><td>350</td></tr>
<tr><td>HA-SH702</td><td>7000</td><td>700</td><td>HA-UH452</td><td>4500</td><td>450</td></tr>
</table>

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
	5	*MTR	Servo motor speed Used to set the rated speed of the servo motor. Set this parameter value properly according to the motor used. When using the HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, this parameter value need not be set since it is automatically judged by merely connecting the motor encoder and servo amplifier. At this time, this parameter value is not changed but use it as it is.	O	2		1 to 3

Servo Motor	Speed [r/min]	Setting
HA-MH	3000	3
HA-FH	3000	3
HA-SH	1000	1
	2000	2
	3000	3
HA-LH	2000	2
HA-UH	2000	2

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Basic parameters	6	*FPB	Feedback pulse Set this parameter value properly according to the motor used. When using the HC-MF, HA-FF, HC-SF, HC-RF or HC-UF series servo motor, this parameter value need not be set since it is automatically judged by merely connecting the motor encoder and servo amplifier. At this time, this parameter value is not changed but use it as it is. 	Setting	Encoder Resolution [r/min]	Servo Motor
---	---	---
0	16384	HA-SH, HA-LH, HA-UH
1	8192	HA-MH, HA-FH		O	0		0 · 1
	7	*POL	Rotation direction setting Used to set the rotation direction of the servo motor. 0: Forward rotation (CCW) with the increase of the positioning address. 1: Reverse rotation (CW) with the increase of the positioning address. CCW CW	O	0		0 · 1.
	8	ATU	Auto tuning Used to select the auto tuning function. 0 0 0 Auto tuning selection 0: Auto tuning selected for use of interpolation axis control, etc. in position control (valid) 1: Auto tuning for ordinary operation (valid) 2: No auto tuning (invalid)	O	0001		0000 to 0002h

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Basic parameters	9	RSP	Servo response setting Used to set the response of auto tuning. `0  0  0  [ ]` Response setting (when auto tuning is valid) Optimum response can be selected according to the rigidity of the machine. As machine rigidity is higher, faster response can be set to improve tracking performance in response to a command and to reduce setting time.	O	0001		0001 to 000Ch

Description / Guideline table:

Machine Type	Setting	Response	Guideline for corresponding machine rigidity	GDL^2/GDM^2 guideline for load inertia	Guideline for Position Settling Time GDL^2/GDM^2 guideline = within 5 times
Normal	1	Low response	Low rigidity		50 to 300ms
	2		to		
	3	Middle response	Medium rigidity		10 to 70ms
	4		to		
	5	High response	High rigidity	1 to 10 times	10 to 30ms
Large friction	8	Low response	Low rigidity		70 to 400ms
	9		to		
	A	Middle response	Medium rigidity		10 to 100ms
	B		to		
	C	High response	High rigidity		10 to 50ms

When changing the setting, look at the vibration and stop settling of the servo motor and machine immediately before they stop and during their stop, and always increase the setting in sequence, beginning with the slower response.

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Basic parameters	10	TLP	Forward rotation torque limit Assume that the rated torque is 100[%]. Used to limit the torque in the forward rotation driving mode. When torque monitor is selected for monitor output, this setting level is 8[V].		300	%	0 to 300
	11	TLN	Reverse rotation torque limit Assume that the rated torque is 100[%]. Used to limit the torque in the forward rotation driving mode. When torque monitor is selected for monitor output, this setting level is 8[V].		300	%	0 to 300
Adjustment parameters	12	DG2	Load inertia ratio Used to set the ratio of the load inertia (inertia moment) to the inertia moment of the servo motor shaft. When auto tuning is selected, the result of auto tuning is automatically used.	O	3.0	×0.1	0.0 to 100.0
	13	PG1	Position loop gain 1 Used to set the gain of position loop 1. Increase the gain to improve trackability performance in response to the position command.	O	70	rad/s	4 to 1000
	14	VG1	Speed loop gain 1 Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically used.	O	1200	rad/s	20 to 5000

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Adjustment parameters	15	PG2	Position loop gain 2 Used to set the gain of the position loop. Set this parameter to increase position response to load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically used.	O	25	rad/s	1 to 500
	16	VG2	Speed loop gain 2 Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically used.	O	600	rad/s	20 to 8000
	17	VIC	Velocity integral compensation Used to set the constant of integral compensation. When auto tuning is selected, the result of auto tuning is automatically used.	O	20	ms	1 to 1000
	18	NCH	Notch filter Used to set the notch frequency to match the response frequency of the mechanical system. 	Setting	Machine Resonance (Notch) Frequency [Hz]
---	---
0	Not used
1	1125
2	563
3	375
4	282
5	225
6	188
7	161		O	0		0 to 7
	19	FFC	Feed forward gain Used to set the feed forward gain for position control. Set 100% to zero the droop pulse value when operation is performed at constant speed. Note that sudden acceleration/deceleration will increase overshoot. As a guideline, acceleration/deceleration time to/from the rated speed is 1s or longer when the set value is 100. When setting this parameter, always set auto tuning to "No" (parameter No. 8).	O	0	%	0 to 100
	20	INP	In-position range Used to set the droop pulse range in which the in-position signal will be output to the servo system controller.	O	100	pulse	0 to 50000
	21	MBR	Electromagnetic brake sequence output Used to set a time delay between electromagnetic brake operation and base drive circuit shut-off.	O	100	ms	0 to 1000

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Adjustment parameters	22	MOD	Monitor output mode Used to set the signal to be output to the analog monitor output. `0` □ `0` □ Monitor CH2 output selection 0: Motor speed (±8V/max. speed) 1: Torque (±8V/max. torque) (Note 1) 2: Motor speed (+8V/max. speed) 3: Torque (+8V/max. torque) (Note 1) 4: Current command (+8V/max. torque) output (Note 2) 5: Command pulse frequency (±8V/400Kpulse/s) 6: Droop pulses 1/1 (±11.6V/2048pulse) 7: Droop pulses 1/4 (±11.6V/8192pulse) 8: Droop pulses 1/16 (±11.6V/32768pulse) 9: Droop pulses 1/32 (±11.6V/65536pulse) A: Droop pulses 1/64 (±11.6V/131072pulse) Monitor CH1 output selection Items are the same as in monitor CH2. Note 1. 8V is output at the maximum torque. However, when parameter No. 10, 11 is used to limit the torque, 8V is output at the limited torque. 2. Used as the reference axis side output of multi-motion.	O	0001		0000 to 0A0Ah
	23	*OP1	Optional function 1 Used to choose the low acoustic noise mode. `0` `0` □ `0` Low acoustic noise mode selection By choosing the low acoustic noise mode, electromagnetic sound generated by the servo motor can be reduced by about 20dB. (Refer to Section 6.2.2.) At this time, the continuous output of the servo motor reduces. 0: Non-low acoustic-noise 3: Low acoustic-noise	O	0000		0000 . 0030h
	24	*OP2	Optional function 2 Used to choose the electromagnetic brake output timing and motor-less operation (test operation). □ □ `0` `0` Selection of motor-less operation 0: Invalid 1: Valid (motor-less operation performed) Electromagnetic brake interlock output timing 0: Output in any of the following statuses independently of the servo motor speed: 1) Servo off 2) Alarm (ALM) occurred 3) Emergency stop signal (EM1) turned off (valid) 1: Output in any of the above 1) to 3) statuses when the motor speed is at or less than the zero speed (parameter No. 30). The time from when the electromagnetic brake interlock signal is output until when the base circuit is shut off can be set in parameter No. 21.	O	0000		0000 to 1100h

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Extension parameters	25	*OP3	For manufacturer setting		0000		
	26	OP4	For manufacturer setting		0000		
	27	MO1	MO1 offset Used to set the offset voltage for monitor output 1.	O	0	mV	−9999 to 9999
	28	MO2	MO2 offset Used to set the offset voltage for monitor output 2.	O	0	mV	−9999 to 9999
	29	MOA	Pre-alarm data selection Used to select the pre-alarm data. ☐ 0 ☐ ☐ ☐ Data selection 2 0: Motor speed (±output) 1: Torque (±output) 2: Motor speed (±output) 3: Torque (±output) 4: Current command output (±output) 5: Command pulse frequency (±output) 6: Droop pulses 1/1 (±output) 7: Droop pulses 1/4 (±output) 8: Droop pulses 1/16 (±output) 9: Droop pulses 1/32 (±output) A: Droop pulses 1/32 (±output) Data selection 1 Items are the same as in data selection 2. Alarm data sampling time selection 0: 1.77 [ms] 1: 3.55 [ms] 2: 7.11 [ms] 3: 14.2 [ms] 4: 28.4 [ms]	O	0001		0000 to 04AAh
	30	ZSP	Zero speed Used to set the output range of the zero speed signal (ZSP).	O	50	r/min	0 to 1000
	31	ERZ	Error excessive alarm level Used to set the output range of the error excessive alarm.	O	80	kpulse	1 to 1000
	32		Optional function 5 Used to select PI-PID control switch-over. ☐ 0 ☐ 0 ☐ 0 ☐ PI-PID control switch over 0: PI control is always valid. 1: Switched to PID control when the droop value set in parameter No. 34 is reached or exceeded. 2: PID control is always valid.	O	0000		0000 to 0002
	33	OP6	For manufacturer setting		0000		
	34	VPI	PI-PID control switch-over position droop Used to set the position droop value (number of pulses) at which PI control is switched over to PID control. Set "0001" in parameter No. 32 to make this function valid.	O	0	pulse	0 to 50000
	35	TTT	For manufacturer setting	O	0		

Classifi-cation	No.	Code	Name and Function	Con-troller	Initial Value	Unit	Setting Range
Extension parameters	36	VDC	Speed differential compensation Used to set the differential compensation value.	O	980		0 to 1000
	37		Spare				
	38		Spare				
	39		Spare				
	40	*BLK	Parameter write inhibit		0000		0000h 000Ah 000Eh

Setting	Setting/Changing from Controller	Setting/Changing from Parameter Unit
0000 (Initial value)	Parameter No.1 to 39	Parameter No.1 to 11, 40
000A	Parameter No.1 to 39	Parameter No.40
000E	Parameter No.1 to 39	Parameter No.1 to 40

6.2 Detailed Description

6.2.1 Analog output

The servo status can be output to two channels in terms of voltage. Use this function when using an ammeter to monitor the servo status or synchronizing the torque/speed with the other servo.

The servo amplifier is factory-set to output the motor speed to CH1 and the generated torque to CH2. The setting can be changed as listed below by changing the parameter No.22 value:

Setting	Output Item	Description	Setting	Output Item	Description
0	Motor speed	8[V] CCW direction / Max. speed / 0 Max. speed / −8[V] CW direction	6	Droop pulses 1/1 (2048pulse)	11.6[V] CCW direction / 2048[pulse] / 0 2048[pulse] / −11.6[V] CW direction
1	Generated torque	8[V] CCW direction / Max. torque / 0 Max. torque / −8[V] CW direction	7	Droop pulses 1/4 (8192pulse)	11.6[V] CCW direction / 8192[pulse] / 0 8192[pulse] / −11.6[V] CW direction
2	Motor speed	CW direction 8[V] CCW direction / Max. rotation speed 0 Max. rotation speed	8	Droop pulses 1/16 (32768pulse)	11.6[V] CCW direction / 32768[pulse] / 0 32768[pulse] / −11.6[V] CW direction
3	Generated torque	CW direction 8[V] CCW direction / Max. torque 0 Max. torque	9	Droop pulses 1/32 (65536pulse)	11.6[V] CCW direction / 65535[pulse] / 0 65535[pulse] / −11.6[V] CW direction
4	Current command (Torque command)	8[V] CCW direction / Max. command current (Max. torque command) / 0 Max. command current (Max. torque command) / −8[V] CW direction	A	Droop pulses 1/64 (131072pulse)	11.6[V] CCW direction / 131072[pulse] / 0 131072[pulse] / −11.6[V] CW direction
5	Command speed	8[V] CCW direction / −400kpps / 0 400kpps / −8[V] CW direction			

Change the following digits of parameter No. 22:

Parameter No.22

0		0		

└─────► Analog monitor ch2 output selection
(Signal output to across MO2-MOG)

└─────────────► Analog monitor ch1 output selection
(Signal output to across MO1-MOG)
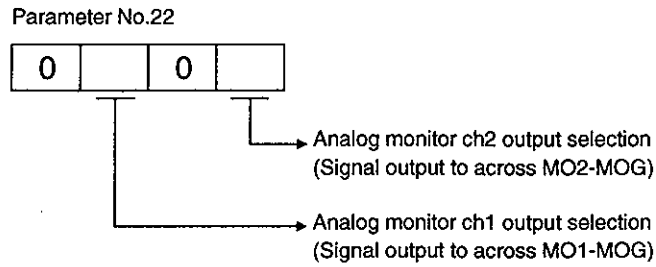
Parameters No. 27 and 28 can be used to set the offset voltages to the analog output voltages. The setting range is between –9999 and 9999mV.

Parameter	Description	Setting Range [mV]
Parameter No.27	Used to set the offset voltage for the analog monitor CH1 output.	–9999 to 9999
Parameter No.28	Used to set the offset voltage for the analog monitor CH2 output.	

6.2.2 Low acoustic noise mode

By setting parameter No. 23 from the controller, select the low acoustic noise mode to improve motor-generated, audible frequency magnetic noise about 20dB.

Parameter No.23

0	0		0

└─────► Low acoustic noise mode
0: Non-low acoustic noise
3: Low acoustic noise

For HC-SF152
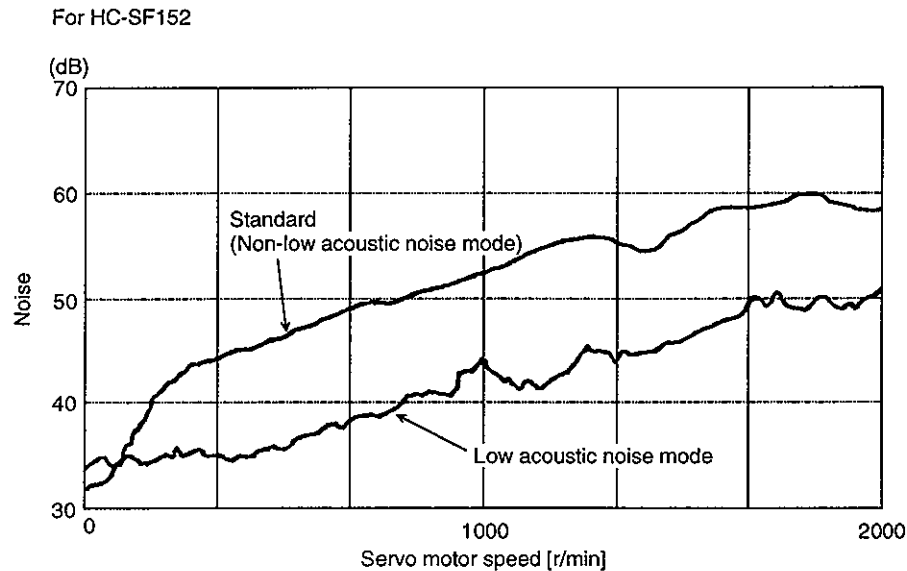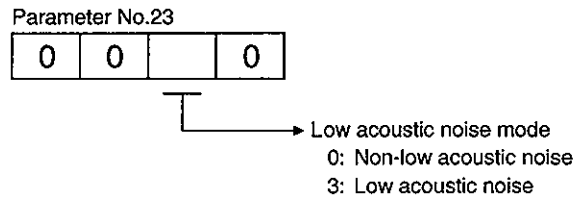
7. PARAMETER UNIT AND DISPLAY SECTION

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

Mode keys···Used to switch between modes displayed on the screen

⬡ MONITOR : Monitoring mode select key
· Used to change the screen display to the monitoring mode.

⬡ ALM/DGN : Alarm/diagnostic mode select key
· Used to change the screen display to the alarm/diagnostic mode.

⬡ PARAM/DATA : Parameter mode select key
· Used to change the screen display to the parameter mode.

⬡ TEST : Test mode select key
· Used to change the screen mode to the test mode.

Display···Liquid crystal screen
(13 characters by 4 digits)
· Interactive parameter setting
· Help function, troubleshooting guidance
· Monitoring

MITSUBISHI   MELSERVO-PRU01A

Operation keys

⬡ HELP : Help mode select key
Used to set the monitor or parameter in a list.

⬡ SHIFT : Shift key
· Used to make the typing of the corresponding shift character (e.g.D of [ᴰ7]) valid.
· Used to switch the screen. Example: Used to alternate between the current alarm and the concurrent alarm.

⬡ CAN : Cancel key
· Used to return to the previous screen.

⬡ ▼ ▲ : Scroll keys
· Used to scroll the screen.
· Hold down the key for more than 1 second to increase the scroll speed.
· Used to move the cursor on the screen.

Numeral keys

⬡ (0) to (ᶠ9): Numerals (0 to F)
· Used to enter the set value of the parameter. To type F, press [ᶠ9] after pressing the [SHIFT] key.

⬡ (1STEP·) : Decimal point

Definition key

⬡ : Definition key
· Used to define the parameter data after it is entered.
· Used to choose the necessary operation on the corresponding function menu screen.

Test run keys

FWD : Forward rotation start key
· Used to start forward rotation in the test run mode.

— REV : –/Reverse rotation start key
· Used to enter the – (negative) sign.
· Used to start reverse rotation in the test run mode.

STOP RESET : Stop/reset key
· Used to stop the test run temporarily.
· Used to reset an alarm or clear date entered.

7.2 Operation of the Parameter Unit

(1) Outline of display sequence

```
┌─────────────────┐
│ SERVO           │
│                 │  ···Servo being initialized
│ Initializing    │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│ COMMUNICATION   │
│                 │  ···Being initialized by
│ Initializing    │     communication
└─────────────────┘
         │
         ▼
┌─────────────────┐
│ CONTROL TYPE    │
│   POSITION      │
└─────────────────┘
```

```
→ JAPANESE      ▲          → MONITOR      ▲
  ENGLISH                    ALM/DIAG.
                ▼            PARAMETER
                             TEST MODE    ▼
```
Japanese-English select screen | Characters displayed on the screen are switched between English and Japanese.

```
CAN
→ MONITOR       ▲      HELP     Press the HELP key to
  ALM/DIAG.                →    move to the HELP scre-
  PARAMETER                ←    en in the mode indicated
  TEST MODE     ▼      CAN      by the cursor.
```
HOME screen   HELP screen

MONITOR — Monitoring mode
```
1 Pulse F/B     ▲
            PLS ▼
```
HELP screen
```
1→ Pulse F/B    ▲
2  Speed F/B
3  Ref.Speed
4  Droop        ▼
```

ALM/DGN — Alarm diagnostic mode
```
1 1st AL--      ▲
  NO ALARM
                ▼
```
HELP screen
```
1  ALARM        ▲
2  Not Rot.
3  ALM Hist.
4→ I/O Sig.     ▼
```

TEST — Test mode
```
<TEST mode>     ▲
■ : On test
0→ Finish
1   JOG feed    ▼
```

PARAM DATA — Parameter mode
```
<PARAM mode>    ▲
Pr.Read:No.
Pr.List :HELP
Copy    :SFT+3  ▼
```
HELP screen
```
<PARAM HELP>    ▲
→List Aii
   List Chg.
                ▼
```
Parameter No. 0 call screen
```
0 MTR type      ▲
             3
0-11            ▼
```

```
0→ blank        ▲
1  AMP sel.
2  R. resist.
3  MTR type     ▼
```

HELP
```
3→ MTR type     ▲
4  MTR cap.
5  MTR speed
6  PLG type     ▼
```

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

(2) Monitoring mode

(3) Alarm mode

ALM
DGN

HELP

```
1→ALARM
2  Not Rot.
3  ALM Hist
4  I/O Sig.
```
HELP screen

1. Current alarm

```
1 1st AL--
   NO ALARM
```

At occurrence of
AL10 alarm

```
1 1st AL10
  Under volt
  Details: ⏎
  Other AL: SFT
```

Cause of alarm occur-
rence (first screen)

```
Power  Volt.
Under  160V
15ms   IPF
```

Cause of alarm occur-
rence (second screen)

```
Insuf.power
capacity
```

Concurrent alarm

```
1 2nd AL20
  PLG err2
  Details: ⏎
  Main AL: SFT
```

Cause of alarm occur-
rence (first screen)

```
2 PLGcon.left
  PLGcable
  has troubl
```

2. Unrotated motor
   reason

```
2 Not Rotate

   Read: ⏎
```

Unrotated motor reason screen

```
Ref.pulse
freq.lower
LSN OFF
LSP OFF
```

```
2 Not Rotate
  Rotating
```

· Subsequent screens

3. Alarm history

```
3 ALM Hist.

   Read: ⏎
```

Alarm history list (first screen)

```
0AL33    0h
1AL52   49h
2AL11   9h
3AL34   67h
```
Time of occurrence
First alarm in past

(Second screen)

Second alarm in past

SHIFT

Alarm history list (first screen)

```
0 Overvolt.
1 Under volt
2 Under volt
3 Under volt
```

(Second screen)

Alarm history list (third screen)

```
8 Under volt
9 NO ALARM
```

Alarm history list (third screen)

```
8AL24   310h
9AL- - - - - - - - -h
```
Indicates alarm has
not occurred.

4. DIO diagnostic

```
4 I/O Signal
   ■: ON
   □: OFF
   Read: ⏎
```

DIO signal list (first screen)

```
DI EMG■
   · · · · · · · · ·
```

DIO signal list (second screen)

```
DI MBR ■  DB □
    OP □
```
Output signal

5. Setting time

```
5 T  after   P
          12mS
```

6. Alarm
   occurrence data

```
6 Before  ALAM

  Monitor  : 1⏎
  Analogue : 2⏎
```

7. Accumulative
   power-on time

```
7 Power ON    T.
      546      Hr
  Num. of Pow.  On
      159
```

8. S/W number

```
8 S/W No.

  BCD-B15W000
      A0
```

9. ABS data

```
10 ABS pos.       0
   CYC0    0
   ABS0    0
```

① ⏎   ② ⏎

Monitor data

```
1 Pulse      F/B
         0 PLS
2 Speed      F/B
         0.0 r/min
```

```
13 P-N Volt
       279  Volt
14 Inertia
         0  times
```

Analog data

```
Analogue

Output: ⏎
```

```
Analogue

Output: ⏎
```

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

7. PARAMETER UNIT AND DISPLAY SECTION

(4) Parameter mode

Calling method 1

Calling method 2

Parameter mode screen

To the next page

To call parameter No. 4

Setting example of
HA-FH motor "0010"

To read and set the
required parameter in
the parameter list.

Cursor

Keep pressing the [▼]/[▲]
key continuously to move
the cursor continuously.

Calls the parameters
of which setting are
other than the factory
settings. The following
screen shows that
parameter No. 1, 3, 9
and 40 have been changed.

To set the load in-
ertia ratio 3 in para-
meter No.9

[CAN] to return
to the parameter
mode screen.

When a wrong numeral
has been input,press
the [STOP/RESET] key
to return to the previous
screen.

From preceding page

SHIFT + ③

<Copy mode>
→Pr. READ
Pr. WRITE
COMPARE

Copy mode screen

▼
▼

<Copy mode>
→Pr. READ
Pr. WRITE
COMPARE

↵

<Copy mode>
Comparing
Waiting

↓

<Copy mode>
COMPLETE
Mode Sel. : CAN

[CAN] to retrun
to the copy
mode screen.

↓

Screen for
parameter verify
error

<Copy mode>
Comparing
Er.PrNo. : SFT
Mode Sel. : CAN

SHIFT

Er.PrNo.
Pr 2   Pr 6
Pr 9   Pr10
Pr11   Pr12

Screen example for
10 different parameters
in verify error

▼

Er.PrNo.
Pr13   Pr14
Pr15   Pr17

<Copy mode>
→Pr. READ
Pr. WRITE
COMPARE

↵

<Copy mode>
Write?
       Yes : ↵
       No : RST

↵

<Copy mode>
Writing
Waiting

↓

<Copy mode>
COMPLETE
→Power Off

Switch the power off
once, then on again.

<Copy mode>
Read?
       Yes : ↵
       No : RST

↵

<Copy mode>
Reading
Waiting

↓

<Copy mode>
COMPLETE
Mode sel. : CAN

[CAN] to return to the
copy mode screen.

Screen for outside-
the-range parametere
setting

Error No : SFT
CORRECT Pr.
Write   Yes : ↵
         No : RST

Screen for write
inhibit error

<Copy mode>
Write Inhibit
SON   ALM PRICT
   Press"CAN"

(5) Test run mode

(TEST)

<TEST MODE>
■.# On test
0 →Finish
1 JOG FEED   Test run mode screen

To the next page

1. Jog operation
[▼] Press once.

<TEST MODE>
■.# On test
0 Finish
1→JOG FEED

· Jog operati-
on setting
list

■<JOG FEED>
→Speed set
Time set
Key list

· Speed
screen

■Speed r/min
200
0 to 4600

· Setting example of speed
3000
[3][0][0][0]

☆ ■Speed r/min
200
0 to 4600

Write of 3000 complete

■Speed r/min
3000
Write complete

· Acceleration/
deceleration   [▼]
time constant screen

■Acc/Dec ms
1000
0 to 50000

· Setting example of time
constant   [°5][0][0]

■Acc/Dec ms
1000
0 to 50000

■Acc/Dec ms
500
Write complete

· Operatin key
display screen [▼]

■Forward : FWD
Reverse : REV
Stop : STOP
Finish : CAN.J

Hold down the [FWD] key to rotate
the servo motor in the forward direction.

Hold down the [-/REV] key to rotate
the servo motor in the reverse direction.

Release the key to stop.

Press the [CAN] key.

■<TEST MODE>
■.# On test
1 JOG FEED
0→Finish

2. Positioning operation
[▼][▼] Press twice.

<TEST MODE>
■.#.On test
1 JOG FEED
2→STEP FEED

· Positioning oper-
ation setting list

■<STEP FEED>
→Speed set
Time set
Pos pulses

· Speed screen

■Speed r/min
200
0 to 4600

· Setting example of speed 1500
[1][°5][0][0]

☆ ■Speed r/min
200
0 to 4600

Write of 1500 complete

■Speed r/min
1500
Write complete

· Acceleration/dece-
leration time cons- [▼]
tant screen

■Acc/Dec ms
1000
0 to 50000

· Setting example of time constant
200
[2][0][0]

■Acc/Dec ms
1000
0 to 50000

■Acc/Dec ms
200
Write complete

· Travel value   [▼]
setting screen

■Pos pulses
100000
1 to 9999999

· Setting of travel value 650000
[°6][°5][0][0][0][0]

☆ ■Pos pulses
100000
1 to 9999999

■Pos pulses
650000
Write complete

(Note) ■Forward : FWD
Reverse : REV
Stop : STOP
Finish : CAN.J

[FWD] : Press the [FWD] key (The servo motor rotates
to start forward rota- (by the set travel value and
tion.   (comes to a stop.

[-/REV] : Press the [-/REV] key (The servo motor rotates
to start reverese rota- (by the set travel value and
tion.   (comes to a stop.

[STOP/RESET] : Press the [STOP/RESET] key to make a temporary
stop.
· Press the same key as in starting (FWD or REV) to
restart.

Press the [STOP/RESET] key during the temporary stop
to clear the remaining travel value.

Press the [CAN] key.

■<TEAT MODE>
■ # On test
1 STEP FEED
0→Finish

To reset the test run

Note. Press the [CAN] key on the screen marked ☆ to call the overshoot diagnostic screen.

V ↓ Over-
↑ shoot
↓ 5%
0 to 5%
overshoot screen

V ↓ Over-
↑ shoot
↓ 15%
0 to 30%
overshoot screen

The value shown at power-on
or no operation is "--%".

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→[    ]
      Finish→Pow.OFF
```

· Allows motor-less operation.
To reset the motor-less oper-
ation, switch the power off on-
ce, then on.

· When the following screen ap-
pears, switch the SON signal
off.

```
■Test Mode no
 selectable
 [          ]
```

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    →MBR □ ▲
ON :1    DB  □
OFF:0         ▼
```

Output status display

Press the [1] key to switch RD output on.

```
■DO    MBR   ■ ▲
ON :1  DB    □
OFF:0         ▼
```

▽ ▽ ▽ ▽ Press four times.

```
■DO    MBR   □ ▲
ON :1→DB     □
OFF:0         ▼
```

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  [        ]
0→Finish         ▼
```

↵

To reset the test run

· When the following screen appears,
switch the SON signal off.

```
■Test Mode not   ▲
 selectable
 [          ]    ▼
```

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
Torque command	-		Screen for future expansion		
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
Peak load factor	Peak load	%	Maximum generated torque is displayed. The effective value in the past 15 seconds 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
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. The servo amplifier display shows the four lower digits of the actual position within one revolution. 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
Bus voltage	P/N Volt	V	The voltage (across P-N) of the main circuit converter is displayed.	0 to 400	0 to 400
Load inertia ratio	Inertia	×0.1 times	The ratio of the servo motor shaft-equivalent load inertia moment to the servo motor shaft's inertia moment is estimated and displayed.	0 to 100	0 to 100

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	1st AL	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 10.2)
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 (14 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	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)

b) Unrotated motor reason

No.	Parameter Unit Display	Description
1	SON off	Indicates that the servo ON command from the servo system controller is off.
2	Alarm	Alarm has occurred.
3	EMG off	Emergency stop (EM1) signal is off.
4	Controller EMG off	Indicates that the emergency stop (EMG) signal off the servo system controller is off.
5	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.
6	Feed speed lower	Indicates that the feedrate is 1r/min or less during position control.
7	Ref. Speed lower	Indicates that the command speed is 1r/min or less during speed control.
8	Speed limit	Indicates that the speed limit region reached and the servo motor speed is 5r/min or less during torque control.

7.5 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.

7.5.1 Jog operation

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

(1) Operation

Connect EM1-EM2 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
Acceleration/deceleration time constant [ms](Note)	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.

7.5.2 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
Acceleration/deceleration time constant [ms](Note)	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.

7.5.3 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 servo off, 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.

7.5.4   DO forced output

When providing the DO forced output, short EM1-EM2.
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).
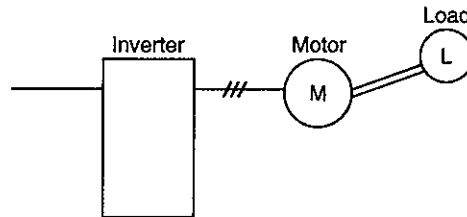
On the other hand, the servo amplifier always detects the positions and speeds of the motor and machine using the servo motor encoder, and exercises control to match the position and speed commands with the actual motor (machine) position and speed. In the servo system, adjustment is needed because:
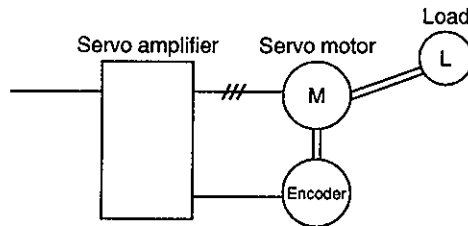
(1) Response changes according to the inertia moment of the machine;

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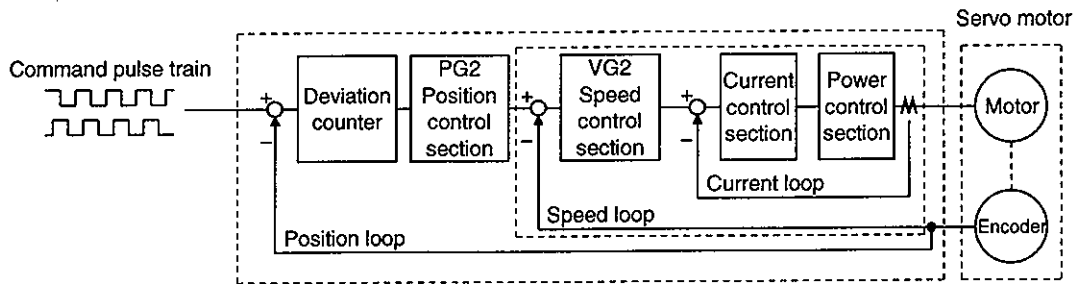
A general servo system configuration is shown above. The servo control system consists of three loops: current loop, speed loop and position loop. Among these three loops, the response of the inside loop must be increased 4 to 6 times higher. If this condition is not satisfied, vibration will be generated.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

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

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

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.8	ATU	Auto tuning
No.9	RSP	Servo response set
No.12	GD2	Ratio of load inertia moment to motor inertia moment
No.13	PG1	Position loop gain 1
No.14	VG1	Speed loop gain 1
No.15	PG2	Position loop gain 2
No.16	VG2	Speed loop gain 2
No.17	VIC	Speed integral compensation
No.18	NCH	Notch filter.

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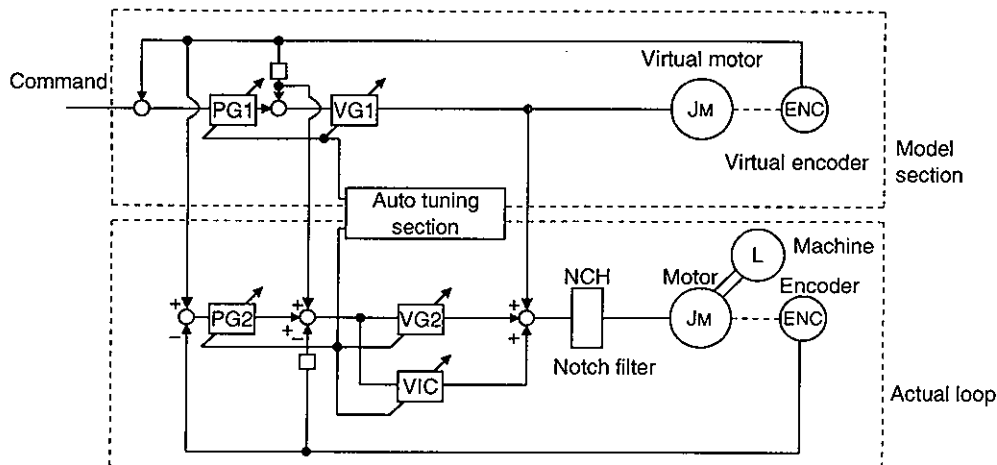
The block diagram of the Servo amplifier servo control section is shown above. (The current loop is omitted.)

(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 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.

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

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.9. 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.8: 0001).
In the factory setting of the servo amplifier, auto tuning is valid and the response setting is "2".
The initial settings provide sufficient tuning for general machines. Higher-level tuning can be provided by adjusting the response setting (first digit of parameter No. 9) 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.9 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. 8 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) Operation pattern
   a) Set the acceleration time (time until the preset speed is reached) to 5s or less and the acceleration/deceleration current to 50% or more.

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

   c) 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 0001 in parameter No.8.Set 0001 in parameter No.9.
   2) Set "Not executed" auto tuning in parameter No.8.
   3) Gradually decrease the speed integral compensation VIC (parameter No.17) setting.

   (b) Adjustment 2
   1) Perform auto tuning with the response setting of slow response.
      Set 0001 in parameter No.8.Set 0001 in parameter No.9.
   2) Set the notch filter (parameter No. 18) in due 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 0001 in parameter No.8.Set 0001 in parameter No.9.

2) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No.18).

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

4) Increase the machine resonance suppression filter value gradually and repeat step 3).

The optimum value is provided at the point just before vibration increases.

5) To further shorten the settling time, gradually increase the response setting in parameter No.9 and repeat steps 1) to 4).

(b) Adjustment 2

1) Choose the response setting of slow response.

Set 0001 in parameter No.8.Set 0001 in parameter No.9.

2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.12).

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.12 value.

Parameter No.	Symbol	Name
No.13	PG1	Position loop gain 1
No.15	PG2	Position loop gain 2
No.14	VG1	Speed loop gain 1
No.16	VG2	Speed loop gain 2
No.17	VIC	Speed integral compensation

3) Set parameter No.8 to □□□2 (auto tuning not executed).

4) Decrease the speed loop gain 2 (parameter No.16) 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.18).

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

7) Increase the machine resonance suppression filter value gradually and repeat step 3).

The optimum value is provided at the point just before vibration increases.

8) When there is no machine resonance, check the operating status and gradually increase the speed loop gain 2 (parameter No.16) and repeat steps 5) to 7) in Adjustment 1.

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.

9) To further shorten the settling time, gradually increase the response setting of parameter No.9 and repeat steps 1) to 8).

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

Pulley

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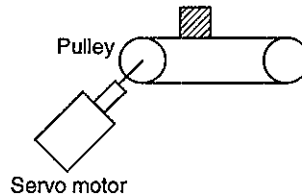
2) Machine in which a disc is rotated without reduction gear

Disc

Servo motor
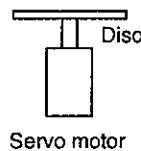
3) Machine of which ballscrew lead is long

Servo motor   Ballscrew

(2) Adjustment procedure

1) Choose the response setting of slow response.

Set 0001 in parameter No.8.Set 0001 in parameter No.9.

2) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.12).

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.12 value.

Parameter No.	Symbol	Name
No.13	PG1	Position loop gain 1
No.15	PG2	Position loop gain 2
No.14	VG1	Speed loop gain 1
No.16	VG2	Speed loop gain 2
No.17	VIC	Speed integral compensation

3) Set parameter No.8 to □□□2 (auto tuning not executed).

4) Alternate a start and a stop several times, execute auto tuning, 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) When it is desired to increase the response further, set parameter No. 8 to 0001 (auto tuning executed) in an operation stop status, and increase the response setting of parameter No. 9.

After that, set parameter No. 8 to 0002 (auto tuning not executed).

8) Reducing the speed loop's integral time constant (parameter No.17) 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 0001 in parameter No.8.Set 0001 in parameter No.9.

　　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.12).

　　　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.12 value.

Parameter No.	Symbol	Name
No.13	PG1	Position loop gain 1
No.15	PG2	Position loop gain 2
No.14	VG1	Speed loop gain 1
No.16	VG2	Speed loop gain 2
No.17	VIC	Speed integral compensation

　　d) Set 0002 in parameter No.8 to make auto tuning invalid.

　　　Make the parameter No.13 to 17 settings manually adjustable.

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

Parameter No.	Symbol	Name	Description
No.13	PG1	Position loop gain 1	Higher setting shortens the settling time but
No.15	PG2	Position loop gain 2	is liable to cause overshooting.
No.14	VG1	Speed loop gain 1	Higher setting improves the servo response
No.16	VG2	Speed loop gain 2	level but is liable to cause vibration.
No.17	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.13 to 16 settings at the same ratio and reducing the speed integral compensation (parameter No.17). The optimum value is provided at the point just before vibration increases. Use of the notch filter (parameter No.18) may increase the limit point.

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 0000 or 0002 in parameter No.8.
　　0000: Interpolation control········ The following parameter values change at the next start/stop.

Parameter No.	Symbol	Name
No.13	PG1	Position loop gain 1
No.15	PG2	Position loop gain 2
No.17	VIC	Speed integral compensation

　　0002: 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 When Alarm or Warning Has Occurred

10.1.1 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 10.1.2 or 10.1.3 and take the appropriate action.

	Indication	Function Name	Parameter Unit Screen Display	Alarm Deactivation			
				Power OFF→ON	Parameter unit "RES"	Alarm reset	CPU reset
Alarm codes	10	Under voltage	Under volt	○	○	○	
	12	Memory alarm 1	Memory er 1	○			
	13	Clock alarm	OSC err	○			
	14	Watchdog	Watch dog	○			
	15	Memory alarm 2	Memory er 2	○			
	16	Encoder alarm 1	PLG err 1	○			
	17	Board alarm	Board err	○			
	19	Memory alarm 3	Memory er 3	○			
	1A	Motor combination error	Motor err.	○			
	20	Encoder alarm 2	PLG err 2	○			
	24	Ground fault	Grounded	○	○	○	
	25	Absolute position erase	ABS lost	○			
	30	Regenerative alarm	Reg. err	○	○	○	
	31	Over speed	Over speed	○	○	○	
	32	Over current	Over curr	○	○	○	
	33	Over voltage	Over volt	○	○	○	
	34	CRC alarm	CRC err	○	○	○	
	35	Command pulse frequency alarm	Ref. f err	○	○	○	
	36	Transfer alarm	trans.err	○	○	○	
	37	Parameter alarm	Pr. err	○			○
	42	Feedback alarm	Pos. err	○	○	○	
	45	Main circuit device overheat	Fin heat	○	○	○	
	46	Servo motor overheat	Motor heat	○	○	○	
	50	Over load 1	Over load 1	○ (Note)	○ (Note)	○ (Note)	
	51	Over load 2	Over load 2	○ (Note)	○ (Note)	○ (Note)	
	52	Error excessive	Over droop	○	○	○	
	8E	RS-232C alarm	RS232 err	○	○	○	
Warning codes	92	Open battery cable warning	BTT cable	Removing the cause of occurrence deactivates the alarm automatically.			
	96	Zero setting error	ZERO set er				
	9F	Battery warning	BTT volt				
	E0	Excessive regenerative load warning	OR warning				
	E1	Over load warning	OL warning				
	E4	Parameter warning	Pr. warning				
	E6	Servo emergency stop	EMG stop				
	E7	PC emergency stop	PCEMG stop				
	E9	Main circuit off warning	Main P-off				

Note: Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.

10.1.2 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 (30)
>   · Overload 1 (50)
>   · Overload 2 (51)
> • The alarms can be deactivated by switching power off, then on or by the error reset command from the servo system controller.
>   Refer to Section 10.1.1 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		
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-H700BN or less : 15ms or less In case of MR-HIIKBN 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 (10) occurs if power is switched on after all connectors are disconnected.	Change the Servo amplifier.
12	Memory alarm 1	RAM, ROM memory fault	Memory er 1	Board error	Faulty parts in the servo amplifier ┌── Checking method ──┐ Alarm (any of 12 to 15) occurs if power is switched on after all connectors are disconnected.	Change the Servo amplifier.
13	Clock alarm	Printed board fault	OSC err			
14	Watch dog	CPU fault	Watch dog			
15	Memory alarm 2	EEP-ROM fault	Memory er 2			
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		
17	Board alarm	CPU/parts fault	Board err	Board error	Faulty parts in the servo amplifier	Change the servo amplifier.
19	Memory alarm 3	Flash ROM fault	Memory alarm 3	Board error	┌── Checking method ──┐ Alarm (17 to 19) occurs if power is switched on after all connectors have been disconnected.	
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.
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.
24	Ground fault	Ground fault occurred at the servo motor outputs (U,V and W phases) of the servo amplifier.	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.
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.	
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		
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/deceleration 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. 3-5 missetting	4. Parameter No. 3 to 5 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.
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 (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.
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.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
34	CRC alarm	CRC alarm command cable fault	CRC err	Ref. cable con left	1. Bus cable is disconnected.	Connect correctly.
				Ref. Cable has troub	2. Bus cable fault.	Change the cable.
				Ext. noise	3. Noise entered the motion network cable.	Take noise suppression measures.
				Terminator con.	4. The terminal connector is disconnected.	Connect the terminal connector.
35	command pulse frequency alarm	Input pulse frequency of the manual pulse generator 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.
36	Transfer alarm		trans err	Ref. cable con left	1. Bus cable is disconnected.	Connect correctly.
				Ref. Cable has troub	2. Bus cable fault.	Change the cable.
				Board error	3. Faulty parts in the servo amplifier.	Change the servo amplifier.
				Terminator con.	4. The terminal connector is disconnected.	Connect the terminal connector.
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.
42	Feedback alarm	Encoder signal is faulty.	Pos. err	PLG trouble	Encoder faulty.	Change the servo motor.
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.
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.
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.

10. TROUBLESHOOTING

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
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	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.
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.

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
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/deceleration time constant.
				Start torque missing	2. Torque limit value (parameter No.47, 48) 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. 13 shortage	4. Position control gain 1 (parameter No.13) 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.
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 600kccps or less.
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.
75	Option memory alarm 2	Option card EEP-ROM fault	OpMemo. er 1	Op. board error		
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.

10.1.3 Remedies for warnings

If the warning that occurred is other than AL E6, AL E9 and ALE4, operation can be performed but If any other warning occurs, the servo amplifier goes into a servo off status. 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		
92	Open battery cable warning	Absolute position detection system battery voltage is low.	BTT cable	BTT cable has troubl	1. Battery cable is open.	Repair cable or changed.
				BTT voltage low	2. battery voltage dropped to 2.8V or less.	Change battery.
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
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.
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.
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. ┌── Checking method ──┐ Refer to 50, 51.	Refer to 50, 51.
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.
E6	Servo emergency stop	EM1-EM2 are open.	EMG stop	EMG off	External emergency stop was made valid. (EM1-EM2 opened.)	Ensure safety and deactivate emergency stop.
E7	PC emergency stop		PCEMG stop	Controller EMG off	Emergency stop signal was entered into the servo system controller.	Ensure safety and deactivate emergency stop.
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.

10.1.4 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	1. Connect properly. 2. Change the cable.
SERVO CPU ERROR	Communication cannot be made at power-on between the servo amplifier and parameter unit.	communication cable open 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.

10.2 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.

ALM/
DGN

```
1  1ST AL10        ▲
   Under volt
   Details: ↵
   Other AL: SFT    ▼
```

Press the key twice. ▼

```
3  ALM Hist.       ▲


   Read: ↵          ▼
```

SHIFT Hold down the SHIFT key and press the (3) key.

```
ALM History
All Clear OK?
   Yes: ↵
   No:  RST
```

Press the key.

```
3  ALM Hist.       ▲


   Read: ↵          ▼
```

The alarm history is cleared and setting is complete.
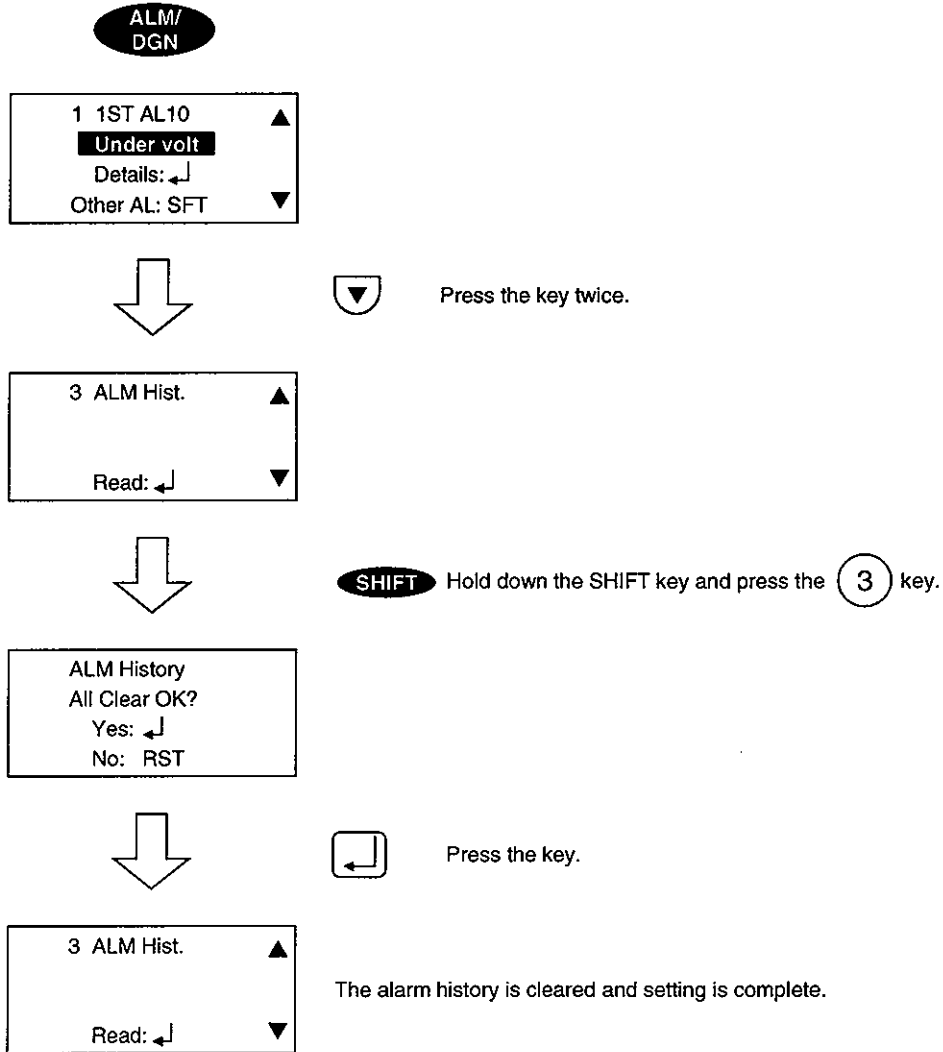
11. SPECIFICATIONS

11.1 Standard specifications

(1) Servo amplifier

Item \ Servo amplifier MR-H□BN		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											
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/s²] {0.6G} or less											
		19.4 [ft/s²] 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. SPECIFICATIONS

11.2 Outline Dimensional Drawings

11.2.1 Servo amplifiers

MR-H10BN(-UE) to MR-H60BN(-UE)
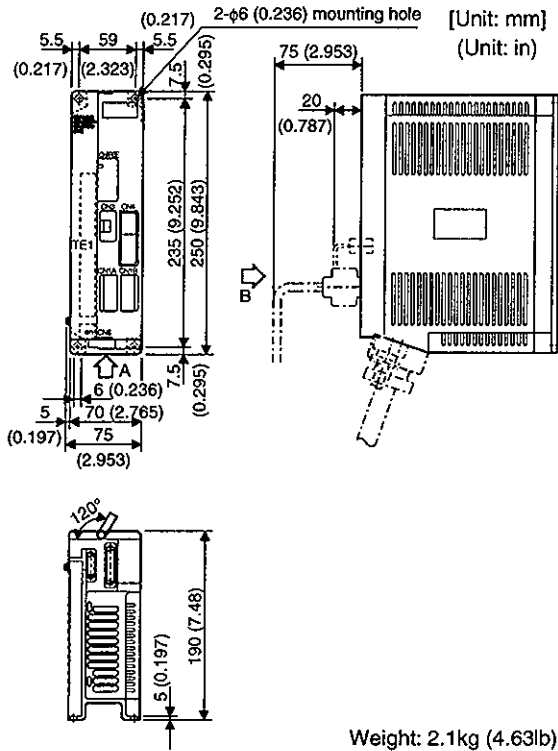
Weight: 2.1kg (4.63lb)

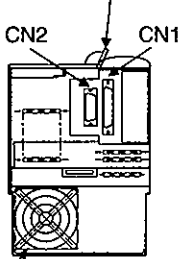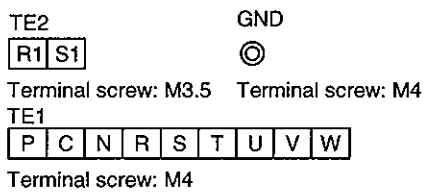| Terminal block TE1	
MR-H☐BN	MR-H☐BN-UE
Terminal screw: M4	Terminal screw: M4
P C N R S T R1 S1 U V W ⏚	P C N L1 L2 L3 L11 L21 U V W (Note) Chassis Note: Keep it open.

MR-H100BN(-UE)

Weight: 2.4kg (5.291lb)

Terminal block TE1	
MR-H☐BN	MR-H☐BN-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-H200BN(-UE) · MR-H350BN(-UE)
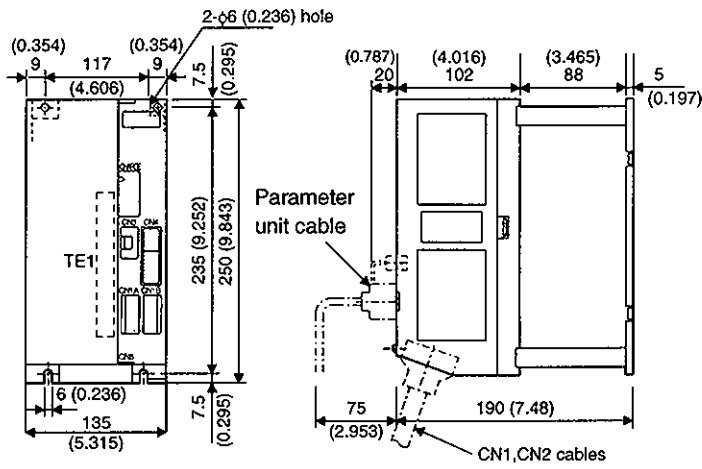
[Unit: mm]
(Unit: in)

Parameter
unit cable

CN1,CN2 cables

Terminal cover

CN2   CN1

Bottom view

Fan

Weight: 4.4kg (9.7lb)

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

Chassis

Note: Keep it open.

MR-H500BN(-UE) · MR-H700BN(-UE)

[Unit: mm]
(Unit: in)

MR-H500AN(-UE)

MR-H700AN(-UE)

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

Terminal block signal arrangement

• MR-H500BN

TE2   GND

R1	S1

◎

Terminal screw: M3.5   Terminal screw: M4

TE1

P	C	N	R	S	T	U	V	W

Terminal screw: M4

• MR-H700BN

TE1

P	C	N	R	S	T	R1	S1	U	V	W	⏚

Terminal screw: M5

• MR-H500BN-UE

TE2   PE

L11	L21

Terminal screw: M4

TE1

P	C	N	L1	L2	L3	U	V	W

Terminal screw: M4

• MR-H700BN-UE

TE1

P	C	N	L1	L2	L3	L11	L21	U	V	W	

Terminal screw: M5

PE

MR-H11KBN(-UE)

[Unit: mm]
(Unit: in)

2-φ10 (0.394) mounting hole

75 (2.953)

20 (0.787)

⬆ Fan air orientation

10 (0.394)

480 (18.898)
500 (19.685)

B

➡

ON

TE2

TE1

10 (0.394)
(0.591) 15
230 (9.055)
⬆A
10 (0.394)
15 (0.591)
260 (10.236)

260 (10.236)
85 (3.346)
13.2 (0.126)

Weight: 21kg (46.297lb)

Terminal block signal arrangement

• MR-H11KBN

TE2

| R1 | S1 | | MS1 | MS2 | |

Terminal screw: M4

TE1

| R | S | T | U | V | W | P | C | N | ⏚ |
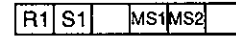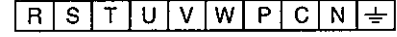
Terminal screw: M5

• MR-H11KBN-UE

TE2
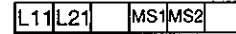
| L11 | L21 | | MS1 | MS2 | |

Terminal screw: M4

TE1

| L1 | L2 | L3 | U | V | W | P | C | N | ⊚ |

Terminal screw: M5

PE

MR-H15KBN(-UE) · MR-H22KBN(-UE)

[Unit: mm]
(Unit: in)

2-φ12 (0.472) mounting hole

75 (2.953)

20 (0.787)

⇧ Fan air orientation

10 (0.394)

480 (18.898)
500 (19.685)

B

TE2

TE1

12 (0.472)

60 (2.362)
230(9.055) A
60 (2.362)
260 (10.236)

10 (0.394)
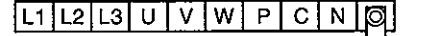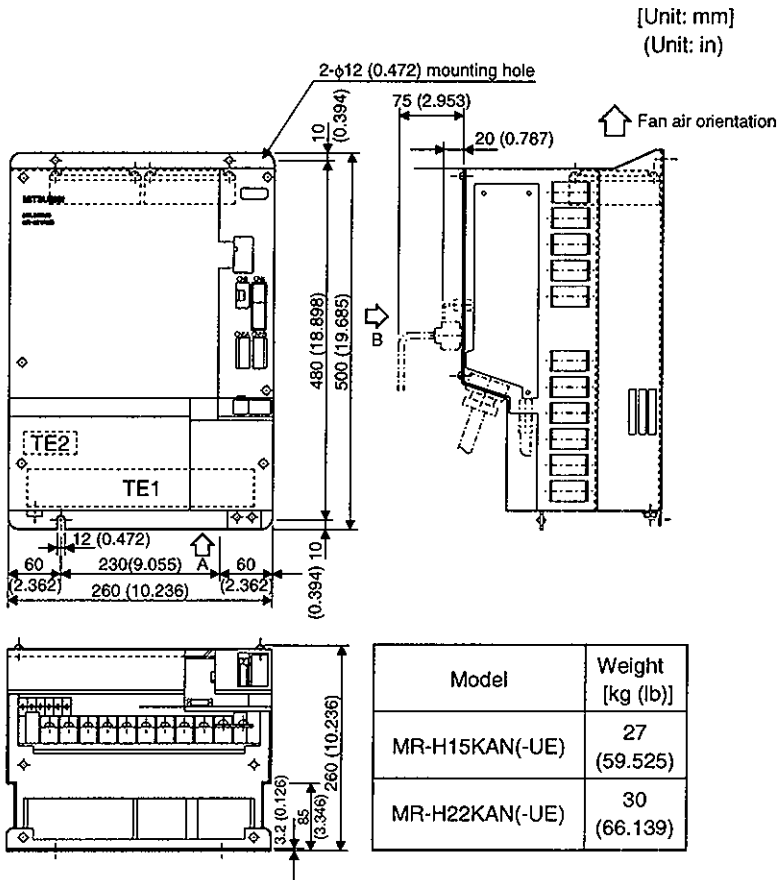
Model	Weight [kg (lb)]
MR-H15KAN(-UE)	27 (59.525)
MR-H22KAN(-UE)	30 (66.139)

260 (10.236)
85 (3.346)
3.2 (0.126)

Terminal block signal arrangement

• MR-H15KBN · MR-H22KBN

TE2

R1	S1		MS1	MS2	

Terminal screw: M4

TE1

R	S	T	U	V	W	P	C	N	⏚
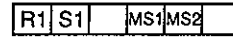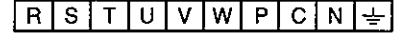
Terminal screw: M6(MR-H15KBN)
M8(MR-H22KBN)

• MR-H15KBN-UE · MR-H22KBN-UE

TE2

L11	L21		MS1	MS2	

Terminal screw: M4

TE1

L1	L2	L3	U	V	W	P	C	N	

Terminal screw: M6(MR-H15KBN)
M8(MR-H22KBN)

PE

11 - 6
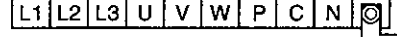
11. SPECIFICATIONS

11.2.2 Connectors

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

[Unit: mm]
(Unit: in)

φ17.0
(0.669)

19.0 (0.748)

42.5 (1.673)

(HONDA)

51.1 (2.012)
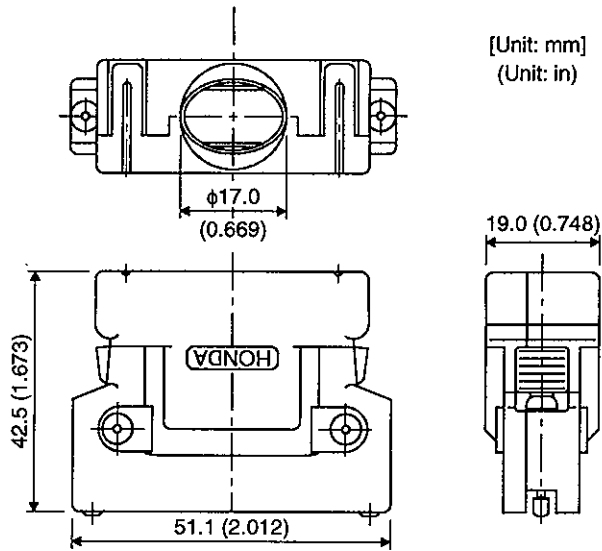
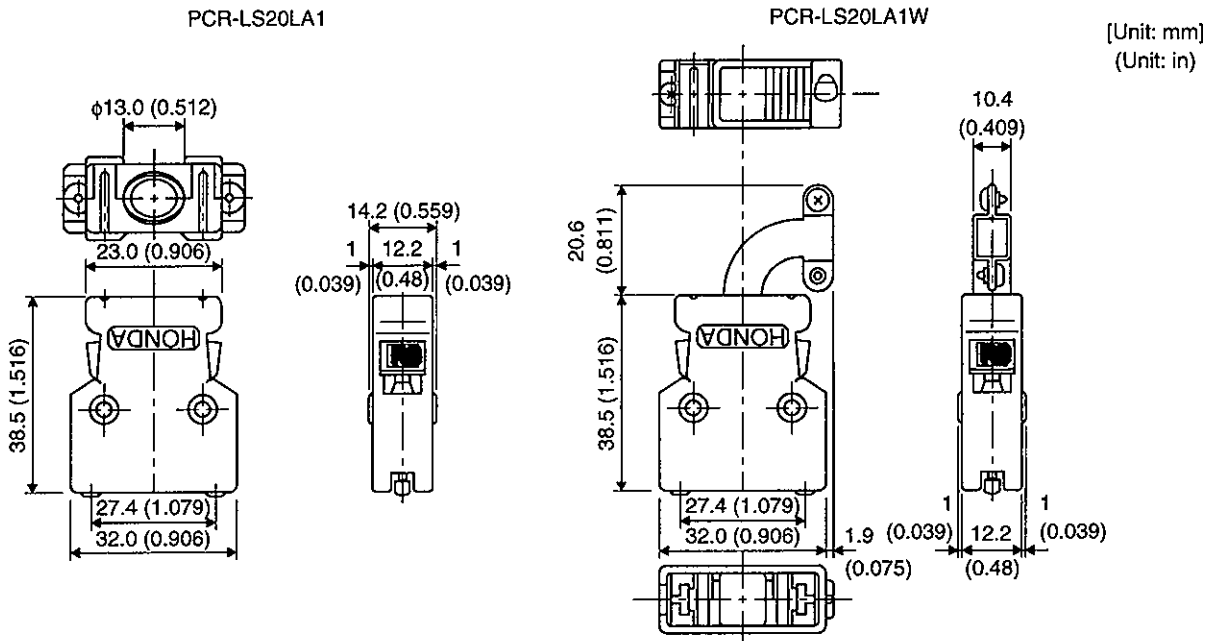| Number of Pins	Model	
	Connector	Case
50	PCR-S50FS (soldering type)	PCR-LS50LA1
	PCR-S50F (insulation displacement type)	

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)
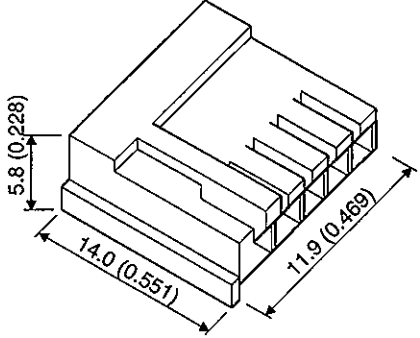
· Contactor Model: 170262-2 (chain type)
                     170204-2 (loose type)
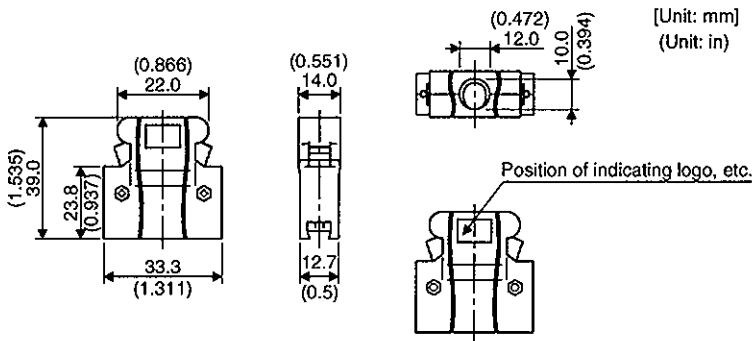   [Unit: mm]
                         (Unit: in)
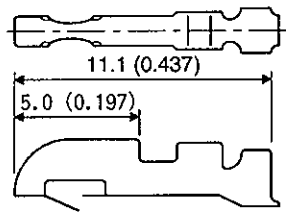
Applicable wire range
AWG: 30-26
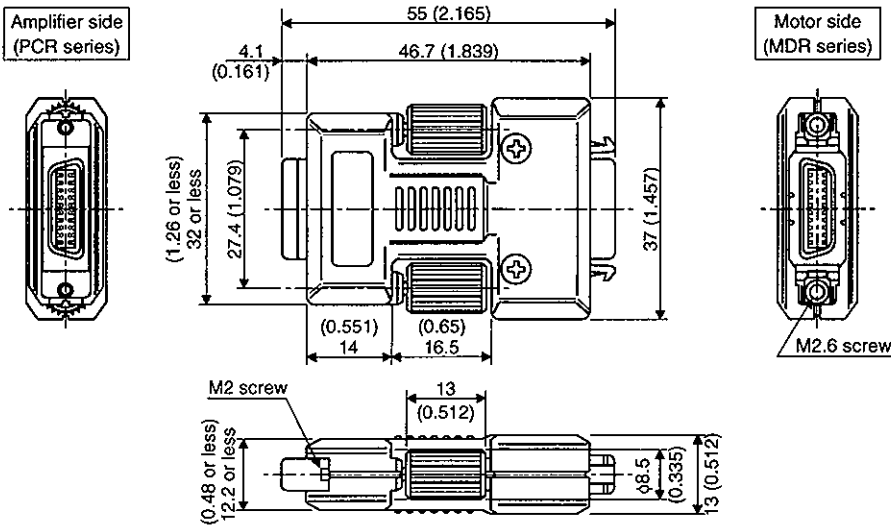(0.05 to 0.15mm²)
Contactor caulking hand tool
Model: 722561-1

(2) Connector for conversion connector

Signal connector

<Sumitomo Three M make>

[Unit: mm]
(Unit: in)

Position of indicating logo, etc.

(3) MR-HCN2 conversion connector

Amplifier side
(PCR series)

Motor side
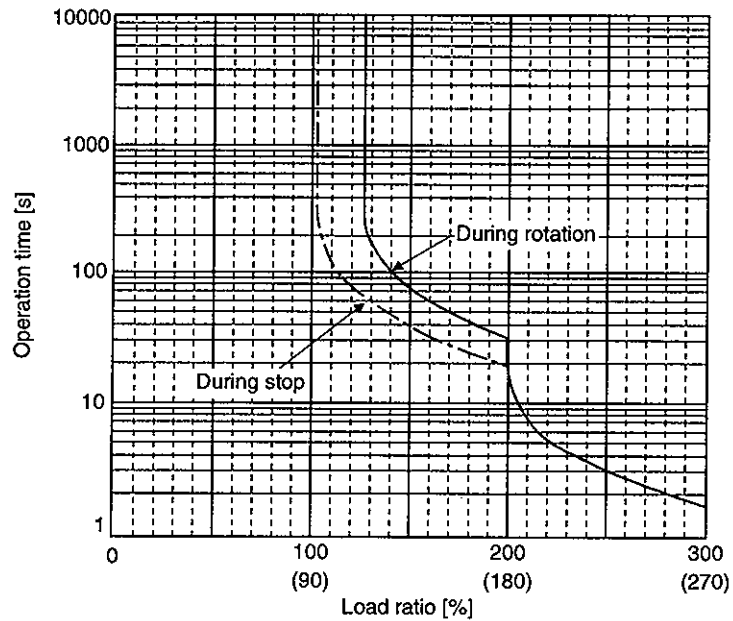(MDR series)

M2.6 screw

M2 screw

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 (50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. Overload 2 alarm (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.

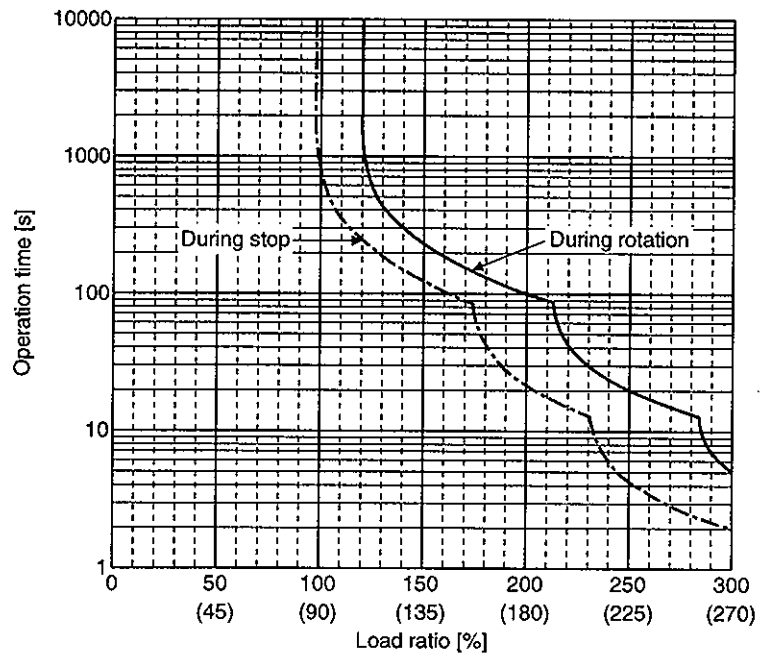If load is applied at a atop (during servo lock), 70% of the rated torque must not be exceeded.

HA-LH serise
(11kW or more)

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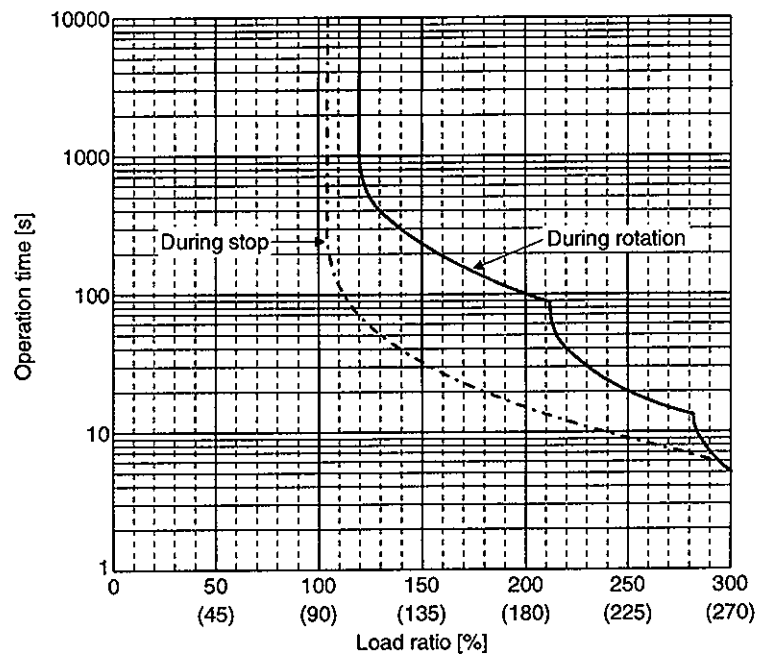

HC-MF serise
HC-SF serise
HC-RF serise
HC-UF serise

Note: Values within parentheses in the graph are those in the low acoustic noise mode.
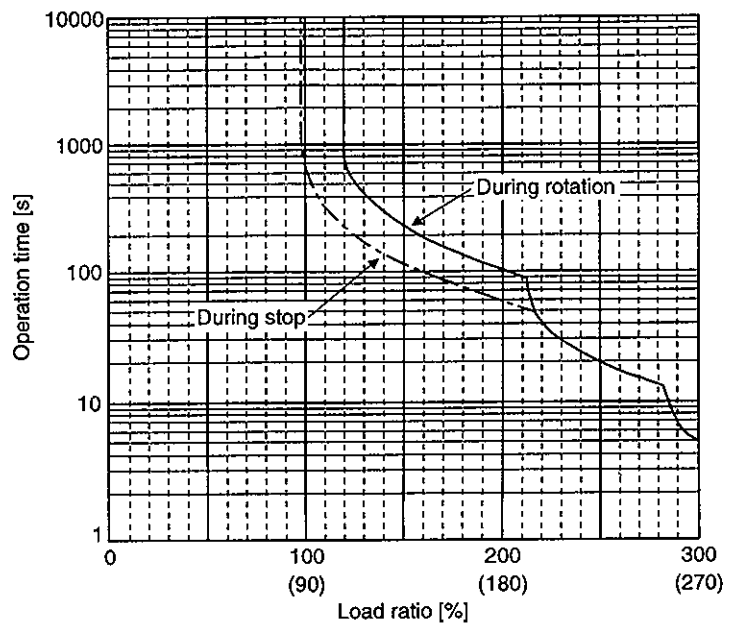
HC-FF serise
(200W or less)

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. CHARACTERISTICS

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	[m²]	[ft²]
MR-H10BN	HA-FF053 · 13	0.3	40	30	0.8	8.6
	HC-UF13	0.3	40	30	0.8	8.6
MR-H20BN	HC-MF053 · 13	0.3	40	30	0.8	8.6
	HA-FF23	0.5	40	30	0.8	8.6
MR-H40BN	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-H60BN	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-H100BN	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-H200BN	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-H350BN	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-H500BN	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-H700BN	HC-SF702	10.0	320	45	6.0	64.6
MR-H11KBN	HA-LH11K2	16	540	57	10.0	107.6
MR-H15KBN	HA-LH15K2	22	660	68	13.0	139.9
MR-H22KBN	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:

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

where, A   : Heat dissipation area [m²]

       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.
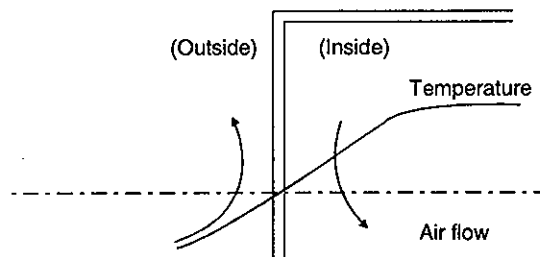

Fig. 12.1 Temperature Distribution in Enclosure

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-H200BN 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.)
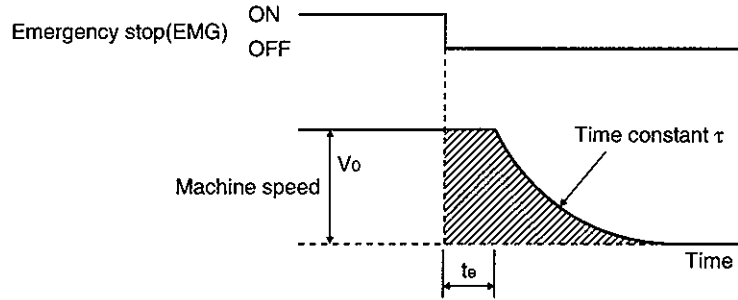

Fig. 12.2 Dynamic Brake Operation Diagram

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

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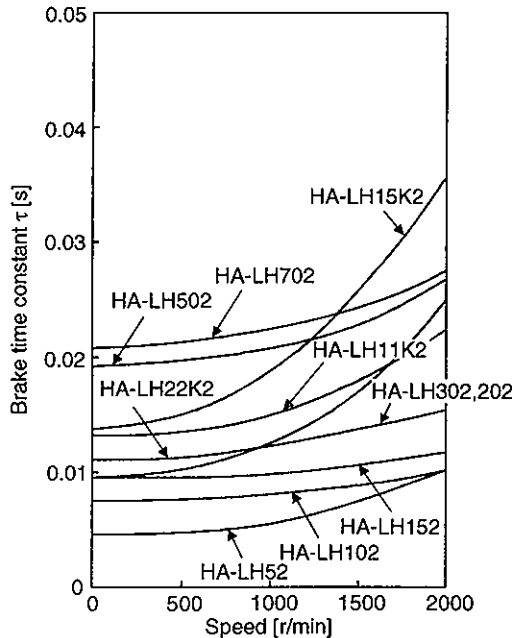
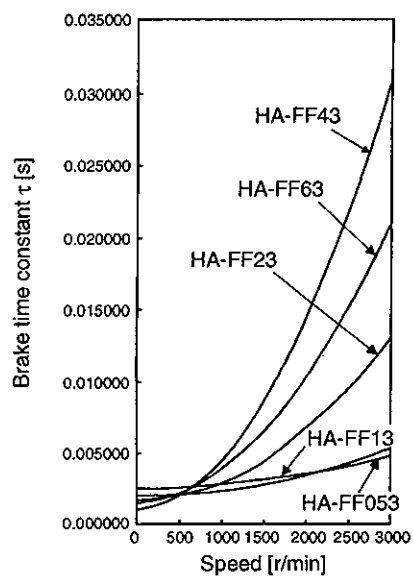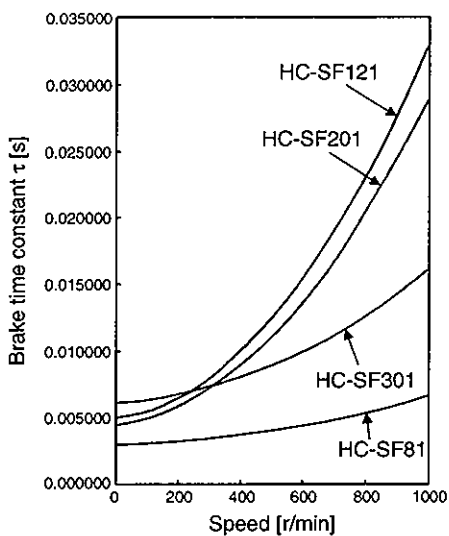a. HA-LH Series

Fig. 12.3 Dynamic Brake Time Constant 1
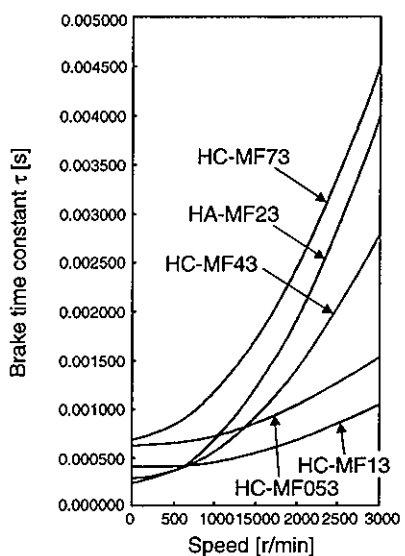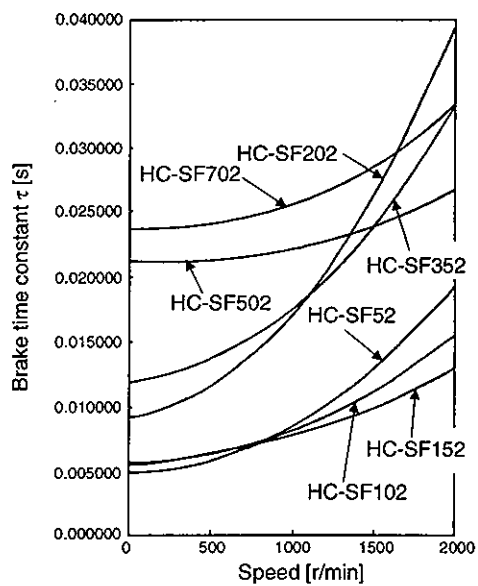
b. HC-MF Series

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

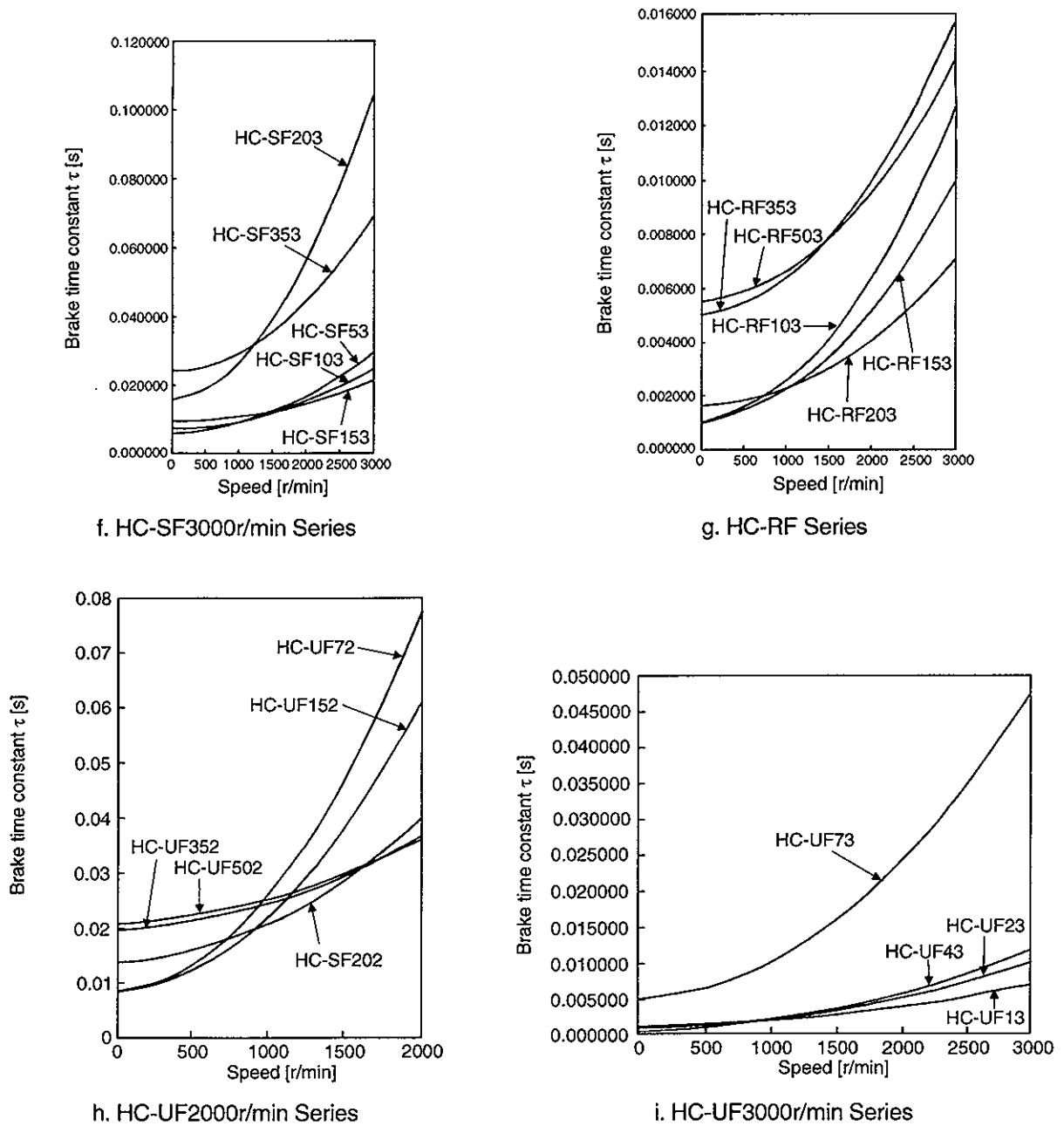h. HC-UF2000r/min Series

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	J_L/J_M
MR-H10BN to MR-H100BN	30 times
MR-H200BN	20 times
MR-H350BN to MR-H700BN	10 times (Note)
MR-H11KBN to MR-H22KBN	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.

a: MR-HSCBL□M
   MR-JCCBL□M-H
   MR-EN1CBL□M-H

b: MR-JCCBL□M-L
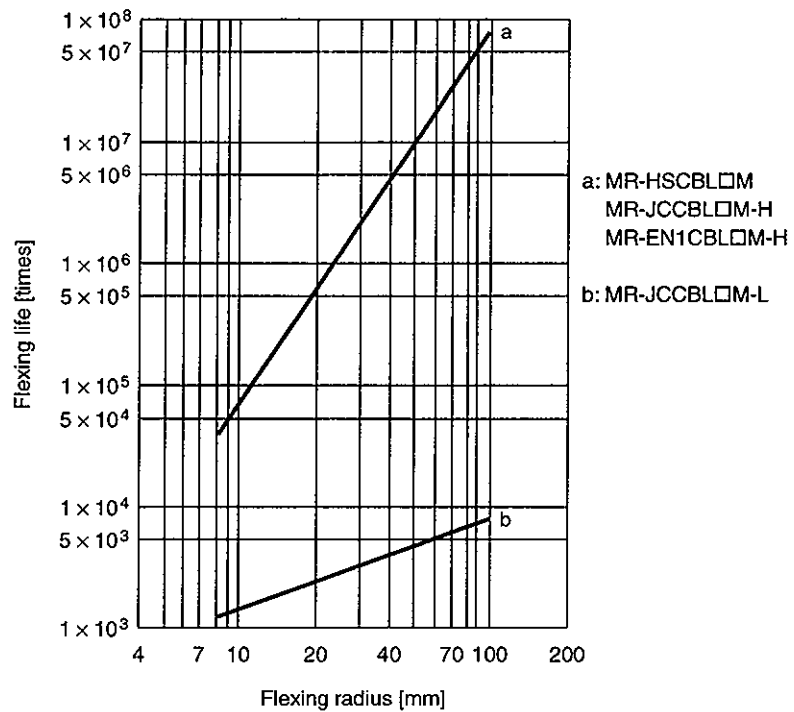
13. OPTIONS AND AUXILIARY EQUIPMENT

| ⚠ 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-BN. It displays parameter settings, test operation and alarms. Use it with the parameter unit cable (MR-PRUCBL□M).

(1) Outline drawing
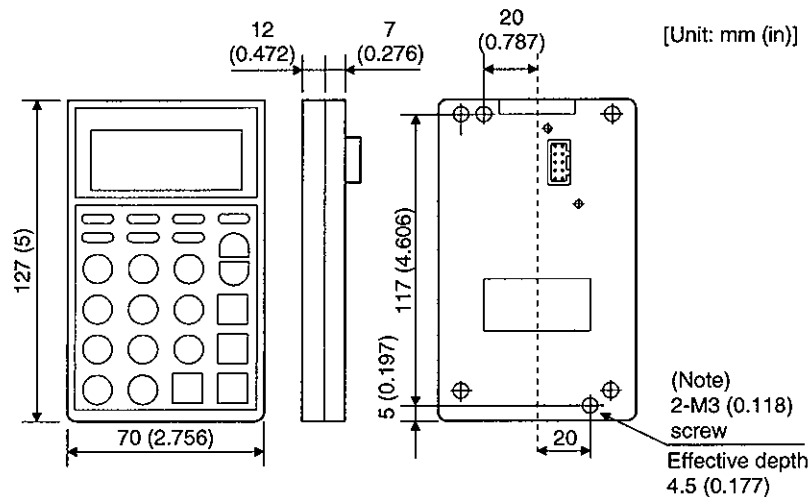
Note: The length of the mounting screw selected should not exceed the effective depth of the parameter unit mounting screw.

(2) Panel cutting dimensions

The following dimensions assume that the parameter unit is installed on a panel or the like.
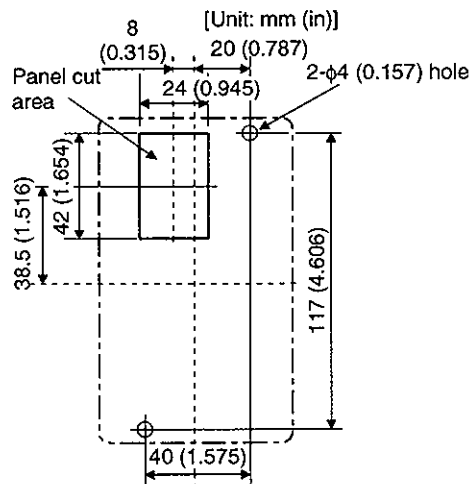
(3) Parameter unit cable

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

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

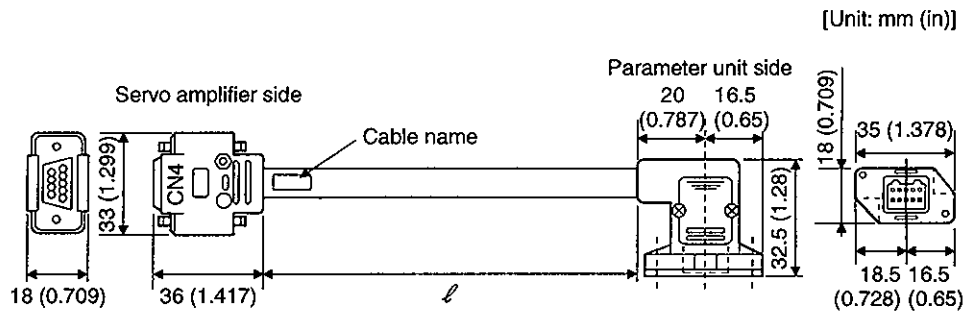| ⚠ CAUTION	• The specified combinations of regenerative brake options and servo amplifiers may only be used. Otherwise, a fire may occur.

(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-H10BN	None	10	30			
MR-H20BN	None	10	30			
MR-H40BN	50			300		
MR-H60BN	50			300		
MR-H100BN	80			300		
MR-H200BN	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-H350BN	130	300		500	
MR-H500BN	130	300		500	
MR-H700BN	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-H11KBN	500 (800)	500 (800)		
MR-H15KBN	850 (1300)		850 (1300)	
MR-H22KBN	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:

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

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.
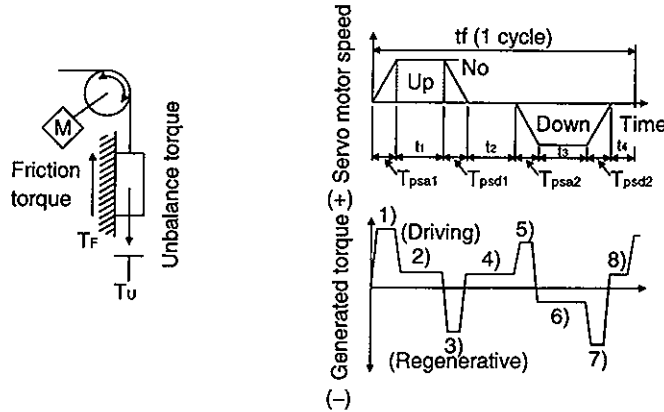
(b) To make selection according to regenerative energy

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)	$T_1 = \dfrac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \dfrac{2}{T_{Psa1}} + T_U + T_F$	$E_1 = \dfrac{0.1047}{2} \cdot N_0 \cdot T_1 \cdot T_{Psa1}$
2)	$T_2 = T_U + T_F$	$E_2 = 0.1047 \cdot N_0 \cdot T_2 \cdot t_1$
3)	$T_3 = \dfrac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \dfrac{1}{T_{Psd1}} + T_U + T_F$	$E_3 = \dfrac{0.1047}{2} \cdot N_0 \cdot T_3 \cdot T_{Psd1}$
4), 8)	$T_4 = T_U$	$E_4 \geq 0$ (No regeneration)
5)	$T_5 = \dfrac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \dfrac{1}{T_{Psa2}} - T_U + T_F$	$E_5 = \dfrac{0.1047}{2} \cdot N_0 \cdot T_5 \cdot T_{Psa2}$
6)	$T_6 = T_U + T_F$	$E_6 = 0.1047 \cdot N_0 \cdot T_6 \cdot t_3$
7)	$T_7 = \dfrac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \dfrac{1}{T_{Psd2}} - T_U + T_F$	$E_7 = \dfrac{0.1047}{2} \cdot N_0 \cdot T_7 \cdot T_{Psd2}$
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]	Servo Amplifier	Inverse Efficiency [%]	Capacitor Charging [J]
MR-H10BN	55	9	MR-H350BN	90	30
MR-H20BN	70	9	MR-H500BN	90	45
MR-H40BN	85	9	MR-H700BN	90	70
MR-H60BN	85	9	MR-H11KBN	90	120
MR-H100BN	80	15	MR-H15KBN	90	180
MR-H200BN	85	25	MR-H22KBN	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.
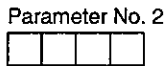
$$ER \ [J] = \eta \cdot Es - Ec$$

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.

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

(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
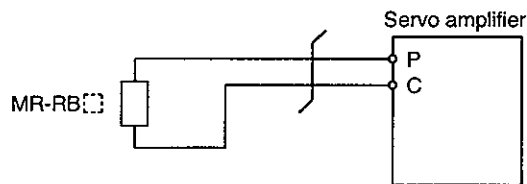
(4) Connection of the regenerative brake option

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.
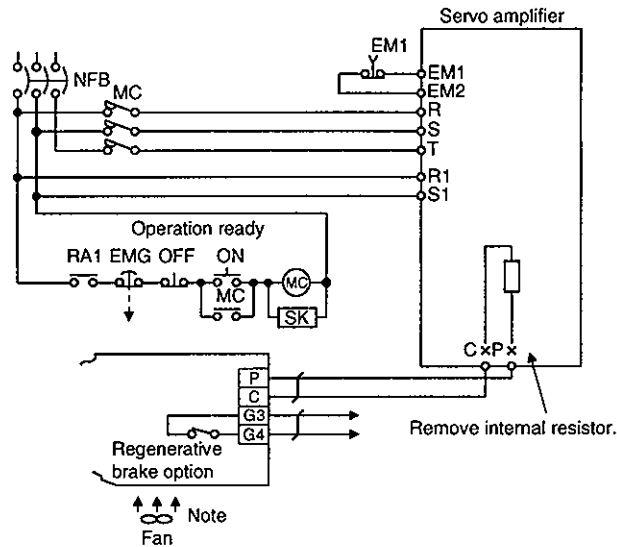
(a) MR-H10BN · MR-H20BN

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

(b) MR-H40BN to MR-H700BN

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 (1.0m²/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.
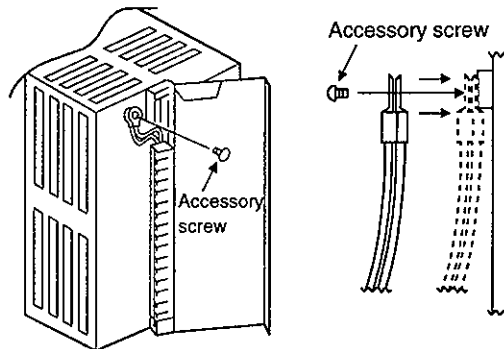
For the MR-RB50, MR-RB51 or MR-RB54, install the cooling fan as shown.

[Unit : mm(in)]
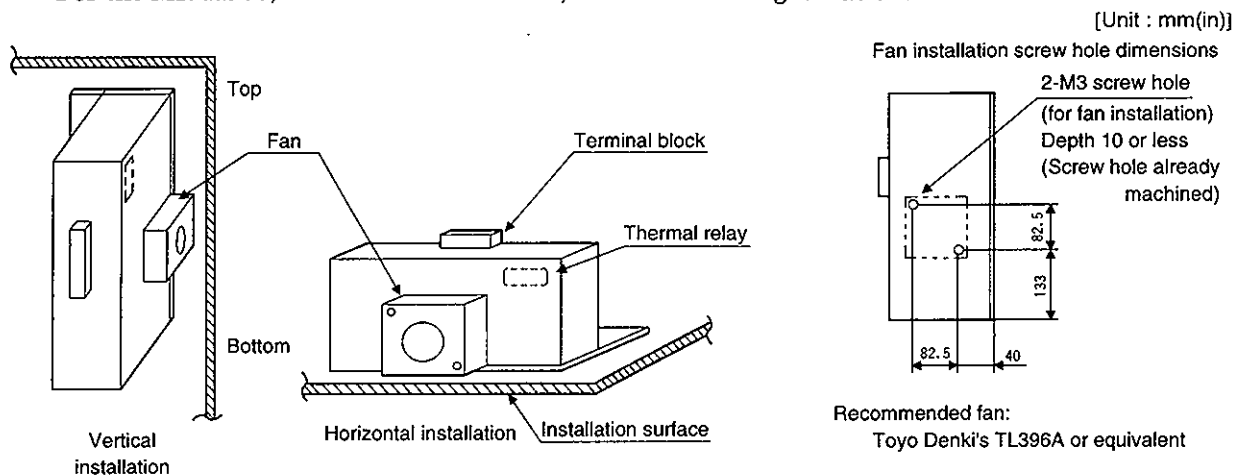
Recommended fan:
Toyo Denki's TL396A or equivalent

(C) MR-H11KBN to MR-H22KBN(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 pa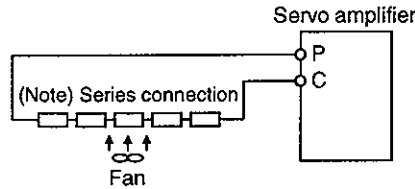rallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative brake resistors burn. Install the resistors at intervals of about 70mm. Cool the resistors with fans to increase the regenerative capability.

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-H11KBN	GRZG400-2Ω	600	800	8	4
MR-H15KBN	GRZG400-1Ω	600	1300	5	5
MR-H22KBN	GRZG400-0.8Ω	600	1300	4	5

(D) MR-H11KBN-P90 to MR-H22KBN-P90 (when using the regenerative brake option)

Cooling the regenerative brake option with fans improves regenerative capability.
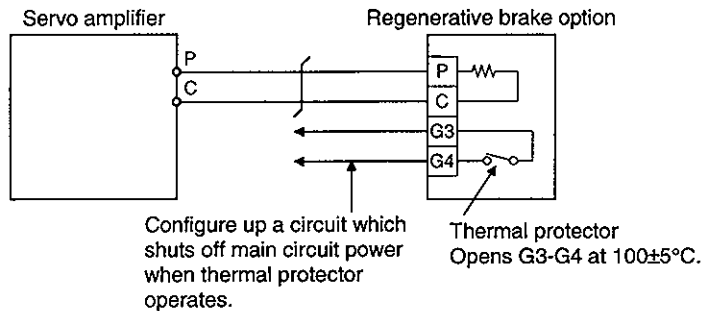
Servo Amplifier	Regenerative Brake Option Model	Resistor (Ω)	Regenerative Power	
			Without Fans	With Fans
MR-H11KBN	MR-RB65	8	500	800
MR-H15KBN	MR-RB66	5	850	1300
MR-H22KBN	MR-RB67	4	850	1300

When using fans, install them using the mounting holes provided in the bottom of the regenerative brake option.
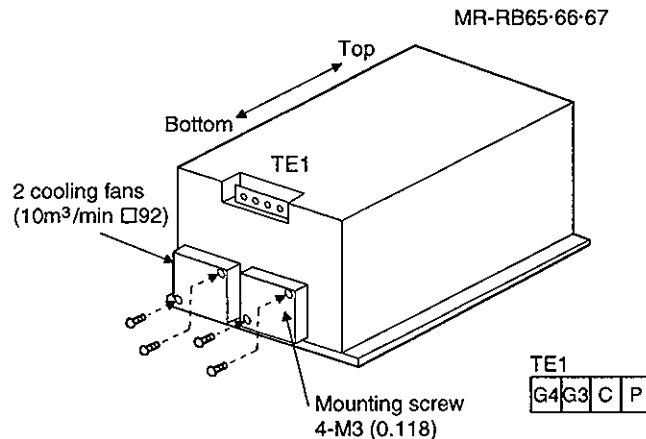
(5) Outline dimension drawings

MR-RB013 · MR-RB033

Regene-rative 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
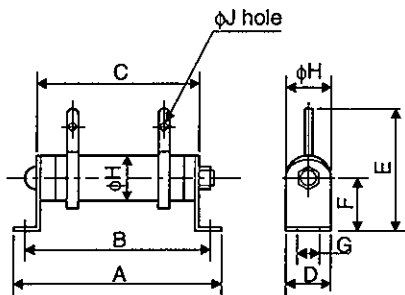

79 (3.11)   [Unit : mm(in)]

150 (5.906)
125 (4.92)

Terminal block

3.2 (0.126)
318 (12.52)
17 (0.669)
7 (0.276)
10 (0.394)
90 (3.543)
100 (3.937)
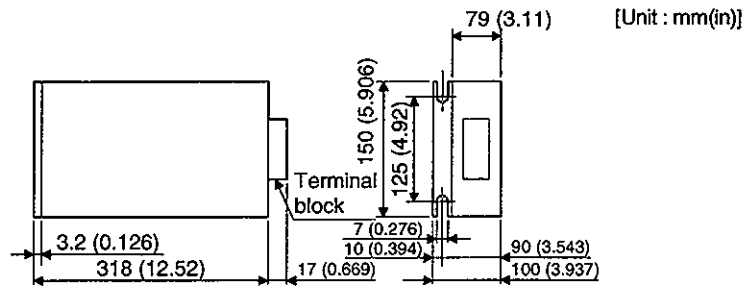
Regenerative Brake Option	Weight [kg(lb)]
MR-RB30	2.9 (6.393)
MR-RB31	
MR-RB32	
MR-RB34	

MR-RB50 · MR-RB51 · MR-RB54

7 × 14 slot   [Unit : mm(in)]

Terminal block

350
325

2.3 (0.091)
200 (7.874)
17 (0.669)
7 (0.276)
12 (0.472)
116 (4.567)
128 (5.039)
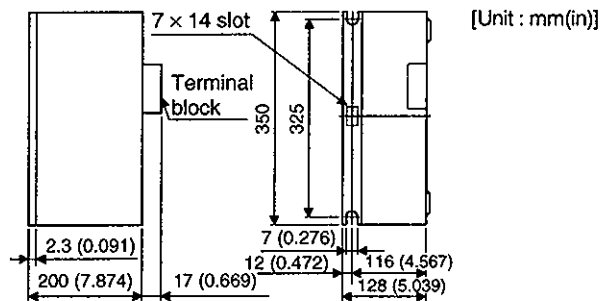
Regenerative Brake Option	Weight [kg(lb)]
MR-RB50	5.6 (12.346)
MR-RB51	
MR-RB54	

MR-RB65 · MR-RB66 · MR-RB67

[Unit : mm(in)]

2-φ10 (0.394)
mounting hole

10 (0.394)

30 (1.181)

480 (18.898)

500 (19.685)

440 (17.323)

TE1

10 (0.394)

230 (9.055)

260 (10.236)

230 (9.055)

10 (0.394)

30 (1.181)

2.3 (0.091)

215 (8.465)
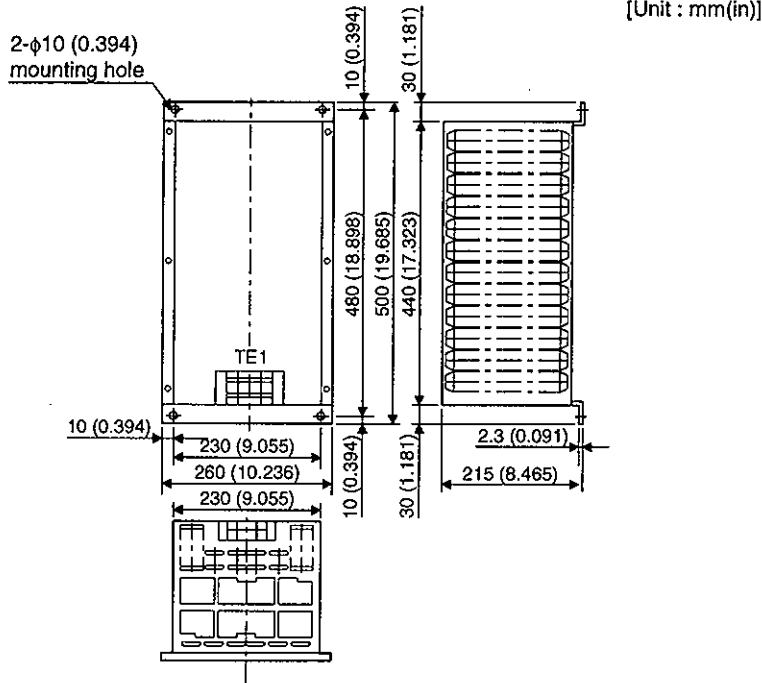
Regenerative Brake Option	Weight [kg(in)]
MR-RB65	10(22.046)
MR-RB66	11(24.251)
MR-RB67	11(24.251)

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

[Unit : mm(in)]

350 (13.78)

φ5.5 (0.217) hole — Terminal block

46 (1.811)

384 (15.118)

410 (16.142)

40 (1.575)

79 (3.11)

9 (0.354)

40 (1.575)
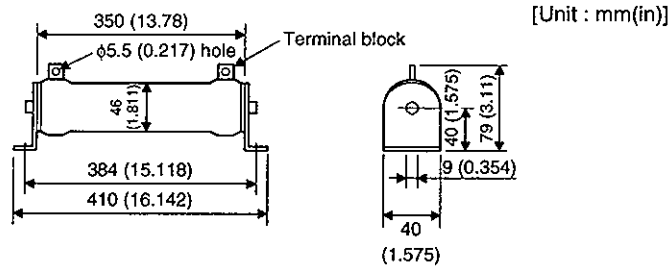
13.1.3 Brake unit

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
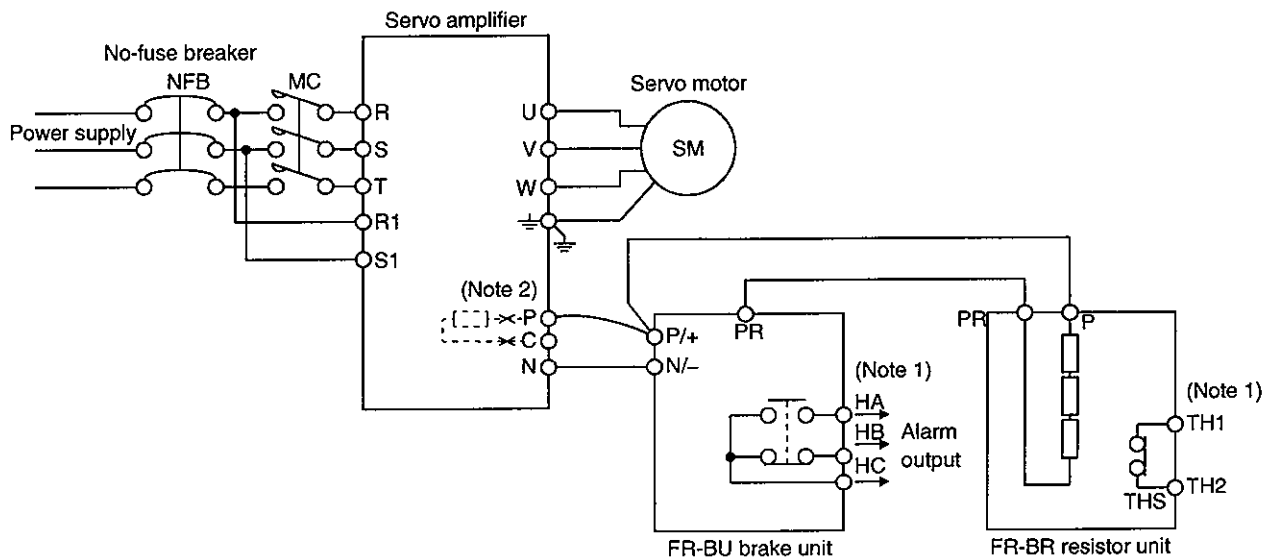
Note 1. Make up the external sequence to switch the power off when an alarm occurs or when the thermal relay is actuated.

Note 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.
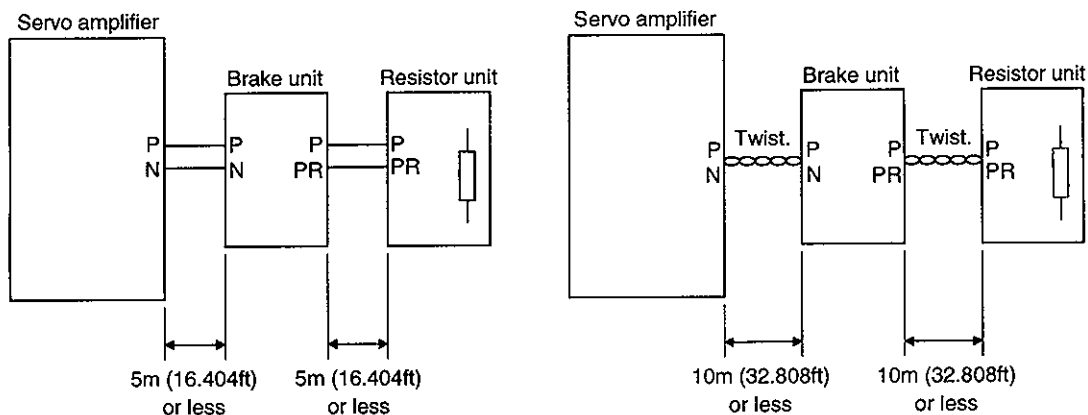
(2) Outside dimensions
· Brake unit (FR-BU)

[Unit : mm(in)]

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

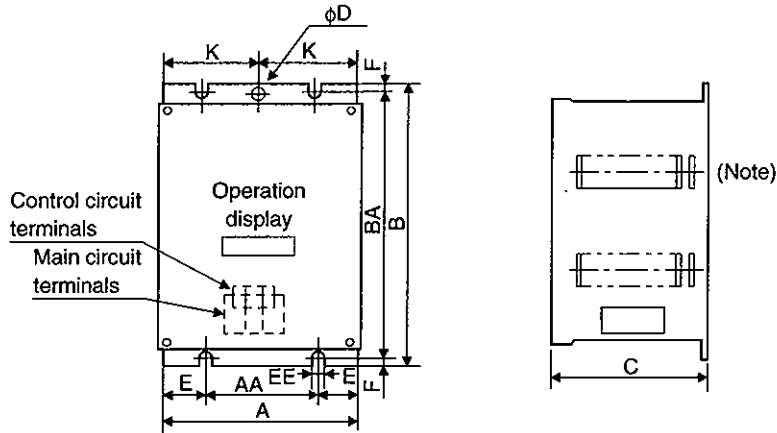| Brake Unit Model	A	AA	B	BA	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-BU-15K	100 (3.937)	60 (2.362)	240 (9.446)	225 (10.039)	128 (5.039)	6 (0.236)	18.5 (0.728)	6 (0.236)	48.5 (1.909)	7.5 (0.295)	2.4 (5.291)
FR-BU-30K	160 (6.299)	90 (3.543)	240 (9.446)	225 (10.039)	128 (5.039)	6 (0.236)	33.5 (1.319)	6 (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)]

· FR-BR-55K
Two eye bolts are provided (as shown below).
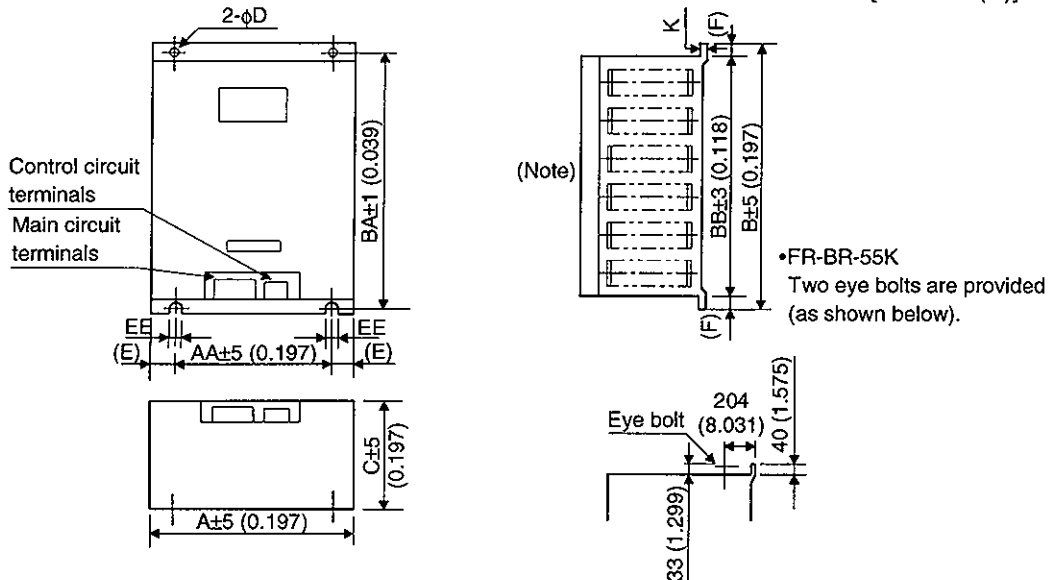
Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

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-H350BN or more.

Model	Nominal Regenerative Power (kW)	Servo Amplifier
FR-RC15	15	MR-H350BN to MR-H700BN
FR-RC30	30	MR-H11KBN MR-H15KBN
FR-RC55	55	MR-H22KBN
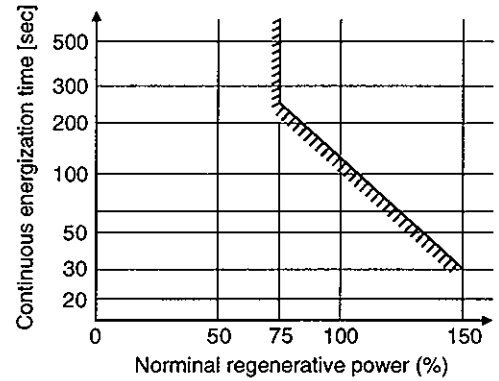
(2) Connection example
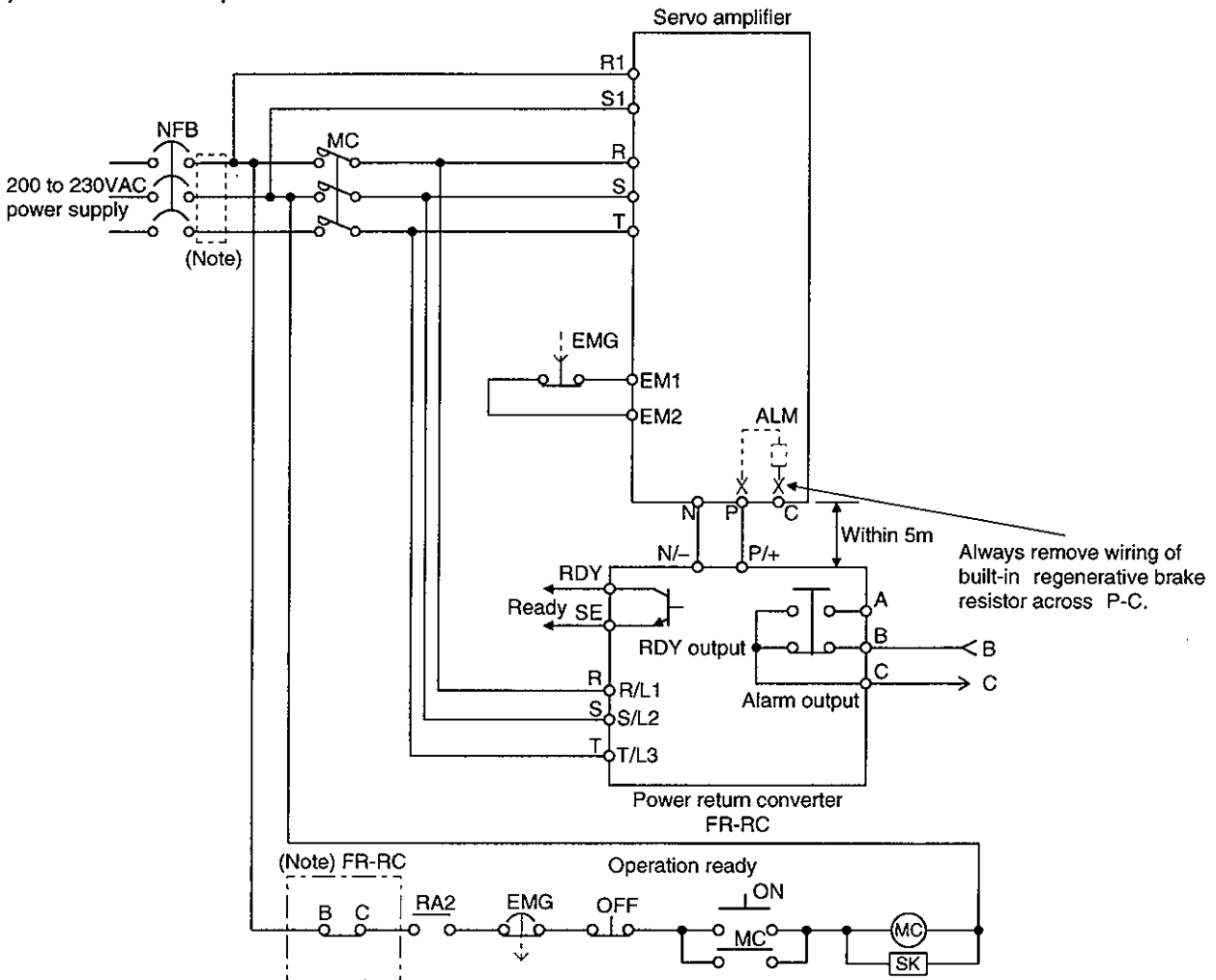
Note: To improve the input power factor or when connecting two or more
FR-RC's to the same power transformer, install the power factor
improving reactor (FR-BAL) in the dotted area.

(3) Outside dimensions of the power return converters

[Unit : mm(in)]

Heat generation area outside mounting dimension
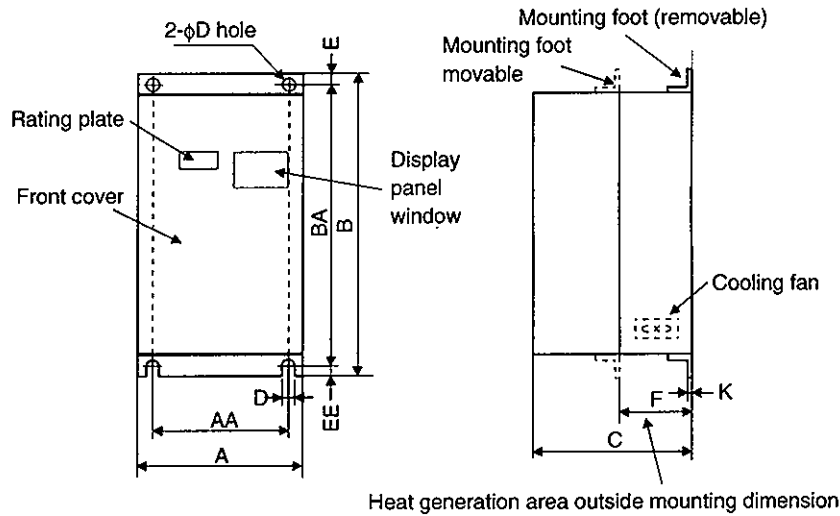
Model	A	AA	B	BA	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-RC-15K	270 (10.630)	200 (7.874)	450 (17.717)	432 (17.008)	195 (7.677)	10 (0.394)	10 (0.394)	8 (0.315)	3.2 (0.126)	87 (3.425)	19 (41.888)
FR-RC-30K	340 (13.386)	270 (10.630)	600 (23.622)	582 (22.913)	195 (7.677)	10 (0.394)	10 (0.394)	8 (0.315)	3.2 (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.
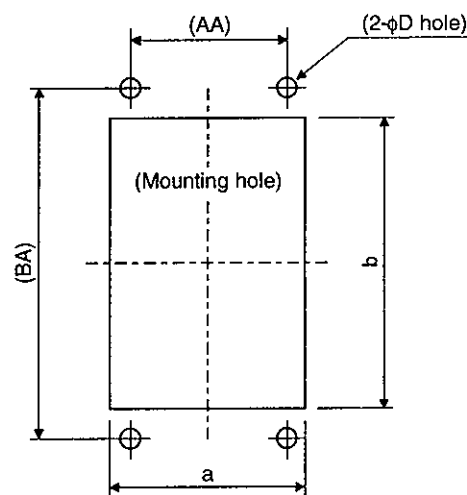
[Unit : mm(in)]

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-H11KBN	DBU-11K
MR-H15KBN	DBU-15K
MR-H22KBN	DBU-22K

(2) Connection example

Servo motor rotation ... Coasting ... Dynamic brake

Alarm (ALM) — Present / Absent

Base — ON / OFF

RA1 — ON / OFF

Dynamic brake — Invalid / Valid

Emergency stop (EMG) — Short / Open

a. Timing chart at alarm (ALM) occurrence

b. Timing chart at emergency stop (EMG) validity
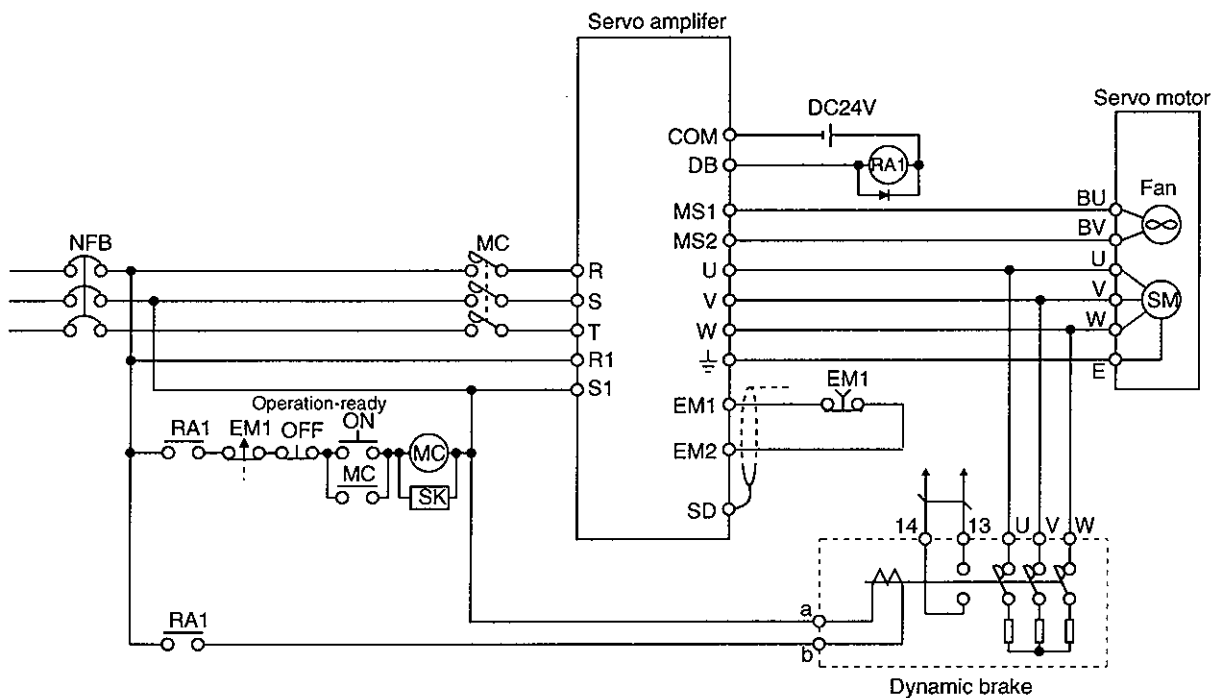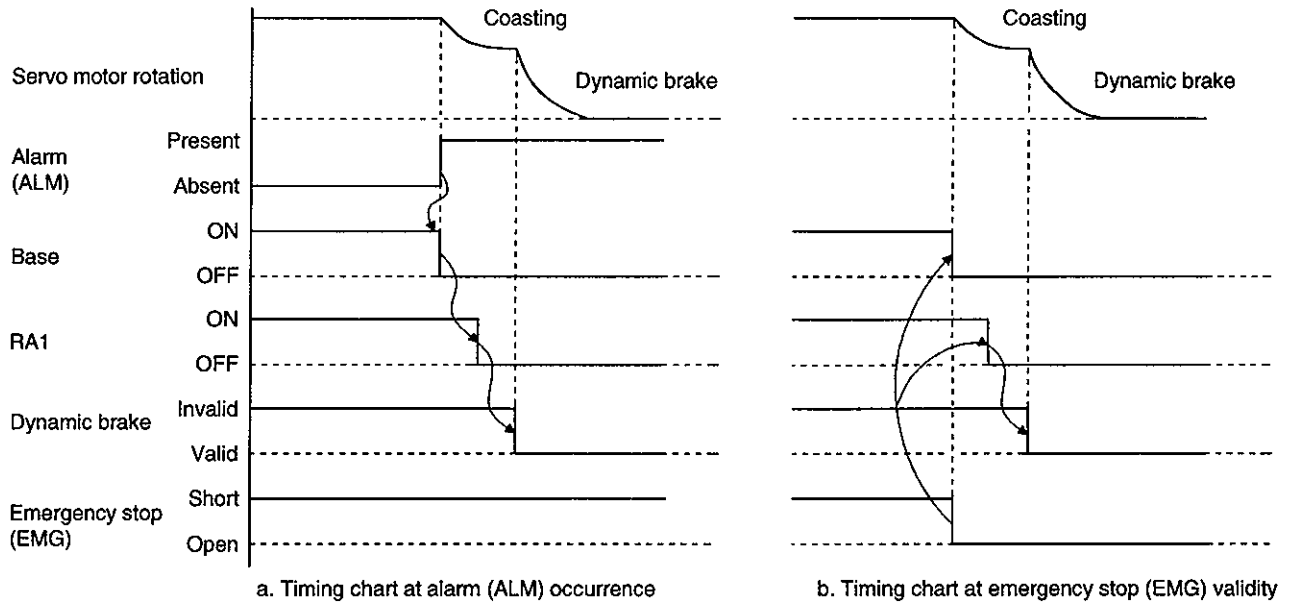
(3) Outline dimension drawing

[Unit: mm (in)]
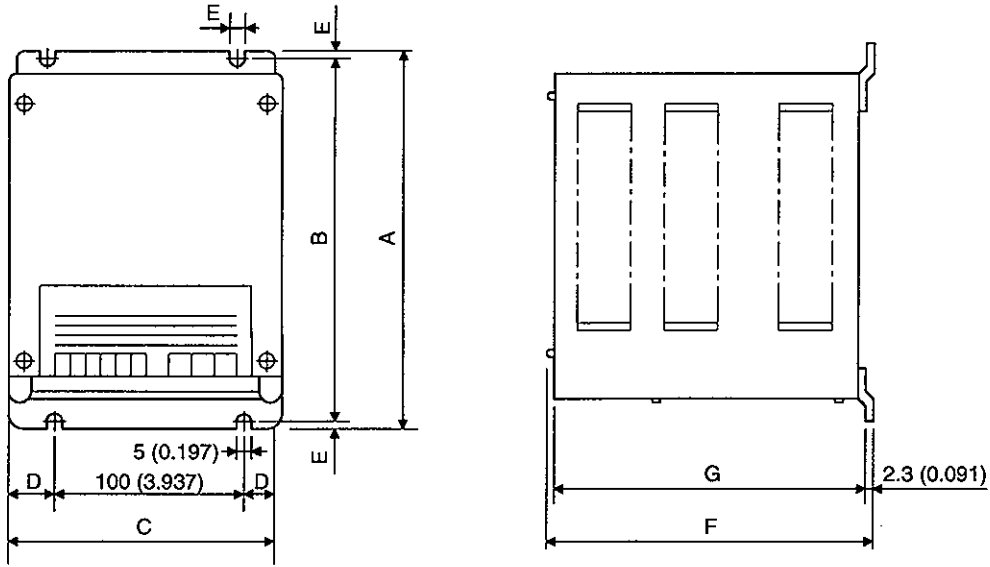
Terminal block

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.
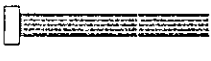
No.	Product Name	Model	Description		Application
1)	Encoder cable	MR-HSCBL☐M Refer to (2) in this section.	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Encoder side connector (Japan Aviation Electronics Industry make) Plug: MS3106B20-29S Cable clamp: 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: YSO10-5 to 8 (Daiwa Dengyo make)	
16)	Bus cable	MR-HBUS□M Refer to (4) in this section.	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	
15)	Bus cable	MR-J2HBUS□M-A Refer to (4) in this section.	Servo amplifier side connector (3M make or equivalent) Connector: 10120-3000VE Shell kit: 10320-52F0-008	Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S20FS Cable: PCR-LS20LA1	
16)	Parameter unit cable	MR-PRUCBL□M Refer to Section 13.1.1.			
17)	Communication cable	MR-HPC98CBL3M Refer to (3) in this section.	(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)	Terminal connector	MR-TM			Connect to CN1B of the last servo amplifier.
20)	Connector for cn6			Connector:FCN-361P008-AU Case:FCN-360C008-B (Fujitsu make)	Supplied
21)	Connector set	MR-HCN1		Servo amplifier side connector (Honda Tsushin Kogyo make) Connector: PCR-S50FS Cable: PCR-LS50LA	
21)	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	SNT
N	SHD
P	
R	LG
S	P5
T	

MR-HSCBL2M
MR-HSCBL5M

MR-HSCBL10M to MR-HSCBL50M

(10m or less)

(10m to 50m)
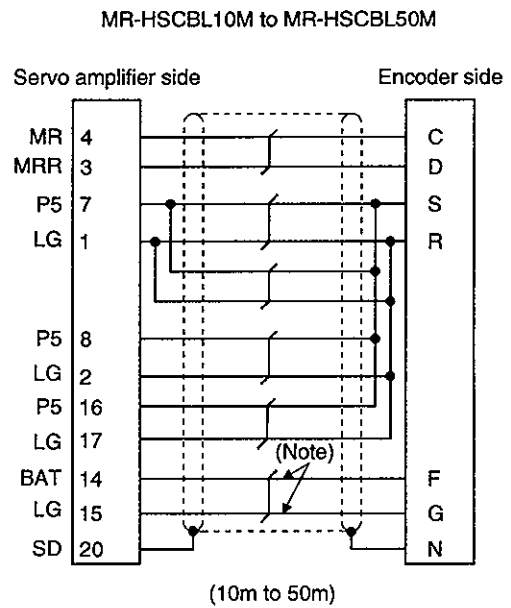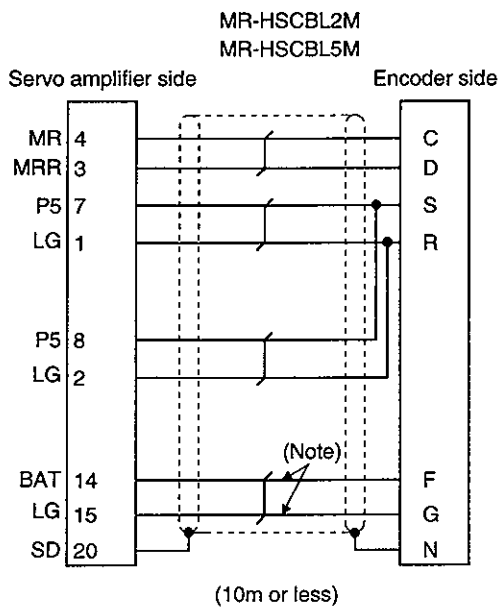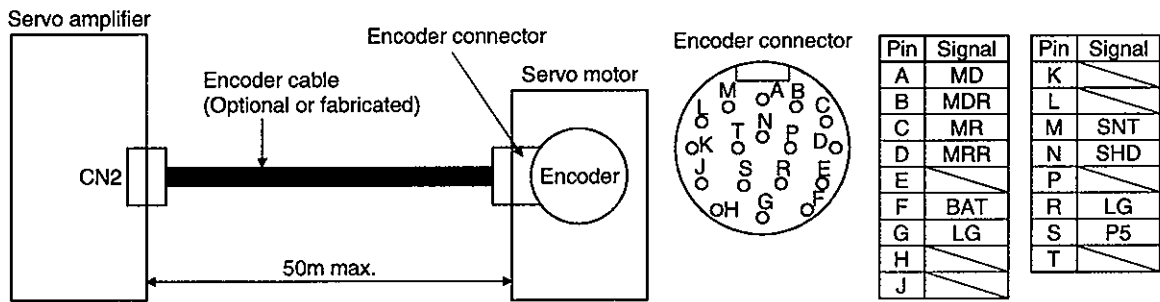
Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

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	Pin	Signal
A	MD	K	
B	MDR	L	
C	MR	M	CNT
D	MRR	N	SHD
E		P	
F	BAT	R	LG
G	LG	S	P5
H		T	
J			
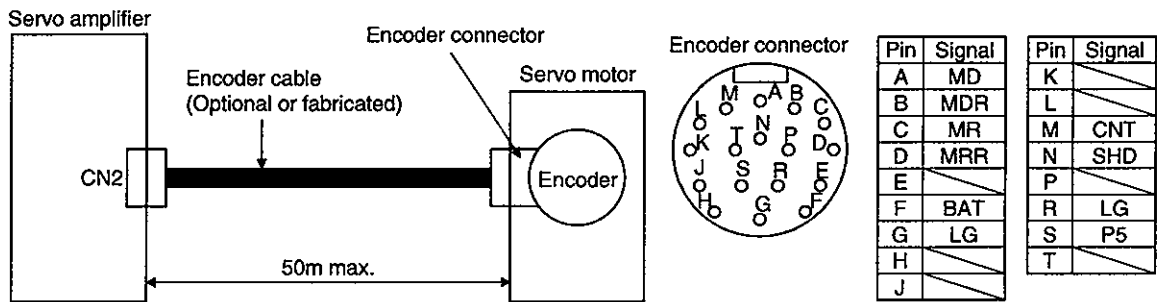
MR-EN1CBL2M-H
MR-EN1CBL5M-H

Servo amplifier side   Encoder side

P5	7	S
LG	1	
P5	8	
LG	2	R
MR	4	C
MRR	3	D
BAT	14	F
LG	15	G
SD	20	N

(Note)

AWG24 used
(less than 10m)

MR-EN1CBL10M-H to MR-EN1CBL50M-H
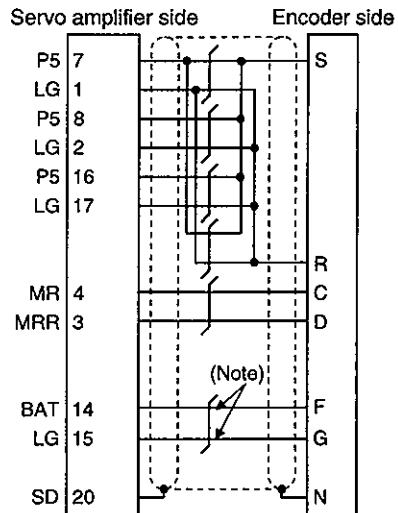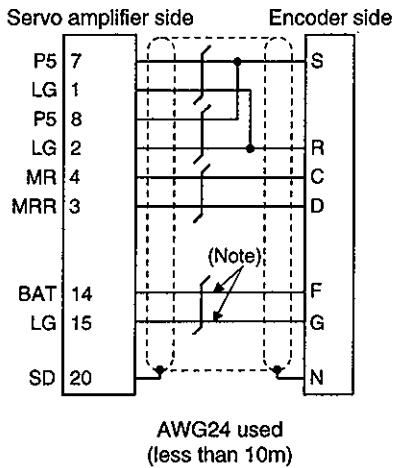
Servo amplifier side   Encoder side

P5	7	S
LG	1	
P5	8	
LG	2	
P5	16	
LG	17	R
MR	4	C
MRR	3	D
BAT	14	F
LG	15	G
SD	20	N

(Note)

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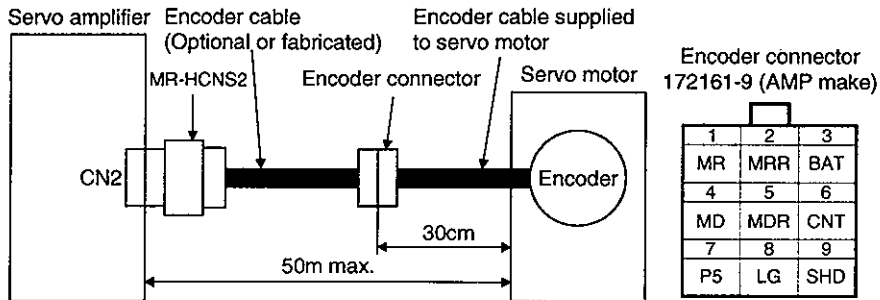
MR-JCCBL2M-L
MR-JCCBL5M-L
MR-JCCBL2M-H
MR-JCCBL5M-H

MR-JCCBL10M-L to MR-JCCBL30M-L

MR-JCCBL10M-H to MR-JCCBL50M-H
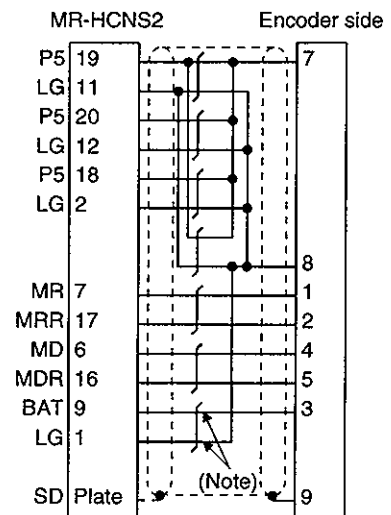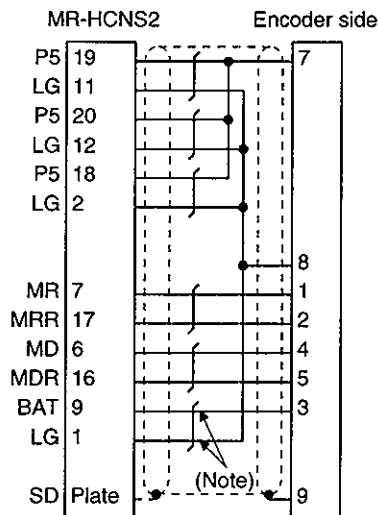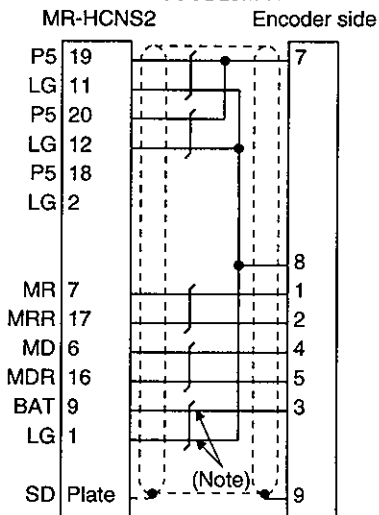
Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

(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.
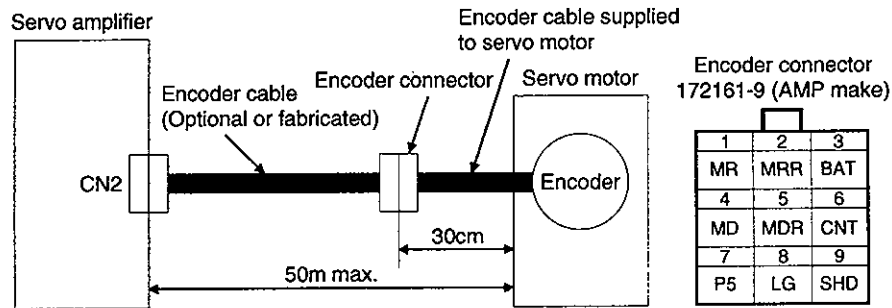
When using AWG24
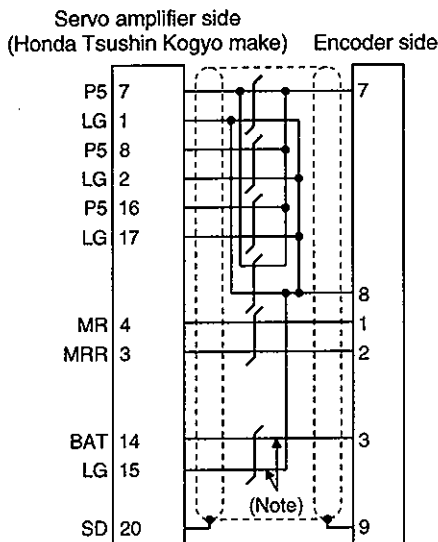
When using AWG22
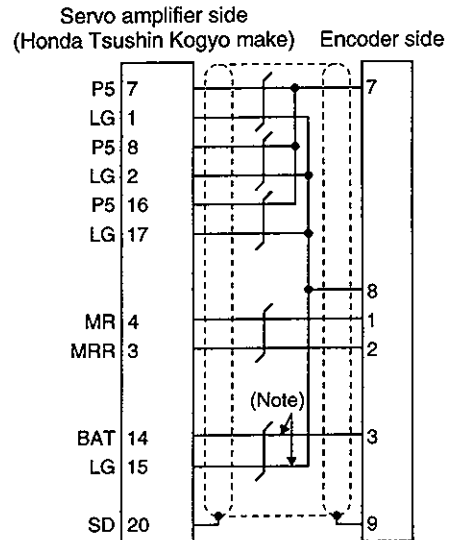
Note: This wiring is required for use in the absolute position detection system.
This wiring is not needed for use in the incremental system.

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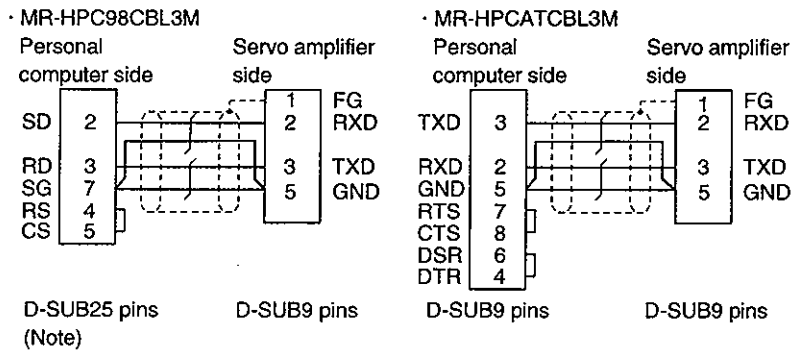
Note: The PC98 Notes having the connector of half-pitch 14 pins are also available.
Confirm the shape of the RS-232C connector of the personal computer used.

(4) Bus cable

⚠ CAUTION	• When fabricating the bus cable, do not make incorrect connection. Doing so can cause misoperation or explosion.

When fabricating this cable, use the recommended cable given in Section 13.2.2 and fabricate it in accordance with the connection diagram shown in this section. The overall distance of the bus cable on the same bus is 30m.

(a) Model definition

Model: MR-HBUS□M

Symbol	Cable Length [m]
05	0.5
1	1
5	5

Model: MR-J2HBUS□M-A

Symbol	Cable Length [m]
05	0.5
5	5

(b) Connection diagram

MR-HBUS□M

PCR-S20FS (Connector)
PCR-LS20LA1 (Case)

PCR-S20FS (Connector)
PCR-LS20LA1 (Case)

LG	1		1
LG	11		11
RD	2		2
RD*	12		12
TD	4		4
TD*	14		14
LG	5		5
LG	15		15
EMG	6		6
EMG*	16		16
BT	9		9
SD	20		20

MR-J2HBUS□M-A

PCR-S20FS (Connector)
PCR-LS20LA1 (Case)

10120-6000EL (Connector)
10320-3210-000 (Shell kit)

LG	1		1
LG	11		11
RD	2		2
RD*	12		12
TD	4		4
TD*	14		14
LG	5		5
LG	15		15
EMG	6		7
EMG*	16		17
SD	20		Plate
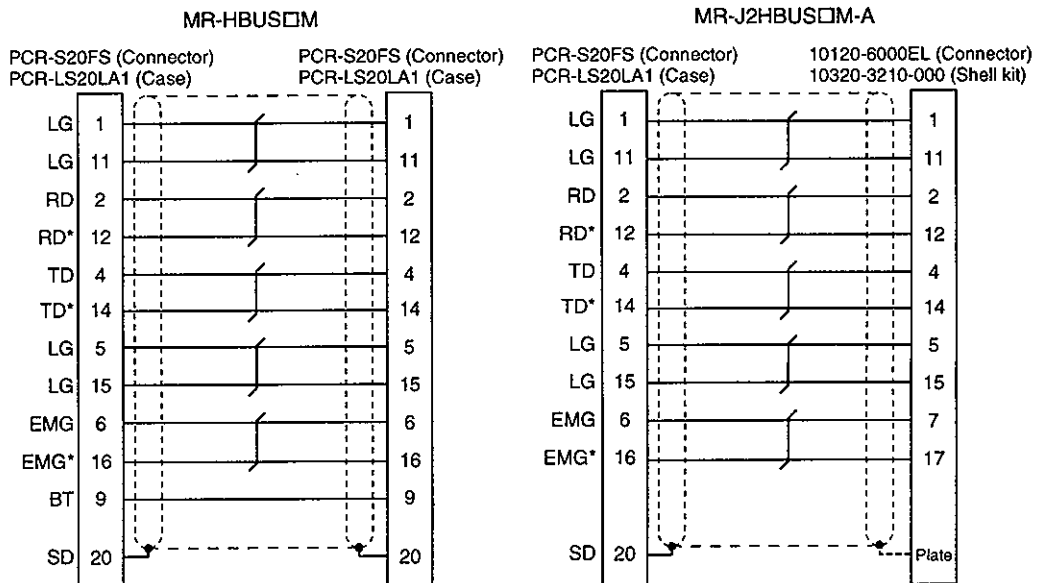
13.1.7 Servo Configuration Software

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
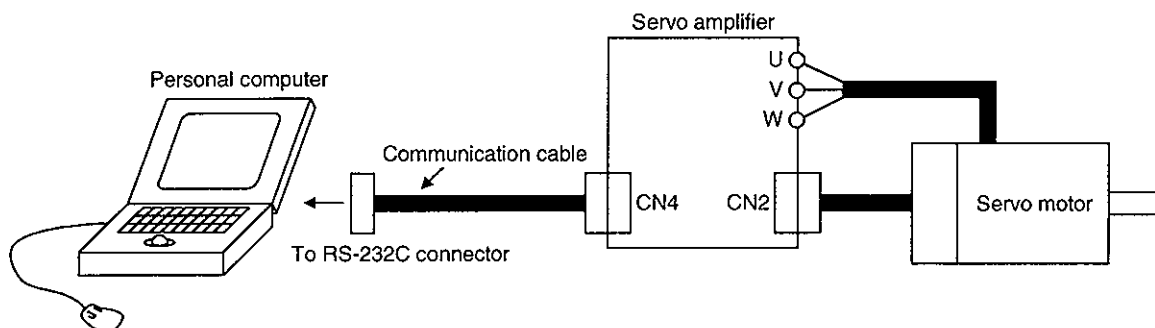
13. OPTIONS AND AUXILIARY EQUIPMENT

13.1.8 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
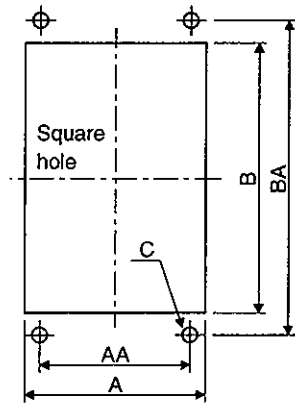
Panel cut dimensions

[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-H200BN MR-H350BN
MR-ACN500	100 (3.937)	370 (14.567)	134 (5.276)	355 (13.976)	4-5M	MR-H500BN
MR-ACN700	170 (6.693)	380 (14.961)	222 (8.740)	360 (14.173)	4-5M	MR-H700BN

(b) MR-ACN11K, MR-ACN22K
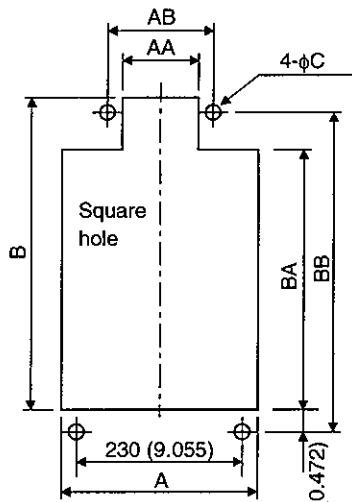
Panel cut dimensions

[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-H11KBN
MR-ACN22K	340 (13.386)	284 (11.181)	308 (12.126)	556 (21.890)	483 (19.016)	483 (20.709)	4-M10	MR-H15KBN MR-H22KBN

(1) Fitting method

(a) MR-ACN350 (for MR-H200BN, MR-H350BN)

Attachment

Fit using the assembling screws.

Servo amplifier

Attachment

Servo amplifier

Square hole

Control box

a. Assembling the heat sink outside mounting attachment

b.Installation to the control box
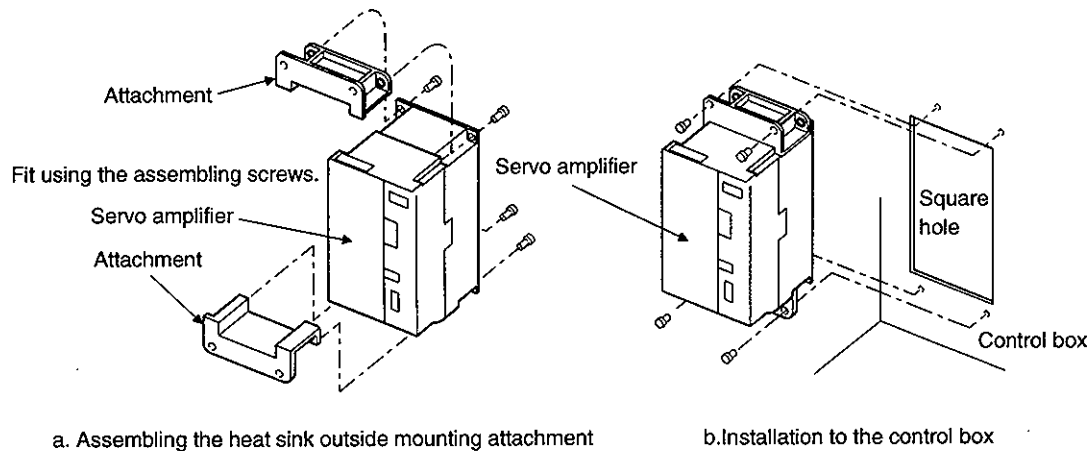
(b) MR-ACN500 (for MR-H500BN), MR-ACN700 (for MR-H700BN)

Attachment

Fit using the assembling screws.

Servo amplifier

Servo amplifier

Square hole

Control box

a. Assembling the heat sink outside mounting attachment

b.Installation to the control box
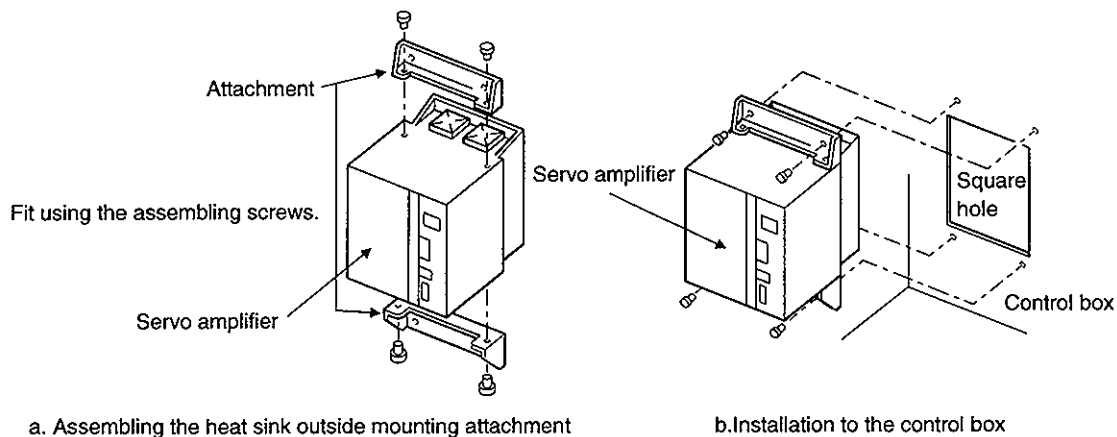
(c) MR-ACN11K (for MR-H11KBN), MR-ACN22K (for MR-H15KBN, MR-H22KBN)

Attachment

Attachment supplied to the servo amplifier (Note)

Note: Remove the attachment supplied and fit it in the specified position.

Square hole

Control box

a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

13 - 31
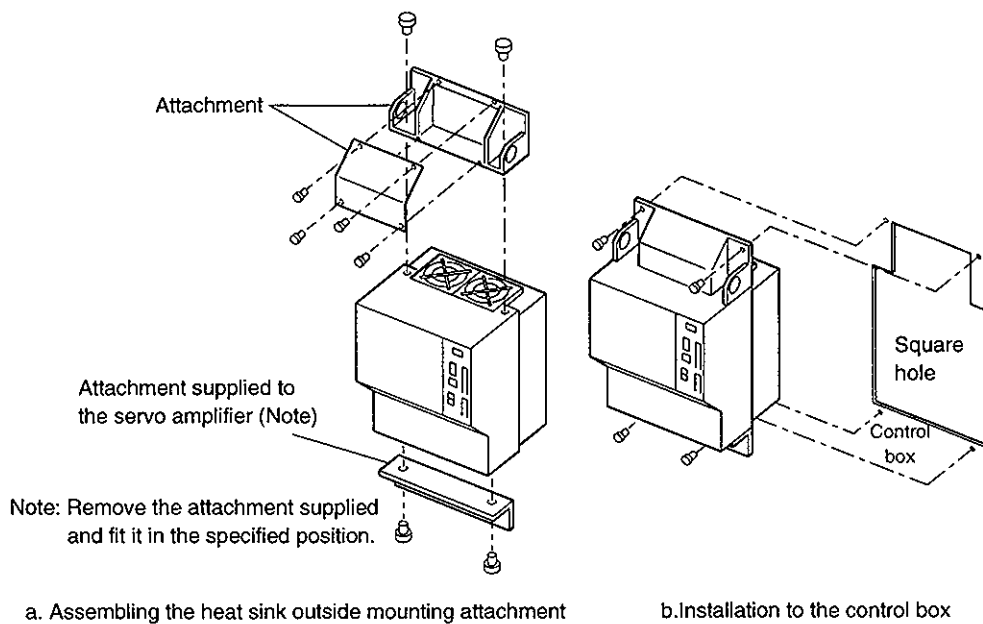
13.1.9 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.
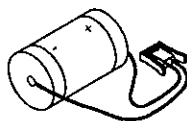
13. OPTIONS AND AUXILIARY EQUIPMENT

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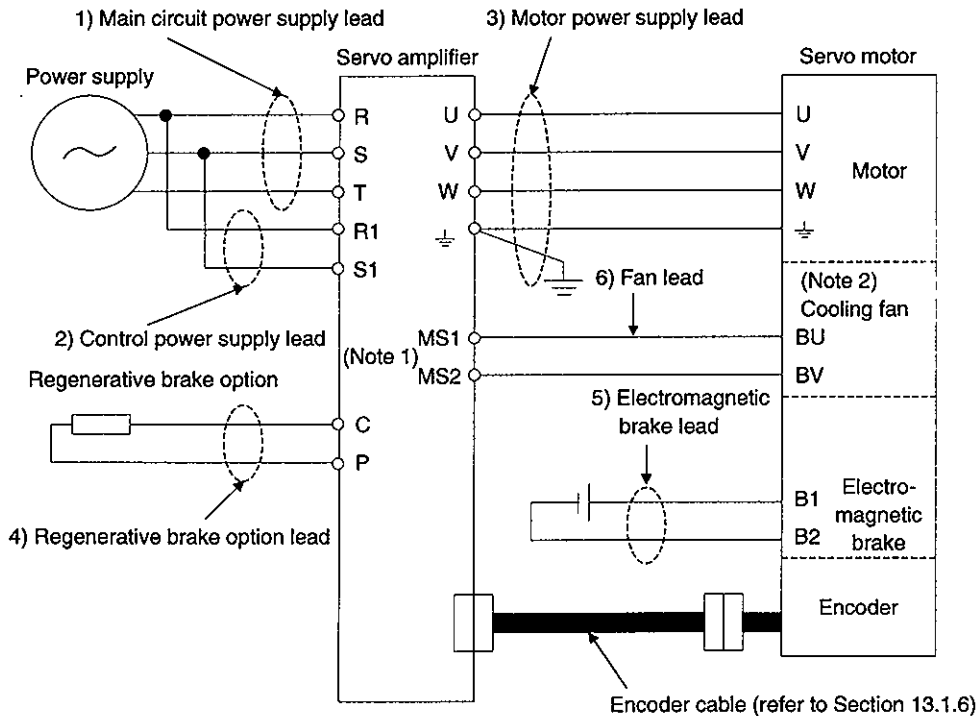
Note: 1. Provided for the 11kW and more servo amplifiers.
2. Provided for the HA-LH11K2 to 22K2 servo motors.

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 3.6.

The crimping terminals used with the U, V and W wires for MR-H11KBN should be those of Japan Crimping Terminal's 22-S5 or equivalent.

Tale 13.1 Recommended Wires

Servo Amplifier	Wires [mm^2]					
	1) R · S · T	2) R1 · S1	3) U · V · W · ⊕	4) P · C	5) B1 · B2	6) BU · BV
MR-H10BN	2	1.25	1.25	2	1.25	
MR-H20BN						
MR-H40BN						
MR-H60BN						
MR-H100BN			2			
MR-H200BN	3.5		3.5			
MR-H350BN	5.5		(Note) 5.5			
MR-H500BN			5.5			
MR-H700BN	8		8	3.5		
MR-H11KBN	14		22	5.5		2
MR-H15KBN	22		30			
MR-H22KBN	50		60			

Note: 3.5mm^2 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 [mm^2]
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 13.3 Wires for Standard Encoder cables

Wire Model	Core Size (mm^2)	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:

Conductor　Insulation sheath
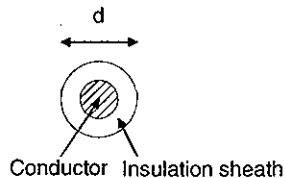
Table 13.3 Wires for Long Flexing Life Encoder Cables

(Note) Junkosha's Wire Model	Core Size [mm²]	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-H10BN	Model NF30 5A	S-N10
MR-H20BN	Model NF30 10A	S-N10
MR-H40BN	Model NF30 10A	S-N10
MR-H60BN	Model NF30 10A	S-N10
MR-H100BN	Model NF30 15A	S-N10
MR-H200BN	Model NF30 20A	S-N18
MR-H350BN	Model NF50 30A	S-N25
MR-H500BN	Model NF50 05A	S-N35
MR-H700BN	Model NF100 75A	S-N50
MR-H11KBN	Model NF100 100A	S-N65
MR-H15KBN	Model NF225 125A	S-N95
MR-H22KBN	Model NF225 175A	S-N125

13.2.3 Power factor improving reactors
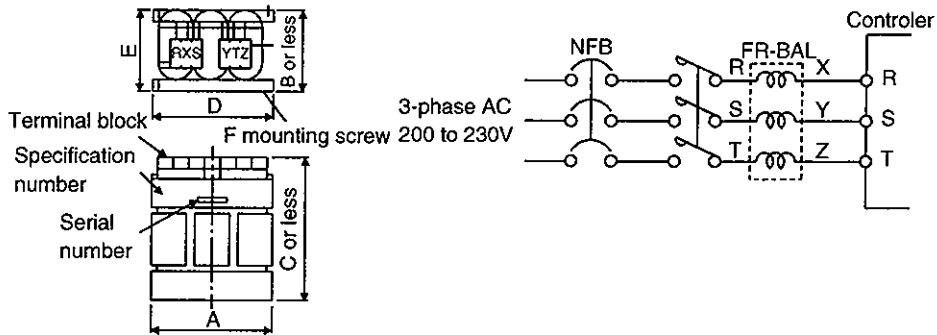
Servo Amplifier	Model	dimensions [mm (in)]						Approx. Weight [kg (lb)]
		A	B	C	D	E	F	
MR-H10BN	FR-BAL-0.4K	135	64	120	120	45	M4	2
MR-H20BN		(5.315)	(2.520)	(4.724)	(4.724)	(1.772)		(4.409)
MR-H40BN	FR-BAL-0.75K	135	74	120	120	57	M4	3
		(5.315)	(2.913)	(4.724)	(4.724)	(2.244)		(6.614)
MR-H60BN	FR-BAL-1.5K	160	76	145	145	55	M4	4
		(6.299)	(2.992)	(5.709)	(5.709)	(2.165)		(8.818)
MR-H100BN	FR-BAL-2.2K	160	96	145	145	75	M4	6
		(6.299)	(3.780)	(5.709)	(5.709)	(2.953)		(13.228)
MR-H200BN	FR-BAL-3.7K	220	95	200	200	70	M5	8.5
		(8.661)	(3.740)	(7.874)	(7.874)	(2.756)		(18.739)
MR-H350BN	FR-BAL-7.5K	220	125	205	200	100	M5	14.5
		(8.661)	(4.921)	(8.071)	(7.874)	(3.937)		(31.967)
MR-H500BN	FR-BAL-11K	280	140	245	255	100	M6	19
		(11.024)	(5.512)	(9.646)	(10.039)	(3.937)		(41.888)
MR-H700BN	FR-BAL-15K	295	156	280	270	110	M6	27
MR-H11KBN		(11.614)	(6.142)	(11.024)	(10.630)	(4.331)		(59.525)
MR-H15KBN	FR-BAL-22K	290	200	300	240	170	M8	35
		(11.417)	(7.874)	(11.811)	(9.449)	(6.693)		(77.162)
MR-H22KBN	FR-BAL-30K	290	220	300	240	190	M8	43
		(11.417)	(8.661)	(11.811)	(9.449)	(7.480)		(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

13.5 (0.53)   4.7±1.0 (0.19±0.04)

16.5 (0.65)

30.0 (1.18) or less

30.0 (1.18) or more

φ0.8

Vinyl tube

Crimping terminal for M4 screw
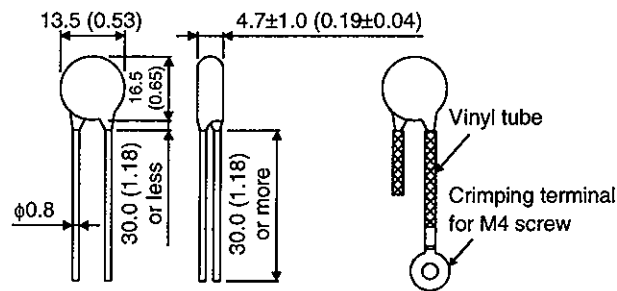
13.2.6 Noise reduction techniques

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 3.6).

(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.
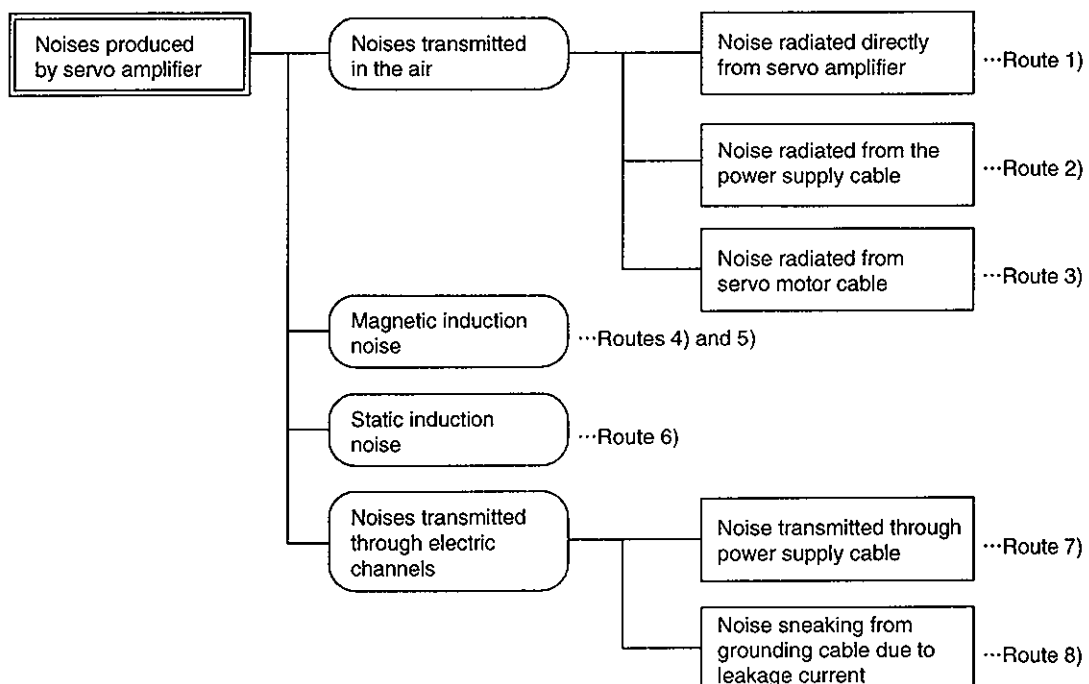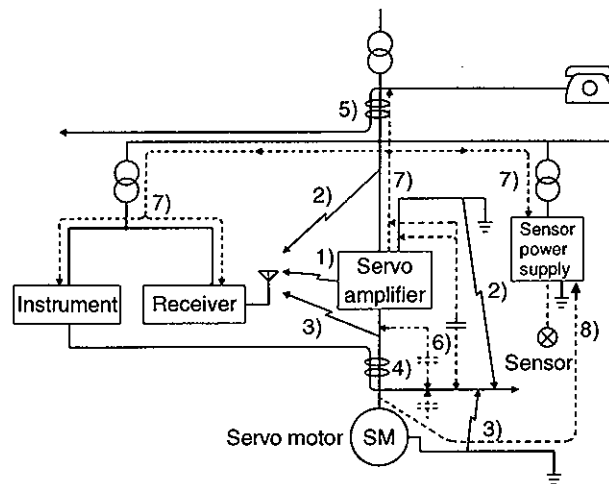
Noise Transmission Route	Suppression Techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the servo amplifier or run near the servo amplifier, such devices 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-BIF·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 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)]

39±1 (1.54±0.04)   Loop for fixing the
34±1   cable band
(1.34±0.04)

φ13±1 (0.51±0.04)
φ30±1 (1.18±0.04)

Product Lot number
name

Outline drawing (ZCAT3035-1330)
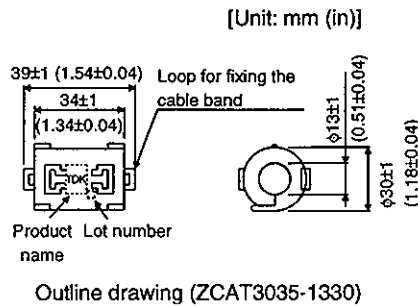
(2) Surge suppressor

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.

Surge suppressor

Surge suppressor

Relay

Surge suppressor

20cm (0.79 in.)
or less
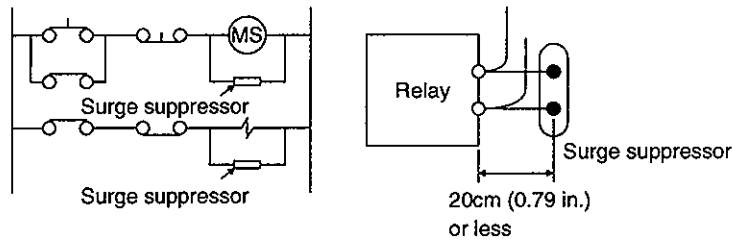
(Ex.) 972A.2003 50411
(Matsuo Electric Co.,Ltd.-200VAC rating)

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.])		

Vinyl sheath

Blue vinyl cord   Red vinyl cord

18±1.5 (0.71±0.06)

6 (0.24)

10±3 (0.39± 0.12)   10 (0.39) or less 10 (0.39) or less 10±3 (0.39± 0.12)
15±1 (0.59±0.04)

φ4 (0.16)
31 (1.22)

200 (7.87)   48±1.5   200 (7.87)
or more   (1.89±0.06)   or more
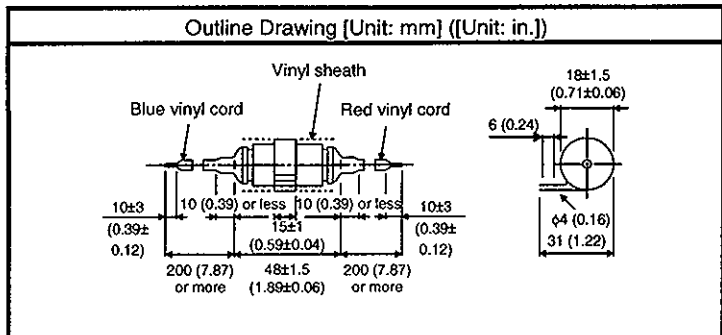
Note that a diode should be installed to a DC relay, DC valve or the like.

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

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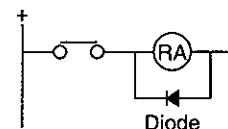
(3) Cable clamp fitting (AERSBAN-□SET)

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)]
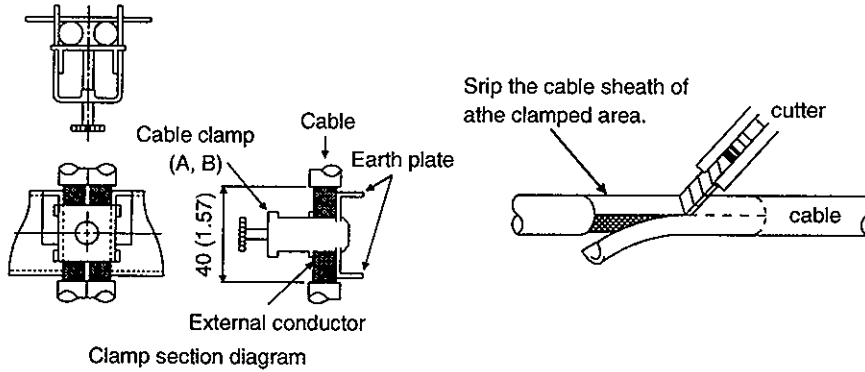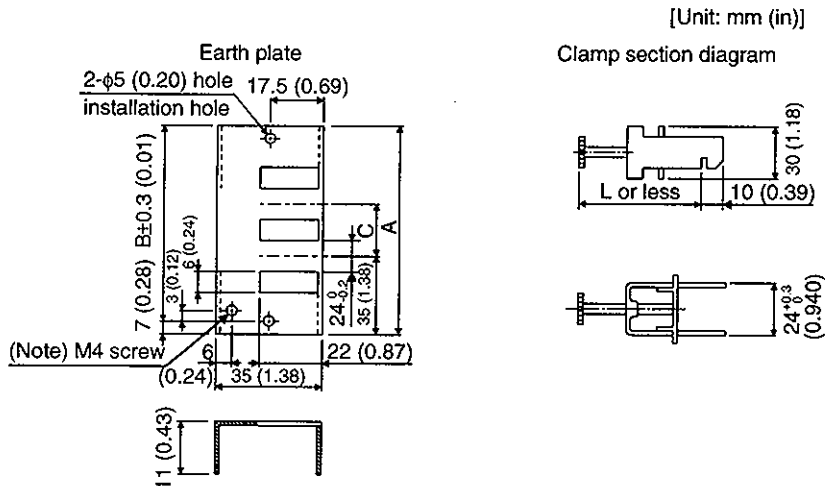
Note: Screw hole for grounding. Connect it to
the earth plate of the control box.
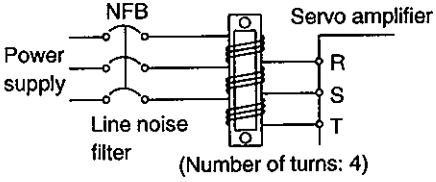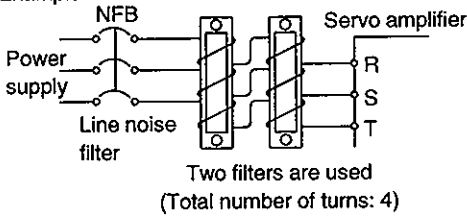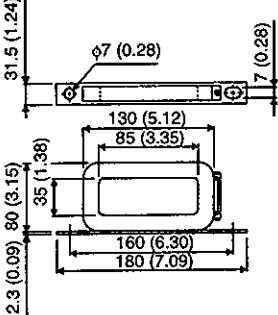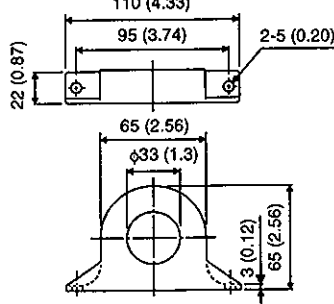
Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

Clamp Fitting	L
A	70 (2.76)
B	45 (1.77)
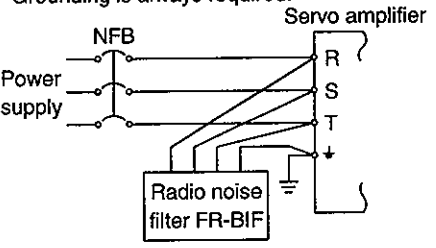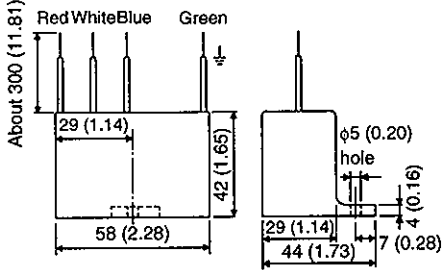
(4) Line noise filter (FR-BLF, FR-BSF01)

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. · 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. · 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 NFB Power supply — Servo amplifier Line noise filter R S T (Number of turns: 4) Example 2 NFB Power supply — Servo amplifier Line noise filter R S T Two filters are used (Total number of turns: 4)	FR-BLF (MR-H350BN or more) 31.5 (1.24) φ7 (0.28) 7 (0.28) 130 (5.12) 85 (3.35) 35 (1.38) 80 (3.15) 160 (6.30) 180 (7.09) 2.3 (0.09) FR-BSF01 (for MR-H200BN or less) 110 (4.33) 95 (3.74) 2-5 (0.20) 22 (0.87) 65 (2.56) φ33 (1.3) 3 (0.12) 65 (2.56)

(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. Servo amplifier NFB Power supply R S T Radio noise filter FR-BIF	Leakage current: 4mA About 300 (11.81) Red White Blue Green 29 (1.14) 42 (1.65) 58 (2.28) φ5 (0.20) hole 29 (1.14) 44 (1.73) 7 (0.28) 4 (0.16)

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 $\geq 10 \cdot \{\text{Ig1+Ign+Iga+K} \cdot \text{(Ig2+Igm)}\}$ [mA] $\cdots\cdots$ (13.2)

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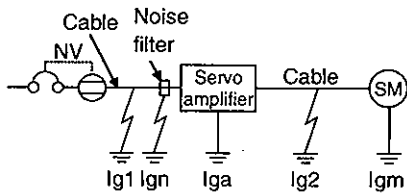
Leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SF NV-CF	1
General models	NV-CA NV-CS NV-SS	3

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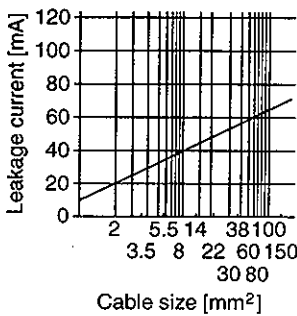
Fig.13.1 Leakage Current Example (Ig1,Ig2)for CV Cable Run in Metal Conduit

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-H10BN to MR-H350BN	15mA
MR-H500BN	30mA
MR-H700BN	50mA
MR-H11KBN to MR-H22KBN	100mA

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions:
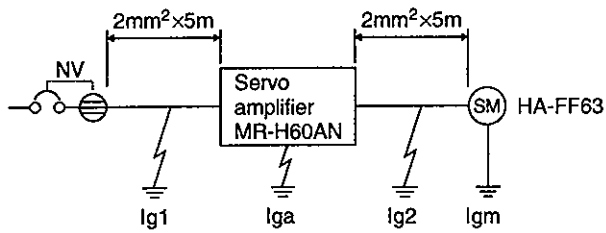
Use a leakage current breaker generally available.
Find the terms of Equation (14.2) from the diagram:

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

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

$$\mathrm{Ign} = 0 \, (\text{not used})$$

$$\mathrm{Iga} = 0.1 \, [\mathrm{mA}]$$

$$\mathrm{Igm} = 0.1 \, [\mathrm{mA}]$$

Insert these values in Equation (13.2):

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

$$\geq 8.0 \, [\mathrm{mA}]$$

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.

14. RS-232C COMMUNICATION FUNCTIONS

> **POINT**
>
> • The parameter settings are overridden by the servo system controller settings.

The MR-H-BN 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.
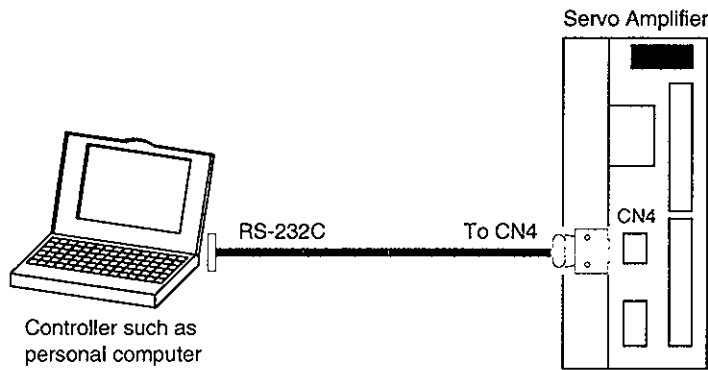
(2) Cable connection diagram

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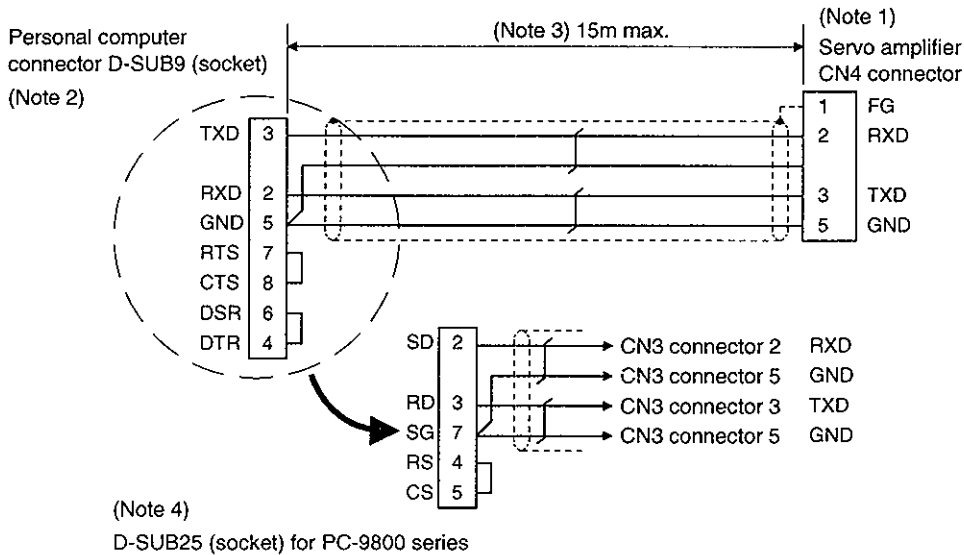
Note: 1. Honda Tsushin's CN3 connector
Connector: DE-9PF-N
Shell kit: DE-C1-J6-S6
2. For the PC-AT compatible controller series.
3. 15m max. in environment of little noise.
4. The PC-9800 series also has the half-pitch type.

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
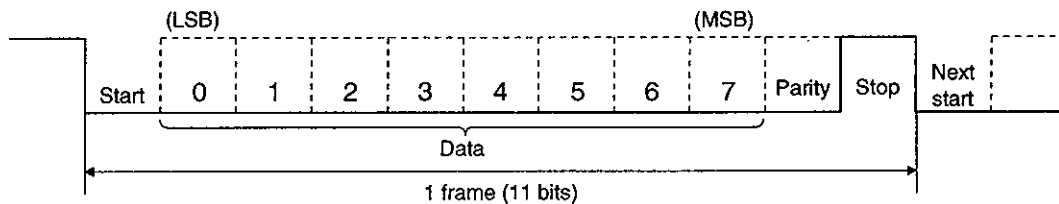
14.3 Protocol

(1) Transmission of data from master station to slave station
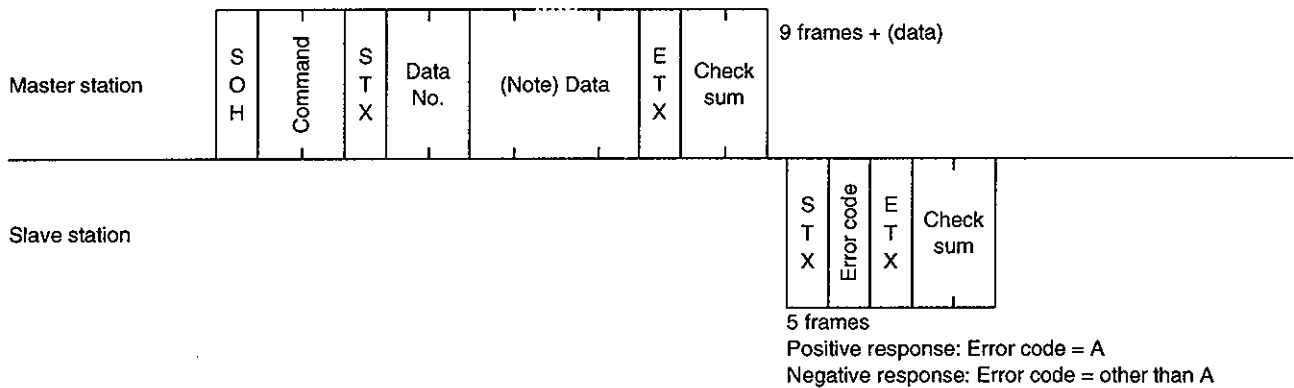
Note: Refer to (4) in this section for the number of data frames.

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

Master station

9 frames						or	9 frames + (data)					
S O H	Command	S T X	Data No.	E T X	Check sum		S O H	Command	S T X	Data No.	(Note) Data	E T X	Check sum

Slave station

		5 frames + (data)			
S T X	Error code	(Note) Data	E T X	Check sum
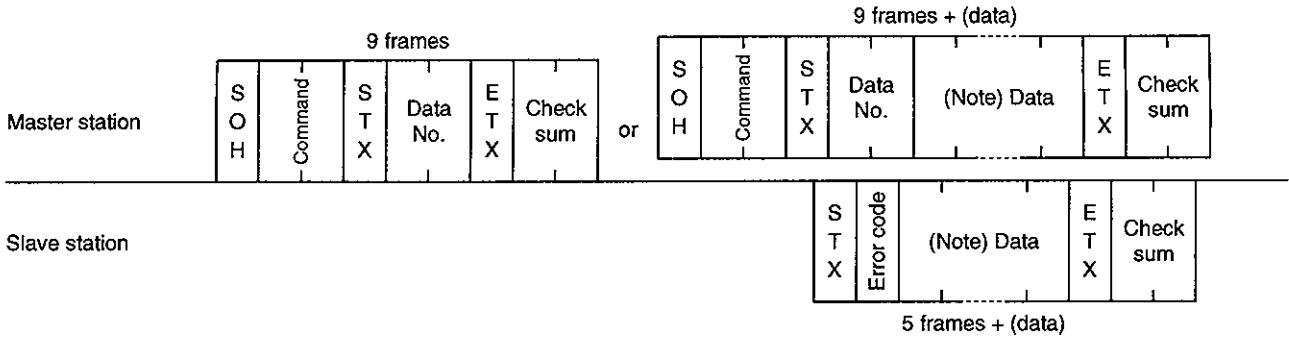
Note: Refer to (4) in this section for the number of data frames.

(3) Recovery of communication status by time-out

Master station

E O T	EOT causes the servo to return to the receive neutral status.

Slave station
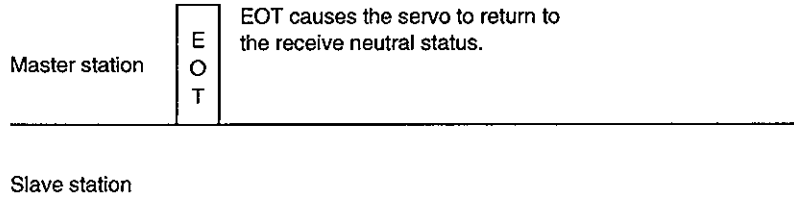
(4) Data frames

The data length depends on the command.
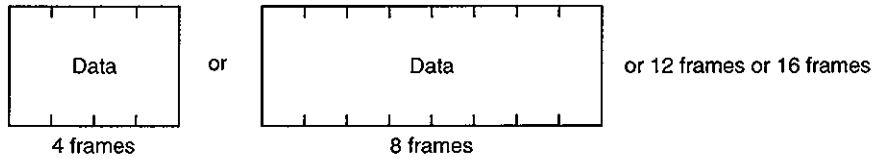
Data	or	Data	or 12 frames or 16 frames
4 frames		8 frames	

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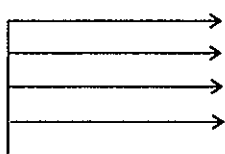
b8	0	0	0	0	0	0	0	0
b7	0	0	0	0	1	1	1	1
b6	0	0	1	1	0	0	1	1
b5	0	1	0	1	0	1	0	1

b8~b5	b4	b3	b2	b1	C / R	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	Space	0	@	P	`	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4			$	4	D	T	d	t
	0	1	0	1	5			%	5	E	U	e	u
	0	1	1	0	6			&	6	F	V	f	v
	0	1	1	1	7			'	7	G	W	g	w
	1	0	0	0	8			(	8	H	X	h	x
	1	0	0	1	9			)	9	I	Y	I	y
	1	0	1	0	10			*	:	J	Z	j	z
	1	0	1	1	11			+	;	K	[	k	{
	1	1	0	0	12			,	<	L	¥	l	|
	1	1	0	1	13			-	=	M	]	m	}
	1	1	1	0	14			.	>	N	^	n	‾
	1	1	1	1	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
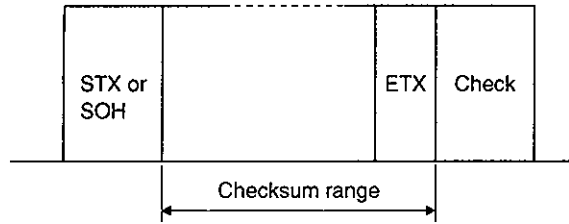
The checksum is sent as a JIS8-coded hexadecimal code representing the lower two digits of the sum of JIS8-coded hexadecimal values up to ETX, with the exception of the first control code (STX or SOH).

(Example)

02H 30H 41H 31H 32H 35H 46H 03H

30H + 41H + 31H + 32H + 35H + 46H + 03H
= 152H

Lower 2 digits 52 is sent after conversion into ASCII code [5][2].
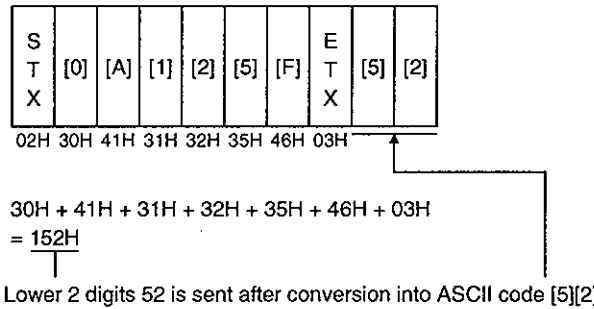
14.7 Time-Out Operation

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)
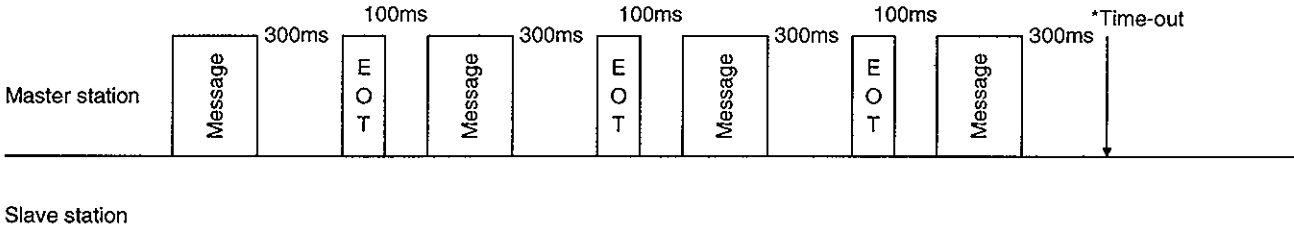
Slave station

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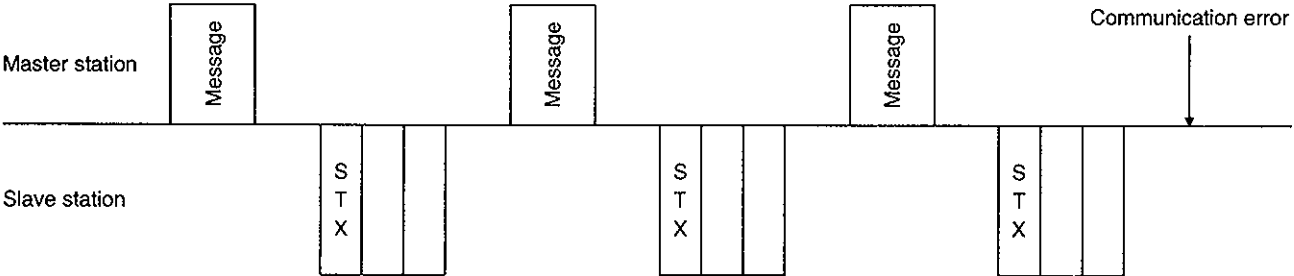
Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry operation is performed three times.

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
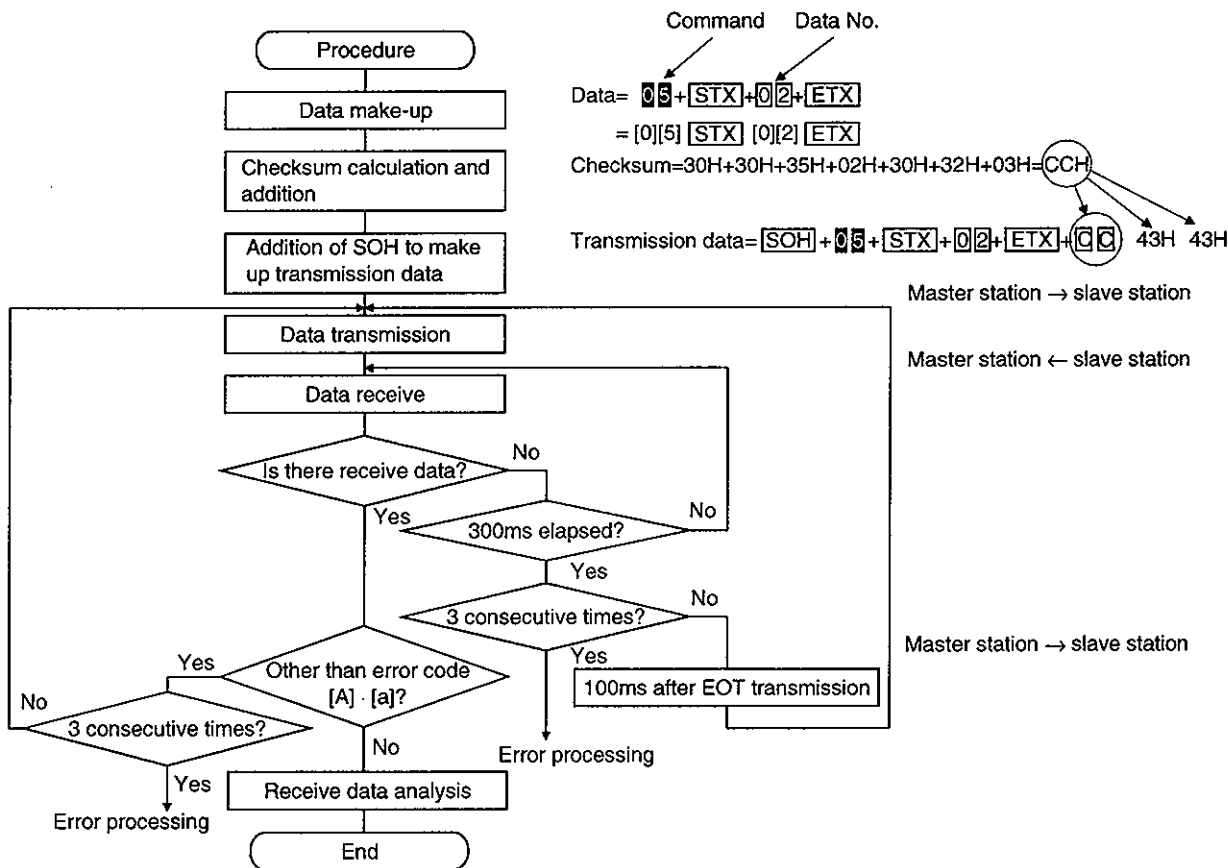
14.11 Command and Data No. List

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]		Torque command	16
[0][1]	[0][7]		Regenerative load factor	16
[0][1]	[0][8]		Effective load factor	16
[0][1]	[0][9]		Peak load factor	16
[0][1]	[0][A]		Within one-revolution position	16
[0][1]	[0][B]		ABS counter	16
[0][1]	[0][C]		Bus voltage	16
[0][1]	[0][D]		Load inertia ratio	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]		Torque command	12
[0][1]	[8][7]		Regenerative load factor	12
[0][1]	[8][8]		Effective load factor	12
[0][1]	[8][9]		Peak load factor	12
[0][1]	[8][A]		Within one-revolution position	12
[0][1]	[8][B]		ABS counter	12
[0][1]	[8][C]		Bus voltage	12
[0][1]	[8][D]		Load inertia ratio	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.)	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.)	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.)	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.)	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 past	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]		Torque command	16
[3][5]	[0][7]		Regenerative load factor	16
[3][5]	[0][8]		Effective load factor	16
[3][5]	[0][9]		Peak load factor	16
[3][5]	[0][A]		Within one-revolution position	16
[3][5]	[0][B]		ABS counter	16
[3][5]	[0][C]		Bus voltage	16
[3][5]	[0][D]		Load inertia ratio	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]		Torque command	12
[3][5]	[8][7]		Regenerative load factor	12
[3][5]	[8][8]		Effective load factor	12
[3][5]	[8][9]		Peak load factor	12
[3][5]	[8][A]		Within one-revolution position	12
[3][5]	[8][B]		ABS counter	12
[3][5]	[8][C]		Bus voltage	12
[3][5]	[8][D]		Load inertia ratio	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	EMG	4
[3][4]	[9][1]		MBR	4
[3][4]	[9][2]		DF	4
[3][4]	[9][3]		OP	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] to [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			Setting Range	Frame Length
[8][B]	[8][1]	DO forced output (MBR)	0000:OFF	0001:ON	0000 · 0001	4
[8][B]	[8][2]	DO forced output (DB)	0000:OFF	0001:ON	0000 · 0001	4

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

Command	Data No.	Description	Setting Range	Frame Length
[A][0]	[0][0]	Switches on/off servo on (SON)/forward rotation start (DI3)/ reverse rotation start (DI4) to perform test operation. (These signals do not exist as external input signals.)	00000000 to FFFFFFFF	8
[A][0]	[0][1]	Forces the external input signals (DI) to turn on/off.	00000000 to FFFFFFFF	8

(8) 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 status.
The receive data is as follows.

| 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 2 | 9 |

Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type)

Display type
[0]: Data must be converted into decimal.
[1]: Data is used unchanged in hexadecimal.

Decimal point position
[0]:No decimal point
[1]:First least significant digit (normally not used)
[2]:Second least significant digit
[3]:Third least significant digit
[4]:Fourth least significant digit
[5]:Fifth least significant digit
[6]:Sixth least significant digit

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.

Data is transferred in hexadecimal.

Decimal point position
[0]:No decimal point
[1]:First least significant digit
[2]:Second least significant digit
[3]:Third least significant digit
[4]:Fourth least significant digit
[5]:Fifth least significant digit
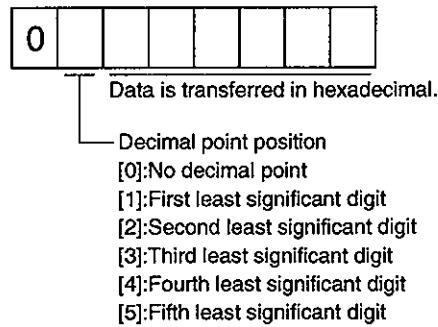
By way of example, here is described how to process the set data when a value of "15.5" is sent.

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.

0	0															

Unit characters (5 digits)   Name characters (9 digits)
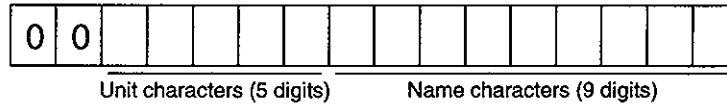
(2) Status display data read

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.

0	0											

Data 32 bits long (represented in hexadecimal)
(Data conversion into display type is required)

Display type
[0]: Used unchanged in hexadecimal
[1]: Conversion into decimal required

Decimal point position
[0]: No decimal point
[1]: Lower first digit (usually not used)
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit
[6]: Lower sixth digit
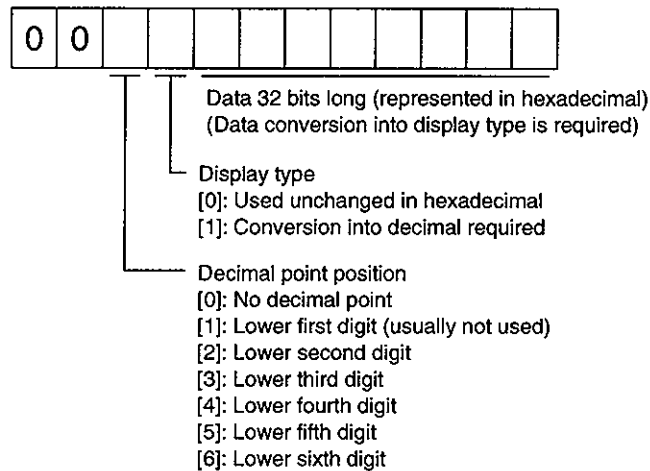
(3) Status display data clear

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.

1) Transmission

Transmit command [0][8] and the data No. corresponding to the parameter No., [0][0] to [6][3].
(Refer to Section 14.11.1.)

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

2) Reply

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

0	0	0										

Name characters (9 digits)

(2) Reading the setting
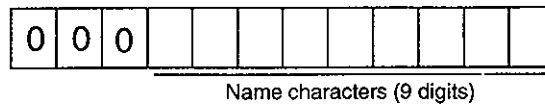
Read the parameter setting.

1) Transmission

Transmit command [0][5] and the data No. corresponding to the parameter No., [0][0] to [6][3].
(Refer to Section 14.11.1.)

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

2) Reply

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

Data is transferred in hexadecimal.

Decimal point position
[0]: No decimal point
[1]: Lower first digit
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit

Display type
0: Used unchanged in hexadecimal.
1: Must be converted into decimal.

Parameter write type
0: Valid after write
1: Valid when power is switched on again after write

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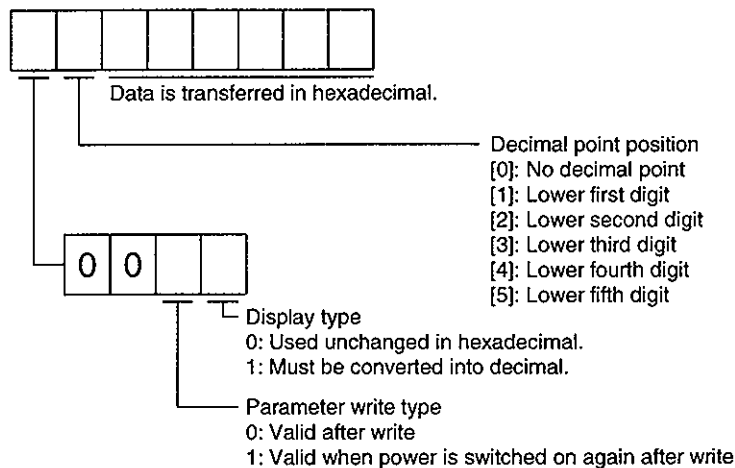, transmit command [0][7] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to Section 14.11.1.)

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

(b) Reply

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

```
┌──┬──┬──┬──┬──┬──┬──┬──┐
│ 0│ 0│  │  │  │  │  │  │
└──┴──┴──┴──┴──┴──┴──┴──┘
```
Data is transferred in hexadecimal.

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

(4) Parameter write

Write the parameter setting into EEP-ROM of the servo amplifier. The set value can be written up to 100,000 times.

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 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.
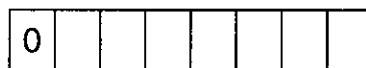
```
┌──┬──┬──┬──┬──┬──┬──┬──┐
│ 0│  │  │  │  │  │  │  │
└──┴──┴──┴──┴──┴──┴──┴──┘
```
Data is transferred in hexadecimal.

Decimal point position
[0]: No decimal point
[1]: Lower first digit
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit

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.

Signal name characters (3 digits)
ON/OFF status
0: OFF
8: ON
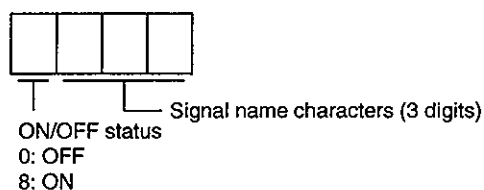
(2) Reading the external output signal ON/OFF status

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.

Signal name characters (3 digits)
ON/OFF status
0: OFF
8: ON
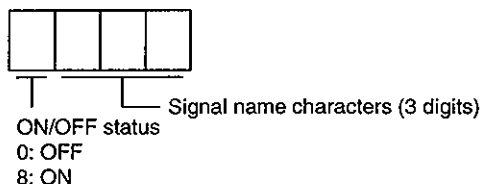
14.12.5 External output signal ON/OFF (DO forced output)

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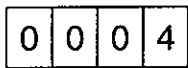
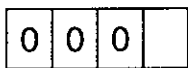Transmit command [8][B] + data No. [0][0] + data "0004" to choose DO forced output.

```
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

```
b31 ------------------------------------------------------b1 b0
│││││││││││││││││││││││││││││││││                             1:ON
                                                             0:OFF
```
Command of each bit is sent to the slave station in hexadecimal.
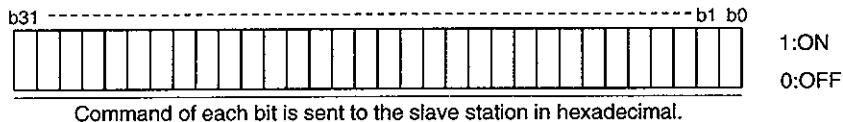
Assignment of CN1 output signals

bit	Signal Name	bit	Signal Name	bit	Signal Name
0		11		22	
1		12		23	
2	MBR	13		24	
3		14		25	
4	DB	15		26	
5		16		27	
6		17		28	
7		18		29	
8		19		30	
9		20		31	
10		21			

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

b31 -- b1 b0

1:ON
0:OFF

Command of each bit is sent to the slave station in hexadecimal.
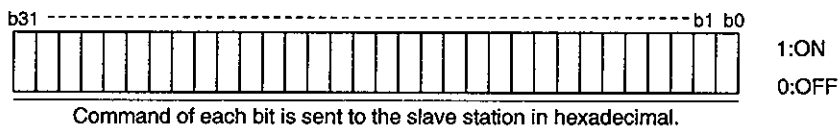
Assignment of CN1 input signals

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	SON	11	DI4	22	
1		12		23	
2		13		24	
3		14		25	
4		15		26	
5		16		27	
6		17		28	
7		18		29	
8		19		30	
9		20		31	
10		21			

14.12.7 Test operation mode

POINT
• When using the RS-232C communication function to perform test operation, set the axis select switch (CS1) of the servo amplifier to "F".

(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.

(a) Turn off all external input signals.

(b) 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

(c) Set the data needed for test operation.

(d) Start.

(e) Continue communication using the status display or other command.

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

(a) Clear the test operation acceleration/deceleration time constant.

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

(b) Cancel the test operation mode.

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

(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 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) Stop

Turn off the signals DI3/DI4 by using command [A][0] + data No. [0][0] .

Item	Command	Data No.	Data
Stop	[A][0]	[0][0]	00000001: Turns on only SON.

(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 c

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.

14.12.8 Alarm history

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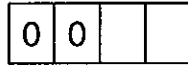
(1) Alarm No. read

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.

└ Alarm No. is transferred in decimal.

For example, "0032" means 32 and "00FF" means _(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

Alarm occurrence time is transferred in hexadecimal.
Hexadecimal must be converted into decimal.

Example:

For data "01F5", the alarm occurred in 501 hours after start of operation.
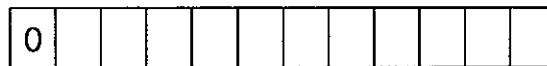
(3) Reading the alarm name

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.

Name characters (11 digits)

(4) Alarm history clear

Erase the alarm history. Transmit the following communication command:

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

14.12.9 Current alarm

(1) Current alarm No. read
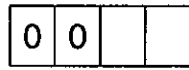Read the alarm No. which is occurring currently.
(a) Transmission
Send command [0][2] and data No. [0][0].
(b) Reply
The slave station sends back the alarm currently occurring.

```
| 0 | 0 |   |   |
```
└ Alarm No. is transferred in decimal.

For example, "0032" means 32 and "00FF" means _(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.

```
| 0 | 0 |   |   |
```
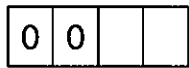└ Alarm No. is transferred in decimal.

(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.

```
| 0 | 0 |   |   |   |   |   |   |   |   |   |   |
```
Name characters (10 digits)

(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.

0	0										

Name characters (10 digits)
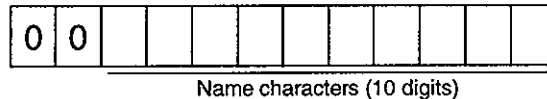
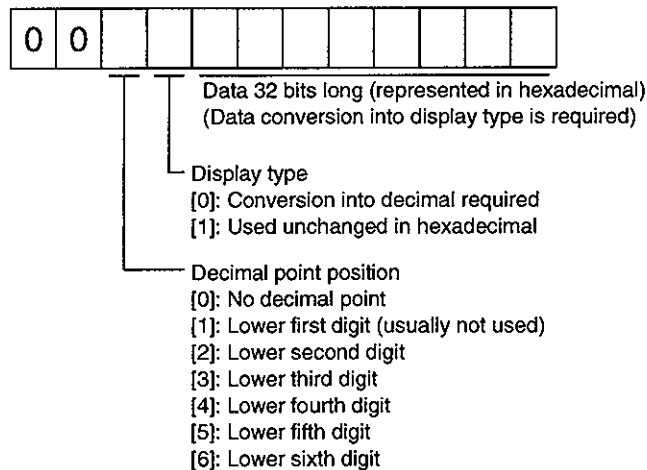(5) Read of the status display at alarm occurrence

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.

0	0									

Data 32 bits long (represented in hexadecimal)
(Data conversion into display type is required)

Display type
[0]: Conversion into decimal required
[1]: Used unchanged in hexadecimal

Decimal point position
[0]: No decimal point
[1]: Lower first digit (usually not used)
[2]: Lower second digit
[3]: Lower third digit
[4]: Lower fourth digit
[5]: Lower fifth digit
[6]: Lower sixth digit

(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

14.12.10 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□BN-UE to MR-H22KBN-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

Control box

15- 1
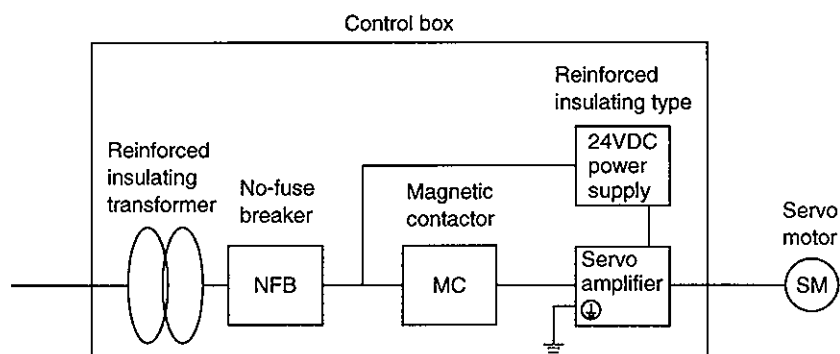
(3) Environment

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).
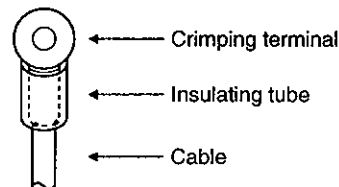
(4) Power supply

(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.

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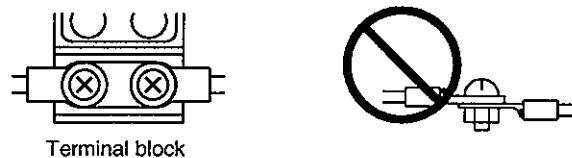
(c) Use the servo motor side power connector which complies with the EN Standard. The EN Standard-compliant power connector sets are available from us as options.

(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 (3.5mm² 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.
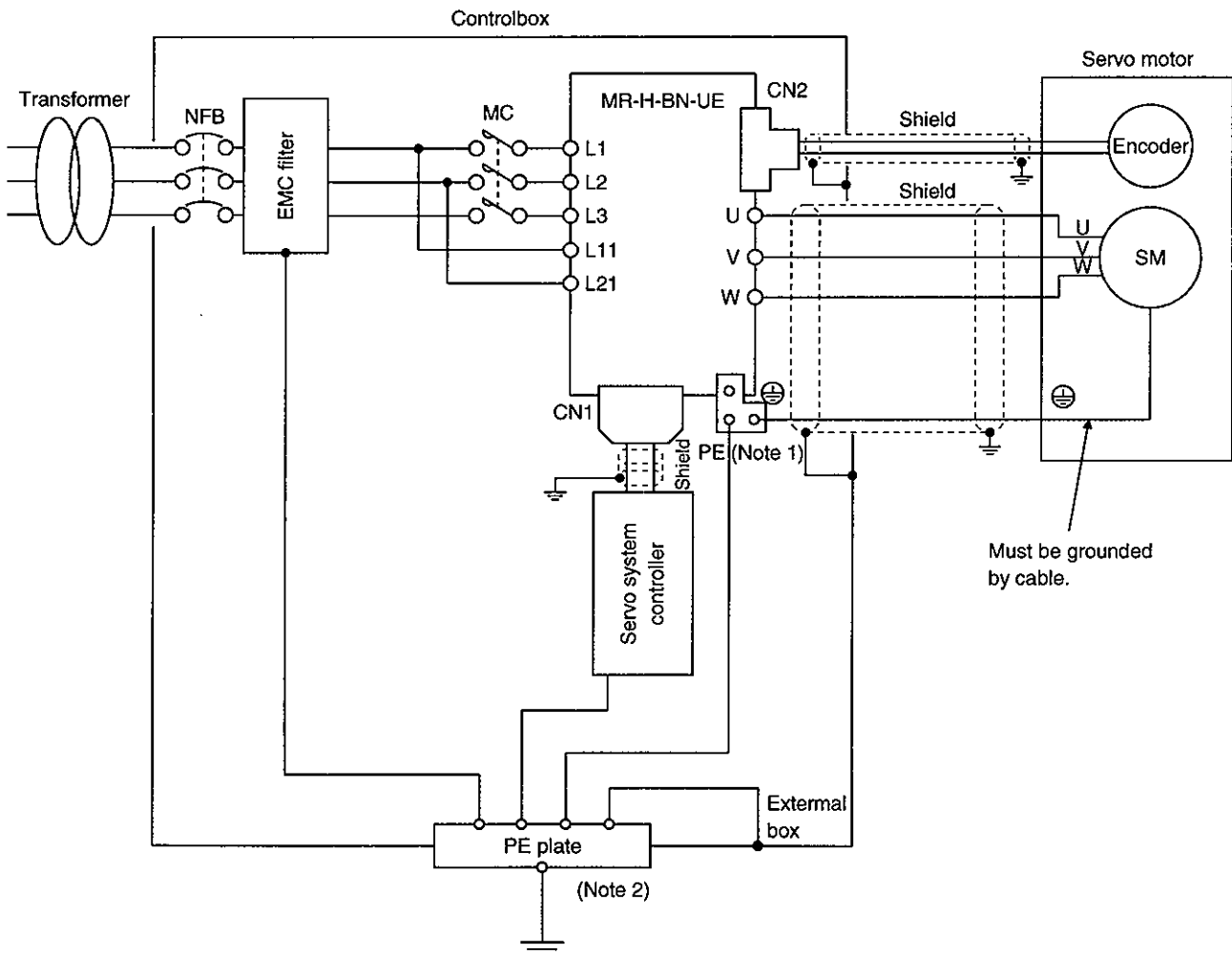
Note: 1. Do not connect two ground cables to the same protective earth (PE) terminal as shown at right below. Always connect cables to the terminals one-to-one as shown at left:

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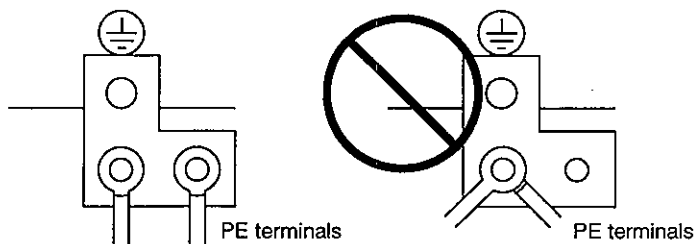
2. For the grounding of the control box, refer to EN60204.

(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] | | | | Electro-magnetic Brake | Power Factor Improving Reactor FR-BAL |
			L1 · L2 · L3 ⏚	(Note 2) U · V · W ⏚	L11 · L21	(Note 3) P · C		
MR-H10BN-UE	Type NF30 5A	S-N10	2	1.25	2	2	1.25	FR-BAL-0.4K
MR-H20BN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-0.4K
MR-H40BN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-0.75K
MR-H60BN-UE	Type NF30 10A	S-N10	2	1.25	2	2		FR-BAL-1.5K
MR-H100BN-UE	Type NF30 15A	S-N10	2	2	2	2		FR-BAL-2.2K
MR-H200BN-UE	Type NF30 20A	S-N18	3.5	3.5	2	2		FR-BAL-3.7K
MR-H350BN-UE	Type NF50 30A	S-N25	5.5	(Note 5) 5.5	2	2		FR-BAL-7.5K
MR-H500BN-UE	Type NF50 50A	S-N35	5.5	5.5	2	2		FR-BAL-11K
MR-H700BN-UE	Type NF100 75A	S-K50	8	8	2	3.5		FR-BAL-15K
MR-H11KBN-UE	Type NF100 100A	S-K65	14	22	2	5.5		FR-BAL-15K
MR-H15KBN-UE	Type NF225 125A	S-K95	22	30	2	5.5		FR-BAL-22K
MR-H22KBN-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.

15.1.3 Standard connection examples
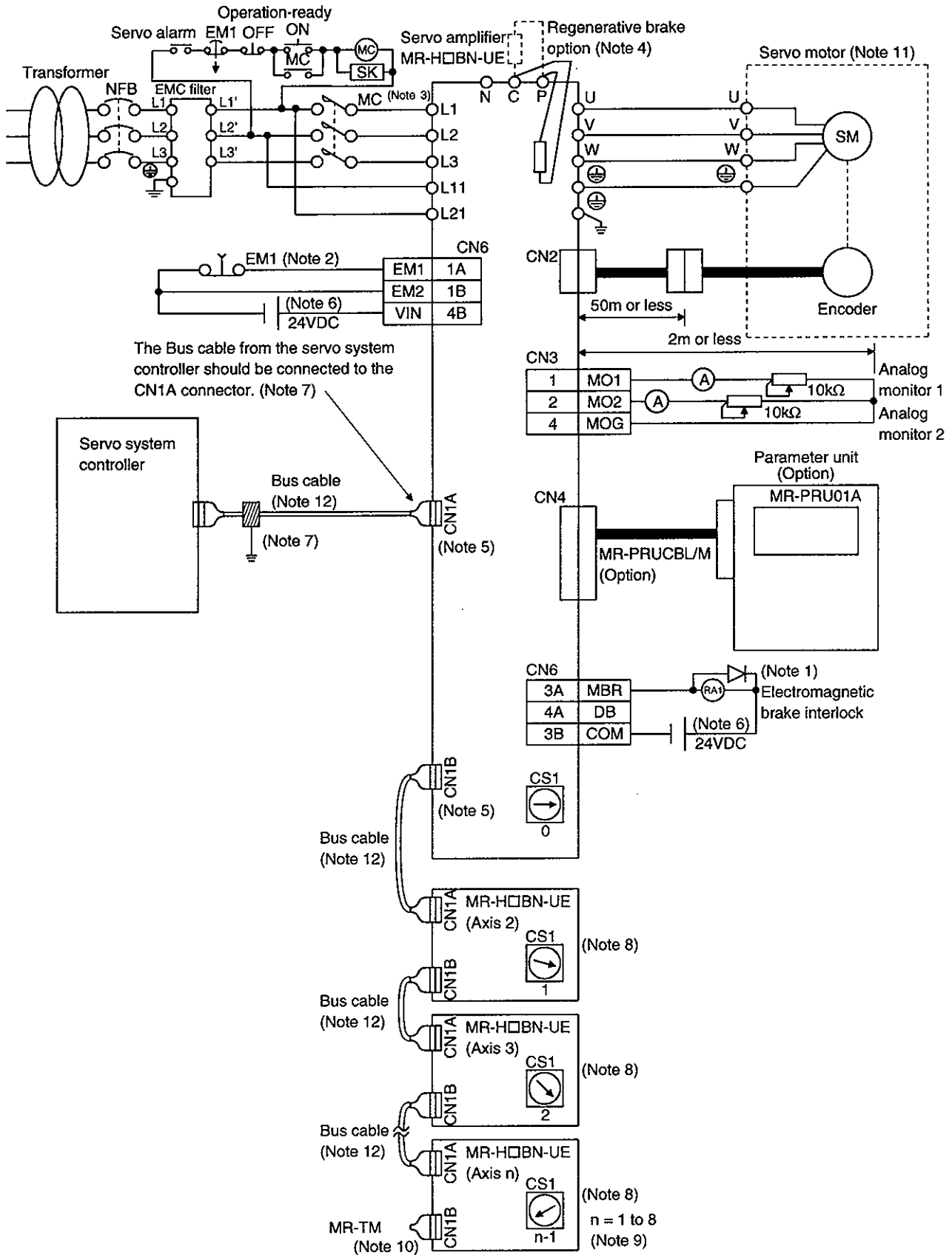
Note: 1. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.

2. The emergency stop switch must be installed.

3. Configure up the power circuit which switches off the magnetic contactor after detection of an alarm.

4. Connect the regenerative brake option across terminals P-C after removing the lead of the built-in regenerative brake resistor from P-C.

5. CN1A and CN1B have the same shape. Wrong connection of the connectors will lead to a fault.

6. Use a 24VDC power supply which has been insulation-reinforced in I/O.
Please connect the 24VDC power supply and connect COM with EM2 on the outside when common.

7. Use the bus cable at the overall distance of 30m or less. In addition, to improve noise immunity, it is recommended to use a cable clamp and data line filters (three or four filters connected in series) near the connector outlet.

8. The wiring of the second and subsequent axes is omitted.

9. Up to eight axes (n = 1 to 8) may be connected. The MR-J-B/MR-J2-B servo may be connected on the same bus.

10. Always insert the termination connector (MR-TM) into CN1B of the servo amplifier located at the termination.

11. The HC-MF-UE series servo motor is connected. Refer to Section 3.6 for connection with the servo motor.

12. The bus cable used with the SSC-NET depends on the preceding or subsequent controller or servo amplifier connected. Refer to Section 3.3 note 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-H10BN-UE to MR-H700BN-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

(1) Short circuit rating

Having been subjected to the short-circuit tests of the UL in the alternating-current circuit whose peak current is limited to 5000A or less, this servo amplifier conforms to this 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-H10BN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	1.25(AWG 16)
MR-H20BN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H40BN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H60BN-UE	2(AWG 14)	1.25(AWG 16)	2(AWG 14)	2(AWG 14)	
MR-H100BN-UE	2(AWG 14)	2(AWG 14)	2(AWG 14)	2(AWG 14)	
MR-H200BN-UE	3.5(AWG 12)	3.5(AWG 12)	2(AWG 14)	2(AWG 14)	
MR-H350BN-UE	5.5(AWG 10)	(Note 4) 5.5(AWG 10)	2(AWG 14)	2(AWG 14)	
MR-H500BN-UE	5.5(AWG 10)	5.5(AWG 10)	2(AWG 14)	2(AWG 14)	
MR-H700BN-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-H10BN-UE	a	a	a	a
MR-H20BN-UE	a	a	a	a
MR-H40BN-UE	a	a	a	a
MR-H60BN-UE	a	a	a	a
MR-H100BN-UE	a	a	a	a
MR-H200BN-UE	b	b	a	a
MR-H350BN-UE	b	b	a	a
MR-H500BN-UE	b	b	c	a
MR-H700BN-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-H10BN-UE	NON-10(Buss) or OT10(Gould)	K5	10	250VAC
MR-H20BN-UE	NON-10(Buss) or OT10(Gould)	K5	10	
MR-H40BN-UE	NON-15(Buss) or OT15(Gould)	K5	15	
MR-H60BN-UE	NON-20(Buss) or OT20(Gould)	K5	20	
MR-H100BN-UE	NON-25(Buss) or OT25(Gould)	K5	25	
MR-H200BN-UE	NON-40(Buss) or OT40(Gould)	K5	40	
MR-H350BN-UE	NON-70(Buss) or OT70(Gould)	K5 or H	70	
MR-H500BN-UE	NON-125(Buss) or OT125(Gould)	K5 or H	125	
MR-H700BN-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□BN-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□BN	MR-H□BN-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.

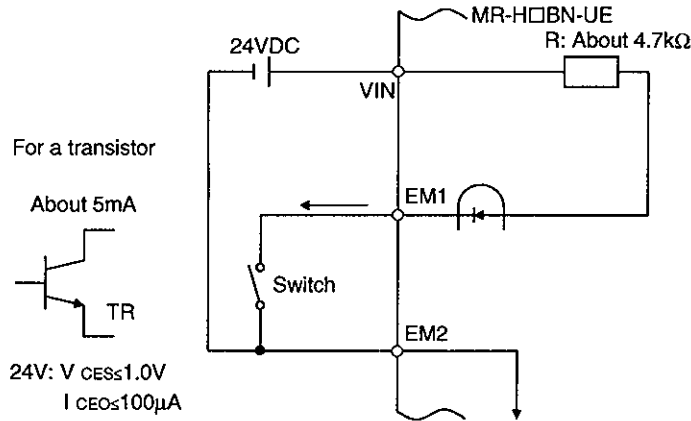| Symbol	Signal	Description
L1, L2, L3	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to L1, L2, L3. For MR-H700□BN-UE or more, the voltage of 50Hz power is 200 to 220V.
U, V, W	Servo motor output	Servo motor power output terminals 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□BN-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-400BN-UE to MR-H700BN-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-H11KBN-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-H11KBN-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.

For a transistor

About 5mA

TR

24V: V $_{CES}$≤1.0V
I $_{CEO}$≤100μA
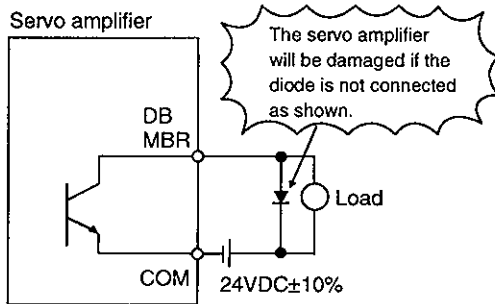
24VDC

VIN

MR-H□BN-UE
R: About 4.7kΩ

EM1

Switch

EM2

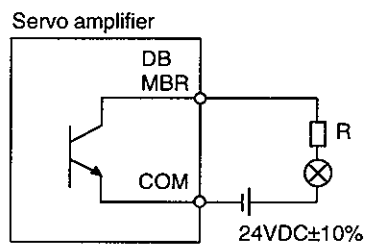(2) Digital output interface DO-1

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

Servo amplifier

DB MBR

The servo amplifier will be damaged if the diode is not connected as shown.

Load

COM   24VDC±10%

· Lamp load

Servo amplifier

DB MBR

COM

R

24VDC±10%

REVISIONS

Print Data	*Manual Number	Revision
Sep., 1998	SH(NA)3192-A	First edition
Sep., 1999	SH(NA)3192-B	Sentences of compliance with the European EC Directives changed.
		Section 1.3.1 : Change from servo amplifier to rating plate. Rating plate changed.
		Section 1.3.2 : Model added.
		Section 1.4 : Note changed.
		Section 2.4 (2) : Sentence modified.
		Chapter 3 : Sentence in WARNING changed.
		Section 3.3.1 : POINT added.
		Section 3.3.2 (2) : Signal in Function/Application deleted.
		Section 3.9.2 (1) (b) : Deletion of servo motor speed dynamic brake in 3).
		Section 3.10 : Partial sentence change.
		Section 4.3 (2) : d# and C# exchanged in display list.
		Section 6.1.2 (2) : Changed to Section 6.2.2 and Refer to Section 13.1 deleted in parameter No. 23.
		Section 7.3 : Effective load factor description modified. Indication ranges changed.
		Section 8.3.2 : POINT addition.
		Section 8.4.2 (2) (b) : Addition of 5) to 7).
		Section 8.4.7 (2) : Addition of 7) and 8).
		Chapter 9 : CAUTION changed to WARNING.
		Section 9.2 : Deletion of NOTE.
		Section 10.1.1 : Partial changes to the alarm and warning lists.
		Section 10.1.2 : POINT sentence addition. Sentence addition. Alarm No. 50 definition changed.
		Section 10.1.3 : Sentence addition
		Section 10.2.2 : Addition made to Alarm No. 51 definition.
		Section 12.1 : Sentence addition.
		Section 12.4 : NOTE deletion.
		Section 13.1.2 (2) (a) : Part of sentence changed to Section 5.1 of the separately available Servo Motor Instruction Manual.
		Section 13.1.4 (2) : Partial connection diagram change.
		Section 13.1.7 (1) : Baudrate 19200bps deleted.
		Section 13.2.1 (1) : Note added to the wire size in 3) of MR-H350BN.
		Section 13.2.2 : Changed to no-fuse breaker model NF50 30A.
		Section 13.2.3 : Changed to power-factor improving reactor model FR-BAL-22K.
		Section 13.2.6 : Power changed to power supply and FR-BIF added in table 7). Installation changed to ground in 8).
		Section 13.2.7 (2) : Changed to selection example (13.2).
		Section 14.1 (2) : Changed to cable connection diagram CN4. Partial figure change. NOTE 4 addition.
		Section 14.11.1 (1) : Partial table change.
		Section 14.11.1 (2) : Partial table change.

		Section 14.11.1 (3) : Partial table change. Section 14.11.1 (4) : Partial table change. Section 14.11.1 (5) : Partial table change. Section 14.11.2 (4) : Data No. changed to [4][F]. Section 14.12.1 (4) : Sentence of set value writing added. Section 14.12.3 (1) (a): Sentence addition. Section 14.12.3 (1) (b): Sentence addition. Section 14.12.3 (3) : Sentence addition. Section 14.12.3 (4) : Sentence addition. Section 14.12.6 : Sentence added. Section 14.12.8 (1) : Sentence addition. Section 14.12.9 (1) (b): AL. Deletion. Sentence addition. Section 14.12.9 (1) 2) : A deleted. Section 15.1.2 (8) : Note 4 and Note 5 added. Section 15.2.3 (1) : Changed to Short-circuit rating. Sentence added. Section 15.2.4 : Note 4 added.