MITSUBISHI

General-Purpose AC Servo

MELSERVO-H Series

General-Purpose Interface
MR-H□AN
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 : 19.6 {2G}
			HC-SF81 HC-SF52 to 152 HC-SF53 to 153 HC-UF 72 · 152	X : 9.8 {1G} Y : 24.5 {2.5G}
			HC-SF121 · 201 HC-SF202 · 352 HC-SF203 · 353 HC-UF202	X : 19.6 {2G} Y : 49 {5G}
			HC-SF301	X : 11.7 {1.2G} 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

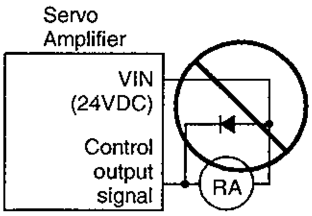
⚠ CAUTION

- 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.



(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

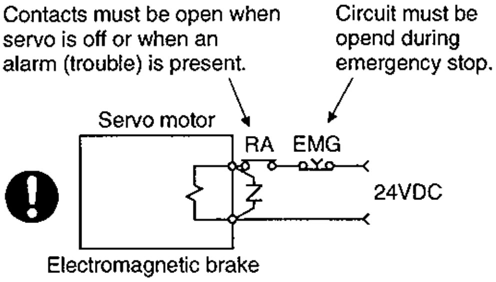
⚠ CAUTION

- 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.



- 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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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.

About the Manuals

This Instruction Manual and the MELSERVO Servo Motor Instruction Manual are required if you use the General-Purpose AC servo MELSERVO-H-AN for the first time. Always purchase them and use the MELSERVO-H-AN 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-AN series general-purpose AC servo is the all-digital, intelligent AC servo which has been wholly digitized in servo control. It has position control, speed control and torque control modes. Further, it can perform operation with the control modes changed, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.

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) Position control mode

An up to 400kpps high-speed pulse train (forward rotation pulse train, reverse rotation pulse train) is used to control the speed and direction of a motor and executes precision positioning (16384 pulses/rev 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.

(2) Speed control mode

An external analog speed command (±10VDC) or parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.

There are also the acceleration/deceleration time constant changing circuit in response to speed control command, the servo lock function at a stop time, and the offset adjustment function in response to external analog speed command.

The internal clamp and external torque limit for servo motor torque are the same as in the position control mode.

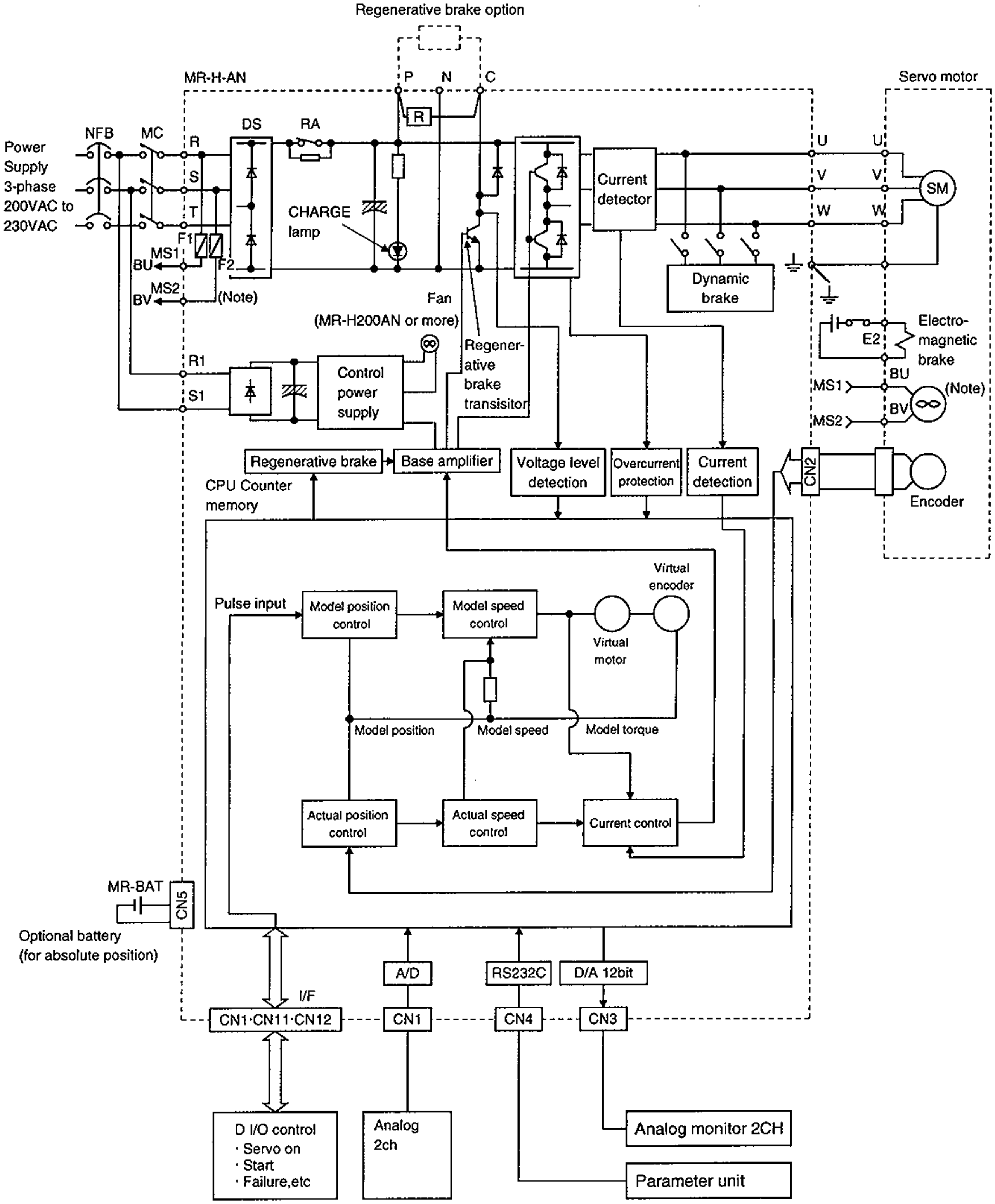
(3) Torque control mode

An external analog torque command (±8VDC) or parameter-driven internal torque command is used to control the torque output by the servo motor.

To protect misoperation under no load, the speed limit function (external or internal setting) is also available for application to tension control, etc.

1.2 Function block diagram

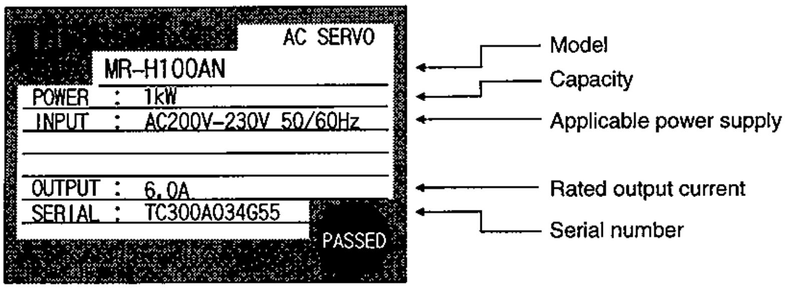
The function block diagram of the MELSERVO-H-AN is shown on the next page.



Note: For 11kW or more

1.3 Model Code Definition

1.3.1 Rating plate



1.3.2 Model code

MR-H□A□□□

Series name

Compliant Standards

Symbol	Compliant Standard
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	○	×
N	○	○

General-purpose 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

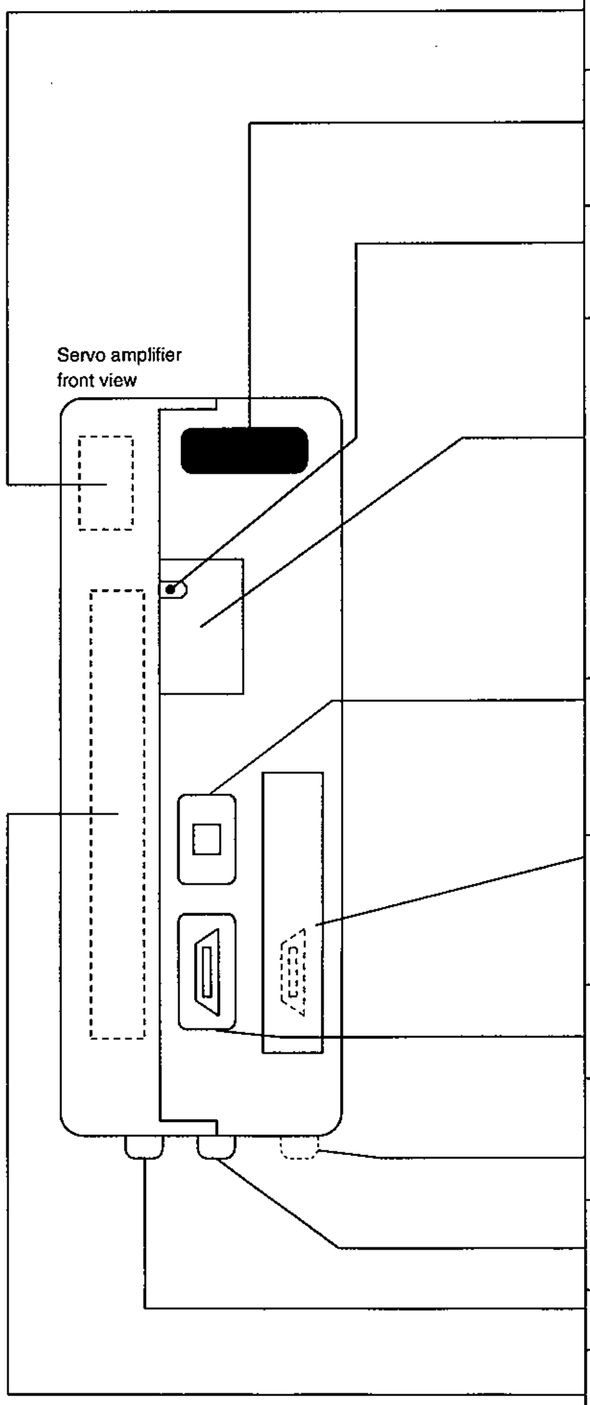
The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the models with electromagnetic brakes, the models with reduction gears, the EN Standard-compliant models and the UL/C-UL Standard-compliant models.
Consult us when using a servo motor which is equipped with a high resolution encoder of 32768 pulses/rev or 131072 pulses/rev.

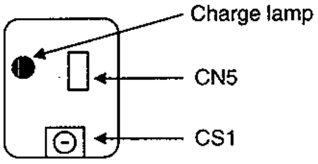
Servo Amplifier	Servo Motor								
	HC-MF□	HA-FF□	HC-SF□			HC-RF□	(Note) HC-UF□		HA-LH□
			1000r/min	2000r/min	3000r/min		2000r/min	3000r/min	
MR-H10AN		053・13						13	
MR-H20AN	053・13	23							
MR-H40AN	23	33・43						23	
MR-H60AN	43	63		52	53			43	52
MR-H100AN	73		81	102	103		72	73	
MR-H200AN			121・201	152・202	153・203	103・153	152		102・152
MR-H350AN			301	352	353	203	202		202
MR-H500AN				502		353・503	352・502		302・502
MR-H700AN				702					702
MR-H11KAN									11K2
MR-H15KAN									15K2
MR-H22KAN									22K2

Note: The HC-UF73・HC-SF203・HC-SF353 may not be connected to some servo amplifiers produced in a certain period. Please consult us.

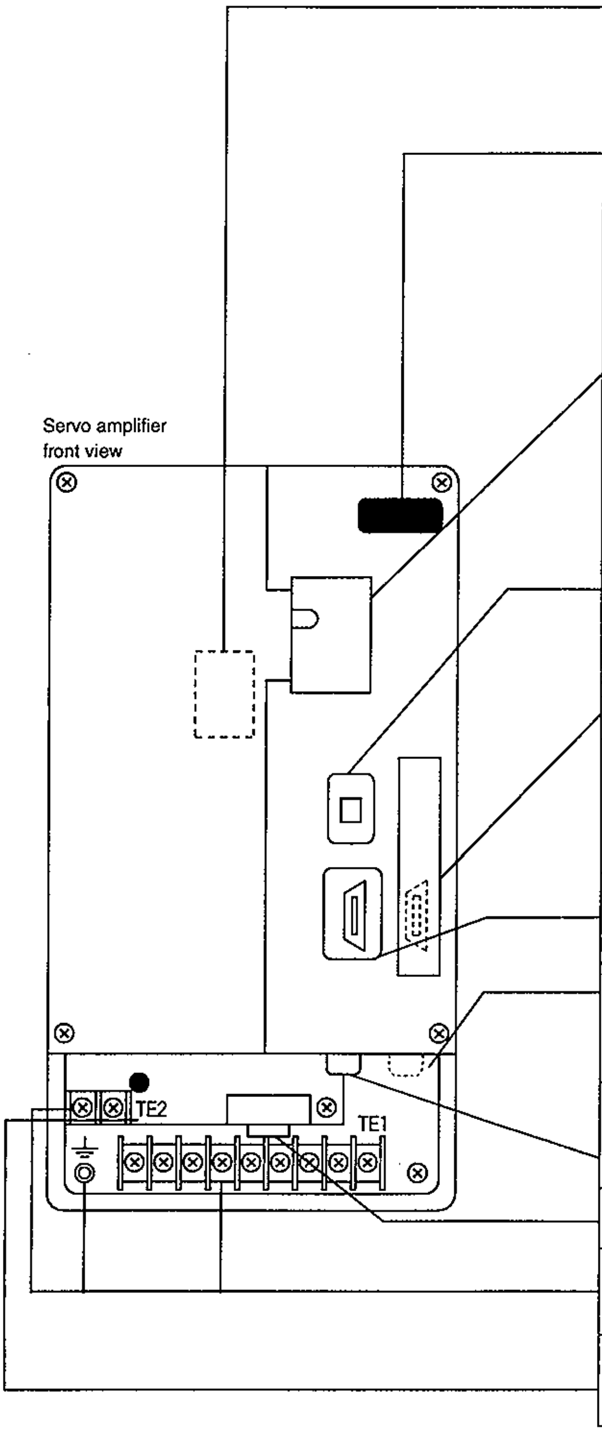
1.5 Parts Identification

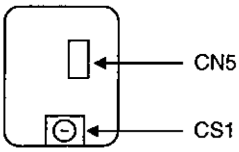
1.5.1 MR-H350AN or less



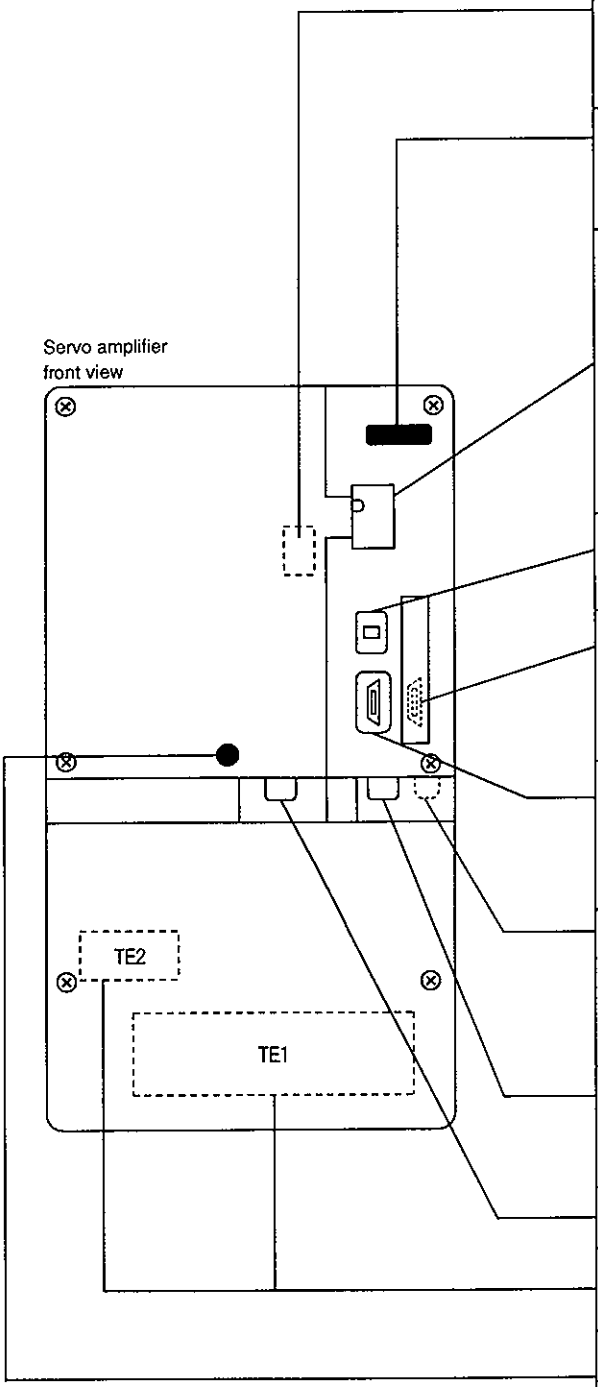
Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 7.3 Section 7.5
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	——
Switch window · CN5 : Connector for connection of the battery for absolute position detection · CS1 : Status indication select switch 	Chapter 5 Section 7.5
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.6.2(6) Section 6.2.2
CN12 (MR-H-D01 option card) Used to input an auxiliary pulse train when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 13.1.1 Chapter 14
CN11 (MR-H-D01 option card) Used to connect extra I/O signals when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
I/O signal connector (CN1) Used to connect digital I/O signals.	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 3.7.2

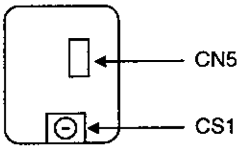
1.5.2 MR-H500AN and MR-H700AN



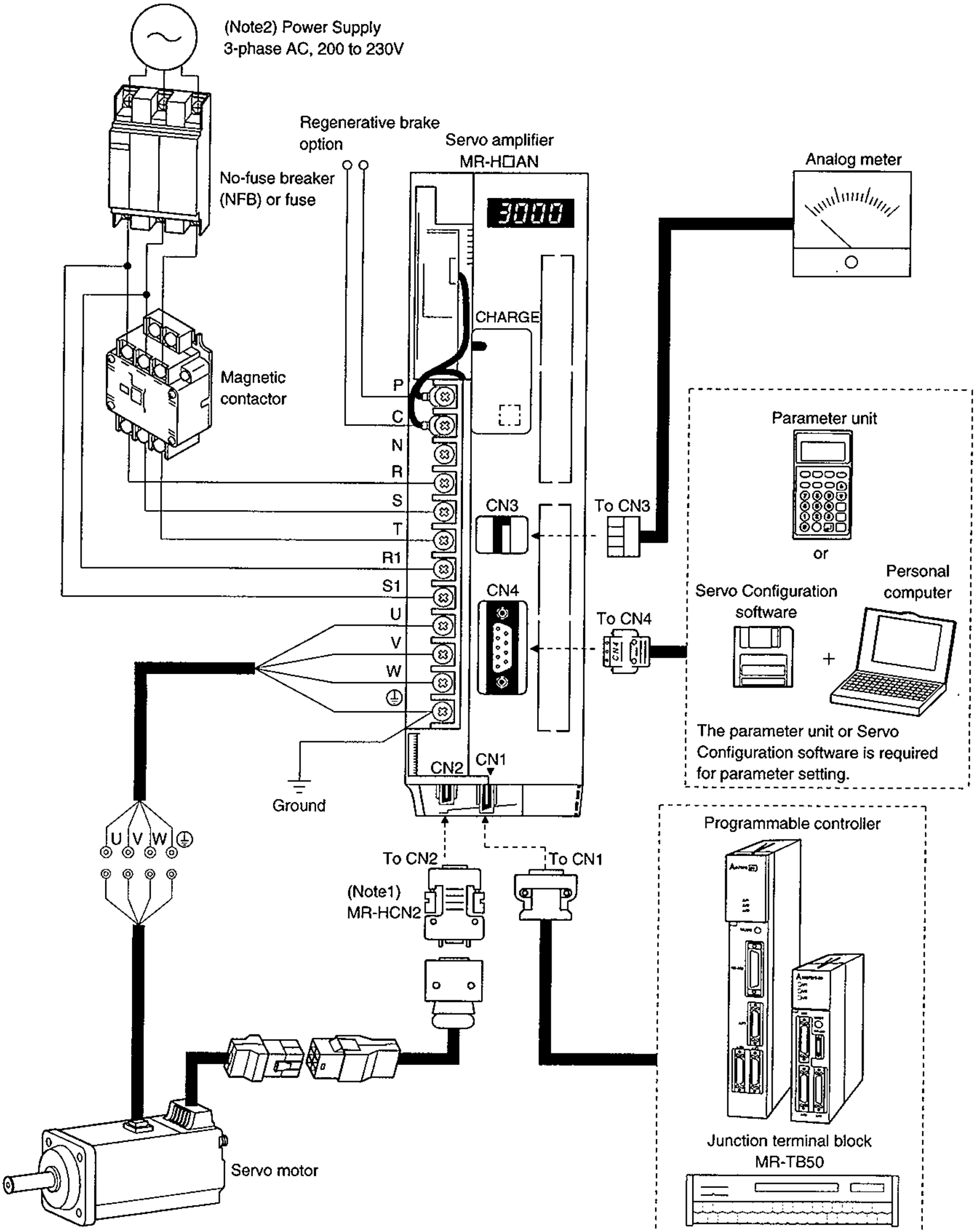
Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 7.3 Section 7.5
Switch window · CN5 : Connector for connection of the battery for absolute position detection · CS1 : Status indication select switch 	Chapter 5 Section 7.5
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.6(4) Section 6.2.2
CN12 (MR-H-D01 option card) Used to input an auxiliary pulse train when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 13.1.1 Chapter 14
CN11 (MR-H-D01 option card) Used to connect extra digital I/O signals when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
I/O signal connector (CN1) Used to connect digital I/O signals.	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.	———
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	Section 3.7.2

1.5.3 MR-H11KAN or more



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 7.3 Section 7.5
Switch window · CN5 : Connector for connection of the battery for absolute position detection · CS1 : Status indication select switch 	Chapter 5 Section 7.5
Analog monitor output connector (CN3) Used to output an analog monitor signal.	Section 3.3.1 Section 3.6(4) Section 6.2.2
CN12 (MR-H-D01 option card) Used to input an auxiliary pulse train when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
Communication connector (CN4) Used for connection with the MR-PRU01A/personal computer.	Section 13.1.1 Chapter 14
CN11 (MR-H-D01 option card) Used to connect extra I/O signals when the MR-H-D01 option card is loaded.	Section 3.3.1 Section 3.4.1 Section 3.4.2 Section 13.1.10
I/O signal connector (CN1) Used to connect digital I/O signals.	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 3.7.2
Charge lamp (in the front panel) Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	————

1.6 Servo System with Auxiliary Equipment



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

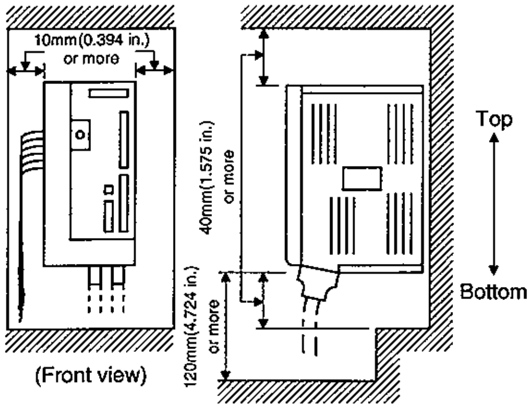
Environment	Conditions
Ambient temperature	0 to +55 [°C] (non-freezing)
	32 to +131 [°F] (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
storage temperature	–20 to +65 [°C] (non-freezing)
	–4 to +149 [°F] (non-freezing)
storage humidity	90%RH or less (non-condensing)
Ambient	Indoors (no 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 controller. 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



(Front view)

(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-H10AN to MR-H60AN, 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 optional encoder cable range. 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.

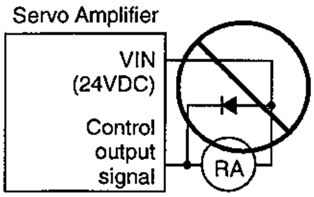
3. SIGNALS AND WIRING

⚠ 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 pin with the same signal name are connected in the servo amplifier.

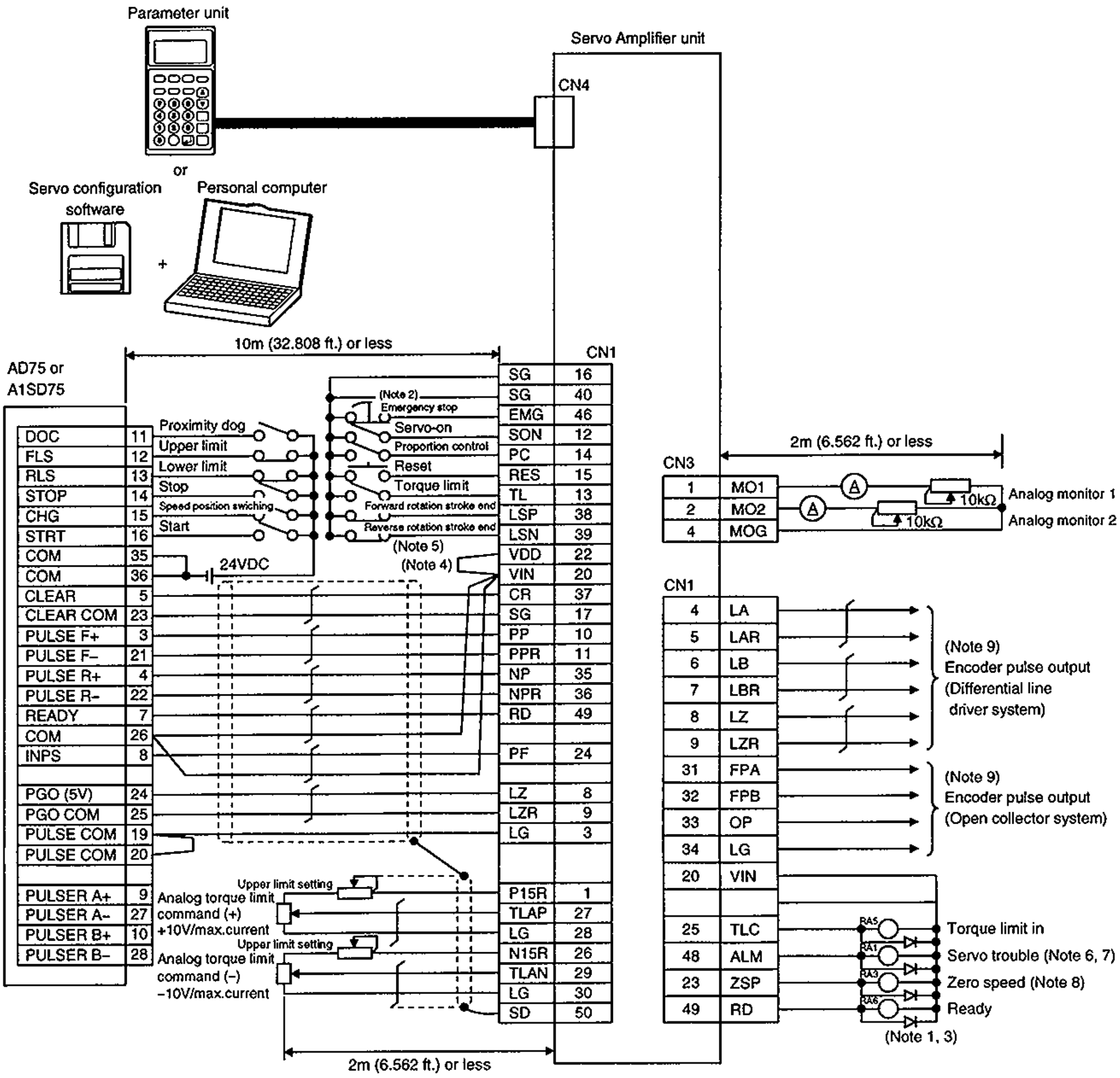
3.1 Connection Example

POINT

- Refer to Section 3.7 for the power line connection and to Section 3.8 for connection with the servo motor.

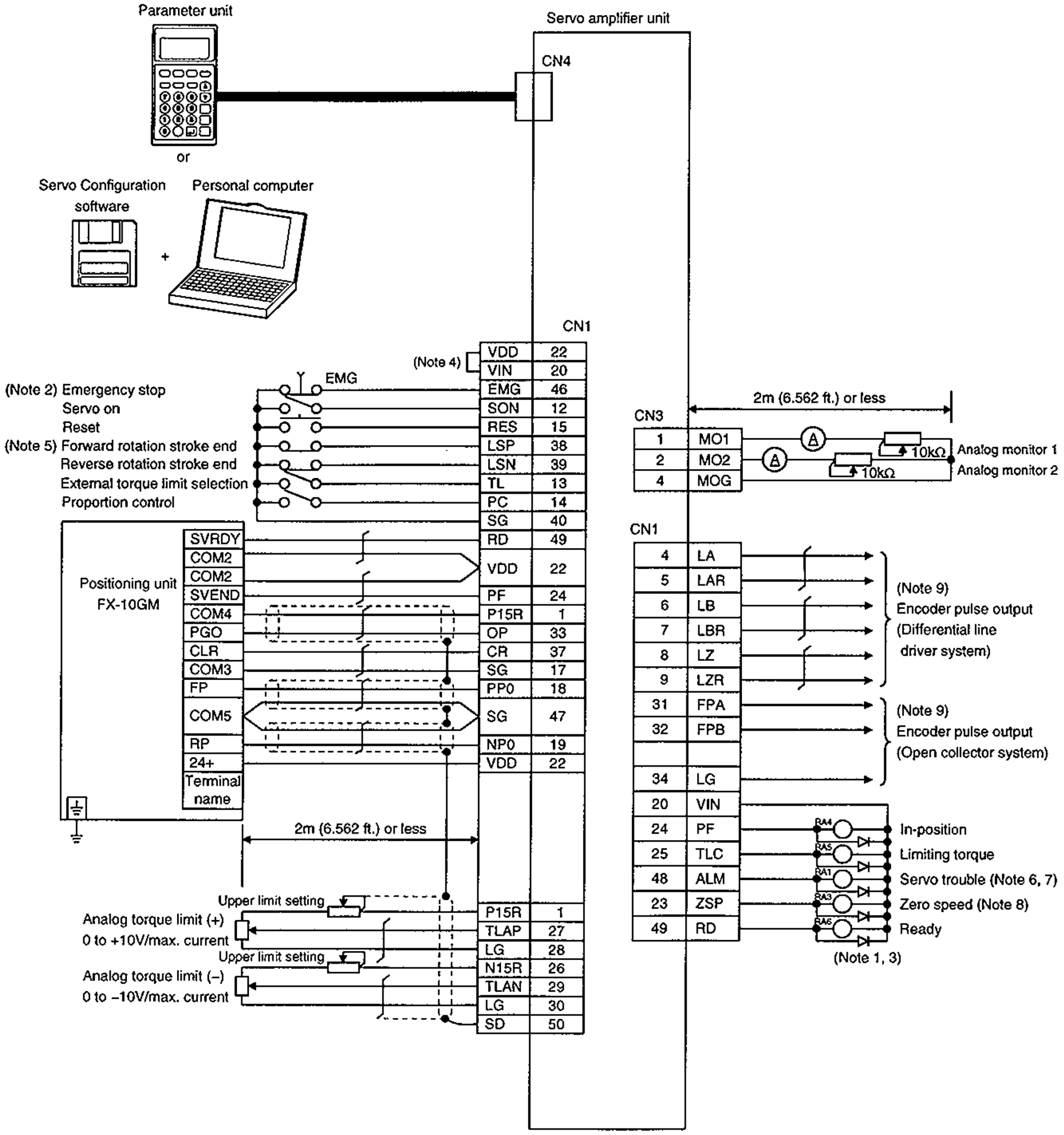
3.1.1 Position control mode

(1) Connection with the AD75P□ (A1SD75P□)



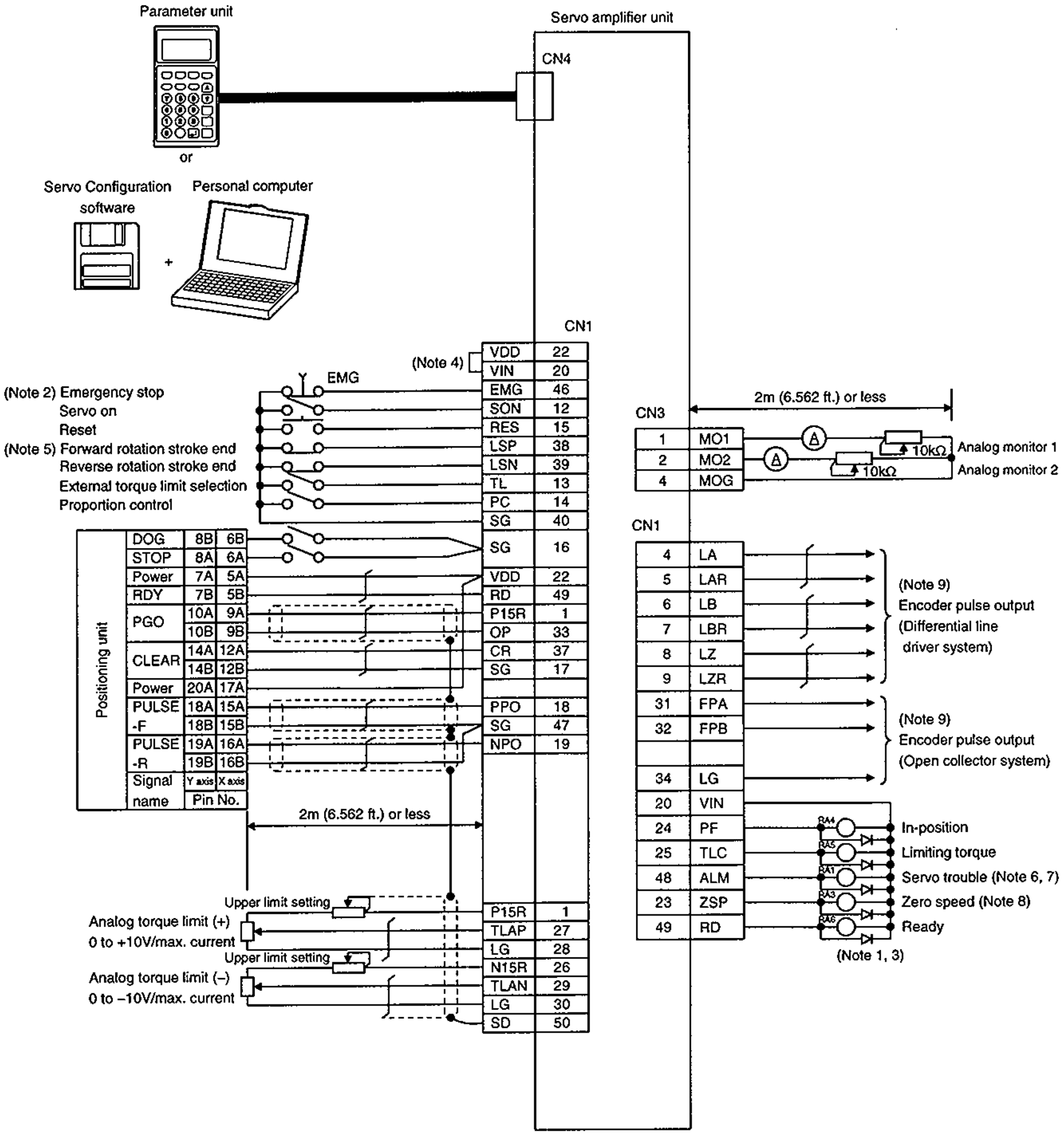
For notes, refer to page 3-5.

(2) Connection with FX-1GM



For notes, refer to page 3-5.

(3) Connection with AD71 (A1SD71)



For notes, refer to page 3-5.

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. The sum of currents that flow in the external relays should be 200mA max. If it exceeds 200mA, supply interface power from external.
4. When using the internal power supply (VDD) as the interface power supply, always connect VDD-VIN. When using the external power supply, open VDD-VIN and connect the power supply across VIN-SG.
5. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
6. ALM-SG are connected in a normal status, i.e. when there is no alarm.
7. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
8. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
9. The following encoder pulses are output:

1) Division ration setting

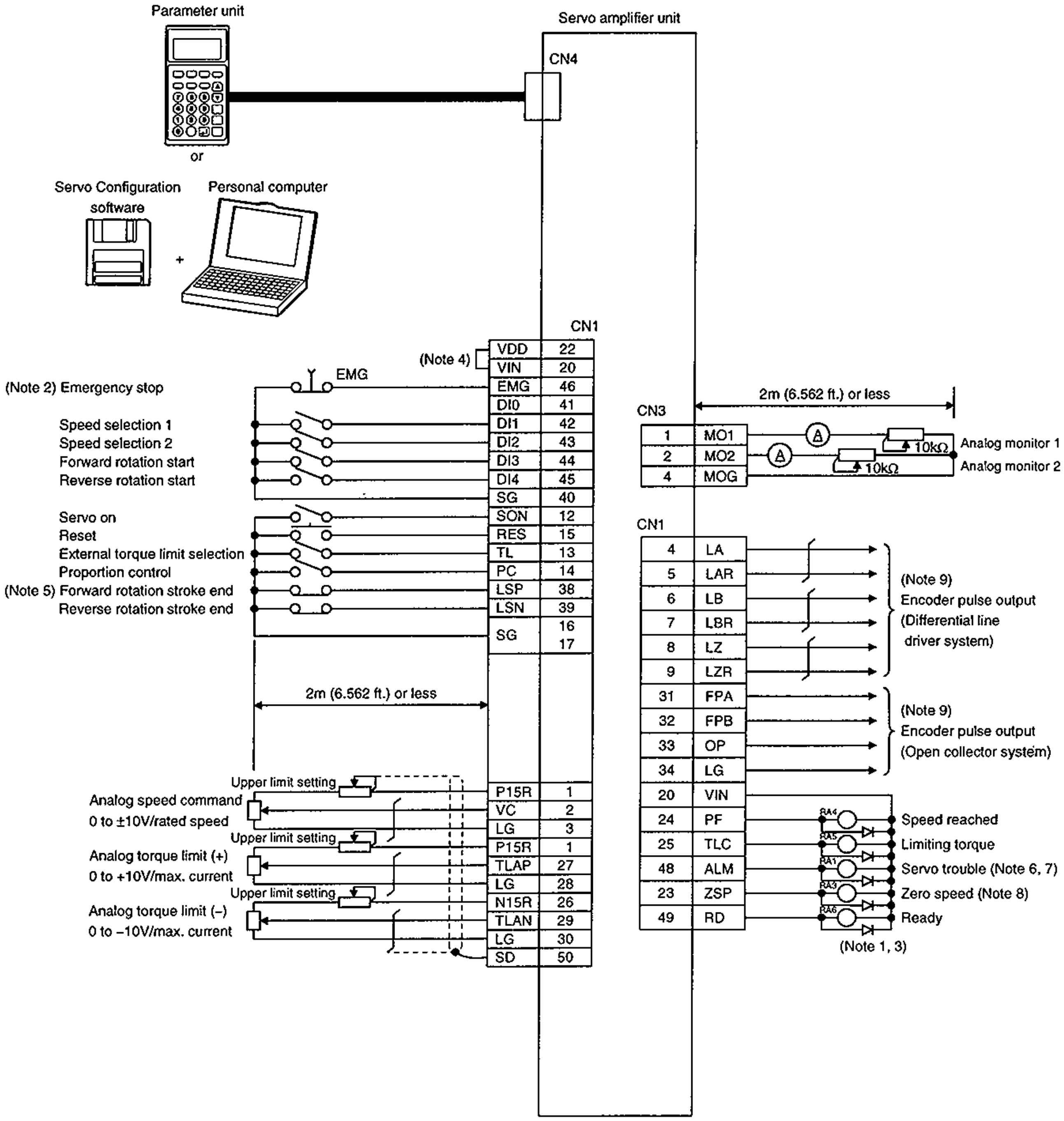
Output pulse = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF · HA-FF HC-UF3000r/min	2048
HC-SF · HC-RF HC-UF2000r/min HA-LH	4096

2) Output pulse setting

Output pulses = (1 to 32768)/4 [pulse/rev]

3.1.2 Speed control mode



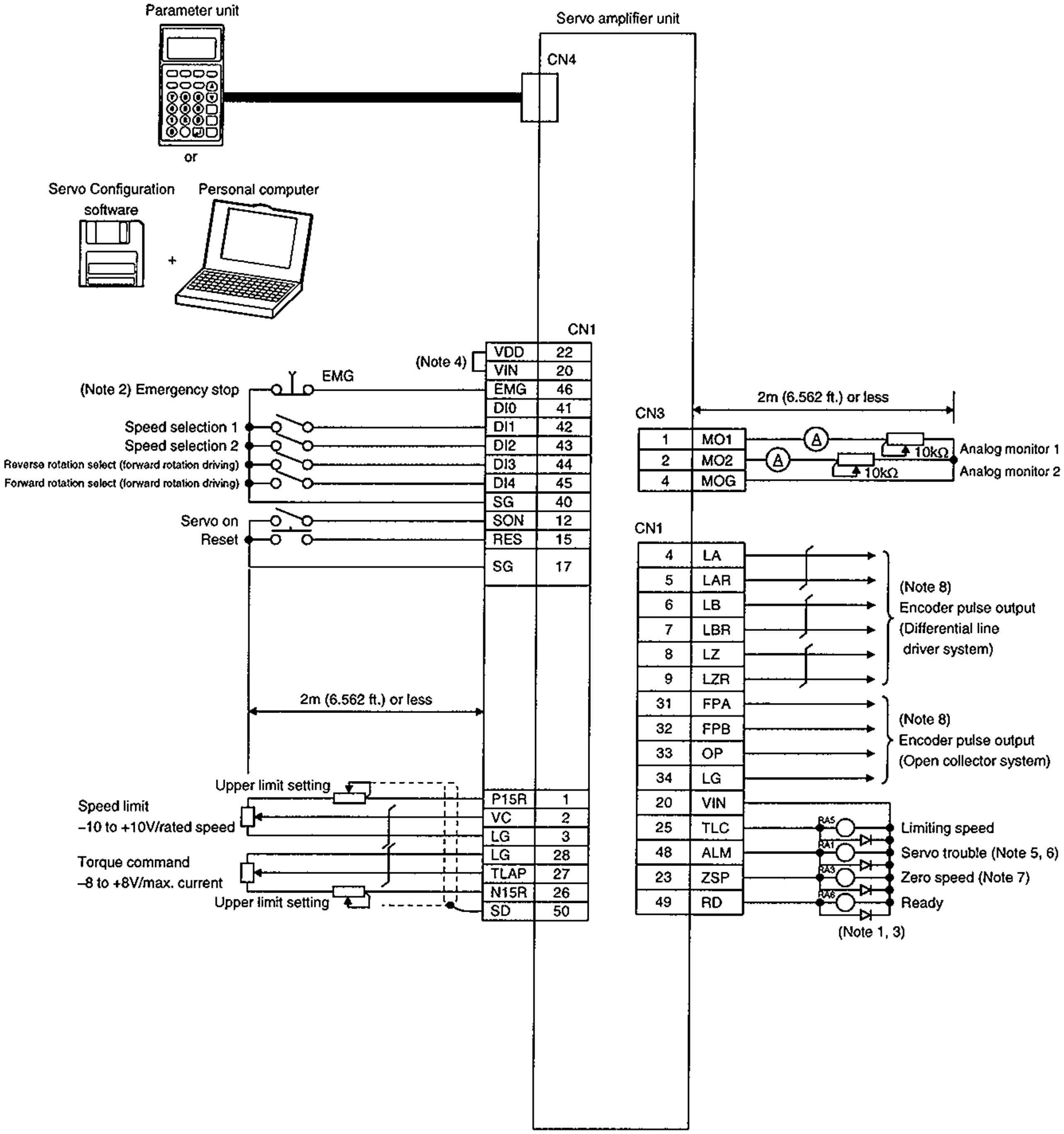
For notes, refer to page 3-7.

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. The sum of currents that flow in the external relays should be 200mA max. If it exceeds 200mA, supply interface power from external.
4. When using the internal power supply (VDD) as the interface power supply, always connect VDD-VIN. When using the external power supply, open VDD-VIN and connect the power supply across VIN-SG.
5. When starting operation, always connect the forward/reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
6. ALM-SG are connected in a normal status, i.e. when there is no alarm.
7. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
8. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
9. The following encoder pulses are output:
1) Division ration setting
Output pulse = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF · HA-FF HC-UF3000r/min	2048
HC-SF · HC-RF HC-UF2000r/min HA-LH	4096

2) Output pulse setting
Output pulses = (1 to 32768)/4 [pulse/rev]

3.1.3 Torque control mode



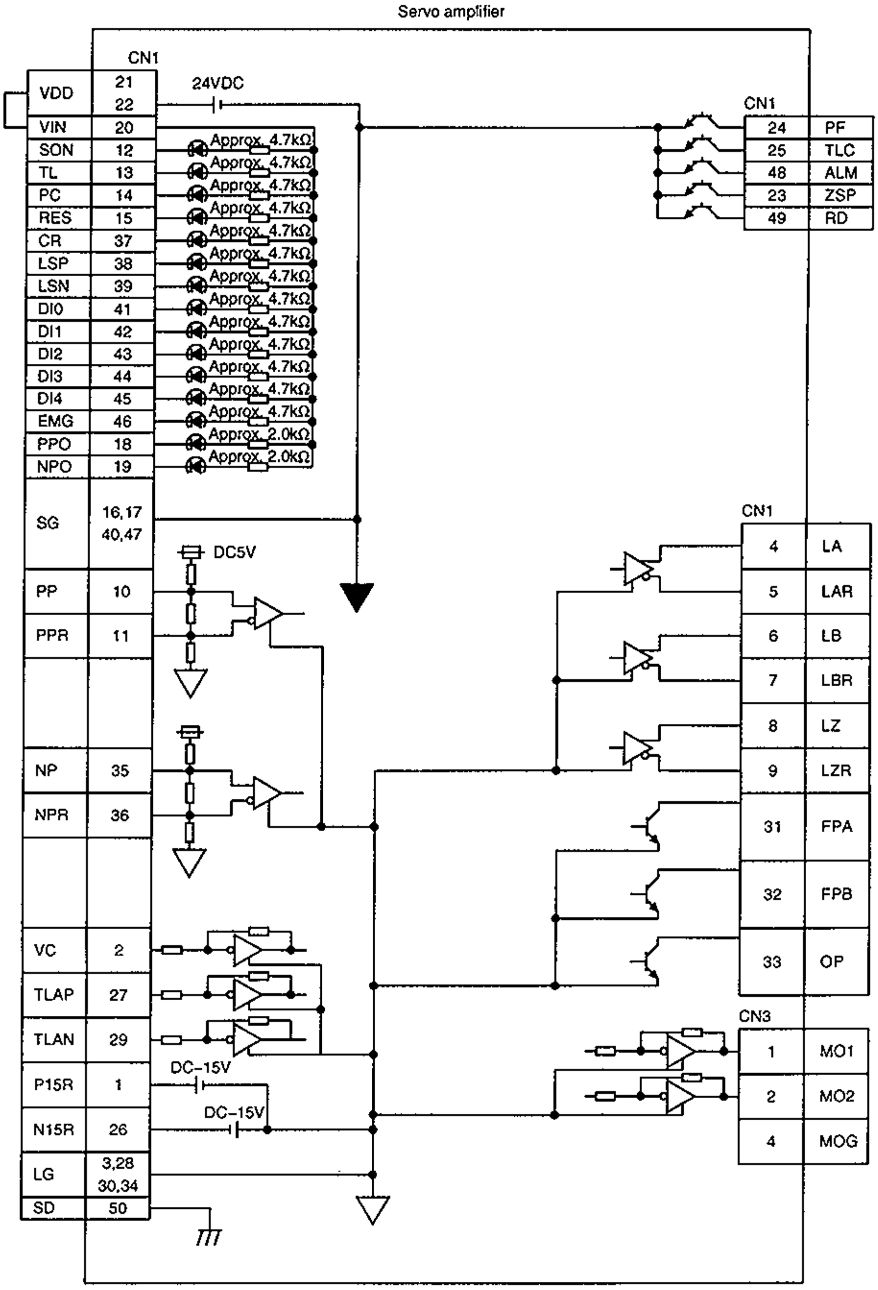
For notes, refer to page 3-9.

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. The sum of currents that flow in the external relays should be 200mA max. If it exceeds 200mA, supply interface power from external.
4. When using the internal power supply (VDD) as the interface power supply, always connect VDD-VIN. When using the external power supply, open VDD-VIN and connect the power supply across VIN-SG.
5. ALM-SG are connected in a normal status, i.e. when there is no alarm.
6. ALM can be changed into the external dynamic brake signal by setting □1□□ in parameter No. 3.
7. ZSP can be changed into the electromagnetic brake interlock signal by setting □□1□ in parameter No. 3.
8. The following encoder pulses are output:
   1) Division ration setting
   Output pulse = P/(1 to 32768) [pulse/rev]

Servo Motor	P Value [pulse/rev]
HC-MF · HA-FF HC-UF3000r/min	2048
HC-SF · HC-RF HC-UF2000r/min HA-LH	4096

   2) Output pulse setting
   Output pulses = (1 to 32768)/4 [pulse/rev]

3.2 Internal Connection Diagram of Servo Amplifier



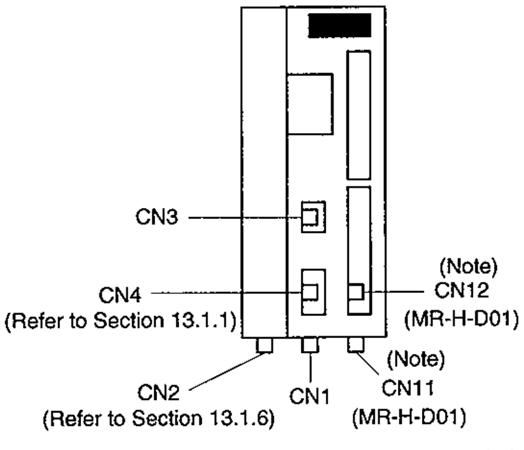
3.3 I/O Signals

3.3.1 Connectors and signal layouts

POINT

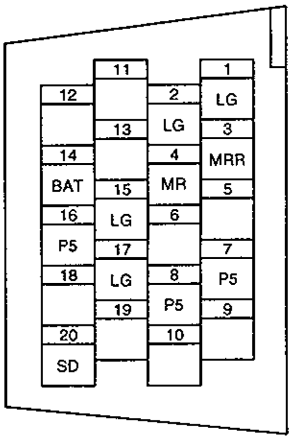
- The signal layouts of the connectors are views from the wiring section of the cable connectors.

MR-H-AN

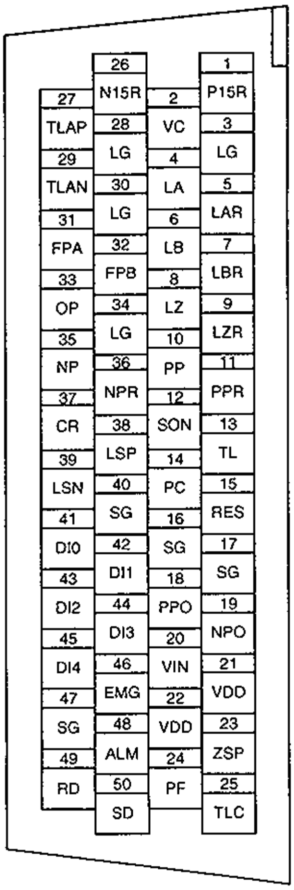


Note: Used when the MR-H-D01 option card is loaded.

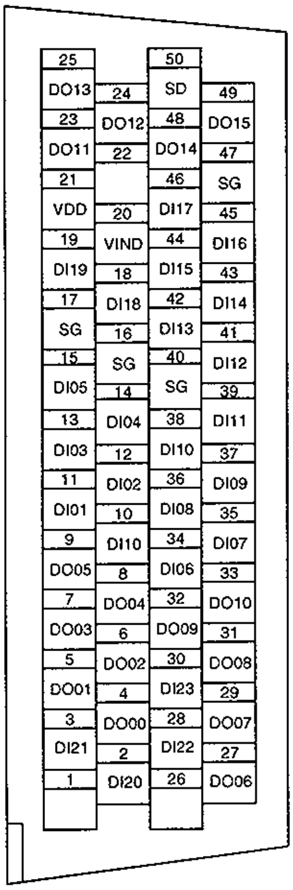
CN2 (for encoder signals)
Model PCR-S20FS (Honda Tsushin make)



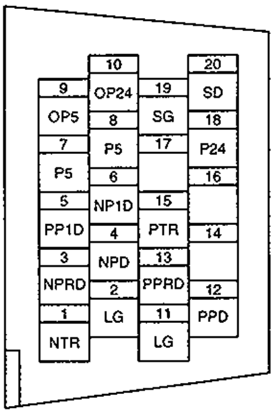
CN1 (for I/O signals)
Model PCR-S50FS (Honda Tsushin make)



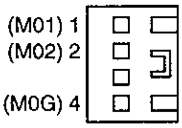
CN11 (for MR-H-D01 I/O signals)
Model PCR-S50FS (Honda Tsushin make)



CN12 (for MR-H-D01 input signals)
Model PCR-S20FS (Honda Tsushin make)



CN3 (for analog monitor)
Model 171822-4 (AMP make)



The signal assignment of connector CN1 changes with the control mode as indicated below:

Pin Code	CN1 Pin No.	I/O Signals in Control Modes					
		Position Control	Position/speed Control	Speed Control	Speed/torque Control	Torque Control	Torque/position Control
SON	12	Servo on	Servo on	Servo on	Servo on	Servo on	Servo on
TL	13	External torque limit	External torque limit	External torque limit	External torque limit/–		–/external torque limit
PC	14	Proportion control	Proportion control	Proportion control	Proportion control	Proportion control	Proportion control
RES	15	Reset	Reset	Reset	Reset	Reset	Reset
LSP	38	Forward rotation stroke end	Forward rotation stroke end	Forward rotation stroke end	Forward rotation stroke end/–		–/Forward rotation stroke end
LSN	39	Reverse rotation stroke end	Reverse rotation stroke end	Reverse rotation stroke end	Reverse rotation stroke end/–		–/Reverse rotation stroke end
CR	37	Clear	Clear/(Note 1) clear	(Note 1) Clear	(Note 1) Clear/–		–/clear
DI0	41		Control mode selection	(Note 3) Speed selection 3	Control mode selection	(Note 3) Speed selection 3	Control mode selection
DI1	42	(Note 2) Electronic gear select 1	(Note 2) Electronic gear select 1/ speed selection 1	Speed selection 1	Speed selection 1	Speed selection 1	Speed selection 1/ (Note 2) electronic gear select 1
DI2	43	(Note 2) Electronic gear select 2	(Note 2) Electronic gear select 2/ speed selection 2	Speed selection 2	Speed selection 2	Speed selection 2	Speed selection 2/ (Note 2) electronic gear select 2
DI3	44		–/forward rotation start	Forward rotation start	Forward rotation start/reverse rotation select	Reverse rotation select	Reverse rotation select/–
DI4	45		–/reverse rotation start	Reverse rotation start	Reverse rotation start/forward rotation select	Forward rotation select	Forward rotation select/–
EMG	46	Emergency stop	Emergency stop	Emergency stop	Emergency stop	Emergency stop	Emergency stop
PPO	18	Forward rotation pulse train	Forward rotation pulse train/–				–/forward rotation pulse train
NPO	16	Reverse rotation pulse train	Reverse rotation pulse train/–				–/reverse rotation pulse train
PP	10	Forward rotation pulse train	Forward rotation pulse train/–				–/forward rotation pulse train
PPR	11						
NP	35	Reverse rotation pulse train	Reverse rotation pulse train/–				–/reverse rotation pulse train
NPR	36						
RD	49	Ready	Ready	Ready	Ready	Ready	Ready
PF	24	In-position	In-position/speed reached	Speed reached	Speed reached/–		–/in-position
TLC	25	Limiting torque	Limiting torque	Limiting torque			–/limiting torque
ZSP	23	Zero speed	Zero speed	Zero speed	Zero speed	Zero speed	Zero speed
ALM	48	Trouble	Trouble	Trouble	Trouble	Trouble	Trouble
VC	2		–/speed command	Speed command	Speed command/speed limit command	Speed limit command	Speed limit command/speed command
TLAP	27	Torque limit command +	Torque limit command +	Torque limit command +	Torque limit command +/torque control command	Torque control command	Torque control command/torque limit command
TLAN	29	Torque limit command–	Torque limit command–	Torque limit command–	Torque limit command –/–		–/torque limit command –

Note: 1. Can be used in a servo lock status by shorting or opening DI3-SG simultaneously.

2. Set □□□1 in parameter No. 41 to make this signal valid.

3. Set □□1□ in parameter No. 41 to make this signal valid.

3.3.2 Explanation of signals

For the I/O interfaces (symbols in I/O column in the table), refer to Section 3.6. The symbols of the axes in the Control Mode column in the table denote the following:
P: Position control mode, S: Speed control mode, T: Torque control mode

(1) CN1

Signal Name	Pin Code	Pin No.	Function/Application	I/O Category	Control Mode
Digital I/F power supply input	VIN	20	Driver power supply input terminal for digital interface Input 24VDC ±10% for input interface. When using an external power supply, connect a 24VDC power supply of 200mA or more to this terminal. Always connect this terminal with VDD when using the internal power supply (VDD) as the interface power supply.		P S T
Driver power supply	VDD	21, 22	+24V±10% is output across VDD-SG. Connect with VIN when using this power supply for the digital interface. Permissible current: 200mA		P S T
24V common	SG	16, 17 40, 47	Common terminals for VDD and VIN. Isolated from LG.		P S T
DC power supply	P15R	1	+15VDC is output across P15R-LG. Use as a power supply for OVR/TLAP. Permissible current: 30mA		P S T
	P15N	26	−15VDC is output across P15N-LG. Use as a power supply for OVR/TLAN. Permissible current: 30mA		P S T
Control common	LG	3, 28 30, 34	Common terminals for TLAP, TLAN, VC, FPA, FPB and OP.		P S T
Shield	SD	50	Connect the servo amplifier end of the shield cable.		P S T
Servo on	SON	12	Ready signal input terminal. Short SON-SG to switch the base circuit on, making the servo amplifier ready to operate. Open them to shut off the base circuit, coasting the servo motor.	DI-1	P S T
Reset	RES	15	Alarm reset signal input terminal. Short RES-SG for longer than 20ms to reset the alarm. While RES-SG are shorted, the base circuit is shut off. However, regenerative alarm (AL30), overload 1 (AL50) and overload 2 (AL51) cannot be reset until the regenerative brake resistor and power transistor temperatures reduce. The following alarms can be reset.	DI-1	P S
Forward rotation start	DI3	44	Forward rotation start signal input terminal. Shorting DI3-SG rotates the servo motor in the CCW direction. Short them together with DI4 to stop.	DI-1	S
Reverse rotation start	DI4	45	Reverse rotation start signal input terminal. Shorting DI4-SG rotates the servo motor in the CW direction. Short them together with DI3 to stop.	DI-1	S
Forward rotation select	DI4	45	Forward rotation start signal input terminal. Shorting DI4-SG causes the servo motor to generate torque in the CCW direction. When they are shorted together with DI3, no torque is generated.	DI-1	T

<table>
<tr><th>Signal Name</th><th>Pin Code</th><th>Pin No.</th><th>Function/Application</th><th>I/O Category</th><th>Control Mode</th></tr>
<tr><td>Reverse rotation select</td><td>DI3</td><td>44</td><td>Reverse rotation start signal input terminal.
Shorting DI3-SG causes the servo motor to generate torque in the CW direction.
When they are shorted together with ST1, no torque is generated.</td><td>DI-1</td><td>T</td></tr>
<tr><td>External torque limit selection</td><td>TL</td><td>13</td><td>External torque limit selection input terminal.
Short TL-SG to make the external analog torque limit valid. Open TL-SG to make the internal torque limit value (parameter No. 40) valid.
For full information, refer to Section 3.4.1 (1).</td><td>DI-1</td><td>P
S</td></tr>
<tr><td>Proportion control</td><td>PC</td><td>14</td><td>Proportion control input terminal.
Short PC-SG to change the speed amplifier from the proportional integral type to the proportional type. In the proportional integral type, if the servo motor at a stop is rotated even one pulse due to an external factor, it generates torque to compensate for a position mismatch.
When the shaft is mechanically locked at a stop after in-position, for example, turn on the proportion control signal (PC) simultaneously with in-position to suppress the unnecessary torque which attempts to compensate for position mismatch.
When the shaft is to be locked a long time, for example, turn on the torque control signal (TL) simultaneously with the proportion control signal, with the analog torque limit set to be less than the rated torque.</td><td>DI-1</td><td>P
S</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>38</td><td rowspan="2">Forward/reverse rotation stroke end signal input terminals.
To start operation, short LSP-SG and/or LSN-SG. Open them to bring the motor to a sudden stop and make it servo-locked.
When these signals are not used, choose "automatically turned on internally" in parameter No. 42.
<table>
<tr><th colspan="2">(Note) External Input Signals</th><th colspan="2">Operation</th></tr>
<tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr>
<tr><td>1</td><td>1</td><td>○</td><td>○</td></tr>
<tr><td>0</td><td>1</td><td></td><td>○</td></tr>
<tr><td>1</td><td>0</td><td>○</td><td></td></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
</table>
Note. 0 : LSP/LSN-SG off (open)
1 : LSP/LSN-SG on (short)</td><td>DI-1</td><td>P
S</td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>39</td><td>DI-1</td><td>P
S</td></tr>
<tr><td>Clear</td><td>CR</td><td>37</td><td>Short CR-SG to clear the deviation counter on its leading edge.
Set □1□□ in parameter No. 41 to keep the counter cleared while CR-SG are shorted. Reserve the pulse width of 10ms or more.
In the speed control mode, this signal is made valid when the motor is servo-locked by opening or shorting DI3-SG and DI4-SG at the same time.
When CR-SG are shorted with the servo motor rotated by external force, the position control counter is cleared and the motor is servo-locked in that position.</td><td>DO-1</td><td>P
S</td></tr>
<tr><td>Ready</td><td>RD</td><td>49</td><td>Ready output terminal.
After servo on, RD-SG are connected in a trouble-free ready status.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td>In-position</td><td>PF</td><td>24</td><td>In-position signal output terminal.
PF-SG are connected when the droop pulse value is less than the in-position range set in the parameter.
Not output while the base circuit is off.</td><td>DO-1</td><td>P</td></tr>
<tr><td>Speed reached</td><td>PF</td><td>24</td><td>Speed reached signal output terminal.
PF-SG are connected when the servo motor speed is within about ±15% of the preset speed.</td><td>DO-1</td><td>S</td></tr>
<tr><td>Limiting torque</td><td>TLC</td><td>25</td><td>Limiting torque signal output terminal.
TLC-SG are connected when the internally or externally set torque limit value is reached.</td><td>DO-1</td><td>P
S</td></tr>
</table>

<table>
<tr><th>Signal Name</th><th>Pin Code</th><th>Pin No.</th><th>Function/Application</th><th>I/O Category</th><th>Control Mode</th></tr>
<tr><td>Limiting speed</td><td>TLC</td><td>25</td><td>Limiting speed signal output terminal.
TLC-SG are connected when the speed limit range is reached.</td><td>DO-1</td><td>T</td></tr>
<tr><td>Warning output</td><td>TLC</td><td>25</td><td>Warning signal output terminal.
When using the warning output signal, set □□1□ in parameter No. 44.
TLC-SG are connected when a warning occurs. They are open in a normal status.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td>Zero speed</td><td>ZSP</td><td>23</td><td>ZSP-SG are connected when the servo motor speed is not more than the value set in the parameter.
The zero speed detection level can be changed with parameter No. 34.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td>Electromagnetic brake interlock</td><td>ZSP</td><td>23</td><td>When using the electromagnetic brake interlock signal, set □□1□ in parameter No. 3.
ZSP-SG are disconnected at servo off or alarm.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td rowspan="3">Control mode selection</td><td rowspan="3">DI0</td><td rowspan="3">41</td><td>In the position/speed control switch-over mode, the control mode is changed as indicated below:
<table>
<tr><th>(Note) DI0</th><th>Control Mode</th></tr>
<tr><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Speed</td></tr>
</table>
Note. 0 : DI0-SG off (open)
1 : DI0-SG on (short))</td><td>DI-1</td><td>P/S</td></tr>
<tr><td>In the speed/torque control switch-over mode, the control mode is changed as indicated below:
<table>
<tr><th>(Note) DI0</th><th>Control Mode</th></tr>
<tr><td>0</td><td>Speed</td></tr>
<tr><td>1</td><td>Torque</td></tr>
</table>
Note. 0 : DI0-SG off (open)
1 : DI0-SG on (short))</td><td>DI-1</td><td>S/T</td></tr>
<tr><td>In the torque/position control switch-over mode, the control mode is changed as indicated below:
<table>
<tr><th>(Note) DI0</th><th>Control Mode</th></tr>
<tr><td>0</td><td>Torque</td></tr>
<tr><td>1</td><td>Position</td></tr>
</table>
Note. 0 : DI0-SG off (open)
1 : DI0-SG on (short))</td><td>DI-1</td><td>T/P</td></tr>
<tr><td>Electronic gear select 1</td><td>DI1</td><td>42</td><td rowspan="2">Electronic gear numerator selection signal input terminals.
When using these signals, set □□□1 in parameter No. 41. Specify any of the DI1-SG and DI2-SG combinations to choose any of the four different electronic gear numerators set in the corresponding parameters.
<table>
<tr><th colspan="2">(Note) External Input Signals</th><th rowspan="2">Electronic Gear Numerator</th></tr>
<tr><th>DI2</th><th>DI1</th></tr>
<tr><td>0</td><td>0</td><td>Parameter No. 4</td></tr>
<tr><td>0</td><td>1</td><td>Parameter No. 24</td></tr>
<tr><td>1</td><td>0</td><td>Parameter No. 25</td></tr>
<tr><td>1</td><td>1</td><td>Parameter No. 26</td></tr>
</table>
Note. 0 : DI-SG off (open)
1 : DI-SG on (short))</td><td rowspan="2">DI-1</td><td rowspan="2">P</td></tr>
<tr><td>Electronic gear select 2</td><td>DI2</td><td>43</td></tr>
</table>

<table>
<tr><th>Signal Name</th><th>Pin Code</th><th>Pin No.</th><th>Function/Application</th><th>I/O Category</th><th>Control Mode</th></tr>
<tr><td>Speed selection 1</td><td>DI1</td><td>42</td><td rowspan="3">Speed selection signal input terminals
Used to select the servo motor speed.
Specify any of the parameter No. 41 setting-DI1, DI2 and DI0 combinations to choose any of the three internal speeds set in the corresponding parameters and the external speed command (VC) or the seven internal speeds and the external speed command (VC).
During operation, these signals can be switched over to change the speed. At this time, the acceleration/deceleration time constants are as set in parameters No. 12/13.
<table>
<tr><th rowspan="2">Parameter No. 41 Setting</th><th colspan="3">(Note) External Input Signals</th><th rowspan="2">Set Speed</th></tr>
<tr><th>DI0</th><th>DI2</th><th>DI1</th></tr>
<tr><td rowspan="4">□□0□</td><td></td><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Parameter No. 9</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Parameter No. 10</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Parameter No. 11</td></tr>
<tr><td rowspan="8">□□1□</td><td>0</td><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Parameter No. 9</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Parameter No. 10</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Parameter No. 11</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Parameter No. 30</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Parameter No. 31</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Parameter No. 32</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Parameter No. 33</td></tr>
</table>
Note. 0 : DI-SG off (open)
1 : DI-SG on (short))</td><td rowspan="3">DI-1</td><td rowspan="3">S</td></tr>
<tr><td>Speed selection 2</td><td>DI2</td><td>43</td></tr>
<tr><td>Speed selection 3</td><td>DI0</td><td>41</td></tr>
<tr><td>Speed selection 1</td><td>DI1</td><td>42</td><td rowspan="2">Speed selection signal input terminals
Used to select the servo motor speed. (Refer to Section 3.4.2 (1))
Specify any of the DI1-SG and DI2-SG combinations to choose any of the three internal speeds set in the corresponding parameters and the external speed command (VC).
When □□1□ is set in parameter No. 41, any of the seven internal speeds set in the corresponding parameters and the external speed command (VC) can be chosen by specifying any of the DI0-SG, DI1-SG and DI2-SG combinations.</td><td rowspan="2">DI-1</td><td rowspan="2">T</td></tr>
<tr><td>Speed selection 2</td><td>DI2</td><td>43</td></tr>
<tr><td>Trouble</td><td rowspan="2">ALM</td><td rowspan="2">48</td><td>Trouble signal output terminal.
ALM-SG are disconnected when the protective circuit is activated to shut off the base circuit at power-off or power-on.
In a normal status, they are connected at power-on.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td>External dynamic brake</td><td>External dynamic brake signal output terminal.
When using the external dynamic brake signal, set □1□□ in parameter No. 3. When the dynamic brake is operated, ALM-SG is disconnected.</td><td>DO-1</td><td>P
S
T</td></tr>
<tr><td>Emergency stop</td><td>EMG</td><td>46</td><td>Emergency stop signal input terminal
Opening EMG-SG puts the motor in an emergency stop status, in which the servo is switched off, the dynamic brake is operated, and the motor comes to a sudden stop.
Short EMG-SG in the emergency stop status to exit from the emergency stop status.</td><td>DI-1</td><td>P
S
T</td></tr>
</table>

<table>
<tr><th>Signal Name</th><th>Pin Code</th><th>Pin No.</th><th>Function/Application</th><th>I/O Category</th><th>Control Mode</th></tr>
<tr><td rowspan="6">Forward rotation pulse train
Reverse rotation pulse train</td><td>PP0</td><td>18</td><td rowspan="6">Command pulse train input terminals.
Open collector or differential line driver system can be selected with parameter No. 3.
The input pulse format can be chosen with parameter No. 21.
1) Open collector system (max. input frequency 200kpps)
Set □□□0 in parameter No. 3.
Forward rotation pulse train across PPO-SG
Reverse rotation pulse train across NPO-SG
2) Differential line driver system (max. input frequency 400kpps)
Set □□□1 in parameter No. 3.
Forward rotation pulse train across PP-PPR
Reverse rotation pulse train across NP-NPR</td><td rowspan="6">DI-2</td><td rowspan="6">P</td></tr>
<tr><td>NP0</td><td>19</td></tr>
<tr><td>PP</td><td>10</td></tr>
<tr><td>PPR</td><td>11</td></tr>
<tr><td>NP</td><td>35</td></tr>
<tr><td>NPR</td><td>36</td></tr>
<tr><td>Speed command</td><td>VC</td><td>2</td><td>External speed command input terminal.
By applying −10 to +10V across VC-LG, set the servo motor speed.
Apply 10[V] to give the speed command set in parameter No. 35.</td><td>Analog input</td><td>S</td></tr>
<tr><td>Speed limit</td><td>VC</td><td>2</td><td>External speed limit input terminal.
By applying −10 to +10V across VC-LG, limit the servo motor speed.
Apply 10[V] to give the speed limit set in parameter No. 35.</td><td>Analog input</td><td>T</td></tr>
<tr><td>Torque limit command +</td><td>TLAP</td><td>27</td><td>By applying 0 to +10V across TLAP-LG, set the servo motor-generated torque in the reverse rotation (CW) direction.
Forward rotation in regenerative mode, reverse rotation in driving mode
Apply 0[V] for zero torque or +10[V] for max. torque.</td><td>Analog input</td><td>P
S</td></tr>
<tr><td>Torque limit command -</td><td>TLAN</td><td>29</td><td>By applying 0 to −10V across TLAN-LG, set the servo motor-generated torque in the forward rotation (CCW) direction.
Reverse rotation in regenerative mode, forward rotation in driving mode
Apply 0[V] for zero torque or −10[V] for max. torque.</td><td>Analog input</td><td>P
S</td></tr>
<tr><td>Analog torque command</td><td>TLAP</td><td>27</td><td>By applying 0 to ±8V across TLAP-LG, set the servo motor-generated torque.
Apply −8[V] for max. torque in CW direction, 0[V] for zero torque, or +8[V] for max. torque in CCW direction.</td><td>Analog input</td><td>T</td></tr>
<tr><td rowspan="3">Encoder pulse output
(open collector system)</td><td>FPA</td><td>31</td><td rowspan="2">Pulses per servo motor revolution are output in the open collector system.
A-phase pulses are output across FPA-LG and B-phase pulses across FPB-LG. For CCW rotation, FPA leads FPB by π/2.
The following pulses are output depending on the parameter No. 39 and 43 settings:
1. Division ratio setting
Output pulses = P/parameter No. 39 [pulse/rev]
Parameter No. 39: 1 to 32768
P:
<table>
<tr><th>Servo Motor</th><th>P Value [pulse/rev]</th></tr>
<tr><td>HC-MF · HA-FF
HC-UF3000r/min</td><td>2048</td></tr>
<tr><td>HC-SF · HC-RF
HC-UF2000r/min
HA-LH</td><td>4096</td></tr>
</table>
2. Output pulse setting
Output pulses = Parameter No. 39:4 [pulse/rev]
Parameter No. 39: 1 to 32768</td><td rowspan="3">DO-2</td><td rowspan="3">P
S
T</td></tr>
<tr><td>FPB</td><td>32</td></tr>
<tr><td>OP</td><td>33</td><td>Zero-phase pulse output terminal.
1 pulse is output per servo motor revolution.
The minimum pulse width is approx. 800μs. When this pulse is used for zeroing, set the creep speed to not more than 100r/min.</td></tr>
</table>

Signal Name	Pin Code	Pin No.	Function/Application	I/O Category	Control Mode
Encoder pulse output (differential line driver system)	LA	4	The same signals as in FPA and FPB are output in the differential line driver system. A-phase pulses are output across LA-LAR and B-phase pulses across LB-LBR. The number of pulses output is the same as that of FPA and FPB.	DO-2	P S T
	LAR	5			
	LB	6			
	LBR	7			
	LZ	8	The same signal as in OP is output across LZ-LZR in the differential line driver system.		
	LZR	9			

(2) CN3

Signal Name	Pin Code	Pin No.	Function/Application	I/O Category	Control Mode
Analog monitor output 1	MO1	1	Data set in parameter No. 17 is output across MO1-MOG in terms of voltage.	Analog input	P S T
Analog monitor output 2	MO2	2	Data set in parameter No. 17 is output across MO2-MOG in terms of voltage.	Analog input	P S T
Monitor common	MOG	4	Common terminal for MO1 and MO2. Connected with LG inside the servo amplifier.		

(3) CN11 (MR-H-D01 option card)

Signal Name	Pin Code	Pin No.	Function/Application	I/O Category	Control Mode
Digital I/F power supply input	VIND	20	Driver power supply input terminal for digital interface Input 24VDC ±10% for input interface. When using an external power supply, connect a 24VDC power supply of 200mA or more to this pin.		P S T
Driver power supply	VDD	21	+24V±10% is output across VDD-SG. Connect with VIND when using this power supply for the digital interface. Permissible current: 200mA		
24V common	SG	16, 17 40, 47	Common terminals for VDD and VIN. Isolated from LG.		
Shield	SD	50	Connect one end of a shield cable.		
Digital input bit 0	DI00	10	Digital input bit 0	DI-1	
Digital input bit 1	DI01	11	Digital input bit 1	DI-1	
Digital input bit 2	DI02	12	Digital input bit 2	DI-1	
Digital input bit 3	DI03	13	Digital input bit 3	DI-1	
Digital input bit 4	DI04	14	Digital input bit 4	DI-1	
Digital input bit 5	DI05	15	Digital input bit 5	DI-1	
Digital input bit 6	DI06	34	Digital input bit 6	DI-1	
Digital input bit 7	DI07	35	Digital input bit 7	DI-1	
Digital input bit 8	DI08	36	Digital input bit 8	DI-1	
Digital input bit 9	DI09	37	Digital input bit 9	DI-1	
Digital input bit 10	DI10	38	Digital input bit 10	DI-1	
Digital input bit 11	DI11	39	Digital input bit 11	DI-1	
Digital input bit 12	DI12	41	Digital input bit 12	DI-1	
Digital input bit 13	DI13	42	Digital input bit 13	DI-1	
Digital input bit 14	DI14	43	Digital input bit 14	DI-1	
Digital input bit 15	DI15	44	Digital input bit 15	DI-1	
Digital input bit 16	DI16	45	Digital input bit 16	DI-1	
Digital input bit 17	DI17	46	Digital input bit 17	DI-1	
Digital input bit 18	DI18	18	Digital input bit 18	DI-1	
Digital input bit 19	DI19	19	Digital input bit 19	DI-1	
Digital input bit 20	DI20	2	Digital input bit 20	DI-1	
Digital input bit 21	DI21	3	Digital input bit 21	DI-1	
Digital input bit 22	DI22	28	Digital input bit 22	DI-1	
Digital input bit 23	DI23	30	Digital input signal bit 23 or strobe signal	DI-1	
Digital output bit 0	DO00	4	Digital output signal bit 0 or alarm code output bit 0	DO-1	
Digital output bit 1	DO01	5	Digital output signal bit 1 or alarm code output bit 1	DO-1	
Digital output bit 2	DO02	6	Digital output signal bit 2 or alarm code output bit 2	DO-1	
Digital output bit 3	DO03	7	Digital output signal bit 3 or alarm code output bit 3	DO-1	
Digital output bit 4	DO04	8	Digital output signal bit 4	DO-1	
Digital output bit 5	DO05	9	Digital output signal bit 5	DO-1	
Digital output bit 6	DO06	27	Digital output signal bit 6	DO-1	
Digital output bit 7	DO07	29	Digital output signal bit 7	DO-1	
Digital output bit 8	DO08	31	Digital output signal bit 8	DO-1	
Digital output bit 9	DO09	32	Digital output signal bit 9	DO-1	
Digital output bit 10	DO10	33	Digital output signal bit 10	DO-1	
Digital output bit 11	DO11	23	Digital output signal bit 11	DO-1	
Digital output bit 12	DO12	24	Digital output signal bit 12	DO-1	
Digital output bit 13	DO13	25	Digital output signal bit 13	DO-1	
Digital output bit 14	DO14	48	Digital output signal bit 14	DO-1	
Digital output bit 15	DO15	49	Digital output signal bit 15	DO-1	

(4) CN12 (MR-H-D01 option card)

Signal Name	Pin Code	Pin No.	Function/Application	I/O Category	Control Mode
24V driver power supply	P24	18	+24V ±10% is output across P24-SG. Connect with OP24 when using this power supply as the one for 24V-line open collector. Permissible current: 200mA		
5V driver power supply	P5	7,8	+5V ±10% is output across P5-SG. Connect with OP5 when using this power supply as the one for 5V-line open collector. Permissible current: 200mA		
24V-line open collector power input	0P24	10	Drive power input terminal for 24V-line open collector Input +24VDC ±10%. When using an external power supply, connect a 24VDC power supply of 200mA or more to this terminal.		
5V-line open collector power input	0P5	9	Drive power input terminal for 5V-line open collector Input +5VDC ±10%. When using an external power supply, connect a 5VDC power supply of 200mA or more to this terminal.		
P24 common	SG	19	Common terminal for P24. Isolated from LG.		
P5 common	LG	2,11	Common terminal for P5. Isolated from SG.		
Shield	SD	20	Connect one end of a shield cable.		
Auxiliary pulse train (open collector system)	PP1D NP1D	5 6	Command pulse train input terminals. When using the open collector system, set □□□0 (initial value) in parameter No. 72. The input pulse format can be chosen with the third and fourth digits of parameter No. 72. 1) 24V line Forward rotation pulse train across PP1D-SG Reverse rotation pulse train across NP1D-SG 2) 5V line Forward rotation pulse train across PP1D-LG Reverse rotation pulse train across NP1D-LG	DI-2	P
Auxiliary pulse train (differential line driver system)	PPD PPRD NPD NPRD	12 13 4 3	Auxiliary pulse train input terminals. Auxiliary pulse train signal is added to the command pulse train signal. When using the differential line driver system, set □□□1 in parameter No. 72. The input pulse format can be chosen with the third and fourth digits of parameter No. 72. Forward rotation pulse train across PPD-PPRD Reverse rotation pulse train across NPD-PPRD	DI-2	P
Terminal reserved for manufacturer	NTR	1	Terminals for manufacturer adjustment. Always short NTR-PTR.	—	—
Terminal reserved for manufacturer	PTR	15		—	—

3.4 Detailed Description of the Signals

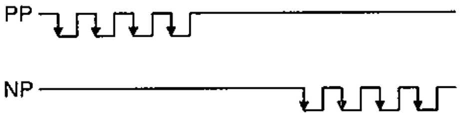
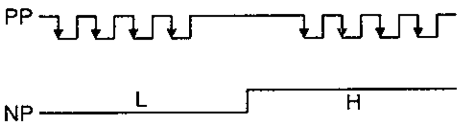
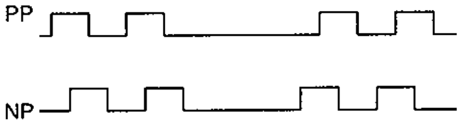
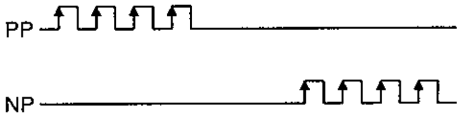
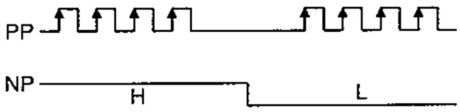
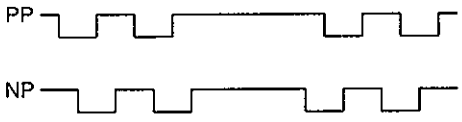
3.4.1 Position control mode

(1) Pulse train input

Encoder pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command pulse train form in parameter No. 21. When the MR-H-D01 option card is used to enter an auxiliary pulse train, set its shape in parameter No. 72.

Arrow  or  in the table indicates the timing of importing a pulse train.

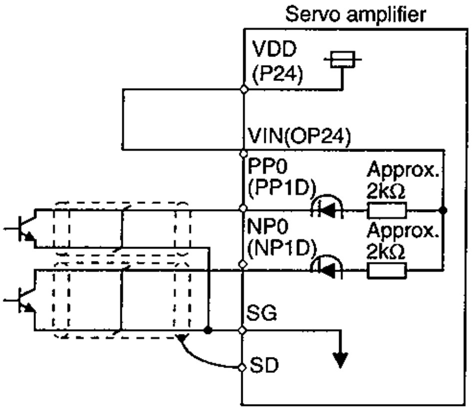
A- and B-phase pulse trains are imported after they have been multiplied by 4.

<table>
<tr><th colspan="2">Pulse Train Form</th><th>Forward Rotation</th><th>Reverse Rotation</th><th>Parameter No. 21
(Command pulse train)</th><th>Parameter No. 72
(Auxiliary pulse train)</th></tr>
<tr><td rowspan="3">Negative logic</td><td>Forward rotation pulse train
Reverse rotation pulse train</td><td colspan="2"> </td><td>010□</td><td>010□</td></tr>
<tr><td>Pulse train + sign</td><td colspan="2"> </td><td>011□</td><td>011□</td></tr>
<tr><td>A-phase pulse train
B-phase pulse train</td><td colspan="2"> </td><td>012□</td><td>012□</td></tr>
<tr><td rowspan="3">Positive logic</td><td>Forward rotation pulse train
Reverse rotation pulse train</td><td colspan="2"> </td><td>000□</td><td>000□</td></tr>
<tr><td>Pulse train + sign</td><td colspan="2"> </td><td>001□</td><td>001□</td></tr>
<tr><td>A-phase pulse train
B-phase pulse train</td><td colspan="2"> </td><td>002□</td><td>002□</td></tr>
</table>

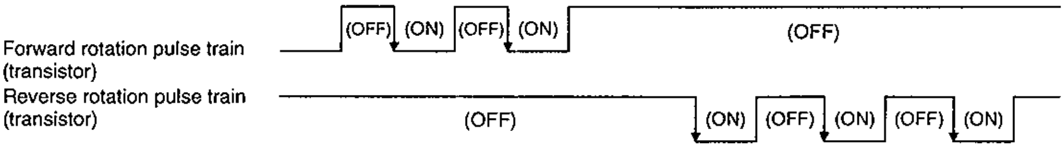
(b) Connections and waveforms

1) Open collector system

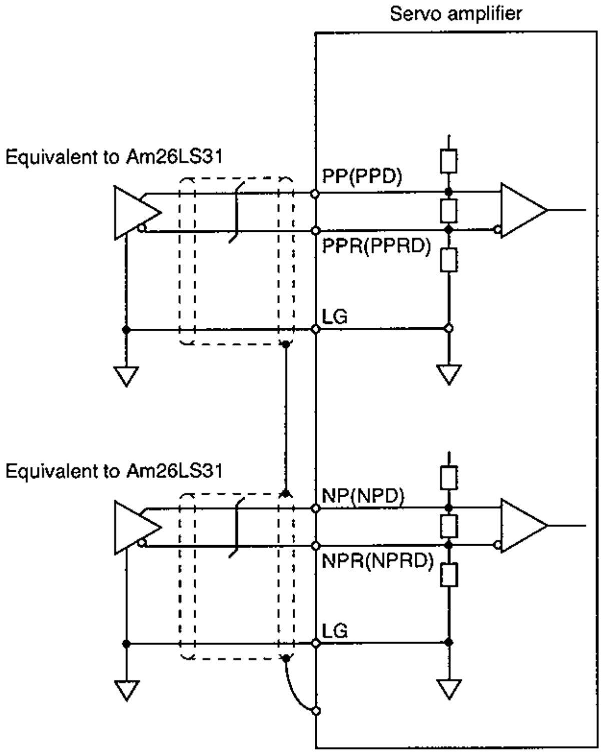
Make the following connections.



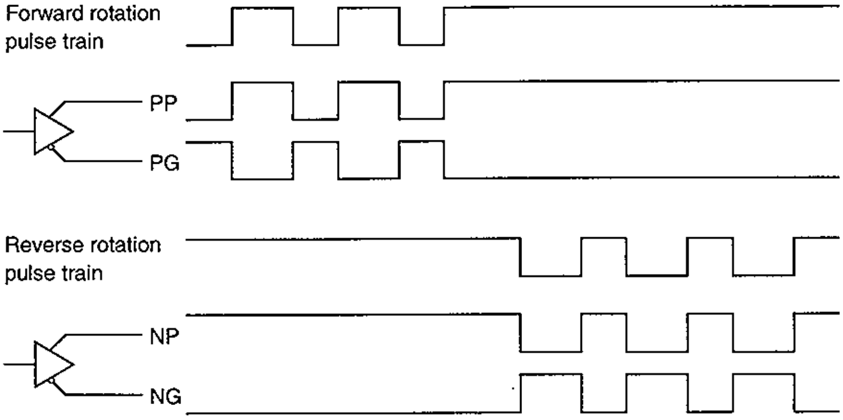
This explanation assumes that the input waveform is set to negative logic/forward rotation pulse train/reverse rotation pulse train (0010 is set in parameter No. 21). The waveforms in the table of this section (a) are voltage waveforms of PP and NP in relation to SG. Their relationships with transistor ON/OFF are as shown below.



2) Differential line driver system
Make the following connections.



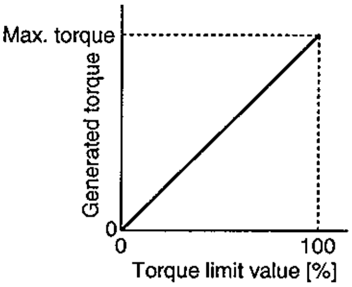
This explanation assumes that the input waveform is set to negative logic/forward rotation pulse train/reverse rotation pulse train (0010 is set in parameter No. 21). In the differential line driver system, the waveforms in the table of this section (1) are as shown below. The waveforms of PP, PG, N and NG are waveforms in relation to the ground of the differential line driver.



(2) Torque limit

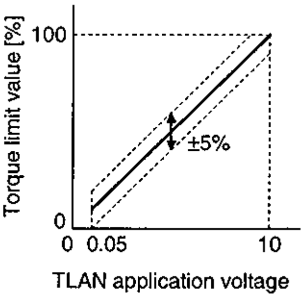
(a) Torque limit and generated torque

By setting parameter No. 40 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor-generated torque is shown below.

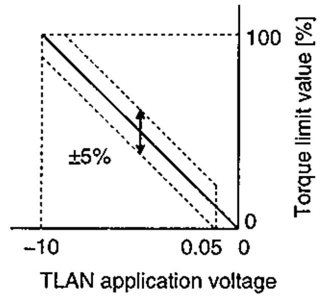


A relationship between the applied voltage of the torque limit command (TLAN/TLAP) and the torque limit value of the servo motor is shown below. Generated torque limit values will vary about 5% relative to the voltage depending on products.

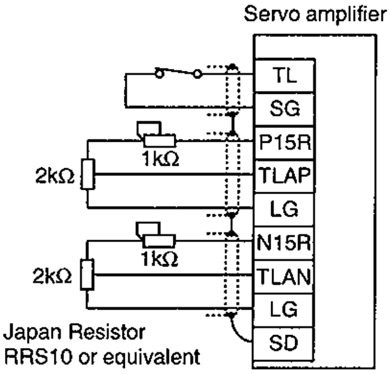
At the voltage of less than 0.05V, generated torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



TLAP application voltage vs. torque limit value in CCW direction



TLAP application voltage vs. torque limit value in CW direction

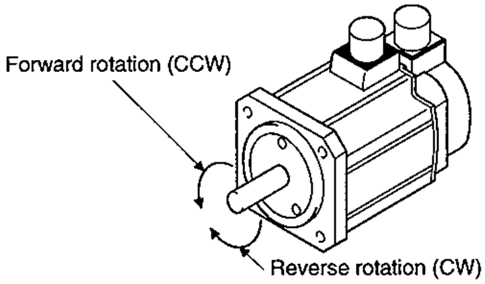


Connection Example

(b) Torque limiting direction

The following table lists relationships between the torque limit command polarity and operation. Take care not to provide a command of opposite polarity.

Input Signal	Applied Voltage [V]	Limited Generated Torque	
		CCW Direction	CW Direction
TLAP	+0.05 to +10	Regenerative	Driving
TLAN	−0.05 to −10	Driving	Regenerative



(c) External torque limit signal (TL) and torque limit

Choose the torque limit made valid by the internal torque limit value 1 using the external torque limit signal (TL) or the torque limit made valid by the torque limit command (TLAP/TLAN) as indicated below:

(Note) TL	Torque Limit Value Made Valid	
	If TLAP/TLAN > Parameter No. 40	If TLAP/TLAN < Parameter No. 40
0	Internal torque limit value 1 (parameter No. 40)	
1	Internal torque limit value 1 (parameter No. 40)	Torque limit command (TLAP·TLAN)

Note. 0 : TL-SG off (open)
1 : TL-SG on (short)

You can make selection between the internal torque limit value 1 and internal torque limit value 2 (parameter No. 54). Set □□□1 in parameter No. 42 to change the function of the external torque limit signal (TL).

Make selection between the internal torque limit value 1 and internal torque limit value 2 as indicated below:

(Note) TL	Torque Limit Value Made Valid	
	If parameter No. 40 >Parameter No. 54	If parameter No. 40 < Parameter No. 54
0	Internal torque limit value 2 (parameter No. 54)	
1	Internal torque limit value 1 (parameter No. 40)	Internal torque limit value 2 (parameter No. 54)

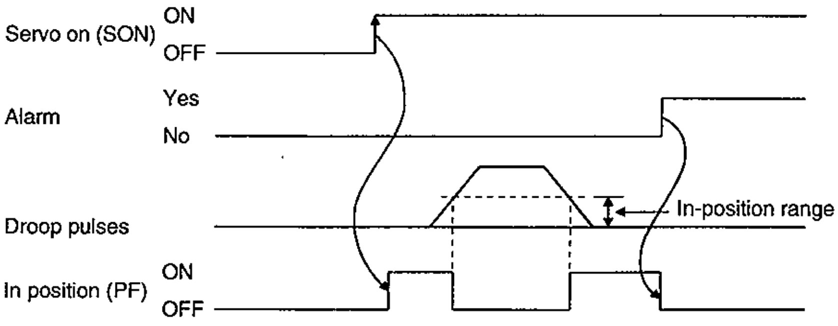
Note. 0: TL-SG off (open)
1: TL-SG on (short)

(d) Limiting torque (TLC)

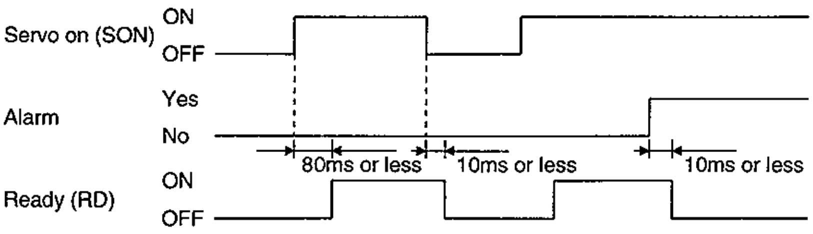
TLC-SG are connected when the torque generated by the servo motor reaches the torque set to internal torque limit value 1·2 or torque limit command.

(3) In-position (PF)

PF-SG are connected when the number of droop pulses in the deviation counter falls within the preset in-position range (parameter No. 6). PF-SG may remain connected when low-speed operation is performed with a large value set as the in-position range.



(4) Ready (RD)

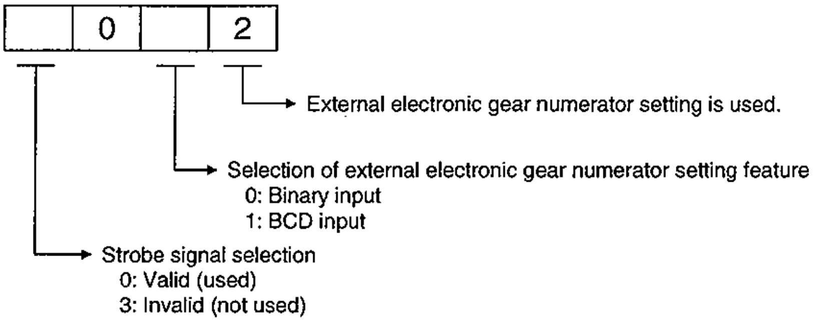


(5) External electronic gear setting

The MR-H-D01 option card can be used to set the electronic gear numerator as desired. Set □□□2 in parameter No. 70. When using the external electronic gear setting, the values set in parameters No. 4 and 24 to 26 are made invalid.

(a) Parameter setting

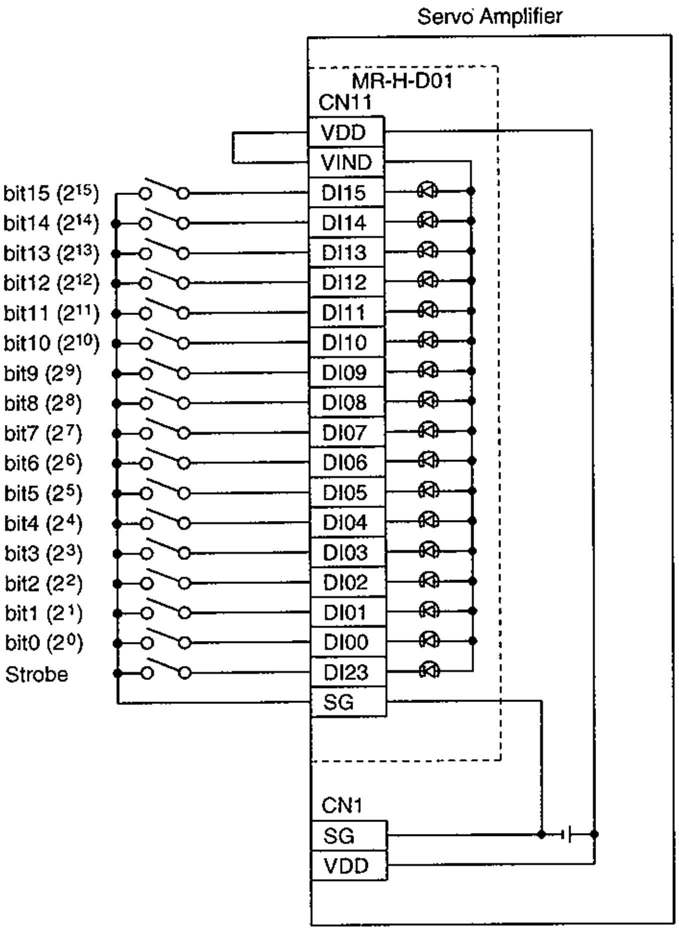
Parameter No. 70



(b) Binary input

By turning on/off DI00 to DI15, the electronic gear numerator can be set in 16-bit binary. Set □□02 in parameter No. 70. The setting range is from 1 to 65535.

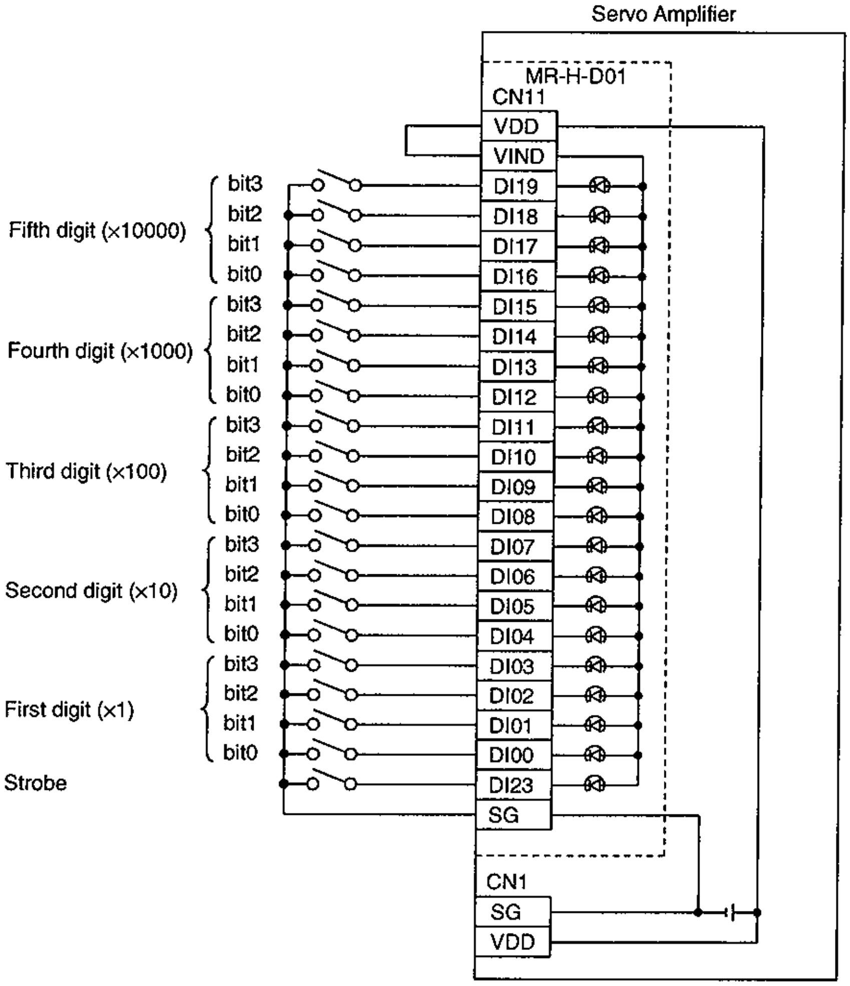
Turning any terminal-SG on is indicated by "1" and off by "0".



(c) 5-digit BCD input

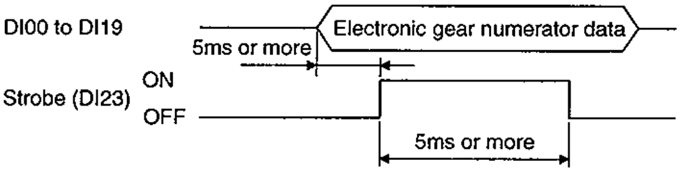
By turning on/off DI00 to DI19, the electronic gear numerator can be set in 5-digit BCD. Set □□12 in parameter No. 70. The setting range is from 1 to 65535.

Turning any terminal-SG on is indicated by "1" and off by "0".



(d) Timing chart

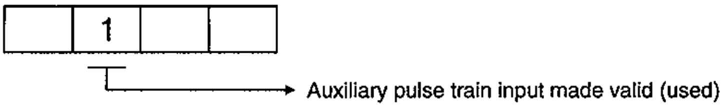
After making the electronic gear numerator setting, turn on the strobe signal (DI23) to read data. Hold the strobe signal on for longer than 10ms, and during this period, keep the electronic gear numerator data unchanged.



By setting 3□□□ in parameter No. 70, the electronic gear numerator data can be read as soon as it has changed, independently of whether DI23 is on or off. However, this function is made valid when the same data is received for longer than 12ms.

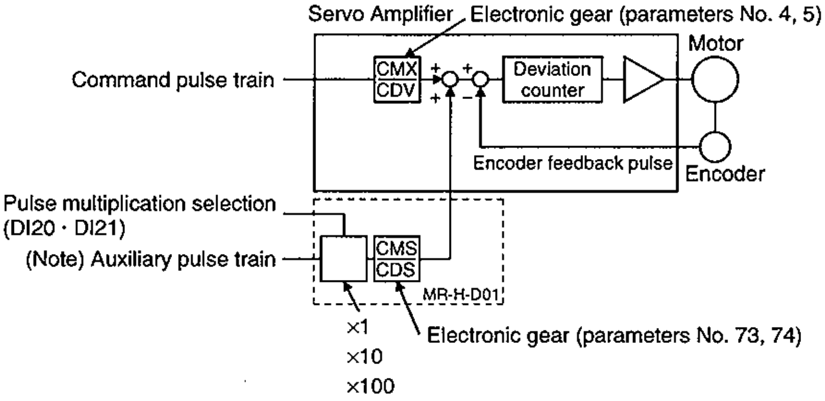
(6) Auxiliary pulse train input

The MR-H-D01 option card can be used to input an auxiliary pulse train. Set □1□□ in parameter No. 70 to make the auxiliary pulse train input valid.



After the auxiliary pulse train has been multiplied by the dedicated electronic gear, it is added to the command pulse train which has been multiplied by the electronic gear. Separately from the command pulse train, use the auxiliary pulse train when performing operation with a manual pulse generator or the like.

The feature of the auxiliary pulse train can be changed with parameter No. 72. Refer to paragraph (1) in this section.



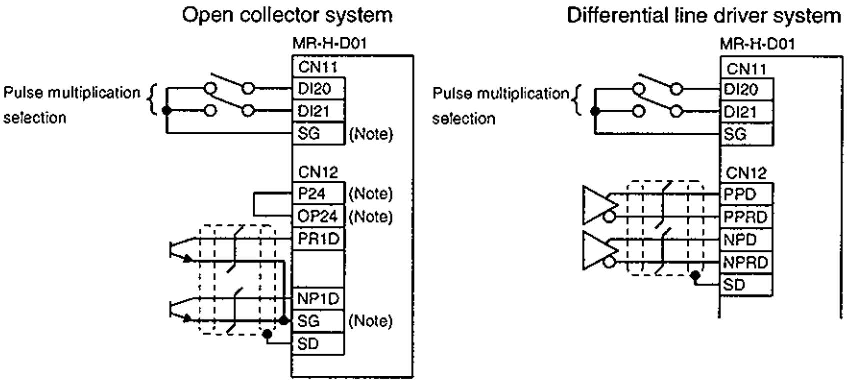
Note: The maximum input pulses are 200kpps in the open collector system or 400kpps in the differential line driver system.

You can use DI20 and DI21 to choose the multiplication of the auxiliary pulse train.

(Note) External Input Signals		Pulse Multiplication
DI21	DI20	
0	0	× 1
0	1	× 10
1	0	× 100
1	1	× 1

Note. 0 : DI-SG off (open)
1 : DI-SG on (short)

Make connection as shown below:



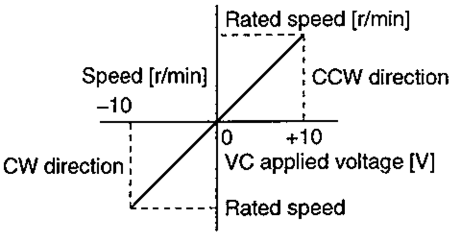
Note: For use in the 24V line. For use in the 5V line, replace the signals as follows:
P24 → P5
OP24 → OP5
SG → LG

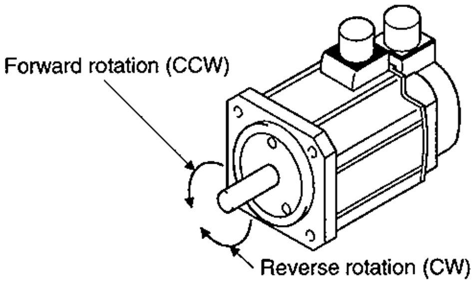
3.4.2 Speed control mode

(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of the analog speed command (VC). A relationship between the analog speed command (VC) applied voltage and the servo motor speed with DI3 on is shown below:

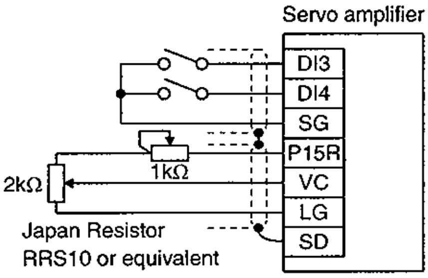




(Note) External Input Signals		Rotation Direction			
		Analog Speed Command (VC)			Internal Speed Commands
DI4	DI3	+ Polarity	0V	−Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)

Note. 0 : DI-SG off (open)
1 : DI-SG on (short)

Generally, make connection as shown below:



(b) Speed selection (DI0), speed selection (DI1), speed selection (DI2) and speed command value
Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (DI1) and speed selection 2 (DI2) or the speed setting made by the analog speed command (VC).

(Note) External Input Signals		Speed Command Value
DI2	DI1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No. 9)
1	0	Internal speed command 2 (parameter No. 10)
1	1	Internal speed command 3 (parameter No. 11)

Note. 0 : DI-SG off (open)
1 : DI-SG on (short)

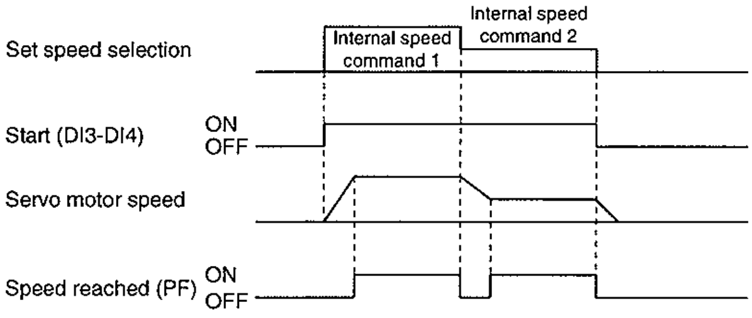
Speed selection 3 (DI0) is made available by setting □□1□ in parameter No. 41. In this case, the internal speed commands 1 to 7 are available.

(Note) External Input Signals			Speed Command Value
DI0	DI1	DI2	
0	0	0	Analog speed command (VC)
0	0	1	Internal speed command 1 (parameter No. 9)
0	1	0	Internal speed command 2 (parameter No. 10)
0	1	1	Internal speed command 3 (parameter No. 11)
1	0	0	Internal speed command 4 (parameter No. 30)
1	0	1	Internal speed command 5 (parameter No. 31)
1	1	0	Internal speed command 6 (parameter No. 32)
1	1	1	Internal speed command 7 (parameter No. 33)

Note. 0 : DI-SG off (open)
1 : DI-SG on (short)

The speed may be changed during rotation. In this case, the values set in parameters No. 12 and 13 are used for acceleration/deceleration.
When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(2) Speed reached (PF)
PF-SG are connected when the servo motor speed nearly reaches the speed set to the internal speed command or analog speed command.



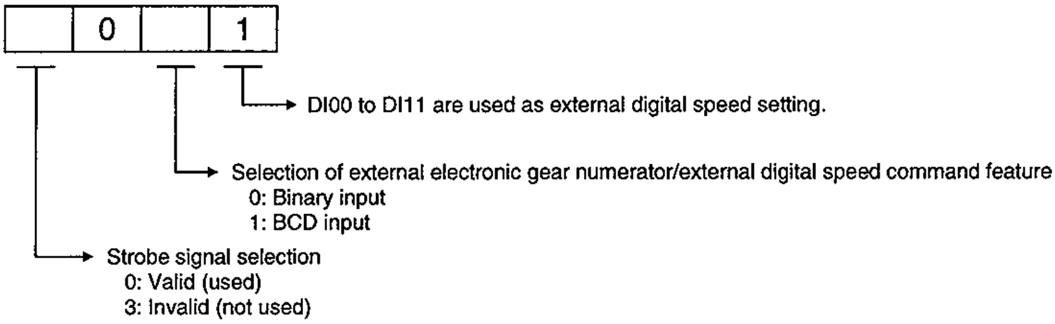
(3) Torque limit
As in Section 3.4.1 (2).

(4) External digital speed command

The MR-H-D01 option card can be used to set the servo motor speed as desired in 12-bit binary. Set □□□1 in parameter No. 70.

(a) Parameter setting

Parameter No.70



DI00 to DI11 are used as external digital speed setting.

Selection of external electronic gear numerator/external digital speed command feature
0: Binary input
1: BCD input

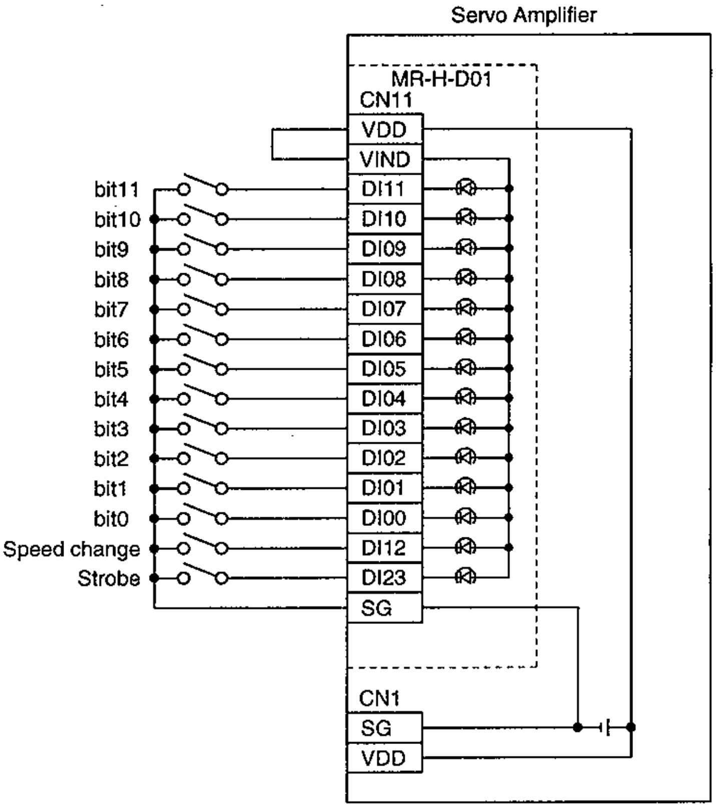
Strobe signal selection
0: Valid (used)
3: Invalid (not used)

(b) Binary input

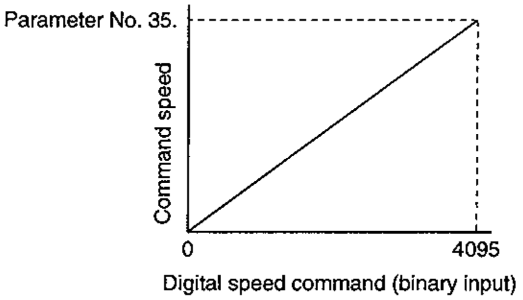
By turning on/off DI00 to DI11, the speed can be set in 12-bit binary. Set □□01 in parameter No. 70.

The setting range is from 0 to 4095.

Turning any terminal-SG on is indicated by "1" and off by "0".



The command speed in response to DI00 to DI11 inputs is shown below. When all bits are on (4095), the command speed is the value set in parameter No. 35.



By turning DI12 on/off, you can choose any of the speed command values of the external digital speed command, external analog speed command (VC) and internal speed commands.

(Note 1) External Input Signals				Speed Command
DI12	(Note 2) DI0	DI2	DI1	
0	0 or 1			External digital speed command (DI00 to DI11)
1	0	0	0	Analog speed command (VC)
1	0	0	1	Internal speed command 1 (parameter No. 9)
1	0	1	0	Internal speed command 2 (parameter No. 10)
1	0	1	1	Internal speed command 3 (parameter No. 11)
1	1	0	0	Internal speed command 4 (parameter No. 30)
1	1	0	1	Internal speed command 5 (parameter No. 31)
1	1	1	0	Internal speed command 6 (parameter No. 32)
1	1	1	1	Internal speed command 7 (parameter No. 33)

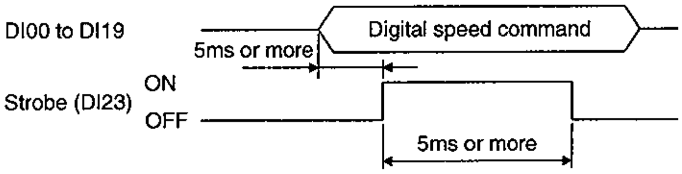
Note. 0 : DI-SG off (open)
1 : DI-SG on (short)
2 : To use DI0, set □□1□ in parameter No. 41.

(c) 5-digit BCD input

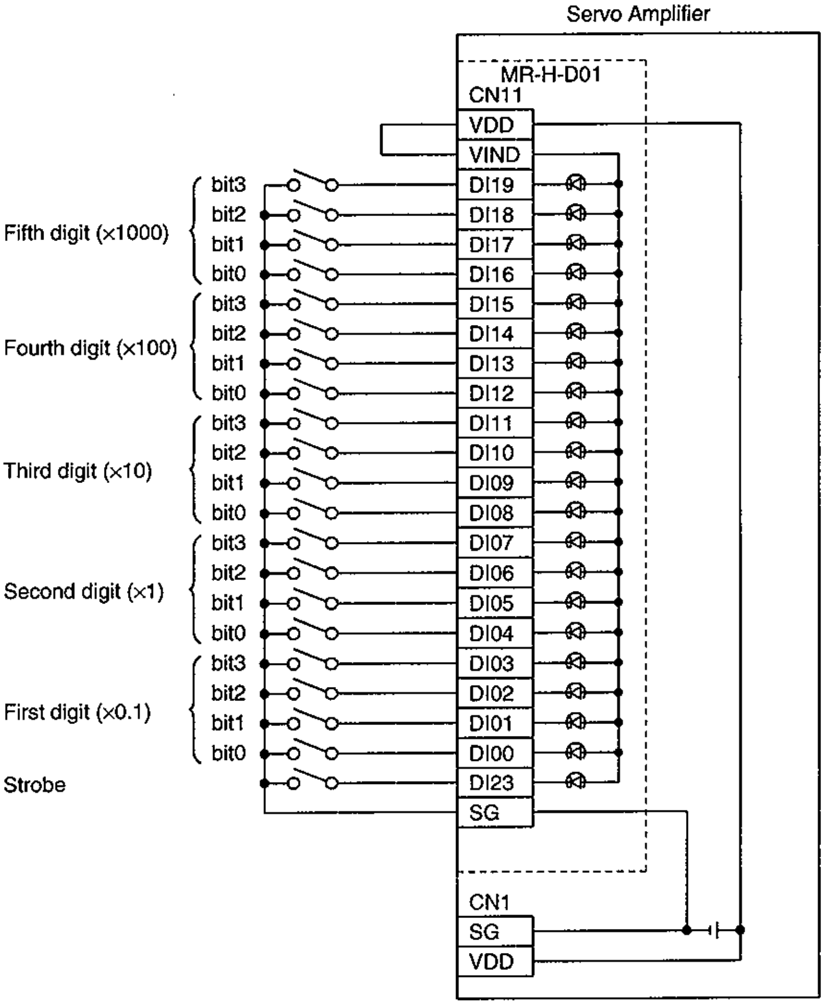
By turning on/off DI00 to DI19, the servo motor speed can be set in 5-digit BCD. Set □□11 in parameter No. 70. The setting range is from 0 to instantaneous permissible speed. When you use the 5-digit BCD input, the command speed change using DI12 and DI0 to DI2 cannot be made. Turning any terminal-SG on is indicated by "1" and off by "0".

(d) Timing chart

After making the electronic gear numerator setting, turn on the strobe signal (DI23) to read data. Hold the strobe signal on for longer than 10ms, and during this period, keep the digital speed command data unchanged.



By setting 3□□□ in parameter No. 70, the digital speed command data can be read as soon as it has changed, independently of whether DI23 is on or off. However, this function is made valid when the same data is received for longer than 12ms.



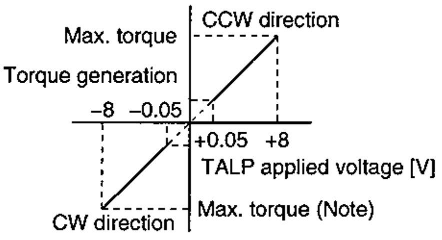
3.4.3 Torque control mode

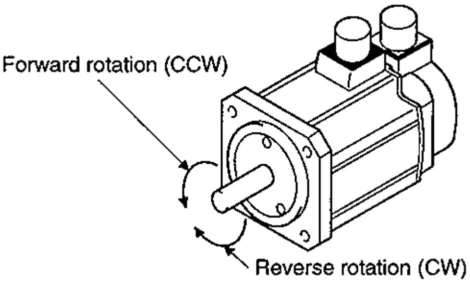
(1) Torque control

(a) Torque command and generated torque

A relationship between the applied voltage of the torque control command (TLAP) and the torque generated by the servo motor is shown below.

The maximum torque is generated at ±8V. Note that the torque generated at ±8V input can be changed with parameter No. 37.





Generated torque limit values will vary about 5% relative to the voltage depending on products.

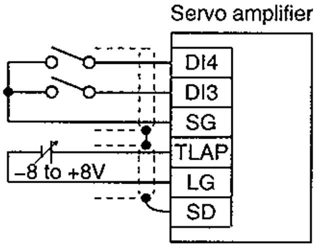
Generated torque may vary at the voltage of −0.05V to +0.05V.

The following table indicates the torque generation directions determined by the forward rotation selection (DI4) and reverse rotation selection (DI3) when the torque control command (TLAP) is used.

(Note) External Input Signals		Rotation Direction		
DI3	DI4	Torque control Command (TLAP)		
		+ Polarity	0V	− Polarity
0	0	No torque	No torque	No torque
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)		CW (forward rotation in driving mode/reverse rotation in regenerative mode)
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)		CCW (reverse rotation in driving mode/forward rotation in regenerative mode)
1	1	No torque		No torque

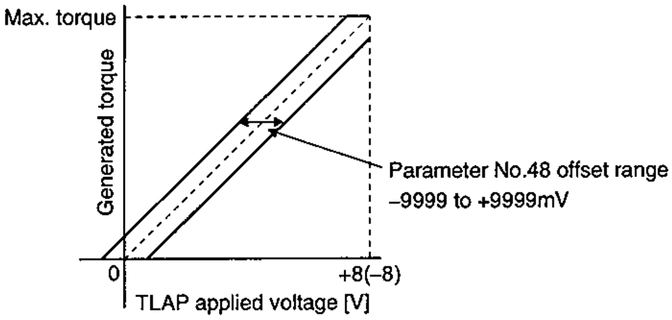
Note. 0: DI-SG off (open)
1: DI-SG on (short)

Generally, make connection as shown below:



(b) Analog torque command offset

Using parameter No. 48, the offset voltage of -9999 to +9999mV can be added to the TLAP applied voltage as shown below.



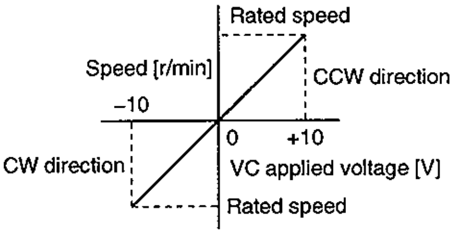
(2) Speed limit

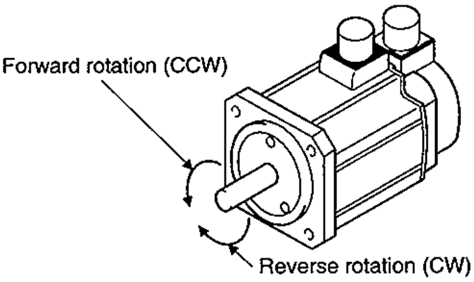
(a) Speed limit value and speed

The speed is limited to the values set in parameters No. 9 to 11 (internal speed limits 1 to 3) or the value set in the applied voltage of the speed limit Command (VC).

A relationship between the speed limit command (VC) applied voltage and the servo motor speed is shown below.

When the motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/m smaller than the desired speed limit value.



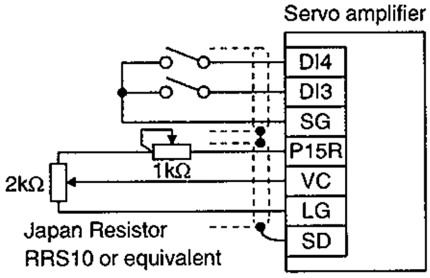


The following table indicates the limit direction according to forward rotation selection (DI4) and reverse rotation selection (DI3) combination:

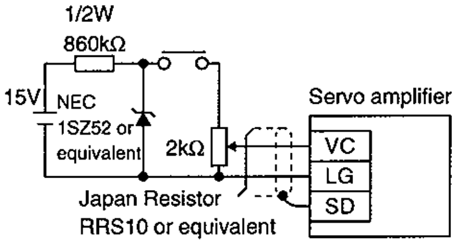
(Note) External Input Signals		Speed Limit Direction		
DI4	DI3	Analog Speed Limit (VLA)		Internal Speed Commands
		+ Polarity	- Polarity	
1	0	CCW	CW	CCW
0	1	CW	CCW	CW

Note. 0: DI-SG off (open)
1: DI-SG on (short)

When a precision speed limit is needed, make the following connection.



Generally, make connection as shown below:
In this case, the temperature fluctuation of the command voltage is ±0.002%/°C. Note that as the maximum value of the command voltage is approx. +6V, adjust the maximum value using parameter No. 35.



(b) Speed selection 1 (DI1)/speed selection 2 (DI2) and speed command values
Choose any of the speed settings made by the internal speed limits 1 to 3 using speed selection 1 (DI1) and speed selection 2 (DI2) or the speed setting made by the speed limit command (VC).

(Note) External Input Signals		Speed Command Value
DI2	DI1	
0	0	Speed limit command (VC)
0	1	Parameter No. 9
1	0	Parameter No. 10
1	1	Parameter No. 11

Note. 0: DI-SG off (open)
1: DI-SG on (short)

When the internal speed commands 1 to 3 are used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (TLC)
TLC-SG are connected when the servo motor speed reaches the limit speed set to any of the internal speed limits 1 to 3 or speed limit command (VC).

3.4.4 Position/speed control change mode

Set □□□1 in parameter No. 2 to switch to the position/speed control change mode. This function is not available in the absolute position detection system.

(1) Control change (DI0)

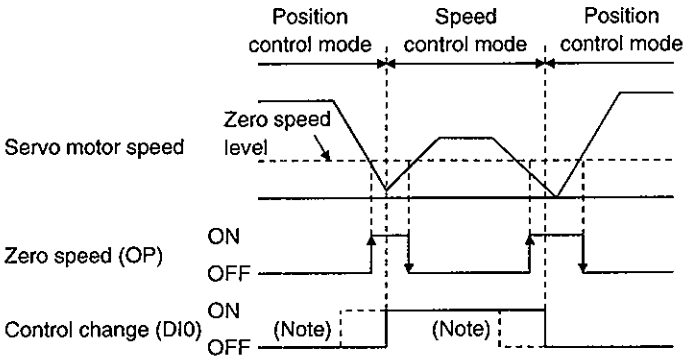
Use control change (DI0) to switch between the position control mode and the speed control mode from an external contact. Relationships between DI0-SG status and control modes are indicated below:

(Note) DI0	Servo Control Mode
0	Position control mode
1	Speed control mode

Note. 0: DI0-SG off (open)
1: DI0-SG on (short)

The control mode may be changed in the zero-speed status. To ensure safety, change control after the servo motor has stopped. When position control mode is changed to speed control mode, droop pulses are reset.

If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



Note: When OP is not on, control cannot be changed if DI0 is switched on-off.
If OP switches on after that, control cannot not be changed.

(2) Torque limit in position control mode

As in Section 3.4.1 (2).

(3) Speed setting in speed control mode

How to use this is the same as in Section 3.4.2 (1).

3.4.5 Speed/torque control change mode

Set □□□3 in parameter No. 2 to switch to the speed/torque control change mode.

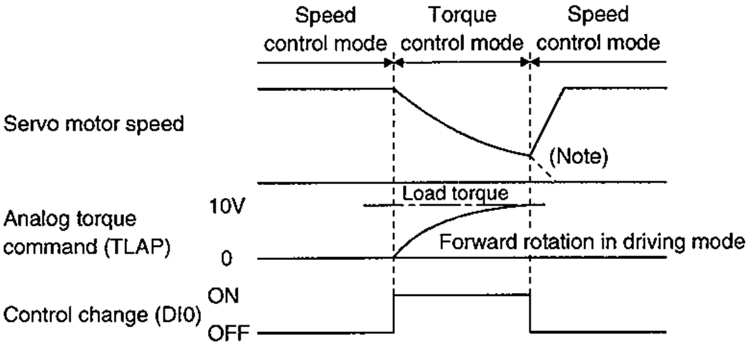
(1) Control change (DI0)

Use control change (DI0) to switch between the speed control mode and the torque control mode from an external contact. Relationships between DI0-SG status and control modes are indicated below:

(Note) DI0	Servo Control Mode
0	Speed control mode
1	Torque control mode

Note. 0: DI0-SG off (open)
1: DI0-SG on (short)

The control mode may be changed at any time. A change timing chart is shown below:



Note: When the start signal (DI3 · DI4) is switched off as soon as the mode is changed to speed control, the servo motor comes to a stop according to the deceleration time constant.

(2) Speed setting in speed control mode

As in Section 3.4.2 (1).

(3) Torque limit in speed control mode

As in Section 3.4.1 (2).

(4) Torque control in torque control mode

As in Section 3.4.3 (1).

(5) Speed limit in torque control mode

As in Section 3.4.3 (2).

3.4.6 Torque/position control change mode

Set □□□5 in parameter No. 2 to switch to the torque/position control change mode. This function is not available for the absolute position detection system.

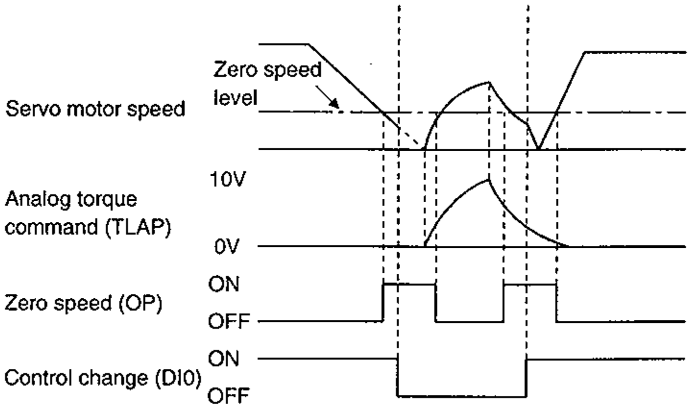
(1) Control change (DI0)

Use control change (DI0) to switch between the torque control mode and the position control mode from an external contact. Relationships between DI0-SG status and control modes are indicated below:

(Note) DI0	Servo Control Mode
0	Torque control mode
1	Position control mode

Note. 0: DI0-SG off (open)
1: DI0-SG on (short)

The control mode may be changed in the zero-speed status.
To ensure safety, change control after the servo motor has stopped. When position control mode is changed to torque control mode, droop pulses are reset.
If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



(2) Speed limit in torque control mode

As in Section 3.4.3 (2).

(3) Torque control in torque control mode

As in Section 3.4.3 (1).

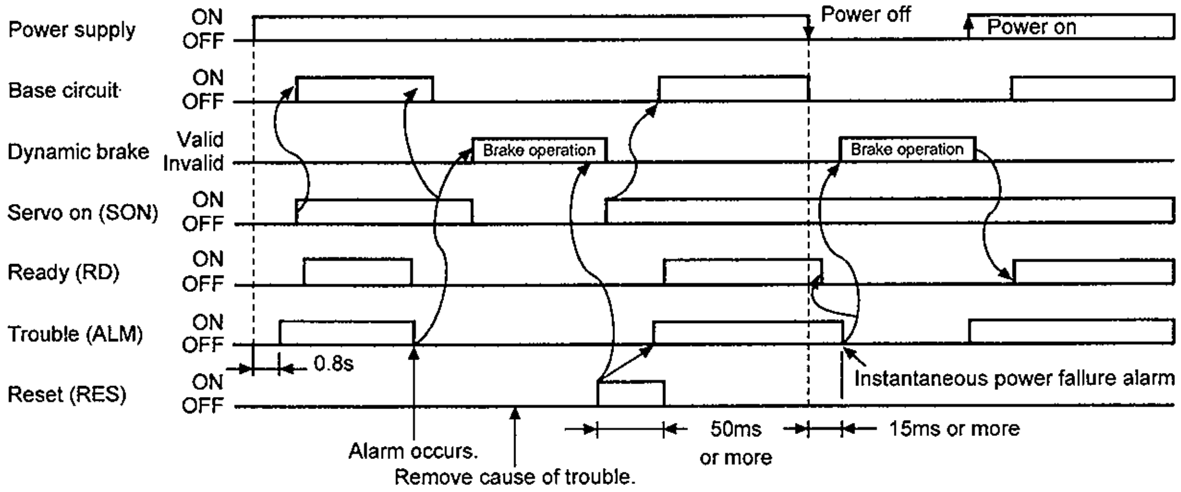
(4) Torque limit in position control mode

As in Section 3.4.1 (2).

3.5 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 or turn the reset signal (RES) off, then on. However, the alarm cannot be reset unless its cause is removed.



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 (AL32), overload 1 (AL50) or overload 2 (AL51) 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 (AL30) 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 (AL10) alarm will occur. If the power failure still persists for 20ms or longer, the control circuit is switched off. When the power failure is reset in this state, the alarm is reset and the servo motor will start suddenly if the servo-on signal (SON) is on. To prevent hazard, make up a sequence which will switch off the servo-on signal (SON) if an alarm occurs.

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.

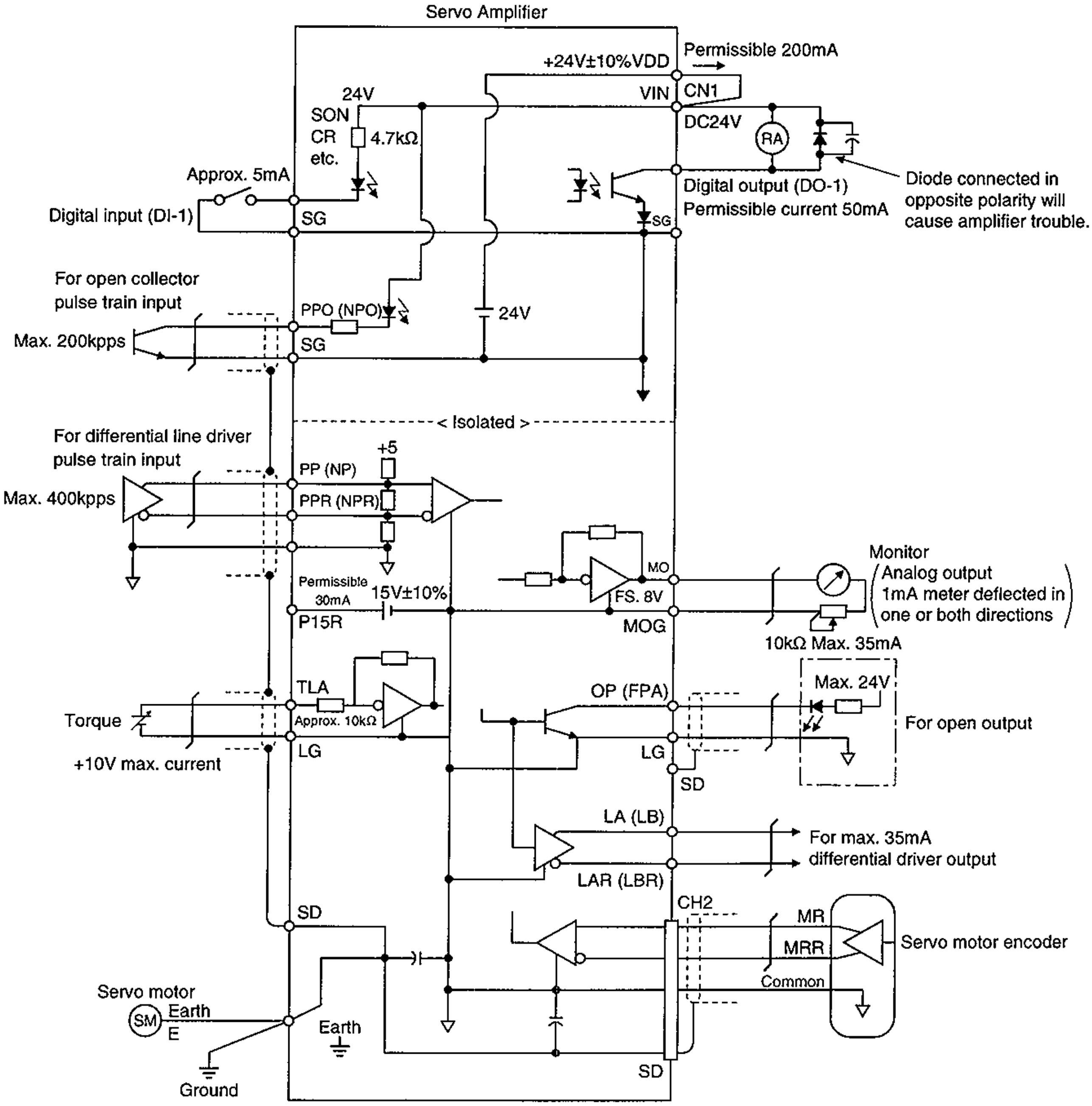
3.6 Interfaces

3.6.1 Common line

POINT

- Do not connect SG-LG-SD externally.

The following diagram shows the power supply and its common lime.



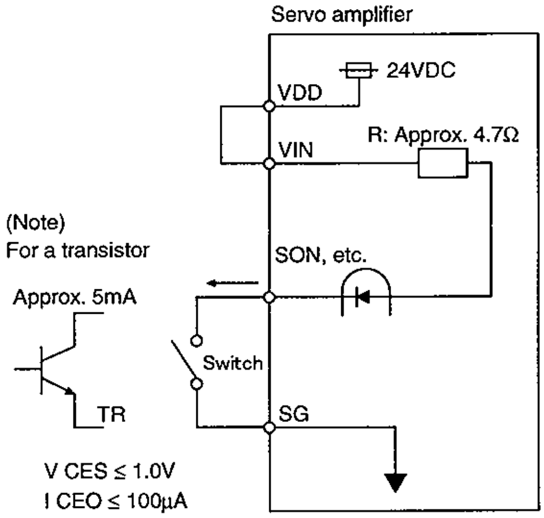
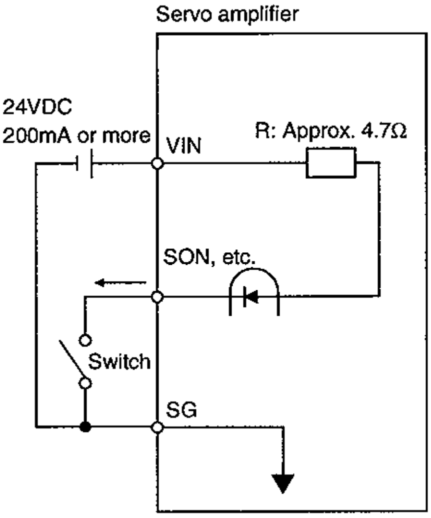
3.6.2 Detailed description of the interfaces

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.

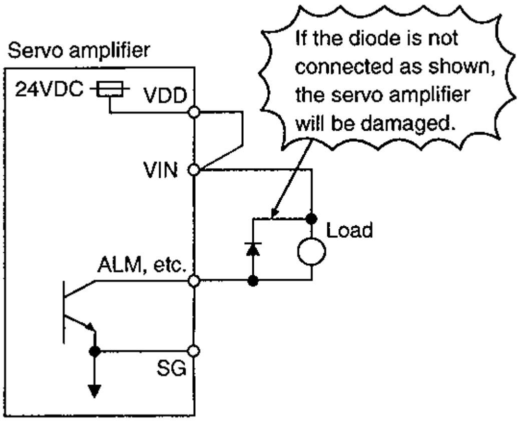
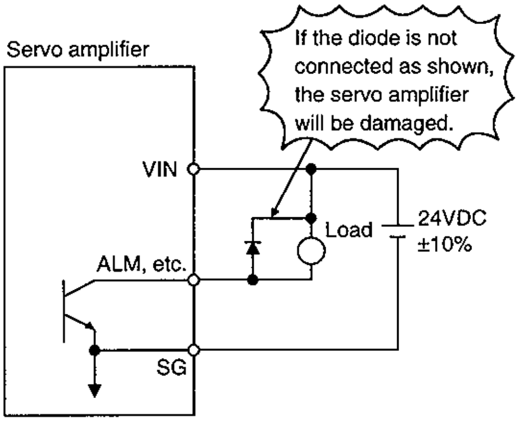
For use of internal power supply	For use of external power supply
	

Note: This also applies to the use of the external power supply.

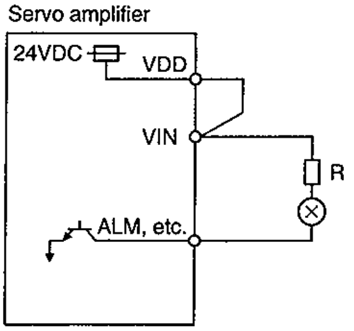
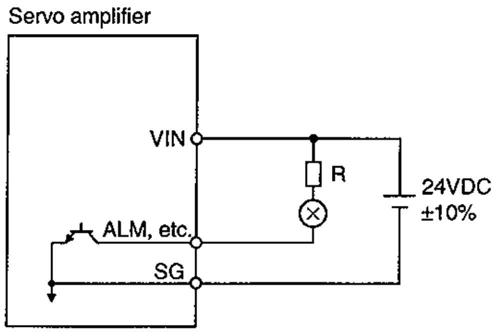
(2) Digital output interface DO-1

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)

1) Inductive load

For use of internal power supply	For use of external power supply
	

2) Lamp load

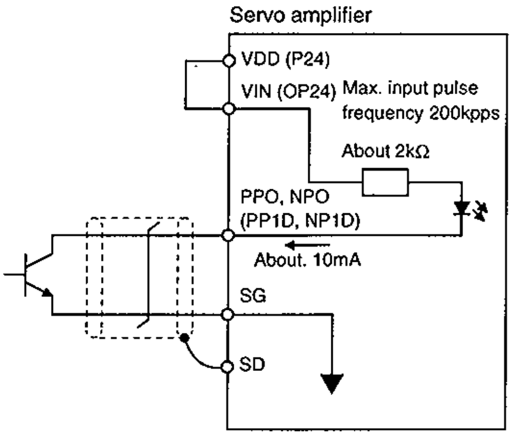
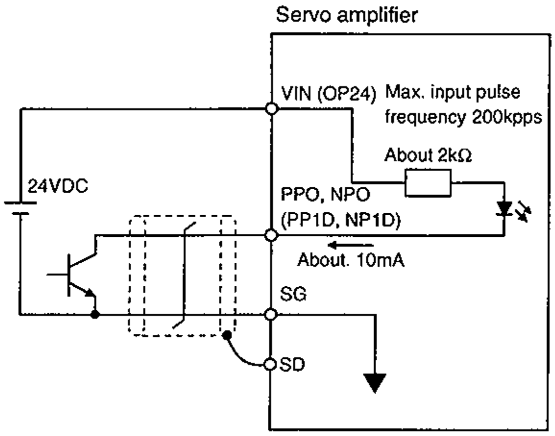
For use of internal power supply	For use of external power supply
	

(3) Pulse train input interface DI-2

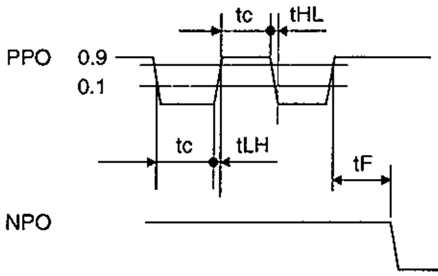
Provide a pulse train signal in the open collector or differential line driver system.

(a) Open collector system

1) Interface

For use of internal power supply	For use of external power supply
	

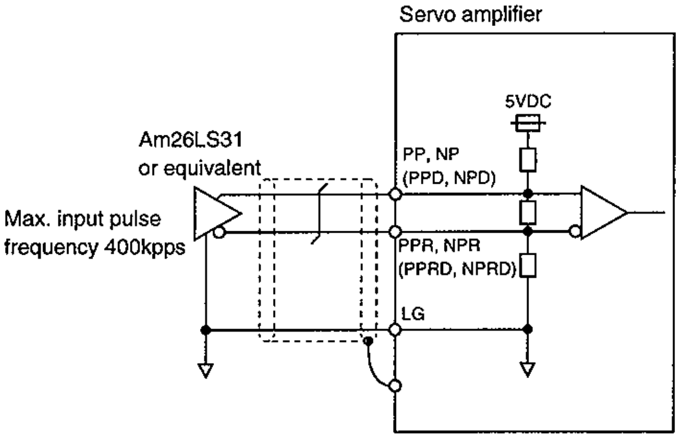
2) Conditions of the input pulse



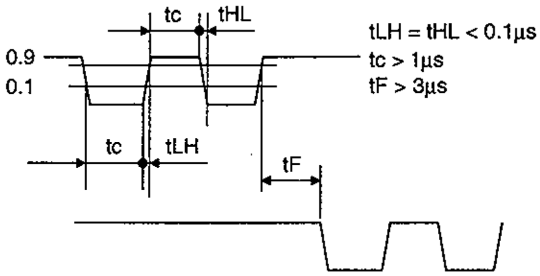
tLH = tHL < 0.2μs
tc > 2μs
tF > 3μs

(b) Differential line driver system

1) Interface



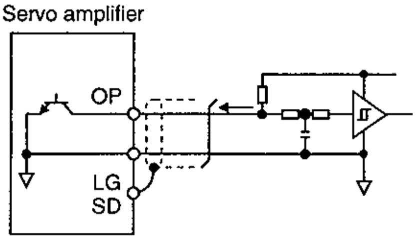
2) Conditions of the input pulse

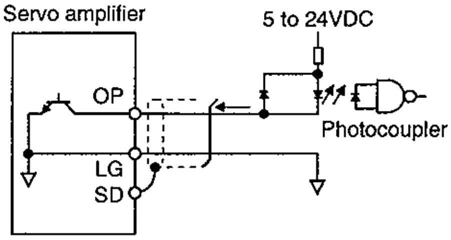


(4) Encoder pulse output DO-2

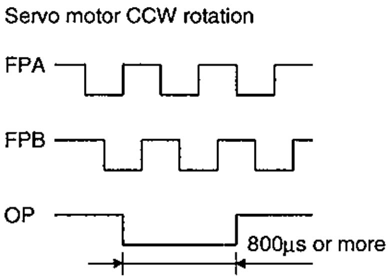
(a) Open collector system

1) Interface





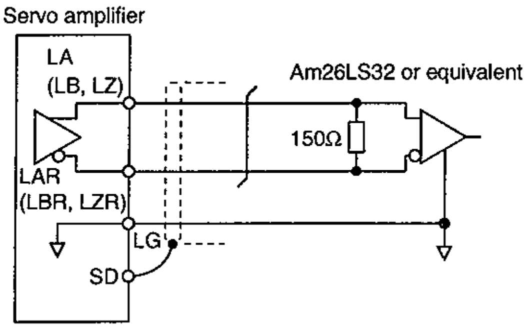
2) Output pulse

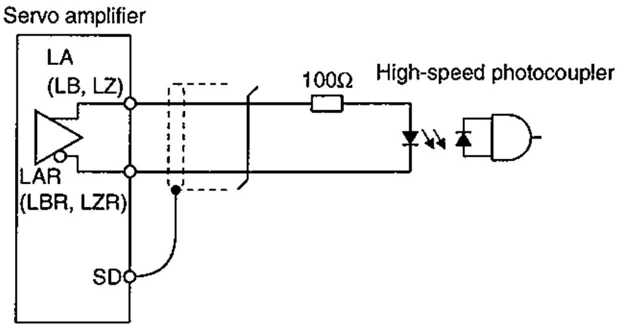


(b) Differential line driver system

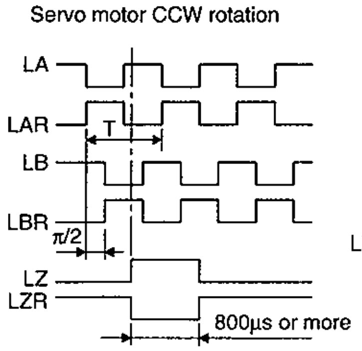
1) Interface

Max. output current: 35mA



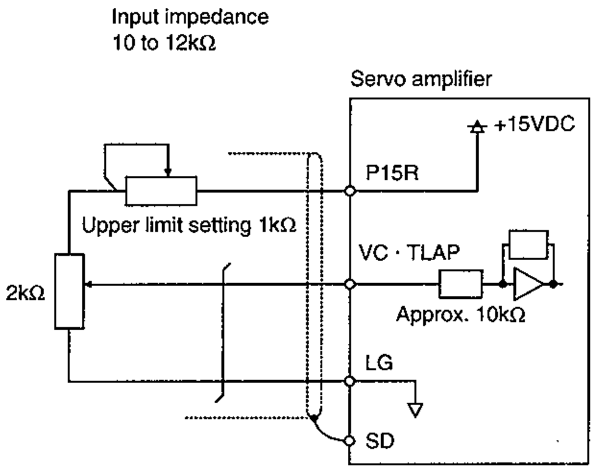


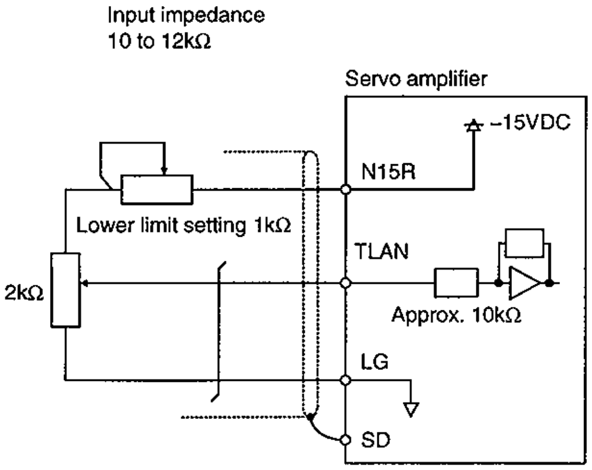
2) Output pulse



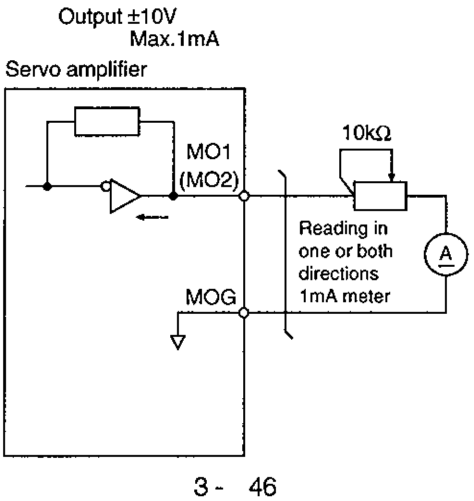
LZ signal varies ±3/8T on its leading edge.

(5) Analog input





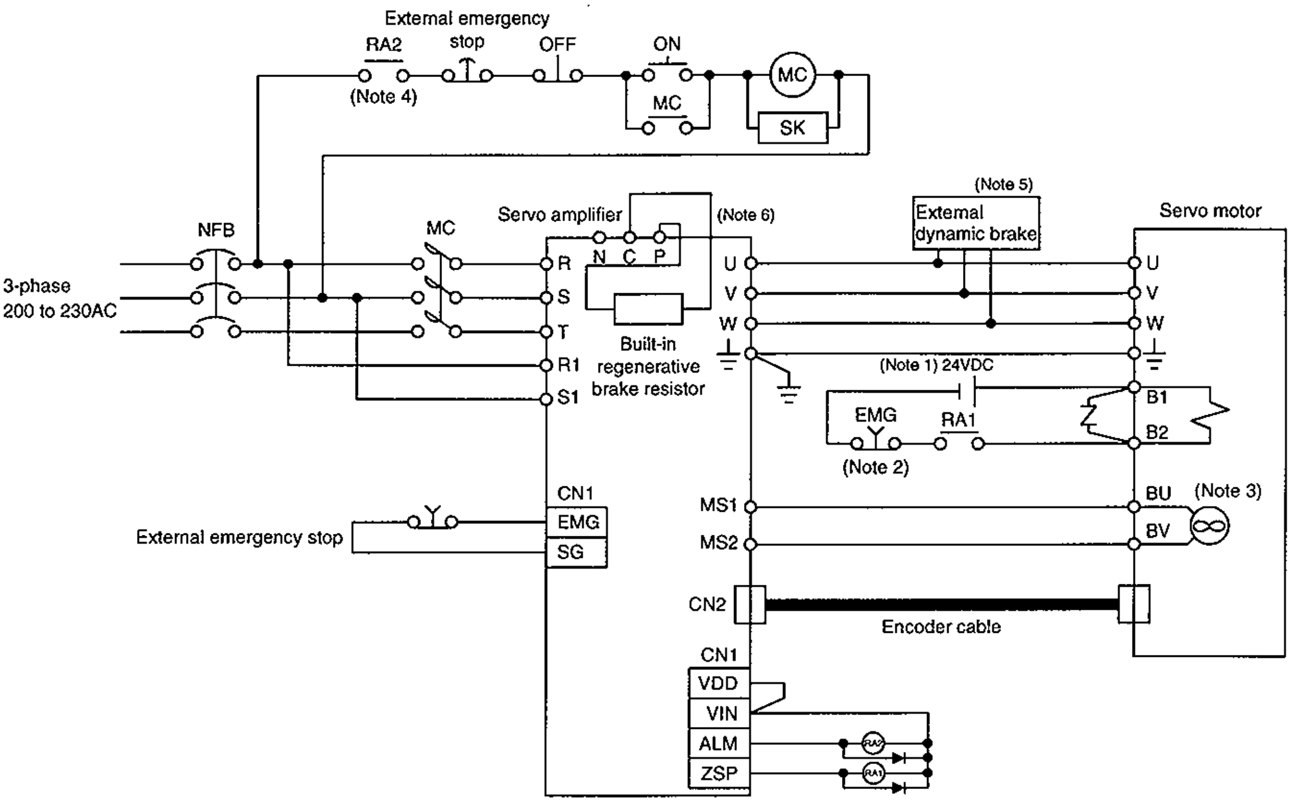
(6) Analog output



3.7 Power Line Circuit

⚠ CAUTION	• When the servo amplifier has become faulty, switch power off on the servo 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.

3.7.1 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 a power circuit which will switch off the magnetic contactor after detection of an alarm.
5. When using the external dynamic brake, refer to Section 13.1.5.
6. When using the regenerative brake option, brake unit or power return converter, refer to Sections 13.1.2 to 13.1.4.

3.7.2 Terminal

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

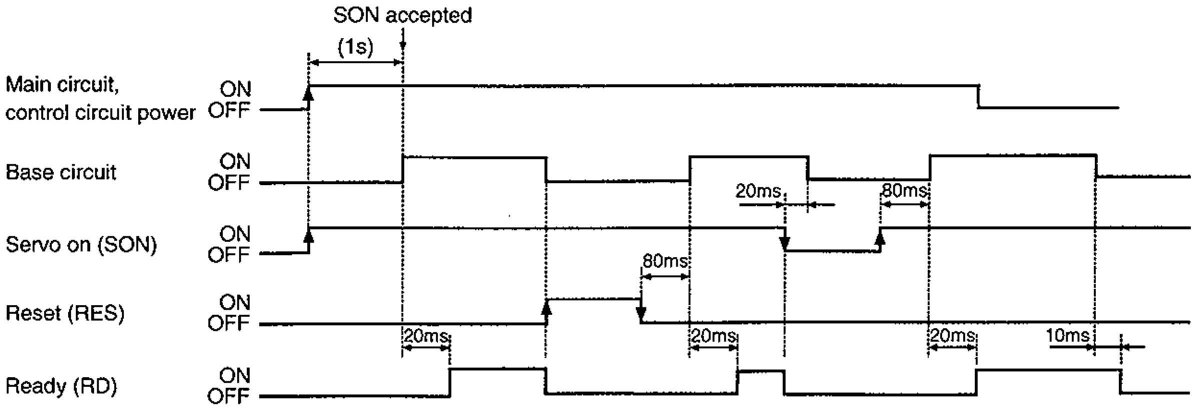
Symbol	Signal	Description
R · S · T	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to R, S, T. For MR-H700AN-UE or more, the voltage of 50Hz power is 200 to 220V.
U, V, W	Servo motor output	Servo motor power output terminals Connect to the servo motor power supply terminals (U, V, W).
R1 · S1	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-H700AN or more, the voltage of 50Hz power is 200 to 220V.
P, C, D	Regenerative brake	Regenerative brake option connection terminals The MR-H400AN to MR-H700AN are factory-connected with a built-in regenerative brake resistor. 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. (Refer to Sections 13.1.2 to 13.1.4.) For MR-H11KAN 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 to HA-LH22K2 servo motors. Provided for the servo amplifiers of MR-H11KAN or more.
⏚	Grounding	Ground terminal Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.

3.7.3 Power-on sequence

(1) Power-on procedure

1) Always wire the power supply as shown in above Section 3.7.1 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 L_{11}, L_{21} 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 signal (SON) about 1 second after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the three-phase power supply, the base circuit will switch on in about 1 second, and the ready signal (RD) will switch on in further about 20ms, making the servo amplifier ready to operate.

(2) Timing chart



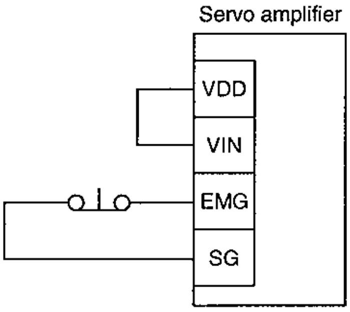
(3) Emergency stop

⚠ CAUTION

- To stop operation and switch power off immediately, provide an external emergency stop circuit.

Make up a circuit which shuts off main circuit power as soon as EMG-SG are opened at an emergency stop. To ensure safety, always install an external emergency stop switch across EMG-SG. By disconnecting EMG-SG, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (ALE6).

During ordinary operation, do not use the external emergency stop signal to alternate stop and run. For the MR-H-AN, if the start signal is on or a pulse train is input during an emergency stop, the servo motor will rotate as soon as the warning is reset. During an emergency stop, always shut off the run command.



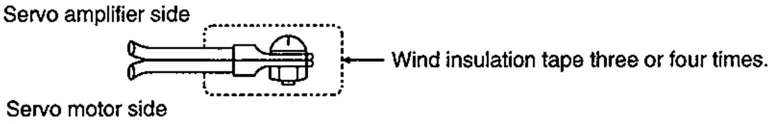
3.8 Connection of Servo Amplifier and Servo Motor

3.8.1 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.



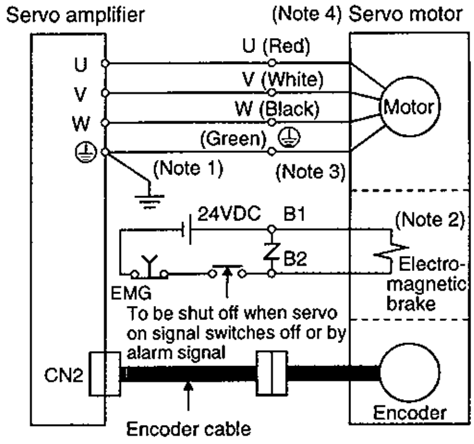
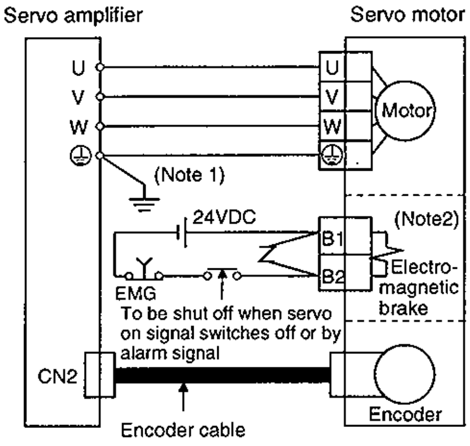
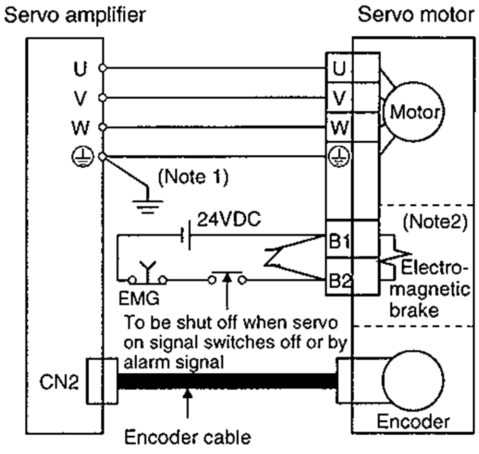
(2) For grounding, connect the earth cable of the servo motor to the ground terminal of the servo amplifier and connect the ground cable of the servo amplifier to the earth via earth plate of the control box.

(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.

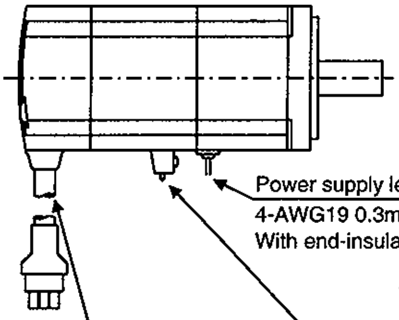
3.8.2 Connection diagram

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 13.1.6.
For the signal layouts of the connectors, refer to Section 3.8.3.

Servo Motor	Connection Diagram
HA-LH11K2 to HA-LH22K HC-MF053 (B) (-UE) to HC-MF73 (B) (-UE) HA-FF053 (B) to HA-FF63 (B) HC-UF13 (B) to HC-UF73 (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. 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 3.8.4.
HA-FF053 (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-CF502(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.

3.8.3 Details of the servo motor side

(1) HC-MF(-UE) series

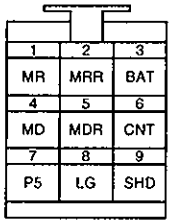


Power supply lead
4-AWG19 0.3m
With end-insulated round crimping terminal 1.25-4
Red : U phase
White : V phase
Black : W phase
Green/yellow : Earth

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

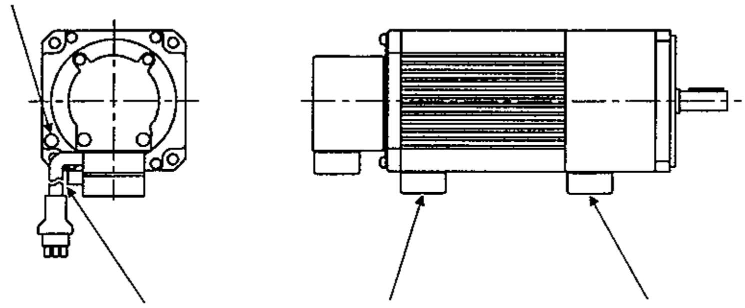
Encoder connector signal arrangement



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

(2) HA-FF series

Earth terminal, M3 screw

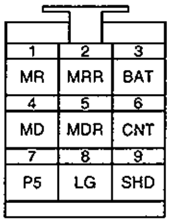


Encoder cable 0.3m
With connector 172169-9
(AMP make)

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

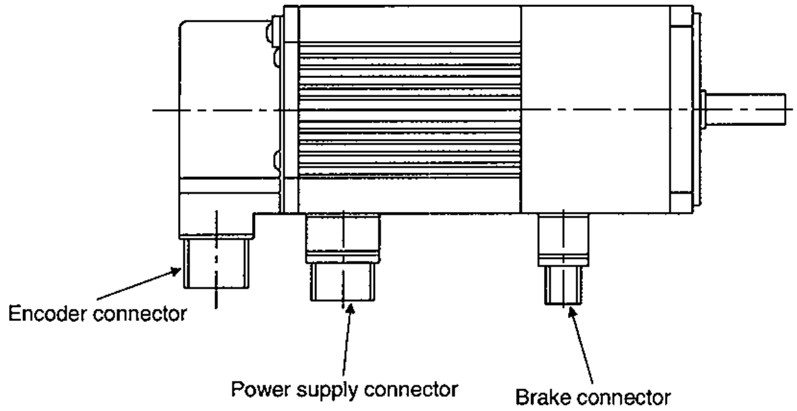
Brake cable
VCTF2-0.5² 0.5m
With end-insulated round crimping terminal 1.25-4

Encoder connector signal arrangement



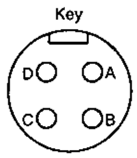
1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	CNT
7	8	9
P5	LG	SHD

(3) HA-FF□C(B)-UE series



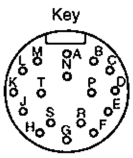
Servo Motor	Connector		
	For Power Supply	For Encoder	For Brake
HA-FF053C(B)-UE to HA-FF63C(B)-UE	CE05-2A14S-2PD-B	MS3102A20-29	MS3102E10SL-4P

Power supply connector signal arrangement
CE05-2A14S-2PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

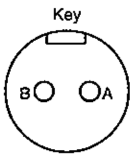
Encoder connector signal arrangement
MS3102A20-29P



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

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

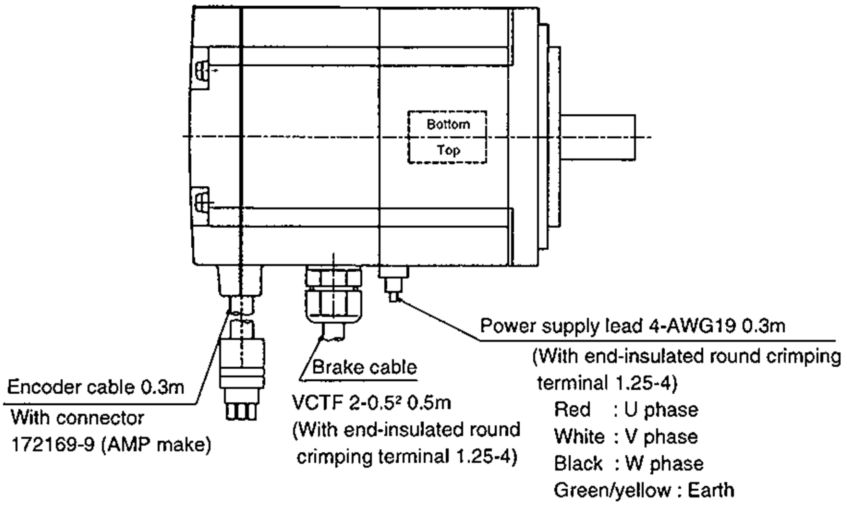
Brake connector signal arrangement
MS3102E10SL-4P



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

Note: 24VDC without polarity.

(4) HC-UF□(B)3000r/min series



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

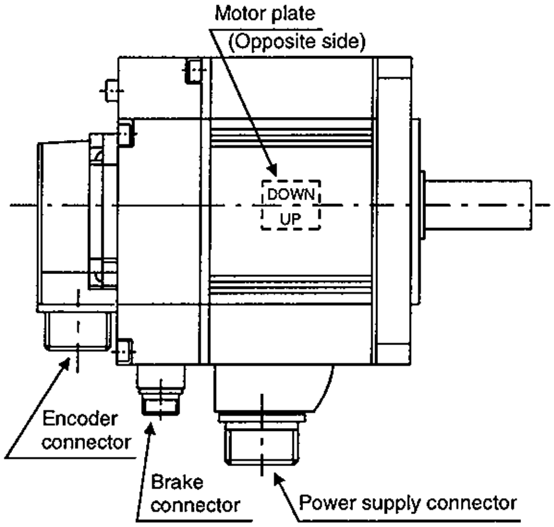
Brake cable
VCTF 2-0.5² 0.5m
(With end-insulated round crimping terminal 1.25-4)

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

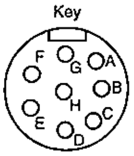
(5) HC-SF□(B) · HC-RF□(B) · HC-UF□(B)2000 r/min series



Servo Motor	Servo Motor Side 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	Also used by power supply
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		Also used by power supply
HC-RF103(B) to 203(B)	CE05-2A22-23PD-B		
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

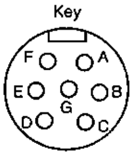
CE05-2A22-23PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	—
F	—
G	(Note) B1
H	(Note) B2

Note: 24VDC, without polarity

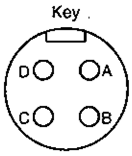
CE05-2A24-10PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	(Note) B1
F	(Note) B2
G	—

Note: 24VDC, without polarity

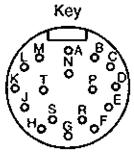
CE05-2A32-17PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

Encoder connector signal arrangement

MS3102A20-29P

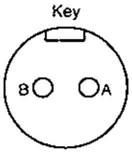


Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	—
F	BAD
G	LG
H	—
J	—

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

Electromagnetic brake connector signal pin-outs

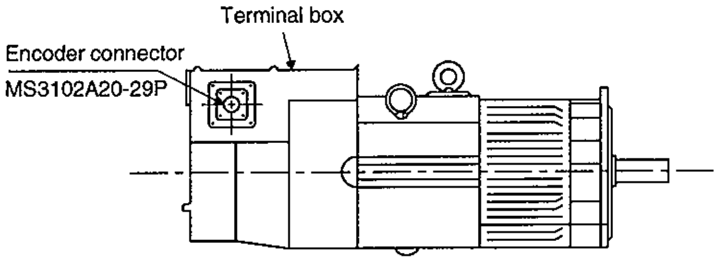
MS3102E10SL-4P



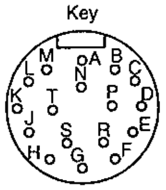
Pin	Signal
A	(Note) B1
B	(Note) B2

Note: 24VDC without polarity

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



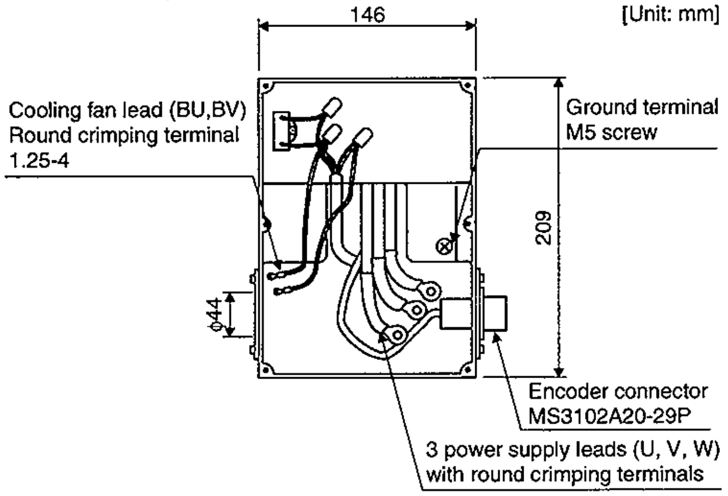
Encoder connector signal arrangement
MS3102A-29P



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

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

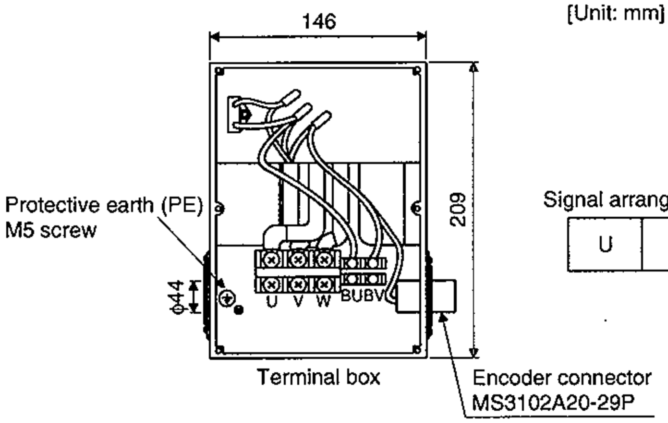
(a) Terminal box of HA-LH11K2 to HA-LH22K2



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 Protective earth (PE)



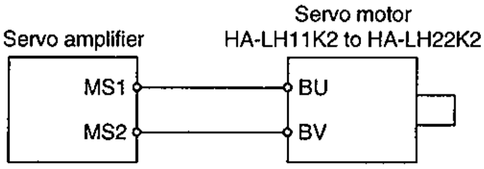
Signal arrangement of terminal block

U	V	W	BU	BV

Servo Motor	Power Supply Connection Screw Size	Fan Connection Screw Size
HA-LH11K2-EC	M6	M4
HA-LH15K2-EC · LH22K2-EC	M8	M4

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

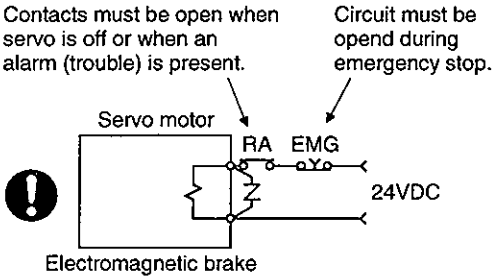
The 11kW or more of the HA-LH series are of totally-enclosed, force-cooled type. When performing operation, supply power to the cooling fan terminals (BU, BV) to operate the cooling fan. (Single-phase 200V, 35W)
Connect the fan terminals (BU, BV) of the servo motor to the cooling fan power terminals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



3.9 Servo Motor with Electromagnetic Brake

⚠ CAUTION

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



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. When using the servo motor with electromagnetic brake, set □□□1 in parameter No. 3 to make the electromagnetic brake interlock signal available. When this signal is used, the zero speed detection signal is made unavailable.
Refer to the connection diagram in Section 3.7.1 and make connection.

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 the power supply, wire it independently of polarity.

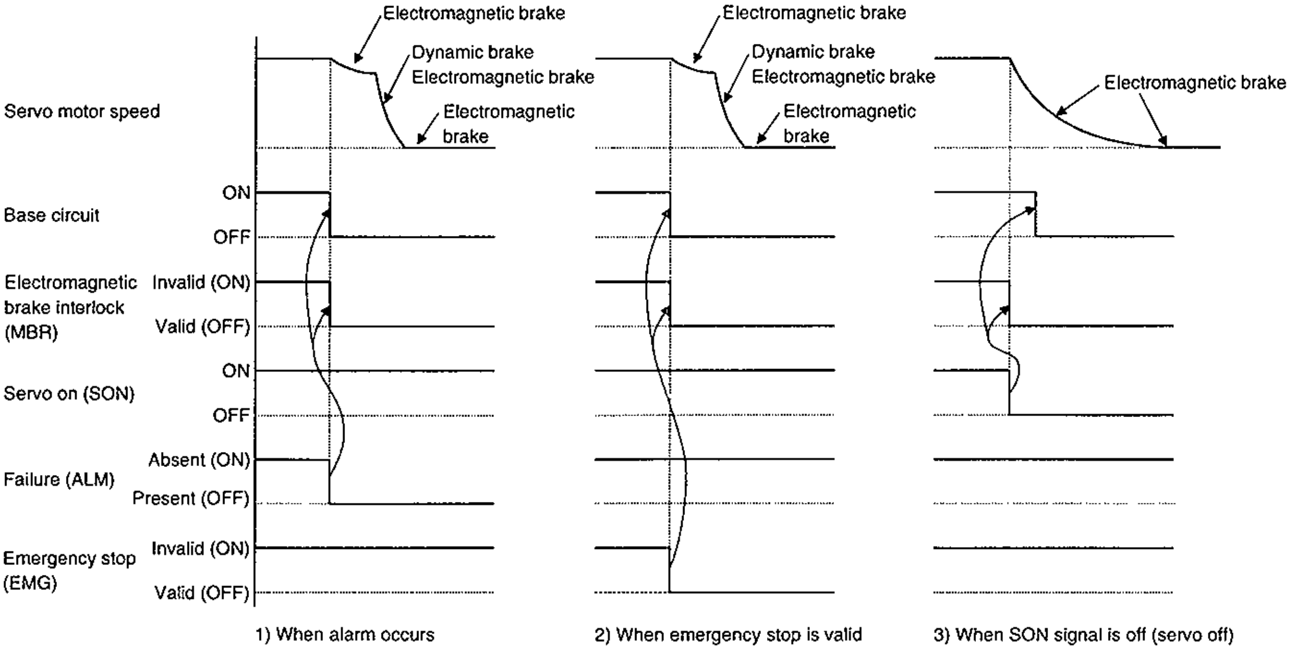
3.9.2 Operation of electromagnetic brake

(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. 44.

(b) Timing chart



(2) Electromagnetic brake operates under the condition in (1) of this section and at zero speed

(a) Setting

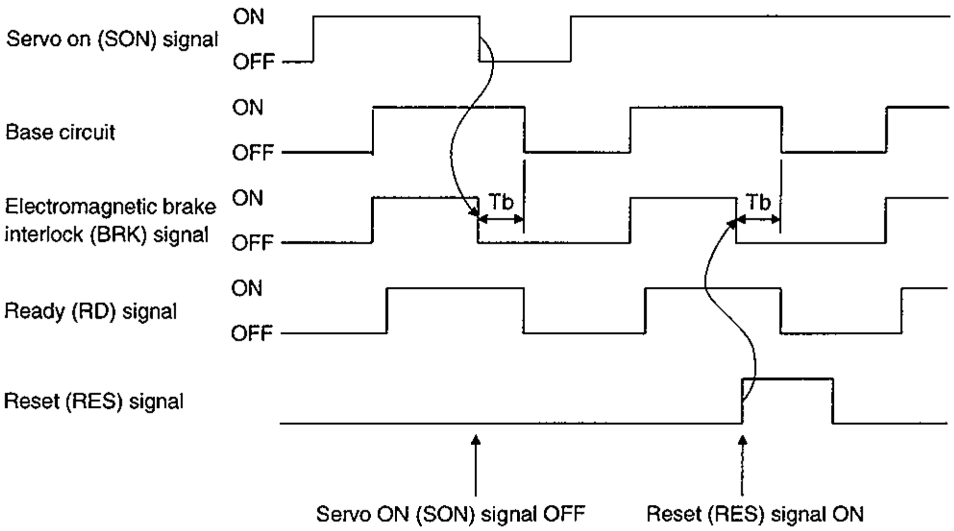
1) Set □1□□ in parameter No. 44.

2) In parameter No. 53, set a time delay (Tb) between electromagnetic brake operation and base circuit shut-off.

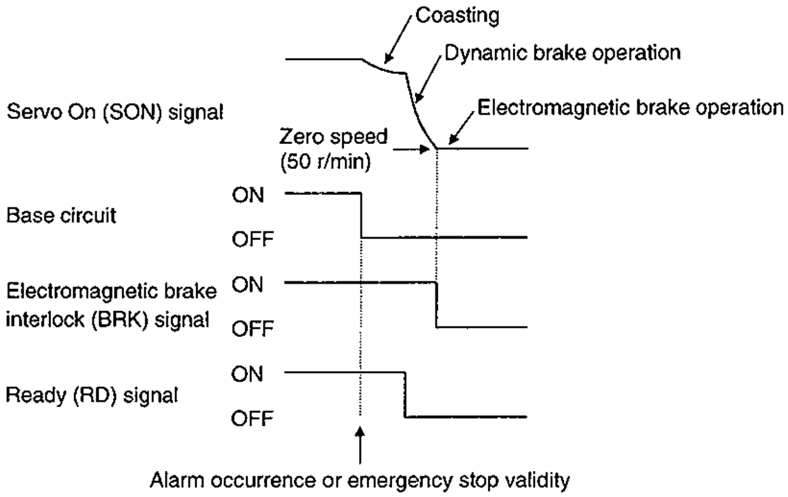
3) In this usage, do not install the EMG switch in Note 2 in the connection diagram of Section 3.7.1.

(b) Timing chart

1) Servo ON, reset timing chart.



2) Alarm occurrence, emergency stop validity timing chart.

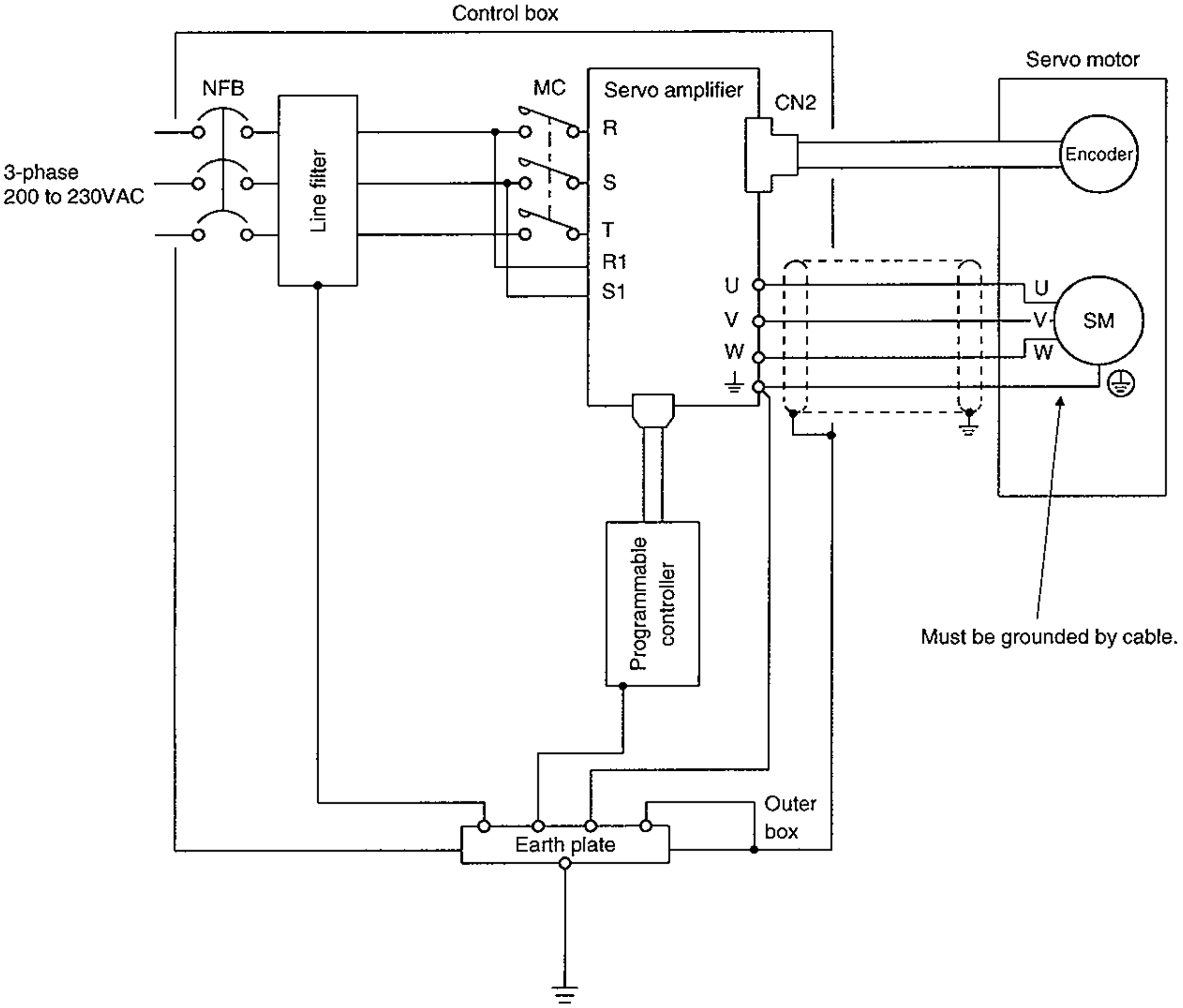


3.10 Grounding

⚠ **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)67310).



4. OPERATION

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) of the servo motor.
(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) When stroke end limit switches are used, the signals across LSP-SG and LSN-SG are on during operation.
(g) 24VDC or higher voltages are not applied to the pins of connectors CN1.
(h) SD and SG of connectors CN1 is not shorted.
(i) The wiring cables are free from excessive force.

(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.

4.2 Startup

⚠ 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 are 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.

4.2.1 Selection of control mode

Use parameter No. 2 to choose the control mode used. After setting, this parameter is made valid by switching power off, then on.

4.2.2 Position control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "Cumulative feedback pulses" appears on the parameter unit.

(2) Test operation 1

Using jog operation in the "test operation mode" the parameter unit, make sure that the servo motor operates. (Refer to Section 7.2, (5).)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 7.2, (4) for the setting method.

Parameter	Name	Setting	Description
No. 2	Servo type	□0□0	First digit : Position control mode Third digit : Regenerative brake option is used
No. 3	Function selection 1	1□□0	First digit: : Open collector system pulse train input Fourth digit : Absolute position detection system
No. 4	Electronic gear numerator (CMX)	2	Electronic gear numerator
No. 5	Electronic gear denominator (CDV)	1	Electronic gear denominator
No. 20	Auto tuning	□0□1	First digit: : Used Third digit : 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:

(a) Switch on main circuit/control power.

(b) Switch on the servo on signal (SON) (short SON-SG).

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

(5) Command pulse input

Entry of a pulse train from the positioning device rotates the servo motor. At first, run it at low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal. On the status display, check the speed, command pulse frequency, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the program of the positioning device.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 20.

(6) Zeroing

Make home position return as required.

(7) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

For the servo motor equipped with electromagnetic brake, refer to Section 3.9.2. Note that the stop pattern of stroke end (LSP/LSN) OFF is as described below.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL E6 occurs.

(d) Stroke end (LSP/LSN) OFF

The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

4.2.3 Speed control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "motor speed" appears on the parameter unit.

(2) Test operation

Using jog operation in the "test operation mode" of the Parameter unit, make sure that the servo motor operates. (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 7.2, (4) for the setting method.

Parameter	Name	Setting	Description
No. 2	Servo type	□1□2	First digit : Speed control mode Third digit : Regenerative brake option is used
No. 9	Internal speed command 1	1000	Set 1000r/min.
No. 10	Internal speed command 2	1500	Set 1500r/min.
No. 11	Internal speed command 3	2000	Set 2000r/min.
No. 12	Acceleration time constant	1000	Set 1000ms.
No. 13	Deceleration time constant	500	Set 500ms.
No. 20	Auto tuning	□0□1	First digit : Used Third digit : 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:

(a) Switch on main circuit/control power.

(b) Switch on the servo on signal (SON) (short SON-SG).

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

(5) Start

Using speed selection 1 (DI1) and speed selection 2 (DI2), choose the servo motor speed. Turn on forward rotation start (DI3) to run the motor in the forward rotation (CCW) direction or reverse rotation start (DI4) to run it in the reverse rotation (CW) direction. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 20.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.9.2 for the servo motor equipped with electromagnetic brake. Note that simultaneous ON or simultaneous OFF of stroke end (LSP, LSN) OFF and forward rotation start (DI3) or reverse rotation start (DI4) signal has the same stop pattern as described below.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL E6 occurs.

(d) Stroke end (LSP/LSN) OFF

The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (DI3) and reverse rotation start (DI4) signals

The servo motor is decelerated to a stop.

4.2.4 Torque control mode

(1) Power on

(a) Switch off the servo on (SON) signal.

(b) When main circuit power/control circuit power is switched on, "Effective load ratio" appears on the parameter unit.

(2) Test operation

Using jog operation in the "test operation mode" of the Parameter unit, make sure that the servo motor operates. (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 7.2, (4) for the setting method.

Parameter	Name	Setting	Description
No. 2	Servo type	□1□4	First digit : Torque control mode Third digit : Regenerative brake option is used
No. 9	Internal speed command 1	1000	Set 1000r/min.
No. 10	Internal speed command 2	1500	Set 1500r/min.
No. 11	Internal speed command 3	2000	Set 2000r/min.
No. 12	Acceleration time constant	1000	Set 1000ms.
No. 13	Deceleration time constant	500	Set 500ms.
No. 20	Auto tuning	□0□1	First digit : Used Third digit : 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) Switch on the servo on signal (SON) (short SON-SG).

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

(5) Start

Using speed selection 1 (DI1) and speed selection 2 (DI2), choose the servo motor speed. Turn on forward rotation select (DI4) to run the motor in the forward rotation (CCW) direction or reverse rotation select (DI3) to run it in the reverse rotation (CW) direction, generating torque. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 20.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor.

For the servo motor equipped with electromagnetic brake, refer to Section 3.9.2.

(a) Servo on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL E6 occurs.

(d) Simultaneous ON or simultaneous OFF of forward rotation select (DI4) and reverse rotation select (DI3) signals

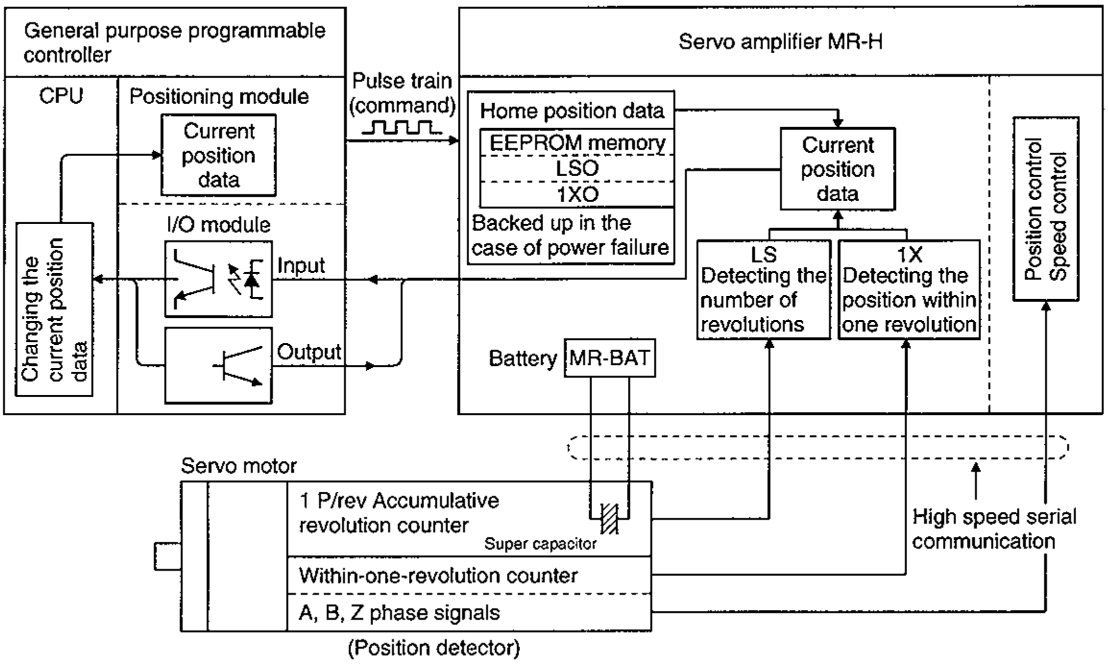
5. ABSOLUTE POSITION DETECTION SYSTEM

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

The absolute position detection system cannot be configured under the following conditions. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, choose incremental in parameter No.3.

(1) Speed control mode, torque control mode.
(2) Control switch-over mode (position/speed, speed/torque, torque/speed).
(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning.
(4) Changing of electronic gear after zero setting.
(5) Use of alarm code output.

5.2 Specifications

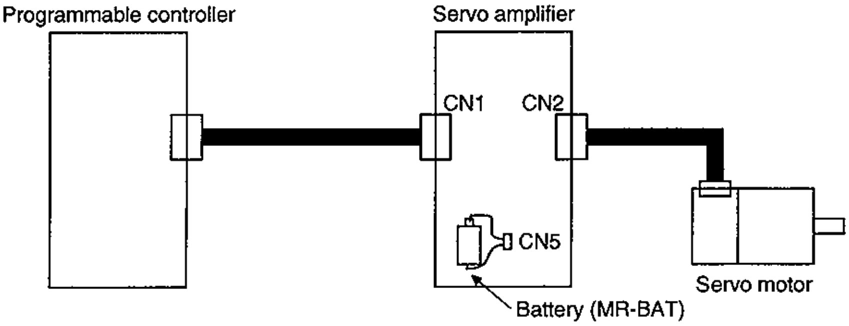
(1) Components

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.

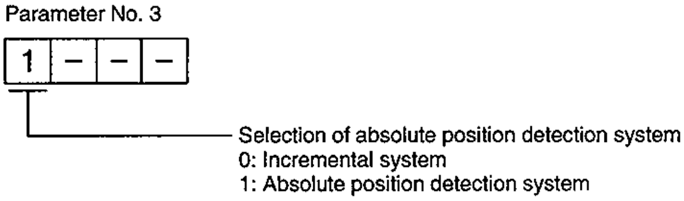
(2) General-purpose programmable controller

Positioning module	I/O module
AD71·AD71S2·AD71S7 A1SD71S2·A1SD71S7 AD75□ A1SD75□	AX40·41·42 AY40·41·42
FX-1PG·FX-1GM FX(E)-20GM·FX-10GM	FX2-32MT



(3) Parameter setting

Set 1□□□ in parameter No.3 to make the absolute position detection system valid.



5.3 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:

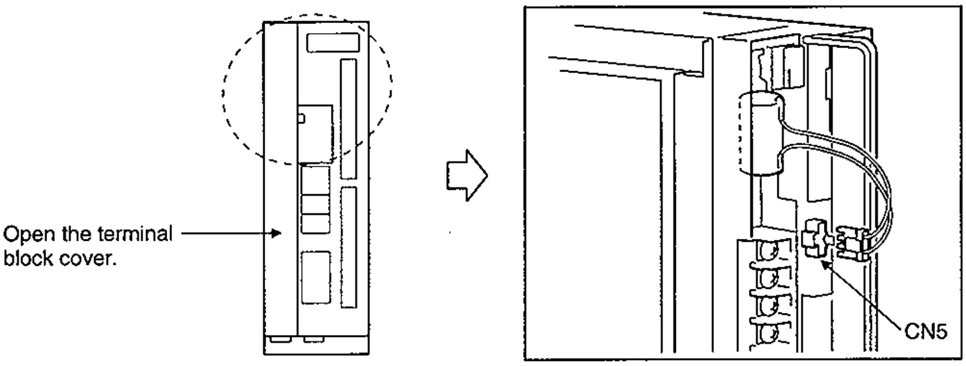
- Ground human body and work bench.
- Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

(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.

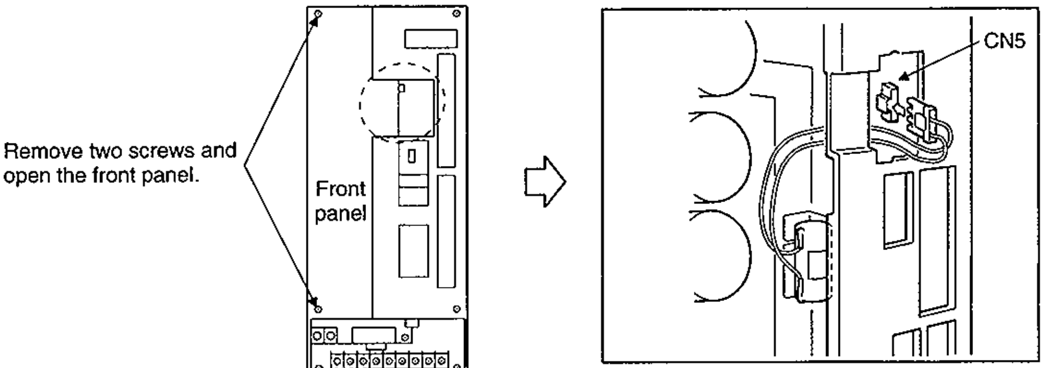
(3) Install the battery connector into CN5 until it clicks.

(a) MR-H10AN to MR-H350AN



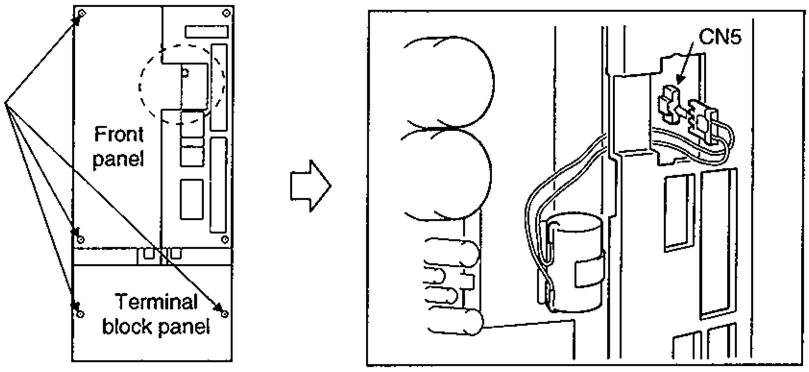
Open the switch window, fit the battery, and insert the plug into CN5

(b) MR-H500AN,MR-H700AN



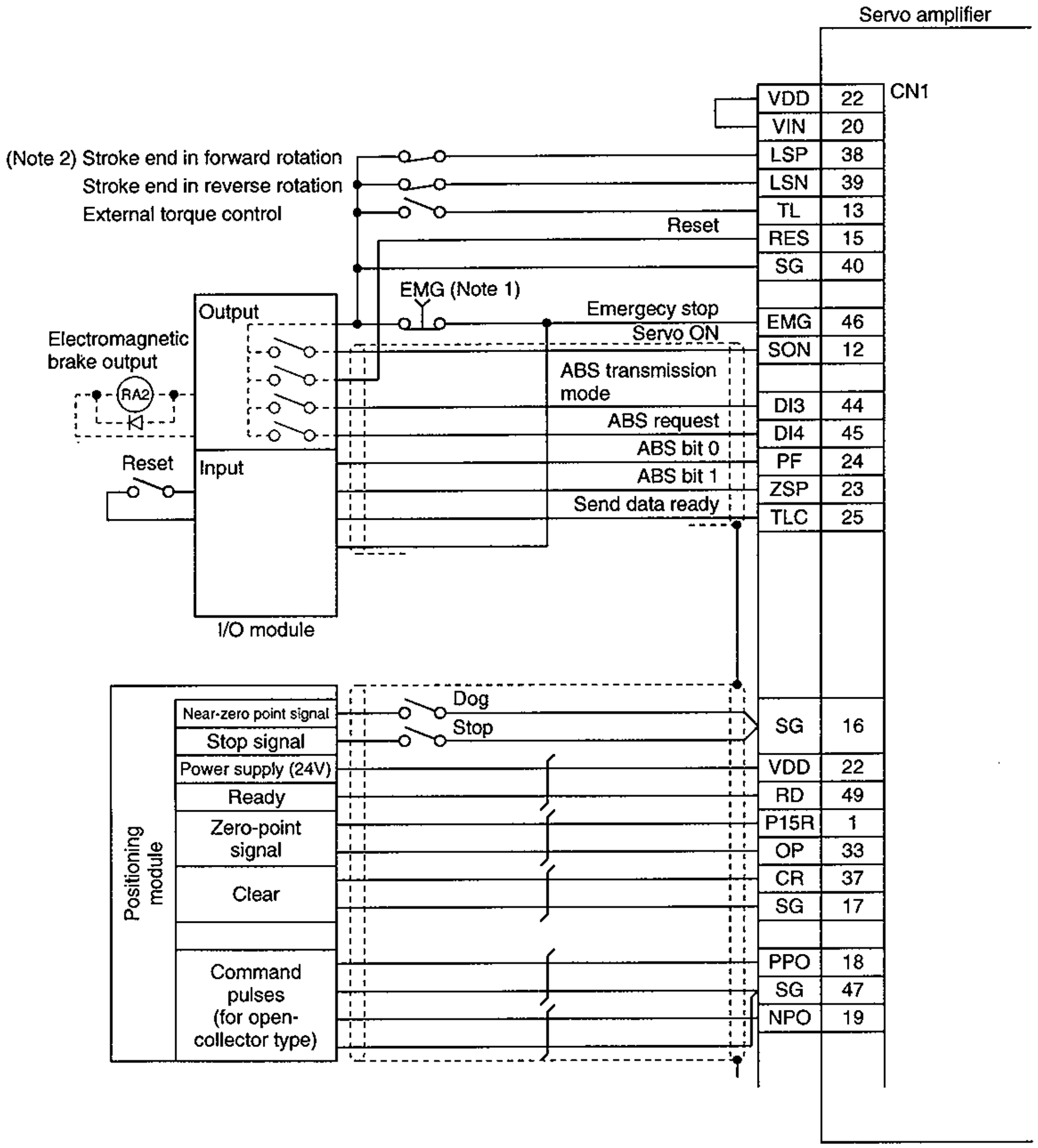
Open the switch window, fit the battery, and insert the plug into CN5

(C) MR-H11KAN to MR-H22KAN


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

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

5.4 Standard Connection Diagram



Note: 1. Always install the emergency stop switch.
2. For operation, always short the forward/reverse rotation stroke end (LSN/LSP) with SG.

5.5 Signal Explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in Section 3.3.2.
For the I/O interfaces (symbols in the I/O Category column in the table), refer to Section 3.6.

Signal Name	Code	Pin No.	Function/Application	I/O Category
ABS transfer mode	DI3	44	The ABS transfer mode terminal. While DI3 is shorted by connection to SG, the servo amplifier is in the ABS transfer mode, and the functions of DI4, PF, ZSP, TLC, and CR are as indicated in this table.	DI-1
ABS request	DI4	45	To be shorted to request the ABS data in the ABS transfer mode.	DI-1
ABS bit 0	PF	24	Indicates the lower bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between PF and SG is closed.	DO-1
ABS bit 1	ZPS	23	Indicates the upper bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between ZSP and SG is closed.	DO-1
Send data ready	TLC	25	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion for the ready state, the circuit between TLC and SG is closed.	DO-1
Zero point set	CR	37	When CR-SG are shorted, the position control counter is cleared and the zeroing data is stored into the non-volatile memory (backup memory).	DI-1

5.6 Startup Procedure

(1) Battery installation

Refer to Section 5.3 "Installation of absolute position backup battery".

(2) Parameter setting

Set 1□□□ in parameter No. 3 of the servo amplifier and switch power off, then on.

(3) Resetting of absolute position erase alarm (AL25)

After connecting the encoder cable, the absolute position erase alarm (AL25) occurs at first power-on. Leave the alarm as it is for a few minutes, then switch power off, then on to reset the alarm.

(4) Confirmation of absolute position data transfer

When the servo on pushbutton is turned on, the absolute position data is transferred to the programmable controller. When the ABS data is transferred properly:

(a) The ready output (RD) turns on.

(b) The programmable controller/ABS data ready contact (M3 for A1SD71, M99 for 1PG) turns on.

(c) The servo parameter unit's absolute position indication or the Servo Configuration software ABS data display window (refer to Section 5.9) and programmable controller side ABS data registers (D3, D4 for A1SD71, D106, D107 for 1PG) show the same value (at the home position address of 0).
If any warning such as ABS time-out warning (ALE5) or programmable controller side transfer error occurs, refer to Section 5.10 or Chapter 10 and take corrective action.

(5) Home position setting

The home position must be set if:

(a) System setup is performed;

(b) The control printed board in the servo amplifier or the amplifier has been changed;

(c) The servo motor has been changed; or

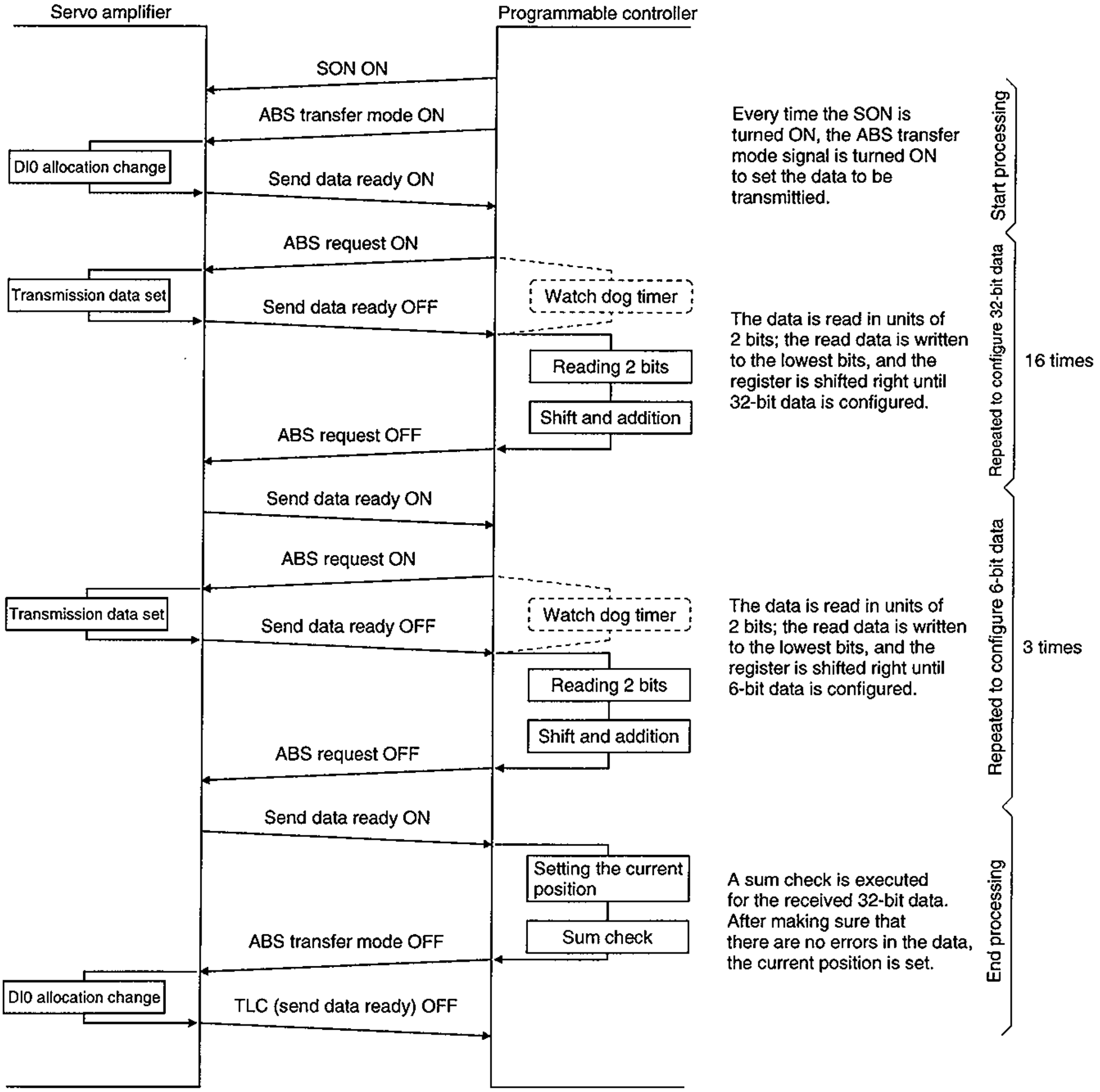
(d) The absolute position erase alarm (AL25) occurred.

In the absolute position system, the absolute position coordinates are made up by making home position setting at the time of system setup.
The motor shaft may misoperate if positioning operation is performed without home position setting.
Always make home position setting before starting operation.
For the home position setting method and types, refer to Section 5.7.3.

5.7 Absolute Position Data Transfer Protocol

5.7.1 Data transfer procedure

Each time the SON signal is turned ON (when the power is switched ON for example), the programmable controller reads the position data (present position) of the servo amplifier.
Time-out monitoring is performed by the programmable controller.

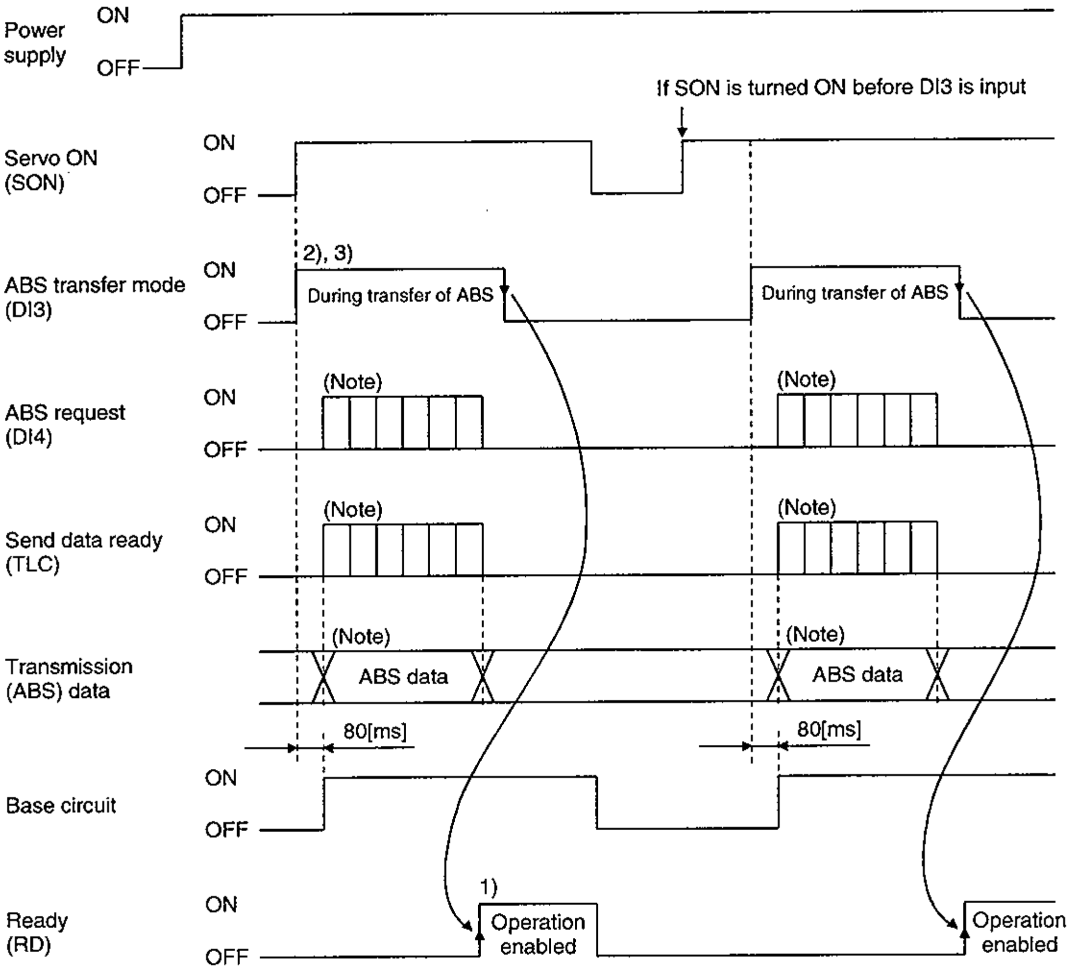


5.7.2 Transfer method

The sequence in which the base circuit is turned ON (servo ON) when it is in the OFF state due to the servo ON (SON) signal going OFF, an emergency stop, or alarm, is explained below. To turn ON the base circuit, the ABS transfer mode signal (DI3) must be turned ON. Unless the ABS transfer mode signal (DI3) is turned ON, the base circuit cannot be turned ON.

(1) At power-on

(a) Timing chart

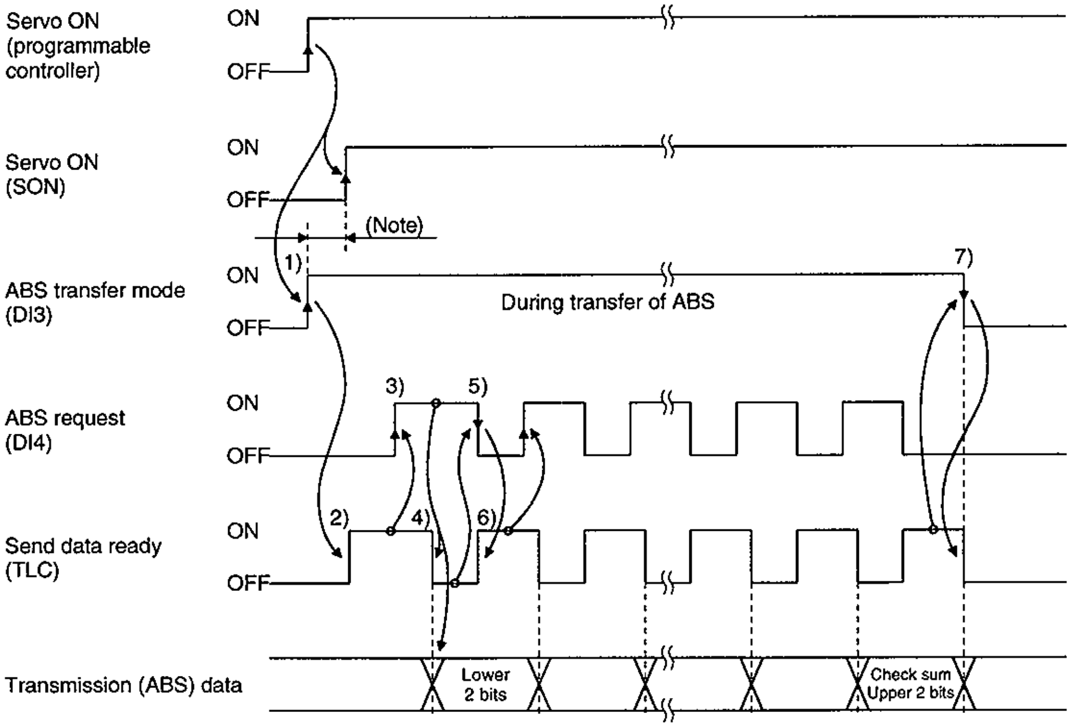


Note: For details, refer to (1) (b) in this section.

1) The ready signal (RD) is turned ON when the ABS transfer mode signal (DI3) is turned OFF after transmission of the ABS data.
   While the ready signal (RD) is ON, the ABS transfer mode signal (DI3) input is not accepted.
2) Even if the servo ON (SON) signal is turned ON before the ABS transfer mode signal (DI3) is turned ON, the base circuit is not turned ON until the ABS transfer mode signal (DI3) is turned ON.
   If a servo alarm has occurred, the ABS transfer mode signal (DI3) is not received.
   The ABS transfer mode signal (DI3) allows data transmission even while a servo warning is occurring.
3) If the ABS transfer mode signal (DI3) is turned OFF during the ABS transfer mode, the ABS transfer mode is interrupted and the time-out error (ALE5) occurs.
4) The functions of output signals such as ZSP, TLC, and PF change depending on the ON/OFF state of the ABS transfer mode signal (DI3).
   Note that if the ABS transfer mode signal (DI3) is turned ON for a purpose other than ABS data transmission, the output signals will be assigned the functions of ABS data transmission.

Symbol	Pin No. (CN1 connector)	Output signal	
		ABS transfer mode (DI3): OFF	ABS transfer mode (DI3): ON
PF	24	Positioning completion	ABS data bit 0
ZSP	23	Zero speed	ABS data bit 1
TLC	25	During torque limit control	Send data ready

(b) Detailed description of absolute position data transfer



Note: If the servo ON (SON) signal is not turned ON within 1 second after the ABS transfer mode signal (DI3) is turned ON, an SON time-out warning (ALEA) occurs. This warning, however, does not interrupt data transmission. It is automatically cleared when the servo ON (SON) signal is turned ON.

1) The programmable controller turns ON the ABS transfer mode signal (DI3) and servo ON (SON) signals at the leading edge of the internal servo ON signal.
2) In response to the ABS transfer mode signal, the servo detects and calculates the absolute position and turns ON the send data ready (TLC) signal to notify the programmable controller that the servo is ready for data transmission.
3) After acknowledging that the ready to send (TLC) signal has been turned ON, the programmable controller turns ABS request (DI4) ON.
4) In response to ABS request (DI4), the servo outputs the lower 2 bits of the ABS data and the ready to send (TLC) signal in the OFF state.
5) After acknowledging that the ready to send (TLC) signal has been turned OFF, which implies that 2 bits of the ABS data have been transmitted, the programmable controller reads the lower 2 bits of the ABS data and then turns OFF the ABS request (DI4).
6) The servo turns ON the ready to send (TLC) so that it can respond to the next request.
   Steps 3) to 6) are repeated until 32-bit data and the 6-bit check sum have been transmitted.
7) After receiving of the check sum, the programmable controller turns the ABS transfer mode signal (DI3) OFF.
   If the ABS transfer mode signal (DI3) is turned OFF during data transmission, the ABS transfer mode is interrupted.

(c) Checksum

The check sum is the code which is used by the programmable controller to check for errors in the received ABS data. The 6-bit check sum is transmitted following the 32-bit ABS data.
At the programmable controller, calculate the sum of the received ABS data using the ladder program and compare it with the check sum code sent from the servo.
The method of calculating the check sum is shown. Every time the programmable controller receives 2 bits of ABS data, it adds the data to obtain the sum of the received data. The check sum is 6-bit data.
Negative data is available for the FX-1PG and unavailable for the A1SD71.

Example: ABS data: −10 (FFFFFFF6H)

$$\begin{array}{r} 10^{b} \\ 01^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ +)\quad 11^{b} \\ \hline 101101^{b} \end{array}$$

<Appendix>

Decimal −10

↓

Hexadecimal FFFF FFF6

↓

Binary 1111 1111 1111··········0110

When the binary data of each 2bits of the ABS data is added up, "10 1101^{b} " is obtained.

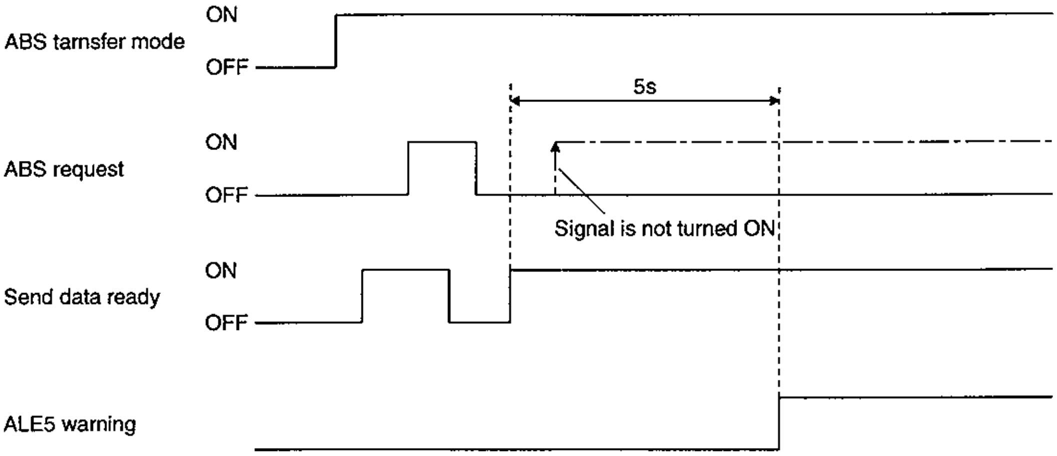
Therefore, the check sum of "-10" (ABS data) is "2D^{b}"

(2) Transmission error

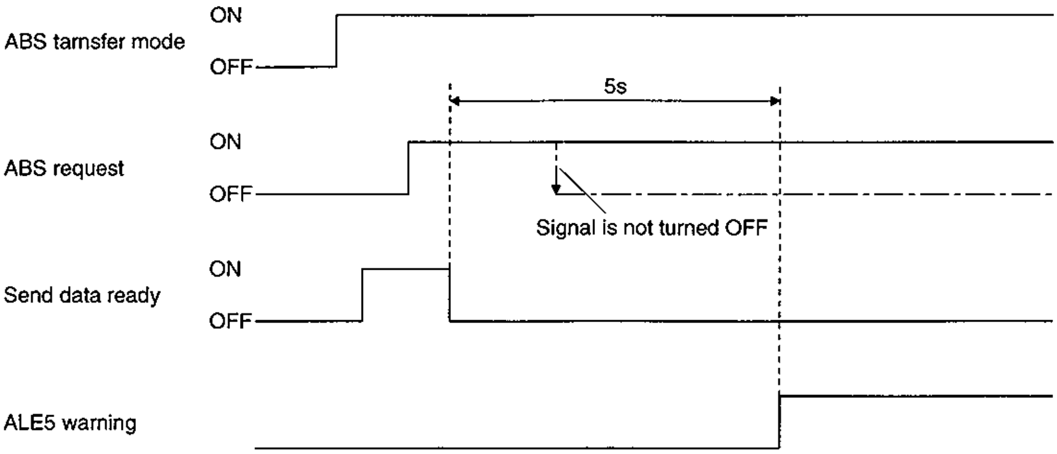
(a) Time-out warning(ALE5)

In the ABS transfer mode, the time-out processing shown below is executed at the servo. If a time-out error occurs, an ABS time-out warning (ALE5) is output.

1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)
If the ABS request signal is not turned ON by the programmable controller within 5s after the send data ready signal is turned ON, this is regarded as a transmission error and the ABS time-out warning (ALE5) is output.

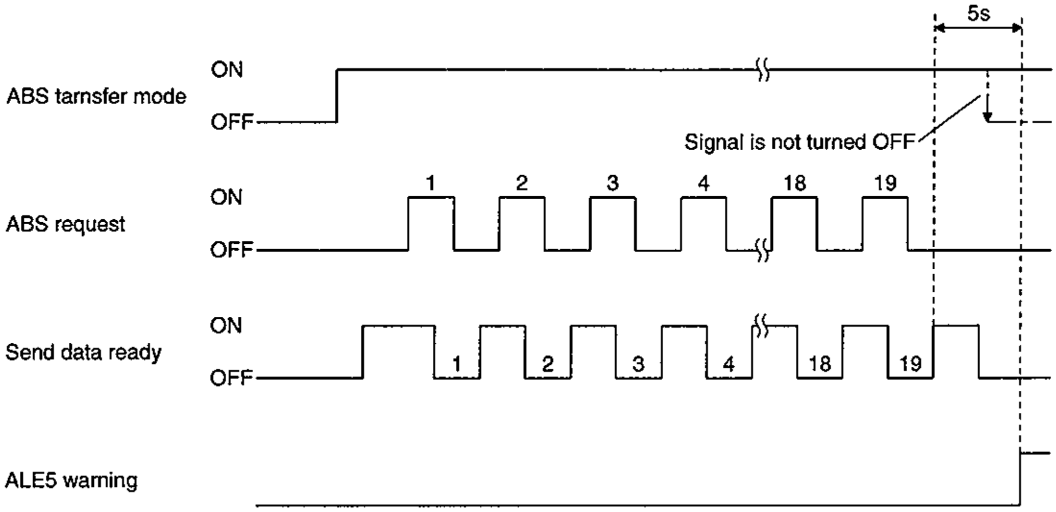


2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)
If the ABS request signal is not turned OFF by the programmable controller within 5s after the send data ready signal is turned OFF, this is regarded as the transmission error and the ABS time-out warning (ALE5) is output.



3) ABS transfer mode finish-time time-out check

If the ABS transfer mode signal is not turned OFF within 5s after the last ready to send signal (19th signal for ABS data transmission) is turned ON, it is regarded as the transmission error and the ABS time-out warning (ALE5) is output.



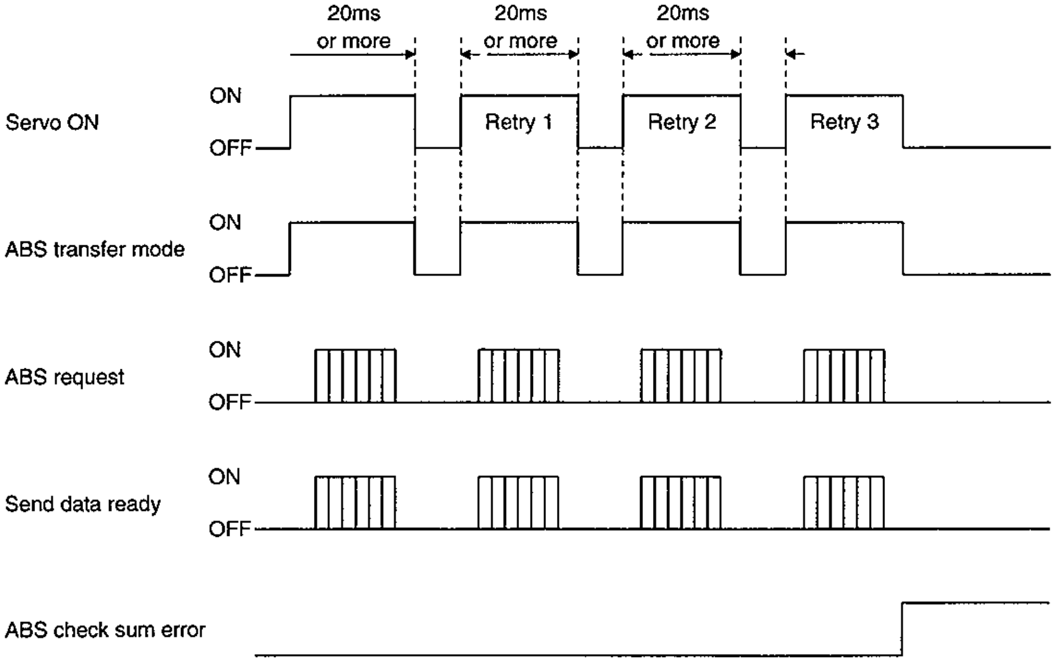
(b) Check sum error

If the check sum error occurs, the programmable controller should retry transmission of the ABS data.

Using the ladder check program, turn OFF the ABS transfer mode (DI3) and servo ON (SON) signals once. Turn them ON again after an OFF time of longer than 20 ms.

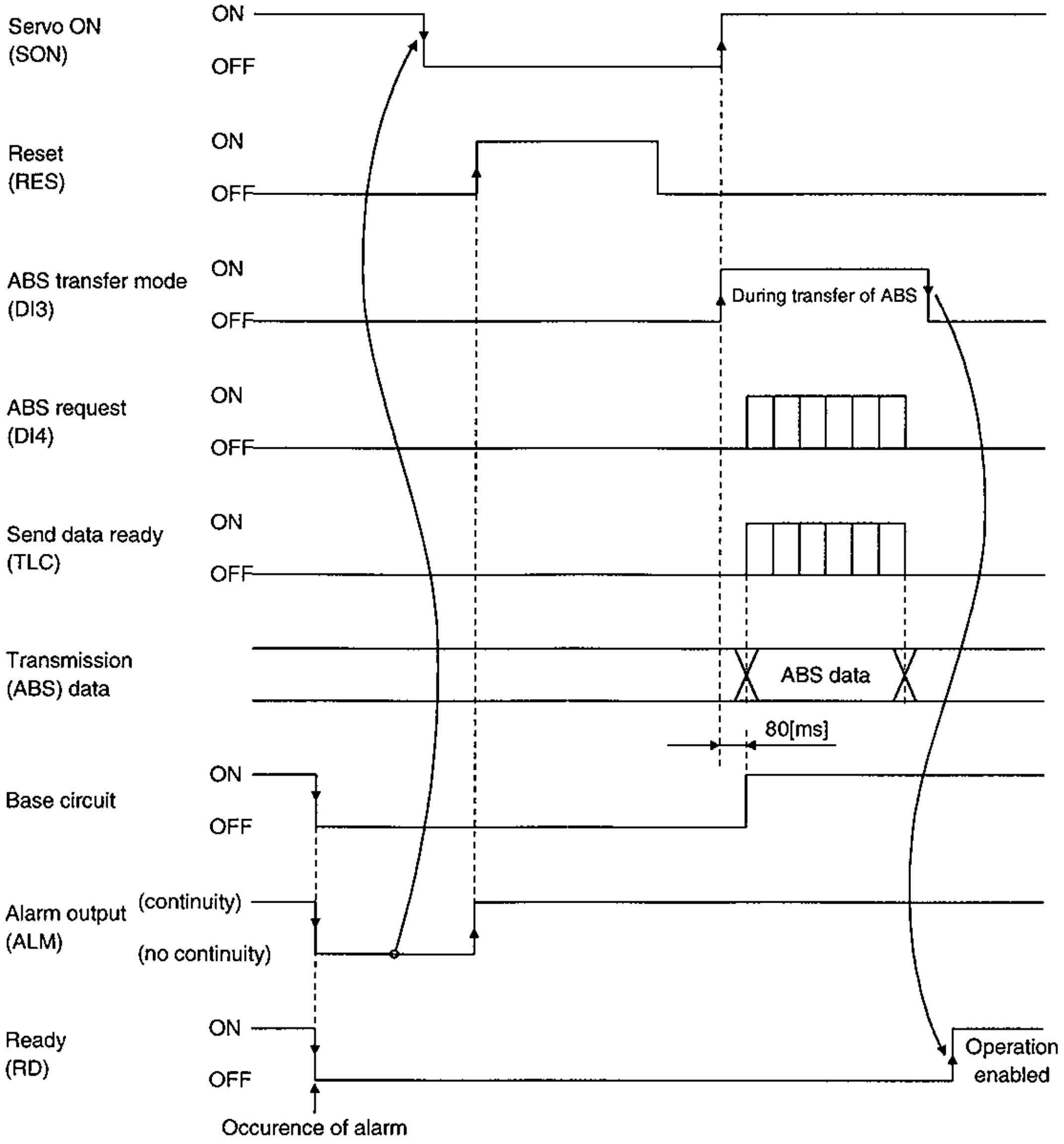
If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

The start command should be interlocked with the ABS data ready signal to disable positioning operation when an check sum error occurs.



(3) At the time of alarm reset

If an alarm occurs, turn OFF the servo ON (SON) signal by detecting the alarm output (ALM).
If an alarm has occurred, the ABS transfer mode signal (DI3) cannot be accepted.
In the reset state, the ABS transfer mode signal (DI3) can be input.
Since the current value is updated during an alarm, a travel during the alarm will be a position droop (droop pulses). If the alarm state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the alarm state at high speed. Read the ABS data again to evade this state.



(4) At the time of emergency stop reset

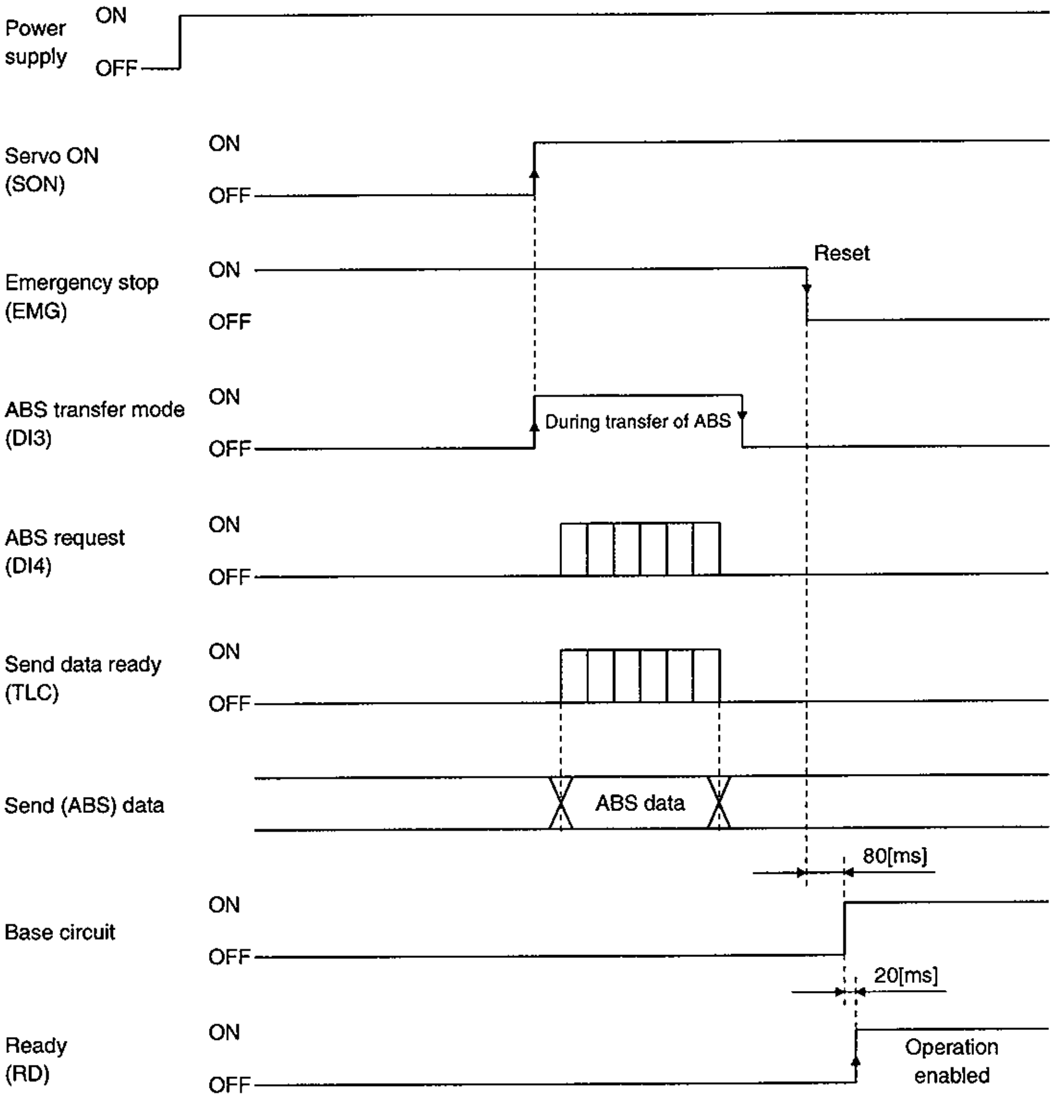
(a) If the power is switched ON in the emergency stop state

The emergency stop state can be reset while the ABS data is being transferred.

If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 80[ms] after resetting. If the ABS transfer mode signal (DI3) is OFF when the base circuit is turned ON, the ready signal (RD) is turned ON 20[ms] after the turning ON of the base circuit. If the ABS transfer mode signal (DI3) is ON when the base circuit is turned ON, it is turned OFF and then the ready signal (RD) is turned ON.

The ABS data can be transmitted after the emergency stop state is reset. Turn ON the ABS transfer signal (DI3) after resetting the emergency stop state.

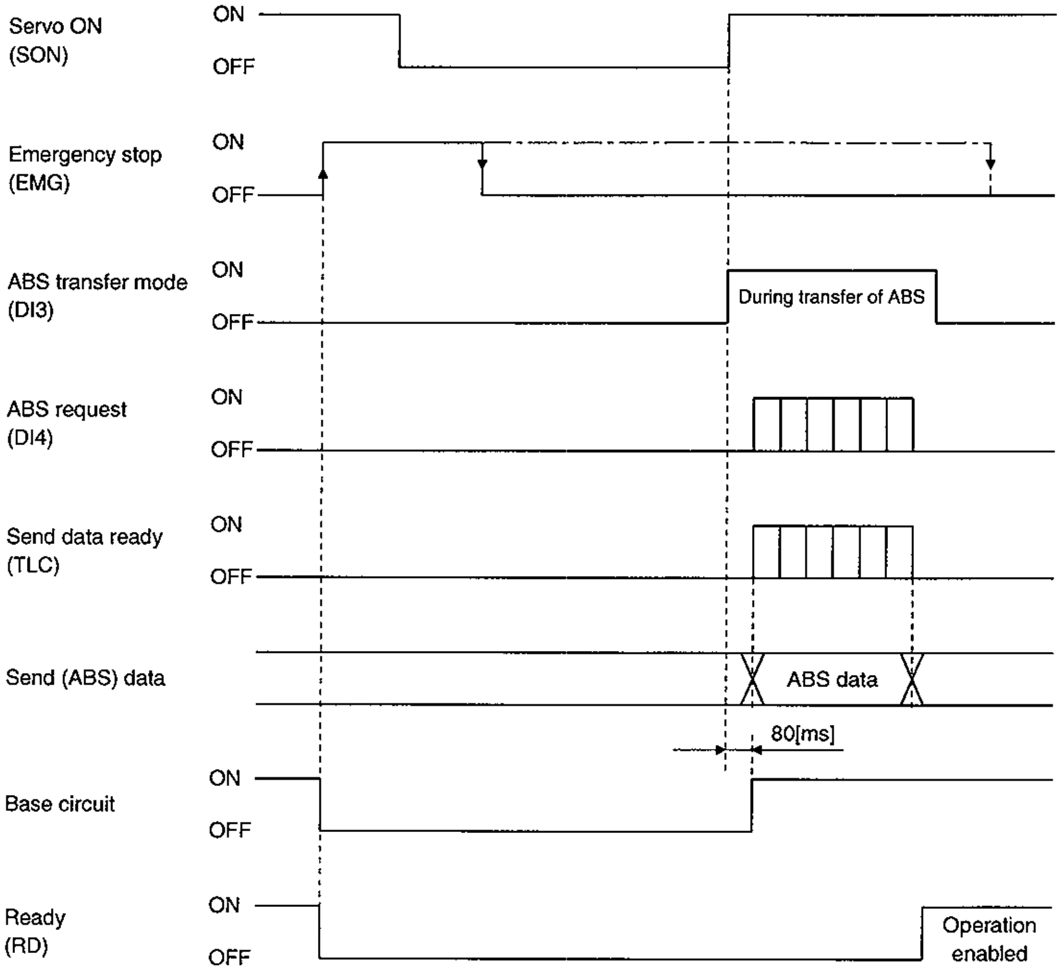
Since the current value is updated during an emergency stop, a travel during the emergency stop will be a position droop (droop pulses). If the emergency stop state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the emergency stop state at high speed. Read the ABS data again to evade this state.



(b) If emergency stop is activated during servo ON

The ABS transfer mode signal (DI3) is permissible while in the emergency stop state. In this case, the base circuit and the ready signal (RD) are turned ON after the emergency stop state is reset. Since the current value is updated during an emergency stop, a travel during the emergency stop will be a position droop (droop pulses). If the emergency stop state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved during the emergency stop state at high speed.

Read the ABS data again to evade this state.



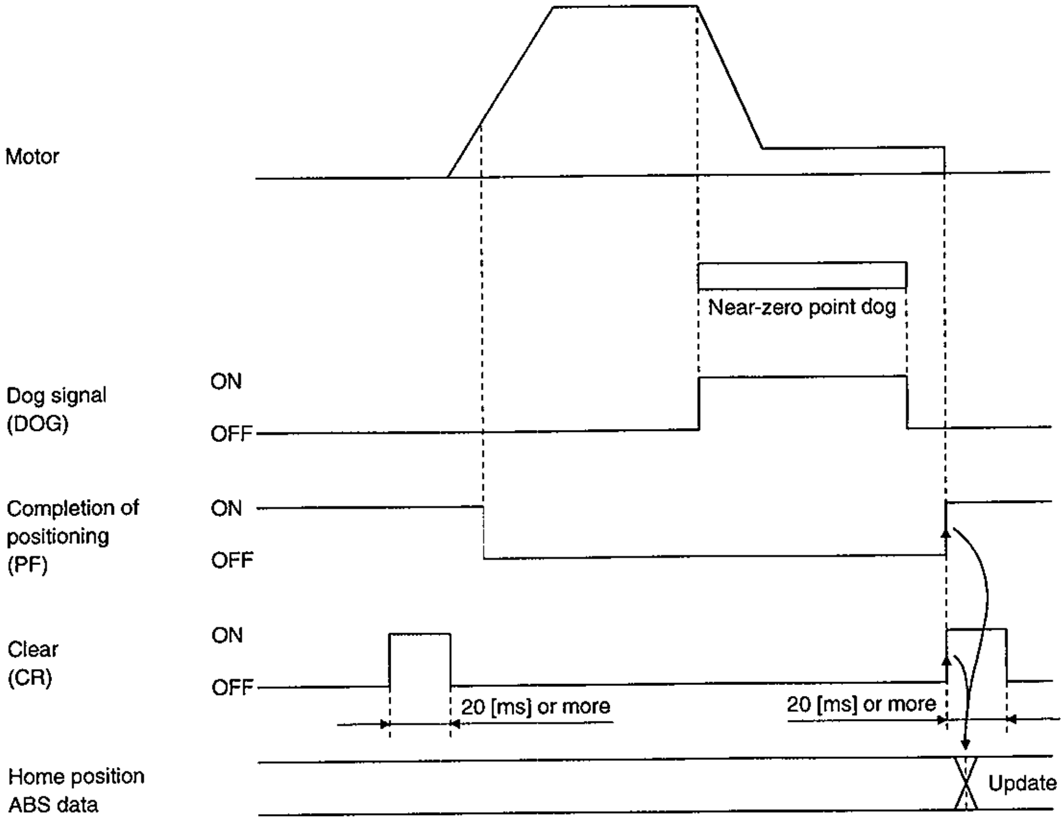
5.7.3 Home Position Setting

(1) Dog type zeroing

Preset a zeroing creep speed at which the machine will not be given impact. On detection of a zero pulse, the clear signal (CR) is turned from off to on. At the same time, the servo amplifier clears the droop pulses, comes to a sudden stop, and stores the stop position into the non-volatile memory as the home position ABS data.

The clear signal should be turned on after it has been confirmed that the in-position (PF) is on. If this condition is not satisfied, the zero setting error (AL96) will occur, but that warning will be reset automatically by making zeroing correctly.

The number of home position setting times is limited to 100,000 times.

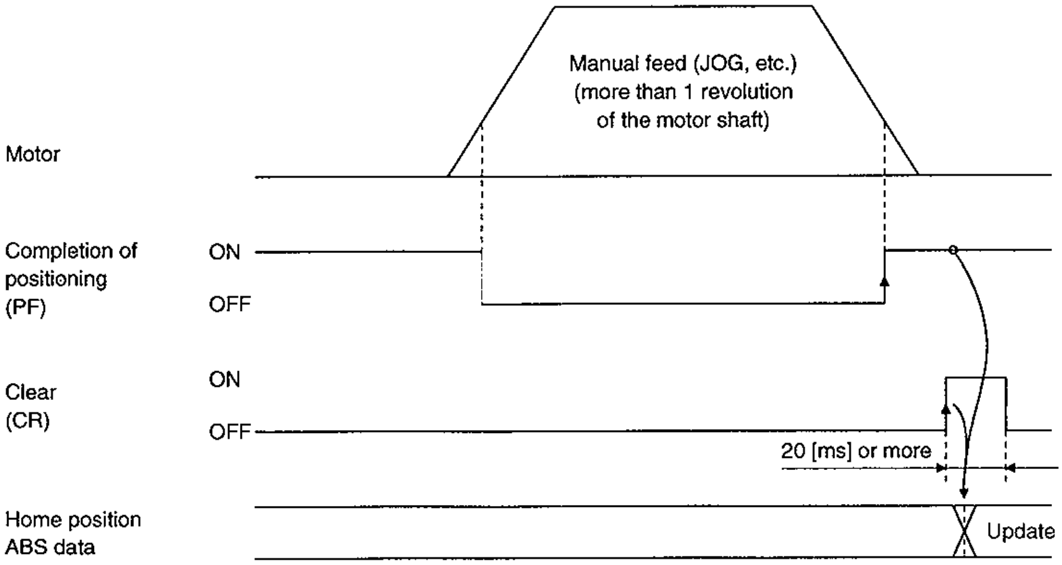


(2) Data set type zeroing

Move the machine to the position where the home position is to be set by performing manual operation such as jog operation to turn the motor shaft more than one revolution. When the clear signal (CR) is on for longer than 20ms, the stop position is stored into the non-volatile memory as the home position ABS data.

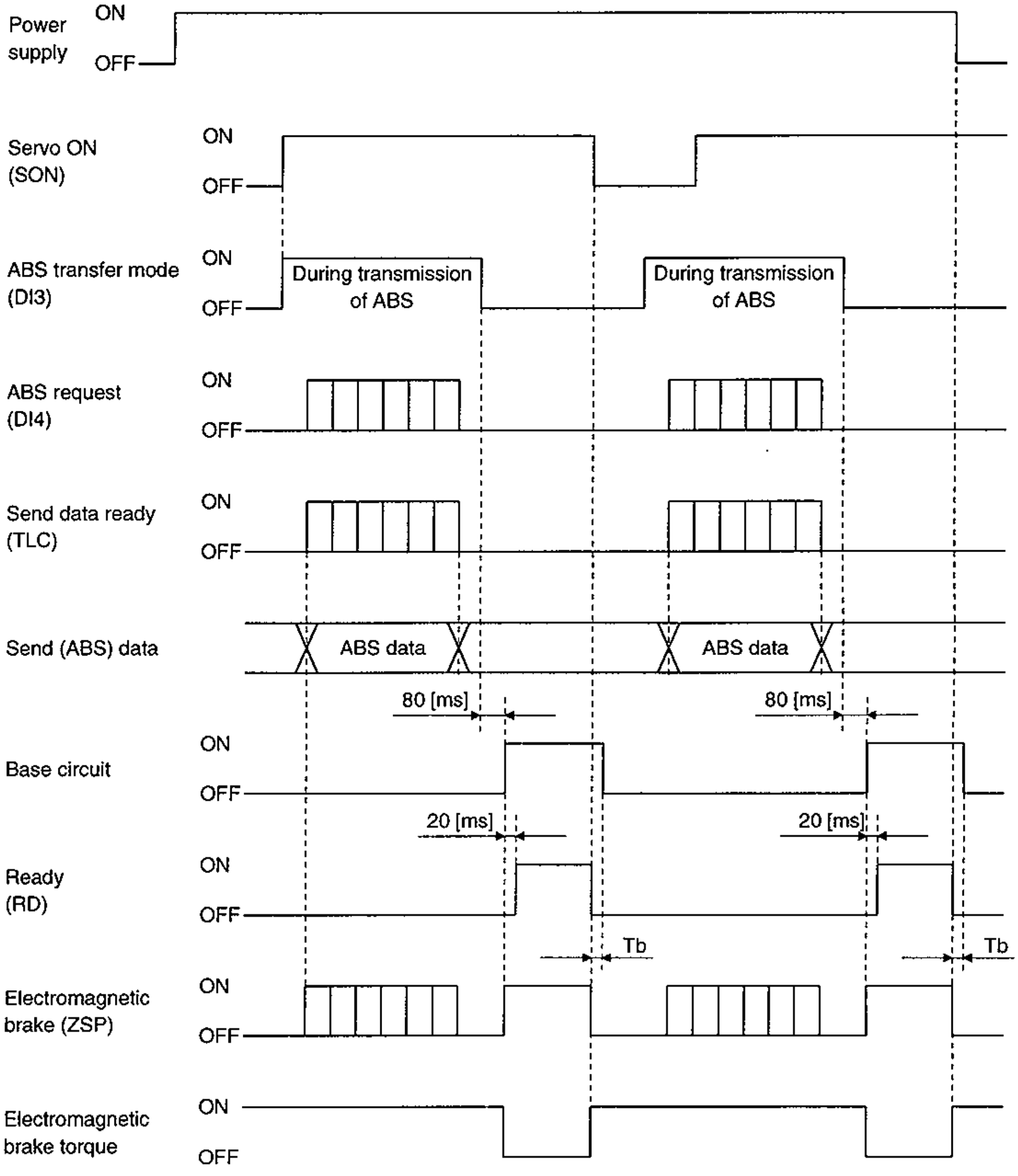
The clear signal should be turned on after it has been confirmed that the in-position (PF) is on. If this condition is not satisfied, the zero setting error (AL96) will occur, but that warning will be reset automatically by making zeroing correctly.

The number of home position setting times is limited to 100,000 times.



5.7.4 Use of servo motor with electromagnetic brake

The timing charts at power on/off and servo on (SON) on/off are given below.
Preset □□1□ in parameter No. 3 to change ZSP into the electromagnetic brake interlock signal. When the ABS transfer mode is ON, the electromagnetic brake interlock (ZSP) is used as the ABS data bit 1.
Hence, make up an external sequence which will cause the electromagnetic brake torque to be generated by the ABS mode (DI3) and electromagnetic brake interlock.



5.7.5 How to process the absolute position data at detection of stroke end

The servo amplifier stops the acceptance of the command pulse when stroke end (LSP·LSN) is detected, clears the droop pulses to 0 at the same time, and stops the servo motor rapidly.
At this time, the programmable controller keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the servo amplifier and the programmable controller, a difference will occur between the position data of the servo amplifier and that of the programmable controller.
To prevent this difference in position data from occurring, do as described below. When the servo amplifier has detected the stroke end, perform jog operation or the like to clear the stroke end. After that, switch the servo ON signal off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the servo amplifier to be transferred to the programmable controller, restoring the normal data.

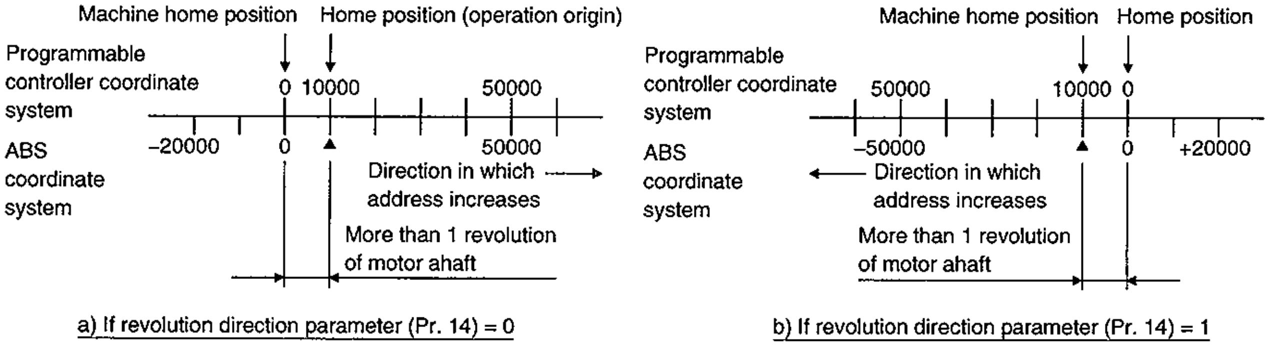
5.8 Examples of Use

5.8.1 MELSEC-A1S (A1SD71)

(1) Instructions

The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the motor enters the range where the coordinate value is negative due to the load torque or a fall on a vertical axis when the power is turned ON/OFF at a point near the machine home position, the system fails to detect the absolute position. To prevent this problem, it is necessary to set the home position (operation origin) for positioning in addition to the machine home position.

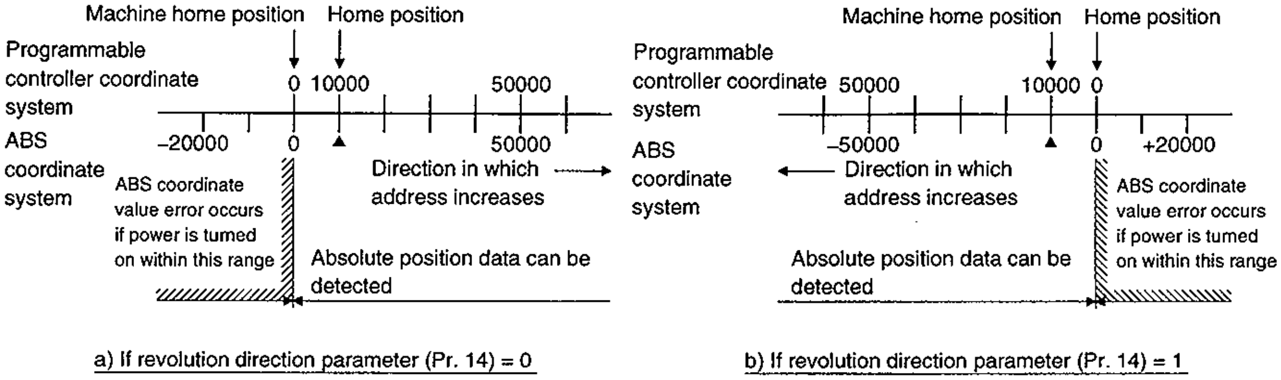
(a) The home position should be set in the direction in which the position address of the programmable controller coordinate system increases on moving away from machine home position, as illustrated below. Note that the home position for positioning must be more than one revolution of the servo motor shaft from the machine home position.
If the address of the machine home position is changed to any value other than "0", the home position should be set in the direction in which the position address increases on moving away from the machine home position (machine home position after changing the home position address) and at a point removed from the machine home position by more than one revolution of the motor shaft.



a) If revolution direction parameter (Pr. 14) = 0

b) If revolution direction parameter (Pr. 14) = 1

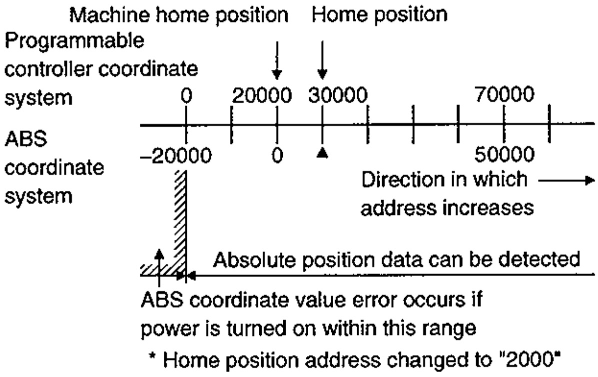
(b) In the range where the address decreases on moving away from the machine home position, do not turn the power supply to the programmable controller or the servo amplifier, the servo ON pushbutton switch, or the PC-RESET switch, ON/OFF. If any of these operations are attempted, the ABS coordinate error (Y4B) is output since the absolute position cannot be detected.



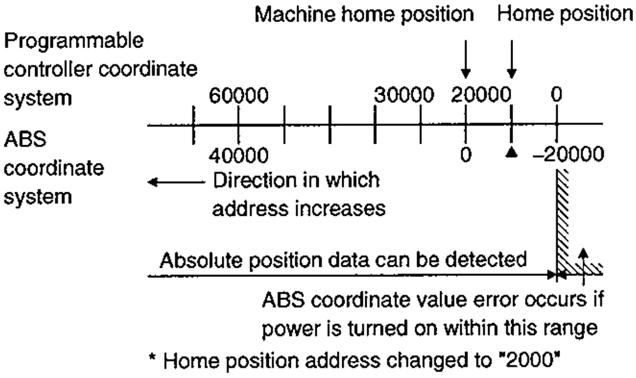
a) If revolution direction parameter (Pr. 14) = 0

b) If revolution direction parameter (Pr. 14) = 1

If the address of the machine home position is changed to any coordinate value other than "0", the programmable controller coordinate system will be as illustrated below.
The power should be turned ON/OFF in the range in which the address increases on moving away from the home position.



a) If revolution direction parameter (Pr. 14) = 0



b) If revolution direction parameter (Pr. 14) = 1

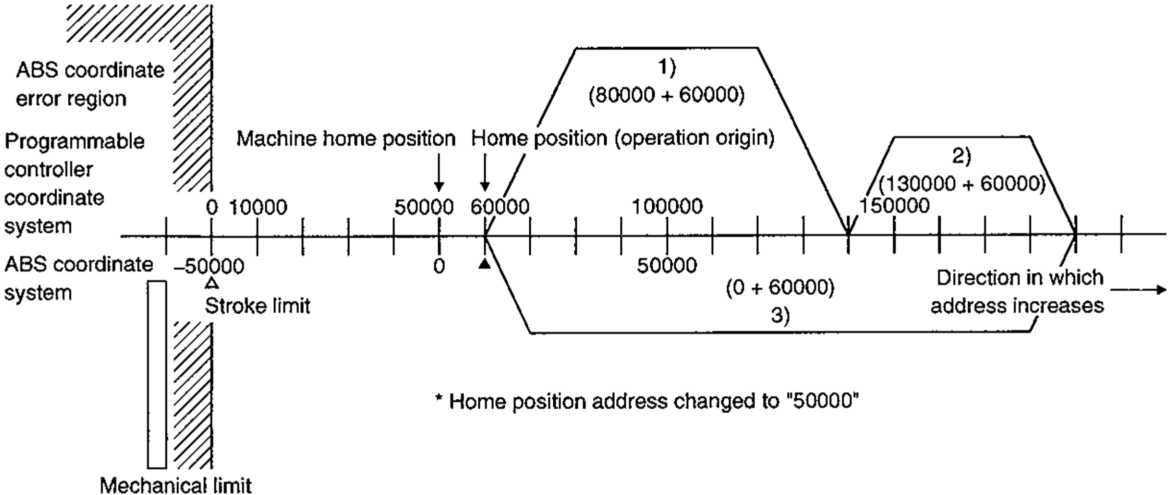
(c) In a positioning program, the address of the positioning point should be determined by adding the home position address to the target position address.

Example) To execute positioning at 1), 2), and 3).

1) Positioning at position address 80000
(PC coordinate 140000)

2) Positioning at position address 130000
(PC coordinate 190000)

3) Positioning at position address 0
(PC coordinate 60000)

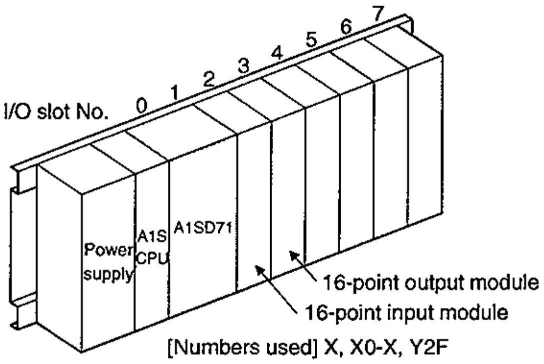


a) If revolution direction parameter (Pr. 14) = 0

(d) Slot arrangement

The sequence programs presented in this section show I/O numbers (X, Y) assuming the arrangement of modules on the main base unit is as illustrated below. A1SD71 is mounted at I/O slots 0 and 1, a 16-point input module at slot 2, and 16-point output module at slot 3. If the actual arrangement of the modules differs from this arrangement, change the X and Y numbers accordingly.

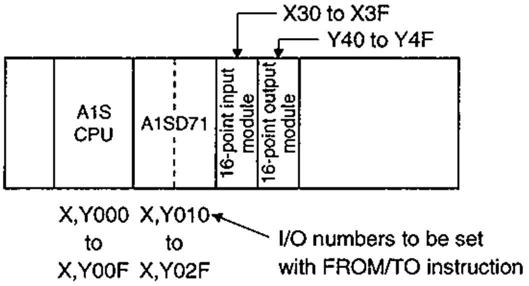
The numbers of the devices (M, D, T, etc.) used in the program can be changed as required.



Example arrangement of modules

(e) Points

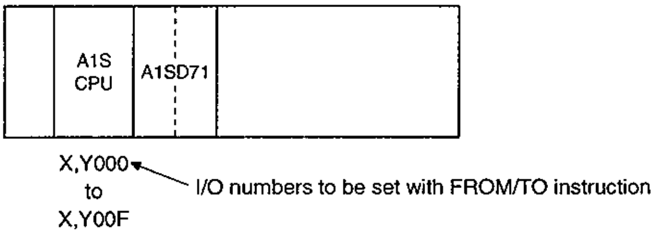
1) The A1SD71 has 48 I/O points and occupies 2 slots. For I/O allocation using the GPP function, follow the instructions given below.
   First slot: Vacant slot 16 points
   Second slot: Special function module 32 points
2) To execute the FROM/TO instruction for the A1SD71, use the head I/O number of the second slot.



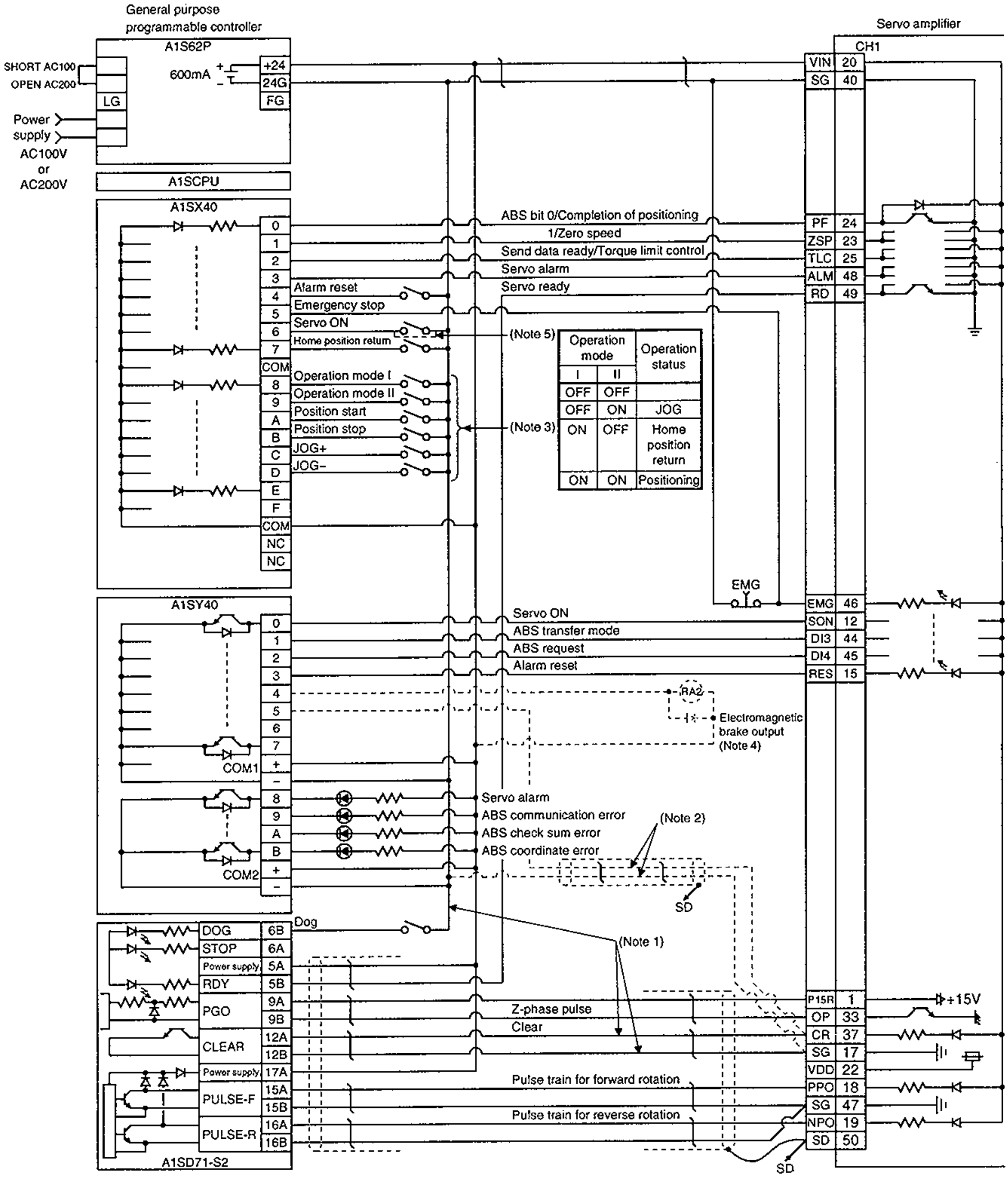
Note: The program example given in (3) in this section is for 1-axis control. Slot allocations are as illustrated to the left. To use the system for 2-axis control, increase the number of I/O points.

Therefore, the I/O number to be set with the FROM/TO instruction is "head I/O number allocated to the A1SD71 + 010H".

3) By setting "0 point of vacant slot" for the first slot of the A1SD71 in the "I/O allocation" of the GPP function, the 16 points in the first slot can be saved.
   In this case, the I/O number to be set with the FROM/TO instruction is the same number as the head I/O number allocated to the A1SD71.



(2) Connection diagram



Operation mode		Operation status
I	II	
OFF	OFF	
OFF	ON	JOG
ON	OFF	Home position return
ON	ON	Positioning

Note 1: To be connected for dog type home position setting. The connection in Note 2 is not required.
2: To be connected for data set type home position setting. The connection in Note 1 is not required.
3: This circuit is for reference only.
4: The electromagnetic brake output should be controlled by connecting the programmable controller output to a relay.
5: To be shorted if a servo ON switch is not used.

(3) Sequence program example

(a) Conditions

This sample program is an ABS sequence program example for a single axis (X axis).

To transmit the ABS data using the OFF-to-ON change of the servo ON signal as the trigger.

1) When the servo ON signal and the GND of the power supply are shorted, the ABS data is transmitted when the power to the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.
2) If a check sum discrepancy is detected in the transmitted data, ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y4A ON).
3) The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y4A ON).
   ON period of ABS transfer mode (Y41)
   ON period of ABS request (Y42)
   OFF period of ready to send ABS data (X32).
4) If the relationship between the polarity (±) of the received ABS data and the setting value for parameter No. 14 (rotating direction) of A1SD71 (AD71) involves negative coordinate values, which cannot be handled by the A1SD71 (AD71), the ABS coordinate error is generated (Y4B ON).

(b) Device list

X input contact		Y output contact	
X30	ABS bit 0 / completion of positioning	Y40	Servo ON
X31	ABS bit 1 / zero speed	Y41	ABS transfer mode
X32	Send ABS data ready / torque limit control	Y42	ABS request
X33	Servo alarm	Y43	Alarm reset
X34	Error reset	X44 (Note 1)	Electromagnetic brake output
X35	Servo emergency stop	Y45 (Note 1)	Clear
X36	Servo ON	Y48	Servo alarm
X37	Home position return start	Y49	ABS communication error
X38	Operation mode I	Y4A	ABS check sum error
X39	Operation mode II	Y4B	ABS coordinate error

D register		M contact	
D0	ABS data transmission counter	M0	ABS data transmission start
D1	Check sum transmission counter	M1	Sum check completion
D2	Check sum addition counter	M2	Sum check discrepancy
D3	ABS data: Lower 16 bits	M3	ABS data ready
D4	ABS data: Upper 16 bits	M4	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M5	Check sum 2 bits read completion
D6	Check data in case of check sum error	M6	ABS 2 bits read completion
D7	Retry frequency	M7	ABS 2 bits request
D8	Forward rotation direction	M8	Servo ON request
D9	Home position address: Lower 16 bits	M9	Servo alarm
D10	Home position address: Upper 16 bits	M10	ABS data transmission retry start pulse
D100	Received shift data: Lower 16 bits	M11	Retry flag setting
D101	Received shift data: Upper 16 bits	M12	Retry flag reset
		M13	PLS processing command
		M20 (Note 1)	Clear signal ON timer request
		M21 (Note 2)	Data set type home position return request

T timer	
T0	ABS transfer mode timer
T1	ABS request response timer
T2	Retry wait timer
T3	Ready to send response timer
T10 (Note 1)	Clear signal ON timer
T200	Transmitted data read 10ms delay timer

C counter	
C0	ABS data receive frequency counter
C1	Check sum receive frequency counter
C2	Retry counter

Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

- Parameters of the A1SD71-S2 (AD71) positioning module
  1) Unit setting : 3=pulse (PLS)
  2) Travel per pulse : 1=1 pulse

To select the unit other than the pulse, conversion into the unit of the feed command value per pulse is required. Hence, add the following program to the area marked Note 1 in the sequence program.

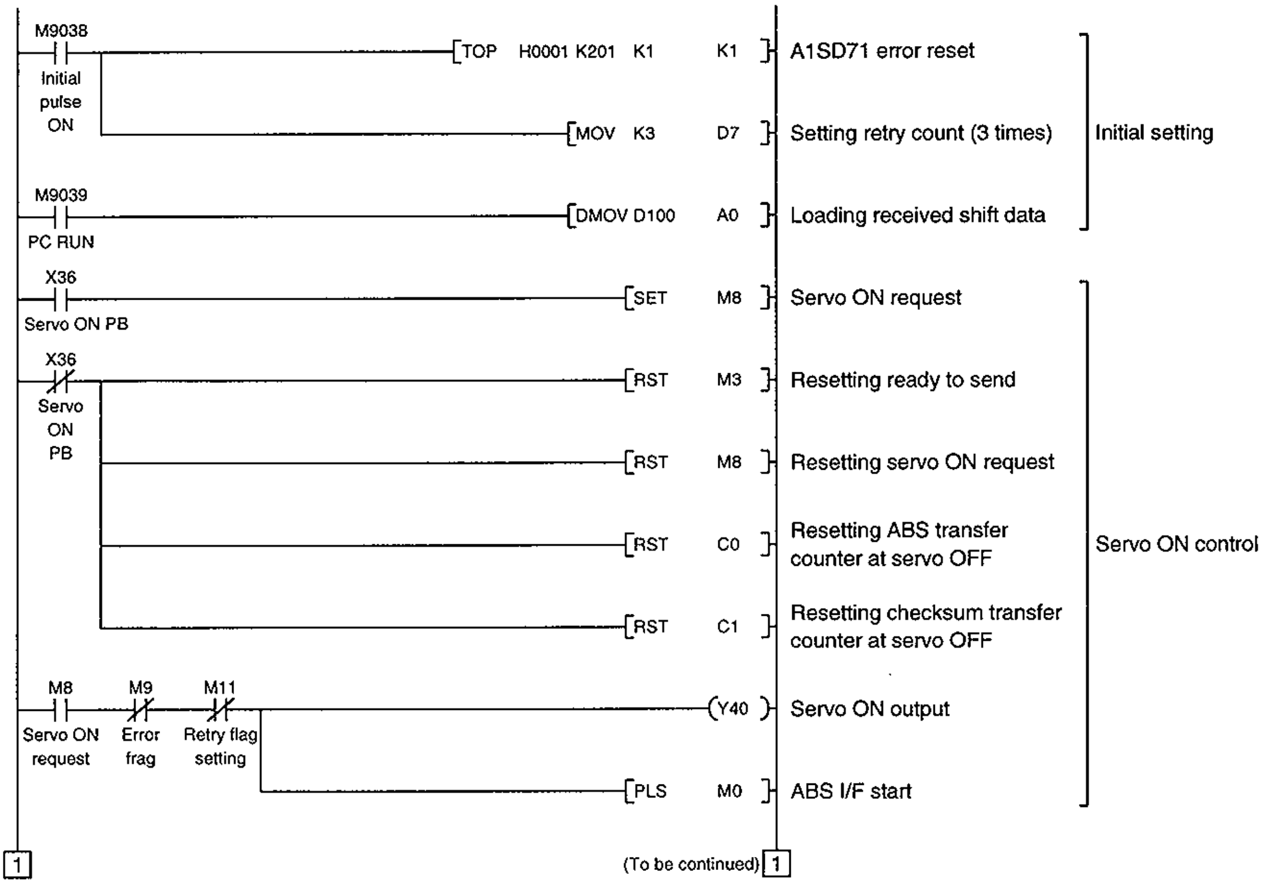
<Additional program>

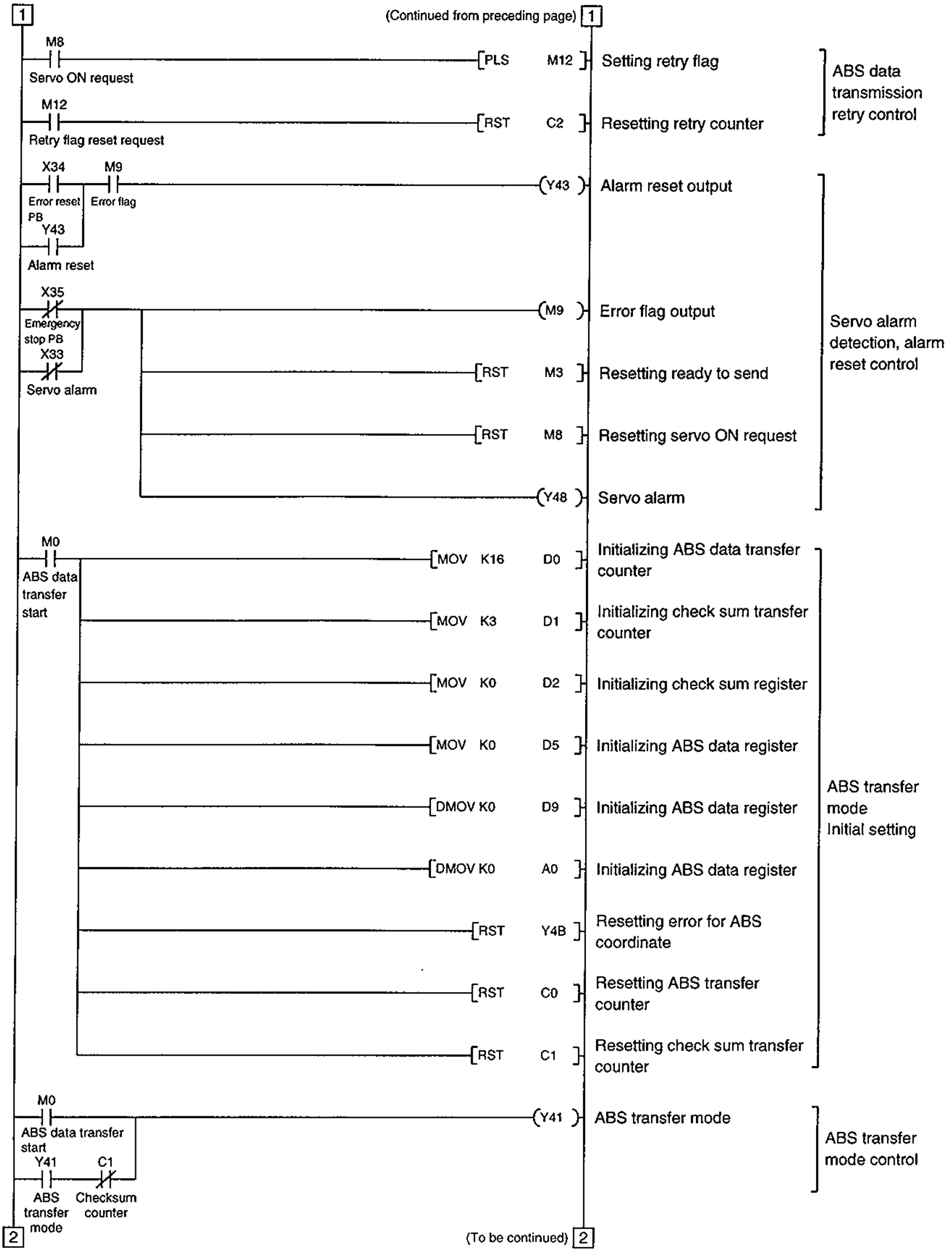
—[D * P K□□ D3 D3]

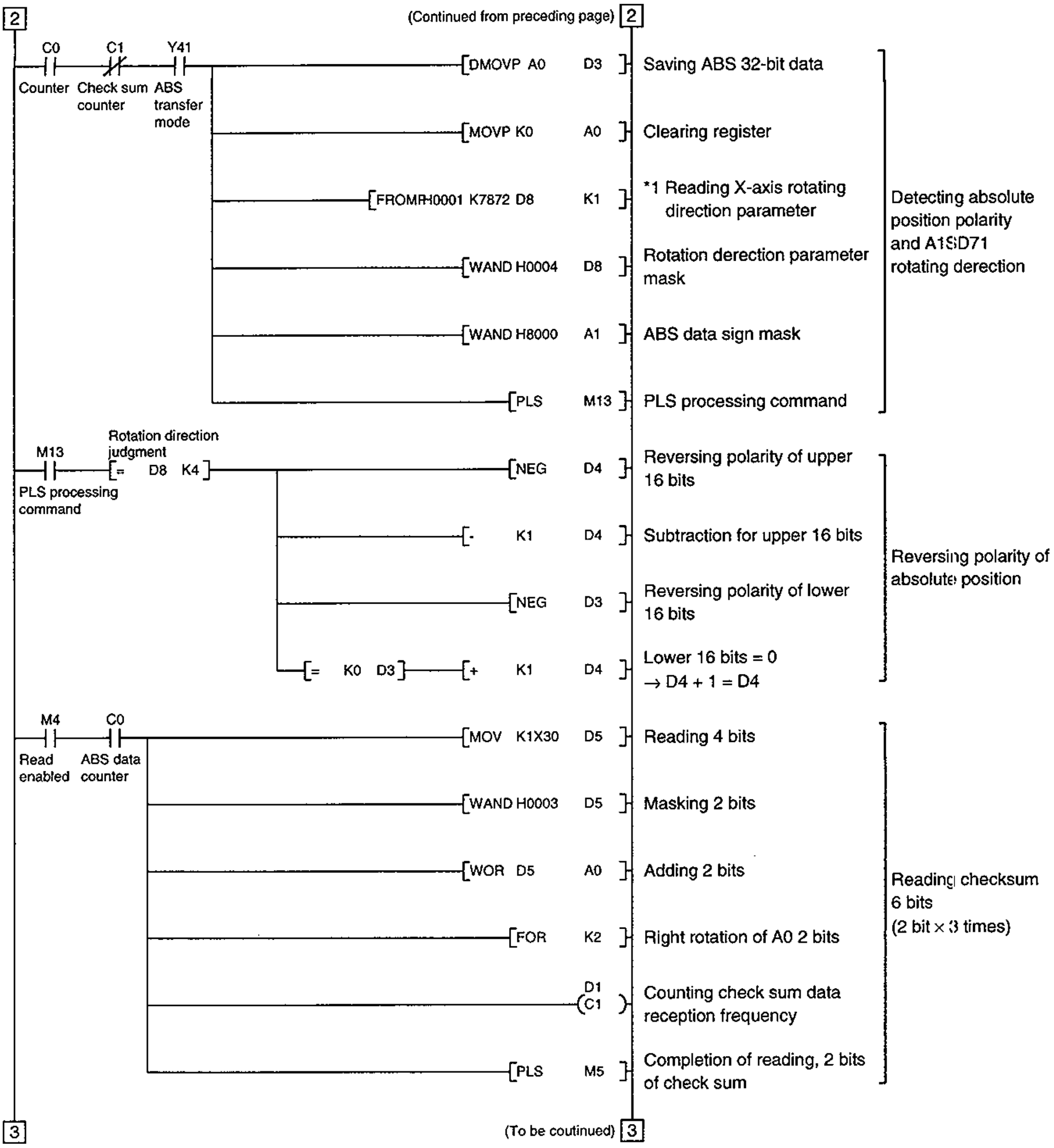
Item	mm			inch			degree			PULS
Unit setting	0			1			2			3
Travel per pulse	0.1 to	1.0 to	10.0	0.00001 to	0.0001 to	0.001 to	0.00001 to	0.0001 to	0.001 to	
Unit of travel	µm/PLS			inch/PLS			degree/PLS			PLS
Constant K for conversion into unit of travel	1 to	10 to	100	1 to	10 to	100	1 to	10 -to	100	None

Reference

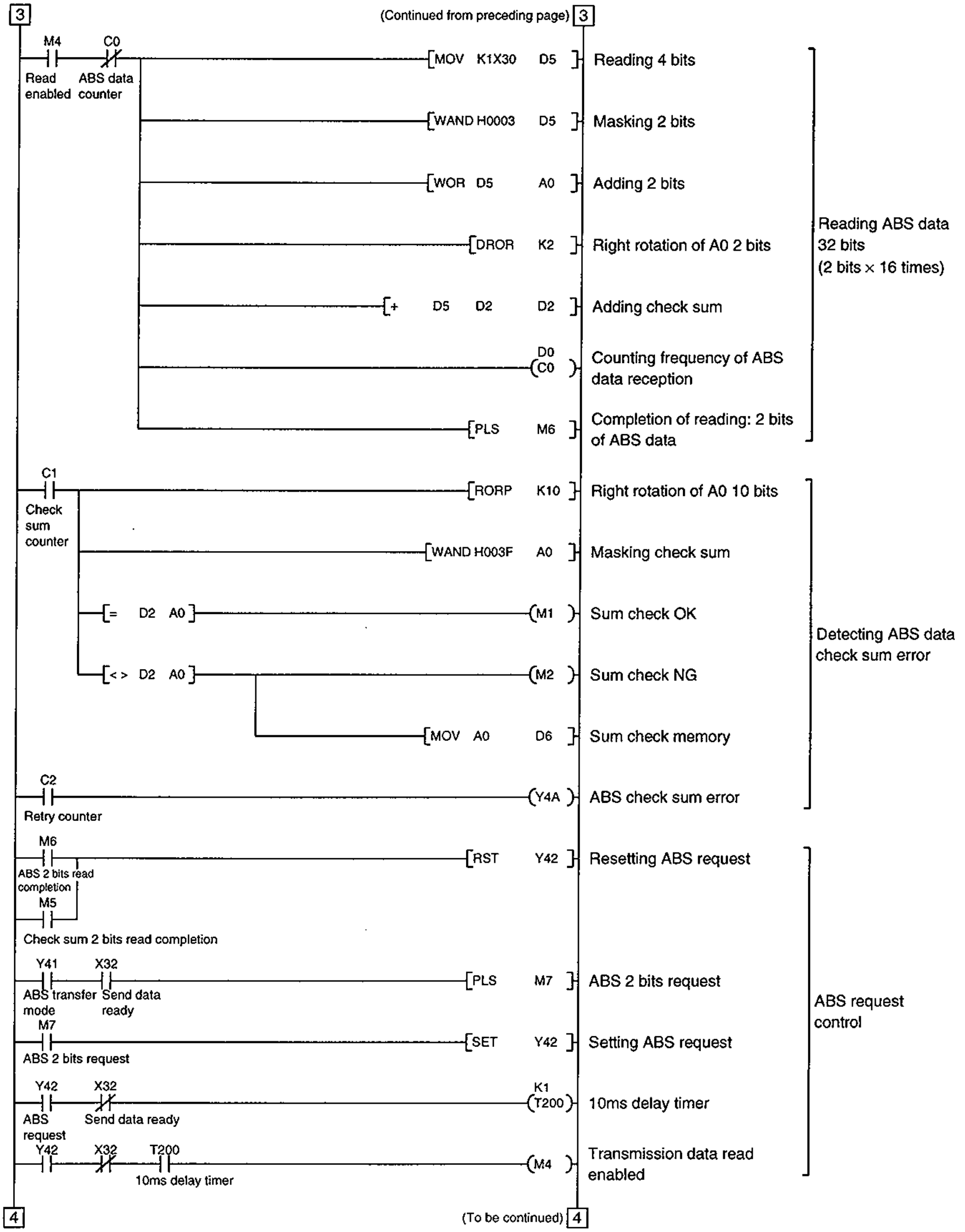
- For 1µm/PLS, set constant K to 10
- For 5µm/PLS, set constant K to 50
- When the unit setting is PULS, the additional program is not required.



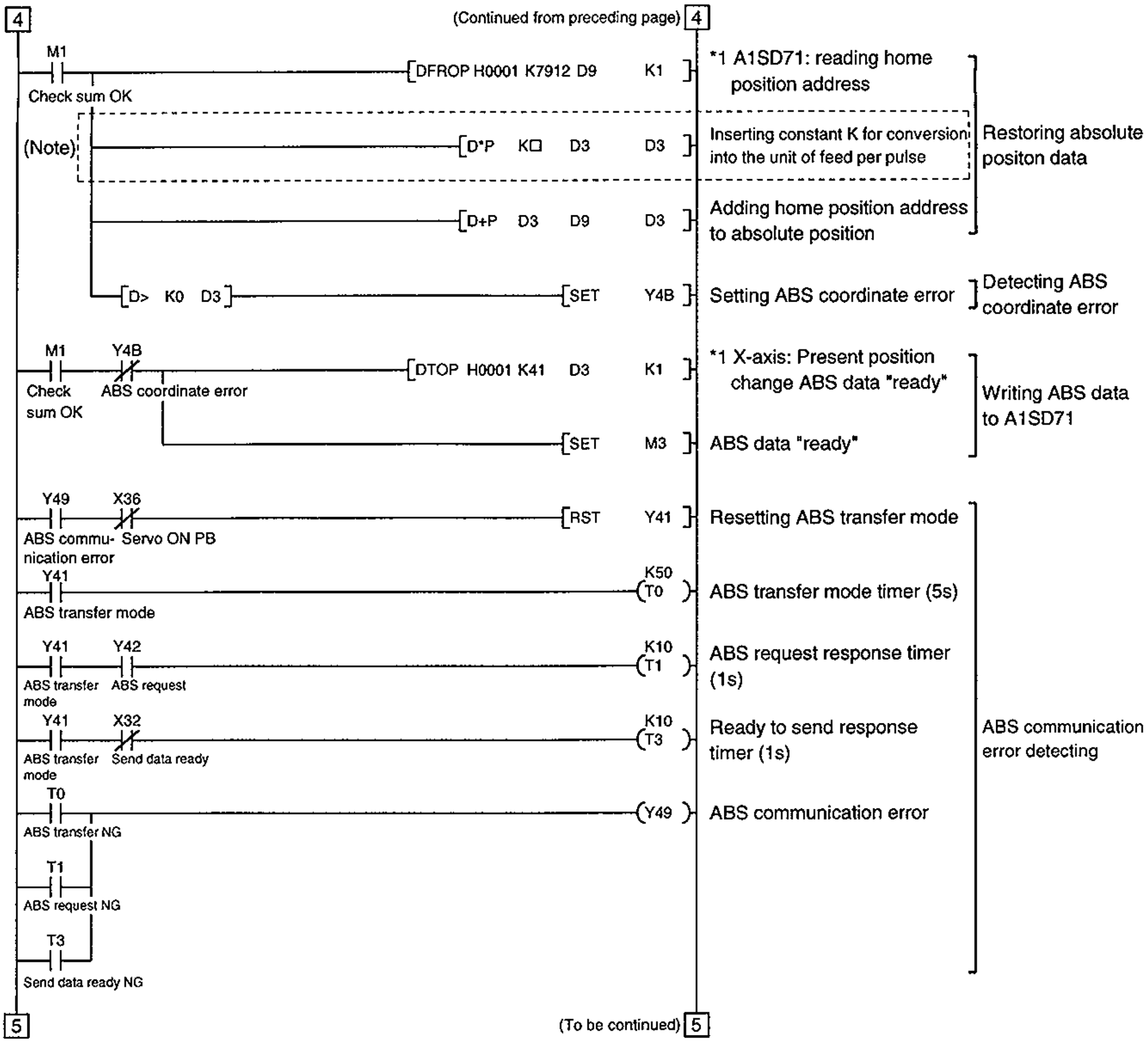

1
(Continued from preceding page) 1
M8
Servo ON request
[PLS M12]
Setting retry flag
M12
Retry flag reset request
[RST C2]
Resetting retry counter
ABS data transmission retry control
X34
M9
Error reset PB
Error flag
Y43
Alarm reset
(Y43)
Alarm reset output
X35
Emergency stop PB
X33
Servo alarm
(M9)
Error flag output
[RST M3]
Resetting ready to send
[RST M8]
Resetting servo ON request
(Y48)
Servo alarm
Servo alarm detection, alarm reset control
M0
ABS data transfer start
[MOV K16 D0]
Initializing ABS data transfer counter
[MOV K3 D1]
Initializing check sum transfer counter
[MOV K0 D2]
Initializing check sum register
[MOV K0 D5]
Initializing ABS data register
[DMOV K0 D9]
Initializing ABS data register
[DMOV K0 A0]
Initializing ABS data register
[RST Y4B]
Resetting error for ABS coordinate
[RST C0]
Resetting ABS transfer counter
[RST C1]
Resetting check sum transfer counter
ABS transfer mode Initial setting
M0
ABS data transfer start
Y41
C1
ABS transfer mode
Checksum counter
(Y41)
ABS transfer mode
ABS transfer mode control
2
(To be continued) 2


2
(Continued from preceding page) 2
C0
C1
Y41
Counter
Check sum counter
ABS transfer mode
DMOVP A0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
FROMP H0001 K7872 D8 K1
*1 Reading X-axis rotating direction parameter
WAND H0004 D8
Rotation derection parameter mask
WAND H8000 A1
ABS data sign mask
PLS M13
PLS processing command
Detecting absolute position polarity and A1SD71 rotating derection
M13
PLS processing command
Rotation direction judgment
= D8 K4
NEG D4
Reversing polarity of upper 16 bits
- K1 D4
Subtraction for upper 16 bits
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits = 0 → D4 + 1 = D4
Reversing polarity of absolute position
M4
C0
Read enabled
ABS data counter
MOV K1X30 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
FOR K2
Right rotation of A0 2 bits
D1
C1
Counting check sum data reception frequency
PLS M5
Completion of reading, 2 bits of check sum
Reading checksum 6 bits (2 bit × 3 times)
3
(To be coutinued) 3

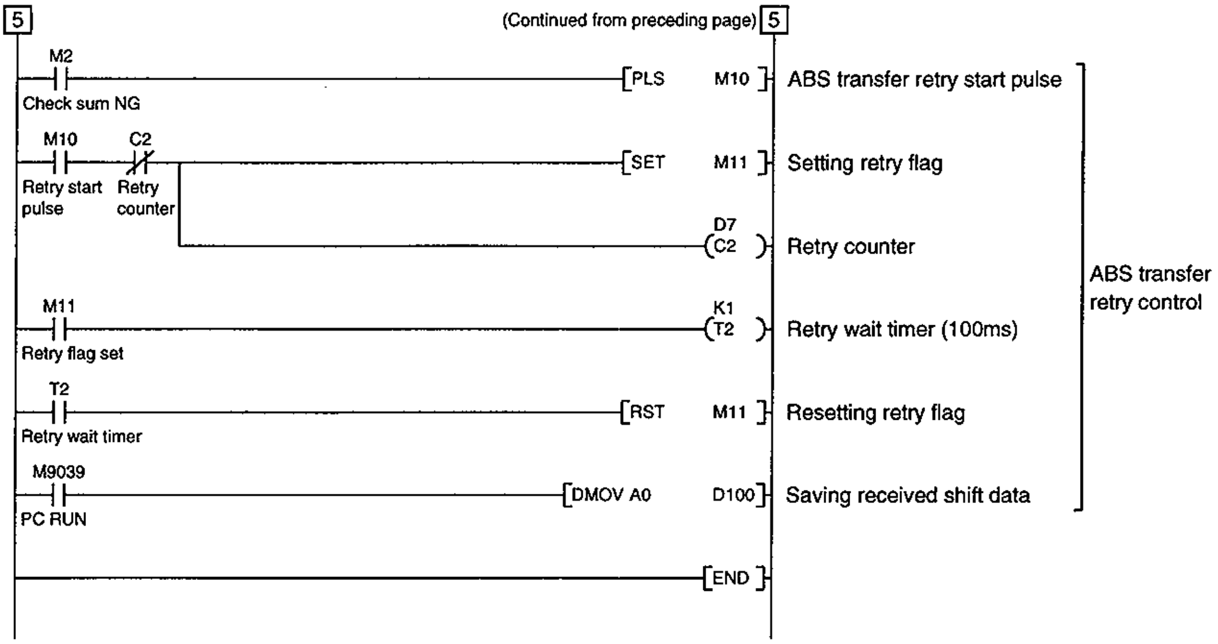
(Continued from preceding page)



(To be continued)



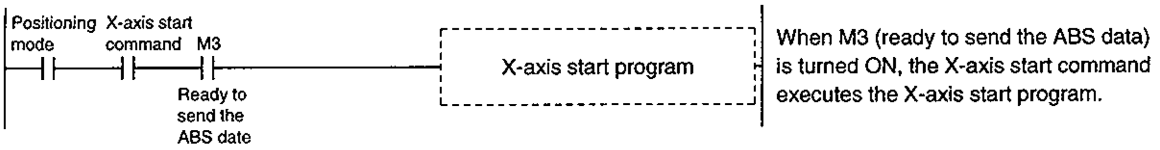
Note: When the unit setting parameter value of the AD71 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To change the unit to × 1μm, and this program to multiple the feed value by 10.



Note: When absolute position data is received at power ON, for example, if a negative coordinate position which cannot be handled by the A1SD71 is detected, the ABS coordenate error (Y4B ON) is generated. If this error is generated, move the axis into the positive coordinate zone in JOG operation. Then, turn OFF the servo ON pushbutton switch and turn it ON again.

(d) X-axis control program

This precludes execution of the X-axis start program while M3 (ready to send the ABS data) is OFF.



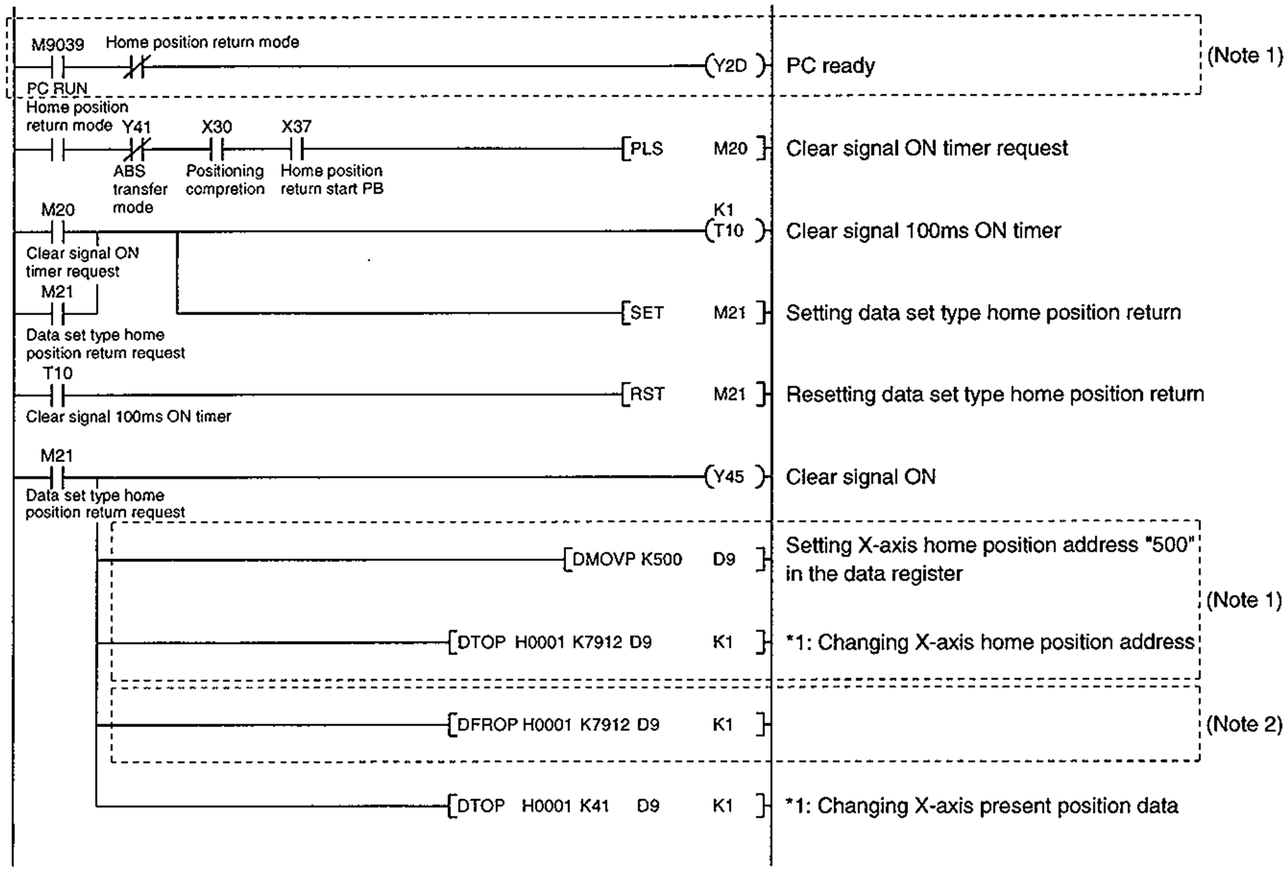
(e) Dog type zeroing

For an example of a program for the dog type home position return operation, refer to the home position return program presented in the User's Manual for A1SD71.

(f) Data set type zeroing

After jogging the machine to the position where the home position is to be set, select the home position return mode and press the home position return start (PB ON) pushbutton switch to set the home position.

Do not turn ON the clear signal (Y45) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



Note 1: If data of the home position address parameter is not written by using an A6GPP programming tool, etc. before starting a program for data set type home position return, the circuits indicated by Note 1 are necessary and the circuit indicated by Note 2 is not necessary.

2: Contrary to Note 1 above, if the home position address is written in the home position address parameter, the circuit indicated by Note 3 is necessary and the circuits indicated by Note 1 are not necessary.

(g) Electromagnetic brake output

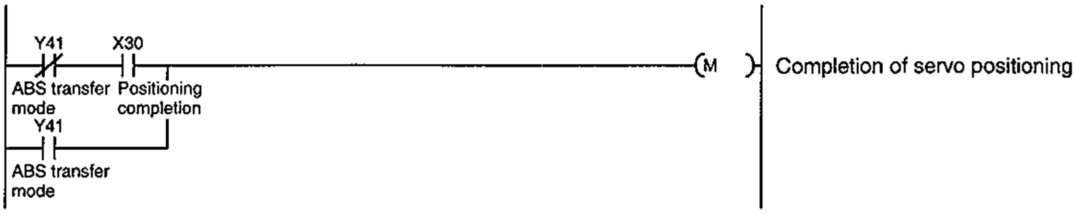
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.

Set 1□1□ in parameter No. 3 of the servo amplifier to choose the electromagnetic brake interlock signal.

(h) Positioning completion

To create the status information for servo positioning completion.

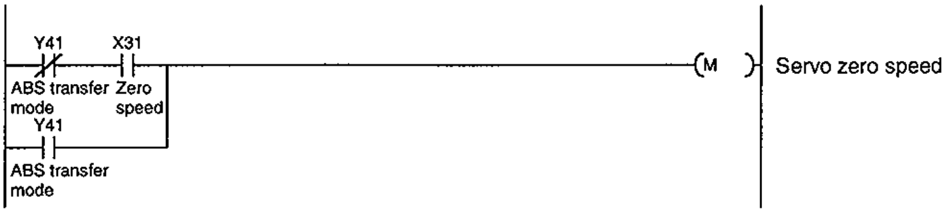
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for servo zero speed

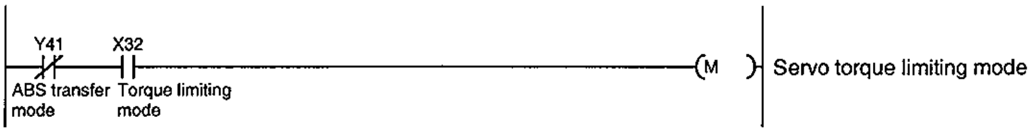
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the servo torque limiting mode

During ABS data transfer (for several seconds after the servo on signal is turned on), the torque limiting must be off.



(4) Sequence program - 2-axis control

The ABS sequence program for the second axis (Y-axis) when one A1SD71 unit is used for X and Y axes is described below. The program can be written in the same manner for the third and later axes.

(a) ABS sequence program for Y-axis

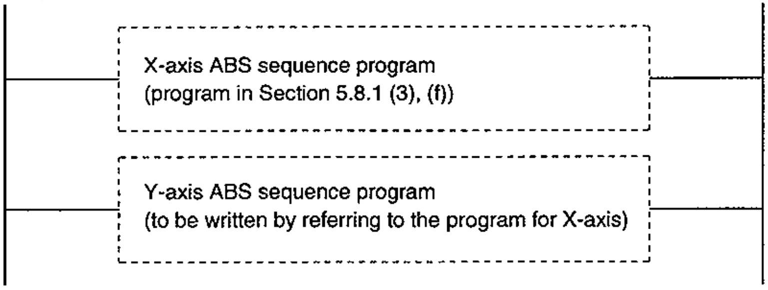
Make the program for Y-axis referring to the program for X-axis.

Allocate the X inputs, Y outputs, D registers, M contacts, T timers, and C counters for the Y-axis so that they will not overlap the allocations for the X-axis.

The A1SD71 has different buffer memory addresses for the X-axis and Y-axis. Change the areas marked *1 in the program in Section 5.8.1 (3),(c) as indicated below to rewrite it for the Y axis.

```
[FROMP H0001 K7872 D8 K1]  →  [FROMP H0001 K7892 D8 K1]
[DFROP H0001 K7912 D9 K1]  →  [DFROP H0001 K7922 D9 K1]
[DTOP  H0001 K41   D3 K1]  →  [DTOP  H0001 K341  D3 K1]
```

[Program configuration]



(b) Data set type zeroing

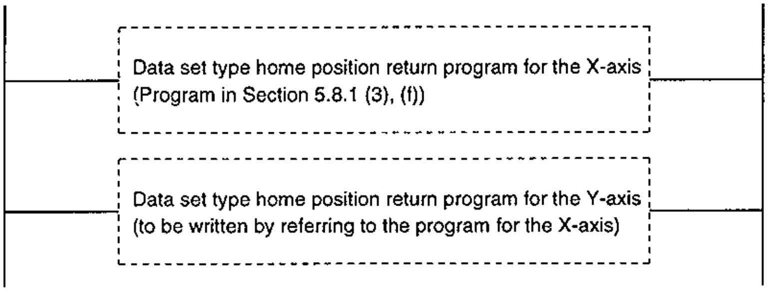
Arrange the data set type zeroing programs given in Section 5.8.1 (3), (f) in series to control two axes.

Allocate the X inputs, Y outputs, D registers, M contacts, and T timers for the Y-axis so that they will not overlap the allocations for the X-axis.

The A1SD71 has different buffer memory addresses for the X-axis and Y-axis. Change the areas marked *1 in the program in Section 5.8.1 (3), (f) (X-axis data set type home position return program) as indicated below to rewrite it for the Y axis.

```
[DTOP  H0001 K7912 D9 K1]  →  [DTOP  H0001 K7922 D9 K1]
[DTOP  H0001 K41   D9 K1]  →  [DTOP  H0001 K341  D9 K1]
```

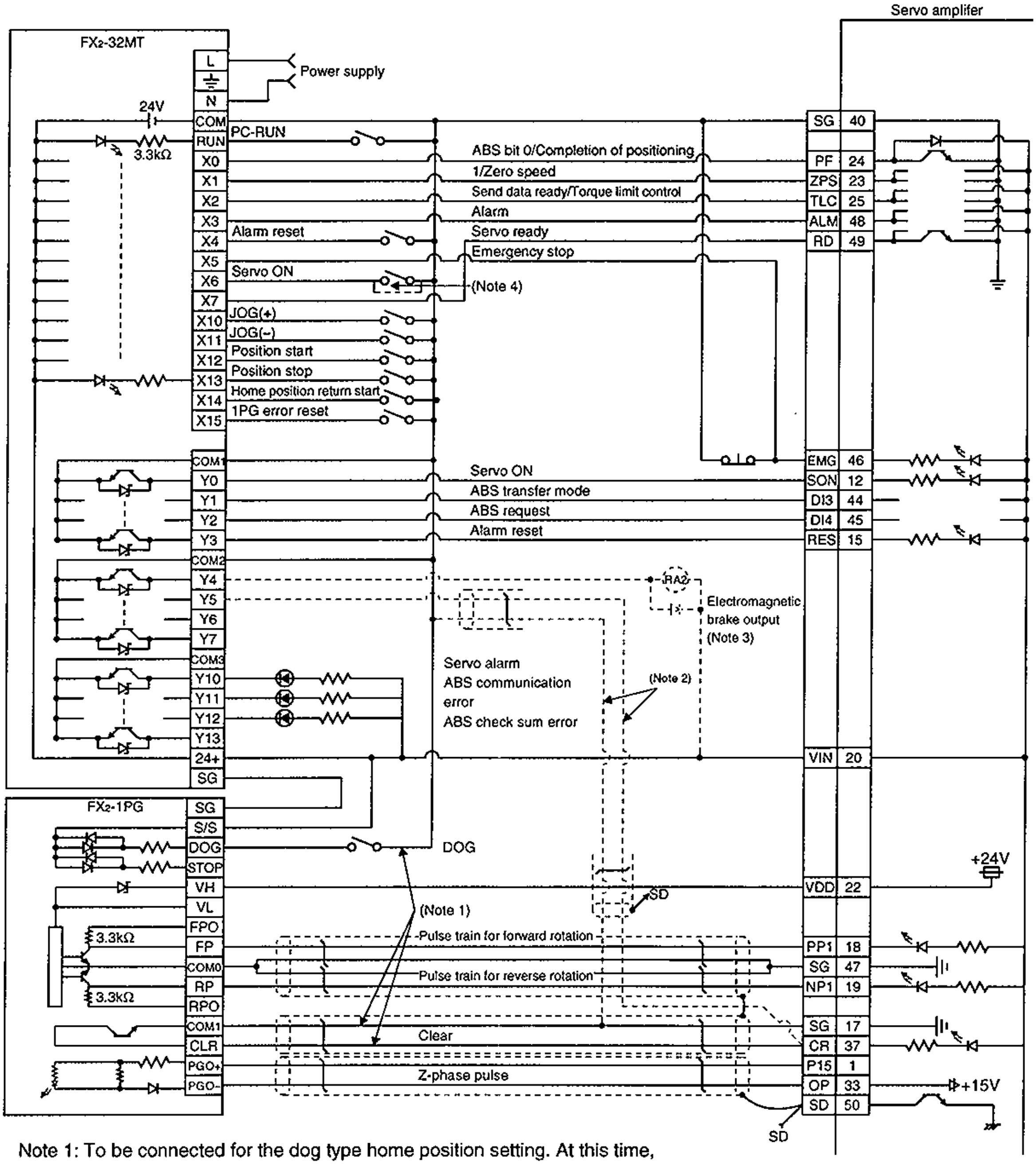
[Program configuration]



5.8.2 MELSEC FX2(N)-32MT (FX2(N)-1PG)

(1) Connection diagram

(a) FX2-32MT (FX2-1PG)



Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

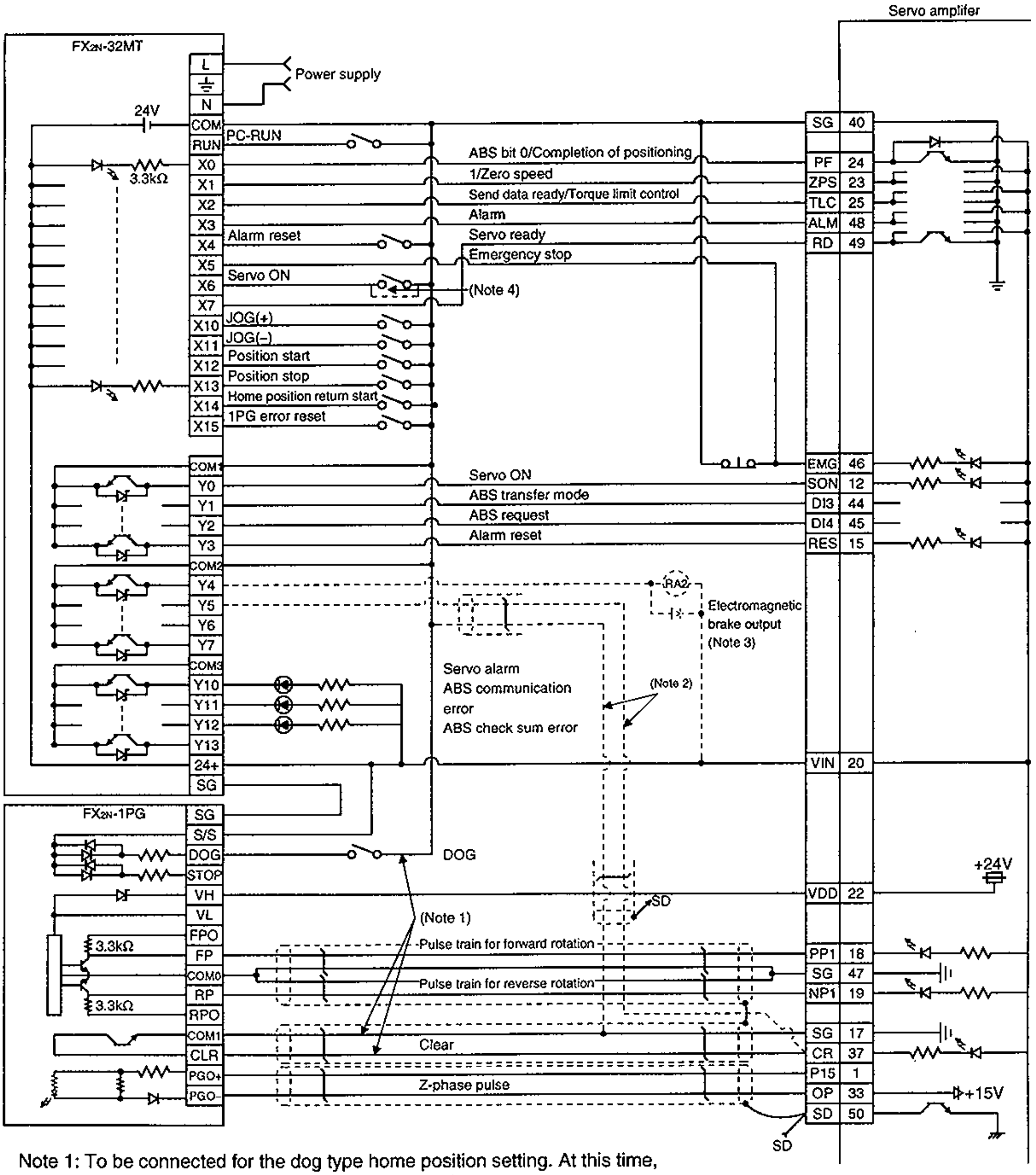
2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

3: Circuit shown for your reference.

4: The electromagnetic brake interlock signal should be controlled by connecting the programmable controller output to a relay.

5: To shorted if a servo ON switch is not used.

(b) FX2N-32MT (FX2N-1PG)



Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

3: The electromagnetic brake interlock signal should be controlled by connecting the programmable controller output to a relay.

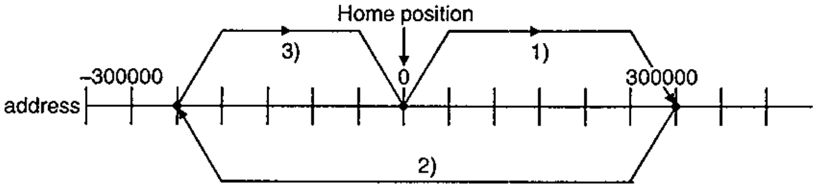
4: To shorted if a servo ON switch is not used.

(2) Sequence program example

(a) Conditions

1) Operation pattern

ABS data transfer is made as soon as the servo on pushbutton is turned on. After that, positioning operation is performed as shown below:



After the completion of ABS data transmission, JOG operation is possible using the JOG+ or JOG– pushbutton switch.

After the completion of ABS data transmission, dog type home position return is possible using the home position return pushbutton switch.

2) Buffer memory assignment

For BFM#26 and later, refer to the FX2(N)-1PG User's Manual.

BMF No.		Name and symbol		Set value	Remark
Upper 16 bits	Lower 16 bits				
—	#0	Pulse rate	A	2000	
#2	#1	Feed rate	B	1000	
—	#3	Parameter		H0000	Command unit: Pulses
#5	#4	Max. speed	Vmax	100000PPS	
—	#6	Bias speed	Vbia	0PPS	
#8	#7	JOG operation	Vjog	10000PPS	
#10	#9	Home position return speed (high speed)	VRT	50000PPS	
—	#11	Home position return speed (creep)	VCL	1000PPS	
—	#12	Home position return zero-point signal count	N	2 pulses	Initial value: 10
#14	#13	Home position address	HP	0	
—	#15	Acceleration/deceleration time	Ta	200ms	Initial value: 100
—	#16	Not usable			
#18	#17	Target address (I)	P(I)	0	
#20	#19	Operation speed (I)	V(I)	100000	Initial value: 10
#22	#21	Target address (II)	P(II)	0	
#24	#23	Operation speed (II)	V(II)	10	
—	#25	Operation command		H0000	

3) Instructions

When the servo ON pushbutton switch and the GND of the power supply are shorted, the ABS data is transmitted when the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

If check sum discrepancy is detected in the transmitted data, the ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y12 ON).

The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y11 ON).

ON period of ABS transfer mode (Y1)

ON period of ABS request (Y2)

OFF period of ready to send the ABS data (X2).

(b) Device list

X input contact	
X0	ABS bit 0 / completion of positioning
X1	ABS bit 1 / zero speed
X2	Send ABS data ready/ torque limit control
X3	Servo alarm
X4	Alarm reset PB
X5	Servo emergency stop
X6	Servo ON PB
X7	Servo ready
X10	JOG (+) PB
X11	JOG (-) PB
X12	Position start PB
X13	Position stop PB
X14	Home position return start PB
X15	1PG error reset

Y output contact	
Y0	Servo ON
Y1	ABS transfer mode
Y2	ABS request
Y3	Alarm reset
Y4(Note 2)	Electromagnetic brake output
Y5(Note 1)	Clear
Y10	Servo alarm
Y11	ABS communication error
Y12	ABS check sum error

D register	
D0	ABS data: Lower 16 bits
D1	ABS data: Upper 16 bits
D2	Check sum addition counter
D3	Check data in case of check sum error
D4	Transmission retry count in check sum discrepancy
D24	Home position address: Lower 16 bits
D25	Home position address: Upper 16 bits
D106	1PG present position address: Lower 16 bits
D107	1PG present position address: Upper 16 bits

M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Spare
M5	Servo ON request
M6	Retry flag
M10	ABS data 2 bit receiving buffer
M11	
M12	
M13	
M20	ABS data 32 bit buffer
↓	
M51	
M52	Check sum 6 bit buffer
↓	
M57	
M58	For checksum comparison
M59	
M62	Sum check discrepancy (greater) >
M63	Sum check discrepancy =
M64	Sum check discrepancy (less) >
M70(Note 1)	Clear signal ON timer request
M71(Note 1)	Data set type home position return request
M99	ABS data ready

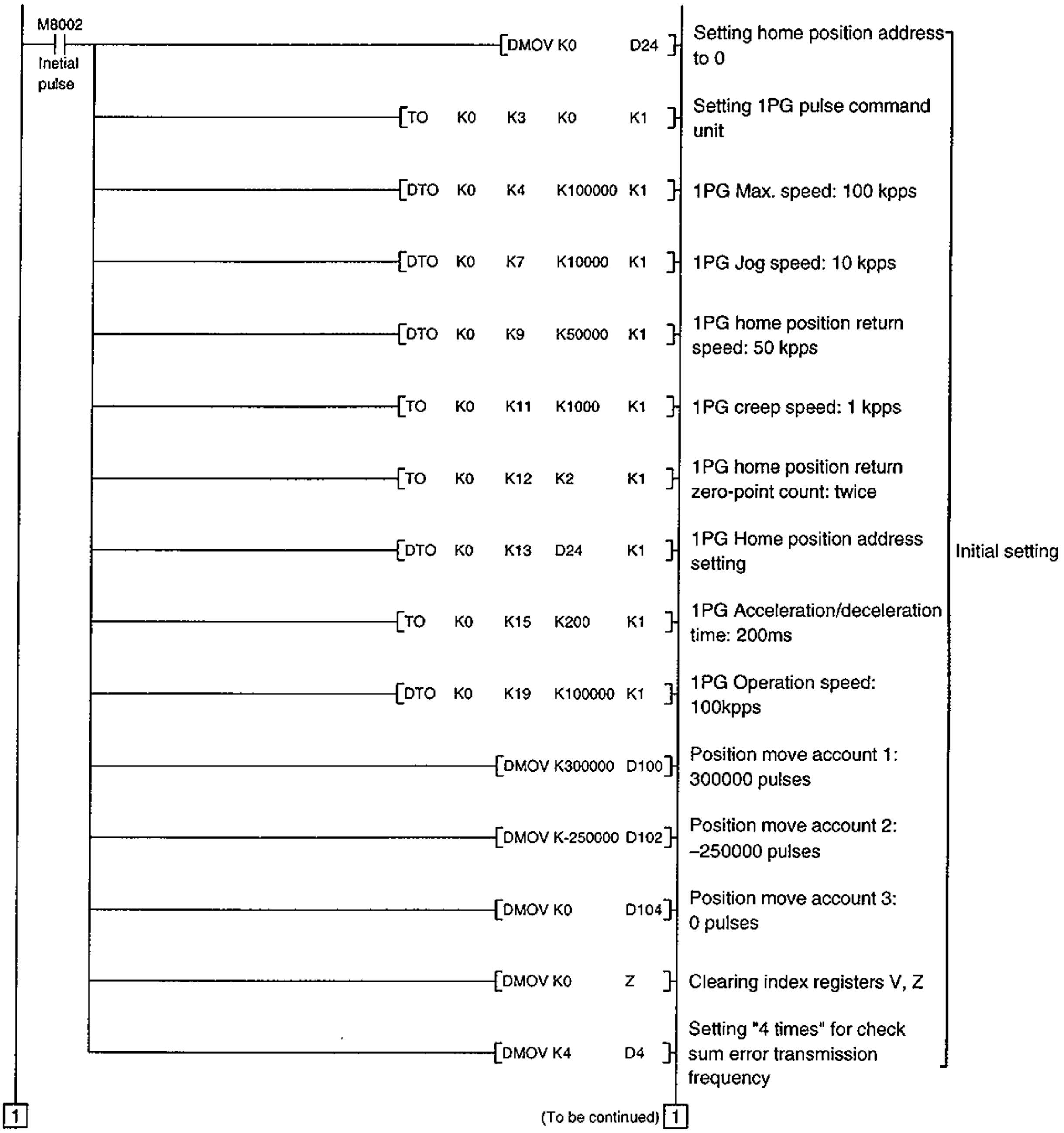
T timer	
T200	Retry wait timer
T201	ABS transfer mode timer
T202	ABS request response timer
T203	Ready to send response timer
T204	ABS data waiting timer
T210(Note 1)	Clear signal ON timer

C counter	
C0	All data reception frequency counter (19 times)
C1	Check sum reception frequency counter
C2	ABS data reception frequency counter (16 times)

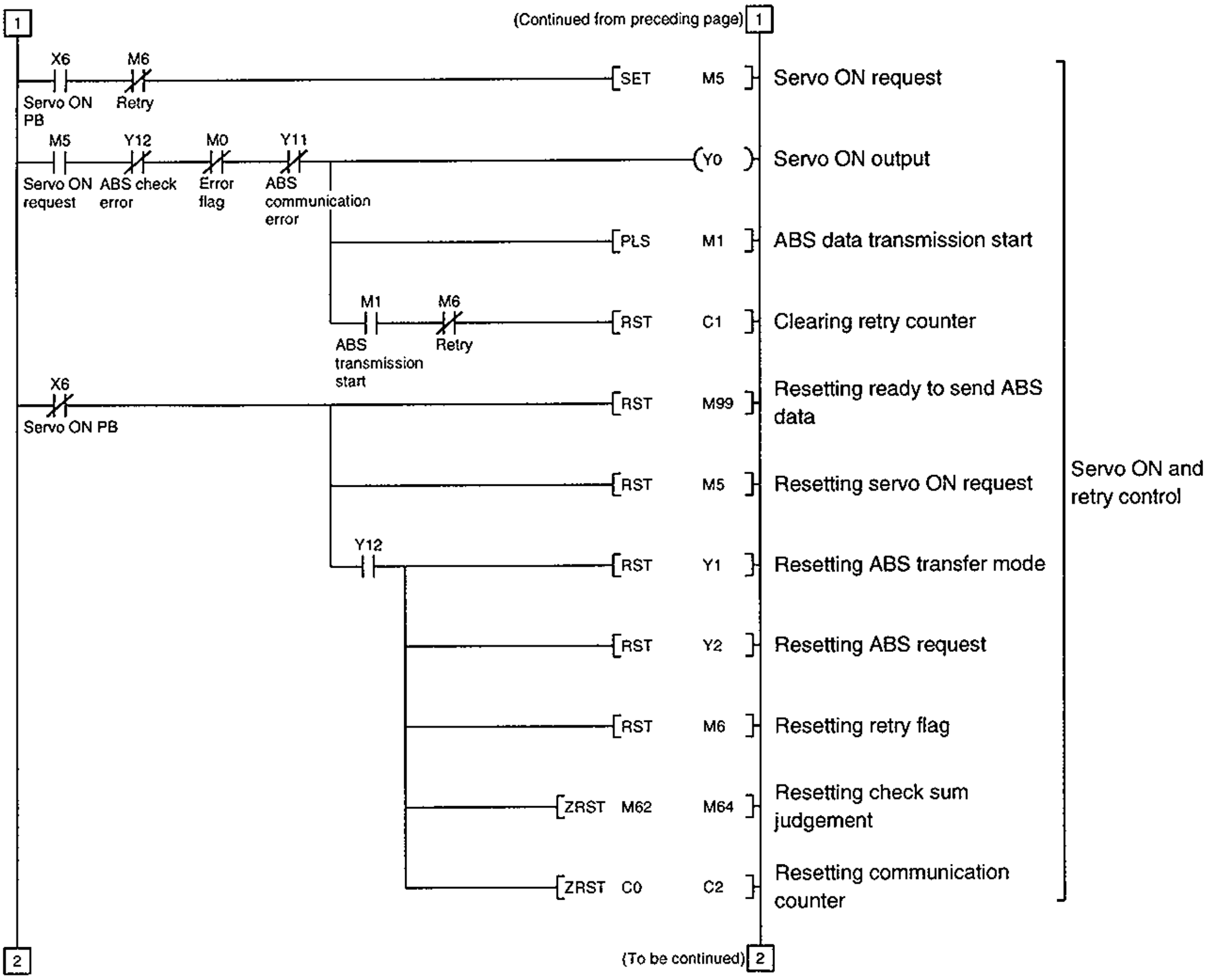
Note 1: Necessary when data set type home position return is executed.

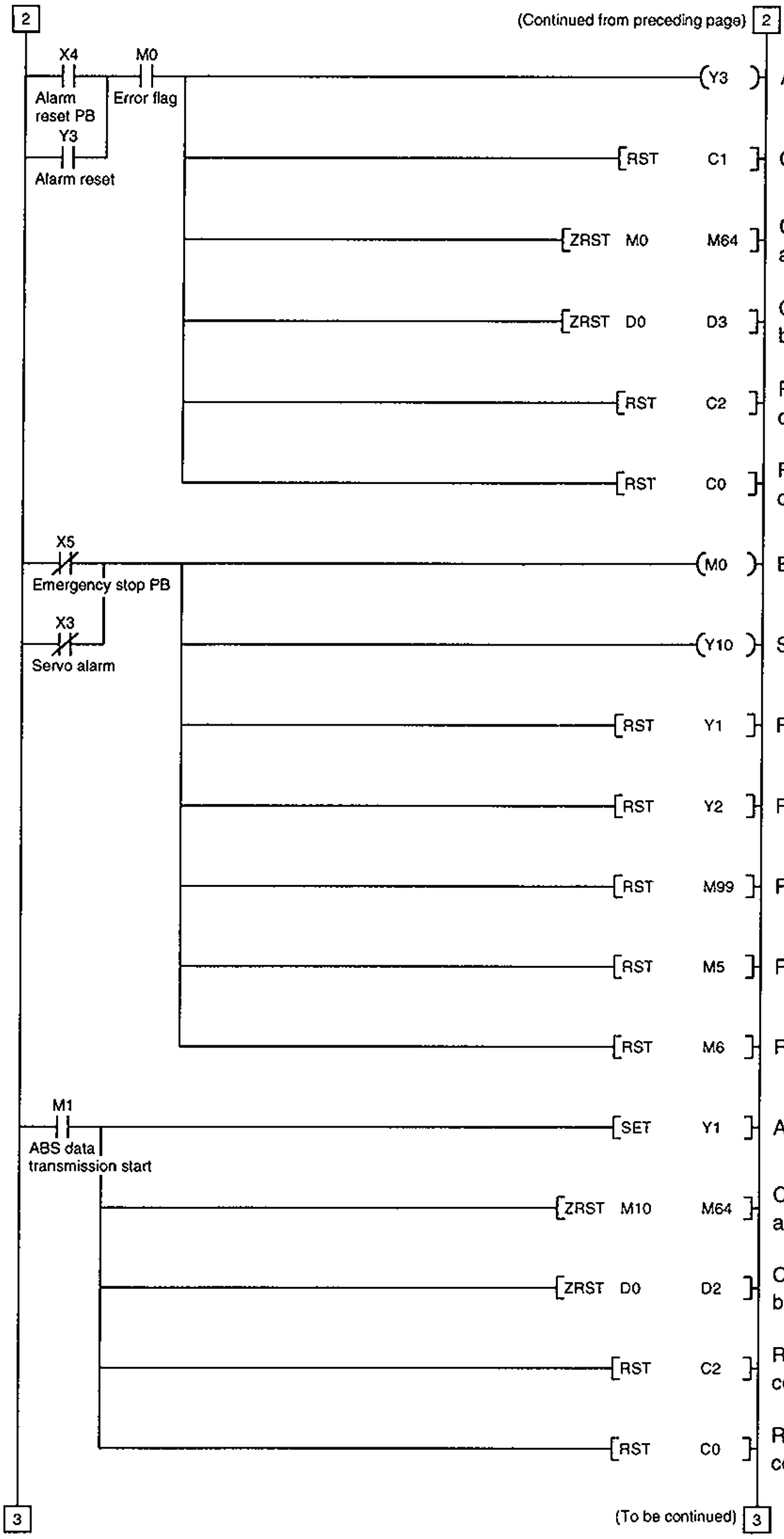
2: Necessary in the event of electromagnetic brake output.

(c) ABS data transfer program for X-axis



[DMOV K0 D24]	Setting home position address to 0
[TO K0 K3 K0 K1]	Setting 1PG pulse command unit
[DTO K0 K4 K100000 K1]	1PG Max. speed: 100 kpps
[DTO K0 K7 K10000 K1]	1PG Jog speed: 10 kpps
[DTO K0 K9 K50000 K1]	1PG home position return speed: 50 kpps
[TO K0 K11 K1000 K1]	1PG creep speed: 1 kpps
[TO K0 K12 K2 K1]	1PG home position return zero-point count: twice
[DTO K0 K13 D24 K1]	1PG Home position address setting
[TO K0 K15 K200 K1]	1PG Acceleration/deceleration time: 200ms
[DTO K0 K19 K100000 K1]	1PG Operation speed: 100kpps
[DMOV K300000 D100]	Position move account 1: 300000 pulses
[DMOV K-250000 D102]	Position move account 2: –250000 pulses
[DMOV K0 D104]	Position move account 3: 0 pulses
[DMOV K0 Z]	Clearing index registers V, Z
[DMOV K4 D4]	Setting "4 times" for check sum error transmission frequency


1
(Continued from preceding page) 1
X6
M6
Servo ON PB
Retry
SET M5
Servo ON request
M5
Y12
M0
Y11
Servo ON request
ABS check error
Error flag
ABS communication error
Y0
Servo ON output
PLS M1
ABS data transmission start
M1
M6
ABS transmission start
Retry
RST C1
Clearing retry counter
X6
Servo ON PB
RST M99
Resetting ready to send ABS data
RST M5
Resetting servo ON request
Y12
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M6
Resetting retry flag
ZRST M62 M64
Resetting check sum judgement
ZRST C0 C2
Resetting communication counter
Servo ON and retry control
2
(To be continued) 2



Alarm reset output

Clearing retry counter

Clearing ABS data receiving area

Clearing ABS receive data buffer

Resetting ABS data reception counter

Resetting all data reception counter

Error flag output

Servo alarm output

Resetting ABS transfer mode

Resetting ABS request

Resetting ready to send

Resetting servo ON request

Resetting retry frag

Servo alarm detection, alarm reset control

ABS transfer mode ON

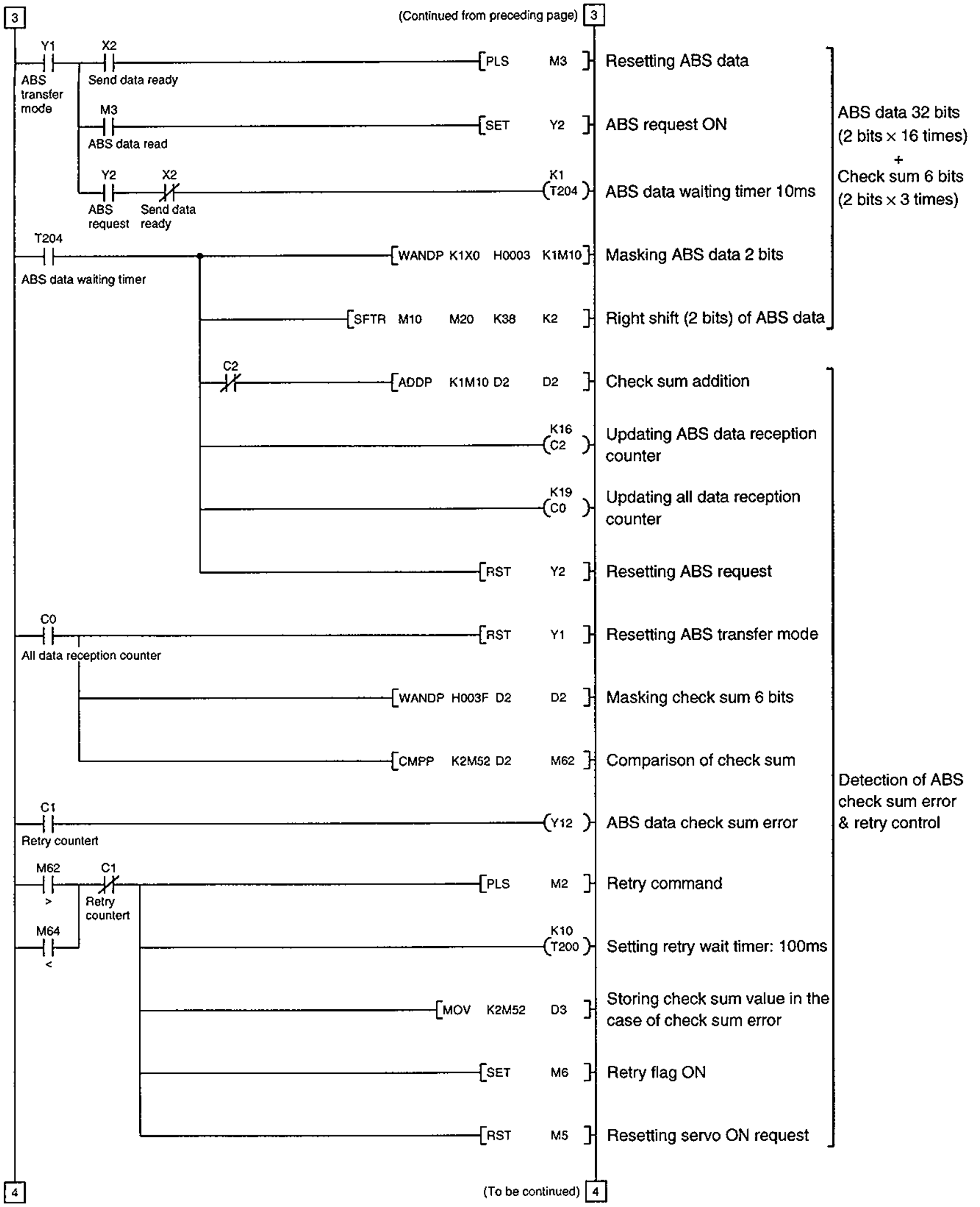
Clearing ABS data reception area

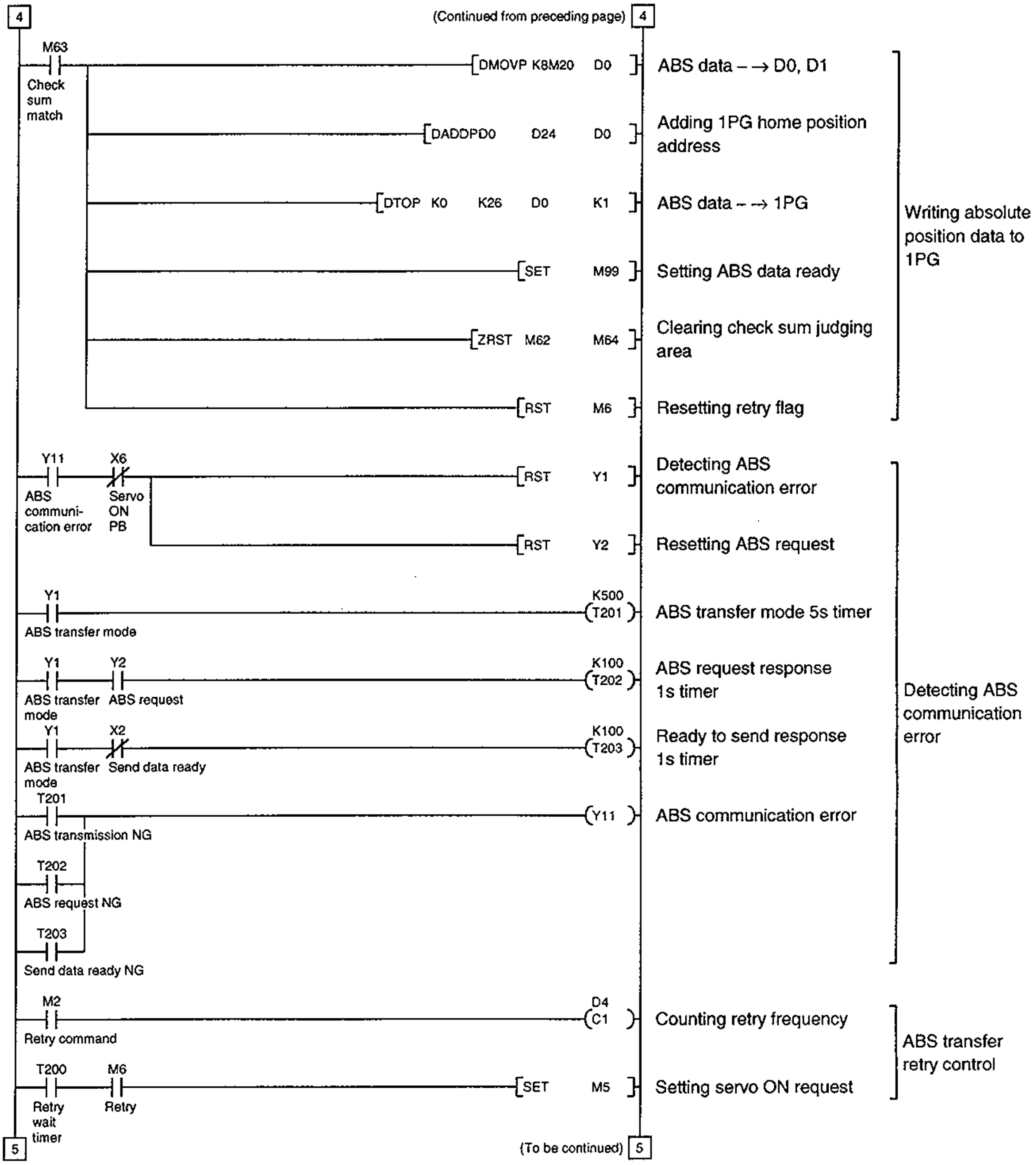
Clearing ABS receiver data buffer

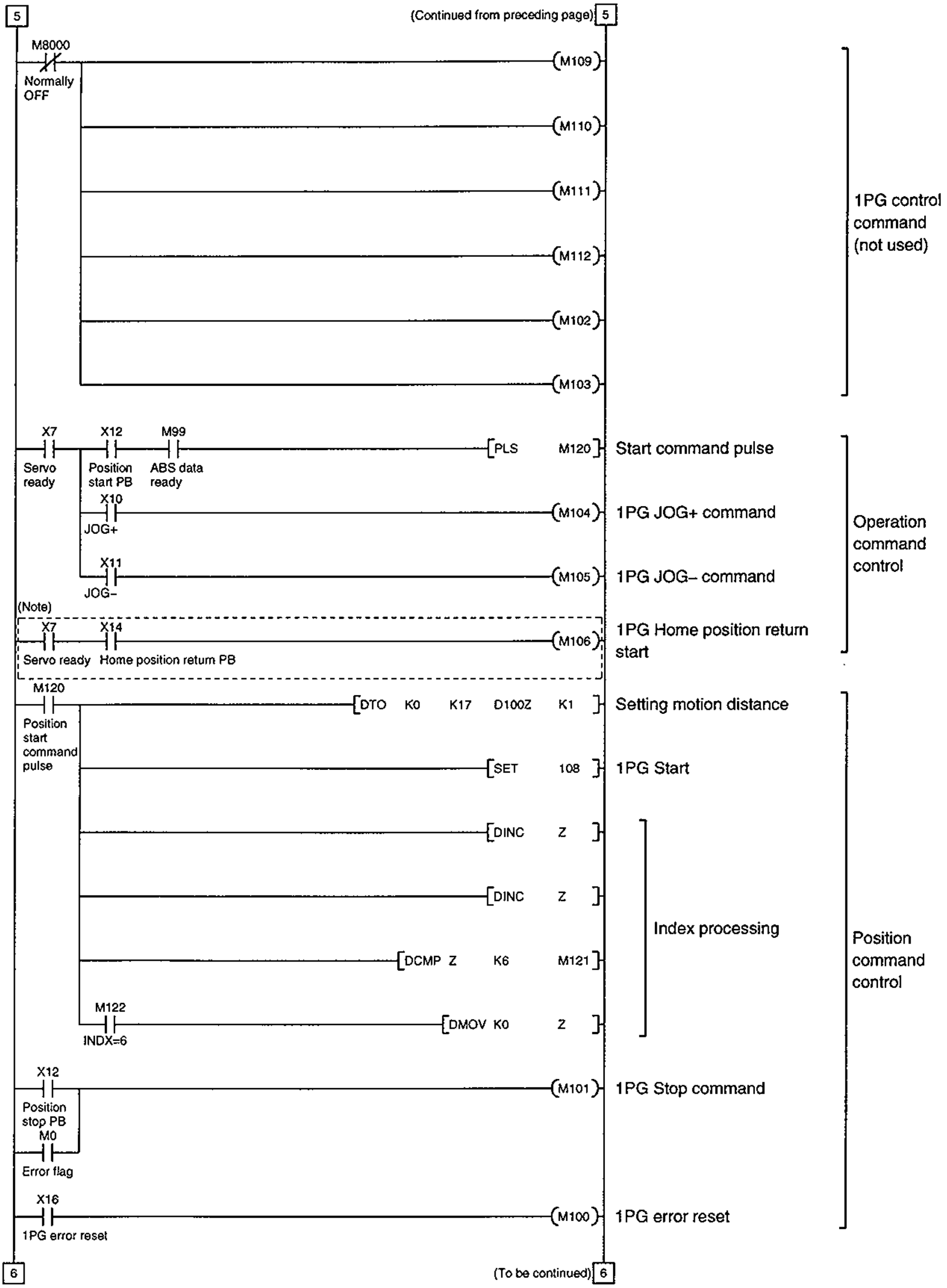
Resetting ABS data reception counter

Resetting all data reception counter

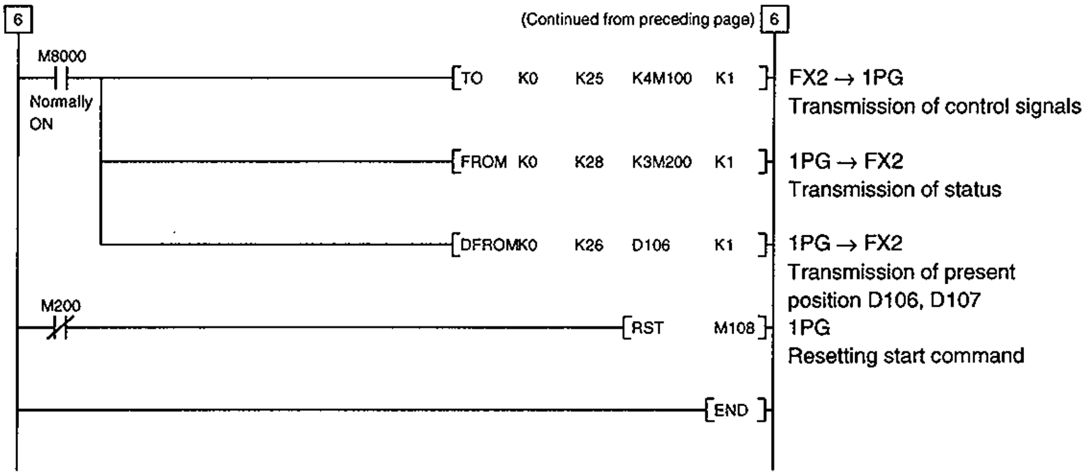
ABS transfer mode
Initial setting


3
(Continued from preceding page) 3
Y1
X2
ABS transfer mode
Send data ready
PLS M3
Resetting ABS data
M3
ABS data read
SET Y2
ABS request ON
Y2
X2
ABS request
Send data ready
K1
T204
ABS data waiting timer 10ms
ABS data 32 bits
(2 bits × 16 times)
+
Check sum 6 bits
(2 bits × 3 times)
T204
ABS data waiting timer
WANDP K1X0 H0003 K1M10
Masking ABS data 2 bits
SFTR M10 M20 K38 K2
Right shift (2 bits) of ABS data
C2
ADDP K1M10 D2 D2
Check sum addition
K16
C2
Updating ABS data reception counter
K19
C0
Updating all data reception counter
RST Y2
Resetting ABS request
C0
All data reception counter
RST Y1
Resetting ABS transfer mode
WANDP H003F D2 D2
Masking check sum 6 bits
CMPP K2M52 D2 M62
Comparison of check sum
Detection of ABS check sum error & retry control
C1
Retry countert
Y12
ABS data check sum error
M62
>
C1
Retry countert
M64
<
PLS M2
Retry command
K10
T200
Setting retry wait timer: 100ms
MOV K2M52 D3
Storing check sum value in the case of check sum error
SET M6
Retry flag ON
RST M5
Resetting servo ON request
4
(To be continued) 4


4
(Continued from preceding page) 4
M63
Check sum match
[DMOVP K8M20 D0]
ABS data --→ D0, D1
[DADDPD0 D24 D0]
Adding 1PG home position address
[DTOP K0 K26 D0 K1]
ABS data --→ 1PG
[SET M99]
Setting ABS data ready
[ZRST M62 M64]
Clearing check sum judging area
[RST M6]
Resetting retry flag
Writing absolute position data to 1PG
Y11
ABS communi-cation error
X6
Servo ON PB
[RST Y1]
Detecting ABS communication error
[RST Y2]
Resetting ABS request
Y1
ABS transfer mode
K500
(T201)
ABS transfer mode 5s timer
Y1
ABS transfer mode
Y2
ABS request
K100
(T202)
ABS request response 1s timer
Y1
ABS transfer mode
X2
Send data ready
K100
(T203)
Ready to send response 1s timer
T201
ABS transmission NG
(Y11)
ABS communication error
T202
ABS request NG
T203
Send data ready NG
Detecting ABS communication error
M2
Retry command
D4
(C1)
Counting retry frequency
T200
Retry wait timer
M6
Retry
[SET M5]
Setting servo ON request
ABS transfer retry control
5
(To be continued) 5



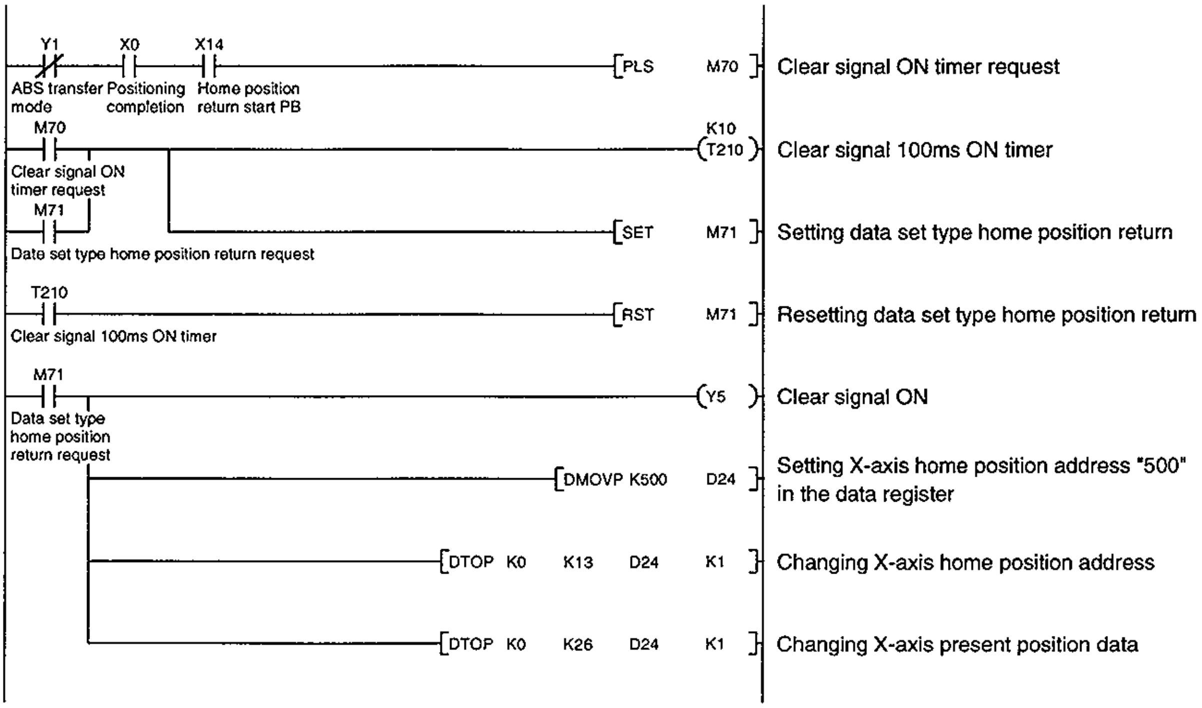
Note: Program example for the dog type zeroing. For the data set type zeroing, refer to the program example in (2), (d) in this section.


6
(Continued from preceding page) 6
M8000
Normally ON
TO K0 K25 K4M100 K1
FX2 → 1PG
Transmission of control signals
FROM K0 K28 K3M200 K1
1PG → FX2
Transmission of status
DFROMK0 K26 D106 K1
1PG → FX2
Transmission of present position D106, D107
M200
RST M108
1PG
Resetting start command
END

(d) Data set type zeroing

After jogging the machine to the position where the home position is to be set, select the home position return mode and press the home position return start (PBON) pushbutton switch to set the home position.

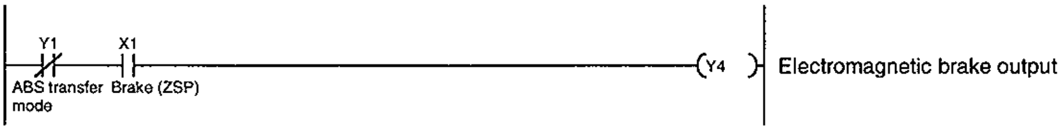
Do not turn ON the clear signal (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(e) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.

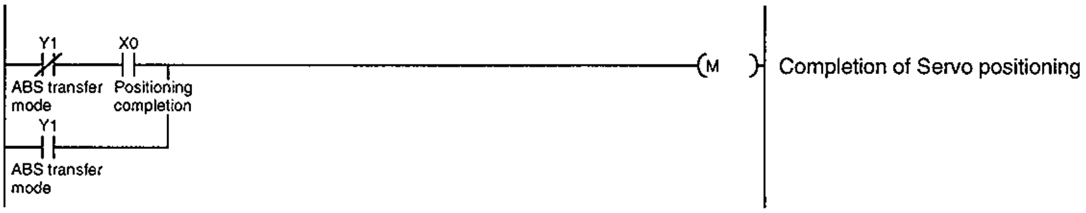
Set 1□1□ in parameter No. 3 of the servo amplifier to choose the electromagnetic brake interlock signal.



(f) Positioning completion

To create the status information for servo positioning completion.

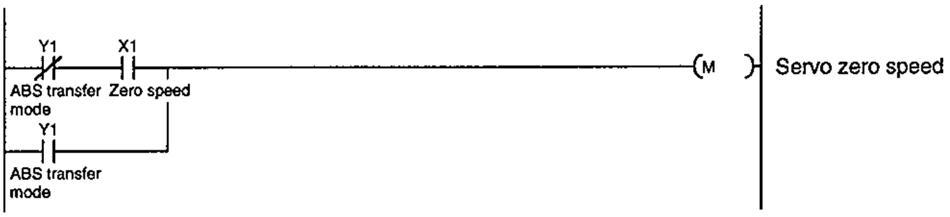
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(g) Zero speed

To create the status information for servo zero speed.

During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



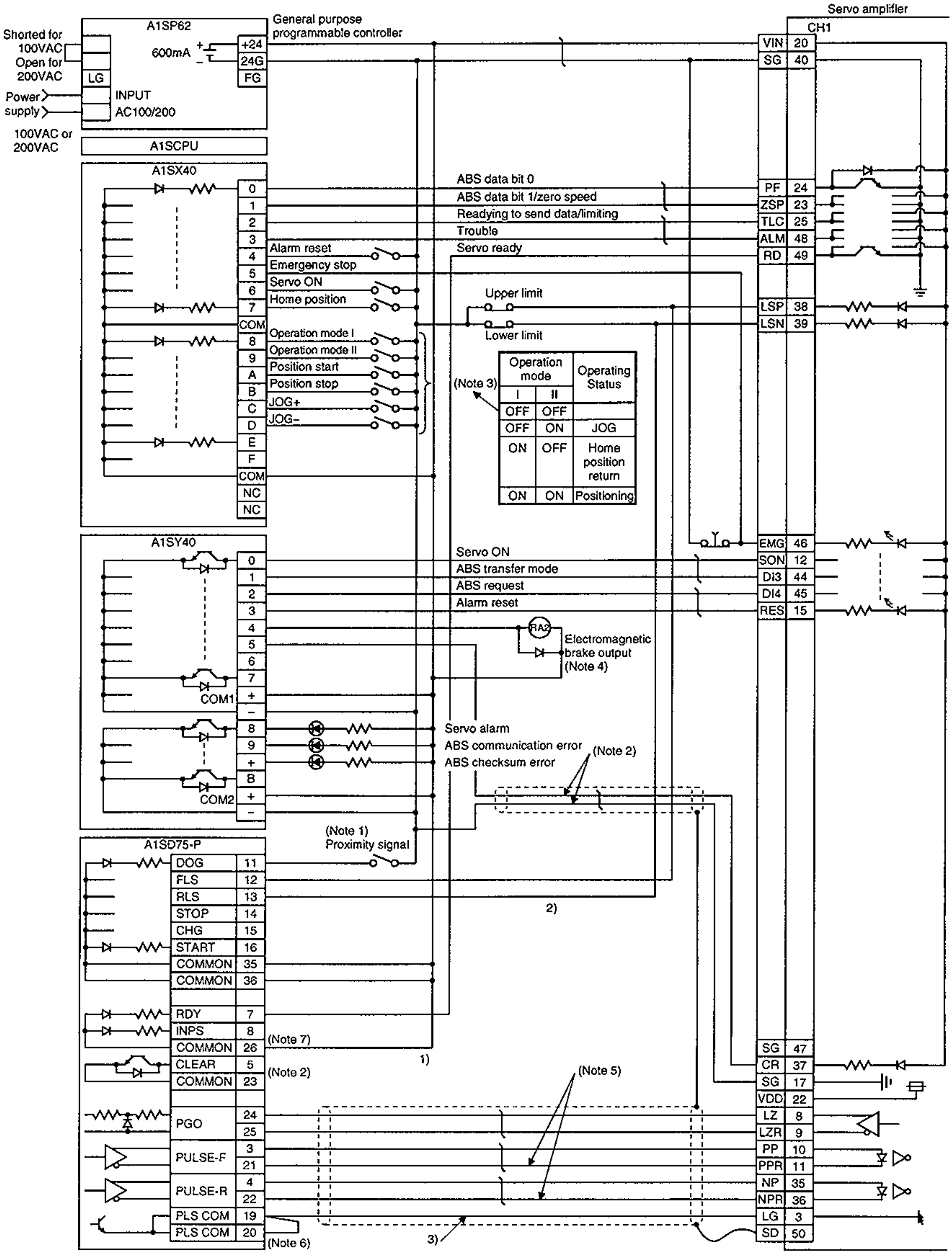
(h) Torque limiting

To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo on signal is turned on), the torque limiting must be off.

5.8.3 MELSEC A1SD75(AD75)

(1) Connection diagram



Operation mode		Operating Status
I	II	
OFF	OFF	
OFF	ON	JOG
ON	OFF	Home position return
ON	ON	Positioning

Note 1: For the dog type home position set. Need not be connected for the data set type.

2: Do not connect the clear signal of the MR-H-AN and the deviation counter clear signal (CLEAR) of the A1SD75 (AD75). If they are connected, the programmable controller will output CLEAR when the system is started up with the servo motor located on the zero signal.

3: This circuit is provided for your reference.

4: The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.

5: For external noise reduction, it is recommended to use the differential line driver system as the pulse train input system.

6: To reinforce noise suppression, connect LG and pulse output COM.

7: Wiring to INPS is not required.

Differences between A1SD75 (AD75) and A1SD71 (AD71) are as follows:

(a) Since the drive unit ready common of the A1SD75 (AD75) positioning module is independent, +24V is supplied to COM (26). 1)

(b) The upper and lower limit signals are added to the A1SD75 (AD75) . When the limit signals are not used, short FLS (12) and RLS (13). 2)

(c) If the connection was made in the open collector system, change it for the differential line driver system. Also, connect LG and pulse output COM to reinforce noise suppression. 3)

(2) Sequence program example

(a) Conditions

1) When the servo ON signal and power supply GND are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.

2) If a checksum mismatch is detected in the transmitted data, data transmission is retried up to three times. If the checksum mismatch still persists after the retries, the ABS checksum error occurs (Y3A ON).

3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON):

ON period of ABS transfer mode (Y31)

ON period of ABS request (Y32)

OFF period of reading to send ABS data (X22)

(b) Device list

X input contact		Y output contact	
X20	ABS bit 0 / positioning completion	Y30	Servo ON
X21	ABS bit 1 / zero speed	Y31	ABS transfer mode
X22	Reading to send ABS data / limiting torque	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset	X34 (Note 2)	Electromagnetic brake output
X25	Servo emergency stop	Y35 (Note 1)	Clear
X26	Servo ON	Y38	Servo alarm
X27	Home position return start	Y39	ABS communication error
X28	Operation mode I 2)	Y3A	ABS checksum error
X29	Operation mode II		
1)	D register	M contact	
D0	ABS data transmission counter	M5	ABS data transmission start
D1	Checksum transmission counter	M6	Sum check completion
D2	Checksum addition register	M7	Sum check mismatch
D3	ABS data: Lower 16 bits	M8	ABS data ready
D4	ABS data: Upper 16 bits	M9	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M10	Checksum 2 bits read completion
D6	Check data in case of checksum error 4)	M11	ABS 2 bits read completion
D7	Number of retries	M12	ABS 2 bits request
D8	Forward rotation direction	M13	Servo ON request
D9	Home position address: Lower 16 bits	M14	Servo alarm
D10	Home position address: Upper 16 bits	M15	ABS data transmission retry start pulse
D11	Drive unit ready data	M16	Retry flag set
D12	Home position return completion data	M17	Retry flag reset
D110	Received shift data: Lower 16 bits	M18	PLS processing command
D111	Received shift data: Upper 16 bits	M20 (Note 1)	Clear signal ON timer request
3)	T timer	M21 (Note 1)	Data set type home position return request
T0	ABS transmission mode timer	M22	Home position return processing instruction
T1	ABS request response timer		
T2	Retry wait timer	M23	Current position change processing instruction
T3	ABS data send reading response timer		
T10 (Note 1)	Clear signal ON timer	M24	Current position change flag
T200	Transmitted data read 10ms delay timer	C counter	
		C0	ABS data receive times counter
		C1	Checksum receive times counter
		C2	Retry counter

Note: 1.Required for data set type home position return.

2.Required for electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

- Parameters of the A1SD75-P1 (AD75-P1) positioning module
  1) Unit setting :3=pulse (PLS)
  2) Travel per pulse :1=1 pulse

To select the unit other than the pulse, conversion into the unit of the feed value per pulse is required. Hence, add the following program to the area marked (Note 1) in the sequence program:

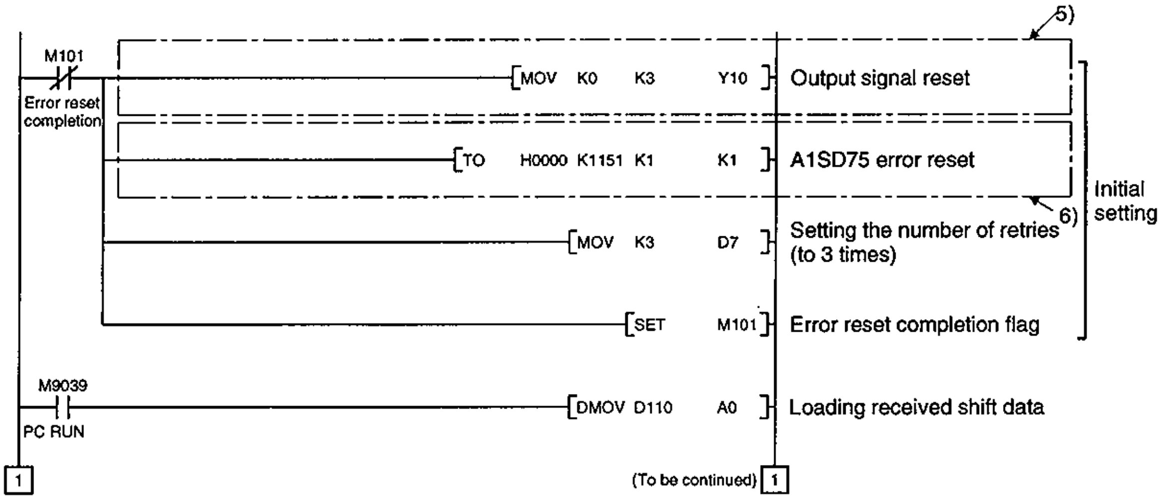
<Additional program>

```
—[D * P K□□ D3 D3]
```

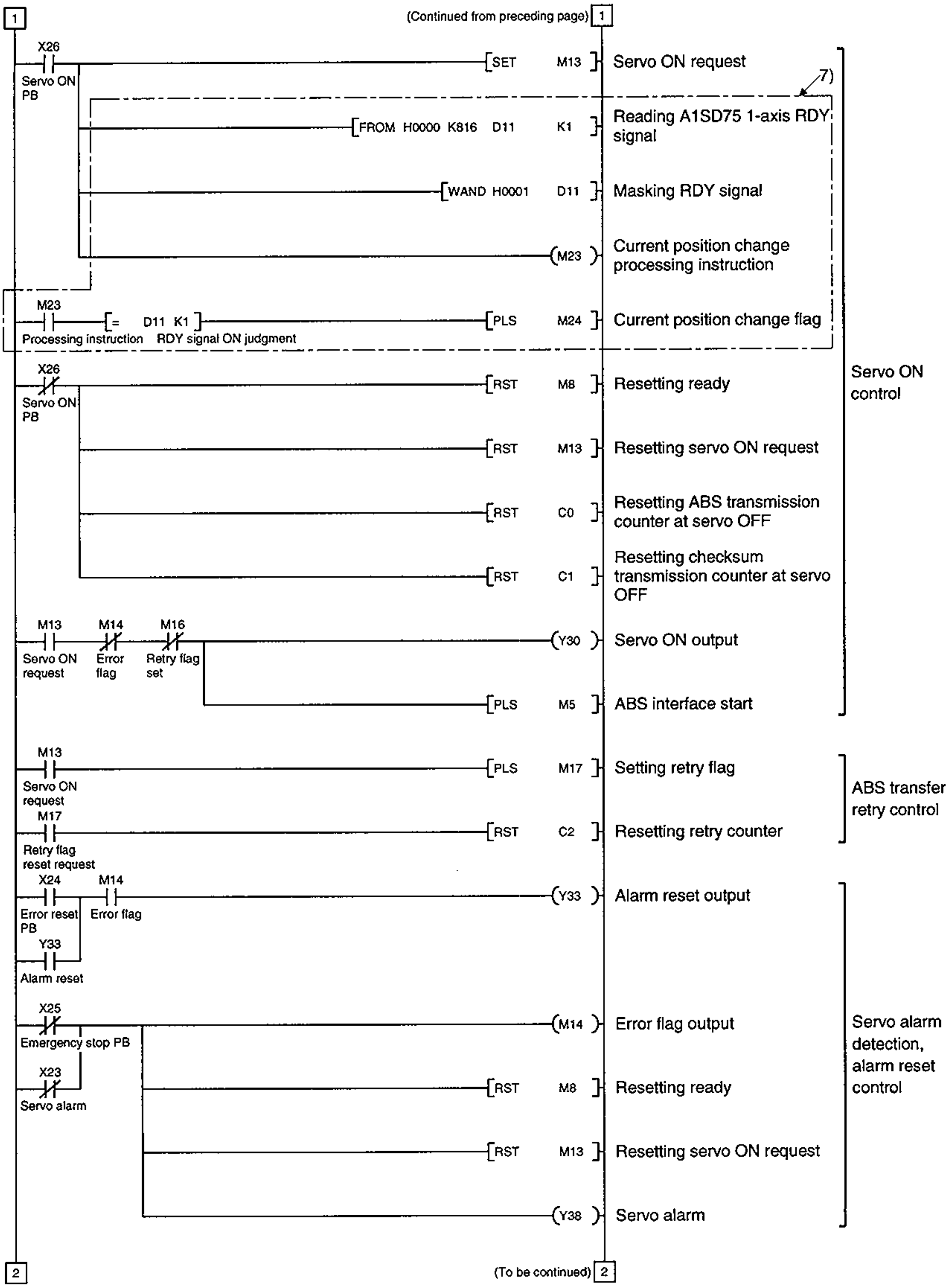
Item	mm				inch				degree				PULS
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.00001 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	µm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	None

Reference

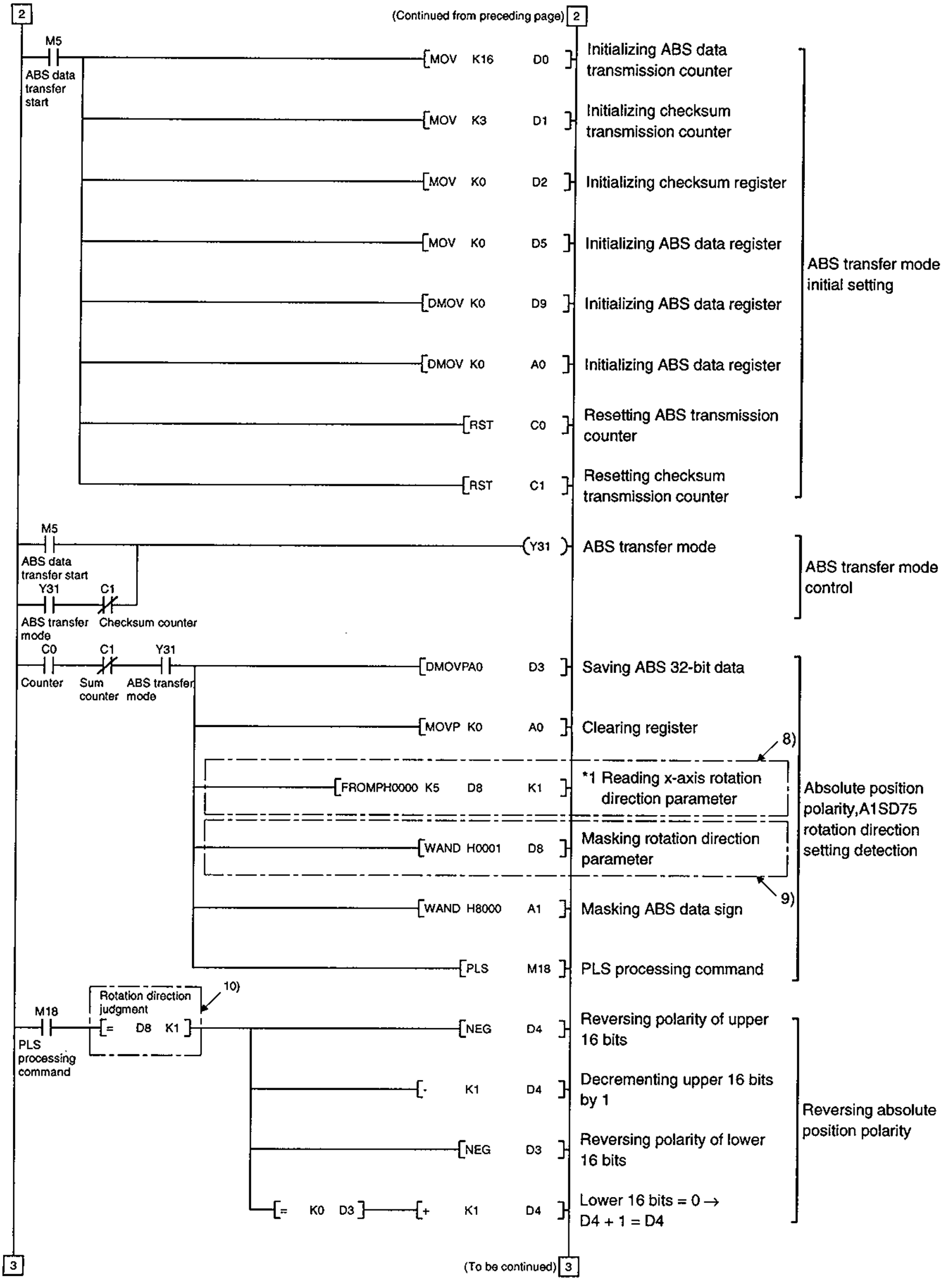
- For 1µm/PLS, set constant K to 10
- For 5µm/PLS, set constant K to 50
- The additional program is not required for the unit setting is PLS.

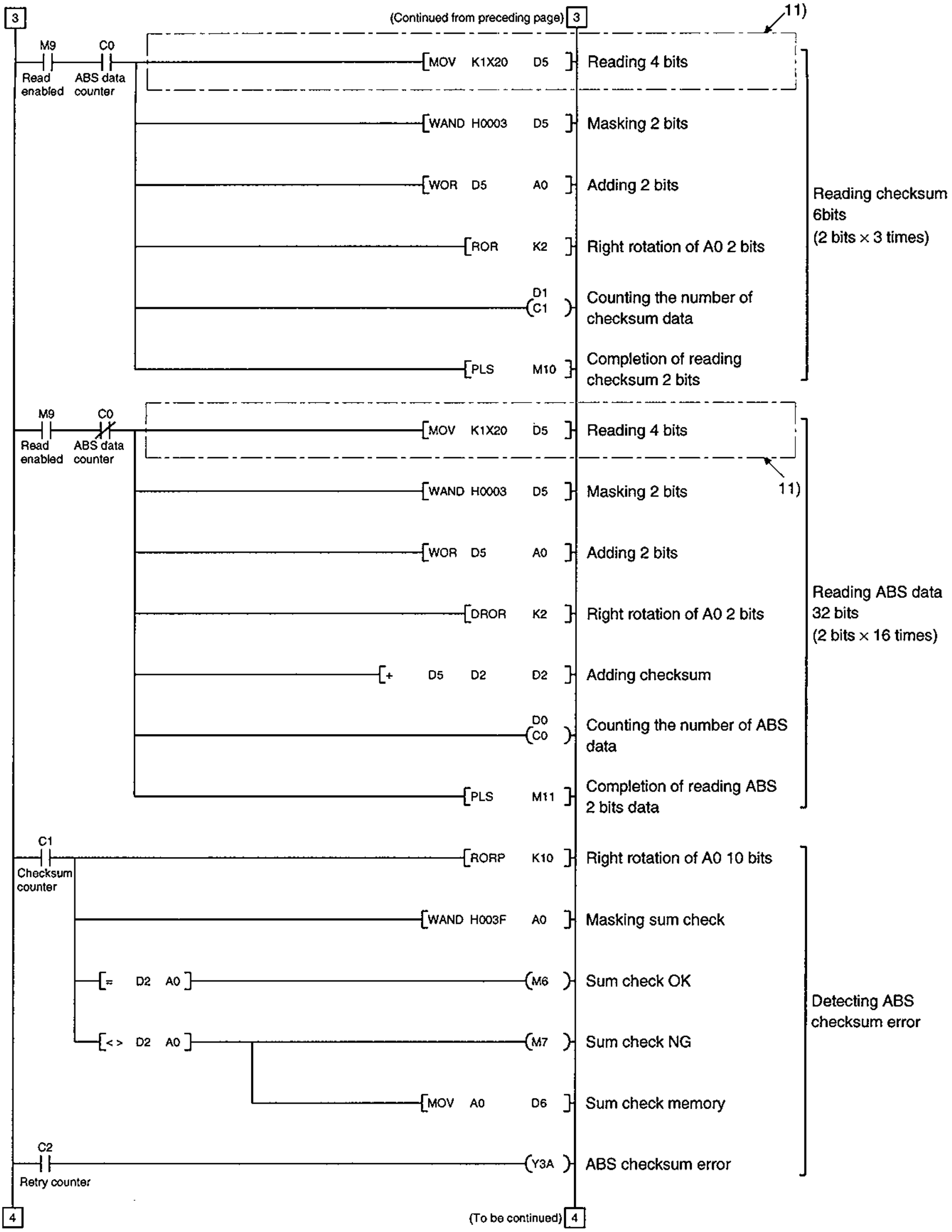


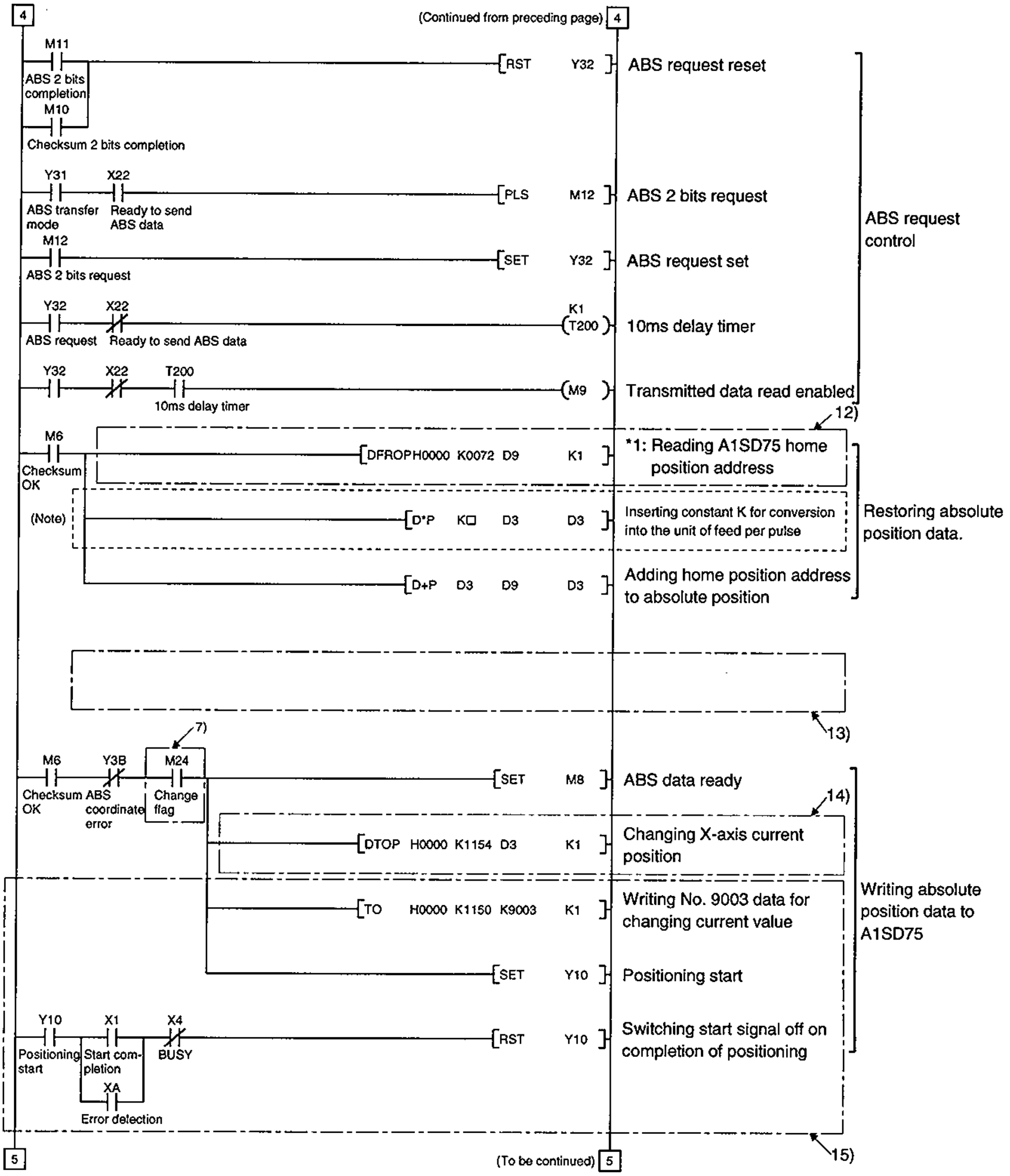
(Continued from preceding page)



(To be continued)

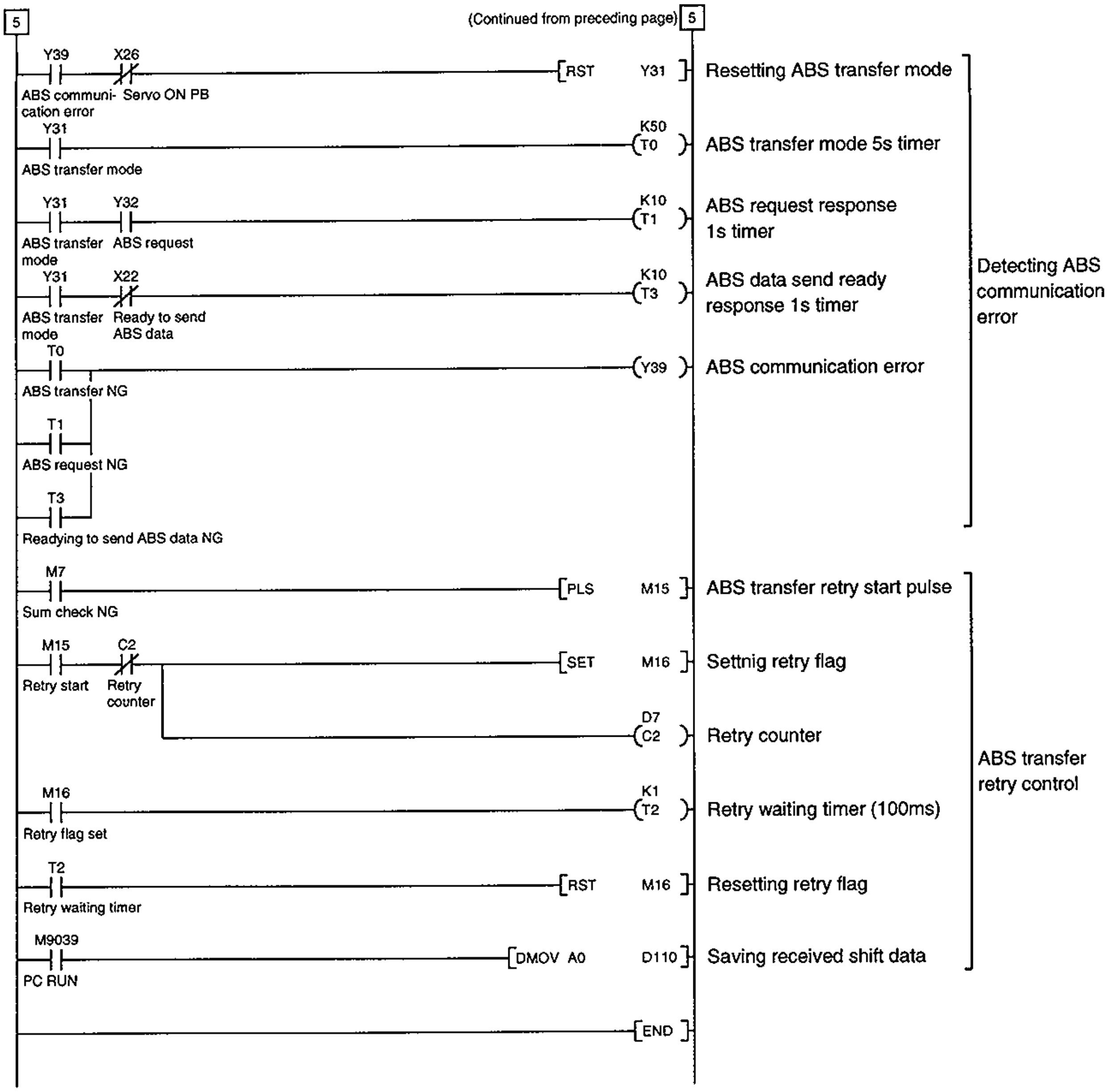

2
(Continued from preceding page) 2
M5
ABS data transfer start
MOV K16 D0
Initializing ABS data transmission counter
MOV K3 D1
Initializing checksum transmission counter
MOV K0 D2
Initializing checksum register
MOV K0 D5
Initializing ABS data register
DMOV K0 D9
Initializing ABS data register
DMOV K0 A0
Initializing ABS data register
RST C0
Resetting ABS transmission counter
RST C1
Resetting checksum transmission counter
ABS transfer mode initial setting
M5
ABS data transfer start
Y31
ABS transfer mode
C1
Checksum counter
Y31
ABS transfer mode
ABS transfer mode control
C0
Counter
C1
Sum counter
Y31
ABS transfer mode
DMOVPA0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
8)
FROMPH0000 K5 D8 K1
*1 Reading x-axis rotation direction parameter
WAND H0001 D8
Masking rotation direction parameter
9)
WAND H8000 A1
Masking ABS data sign
PLS M18
PLS processing command
Absolute position polarity,A1SD75 rotation direction setting detection
10)
Rotation direction judgment
M18
PLS processing command
= D8 K1
NEG D4
Reversing polarity of upper 16 bits
- K1 D4
Decrementing upper 16 bits by 1
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits = 0 → D4 + 1 = D4
Reversing absolute position polarity
3
(To be continued) 3


3
(Continued from preceding page) 3
11)
M9
C0
Read enabled
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
ROR K2
Right rotation of A0 2 bits
D1
C1
Counting the number of checksum data
PLS M10
Completion of reading checksum 2 bits
Reading checksum 6bits (2 bits × 3 times)
M9
C0
Read enabled
ABS data counter
MOV K1X20 D5
Reading 4 bits
11)
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding checksum
D0
C0
Counting the number of ABS data
PLS M11
Completion of reading ABS 2 bits data
Reading ABS data 32 bits (2 bits × 16 times)
C1
Checksum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking sum check
= D2 A0
M6
Sum check OK
<> D2 A0
M7
Sum check NG
MOV A0 D6
Sum check memory
Detecting ABS checksum error
C2
Retry counter
Y3A
ABS checksum error
4
(To be continued) 4



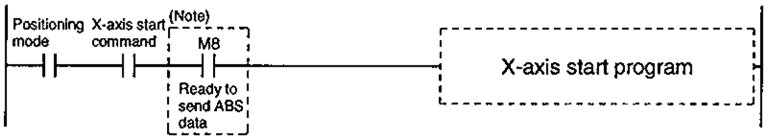
Note: When the unit setting parameter value of the AD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To set the unit to × 1μm, add this program to multiple the feed value by 10.

(Continued from preceding page)



(d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.



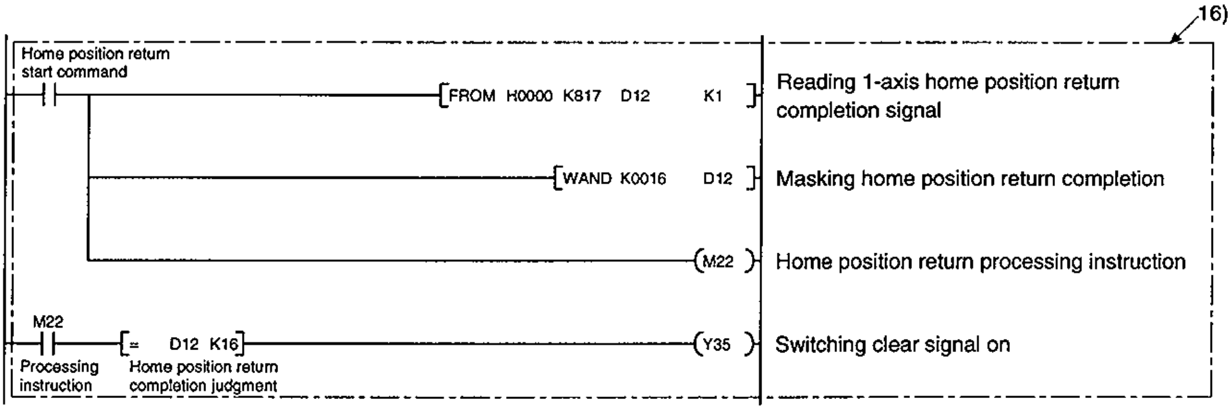
When "M8" (ready to send ABS data) switches on, the X-axis start program is executed by the X-axis start command.

(e) Dog type home position return

Refer to the home position return program in the A1SD75 User's Manual.

Note that this program requires a program which outputs the clear signal (Y35) after completion of home position return.

Add the following program:



Reading 1-axis home position return completion signal

Masking home position return completion

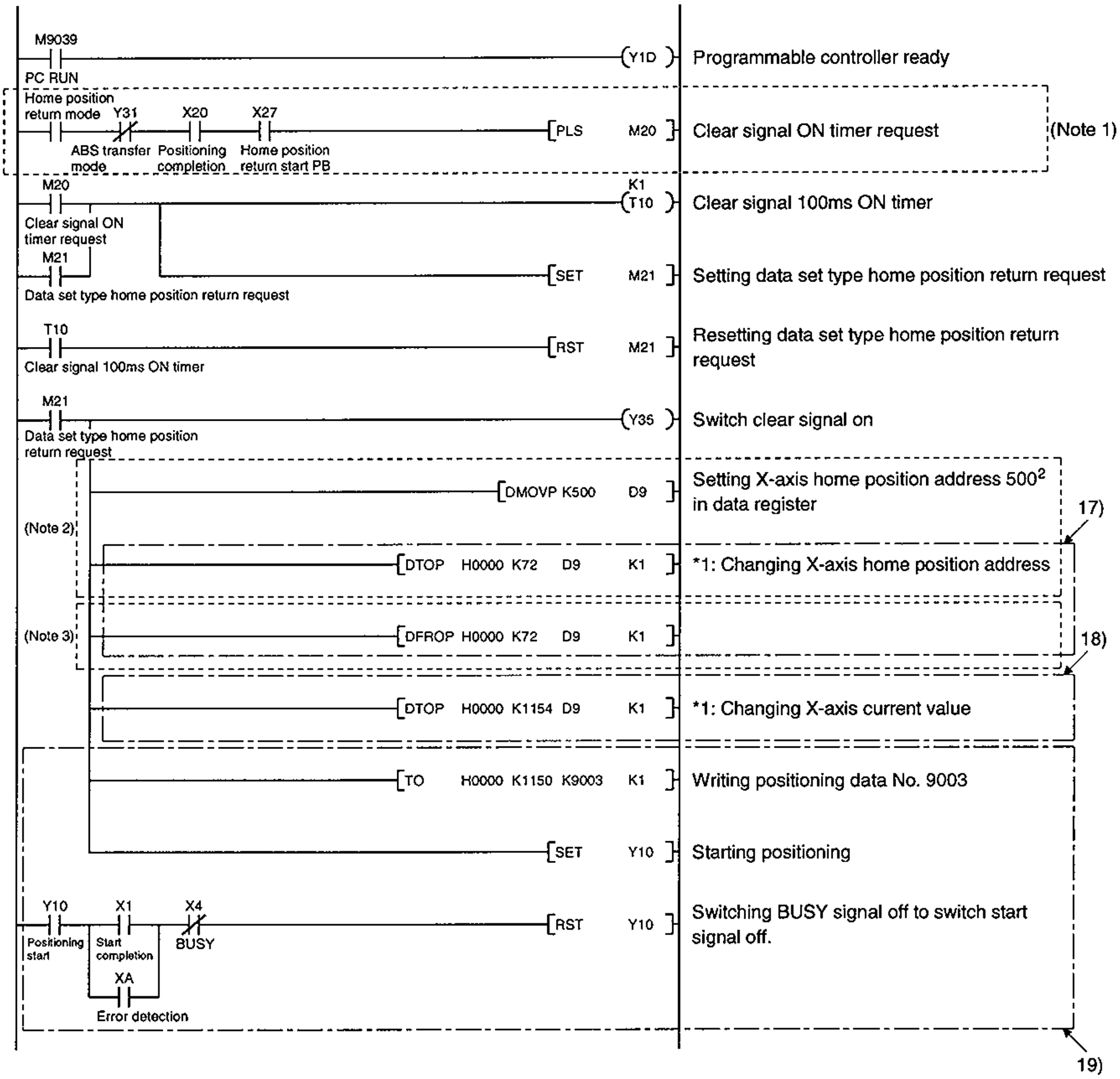
Home position return processing instruction

Switching clear signal on

(f) Data set type zeroing

After jogging the machine to the position where the home position is to be set (e.g. 500), choose the zeroing mode and set the home position with the zeroing start (PB ON).

Do not switch on the clear signal (Y35) for any other operation than home position return. To do so will cause a position shift.



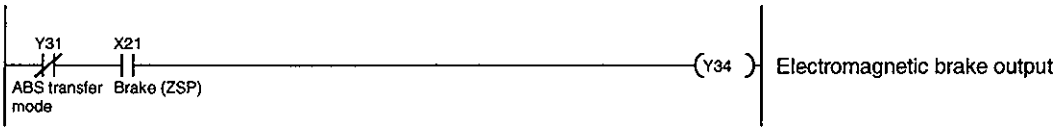
Note 1: If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

2: Contrary to above 2, if the home position address is written in the home position address parameter, the sequence circuit (Note1) is not required but this sequence circuit (Note 2) is required.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.

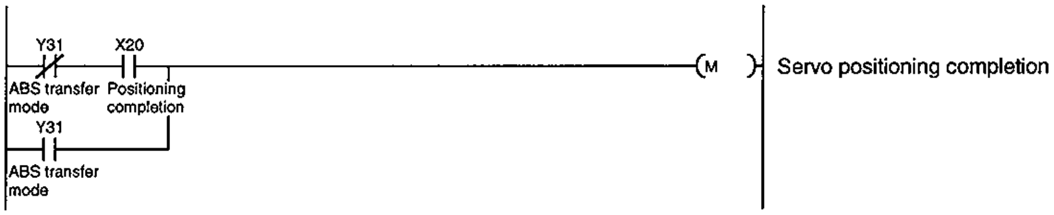
Set 1□1□ in parameter No. 3 of the servo amplifier to choose the electromagnetic brake interlock signal.



(h) Positioning completion

To create the status information for servo positioning completion.

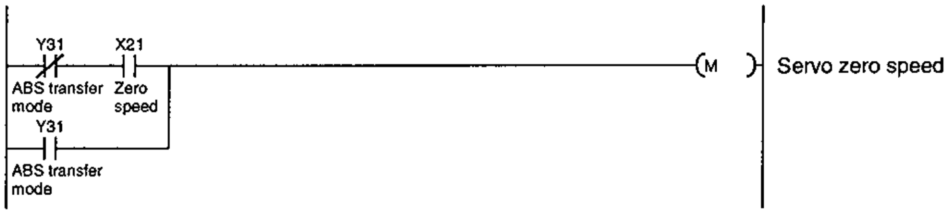
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for servo zero speed.

During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo on signal is turned on), the torque limiting must be off.

(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single A1SD71 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

Refer to the X-axis ABS sequence program and create the Y-axis program.

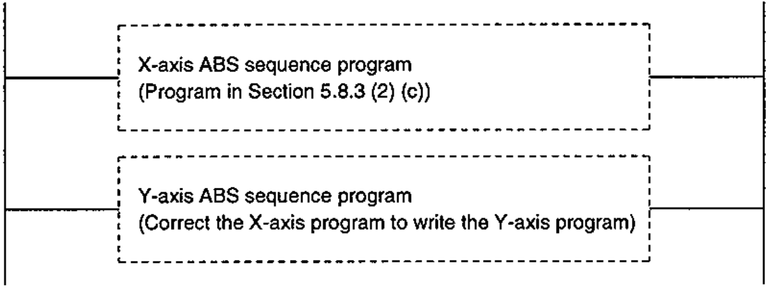
Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 5.8.3 (2), (c) should be changed as indicated below for use with the Y axis:

```
[FROMP H0000 K5    D8    K1]  →  [FROMP H0000 K155  D8    K1]
[DFROP H0000 K72   D9    K1]  →  [DFROP H0000 K222  D9    K1]
[DTOP  H0000 K1154 D3    K1]  →  [DTOP  H0000 K1204 D3    K1]
[TO    H0000 K1150 K9003 K1]  →  [TO    H0000 K1200 K9003 K1]
```

20)

[Program configuration]



(b) Data set type zeroing

Arrange the data set type zeroing programs given in Section 5.8.3 (2), (f) in series to control two axes.

Refer to the X-axis data set type zeroing program and create the Y-axis program.

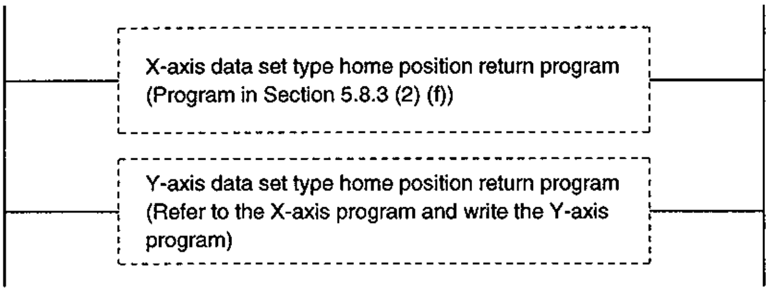
Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 5.8.3 (2), (f) should be changed as indicated below for use with the Y axis:

```
[DTOP H0000 K72   D9    K1]  →  [DTOP H0000 K222  D9    K1]
[DTOP H0000 K1154 D9    K1]  →  [DTOP H0000 K1204 D3    K1]
[TO   H0000 K1150 K9003 K1]  →  [TO   H0000 K1200 K9003 K1]
```

20)

[Program configuration]



(4) Differences between A1SD75 (AD75) and A1SD71 (AD71)

The sequence programs shown in (2) of this section differ from those for the A1SD71 (AD71) in the following portions. 1) to 20) in the following sentences indicate the numbers in the programs given in (2) of this section.

(a) Devices used

Since the A1SD75 (AD75) is a one-slot module which occupies 32 I/O points, the I/O devices are different, as indicated by 1) and 2), from those of the two-slot A1SD71 which occupies 48 point. The A1SD75 (AD75) uses the devices indicated in the following table, and its D registers and M contacts are different as indicated by 3) and 4).

Device Name	Devices			Application	Bit Device : Data at ON Data Register :Stored data
	Axis 1	Axis 2	Axis 3		
Input	X0			AD75 ready	Not ready/ WDT error
	X4	X5	X6	BUSY	BUSY(running)
	XA	XB	XC	Error detection	Error detection
Output	Y10	Y11	Y12	Positioning start	Start being requested
	Y13	Y14	Y1C	Axis stop	Stop being requested
	Y16	Y18	Y1A	Forward rotation jog start	Forward rotation being started
	Y17	Y19	Y1B	Reverse rotation jog start	Reverse rotation being started
	Y1D			Programmable controller ready	Programmable controller CPU normal
internal relay	M0			Parameter setting completion flag	Setting complete
	M1			Flash ROM registration processing flag	Processing
	M2	M3	M4	Axis error reset requesting flag	Requesting
	M100			AD75 normal flag	AD75 normal
	M101			Initial error reset completion flag	Error reset complete
	M102			All BUSY signal OFF flag	All BUSY signal OFF
	M103			AD75 operable flag	Operable
Data register	D100			Flash ROM registration results	Registration results
	D101	D102	D103	Axis error code	Error code
	D104	D105	D106	Axis warning code	Warning code
	D107	D108	D109	Axis error reset results	Axis error reset results

(b) ABS sequence program example

1) Initial setting

To reset the error of the A1SD75, the program 5) is added to reset all output signals at start-up. The axis error reset buffer memory address is changed from 201 to 1154 (axis 1) and the slot number from H0001 (slot number 1) to H0000 (slot number 2) 6).

2) Absolute position polarity, A1SD75 rotation direction setting detection

The slot number and buffer memory of the X-axis rotation direction parameter reading area are changed from [FROMP H0001 K7872 D8 K1] to [FROMP H0000 K5 D8 K1] 8).

The rotation direction parameter masking area is changed from [WAND H0004 D8] to [WAND H0001 D8] 9).

3) Reversing absolute position polarity

The rotation direction judging area is changed from [= D8 K4] to [= D8 K1] 10).

4) Reading checksum 6 bits, reading ABS data 32 bits

The 4 bits reading area is changed from [MOV K1 X30D5] to [MOV K1X20 D5] 11).

5) Restoring absolute position data

The slot number and buffer address of the A1SD75 home position address reading area are changed from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 12)

6) Writing absolute position data to A1SD75

The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 14). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003.

Therefore, the starting program for positioning data No.9003 15) is added.

7) X-axis data set type home position return program

The slot numbers and buffer addresses of the X-axis home position address changing area are changed from [DTOP H0001 K7912 D9 K1] to [DTOP H0000 K72 D9 K1] and from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 17).

The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 18). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003.

Therefore, the starting program for positioning data No.9003 19) is added.

8) Y-axis sequence program, Y-axis data set type home position return program

The slot numbers and buffer addresses are changed as indicated by 20).

9) Writing absolute position data to AD75

The A1SD75 (AD75) allows the current position to be changed only when the ready signal of the MR-H□A is on. Therefore, if the CPU scan is fast, the program for A1SD71 may change the current position before the ready signal switches on. 7) is added because the current position must be changed after it has been confirmed that the drive unit ready signal of the A1SD75 (D75) has switched on/off.

10) ABS coordinate error detection

As the A1SD75 (AD75) can handle the negative-polarity coordinate position that the A1SD71 could not handle, the program for ABS coordinate error detection is deleted. 13)

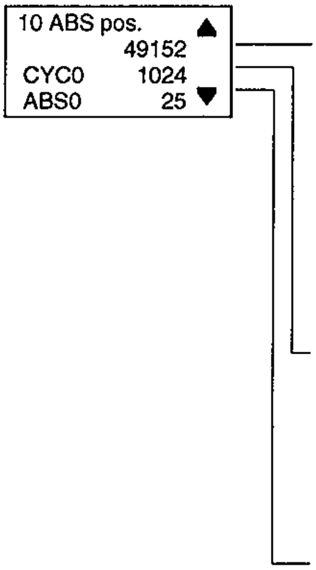
11) Dog type home position return program

Due to the changes in wiring described in Paragraph (4) in "Differences between A1SD75 (AD75) and A1SD71 (AD71)" of Section 6.3.1, the program for outputting the clear signal (Y35) after completion of a home position return is required. 16)

5.9 Confirmation of Absolute Position Detection Data

5.9.1 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

Unit: Encoder feedback pulse
to make conversion into the command pulse unit, multiply the reciprocal ratio of the electronic gear (CDV/CMX).

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.

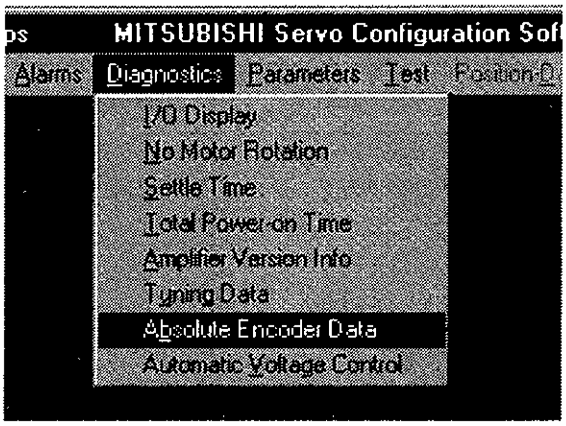
Display range :32768 to 32767

Unit : Turns

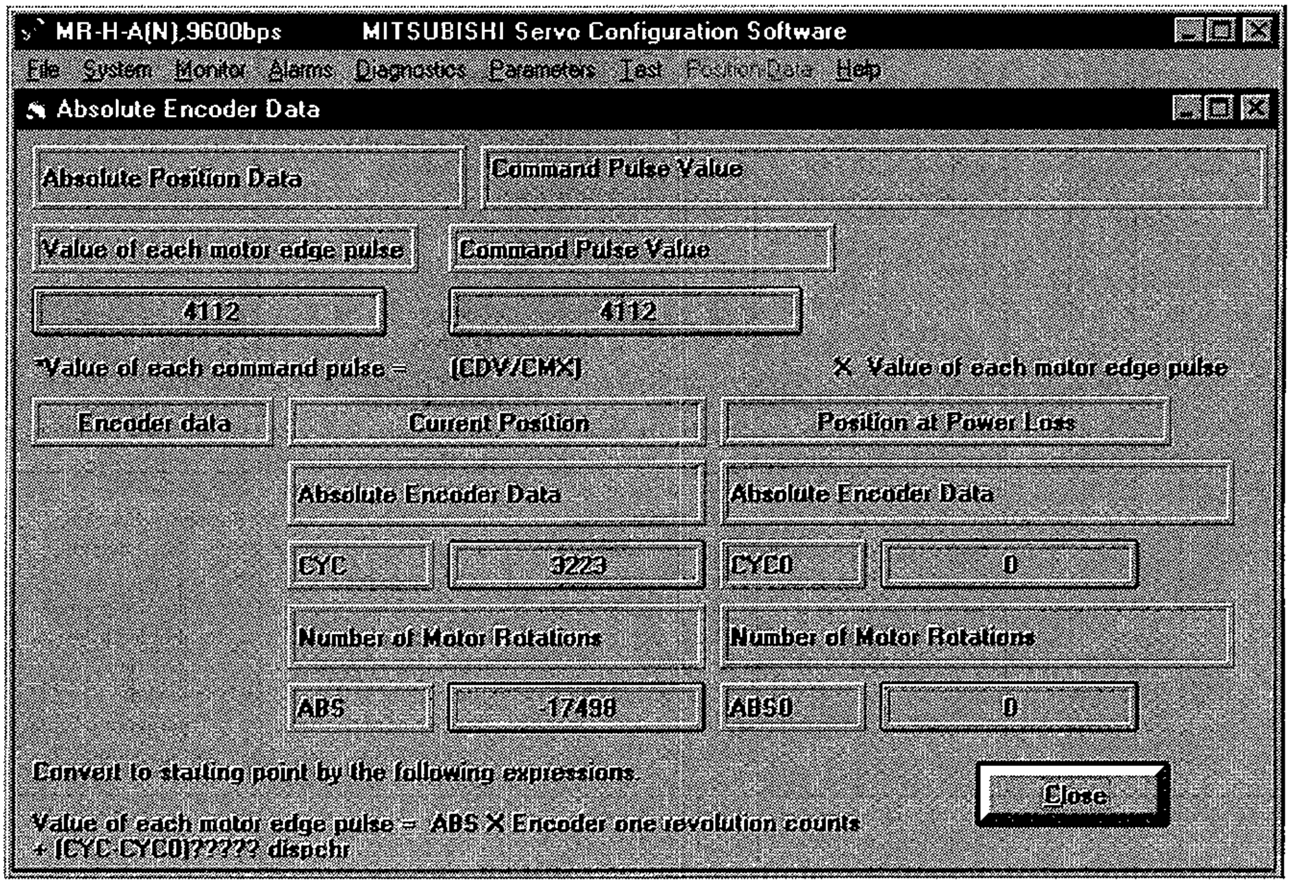
5.9.2 Using the Servo Configuration software

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.



Absolute Position Data
Command Pulse Value

Value of each motor edge pulse: 4112
Command Pulse Value: 4112

Value of each command pulse = (CDV/CMX) X Value of each motor edge pulse

Encoder data

Current Position
Absolute Encoder Data
CYC: 3223
Number of Motor Rotations
ABS: -17498

Position at Power Loss
Absolute Encoder Data
CYC0: 0
Number of Motor Rotations
ABS0: 0

Convert to starting point by the following expressions.
Value of each motor edge pulse = ABS X Encoder one revolution counts
+ (CYC-CYC0)????? dispchr

(3) Press the "Close" button to close the Absolute Encoder Data display window.

5.10 Absolute Position Data Transfer Errors

5.10.1 Corrective actions

(1) Error list

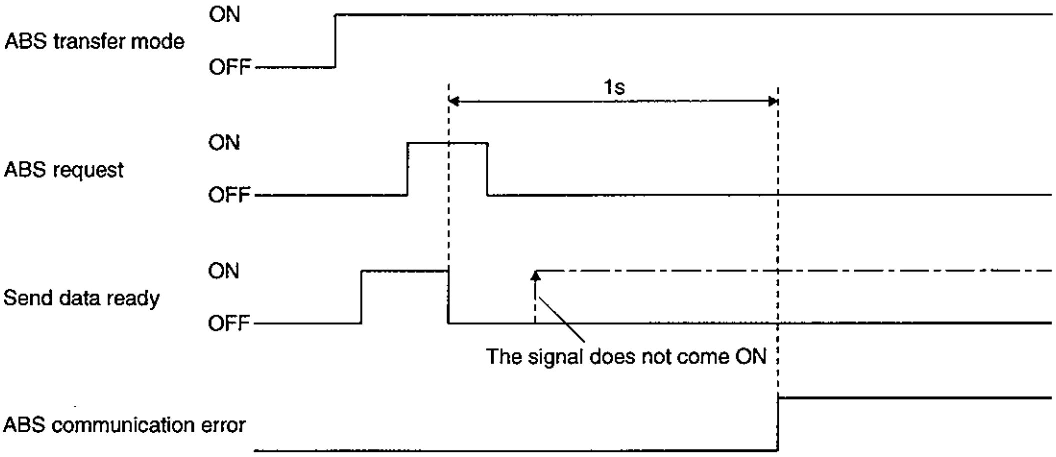
The number within parentheses in the table indicates the output coil or input contact number of the A1SD71 (AD71).

Error item	Output coil		Cause of actuation	Cause of error	Inspection	Corrective action
	AD71	1PG				
(Note) ABS communication error	Y49	Y11	•The ABS data transfer mode signal (Y41) is not completed within 5s. •The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON. •The ready to send signal (X32) remains OFF for longer than 1s.	1) Wiring for the control signal (ABS transfer mode signal,, ABS data request signal, or ready to send signal) is disconnected or connected to the SG terminal. 2) PC ladder program error. 3) Defective input or output module. 4) Defective PCB in the servo amplifier. 5) Power supply to the servo amplifier is OFF.	•Check the wiring for continuity. •Check the PC ladder program. •Replace the input or output module. •Replace the servo amplifier. •Turn ON the power to the servo amplifier.	•Correct the wiring. •Correct the program. •Replace the input or output module. •Replace the amplifier. •Turn on the power to the servo amplifier.
ABS data check sum error	Y4A	Y12	•Discrepancy in sum check occurred four times consecutively.	1) Wiring for the ABS data signal (ABS bit 0 (PF), bit 1 (ZSP)) is disconnected or connected to the SG terminal. 2) PC ladder program error. 3) Defective input module. 4) Defective PCB in the servo amplifier.	•Check the wiring for continuity. •Check the PC ladder program. •Replace the input module. •Replace the servo amplifier.	•Correct the wiring. •Correct the program. •Replace the input or output module. •Replace the amplifier.
ABS coordinate error	Y4B		•The motor position is in the negative coordinate value range when the servo is turned ON or when power supply is turned ON.	1) The servo is turned ON or the power supply is turned ON near the machine home position or in the zone in which addresses decrease. 2) The machine falls on a vertical axis when the servo signal is turned ON/OFF.	•Turn ON the servo at a point more than one motor shaft revolution away from the machine home position in the range in which addresses increase. •Change the electromagnetic brake operation sequence (brake ON/OFF time).	•Reconsider the position where the servo is turned ON. •Set the home position for positioning apart from the machine home position. •Change the electromagnetic brake operation sequence.
Servo alarm	Y48	Y10	•Alarm relating to the servo amplifier, or emergency stop,, is turned ON.	1) Emergency stop (EMG) of the servo amplifier was turned off. 2) Trouble (ALM) of the servo amplifier was turned on.		•After ensuring safety, turn EMG on. •Refer to Section 10.2.2 and take action.

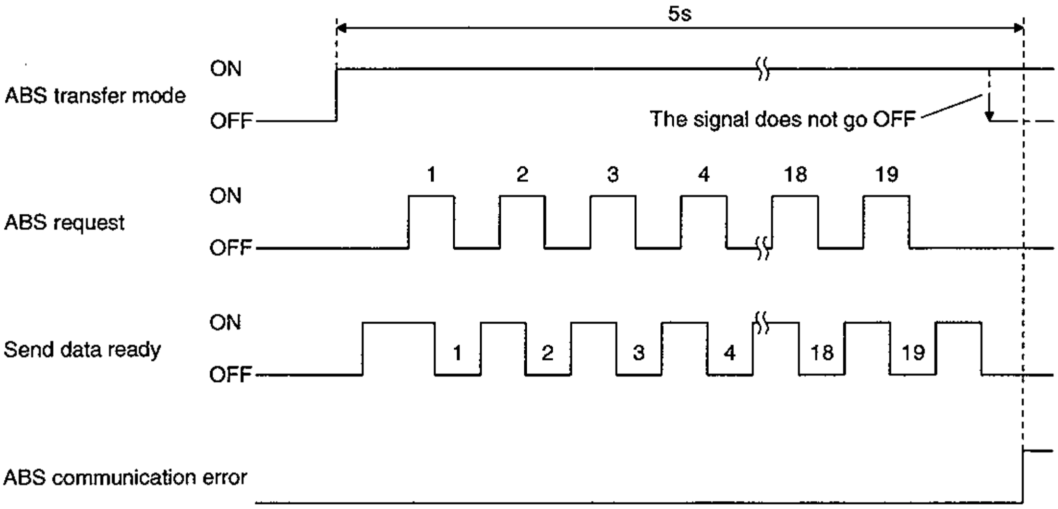
Note: Refer to (2) in this section for details of error occurrence definitions.

(2) ABS communication error

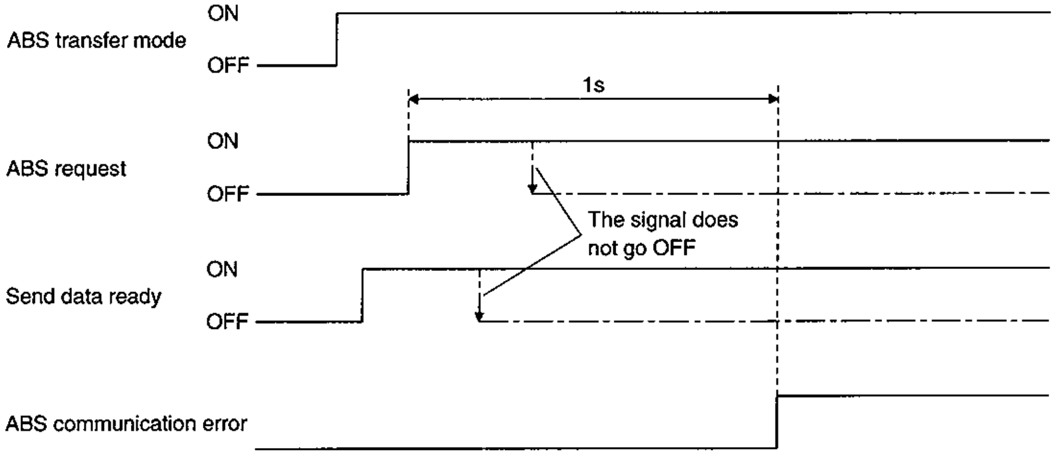
(a) The OFF period of the send data ready signal output from the servo amplifier is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (ALE5) is generated at the servo amplifier due to an ABS request ON time time-out.



(b) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked.
If the ABS transfer time is longer than 5s, this is communication error occurs if the ABS time-out warning (ALE5) is generated at the servo amplifier due to an ABS transfer mode completion time time-out



(c) To detect the ABS time-out warning (ALE5) at the servo amplifier, the time required for the ABS request signal to go OFF after it has been turned ON (ABS request time) is checked. If the ABS request remains ON for longer than 1s, it is regarded that an fault relating to the ABS request signal or the send data ready signal has occurred, and the ABS communication error is generated. The ABS communication error occurs if the ABS time-out warning (ALE5) is generated at the servo amplifier due to an ABS request OFF time time-out.



5.10.2 Error resetting conditions

Always remove the cause of the error before resetting the error.

Name	Output Coils		Servo Status	Resetting Condition
	AD71	1PG		
ABS communication error	Y49	Y11	Ready (RD) signal off	Reset when servo on PB (X36) signal turns off.
ABS checksum error	Y4A	Y12	Ready (RD) signal on	For AD71 Reset when servo on PB (X36) signal turns from off to on. For FX-1PG Reset when servo on PB (X36) signal turns off.
ABS coordinate error	Y48	–	Ready (RD) signal on	Reset when servo on PB (X36) signal turns from off to on after a motion to (+) coordinate is made by jog operation.
Servo alarm	Y48	Y10	Ready (RD) signal on	Reset when alarm reset PB turns on or power switches from off to on.

6. PARAMETERS

⚠ CAUTION

- Never adjust or change the parameter values extremely as it will make operation instable.

6.1 Parameter List

6.1.1 Parameter write inhibit

In the general purpose AC servo amplifier MR-H-AN, its parameters are classified into the basic parameters (No.0 to 19) and expansion parameters (No.20 to 64) and option parameter (No.65 to 74) according to their safety aspects and frequencies of use. In the factory setting condition, the customer can change the basic parameter values but cannot change the expansion parameter values. When fine adjustment, e.g. gain adjustment, is required, change the parameter No.19 setting to make the expansion parameters write-enabled.

After setting the parameter No.19 value, switch power off, then on to make that setting valid.

Parameter No.19 Setting	Operation	Basic Parameters No.0 to No.19	Expansion Parameters No.20 to No.64	Expansion Parameters No.65 to No.74
□□□0 (initial value)	Reference	○		(Note) ×
	Write	○		(Note) ×
□□□A	Reference	No.19 only		
	Write	No.19 only		
□□□C	Reference	○	○	○
	Write	○		
□□□E	Reference	○	○	○
	Write	○	○	○

Note: Reference and write are enabled when the MR-H-D01 option card or MR-H-E02 option card is used.

6.1.2 Lists

POINT

- 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 parameter No. 0 and 1 values 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.
P : Position control mode
S : Speed control mode
T : Torque control mode

(1) Item list

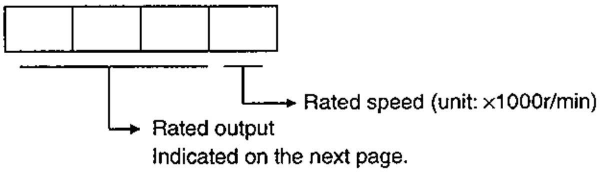
classification	No.	Code	Name	Parameter Unit Screen Display	Control Mode	Initial Value	Unit	Customer Setting
Basic parameter	0	*MSR	Motor series	0 MTR ser.	P,S,T			
	1	*MTY	Motor type	1 MTR type	P,S,T			
	2	*STY	Servo type	2 Servo type	P,S,T	0000		
	3	*STO	Function selection 1	3 Function 1	P,S,T	0000		
	4	CMX	Electronic gear numerator	4 E-gear-N	P	1		
	5	CDV	Electronic gear denominator	5 E-gear-D	P	1		
	6	INP	In-position range	6 INP zone	P	100	pulse	
	7	PG1	Position loop gain 1	7 Pos. gain 1	P	70	rad/s	
	8	PST	Position command acceleration /deceleration time constant (smoothing)	8 P time-c	P	3	ms	
	9	SC1	Internal speed command 1	9 Speed 1	S	100.0	r/min	
			Internal speed limit 1		T			
	10	SC2	Internal speed command 2	10 Speed 2	S	500.0	r/min	
			Internal speed limit 2		T			
	11	SC3	Internal speed command 3	11 Speed 3	S	1000.0	r/min	
			Internal speed limit 3		T			
	12	STA	Acceleration time constant	12 Acc. time	S	0	ms	
	13	STB	Deceleration time constant	13 Dec. time	S	0	ms	
	14	STC	S-pattern acceleration/deceleration time constant	14 S time-c	S	0	ms	
	15	TQC	Torque command time constant	15 T time-c	T	0	ms	
	16	TLT	Torque limit time constant	16 TL time-c	P,S	0		
	17	MOD	Analog monitor output	17 Moni. sel.	P,S,T	0001		
	18	DMD	Status display selection	18 Disp. sel.	P,S,T	0000		
	19	*BLK	Parameter write disable	19 Pr. block	P,S,T	0000		

classification	No.	Code	Name	Parameter Unit Screen Display	Control Mode	Initial Value	Unit	Customer Setting
Extension parameter	20	OP1	Function selection 2	20 Function 2	P,S	0001		
	21	*OP2	Function selection 3	21 Function 3	P,S,T	0000		
	22	*OP3	Function selection 4	22 Function 4	P,S	0000		
	23	FFC	Feed forward gain	23 FF gain	P,S	0	%	
	24	CM1	Electronic gear numerator 2	22 E-gear-N2	P	1		
	25	CM2	Electronic gear numerator 3	25 E-gear-N3	P	1		
	26	CM3	Electronic gear numerator 4	26 E-gear-N4	P	1		
	27	ERZ	Excessive error alarm level	27 AL52 level	P	80	K pulse	
	28	STD	Second acceleration time constant	28 Acc. time 2	S	0	ms	
	29	STE	Second deceleration time constant	29 Dec. time 2	S	0	ms	
	30	SC4	Internal speed command 4 Internal speed limit 4	30 Speed 4	S T	100.0	r/min	
	31	SC5	Internal speed command 5 Internal speed limit 5	31 Speed 5	S T	200.0	r/min	
	32	SC6	Internal speed command 6 Internal speed limit 6	32 Speed 6	S T	500.0	r/min	
	33	SC7	Internal speed command 7 Internal speed limit 7	33 Speed 7	S T	1000.0	r/min	
	34	ZSP	Zero speed	34 Zero SPD	P,S,T	50	r/min	
	35	VCM	Speed at 10V command	35 Speed/10V	S		r/min	
	36	*VCA	VC speed command average	36 VC Averag	S	1		
	37	TLC	Torque control command full-speed value	37 Torque/8V	T	100		
	38		Spare	38 Torq. com.		20		
	39	*ENR	Encoder output division ratio	39 PLG out dv	P,S,T	1	pulse	
	40	TLL	Internal torque limit 1	40 TQ limit	P,S	100	%	
	41	*IP1	Input signal selection 1	41 DI Sel.1	P,S,T	0000		
	42	*IP2	Input signal selection 2	42 DI Sel.2	P,S,T	0000		
	43	*OP4	Function selection 5	43 Function 5	P,S,T	0000		
	44	*OPC	Output signal selection	44 DO Sel.	P,S,T	0000		
	45	MVC	Machine speed conversion constant	45 M-speed	P,S,T	1.0000		
	46	MOA	Pre-alarm data selection	46 ALM memo	P,S,T	0001		
	47	VCO	VC offset	47 VC offset	S	0	mV	
	48	TPO	TLAP offset	48 TLAP offset	P,S,T	0	mV	
	49	TNO	TLAN offset	49 TLAN offset	P,S,T	0	mV	
	50	MO1	MO1 offset	50 MO1offset	P,S,T	0	mV	
	51	MO2	MO2 offset	51 MO2offset	P,S,T	0	mV	
	52		Spare	52 SIO sel.		0000		
	53	MBR	Electromagnetic brake sequence output	53 BRK timing	P,S,T	100	ms	
	54	TL2	Internal torque limit 2	54 TQ limit2	P,S	100	%	
	55		Spare	55 V-limit		0.0		
	56	DIF	DI signal filter	56 DI filter	P,S,T	0		
	57		Spare	57 PID droop		0		
	58	DG2	Ratio of load inertia moment to Servo motor inertia moment	58 Inertia	P,S,T	2.0	Times	
	59	NCH	Machine resonance suppression filter	59 N-filtia	P,S,T	0		
	60	PG2	Position loop gain 2	60 Pos. gain2	P	25	rad/s	
	61	VG1	Speed loop gain 1	61 V-gain 1	P,S	1200	rad/s	
	62	VG2	Speed loop gain 2	62 V-gain 2	P,S	600	rad/s	
	63	VIC	Speed integral compensation	63 V-int com	P,S	20	ms	
	64	VDC	Speed differential compensation	64 V-dif com	P,S	980		

classification	No.	Code	Name	Parameter Unit Screen Display	Control Mode	Initial Value	Unit	Customer Setting
Option parameter	65		For option card MR-H-E02	65 PLG type				
	66		For option card MR-H-E02	66 OP.M ser.				
	67		Spare	67 OP.M typ.				
	68		Spare	68				
	69		Spare	69				
	70	DIS	Input signal selection	70 OP.DI	P,S	0000		
	71	DOS	Output signal selection	71 OP.D0	P,S,T	0000		
	72	DPS	Auxiliary pulse form selection	72 OP.pulse	P	0000		
	73	CMS	Auxiliary pulse input electronic gear numerator	73 OP.gear-N	P	1		
	74	CDS	Auxiliary pulse input electronic gear denominator	74 OP.gear-D	P	1		
	75		Spare	75				
	76		Spare	76				
	77		Spare	77				
	78		Spare	78				
	78		Spare	78				

(2) Details list

(a) Basic parameters

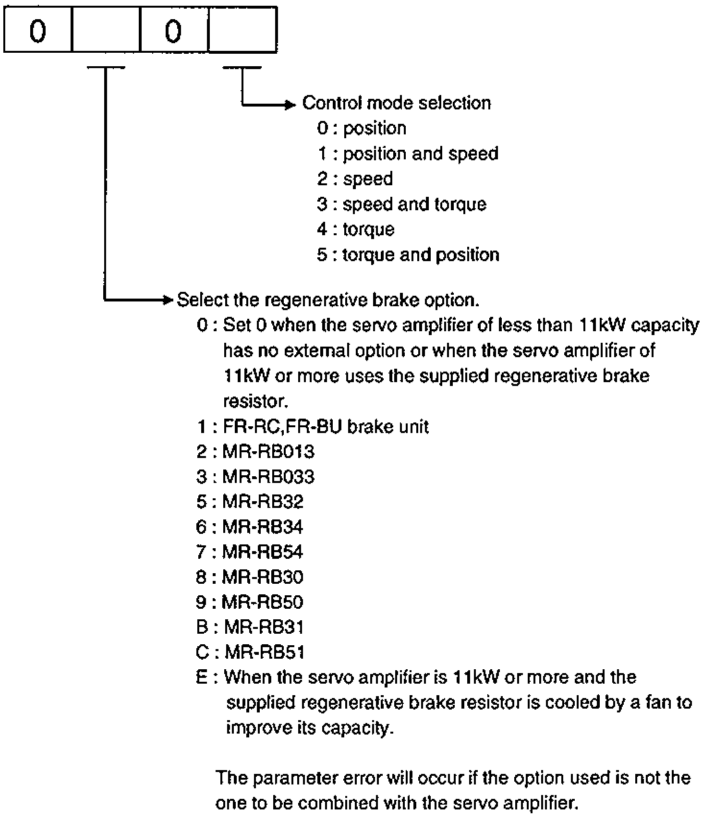
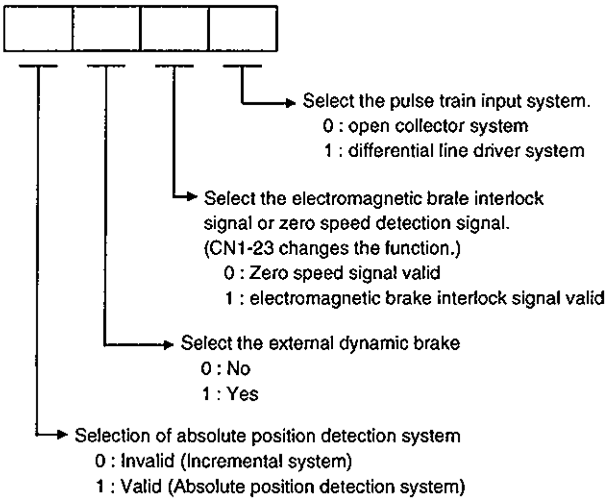
<table>
<tr><th>classification</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Control Mode</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td>Basic parameter</td><td>0</td><td>*MSR</td><td>Motor series:
Used to choose the servo motor series.
When using the HC-MF, HA-FF, 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 changed but may be used 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>
</td><td>P
S
T</td><td></td><td></td><td>0000
to
0003
·
0005</td></tr>
<tr><td></td><td>1</td><td>*MTY</td><td>Motor type:
Used to set the parameter (servo motor capacity) according to the motor used.
The servo amplifier and servo motor to be set should be any of their combinations having the parameter values in the table.
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 changed but may be used as it is.


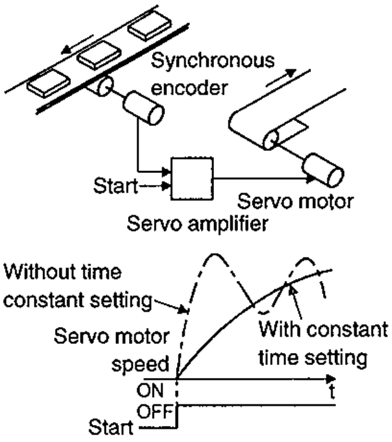
</td><td>P
S
T</td><td></td><td></td><td></td></tr>
</table>

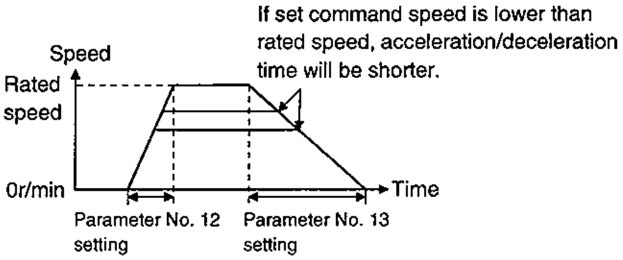
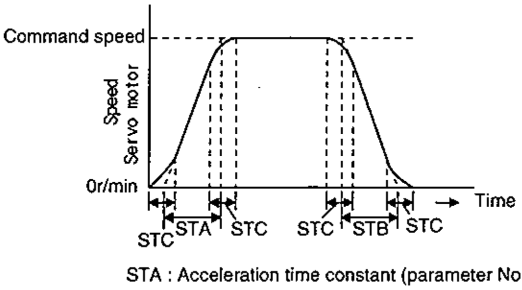
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	1	*MTY			As in the left table.		As in the left table.

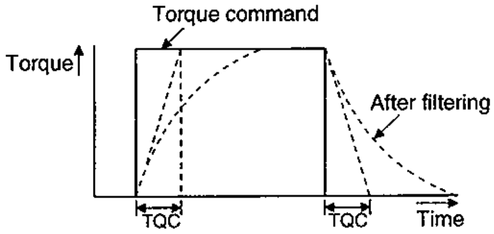
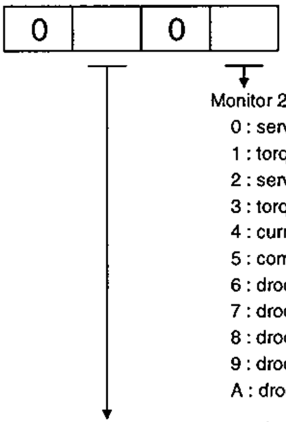
			Servo Amplifier MR-H□AN											
	Servo Motor	Capacity (W)	10	20	40	60	100	200	350	500	700	11K	15K	22K
Ultracompac	HA-MH053	50		053										
	HA-MH13	100		13										
	HA-MH23	200			23									
	HA-MH43	400				43								
	HA-MH73	750					73							
Small capacity	HA-FH053	50	$\boxed{053}$											
	HA-FH13	100	13											
	HA-FH23	200		$\boxed{23}$										
	HA-FH33	300			$\boxed{33}$									
	HA-FH43	400			43									
	HA-FH63	600				63								
1000r/min	HA-SH81	850					81							
	HA-SH121	1200						121						
	HA-SH201	2000						201						
	HA-SH301	3000							301					
2000r/min	HA-SH52	500				$\boxed{52}$								
	HA-SH102	1000					$\boxed{102}$							
	HA-SH152	1500						$\boxed{152}$						
	HA-SH202	2000						202						
	HA-SH352	3500							$\boxed{352}$					
	HA-SH502	5000								$\boxed{502}$				
	HA-SH702	7000									$\boxed{702}$			
3000r/min	HA-SH53	500				53								
	HA-SH103	1000					103							
	HA-SH153	1500						153						
	HA-SH203	2000						203						
	HA-SH353	3500							353					
Low inertia	HA-LH52	500				$\boxed{52}$								
	HA-LH102	1000						102						
	HA-LH152	1500						$\boxed{152}$						
	HA-LH202	2000							202					
	HA-LH302	3000								302				
	HA-LH502	5000								$\boxed{502}$				
	HA-LH702	7000									$\boxed{702}$			
Large capacity	HA-LH11K2	11000										$\boxed{1102}$		
	HA-LH15K2	15000											$\boxed{1502}$	
	HA-LH22K2	22000												$\boxed{2202}$
Pancake	HA-UH32	300			32									
	HA-UH52	500				$\boxed{52}$								
	HA-UH102	1000						102						
	HA-UH152	1500						$\boxed{152}$						
	HA-UH222	2200							222					
	HA-UH352	3500								352				
	HA-UH452	4500								452				

□ Values within are factory settings.

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	2	*STY	Servo type: Used to choose the control mode and regenerative brake option.  Control mode selection 0 : position 1 : position and speed 2 : speed 3 : speed and torque 4 : torque 5 : torque and position Select the regenerative brake option. 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. 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 is cooled by a fan to improve its capacity. The parameter error will occur if the option used is not the one to be combined with the servo amplifier.	P S T	0001		0000 to 0E05h
	3	*ST0	Function selection 1: Used to choose the optional functions.  Select the pulse train input system. 0 : open collector system 1 : differential line driver system Select the electromagnetic brale interlock signal or zero speed detection signal. (CN1-23 changes the function.) 0 : Zero speed signal valid 1 : electromagnetic brake interlock signal valid Select the external dynamic brake 0 : No 1 : Yes Selection of absolute position detection system 0 : Invalid (Incremental system) 1 : Valid (Absolute position detection system)	P S T	0000		0000 to 1111h

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	4	*CMX	Electronic gear denominator: Set the value within the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$ Always set the electronic gear in the servo off status to prevent misoperation due to wrong setting For the setting, refer to Section 6.2.1. Set the multiplier for the command pulse input. $\xrightarrow[f_1]{\text{Command pulse input}} \boxed{\frac{CMX}{CDV}} \xrightarrow{\text{Position command}}$ $f_2 = f_1 \cdot \frac{CMX}{CDV}$ Note: Set the value using the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$ as a guideline. Use the following formula to change the setting of input pulse count per servo motor revolution. (Example: HC-MF series: 8192 pulses/rev) $8192 \cdot \frac{CDV}{CMX}$ (pulse/rev)	P	1		1 to 50000
	5	CDV	Electronic gear denominator: Refer to parameter No. 4.	P	1		1 to 50000
	6	INP	In-position range: Used to set the range of the counter pulse value which provides the imposition output.	P	100	pulse	0 to 50000
	7	PG1	Position loop gain 1: Used to set the gain of the position loop. Increase the gain to raise the follow-up performance with the position command.	P	70	rad/s	4 to 1000
	8	PST	Position command acceleration/deceleration time constant (smoothing): Set this value when filtering input pulses to smooth speed variation. When the command is given from the synchronous encoder or the like, synchronous operation can be started smoothly if the operation starts. 	P	3	ms	0 to 50000
	9	SC1	Internal speed command 1: Used to set speed 1 of the internal speed command.	S	100	r/min	0 to max. speed
			Internal speed limit 1: Used to set speed 1 of the internal speed limit.	T			

classifi-cation	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	10	SC2	Internal speed command 2: Used to set speed 2 of the internal speed command.	S	500	r/min	0 to max. speed
			Internal command limit 2: Used to set speed 2 of the internal speed limit.	T			
	11	SC3	Internal speed command 3: Used to set speed 3 of the internal speed command.	S	1000	r/min	0 to max. speed
			Internal command limit 3: Used to set speed 3 of the internal speed limit.	T			
	12	STA	Acceleration time constant: For the analog speed command and internal speed commands 1 to 3, this parameter is used to set the acceleration time until the rated speed is reached from 0r/min. When forming a position loop externally, the parameter No. 12 and 13 values should be 0 or smallest possible.  Example Set 3000 (3s) to accelerate the HC-MF series servo motor (rated speed 3000r/min) from 0r/min to 1000r/min in 1s.	S	0	ms	0 to 50000
	13	STB	Deceleration time constant: For the analog speed command and internal speed commands 1 to 3, this parameter is used to set the deceleration time until zero speed is reached from the rated speed.	S	0	ms	0 to 50000
	14	STC	S-pattern acceleration/deceleration time constant: Used to smooth the start/stop of the servo motor.  STA : Acceleration time constant (parameter No. 12) STB : Deceleration time constant (parameter No. 13) STC : S-pattern acceleration/deceleration constant (parameter No. 14)	S	0	ms	0 to 5000

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	15	TQC	Torque command time constant: Used to set time constant when the primary delay filter is provided for the torque command.  TQC : Torque command time constant	T	0	ms	0 to 50000
	16	TLT	Torque limit time constant: Used to set the time constant of the primary delay filter for the torque limit. Refer to parameter No.16.	P S	0	ms	0 to 50000
	17	MOD	Analog monitor output: Used to set the signal to be output to the analog monitor output.  Monitor 2 output selection 0 : servo motor speed (±8V/max.speed) 1 : torque (±8V/max.torque) (Note) 2 : servo motor speed (+8V/max.speed) 3 : torque (+8V/max.torque) (Note) 4 : current command output 5 : command pulse frequency(±8V/400kpps) 6 : droop pulse value 1/1 (±11.6V/2048 pulses) 7 : droop pulse value 1/4 (±11.6V/8192 pulses) 8 : droop pulse value 1/16 (±11.6V/32768 pulses) 9 : droop pulse value 1/32(±11.6V/65536 pulses) A : droop pulse value 1/64 (±11.6V/131072 pulses) Monitor 1 output selection Items are as in monitor 2 output selection. Note: 8V is output at the maximum torque. However, when parameter No. 40 is used to limit the torque, 8V is output at the limited torque.	P S T	0001		0000 to 0A0Ah

<table>
<tr><th>classifi-cation</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Control Mode</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td rowspan="2">Basic parameter</td><td>18</td><td>DMD</td><td>Status display selection:
Used to choose the status display to be provided at power-on.
Servo amplifier display
(valid when rotary switch CS1 is 0)
0 : feedback pulse value
1 : servo motor speed
2 : command speed
3 : droop pulse value
4 : command pulse value
5 : command pulse frequency
6 : speed command voltage
7 : reverse rotation torque limit command voltage
8 : forward rotation torque limit command voltage
9 : regenerative load factor
A : effective load factor
B : peak load factor
C : within-1-revolution position
D : ABS counter
E : bus voltage
F : blank
Automatic switching of servo amplifier display
0 : Automatic
The status shown changes with the control mode of the servo as follows:
Position control mode : feedback pulse value
Speed control mode : servo motor speed
Torque control mode : effective load factor
1 : Manual
The status set in the first digit is shown.
Parameter unit status display at power-on
0 : feedback pulse value
1 : servo motor speed
2 : command speed
3 : droop pulse value
4 : command pulse value
5 : command pulse frequency
6 : speed command voltage
7 : reverse rotation torque limit command voltage
8 : forward rotation torque limit command voltage
9 : regenerative load factor
A : effective load factor
B : peak load factor
C : within-1-revolution position
D : ABS counter
E : machine speed
F : bus voltage
Automatic switching of parameter unit status display at power-on
0 : Automatic
The status shown changes with the control mode of the servo as follows:
Position control mode : feedback pulse value
Speed control mode : servo motor speed
Torque control mode : effective load factor
1 : Manual
The status set in the third digit is shown.</td><td>P
S
T</td><td>0000</td><td></td><td>0000
to
1F1Fh</td></tr>
<tr><td>19</td><td>*BLK</td><td>Parameter write disable:
Used to limit parameter write.
<table>
<tr><th>Setting</th><th>Operation</th><th>Parameter No.0 to No.19</th><th>Parameter No.20 to No.74</th></tr>
<tr><td rowspan="2">□□□0
(initial value)</td><td>Reference</td><td>○</td><td></td></tr>
<tr><td>Write</td><td>○</td><td></td></tr>
<tr><td rowspan="2">□□□A</td><td>Reference</td><td>No.19 only</td><td></td></tr>
<tr><td>Write</td><td>No.19 only</td><td></td></tr>
<tr><td rowspan="2">□□□C</td><td>Reference</td><td>○</td><td>○</td></tr>
<tr><td>Write</td><td>○</td><td></td></tr>
<tr><td rowspan="2">□□□E</td><td>Reference</td><td>○</td><td>○</td></tr>
<tr><td>Write</td><td>○</td><td>○</td></tr>
</table></td><td></td><td>0000</td><td></td><td>0000
to
000Eh</td></tr>
</table>

(b) Extension parameters

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	20	OP1	Function selection 2: Used to choose automatic restart after instantaneous power failure and servo lock in the auto tuning/speed control mode.		0001		0000 to 1C12h

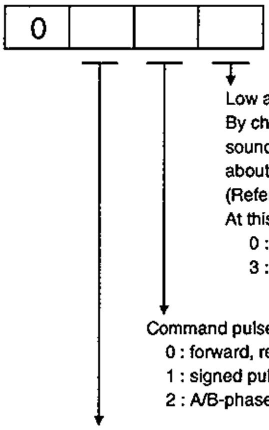
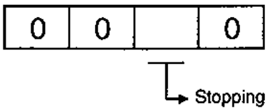
Auto tuning selection
0 : auto tuning selected for use of interpolation axis control, etc. in position control (valid)
1 : auto tuning for ordinary operation (valid)
2 : no auto tuning (invalid)

Automatic restart after instantaneous power failure (speed control mode)
Restart can be made without an alarm (AL10) stop when power is restored after instantaneous power failure.
0 : invalid
1 : valid

Response setting (when auto tuning is valid)
Optimum response can be selected according to the rigidity of the machine. As the machine has higher rigidity, faster response can be set to improve tracking performance in response to a command and to reduce setting time.
When changing the value, always increase the setting from lower to higher response levels while simultaneously checking the vibration and settling of the servo motor and machine immediately before a stop and during a stop.

Machine Type	Set Value	Description			Guideline of Position Setting Time (GDL^2/GDM^2 guideline = within 5 times)
		Response	Guideline of corresponding machine rigidity	GDL^2/GDM^2 guideline of load inertia	
Initial value	0	Low response	Low to high rigidity	1 to 5 times	
Ordinary	1	Low response	Low rigidity	1 to 10 times	50 to 300mS
	2		to		10 to 70mS
	3	Middle response	Medium rigidity		
	4		to		10 to 30mS
	5	Hight response	High rigidity		
Large friction	8	Low response	Low rigidity		70 to 400mS
	9		to		10 to 100mS
	A	Middle response	Medium rigidity		
	B		to		10 to 50mS
	C	Hight response	High rigidity		

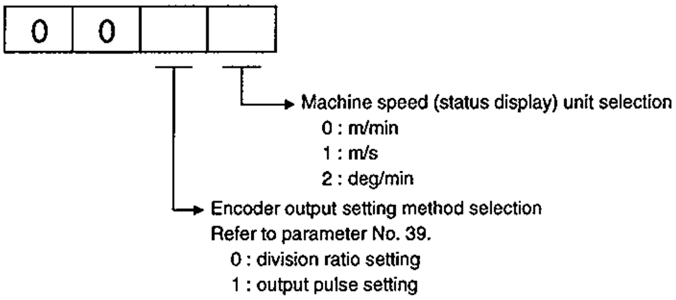
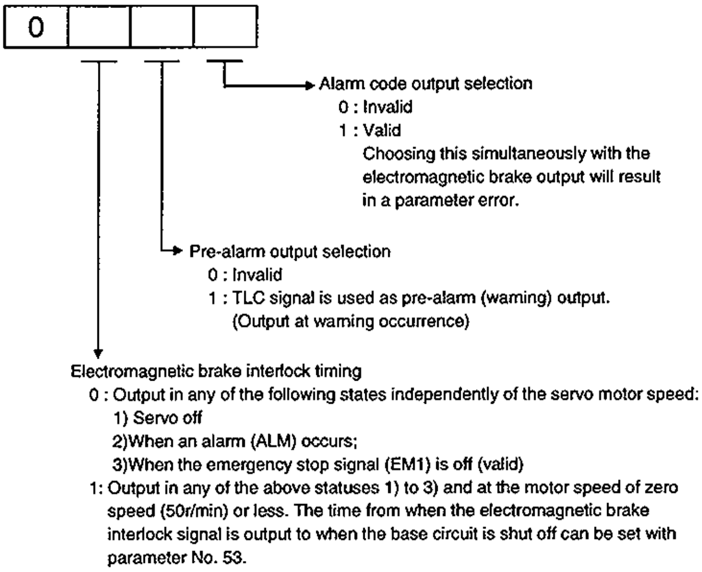
Speed control servo lock selection
When this function is made valid, the servo motor shaft attempts to return to the original position if it is turned by external force.
When this function is invalid, counterforce matching the external force is produced but the shaft does not return to the original position.
0 : valid
1 : invalid

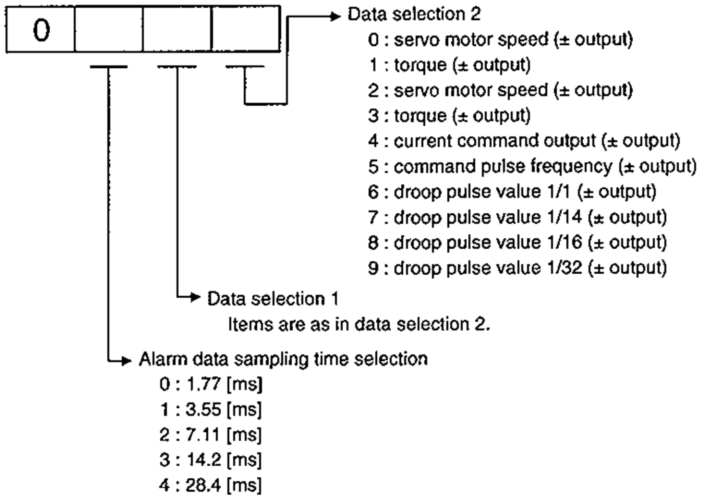
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	21	*OP2	Function selection 3: Used to select the option function.  Low acoustic noise mode selection By choosing the low acoustic noise mode, electromagnetic sound generated by the servo motor can be reduced by about 20dB. (Refer to Section 6.2.4.) At this time, the continuous output of the servo motor reduces. 0 : non-low acoustic noise 3 : low acoustic noise Command pulse input form 0 : forward, reverse rotation pulse train 1 : signed pulse train 2 : A/B-phase pulse Command pulse logic selection 0 : Positive logic 1 : Negative logic	P S T	0000		0000 to 0123h
	22	*OP3	Function selection 4 Used to choose the stop processing performed when LSP/LSN signal turns off.  Stopping pattern when LSP/LSN signal is turned off (made valid) 0 : sudden stop 1 : slow stop In the position control mode, deceleration is made according to the parameter No. 8 value. In the speed control mode, deceleration is made according to the parameter No. 13 value.	P S T	0000		0000 to 0010h
	23	FFC	Feed forward gain: Used to set the feed forward gain for position control. When this value is set to 100%, droop pulses are not produced during constant-speed operation. Note that sudden acceleration/deceleration increases overshoot, (As a guideline, acceleration/deceleration time up to the rated speed is 1S or more at the FFC of 100.) When setting this parameter value, always choose "no" auto tuning (parameter No. 20).	P S	0	%	0 to 100
	24	CM1	Electronic gear numerator 2: When using this parameter, set □□□1 in parameter No. 41. The electronic gear numerators of parameters No. 4 and 24 to 26 can be selected with DI1 and DI2. Set this value in the range of $\frac{1}{50}<\frac{CMX}{CDV}<50$	P	1		1 to 50000

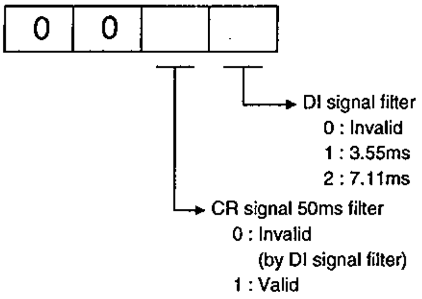
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	21	CM2	Electronic gear numerator 3: As in parameter No. 24.	P	1		1 to 50000
	26	CM3	Electronic gear numerator 4: As in parameter No. 24.	P	1		1 to 50000
	27	ERZ	Excessive error alarm level: Used to set the range in which the counter pulse value excess alarm is given.	P	80	kpulse	1 to 1000
	28	STD	Second acceleration time constant: When using this parameter, set 1□□□ in parameter No. 41. Using CR, you can choose either of the acceleration time constants of parameter No. 12 and this parameter.	S	0	ms	0 to 50000
	29	STE	Second deceleration time constant: When using this parameter, set 1□□□ in parameter No. 41. Using CR, you can choose either of the deceleration time constants of parameter No. 13 and this parameter.	S	0	ms	0 to 50000
	30	SC4	Internal speed command 4: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 4 of the internal speed command. Using DI0, DI1 and DI2, you can choose any of the speed commands of VC, parameters No. 9 to 11 and 30 to 33.	S	100.0	r/min	0 to max speed
			Internal speed limit 4: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 4 of the internal speed limit. Using DI0, DI1 and DI2, you can choose any of the speed limits of VC, parameters No. 9 to 11 and 30 to 33.	T			
	31	SC5	Internal speed command 5: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 5 of the internal speed command.	S	200.0	r/min	0 to max speed
			Internal speed limit 5: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 5 of the internal speed limit.	T			
	32	SC6	Internal speed command 6: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 6 of the internal speed command.	S	500.0	r/min	0 to max speed
			Internal speed limit 6: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 6 of the internal speed limit.	T			
	33	SC7	Internal speed command 7: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 7 of the internal speed command.	S	1000.0	r/min	0 to max speed
			Internal speed limit 7: When using this parameter, set □□1□ in parameter No. 41. Used to set speed 7 of the internal speed limit.	T			

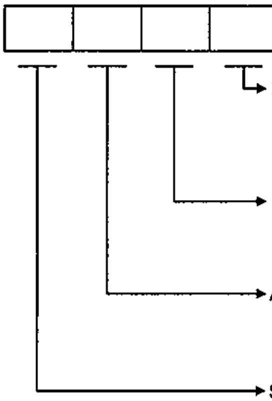
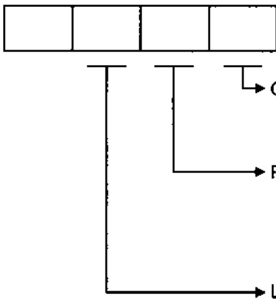
classifi-cation	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	34	ZSP	Zero speed: Used to set the output range of zero speed signal (ZSP).	P S T	50	r/min	0 to 10000
	35	VCM	Speed at 10V command: Used to set the speed at the analog speed command (VC) of max. input voltage (10V).	S		r/min	0 to 10000
	36	*VCA	VC speed command average: Used to set the sampling time when the analog speed commands are averaged.	S	1		0 to 3
	37	TLC	Analog torque command full-scale Set this value on the assumption that the output torque at the analog torque command TLAP of ± 8V is the maximum torque of 100 [%]. For example, when this value is set to 50 and TLAP = +8V Output torque = max. torque × 50/100	T	100	%	0 to 100
	38		Spare				
	39	*ENR	Encoder output division ratio: Used to set the encoder pulses output by the servo amplifier. Use parameter No. 43 to choose the output division ratio setting or output pulse setting. 1. Output division ratio setting Set □□0□ (initial value) in parameter No. 43. Division is made at the value set for the number of pulses per servo motor revolution. $\text{Out pulses}=\frac{\text{Resolution per servo motor revolution}}{\text{Setting}}\ \text{(Pulse/rev)}$ 2. Output pulse setting Set □□1□ in parameter No. 43. Division is made at the value set for the number of pulses per servo motor revolution. $\text{output pulses} = \frac{\text{setting}}{4}\ \text{(pulse/rev)}$	P S T	1		1 to 32768
	40	TLL	Internal torque limit 1: Set to define the maximum torque as 100% However, when the external torque limit is valid, torque is limited at either of the lower level values. When torque monitoring has been selected for monitor output, this set level is 8V. The monitored torque of the analog monitor output is 8[V] at the maximum torque.	P S	100	%	0 to 100

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	41	*IP1	Input signal selection 1: Used to choose the input signal functions. → Electronic gear 4-step switching DI1 and DI2 are used as the electronic gear numerator selection signals. 0 : invalid (not used) 1 : valid DI1 and DI2 are used as the electronic gear numerator switch-over signals. Electronic gear numerators 2 to 4 are made available. → Internal 7-speed setting DI0 is used as speed selection 3. 0 : invalid (not used) 1 : valid DI0 is used as the speed selection 3 signal. Internal speed commands 4 to 7 are made available. → Clear signal (CR) function selection 0 : Droop pulses are cleared on leading edge. 1 : Droop pulses are always cleared while on. → CN1-37 pin (CR) function changing 0 : Clear signal 1 : Second acceleration/deceleration signal	S P S T S	0000		0000 to 1111h
	42	*IP2	Input signal selection 2: Used to select the internal signal functions. External torque limit (TL) switch-over function selection 0 : ON: Torque limit command is valid. However, when the internal torque limit value 1 (parameter No. 40) is smaller than the torque limit value command, the internal torque limit value 1 is valid. OFF: The internal torque limit value 1 is valid. 1 : ON: The internal torque limit value 2 (parameter No. 54) is valid. OFF: The internal torque limit value 1 (parameter No. 40) is valid. However, when the internal torque limit value 2 is smaller than the torque limit value 1, the internal torque limit value 2 is always valid. → Servo on signal (SON) input selection 0 : ON/OFF by external input signal 1 : Automatic ON inside servo amplifier (External wiring not needed) → Forward rotation stroke end signal (LSP) input selection 0 : ON/OFF by external input signal 1 : Automatic ON inside servo amplifier (External wiring not needed) → Reverse rotation stroke end signal (LSN) input selection 0 : ON/OFF by external input signal 1 : Automatic ON inside servo amplifier (External wiring not needed)	P S P S T P S	0000		0000 to 1111h

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	43	*OP4	Function selection 5: Used to choose the encoder output pulse setting method and the machine speed display unit for status display.  Machine speed (status display) unit selection 0 : m/min 1 : m/s 2 : deg/min Encoder output setting method selection Refer to parameter No. 39. 0 : division ratio setting 1 : output pulse setting	P S T	0000		0000 to 0012h
	44	*OPC	Output signal selection: Used to select the output signal functions.  Alarm code output selection 0 : Invalid 1 : Valid Choosing this simultaneously with the electromagnetic brake output will result in a parameter error. Pre-alarm output selection 0 : Invalid 1 : TLC signal is used as pre-alarm (warning) output. (Output at warning occurrence) Electromagnetic brake interlock timing 0 : Output in any of the following states independently of the servo motor speed: 1) Servo off 2)When an alarm (ALM) occurs; 3)When the emergency stop signal (EM1) is off (valid) 1: Output in any of the above statuses 1) to 3) and at the motor speed of zero speed (50r/min) or less. The time from when the electromagnetic brake interlock signal is output to when the base circuit is shut off can be set with parameter No. 53.	P S T	0000		0000 to 0111h
	45	MVC	Machine speed conversion constant: Used to set the factor for converting the speed into the machine speed.	P S T	1.0000		0 to 5.0000

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	46	MOA	Pre-alarm data selection: Used to choose the pre-alarm data to be output.  0 Data selection 2 0 : servo motor speed (± output) 1 : torque (± output) 2 : servo motor speed (± output) 3 : torque (± output) 4 : current command output (± output) 5 : command pulse frequency (± output) 6 : droop pulse value 1/1 (± output) 7 : droop pulse value 1/14 (± output) 8 : droop pulse value 1/16 (± output) 9 : droop pulse value 1/32 (± output) Data selection 1 Items are 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]	P S T	0001		0000 to 0499h
	47	VCO	VC offset: Used to set the offset voltage for the speed command.	S	0	mV	-9999 to 9999
			VC offset: Used to set the offset voltage for the speed limit command.	T	0	mV	-9999 to 9999
	48	TPO	TLAP offset: Used to set the offset voltage for the reverse rotation side torque limit command+.	P S	0	mV	-9999 to 9999
			TLAP offset: Used to set the offset voltage for the torque command.	T	0	mV	-9999 to 9999
	49	TNO	TLAN offset: Used to set the offset voltage for the forward rotation side torque limit command-.	P S	0	mV	-9999 to 9999
	50	MO1	MO1 offset: Used to set the offset voltage for monitor output 1.	P S T	0	mV	-9999 to 9999
	51	MO2	MO2 offset: Used to set the offset voltage for monitor output 2.	P S T	0	mV	-9999 to 9999
	52		Spare		0000		
	53	MBR	Electromagnetic brake sequence output: Used to set time delay between electromagnetic brake operation and base drive circuit shut-off.	P S T	100	ms	0 to 1000
	54	TL2	Internal torque limit 2: Set to define the maximum torque as 100%. Set □□□1 in parameter No. 42 and turn on the external torque limit signal (TL) to limit the torque at the value of this parameter. The value of this parameter should be greater than the internal torque limit value in parameter No. 40. If it is smaller, this parameter is made valid independently of TL switch-over.	P S	100	%	0 to 100
	55		Spare		0.0		

<table>
<tr><th>classification</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Control Mode</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td rowspan="9">Extension parameter</td><td>56</td><td>DIF</td><td>DI signal filter
Used to choose the time of filtering the digital input signal.
 </td><td>P
S
T
P
S</td><td>0</td><td></td><td>0000
to
0012h</td></tr>
<tr><td>57</td><td></td><td>Spare</td><td></td><td>0</td><td></td><td></td></tr>
<tr><td>58</td><td>DG2</td><td>Ratio of load inertia moment to motor inertia moment:
Used to set the ratio of load inertia moment to servo motor shaft inertia moment.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P
S
T</td><td>2.0</td><td>Times</td><td>0.0
to
100.0</td></tr>
<tr><td>59</td><td>NCH</td><td>Machine resonance suppression filter:
Used to set the frequency to mach the resonance frequency of the mechanical system.
<table>
<tr><th>Set Value</th><th>Machine Resonance Frequency (Hz)</th></tr>
<tr><td>0</td><td>Not used</td></tr>
<tr><td>1</td><td>1125</td></tr>
<tr><td>2</td><td>563</td></tr>
<tr><td>3</td><td>375</td></tr>
<tr><td>4</td><td>282</td></tr>
<tr><td>5</td><td>225</td></tr>
<tr><td>6</td><td>188</td></tr>
<tr><td>7</td><td>161</td></tr>
</table></td><td>P
S
T</td><td>0</td><td></td><td>0 to 7</td></tr>
<tr><td>60</td><td>PG2</td><td>Position loop gain 2:
Used to set the gain of the position loop.
Set this value when increasing the position response to load disturbance. Higher setting improves the response level but makes vibration and noise more liable to be produced.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P</td><td>25</td><td>rad/s</td><td>1
to
500</td></tr>
<tr><td>61</td><td>VG1</td><td>Speed loop gain 1:
Normally, this parameter value need not be changed. Higher setting improves the response level but makes vibration and noise more liable to be produced.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P
S</td><td>1200</td><td>rad/s</td><td>20
to
5000</td></tr>
<tr><td>62</td><td>VG2</td><td>Speed loop gain 2:
Set this parameter when vibration is generated on a low-rigidity machine or on a machine which has large backlash. Higher setting improves the response level but makes vibration and noise more liable to be produced.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P
S</td><td>600</td><td>rad/s</td><td>20
to
5000</td></tr>
<tr><td>63</td><td>VIC</td><td>Speed integral compensation:
Used to set the time constant of integral compensation.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P
S</td><td>20</td><td>ms</td><td>1
to
1000</td></tr>
<tr><td>64</td><td>VDC</td><td>Speed differential compensation:
Used to set the differential compensation value.
When auto tuning is selected, the result of auto tuning is automatically used.</td><td>P
S</td><td>980</td><td></td><td>0
to
1000</td></tr>
</table>

classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Option parameter	65 66		For option card MR-H-E02 Set this value when using the MR-H-E02. Refer to the MR-H-E02 Installation Guide.				
	67 to 69		Spare				
	70	DIS	Input signal selection: Used to select the application and mode of the input signal.  Function selection 0: not used 1: digital speed command 2: electronic gear ratio external setting Binary/BCD selection 0: binary input 1: BCD input Auxiliary pulse valid/invalid selection 0: invalid 1: valid Strobe valid/invalid selection 0: valid 3: automatic Note 1. For the digital speed command, binary input is only valid and BCD cannot be selected. 2. When the auxiliary pulse is made valid, set the required values in parameter No.72.	P S P S P P S	0000		0000h to 4112h
	71	DOS	Output signal selection: Used to select the application of the output signal. Set value 0: not used 1: 4-bit alarm code is used.	P S T	0000		0000h to 0000h
	72	DPS	Auxiliary pulse form selection: Used to select type, etc. of the auxiliary pulse input.  Open collector/differential selection 0: open collector input 1: differential input Pulse type selection 0: forward-reverse pulse train 1: signed pulse train 2: AB phase pulse train Logic selection 0: positive logic 1: negative logic	P	0000		0000h to 0121h
	73	CMS	Auxiliary pulse input electronic gear numerator: Used to set the multiplier of the auxiliary pulse input. $\text{Auxiliary pulse input } f_1 \xrightarrow{} \boxed{\frac{CMX}{CDV}} \xrightarrow{} \text{Position command } f_2 = f_1 \times \frac{CMX}{CDV}$ Note: Set within the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$.	P	1	1	1 to 32767
	74	CDS	Auxiliary pulse input electronic gear denominator: Used to set the divisor of the auxiliary pulse input.	P	1	1	32767
	75 to 79		Spare				

6.2 Detailed Description

6.2.1 Electronic gear

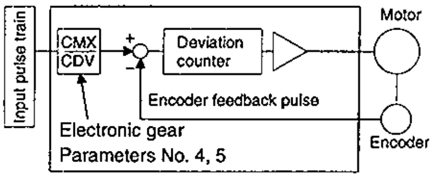
POINT

- The guideline of the electronic gear setting range is $\frac{1}{50} < \frac{CMX}{CDV} < 50$. If the set value is outside this range, noise may be generated during acceleration/deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.

(1) Concept of electronic gear

The machine can be moved at any multiplication factor to input pulses.

$$\frac{CMX}{CDV} = \frac{\text{Parameter No.4}}{\text{Parameter No.5}}$$



The following setting examples are used to explain how to calculate the electronic gear:

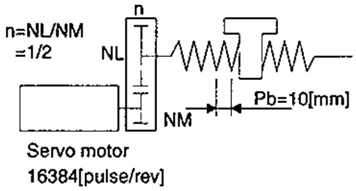
(a) For motion in increments of 10 μm per pulse

Machine specifications

Ballscrew lead Pb=10[mm]

Reduction ratio: n=1/2

Servo motor resolution: Pt=16384 [pulses/rev]



$$\frac{CMX}{CDV} = \Delta l_0 \cdot \frac{Pt}{\Delta S} = \Delta l_0 \cdot \frac{Pt}{n \cdot Pb} = 10 \times 10^{-3} \cdot \frac{16384}{1/2 \cdot 10} = \frac{32768}{1000} = \frac{4096}{125}$$

Hence, set 4096 to CMX and 125 to CDV.

(b) Conveyor setting example

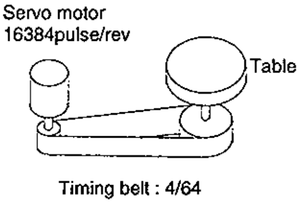
For rotation in increments of 0.01° per pulse

Machine specifications

Table resolution: 36000 pulses/rev

Reduction ratio: n=4/64

Servo motor resolution: Pt=16384 [pulses/rev]



$$\frac{CMX}{CDV} = \frac{Pt}{\Delta S} = \frac{Pt}{36000 \times 4/64} = \frac{262144}{36000} = \frac{8192}{1125}$$

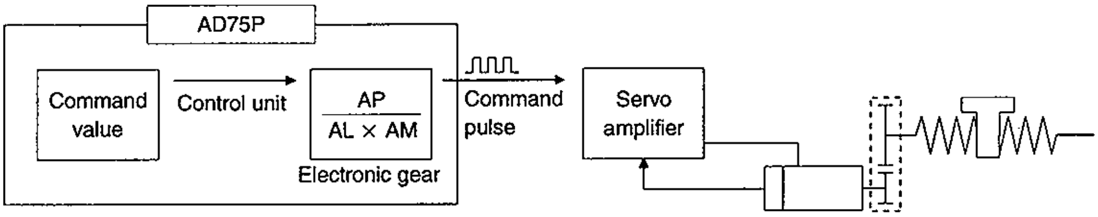
Reduce CDV to 50000 or less and round off the result to the units.

Hence, set 8192 to CMX and 1125 to CDV.

(2) Setting for use of AD75P

The AD75P also has the following electronic gear parameters. Normally, the servo amplifier side electronic gear must also be set due to the restriction on the command pulse frequency (differential 500kpps, open collector 200kpps).

AP: Number of pulses per motor revolution
AL: Moving distance per motor revolution
AM: Unit scale factor



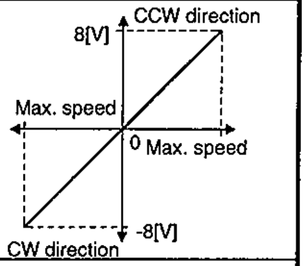
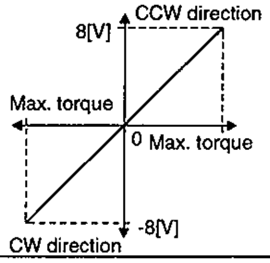
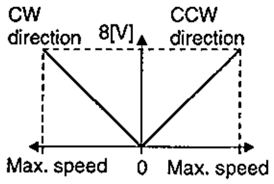
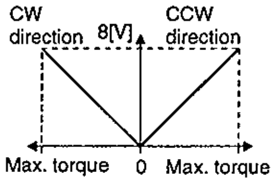
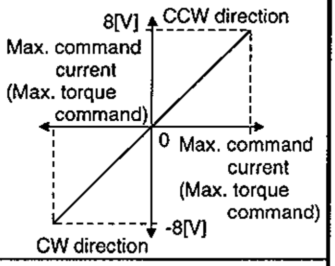
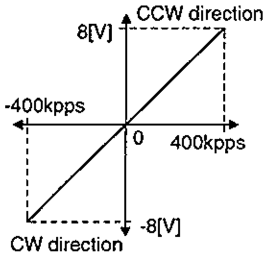
Electronic gear setting example for use of AD75P

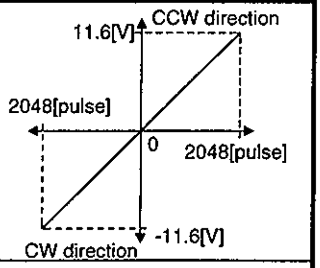
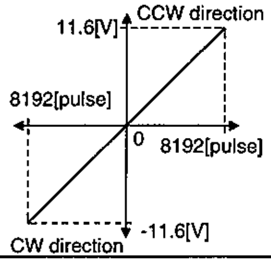
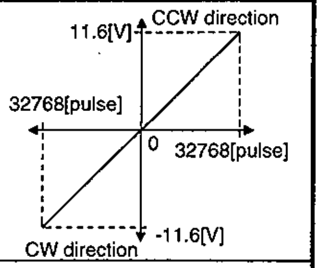
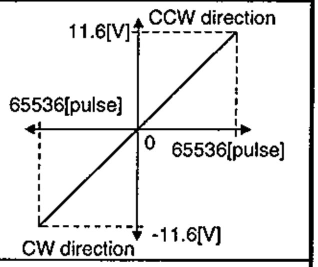
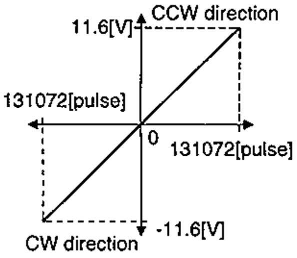
Rated Servo Motor Speed				3000r/min	
Servo amplifier	Input system			Open collector	Differential line driver
	Max. input pulse frequency			200kpps	400kpps
	Feedback pulse/revolution			8192pulse/rev	
	Electronic gear (CMX/CDV)			125/256	1/1
AD75P	Command pulse frequency (Note 1)			200kpps	409.6kpps
	Number of pulses per servo motor revolution as viewed from AD75P			4000pulse/rev	8192/rev
	Electronic gear	Minimum command unit 1pulse	AP	1	1(Note 2)
			AL	1	1(Note 2)
			AM	1	1(Note 2)
		Minimum command unit 0.1μm(Note 3)	AP	4000	8192
			AL	1000	1000
			AM	100	100

Note: 1. Command pulse frequency at rated speed
2. Assuming that AP=8192 and AL=8000, the command unit amount per motor revolution is 8000 pulses/rev, which makes positioning data setting easier.
3. In the case where the ballscrew lead is 10mm.

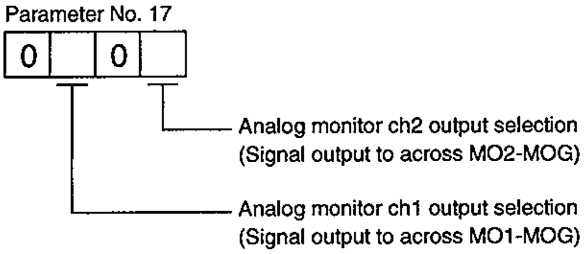
6.2.2 Analog output

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.17 value:

Setting	Output Item	Description
0	Motor speed	
1	Generated torque	
2	Motor speed	
3	Generated torque	
4	Current command (Torque command)	
5	Command speed	

Setting	Output Item	Description
6	Droop pulses 1/1 (128pulse)	
7	Droop pulses 1/4 (2048pulse)	
8	Droop pulses 1/16 (8192pulse)	
9	Droop pulses 1/32 (32768pulse)	
A	Droop pulses 1/64 (131072pulse)	

Change the following digits of parameter No.17:



Parameters No.50 and 51 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.50	Used to set the offset voltage for the analog monitor CH1 output.	−9999 to 9999
Parameter No.51	Used to set the offset voltage for the analog monitor CH2 output.	

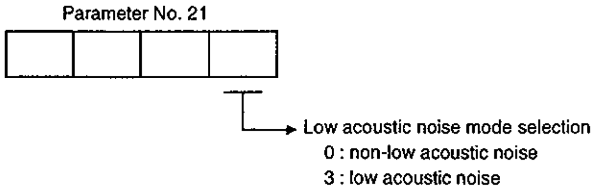
6.2.3 Using forward/reverse rotation stroke end to change the stopping pattern

The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing the parameter No. 22 value.

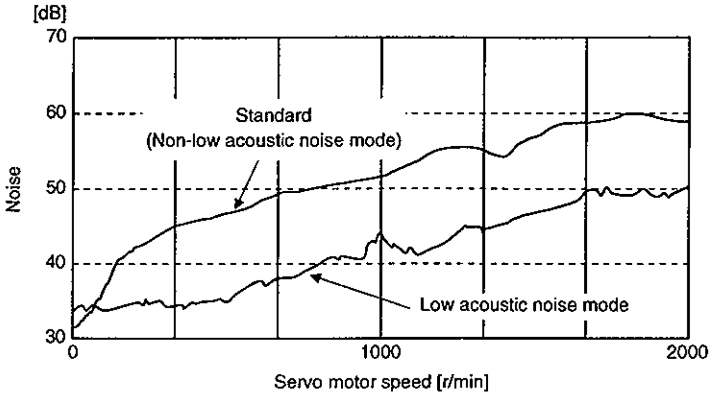
Parameter No.22 Setting	Stopping Method
□□0□ (initial value)	Sudden stop Droop pulses are reset to make a stop.
□□1□	Slow stop Position control mode : The motor is decelerated to a stop in accordance with the parameter No. 8 value. Speed control mode : The motor is decelerated to a stop in accordance with the parameter No. 13 value.

6.2.4 Low acoustic noise mode

By choosing the low acoustic noise mode in parameter No. 21, the electromagnetic noise of audible frequency generated by the servo motor can be suppressed by about 20dB.



For HC-SF152



CONTENTS

1. FUNCTIONS AND CONFIGURATION 1 - 1 to 1 - 8

2. INSTALLATION 2 - 1 to 2 - 3

3. SIGNALS AND WIRING 3 - 1 to 3 -59

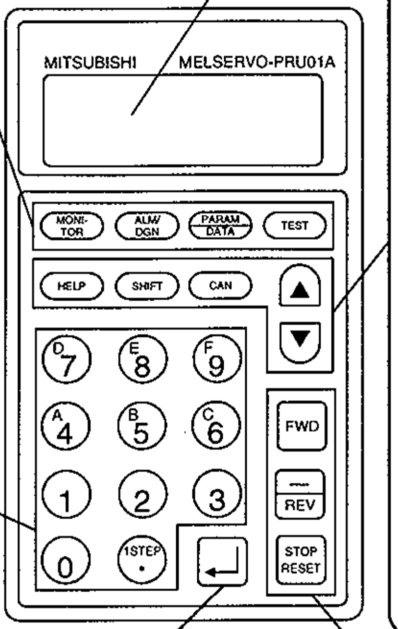
15. COMPLIANCE WITH THE EUROPEAN EC DIRECTIVES AND UL/C-UL STANDARD 15- 1 to 15-18

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

MONI-TOR : 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

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 [^{D}7]) 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 ^{F}9 : Numerals (0 to F)
- Used to enter the set value of the parameter. To type F, press [^{F}9] after pressing the [SHIFT] key.

STEP . : 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

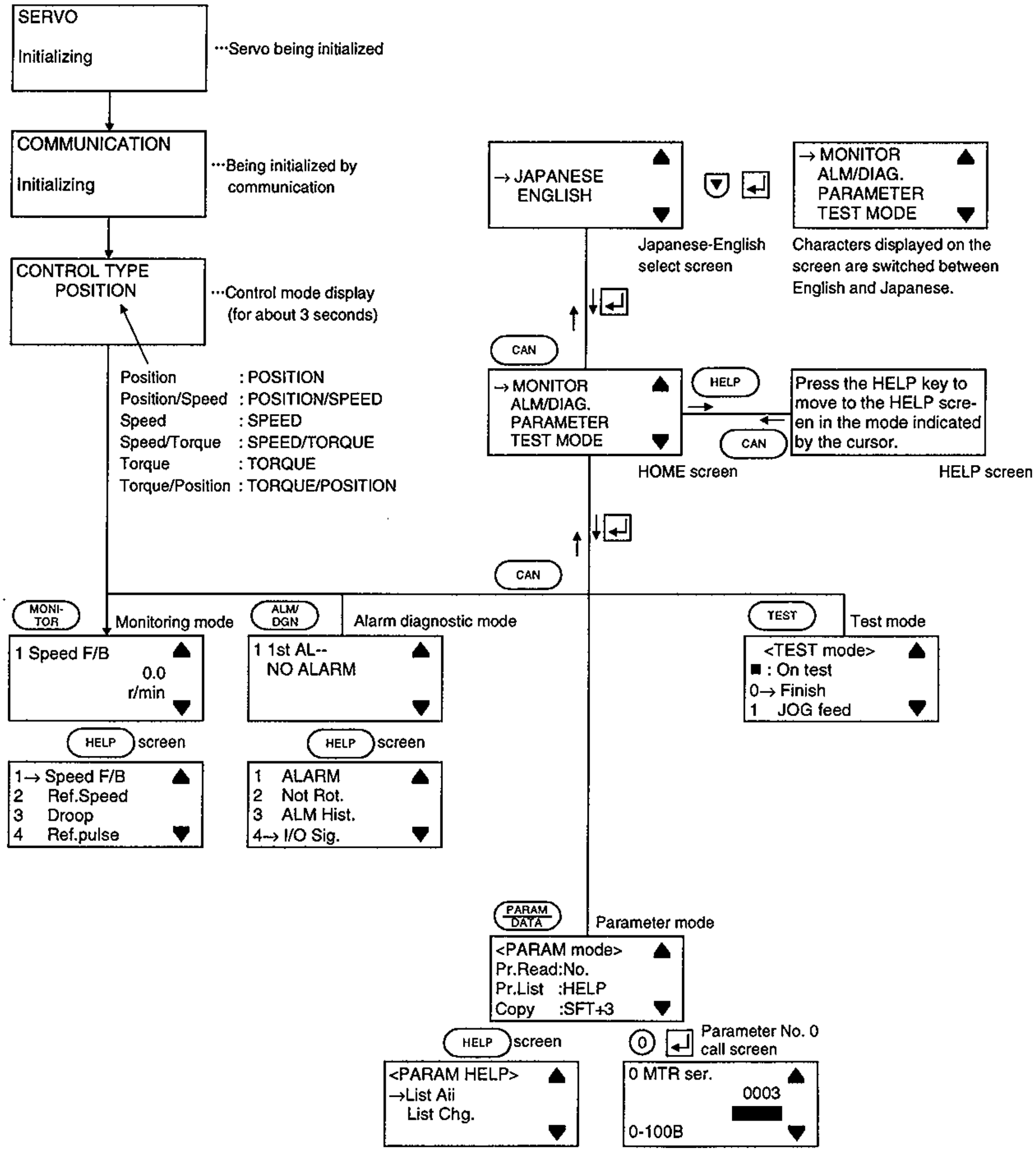
FWD : Forward rotation start key
- Used to start forward rotation in the test run mode.

— 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.

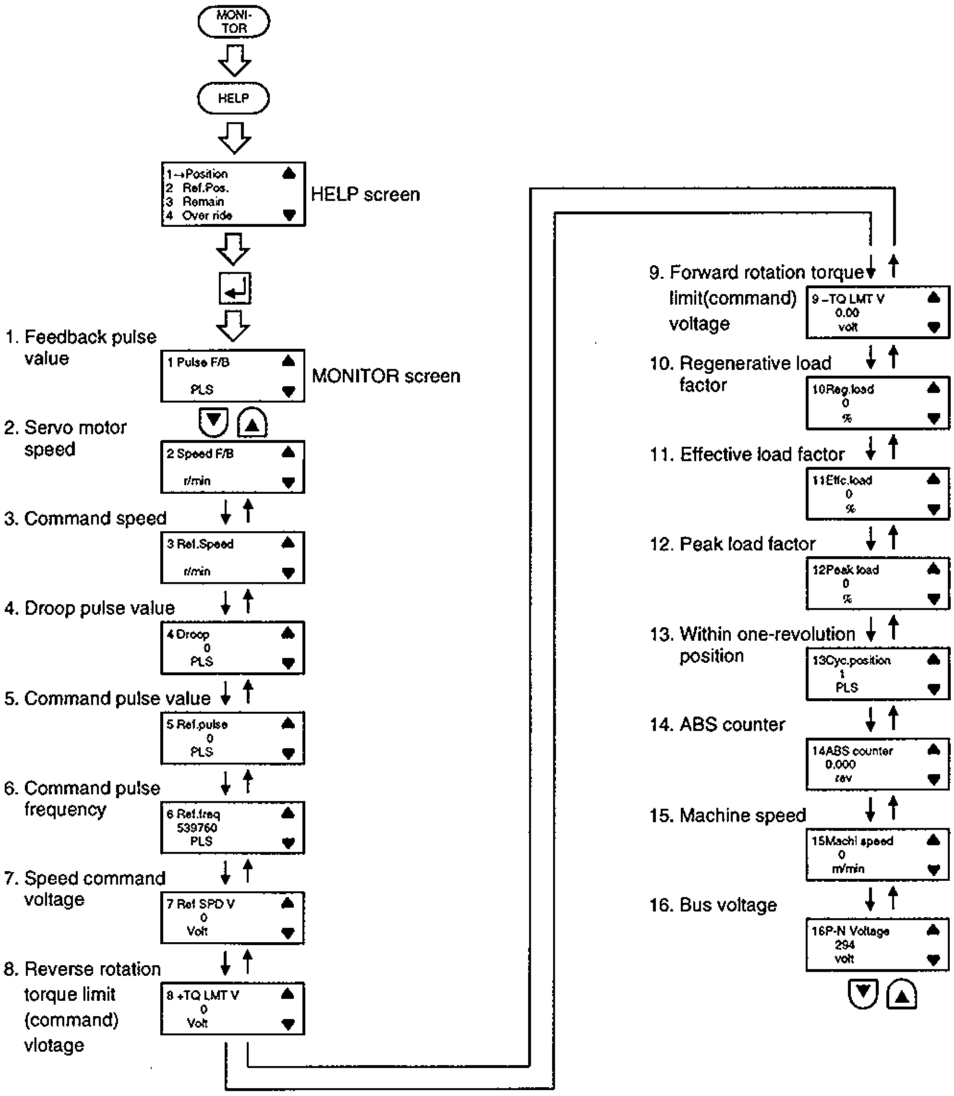
7.2 Operation of the Parameter Unit

(1) Outline of display sequence

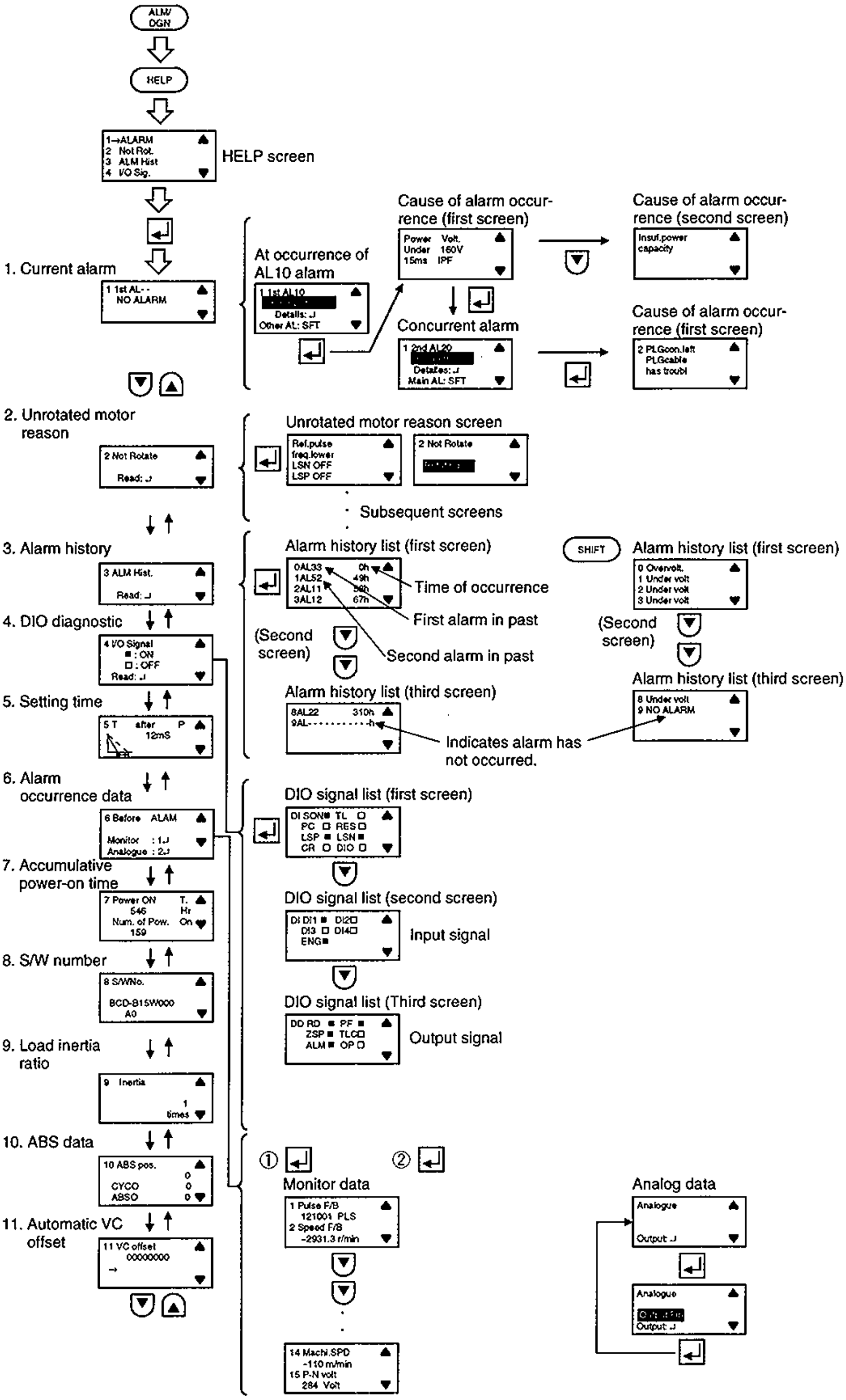


The displays and operation procedure in each mode are given on the following pages. Refer to them.

(2) Monitoring mode

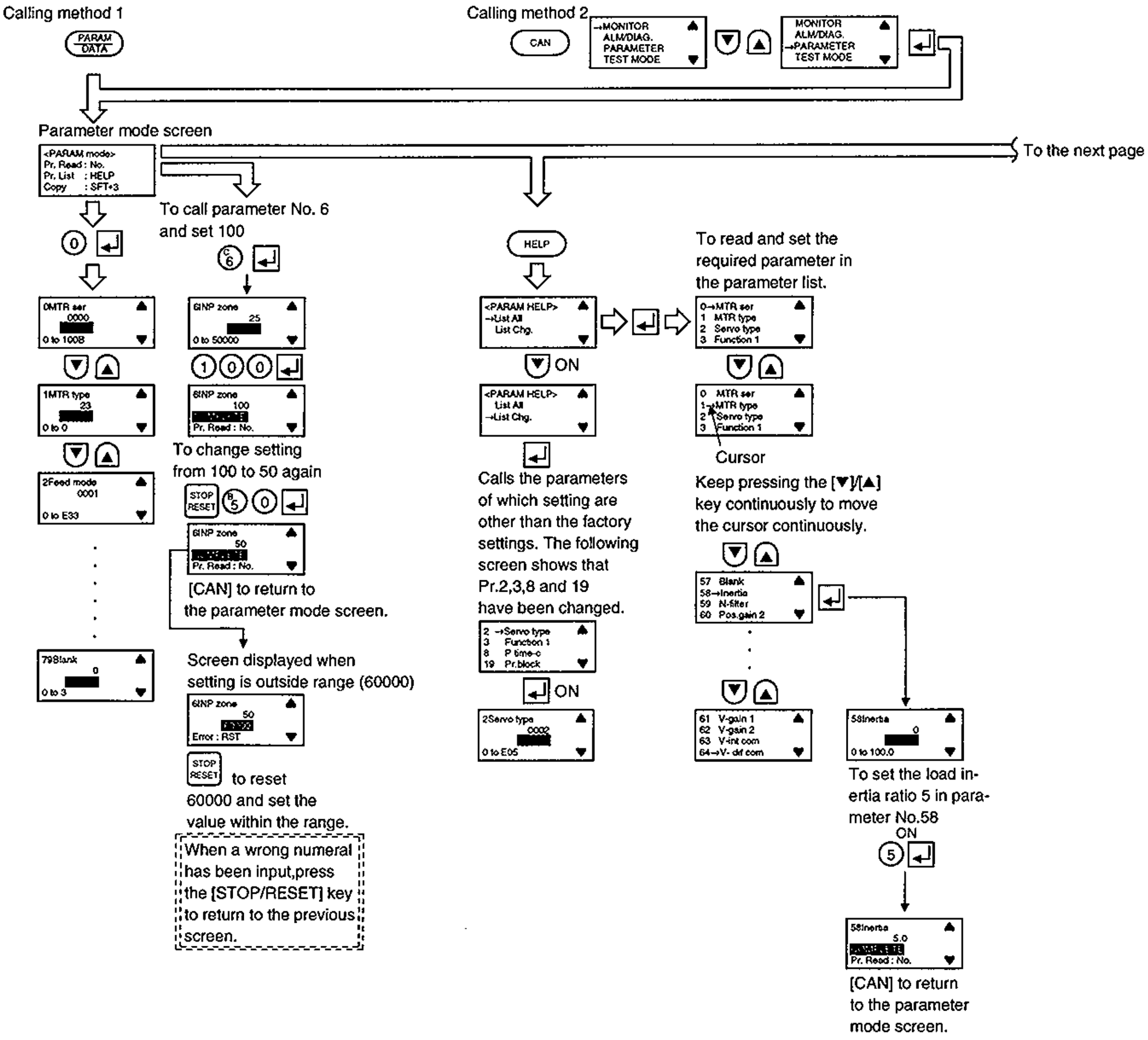


(3) Alarm mode



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

(4) Parameter mode



To call parameter No. 6 and set 100

To change setting from 100 to 50 again

[CAN] to return to the parameter mode screen.

Screen displayed when setting is outside range (60000)

to reset 60000 and set the value within the range.

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

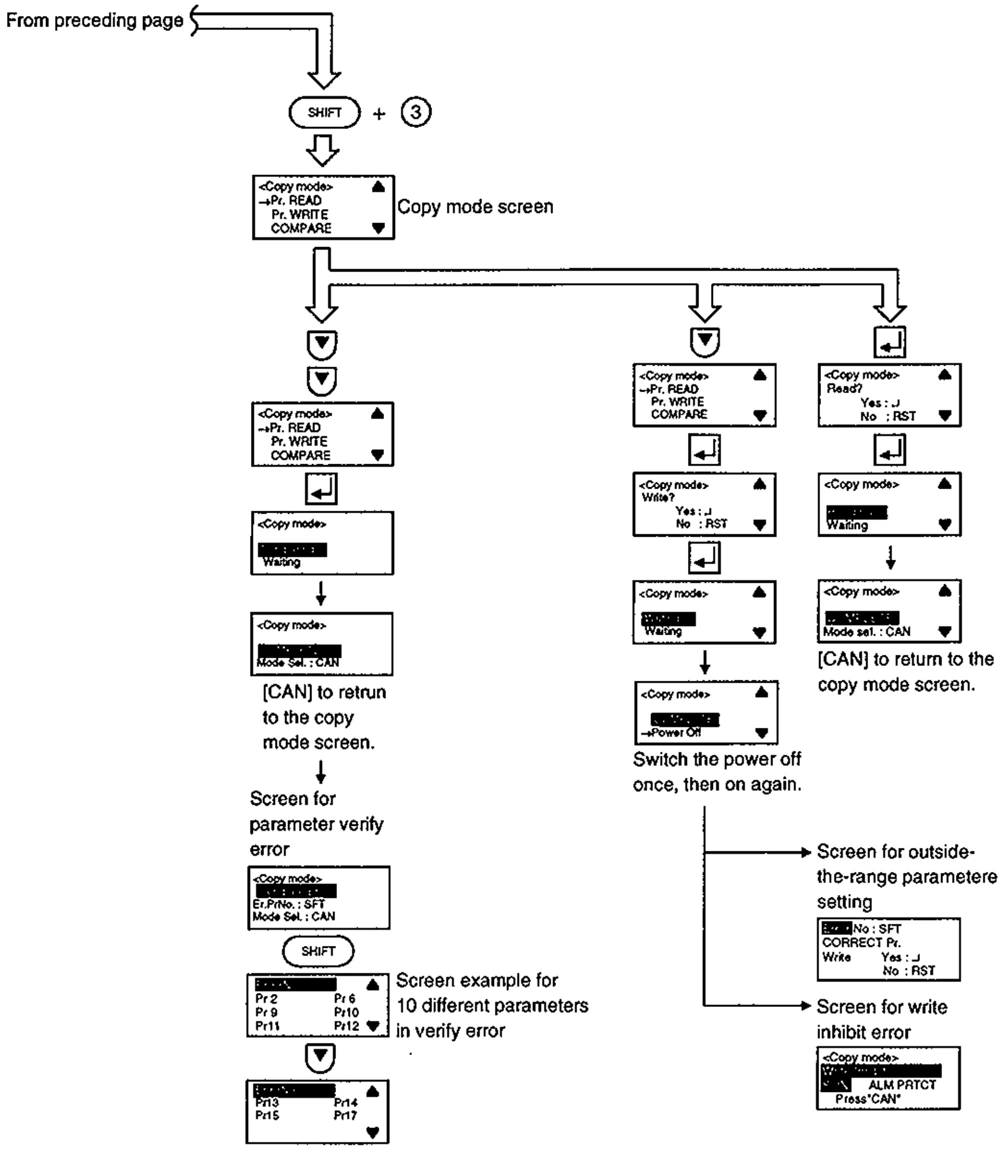
Calls the parameters of which setting are other than the factory settings. The following screen shows that Pr.2,3,8 and 19 have been changed.

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

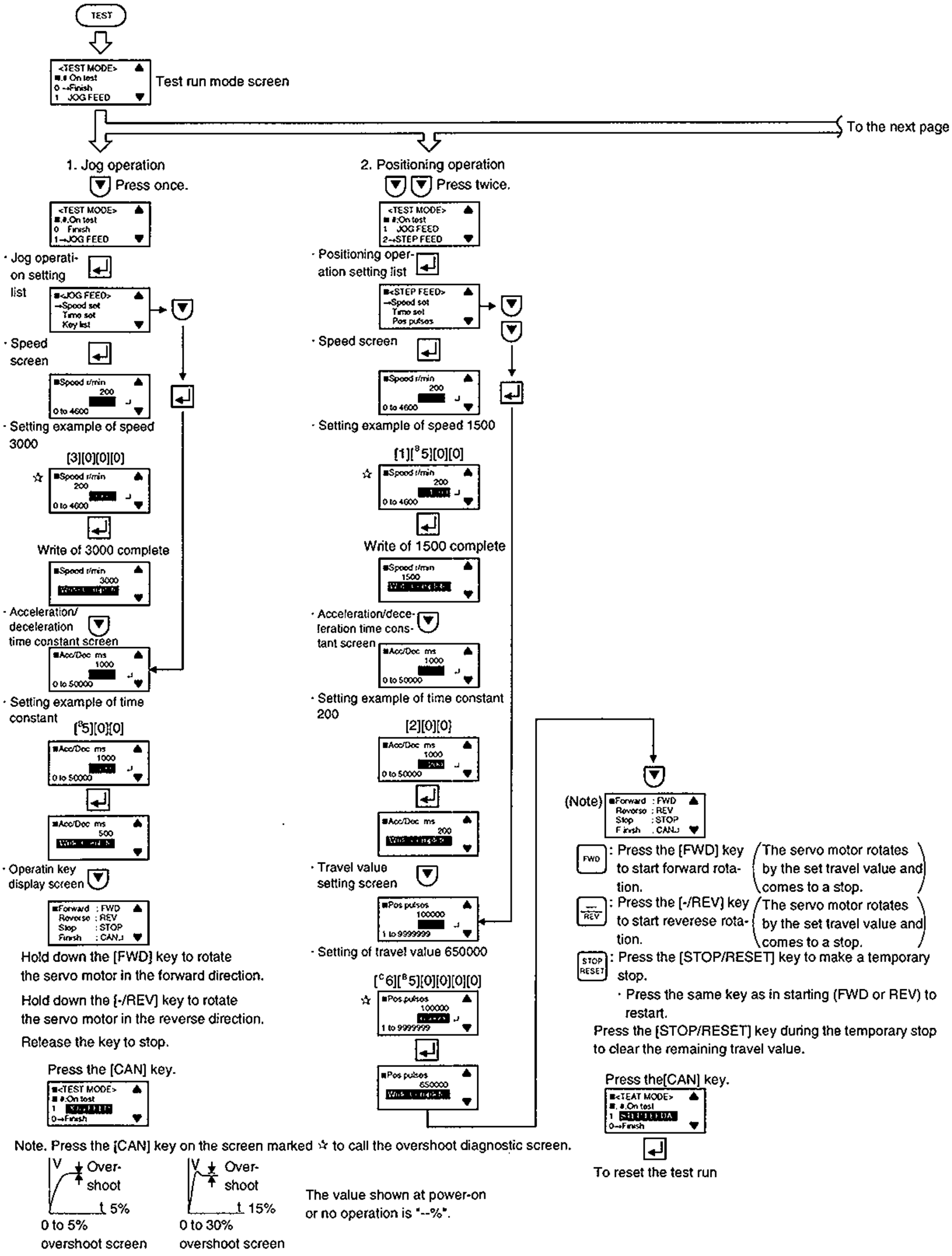
Keep pressing the [▼]/[▲] key continuously to move the cursor continuously.

To set the load inertia ratio 5 in parameter No.58

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

(5) Test run mode



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.

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

REV : Press the [-/REV] key to start reverese rotation. (The servo motor rotates by the set travel value and 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.

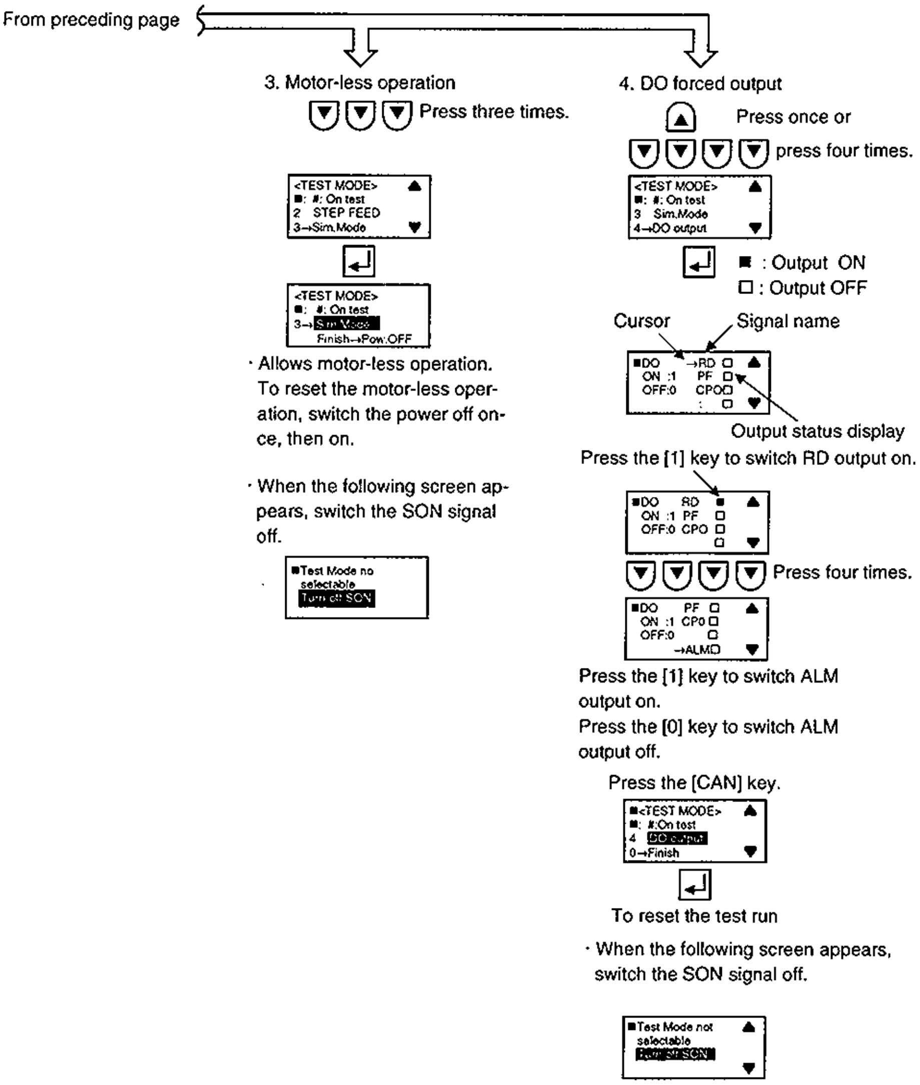
Press the [STOP/RESET] key during the temporary stop to clear the remaining travel value.

Press the[CAN] key.

To reset the test run

Note. Press the [CAN] key on the screen marked ☆ to call the overshoot diagnostic 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→Sim.Mode
    Finish→Pow:OFF
```

- Allows motor-less operation. To reset the motor-less operation, switch the power off once, then on.
- When the following screen appears, switch the SON signal off.

```
■Test Mode no
 selectable
 Turn off SON
```

4. DO forced output

Press once or press four times.

```
<TEST MODE>       ▲
■: #: On test
3   Sim.Mode
4→DO output       ▼
```

■ : Output ON
□ : Output OFF

Cursor

Signal name

```
■DO      →RD □   ▲
 ON :1    PF □
 OFF:0    CPO□
          :  □   ▼
```

Output status display

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

```
■DO     RD  ■    ▲
 ON :1  PF  □
 OFF:0  CPO □
            □    ▼
```

Press four times.

```
■DO     PF □     ▲
 ON :1  CP0□
 OFF:0     □
       →ALM□     ▼
```

Press the [1] key to switch ALM output on.
Press the [0] key to switch ALM output off.

Press the [CAN] key.

```
■<TEST MODE>      ▲
■: #:On test
4  DO output
0→Finish          ▼
```

To reset the test run

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

```
■Test Mode not    ▲
 selectable
 Turn off SON
                  ▼
```

7.3 Status Display

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

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

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

7.4 Alarm/Diagnosis

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

(1) Servo amplifier display

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

(2) Parameter unit

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

a) Alarm/diagnosis list

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

b) Unrotated motor reason

O: Relevant, \: Irrelevant

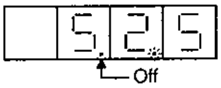
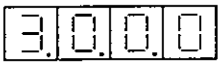
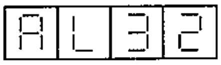
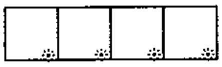
No.	Parameter Unit Display	Description	Control Mode		
			Position	Speed	Torque
1	SON off	Servo on (SON) signal is off.	O	O	O
2	Alarm	Alarm has occurred.	O	O	O
3	RES on	Reset (RES) signal is on.	O	O	O
4	EMG off	Emergency stop (EMG) signal is off.	O	O	O
5	LSP on	Forward rotation stroke end (LSP) signal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

7.5 Servo Amplifier Display

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

7.5.1 Display examples

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

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

7.5.2 Selection of display data

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

(1) Parameter setting

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

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

Automatic switching to servo amplifier display

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

Parameter unit status display at power-on

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

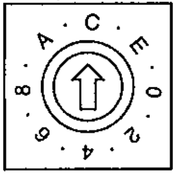
Automatic switching of parameter unit status display at power-on

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

(2) Setting of rotary switch CS1

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

Rotary switch CS1



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

7.6 Test Operation Mode

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

The parameter unit can be used to run the servo motor. For the way of operating the parameter unit, refer to Section 7.2.

When a servo motor with electromagnetic brake is used with the machine to prevent the servo motor from starting in a brake operating status, always make up a sequence circuit which will operate the brake with the electromagnetic brake signal (ZSP) of the servo amplifier.

7.6.1 Jog operation

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

(1) Operation

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

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

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

How to use the keys is listed below:

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

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

(2) Status display

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

7.6.2 Positioning operation

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

(1) Operation

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

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

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

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

How to use the keys is listed below:

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

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

(2) Status display

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

7.6.3 Motorless operation

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

(1) Operation

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

(2) Status display

The status display can be monitored during motorless operation.

(3) Termination of motorless operation

Switch power off to end motorless operation.

7.6.4 DO forced output

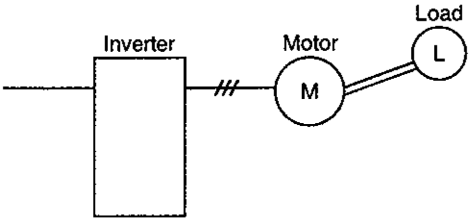
Each output signal can be turned on/off independently of the input signals and servo status. This function can be used for servo wiring check, etc.

8. ADJUSTMENT

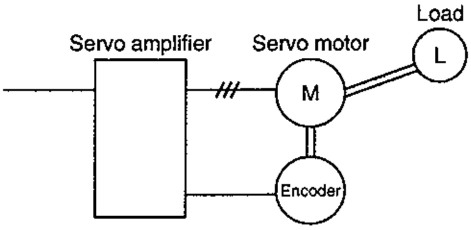
8.1 What Is Gain Adjustment?

8.1.1 Difference between servo amplifier and other drives

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

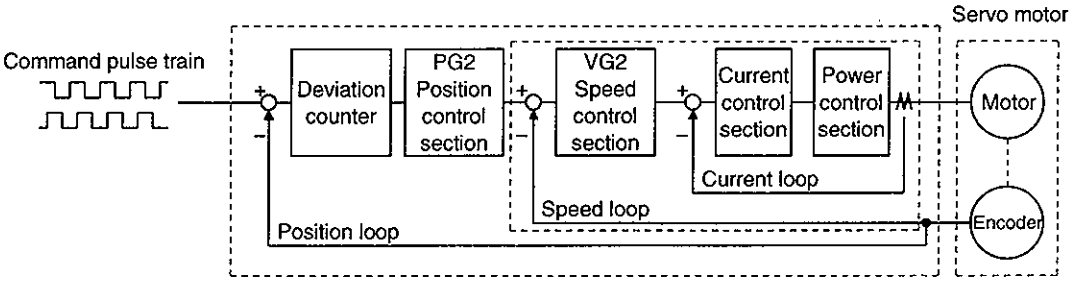


On the other hand, the servo amplifier always detects the positions and speeds of the motor and machine using the servo motor encoder, and exercises control to match the position and speed commands with the actual motor (machine) position and speed. In the servo system, adjustment is needed because:



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

8.1.2 Basics of the servo system



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

(1) Current loop

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

(2) Speed loop

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

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

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

J_L = load inertia moment

J_M = servo motor shaft inertia moment

(3) Position loop

The response level will not vary according to machine conditions.

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

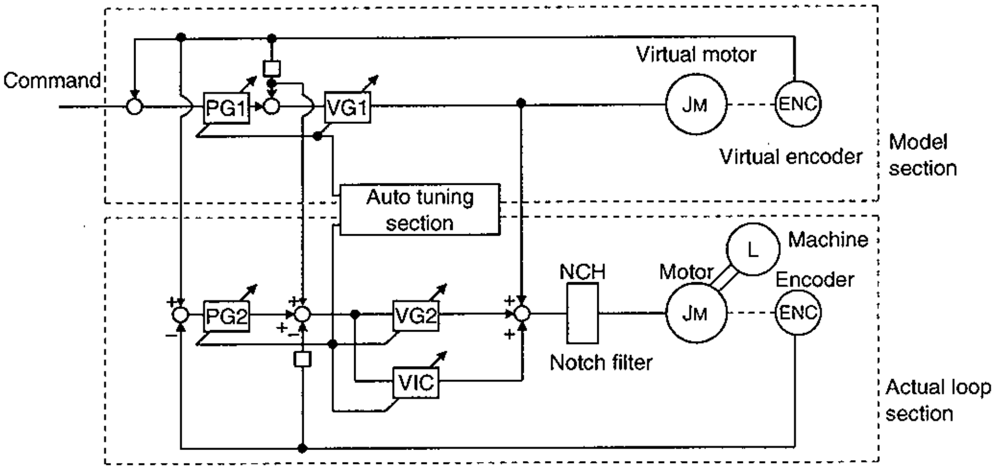
When the motor is installed to the machine, the gain must be adjusted to satisfy f_v = 4 to 6f_p according to the load inertia moment ratio m.

8.2 Gain adjustment

8.2.1 Parameters required for gain adjustment

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

8.2.2 Block diagram



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

(1) Actual loop section

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

(2) Model section

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

(3) Auto tuning section

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

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

8.2.3 What is auto tuning?

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

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

J : Inertia moment
ω : Angular speed
T : Torque

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

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

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

8.3 Gain Adjustment by Auto Tuning

8.3.1 Adjustment method

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

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

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

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

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

8.3.2 Valid conditions

POINT

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

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

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

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

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

8.4 Manual Gain Adjustment

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

8.4.1 When machine rigidity is low

(1) Machine condition

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

(2) Adjustment procedure

(a) Adjustment 1

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

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

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

(b) Adjustment 2

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

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

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

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

8.4.2 When the machine vibrates due to machine resonance frequency

(1) Machine condition

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

(2) Adjustment procedure

(a) Adjustment 1

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

(b) Adjustment 2

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

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

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

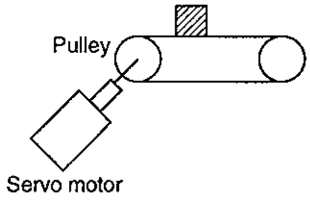
8.4.3 Load inertia moment is 20 or more times

(1) Machine condition

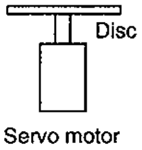
The machine inertia moment is 20 times or more and the servo motor oscillates at low frequency (5Hz or more). At this time, servo motor shaft vibration can be confirmed visually.

This adjustment method is valid for the following machines:

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



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



3) Machine of which ballscrew lead is long

(2) Adjustment procedure

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

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

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

3) Set parameter No. 20 to □□□2 (auto tuning not executed).

4) Alternate a start and a stop several times and check whether the machine does not vibrate.

5) If vibration still persists, repeat steps 1) and 4).

6) If vibration still persists, make (a) Adjustment 1 and (b)Adjustment 2 in paragraph (2) of Section 8.4.2.

7) If you want to further increase the response, set parameter No. 20 to "auto tuning executed" (first digit) with operation at a stop, and increase the response setting (third digit). After that, set the parameter to "auto tuning not executed" (first digit).
For example, after setting parameter No. 20 to "□2□1", set it to "□2□2".

8) Reducing the speed loop's integral time constant (parameter No. 63) may improve the performance. However, making it too small may generate vibration.

8.4.4 When shortening the settling time

(1) Machine condition

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

(2) Adjustment procedure

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

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

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

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

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

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

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

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

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

(1) Machine condition

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

(2) Adjustment procedure

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

b) Set □□□0 or □□□2 in parameter No.20.

□□□0: Interpolation control······· The following parameter values change at the next start/stop.

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

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

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

9. INSPECTION

⚠ WARNING

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

POINT

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

9.1 Inspection

It is recommended to make the following checks periodically:

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

9.2 Life

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

For parts replacement, please contact your sales representative.

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

(1) Smoothing capacitor

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

(2) Relays

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

(3) Servo amplifier cooling fan

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

(4) Servo motor bearings

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

(5) Servo motor oil seal, V ring

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

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

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

10. TROUBLESHOOTING

10.1 Trouble at Start-Up

⚠CAUTION

- Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT

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

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

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

10.2 When Alarm or Warning Has Occurred

10.2.1 Alarms and Warning list

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

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

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

10.2.2 Remedies for alarms

⚠CAUTION

- When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.

POINT

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

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

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

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

Indication	Name	Definition	Parameter Unit Screen Display		Cause	Action
			Current Alarm (name and definition)	Alarm Occurrence Factor		
AL 31	Over speed	Speed has exceeded the instantaneous permissible speed.	Over speed	Ref/ pulse f exceeded	1. Input command pulse frequency exceeded the permissible instantaneous speed frequency.	Set command pulses correctly.
				Acc. time-C shortage	2. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/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. 1 missetting	4. Parameter No. 1 setting error.	Set correctly.
				E-gear rate too large	5. Electronic gear ratio too high.	Set correctly.
				PLG trouble	6. Encoder faulty.	Change the servo motor.
AL 32	Over current	Current that flew is higher than the permissible current of the servo amplifier.	Over curr.	UVW short circuit	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring.
				IPM dameged	2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (AL 32) occurs if power is switched on after U, V and W are disconnected.	Change the servo amplifier
				UVW fault	3. Ground fault occurred in servo amplifier output phases U, V and W.	Correct the wiring.
				Ext. noise	4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
AL 33	Over voltage	Converter bus voltage exceeded 400V.	Over volt.	Reg. Resist. Has trouble	1. Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected.	1. Change lead. 2. Connect correctly.
				Reg. Tr. damaged	2. Regenerative transistor faulty.	
				Reg. Resist has trouble	3. Wire breakage of built-in regenerative brake resistor or regenerative brake option	1. For wire breakage of built-in regenerative brake resistor, change servo amplifier. 2. For wire breakage of regenerative brake option, change regenerative brake option.
				Power volt exceeded	4. Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Add regenerative brake option or increase capacity.
					5. Power supply voltage high.	Review the power supply.
AL 35	command pulse frequency alarm	Input pulse frequency is too high.	Ref. f err	Ref. pulse f exceeded	1. Command pulse frequency too high.	Change the command pulse frequency to a proper value.
				Ref. pulse has noise	2. Noise entered the command pulse.	Take action against noise.

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

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

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

10.2.3 Remedies for warnings

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

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

10.2.4 RS-232C communication error

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

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

10.3 Clearing the Alarm History

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

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

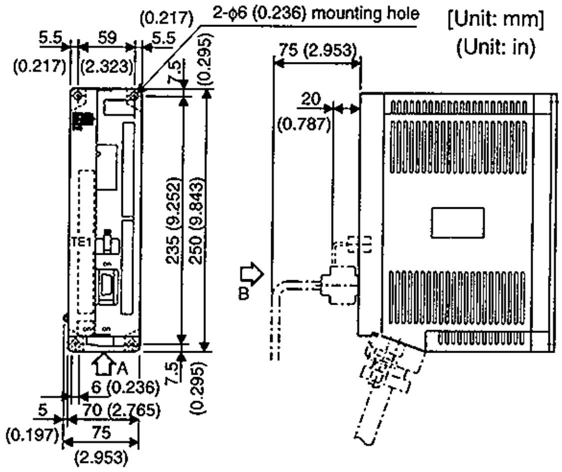
(1) Servo amplifier

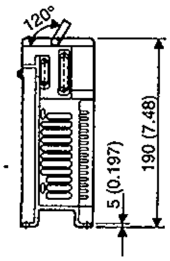
Servo amplifier MR-H□AN Item		10	20	40	60	100	200	350	500	700	11K	15K	22K
Power supply	Voltage/frequency	3-phase 200 to 230VAC, 50/60Hz								3-phase 200 to 220VAC, 50Hz 3-phase 200 to 230VAC, 60Hz			
	Permissible voltage fluctuation	3-phase 170 to 253VAC, 50/60Hz								3-phase 170 to 242VAC, 50Hz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

11.2 Outline Dimensional Drawings

11.2.1 Servo amplifiers

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



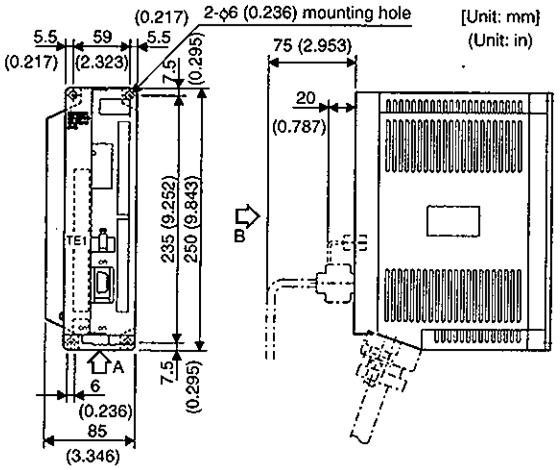


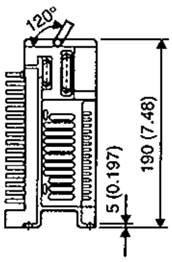
Weight: 2.1kg (4.63lb)

Terminal block TE1

MR-H□AN	MR-H□AN-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-H100AN(-UE)





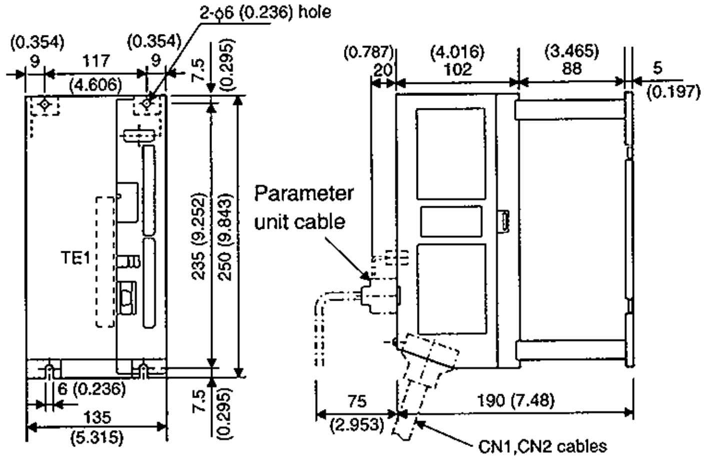
Weight: 2.4kg (5.291lb)

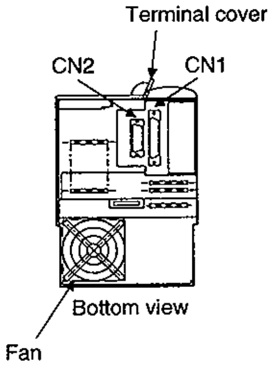
Terminal block TE1

MR-H□AN	MR-H□AN-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.

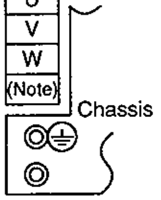
MR-H200AN(-UE) · MR-H350AN(-UE)

[Unit: mm]
(Unit: in)



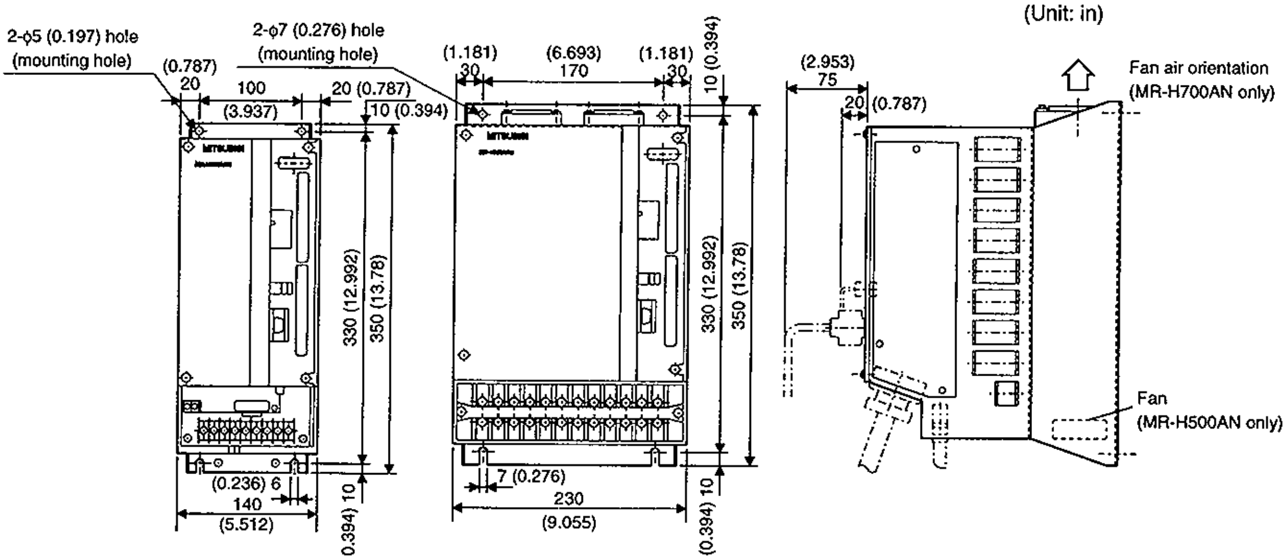


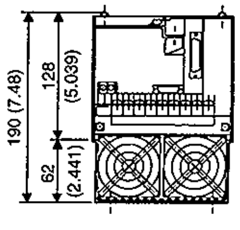
Weight: 4.4kg (9.7lb)

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

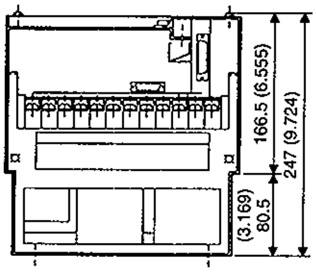
MR-H500AN(-UE) · MR-H700AN(-UE)

[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-H500AN

TE2

R1	S1

Terminal screw: M3.5

GND

◎

Terminal screw: M4

TE1

P	C	N	R	S	T	U	V	W

Terminal screw: M4

- MR-H700AN

TE1

P	C	N	R	S	T	R1	S1	U	V	W	⏚

Terminal screw: M5

- MR-H500AN-UE

TE2

L11	L21

PE

Terminal screw: M4

TE1

P	C	N	L1	L2	L3	U	V	W

Terminal screw: M4

- MR-H700AN-UE

TE1

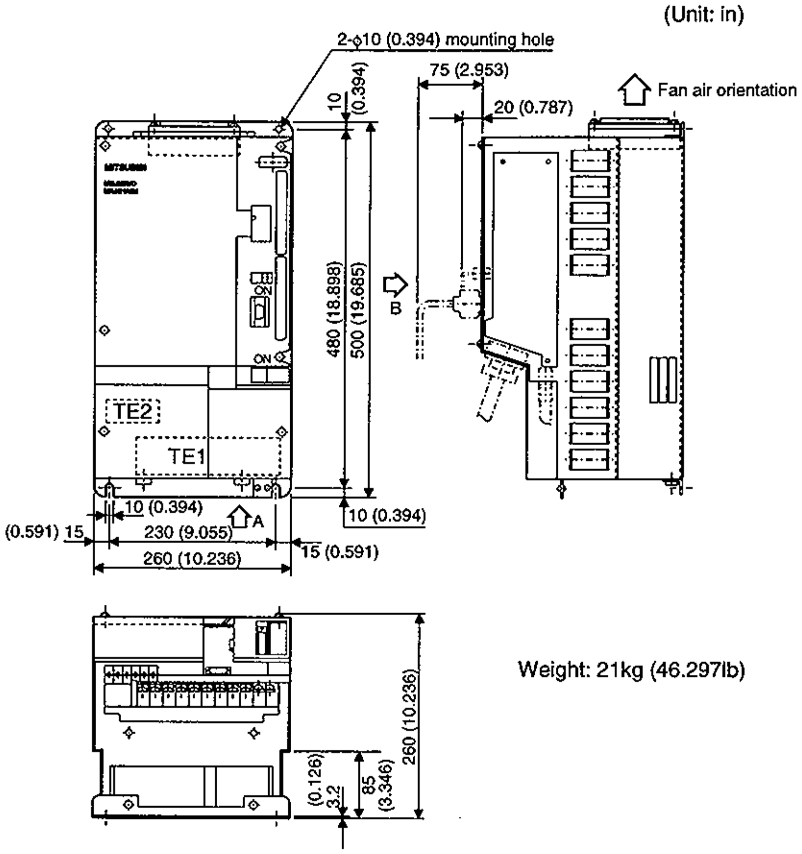
P	C	N	L1	L2	L3	L11	L21	U	V	W

Terminal screw: M5

PE

MR-H11KAN(-UE)

[Unit: mm]
(Unit: in)



Weight: 21kg (46.297lb)

Terminal block signal arrangement

- MR-H11KAN

TE2

R1	S1		MS1	MS2	

Terminal screw: M4

TE1

R	S	T	U	V	W	P	C	N	⏚

Terminal screw: M5

- MR-H11KAN-UE

TE2

L11	L21		MS1	MS2	

Terminal screw: M4

TE1

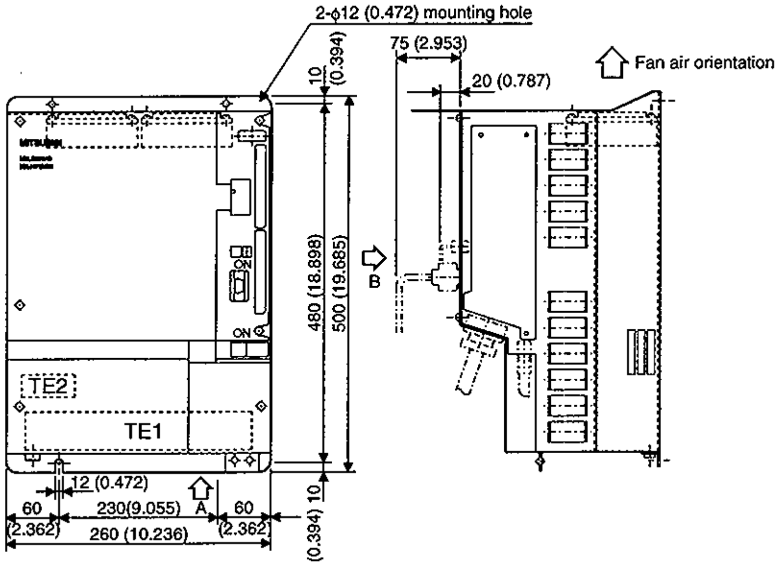
L1	L2	L3	U	V	W	P	C	N	◎

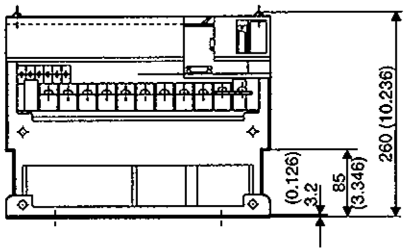
Terminal screw: M5

PE

MR-H15KAN(-UE) · MR-H22KAN(-UE)

[Unit: mm]
(Unit: in)





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

Terminal block signal arrangement

- MR-H15KAN · MR-H22KAN

TE2

R1	S1		MS1	MS2	

Terminal screw: M4

TE1

R	S	T	U	V	W	P	C	N	⏚

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

- MR-H15KAN-UE · MR-H22KAN-UE

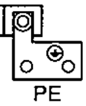
TE2

L11	L21		MS1	MS2	

Terminal screw: M4

TE1

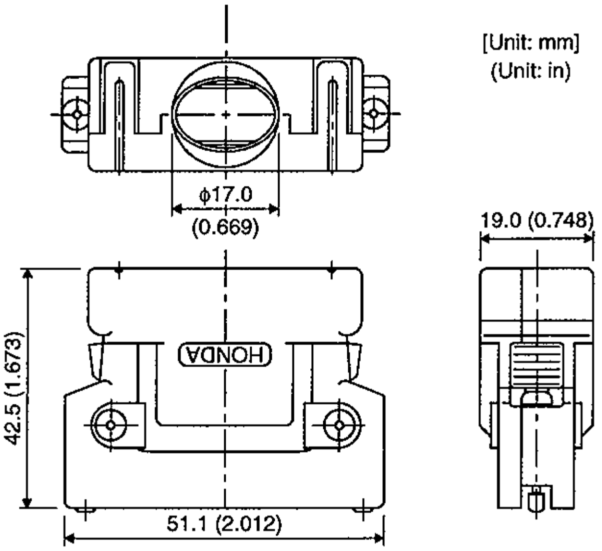
L1	L2	L3	U	V	W	P	C	N



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

11.2.2 Connectors

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

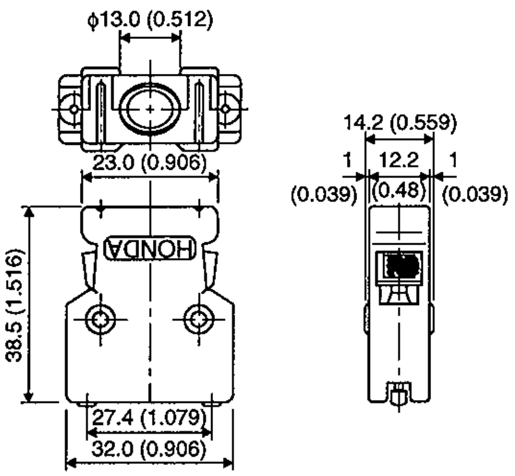


Number of Pins	Model	
	Connector	Case
50	PCR-S50FS (soldering type)	PCR-LS50LA1
	PCR-S50F (insulation displacement type)	

Crimping terminal: FHAT-002A

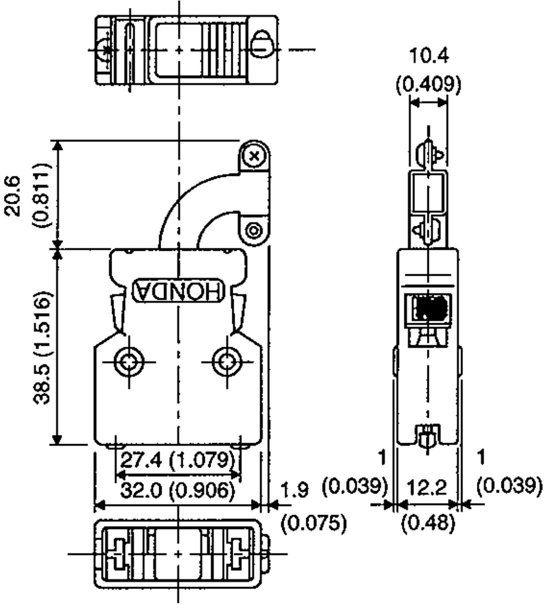
Note: PCR-S50F is not an option and is to be supplied by the customer.

PCR-LS20LA1



PCR-LS20LA1W

[Unit: mm]
(Unit: in)



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

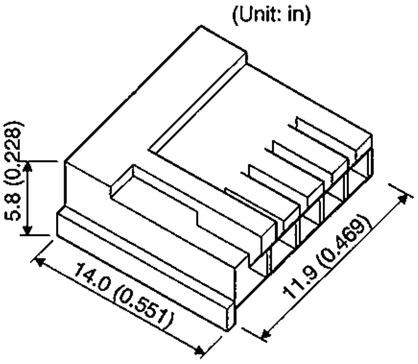
Crimping terminal: FHAT-002A

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

<Nippon AMP make>

- Housing Model: 171822-4

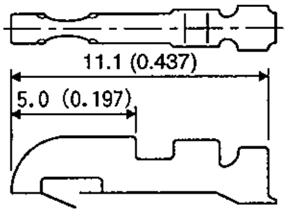
[Unit: mm]
(Unit: in)



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

[Unit: mm]
(Unit: in)

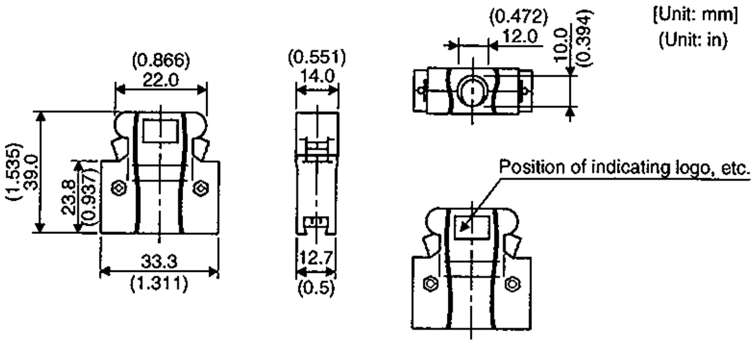
Applicable wire range
AWG: 30-26
(0.05 to 0.15mm^2)
Contactor caulking hand tool
Model: 722561-1



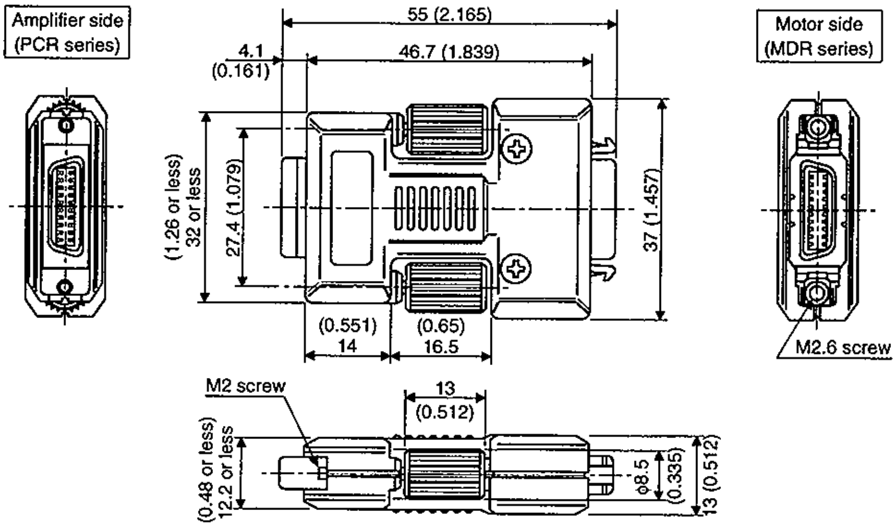
(2) Connector for conversion connector

Signal connector

<Sumitomo Three M make>



(3) MR-HCN2 conversion connector



12. CHARACTERISTICS

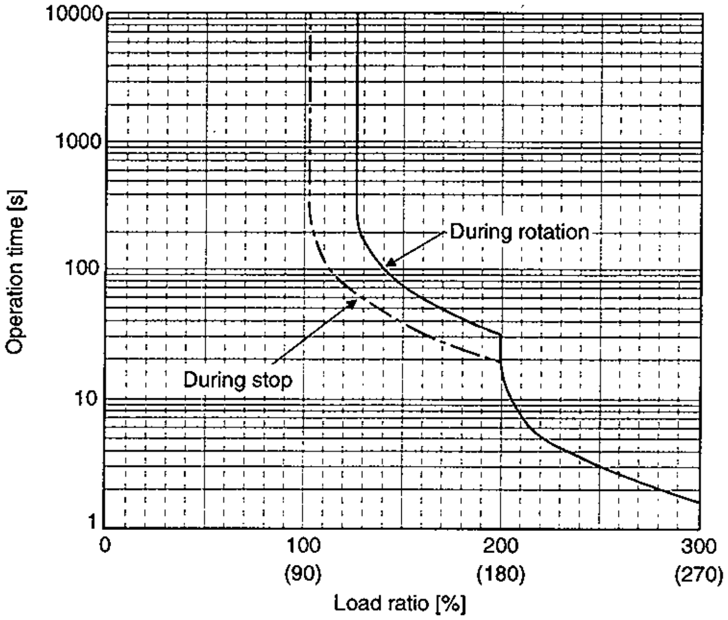
12.1 Overload Protection Characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. Overload 1 alarm (AL 50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. Overload 2 alarm (AL 51) occurs if the maximum current flew continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.

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

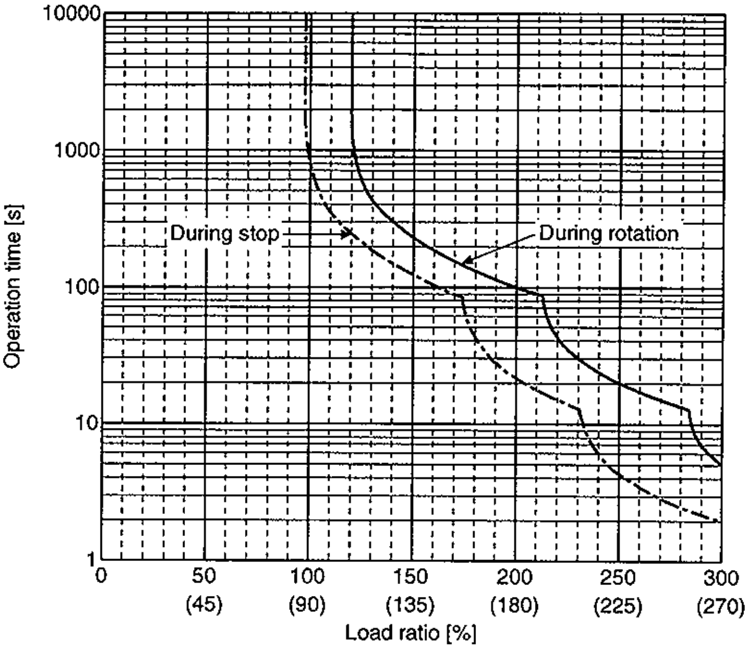
HA-LH serise
(11kW or more)

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



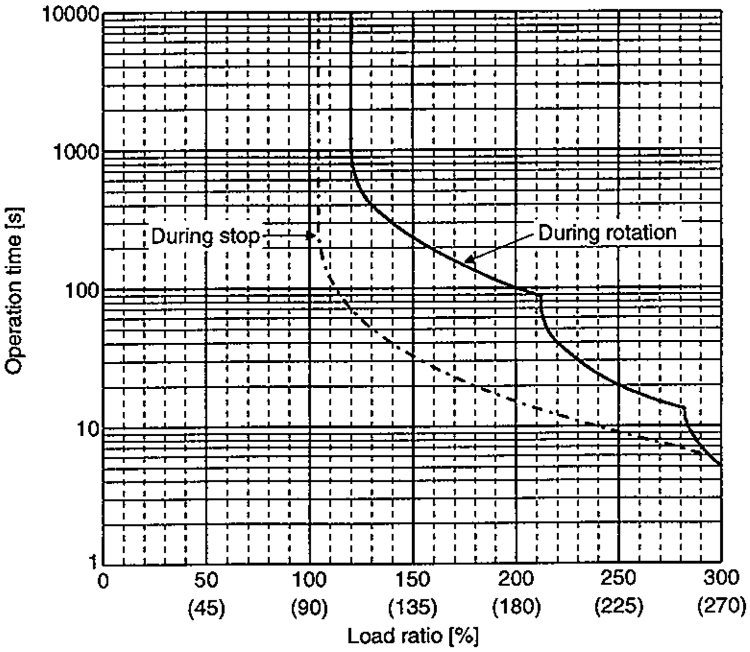
HC-MF serise
HC-SF serise
HC-RF serise
HC-UF serise

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



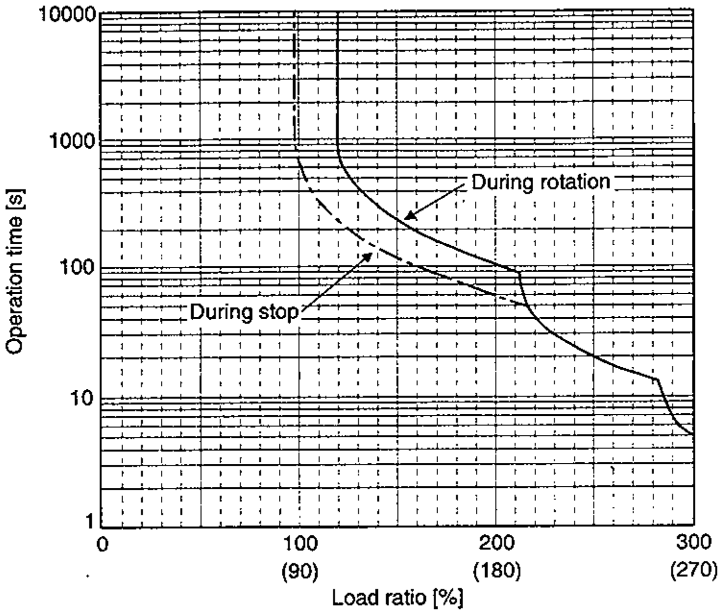
HC-FF serise
(200W or less)

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



HC-FF serise
(300W or more)

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



12.2 Power Supply Equipment Capacity and Generated Loss

(1) Amount of heat generated by the servo amplifier

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

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

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

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

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

(2) Heat dissipation area for enclosed servo amplifier

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

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

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

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

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

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

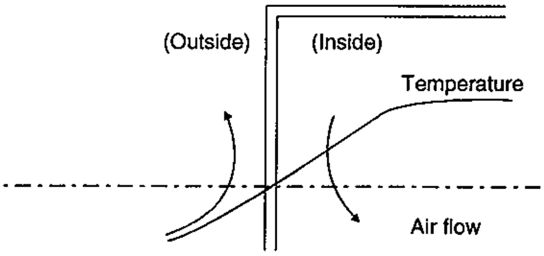


Fig. 12.1 Temperature Distribution in Enclosure

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

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

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

12.3 Dynamic Brake Characteristics

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

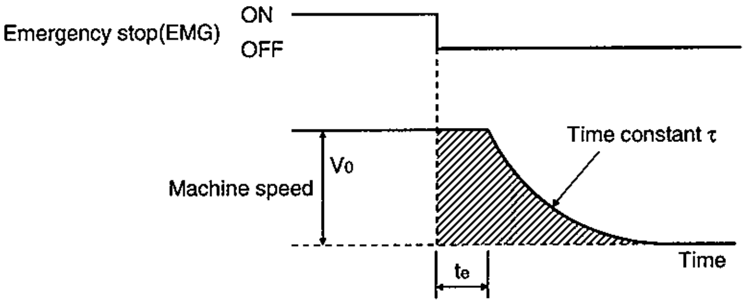
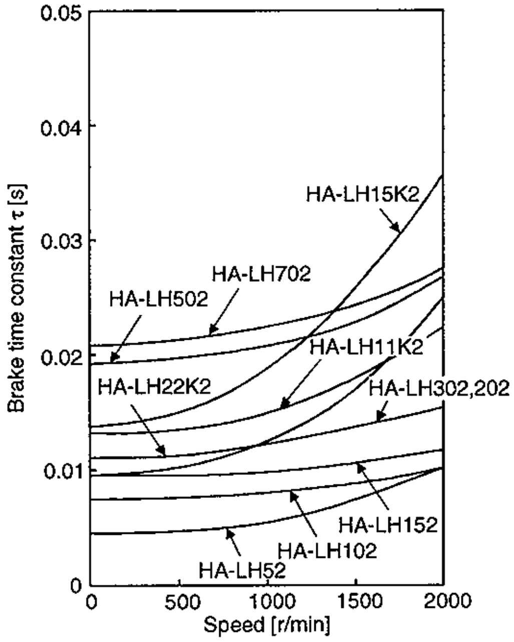


Fig. 12.2 Dynamic Brake Operation Diagram

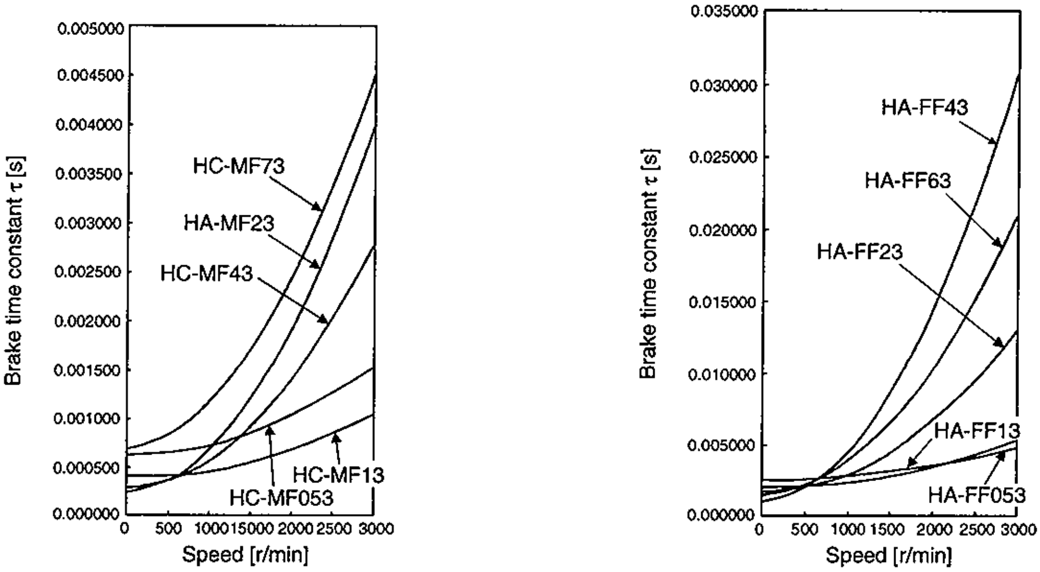
$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left[1 + \frac{J_L}{J_M} \right] \right\} \cdots\cdots (12.2)$$

L_{max} : Maximum coasting distance ······ [mm][in]
V_0 : Machine rapid feedrate ······ [mm/min][in/min]
J_M : Servo motor inertial moment ······ [kg · cm^2][oz · in^2]
J_L : Load inertia moment converted into equivalent value on servo motor shaft ······ [kg · cm^2][oz · in^2]
τ : Brake time constant (Fig. 12.3 · Table 12.4) ······ [s]
t_e : Delay time of control section (Fig. 12.2) ······ [s]
(There is internal relay delay time of about 30ms.)



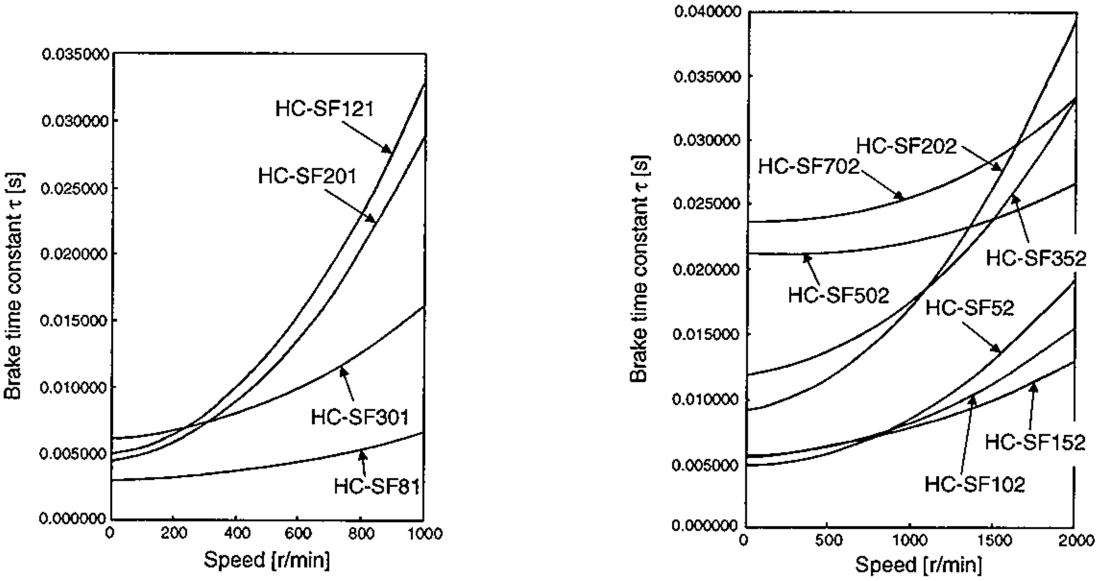
a. HA-LH Series

Fig. 12.3 Dynamic Brake Time Constant 1



b. HC-MF Series

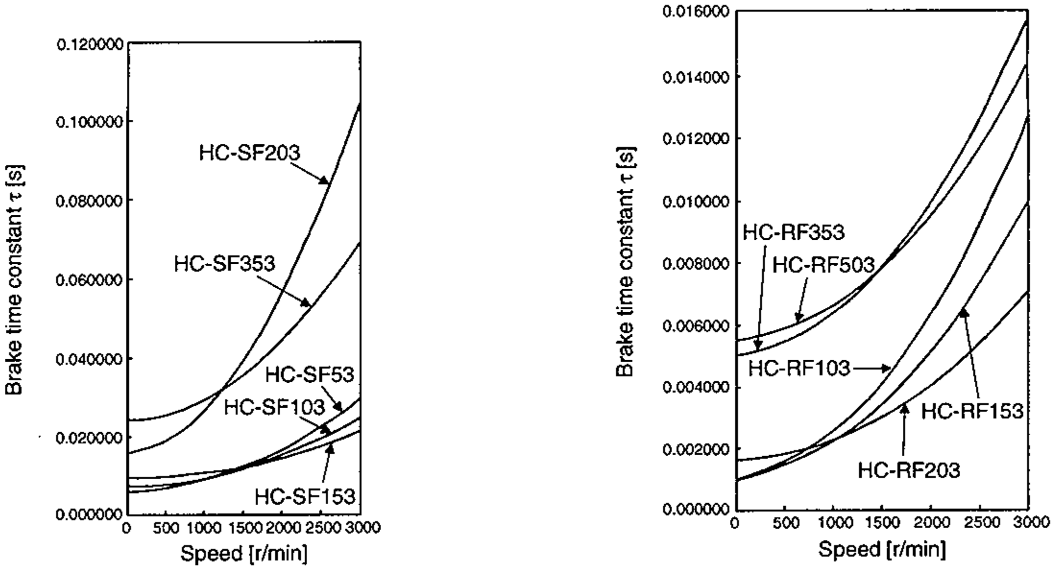
c. HA-FF Series



d. HC-SF1000r/min Series

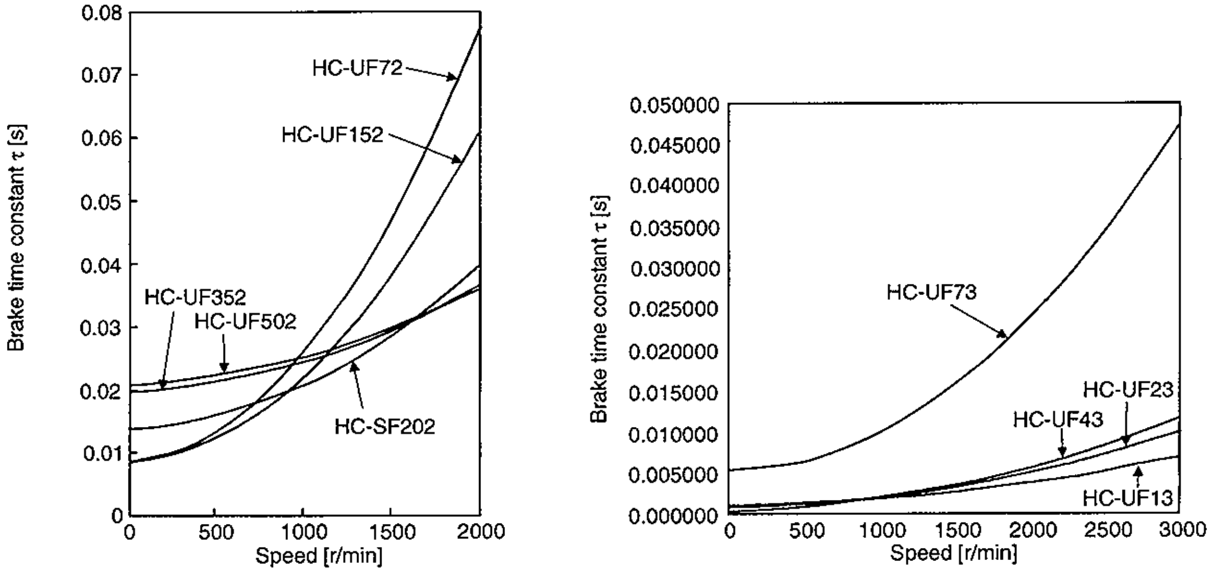
e. HC-SF2000r/min Series

Fig. 12.4 Dynamic Brake Time Constant 2



f. HC-SF3000r/min Series

g. HC-RF Series



h. HC-UF2000r/min Series

i. HC-UF3000r/min Series

Fig. 12.5 Dynamic Brake Time Constant 3

[Dynamic brake's permissible load inertia moment]

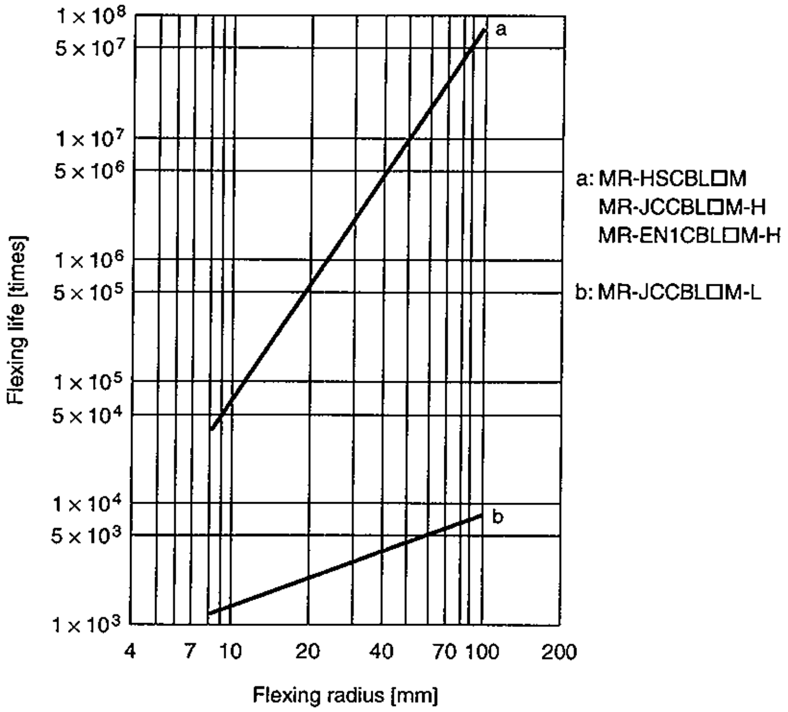
If the dynamic brake is operated at the load inertia moment above the corresponding value indicated in the following list, the brake resistor in the servo amplifier (external brake resistor for 11kW or more) may burn out. If the value is exceeded, contact us.

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

Note: 15 times for the HC-SF series.

12.4 Encoder Cable Flexing Life

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



13. OPTIONS AND AUXILIARY EQUIPMENT

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

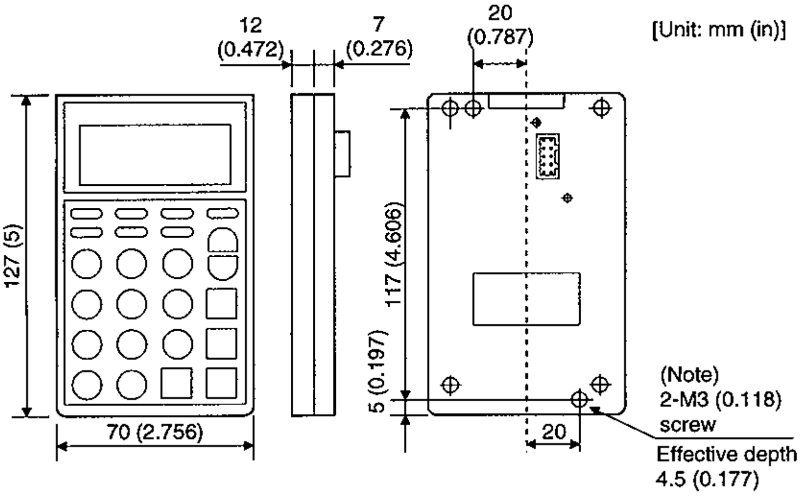
⚠CAUTION	• Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.

13.1 Options

13.1.1 Parameter unit

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

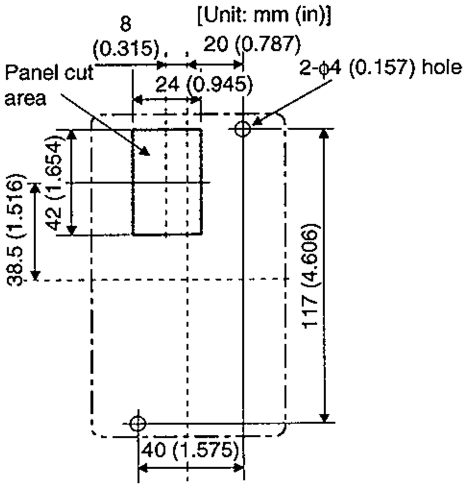
(1) Outline drawing



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

(2) Panel cutting dimensions

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



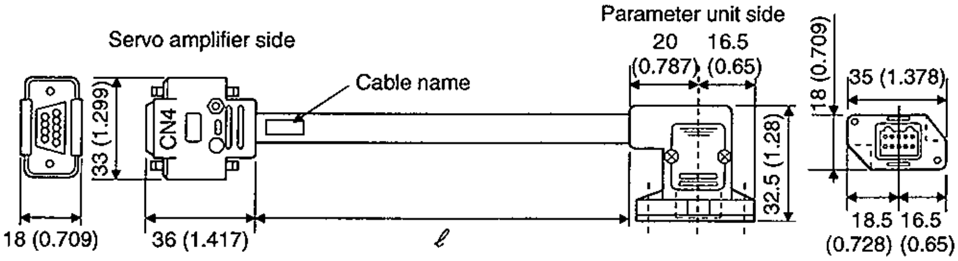
(3) Parameter unit cable

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

Model: MR-PRUCBL□M

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

[Unit: mm (in)]



13.1.2 Regenerative brake options

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

(1) Combination and regenerative power

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

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

Note: Always install a cooling fan.

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

Note: Always install a cooling fan.

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

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

(2) Selection of the regenerative brake option

(a) Simple selection method

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

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

where m = load inertia moment/servo motor inertia moment

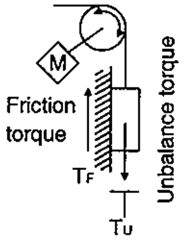
From the permissible duty, find whether the regenerative brake option is required or not.
Permissible duty < number of positioning times [times/min]
Select the regenerative brake option out of the combinations in (1) in this section.

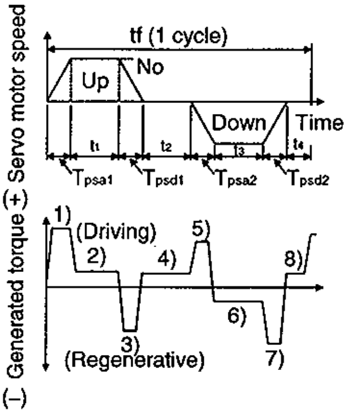
(b) To make selection according to regenerative energy

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

1) Regenerative energy calculation

Use the following table to calculate the regenerative energy.





Formulas for Calculating Torque and Energy in Operation

Regenerative Power	Torque Applied To Servo Motor [N □ m]	Energy [J]
1)	$T_1=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psd1}}+T_U+T_F$	$E_1=\frac{0.1047}{2}\cdot No\cdot T_1\cdot T_{Psa1}$
2)	$T_2=T_U+T_F$	$E_2=0.1047\cdot No\cdot T_2\cdot t_1$
3)	$T_3=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psd1}}+T_U+T_F$	$E_3=\frac{0.1047}{2}\cdot No\cdot T_3\cdot T_{Psd1}$
4), 8)	$T_4=T_U$	$E_4\geq0$ (No regeneration)
5)	$T_5=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psa2}}-T_U+T_F$	$E_5=\frac{0.1047}{2}\cdot No\cdot T_5\cdot T_{Psa2}$
6)	$T_6=T_U+T_F$	$E_6=0.1047\cdot No\cdot T_6\cdot t_3$
7)	$T_7=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psd2}}-T_U+T_F$	$E7=\frac{0.1047}{2}\cdot No\cdot T_7\cdot T_{Psd2}$
Sum total of regenerative energies		Sum total of negative energies in 1) to 8)

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

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

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

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

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

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

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

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

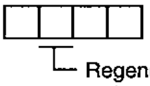
Calculate the power consumption of the regenerative brake option on the basis of single-cycle operation period tf [s] to select the necessary regenerative brake option.

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

(3) Parameter setting

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

Parameter No. 2



Regenerative brake option selection

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

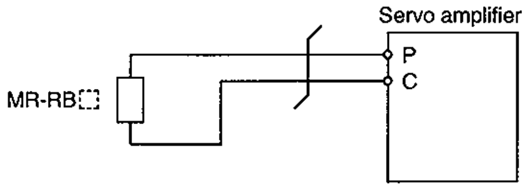
(4) Connection of the regenerative brake option

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

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

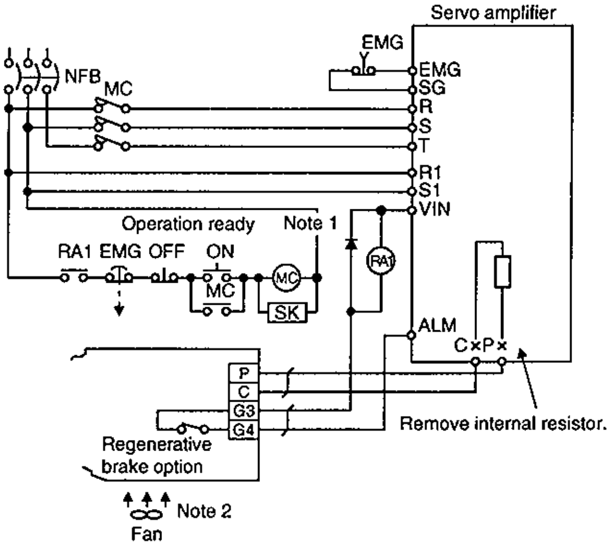
(a) MR-H10AN · MR-H20AN

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



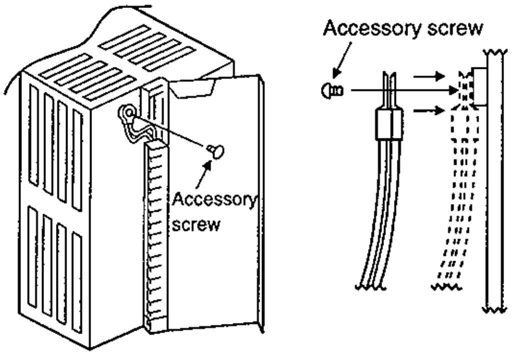
(b) MR-H40AN to MR-H700AN

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



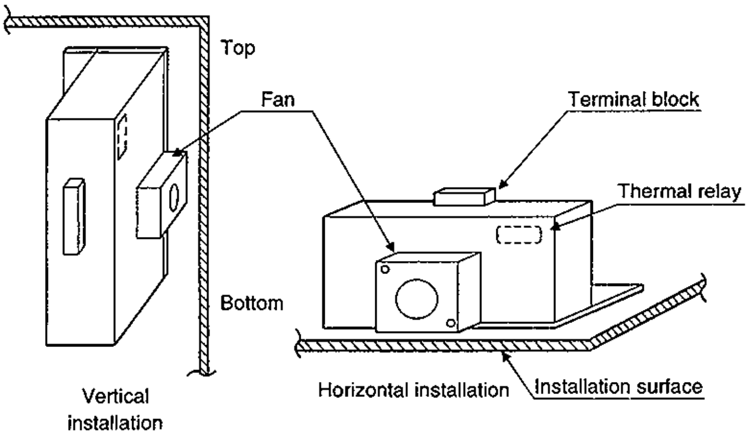
Note: When the MR-RB5□ is used, cool it forcibly by the cooling fan (1.0m² /min, about □92).

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.

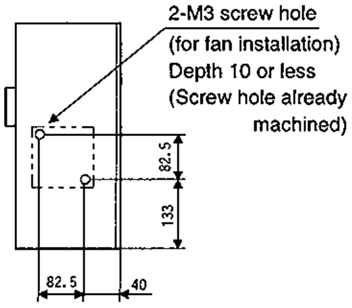


For the MR-RB50, MR-RB51 or MR-RB54, install the cooling fan as shown.

[Unit : mm(in)]



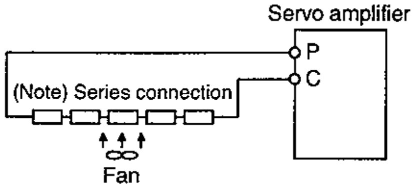
Fan installation screw hole dimensions



Recommended fan:
Toyo Denki's TL396A or equivalent

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

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

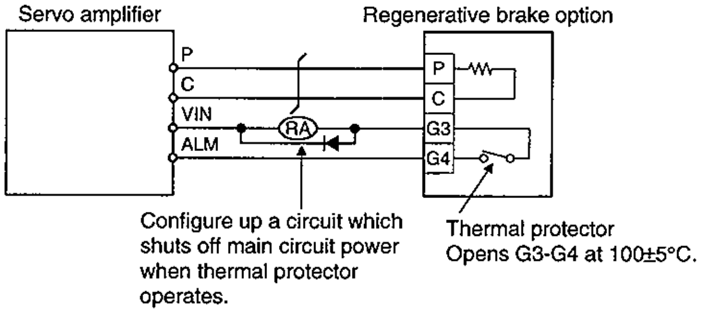


Note: The number of resistors connected in series depends on the resistor type.

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

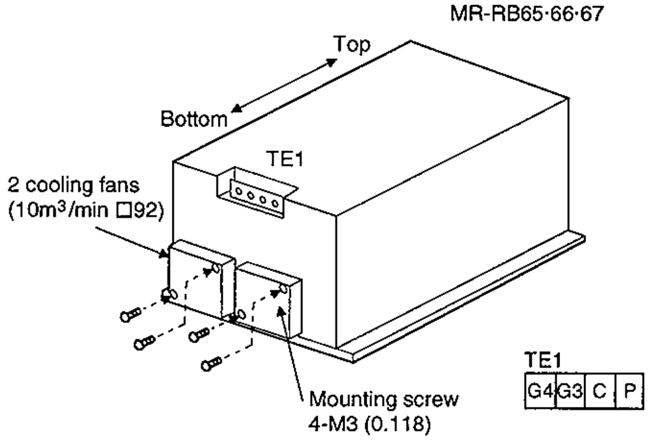
(D) MR-H11KAN-P90 to MR-H22KAN-P90 (when using the regenerative brake option)

Cooling the regenerative brake option with fans improves regenerative capability.



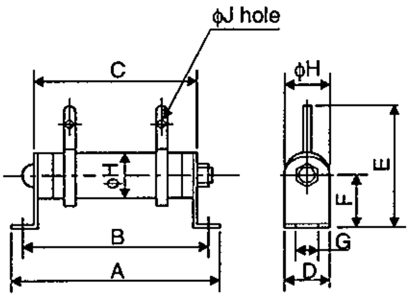
Servo Amplifier	Regenerative Brake Option Model	Resistor (Ω)	Regenerative Power	
			Without Fans	With Fans
MR-H11KAN	MR-RB65	8	500	800
MR-H15KAN	MR-RB66	5	850	1300
MR-H22KAN	MR-RB67	4	850	1300

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



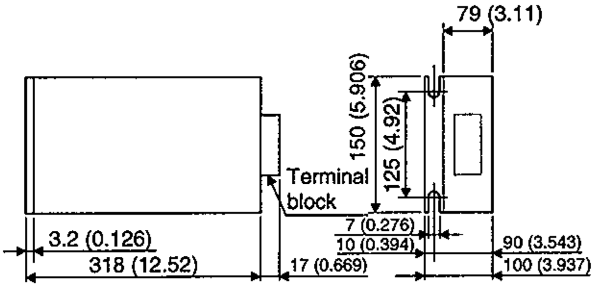
(5) Outline dimension drawings

MR-RB013 · MR-RB033



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

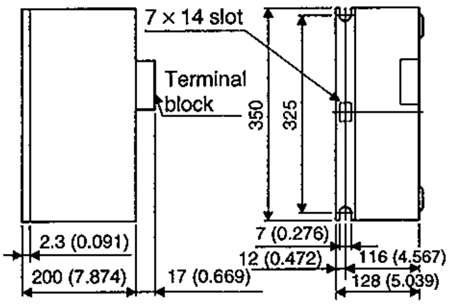
MR-RB30 · MR-RB31 · MR-RB32 · MR-RB34



[Unit : mm(in)]

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

MR-RB50 · MR-RB51 · MR-RB54

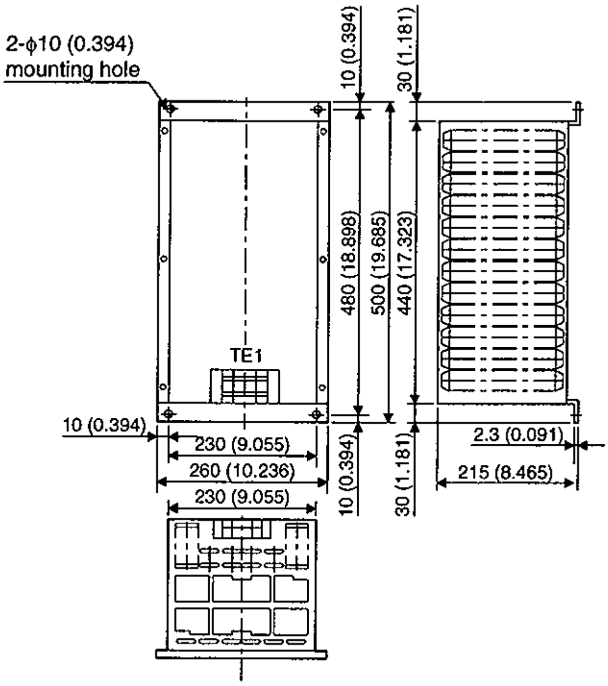


[Unit : mm(in)]

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

MR-RB65 · MR-RB66 · MR-RB67

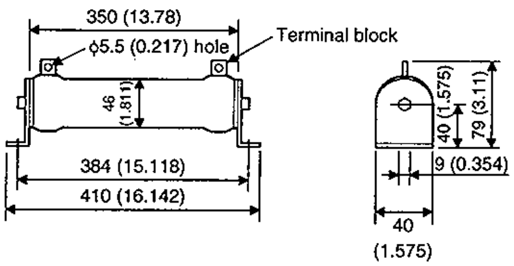
[Unit : mm(in)]



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

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

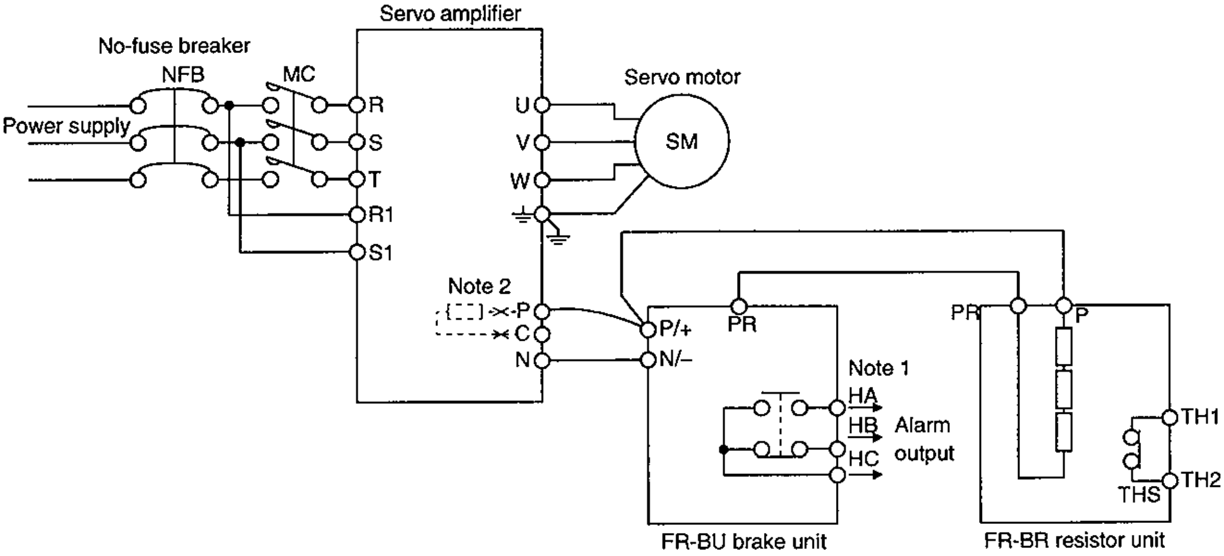
[Unit : mm(in)]



13.1.3 Brake unit

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

(1) Connection example for use of brake unit

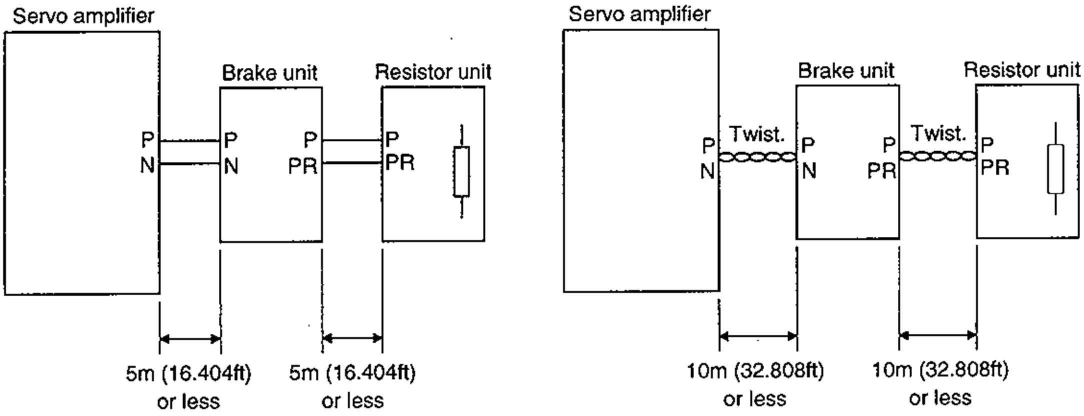


Note 1. Make up the external sequence to switch the power off when an alarm occurs or when the thermal relay is actuated.

2. The cables of the resistor in the amplifier across P-C must be disconnected.

The cables between the servo amplifier and brake unit and between the resistor unit and brake unit should be as short as possible. The cables longer than 5m should be twisted. (If twisted, the cables must not be longer than 10m.)

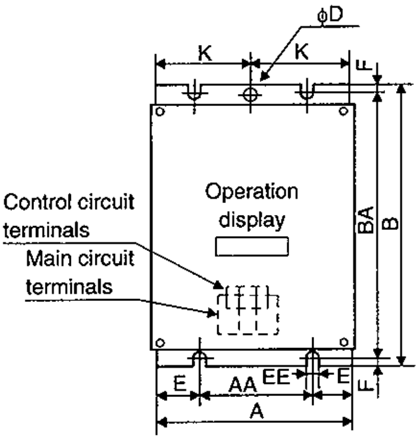
The cable size should be equal to or larger than the recommended size. See the brake unit instruction manual. You cannot connect one set of brake unit to two servo amplifiers or two sets of brake units to one servo amplifier.

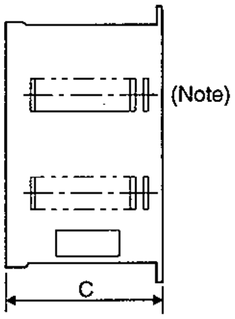


(2) Outside dimensions

· Brake unit (FR-BU)

[Unit : mm(in)]



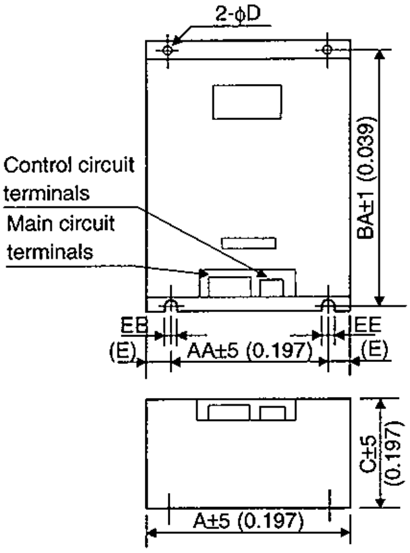


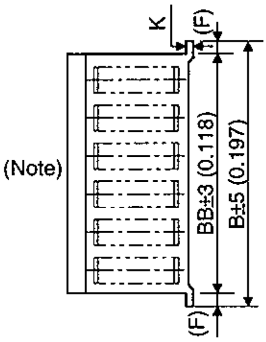
Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

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

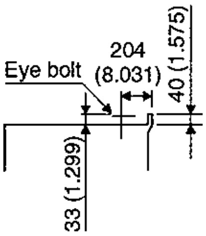
· Resistor unit (FR-BR)

[Unit : mm(in)]





•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

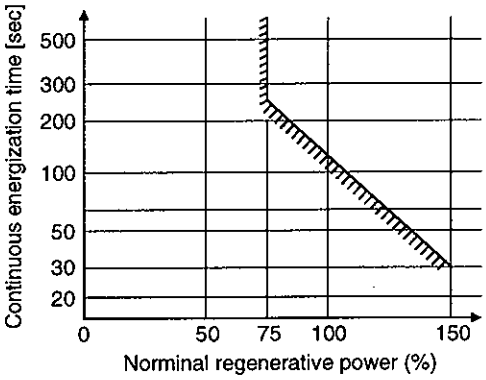
- The brake unit and resistor unit of other than 200V class are not applicable to the servo amplifier.
- The brake unit and resistor unit of the same capacity must be combined. The units of different capacities may result in damage.
- The brake unit and resistor unit must be installed on a vertical surface 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

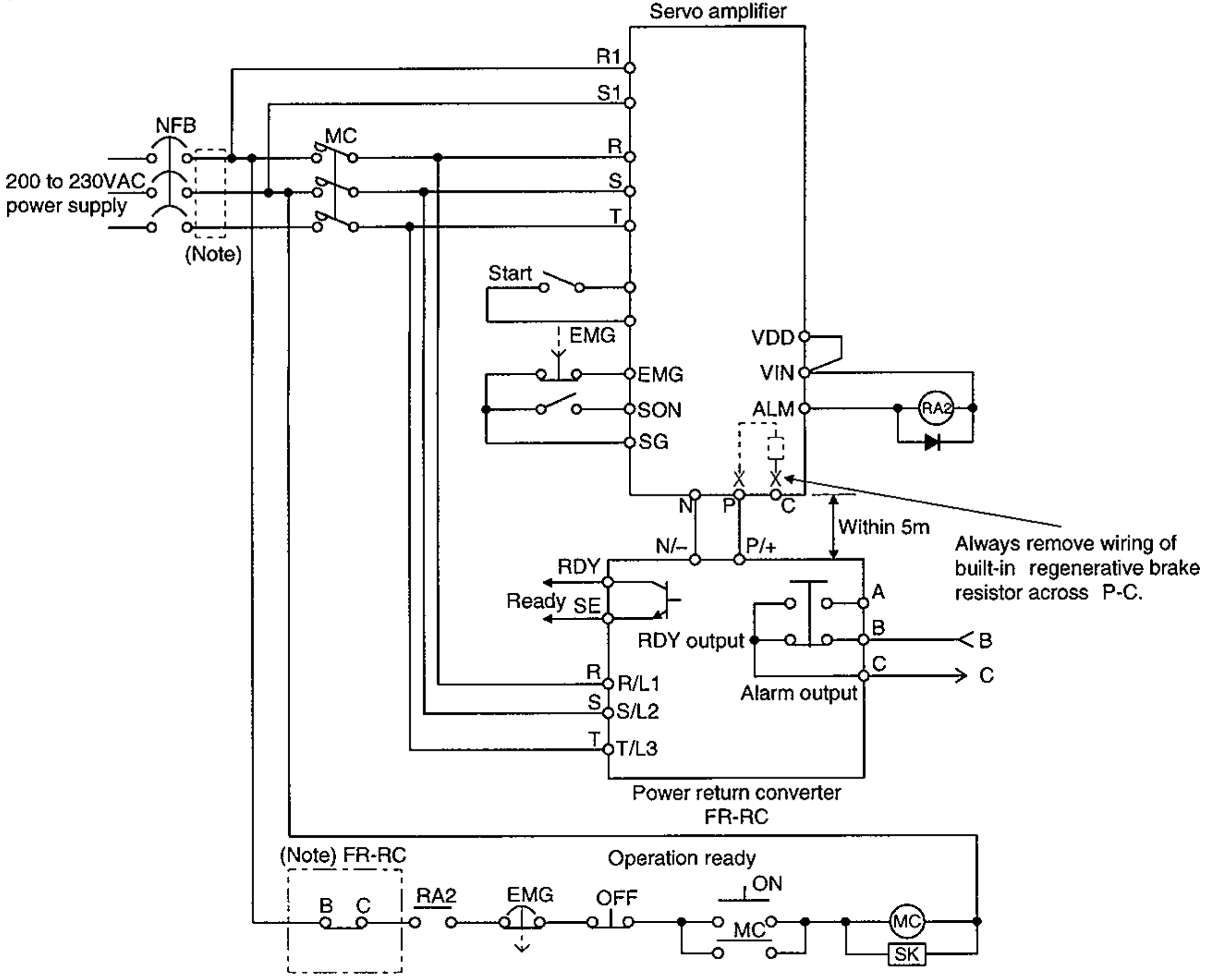
(1) Selection

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-H350AN or more.

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



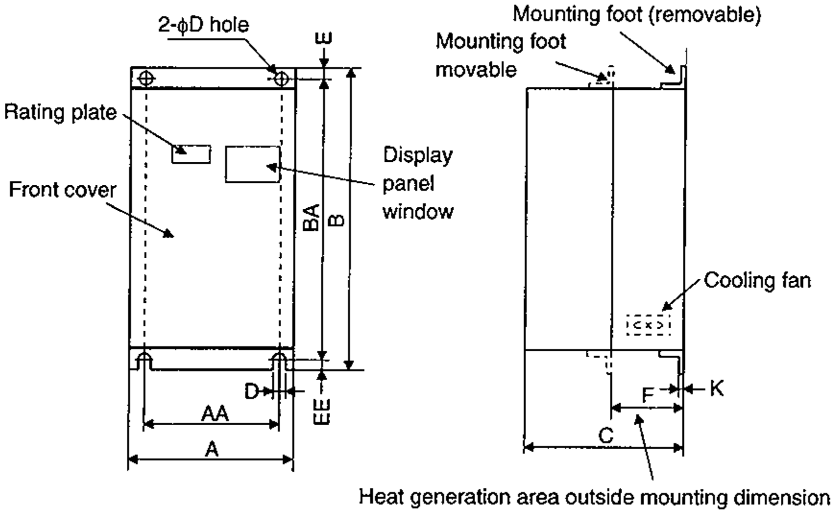
(2) Connection example



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

(3) Outside dimensions of the power return converters

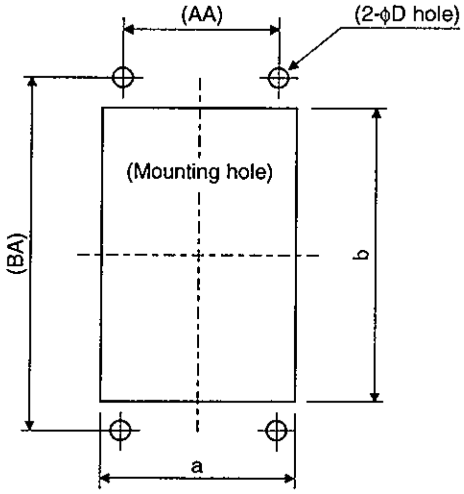
[Unit : mm(in)]



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

(4) Mounting hole machining dimensions

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



[Unit : mm(in)]

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

13.1.5 External dynamic brake

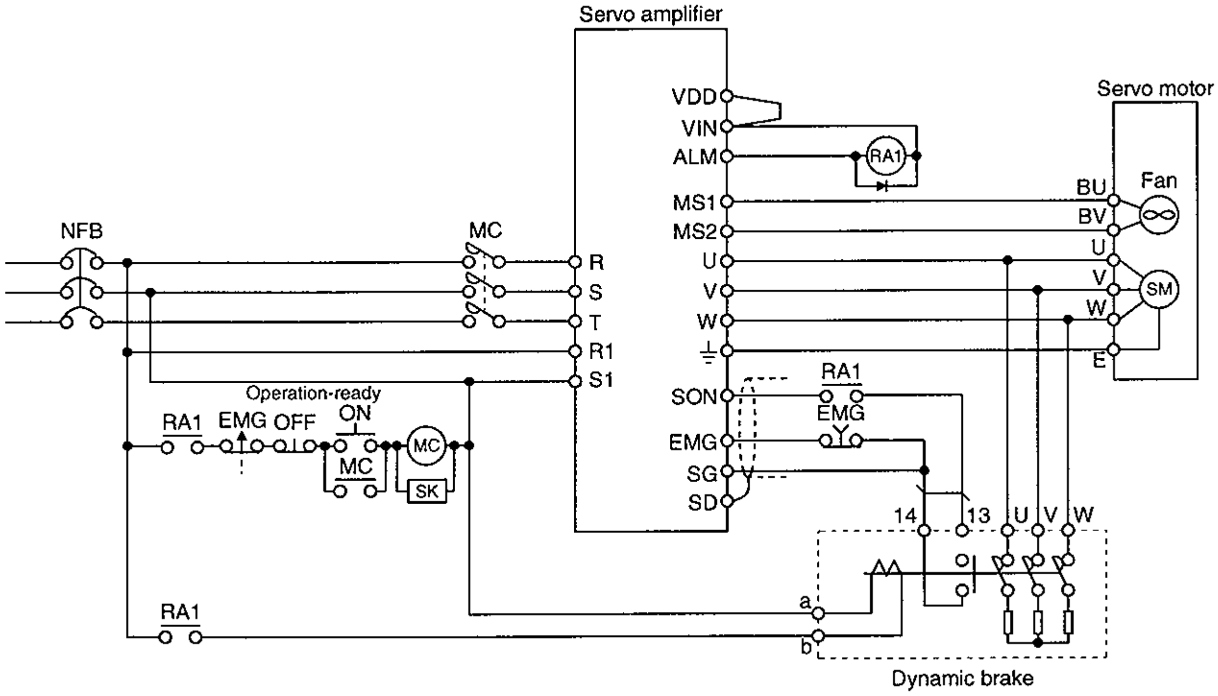
(1) Selection of dynamic brake

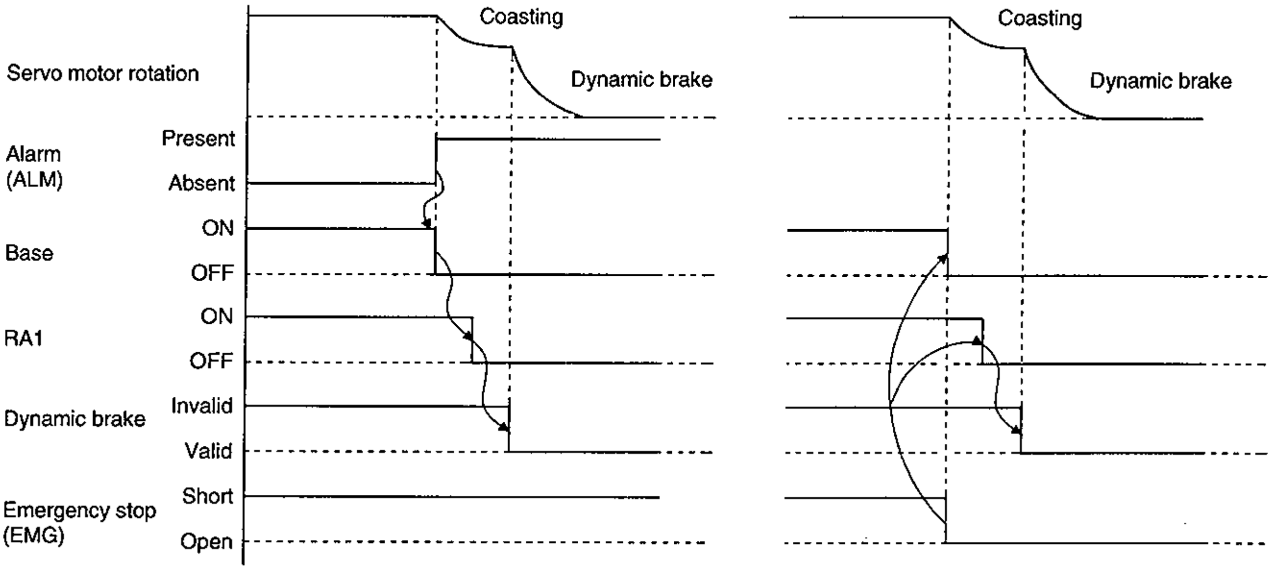
The dynamic brake is designed to bring the motor to a sudden stop when a power failure occurs or the protective circuit is activated. This brake is contained in the servo amplifier of 7kW or less but is not included in the servo amplifier of 11kW or more. When this brake is required, refer to the following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

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

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

(2) Connection example



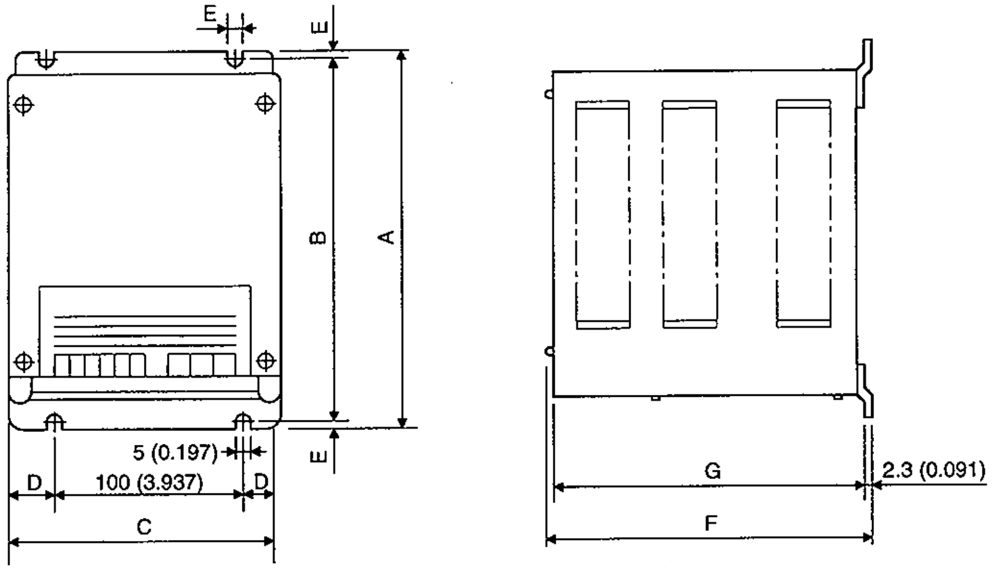


a. Timing chart at alarm (ALM) occurrence

b. Timing chart at emergency stop (EMG) validity

(3) Outline dimension drawing

[Unit: mm (in)]



Terminal block

E (GND)		a	b	13	14

Screw: M3.5

U	V	W

Screw: M4

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

POINT

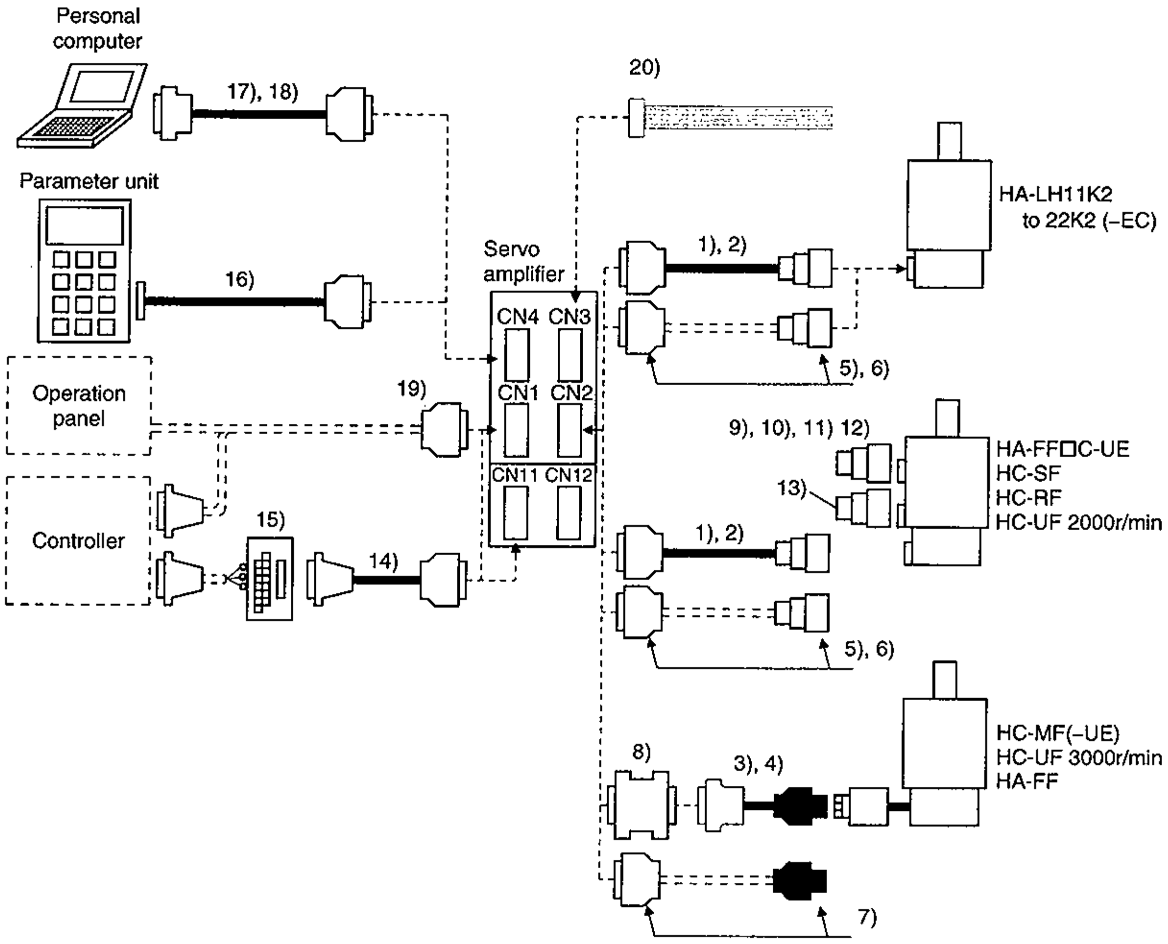
- Configure up a sequence which switches off the contact of the brake unit after (or as soon as) it has turned off the servo on signal at a power failure or failure.
- For the braking time taken when the dynamic brake is operated, refer to Section 12.3.
- The brake unit is rated for a short duration.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

13.1.6 Cables and connectors

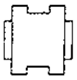
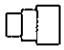
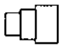
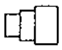
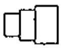
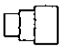
(1) Cable make-up

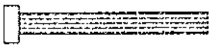
The following cables are used for connection with the servo motor and other models.

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



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

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

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

(2) Encoder cable

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

POINT

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

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

(a) Selection

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

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

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

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

3 Not oil-proof.

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

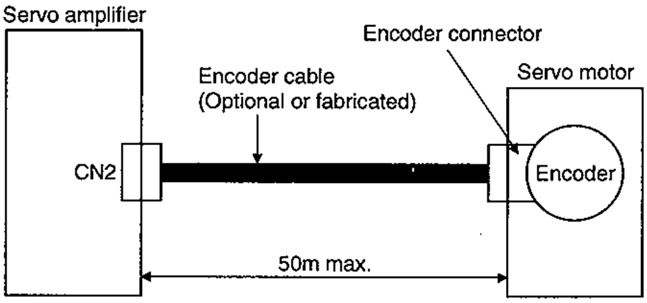
1) Explanation of model name

Model: MR-HSCBL□M

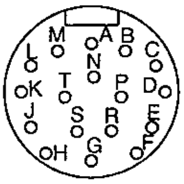
Symbol	Cable Length [m]
2	2
5	5
10	10
20	20
30	30
40	40
50	50

2) Connection diagram

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



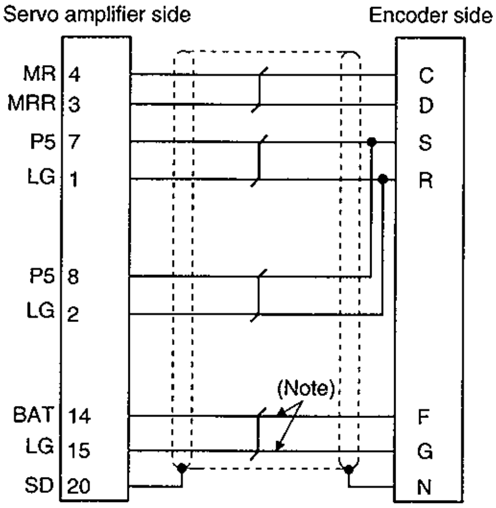
Encoder connector



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

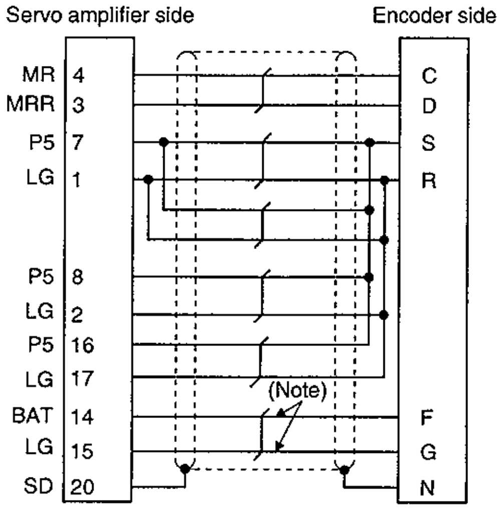
Pin	Signal
K	—
L	—
M	CNT
N	SHD
P	—
R	LG
S	P5
T	—

MR-HSCBL2M
MR-HSCBL5M



(10m or less)

MR-HSCBL10M to MR-HSCBL50M



(10m to 50m)

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

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

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

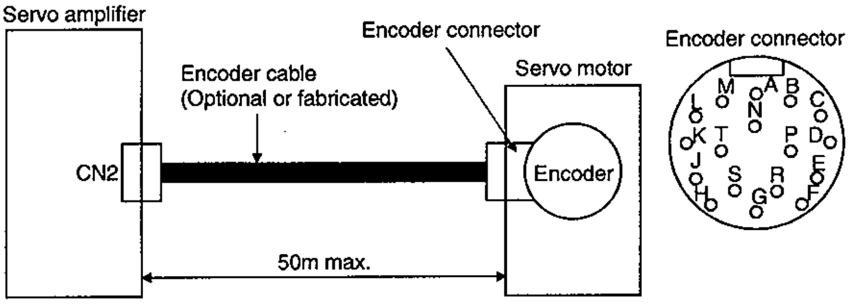
1) Explanation of model name

Model: MR-EN1CBL□M-H

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

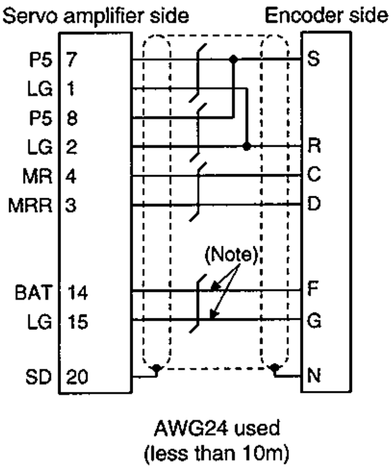
2) Connection diagram

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

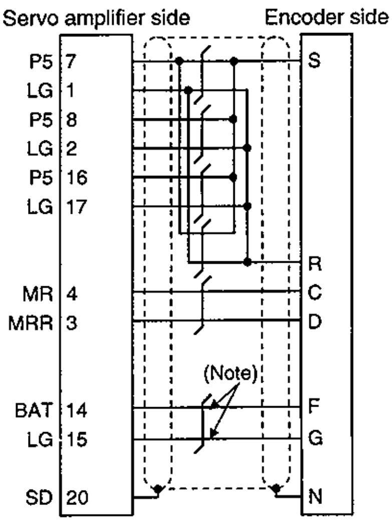


Pin	Signal	Pin	Signal
A	MD	K	—
B	MDR	L	—
C	MR	M	CNT
D	MRR	N	SHD
E	—	P	—
F	BAT	R	LG
G	LG	S	P5
H	—	T	—
J	—		

MR-EN1CBL2M-H
MR-EN1CBL5M-H



MR-EN1CBL10M-H to MR-EN1CBL50M-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.

AWG24 used
(10m to 50m)

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-□

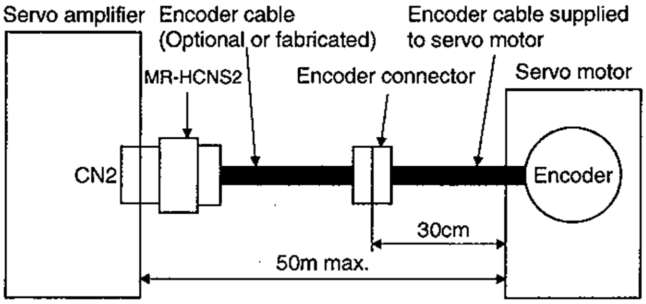
Symbol	Specifications
L	Standard flexing life
H	Long flexing life

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

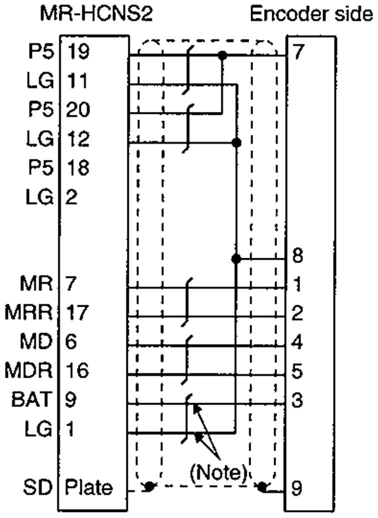
Refer to Section 3.3.1 for the servo amplifier side pin assignment.



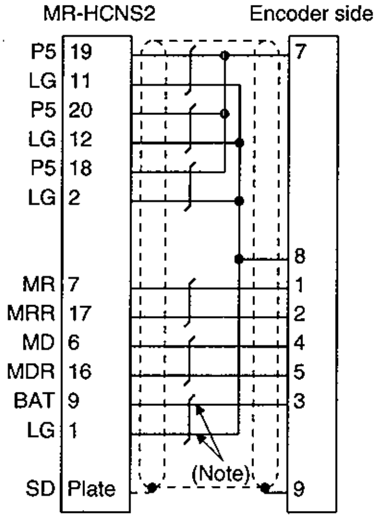
Encoder connector
172161-9 (AMP make)

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

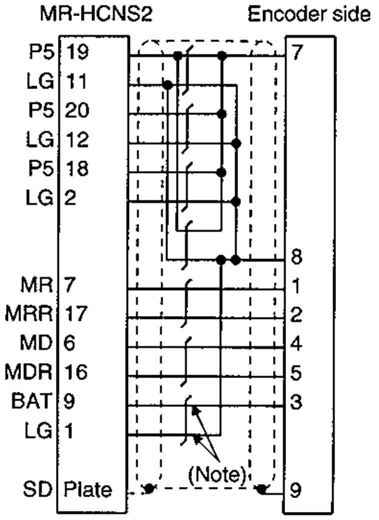
MR-JCCBL2M-L
MR-JCCBL5M-L
MR-JCCBL2M-H
MR-JCCBL5M-H



MR-JCCBL10M-L to MR-JCCBL30M-L



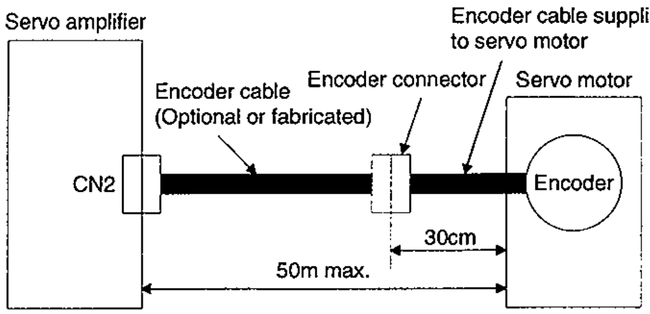
MR-JCCBL10M-H to MR-JCCBL50M-H



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

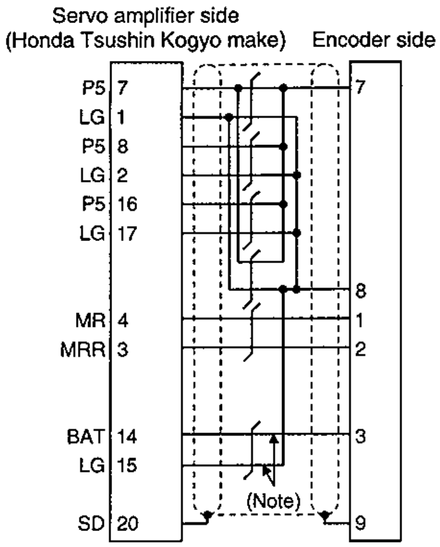
Refer to Section 3.3.1 for the servo amplifier side pin assignment. Use the recommended wires given in Section 13.2.1 and fabricate the encoder cable in accordance with the connection diagram shown below. In this connection, an up to 50m long encoder cable including the encoder cable supplied to the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



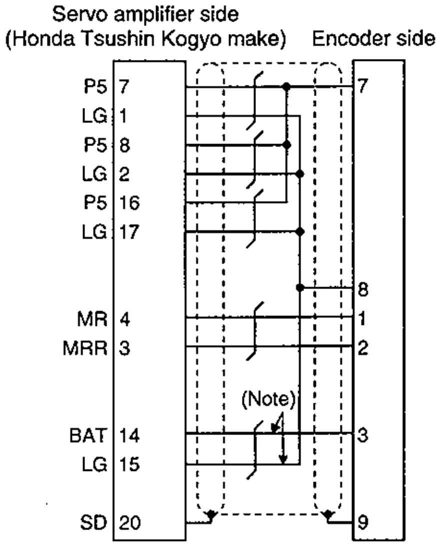
Encoder connector
172161-9 (AMP make)

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

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.

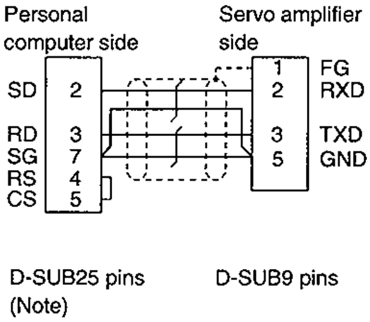
Select the communication cable according to the shape of the RS-232C connector of the personal computer used. When fabricating the cable, refer to the connection diagram in this section.

The following must be observed in fabrication:

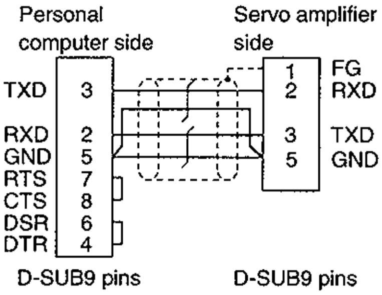
- Always use a shielded, multi-core cable and connect the shield with FG securely.
- The optional communication cable is 3m (10 ft) long. When the cable is fabricated, its maximum length is 15m (49 ft) in offices of good environment with minimal noise.

Connection diagram

· MR-HPC98CBL3M



· MR-HPCATCBL3M

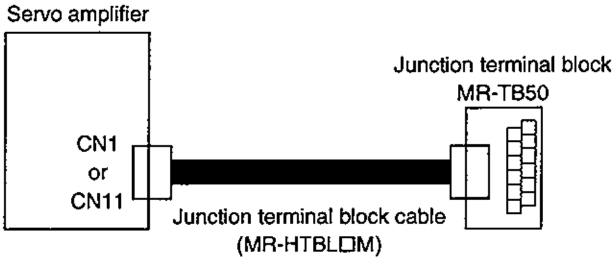


Note: The PC98 Notes having the connector of half-pitch 14 pins are also available.
Confirm the shape of the RS-232C connector of the personal computer used.

13.1.7 Junction terminal block (MR-TB50)

(1) How to use the junction terminal block

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



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

(2) Terminal block labels

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

(a) For CN1

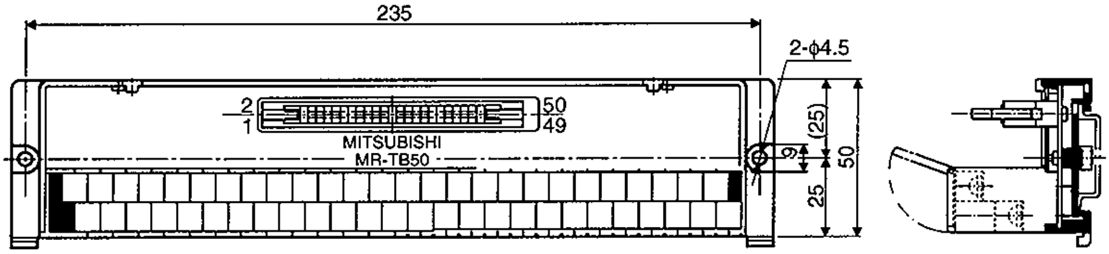
VDD	CR	PPO	NPO	SG	SG	PC	LSP	TL	PF	ALM	DI0	DI2	DI4	P15R	LA	LB	LZ	FPA	PPB	N15R	LG	TLAN	PPR	NPR
RD	SG	SG	VDD	VIN	SON	RES	LSN	ZSP	TLC	EMG	DI1	DI3	LG	OP	LAR	LBR	LZR	LG	LG	VC	TLAP	PP	NP	SD

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

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

(3) Outline drawing

[Unit: mm]



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

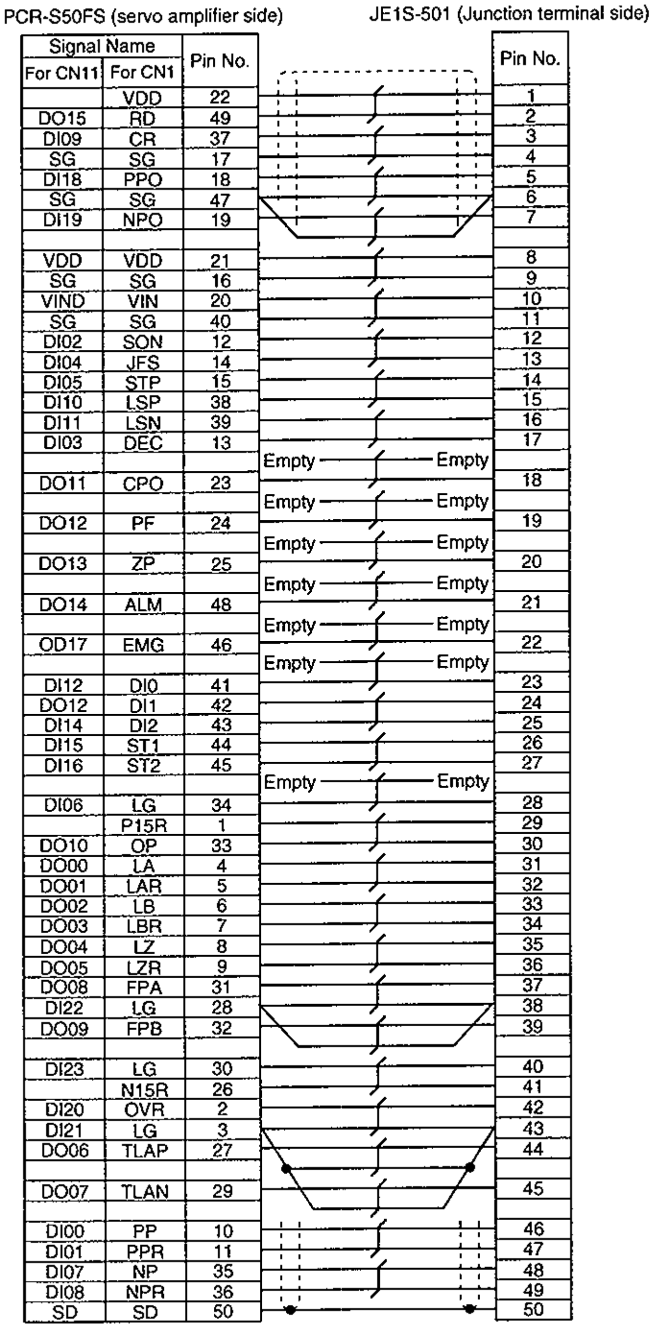
(4) Junction terminal block cable (MR-HTBL□M)

(a) Explanation of model name

Model: MR-HTBL□M

Symbol	Cable Length [m]
05	0.5
1	1

(b) Connection diagram



PCR-S50FS (servo amplifier side)

JE1S-501 (Junction terminal side)

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

13.1.8 Servo Configuration Software

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

(1) Specifications

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

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

(2) System configuration

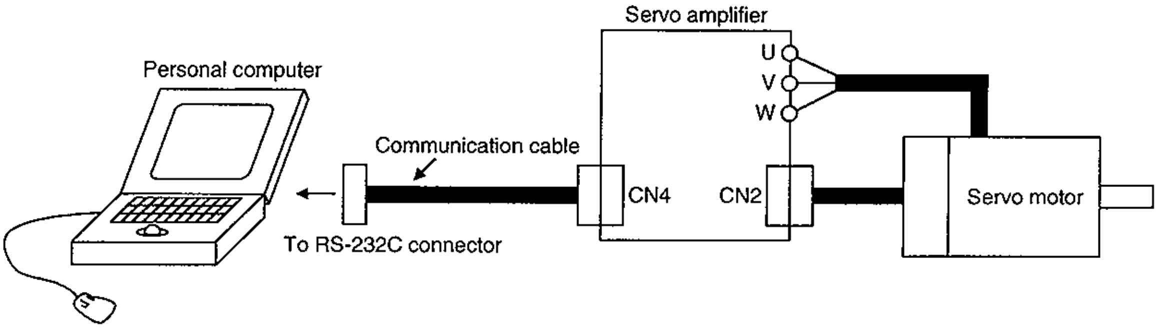
(a) Components

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

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

Note: Windows is a registered trademark of Microsoft Corporation.

(b) Configuration diagram

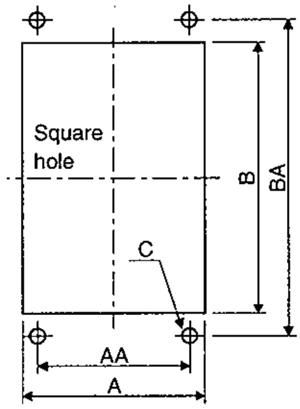


13.1.9 Heat sink outside mounting attachment (MR-ACN)

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

(1) Panel cut dimensions

(a) MR-ACN350 to MR-ACN700

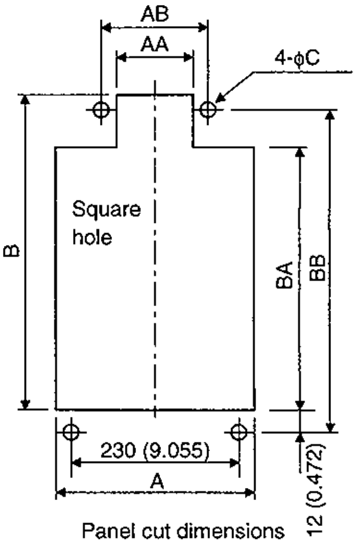


Panel cut dimensions

[Unit: mm (in)]

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

(b) MR-ACN11K, MR-ACN22K



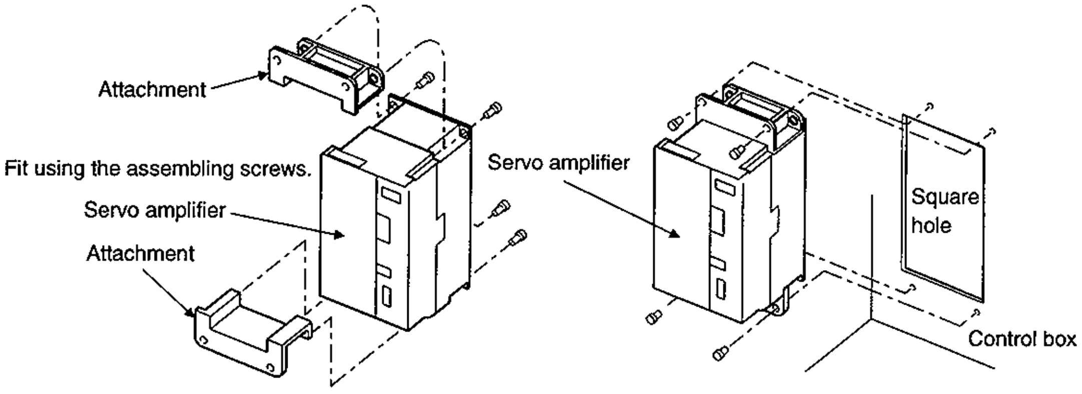
Panel cut dimensions

[Unit: mm (in)]

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

(1) Fitting method

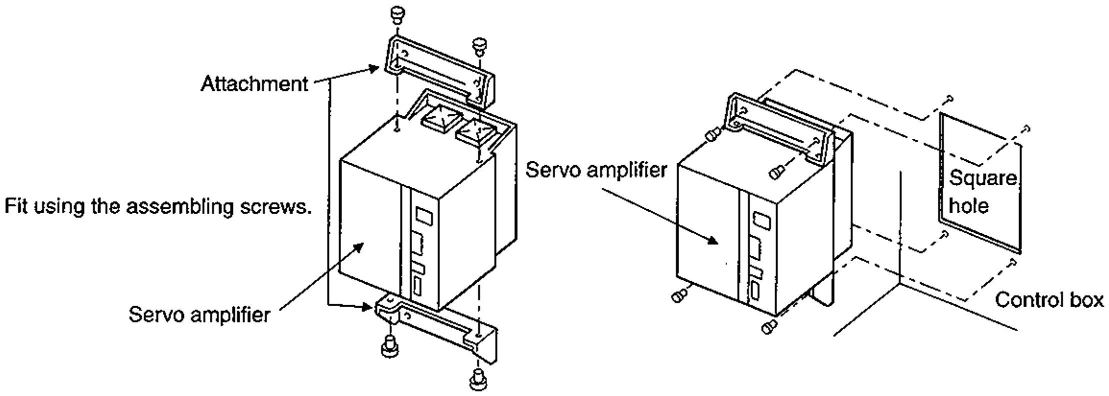
(a) MR-ACN350 (for MR-H200AN, MR-H350AN)



a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

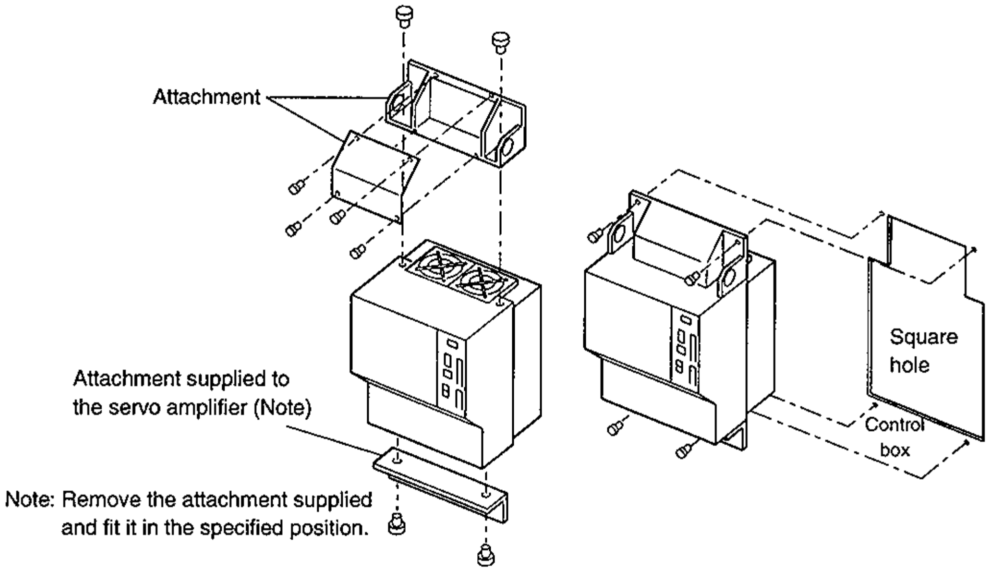
(b) MR-ACN500 (for MR-H500AN), MR-ACN700 (for MR-H700AN)



a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

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



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

a. Assembling the heat sink outside mounting attachment

b.Installation to the control box

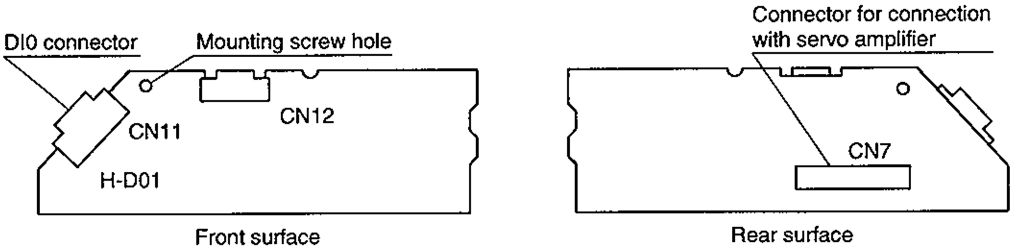
13.1.10 MR-H-D01 option card

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

(1) Specifications

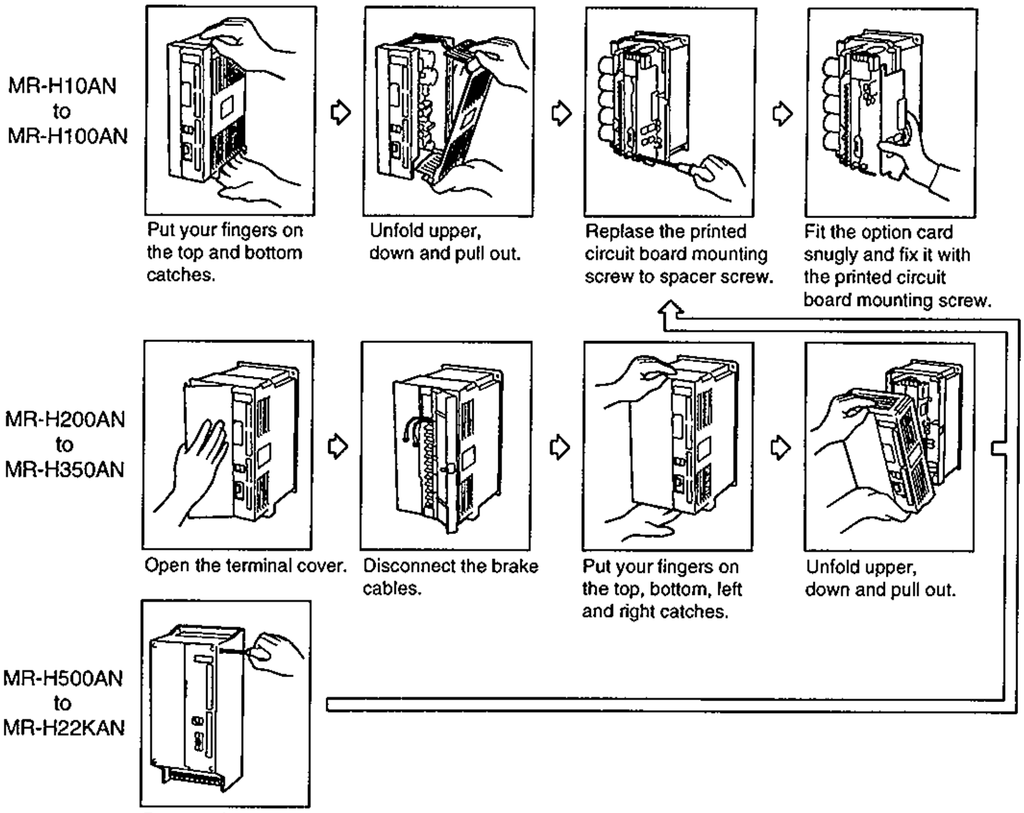
Item		Specifications
Function		Extra digital I/O, point table expansion memory
Digital input		24 points, photocoupler isolated, 24VDC, 5mA
Digital output		16 points, open collector, 24VDC, 50mA max.
Pulse train input	System	Forward/reverse rotation pulse train, 2-phase pulse train, signed pulse train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

(2) Part names



(3) Installation to servo amplifier

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



MR-H10AN to MR-H100AN:

Put your fingers on the top and bottom catches.

Unfold upper, down and pull out.

Replase the printed circuit board mounting screw to spacer screw.

Fit the option card snugly and fix it with the printed circuit board mounting screw.

MR-H200AN to MR-H350AN:

Open the terminal cover.

Disconnect the brake cables.

Put your fingers on the top, bottom, left and right catches.

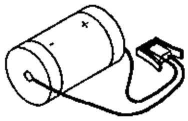
Unfold upper, down and pull out.

MR-H500AN to MR-H22KAN:

Remove three screws and open the side panel. Remove the connector cover.

13.1.11 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



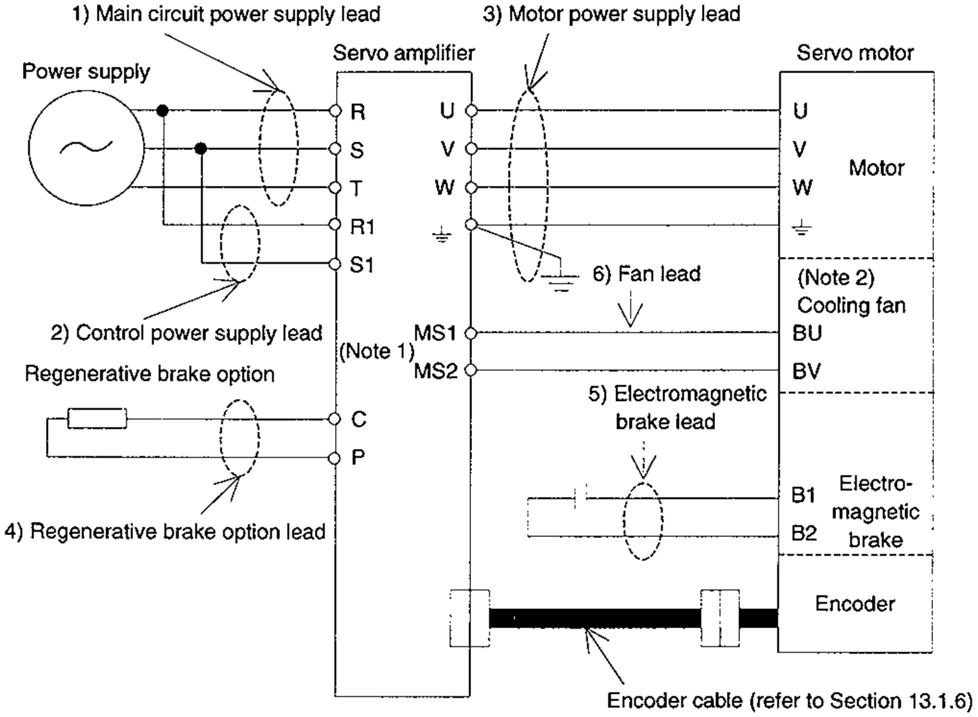
13.2 Auxiliary Equipment

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

13.2.1 Recommended wires

(1) Wires for power supply wiring

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



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

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

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

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

Tale 13.1 Recommended Wires

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

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

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

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

(2) Wires for cables

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

Table 13.2 Wires for Standard Encoder cables

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

Note 1: Value in parentheses is max. OD.

2: d is as shown below:

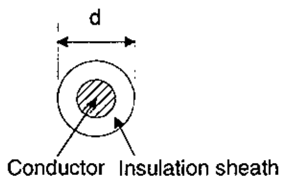


Table 13.3 Wires for Long Flexing Life Encoder Cables

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

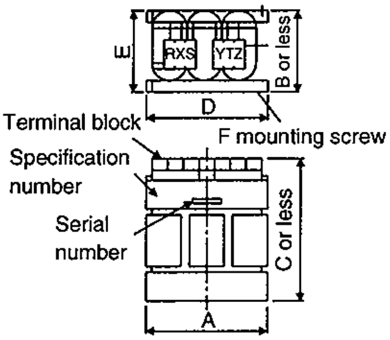
Note: purchase from Toa Electric industry

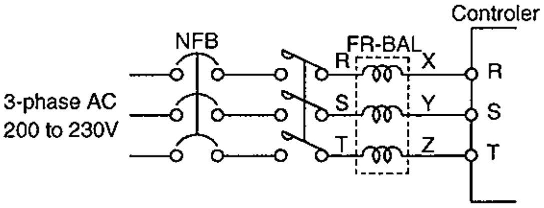
13.2.2 No-fuse breakers, magnetic contactors

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

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

13.2.3 Power factor improving reactors





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

13.2.4 Relays

The following relays should be used with the interfaces:

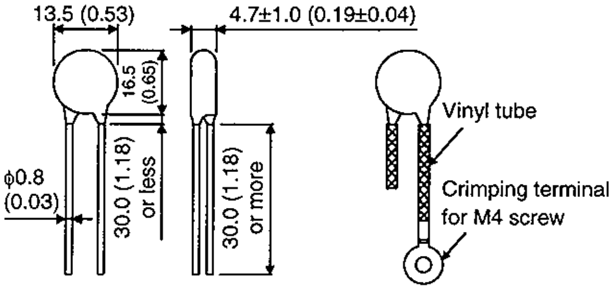
Interface	Selection Example
Relay used especially for switching on-off analog input command and input command (interface DI-1) signals	To prevent defective contacts , use a relay for small signal (twin contacts). (Ex.) OMRON : type G2A , MY
Relay used for digital output signals (interface DO-1)	Small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

13.2.5 Surge absorbers

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

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

Note: 1 time = 8 × 20μs



13.2.6 Noise reduction techniques

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

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

(1) General reduction techniques

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

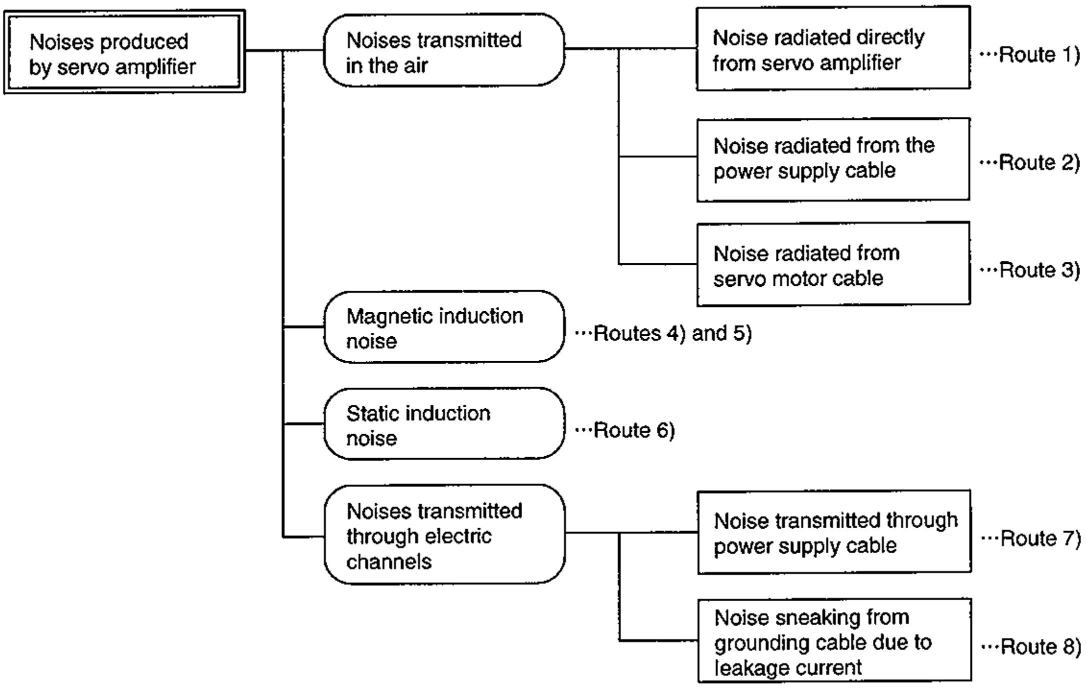
(2) Reduction techniques for external noises that cause the servo amplifier to malfunction

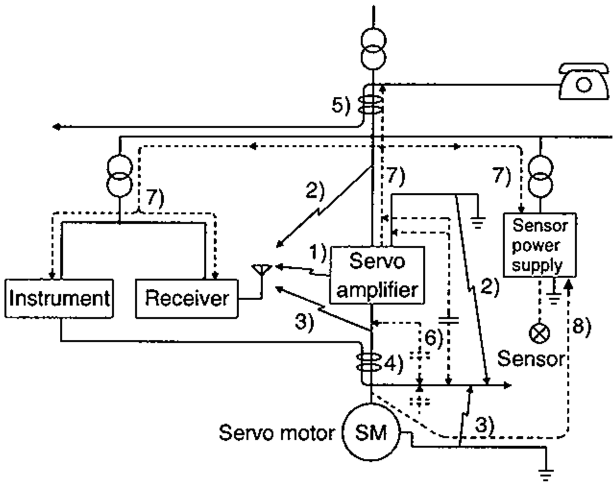
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

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

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

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





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

(1) Data line filter

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

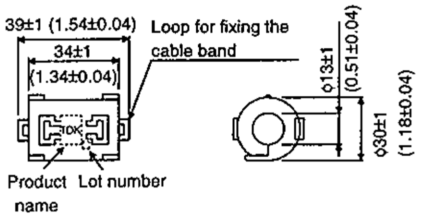
Example: Data line filter: ZCAT3035-1330 [TDK]
ESD-SR-25 [Tokin]

Impedance specifications (ZCAT3035-1330)

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

The above impedances are reference values and not guaranteed values.

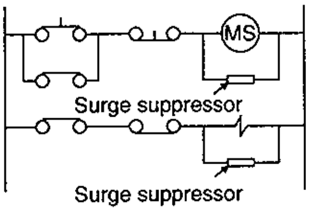
[Unit: mm (in)]

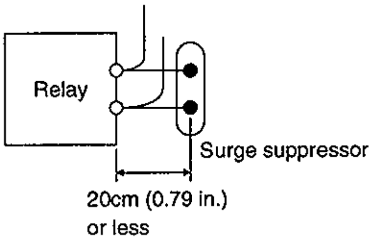


Outline drawing (ZCAT3035-1330)

(2) Surge suppressor

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

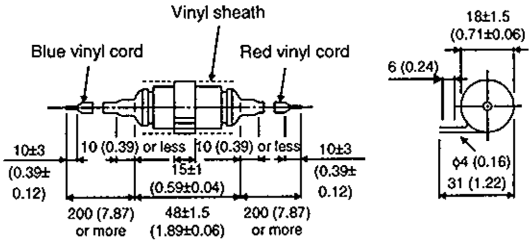




(Ex.) 972A.2003 50411
(Matsuo Electric Co.,Ltd.-200VAC rating)

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

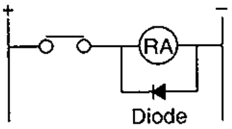
Outline Drawing [Unit: mm] ([Unit: in.])



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

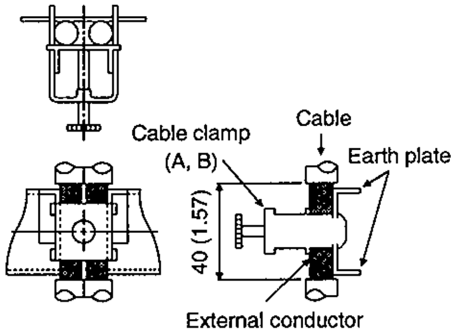
Maximum voltage: Not less than 4 times the drive voltage of the relay or the like

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

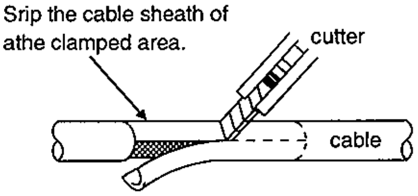


(3) Cable clamp fitting (AERSBAN-☐SET)

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



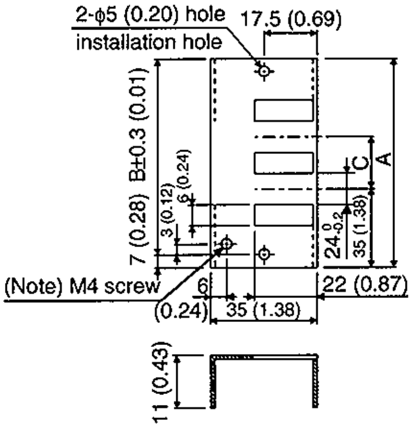
Clamp section diagram



· Outline drawing

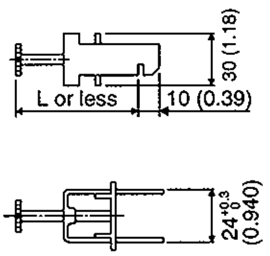
[Unit: mm (in)]

Earth plate



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

Clamp section diagram

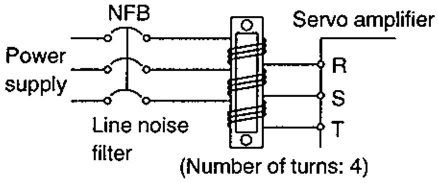
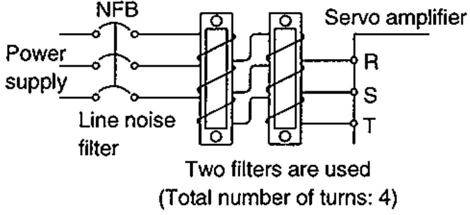
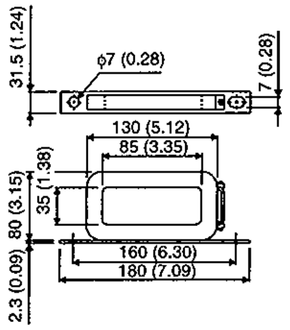
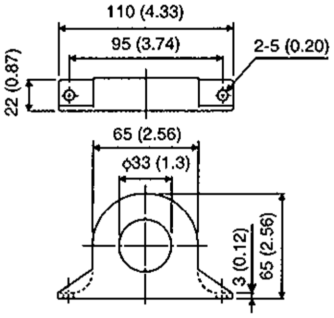


Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

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

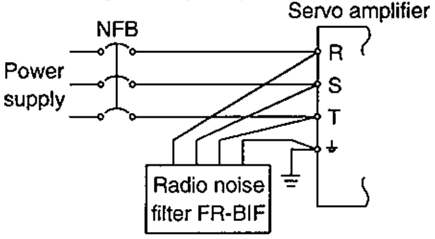
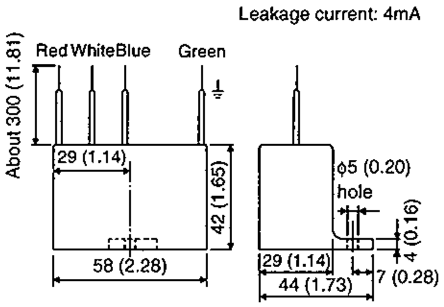
(4) Line noise filter (FR-BLF, FR-BSF01)

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

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

(5) Radio noise filter (FR-BIF)

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

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

13.2.7 Leakage current breaker

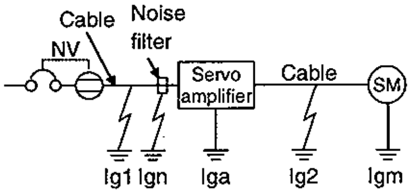
(1) Selection method

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



K: Constant considering the harmonic contents

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

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

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

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

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

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

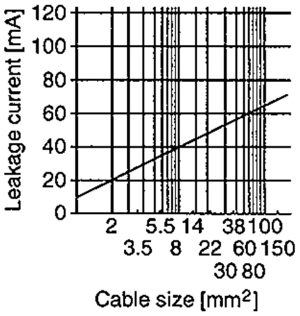


Fig.13.1 Leakage Current Example (Ig1,Ig2)for CV Cable Run in Metal Conduit

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

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

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

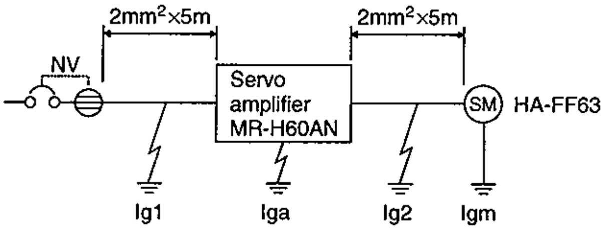
Servo Amplifier Capacity [kW]	Leakage Current [mA]
All series	2

Table 13.6Leakage Circuit Breaker Selection Example

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

(2) Selection example

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



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

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

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

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (13.2):

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

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

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

13.2.8 Setting potentiometers for analog inputs

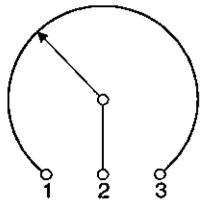
The following variable resistors are available for use with analog inputs such as override and analog torque commands:

(1) Single-revolution type

WA2WYA2SEBK2KΩ (Japan Resistor make)

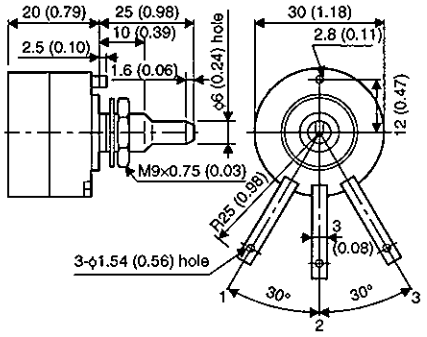
Rated Power	Resistance	Resistance Tolerance	dielectric Strength (for 1 minute)	Insulation Resistance	Mechanical Rotary Angle	Rotary Torque
2W	2kΩ	±10%	700V A.C	100MΩor more	300°±5°	10 to 100g-cm or less

connection diagram



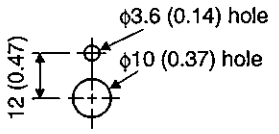
Outline dimension drawing

[Unit: mm (in)]



Panel hole machining diagram

[Unit: mm (in)]

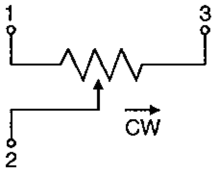


(2) Multi-revolution type

RRS10(M)2KΩ (Japan Resistor make)

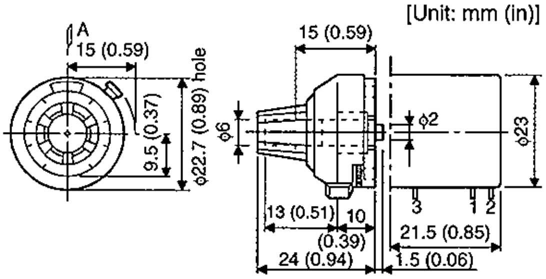
Rated Power	Resistance	Resistance Tolerance	dielectric Strength (for 1 minute)	Insulation Resistance	Mechanical Rotary Angle	Rotary Torque
1W	2kΩ	±10%	700V A.C	1000MΩ or more	3600° $^{+10°}_{-0°}$	100g-cm or less

connection diagram



Outline dimension drawing

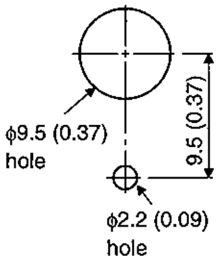
[Unit: mm (in)]



Panel hole machining diagram

[Unit: mm (in)]

Panel thickness: 2 to 6 (0.08 to 0.24)



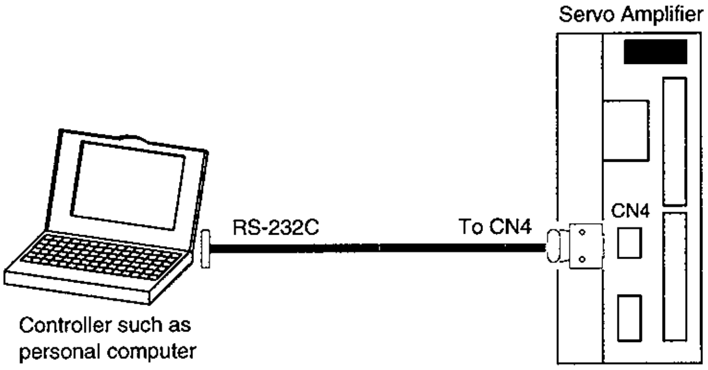
14. RS-232C COMMUNICATION FUNCTIONS

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

14.1 Configuration

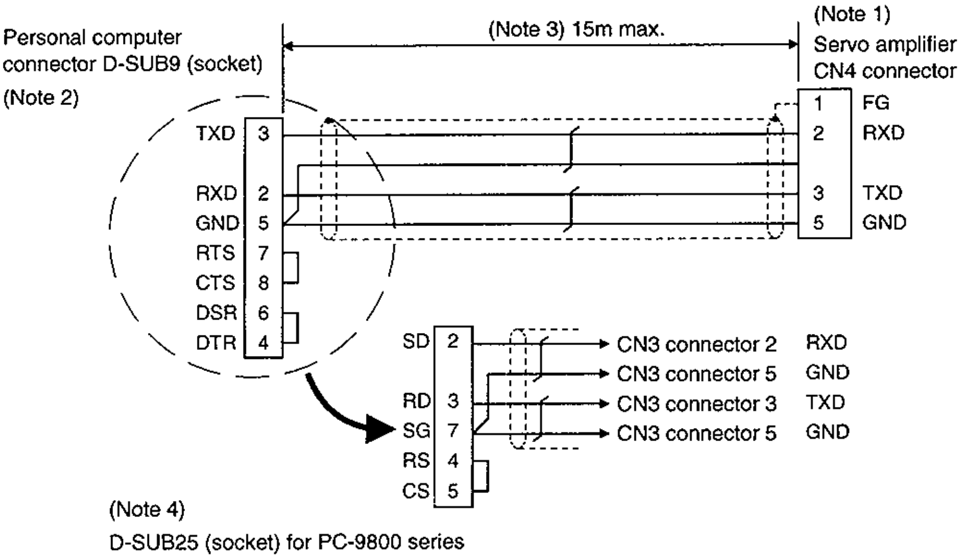
(1) Outline

A single axis of servo amplifier is operated.



(2) Cable connection diagram

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

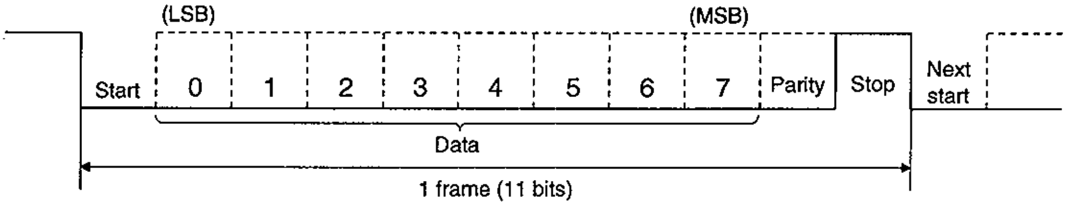


Note: 1. Honda Tsushin's CN3 connector
Connector: DE-9PF-N
Shell kit: DE-C1-J6-S6
2. For the PC-AT compatible controller series.
3. 15m max. in environment of little noise.
4. The PC-9800 series also has the half-pitch type.

14.2 Communication Specifications

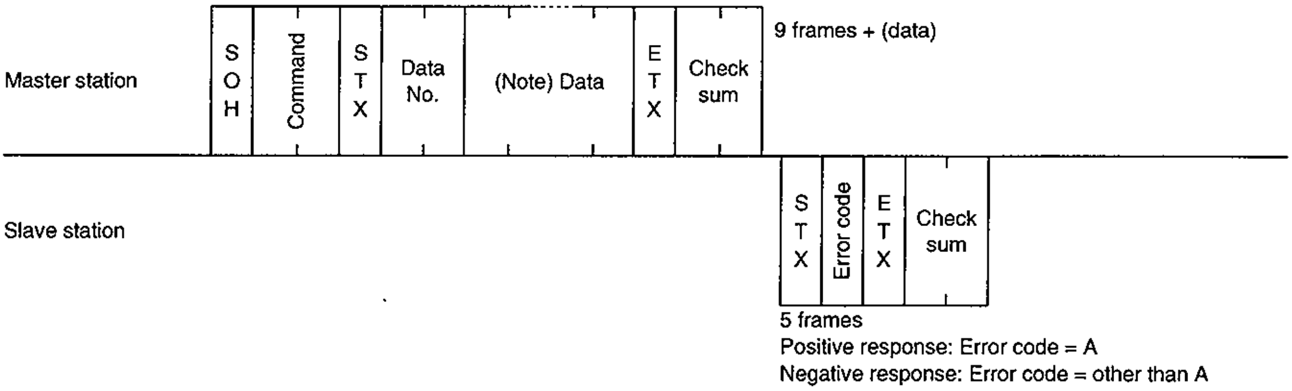
Servo Amplifier is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (servo amplifier) is called a slave station. When fetching data successively,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

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



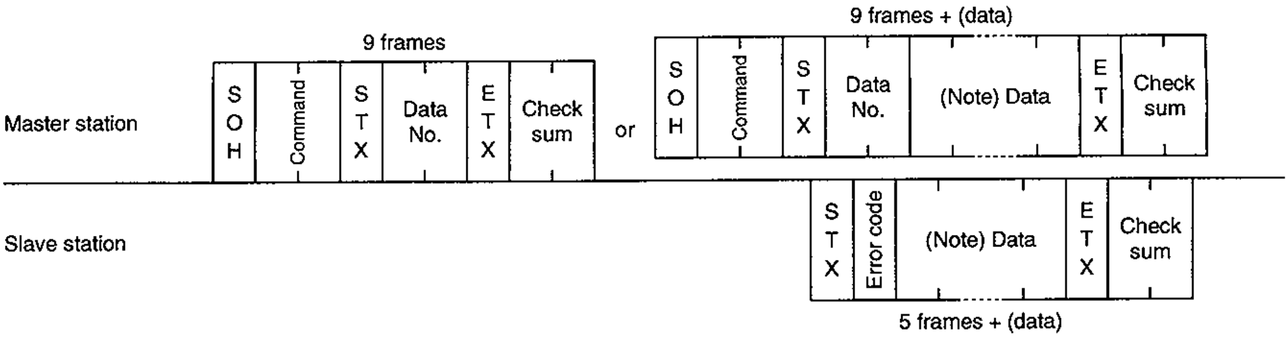
14.3 Protocol

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



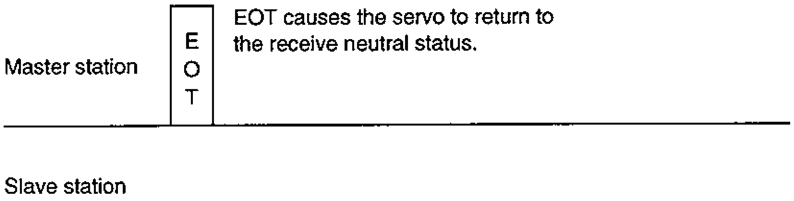
Note: Refer to (4) in this section for the number of data frames.

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



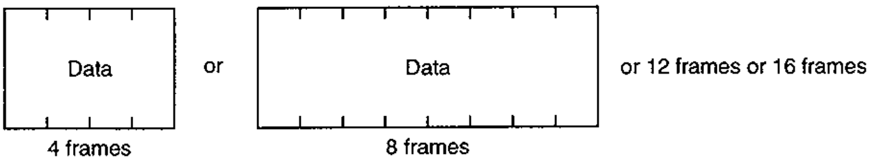
Note: Refer to (4) in this section for the number of data frames.

(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



14.4 Character Codes

(1) Control codes

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

(2) Codes for data

JIS8 unit codes are used.

b_8	0	0	0	0	0	0	0	0
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8~b_5	b_4	b_3	b_2	b_1
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

R \ C	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC$_1$	!	1	A	Q	a	q
2	STX	DC$_2$	"	2	B	R	b	r
3	ETX	DC$_3$	#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	I	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	|
13			-	=	M	]	m	}
14			.	>	N	^	n	‾
15			/	?	O	_	o	DEL

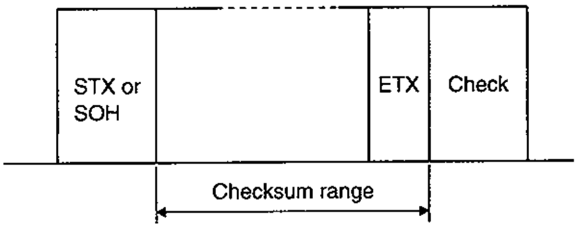
14.5 Error Codes

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

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

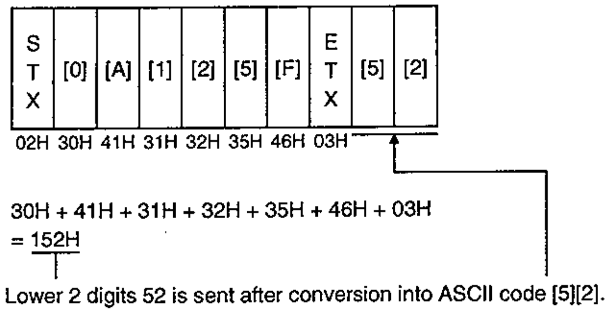
14.6 Checksum

Checksum range



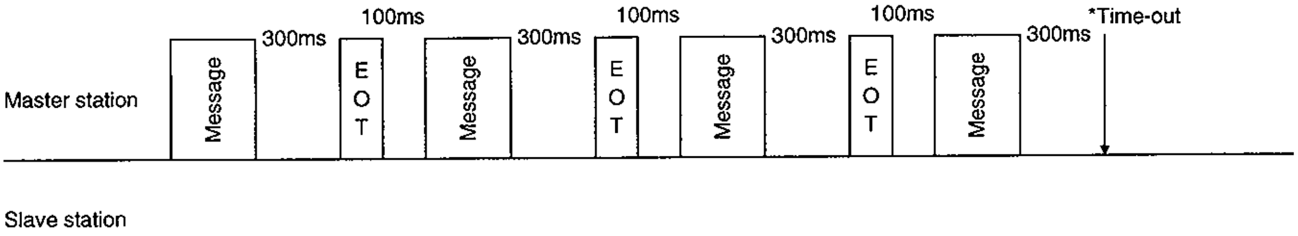
The checksum is sent as a JIS8-coded hexadecimal code representing the lower two digits of the sum of JIS8-coded hexadecimal values up to ETX, with the exception of the first control code (STX or SOH).

(Example)



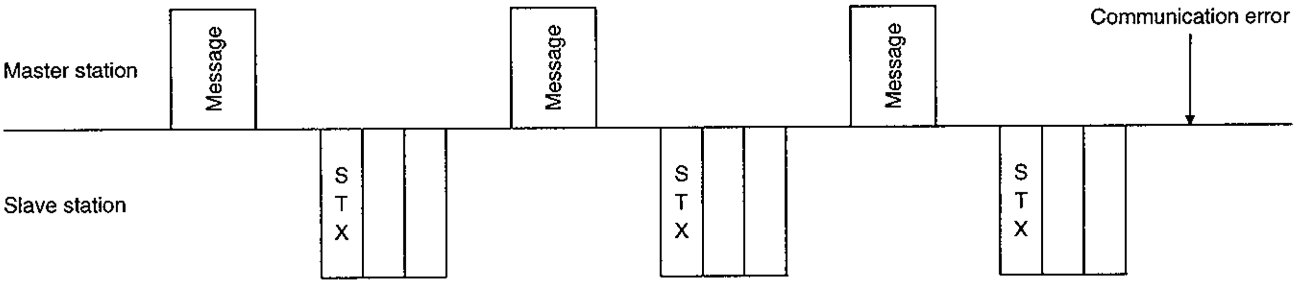
14.7 Time-Out Operation

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



14.8 Retry Operation

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



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

14.9 Initialization

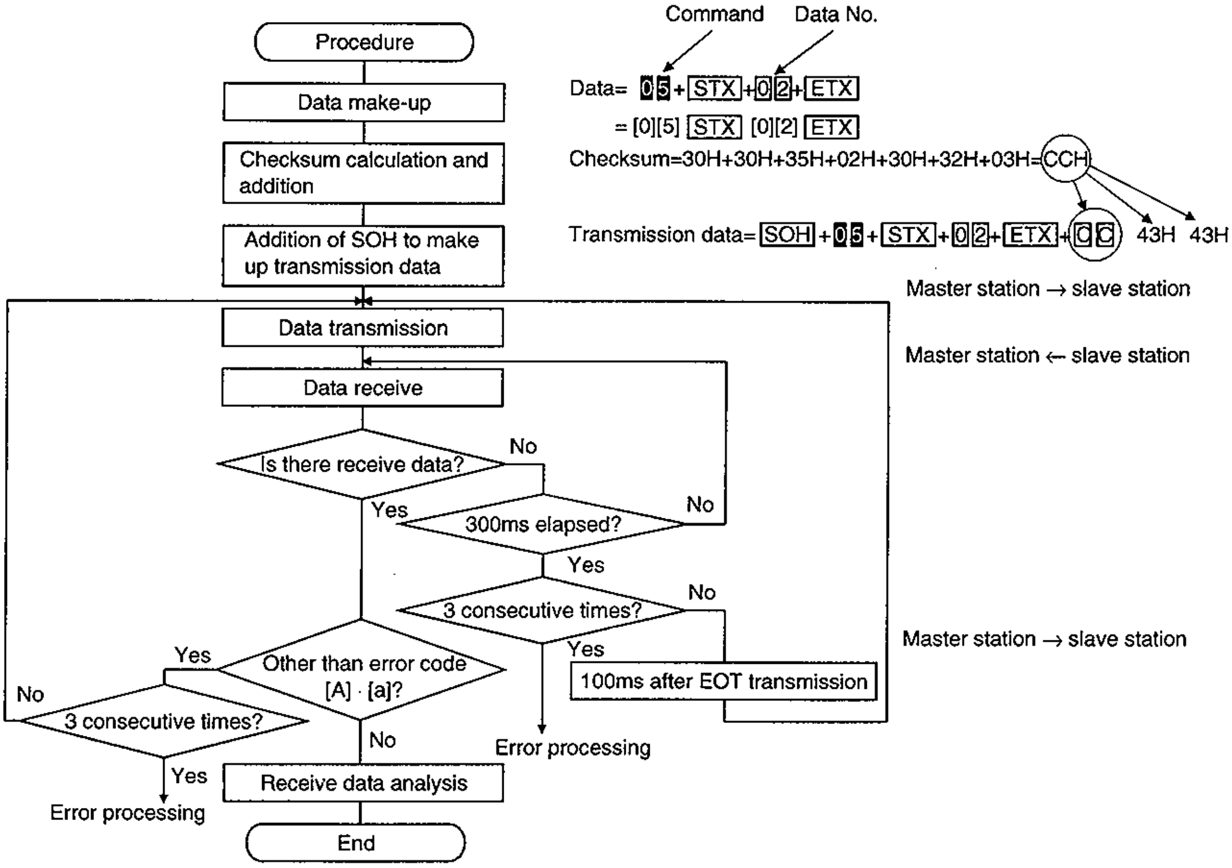
After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after:

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

14.10 Communication Procedure Example

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

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



14.11 Command and Data No. List

14.11.1 Read commands

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

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

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

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

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

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

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

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

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

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

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

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

14.11.2 Write commands

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

14.12 Detailed Explanations of Commands

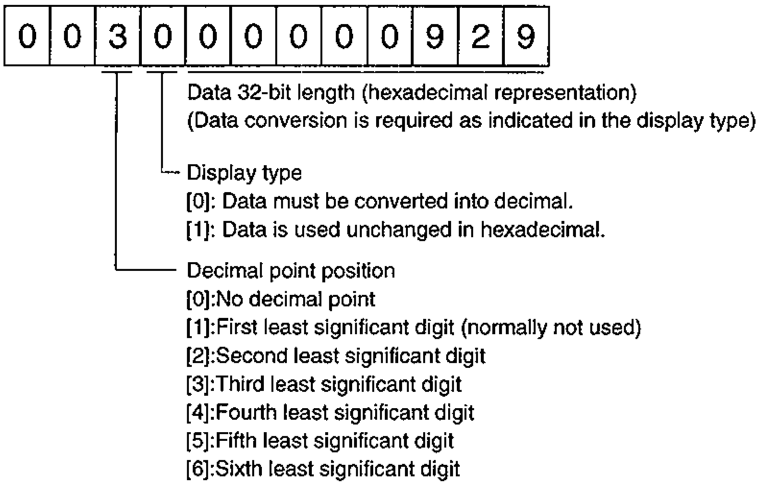
14.12.1 Data processing

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

(1) Processing the read data

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

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



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.

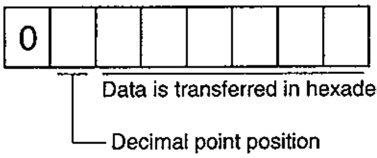
Decimal point position
[0]:No decimal point
[1]:First least significant digit (normally not used)
[2]:Second least significant digit
[3]:Third least significant digit
[4]:Fourth least significant digit
[5]:Fifth least significant digit
[6]:Sixth least significant digit

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

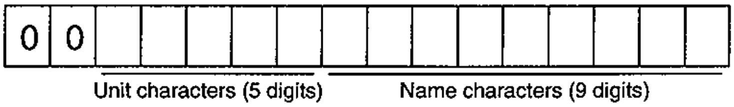
Read the status display name and unit.

(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.



(2) Status display data read

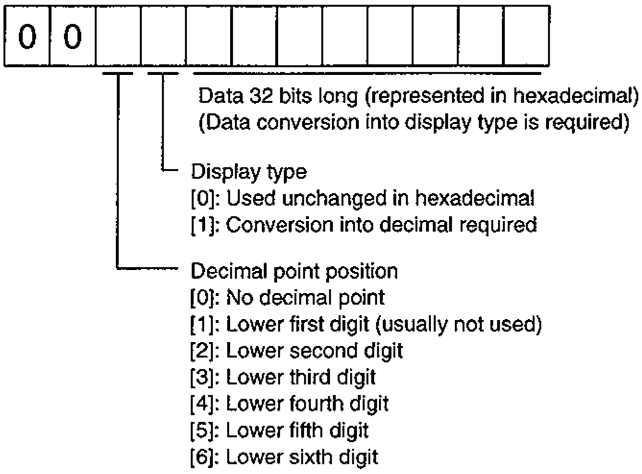
Read the status display data and processing information.

(a) Transmission

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

(b) Reply

The slave station sends back the status display data requested.



(3) Status display data clear

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

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

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

14.12.3 Parameters

(1) Reading the name

Read the parameter name.

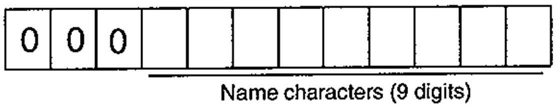
(a) Transmission

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

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

(b) Reply

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



(2) Reading the setting

Read the parameter setting.

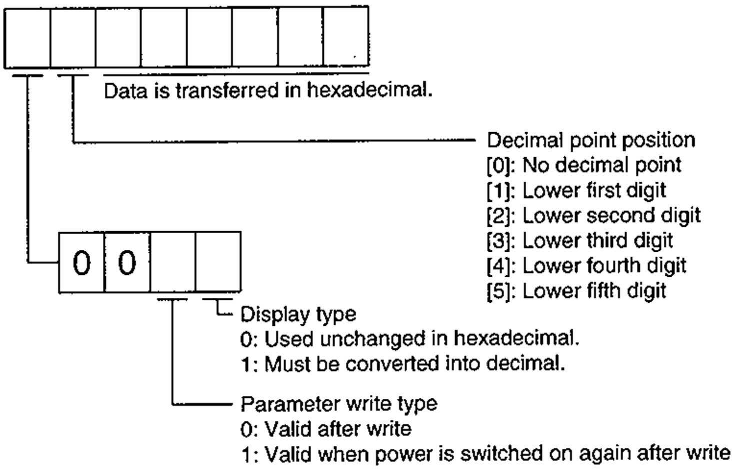
(a) Transmission

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

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

(b) Reply

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



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

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

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

(3) Reading the setting range

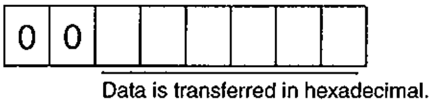
Read the parameter setting range.

(a) Transmission

When reading the upper limit value, transmit command [0][6] and the data No. corresponding to the parameter No., [0][0] to [F][F]. When reading the lower limit value, transmit command [0][7] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to Section 14.11.1.)
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

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

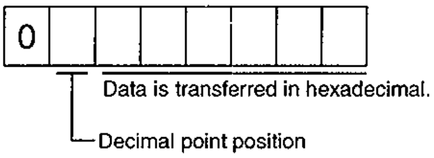


For example, data "10FFFFEC" means -20.

(4) Parameter write

Write the parameter setting into EEP-ROM of the servo amplifier.
Parameter settings may be written up to 100,000 times. Write the value within the setting enabled range. For the setting enabled range, refer to Section 6.1 or read the setting range by performing operation in (3) of this section.
Transmit command [8][4], the data No. , and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.
Write the data after making sure that it is within the upper/lower limit value range.
Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

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



[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

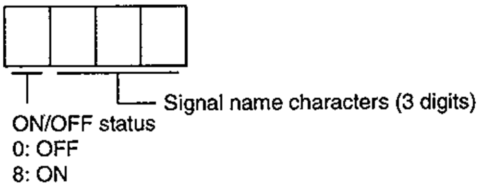
Read the ON/OFF status of the external input signal. When the master station transmits the data No. to the slave station, the slave station sends back the corresponding ON/OFF status to the master station.

(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.



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

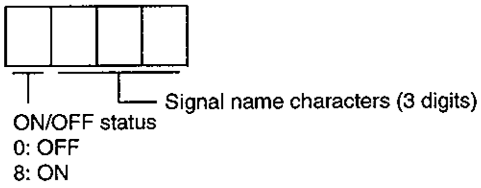
Read the ON/OFF status of the external output signal. When the master station transmits the data No. to the slave station, the slave station sends back the corresponding ON/OFF status to the master station.

(a) Transmission

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

(b) Reply

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

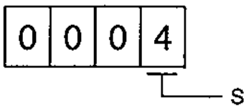


14.12.5 External output signal ON/OFF (DO forced output)

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

(1) Choosing DO forced output in test operation mode

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

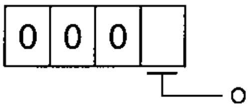


Selection of test operation mode
4: DO forced output (output signal forced output)

(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.



ON/OFF command
0: OFF
1: ON

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

Transmit the following communication commands:

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

1:ON
0:OFF

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

Assignment of CN1 output signals

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

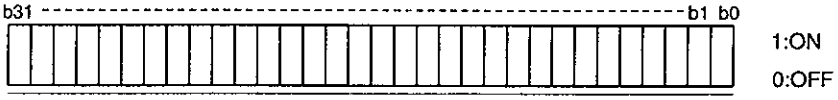
Assignment of CN11 (MR-H-D01 option card) output signals

bit	Signal Name
0	DO00
1	DO01
2	DO02
3	DO03
4	DO04
5	DO05
6	DO06
7	DO07
8	DO08
9	DO09
10	DO10
11	DO11
12	DO12
13	DO13
14	DO14
15	DO15
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	

14.12.6 External input signal ON/OFF

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

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



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

Assignment of CN1 input signals

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	SON	11	DI4	22	
1	TL	12		23	
2	PC	13		24	
3	RES	14		25	
4		15		26	
5		16		27	
6	CR	17		28	
7	DI0	18		29	
8	DI1	19		30	
9	DI2	20		31	
10	DI3	21			

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

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	DI00	11	DI11	22	DI22
1	DI01	12	DI12	23	DI23
2	DI02	13	DI13	24	
3	DI03	14	DI14	25	
4	DI04	15	DI15	26	
5	DI05	16	DI16	27	
6	DI06	17	DI17	28	
7	DI07	18	DI18	29	
8	DI08	19	DI19	30	
9	DI09	20	DI20	31	
10	DI10	21	DI21		

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

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

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

(1) Disabling/enabling the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.

Transmit the following communication commands:

(a) Disable

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

(b) Enable

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

(2) Disabling/enabling only the external input signals (DI) with the exception of EMG, LSP and LSN.

Transmit the following communication commands:

(a) Disable

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

(b) Enable

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

(3) Disabling/enabling only the external analog input signals.

Transmit the following communication commands:

(a) Disable

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

(b) Enable

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

(4) Disabling/enabling the external output signals (DO)

Transmit the following communication commands:

(a) Disable

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

(b) Enable

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

14.12.8 Test operation mode

(1) Instructions for test operation mode

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

1) Turn off all external input signals.

2) Disable the external input signals.

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

3) Choose the test operation mode.

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

4) Set the data needed for test operation.

5) Start.

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

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

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

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

2) Cancel the test operation mode.

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

3) Enable the disabled external input signals.

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

(2) Jog operation

Transmit the following communication commands:

(a) Setting of jog operation data

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

(b) Start

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

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

(3) Positioning operation

Transmit the following communication commands:

(a) Setting of positioning operation data

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

(b) Start

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

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

(c) Temporary stop

A temporary stop can be made during positioning operation.

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

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

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

14.12.9 Alarm history

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

(1) Alarm No. read

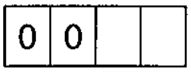
Read the alarm No. which occurred in the past.

(a) Transmission

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

(b) Reply

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



Alarm No. is transferred in decimal.

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

(2) Alarm occurrence time read

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

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

(a) Transmission

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

Refer to Section 8.11.1.

(b) Reply

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

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

(3) Reading the alarm name

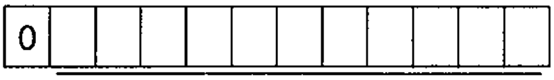
Read the name of the past alarm.

(a) Transmission

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

(b) Reply

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



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

14.12.10 Current alarm

(1) Current alarm No. read

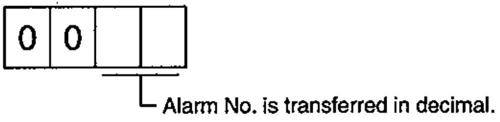
Read the alarm No. which is occurring currently.

(a) Transmission

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

(b) Reply

The slave station sends back the alarm currently occurring.



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

(2) Reading the concurrent alarm No.

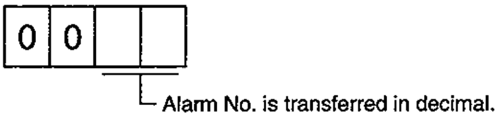
Read the concurrent alarm No.

(a) Transmission

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

(b) Reply

The slave station sends back the concurrent alarm.



(3) Reading the current alarm name

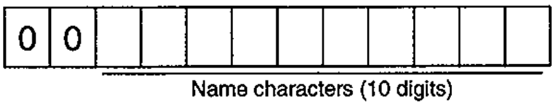
Read the name of the current alarm.

(a) Transmission

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

(b) Reply

The slave station sends back the current alarm.



(4) Reading the concurrent alarm name

Read the concurrent alarm name.

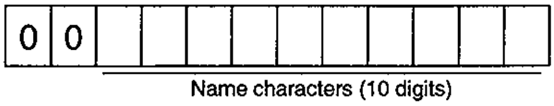
(a) Transmission

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

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

(b) Reply

The slave station sends back the concurrent alarm.



(5) Read of the status display at alarm occurrence

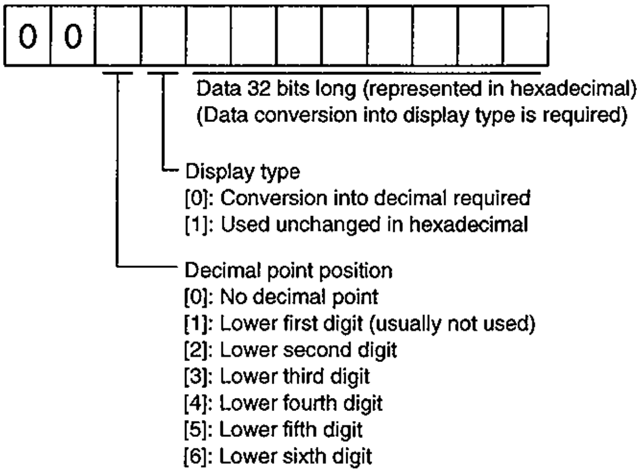
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

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

(b) Reply

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



(6) Current alarm clear

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

Transmission

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

(7) Analog output of data before alarm occurrence

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

Transmit the following communication command:

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

14.12.11 Selection between Japanese and English

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

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

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

15.1 Compliance With EC Directives

15.1.1 What are EC directives?

The EC Directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the Machinery Directive (effective in January, 1995), EMC Directive (effective in January, 1996) and Low Voltage Directive (effective in January, 1997) of the EC Directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies to machines and equipment into which servo amplifiers have been installed.

The servo amplifiers do not function independently but are designed for use with machines and equipment. Therefore, the CE marking does not apply to the servo amplifiers but applies to the machines and equipment into which the servo amplifiers are installed.

This servo amplifier conforms to the standards related to the Low Voltage Directive to facilitate CE marking on machines and equipment into which the servo amplifiers will be installed. To ensure ease of compliance with the EMC Directive, Mitsubishi Electric prepared the "EMC INSTALLATION GUIDELINES" (IB(NA)67310) which provides servo amplifier installation, control box making and other procedures. Please contact your sales representative.

15.1.2 For compliance

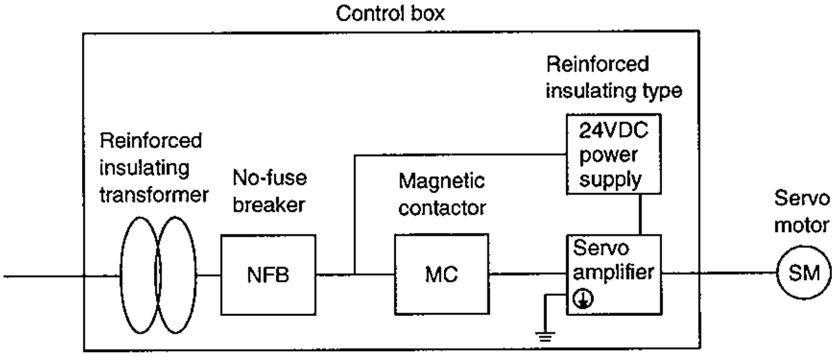
(1) Servo amplifiers and servo motors used

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

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

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

(2) Structure



(3) Environment

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

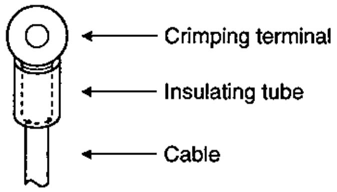
(4) Power supply

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

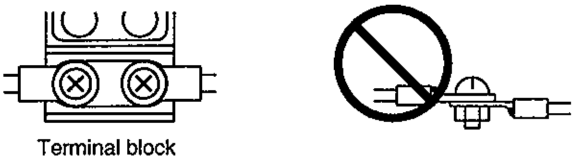
(b) When supplying interface power from external, use a 24VDC power supply which has been insulation-reinforced in I/O.

(5) Wiring

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



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



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

(6) Noise reduction techniques

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

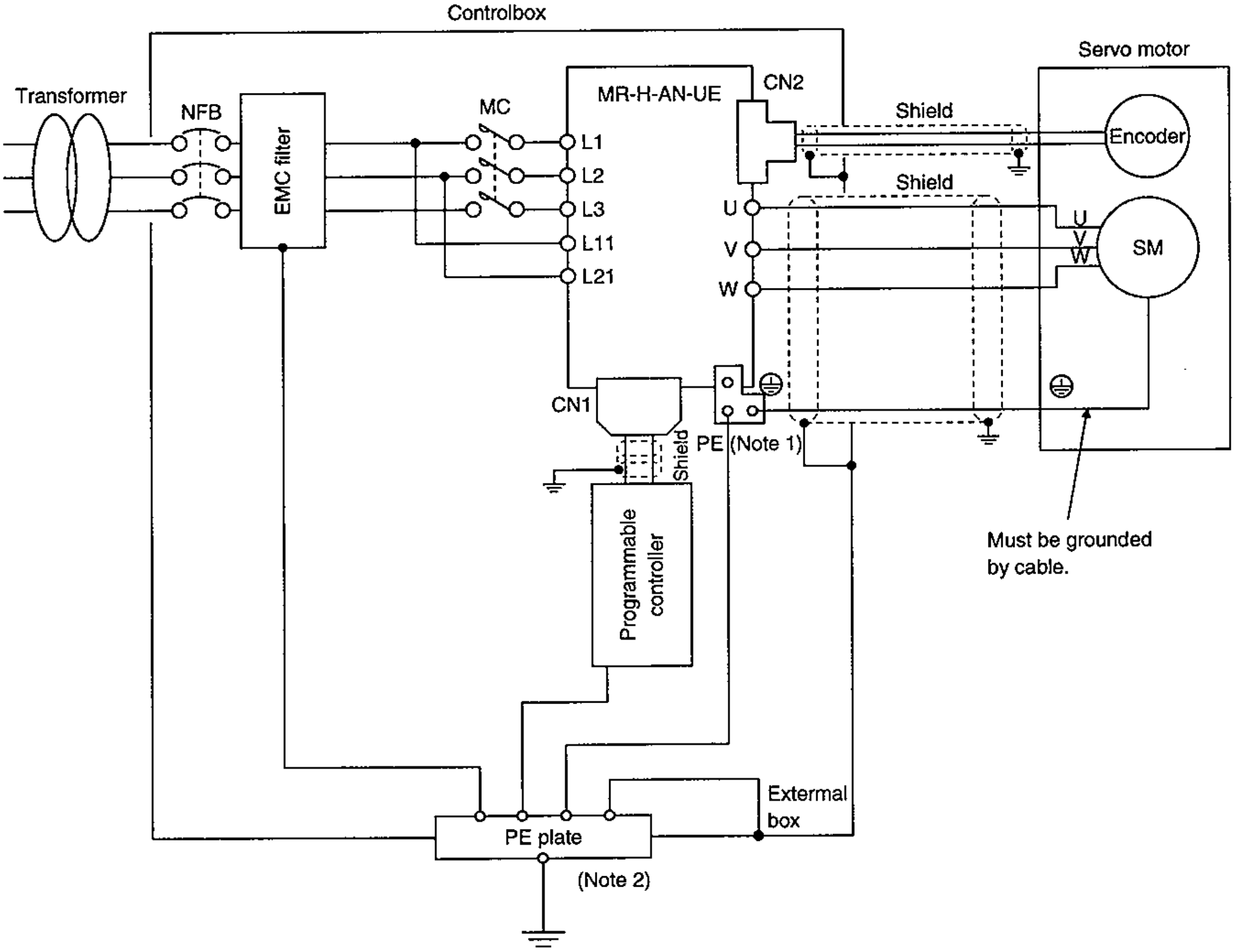
(7) Grounding

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

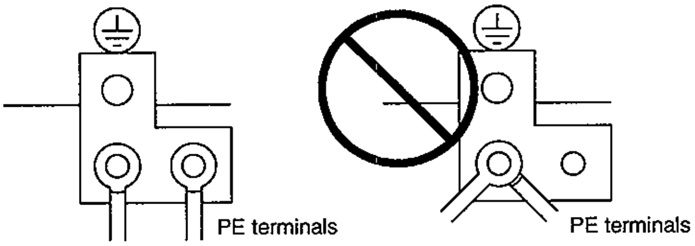
The servo amplifier switches the power transistor to supply power to the servo motor. Depending on the routing of the wiring and ground cables, the servo amplifier may be affected by the switching noises (due to di/dt and dv/dt) of the transistor.

To prevent such a fault, refer to the following diagram and use the thickest possible ground cables (3.5mm^2 or larger preferable), such as flat mesh copper cables, to securely ground the servo amplifier and servo motor.

Even when a leakage current breaker is used, always earth the protective earth (PE) terminal of the servo amplifier to prevent an electric shock.



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



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

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

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

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

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

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

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

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

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

(9) Performing EMC tests

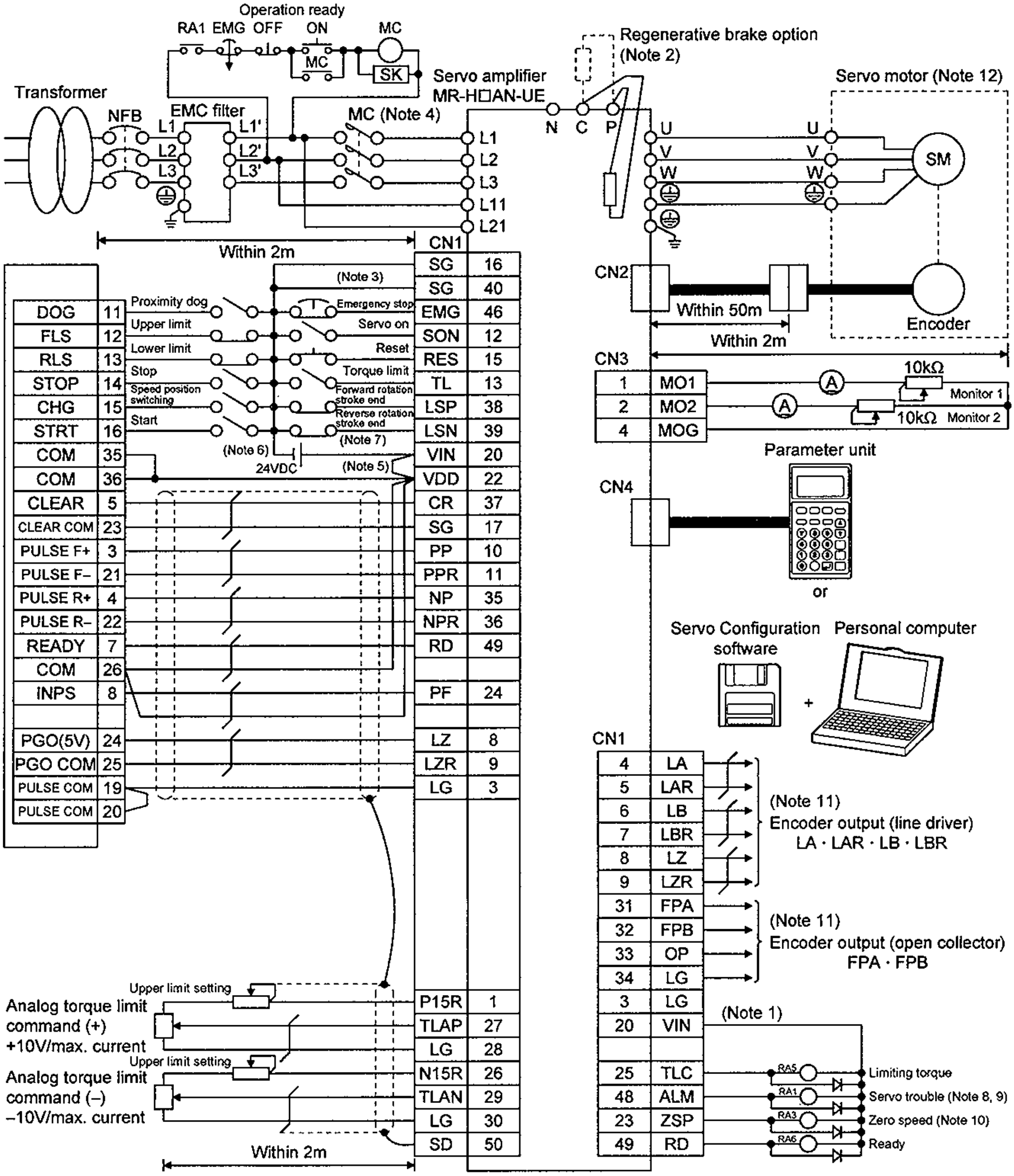
When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

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

15.1.3 Standard connection examples

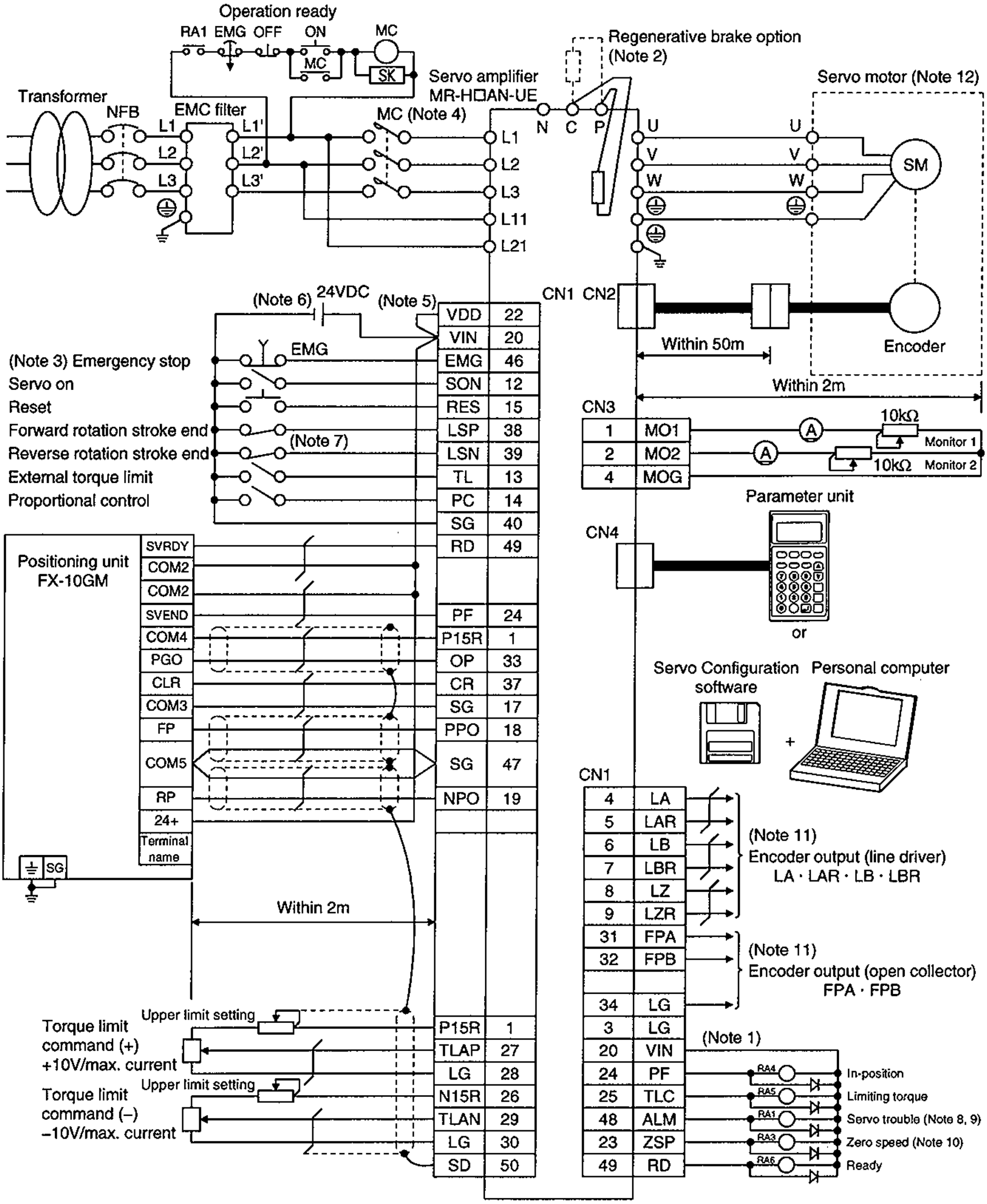
(1) Position control mode

(a) AD75 (A1SD75)



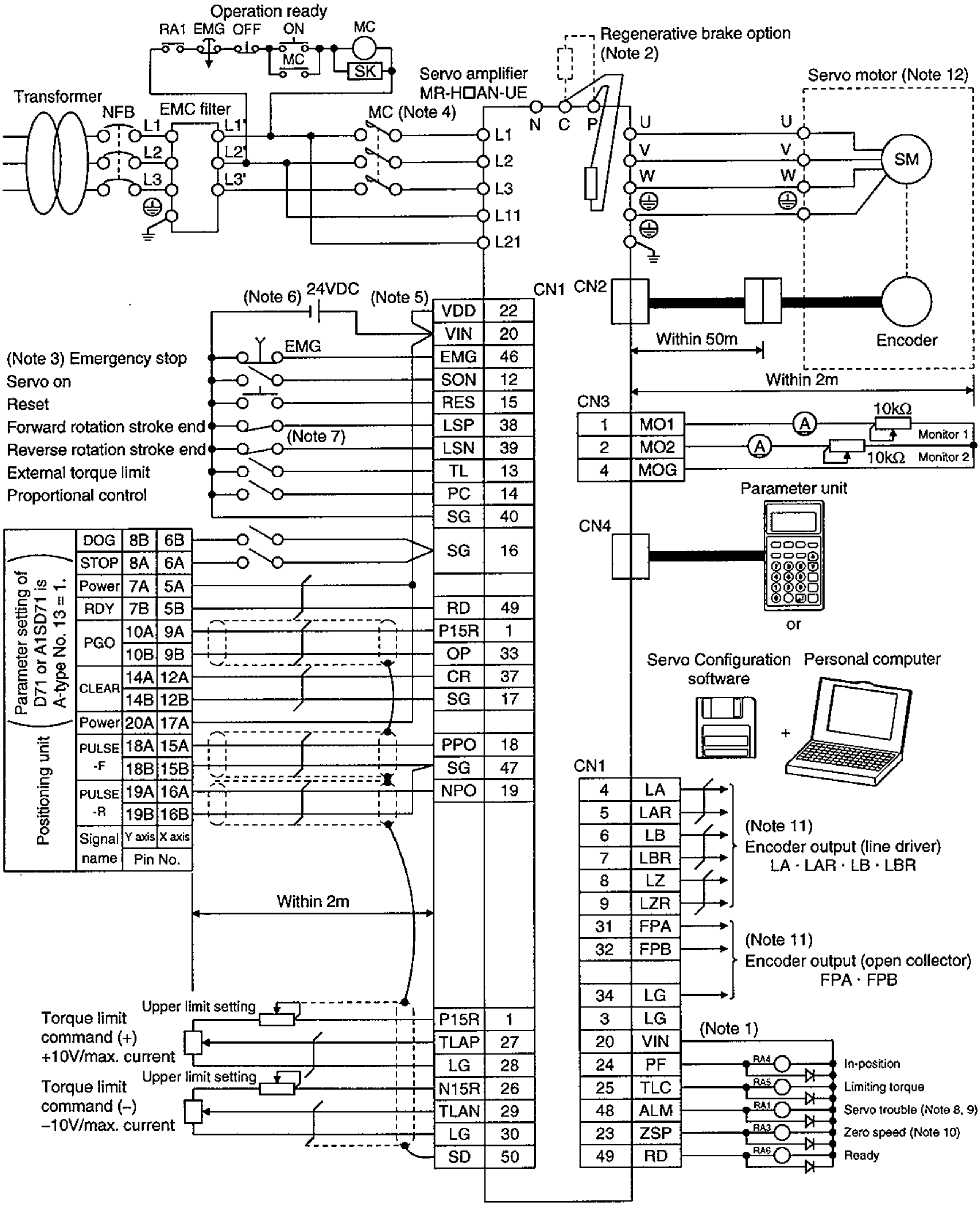
For the notes, refer to page 15-8.

(b) FX-10GM



For the notes, refer to page 15-8.

(c) AD71 (A1SD71)



For the notes, refer to page 15-8.

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

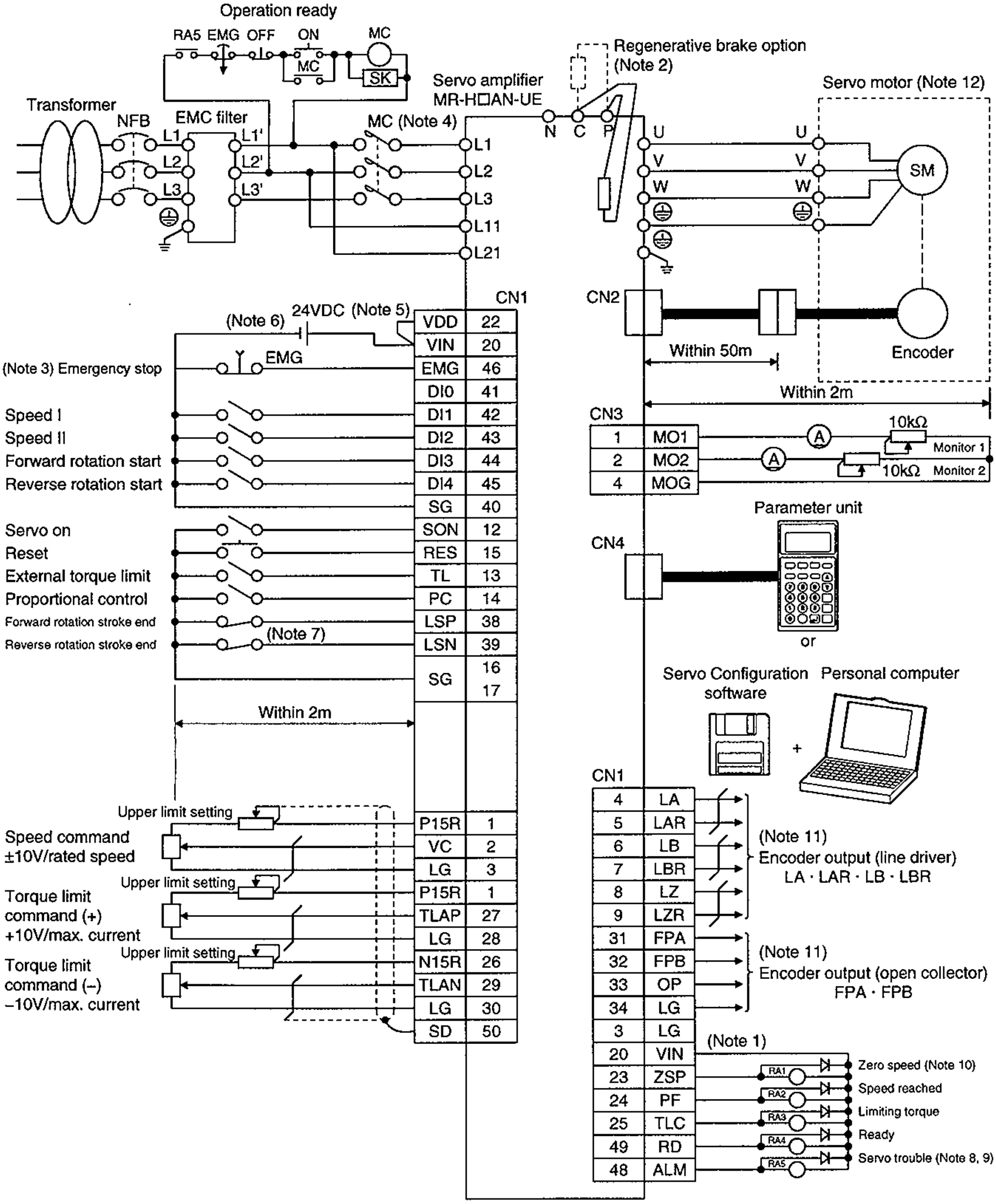
2. Connect the regenerative brake option across terminals P-C after removing the lead of the built-in regenerative brake resistor from P-C.
3. The emergency stop switch must be installed.
4. Configure up the power circuit which switches off the magnetic contactor after detection of an alarm.
5. The MR-H□AN-UE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

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

    (b) Output pulse setting
    Output pulses = (1 to 32768)/4 [pulse/rev]

12. Connection for the HC-MF-UE series. For connection of the other motor, refer to Section 3.8.

(2) Speed control mode



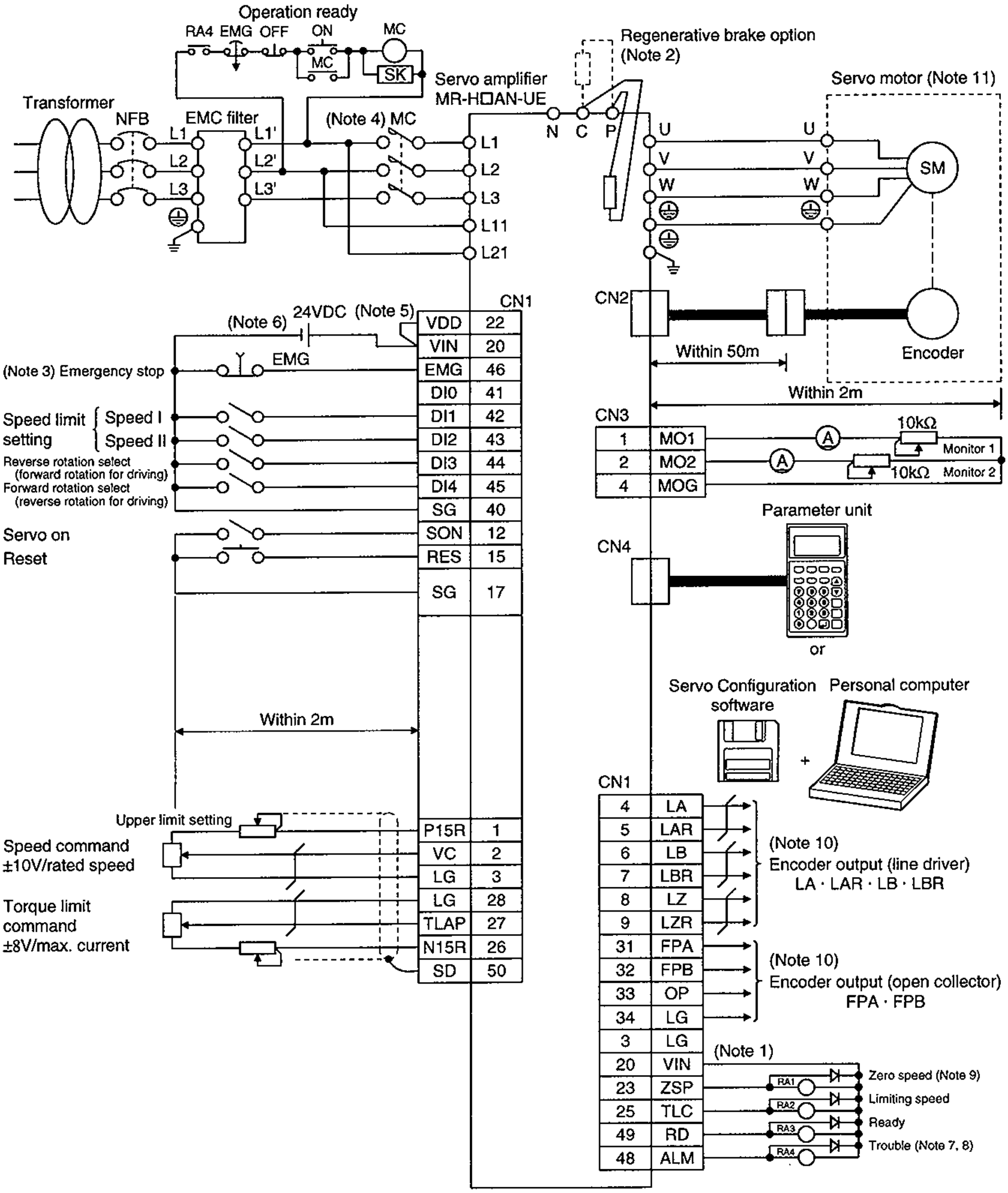
For the notes, refer to the next page.

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

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

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

(3) Standard connection example in torque control operation mode



For the notes, refer to the next page.

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

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

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

15.2 Conformance With UL/C-UL Standard

15.2.1 Servo amplifier and servo motor used

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

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

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

15.2.2 Installation

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

15.2.3 Power supply capacity

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

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

15.2.4 Wires

Always use the wires specified in this section.

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

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

15.2.5 Crimping terminals and crimping tools

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

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

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

Note: AMP make

15.2.6 Fuses

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

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

15.2.7 Terminal block tightening torque

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

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

15.2.8 Standard connection example

Same as in Section 15.1.3.

15.3 Signals

15.3.1 Main circuit terminal block

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

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

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

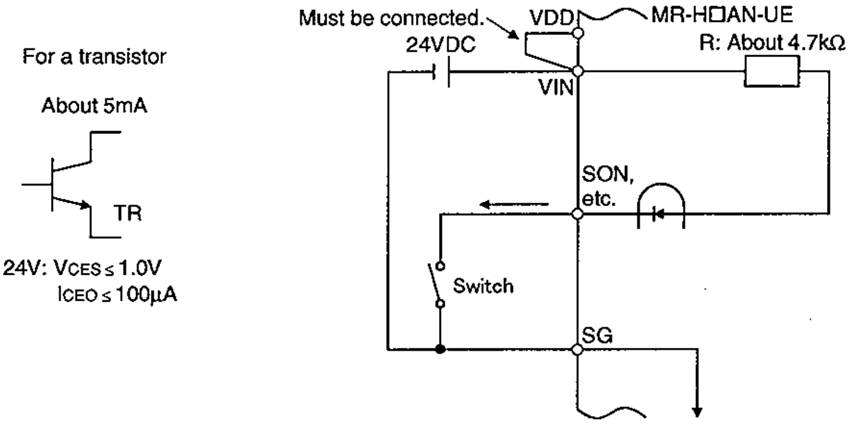
Symbol	Signal	Description
L1, L2, L3	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to L1, L2, L3. For MR-H700□AN-UE or more, the voltage of 50Hz power is 200 to 220V.
U, V, W	Servo motor output	Servo motor power output terminals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

15.3.2 Interfaces

(1) Digital input interface DI-1

Always use an external power supply.

Provide a signal using a relay or open collector transistor.

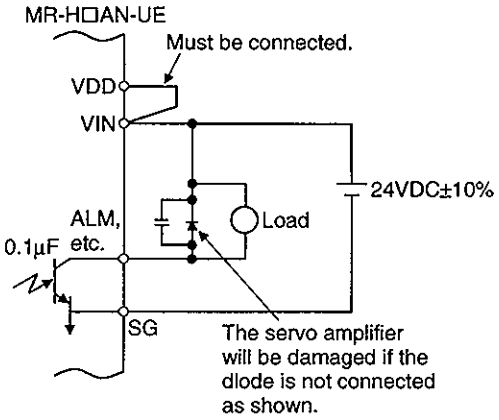


(2) Digital output interface DO-1

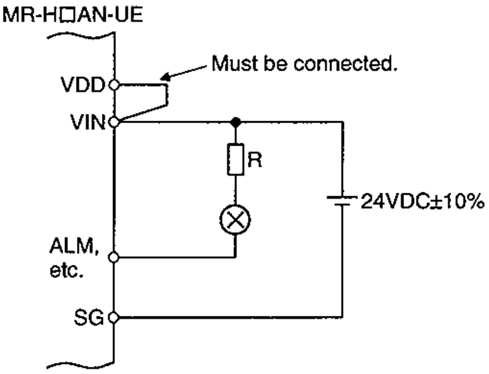
Always use an external power supply.

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

- Inductive load



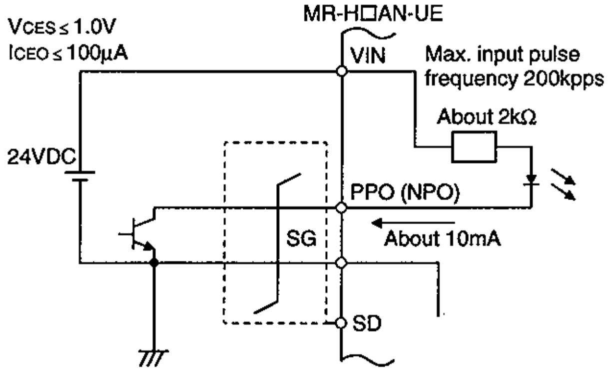
- Lamp load



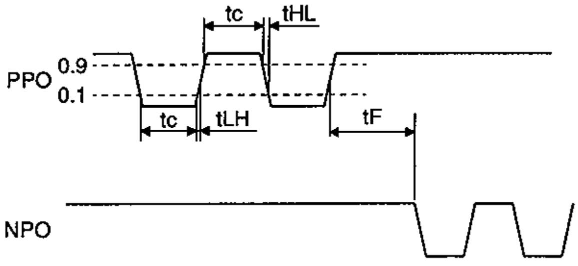
(3) Pulse train input interface DI-2

(a) Open collector system

· Interface example



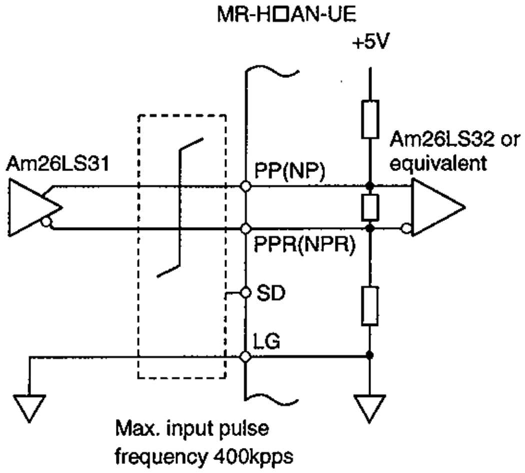
· Input pulse conditions



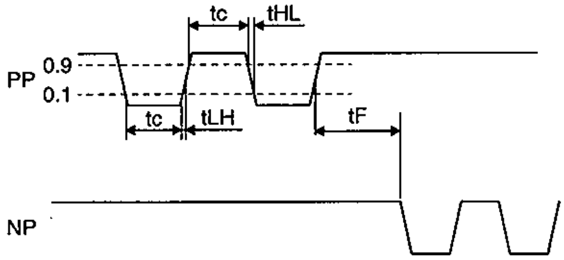
tLH = tHL < 0.2μs
tc > 2μs
tF < 3μs

(b) Differential line driver system

· Interface example



· Input pulse conditions



tLH = tHL < 0.1μs
tc > 1μs
tF < 3μs

REVISIONS

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

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

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