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:

<table>
<tr><th colspan="3" rowspan="2">Environment</th><th colspan="3">Conditions</th></tr>
<tr><th>Servo amplifier</th><th colspan="2">Servo Motor</th></tr>
<tr><td rowspan="2">Ambient temperature</td><td>[°C]</td><td>0 to +55 (non-freezing)</td><td colspan="2">0 to +40 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>32 to 131 (non-freezing)</td><td colspan="2">32 to 104 (non-freezing)</td></tr>
<tr><td colspan="2">Ambient humidity</td><td>90%RH or less (non-condensing)</td><td colspan="2">80%RH or less (non-condensing)</td></tr>
<tr><td rowspan="2">Storage temperature</td><td>[°C]</td><td>–20 to +65 (non-freezing)</td><td colspan="2">–15 to +70 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>–4 to 149 (non-freezing)</td><td colspan="2">5 to 158 (non-freezing)</td></tr>
<tr><td colspan="2">Storage humidity</td><td colspan="3">90%RH or less (non-condensing)</td></tr>
<tr><td colspan="2">Ambience</td><td colspan="3">Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="3">Max. 1000m (3280 ft) above sea level</td></tr>
<tr><td rowspan="8">Vibration</td><td rowspan="4">[m/s^2]</td><td rowspan="4">5.9 {0.6G} or less</td><td>HC-MF Series
HA-FF Series
HC-UF 13 to 73</td><td>X · Y : 19.6 {2G}</td></tr>
<tr><td>HC-SF81
HC-SF52 to 152
HC-SF53 to 153
HC-UF 72 · 152</td><td>X : 9.8 {1G}
Y : 24.5 {2.5G}</td></tr>
<tr><td>HC-SF121 · 201
HC-SF202 · 352
HC-SF203 · 353
HC-UF202</td><td>X : 19.6 {2G}
Y : 49 {5G}</td></tr>
<tr><td>HC-SF301</td><td>X : 11.7 {1.2G}
Y : 29.4 {3G}</td></tr>
<tr><td rowspan="4">[ft/s^2]</td><td rowspan="4">19.4 or less</td><td>HC-MF Series
HA-FF Series
HC-UF 13 to 73</td><td>X · Y : 64</td></tr>
<tr><td>HC-SF81
HC-SF52 to 152
HC-SF53 to 153
HC-UF 72 · 152</td><td>X : 32
Y : 80</td></tr>
<tr><td>HC-SF121 · 201
HC-SF202 · 352
HC-SF203 · 353
HC-UF202</td><td>X : 64
Y : 161</td></tr>
<tr><td>HC-SF301</td><td>X : 38
Y : 96</td></tr>
</table>

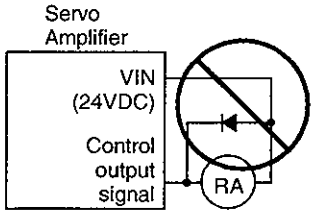
⚠ CAUTION

- 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

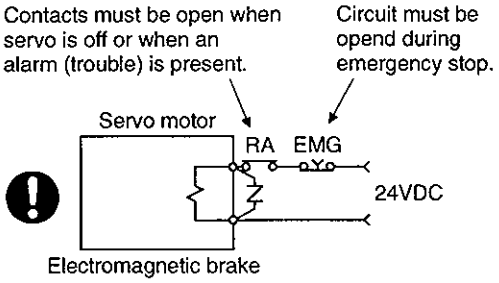
⚠ CAUTION

- 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.

CONTENTS

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.

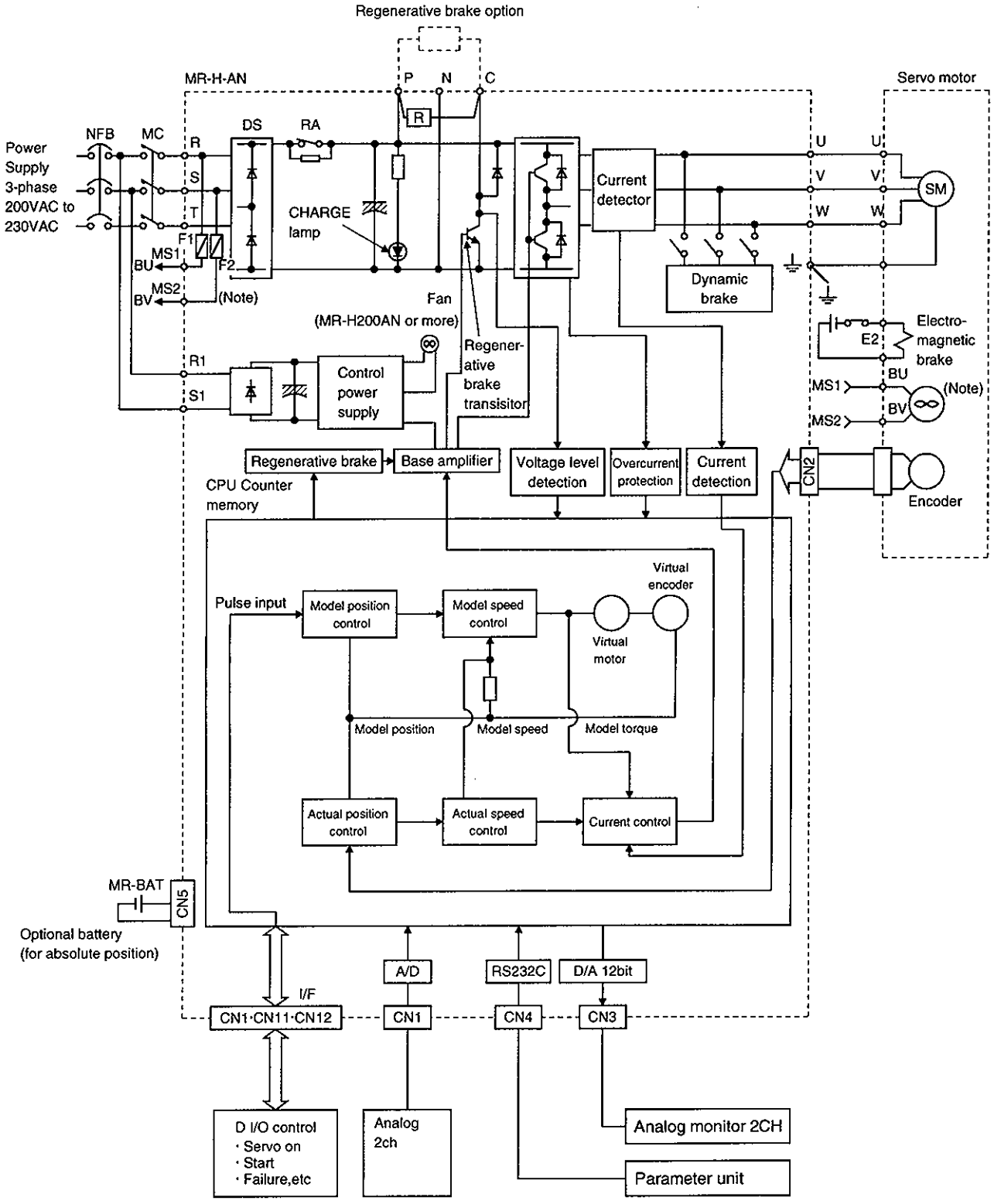
(3) Torque control mode

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

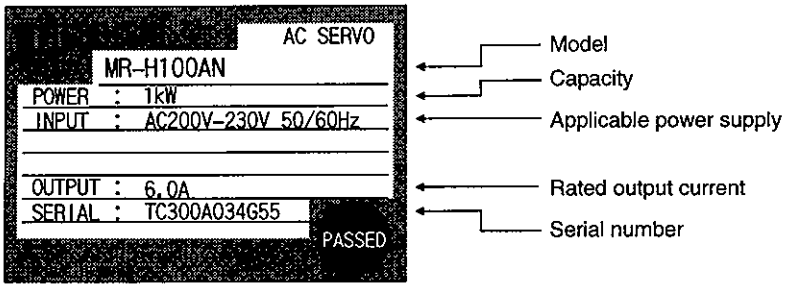
The function block diagram of the MELSERVO-H-AN is shown on the next page.



Note: For 11kW or more

1.3 Model Code Definition

1.3.1 Rating plate



1.3.2 Model code

M R - 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

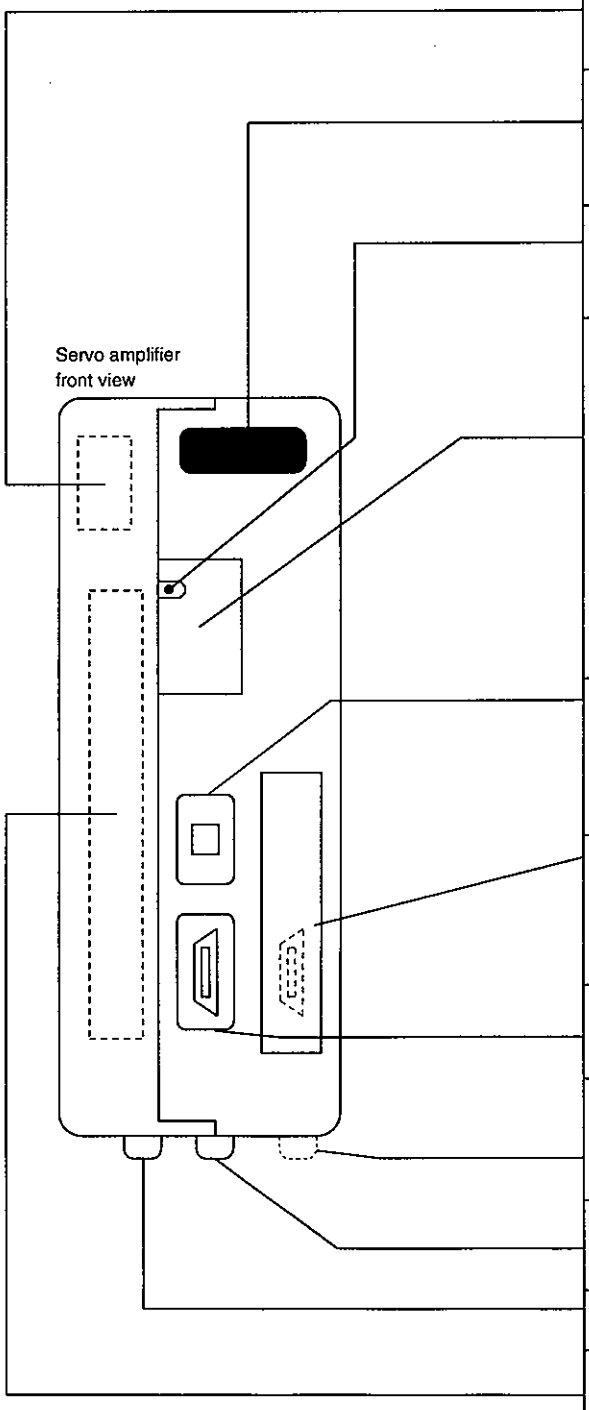
The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the models with electromagnetic brakes, the models with reduction gears, the EN Standard-compliant models and the UL/C-UL Standard-compliant models.
Consult us when using a servo motor which is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

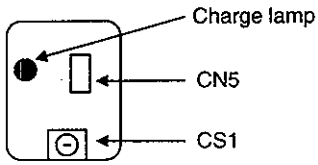
Servo Amplifier	Servo Motor								
	HC-MF□	HA-FF□	HC-SF□			HC-RF□	(Note) HC-UF□		HA-LH□
			1000r/min	2000r/min	3000r/min		2000r/min	3000r/min	
MR-H10AN		053・13						13	
MR-H20AN	053・13	23							
MR-H40AN	23	33・43						23	
MR-H60AN	43	63		52	53			43	52
MR-H100AN	73		81	102	103		72	73	
MR-H200AN			121・201	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.

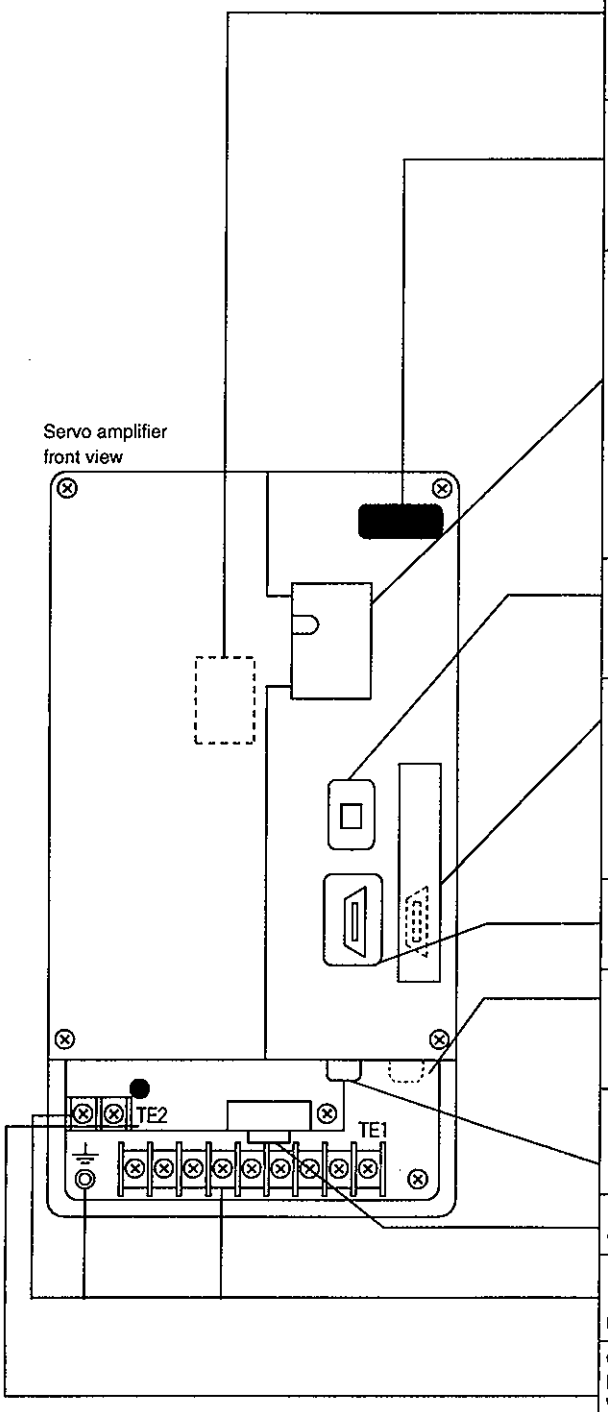
1.5 Parts Identification

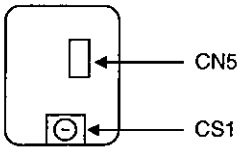
1.5.1 MR-H350AN or less



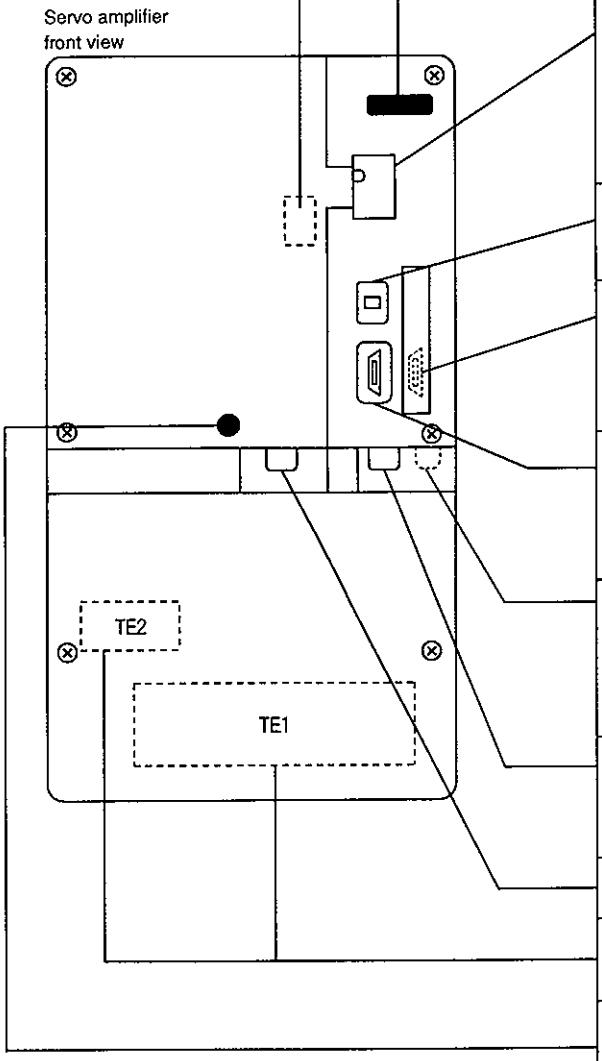
Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 7.3 Section 7.5
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do 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

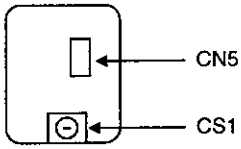
1.5.2 MR-H500AN and MR-H700AN



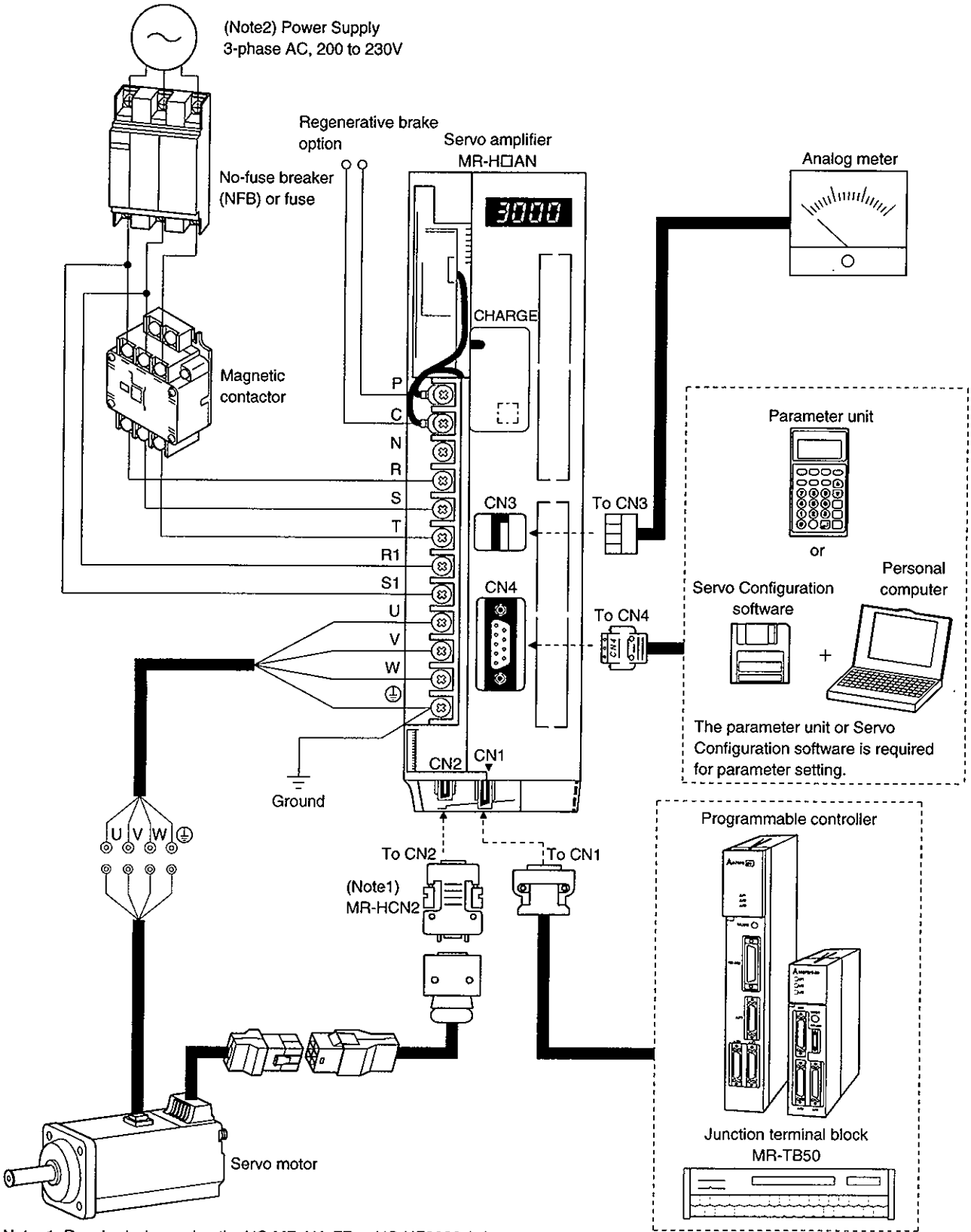
Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 7.3 Section 7.5
Switch window · CN5 : Connector for connection of the battery for absolute position detection · 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

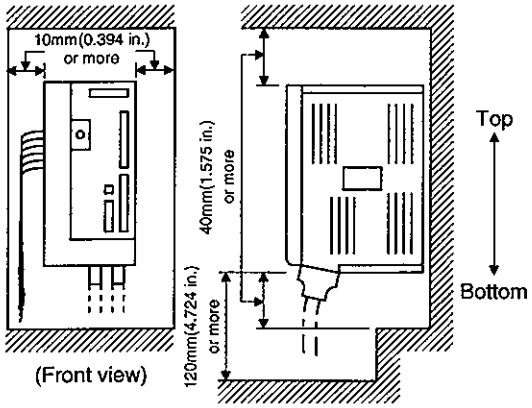
Environment	Conditions
Ambient temperature	0 to +55 [°C] (non-freezing)
	32 to +131 [°F] (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
storage temperature	−20 to +65 [°C] (non-freezing)
	−4 to +149 [°F] (non-freezing)
storage humidity	90%RH or less (non-condensing)
Ambient	Indoors (no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



(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.

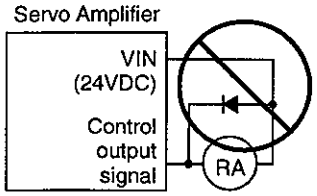
3. SIGNALS AND WIRING

⚠ 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.

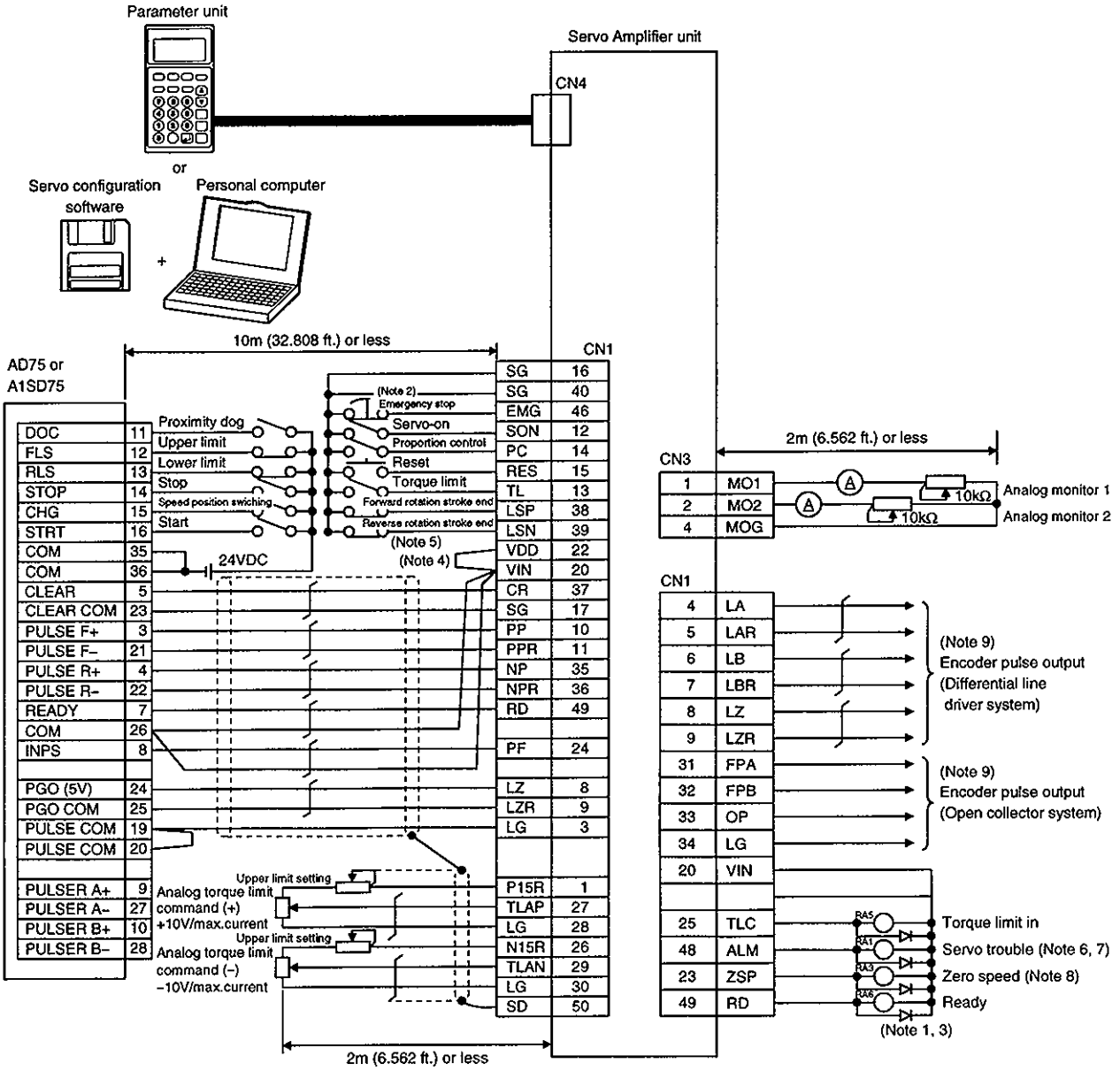
3.1 Connection Example

POINT

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

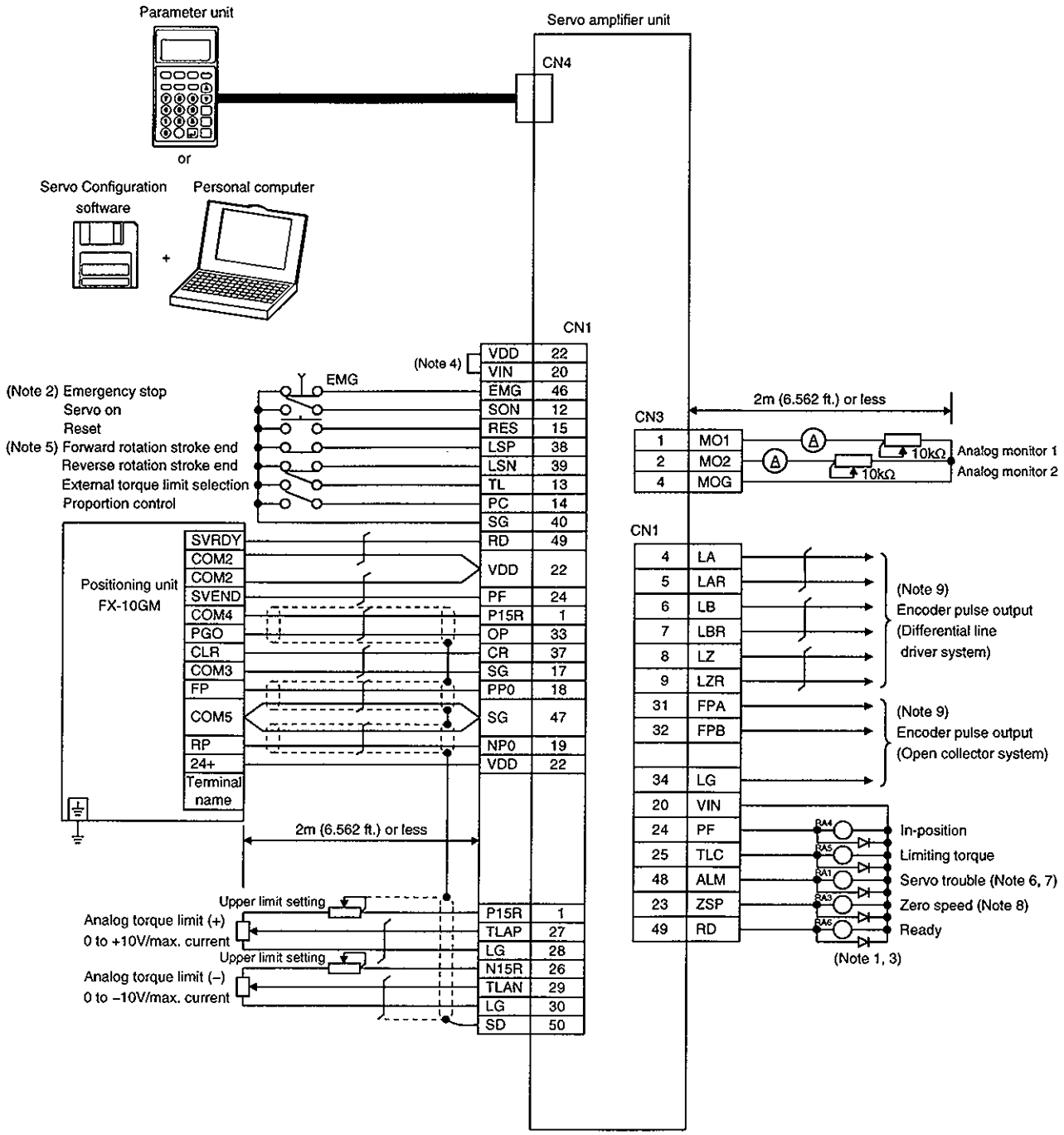
3.1.1 Position control mode

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



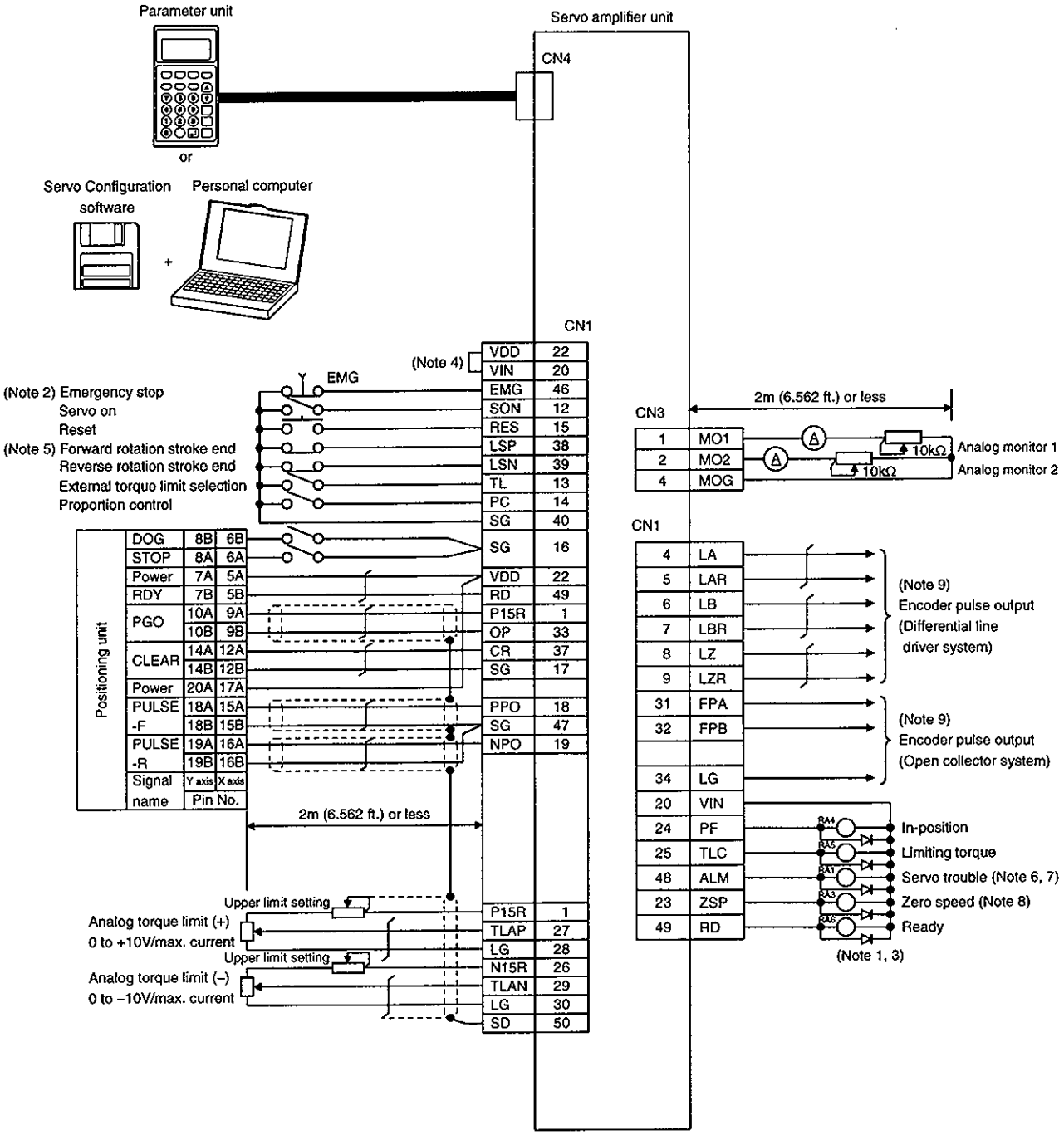
For notes, refer to page 3-5.

(2) Connection with FX-1GM



For notes, refer to page 3-5.

(3) Connection with AD71 (A1SD71)



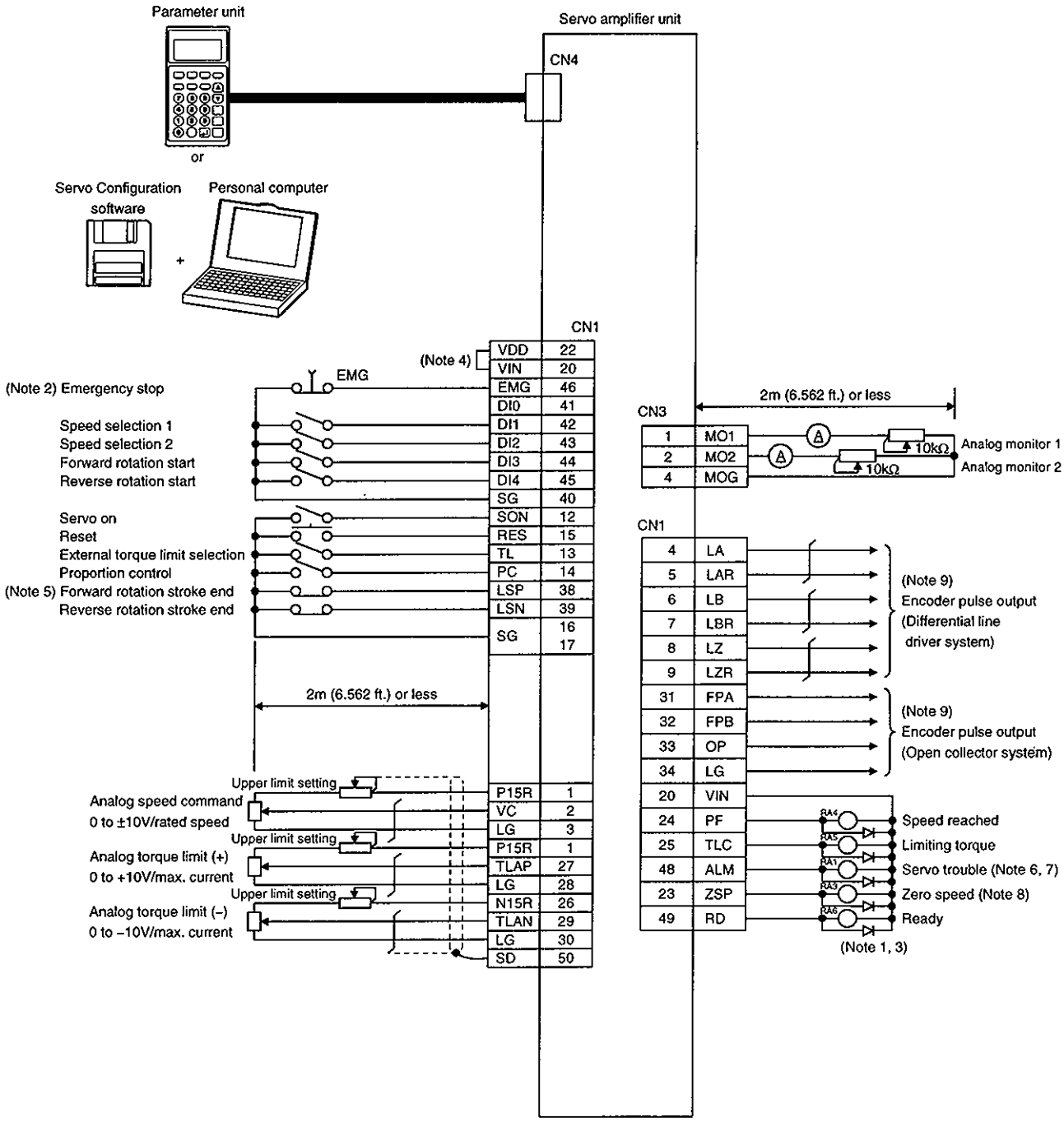
For notes, refer to page 3-5.

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



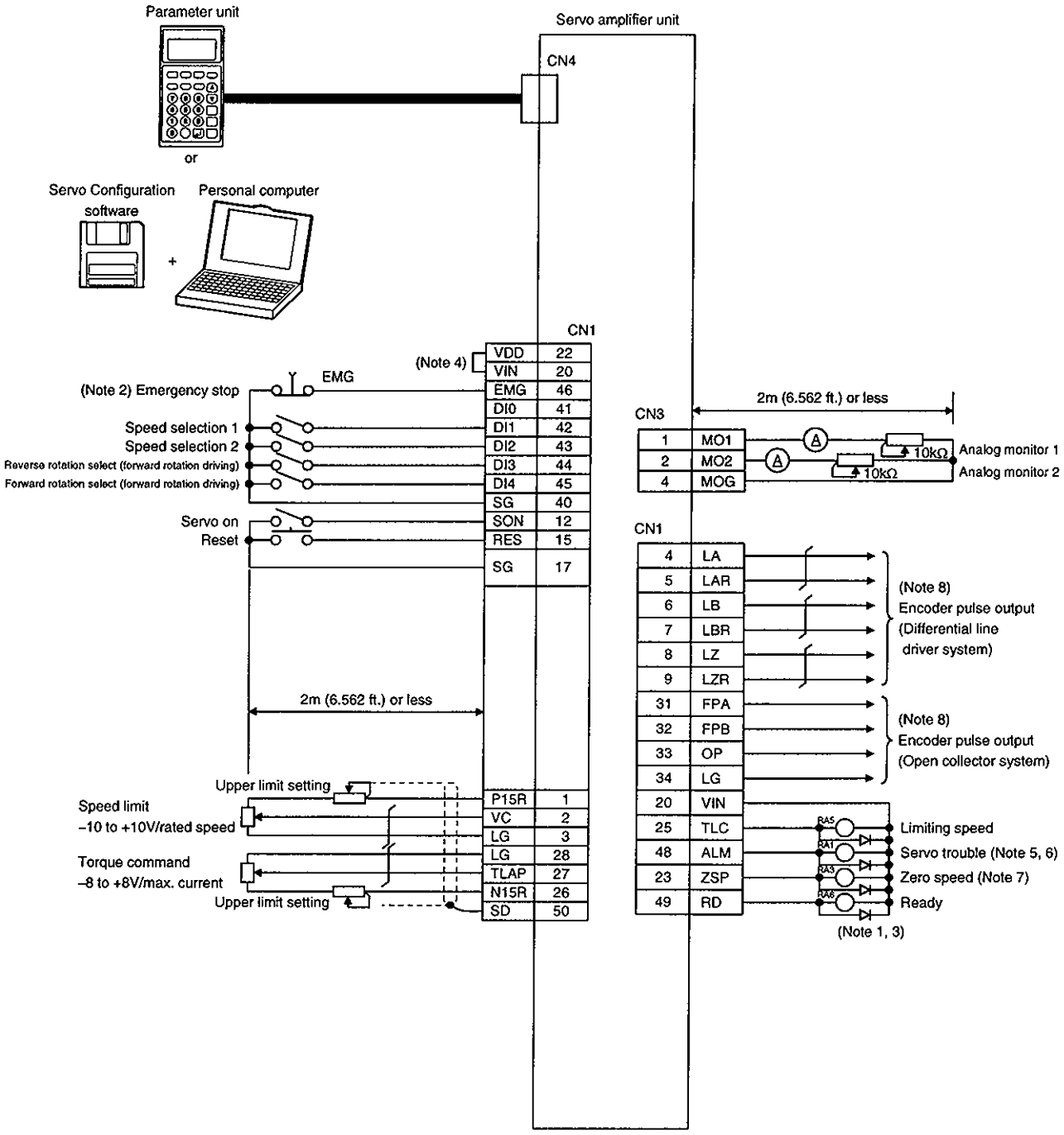
For notes, refer to page 3-7.

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



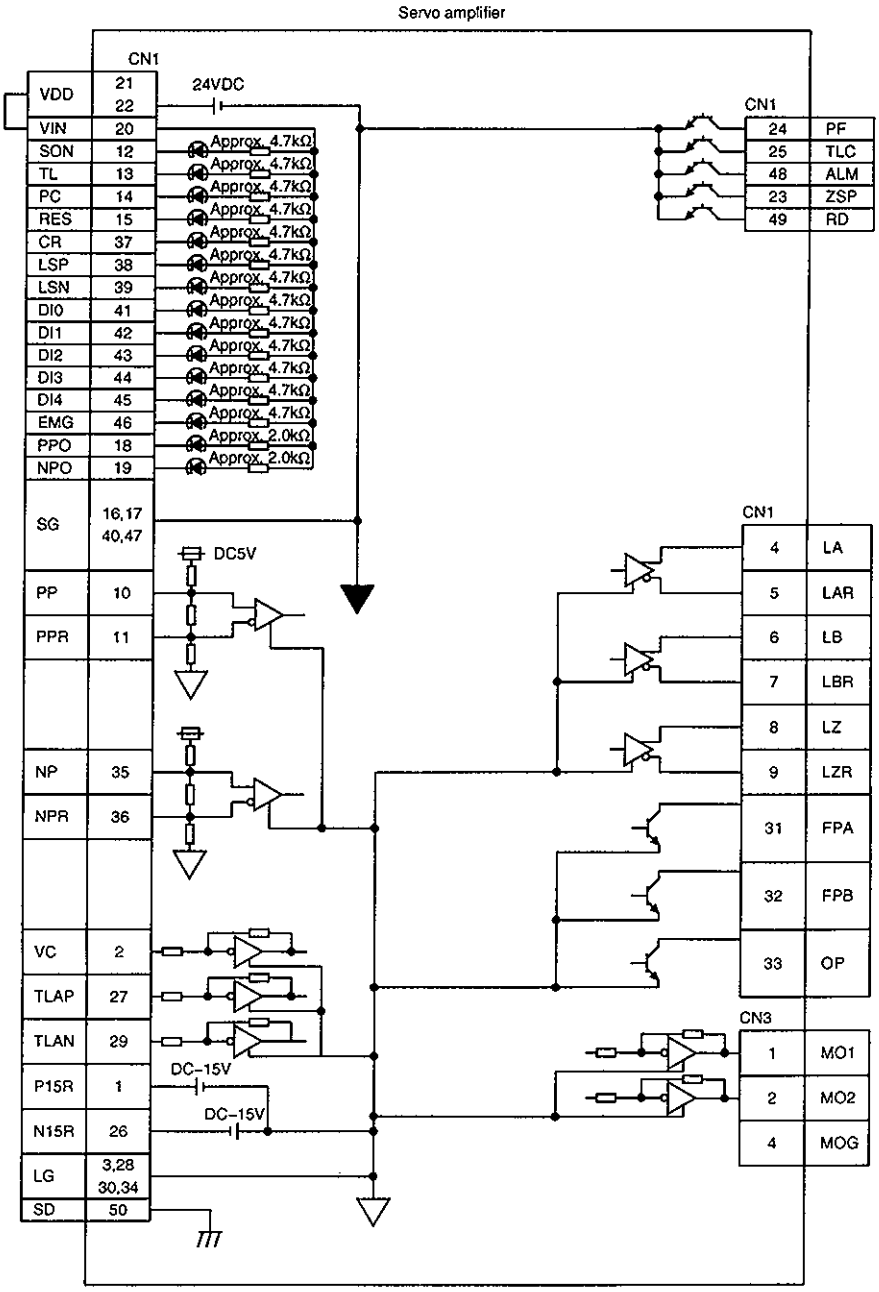
For notes, refer to page 3-9.

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

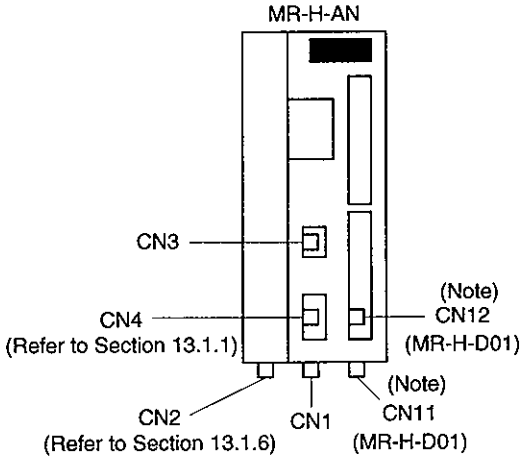


3.3 I/O Signals

3.3.1 Connectors and signal layouts

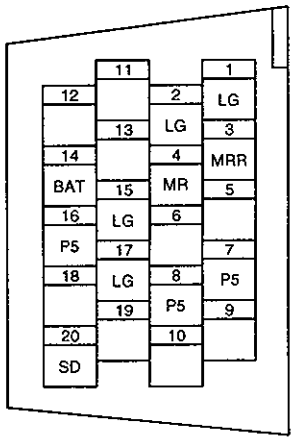
POINT

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

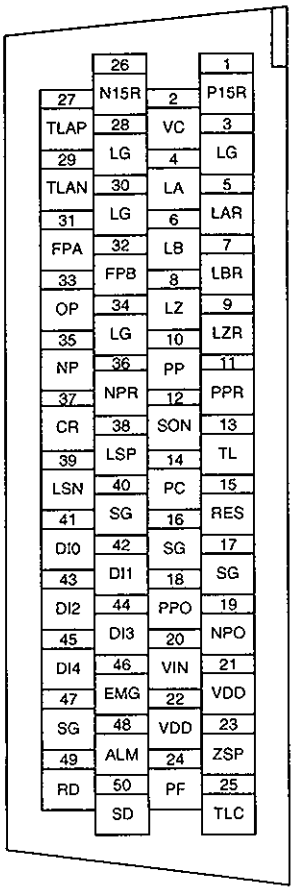


Note: Used when the MR-H-D01 option card is loaded.

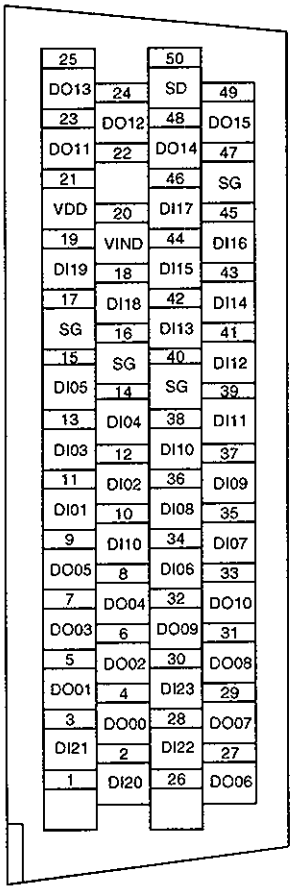
CN2 (for encoder signals)
Model PCR-S20FS (Honda Tsushin make)



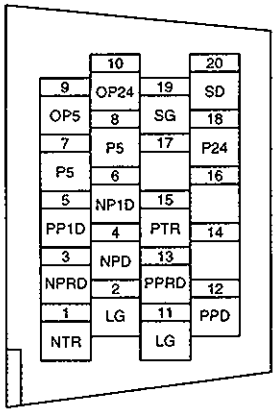
CN1 (for I/O signals)
Model PCR-S50FS (Honda Tsushin make)



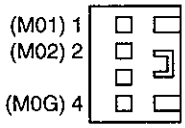
CN11 (for MR-H-D01 I/O signals)
Model PCR-S50FS (Honda Tsushin make)



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>O</td><td>O</td></tr><tr><td>0</td><td>1</td><td></td><td>O</td></tr><tr><td>1</td><td>0</td><td>O</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>ALM</td><td>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></td><td></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>Forward rotation pulse train
Reverse rotation pulse train</td><td>PP0
NP0
PP
PPR
NP
NPR</td><td>18
19
10
11
35
36</td><td>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>DI-2</td><td>P</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>Encoder pulse output
(open collector system)</td><td>FPA</td><td>31</td><td>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>DO-2</td><td>P
S
T</td></tr>
<tr><td></td><td>FPB</td><td>32</td><td></td><td></td><td></td></tr>
<tr><td></td><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><td></td><td></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	5	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
	NP1D	6			
Auxiliary pulse train (differential line driver system)	PPD	12	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
	PPRD	13			
	NPD	4			
	NPRD	3			
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

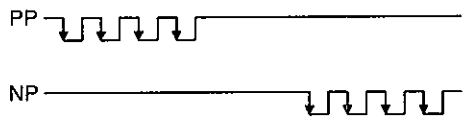
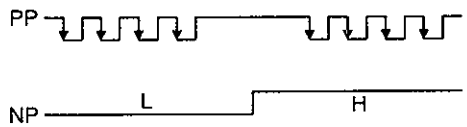
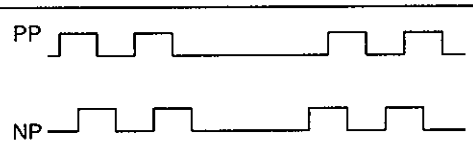
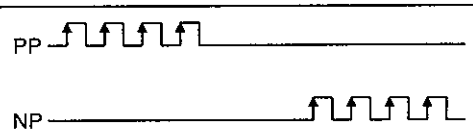
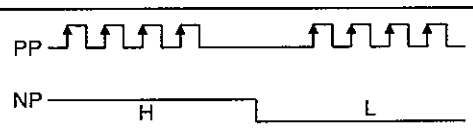
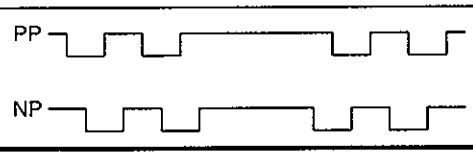
3.4.1 Position control mode

(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.

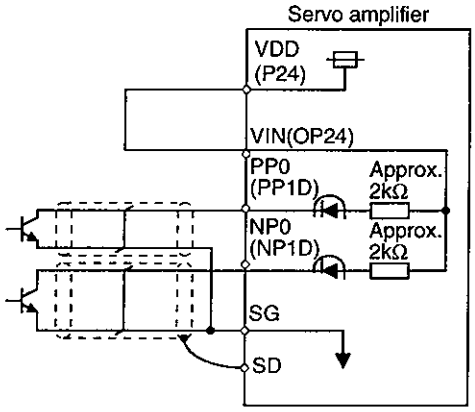
A- and B-phase pulse trains are imported after they have been multiplied by 4.

Pulse Train Form		Forward Rotation / Reverse Rotation	Parameter No. 21 (Command pulse train)	Parameter No. 72 (Auxiliary pulse train)
Negative logic	Forward rotation pulse train Reverse rotation pulse train		010□	010□
	Pulse train + sign		011□	011□
	A-phase pulse train B-phase pulse train		012□	012□
Positive logic	Forward rotation pulse train Reverse rotation pulse train		000□	000□
	Pulse train + sign		001□	001□
	A-phase pulse train B-phase pulse train		002□	002□

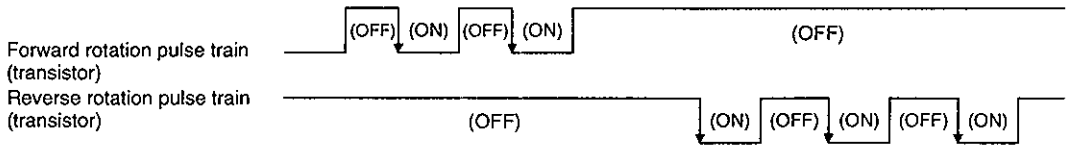
(b) Connections and waveforms

1) Open collector system

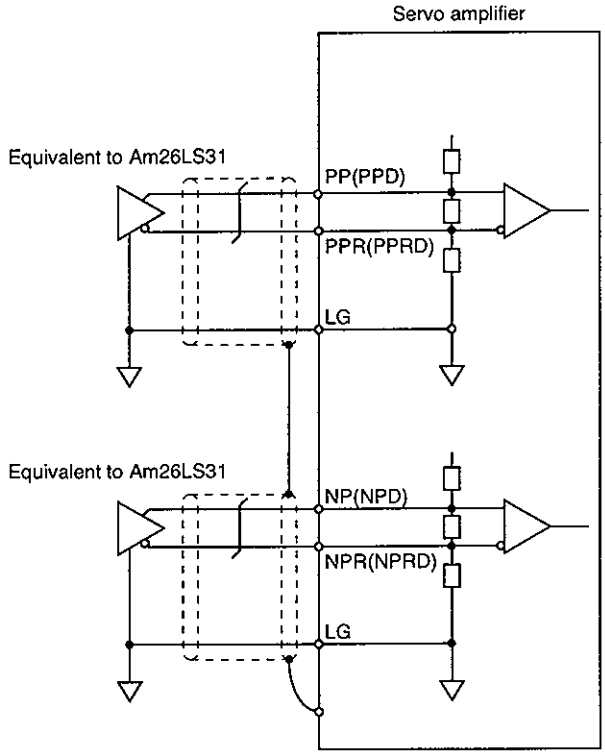
Make the following connections.



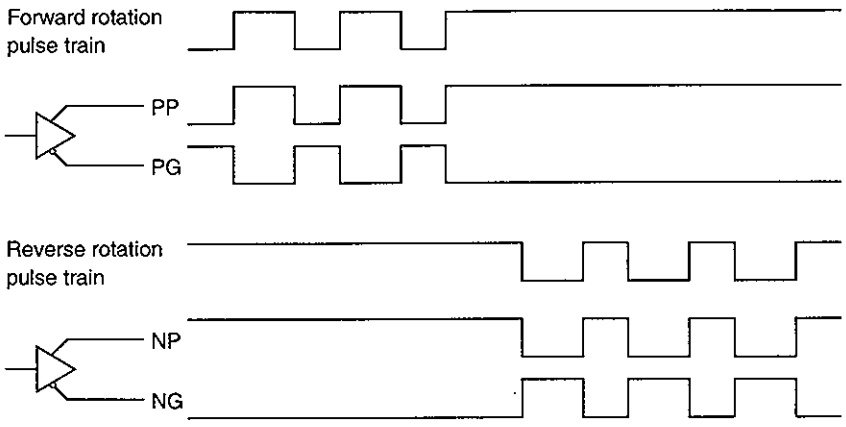
This explanation assumes that the input waveform is set to negative logic/forward rotation pulse train/reverse rotation pulse train (0010 is set in parameter No. 21). The waveforms in the table of this section (a) are voltage waveforms of PP and NP in relation to SG. Their relationships with transistor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



2) Differential line driver system
Make the following connections.



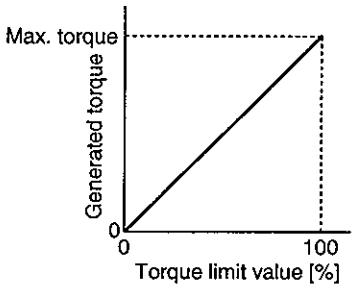
This explanation assumes that the input waveform is set to negative logic/forward rotation pulse train/reverse rotation pulse train (0010 is set in parameter No. 21). In the differential line driver system, the waveforms in the table of this section (1) are as shown below. The waveforms of PP, PG, N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



(2) Torque limit

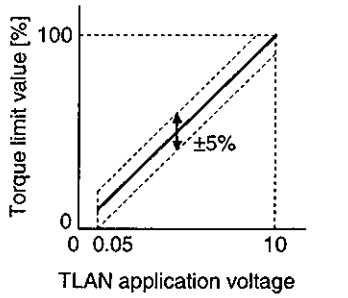
(a) Torque limit and generated torque

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.

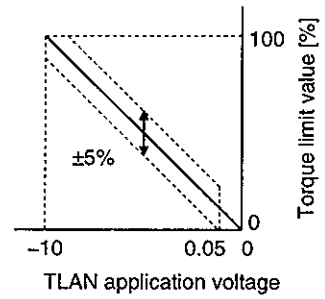


A relationship between the applied voltage of the torque limit command (TLAN/TLAP) and the torque limit value of the servo motor is shown below. Generated torque limit values will vary about 5% relative to the voltage depending on products.

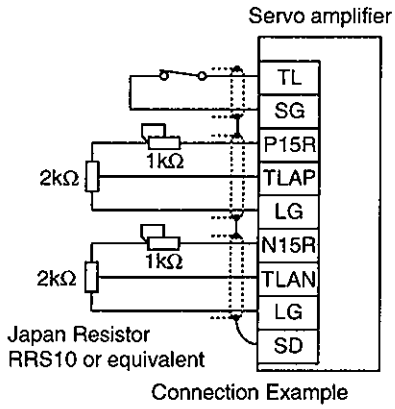
At the voltage of less than 0.05V, generated torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



TLAP application voltage vs. torque limit value in CCW direction



TLAP application voltage vs. torque limit value in CW direction

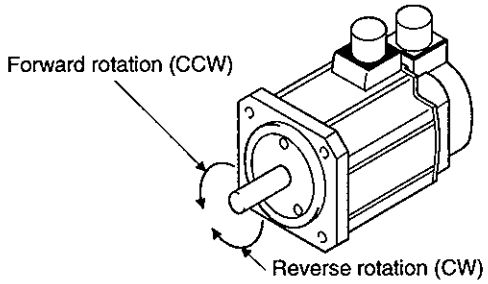


Connection Example

(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)

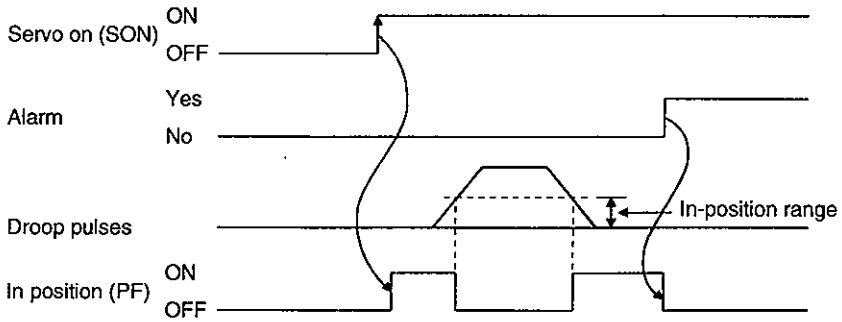
Note. 0: TL-SG off (open)
1: TL-SG on (short)

(d) Limiting torque (TLC)

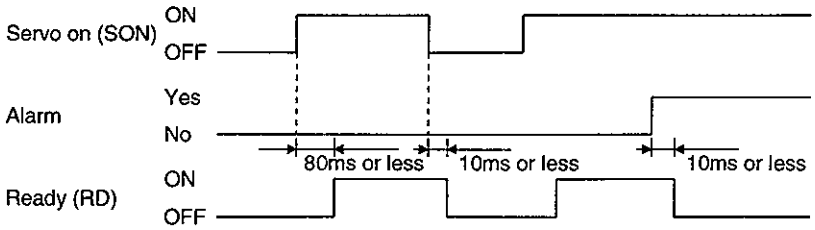
TLC-SG are connected when the torque generated by the servo motor reaches the torque set to internal torque limit value 1·2 or torque limit command.

(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)

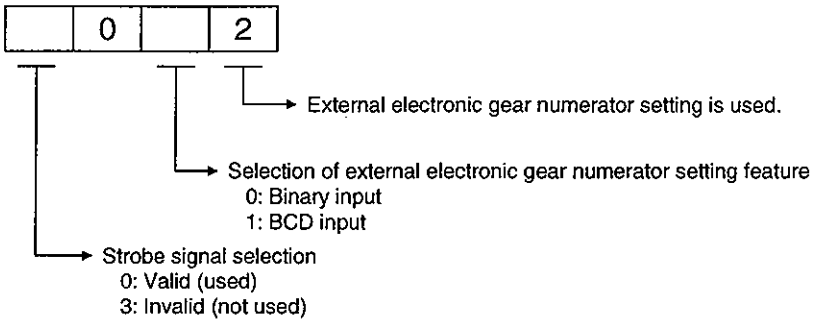


(5) External electronic gear setting

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

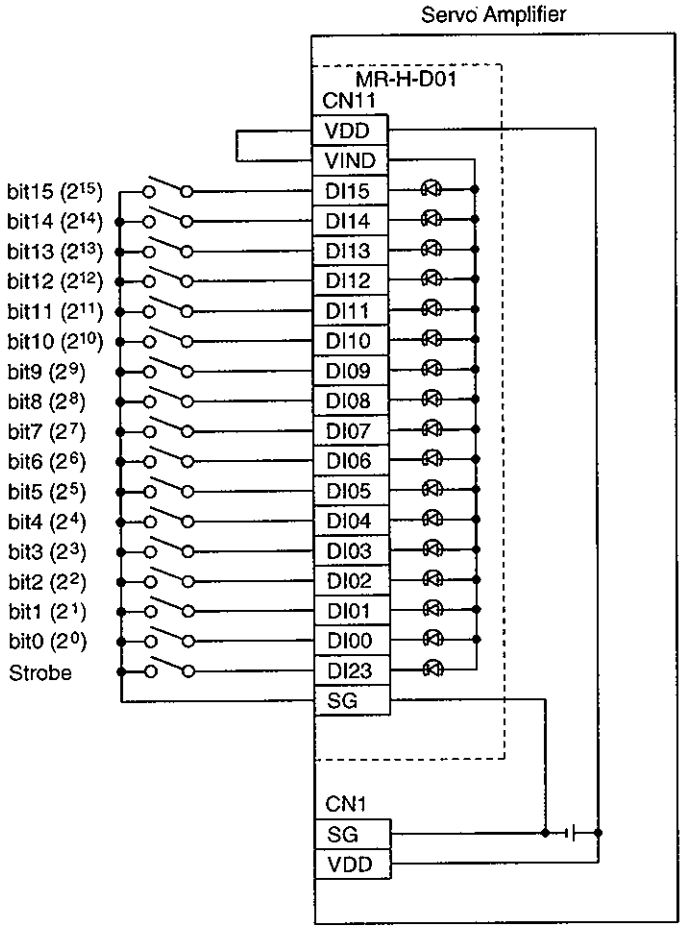
Parameter No. 70



(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.

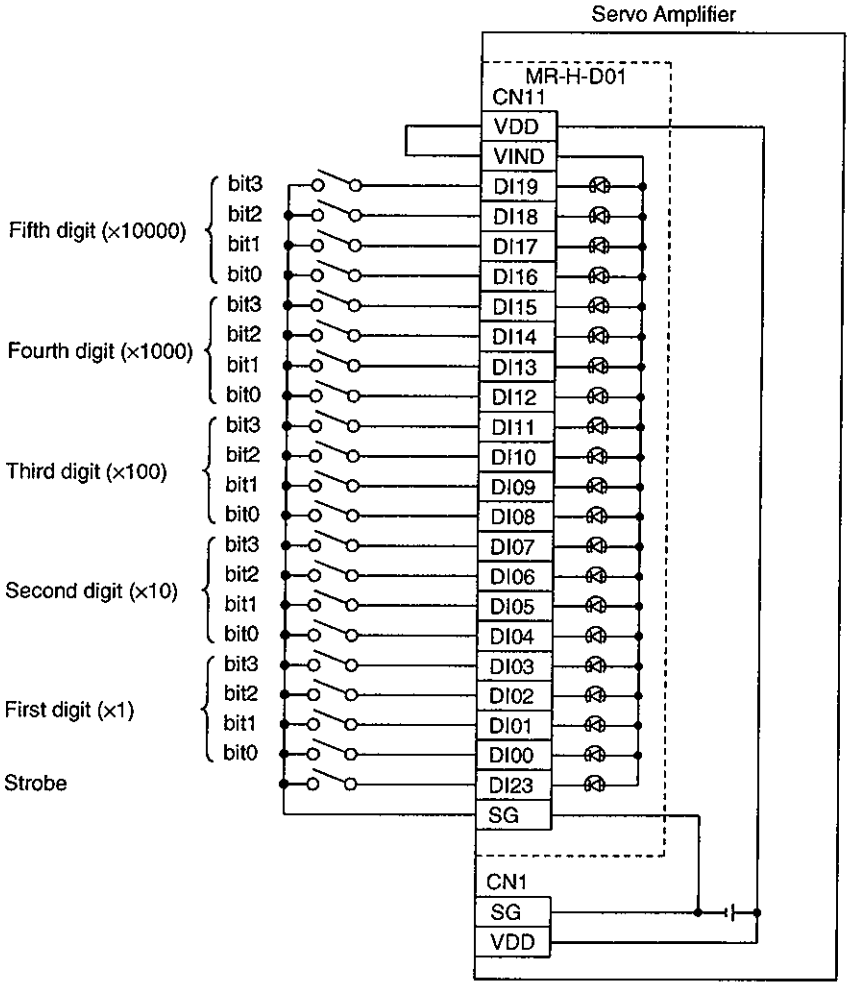
Turning any terminal-SG on is indicated by "1" and off by "0".



(c) 5-digit BCD input

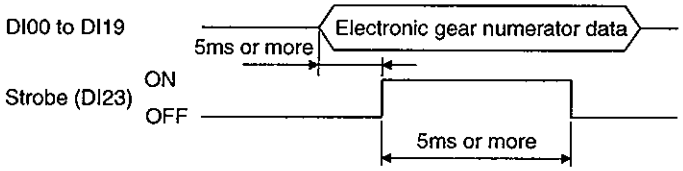
By turning on/off DI00 to DI19, the electronic gear numerator can be set in 5-digit BCD. Set □□12 in parameter No. 70. The setting range is from 1 to 65535.

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.



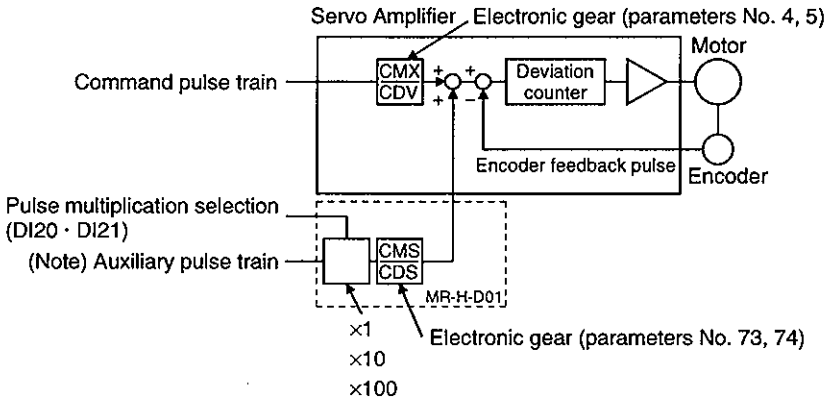
By setting 3□□□ in parameter No. 70, the electronic gear numerator data can be read as soon as it has changed, independently of whether DI23 is on or off. However, this function is made valid when the same data is received for longer than 12ms.

(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.



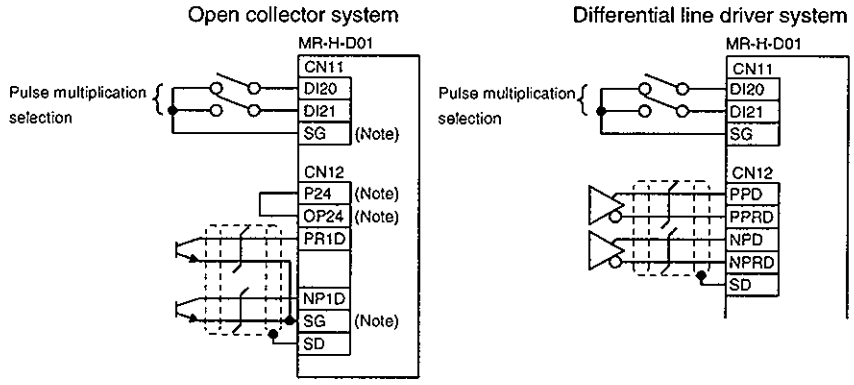
Note: The maximum input pulses are 200kpps in the open collector system or 400kpps in the differential line driver system.

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:



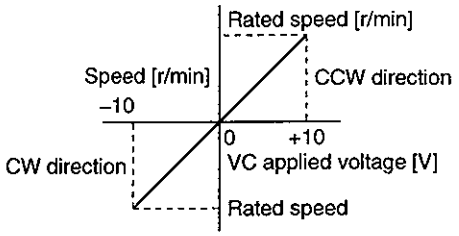
Note: For use in the 24V line. For use in the 5V line, replace the signals as follows:
P24 → P5
OP24 → OP5
SG → LG

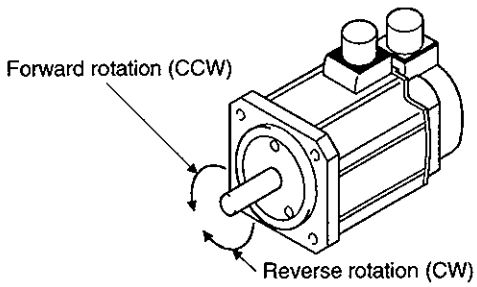
3.4.2 Speed control mode

(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:

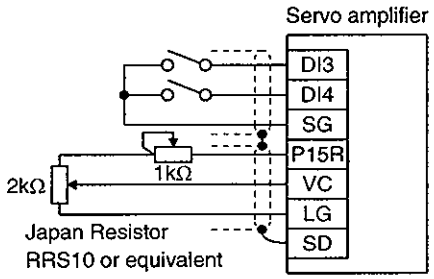




(Note) External Input Signals		Rotation Direction			
DI4	DI3	Analog Speed Command (VC)			Internal Speed Commands
		+ Polarity	0V	–Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo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

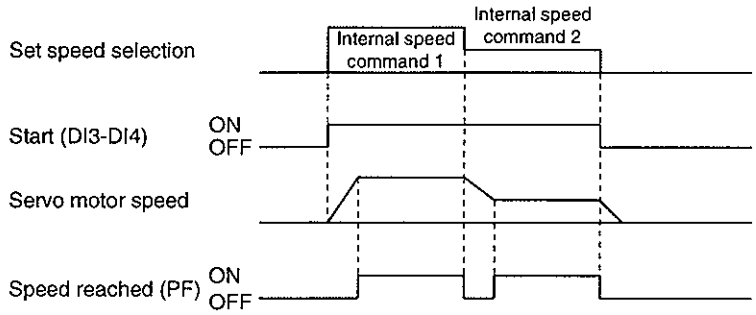
Note. 0 : DI-SG off (open)
1 : DI-SG on (short)

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

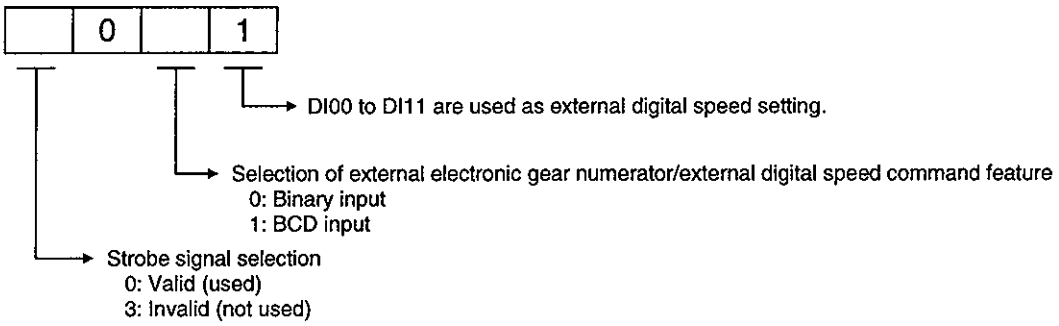
As in Section 3.4.1 (2).

(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

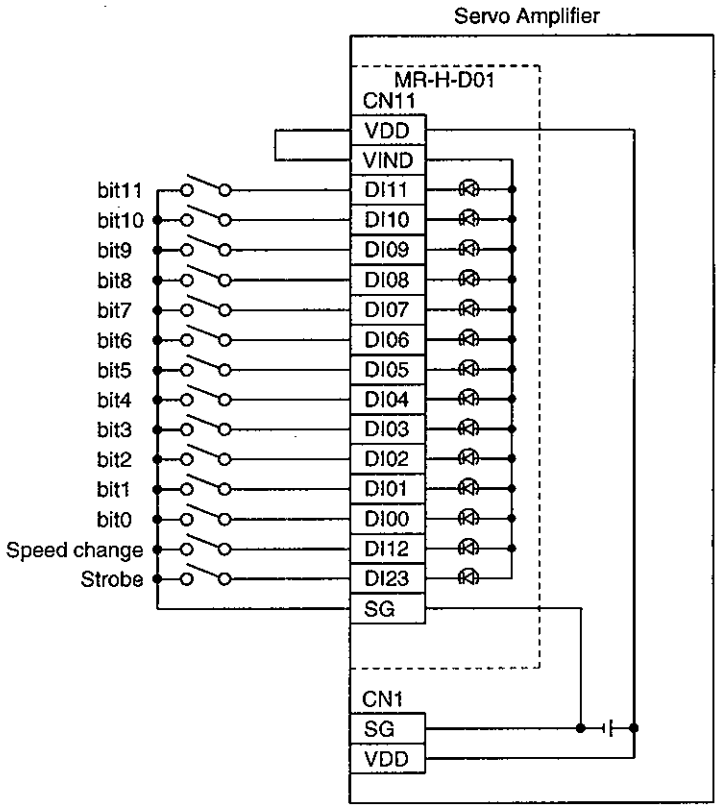


(b) Binary input

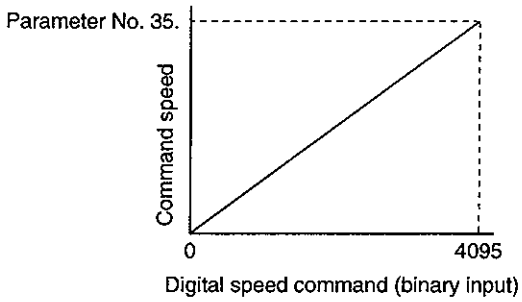
By turning on/off DI00 to DI11, the speed can be set in 12-bit binary. Set □□01 in parameter No. 70.

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)

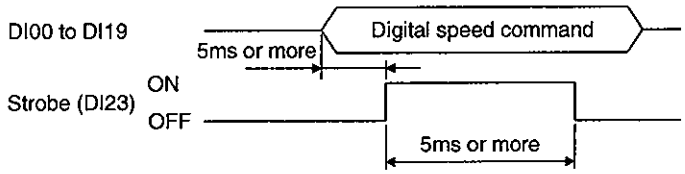
Note. 0 : DI-SG off (open)
1 : DI-SG on (short)
2 : To use DI0, set □□1□ in parameter No. 41.

(c) 5-digit BCD input

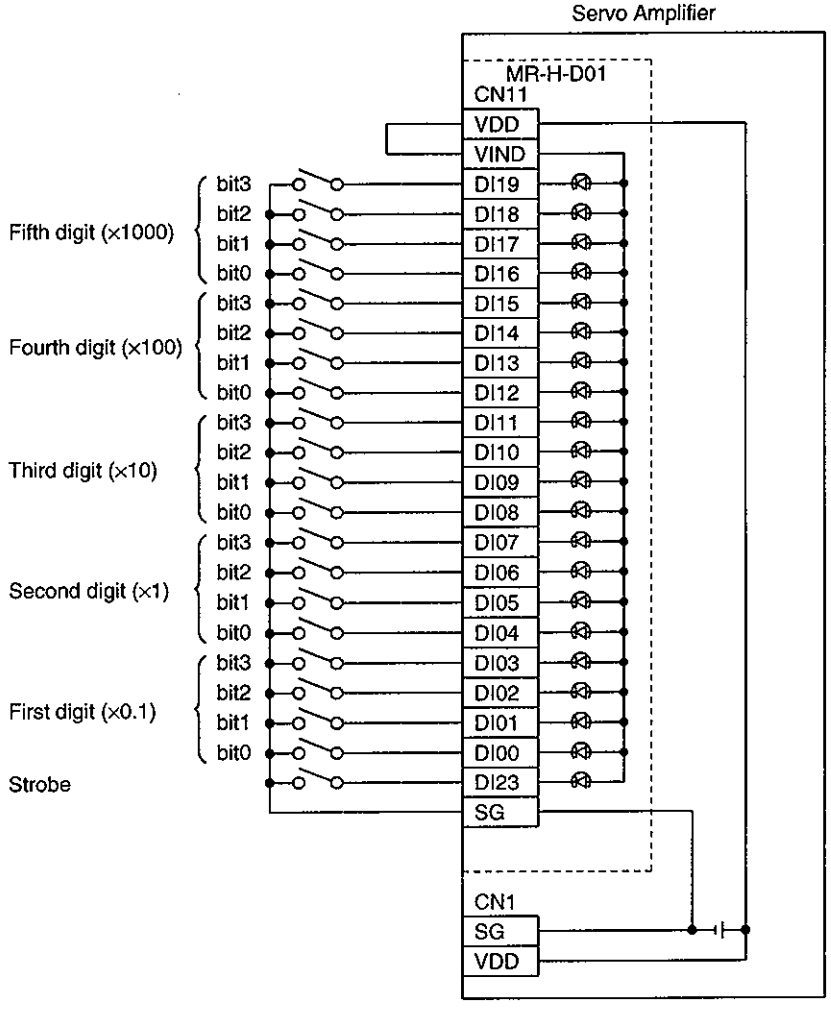
By turning on/off DI00 to DI19, the servo motor speed can be set in 5-digit BCD. Set □□11 in parameter No. 70. The setting range is from 0 to instantaneous permissible speed. When you use the 5-digit BCD input, the command speed change using DI12 and DI0 to DI2 cannot be made. Turning any terminal-SG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



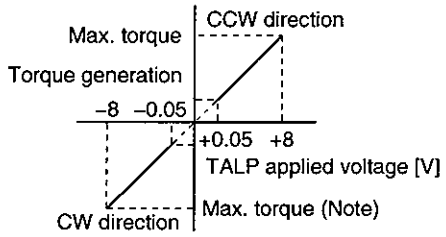
3.4.3 Torque control mode

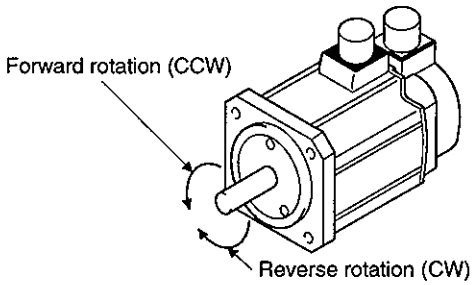
(1) Torque control

(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.

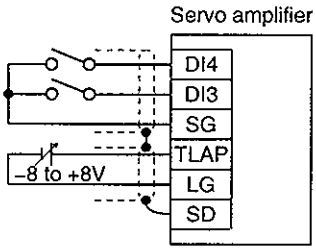
Generated torque may vary at the voltage of −0.05V to +0.05V.

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

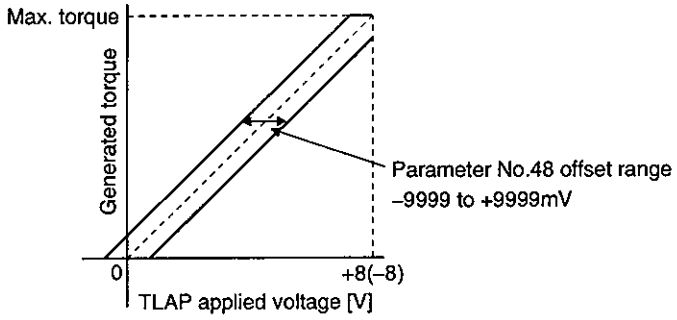
Note. 0: DI-SG off (open)
1: DI-SG on (short)

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.



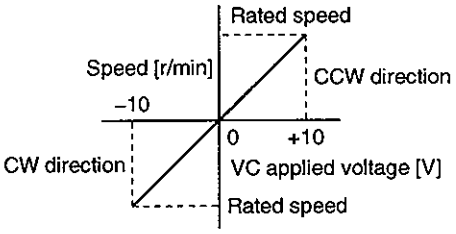
(2) Speed limit

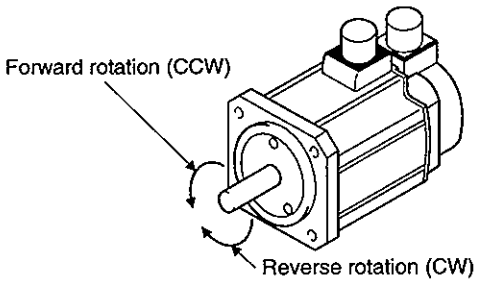
(a) Speed limit value and speed

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.



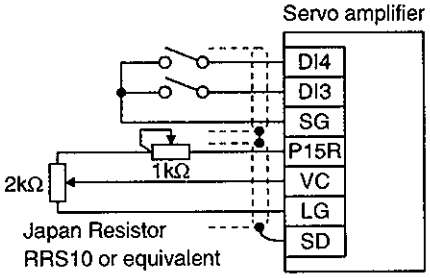


The following table indicates the limit direction according to forward rotation selection (DI4) and reverse rotation selection (DI3) combination:

(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

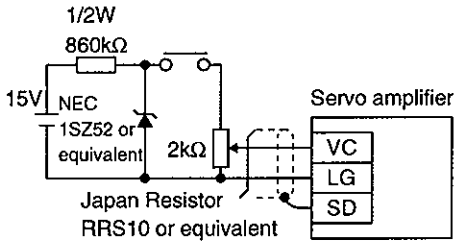
Note. 0: DI-SG off (open)
1: DI-SG on (short)

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)

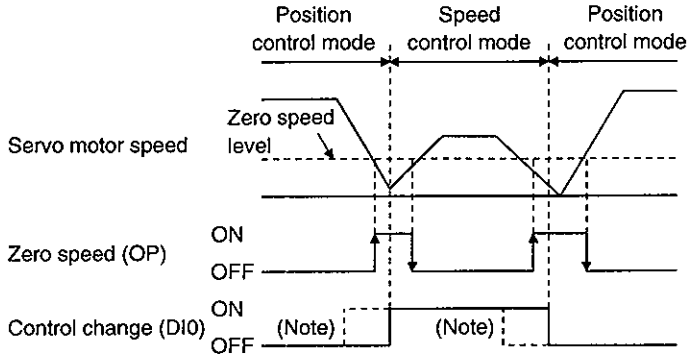
Use control change (DI0) to switch between the position control mode and the speed control mode from an external contact. Relationships between DI0-SG status and control modes are indicated below:

(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.

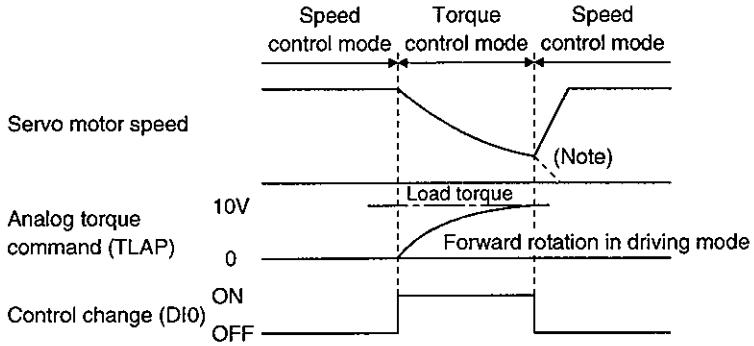
(1) Control change (DI0)

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:

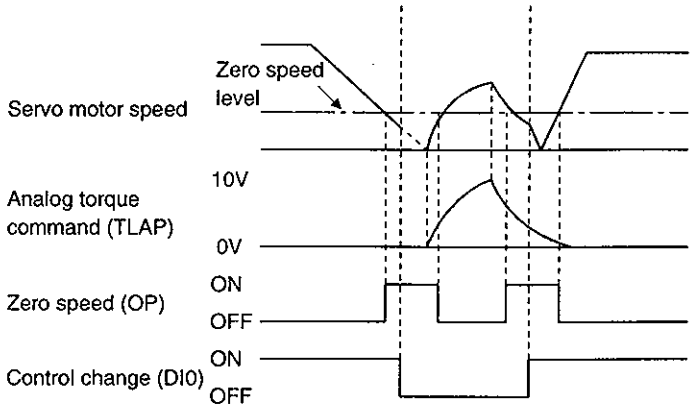
(Note) DI0	Servo Control Mode
0	Torque control mode
1	Position control mode

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).

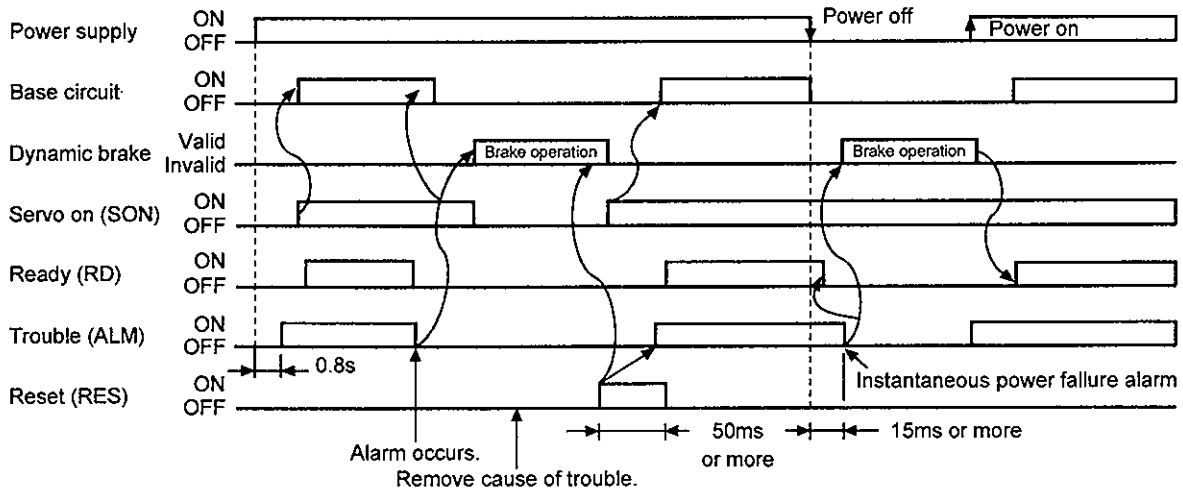
(4) Torque limit in position control mode

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

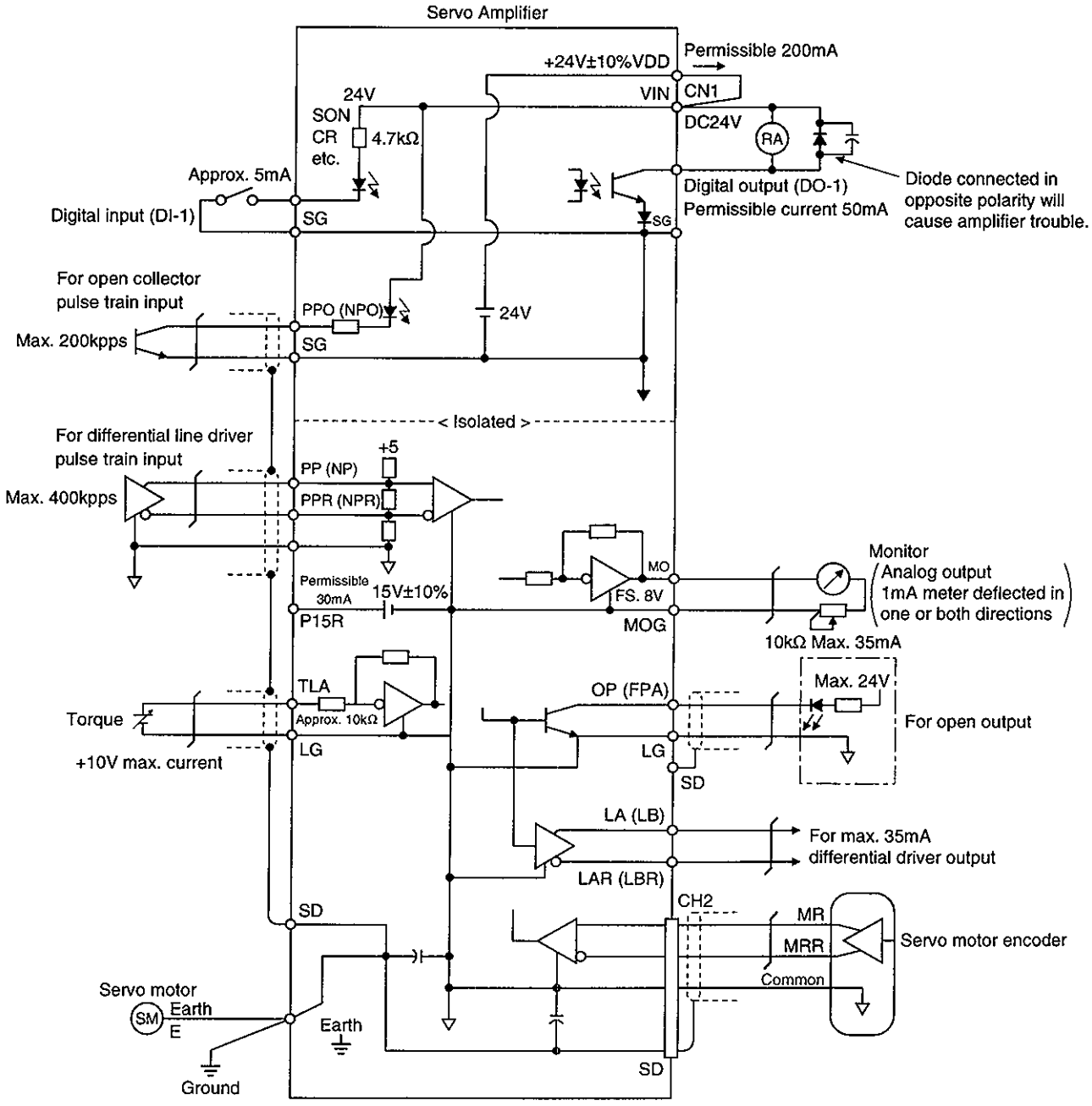
When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a return to home position.

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.

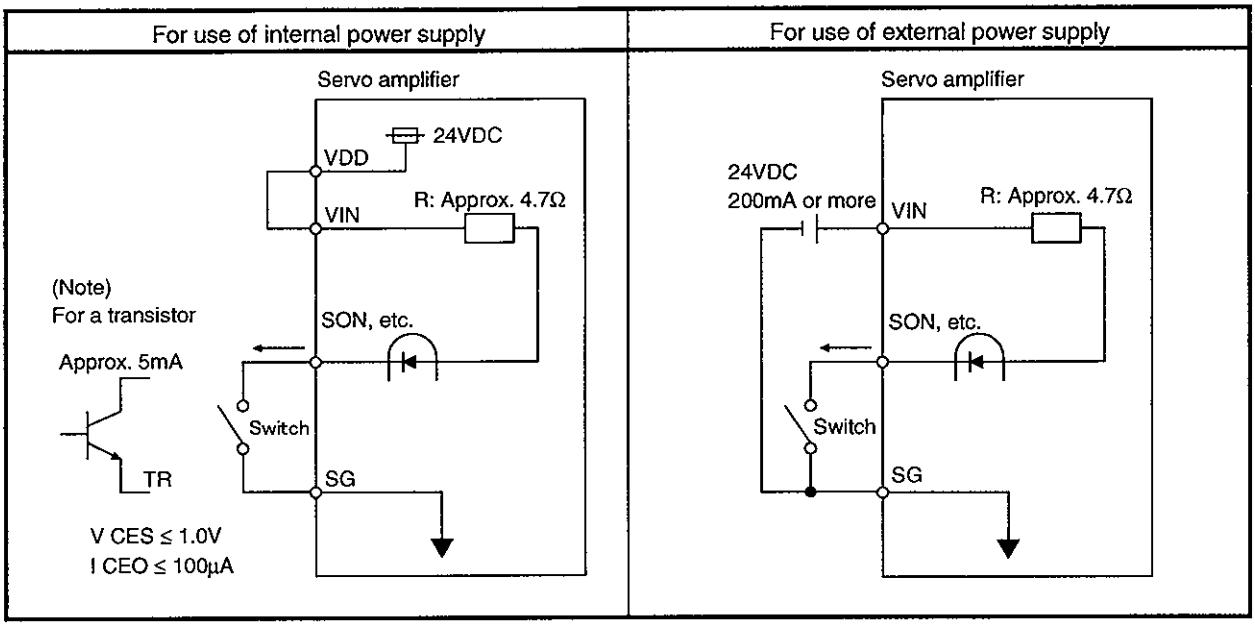


3.6.2 Detailed description of the interfaces

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.

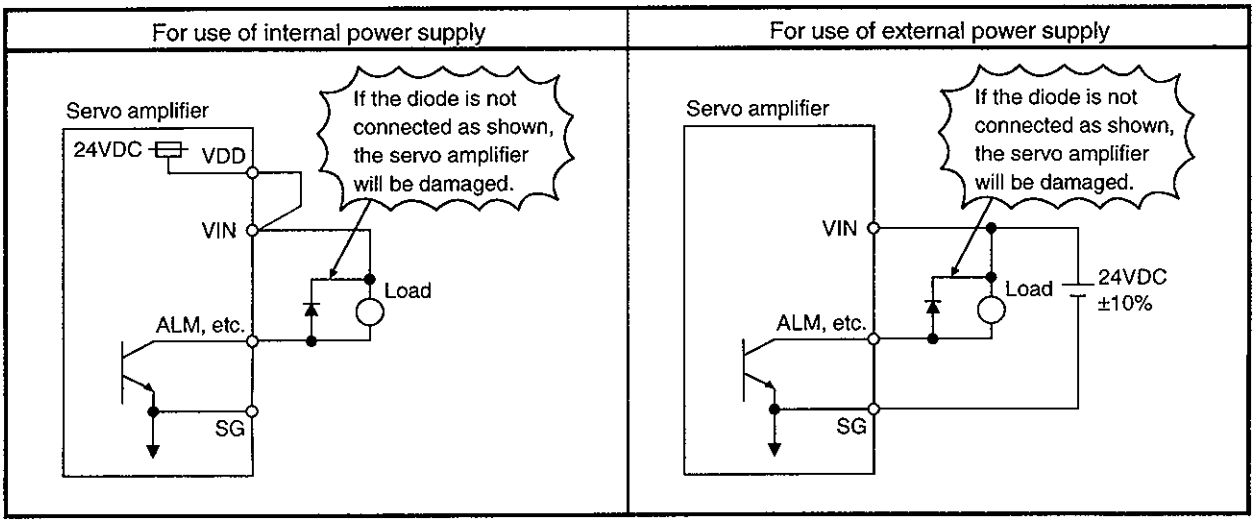


Note: This also applies to the use of the external power supply.

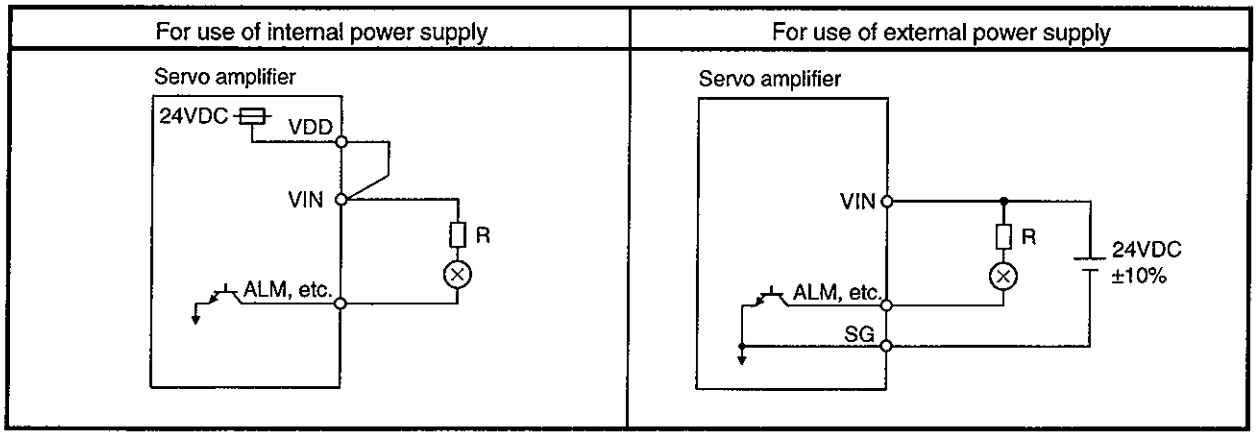
(2) Digital output interface DO-1

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



2) Lamp load

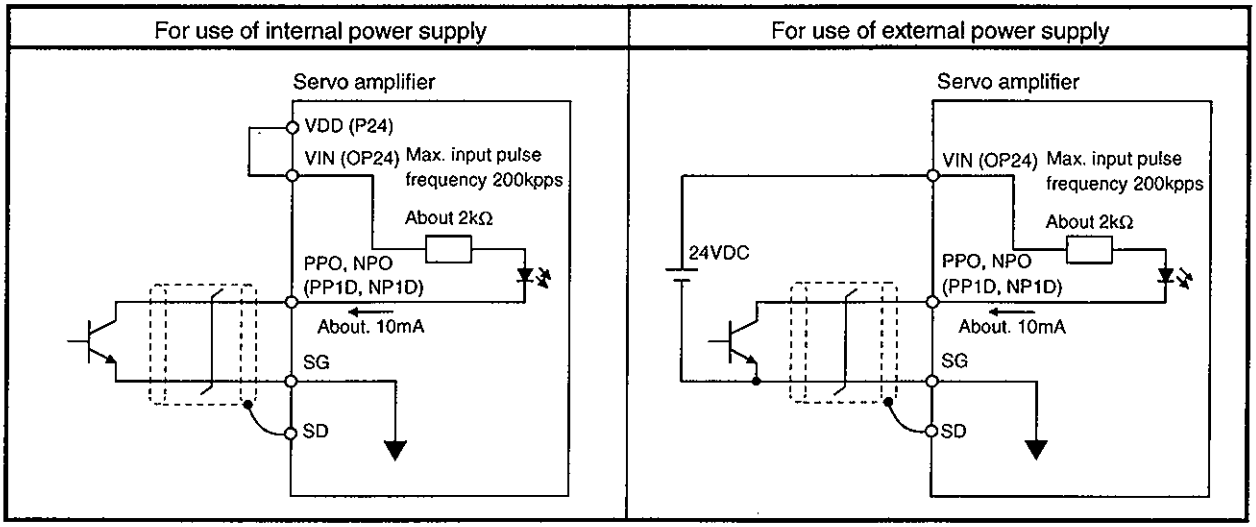


(3) Pulse train input interface DI-2

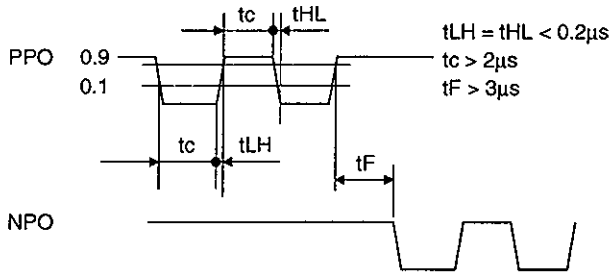
Provide a pulse train signal in the open collector or differential line driver system.

(a) Open collector system

1) Interface

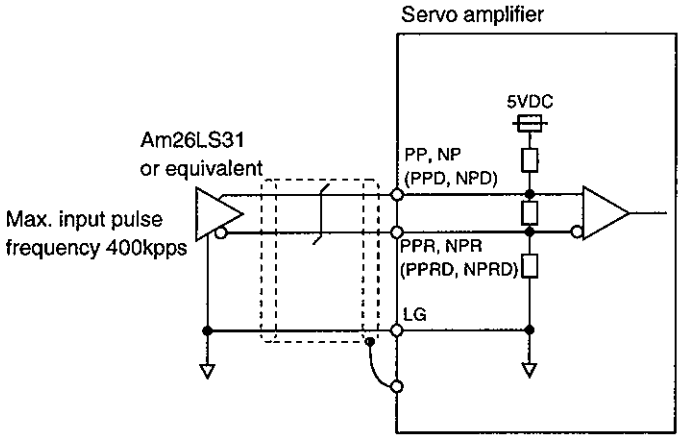


2) Conditions of the input pulse

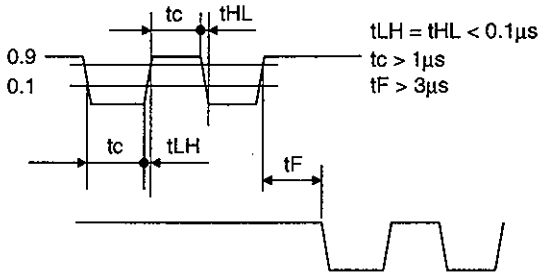


(b) Differential line driver system

1) Interface



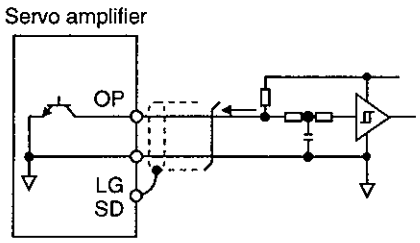
2) Conditions of the input pulse

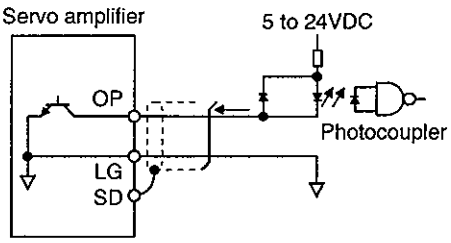


(4) Encoder pulse output DO-2

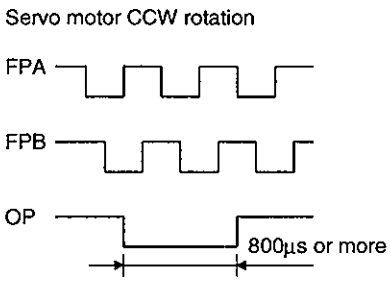
(a) Open collector system

1) Interface





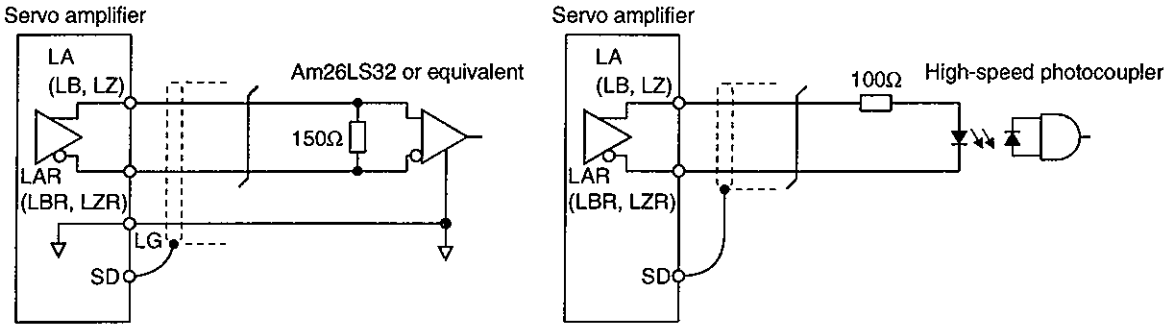
2) Output pulse



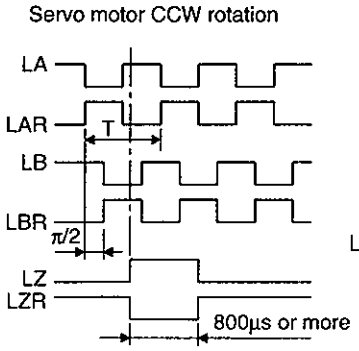
(b) Differential line driver system

1) Interface

Max. output current: 35mA



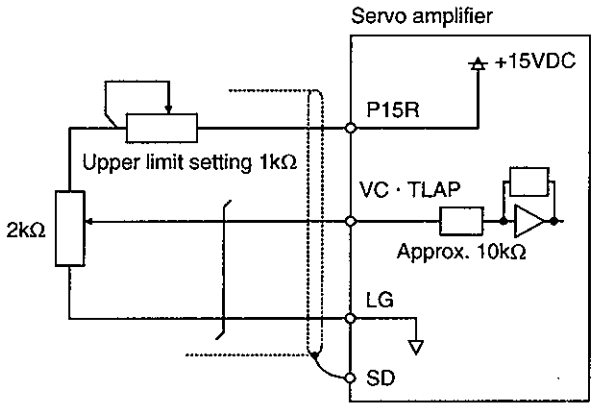
2) Output pulse



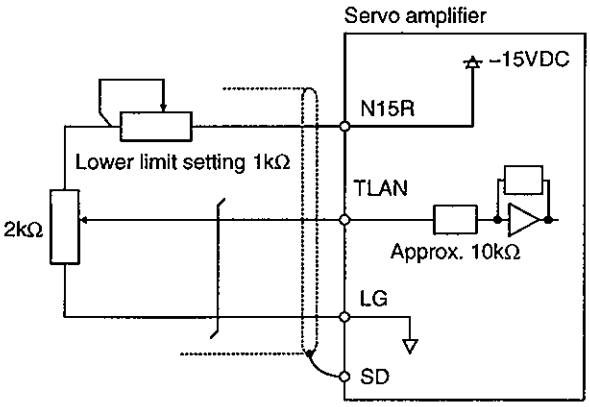
LZ signal varies ±3/8T on its leading edge.

(5) Analog input

Input impedance
10 to 12kΩ

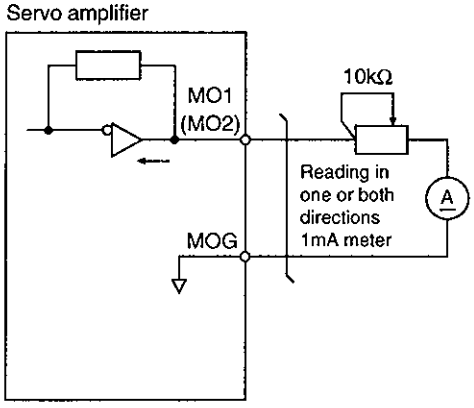


Input impedance
10 to 12kΩ



(6) Analog output

Output ±10V
Max.1mA

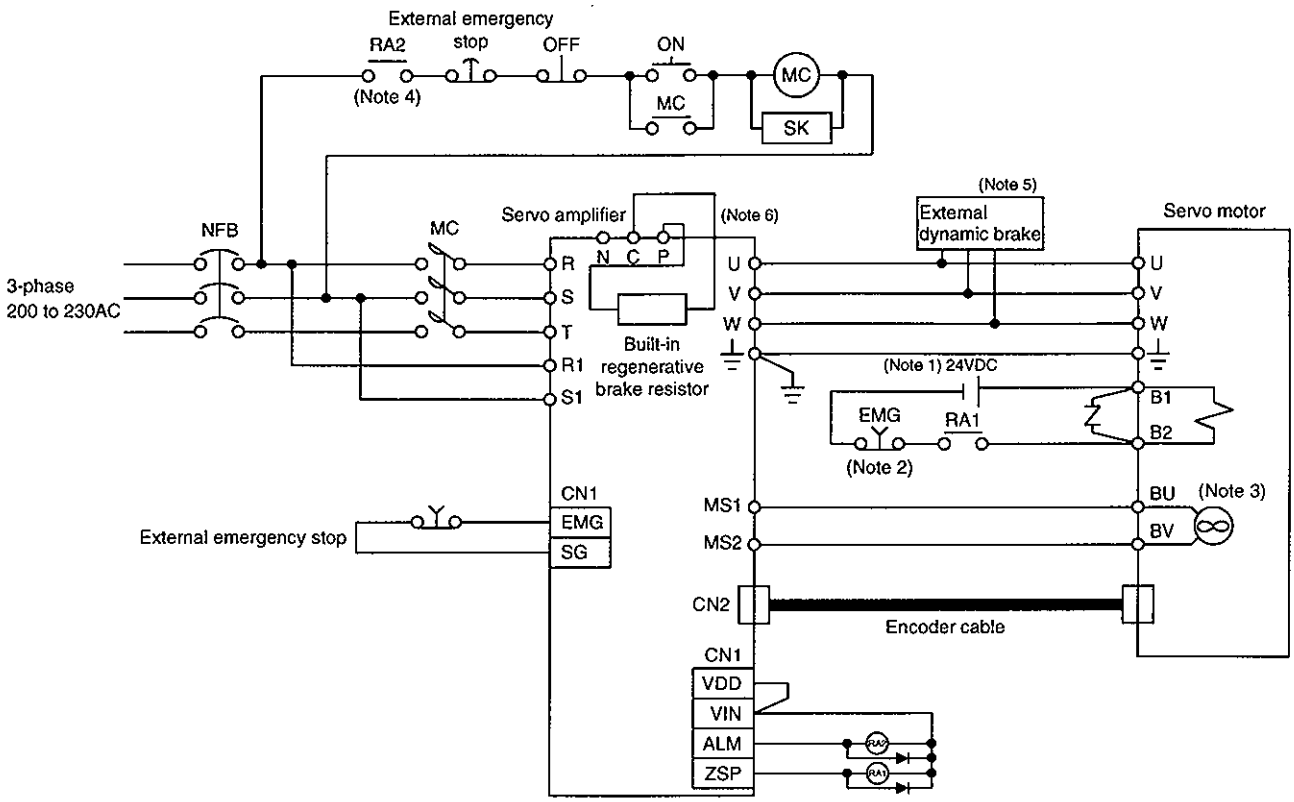


3.7 Power Line Circuit

⚠ 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.

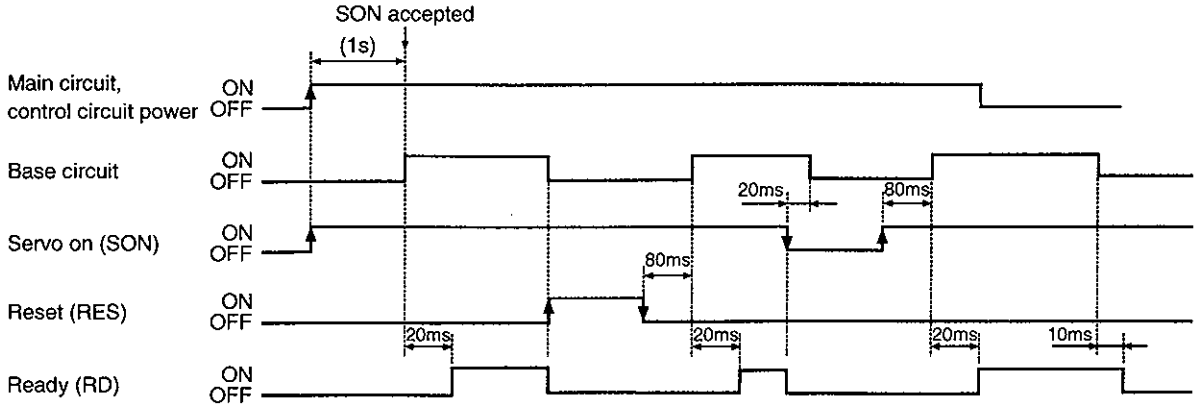
Symbol	Signal	Description
R · S · T	Main circuit power supply	Main circuit power input terminals Connect a three-phase 200 to 230VAC, 50/60Hz power supply to R, S, T. For MR-H700AN-UE or more, the voltage of 50Hz power is 200 to 220V.
U, V, W	Servo motor output	Servo motor power output terminals Connect to the servo motor power supply terminals (U, V, W).
R_1 · S_1	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 L11, L21 simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.
3) The servo amplifier can accept the servo-on 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.

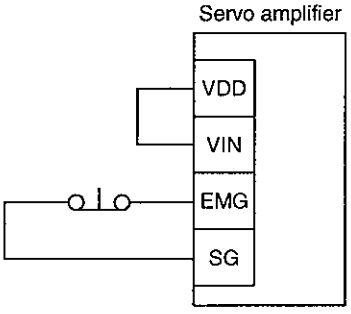
(2) Timing chart



(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.



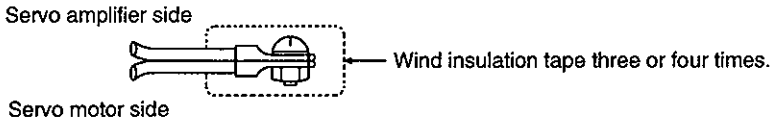
3.8 Connection of Servo Amplifier and Servo Motor

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.



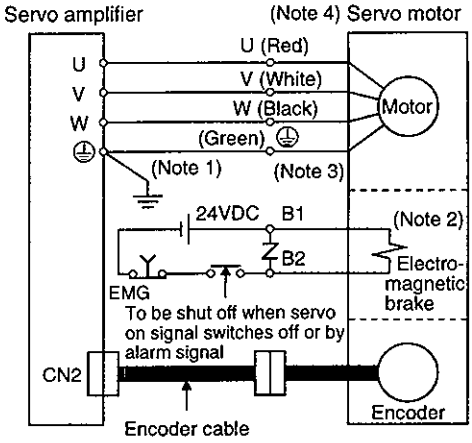
(2) For grounding, connect the earth cable of the servo motor to the ground terminal of the servo amplifier and connect the ground cable of the servo amplifier to the earth via earth plate of the control box.

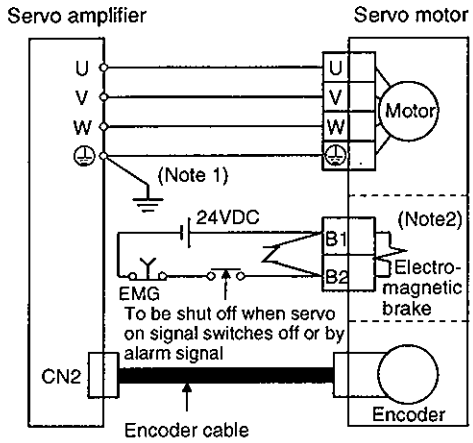
(3) Supply exclusive 24VDC power to the brake lead of the servo motor with electromagnetic brake.

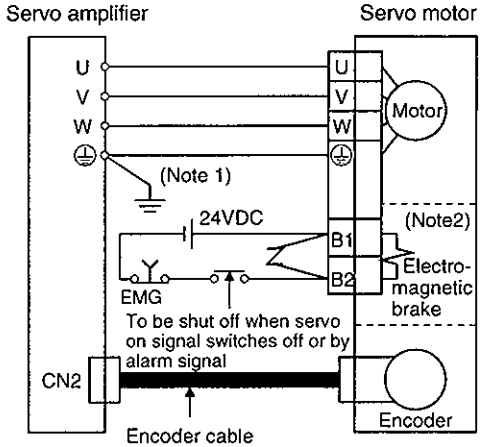
The connection method differs according to the series and capacity of the servo motor and whether or not the servo motor has the electromagnetic brake. Perform wiring in accordance with this section.

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.

<table>
<tr><th>Servo Motor</th><th>Connection Diagram</th></tr>
<tr><td>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)</td><td>


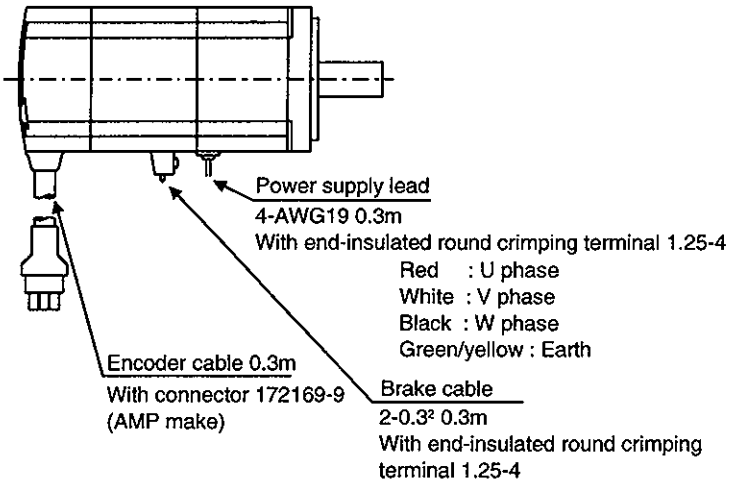
Note 1. To prevent an electric shock, always connect the earth terminal of the servo amplifier to the earth of the control box.
2. This circuit applies to the servo motor with electromagnetic brake.
3. For the HA-FF series, connect the ground cable to the earth terminal of the servo motor.
4. The HA-LH11K2 to HA-LH22K2 are equipped with a cooling fan. For wiring, refer to Section 3.8.4.
</td></tr>
<tr><td>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)</td><td>


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.
</td></tr>
<tr><td>HC-SF52 (B) to HC-SF152 (B)
HC-RF103 (B) to HC-RF503 (B)
HC-UF72 (B) · HC-UF152 (B)</td><td>


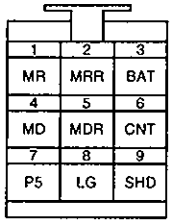
Note 1. To prevent an electric shock, always connect the earth terminal of the servo amplifier to the earth of the control box.
2. This circuit applies to the servo motor with electromagnetic brake.
</td></tr>
</table>

3.8.3 Details of the servo motor side

(1) HC-MF(-UE) series

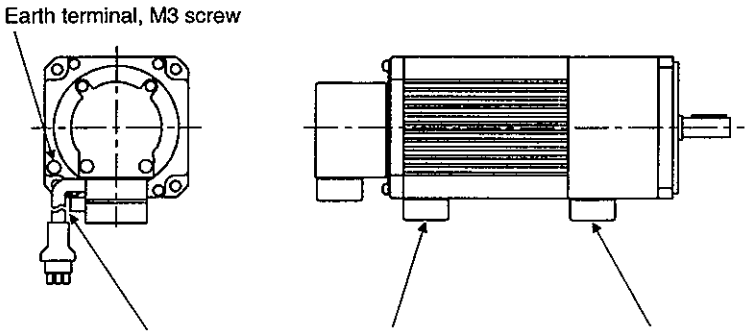


Encoder connector signal arrangement

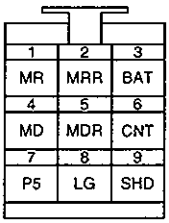


1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	CNT
7	8	9
P5	LG	SHD

(2) HA-FF series

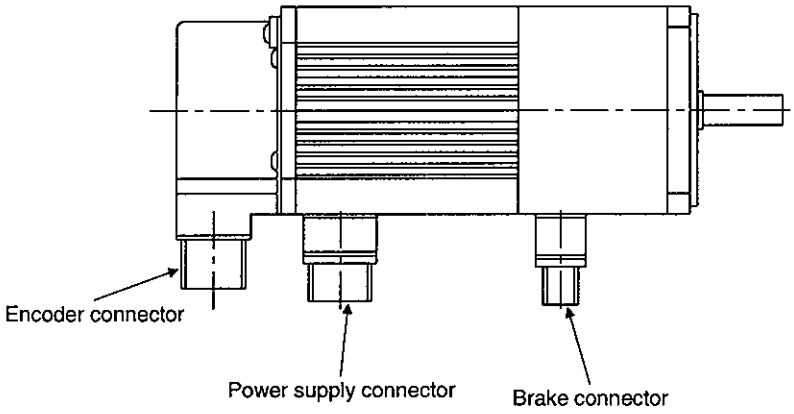


Encoder connector signal arrangement



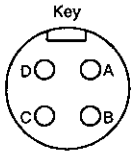
1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	CNT
7	8	9
P5	LG	SHD

(3) HA-FF□C(B)-UE series



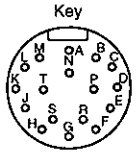
Servo Motor	Connector		
	For Power Supply	For Encoder	For Brake
HA-FF053C(B)-UE to HA-FF63C(B)-UE	CE05-2A14S-2PD-B	MS3102A20-29	MS3102E10SL-4P

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



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

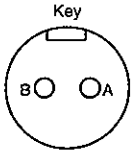
Encoder connector signal arrangement
MS3102A20-29P



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	—

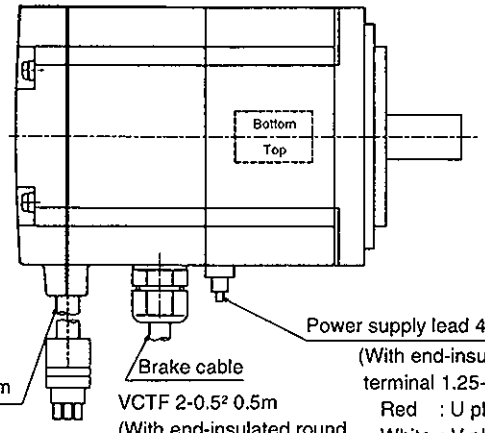
Brake connector signal arrangement
MS3102E10SL-4P



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)

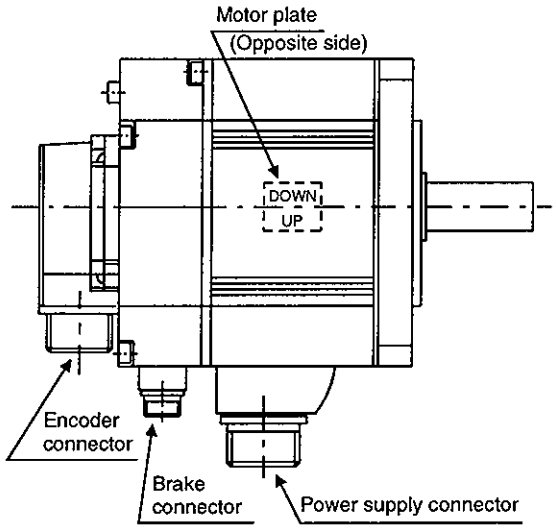
Brake cable
VCTF 2-0.5² 0.5m
(With end-insulated round crimping terminal 1.25-4)

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

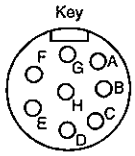
(5) HC-SF□(B) · HC-RF□(B) · HC-UF□(B)2000 r/min series



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

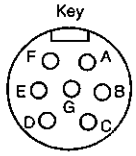
CE05-2A22-23PD-B



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

Note: 24VDC, without polarity

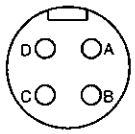
CE05-2A24-10PD-B



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

Note: 24VDC, without polarity

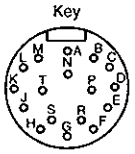
CE05-2A32-17PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

Encoder connector signal arrangement

MS3102A20-29P

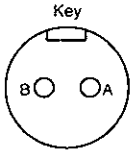


Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	—
F	BAD
G	LG
H	—
J	—

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

Electromagnetic brake connector signal pin-outs

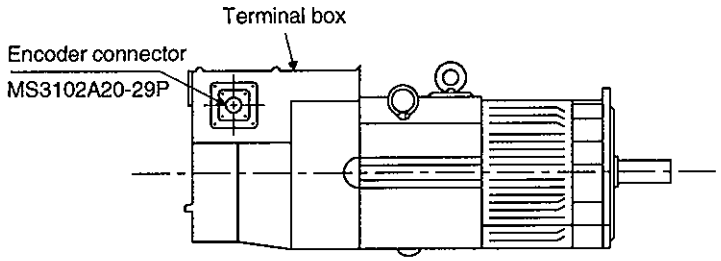
MS3102E10SL-4P



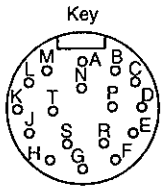
Pin	Signal
A	(Note) B1
B	(Note) B2

Note: 24VDC without polarity

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



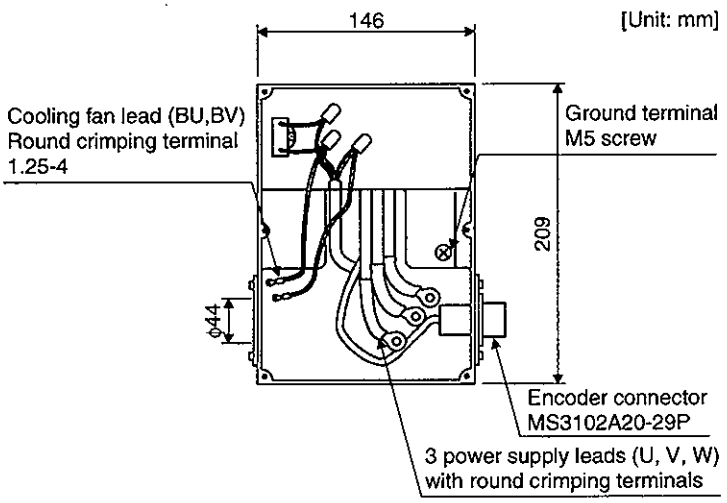
Encoder connector signal arrangement
MS3102A-29P



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	—

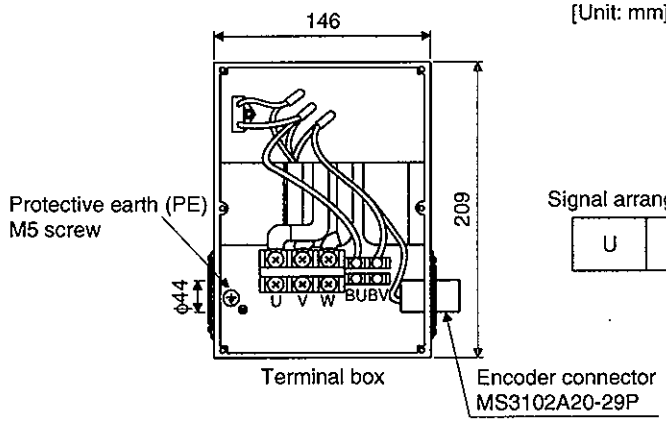
(a) Terminal box of HA-LH11K2 to HA-LH22K2



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)



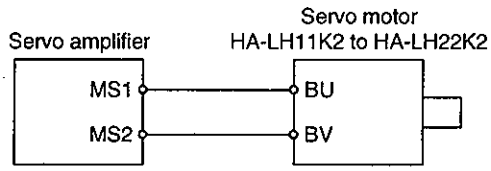
Signal arrangement of terminal block

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)

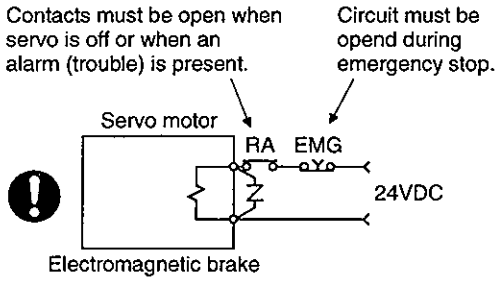
The 11kW or more of the HA-LH series are of totally-enclosed, force-cooled type. When performing operation, supply power to the cooling fan terminals (BU, BV) to operate the cooling fan. (Single-phase 200V, 35W)
Connect the fan terminals (BU, BV) of the servo motor to the cooling fan power terminals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

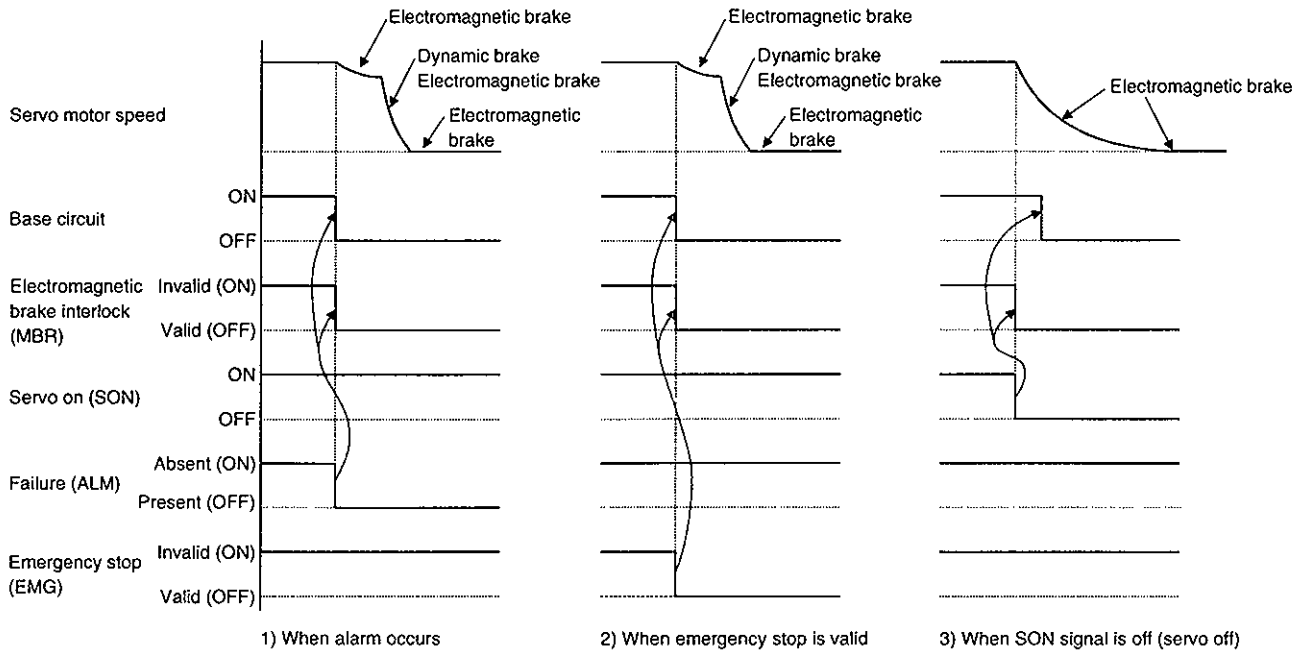
3.9.2 Operation of electromagnetic brake

(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

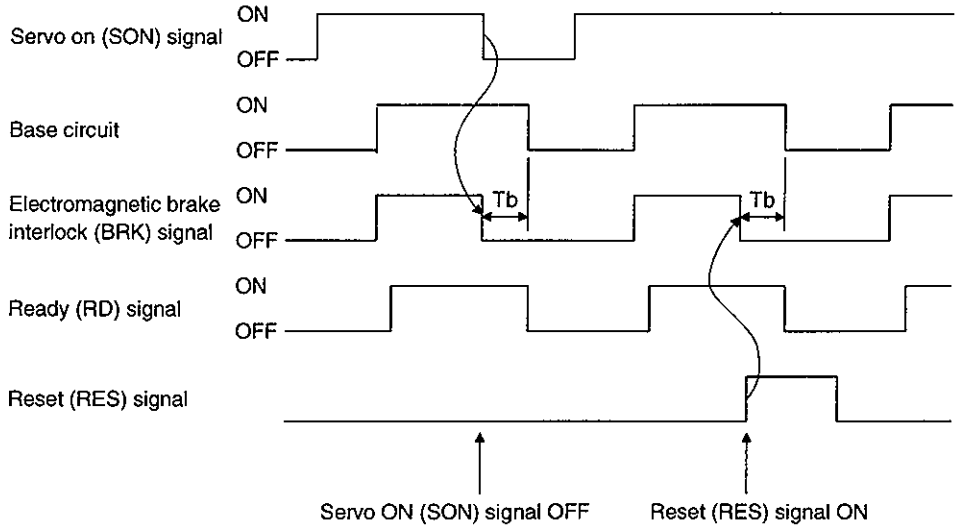
1) Set □1□□ in parameter No. 44.

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

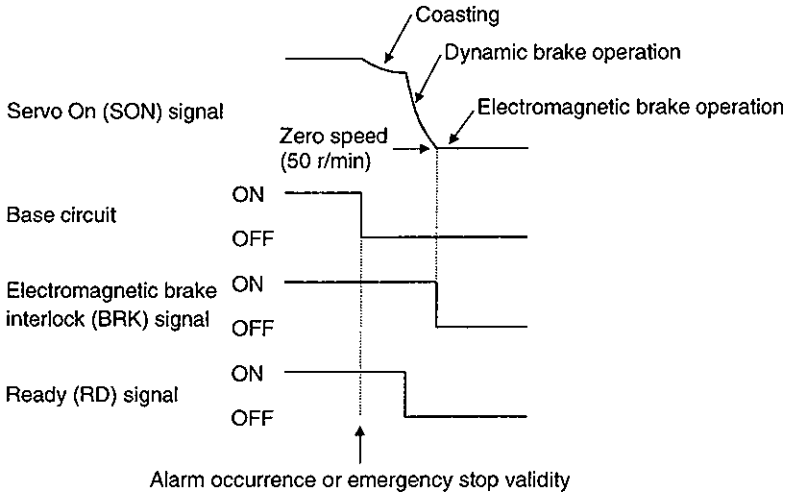
3) In this usage, do not install the EMG switch in Note 2 in the connection diagram of Section 3.7.1.

(b) Timing chart

1) Servo ON, reset timing chart.



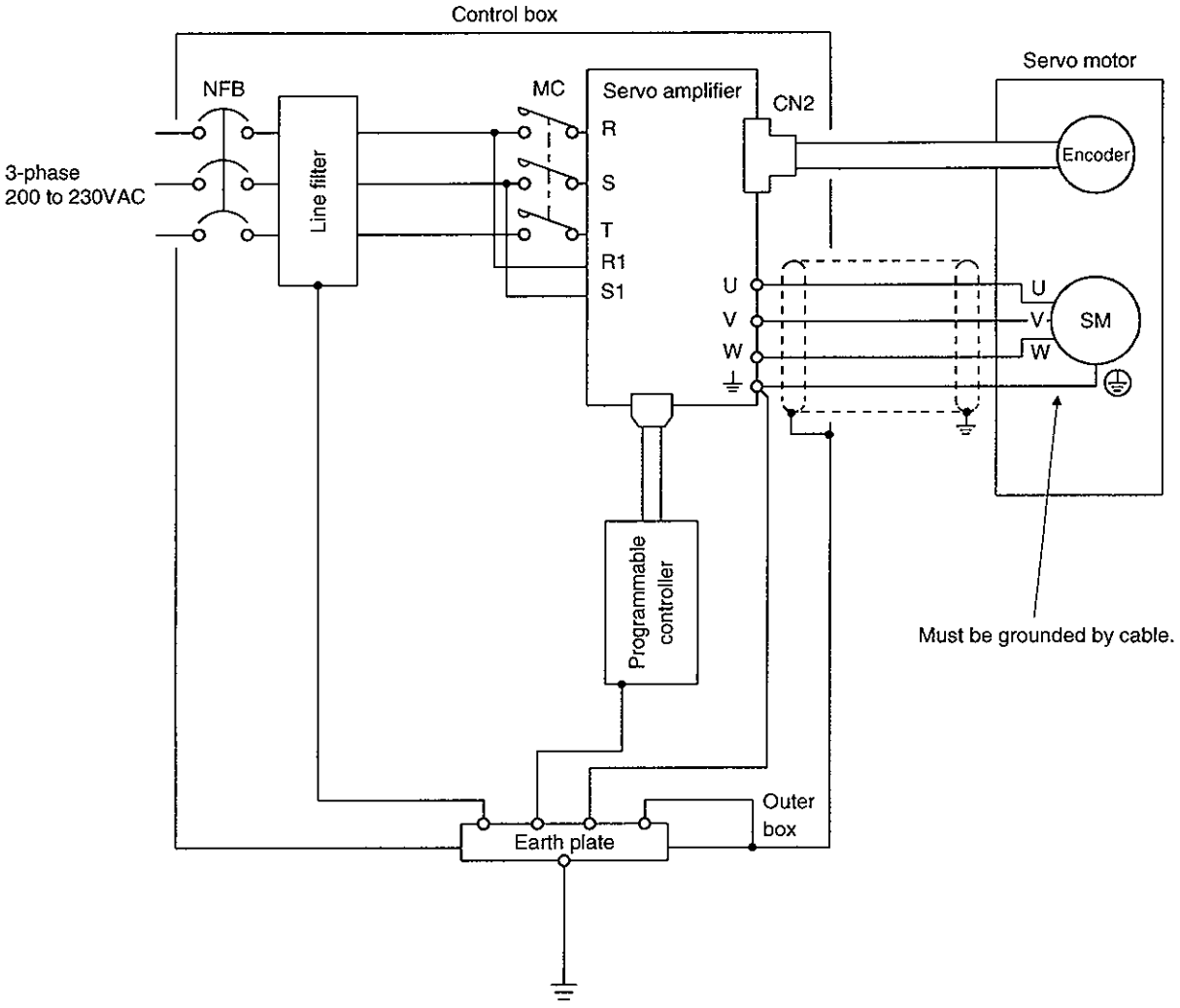
2) Alarm occurrence, emergency stop validity timing chart.



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.

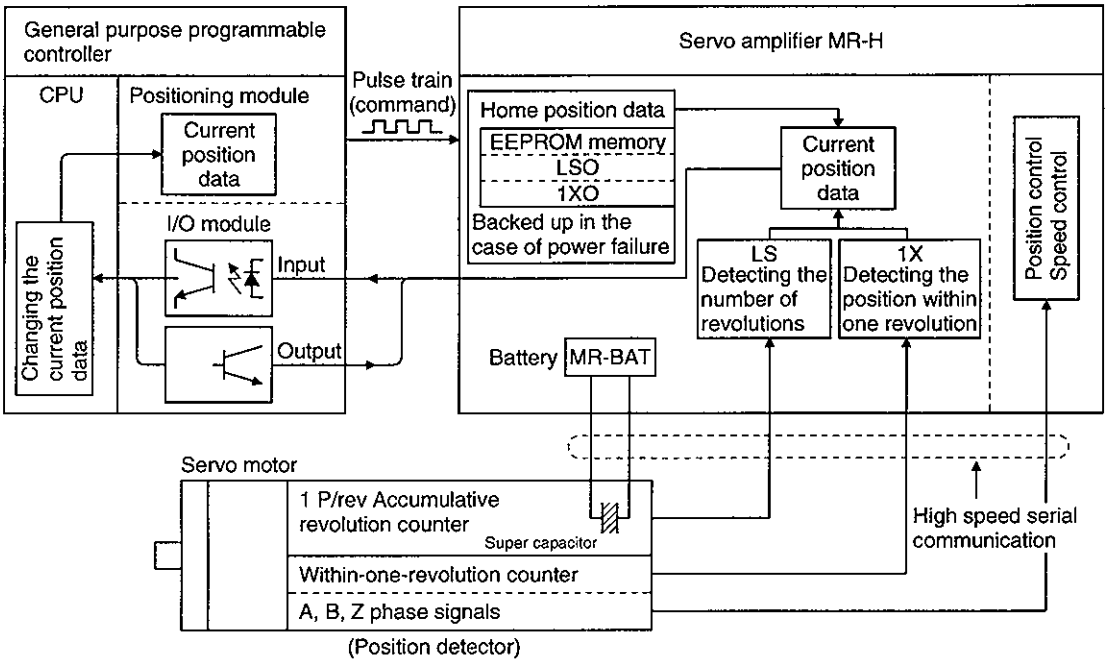
(d) Simultaneous ON or simultaneous OFF of forward rotation select (DI4) and reverse rotation select (DI3) signals

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

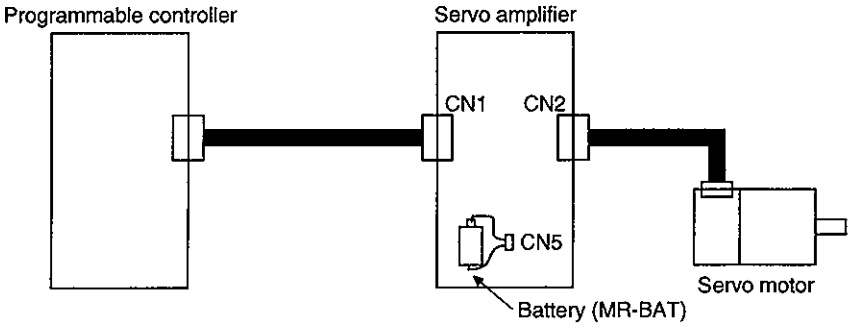
(1) Components

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.

Parameter No. 3

1	–	–	–

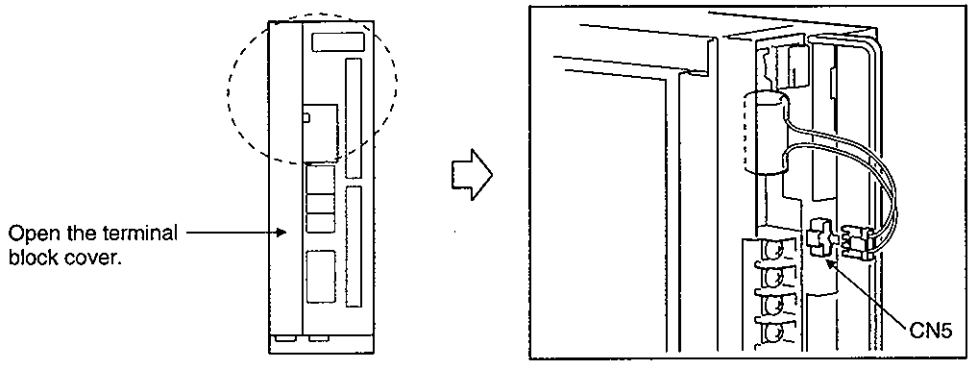
Selection of absolute position detection system
0: Incremental system
1: Absolute position detection system

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.

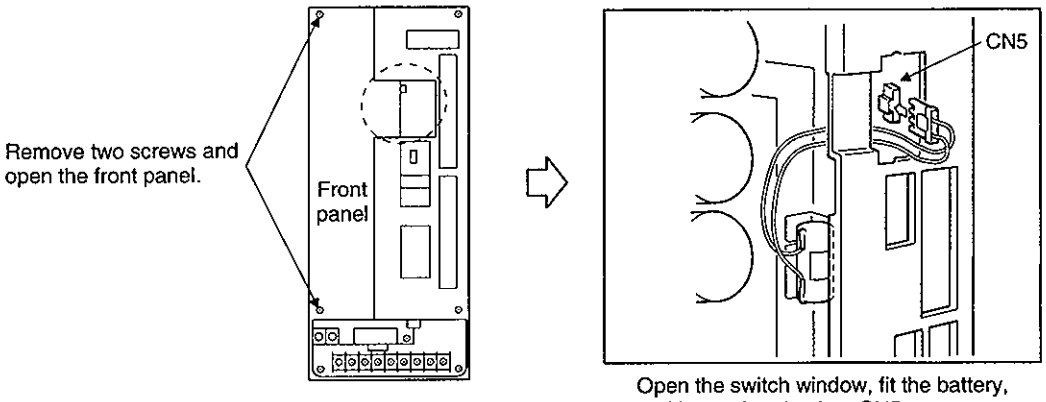
> **POINT**
> The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:
> • Ground human body and work bench.
> • Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

(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



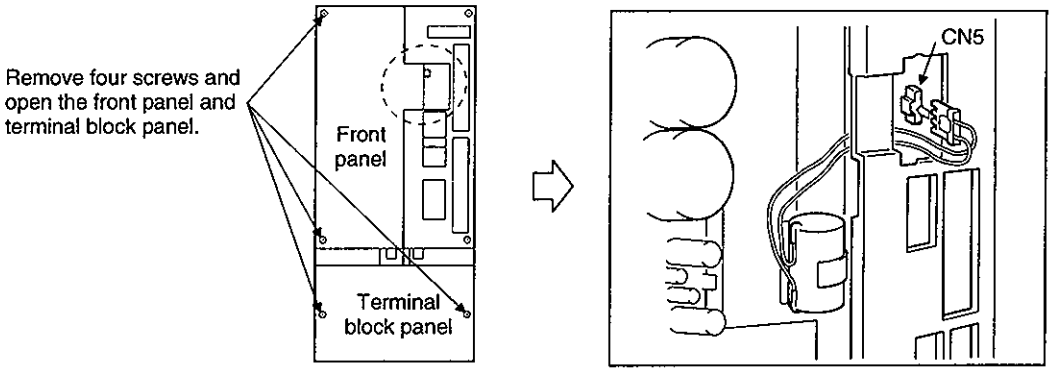
Open the switch window, fit the battery, and insert the plug into CN5

(b) MR-H500AN,MR-H700AN



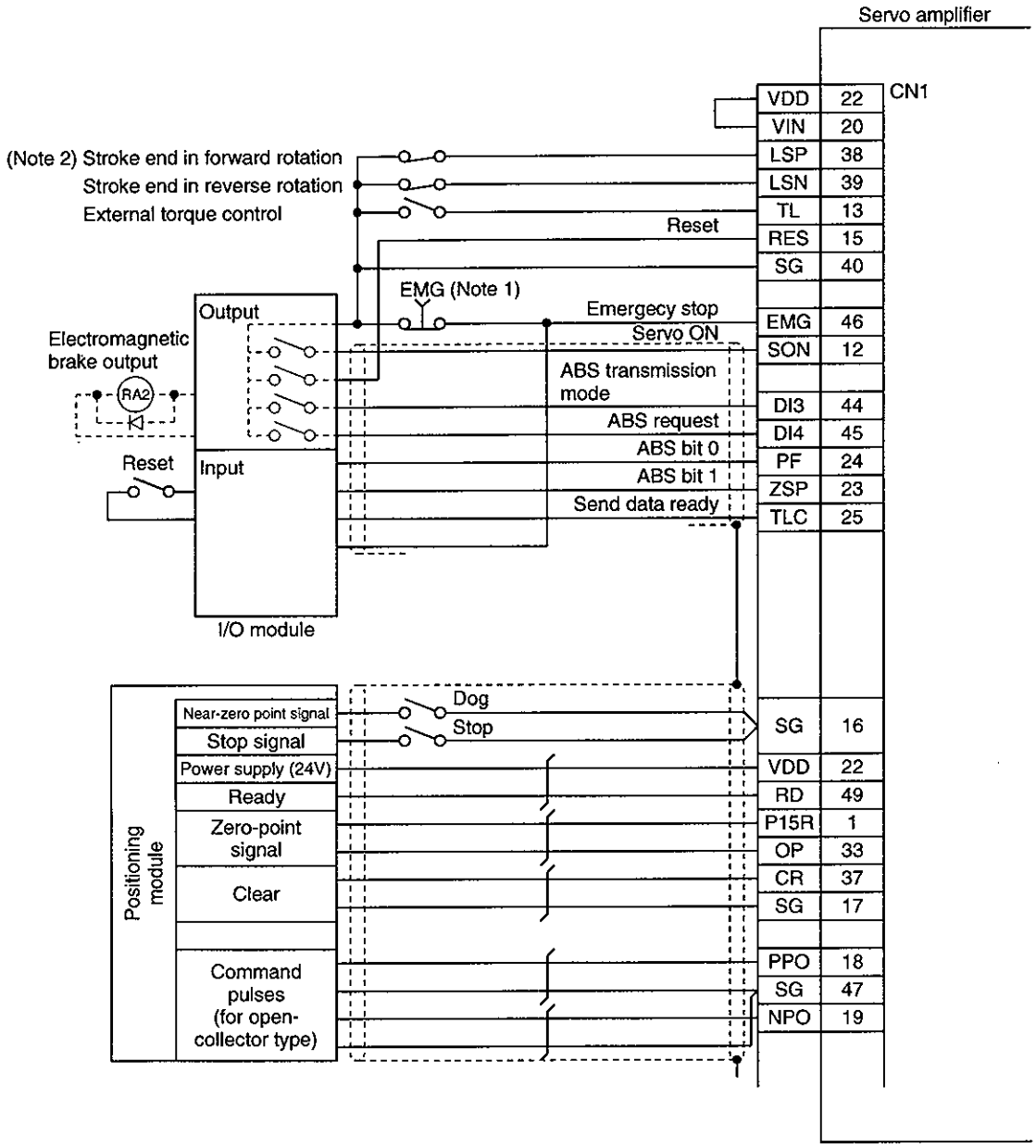
Open the switch window, fit the battery, and insert the plug into CN5

(C) MR-H11KAN to MR-H22KAN



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

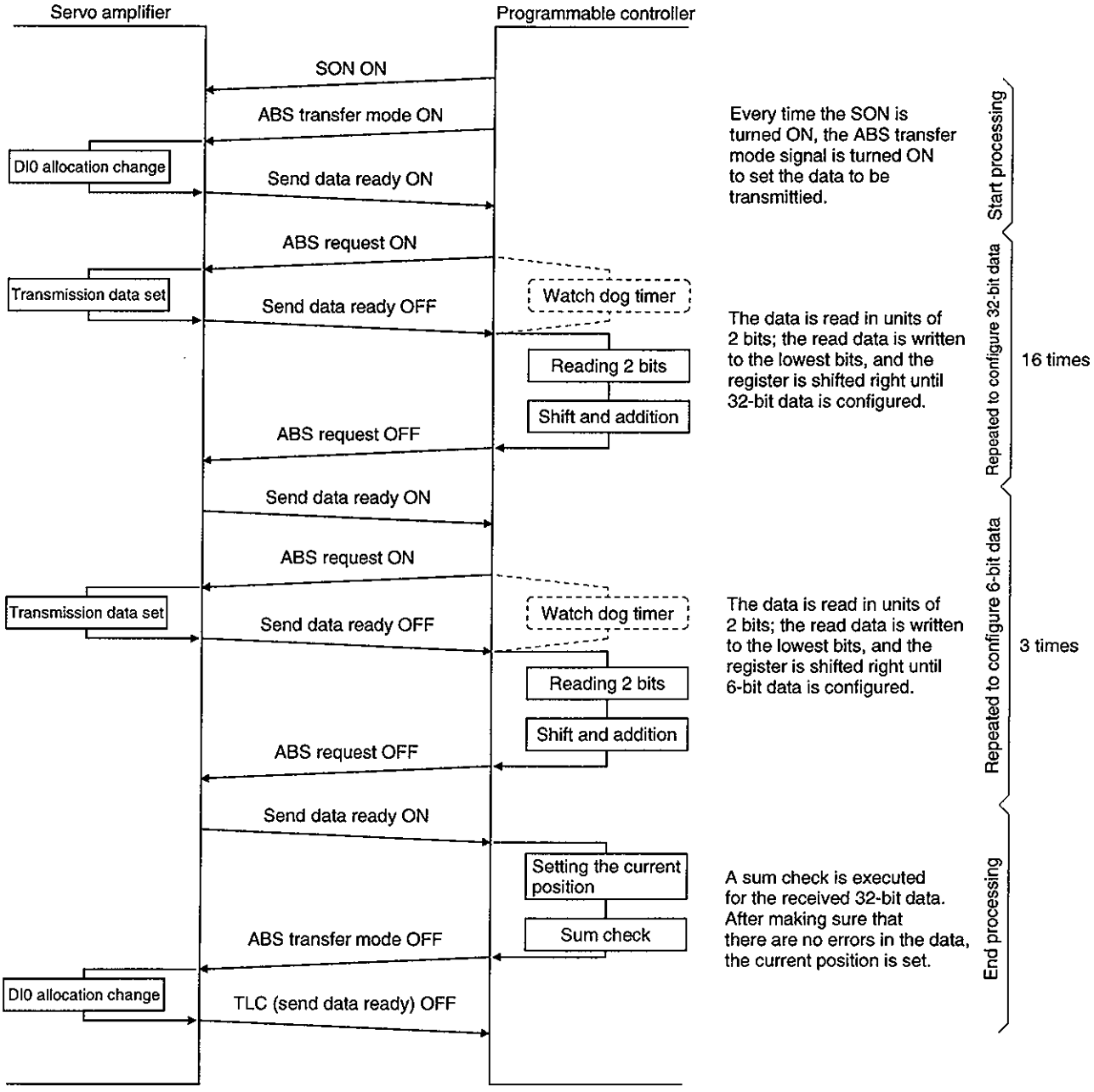
(d) The absolute position erase alarm (AL25) occurred.

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.

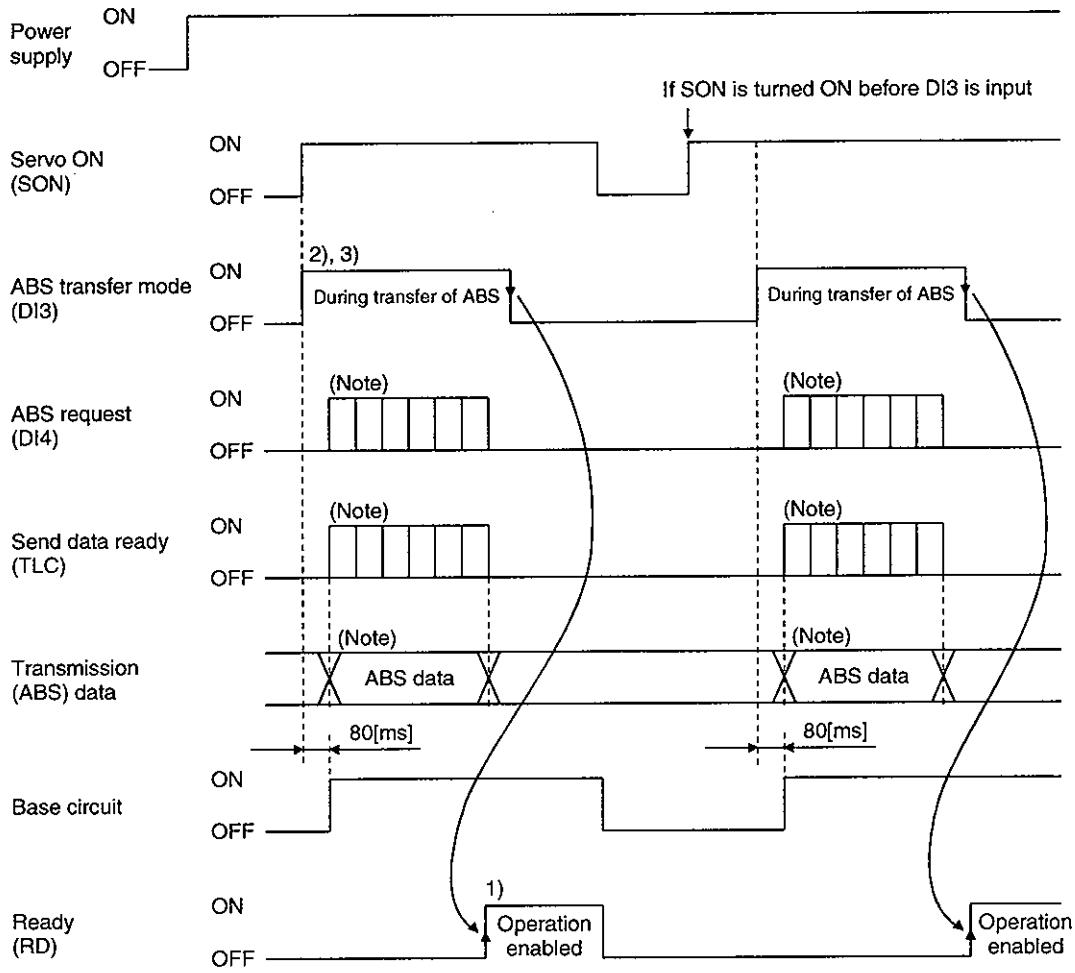


5.7.2 Transfer method

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

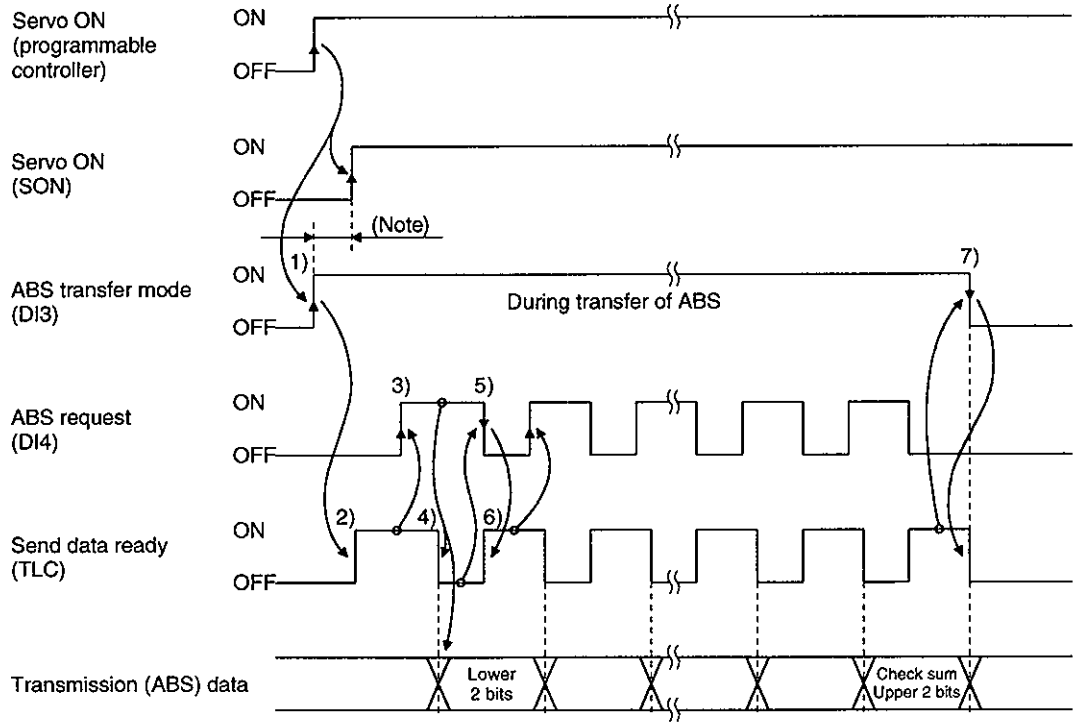


Note: For details, refer to (1) (b) in this section.

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)

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}
101101^{b}

<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 "$2D^{b}$"

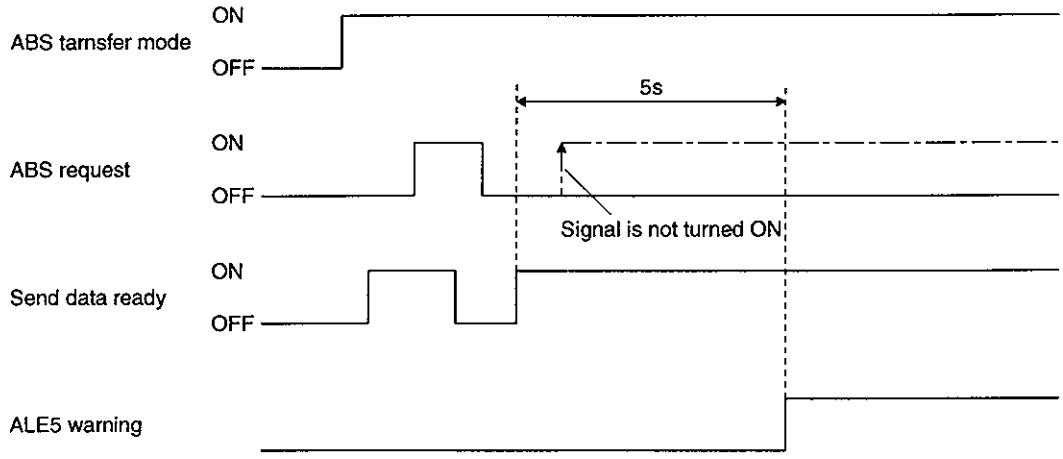
(2) Transmission error

(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.

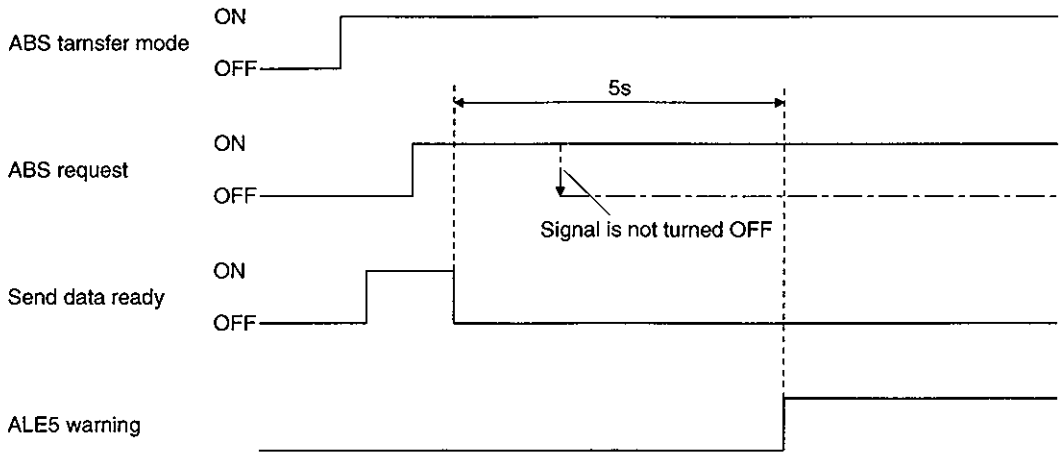
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

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.



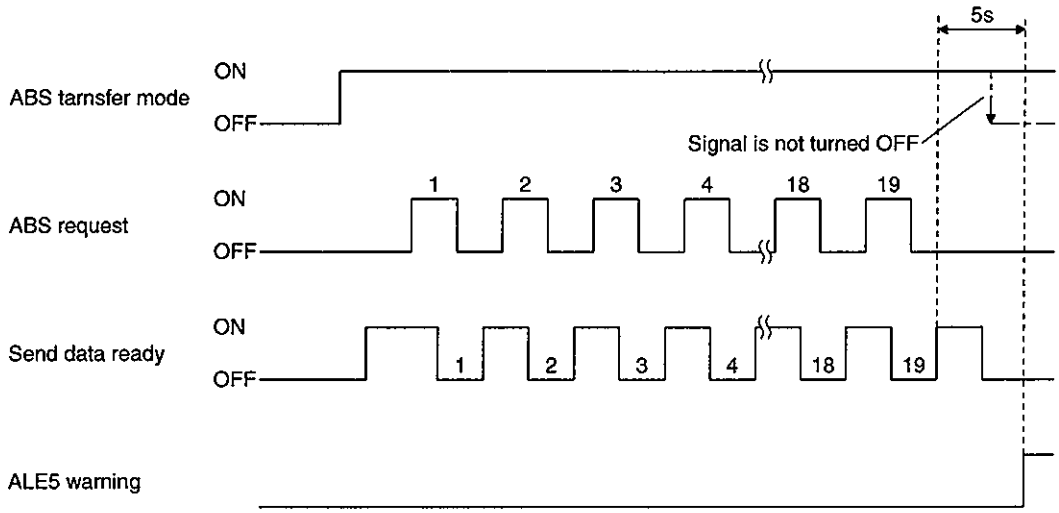
2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

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.



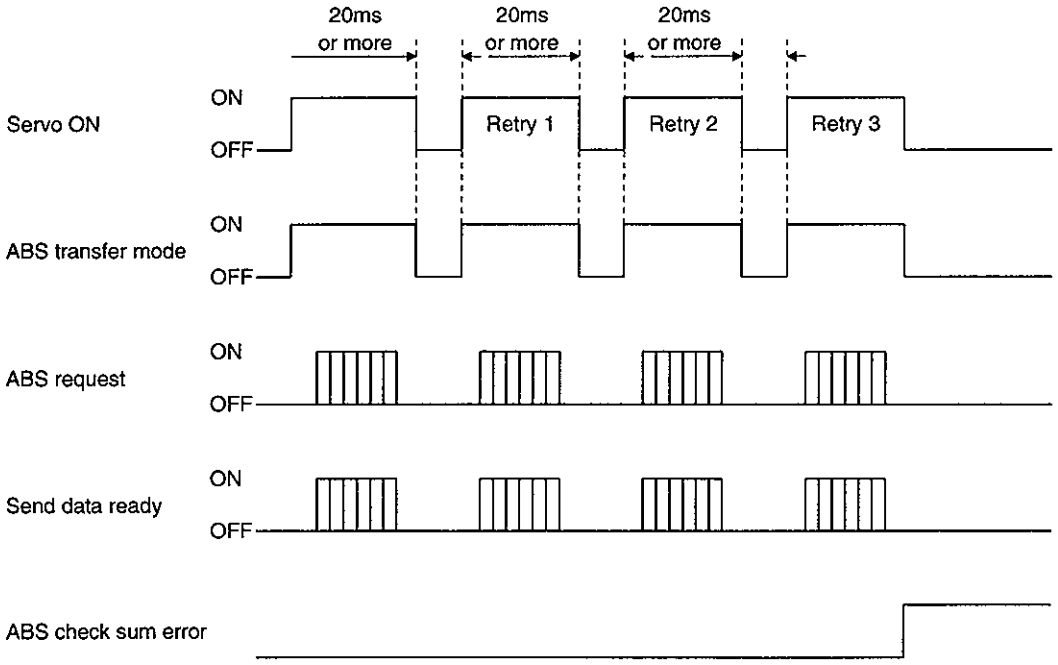
(b) Check sum error

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.

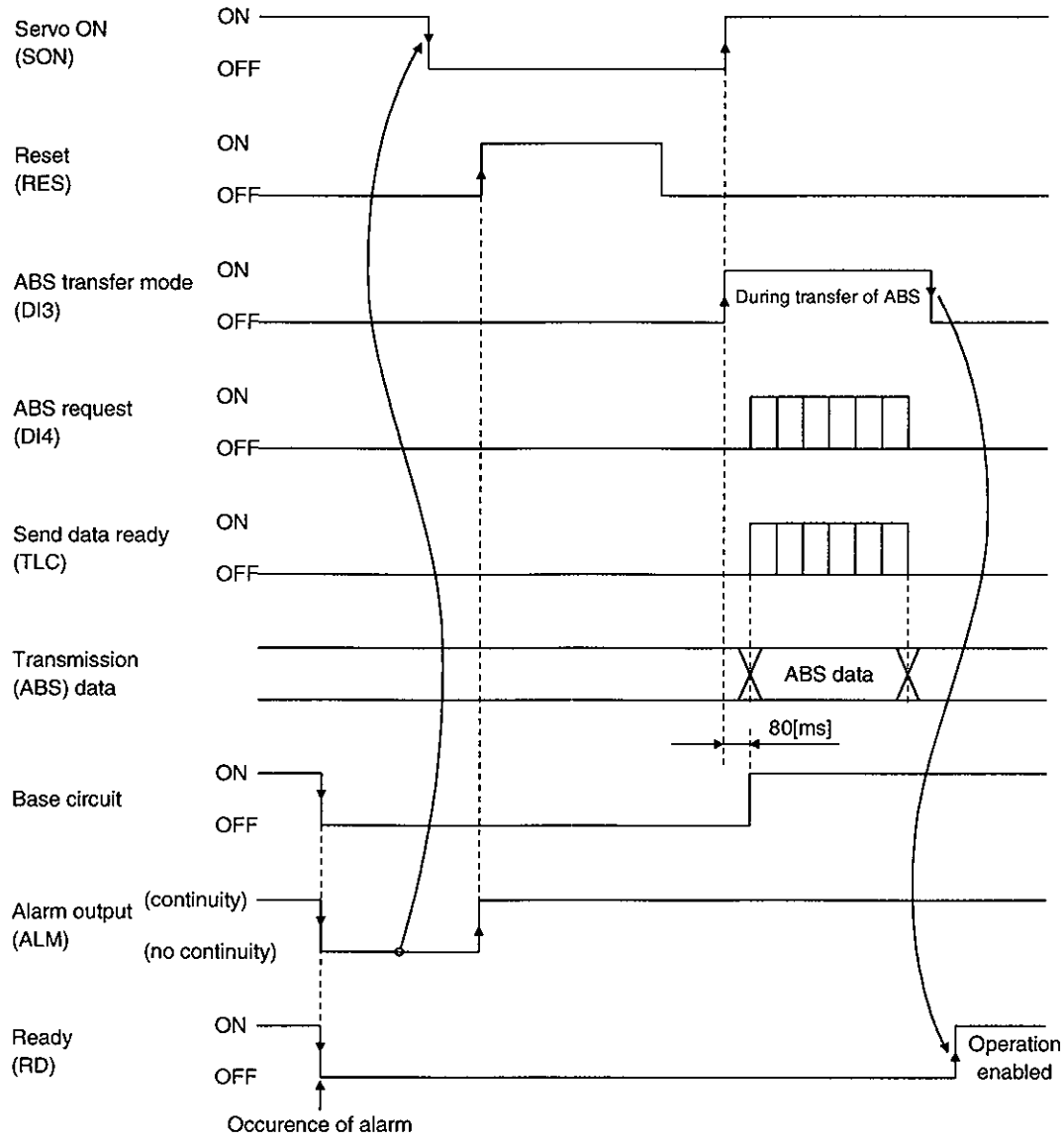
If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

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

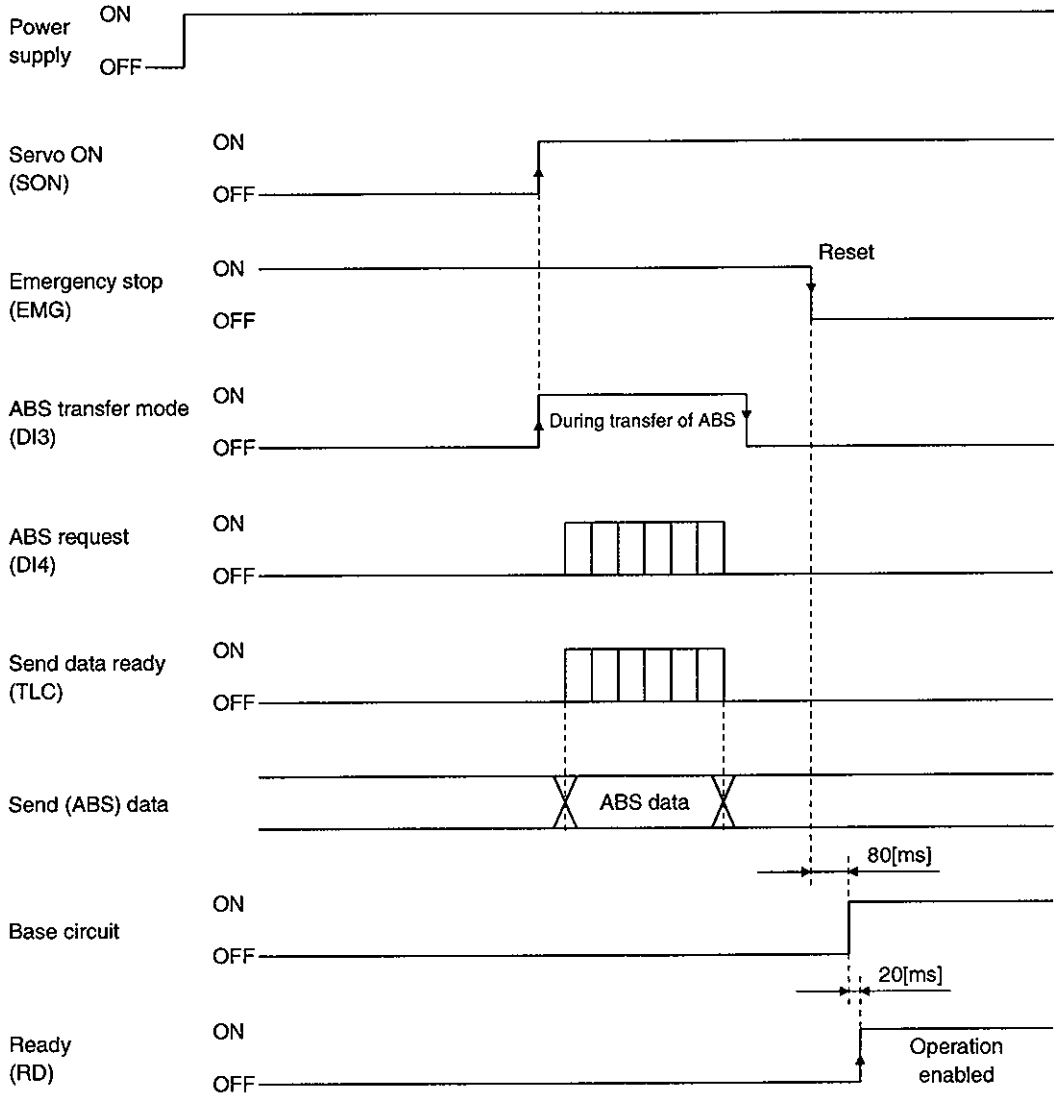
(a) If the power is switched ON in the emergency stop state

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.

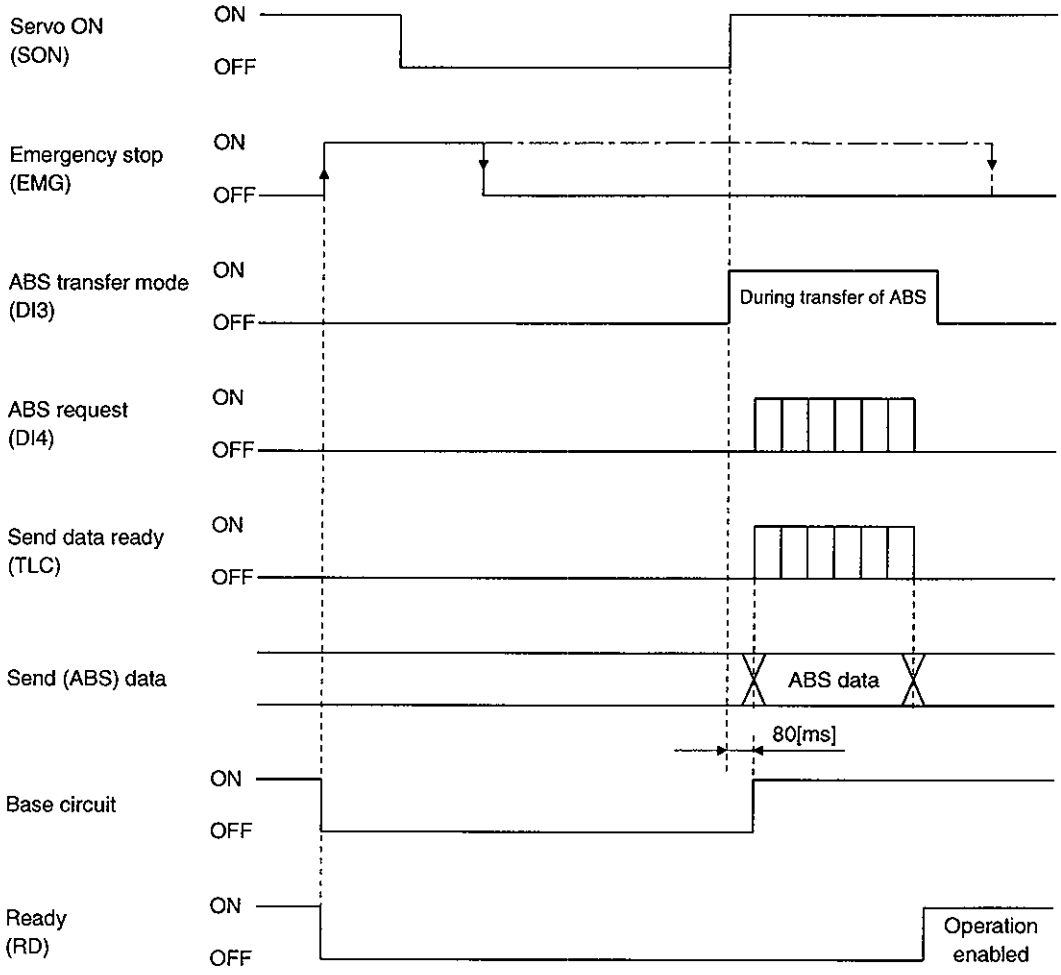
Since the current value is updated during an emergency stop, a travel during the emergency stop will be a position droop (droop pulses). If the emergency stop state is reset and the base circuit is turned ON in this condition, the motor will operate to return the machine by the distance that it moved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



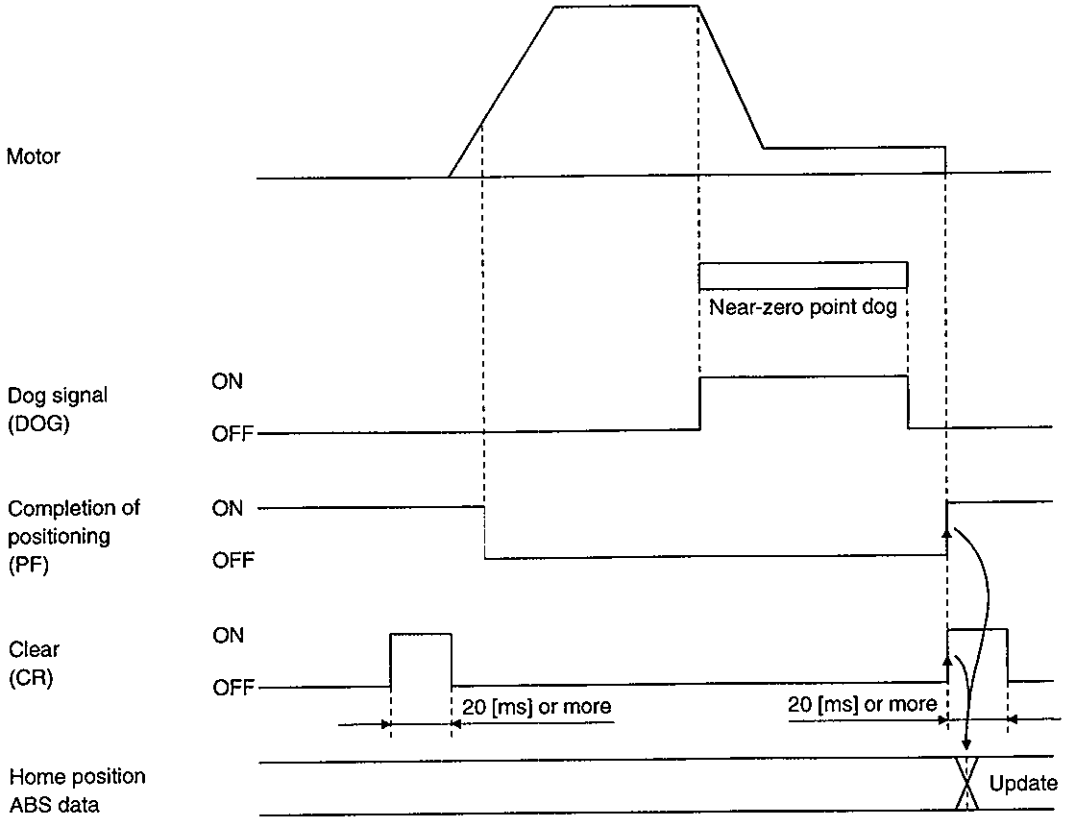
5.7.3 Home Position Setting

(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.

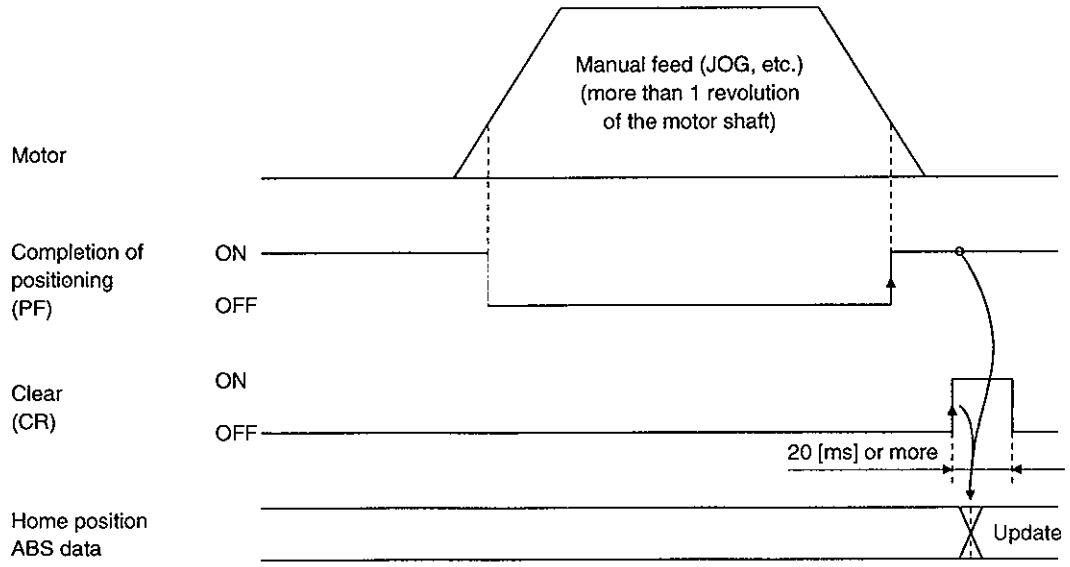


(2) Data set type zeroing

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.

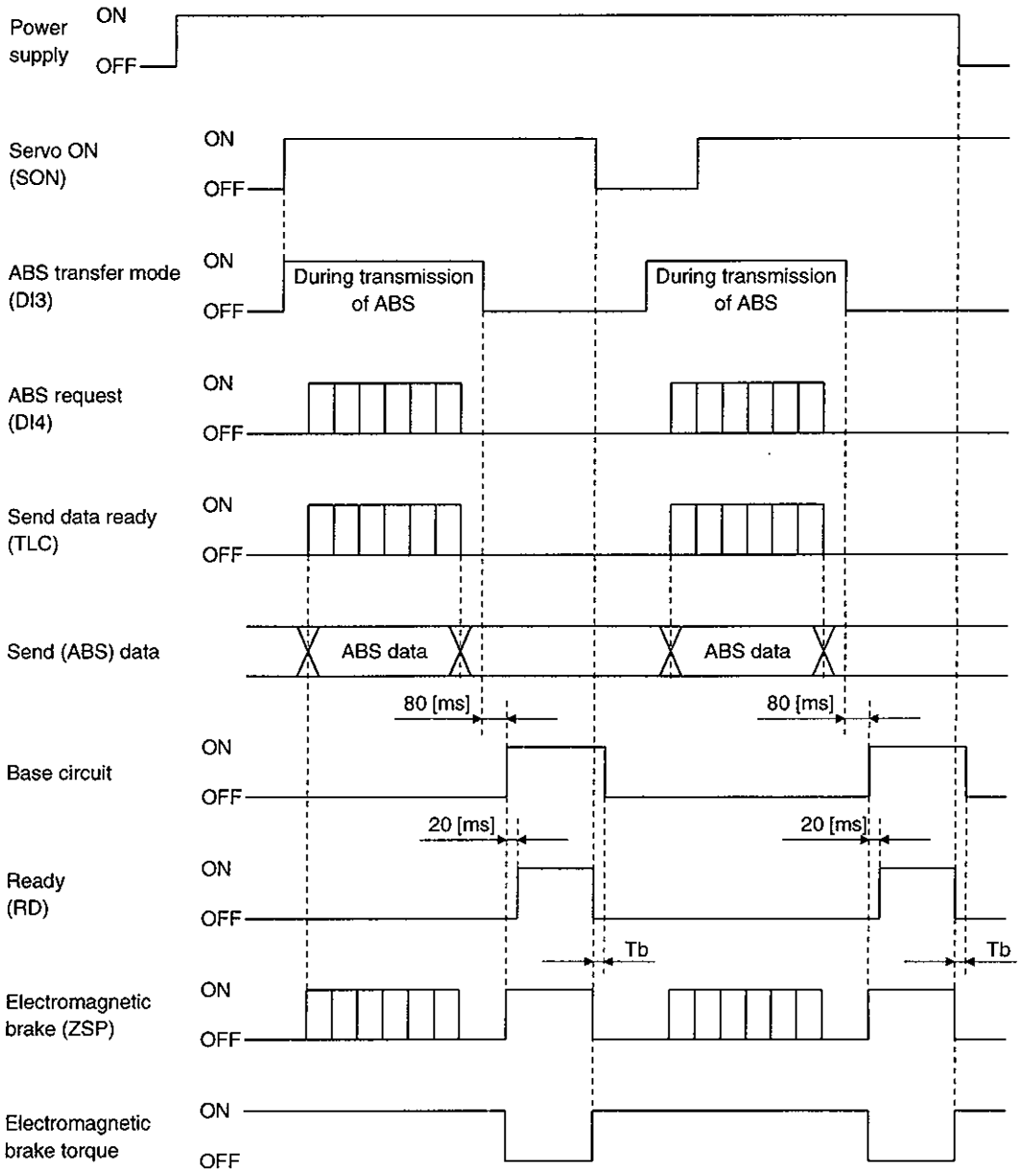
The clear signal should be turned on after it has been confirmed that the in-position (PF) is on. If this condition is not satisfied, the zero setting error (AL96) will occur, but that warning will be reset automatically by making zeroing correctly.

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

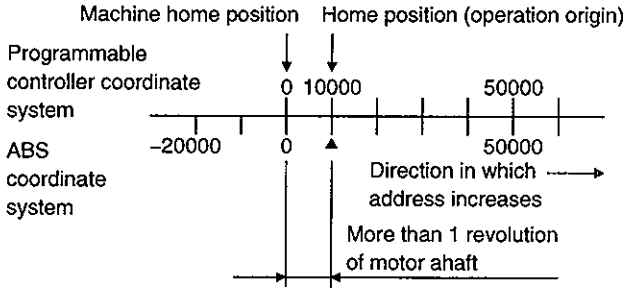
5.8.1 MELSEC-A1S (A1SD71)

(1) Instructions

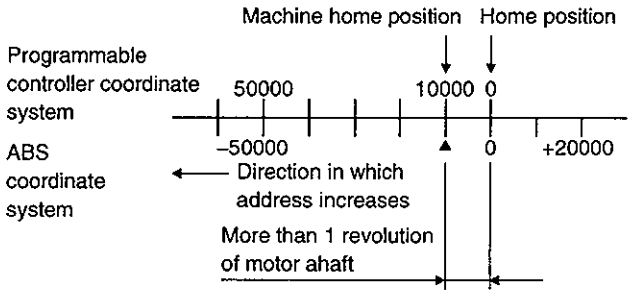
The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the 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.

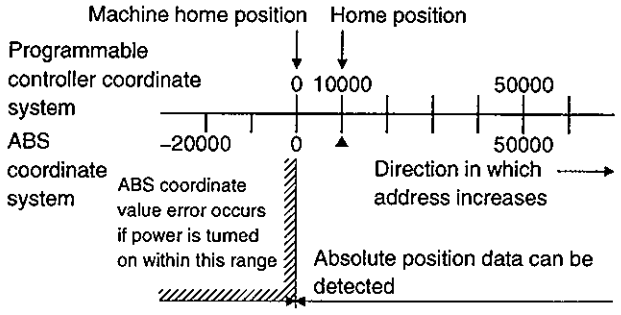


a) If revolution direction parameter (Pr. 14) = 0

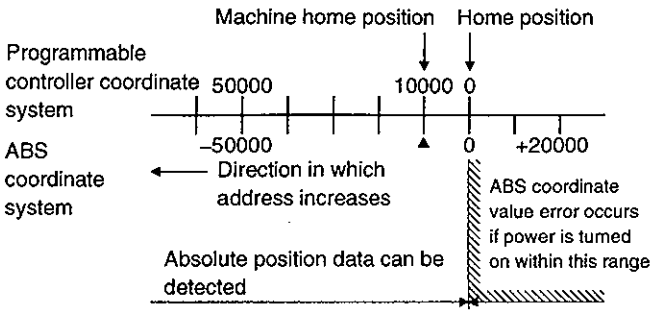


b) If revolution direction parameter (Pr. 14) = 1

(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.

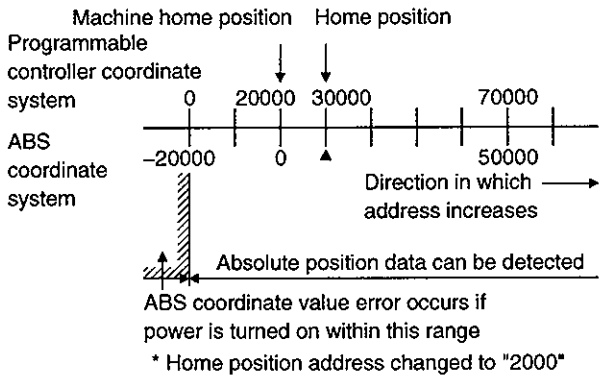


a) If revolution direction parameter (Pr. 14) = 0

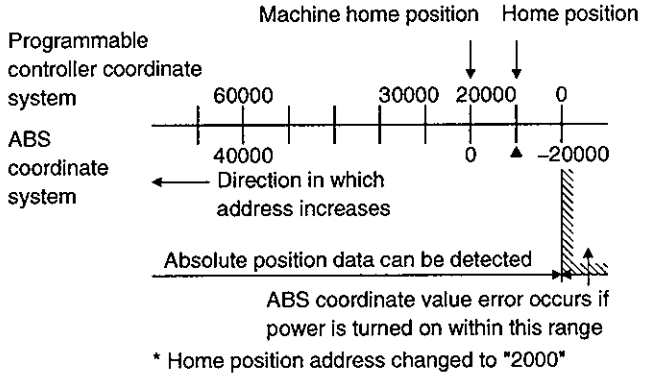


b) If revolution direction parameter (Pr. 14) = 1

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.



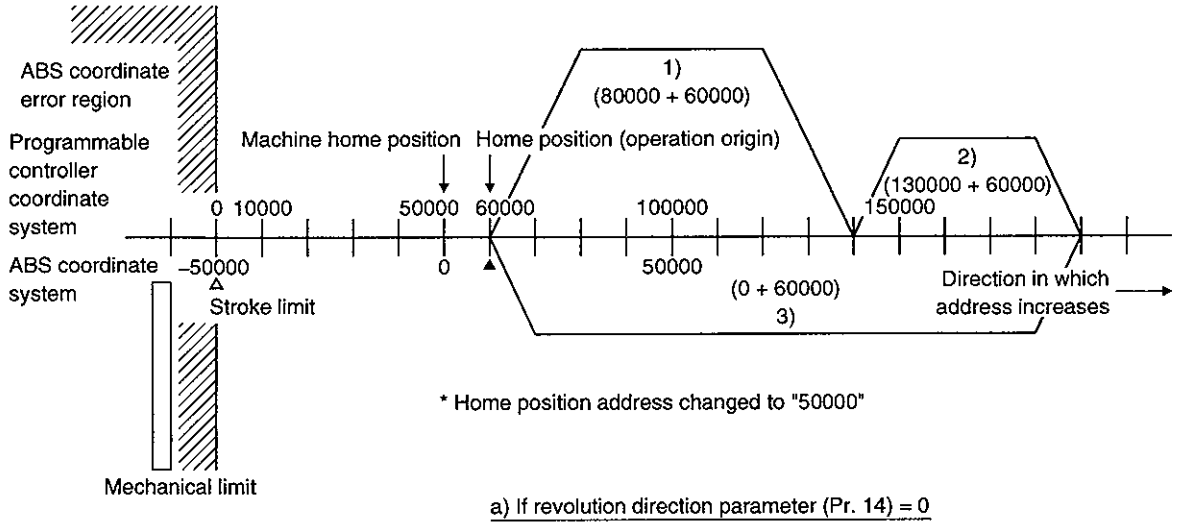
a) If revolution direction parameter (Pr. 14) = 0



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)

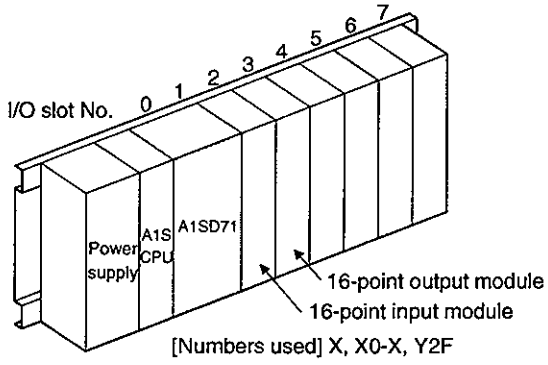


a) If revolution direction parameter (Pr. 14) = 0

(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

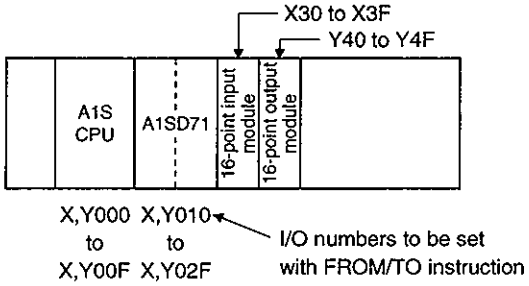
(e) Points

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.

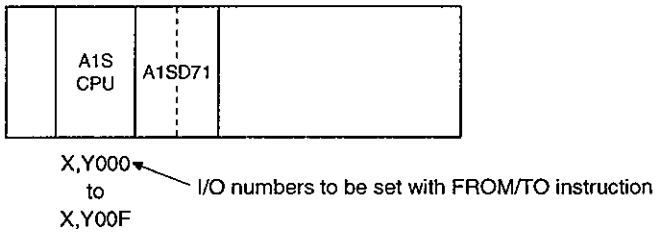


Note: The program example given in (3) in this section is for 1-axis control. Slot allocations are as illustrated to the left. To use the system for 2-axis control, increase the number of I/O points.

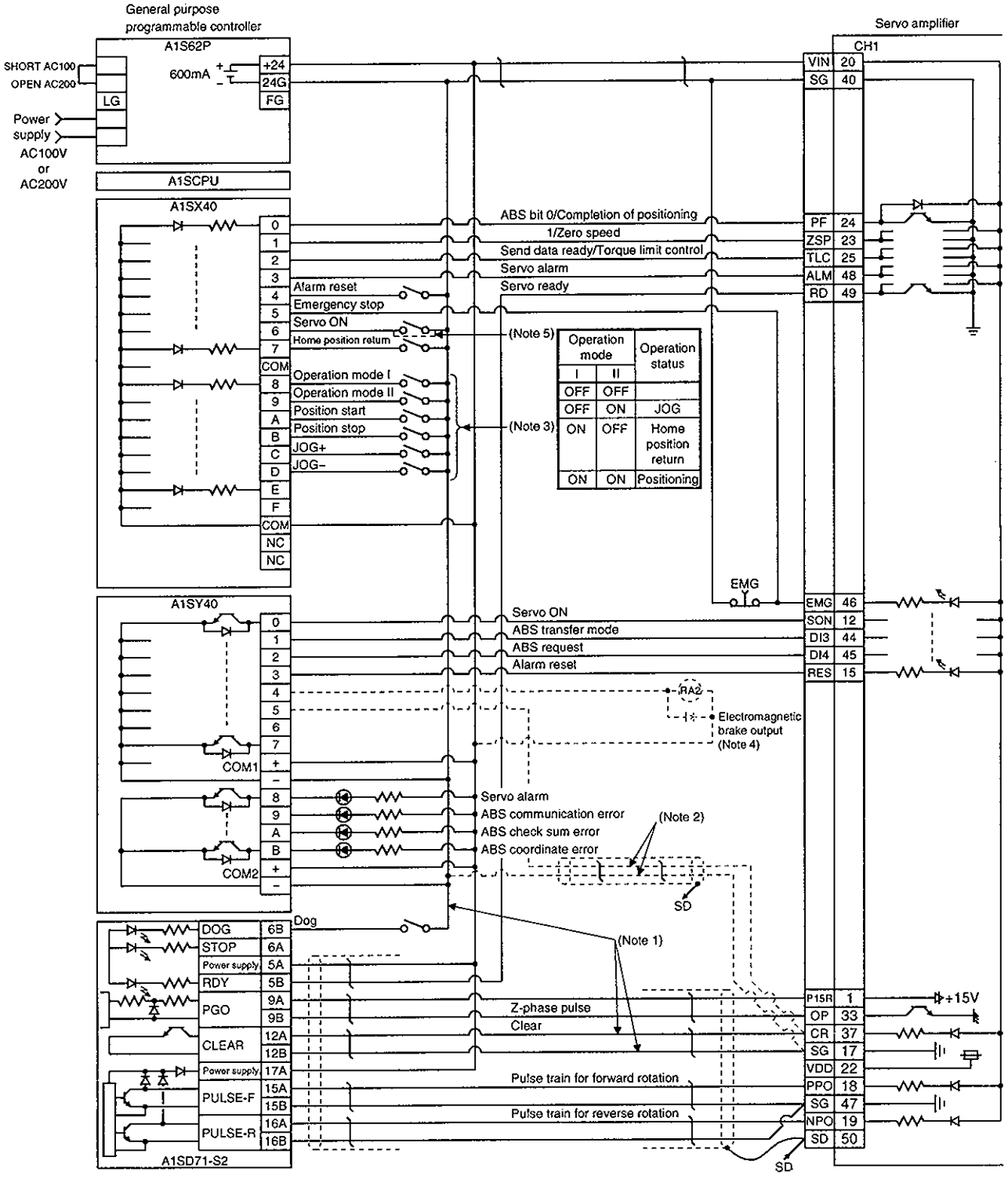
Therefore, the I/O number to be set with the FROM/TO instruction is "head I/O number allocated to the A1SD71 + 010H".

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



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
T timer		M13	PLS processing command
T0	ABS transfer mode timer	M20 (Note 1)	Clear signal ON timer request
T1	ABS request response timer	M21 (Note 2)	Data set type home position return request
T2	Retry wait timer	**C counter**	
T3	Ready to send response timer	C0	ABS data receive frequency counter
T10 (Note 1)	Clear signal ON timer	C1	Check sum receive frequency counter
T200	Transmitted data read 10ms delay timer	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:

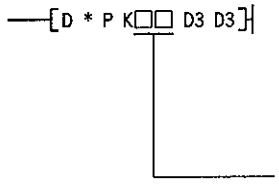
- Parameters of the A1SD71-S2 (AD71) positioning module

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.

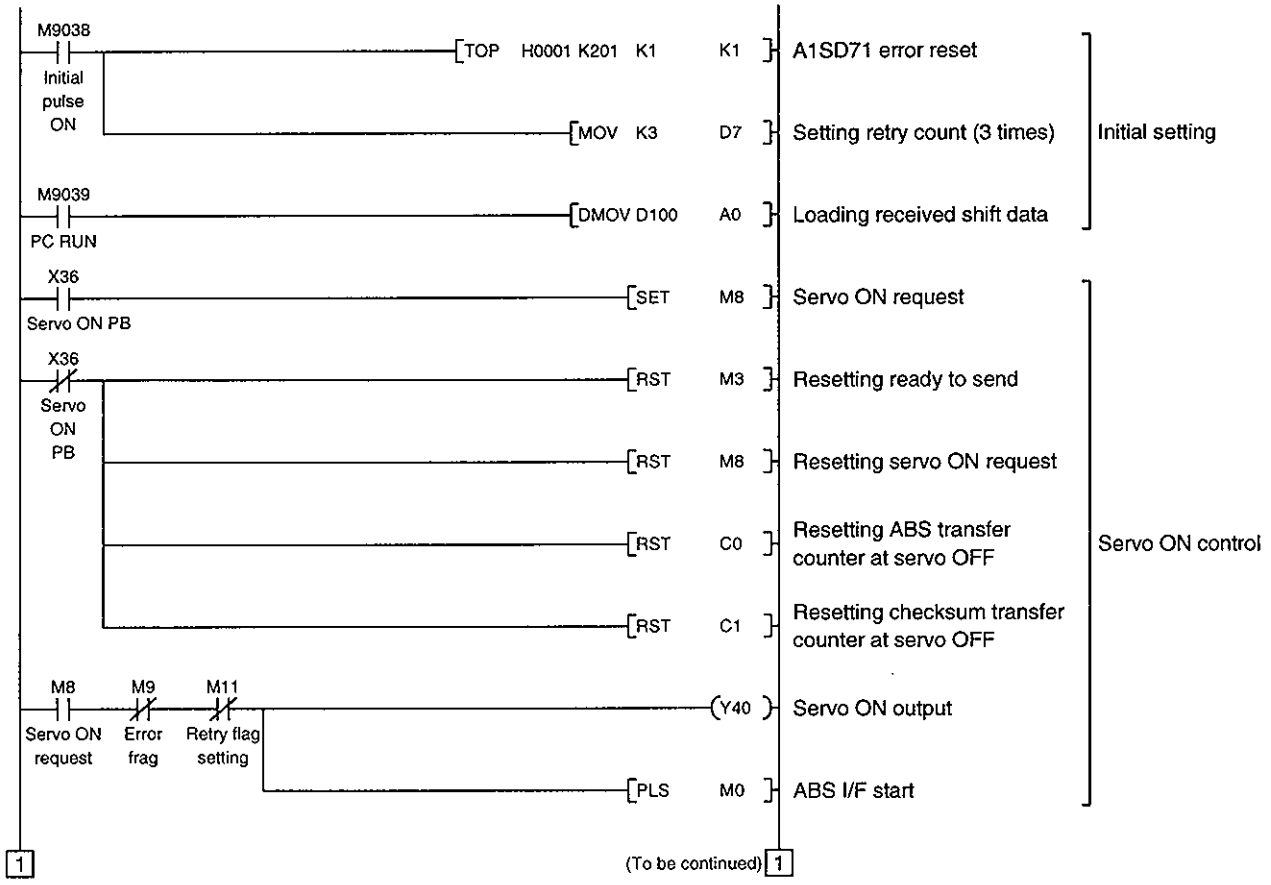
<Additional program>

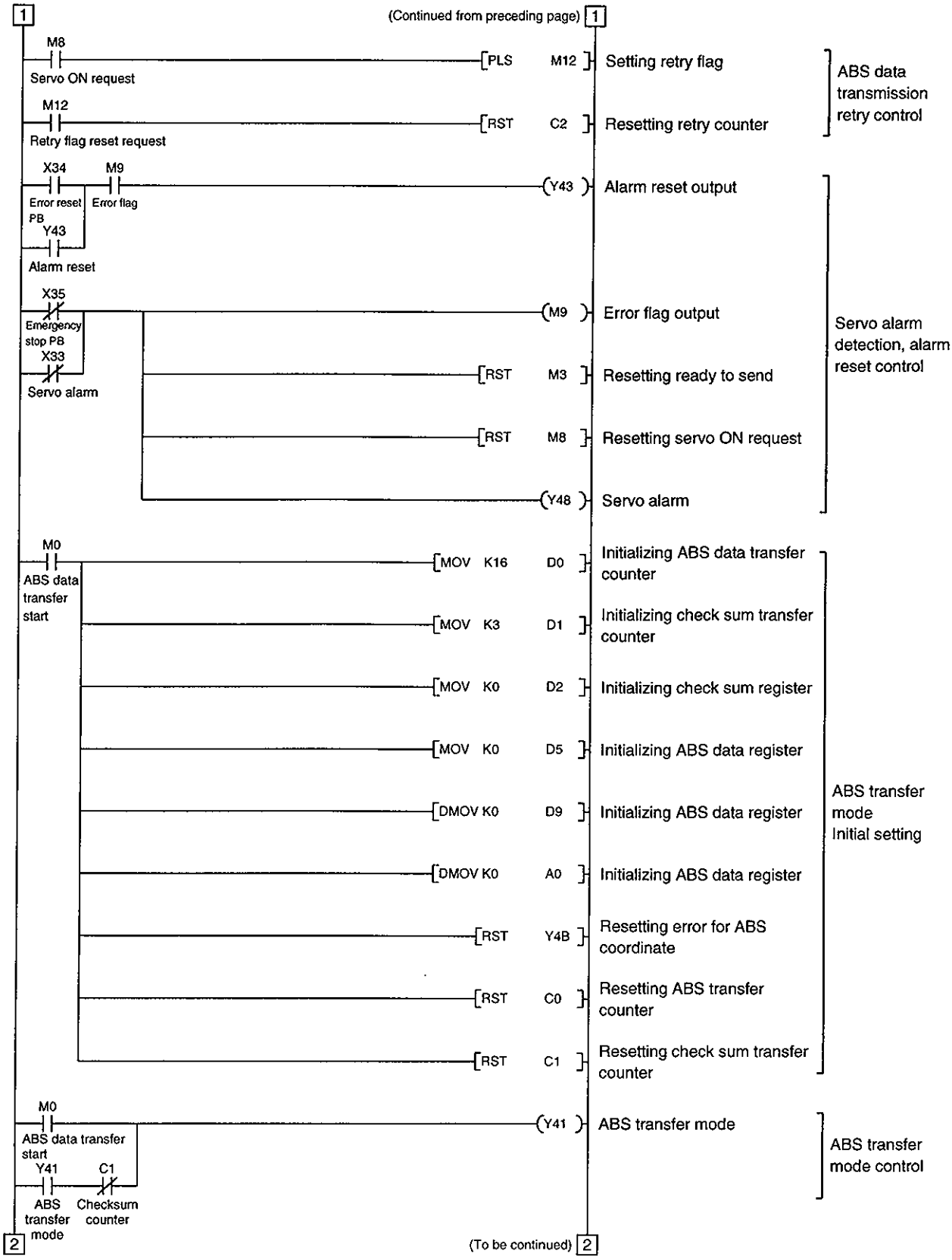


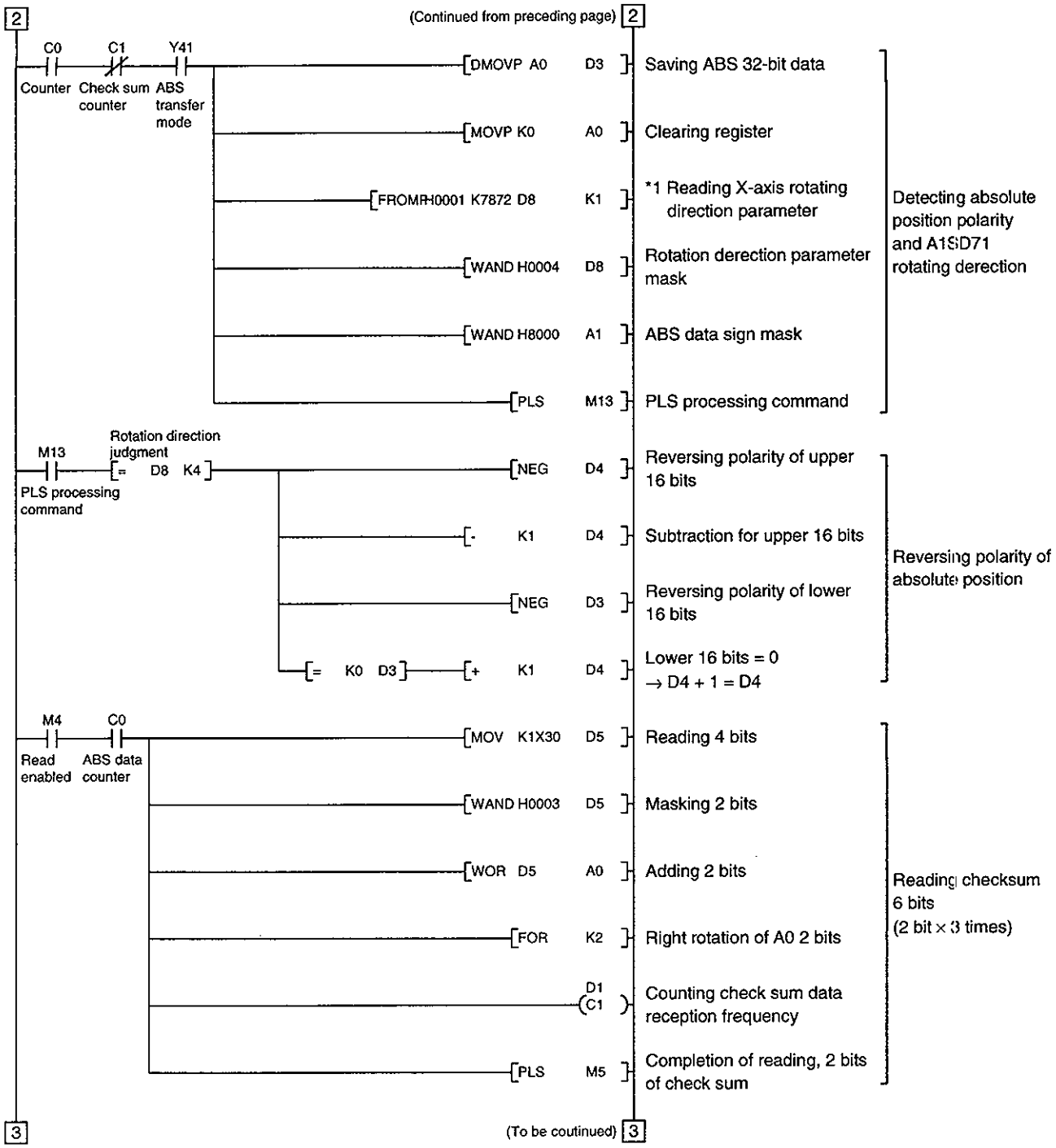
Item	mm			inch			degree			PULS
Unit setting	0			1			2			3
Travel per pulse	0.1 to	1.0 to	10.0	0.00001 to	0.0001 to	0.001 to	0.00001 to	0.0001 to	0.001 to	
Unit of travel	μm/PLS			inch/PLS			degree/PLS			PLS
Constant K for conversion into unit of travel	1 to	10 to	100	1 to	10 to	100	1 to	10 ~to	100	None

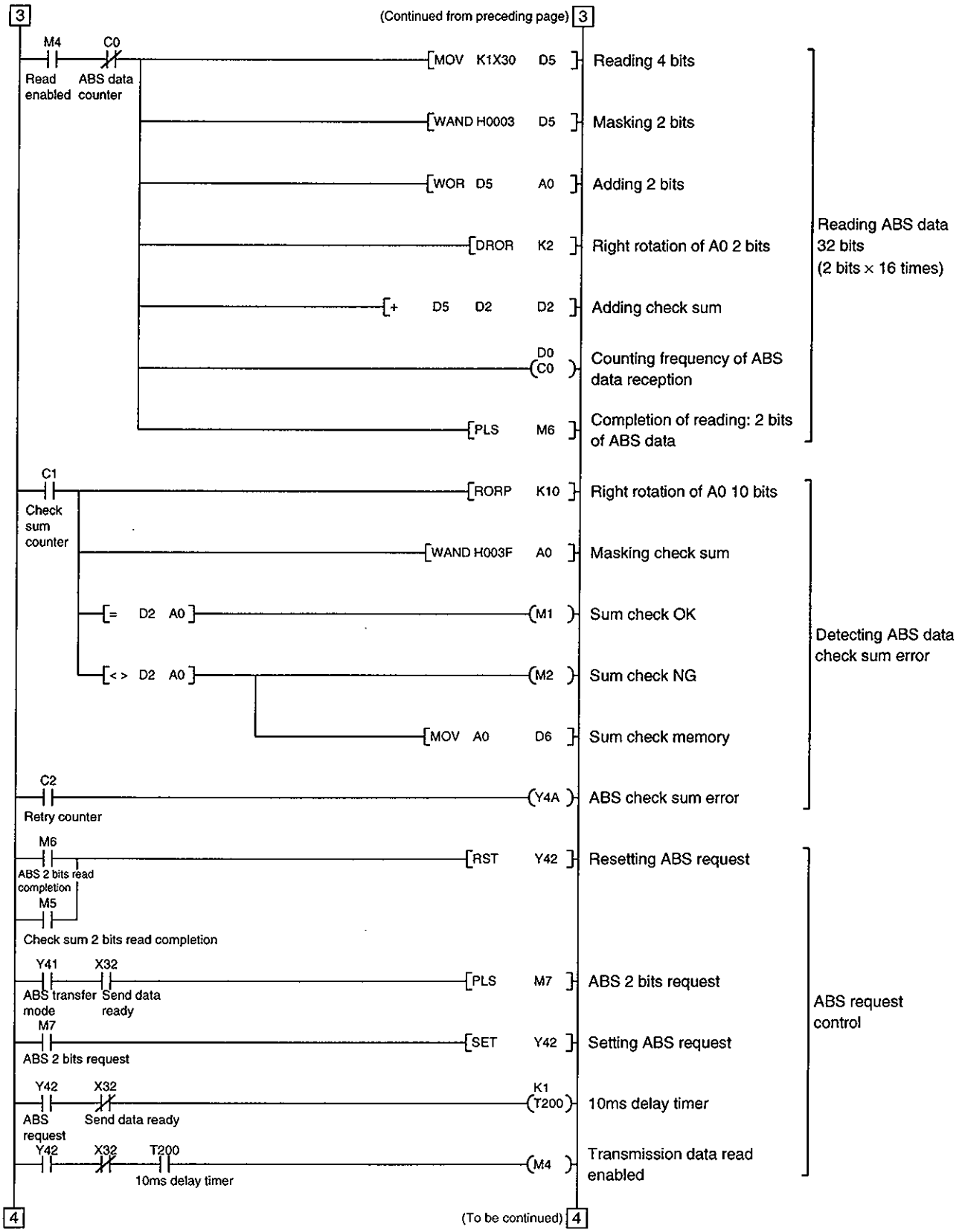
Reference

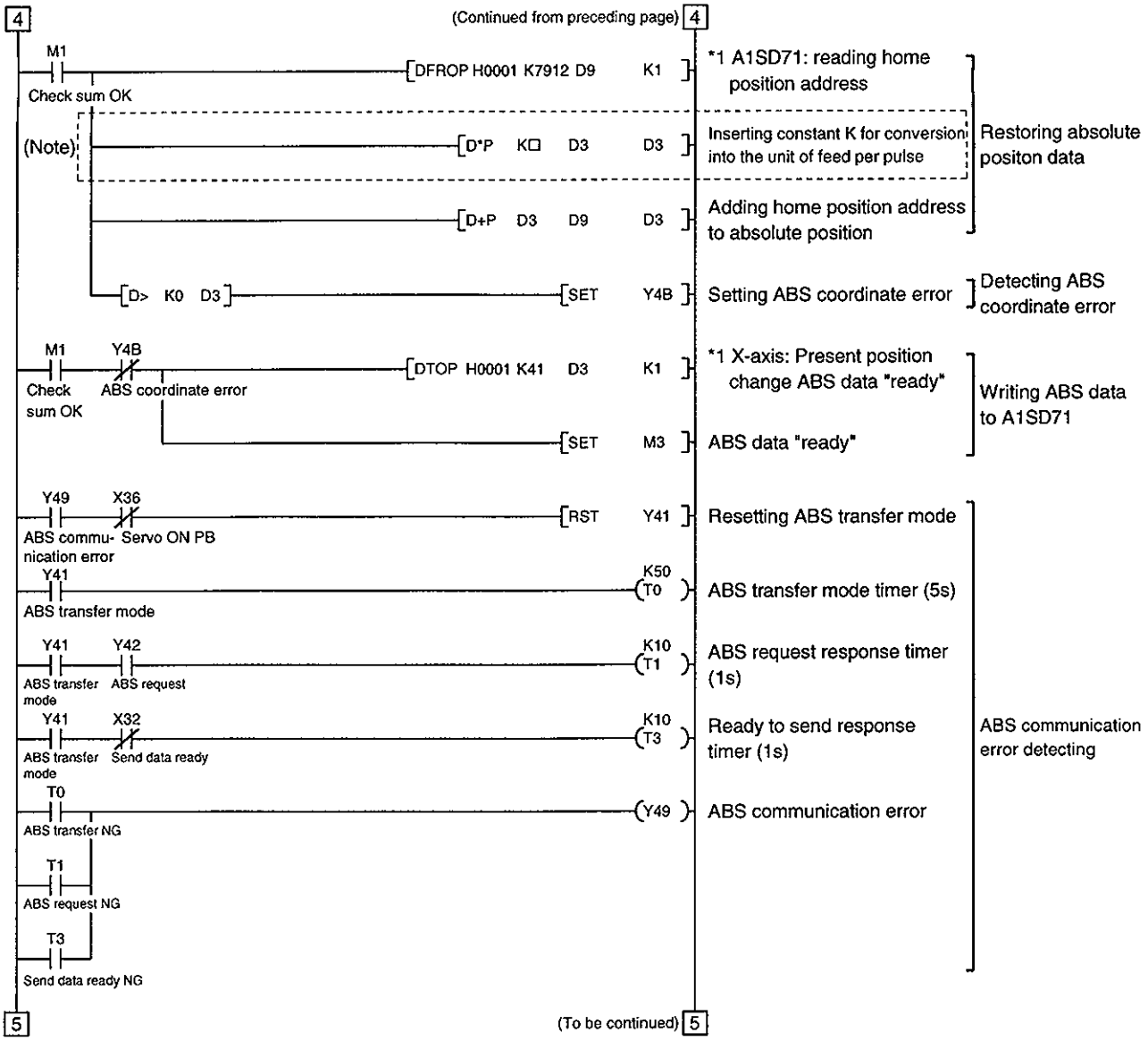
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- When the unit setting is PULS, the additional program is not required.



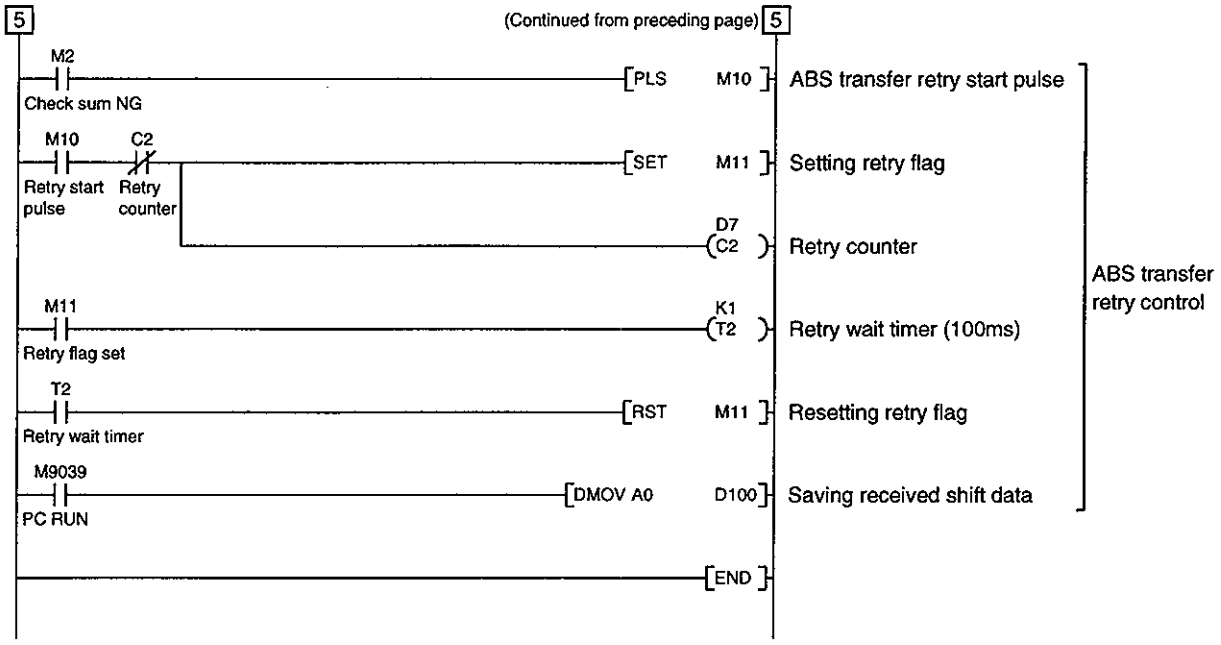

1
(Continued from preceding page)
1
M8
Servo ON request
PLS M12
Setting retry flag
M12
Retry flag reset request
RST C2
Resetting retry counter
ABS data transmission retry control
X34
Error reset PB
M9
Error flag
Y43
Alarm reset output
Y43
Alarm reset
X35
Emergency stop PB
X33
Servo alarm
M9
Error flag 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
ABS transfer mode
C1
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
FROMRH0001 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
Rotation direction judgment
= D8 K4
PLS processing command
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


3
(Continued from preceding page)
3
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
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding check sum
D0
C0
Counting frequency of ABS data reception
PLS M6
Completion of reading: 2 bits of ABS data
Reading ABS data 32 bits (2 bits × 16 times)
C1
Check sum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking check sum
= D2 A0
M1
Sum check OK
< > D2 A0
M2
Sum check NG
MOV A0 D6
Sum check memory
C2
Retry counter
Y4A
ABS check sum error
Detecting ABS data check sum error
M6
ABS 2 bits read completion
M5
Check sum 2 bits read completion
RST Y42
Resetting ABS request
Y41
ABS transfer mode
X32
Send data ready
PLS M7
ABS 2 bits request
M7
ABS 2 bits request
SET Y42
Setting ABS request
Y42
ABS request
X32
Send data ready
K1
T200
10ms delay timer
Y42
X32
T200
10ms delay timer
M4
Transmission data read enabled
ABS request control
4
(To be continued)
4



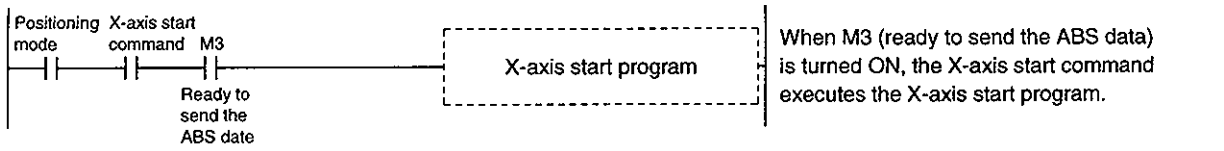
Note: When the unit setting parameter value of the AD71 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To change the unit to × 1μm, and this program to multiple the feed value by 10.



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.



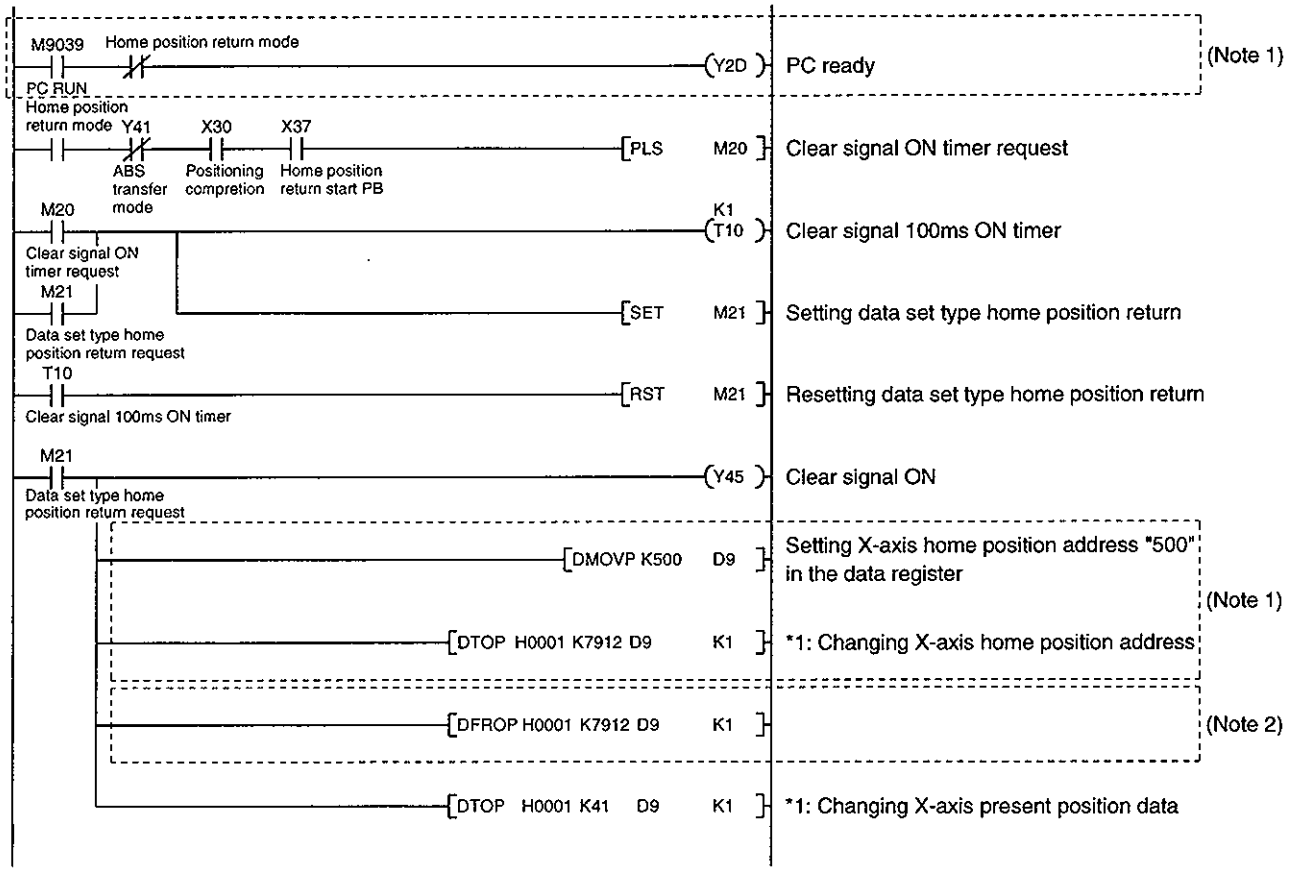
(e) Dog type zeroing

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

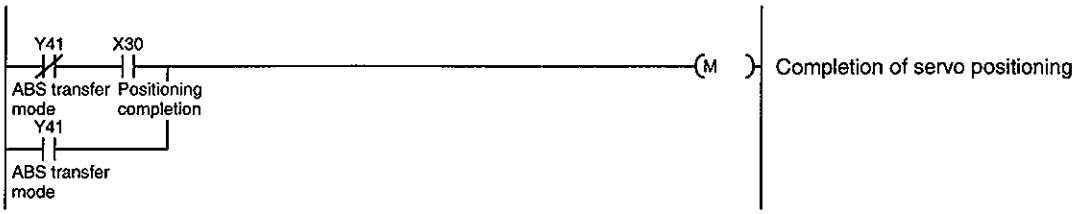
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.

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.

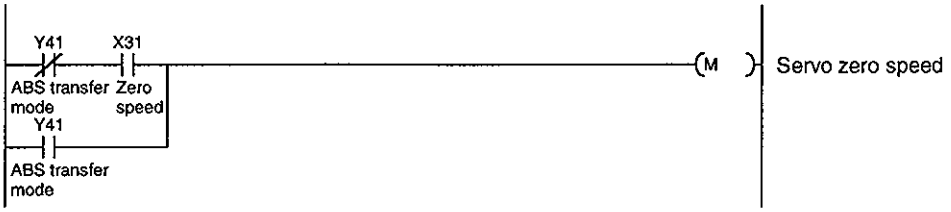
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for servo zero speed

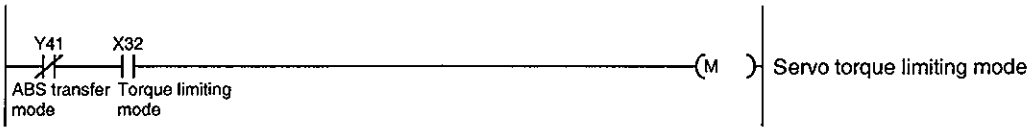
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(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

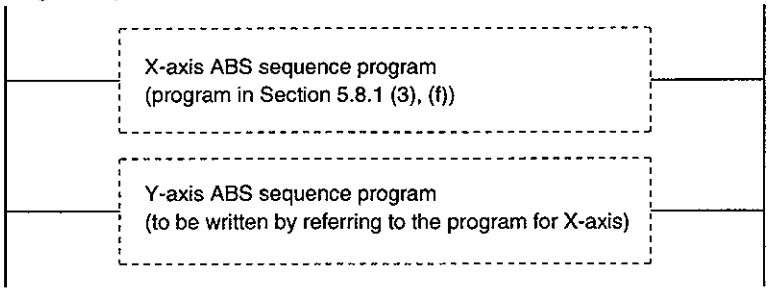
Make the program for Y-axis referring to the program for X-axis.

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

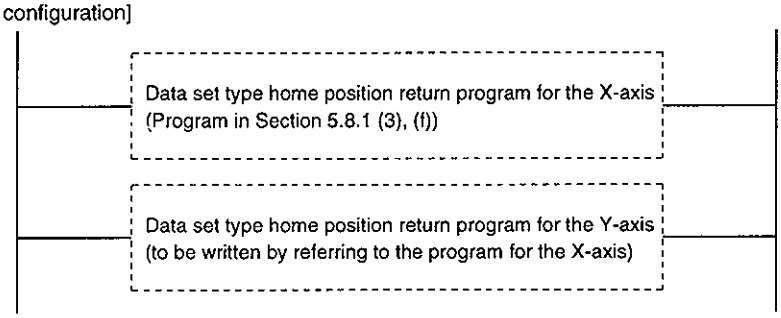
Arrange the data set type zeroing programs given in Section 5.8.1 (3), (f) in series to control two axes.

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]
```

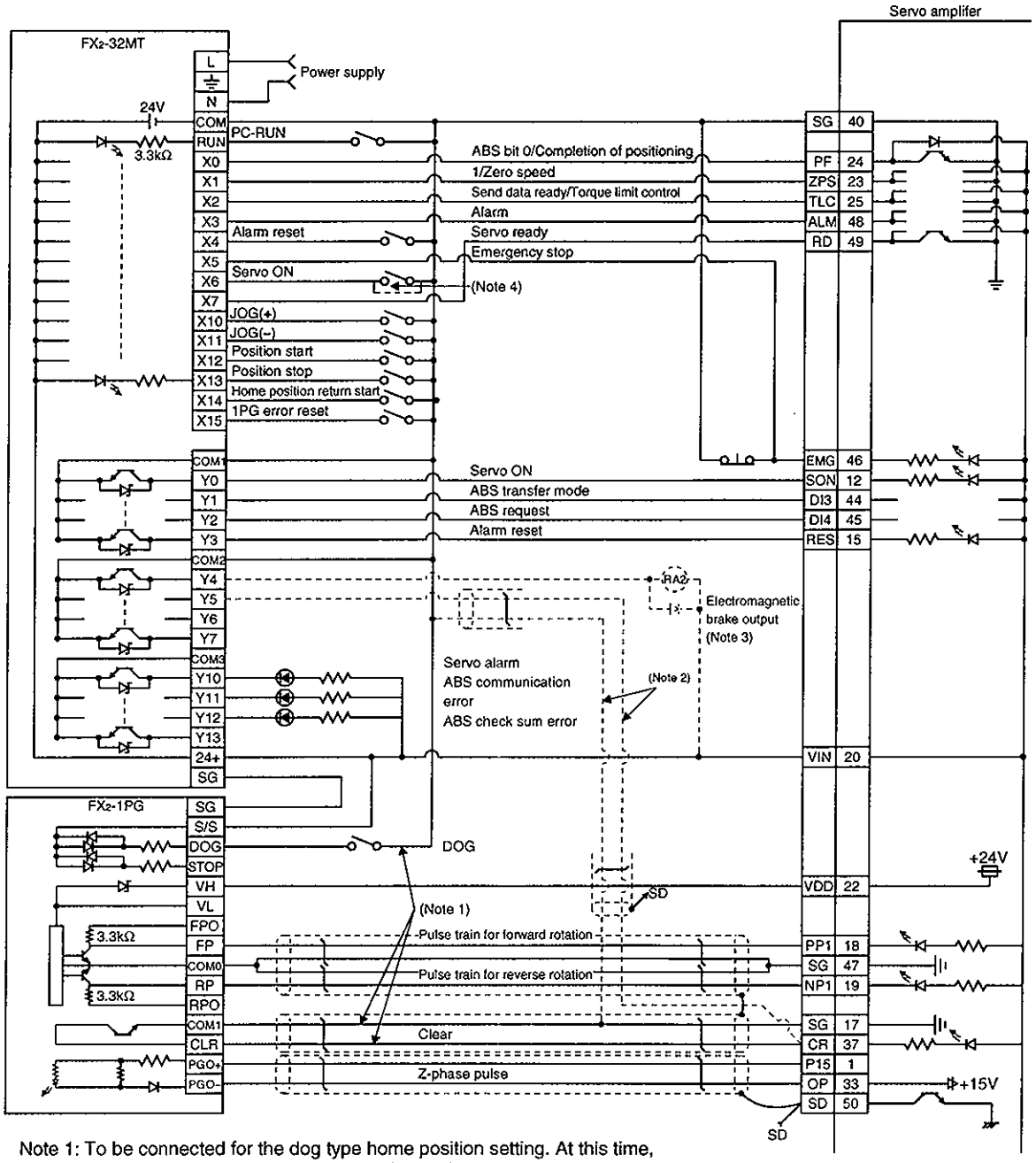
[Program configuration]



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).

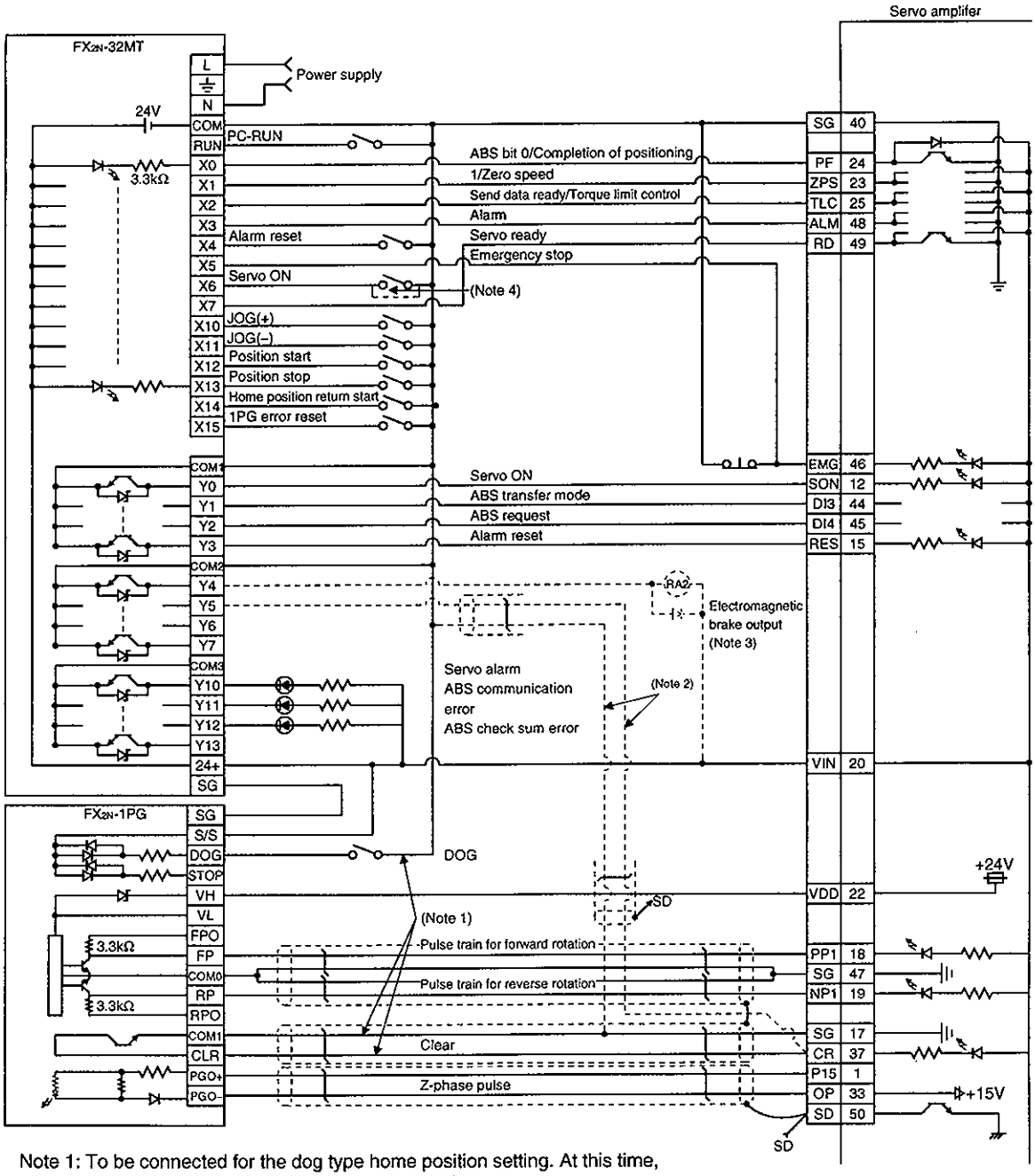
2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

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)



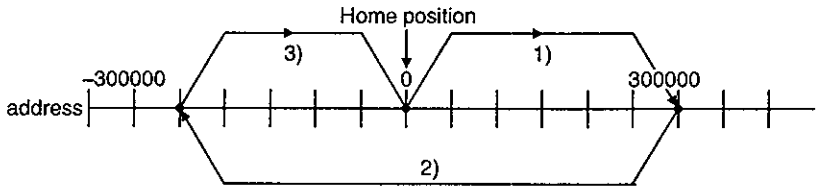
Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).
2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).
3: The electromagnetic brake interlock signal should be 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

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

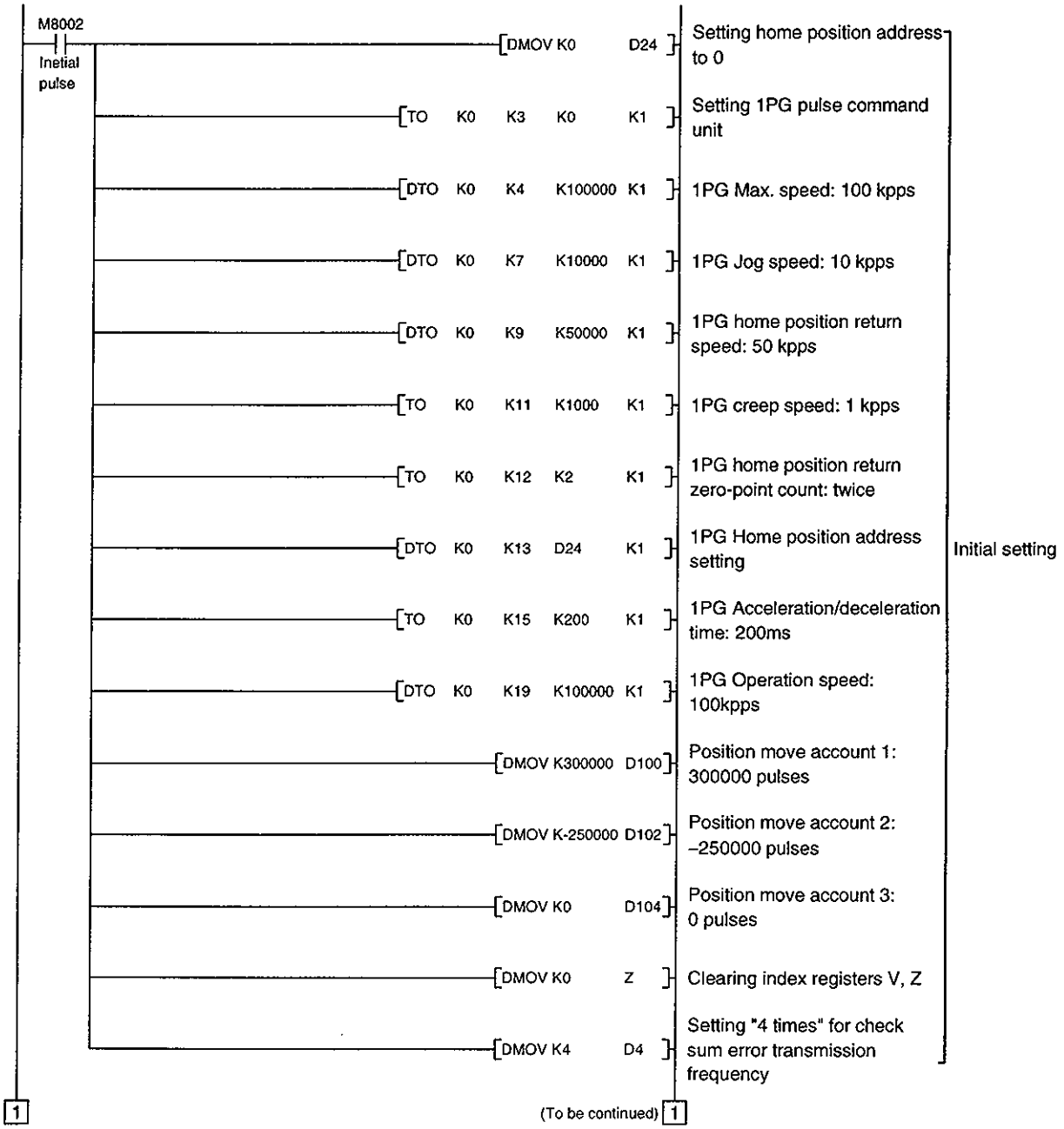
M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Spare
M5	Servo ON request
M6	Retry flag
M10	ABS data 2 bit receiving buffer
M11	
M12	
M13	
M20 ↓ M51	ABS data 32 bit buffer
M52 ↓ M57	Check sum 6 bit buffer
M58	For checksum comparison
M59	
M62	Sum check discrepancy (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

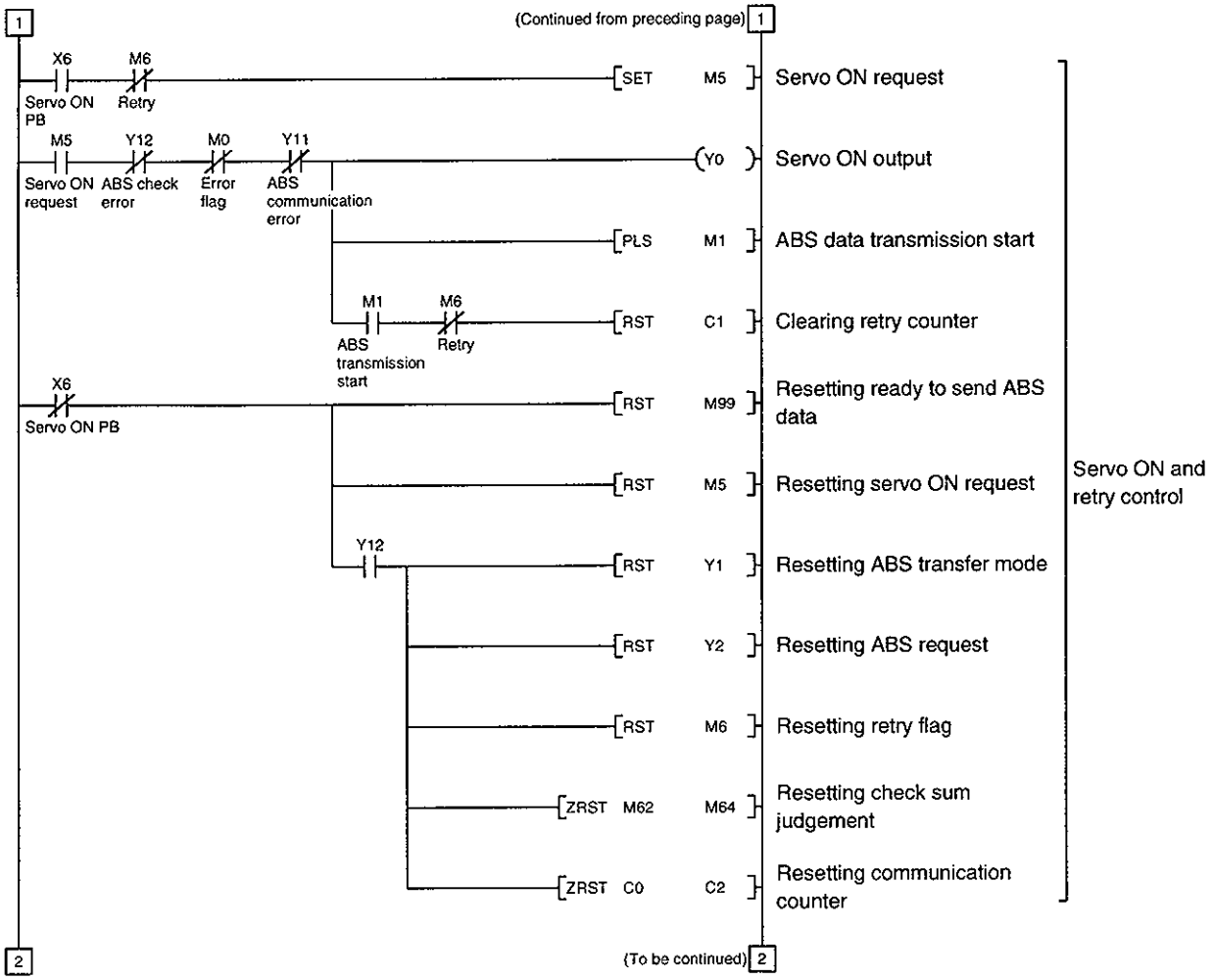
C counter	
C0	All data reception frequency counter (19 times)
C1	Check sum reception frequency counter
C2	ABS data reception frequency counter (16 times)

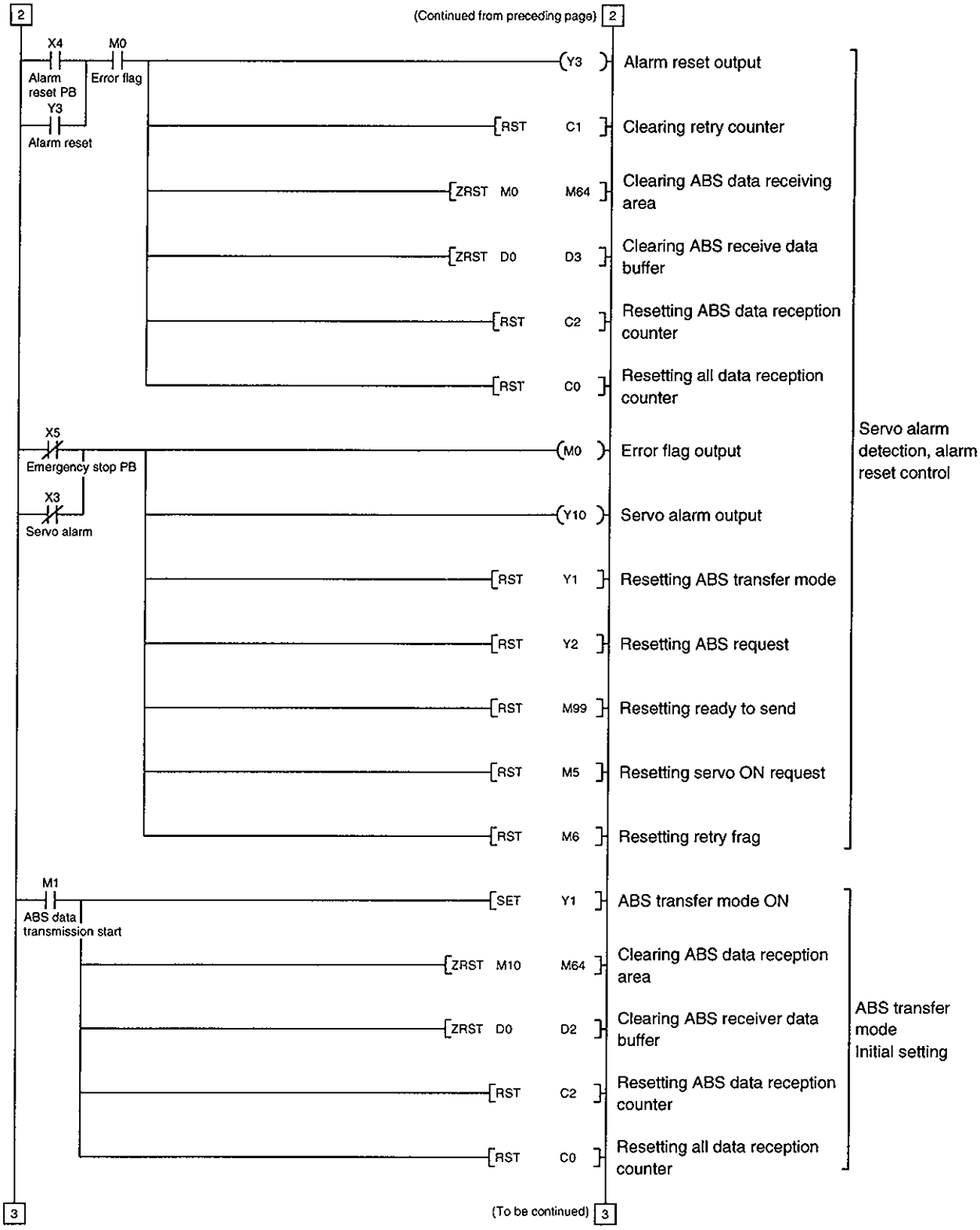
Note 1: Necessary when data set type home position return is executed.

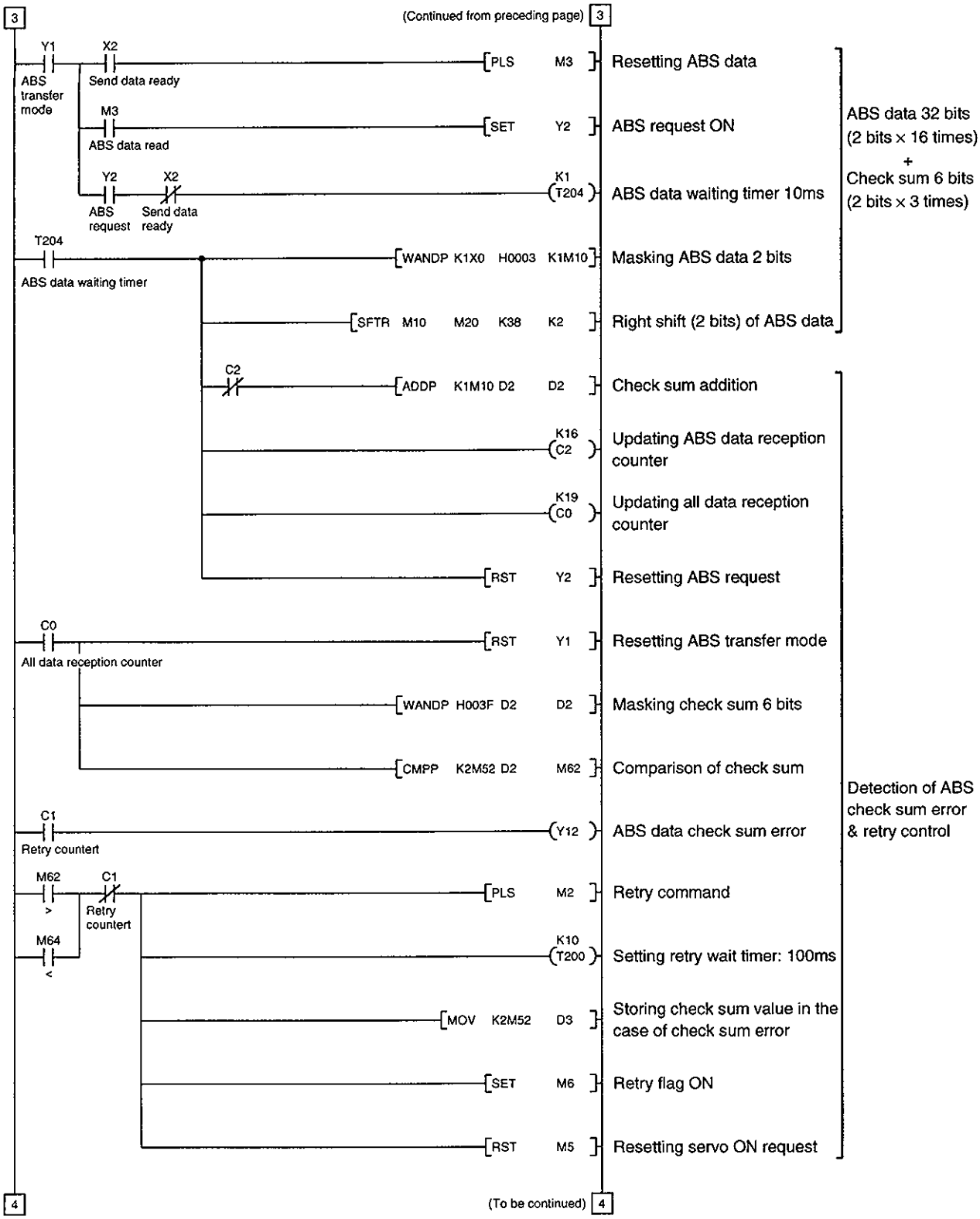
2: Necessary in the event of electromagnetic brake output.

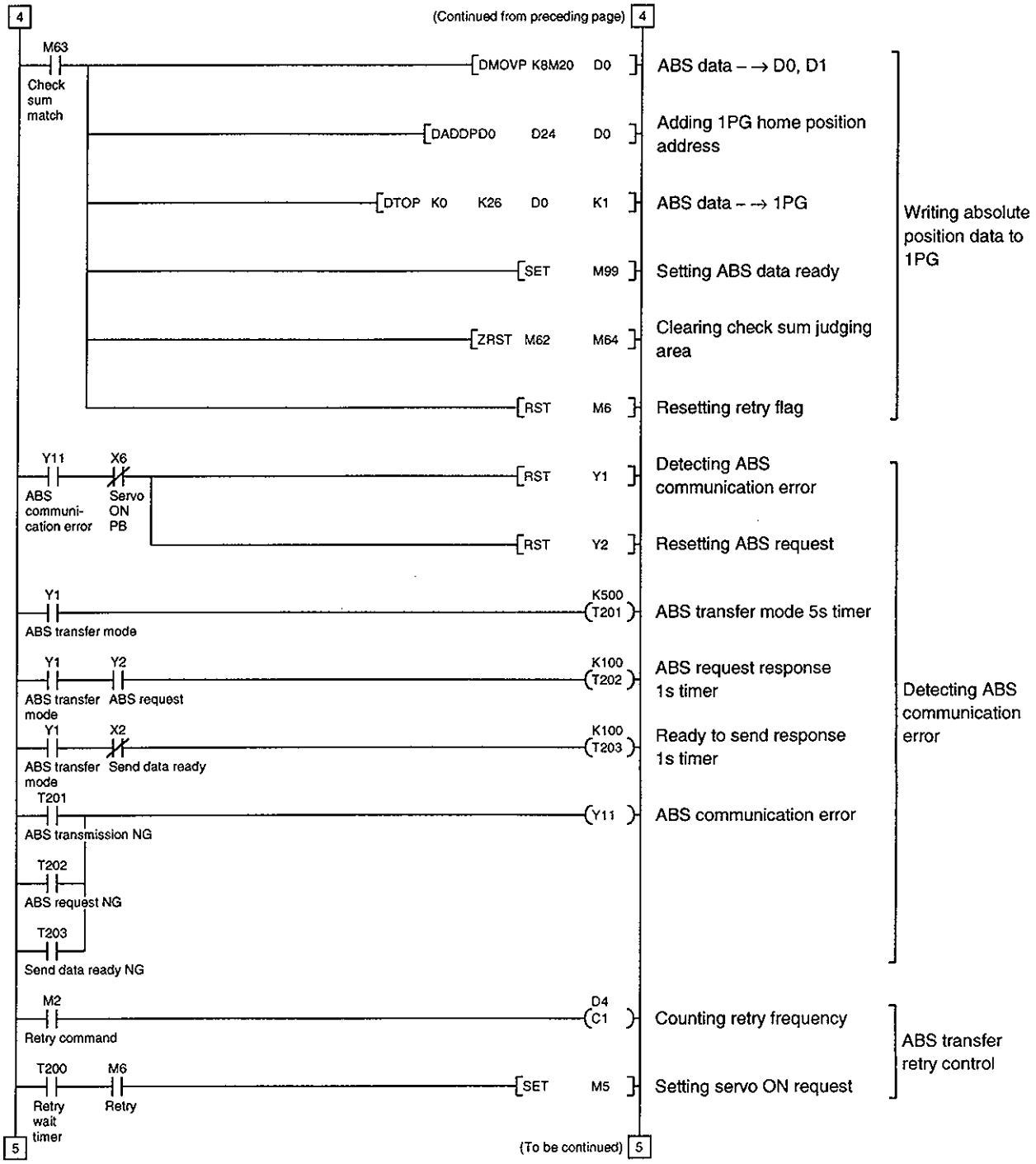
(c) ABS data transfer program for X-axis

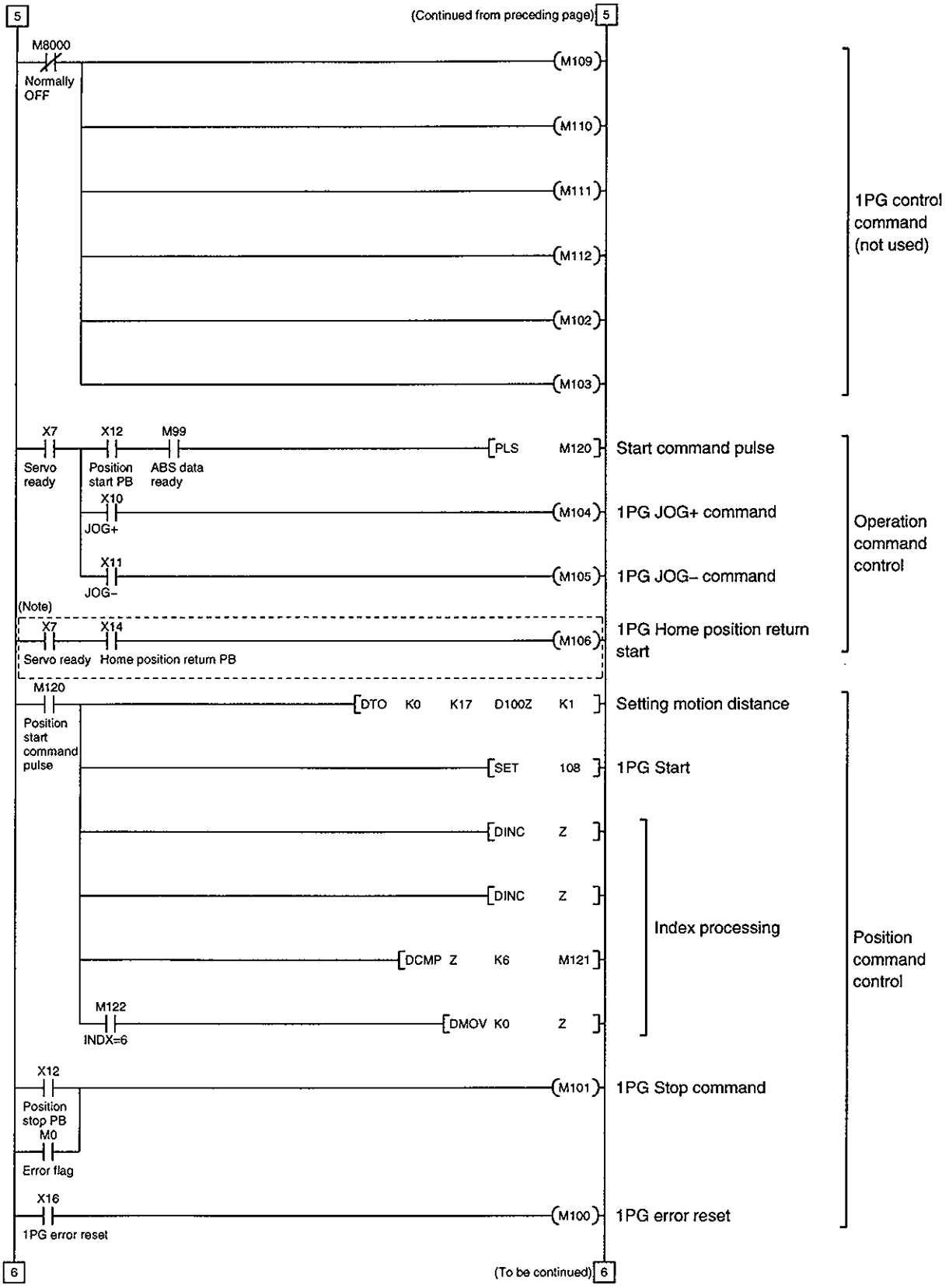



1
(Continued from preceding page)
1
X6
Servo ON PB
M6
Retry
SET M5
Servo ON request
M5
Servo ON request
Y12
ABS check error
M0
Error flag
Y11
ABS communication error
Y0
Servo ON output
PLS M1
ABS data transmission start
M1
ABS transmission start
M6
Retry
RST C1
Clearing retry counter
X6
Servo ON PB
RST 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

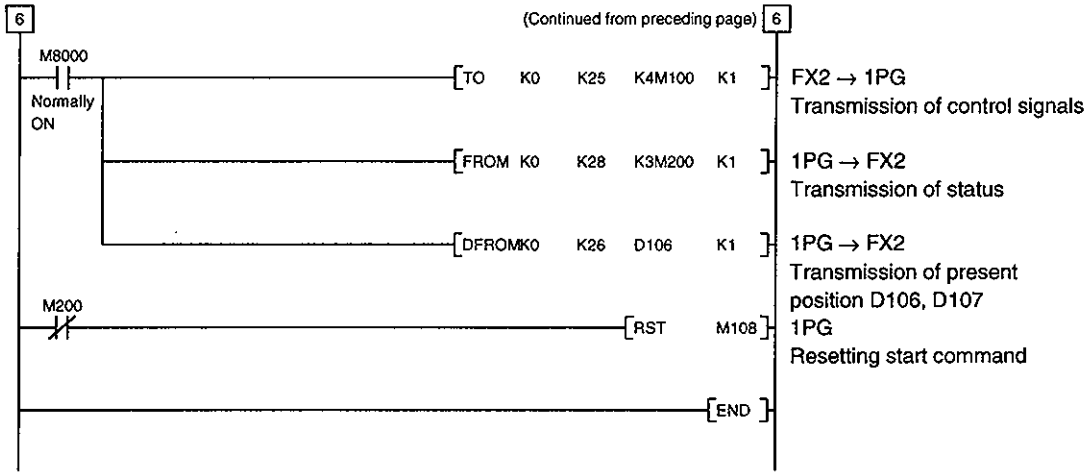

2
(Continued from preceding page)
2
X4
Alarm reset PB
M0
Error flag
Y3
Alarm reset
Y3
Alarm reset output
RST C1
Clearing retry counter
ZRST M0 M64
Clearing ABS data receiving area
ZRST D0 D3
Clearing ABS receive data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
X5
Emergency stop PB
X3
Servo alarm
M0
Error flag output
Y10
Servo alarm output
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M99
Resetting ready to send
RST M5
Resetting servo ON request
RST M6
Resetting retry frag
Servo alarm detection, alarm reset control
M1
ABS data transmission start
SET Y1
ABS transfer mode ON
ZRST M10 M64
Clearing ABS data reception area
ZRST D0 D2
Clearing ABS receiver data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
ABS transfer mode Initial setting
3
(To be continued)
3


3
(Continued from preceding page) 3
Y1
ABS transfer mode
X2
Send data ready
PLS M3
Resetting ABS data
M3
ABS data read
SET Y2
ABS request ON
Y2
ABS request
X2
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
C1
Retry countert
Y12
ABS data check sum error
Detection of ABS check sum error & retry control
M62
>
C1
Retry countert
PLS M2
Retry command
M64
<
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



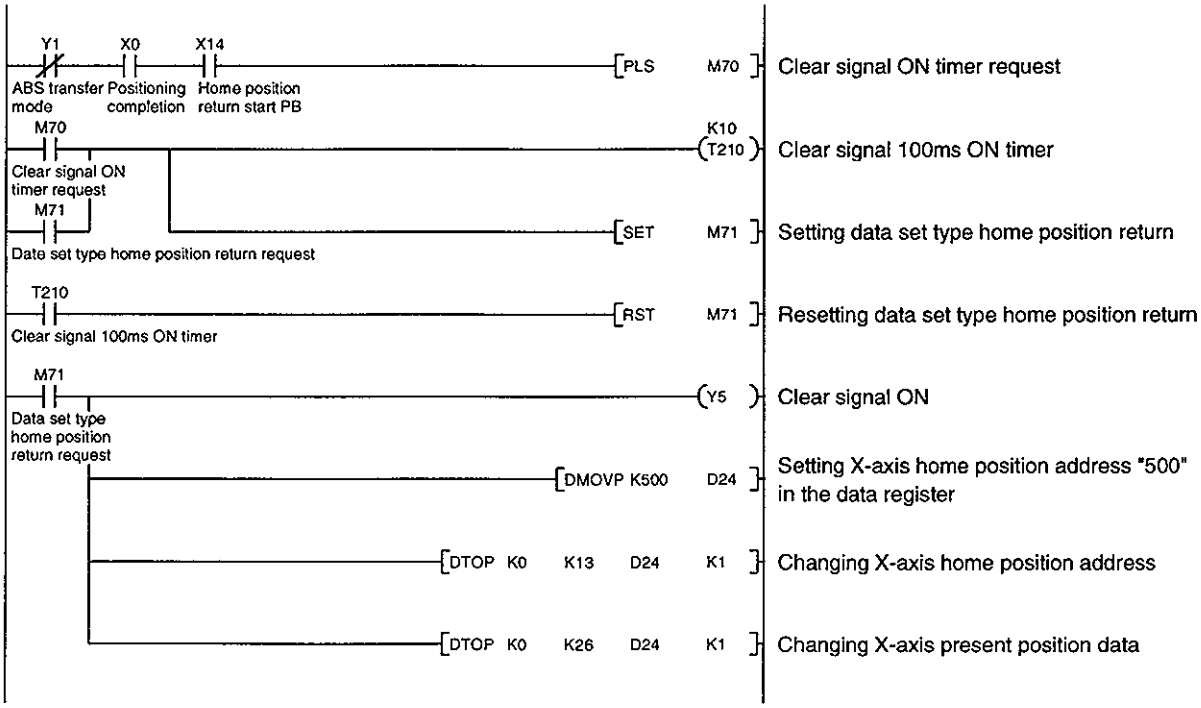
Note: Program example for the dog type zeroing. For the data set type zeroing, refer to the program example in (2), (d) in this section.


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.

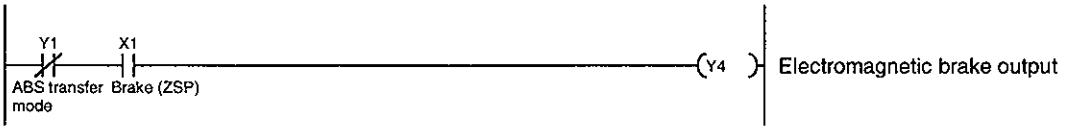
Do not turn ON the clear signal (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(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

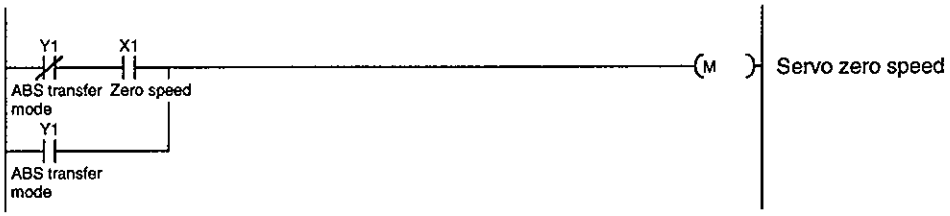
To create the status information for servo positioning completion.

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.



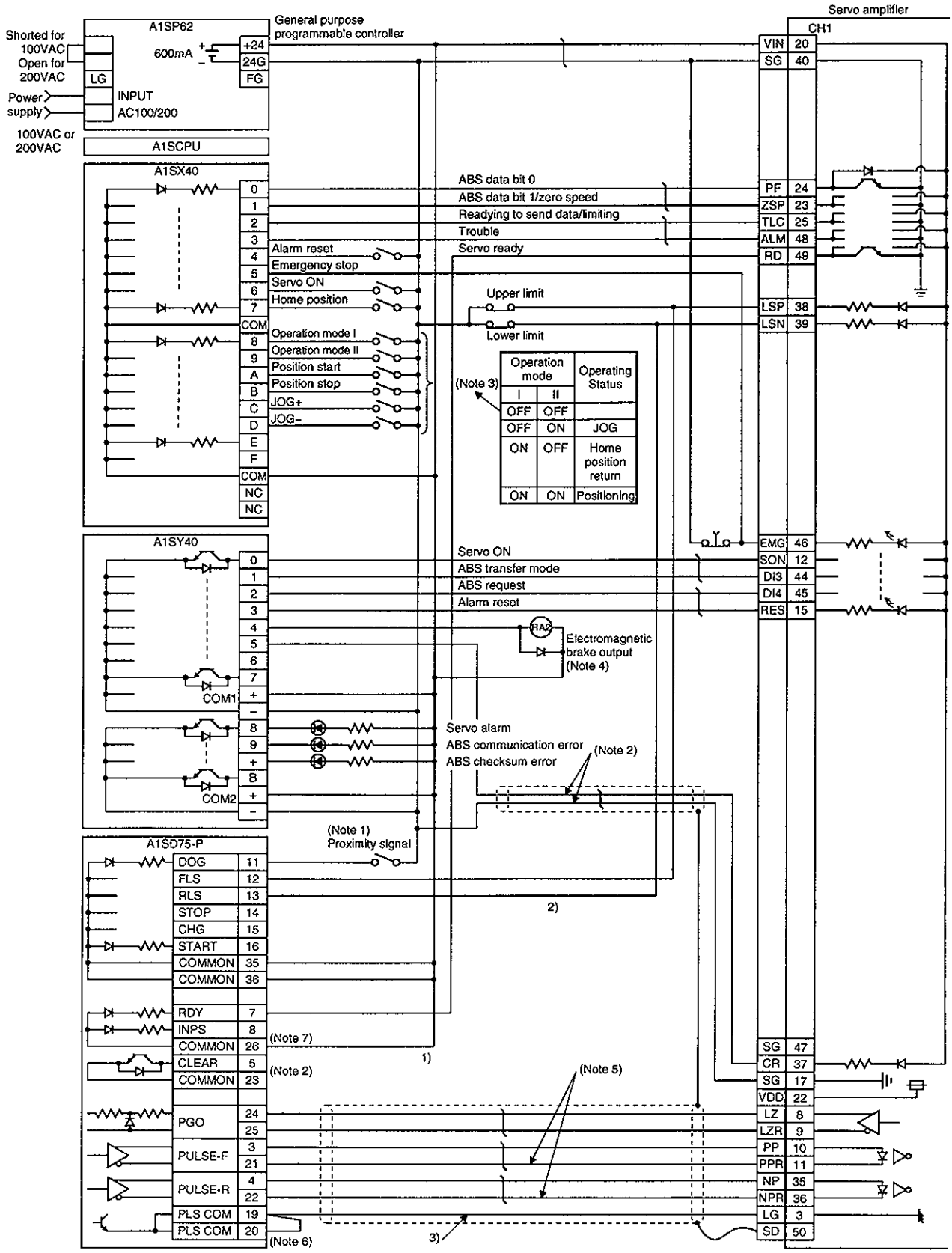
(h) Torque limiting

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



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	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	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	M23	Current position change processing instruction
T2	Retry wait timer	M24	Current position change flag
T3	ABS data send reading response timer	C counter	
T10 (Note 1)	Clear signal ON timer	C0	ABS data receive times counter
T200	Transmitted data read 10ms delay timer	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:

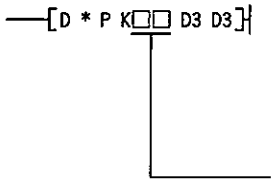
•Parameters of the A1SD75-P1 (AD75-P1) positioning module

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>



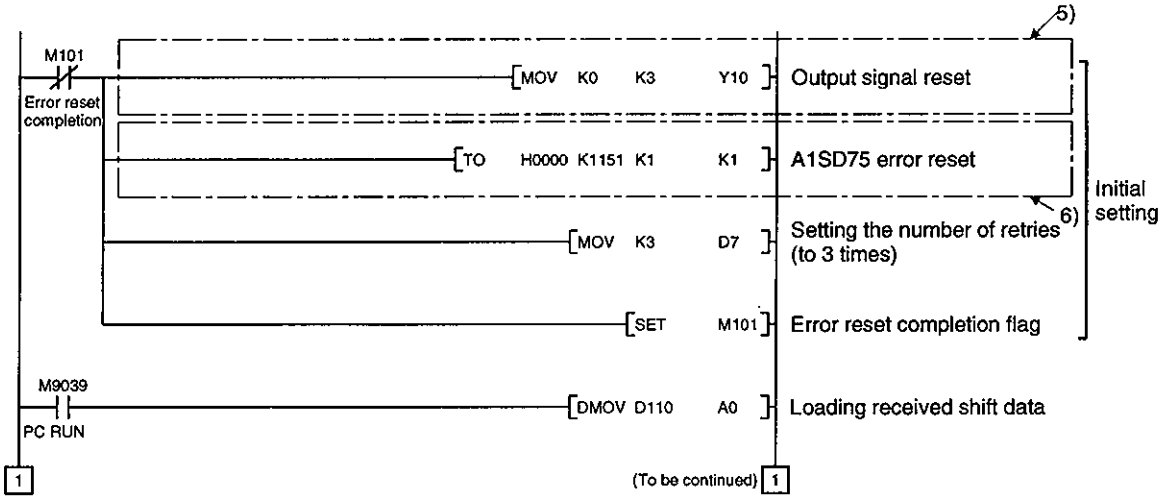
Item	mm				inch				degree				PULS
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.00001 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	μm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000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

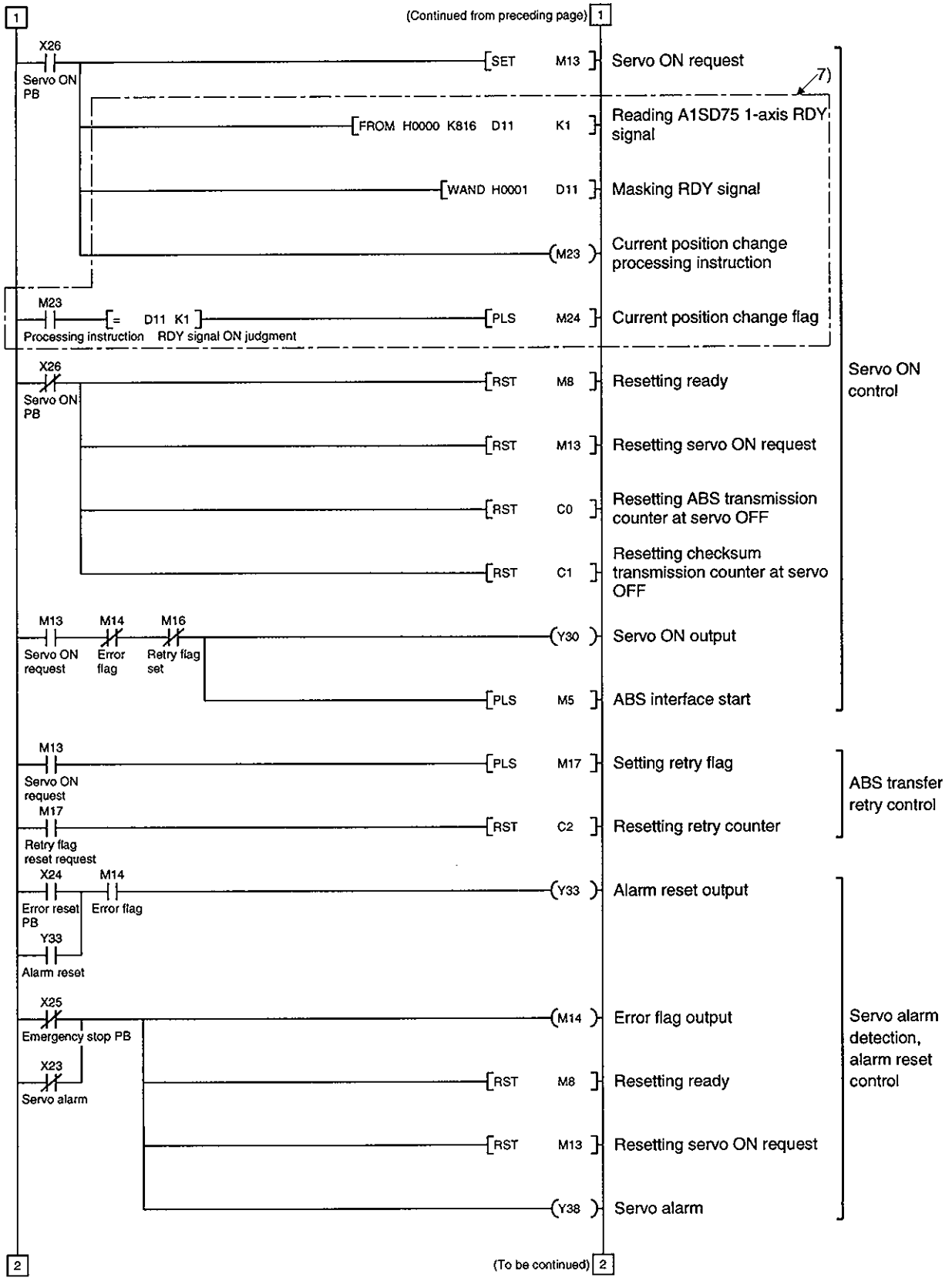
Reference

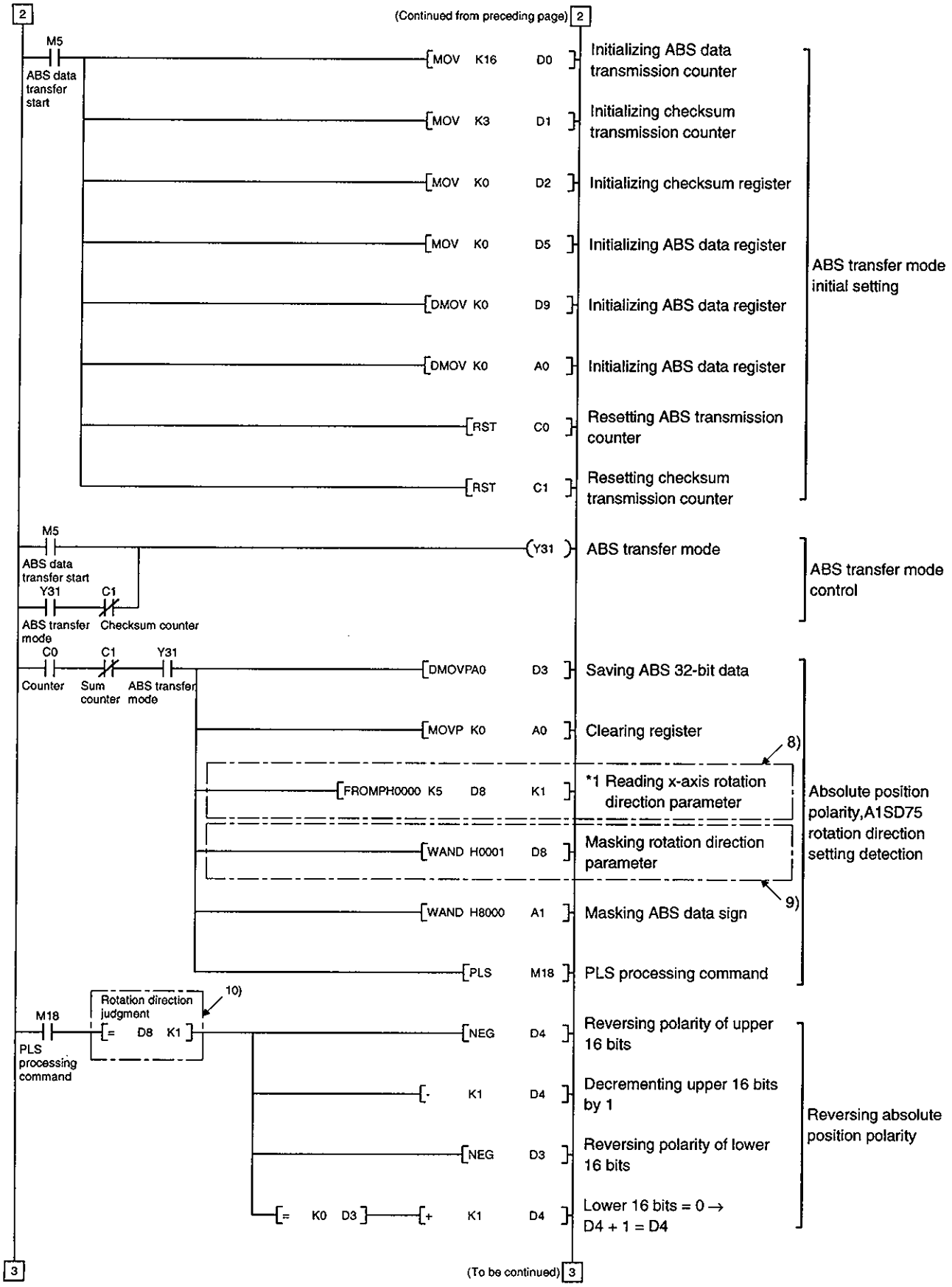
•For 1μm/PLS, set constant K to 10

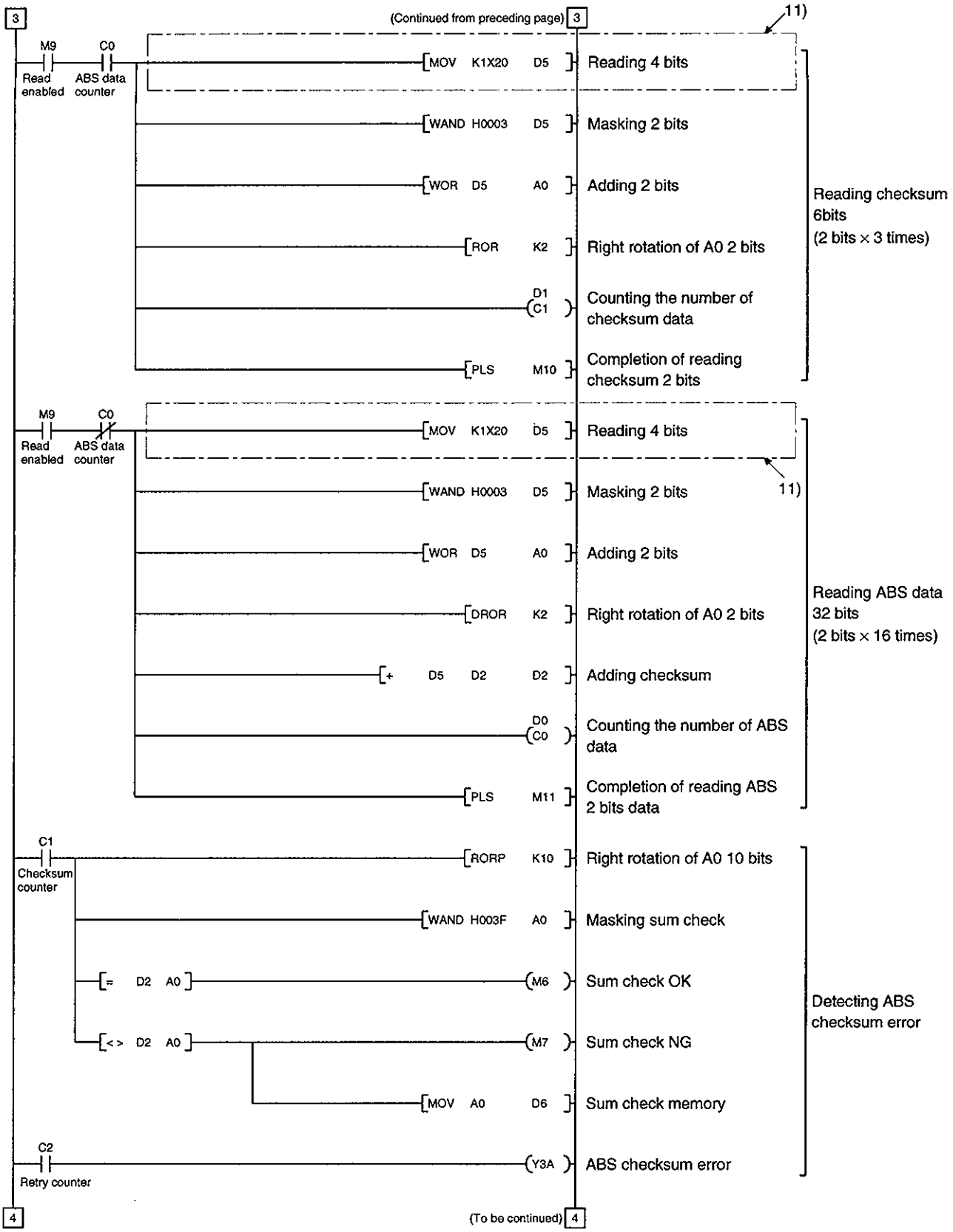
•For 5μm/PLS, set constant K to 50

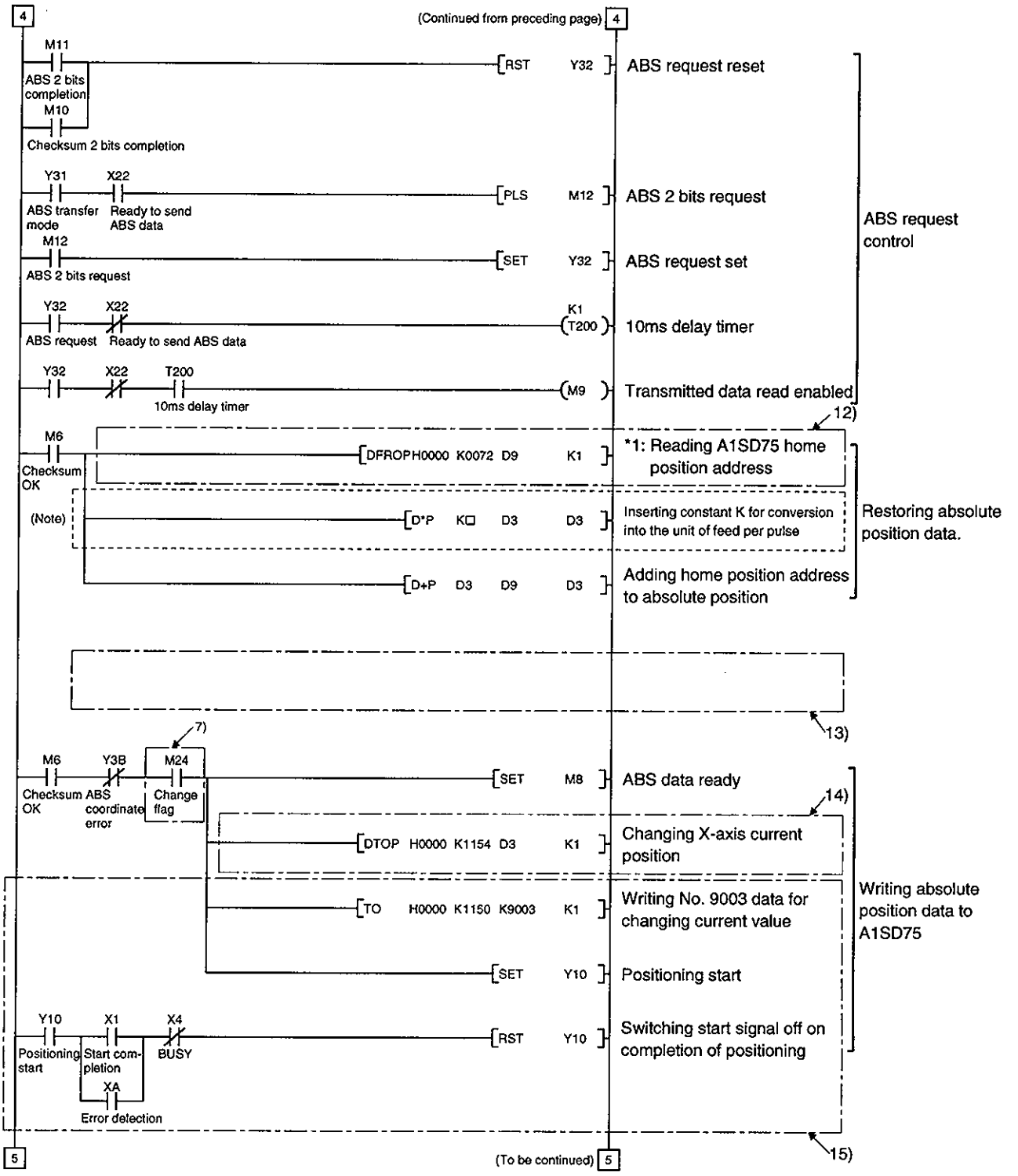
•The additional program is not required for the unit setting is PLS.



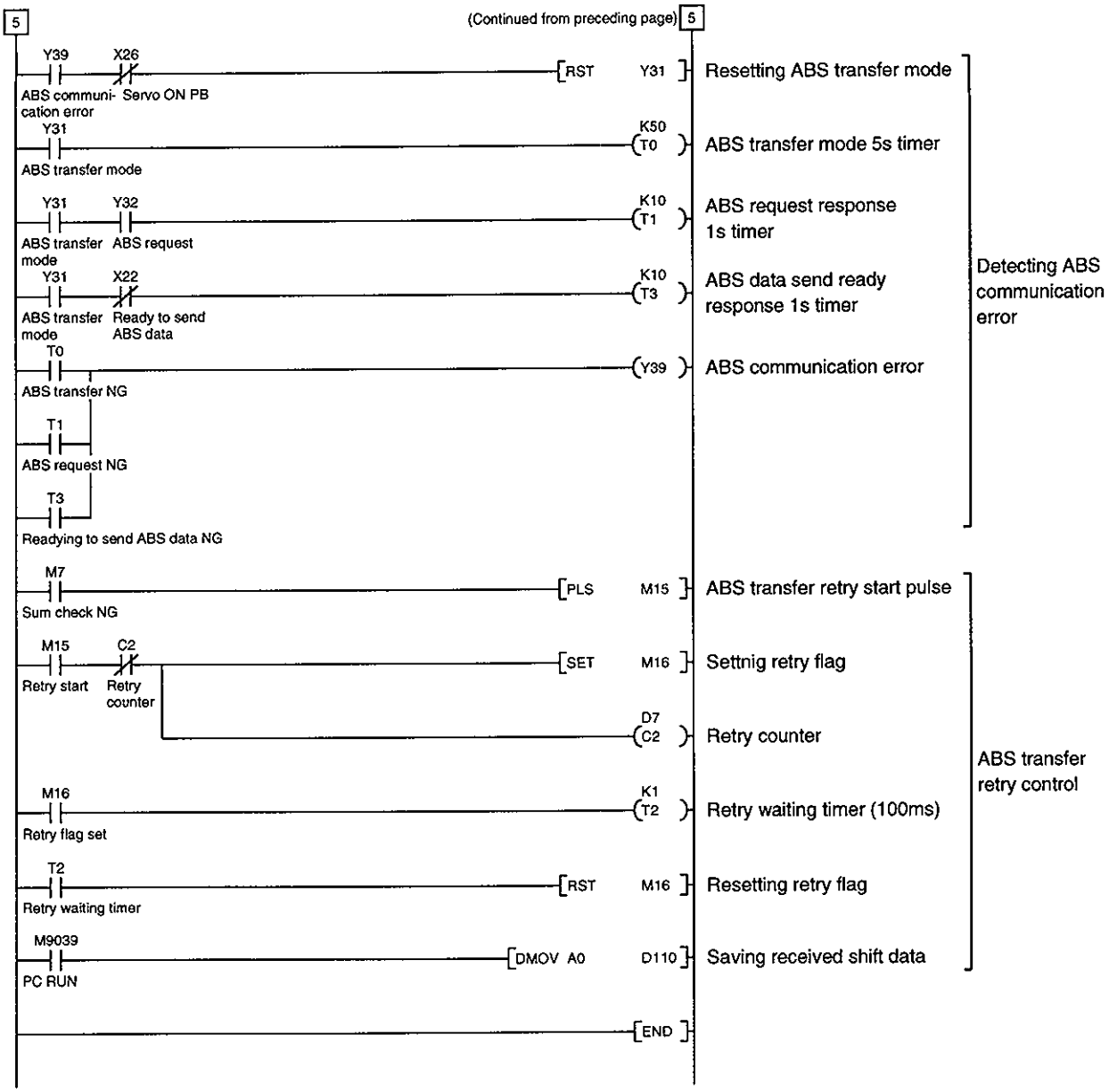

1
(Continued from preceding page) 1
X26
Servo ON PB
SET M13
Servo ON request
7)
FROM H0000 K816 D11 K1
Reading A1SD75 1-axis RDY signal
WAND H0001 D11
Masking RDY signal
M23
Current position change processing instruction
M23
= D11 K1
Processing instruction RDY signal ON judgment
PLS M24
Current position change flag
X26
Servo ON PB
RST M8
Resetting ready
RST M13
Resetting servo ON request
RST C0
Resetting ABS transmission counter at servo OFF
RST C1
Resetting checksum transmission counter at servo OFF
Servo ON control
M13
Servo ON request
M14
Error flag
M16
Retry flag set
Y30
Servo ON output
PLS M5
ABS interface start
M13
Servo ON request
PLS M17
Setting retry flag
M17
Retry flag reset request
RST C2
Resetting retry counter
ABS transfer retry control
X24
Error reset PB
M14
Error flag
Y33
Alarm reset
Y33
Alarm reset output
X25
Emergency stop PB
M14
Error flag output
X23
Servo alarm
RST M8
Resetting ready
RST M13
Resetting servo ON request
Y38
Servo alarm
Servo alarm detection, alarm reset control
2
(To be continued) 2


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
Y31 ABS transfer mode
ABS transfer mode
C1
Checksum counter
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
Read enabled
C0
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
Read enabled
C0
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
C2
Retry counter
Y3A
ABS checksum error
Detecting ABS checksum error
4
(To be continued) 4

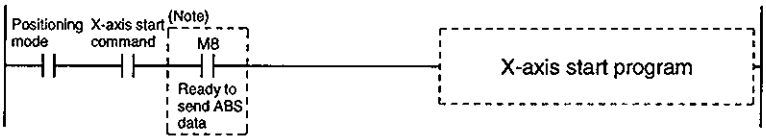


Note: When the unit setting parameter value of the AD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To set the unit to × 1μm, add this program to multiple the feed value by 10.


5
(Continued from preceding page) 5
Y39 X26
ABS communi- Servo ON PB
cation error
RST Y31
Resetting ABS transfer mode
Y31
ABS transfer mode
K50 T0
ABS transfer mode 5s timer
Y31 Y32
ABS transfer ABS request
mode
K10 T1
ABS request response 1s timer
Y31 X22
ABS transfer Ready to send
mode ABS data
K10 T3
ABS data send ready response 1s timer
T0
ABS transfer NG
Y39
ABS communication error
T1
ABS request NG
T3
Readying to send ABS data NG
Detecting ABS communication error
M7
Sum check NG
PLS M15
ABS transfer retry start pulse
M15 C2
Retry start Retry counter
SET M16
Settnig retry flag
D7 C2
Retry counter
M16
Retry flag set
K1 T2
Retry waiting timer (100ms)
T2
Retry waiting timer
RST M16
Resetting retry flag
M9039
PC RUN
DMOV A0 D110
Saving received shift data
ABS transfer retry control
END

(d) X-axis program

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

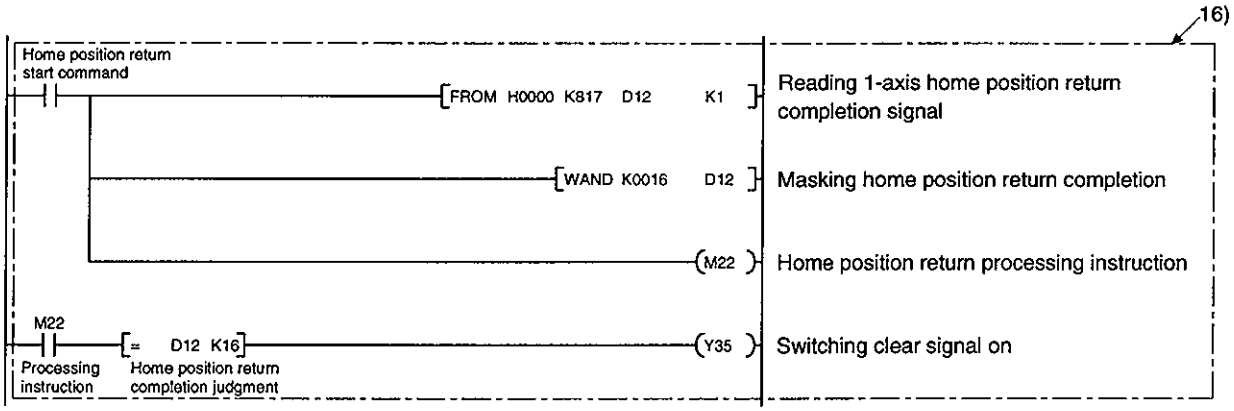


(e) Dog type home position return

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.

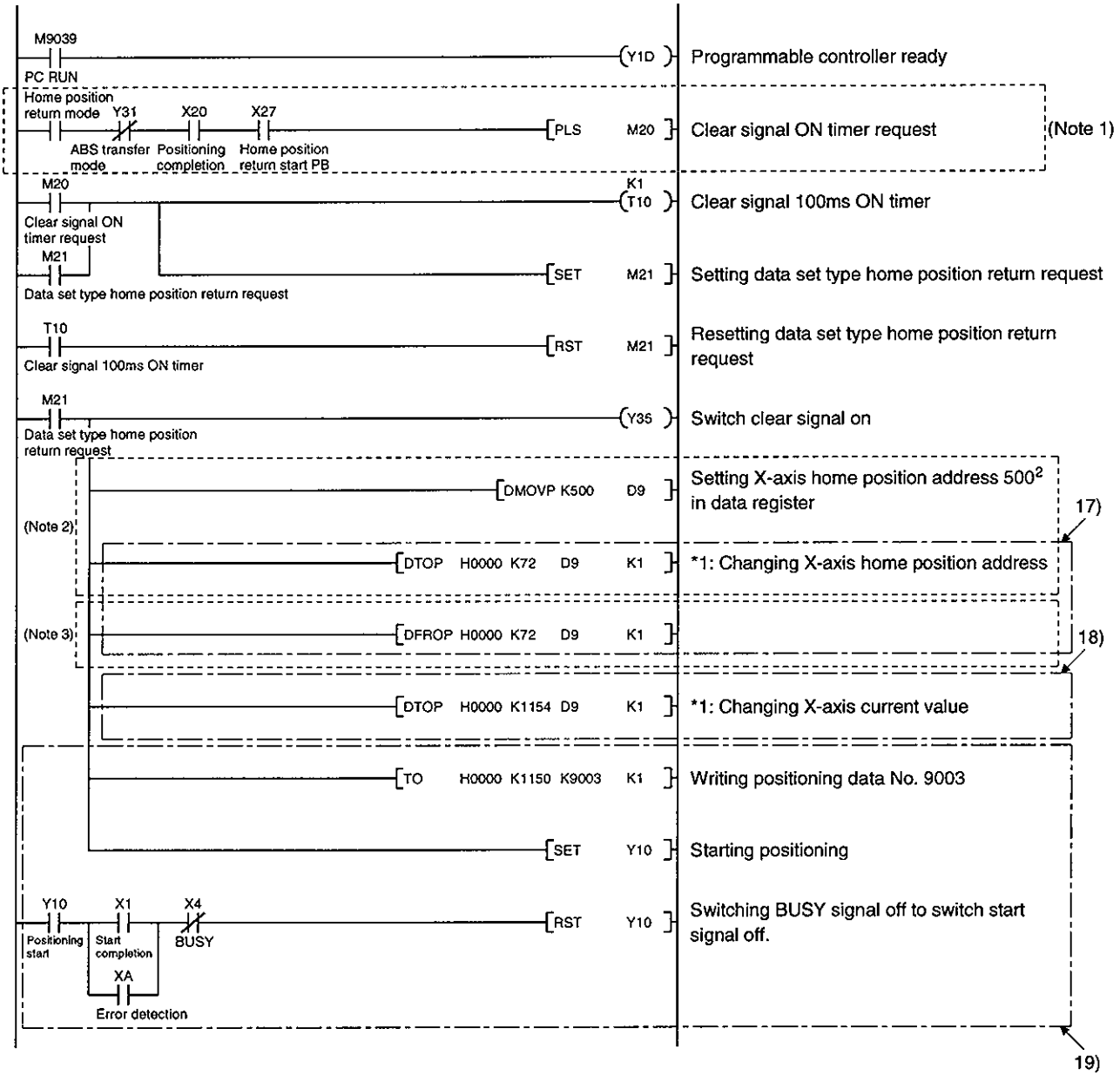
Add the following program:



(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.



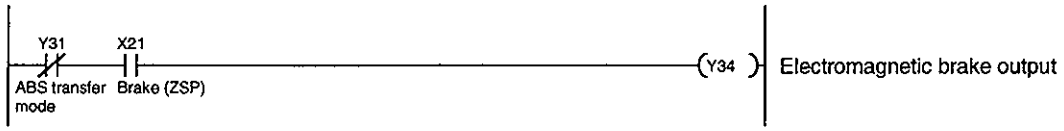
Note 1: If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

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.

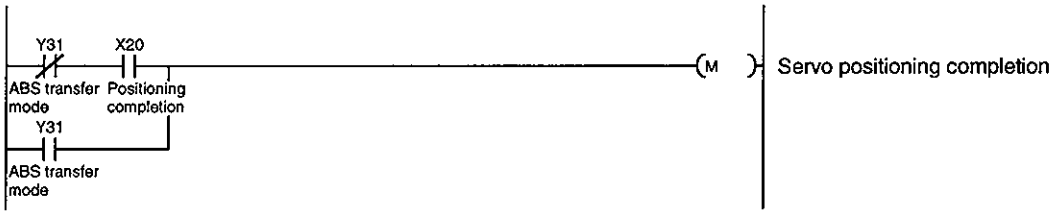
Set 1□1□ in parameter No. 3 of the servo amplifier to choose the electromagnetic brake interlock signal.



(h) Positioning completion

To create the status information for servo positioning completion.

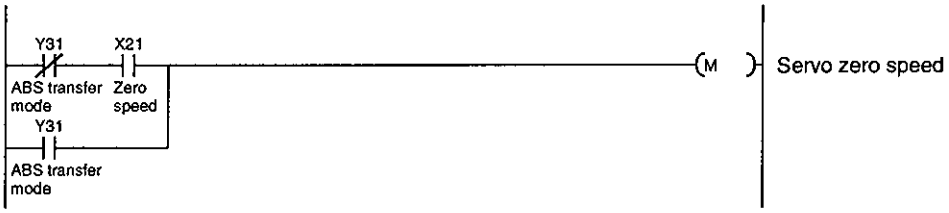
During ABS data transfer (for several seconds after the servo on signal is turned on), the servo motor must be at a stop.



(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

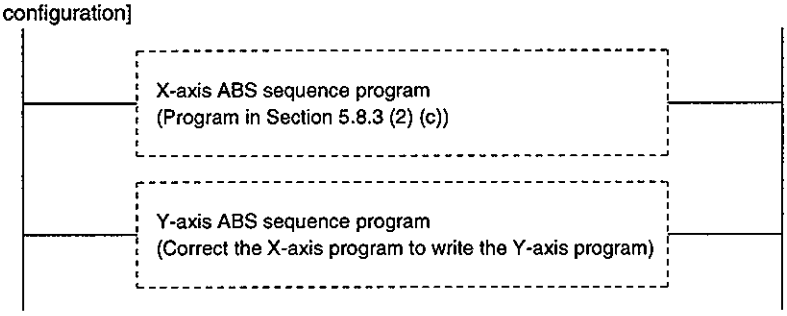
Refer to the X-axis ABS sequence program and create the Y-axis program.

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.

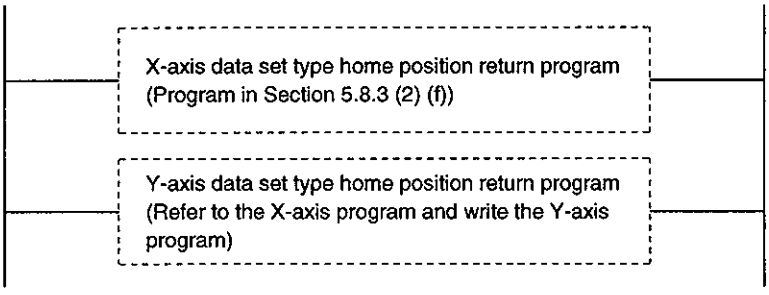
Refer to the X-axis data set type zeroing program and create the Y-axis program.

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.

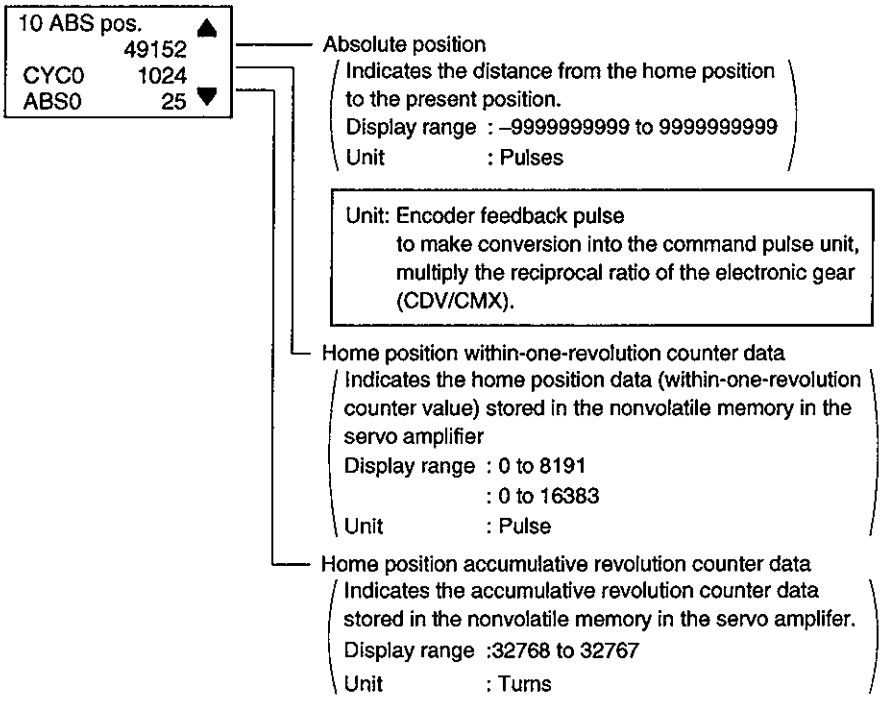
10) ABS coordinate error detection
As the A1SD75 (AD75) can handle the negative-polarity coordinate position that the A1SD71 could not handle, the program for ABS coordinate error detection is deleted. 13)

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

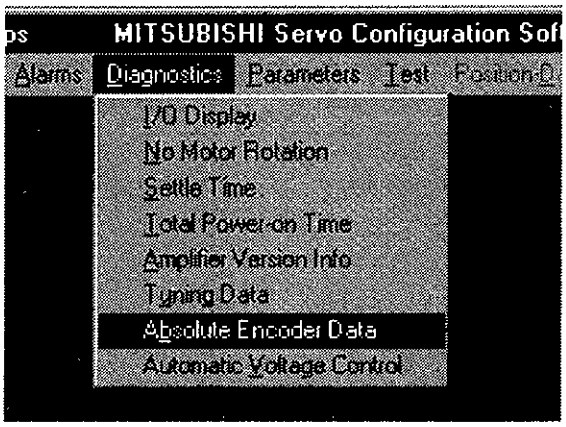
5.9.1 Using the parameter unit

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).

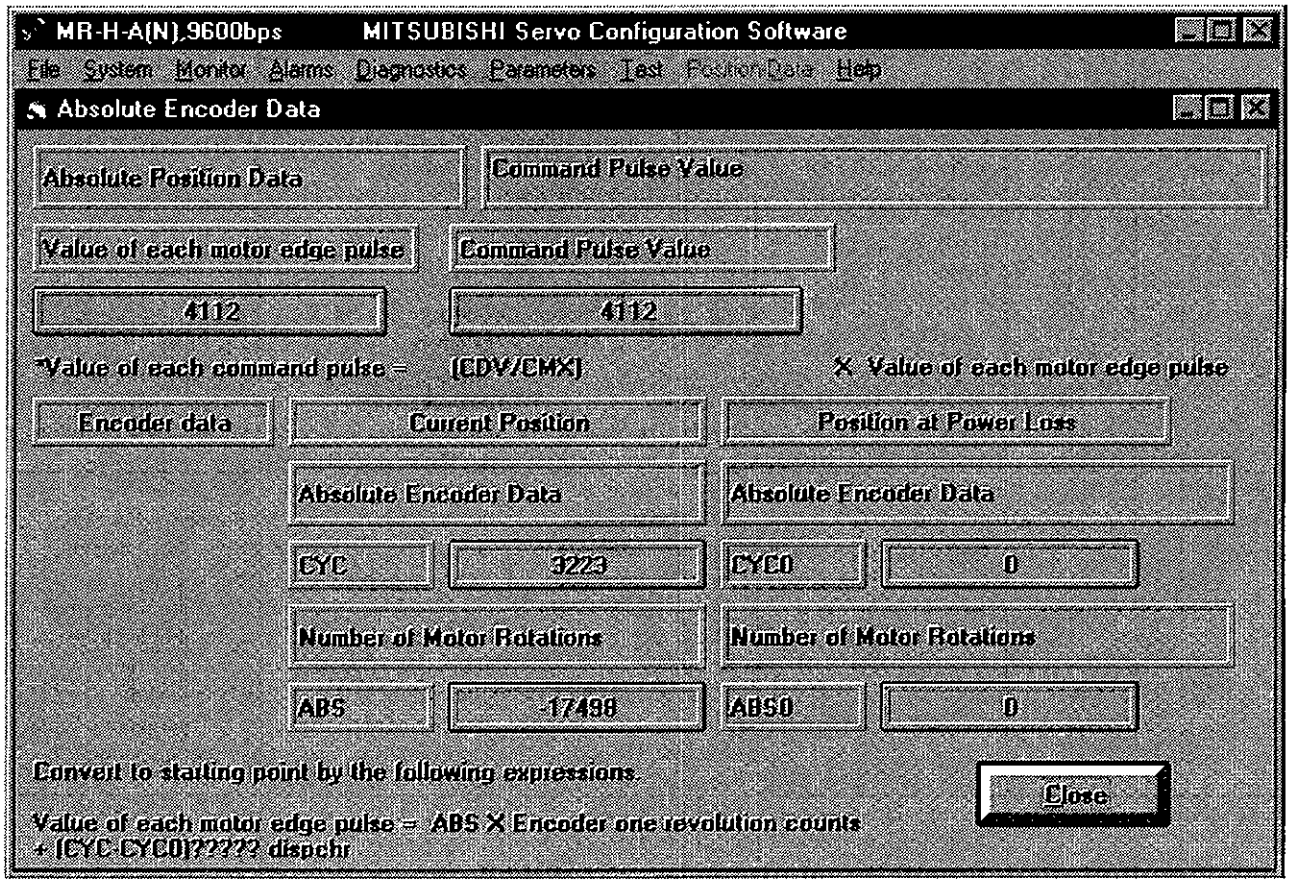


5.9.2 Using the Servo Configuration software

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.



(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

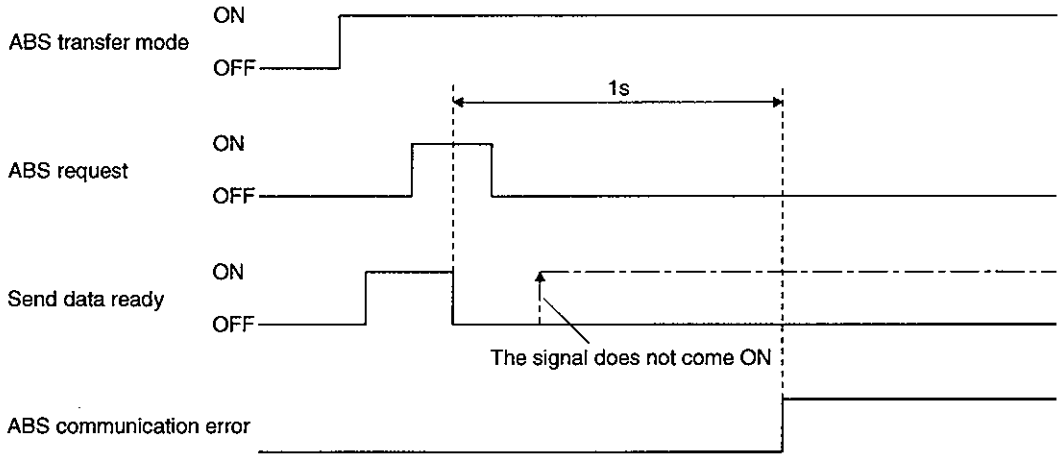
The number within parentheses in the table indicates the output coil or input contact number of the A1SD71 (AD71).

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.

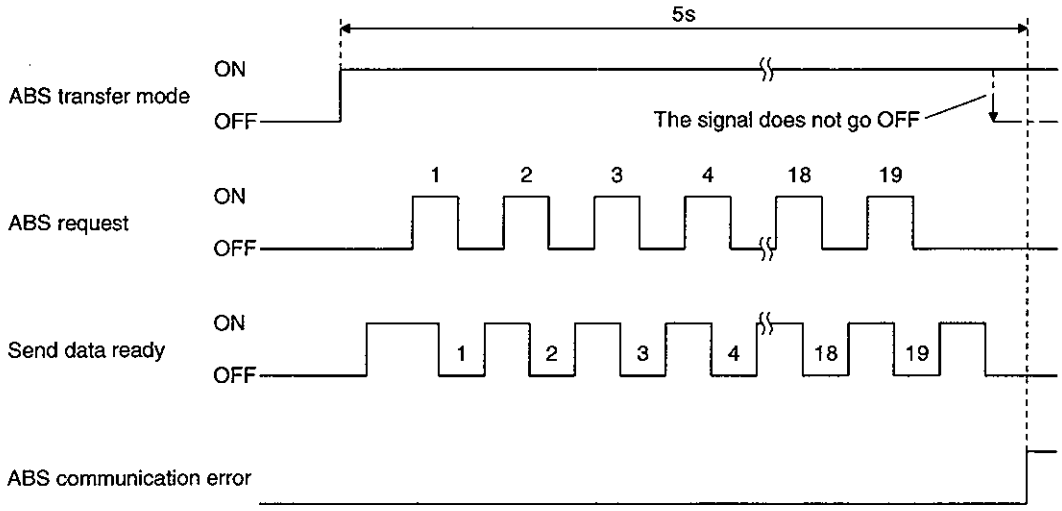
Note: Refer to (2) in this section for details of error occurrence definitions.

(2) ABS communication error

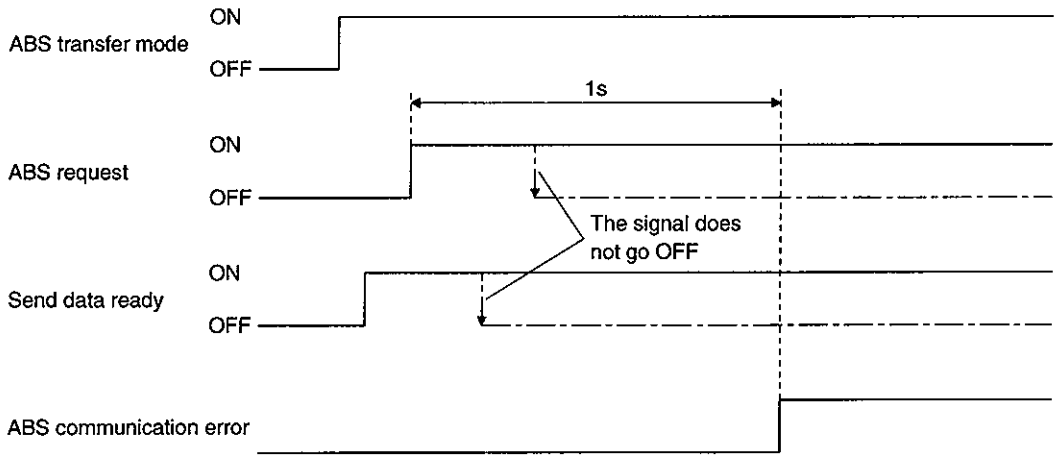
(a) The OFF period of the send data ready signal output from the servo amplifier is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (ALE5) is generated at the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

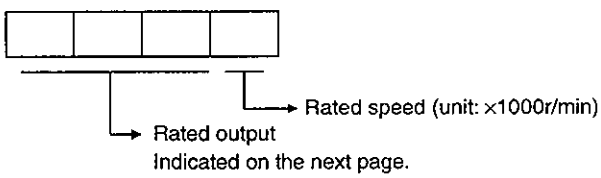
classification	No.	Code	Name	Parameter Unit Screen Display	Control Mode	Initial Value	Unit	Customer Setting
Basic parameter	0	*MSR	Motor series	0 MTR ser.	P,S,T			
	1	*MTY	Motor type	1 MTR type	P,S,T			
	2	*STY	Servo type	2 Servo type	P,S,T	0000		
	3	*STO	Function selection 1	3 Function 1	P,S,T	0000		
	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		

classifi-cation	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

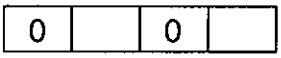
<table>
<tr><th>classification</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Control Mode</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td rowspan="2">Basic parameter</td><td>0</td><td>*MSR</td><td>Motor series:
Used to choose the servo motor series.
When using 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>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.
 

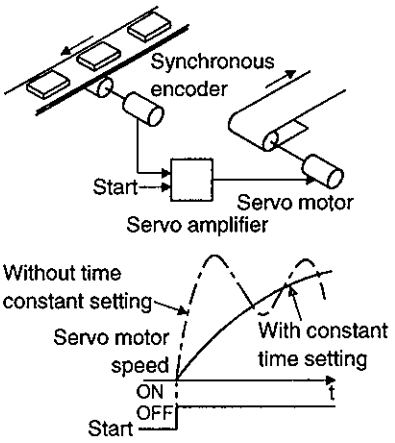
Indicated on the next page.</td><td>P
S
T</td><td></td><td></td><td></td></tr>
</table>

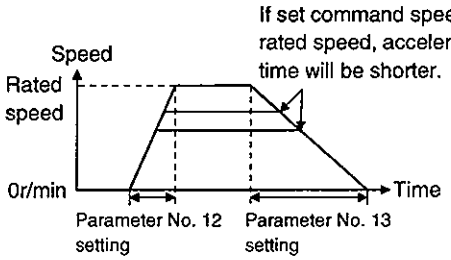
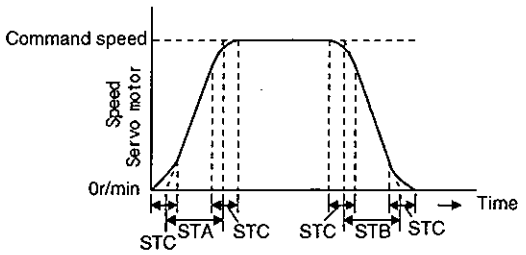
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	1	*MTY			As in the left table.		As in the left table.

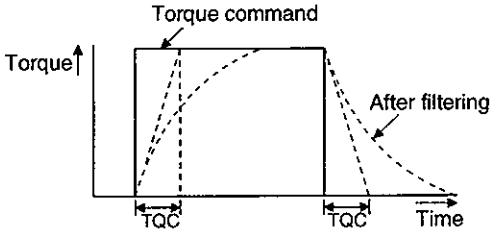
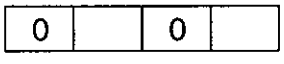
	Servo Motor	Capacity (W)	Servo Amplifier MR-H□AN 10	20	40	60	100	200	350	500	700	11K	15K	22K
Ultracompac	HA-MH053	50		053										
	HA-MH13	100		13										
	HA-MH23	200			23									
	HA-MH43	400				43								
	HA-MH73	750					73							
Small capacity	HA-FH053	50	053											
	HA-FH13	100	13			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

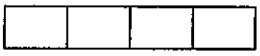
□ Values within are factory settings.。

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

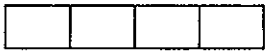
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	4	*CMX	Electronic gear denominator: Set the value within the range of $\frac{1}{50} < \frac{CMX}{CDV} < 50$ Always set the electronic gear in the servo off status to prevent misoperation due to wrong setting For the setting, refer to Section 6.2.1. Set the multiplier for the command pulse input. Command pulse input f_1 → [CMX/CDV] → 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			

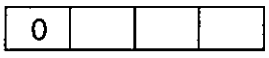
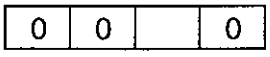
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Basic parameter	10	SC2	Internal speed command 2: Used to set speed 2 of the internal speed command.	S	500	r/min	0 to max. speed
			Internal command limit 2: Used to set speed 2 of the internal speed limit.	T			
	11	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>O</td><td></td></tr><tr><td>Write</td><td>O</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>O</td><td>O</td></tr><tr><td>Write</td><td>O</td><td></td></tr><tr><td rowspan="2">□□□E</td><td>Reference</td><td>O</td><td>O</td></tr><tr><td>Write</td><td>O</td><td>O</td></tr></table></td><td></td><td>0000</td><td></td><td>0000
to
000Eh</td></tr>
</table>

(b) Extension 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>Extension parameter</td><td>20</td><td>OP1</td><td>
Function selection 2:
Used to choose automatic restart after instantaneous power failure and servo lock in the auto tuning/speed control mode.

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.
<table>
<tr><th rowspan="2">Machine Type</th><th rowspan="2">Set Value</th><th colspan="3">Description</th><th rowspan="2">Guideline of Position Setting Time (GDL^2/GDM^2 guideline = within 5 times)</th></tr>
<tr><th>Response</th><th>Guideline of corresponding machine rigidity</th><th>GDL^2/GDM^2 guideline of load inertia</th></tr>
<tr><td>Initial value</td><td>0</td><td>Low response</td><td>Low to high rigidity</td><td>1 to 5 times</td><td></td></tr>
<tr><td rowspan="5">Ordinary</td><td>1</td><td>Low response</td><td>Low rigidity</td><td rowspan="8">1 to 10 times</td><td>50 to 300mS</td></tr>
<tr><td>2</td><td rowspan="2">Middle response</td><td rowspan="2">to
Medium rigidity</td><td rowspan="2">10 to 70mS</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="2">Hight response</td><td rowspan="2">to
High rigidity</td><td rowspan="2">10 to 30mS</td></tr>
<tr><td>5</td></tr>
<tr><td rowspan="5">Large friction</td><td>8</td><td>Low response</td><td>Low rigidity</td><td>70 to 400mS</td></tr>
<tr><td>9</td><td rowspan="2">Middle response</td><td rowspan="2">to
Medium rigidity</td><td rowspan="2">10 to 100mS</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td><td rowspan="2">Hight response</td><td rowspan="2">to
High rigidity</td><td rowspan="2">10 to 50mS</td></tr>
<tr><td>C</td></tr>
</table>
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
</td><td></td><td>0001</td><td></td><td>0000
to
1C12h</td></tr>
</table>

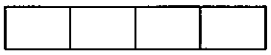
classification	No.	Code	Name and Function	Control Mode	Initial Value	Unit	Setting Range
Extension parameter	21	*OP2	Function selection 3: Used to select the option function.  Low acoustic noise mode selection By choosing the low acoustic noise mode, electromagnetic sound generated by the servo motor 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			

classification	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. Out pulses= $\frac{\text{Resolution per servo motor revolution}}{\text{Setting}}$ (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. output pulses = $\frac{\text{setting}}{4}$ (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

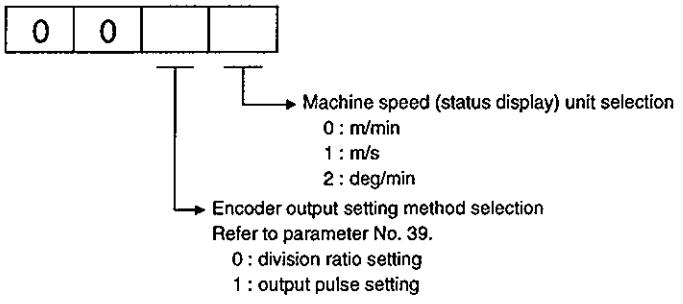
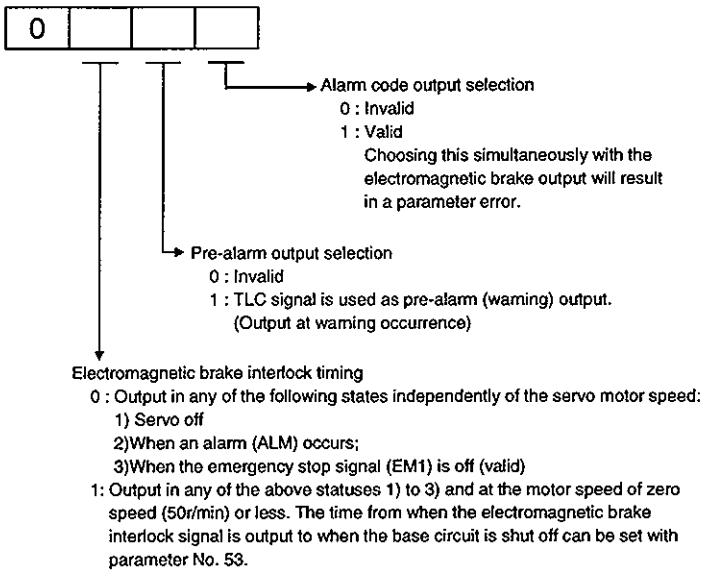
<table>
<tr><th>classifi-
cation</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Control
Mode</th><th>Initial
Value</th><th>Unit</th><th>Setting
Range</th></tr>
<tr><td rowspan="2">Extension parameter</td><td>41</td><td>*IP1</td><td>Input signal selection 1:
Used to choose the input signal 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</td><td>S
P

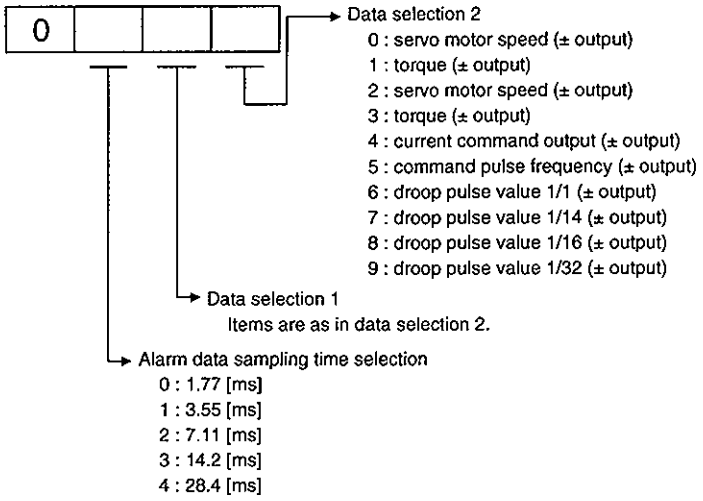
S
T

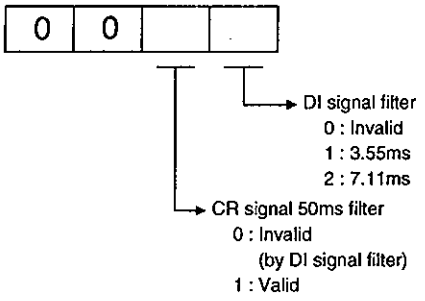
S</td><td>0000</td><td></td><td>0000
to
1111h</td></tr>
<tr><td>42</td><td>*IP2</td><td>Input signal selection 2:
Used to select the internal signal functions.
 
External torque limit (TL) switch-over function selection
0 :
ON: Torque limit command is valid. However, when the internal torque limit value 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)</td><td>P
S

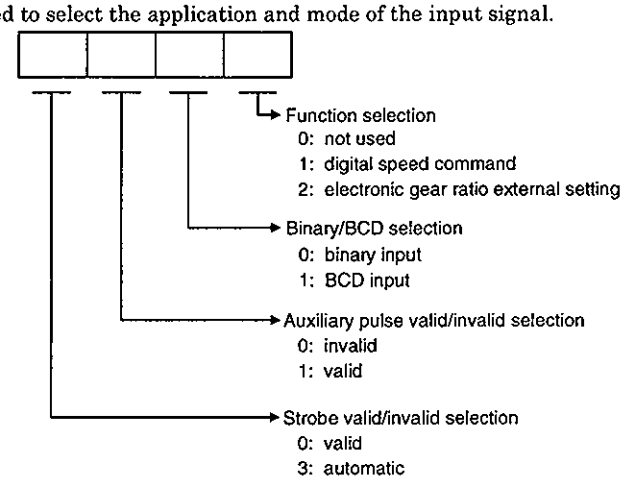
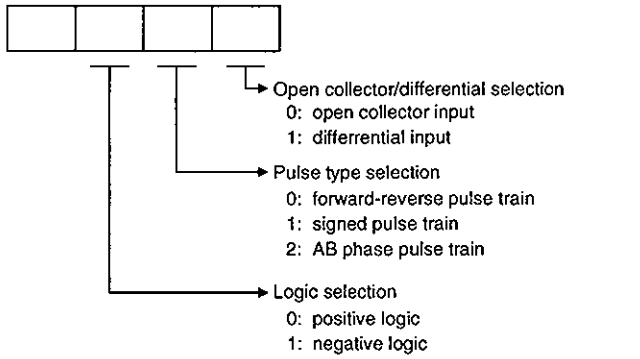
P
S
T

P
S</td><td>0000</td><td></td><td>0000 to
1111h</td></tr>
</table>

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.  	P S T	0000		0000 to 0012h
	44	*OPC	Output signal selection: Used to select the output signal functions.  	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.  	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="11">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.  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.  	P	0000		0000h to 0121h
	73	CMS	Auxiliary pulse input electronic gear numerator: Used to set the multiplier of the auxiliary pulse input. Auxiliary pulse input f_1 → CMX/CDV → 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

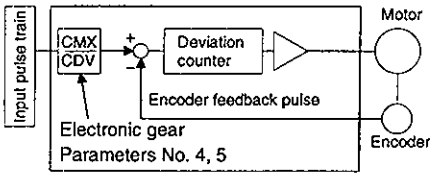
POINT

- 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.

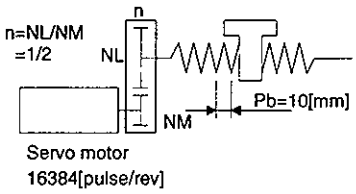
$$\frac{CMX}{CDV} = \frac{\text{Parameter No.4}}{\text{Parameter No.5}}$$



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

(a) For motion in increments of 10 μ m per pulse

Machine specifications



Ballscrew lead Pb=10[mm]
Reduction ratio: n=1/2
Servo motor resolution: Pt=16384 [pulses/rev]

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

Hence, set 4096 to CMX and 125 to CDV.

(b) Conveyor setting example

For rotation in increments of 0.01° per pulse

Machine specifications

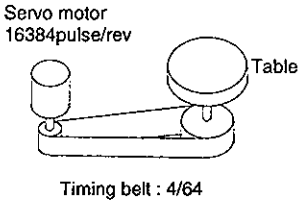


Table resolution: 36000 pulses/rev
Reduction ratio: n=4/64
Servo motor resolution: Pt=16384 [pulses/rev]

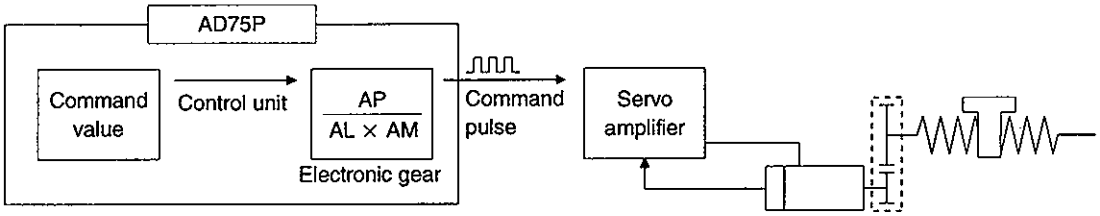
$$\frac{CMX}{CDV} = \frac{Pt}{\Delta S} = \frac{Pt}{36000 \times 4/64} = \frac{262144}{36000} = \frac{8192}{1125}$$

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

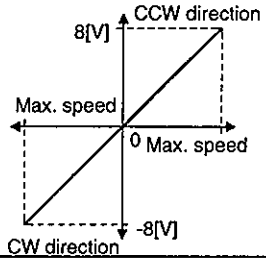
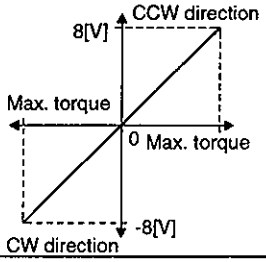
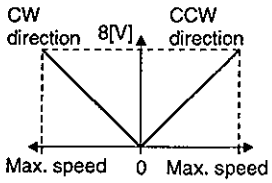
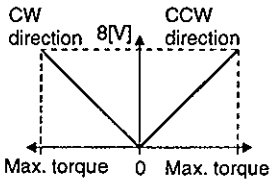
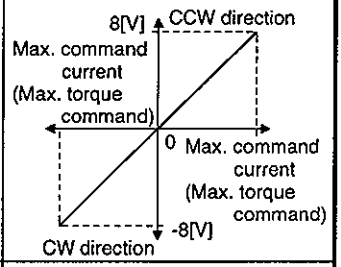
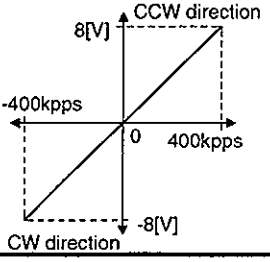
Rated Servo Motor Speed				3000r/min	
Servo amplifier	Input system			Open collector	Differential line driver
	Max. input pulse frequency			200kpps	400kpps
	Feedback pulse/revolution			8192pulse/rev	
	Electronic gear (CMX/CDV)			125/256	1/1
AD75P	Command pulse frequency (Note 1)			200kpps	409.6kpps
	Number 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

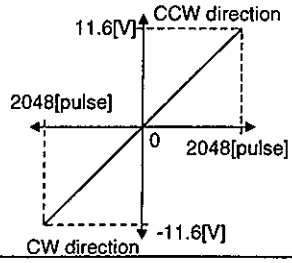
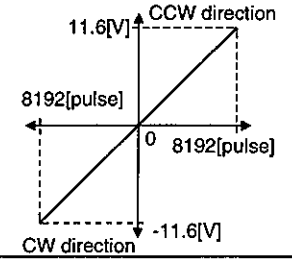
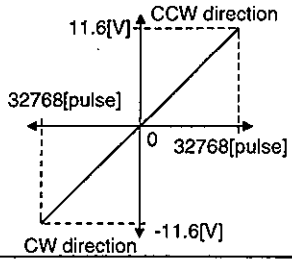
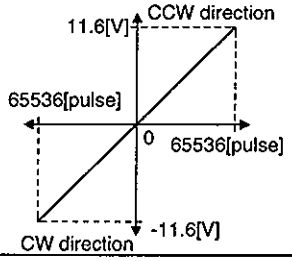
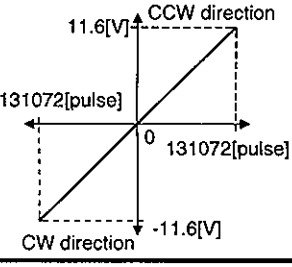
Note: 1. Command pulse frequency at rated speed

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.

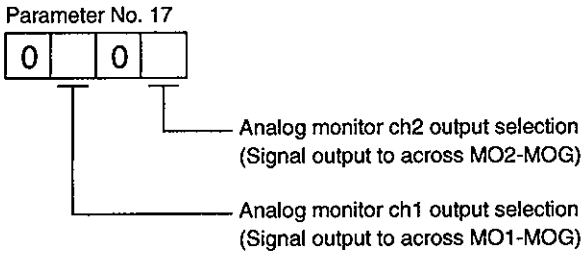
6.2.2 Analog output

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.	

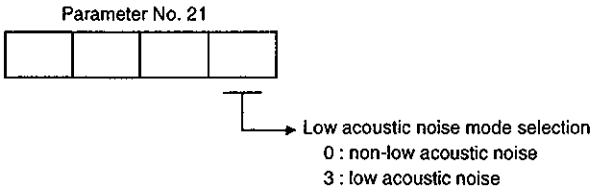
6.2.3 Using forward/reverse rotation stroke end to change the stopping pattern

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