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MELSERVO

Servo amplifier and motors

Instruction Manual

MR-J2S-B/B4

Art.-No.: 168353
07 06 2006
Version A

MITSUBISHI ELECTRIC INDUSTRIAL AUTOMATION

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Instruction Manual
Servo amplifier MR-J2S-B/B4
Art.-N0.: 168353

Version	Changes / Additions / Corrections
A 06/2006 pdp	—

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About this Manual

The text, illustrations, diagrams and examples in this manual
are solely for clarification purposes for the installation,
handling and operation of the servo motors and amplifiers of the
MELSERVO J2-Super-Series.

If you have any questions concerning the programming and operation of the equipment
described in this manual, please contact your relevant sales office
or department (refer to back of cover).
Current information and answers to frequently asked questions are also
available through the Internet (www.mitsubishi-automation.com).

MITSUBISHI ELECTRIC EUROPE B.V. reserves the right to make
changes both to this manual and to the specifications and design of the
hardware at any time without prior notice.

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Safety Instructions

General safety instructions

For qualified staff only

This manual is intended exclusively for acknowledged and qualified electricians who are totally conversant with the safety standards of electrical drive and automation technology. Project management, installation, setup, maintenance and testing of the equipment must be carried out by an acknowledged and qualified electrician who is totally conversant with the safety standards of electrical drive and automation technology.

Proper use of equipment

MELSERVO-Series equipment is only designed for use in the areas described in this manual. Be sure to comply with all the characteristics stated in this manual. Only additional or supplementary devices recommended by MITSUBISHI ELECTRIC EUROPE may be used.

Any other use or application of the products is deemed to be improper.

Relevant safety regulations

All safety and accident prevention regulations relevant to your specific application must be observed in the system design, installation, setup, maintenance, servicing and testing of these products.

The regulations listed below are particularly important. This list does not claim to be complete; however, you are responsible for knowing and applying the regulations applicable to you.

- VDE/EN Standards
  - VDE 0100
    (Regulations for electrical installations with rated voltages up to 1,000V)
  - VDE 0105
    (Operation of electrical installations)
  - VDE 0113
    (Electrical systems with electronic equipment)
  - VDE 0160
    (Configuration of electrical systems and electrical equipment)
- Fire prevention regulations
- Accident prevention regulations
  - VBG No. 4 (electrical systems and equipment)
- Low-voltage regulation

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Special instructions for working with this manual

In this manual special warnings that are important for the proper and safe use of the products are clearly identified as follows:



DANGER:

Personnel health and injury warnings. Failure to observe the precautions described here can result in serious health and injury hazards.



CAUTION:

Equipment and property damage warnings. Failure to observe the precautions described here can result in serious damage to the equipment or other property.

NOTE

means that incorrect handling may lead to erroneous operation of the servo amplifier or servo motor. However, there is no risk to the health of the operators or of damage to the equipment or other property.

This note is also used to indicate an other parameter setting, an other function, an other use or it provides information for the employment of additional or supplementary devices.

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Compliance with EC Directives

EC directives are intended to allow the liberal sales of goods within the EU. With the establishment of “essential safety regulations” the EC directives ensure that technical barriers to trade between member states of the EU are excluded. In the member states of the EU the machine directive (in force since January 1995), the EMC directive (in force since January 1996) and the low-voltage directive (in force since January 1997) of the EC directives determine the guarantee of the presence of fundamental safety requirements and the display of the “CE” mark.

Conformity with EC directives is indicated by the submission of a Declaration of Conformity as well as the display of the “CE” mark on the product, its packaging or its operating instructions.

The above directives relate only to devices and systems and not to single components, unless the components have a direct function for the end user. As a servo amplifier together with a servo motor have to be installed with a controller and other mechanical parts in order to serve a useful purpose for the end user, servo amplifiers do not possess this function. Consequently they can be described as a complex component for which a conformity declaration or the “CE” mark is not required. This position is also supported by CEMEP, the European association of manufacturers of electronic drive technology and electrical machines.

The servo amplifiers do, however, comply with the relevant low-voltage directive, which is a prerequisite for the “CE” mark on machines or accessories in which the servo amplifier is used. To ensure conformity with the requirements of the EMC directive, MITSUBISHI ELECTRIC has produced the manual “EMC INSTALLATION GUIDELINES” (article number: 103944) in which the installation of the servo amplifier, the construction of a control cabinet and other installation tasks are described. Please contact the relevant sales partner who is responsible for you.

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Special safety instructions

The following notes on sources of danger should be interpreted as general guidelines for servo drives in association with other devices. These precautions must always be observed in the design, installation and operation of all control systems.



DANGER:

- ***Observe all safety and accident prevention regulations applicable to your specific application. Installation, wiring and opening of the assemblies, components and devices may only be performed with all power supplies disconnected.***
- ***Prior to carrying out any installation work, wiring and opening assemblies, components and devices you must disconnect the power supply to the units and wait for at least 10 minutes. Prior to touching anything measure the residual voltage in condensers, etc. with a voltmeter to ensure that the voltage has been sufficiently reduced.***
- ***Never touch the servo amplifier or servo motor or the optional brake resistor during or shortly after operation whilst they are still live. The components can get very hot – there is a risk of getting burned.***
- ***Assemblies, components and devices must always be installed in a shockproof housing fitted with a proper cover and protective equipment.***
- ***Devices with a permanent connection to the mains power supply must be integrated in the building installations with an all-pole disconnection switch and a suitable fuse.***
- ***Ground the servo amplifier and servo motor securely.***
- ***Check power cables and lines connected to the equipment regularly for breaks and insulation damage. If cable damage is found, immediately disconnect the equipment and the cables from the power supply and replace the defective cabling.***
- ***Before using the equipment for the first time check that the power supply rating matches that of the local mains power.***
- ***EMERGENCY OFF facilities in accordance with VDE 0113 must remain effective in all operating modes of the servo motor. The EMERGENCY OFF facility reset function must be designed so that it cannot cause an uncontrolled or undefined restart.***
- ***The EMERGENCY OFF facility must be wired so that the electromagnetic brake is also activated during an EMERGENCY OFF.***
- ***Residual current protective devices pursuant to DIN VDE Standard 0641 Parts 1–3 are not adequate on their own as protection against indirect contact for installations with servo amplifier. Additional and/or other protection facilities are essential for such installations.***

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Special safety instructions for the devices

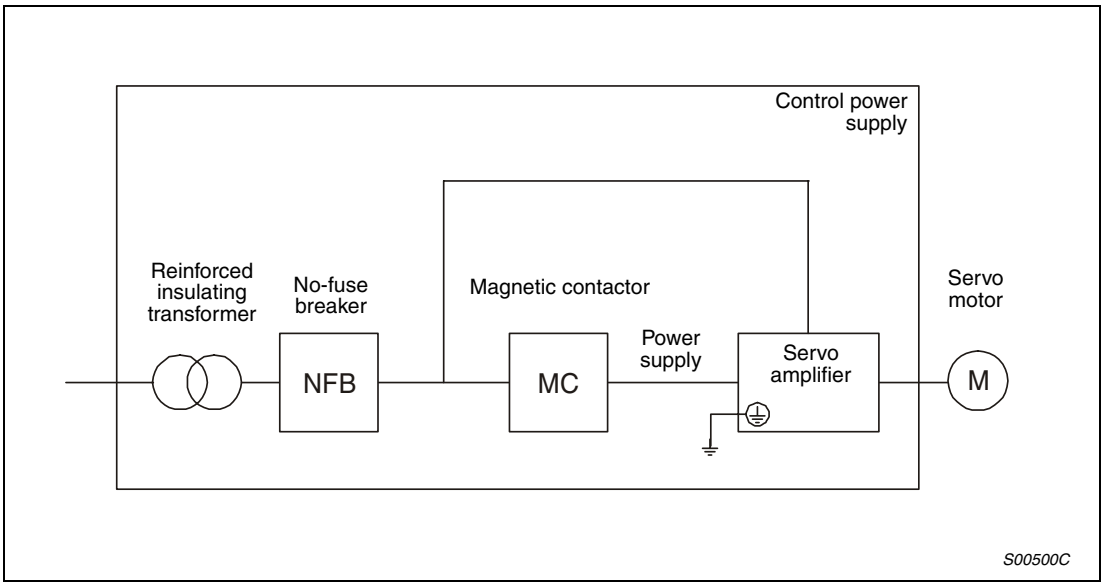


CAUTION:

- ***During the installation of servo systems beware of the heat that builds up during operation. Make sure that there is adequate clearance between the individual modules and enough ventilation to allow the heat to be dissipated.***
- ***Never install servo amplifiers or servo motors or the optional brake unit close to easily flammable materials.***
- ***When using a servo system always observe strict compliance with electrical characteristics and physical dimensions.***
- ***In the event of a defect arising in the servo amplifier, servo motor or optional brake resistor immediately switch the power off to the servo drive, as otherwise it may lead to overheating and self-ignition of the devices.***

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Configuration

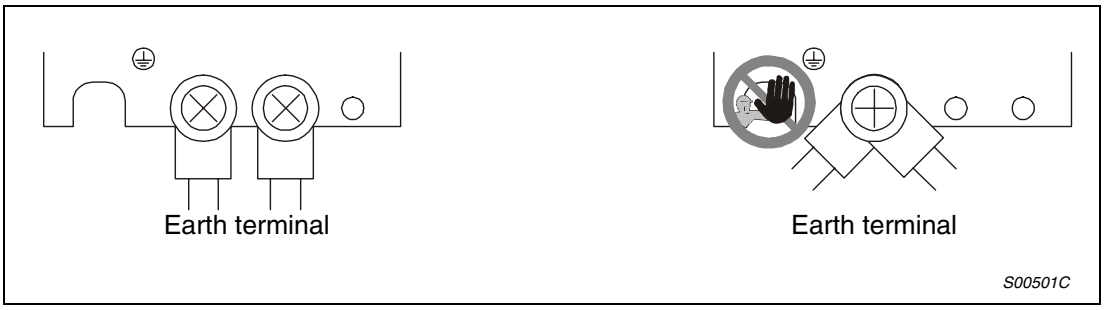


Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC60664-1. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

Grounding

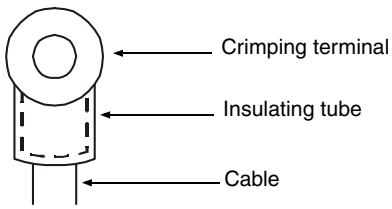
To prevent an electric shock, always connect the protective earth terminals of the servo amplifier to the protective earth of the control box. Do not connect two or more ground cables to the same protective earth terminal.



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Wiring

The cables are connected via insulated tubular cable sockets to the terminal strip of the servo amplifier.



Use only the connectors designed for it to attach the servo motor to the servo amplifier. The connectors can be ordered as accessories.

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1 Introduction

1.1 Features and configuration

Apart from possessing the functions of the servo amplifiers MR-J2-Series, the servo amplifiers MR-J2-Super have additional features and functions.

The servo amplifiers MR-J2S-B and MR-J2S-B4 are designed for operation with a Mitsubishi-Motion-Controller via a serial bus (SSCNET). For this the servo amplifier reads in the position data directly so that it can then execute the positioning process.

Through the specification of speed and direction of rotation via the command unit, precise positioning is possible. To protect the power transistor against over-current resulting from great accelerations or delays or overload the servo amplifier is equipped with a speed limitation feature. The value for speed limitation can be varied and may be specified via an external analogue input or a parameter.

The RS232C or RS422 interface permits serial communications between the servo amplifier and a PC. Using the Windows-supported setup software, functions such as parameter setting, test runs, status display, amplifier setting, etc. can be carried out. By means of real-time auto-tuning it is possible to undertake an automatic adjustment of the amplifier settings to the machine.

The MR-J2-Super series servo motor is equipped with an absolute position encoder which has the resolution of 131072 pulses/rev to ensure more accurate control as compared to the MR-J2 series.

Simply adding a battery to the servo amplifier makes up an absolute position detection system. This makes home position return unnecessary at power-on or alarm occurrence by setting a home position once.

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1.2 Function block diagram

1.2.1 Servo amplifiers 200V

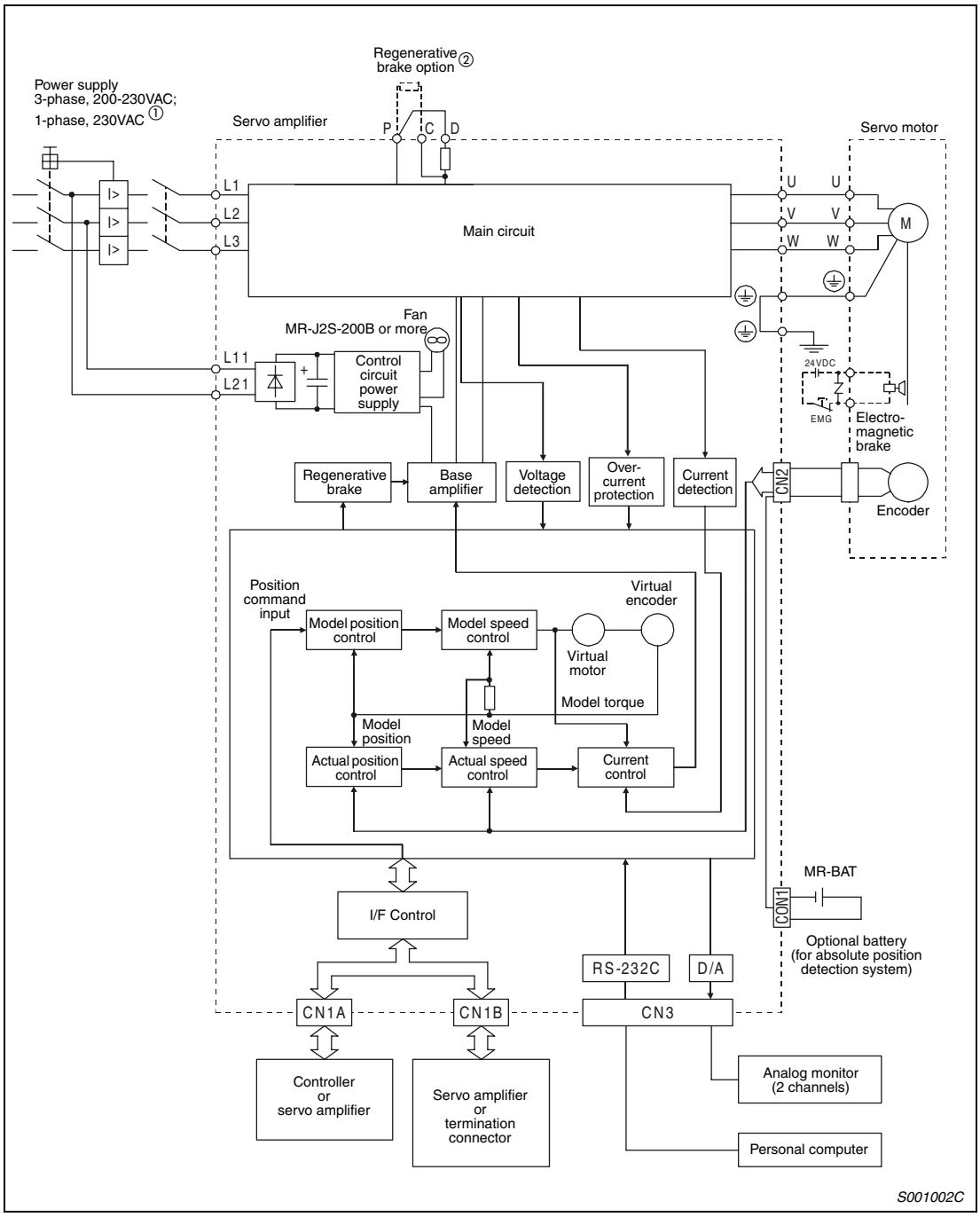


Fig. 1-1: *Block diagram for Servo amplifier MR-J2-Super*

① Up to 750 W a 1-phase power supply is possible. For details of connecting the power supply please see section 3.5.

② The connection of terminals shown for the optional regenerative braking resistor applies exclusively to servo amplifiers MR-J2S-350B or smaller. For exact descriptions of the wiring of terminals for other performance classes, please see tab. 3-4.

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1.2.2 Servo amplifiers 400V

MR-J2S-200B4 or less

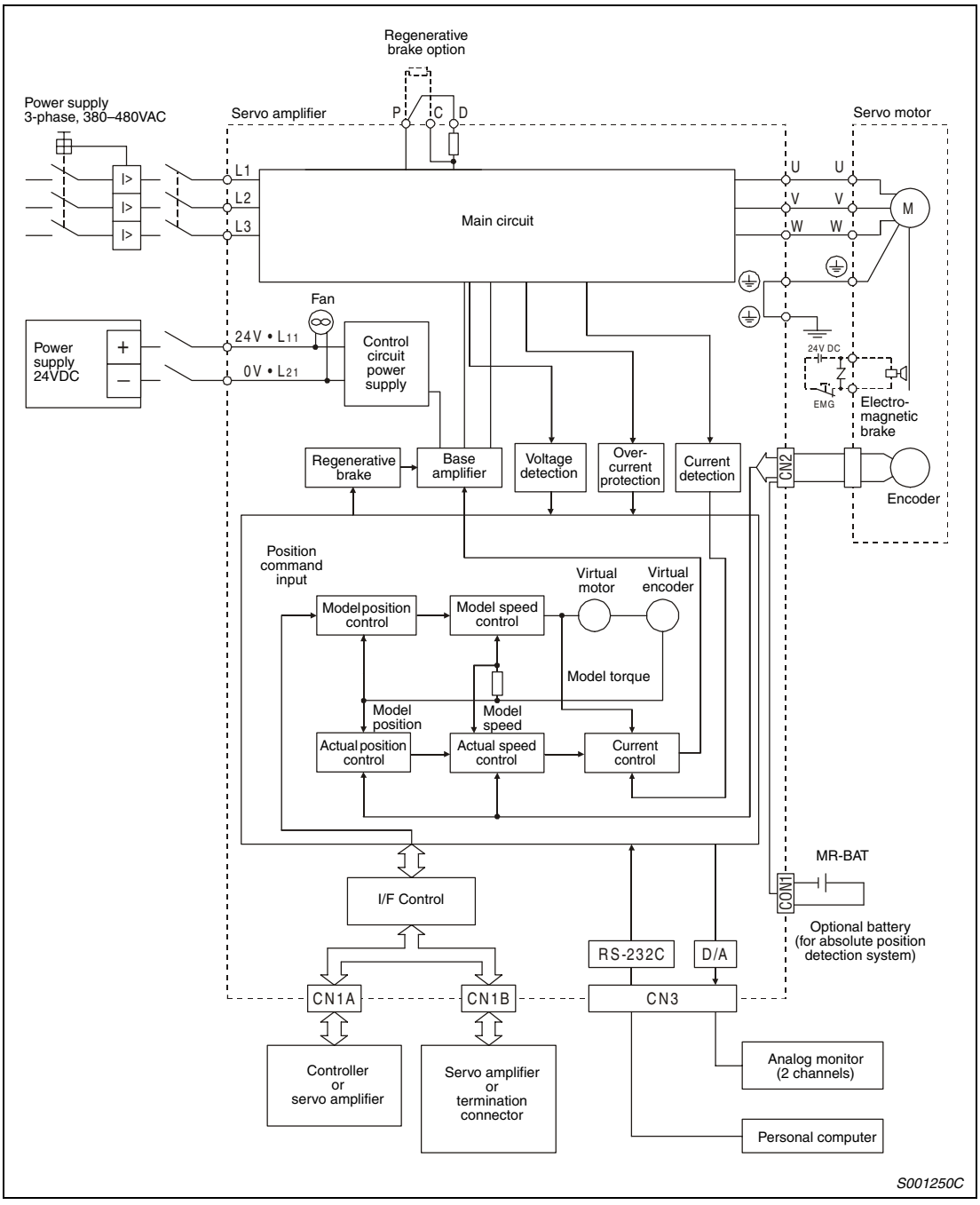


Fig. 1-2: *Block diagram for Servo amplifier MR-J2-Super*

When connecting an optional regeneration brake resistor, always remove the lead from across the terminals P and D.

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MR-J2S-350B4 to 700B4

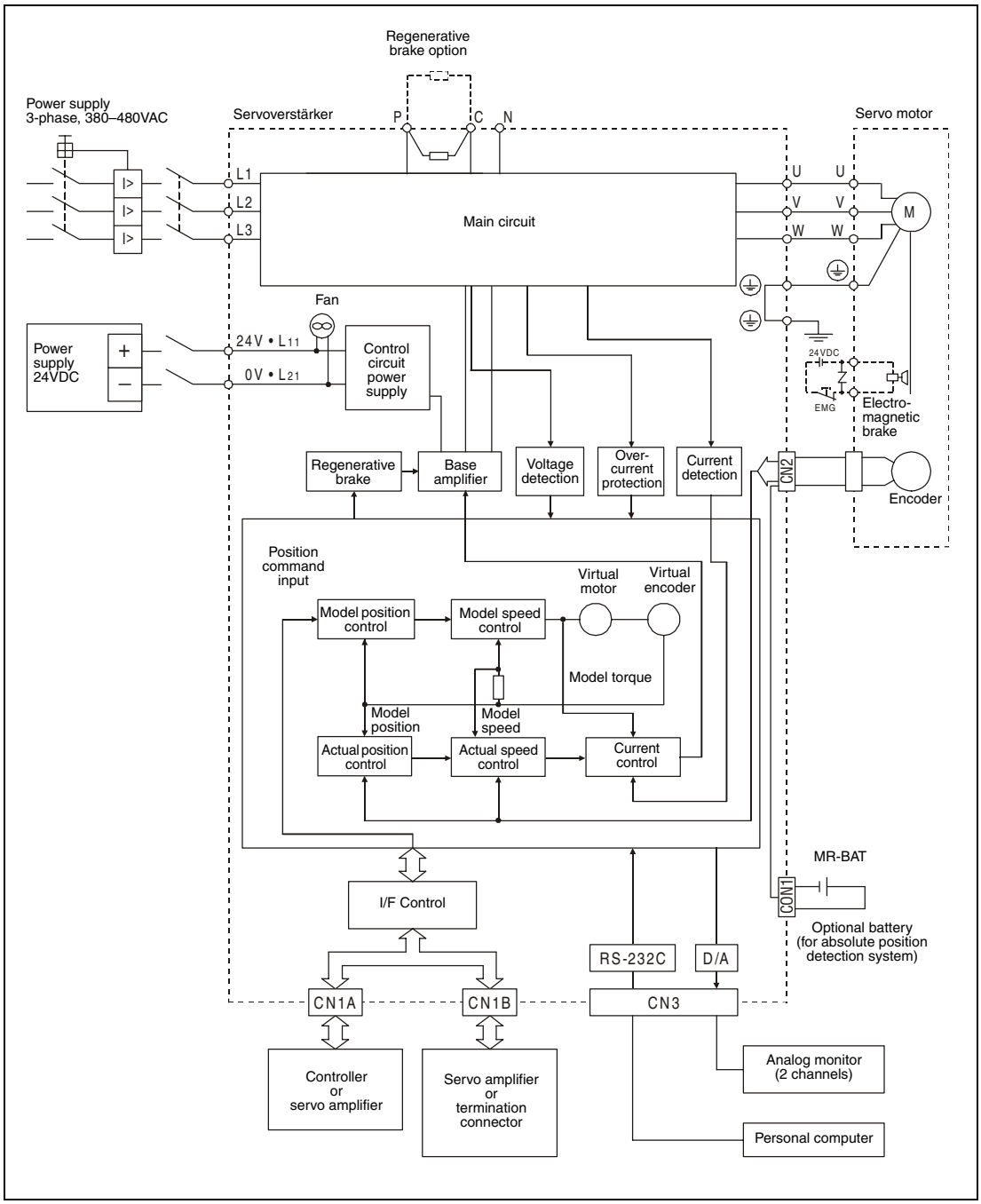


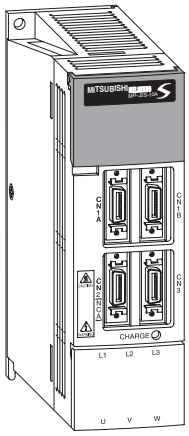
Fig. 1-3: *Block diagram for Servo amplifier MR-J2-Super*

When connecting an optional regeneration brake resistor, always remove the lead from across the terminals P and C.

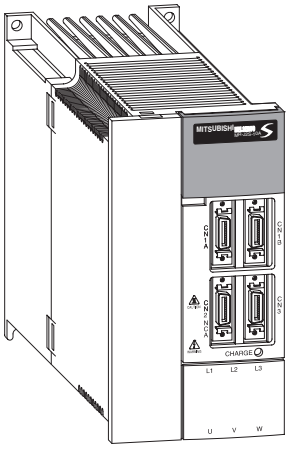
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1.3 Model overview

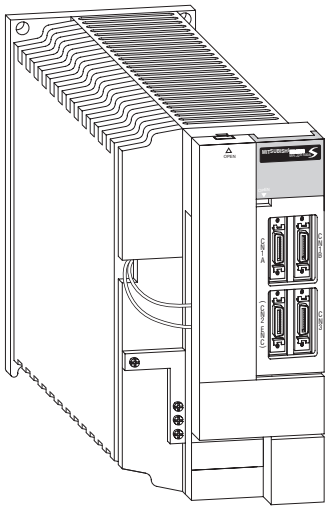
1.3.1 Servo amplifiers 200V



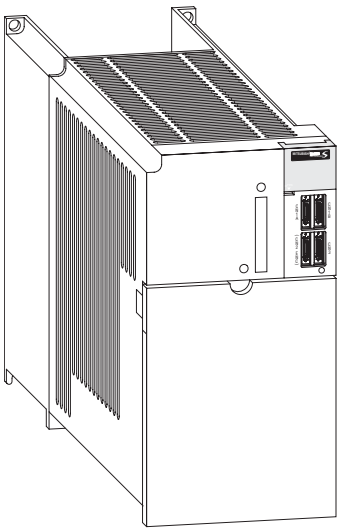
MR-J2S-100B or less



MR-J2S-200B/350B



MR-J2S-500B



MR-J2S-700B

MR-J2-□B

Series

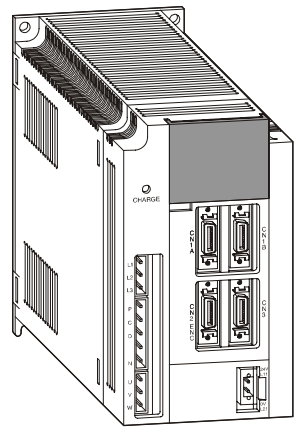
Code	Compatible servo motors			
	HC-KFS□	HC-MFS□	HC-SFS□	HC-RFS
10	035/13	053/13	—	—
20	23	23	—	—
40	43	43	—	—
60	—	—	52	—
70	73	73	—	—
100	—	—	102	—
200	—	—	152/202	103/153
350	—	—	352	203
500	—	—	502	353/503
700	—	—	702	—

S000847T, S000955T, S000913T, S000914T

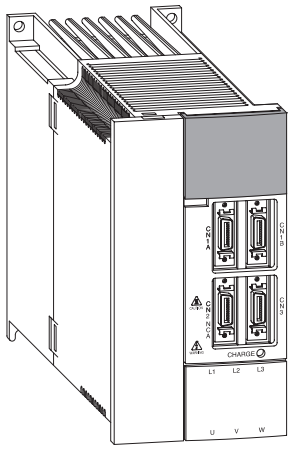
Fig. 1-4: *Model designation of servo amplifiers 200V*

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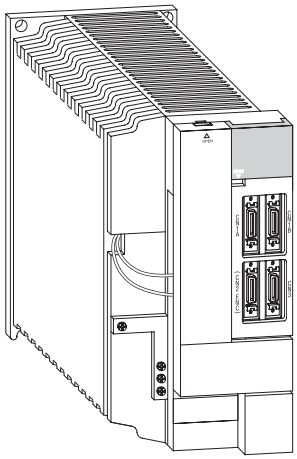
1.3.2 Servo amplifiers 400V



MR-J2S-200B4 or less



MR-J2S-350B4 and MR-J2S-500B4



MR-J2S-700B4

MR-J2S- B4

Series

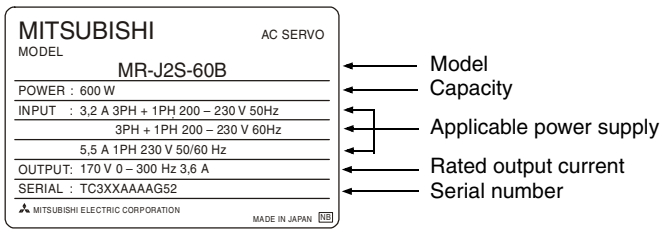
Code	Power supply
4	380–480VAC

Code	Compatible servo motors
	HC-SFS
60	524
100	1024
200	1524/2024
350	3524
500	5024
700	7024

S001196C, S001060E, S001061E

Fig. 1-5: *Model designation of servo amplifiers 400V*

1.3.3 Rating plate



S001001C

Fig. 1-6: *Rating plate*

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1.3.4 Servo motors

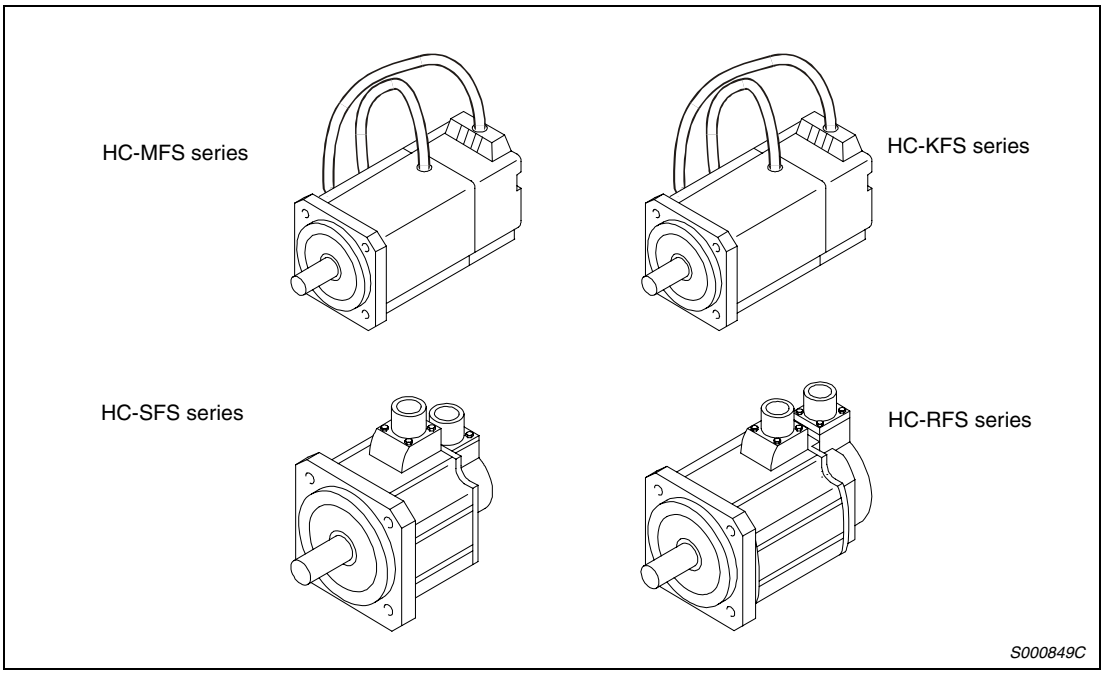


Fig. 1-7: *Servo motors*

Servo motors 200V

HC - MFS□ □ □

Motor series
HC-MFS
HC-KFS
HC-SFS
HC-RFS

Code	Electromagnetic brake
—	—
B	✓

Code	Rated speed [r/min]
2	2000
3	3000

Code	Rated speed [r/min]	Code	Rated output [W]
05	50	10	1000
31	100	15	1500
2	200	20	2000
4	400	35	3500
5	500	50	5000
7	750	70	7000

Fig. 1-8: *Model designation of servo motors 200V*

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Servo motors 400V

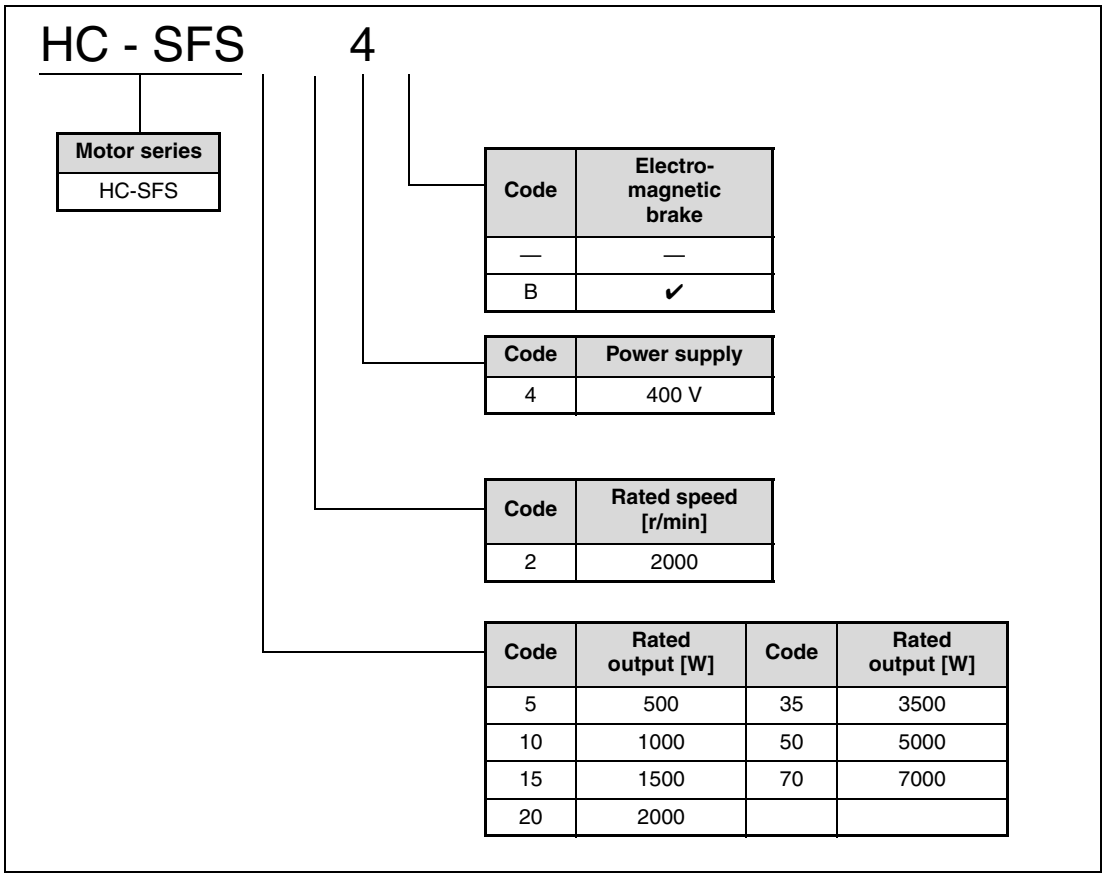


Fig. 1-9: *Model designation of servo motors 400V*

NOTE All motors conform to the following standards: EN, UL, cUL

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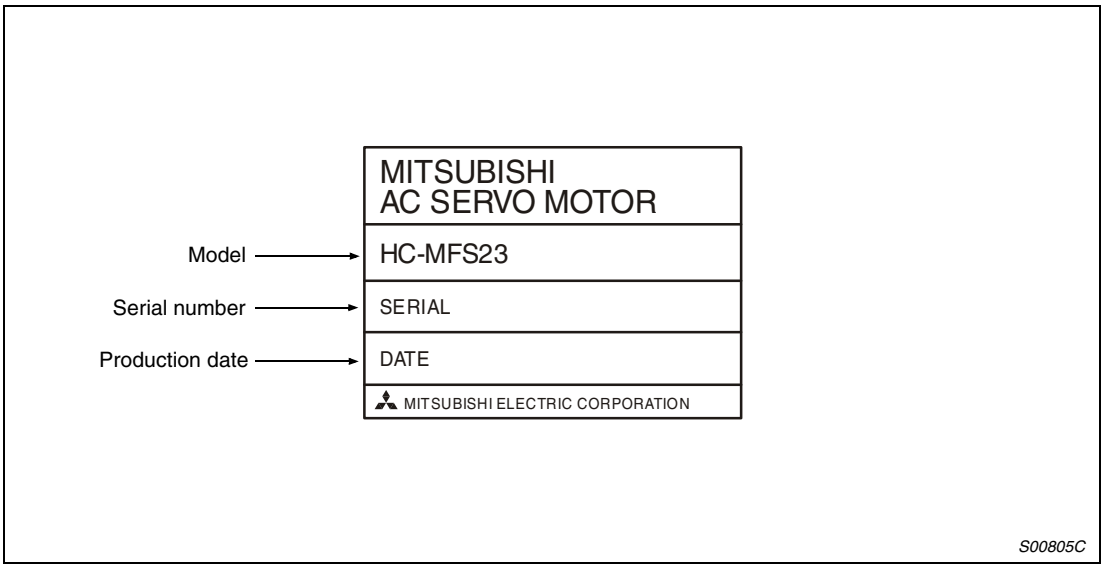


Fig. 1-10: *Rating plate*

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1.4 Removal and reinstallation of the front cover

For models MR-J2S-200B or larger the front cover must be removed before the battery holder and terminal strips for connecting the power supply of the motor TE1) and control voltage (TE2) are accessible.

DANGER:

Prior to removing the front cover the power supply must be switched off and at least 10 minutes must then elapse. This time interval is required for the condensers to discharge to a harmless voltage level after turning off the mains power supply.

Removal the front cover for MR-J2S-200B and MR-J2S-350B

① Hold down the removing knob.

② Pull the front cover toward you.

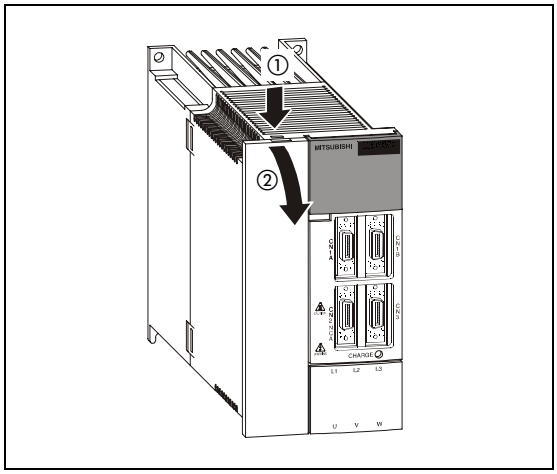


Abb. 1-11:
Removal the front cover

S000513C

Reinstallation the front cover for MR-J2S-200B and MR-J2S-350B

① Insert the front cover hooks into the front cover sockets of the servo amplifier.

② Press the front cover against the servo amplifier until the removing knob clicks.

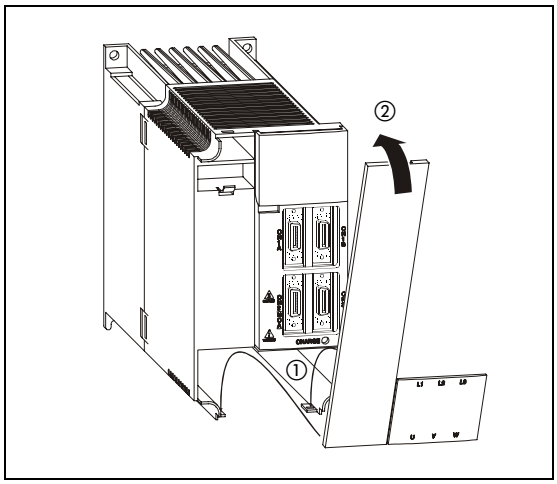


Abb. 1-12:
Reinstallation the front cover

S000514C

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Removal the front cover for MR-J2S-500B, MR-J2S-350B4 and MR-J2S-500B4

① Hold down the removing knob.

② Pull the front cover toward you.

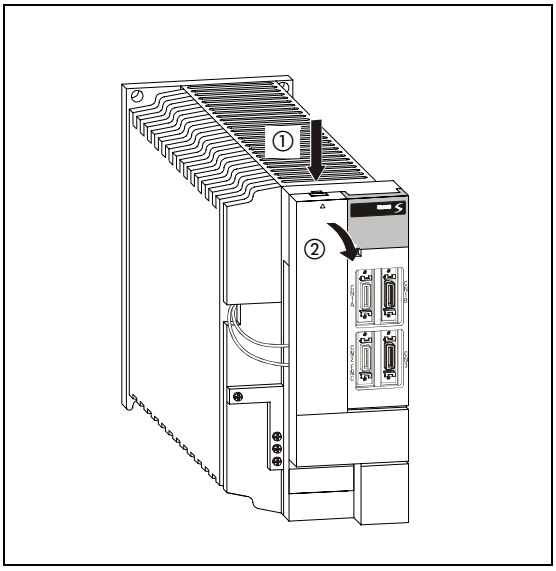


Abb. 1-13:
Removal the front cover

S000909C

Reinstallation the front cover for MR-J2S-500B, MR-J2S-350B4 and MR-J2S-500B4

① Insert the front cover hooks into the front cover sockets of the servo amplifier.

② Press the front cover against the servo amplifier until the removing knob clicks.

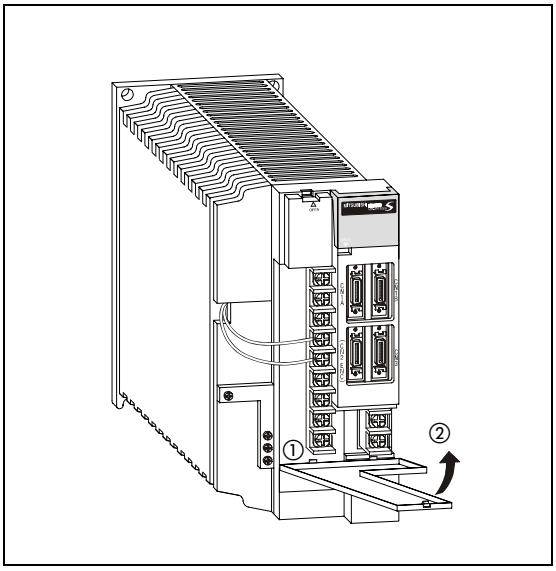


Abb. 1-14:
Reinstallation the front cover

S000910C

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Removal the front cover for MR-J2S-700B and MR-J2S-700B4

Press the lock on the side of the front cover inwards.

Put a finger in the recess in the middle of the front cover and pull it off to the front.

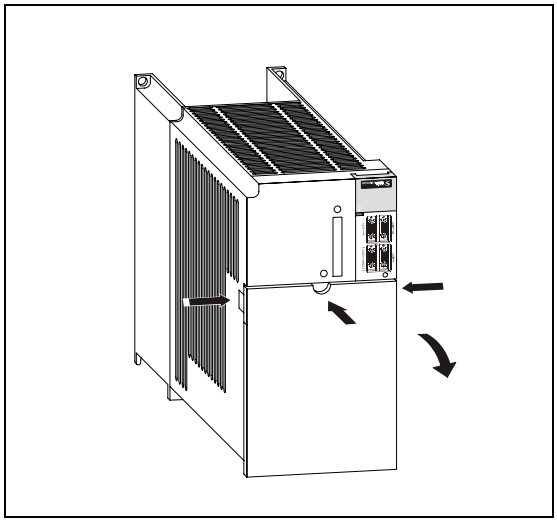


Abb. 1-15:
Removal the front cover

S000911C

Reinstallation the front cover for MR-J2S-700B and MR-J2S-700B4

Insert the front cover hooks into the front cover sockets of the servo amplifier.

Press the front cover against the servo amplifier until the removing knob clicks.

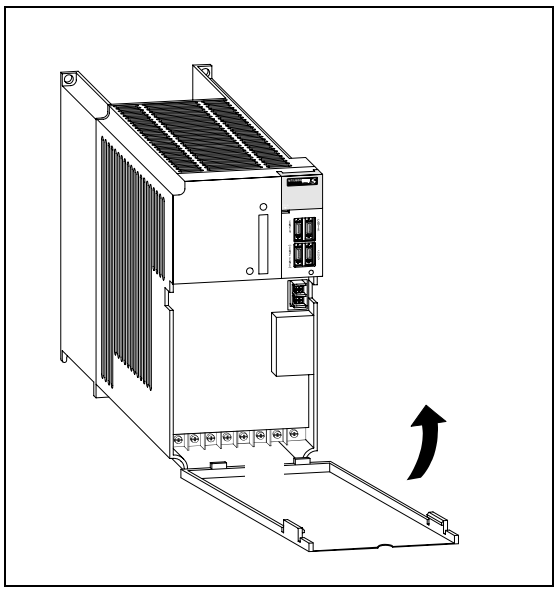


Abb. 1-16:
Reinstallation the front cover

S000912C

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1.5 Operating elements

1.5.1 Servo amplifier 200V

Servo amplifier MR-J2S-350B or less

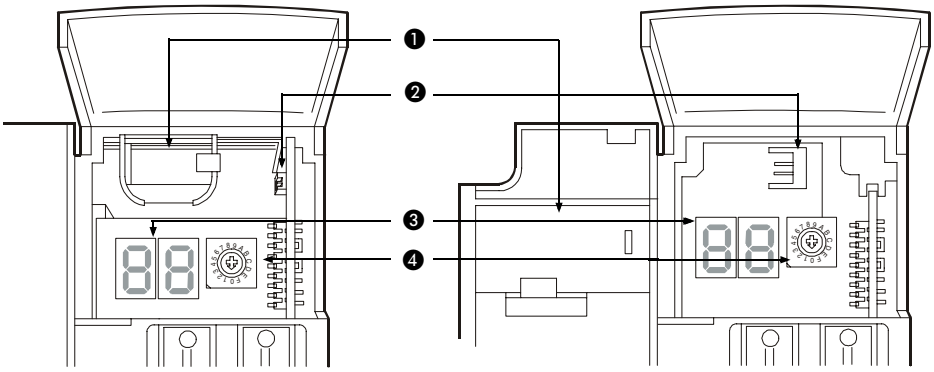


Fig. 1-17: *Servo amplifier MR-J2S-350B or less*

No.	Name	Description	Reference
❶	Battery holder	Contains the battery (optional) for absolute position data backup.	Chap. 6
❷	Battery connector (CON1)	Used to connect the battery.	Section 6.1.4
❸	Display	The two-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
❹	Station number (CS1) 	Switch to set the station number of the servo amplifier.	Section 3.9

Tab. 1-1: *Operating elements and their meaning*

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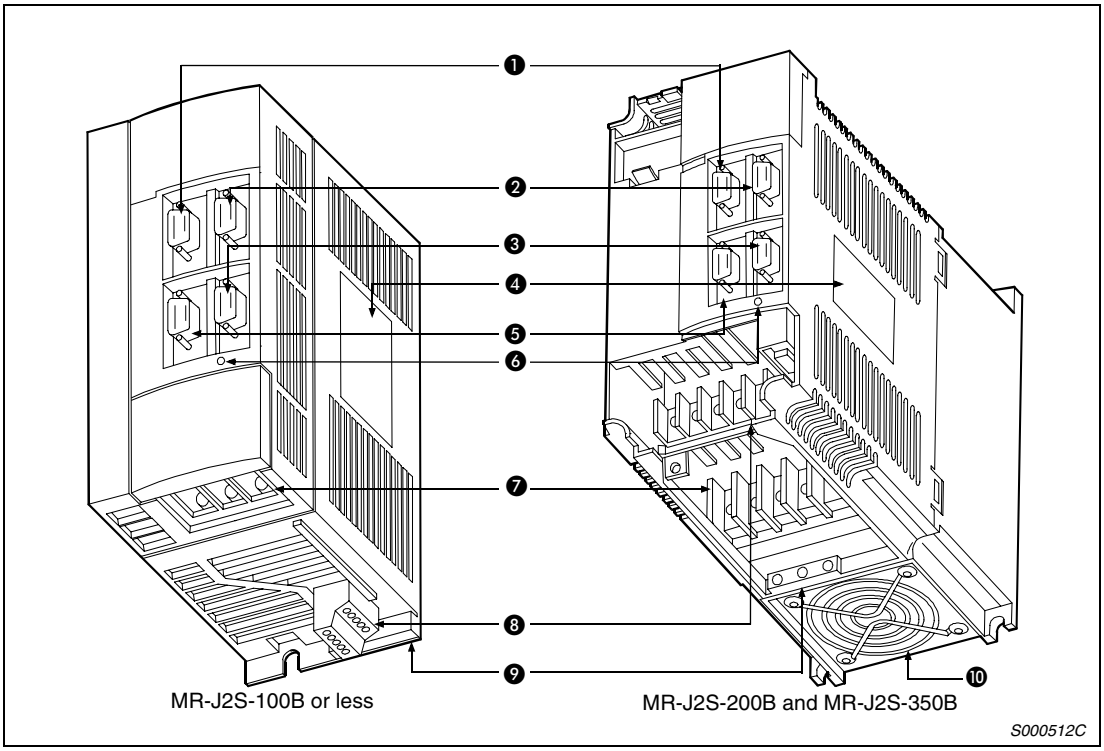


Fig. 1-18: *Servo amplifier MR-J2S-350B or less*

No.	Name	Description	Reference
❶	Bus cable connector (CN1A)	Used to connect the servo system controller or preceding axis servo amplifier.	Section 3.1.3
❷	Bus cable connector (CN1B)	Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM)	Section 3.1.3
❸	Communication connector (CN3)	Used to connect a personal computer or output analog monitor data.	Section 3.1.3
❹	Name plate	—	Section 1.3.3
❺	Encoder connector (CN2)	Used for connection of the servo motor encoder.	Section 3.1.3
❻	Charge lamp	Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	—
❼	Main circuit terminal block (TE1)	Used to connect the input power supply and servo motor.	Section 3.1.2
❽	Control circuit terminal block (TE2)	Used to connect the control circuit power supply and regenerative brake option.	Section 3.1.2
❾	Protective earth terminal (PE)	Module grounding	Section 3.4
❿	Fan	—	—

Tab. 1-2: *Operating elements and their meaning*

CAUTION:

Any mixing up of the connectors CN1A, CN1B, CN3 and CN2 can lead to a shortcircuit and damage to the inputs and outputs.

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Servo amplifier MR-J2S-500B and MR-J2S-700B

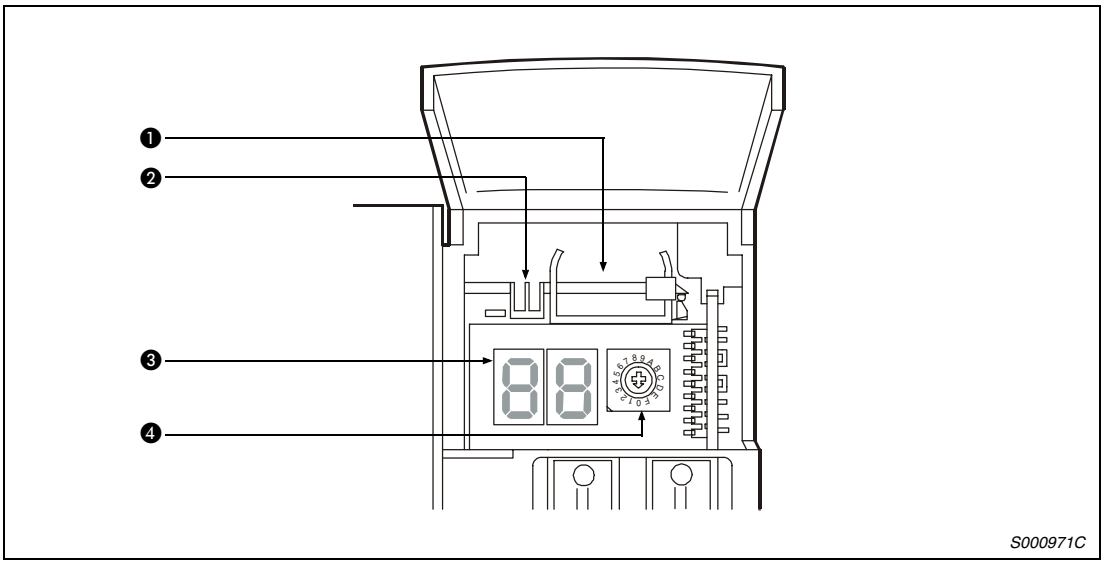


Fig. 1-19: *Servo amplifier MR-J2S-500B and MR-J2S-700B*

No.	Name	Description	Reference
	Battery holder	Contains the battery (optional) for absolute position data backup.	Chap. 6
	Battery connector (CON1)	Used to connect the battery.	Section 6.1.4
	Display	The two-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
	Station number (CS1) 	Switch to set the station number of the servo amplifier.	Section 3.9

Tab. 1-3: *Operating elements and their meaning*

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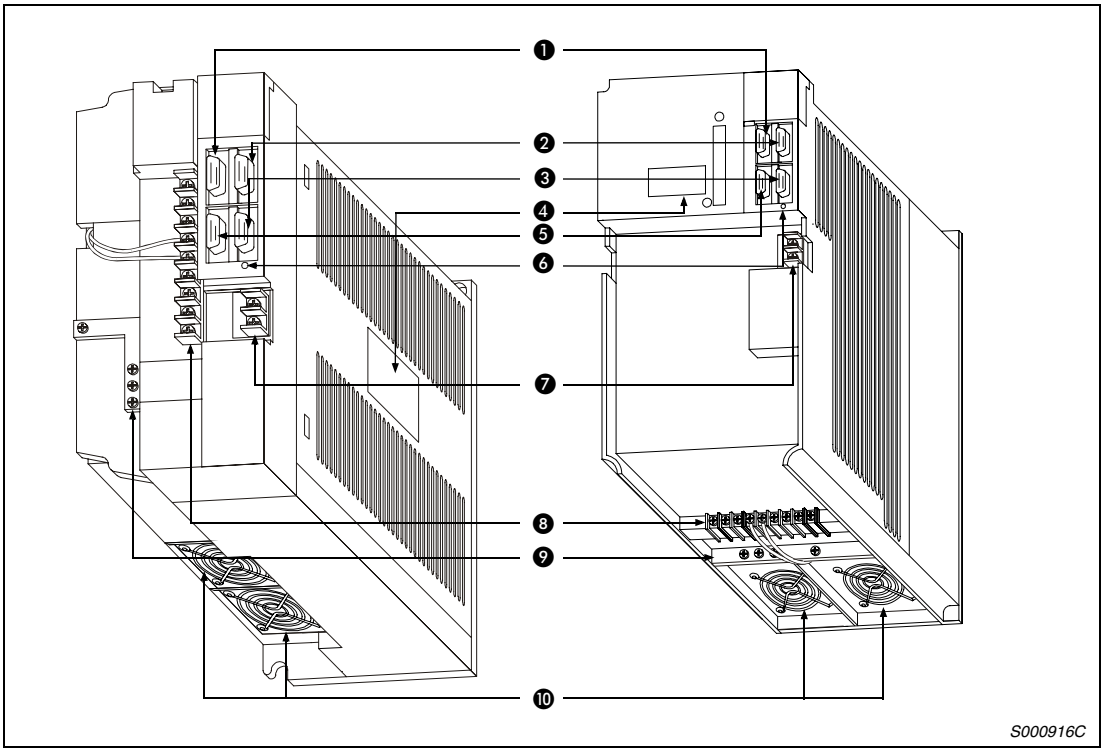


Fig. 1-20: *Servo amplifier MR-J2S-500B and MR-J2S-700B*

No.	Name	Description	Reference
❶	Bus cable connector (CN1A)	Used to connect the servo system controller or preceding axis servo amplifier.	Section 3.1.3
❷	Bus cable connector (CN1B)	Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM)	Section 3.1.3
❸	Communication connector (CN3)	Used to connect a personal computer or output analog monitor data.	Section 3.1.3
❹	Name plate	—	Section 1.3.3
❺	Encoder connector (CN2)	Used for connection of the servo motor encoder.	Section 3.1.3
❻	Charge lamp	Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables	—
❼	Main circuit terminal block (TE1)	Used to connect the input power supply and servo motor.	Section 3.1.2
❽	Control circuit terminal block (TE2)	Used to connect the control circuit power supply and regenerative brake option.	Section 3.1.2
❾	Protective earth terminal (PE)	Module grounding	Section 3.4
❿	Fan	—	—

Tab. 1-4: *Operating elements and their meaning*

CAUTION:

Any mixing up of the connectors CN1A, CN1B, CN3 and CN2 can lead to a shortcircuit and damage to the inputs and outputs.

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1.5.2 Servo amplifier 400V

Servo amplifier MR-J2S-60B4 to MR-J2S-200B4

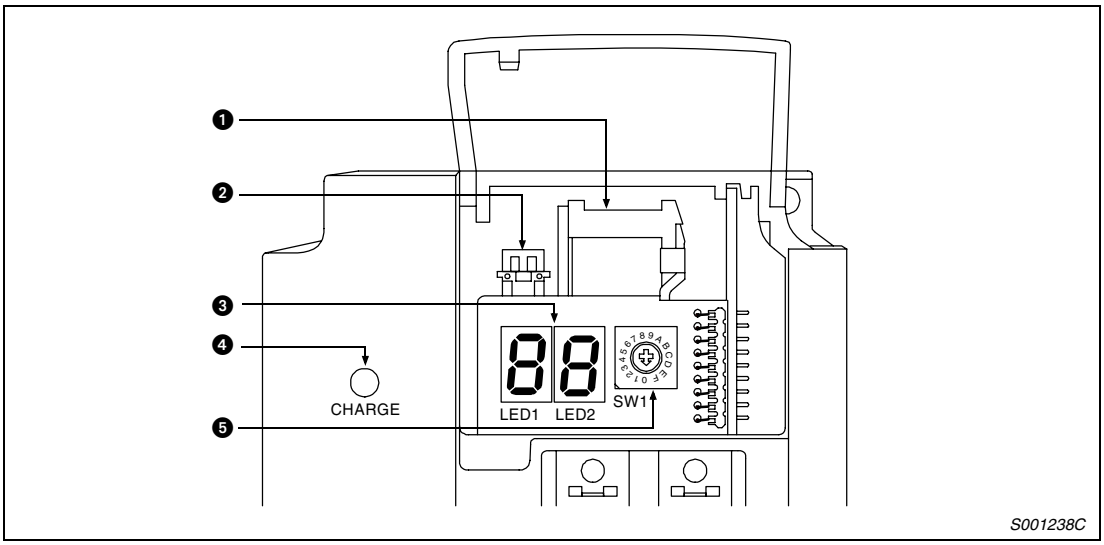


Fig. 1-21: *Servo amplifier MR-J2S-60B4 to MR-J2S-200B4*

No.	Name	Description	Reference
	Battery holder	Contains the battery (optional) for absolute position data backup.	Chap. 6
	Battery connector (CON1)	Used to connect the battery.	Section 6.1.4
	Display	The five-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
	Charge lamp	Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables	—
	Station number (CS1) 	Switch to set the station number of the servo amplifier.	Section 3.9

Tab. 1-5: *Operating elements and their meaning*

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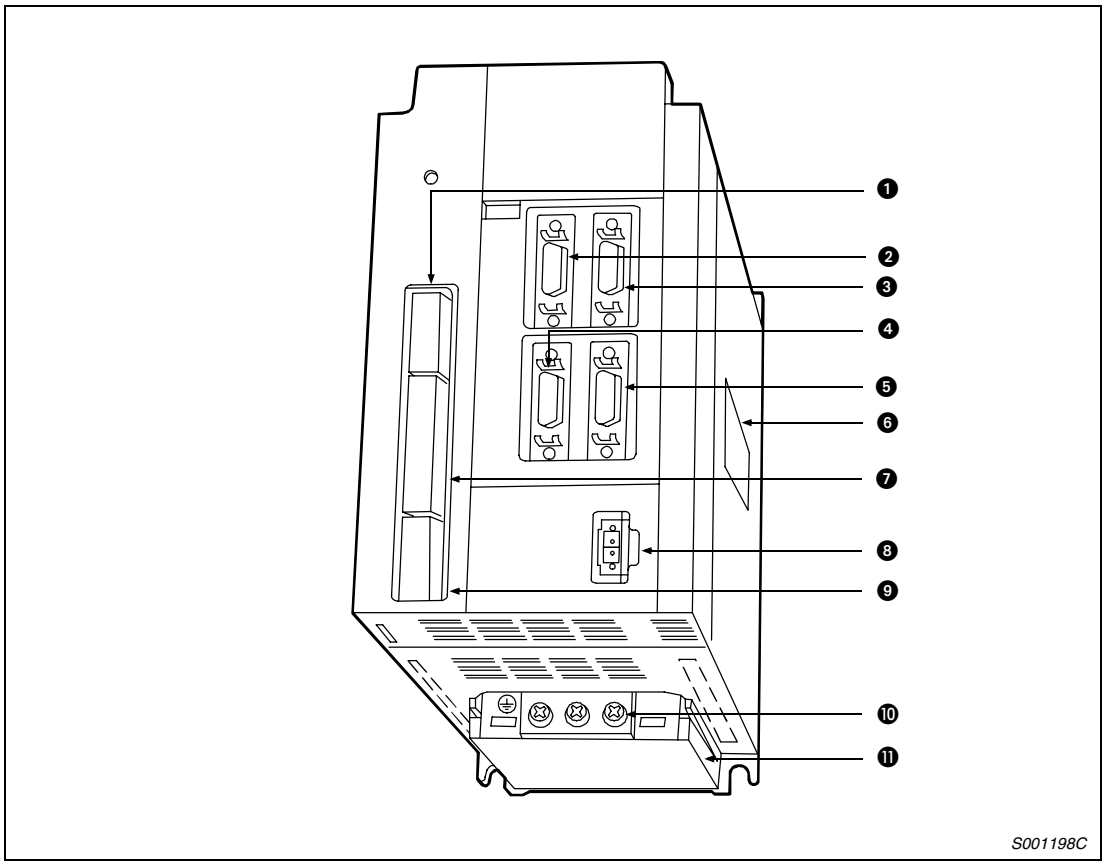


Fig. 1-22: *Servo amplifier MR-J2S-60B4 to MR-J2S-200B4*

No.	Name	Description	Reference
❶	Main circuit connector (CNP1)	Used to connect the input power supply	Section 3.1.3
❷	Bus cable connector (CN1A)	Used to connect the servo system controller or preceding axis servo amplifier.	Section 3.1.3
❸	Bus cable connector (CN1B)	Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM)	Section 3.1.3
❹	Encoder connector (CN2)	Used for connection of the servo motor encoder.	Section 3.1.3
❺	Communication connector (CN3)	Used to connect a personal computer or output analog monitor data.	Section 3.1.3
❻	Name plate	—	Section 1.3.3
❼	Regeneration connector	Used to connect the regeneration brake option.	—
❽	Control circuit terminal block (CN4)	Used to connect the control circuit power supply.	Section 3.1.2
❾	Motor power supply connector (CNP3)	Used to connect the servo motor	Section 3.1.2
❿	Protective earth terminal (PE)	Module grounding	Section 3.4
⓫	Fan	—	—

Tab. 1-6: *Operating elements and their meaning*

CAUTION:

Any mixing up of the connectors CN1A, CN1B, CN2 and CN3 can lead to a shortcircuit and damage to the inputs and outputs.

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Servo amplifier MR-J2S-350B4 to MR-J2S-700B4

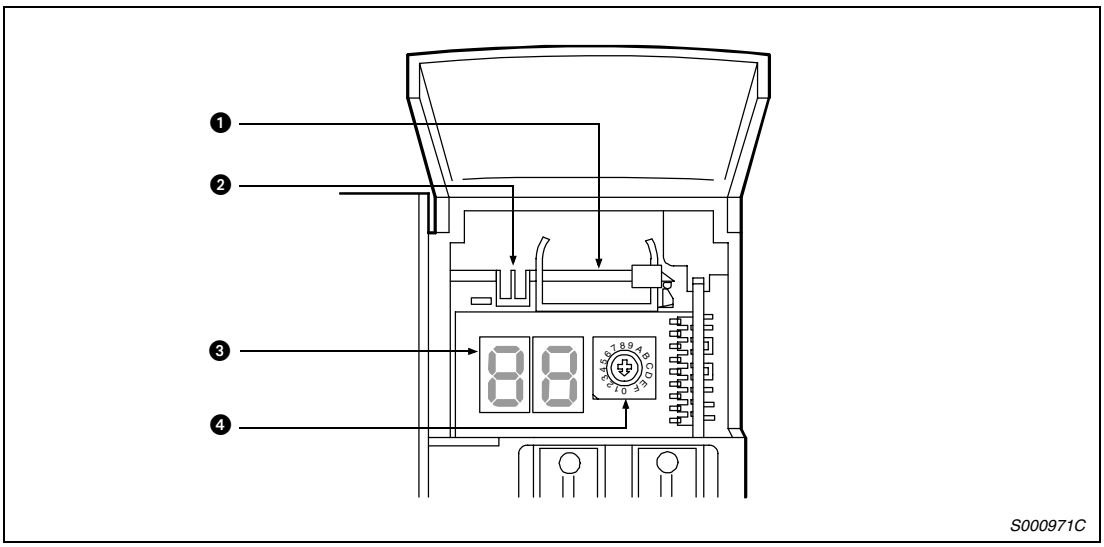


Fig. 1-23: *Servo amplifier MR-J2S-350B4 to MR-J2S-700B4*

No.	Name	Description	Reference
	Battery holder	Contains the battery (optional) for absolute position data backup.	Chap. 6
	Battery connector (CON1)	Used to connect the battery.	Section 6.1.4
	Display	The five-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
	Station number (CS1) 	Switch to set the station number of the servo amplifier.	Section 3.9

Tab. 1-7: *Operating elements and their meaning*

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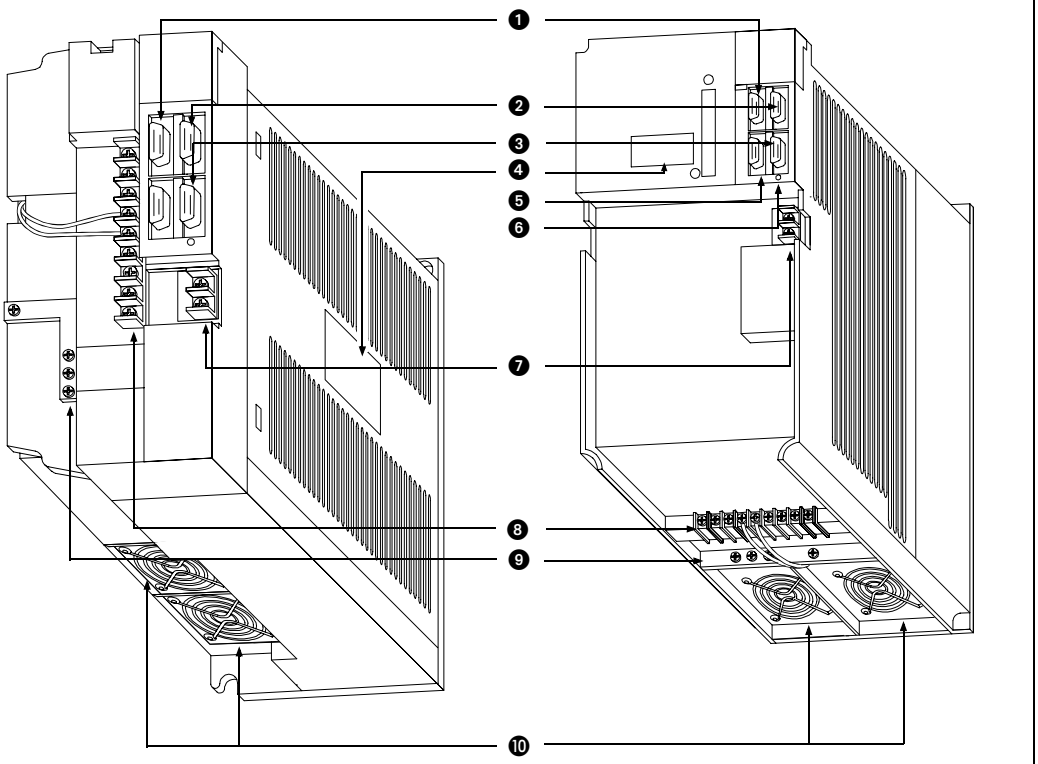


Fig. 1-24: *Servo amplifier MR-J2S-350B4 to MR-J2S-700B4*

No.	Name	Description	Reference
❶	Bus cable connector (CN1A)	Used to connect the servo system controller or preceding axis servo amplifier.	Section 3.1.3
❷	Bus cable connector (CN1B)	Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM)	Section 3.1.3
❸	Communication connector (CN3)	Used to connect a personal computer or output analog monitor data.	Section 3.1.3
❹	Name plate	—	Section 1.3.3
❺	Encoder connector (CN2)	Used for connection of the servo motor encoder.	Section 3.1.3
❻	Charge lamp	Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables	—
❼	Control circuit terminal block (TE2)	Used to connect the control circuit power supply.	Section 3.1.2
❽	Main circuit terminal block (TE1)	Used to connect the input power supply, regenerative brake option and servo motor.	Section 3.1.2
❾	Protective earth terminal (PE)	Module grounding	Section 3.4
❿	Fan	—	—

Tab. 1-8: *Operating elements and their meaning*

CAUTION:

Any mixing up of the connectors CN1A, CN1B, CN2 and CN3 can lead to a shortcircuit and damage to the inputs and outputs.

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1.5.3 Servo motor

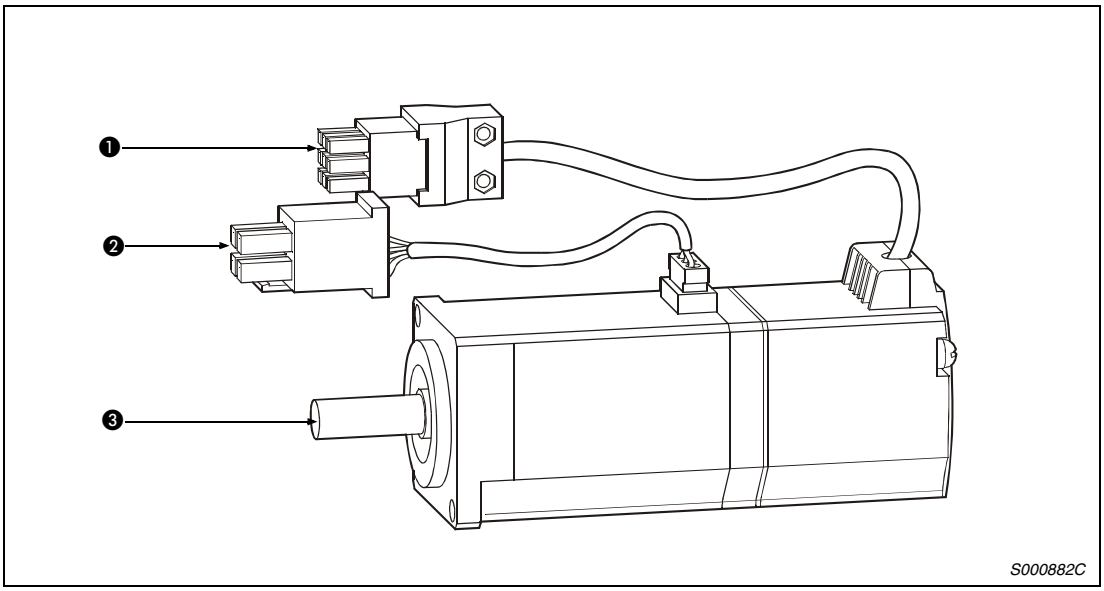


Fig. 1-25: *Servo motor*

No.	Name	Description	Reference
	Encoder connector	Cable for connection of encoders	Section 7.1.3
	Power supply connector, brake	Power supply cable (U, V, W), Earth cable, Brake (for motor with electromagnetic brake)	Section 3.2
	Servo motor shaft	Shaft of servo motor	Section 2.1.2

Tab. 1-9: *Operating elements and their meaning*

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1.6 Functions

Function	Description	Reference
High-resolution encoder	Motor encoder has a resolution of 131072 pulses/rev.	—
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	Chap. 6
Adaptive vibration suppression control	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 5.1.2
Vibration suppression control	Vibrations with an amplitude of ±1 impulse on stopping the servo motor are suppressed.	Parameter 24
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 5.1.3
Machine analyzer function	By attaching the MR-J2-Super to a PC on which the setup software is installed, the frequency characteristics of the mechanical system can be recorded.	—
Machine simulation	Can simulate machine motions on a personal computer screen on the basis of the machine analyser results.	—
Gain search function	Personal computer changes gains automatically and searches for overshoot-free gains in a short time.	—
Real-time auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies. This function is more powerful on the MR-J2-Super than on the MR-J2.	Section 4.6.3
Analog monitor output	Servo status is output in terms of voltage in real time.	Parameter 22
Torque limit	Servo motor torque can be limited to any value.	Parameter 10, 11
Forced stop	The external EMERGENCY OFF signal (EM1) can be released internally.	Parameter 23
Forced output signal	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	Section 4.4
Test operation mode	The servo motor can be operated from the servo amplifier without a start signal.	Section 4.4
Regenerative brake option	Used when the built-in regenerative brake resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	Section 7.1.1
Setup software	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	—

Tab. 1-10: *Function description*

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1.7 System configuration

CAUTION:
To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.

1.7.1 Servo amplifiers 200V

System configuration for MR-J2S-100B or less

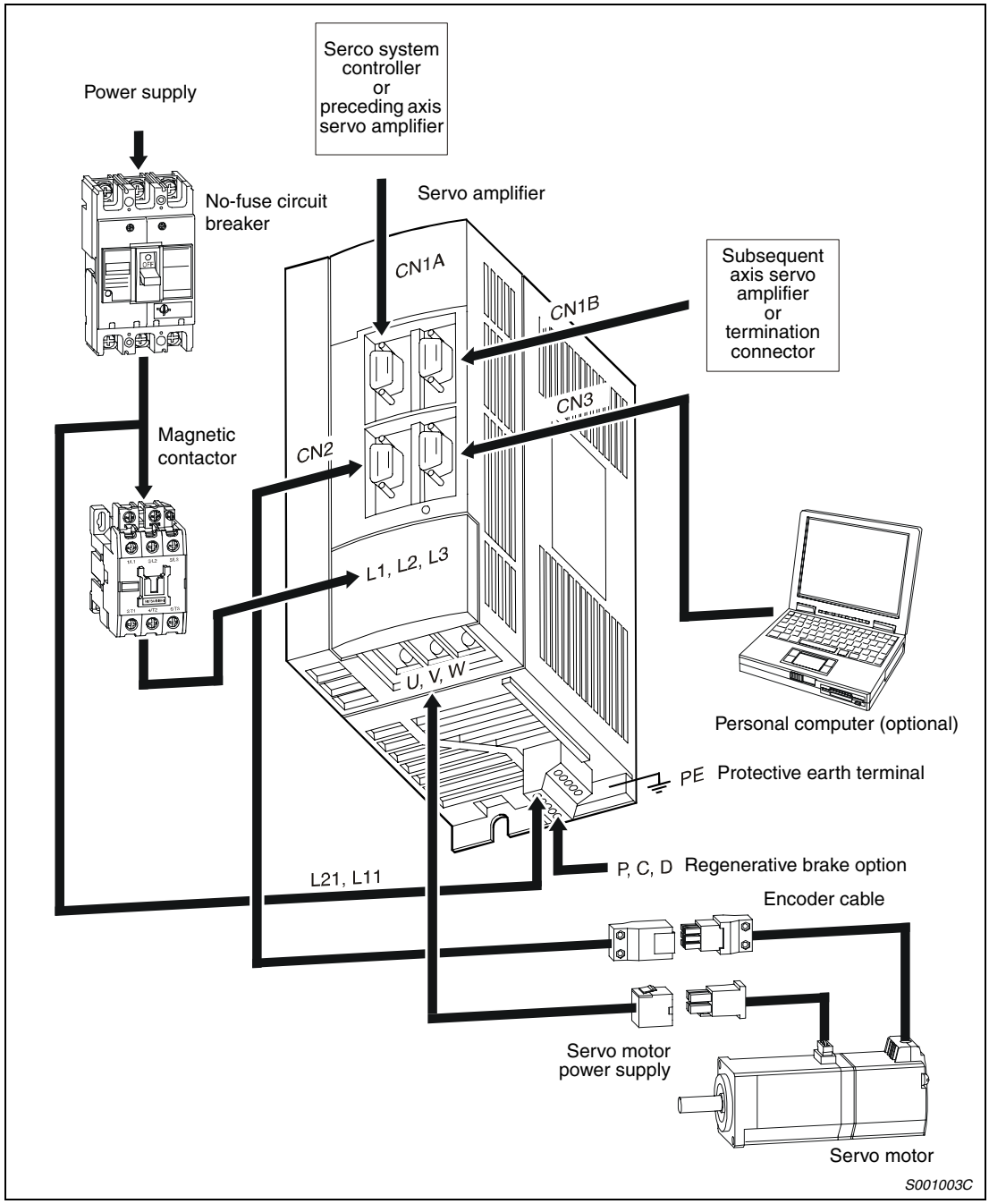


Fig. 1-26: *Overview of the system configuration for MR-J2S-100B or less*

NOTE A listing of options and auxillary equipment can be find in Tab. 1-11 on page 1-26.

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System configuration for MR-J2S-200B and MR-J2S-350B

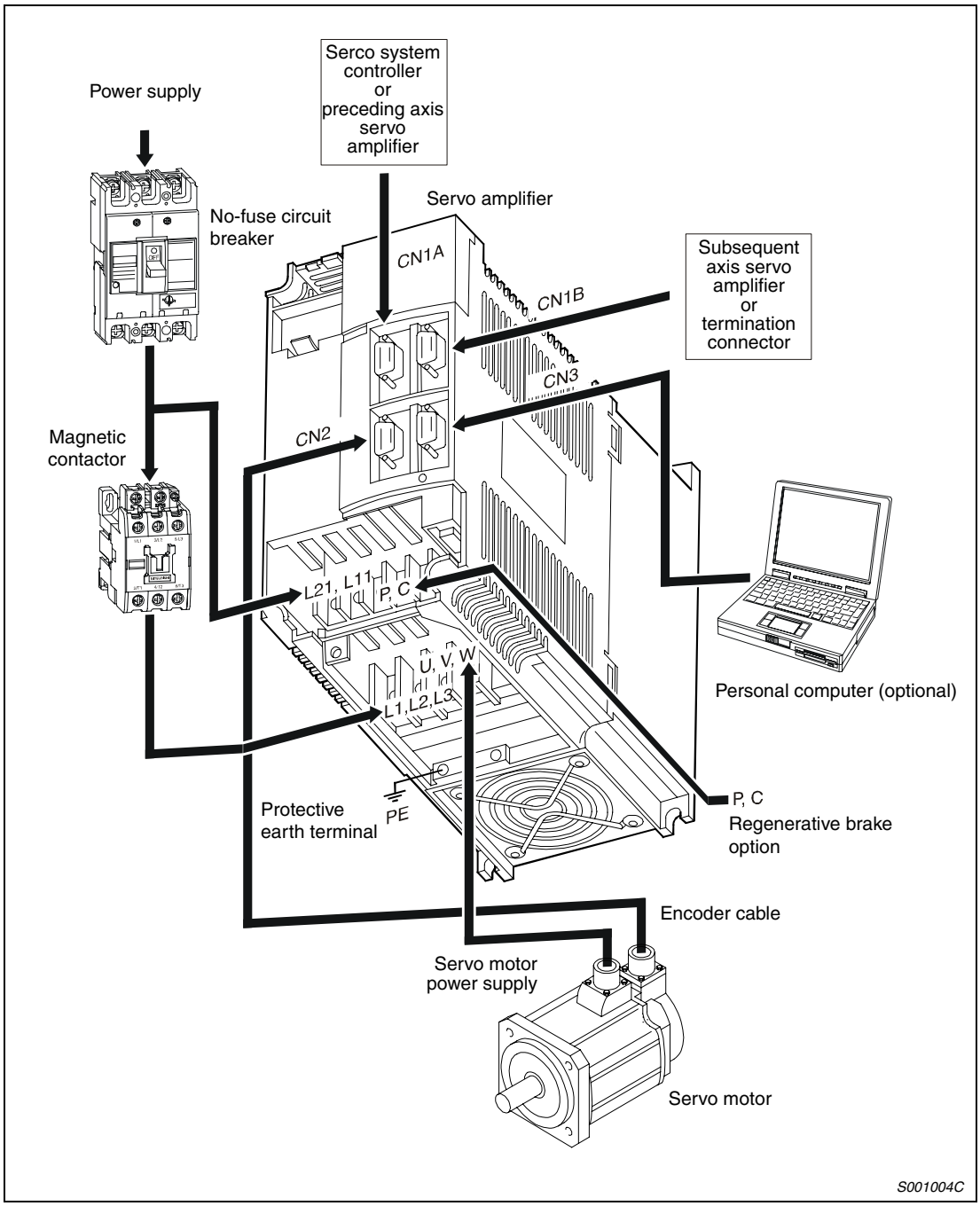


Fig. 1-27: *Overview of the system configuration for MR-J2S-200B and MR-J2S-350B*

NOTE A listing of options and auxillary equipment can be find in Tab. 1-11 on page 1-26.

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System configuration for MR-J2S-500B

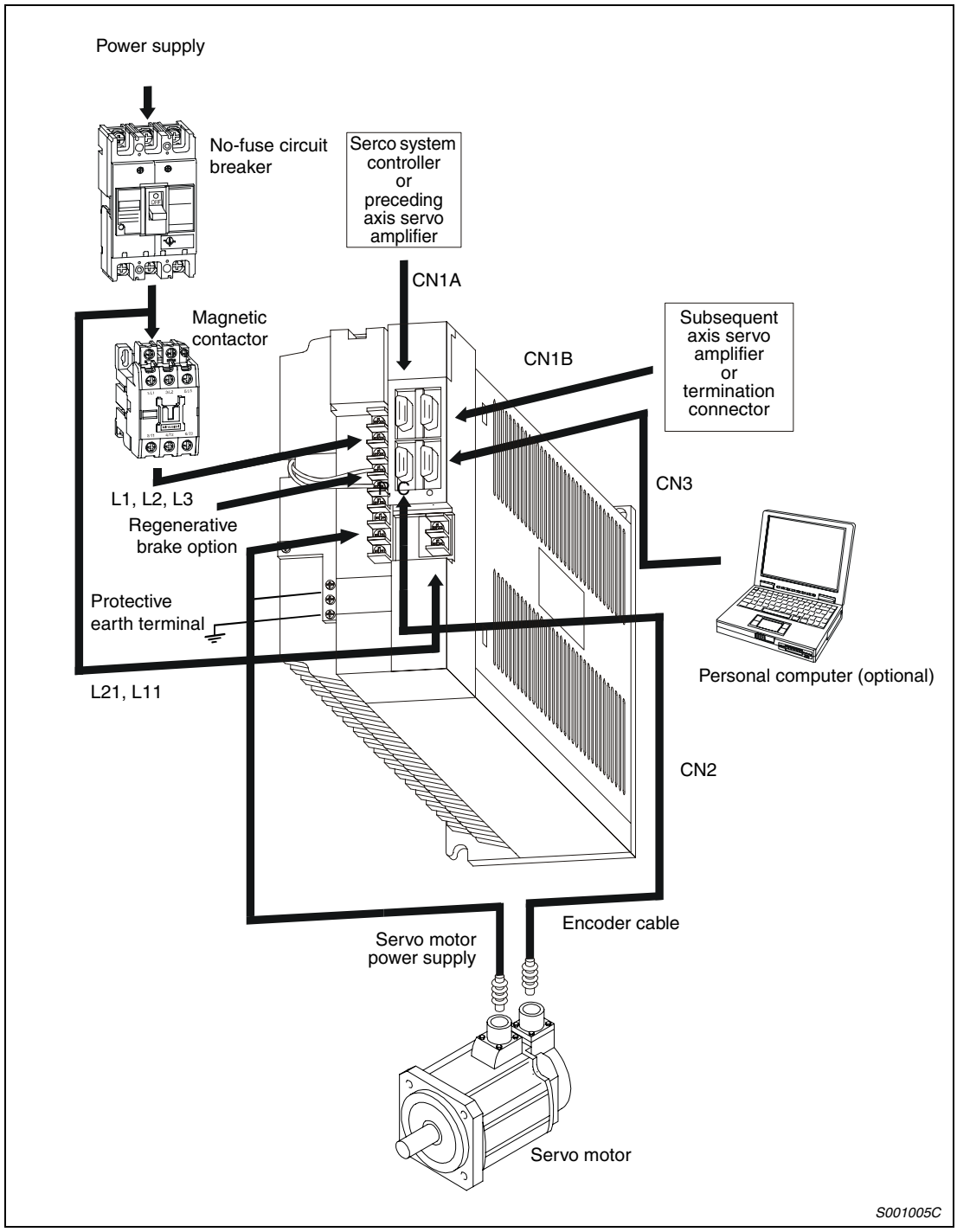


Fig. 1-28: *Overview of the system configuration for MR-J2S-500B*

NOTE A listing of options and auxillary equipment can be find in Tab. 1-11 on page 1-26.

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System configuration for MR-J2S-700B

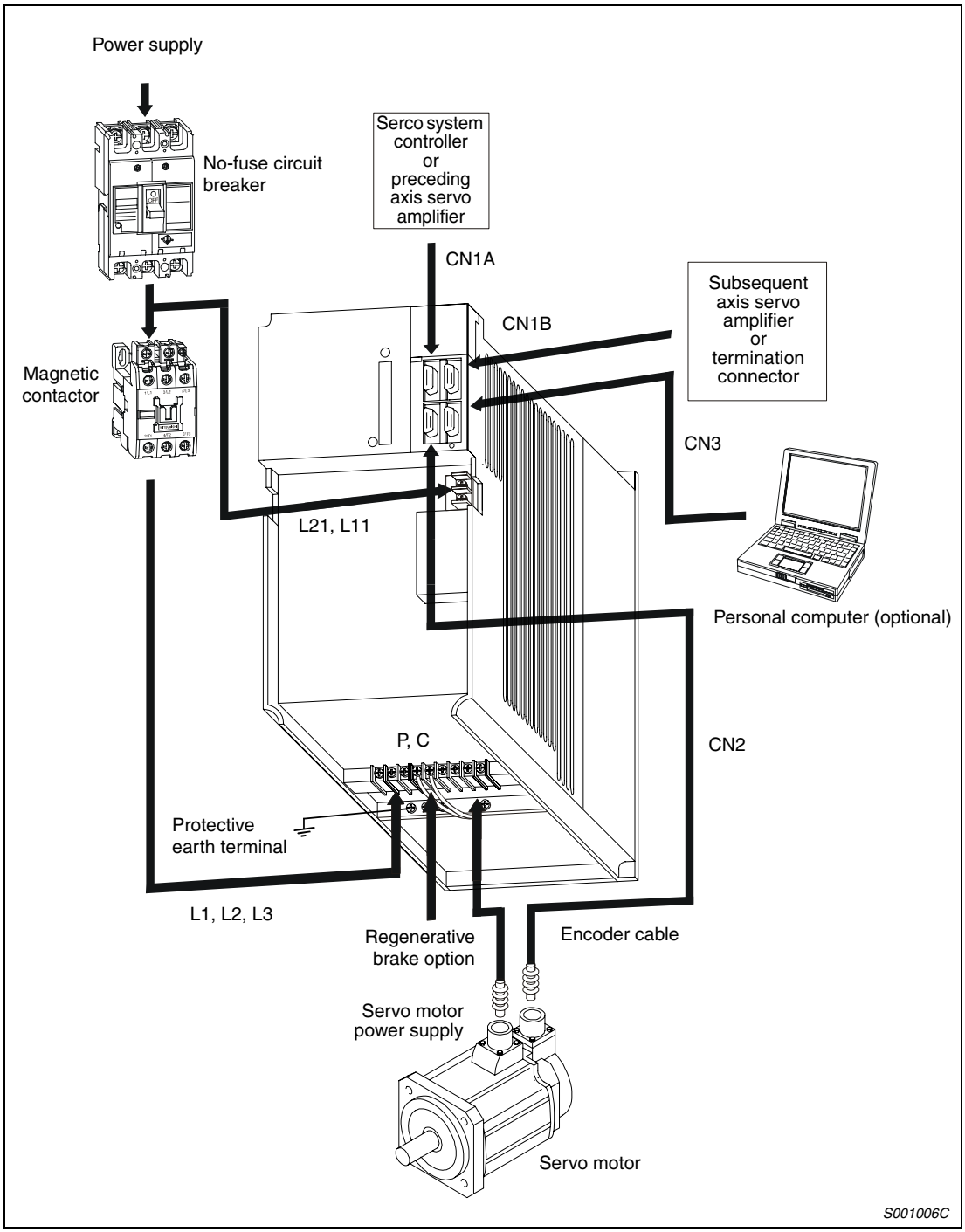


Fig. 1-29: *Overview of the system configuration for MR-J2S-700B*

Options and auxiliary equipment	Reference
No-fuse circuit breaker	Section 3.1.1
Magnetic contactor	Section 3.1.1
Regenerative brake option	Section 7.1.1
Cables	Section 7.1.2
Power factor improving reactor (U_E/U_A = 400V/230V)	Section 7.2.1

Tab. 1-11: *Options and auxiliary equipment*

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1.7.2 Servo amplifier 400V

System configuration for MR-J2S-200B4 or less

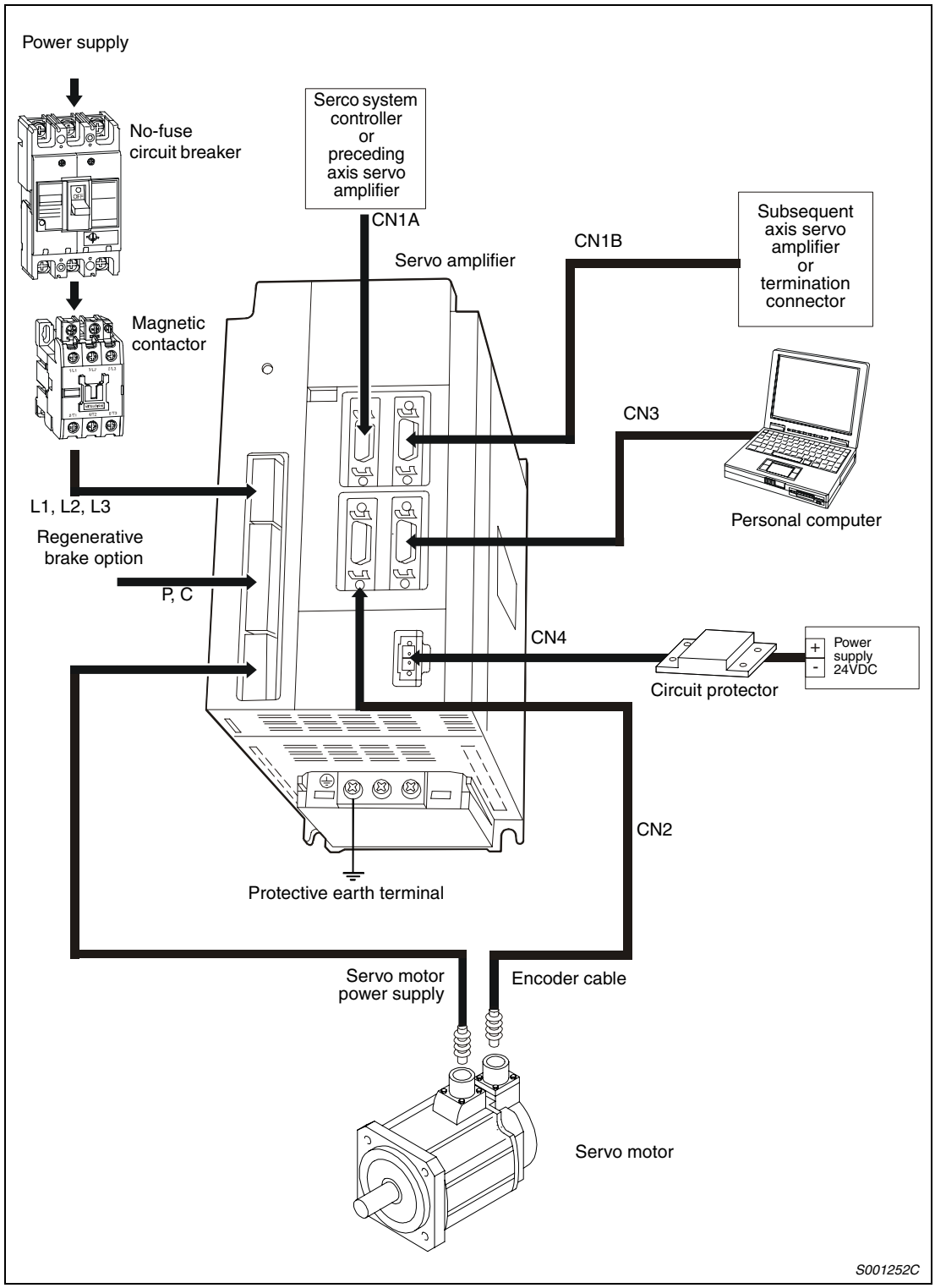


Fig. 1-30: *Overview of the system configuration for MR-J2S-200B4 or less*

NOTE A listing of options and auxillary equipment can be find in Tab. 1-12 on page 1-29.

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System configuration for MR-J2S-350B4 and MR-J2S-500B4

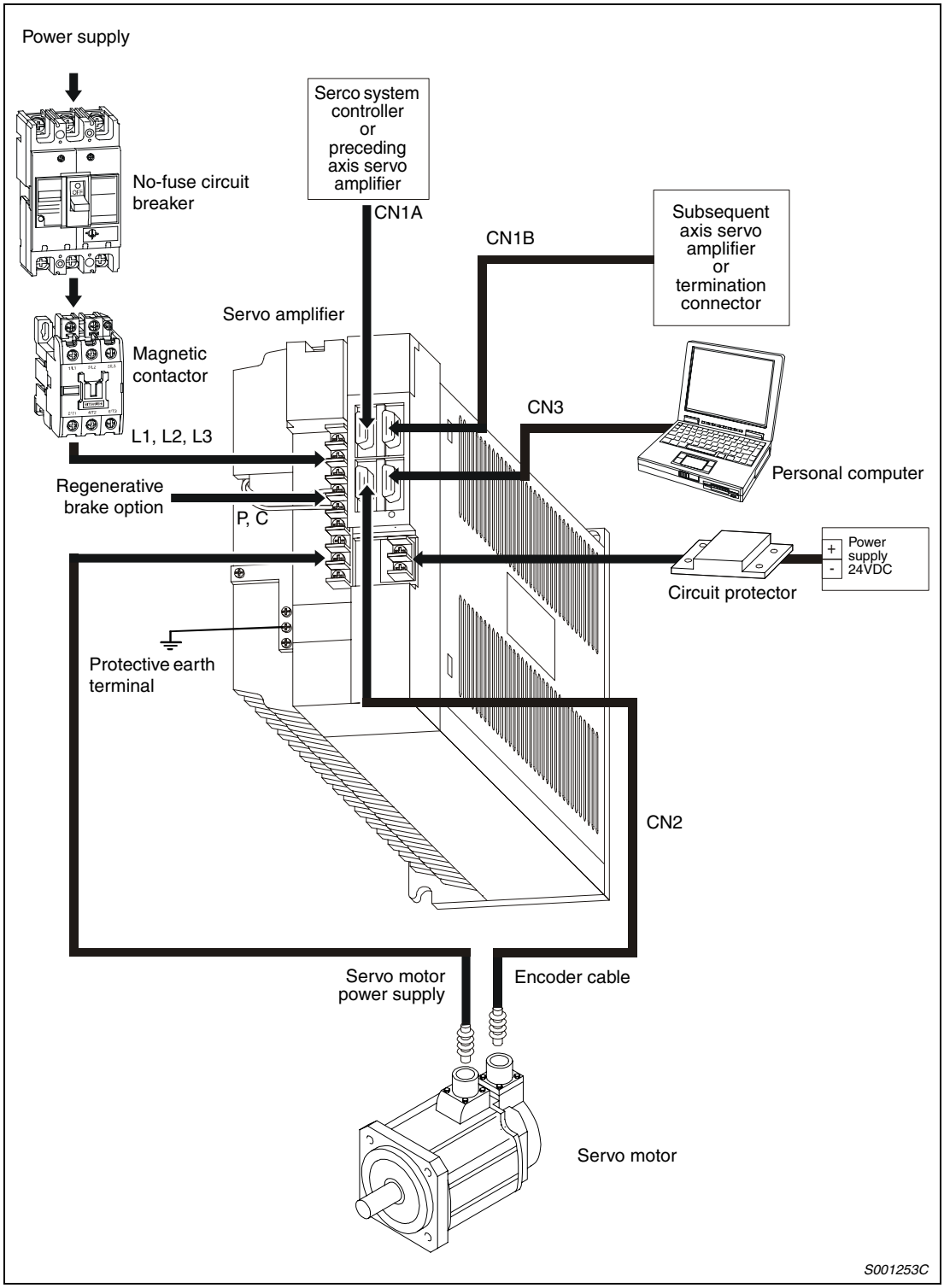


Fig. 1-31: *Overview of the system configuration for MR-J2S-350B4 and MR-J2S-500B4*

NOTE A listing of options and auxillary equipment can be find in Tab. 1-12 on page 1-29.

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System configuration for MR-J2S-700B4

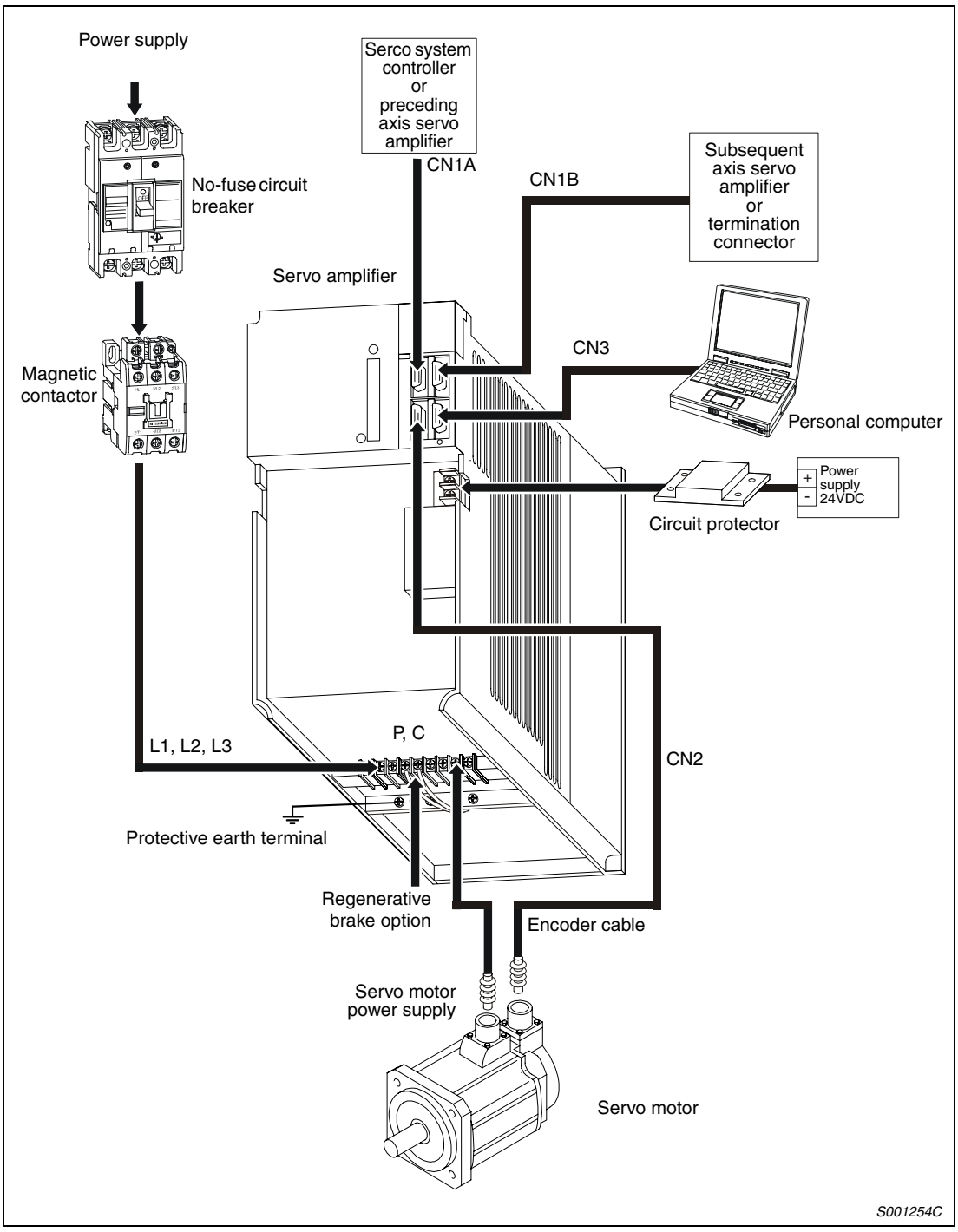


Fig. 1-32: *Overview of the system configuration for MR-J2S-700B4*

Options and auxiliary equipment	Reference
No-fuse circuit breaker	Section 3.1.1
Magnetic contacto	Section 3.1.1
Regenerative brake option	Section 7.1.1
Cables	Section 7.1.2

Tab. 1-12: *Options and auxiliary equipment*

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2 Installation

2.1 General environmental conditions



CAUTION:

- ***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.***

Environmental conditions	Data	
	Servo amplifier	**Servo motor**
Ambient temperature during operation	0 to +55°C (non-freezing)	0 to +40°C (non-freezing)
Ambient humidity during operation	Max. 90% (no condensation)	Max. 80% (no condensation)
Ambient temperature in storage	–20 to +65°C	–15 to +70°C
Ambient humidity in storage	Max. 90% (no condensation)	Max. 90% (no condensation)
Ambience	Indoors (no direct sunlight); no corrosive gas, no inflammable gas, no oil mist, no dust)	
Altitude above sea level	Max. 1000m	
Protective structure	IP00	HC-KFS/MFS: IP55, HC-SFS/RFS: IP65
Vibration	Max. 5.9m/s² (0,6 g)	Section 2.1.2

Tab. 2-1: *Environmental condition overview*

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2.1.1 Installation of servo amplifiers

CAUTION:

- ***When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.***
- ***Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box or a fan installed on the ceiling.***

Installation of one servo amplifier

The servo amplifier must be installed as shown in the following diagram, upright on a vertical and smooth wall.

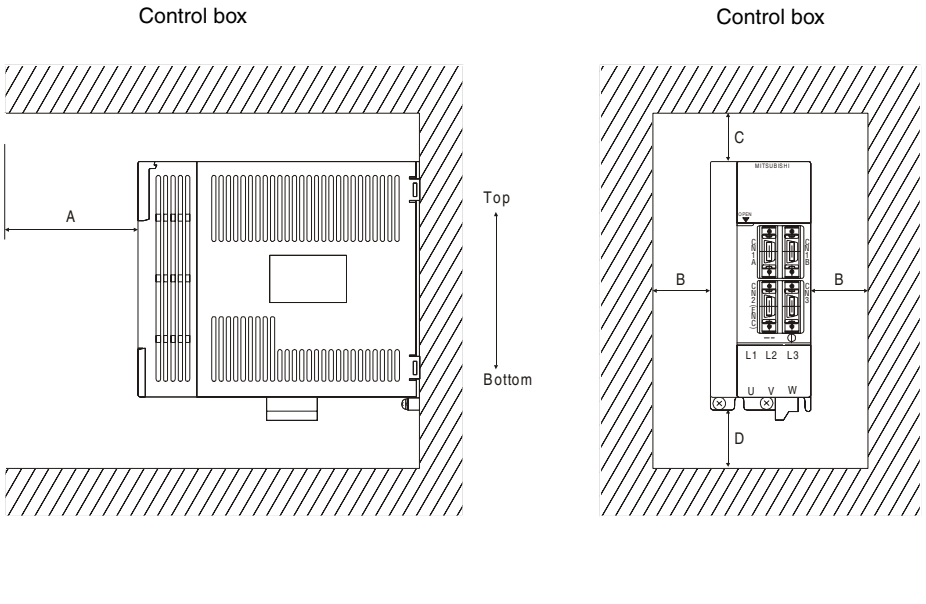


Fig. 2-1: *Installation direction and clearances*

Servo amplifier	Minimal installation clearance [mm]			
	A	B	C	D
Servo amplifiers 200V	70	10	40	40
Servo amplifiers 400V	75 ①			120

Tab. 2-2: *Minimal installation clearance*

① The distance A for the servo amplifier MR-J2S-700B4 is 70mm.

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Installation of two or more servo amplifiers and other equipment

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box. Due to the power loss of the units it must be ensured that the internal temperature of the control cabinet does not exceed the ambient temperature of +55 °C allowed for the servo amplifier. If necessary, the control cabinet will have to be ventilated. In this case, however, the servo amplifier must not be installed in the flow of coolant of some other operating agent. The fan(s) in the forced-cooling housing must be installed taking into account the provision of an optimum supply of cool air.

For details of the heat dissipation of control cabinets and housings please see the manufacturer's specifications.

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.

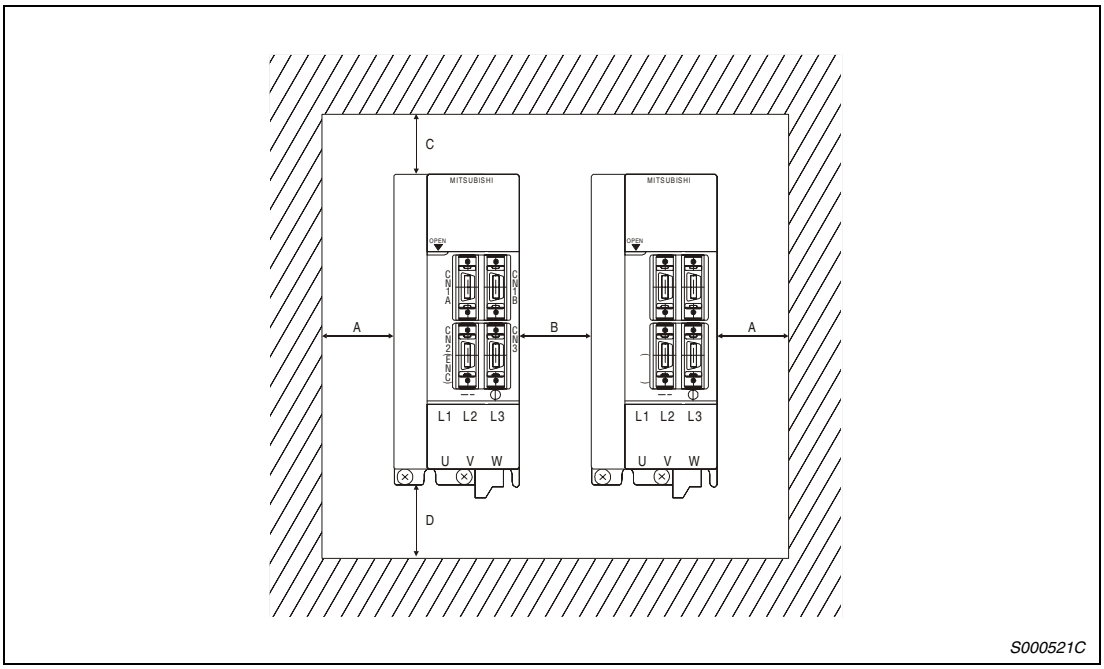


Fig. 2-2: *Installation of two or more servo amplifiers*

Servo amplifier	Minimal installation clearance [mm]			
	A	B	C	D
Servo amplifiers 200V	30	10	100	40
Servo amplifiers 400V				120

Tab. 2-3: *Minimal installation clearance*

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2.1.2 Installation of servo motors

Safety instructions

CAUTION:

- ***Do not hold the cable, shaft or encoder to carry the servo motor. Otherwise, a fault or injury may occur.***
- ***Securely fix the servo motor to the machine. If fixed insecurely, the servo motor will come off during operation, leading to injury.***
- ***When coupling the shaft end of the servo motor, do not subject the shaft end to impact, such as hammering. The encoder may become faulty.***
- ***Secure the motor shaft and rotating parts against access through appropriate covers.***
- ***Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break, leading to injury.***

Instructions for the protection of the servo motor shaft

- When mounting a pulley to the servo motor shaft provided with a keyway, use the screw hole in the shaft end (refer fig. 2-3). To fit the pulley, first insert a double-end stud into the screw hole of the shaft, put a washer against the end face of the coupling, and insert and tighten a nut to force the pulley in.
  Under no circumstances must you use a hammer for installation work on the servo motor shaft.

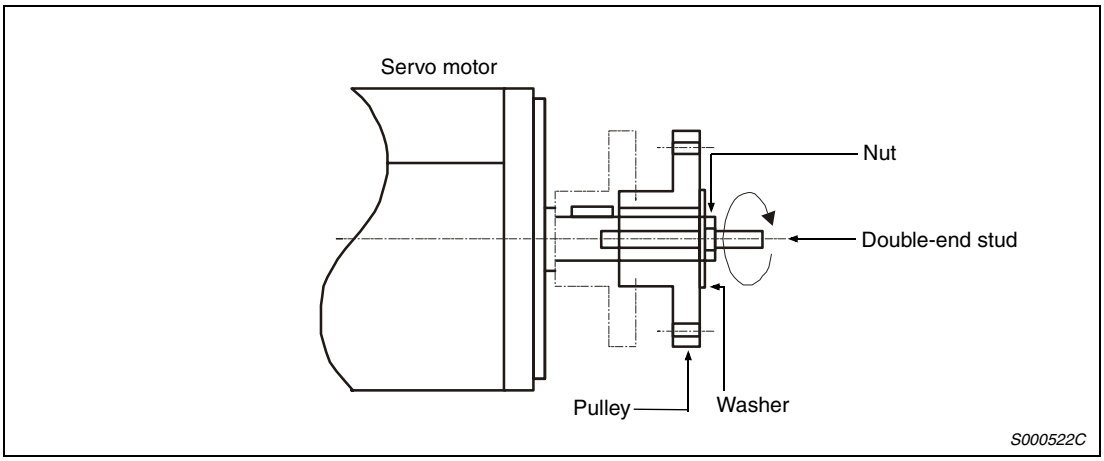


Fig. 2-3: *Installing a pulley*

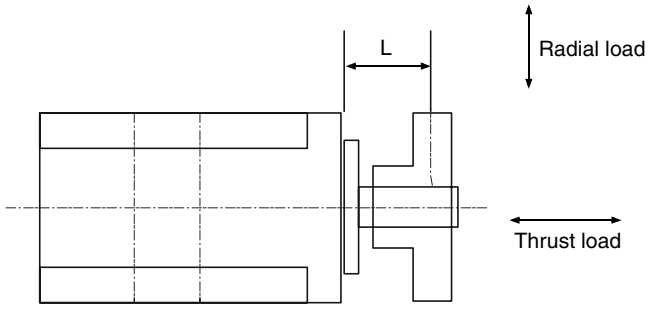
- For servo motors with the shaft without a keyway, use a friction coupling or the like.
- When removing the pulley, use a pulley remover to protect the shaft or the motor from impact.
- The orientation of the encoder on the servo motor cannot be changed.

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- For installation of the servo motor, use spring washers, etc. and fully tighten the bolts so that they do not become loose due to vibration.
- When using a pulley, a chain wheel or synchronising pulley select a diameter that will not exceed the permissible radial load (see table below).
- Do not use any inelastic, rigid connections that may lead to excessive bending moments to the shaft and thus cause the shaft to break.

Servo motor		L [mm]	Permissible radial load [N]	Permissible thrust load [N]
HC-MFS	053/13	25	88	59
	23/43	30	245	98
	73	40	392	147
HC-KFS	053/13	25	88	59
	23/43/73	30	245	98
HC-SFS	52 to 152	55	980	490
	524 to 1524			
	202 to 702	79	2058	980
	2024 to 7024			
HC-RFS	103 to 203	45	686	196
	353/503	63	980	392

Tab. 2-4: *Permitted radial load and axial load of servo motor*



L: Distance from flange mounting surface to load center

S000523C

Fig. 2-4: *Directions of action of forces on the servo motor*

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Vibration

Servo motor	Vibration
HC-KFS HC-MFS	X, Y: 49m/s^2 (5g) (refer fig. 2-6)
HC-SFS52 to 152 HC-SFS524 to 1524 HC-RFS	X, Y: 24.5m/s^2 (2.5g) (refer fig. 2-6)
HC-SFS202, 352 HC-SFS2024, 3524	X: 24.5m/s^2 (2.5g) Y: 49m/s^2 (5g) (refer fig. 2-6)
HC-SFS502, 702 HC-SFS5024, 7024	X: 24.5m/s^2 (2.5g) Y: 29.4m/s^2 (3g) (refer fig. 2-6)

Fig. 2-5: *Vibration resistance of the servo motors*

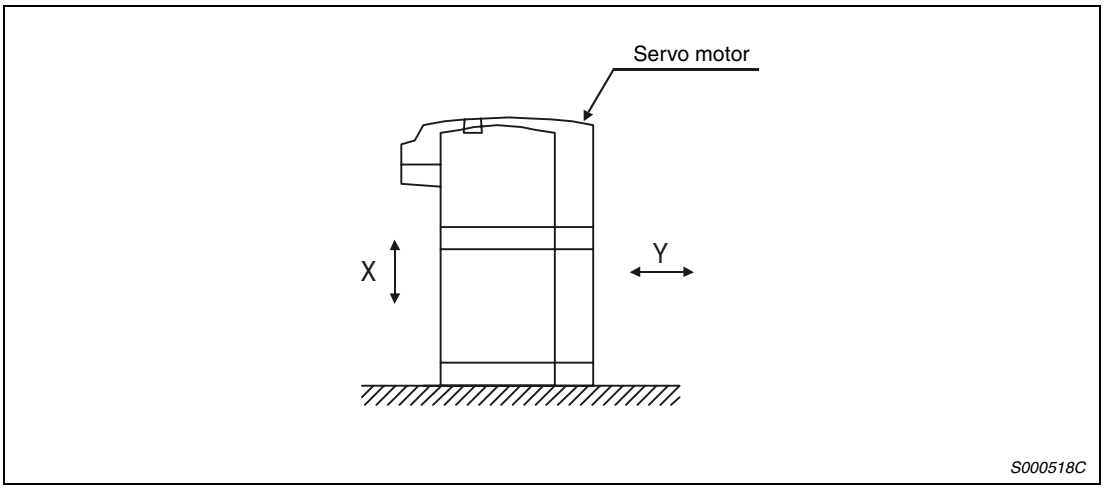


Fig. 2-6: *Vibration directions on the servo motor*

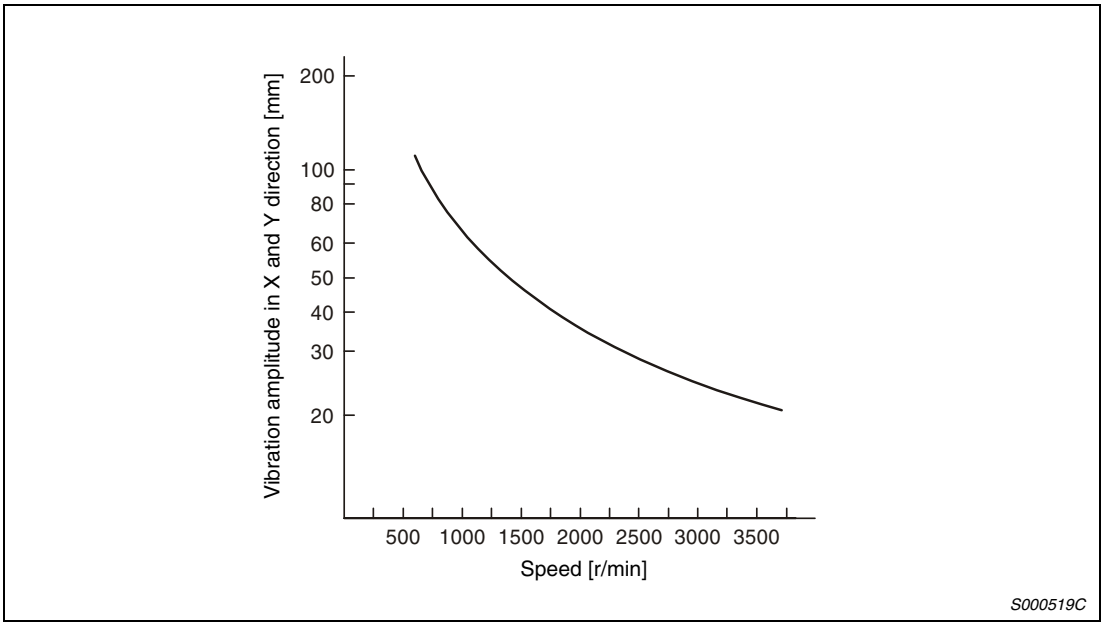


Fig. 2-7: *Graphic representation of the vibration amplitudes of the servo motor*

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Protection from oil and water

When the gear box is mounted horizontally, the oil level in the gear box should always be lower than the oil seal lip on the servo motor shaft. If it is higher than the oil seal lip, oil will enter the servo motor, leading to a fault. Make sure there is a ventilation hole in the gear box to prevent any pressure build up in the gear box.

The following table presents an overview of the minimum clearances between the oil level and the servo motor shaft centre:

Servo motor		Height above oil level [mm]
HC-SFS	52 to 152	20
	524 to 1524	
	202 to 702	25
	2024 to 7024	
HC-RFS	103 to 503	20

Tab. 2-5: *Minimum clearances between the oil level and the servo motor shaft centre*

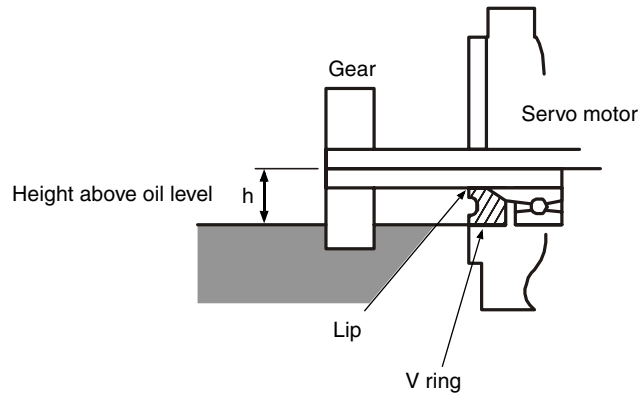


Fig. 2-8: *Arrangement*

CAUTION:

The servo motors in the HC-MFS- and KC-KFS-Series do not have any oil seal on the shaft. Here the sealing must occur on the gear side.

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When installing the servo motor horizontally, face the power cable and encoder cable downward. When installing the servo motor vertically, lay the cables with an adequate cable trap to avoid mechanical load on the cable and motor.

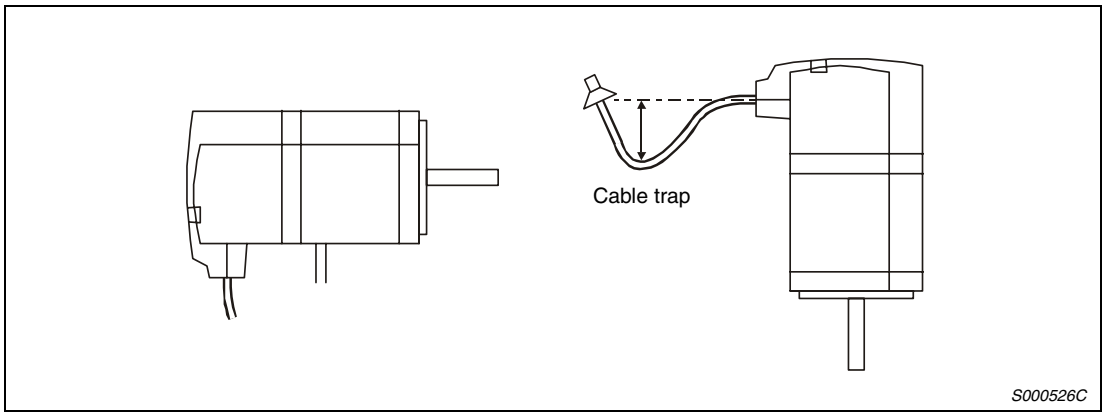


Fig. 2-9: *Installing the servo motor horizontally and vertically showing cable trap*

Make sure that the cables leading to the servo motor does not pass through oil or water. Due to the effects of capillarity, oil or water could get into the motor via the cables.

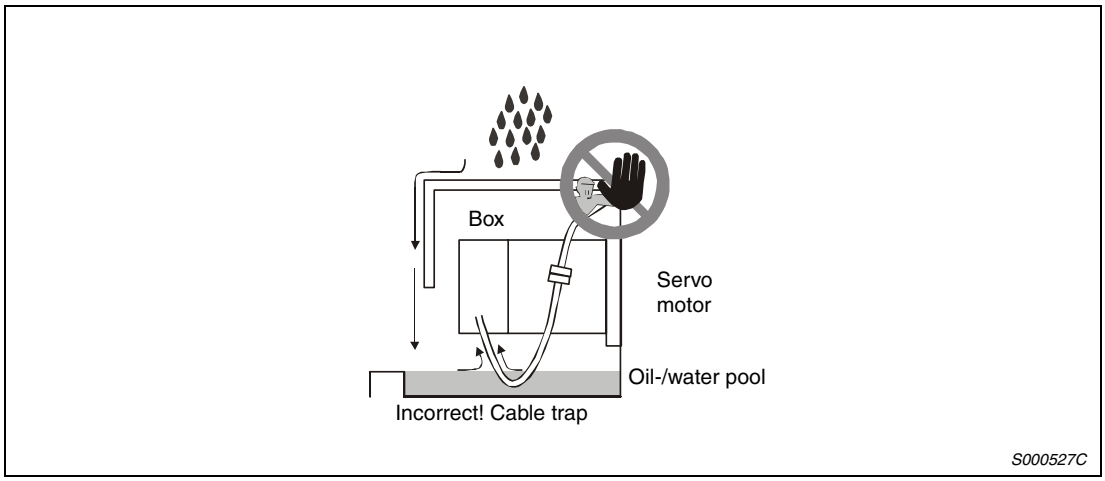


Fig. 2-10: *Do not lay the cables to the motor in oil or water*

When the servo motor is to be installed with the shaft end at top, provide measures so that it is not exposed to oil and water entering from the machine side, gear box, etc.

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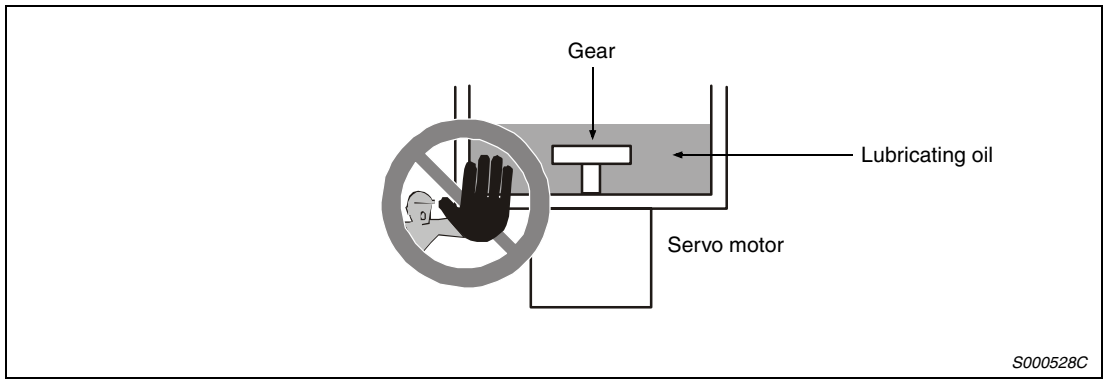


Fig. 2-11: *Installation of the motor with the shaft at the top*

In general the installation of the servo motor can be in any desired location or position. When the servo motor with electromagnetic brake is installed with the shaft end at top, the brake plate may generate sliding sound but it is not a fault.

Laying the cables

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

In situations where the servo motor moves, the cable must not be under tension. If the cables are laid in a cable duct, there must be a sufficient amount of play in the cable lengths of the motor and encoder cables.

The flexing service life of encoder cables is presented in fig. 2-12. The useful service life of the encoder cable MR-JCCBLmM-L will be at an end after flexing 5000 times with a flexing radius of 60 mm. In practice you should plan to have a certain safety margin. For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible.

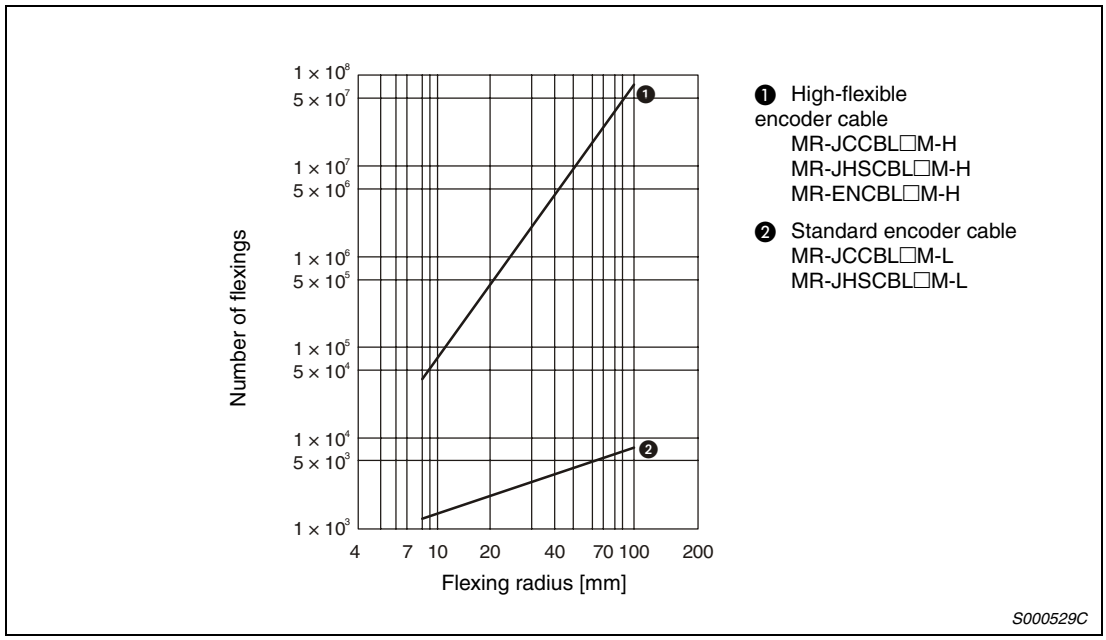


Fig. 2-12: *Number of flexings depending on the flexing radius*

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3 Connection

3.1 Connection of servo amplifier

CAUTION:

Only the voltage stated may be connected to the relevant terminals. An incorrect voltage can lead to damage to the servo amplifier.

3.1.1 No-fuse circuit breakers, fuses, magnetic contactors and cables

The terminal strips for mains and motor connections become visible after opening the flap on the front cover (MR-J2S-100B or less) or after removing the front cover (MR-J2S-200B or larger and MR-J2S-350B4 or larger). Mains power is connected via terminals L1, L2 and L3. In the case of 200V models up to 750W a 1-phase connection is possible.

Connect the motor to the output terminals U, V and W.

For a description of the terminals for the power connections see Tab. 3-4 and Tab. 3-5 on page 3-4.

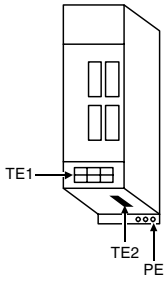
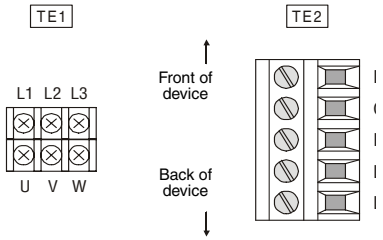
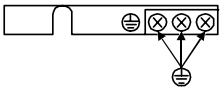
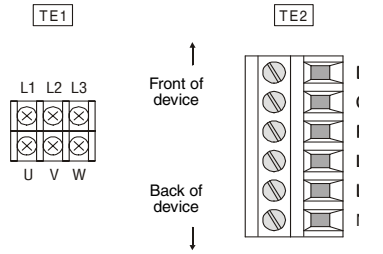
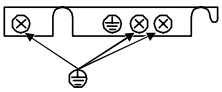
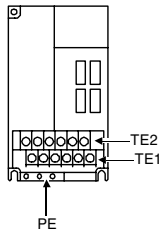
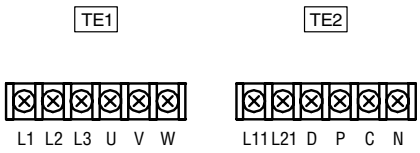
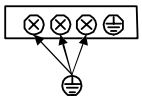
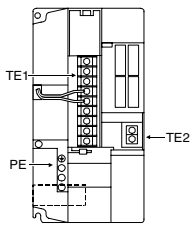
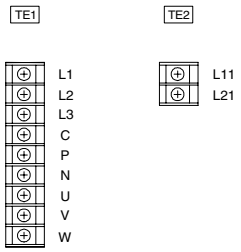
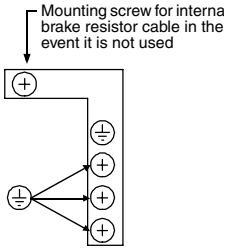
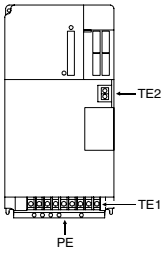
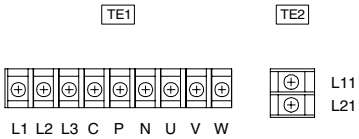
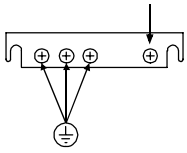
The following accessories in this section are to be used for the operation of the servo amplifier and servo motor:

Servo amplifier		Injection			Dimensions [mm²]			
		No-fuse ciruit breaker	Fuse	Magnetic contactor	L1-L2-L3	L11-L21	U-V-W	Electro-magnetic brake
Servo amplifier 200V	MR-J2S-10B	NF30, 5 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-20B	NF30, 5 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-40B	NF30, 10 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-60B	NF30, 15 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-70B	NF30, 15 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-100B	NF30, 15 A	16 A	S-N10	1.5	1.5	2.5	1.5
	MR-J2S-200B	NF30, 20 A	20 A	S-N18	2.5–4	1.5	4	1.5
	MR-J2S-350B	NF30, 20 A	25 A	S-N20	4–6	1.5	6	1.5
	MR-J2S-500B	NF50, 50 A	50 A	S-N35	4–6	1.5	6	1.5
	MR-J2S-700B	NF100, 75 A	50 A	S-N50	10	1.5	10	1.5
Servo amplifier 400V	MR-J2S-60B4	NF30, 5 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-100B4	NF30, 10 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-200B4	NF30, 15 A	16 A	S-N10	1.5	1.5	1.5	1.5
	MR-J2S-350B4	NF30, 20 A	20 A	S-N18	2.5–4	1.5	4	1.5
	MR-J2S-500B4	NF30, 20 A	25 A	S-N20	4–6	1.5	6	1.5
	MR-J2S-700B4	NF50, 50 A	50 A	S-N35	4–6	1.5	6	1.5

Tab. 3-1: *Required equipment*

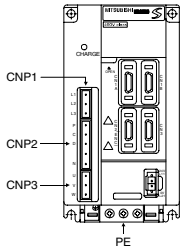
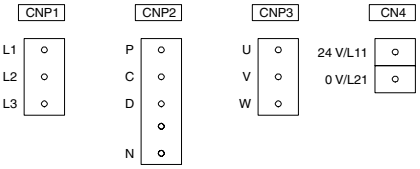
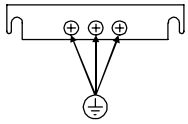
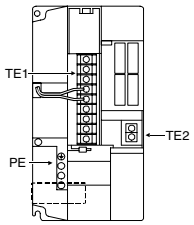
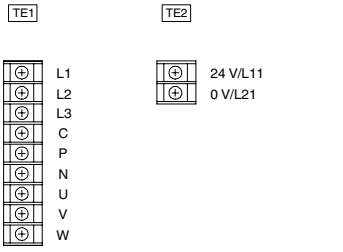
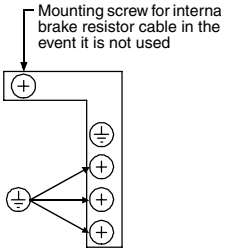
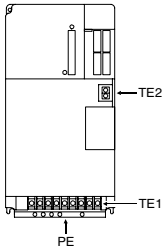
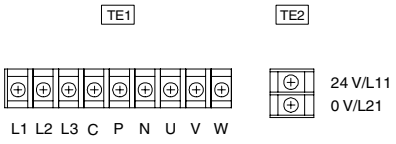
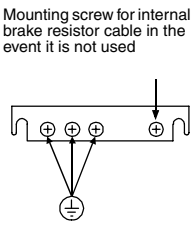
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3.1.2 Control circuit and main circuit terminal block

Servo amplifier			Connectors: Main circuit/control circuit/ brake restistor/brake unit	Connectors: Protective earth PE
Servo amplifier 200V	MR-J2S-10B to MR-J2S-60B	 S000919C	 S001222C	 S000539C
	MR-J2S-70B MR-J2S-100B		 S001223C	 S000540C
	MR-J2S-200B MR-J2S-350B	 S000920C	 S001224C	 S000541C
	MR-J2S-500B	 S000921C	 S001225C	 S000925C
	MR-J2S-700B	 S000922C	 S001226C	 S000927C

Tab. 3-2: *Terminals of servo amplifier 200V*

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Servo amplifier			Connectors: Main circuit/control circuit/ brake restistor/brake unit	Connectors: Protective earth PE
Servo amplifier 400V	MR-J2S-60B4 to MR-J2S-200B4	 S001204C	 S001227C	 S001208C
	MR-J2S-350B4 to MR-J2S-500B4	 S000921C	 S001228C	 S000925C
	MR-J2S-700B4	 S000922C	 S001229C	 S000927C

Tab. 3-3: *Terminals of servo amplifier 400V*

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Main circuit terminal overview for MR-J2S-60B to MR-J2S-700B

Terminal	Signal	Description
L1, L2, L3	Main circuit power supply	The rated voltage range is 3-phase 200 to 230V AC, 50/60 Hz. Up to 750 W a 1-phase power supply is possible.
L11, L21	Control circuit power supply	The rated voltage range is 1-phase 200 to 230V AC, 50/60 Hz. Here L11 must be equal in phase to L1 and L21 equal in phase to L2.
N	Brake unit option	When using the optional brake unit, connect it across the terminals P and N. Before connecting the optional brake unit, you must disconnect the internal brake resistor across the terminals P and C. Do not connect a optional brake unit to the servo amplifier of MR-J2S-350B or less.
P, C, D	Regenerative brake option/brake unit	**MR-J2S-350B or less** The terminals P and D are factory-connected. When connecting an optional regenerative brake, always disconnect the cable connection across P and D. Connect the optional regenerative brake across the terminals P and C. Do not connect a optional brake unit to the servo amplifier of MR-J2S-350B or less. **MR-J2S-500B or more** When connecting an optional regenerative brake or brake unit, always disconnect the cable connection across P and C of the internal brake resistor. Connect the optional regenerative brake across the terminals P and C. When using the optional brake unit, connect it across the terminals P and N.
U, V, W	Servo motor output	Connect to the servo motor power supply terminals U, V, W.
PE	Protective earth	Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.

Tab. 3-4: *Signal overview (MR-J2S-60B to MR-J2S-700B)*

Main circuit terminal overview for MR-J2S-60B4 to MR-J2S-700B4

Terminal	Signal	Description
L1, L2, L3	Main circuit power supply	The rated voltage range is 3-phase 380 to 480V AC, 50/60Hz.
24V/L11, 0V/L21	Control circuit power supply	Connect a 24VDC source here. Make sure that the plus pole of the DC source is connected to terminal 24V/L11 and the minus pole of the DC source to terminal 0V/L21.
N	Brake unit option	When using the optional brake unit, connect it across the terminals P and N. Before connecting the optional brake unit, you must disconnect the internal brake resistor across the terminals P and C. Do not connect a optional brake unit to the servo amplifier of MR-J2S-200B4 or less.
P, C, D	Regenerative brake option/brake unit	**MR-J2S-200B4 or less** The terminals P and D are factory-connected. When connecting an optional regenerative brake, always disconnect the cable connection across P and D. Connect the optional regenerative brake across the terminals P and C. Do not connect a optional brake unit to the servo amplifier of MR-J2S-200B4 or less. **MR-J2S-350B4 or more** When connecting an optional regenerative brake or brake unit, always disconnect the cable connection across P and C of the internal brake resistor. Connect the optional regenerative brake across the terminals P and C. When using the optional brake unit, connect it across the terminals P and N.
U, V, W	Servo motor output	Connect to the servo motor power supply terminals U, V, W.
PE	Protective earth	Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.

Tab. 3-5: *Signal overview (MR-J2S-60B4 to MR-J2S-700B4)*

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3.1.3 Signal lines

The servo amplifier has four signal connectors. You will find the pin configuration of the connectors on the next page.

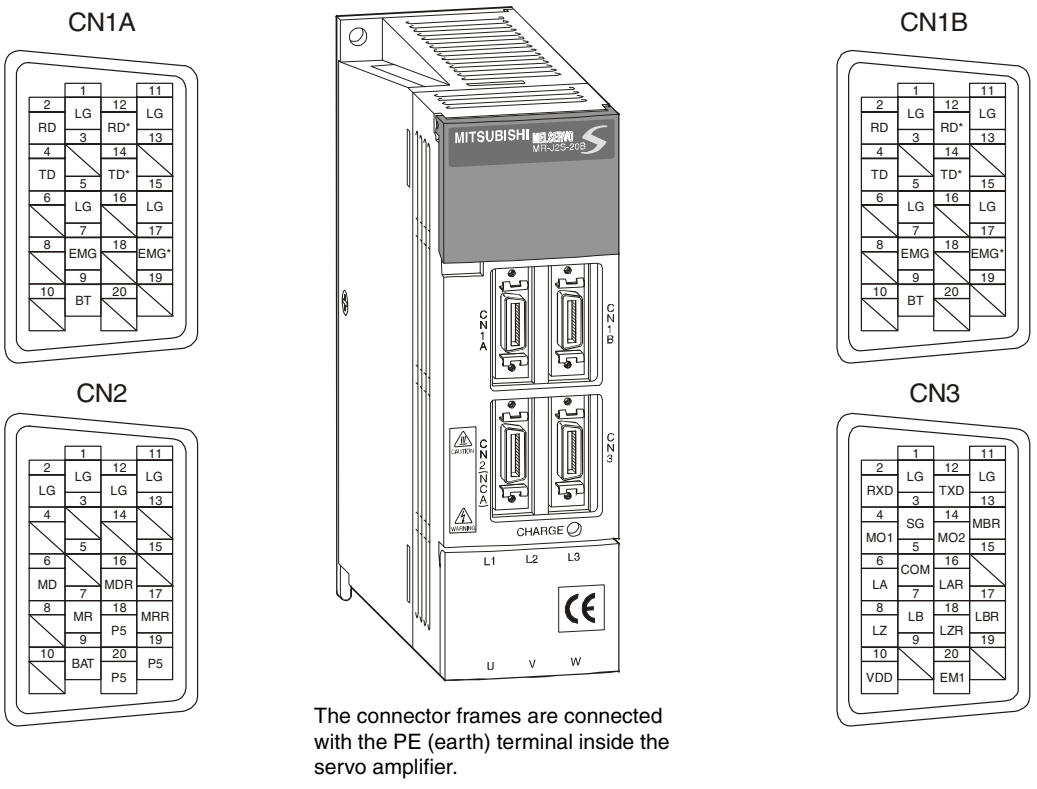


Fig. 3-1: *Signal connector*

NOTE The display of the pin configuration in fig. 3-1 shows the view from the soldering tag side.

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Interface explanations

Connector	Name	Description
CN1A	Connector for bus cable from preceding axis.	Used for connection with the controller or preceding-axis servo amplifier.
CN1B	Connector for bus cable to next axis	Used for connection with the next-axis servo amplifier or for connection of the termination connector.
CN2	Encoder connector	Used for connection with the servo motor encoder.
CN3	Communication connector	Used for connection with the personal computer. Serves as an I/O signal connector when the personal computer is not used.

Tab. 3-6: *Description of interfaces CN1A, CN1B CN2 and CN3*

Input signal

Signal	Symbol	Pin-No.	Description	I/O
Forced stop	EM1	CN3-20	Turning off EM1 puts the servo motor in a forced stop status, in which the servo is switched off and the dynamic brake is operated to stop the servo motor. Turn on EM1 in the forced stop status to reset this status.	DI-1

Tab. 3-7: *Input signal*

Output signals

Signal	Symbol	Pin-No.	Description	I/O
Electromagnetic brake interlock	MBR	CN3-13	With switched off signal “Servo ON” MBR-SG is opened.	DO1
Encoder A-phase pulse (Differential outputs)	LA LAR	CN3-6 CN3-16	Outputs pulses per servo motor revolution set in parameter No. 38. In forward rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2.	DO2
Encoder B-phase pulse (Differential outputs)	LB LBR	CN3-7 CN3-17		
Encoder Z-phase pulse (Differential outputs)	LZ LZR	CN3-8 CN3-18	The zero-phase signal of the encoder is output.	DO2
Analog monitor 1	MO1	CN3-4	The data set for CH1 in parameter 22 are output as analog via MO1-LG.	Analog output
Analog monitor 2	MO2	CN3-14	The data set for CH2 in parameter 22 are output as analog via MO1-LG.	Analog output

Tab. 3-8: *Output signals*

Power supply

Signal	Symbol	Pin-No.	Description
24VDC output	VDD	CN3-10	Internal voltage source output voltage at the terminals VDD R SG: +24VDC ± 10 %. Output current: max. 80mA
	SG	CN3-3	
Common for digital inputs	COM	CN3-5	Common reference point for the digital inputs, voltaically separated from terminal LG
Common for control signals	LG	CN3-1 CN3-11	Common for analog outputs MO1 and MO2
Shield	SD	Plate	Connect the shield of signal cable here.

Tab. 3-9: *Power supply*

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3.1.4 Interfaces

The connection of external periphery to the interface described in section 3.1.3 is covered in the following.

Digital input interface DI-1

Give a signal with a relay or open collector transistor.

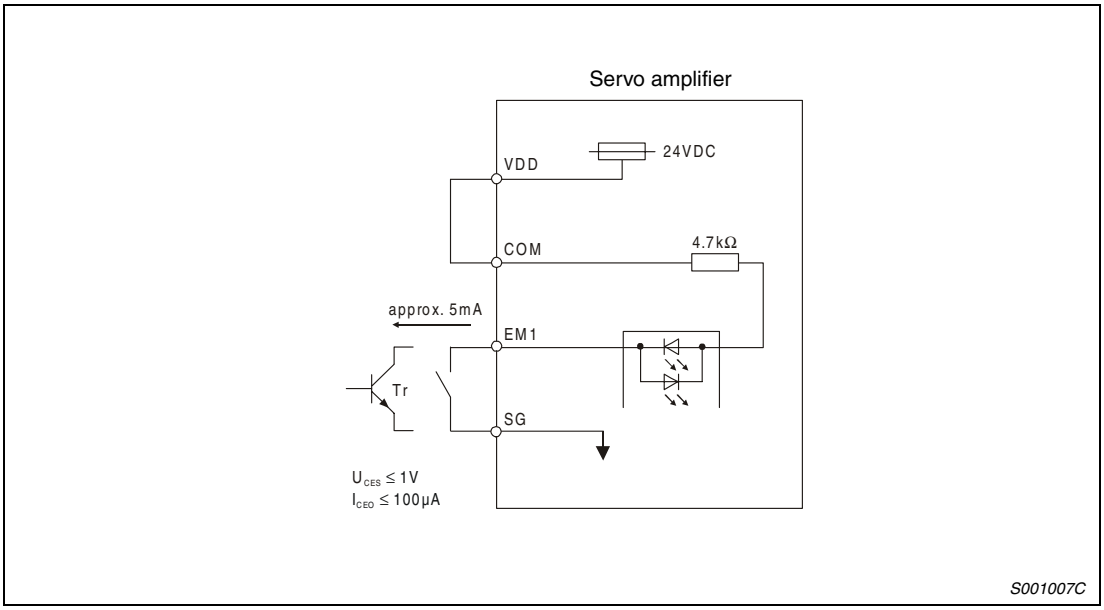


Fig. 3-2: *External device connection*

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Digital output interface DO-1

Via this interface a control lamp, a relay or an photocoupler may be addressed, for example. Provide a diode (D) for an inductive load, or an inrush current suppressing resistor (R) for a lamp load. (Permissable current: 40mA, inrush current: 100mA).

- Inductive Load

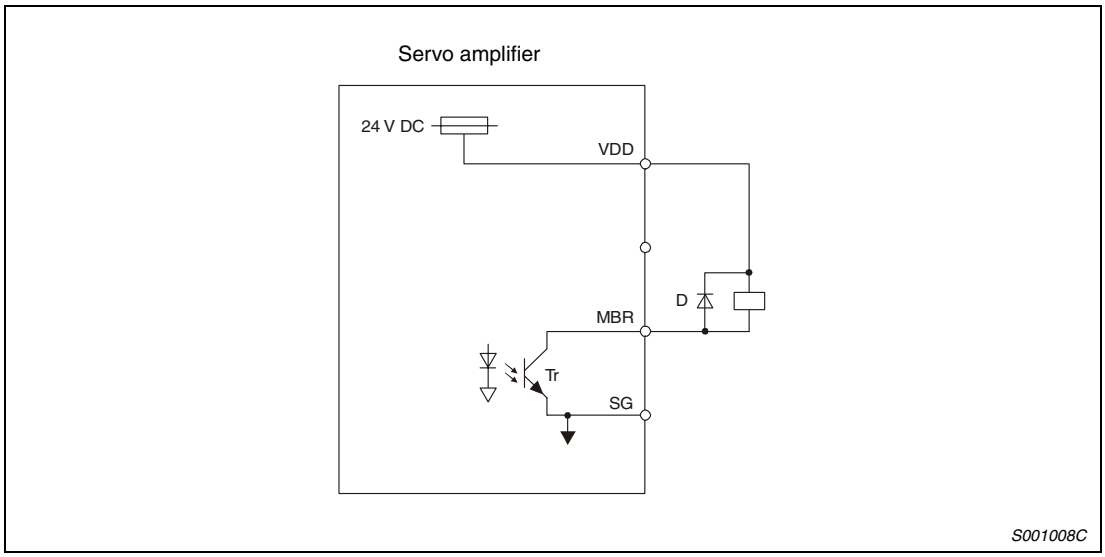


Fig. 3-3: *Inductive load connection*

CAUTION:

When connecting an inductive load be sure to observe the correct polarity of the recovery diode D. Connecting it backwards could cause the servo amplifier to be damaged.

- Lamp connection

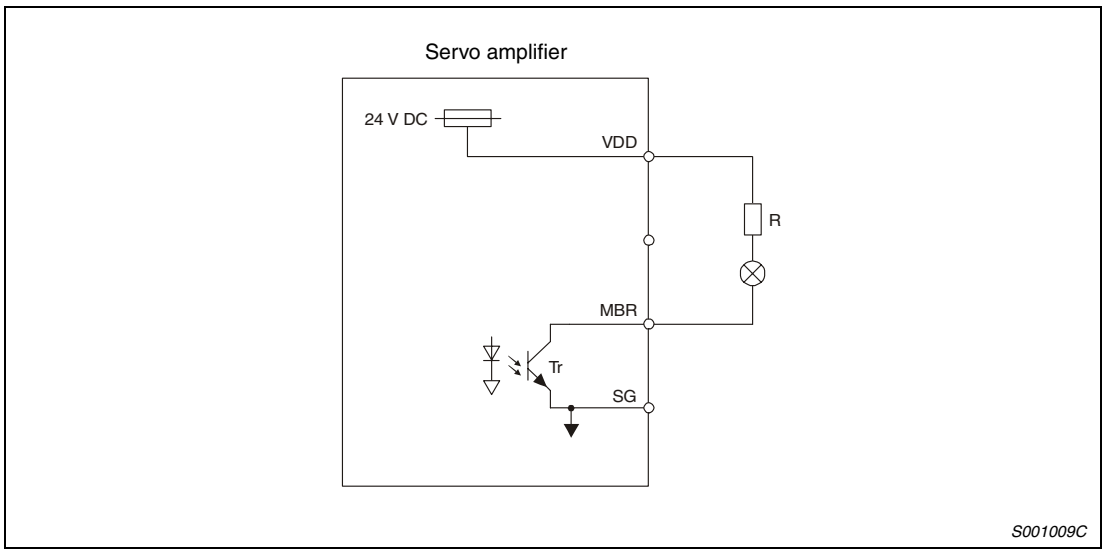


Fig. 3-4: *Lamp connection*

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Emulated encoder output

- Differential output
  max. output current: 35mA

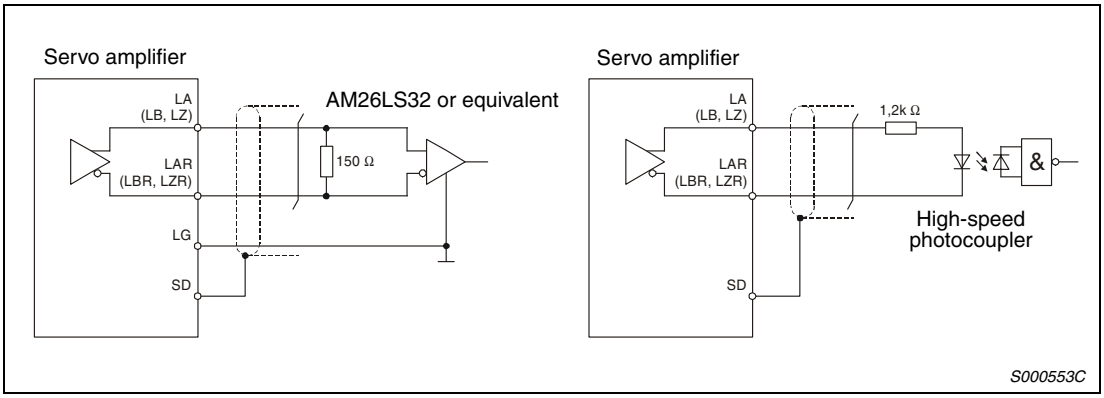


Fig. 3-5: *Example*

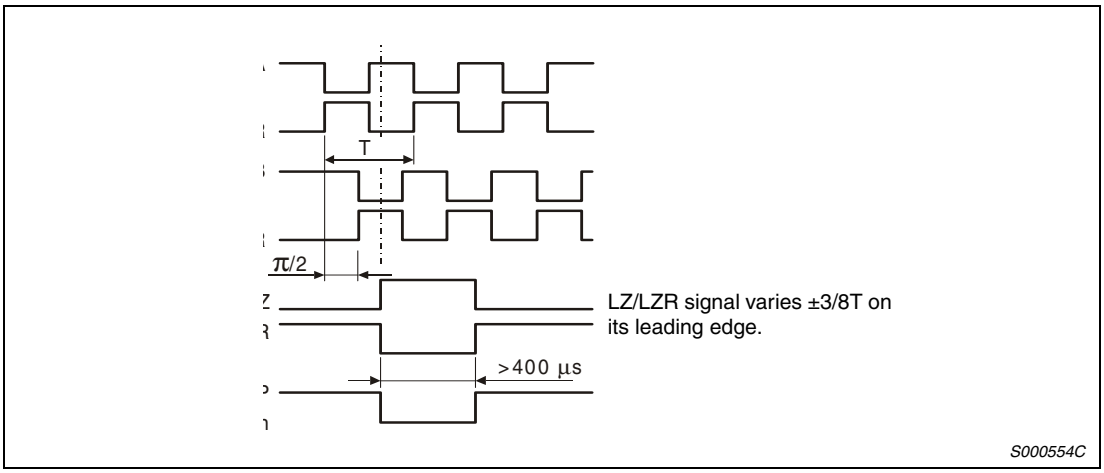


Fig. 3-6: *Time response of the output signals*

Analog output

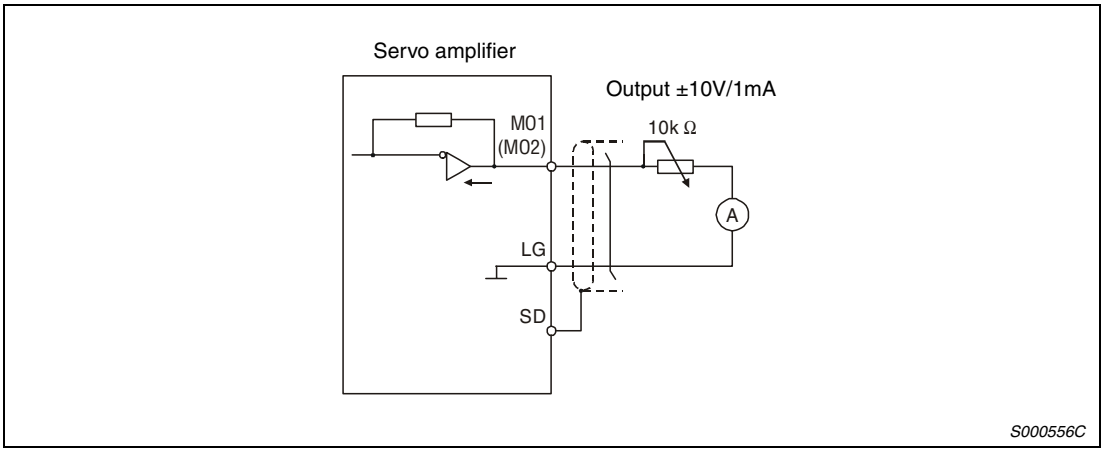


Fig. 3-7: *Example for an interface*

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3.2 Servo motor

3.2.1 Connection of servo motors

CAUTION:

- ***Ground the servo amplifier and servo motor securely.***
  To prevent an electric shock, always connect the protective earth terminal (PE) of the servo amplifier marked with ⏚, with the protective earth of the control box.
- ***Connect the cables to the servo amplifier and servo motor with the right terminals and the correct phases (U, V, W) . Otherwise the servo motor will not work correctly.***
- ***Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occure.***

① Connect the servo motors via corresponding power supply connector.

② For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal of the servo amplifier. Simultaneouse connect the ground cable of the servo amplifier to the earth via the protective earth of the control box. Refer fig. 3-8.

③ When using a servo motor with brake then it must be connected via an external voltage source of 24VDC.

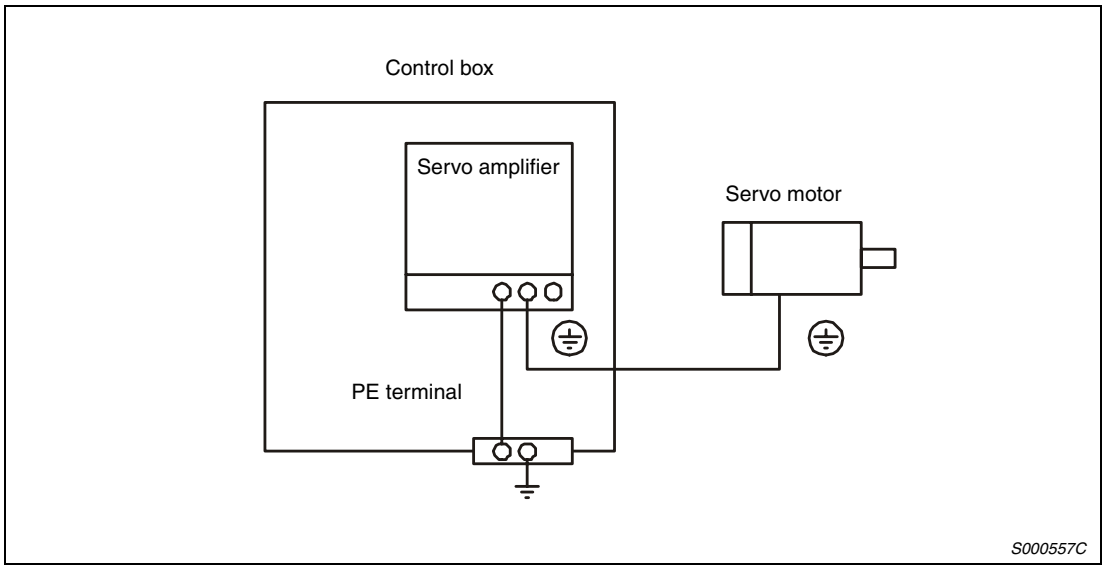


Fig. 3-8: *Protective earth connection*

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3.2.2 Motor connector

Servo motor series HC-KFS (B)/HC-MFS (B)

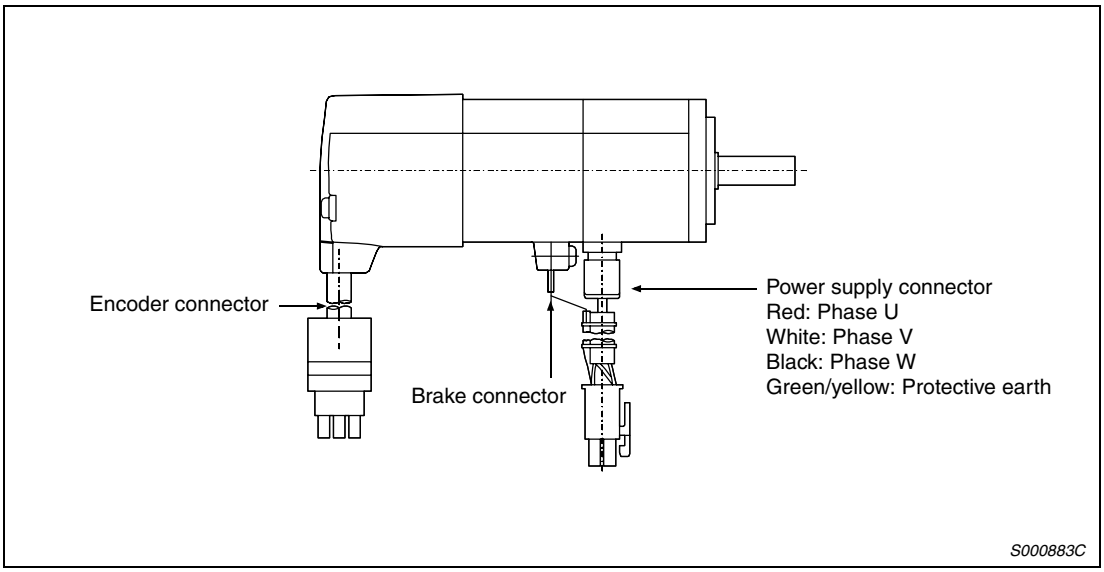
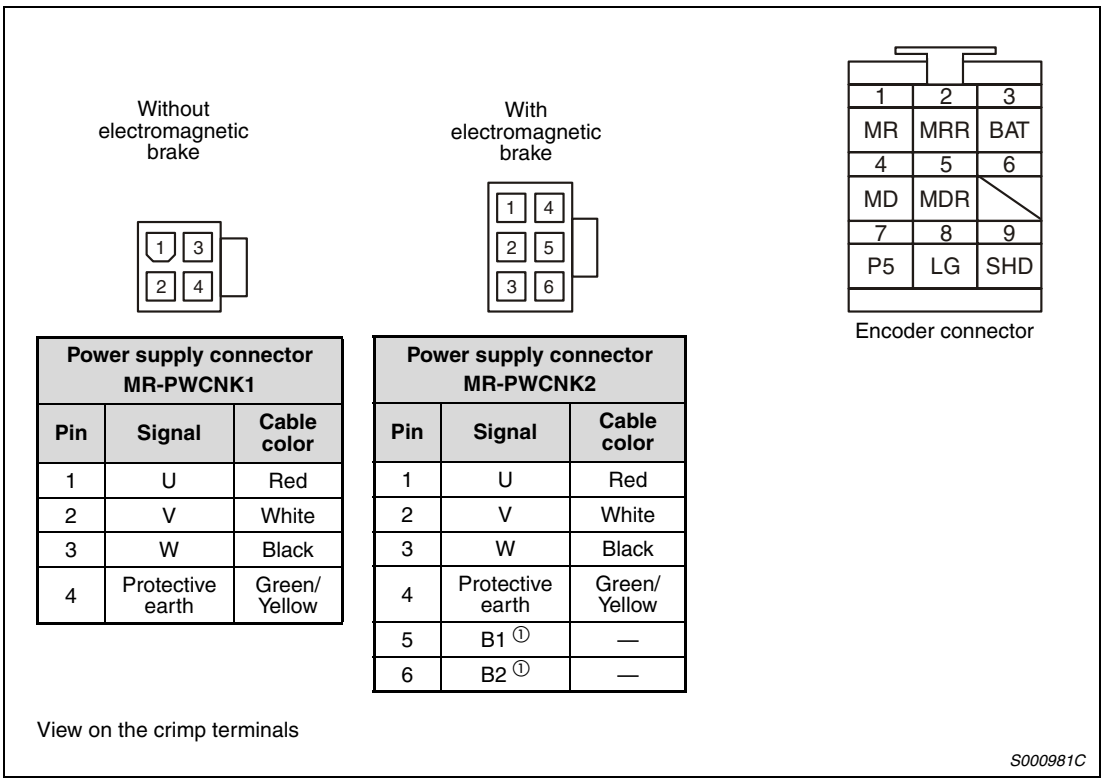


Fig. 3-9: *Servo motor series HC-KFS (B) and HC-MFS (B)*



Power supply connector MR-PWCNK1		
Pin	**Signal**	**Cable color**
1	U	Red
2	V	White
3	W	Black
4	Protective earth	Green/ Yellow

Power supply connector MR-PWCNK2		
Pin	**Signal**	**Cable color**
1	U	Red
2	V	White
3	W	Black
4	Protective earth	Green/ Yellow
5	B1 ①	—
6	B2 ①	—

Fig. 3-10: *Connections of power supply, encoder and electromagnetic brake*

① 24VDC no polarity

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Servo motor series HC-SFS/HC-RFS

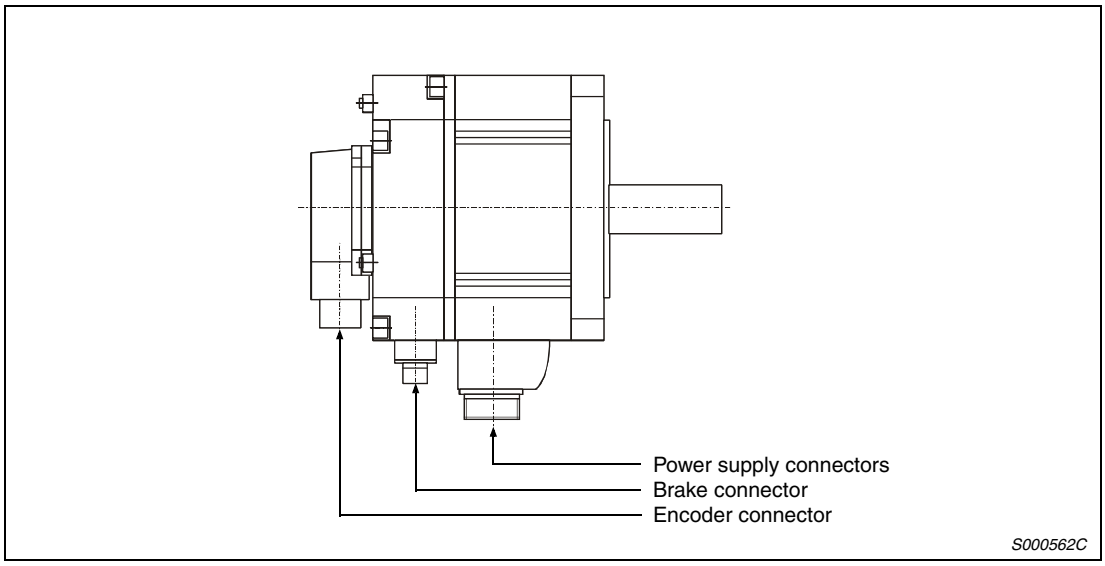
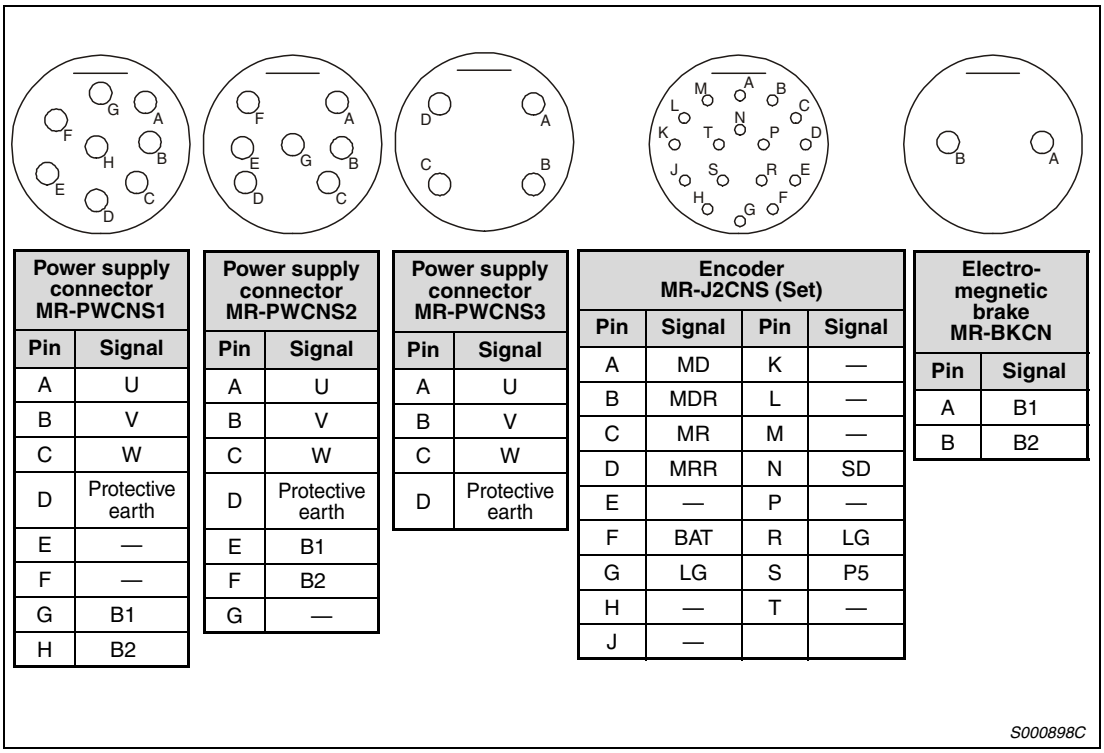


Fig. 3-11: *Servo motor series HC-SFS/HC-RFS*

Servo motor		Connectors		
		Power supply	**Encoder**	**Electromagnetic brake**
Servo motor 200V	HC-SFS52	MR-PWCNS1	MR-J2CNS (Set)	In the power supply connector
	HC-SFS102			
	HC-SFS152			
	HC-SFS202	MR-PWCNS2		MR-BKCN
	HC-SFS352			
	HC-SFS502			
	HC-SFS702	MR-PWCNS3		
	HC-RFS103	MR-PWCNS1		In the power supply connector
	HC-RFS153			
	HC-RFS203			
	HC-RFS353	MR-PWCNS2		
	HC-RFS503			
Servo motor 400V	HC-SFS524	MR-PWCNS1	MR-J2CNS (Set)	In the power supply connector
	HC-SFS1024			
	HC-SFS1524			
	HC-SFS2024	MR-PWCNS2		MR-BKCN
	HC-SFS3524			
	HC-SFS5024			
	HC-SFS7024	MR-PWCNS3		

Tab. 3-10: *Power supply and encoder interfaces*

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Power supply connector MR-PWCNS1	
Pin	Signal
A	U
B	V
C	W
D	Protective earth
E	—
F	—
G	B1
H	B2

Power supply connector MR-PWCNS2	
Pin	Signal
A	U
B	V
C	W
D	Protective earth
E	B1
F	B2
G	—

Power supply connector MR-PWCNS3	
Pin	Signal
A	U
B	V
C	W
D	Protective earth

Encoder MR-J2CNS (Set)			
Pin	Signal	Pin	Signal
A	MD	K	—
B	MDR	L	—
C	MR	M	—
D	MRR	N	SD
E	—	P	—
F	BAT	R	LG
G	LG	S	P5
H	—	T	—
J	—		

Electro-megnetic brake MR-BKCN	
Pin	Signal
A	B1
B	B2

Fig. 3-12: *Connections of power supply, encoder and electromagnetic brake*

24VDC no polarity
For the motors HC-SFS52B/102B/152B and motors HC-RFS103B/153B/203B/353B/503B the attachment for the electromagnetic brake is integrated into the power supply connector.

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3.3 Internal circuit and common

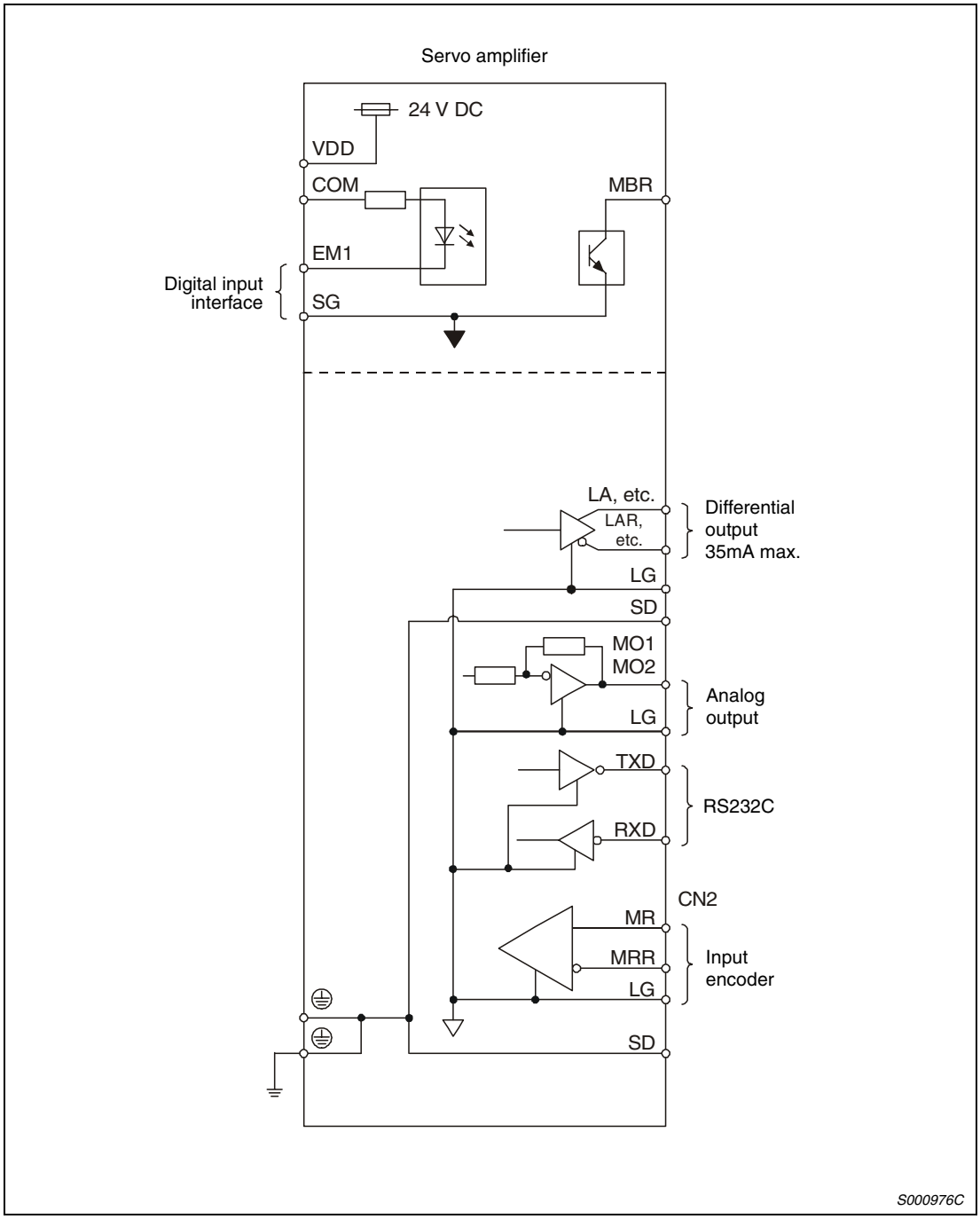


Fig. 3-13: *Internal circuit and common*

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3.4 Grounding

DANGER:

- ***Ground the servo amplifier and servo motor securely.***
- ***To prevent an electric shock, always connect the protective earth terminal (PE) of the servo amplifier marked with ⏚, with the protective earth of the control box.***

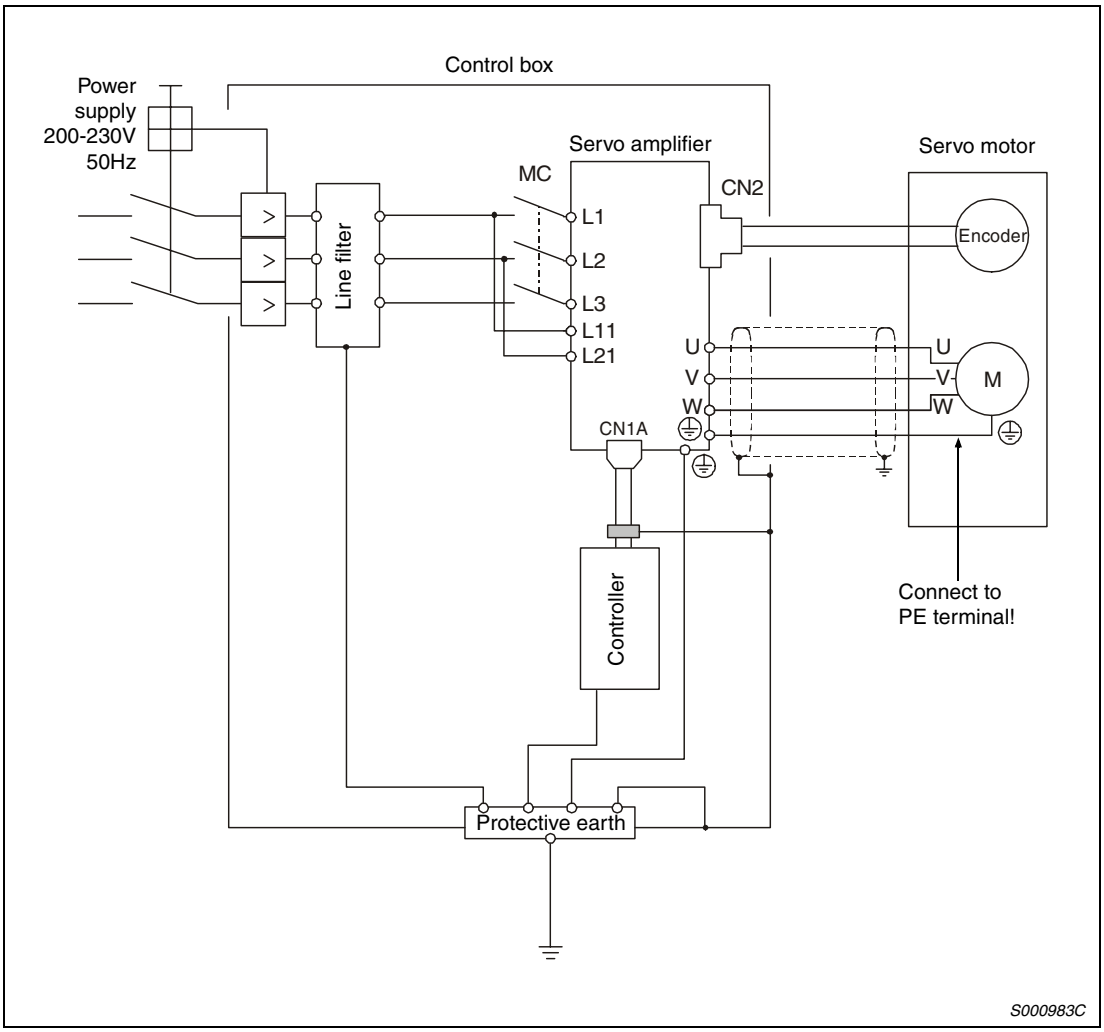


Fig. 3-14: *Grounding*

Ground the bus cable near the controller! That way you reduce the influence of external noise. Another possibility to reduce noise interference is to build in filters.

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3.5 Power supply



DANGER:

When the servo amplifier has become faulty, switch power off on the amplifier power side.

Power-on procedure

Always wire the power supply using the magnetic contactor with the main circuit power supply L1, L2 and L3 or L1 and L2 for 1-phase connection.

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

The servo amplifier can accept the "servo ON" command within 3s the 3-phase power supply is switched on.

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3.5.1 Connection example

Connection for servo amplifier 200V

Connection examples for 1-phase and 3-phase power supplies are illustrated in the following diagrams:

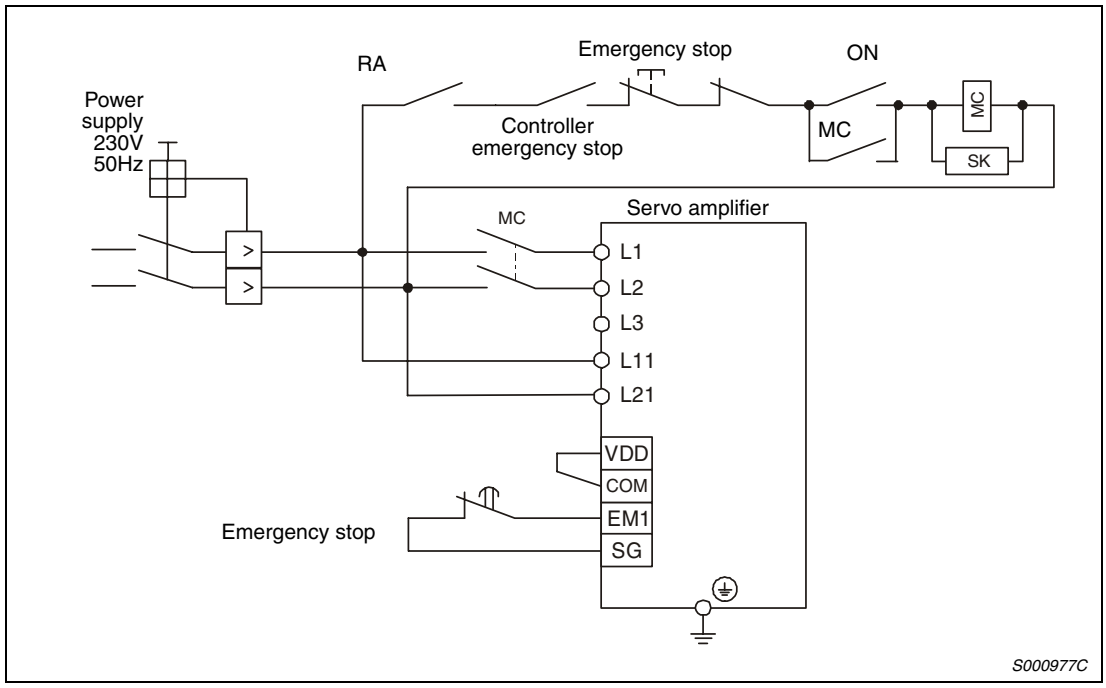


Fig. 3-15: *1-phase connection of servo amplifier*

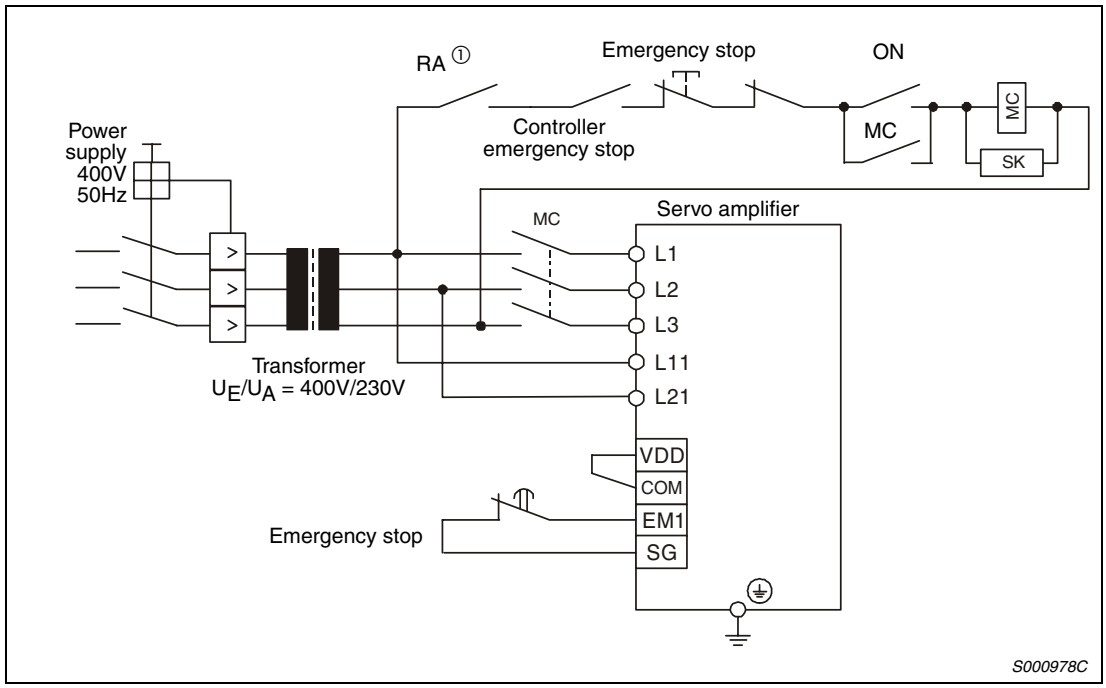


Fig. 3-16: *3-phase connection of servo amplifier*

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

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Connection for servo amplifier 400V

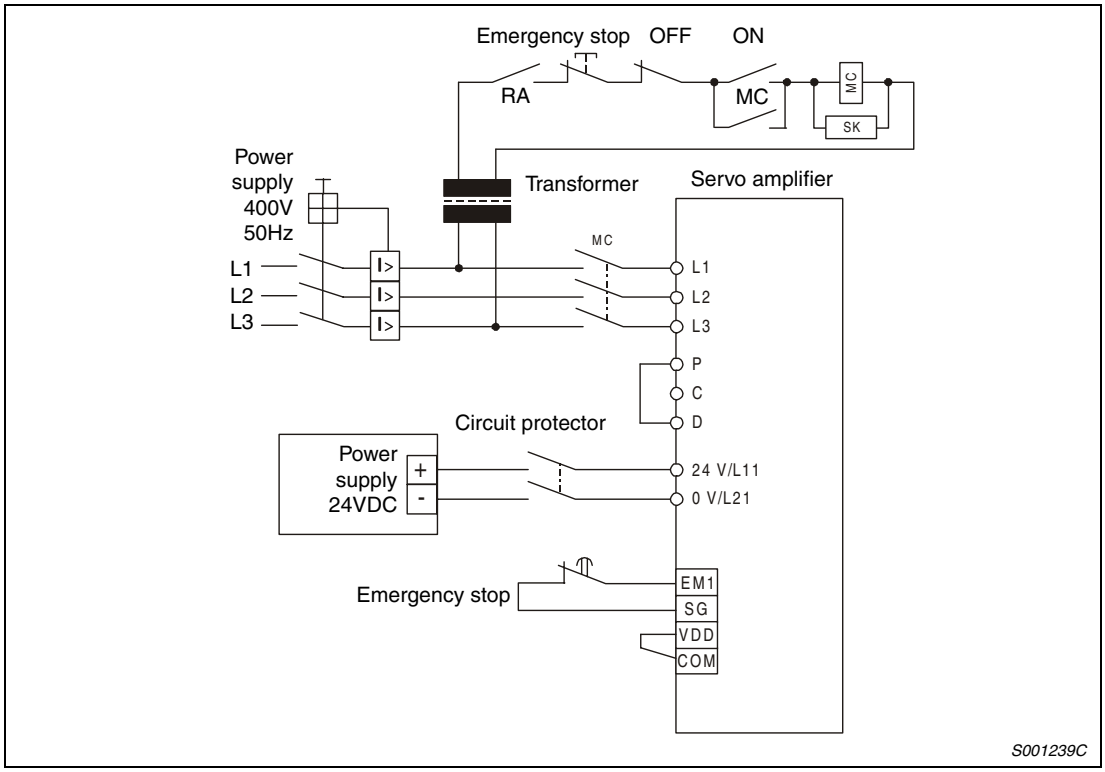


Fig. 3-17: *Servo amplifier MR-J2S-60B4 to MR-J2S-200B4*

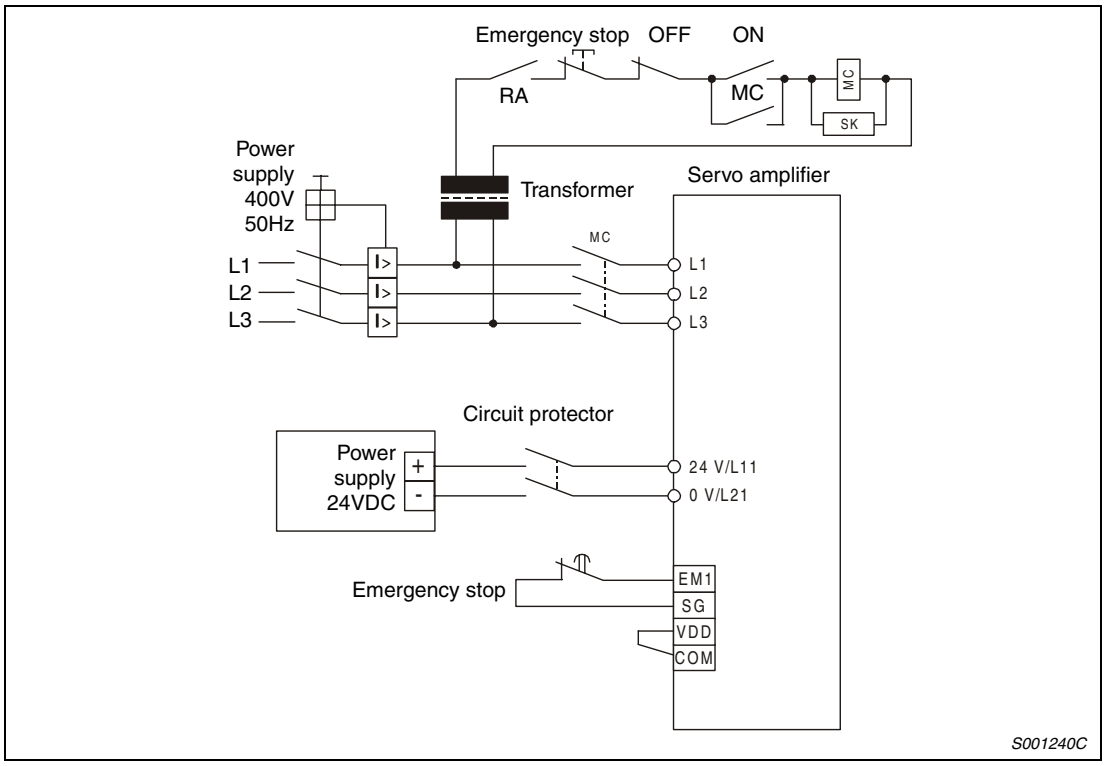


Fig. 3-18: *Servo amplifier MR-J2S-350B4 to MR-J2S-700B4*

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Timing chart

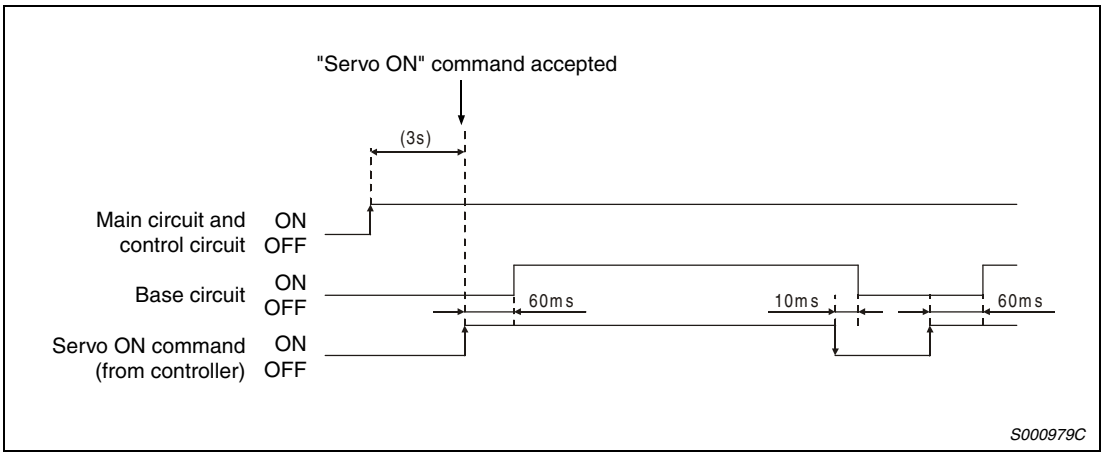


Fig. 3-19: *Timing chart for switching on the power supply*

Emergency stop

For safety's sake an EMERGENCY OFF switch must always be installed between the terminals EM1 and SG. When the contact is interrupted, the servo motor is switched to a resistance brake (dynamic brake) integrated into the unit and brought to a stop as soon as possible. Simultaneously the EMERGENCY OFF message (E6) appears on the display.

During ordinary operation, do not use emergency stop circuit to alternate stop and run.

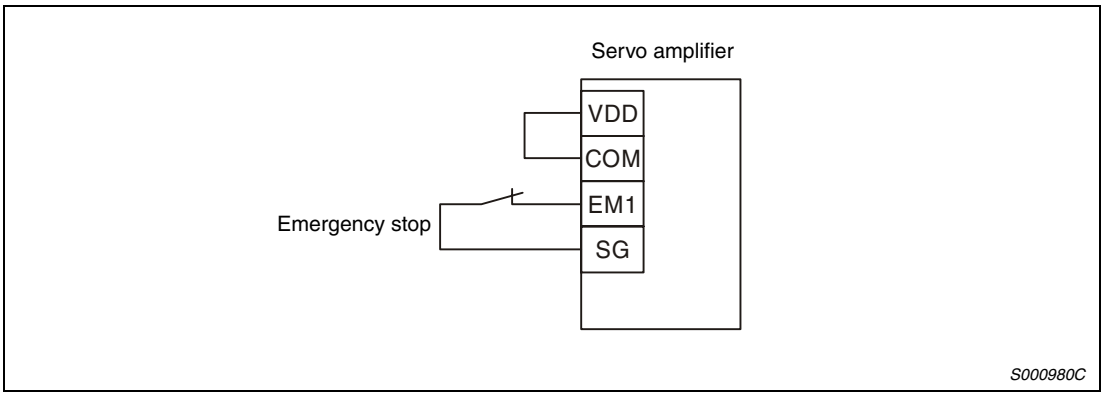


Fig. 3-20: *Emergency stop circuit*

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3.6 Alarm occurence 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.

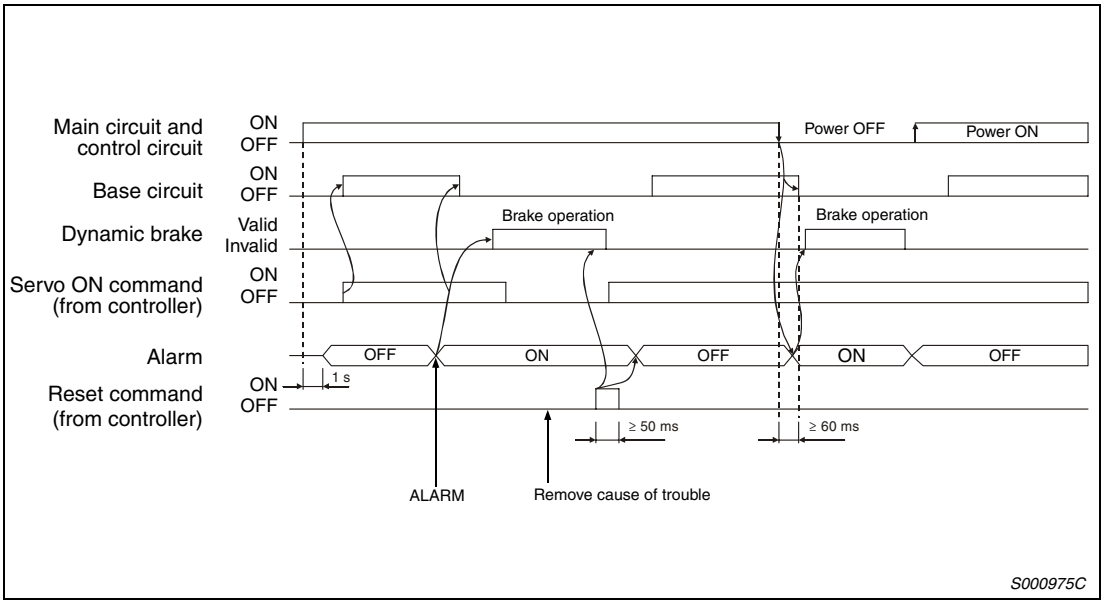


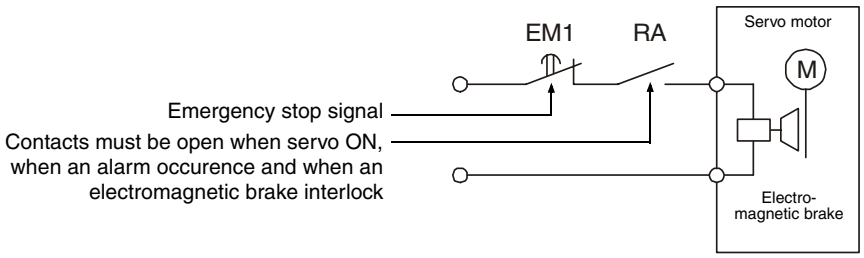
Fig. 3-21: *Alarm occurence timing chart*

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3.7 Servo motor with electromagnetic brake

CAUTION:

Configure the electromagnetic brake circuit so that it is activated not only by the interface unit signals but also by a emergency stop.



Connection diagram

Please observe closely the following instructions for the use of a servo motor with electromagnetic brake.

CAUTION:

The electromagnetic brake is only intended for holding a static load, e.g. from vertical lifting axes. The braking effect and frequent switching of the EMERGENCY OFF function will result in the destruction of the brake after only a few cycles.

① Provide a separate power source of 24VDC for the electromagnetic brake.

② The brake will operate when the power switches off.

③ Switch off the SON command after the servo motor has stopped.

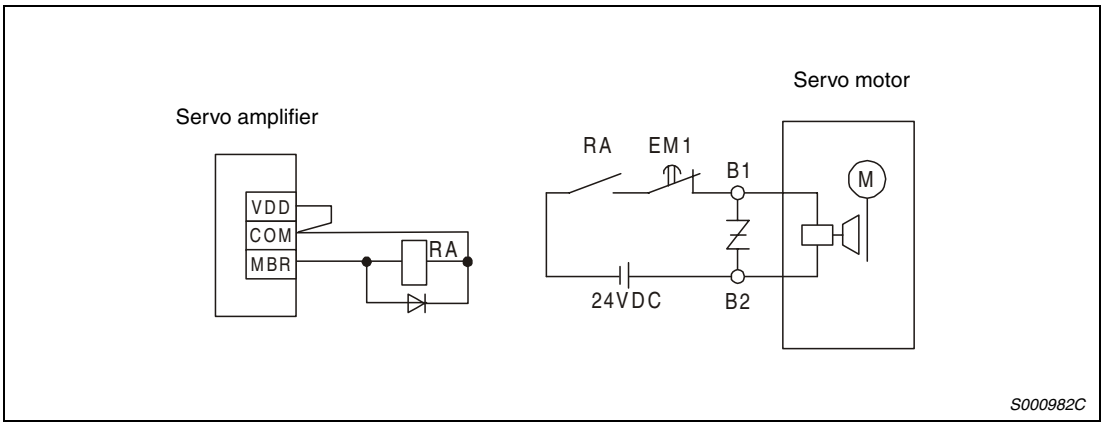


Fig. 3-22: *Connection diagram*

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Setting procedure

The setting for the electromacnetic brake is as follows:

In Parameter 21 set the time delay (T_b) from electromagnetic brake operation to base circuit shut-off, shown in fig. 3-23.

Use parameter 30 to set the rotation speed at which the electromagnetic brake is to be activated when there is an alarm or an EMERGENCY OFF.

Timing charts

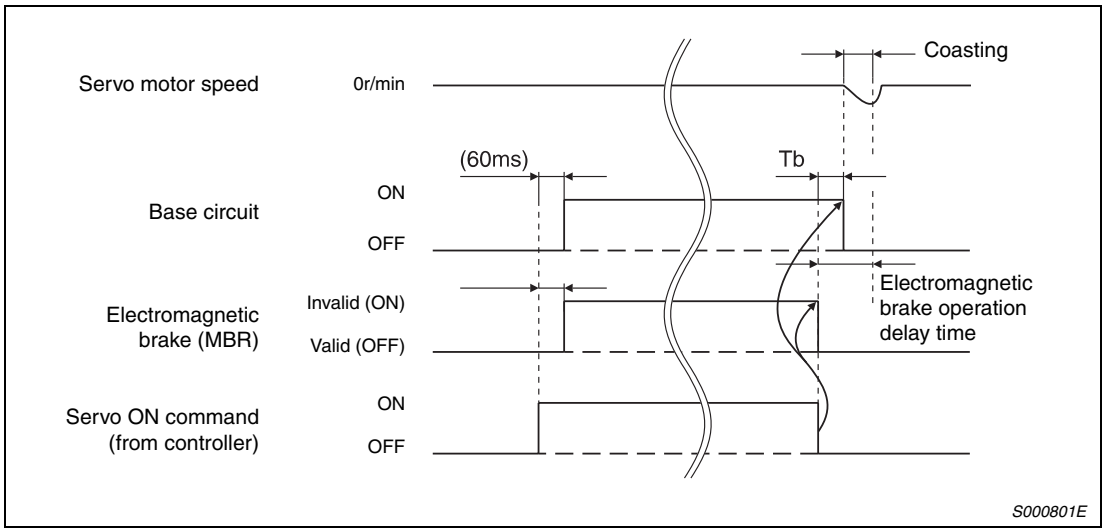


Fig. 3-23: *Servo ON command (from controller) ON/OFF*

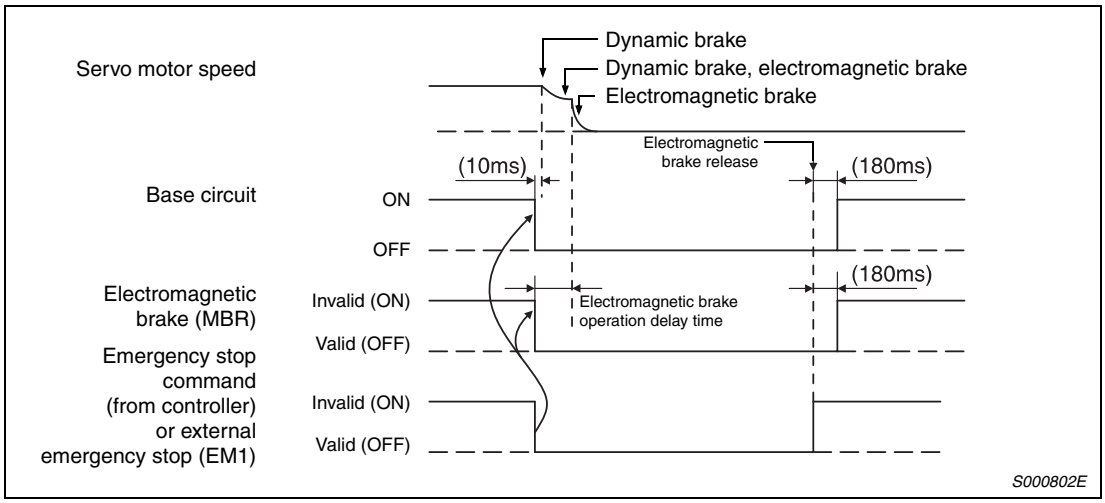


Fig. 3-24: *Emergency stop command from controller or external emergency stop (EM1) ON/OFF*

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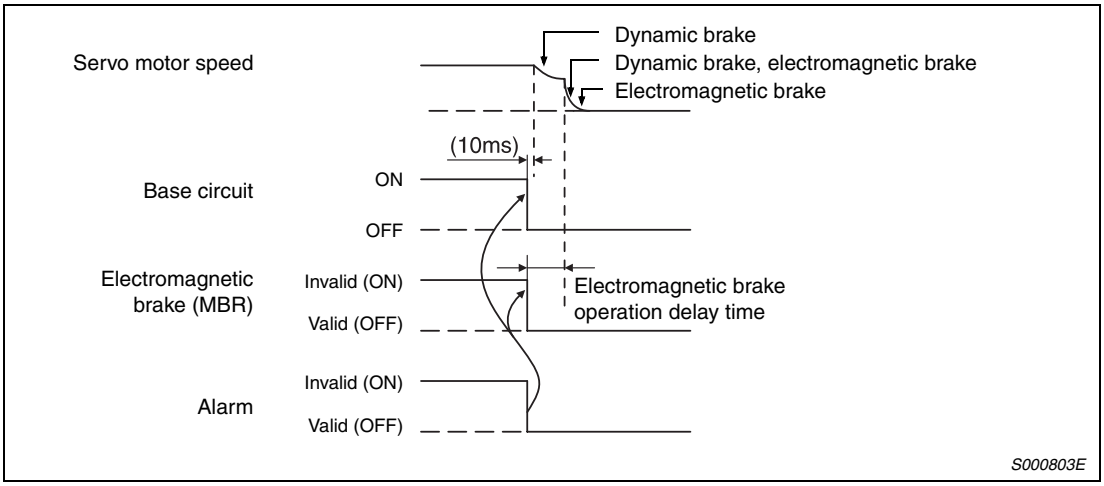


Fig. 3-25: *Alarm occurence*

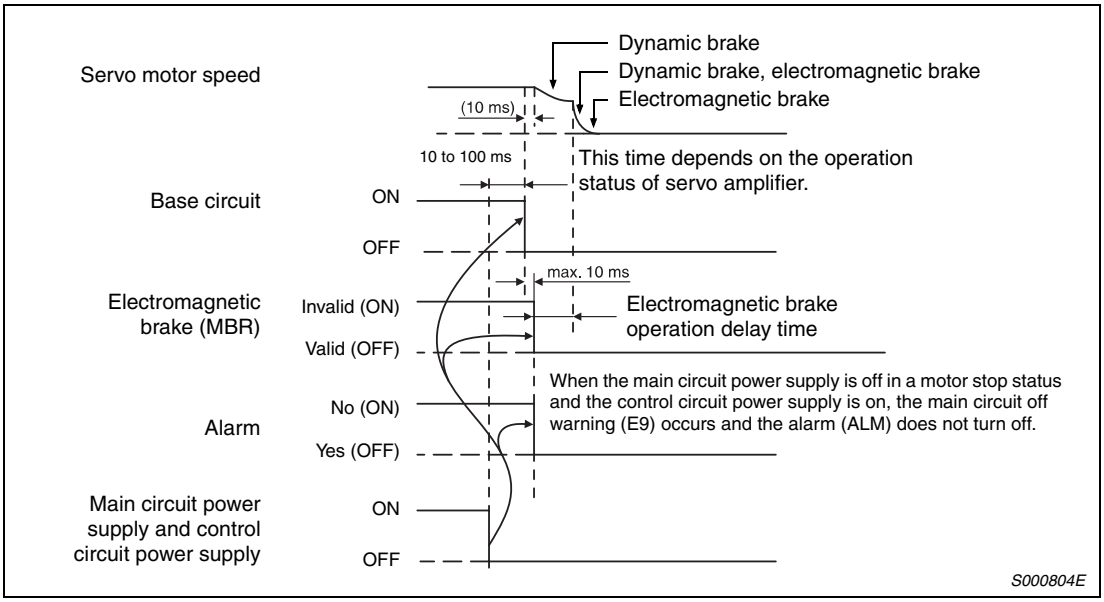


Fig. 3-26: *Main and control circuit power supplies OFF*

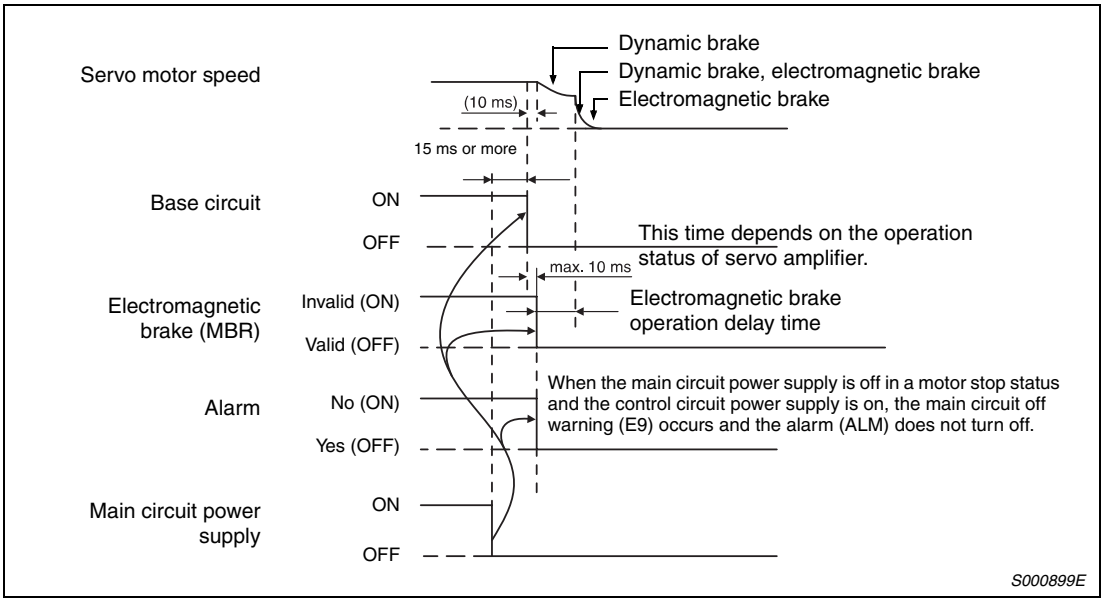


Fig. 3-27: *Main circuit power supply OFF (control circuit power supply remains ON.)*

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3.8 Examples of standard wiring diagrams

In the following illustrations there is presented a wiring diagram for a 200V and a 400V servo amplifier.

NOTE Please take all notes given in this chapter into account.

Servo amplifier 200V

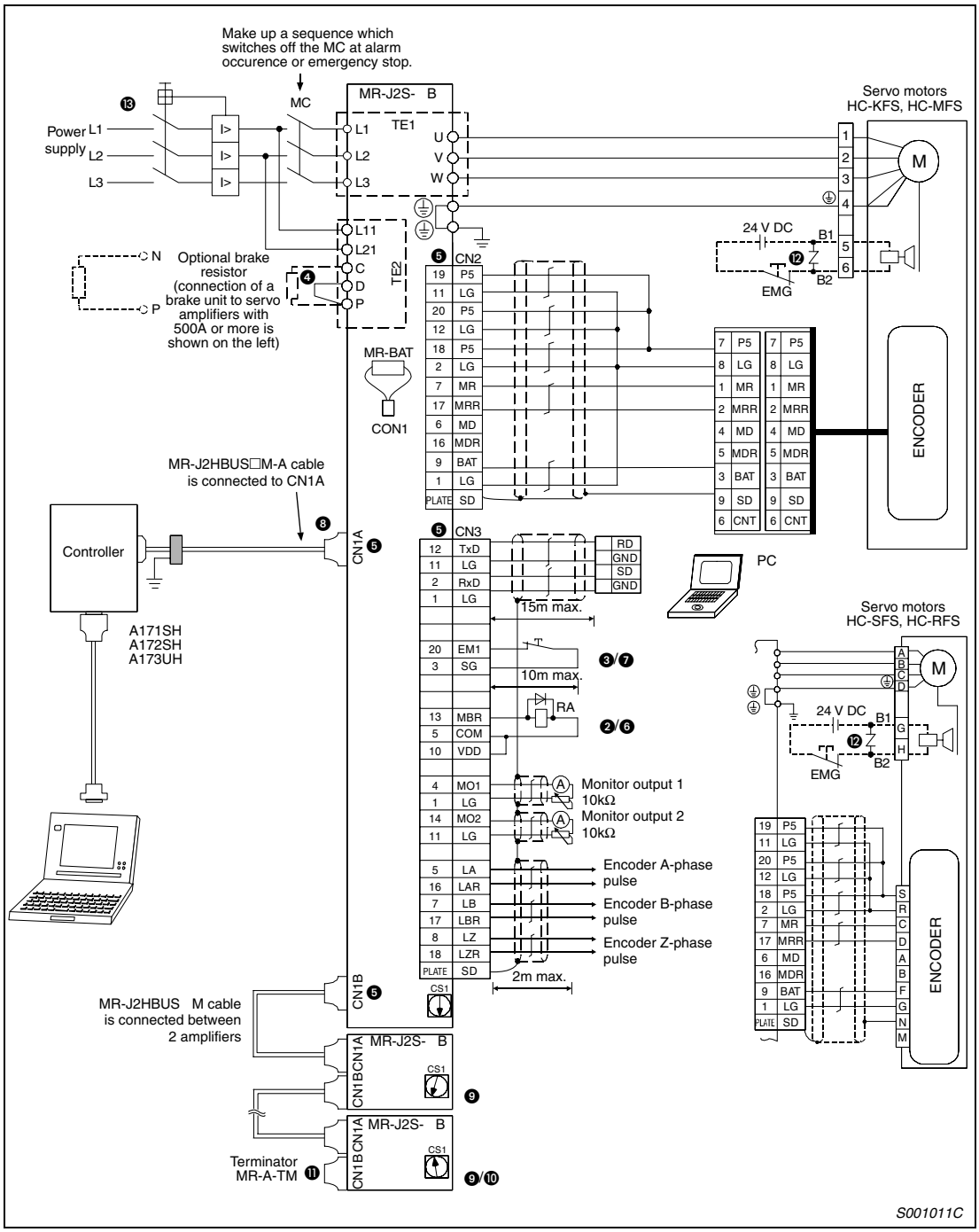


Fig. 3-28: *Standard wiring diagram for amplifier 200V*

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Servo amplifier 400V

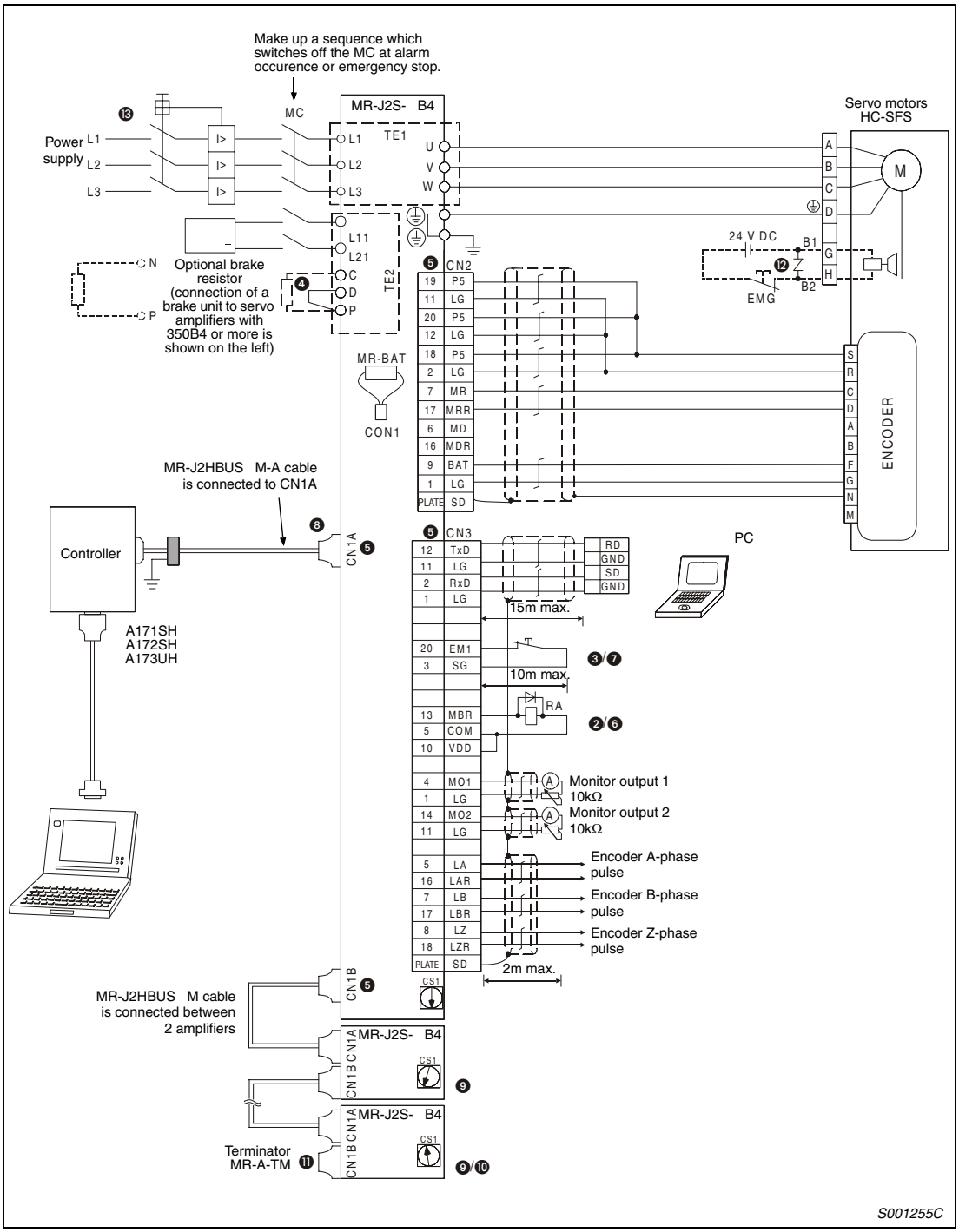


Fig. 3-29: *Standard wiring diagram for amplifier 400V*

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DANGER:

❶ ***Ground the servo amplifier and servo motor securely.***

To prevent an electric shock, always connect the protective earth terminal (PE) of the servo amplifier marked with ⏚, with the protective earth of the control box.

CAUTION:

❷ ***Do not reverse the diode's direction. Connecting it backwards could cause the amplifier to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.***

❸ ***If the controller is not equipped with an EMERGENCY OFF function, then an external EMERGENCY OFF switch must be installed.***

Notes to fig. 3-28 and fig. 3-29:

❹ The connection of terminals shown for the optional regenerative braking resistor applies exclusively to servo amplifiers MR-J2S-350B or less and MR-J2S-200B4 or less. For exact descriptions of the wiring of terminals for other performance classes, please see Tab. 3-4 and Tab. 3-5.

❺ CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault or may lead to a destruction of the inputs/outputs.

❻ The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external.

❼ Prior to starting up operations the external EMERGENCY OFF signal (EM1) must be switched on (opener). By setting parameter 23 to "0001" the external EMERGENCY OFF switch may be deactivated.

❽ Total length of the MR-J2HBUSM-A and MR-J2HBUSM cables = max. 30m. Use of a cable clamp or data line filters (3–4 in a row) near the connector pull to enhance noise resistence is recommended.

❾ Motor-side wiring after the second axis has been omitted.

❿ Up to 8 axes (n = 0–7) can be connected. MR-H-B series servo amplifiers can be connected to the same bus (however, it requires a different cable).

⓫ For termination the connector CN1B of the last servo amplifier must be fitted with the terminating resistance MR-A-TM.

⓬ Only for motors with electromagnetic brake.

⓭ A 1-phase 230VAC power supply can be used with servo amplifiers rated at MR-J2S-70A or less. Please connect the power supply using only terminals L1 and L2. Do not connect anything to L3.

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3.9 Station number setting

Use the coding switch (CS1) to set the station number for the servo amplifier. If the same numbers are set to different servo amplifier in a single communication system, the system will not operate properly. Set the switch to "F" when executing the test operation mode using the setup-software.

NOTE

The station number set to CS1 should be the same as the one set to the servo system controller.

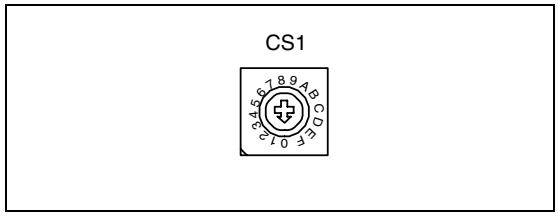


Abb. 3-30:
Station number setting switch

S000972C

Setting	Description
0	Station 1
1	Station 2
2	Station 3
3	Station 4
4	Station 5
5	Station 6
6	Station 7
7	Station 8
8	—
9	—
A	—
B	—
C	—
D	—
E	—
F	Test operation mode or when machine analyzer is used (refer section 4.6.2)

Abb. 3-31:
Station number setting

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4 Operation

4.1 Points to check prior to starting operation

Wiring

Before starting operation, check the following:

- A correct power supply is connected to the power input terminals (3-phase: L1, L2, L3, 1-phase: L11, L21) of the servo amplifier.
- 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.

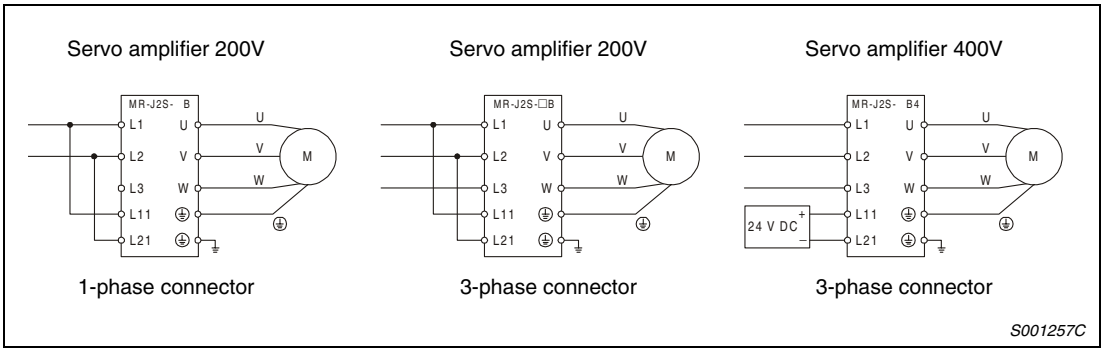


Fig. 4-1: *Wiring*

- The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals (L1, L2, L3) of the servo motor.

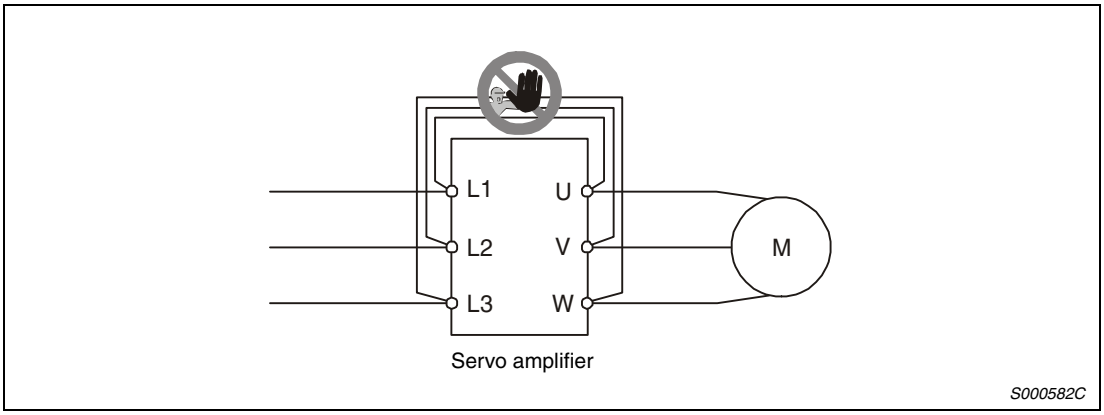


Fig. 4-2: *Short circuit*

- Ground the servo amplifier and servo motor securely.
- When using a regenerative brake option or brake unit:
  - always remove the lead across the terminals D and P for the servo amplifier MR-J2S-350B or less and MR-J2S-200B4 or less.
  - disconnect the cable connections to the internal brake resistor between the terminals P and C for the servo amplifier MR-J2S-500B or more and MR-J2S-350B4 or more.

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- 24VDC or higher voltages are not applied to the pins of connector CN3.
- SD and SG of connector CN3 are not shorted.

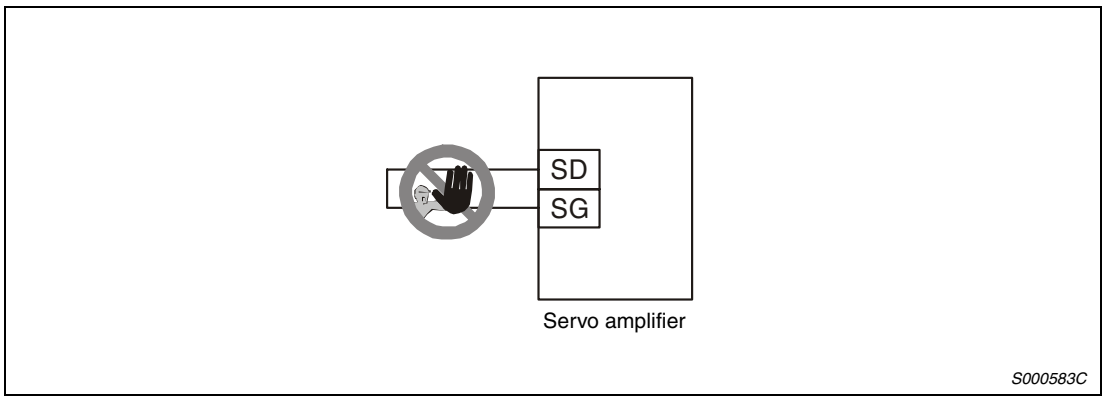


Fig. 4-3: *Short-circuit of SD and SG*

- The connection cable are not under a mechanical load (tension or excessive bend etc.).
- CN1A should be connected with the bus cable connected to the servo system controller or preceding axis servo amplifier, and CN1B should connected with the bus cable connected to the subsequent axis servo amplifier or with the termination connector (MR-A-TM.)

Station number

The station number setting of CS1 should be the same as that of the servo system controller. (refer section 3.9).

Parameter

Check the parameter setting on the servo system controller screen or using the setup-software.

Environment

Before starting operation, check the following:

- Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

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4.2 Procedures before Operation

DANGER:

- ***Do not operate the switches with wet hands. You may get an electric shock.***
- ***Do not operate the controller with the front cover removed. There is the risk of getting an electric shock from live parts.***
- ***During power-on or operation, do not open the front cover. You may get an electric shock.***
- ***Before starting operation, check the parameters. Through the incorrect setting of parameters some machines may execute unexpected movements.***
- ***Never touch the cooling fins of the servo amplifier, the brake resistor, servo motor or other components while the power supply is still on or shortly after switching it off. They can become very hot and touching them could result in serious burns.***

4.2.1 Start up procedure

Power on

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

In the absolute position detection system, first power-on results in the absolute position lost (25) alarm and the servo system cannot be switched on. This is not a failure and takes place due to the uncharged capacitor in the encoder.The alarm can be deactivated by keeping power on for a few minutes in the alarm status and then switching power off once and on again.

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

Parameter setting

Set the parameters according to the structure and specifications of the machine.

Pr.-No.	Name	Setting	Description
7	Rotation direction setting	0	Increase in positioning address rotates the motor in the forward direction
8	Auto tuning	□□□1	Used
9	Servo response	5	Slow response (initial value)

Tab. 4-1: *Setting value and control function*

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

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Servo on

Switch the servo-on in the following procedure:

① Switch on main circuit and control circuit power supply.

② The controller transmits the "servo ON" command.

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

Home position return

Always perform home position return before starting positioning operation.

Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop.
When the servo motor is equipped with an electromagnetic brake, refer to section 3.7.

	Operation	Stopping condition
Servo system controller	"Servo OFF" command	The base circuit is shut off and the servo motor coasts.
	Emergency stop command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to stop. The controller emergency stop warning (E7) occurs.
Servo amplifier	Alarm occurrence	The base circuit is shut off and the dynamic brake operates to bring the servo motor to stop.
	External EMERGENCY OFF switch (EM1) is pressed.	The base circuit is shut off and the dynamic brake operates to bring the servo motor to stop. The servo forced stop warning (E6) occurs.

Tab. 4-2: *Stopping condition*

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4.3 Display and Operation

4.3.1 Display sequence

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

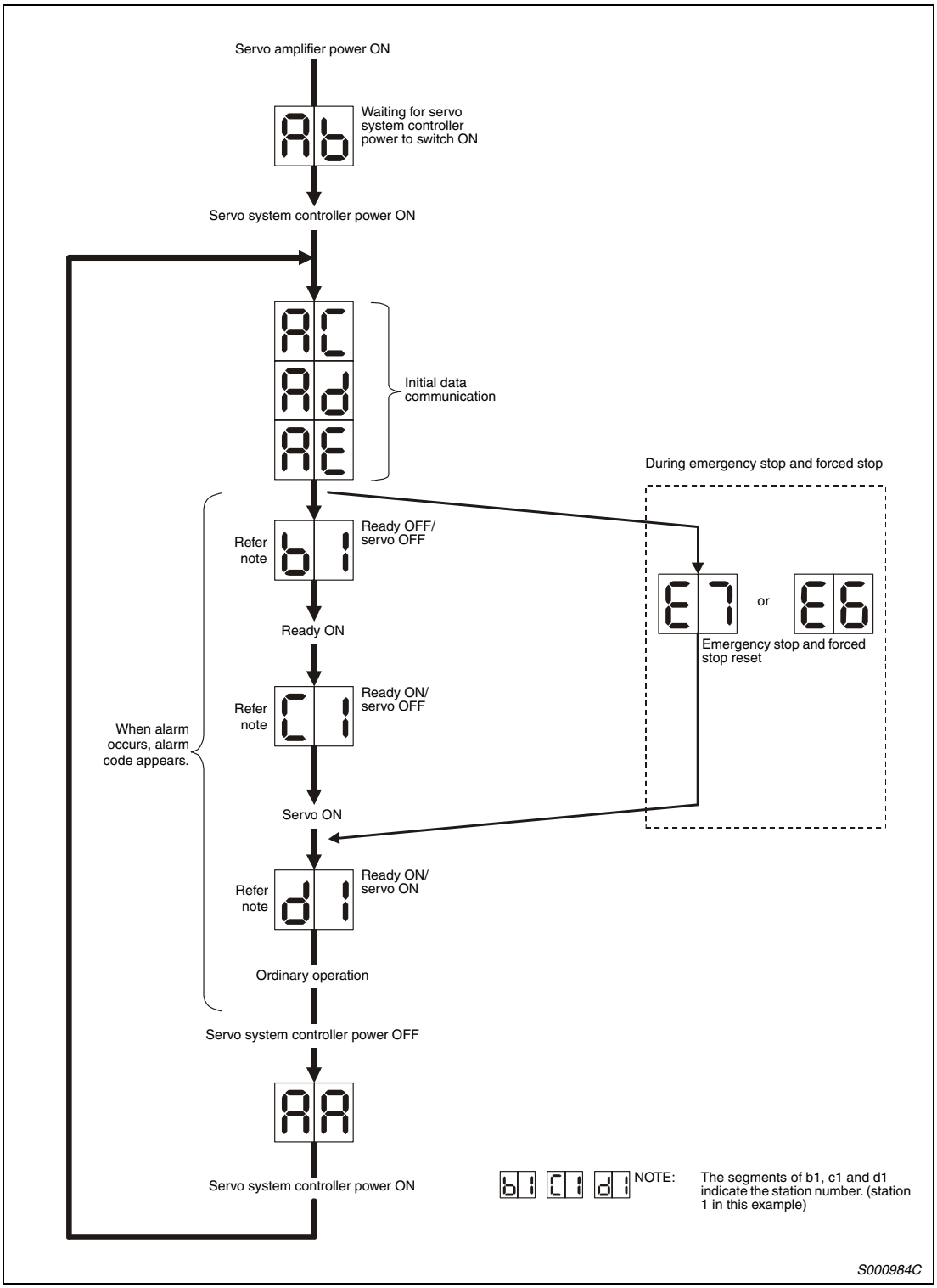


Fig. 4-4: *Display sequence*

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4.3.2 Indication list

Display	Status	Description
AA	Initializing	The servo amplifier was switched on when power to the servo system controller is off.
Ab	Initializing	• Power to the servo system controller was switched off during power-on of the servo amplifier. The station number set to the servo system controller does not match the station number set with the coding switch (CS1) of the servo amplifier. A servo amplifier fault occurred or an error took place in communication with the servo system controller. In this case, the indication changes: Ab → AC → Ad → Ab. The servo system controller is faulty.
AC	Initializing	Communication started between the servo system controller and servo amplifier
Ad	Initializing	The initial parameters from the servo system controller were received.
AE	Initialize completion	Initial data communication with the serco system controller was completed.
b# ①	Ready OFF	The ready off signal from the servo system controller was received.
d# ①	Servo ON	The servo on signal from the servo system controller was received.
C# ①	Servo OFF	The servo off signal from the servo system controller was received
** ②	Alarm/Warning	The alarm No./warning No. that occurred is displayed.
88	CPU error	—
b0. ③	Test operation mode ③	JOG operation, positioning operation, programmed operation, forced output signal
b#. d#. c#.		Motor-less operation

Tab. 4-3: *Indication list*

① The character "#" denotes any of numerals 0 to 8 and what it means is listed in Tab. 4-4.

② The character "**" indicates the warning/alarm number.

③ To execute this functions the setup-software is required.

#	Description
0	Test operation mode
1	Station 1
2	Station 2
3	Station 3
4	Station 4
5	Station 5
6	Station 6
7	Station 7
8	Station 8

Tab. 4-4:
Meaning of character "#"

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4.4 Test operation mode

CAUTION:

- ***The test operation mode is designed for servo operation confirmation and not for machine operation confirmation. Do not use this mode with the machine. Always use the servo motor alone.***
- ***If an operation fault occurred, use the forced stop (EM1) to make a stop.***

By using a personal computer and the setup-software, you can execute jog operation, positioning operation, motor-less operation and forced output without connecting the motion controller.

Use the system setup according to fig. 3-28 and fig. 3-29.

NOTE For full information of this functions, refer to the setup-software manual.

- JOG operation

Jog operation can be performed without using the servo system controller. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the jog operation screen of the setup-software.

	Initial value	Setting range
Speed [r/min]	200	0 to 5175
Acceleration/deceleration time constant [ms]	1000	0 to 20000

Tab. 4-5: *JOG operation settings*

Function	Button
Forward rotation start	Forward
Reverse rotation start	Reverse
Stop	Stop

Tab. 4-6: *Operation method*

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● Positioning operation

Positioning operation can be performed without using the servo system controller. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the positioning operation screen of the setup-software.

Name	Initial value	Setting range
Travel [pulse]	131072	0 to 9999999
Speed [r/min]	200	0 to 5175
Acceleration/deceleration time constant [ms]	1000	0 to 20000

Tab. 4-7: *Positioning operation settings*

Function	Button
Forward rotation start	Forward
Reverse rotation start	Reverse
Pause	Pause

Tab. 4-8: *Operation method*

● Program operation

Program operation can be performed in two or more operation patterns combined, without using the servo system controller. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the programmed operation screen of the setup-software..

Function	Button
Start	Start
Stop	Reset

Tab. 4-9: *Operation method*

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● Motor-less operation

Without connecting the servo motor, output signals or status displays can be provided in response to the servo system controller commands as if the servo motor is actually running. This operation may be used to check the servo system controller sequence. Use this operation with the servo amplifier connected to the servo system controller.

NOTE

Motor-less operation may be used with the setup-software. However, use motor-less operation which is available by making the servo system controller parameter setting.

Exercise control on the motor-less operation screen of the setup-software.

Load	Setting
Load torque	0
Load inertia moment ratio	Same as servo motor inertia moment

Tab. 4-10: *Load settings*

The following alarms and warning do not occur for operation without servo motor:

– Encoder error 1 (16)

– Encoder error 2 (20)

– Absolute position erasure (25)

– Battery cable breakage warning (92)

All other alarms and warnings occur as when the servo motor is connected

● Forced output signal

Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc.

Exercise control on the forced output screen of the setup-software.

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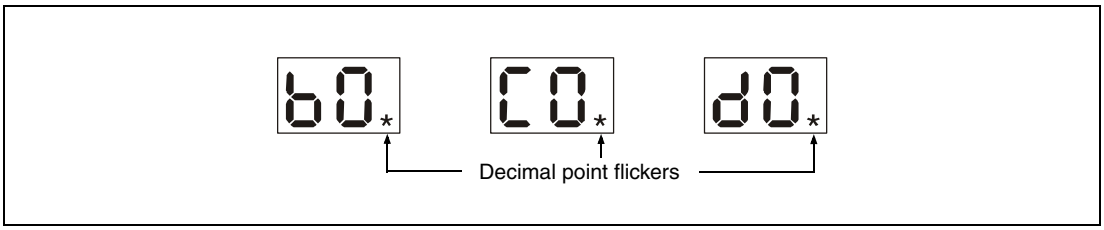
4.4.1 Test operation procedure

JOG operation, positioning operation, program operation, forced output

Switch power off.

Set the coding switch CS1 to „F“.
When CS1 is set to the station number and operation is performed by the servo system controller, the test operation mode screen is displayed on the personal computer, but no function is performed.

③ Switch servo amplifier power on. When initialization is over, the display shows the following screen:

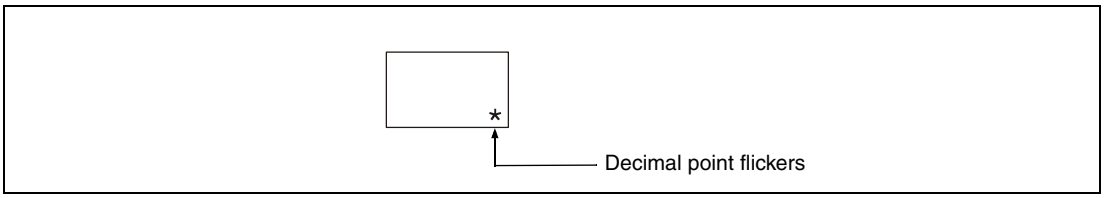


④ Perform operation with the personal computer.

Motor-less operation

Switch off the servo amplifier.

Perform motor-less operation with the personal computer. The display shows the following screen:



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4.5 Parameter

When the servo amplifier is connected with the servo system controller, the parameters are set to the values of the servo system controller. Switching power off, then on makes the values set on the setup-software invalid and the servo system controller values valid.

NOTES

In the maker setting parameters, do not set any values other than the initial values.

Setting may not be made to some parameters and ranges depending on the model or version of the servo system controller. For details, refer to the servo system controller user's manual.

4.5.1 Parameter write inhibit

The release of access to the parameters is established via parameter 40 (parameter write protection). Parameter No. 40 is made valid by switching power off, then on after setting its value.

The following table provides an overview over the settings of parameter No. 40:

Setting	Function	Operation from controller	Operation from setup-software
0000 (Initial value)	Read	Parameter No. 1 to No. 39	Parameter No. 1 to No. 11 and No. 40
	Write		
000A	Read	Parameter No. 1 to No. 39	Parameter No. 40
	Write		
000C	Read	Parameter No. 1 to No. 39	Parameter No. 1 to No. 40
	Write		Parameter No. 1 to No. 11 and No. 40
000E	Read	Parameter No. 1 to No. 39	Parameter No. 1 to No. 40
	Write		
100E	Read	Parameter No. 1 to No. 39	Parameter No. 1 to No. 40
	Write		Parameter No. 40

Tab. 4-11: *Parameter settings*

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4.5.2 Parameter overview

Function	No.	Symbol	Name	Initial value	Unit	Customer setting
Basic parameters	1	AMS	Amplifier setting	0000	—	
	2	REG	Regenerative brake resistor	0000	—	
	3	—	Reserved	0080	—	
	4	—		000	—	
	5	—		1	—	
	6	FPB	Feedback pulse number	0	—	
	7	POL	Rotation direction selection	0	—	
	8	ATU	Auto tuning	0001	—	
	9	RSP	Response auto tuning	0005	—	
	10	TLP	Forward rotation torque limit	300	%	
	11	TLN	Reverse rotation torque limit	300	%	
Adjustment parameters	12	GD2	Ratio of load inertia moment to servo motor inertia moment	7.0	Times	
	13	PG1	Position control gain 1	35	rad/s	
	14	VG1	Speed control gain 1	177	rad/s	
	15	PG2	Position control gain 2	35	rad/s	
	16	VG2	Speed control gains 2	817	rad/s	
	17	VIC	Speed integral compensation	48	ms	
	18	NCH	Machine resonance suppression filter	0000	—	
	19	FFC	Feed forward gain	0	%	
	20	INP	In-position range	100	Pulse	
	21	MBR	Electromagnetic brake sequence output	0	ms	
	22	MOD	Analog monitor output	0001	—	
	23	OP1	Function selection1	0000	—	
	24	OP2	Function selection 2	0000	—	
	25	LPF	Low-pass filter for adaptive vibration suppression control	0000	—	
	26	—	Reserved	0	—	

Tab. 4-12: *Parameter overview (1)*

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Function	No.	Symbol	Name	Initial value	Unit	Customer setting
Expansion parameters	27	MO1	Analog output 1 offset	0	mV	
	28	MO2	Analog output 2 offset	0	mV	
	29	—	Reserved	0001	—	
	30	ZSP	Zero speed	50	r/min	
	31	ERZ	Error excessive alarm level	80	0.1 × r	
	32	OP5	Function selection 5	0000	—	
	33	OP6	Function selection 6	0000	—	
	34	VPI	PI-/PID control switch-over position droop	0	Pulse	
	35	—	Reserved	0	—	
	36	VDC	Speed differential compensation	980	—	
	37	—	Reserved	0010	—	
	38	ENR	Encoder output pulses	4000	Pulse/r	
	39	—	Reserved	0	—	
	40	BLK	Parameter entry prohibition	0000	—	

Tab. 4-12: *Parameter overview (2)*

Set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

The values corresponds with the factory settings of the servo amplifier. Connecting it with the servo system controller and switching power on changes them to the settings of the servo system controller.

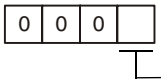
Setting and changing cannot be made from the peripheral software of the motion controller.

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4.5.3 Parameter description:

Number	Symbol	Initial value	Unit	Setting range
1	AMS	0000		Refer description

Amplifier setting
Used to select the absolute position detection.

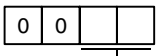


Positioning
0: Standard (incremental)
1: Absolute position detection system

2	REG	0000		Refer description

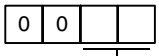
Regenerative brake resistor

Servo amplifier 200V



Regenerative selection brake option
00: No brake resistor
01: FR-RC, FR-BU
05: MR-RFH220-40
08: MR-RFH400-13
09: MR-RFH400-13
0B: MR-RFH400-6.7
0C: MR-RFH400-6.7
10: MR-RFH75-40
11: MR-RFH75-40

Servo amplifier 400V



Regenerative selection brake option
00: No brake resistor
01: FR-RC-H , FR-BU-H
80: MR-RB3H-4
81: MR-RB5H-4/MR-PWR-T-600-80
82: MR-RB3G-4
83: MR-RB5G-4/MR-PWR-T-600-47
84: MR-RB34-4
85: MR-RB54-4/MR-PWR-T-600-26
86: MR-RB1L-4/MR-PWR-T-150-270
87: MR-RB3M-4/MR-PWR-T-400-120

CAUTION:
Wrong setting may cause the regenerative brake option to burn.
NOTE:
If the regenerative brake option selected is not for use with the servo amplifier, parameter error (37) occurs.

3		0080		

Reserved
Do not change this parameter.

4		0000		

Reserved
Do not change this parameter.

5		1		

Reserved
Do not change this parameter.

Tab. 4-13: *Parameter list details (1)*

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Number	Symbol	Initial value	Unit	Setting range
6	**FBP**	**0**		**Refer description**

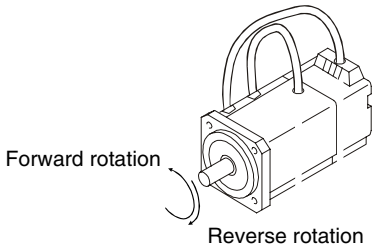
Feedback pulse number
Set the number of pulses per revolution in the controller side command unit.
Information on the motor such as the feedback pulse value, present position, droop pulses and within-one-revolution position are derived from this setting.

Setting	Number of feedback pulses
0	16384
1	8192
6	32768
7	131072
255	Depending on the motor resolution pulses

NOTE:
If the number of pulses set exceeds the actual motor resolution, the motor resolution is set automatically.

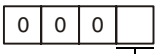
7	**POL**	**0**		**Refer description**

Rotation direction selection
Used to select the rotation direction of the servo motor.
0: Forward rotation with the increase of the address
1: Reverse rotation with the increase of the address



8	**ATU**	**0001**		**Refer description**

Auto tuning
Used to select the gain adjustment mode of auto tuning.



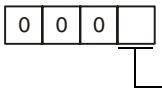
Setting	Adjustment method	Description
0	Interpolation mode	Only position control gain 1 (Pr. 13)
1	Auto tuning mode 1	Setting for position and rotation speed control loops
3	Auto tuning mode 2	Inertia ratio setting (Pr. 12) Response level setting can be changed.
4	Manual mode 1	Simple manual adjustment
2	Manual mode 2	Manual adjustment of all gains.

Tab. 4-13: *Parameter list details (2)*

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Number	Symbol	Initial value	Unit	Setting range
9	**RSP**	**0005**		**Refer description**

Response auto tuning
Used to select the response of auto tuning.



Value	Response characteristic	Machine resonance frequency
1	Low	15Hz
2		20Hz
3		25Hz
4		30Hz
5		35Hz
6		45Hz
7		55Hz
8	Middle	70Hz
9		85Hz
A		105Hz
B		130Hz
C		160Hz
D		200Hz
E		240Hz
F	High	300Hz

10	TLP	300	%	0–500

Forward rotation torque limit
Assume that the maximum rated torque is 100%.
Use the parameter to limit the torque in the forward rotation driving mode and reverse rotation regenerative mode.
In other than the test operation mode on the setup-software, the torque limit value on the servo system controller side is made valid.

11	TLN	300	%	0–500

Reverse rotation torque limit
Assume that the maximum rated torque is 100%.
Use the parameter to limit the torque in the forward rotation driving mode and forward rotation regenerative mode.
In other than the test operation mode on the setup-software, the torque limit value on the servo system controller side is made valid.

12	GD2	7.0		0–300,0

Ratio of load inertia moment to servo motor inertia moment
Used to set the ratio of the load inertia to the inertia moment of the servo motor shaft.
When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used.

13	PG1	35	rad/s	4–2000

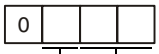
Position control gain 1
When auto tuning 1 or 2 is switched on (parameter 8) this parameter optimises itself constantly
(no function when auto tuning is switched off).

Tab. 4-13: *Parameter list details (3)*

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Number	Symbol	Initial value	Unit	Setting range
14	VG1	177	rad/s	20–5000
Speed control gain1 If auto tuning 1 or 2 (parameter 8) or interpolation mode is selected, then this parameter will optimise itself automatically. If auto tuning or interpolation mode is de-selected, then this parameter should not be changed. Higher setting increases the response level but is liable to generate vibrations.				
15	PG2	35	rad/s	1–1000
Position control gain 2 Set this parameter to increase position response to load disturbance. Higher setting increases the response level but is liable to generate vibrations. If auto tuning 1 or 2, manual setting method or interpolation mode (pr. 8) is selected, then this parameter will optimise itself automatically. If auto tuning 1 or 2, manual setting method or interpolation mode is de-selected, then the position control loop must be set via this parameter.				
16	VG2	817	rad/s	20–5000
Speed control gain 2 Set this parameter to increase position response to load disturbance. Higher setting increases the response level but is liable to generate vibrations. If auto tuning 1 or 2 or interpolation mode (pr. 8) is selected, then this parameter will optimise itself automatically. If auto tuning 1 or 2 or interpolation mode is de-selected, then the revolution speed control loop must be set via this parameter.				
17	VIC	48	ms	1–1000
Speed integral compensation If auto tuning 1 or 2 or interpolation mode (pr. 8) is selected, then this parameter will optimise itself automatically.				
18	NCH	0		Refer description

Machine resonance suppression filter



Resonance frequency

Setting	Frequency	Setting	Frequency	Setting	Frequency	Setting	Frequency
00	—	08	562.5	10	281.3	18	187.5
01	4500	09	500	11	264.7	19	180
02	2250	0A	450	12	250	1A	173.1
03	1500	0B	409.1	13	236.8	1B	166.7
04	1125	0C	375	14	225	1C	160.1
05	900	0D	346.2	15	214.3	1D	155.2
06	750	0E	321.4	16	204.5	1E	150
07	642.9	0F	300	17	195.7	1F	145.2

Attenuation

Setting	Attenuation
0	40 dB
1	14 dB
2	8 dB
3	4 dB

Tab. 4-13: *Parameter list details (4)*

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Number	Symbol	Initial value	Unit	Setting range
19	FFC	0	%	0–100
Feed forward gain Pre-regulation to minimise the control deviation for position control. When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot.				
20	INP	100	Pulse	0–50000
In-position range Used to set the droop pulse range in which the in-position will be output to the controller. The control deviation is not affected by the electronic gear. Make setting in the feedback pulse unit (parameter No. 6). Example: when you want to set 10μm in the conditions that the ballscrew is direct coupled, the lead is 10mm, and the feedback pulses are 8192 pulses/rev (parameter No. 6: 1), set "8" in parameter 20 as indicated by the following expression. $\frac{10 \times 10^{-6}}{10 \times 10^{-3}} \times 81920 = 8.192 = 8$				
21	MBR	100	ms	0–1000
Electromagnetic brake sequence output Used to set a time delay from when the electromagnetic brake interlock signal (MBR) turns off until the base circuit is shut off.				
22	MOD	0100		Refer description

Analog monitor output

0 | | 0 |

MO1

The settings corresponds to MO2

MO2

Setting	Servo amplifier 200V	Servo amplifier 400V
0	Servo motor speed (±8V/max. speed)	
1	Torque (±8V/maxi. torque)	
2	Servo motor speed (+8V/max. speed)	
3	Torque (+8V/maxi. torque)	
4	Current set point (±8V/max. rated current)	
5	Speed set point (±8V/max. speed)	
6	Contouring error (±10V/128 Pulse)	
7	Contouring error (±10V/2048 Pulse)	
8	Contouring error (±10V/8192 Pulse)	
9	Contouring error (±10V/32768 Pulse)	
A	Contouring error (±10V/131072 Pulse)	
B	Bus voltage (+8V/400V)	Bus voltage (+8V/800V)

23	OP1	0000		Refer description

Function selection 1: Used to make the servo forced stop function invalid

0 | 0 | 0 |

Servo forced stop selection
0: Valid (Use the forced stop EM1.)
1: Invalid (Do not use the forced stop EM1. Automatically switched on internally.)

Tab. 4-13: *Parameter list details (5)*

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Number	Symbol	Initial value	Unit	Setting range
24	OP2	0000		Refer description

Function selection 2: Used to select slight vibration suppression control and motor-less operation

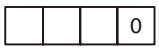


Used to suppress vibration at a stop.
Made this function valid when auto tuning selection is set to "0002" in parameter No. 8.
0: no suppression
1: suppression

Motor-less operation selection
0: invalid
1: valid
When motor-less operation is made valid, signal output or status display can be provided as if the servo motor is running actually in response to the servo system controller command, without the servo motor being connected. Control of operation without servo motor occurs via the setup software.

Number	Symbol	Initial value	Unit	Setting range
25	LPF	0000		Refer description

Low-pass filter for automatic vibration suppression



Low-pass filter
0: valid
1: invalid
When the filter is activated the following limit frequency results:

$$\text{Limit frequency} = \frac{VG2 \times 10}{2\pi(1 + GD2 \times 0.1)}$$

Adaptive vibration suppression control
If you have selected the setting “active” or “hold” during automatic vibration suppression, then filter (pr. 18) is ineffective.
0: invalid
1: valid
The resonance frequency is constantly determined and the filter set accordingly.
2: held
The pre-set resonance frequency of the filter is maintained.

Adaptive vibration suppression control sensitivity selection
0: normal sensitivity
1: large sensitivity

Number	Symbol	Initial value	Unit	Setting range
26		0		

Reserved
Do not change this parameter.

Tab. 4-13: *Parameter list details (6)*

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Number	Symbol	Initial value	Unit	Setting range
27	**MO1**	**0**	**mV**	**–999–999**
Analog monitor 1 offset Used to set the offset voltage of the analog monitor 1 (MO1) output.				
28	**MO2**	**0**	**mV**	**–999–999**
Analog monitor 2 offset Used to set the offset voltage of the analog monitor 2 (MO2) output.				
29		**0001**		
Reserved Do not change this parameter.				
30	**ZSP**	**50**	**r/min**	**0–10000**
Entry of the rotation speed under which the output signal “Rotation speed “ is output.				
31	**ERZ**	**80**	**0.1 × U**	**0–1000**
Switching threshold contouring error If the switching threshold is exceeded error message 52 is issued.				
32	**OP5**	**0000**		**Refer description**
Function selection 5 Used to select PI-PID control switch-over. 0 0 0 □ PI- PID control switch over selection 0: PI control is always valid. 1: For position control the switch-over is dependent on contouring error (refer to parameter 34). 2: PID control is always valid.				
33	**OP6**	**0000**		**Refer description**
Function selection 6 Used to select the serial communication baud rate, serial communication response delay time setting and encoder output pulse setting. 0 □ □ □ Serial communication baud rate selection 0: 9600 Bit/s 1: 19200 Bit/s 2: 38400 Bit/s 3: 57600 Bit/s Serial communication response delay time 0: turned off 1: The response is sent after a time delay of at least 800ms. Encoder output pulse setting (also refer parameter No. 38) 0: Direct output of the encoder pulses 1: Setting the divisor for pulse output				

Tab. 4-13: *Parameter list details (7)*

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Number	Symbol	Initial value	Unit	Setting range
34	VPI	0	Pulse	0–50000
PI-/PID control switch-over position droop Setting the switching threshold of the contouring error (in pulses) for the switch-over from PI to PID control. Set "0001" in parameter No. 32 to make this function valid.				
35		0		
Reserved Do not change this parameter.				
36	VDC	980	r/min	0–1000
Speed differential compensation If auto tuning (pr. 8) is selected then this parameter optimises itself automatically.				
37		0010		
Reserved Do not change this parameter.				
38	ENR	4000	Pulse/r	
Encoder simulation resolution Setting the number of pulses (A-phase, B-phase) which is output for a complete revolution of the motor at the simulated encoder output. The number of A-phase and B-phase pulses actually output is 1/4 times greater than the preset number of pulses. Therefore, set the value 4 times greater than the desired pulses.You can use parameter No. 33 to adjust the output pulse. The maximum output frequency is 1.3Mpps (after multiplication by 4). Setting example: With pr. 33 the direct pulse output is selected (contents of pr. 33: 0mmm). For a target in pr. 38 of 5600, for one revolution of the motor 5600/4 = 1400 pulses are output. Parameter 33 is set so that (contents of pr. 33: 1mmm), the pulses that are produced for a full rotation of the motor, are divided by the figure specified in pr. 38. If, for example, the figure “8” is specified in parameter 38, then for one revolution of the motor (131072/8) × 1/4 = 4096 pulses are output.				
39		0		
Reserved Do not change this parameter.				

Tab. 4-13: *Parameter list details (8)*

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<table>
<tr><th>Number</th><th>Symbol</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td colspan="5"></td></tr>
<tr><td>40</td><td>BLK</td><td>0000</td><td></td><td>Refer description</td></tr>
<tr><td colspan="5">Parameter entry prohibition
Depending on the setting, various parameter ranges may be blocked for reading or writing (refer topage 4-11).
<table>
<tr><th>Setting</th><th>Function</th><th>Operation from controller</th><th>Operation from setup-software</th></tr>
<tr><td rowspan="2">0000
(Initial value)</td><td>Read</td><td rowspan="2">Parameter No. 1 to No. 39</td><td rowspan="2">Parameter No. 1 to No. 11 and No. 40</td></tr>
<tr><td>Write</td></tr>
<tr><td rowspan="2">000A</td><td>Read</td><td rowspan="2">Parameter No. 1 to No. 39</td><td rowspan="2">Parameter No. 40</td></tr>
<tr><td>Write</td></tr>
<tr><td rowspan="2">000C</td><td>Read</td><td rowspan="2">Parameter No. 1 to No. 39</td><td>Parameter No. 1 to No. 40</td></tr>
<tr><td>Write</td><td>Parameter No. 1 to No. 11 and No. 40</td></tr>
<tr><td rowspan="2">000E</td><td>Read</td><td rowspan="2">Parameter No. 1 to No. 39</td><td rowspan="2">Parameter No. 1 to No. 40</td></tr>
<tr><td>Write</td></tr>
<tr><td rowspan="2">100E</td><td>Read</td><td rowspan="2">Parameter No. 1 to No. 39</td><td>Parameter No. 1 to No. 40</td></tr>
<tr><td>Write</td><td>Parameter No. 40</td></tr>
</table></td></tr>
</table>

Tab. 4-13: *Parameter list details (9)*

Set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

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4.6 Gain

4.6.1 Gain adjustment

The gain adjustment in this section can be made on a single servo amplifier. For gain adjustment, first execute auto tuning mode 1. If you are not satisfied with the movement processes of the machine during operation, then carry out the following steps in the order that they are specified:

- Auto tuning mode 2
- Manual setting of the gain factor 1
- Manual setting of the gain factor 2

The following table shows the items of the different gain setting methods:

Method	Parameter No. 8 setting	Inertia ratio	Automatically set parameters	Manually set parameters
Auto tuning 1	0001	Always estimated	GD2 (parameter No. 12), PG1 (parameter No. 13), VG1 (parameter No. 14), PG2 (parameter No. 15), VG2 (parameter No. 16), VIC (parameter No. 17)	Response characteristic in parameter No. 9
Auto tuning 2	0003	As set in parameter No. 12	PG1 (parameter No. 13), VG1 (Pparameter No. 14), PG2 (parameter No. 15), VG2 (parameter No. 16), VIC (parameter No. 17)	GD2 (parameter No. 12), Response characteristic in parameter No. 9
Manual mode 1	0004		VG1 (parameter No. 14) PG2 (parameter No. 15),	GD2 (parameter No. 12), PG1 (parameter No. 13), VG2 (parameter No. 16), VIC (parameter No. 17)
Manual mode 2	0002		—	GD2 (parameter No. 12), PG1 (parameter No. 13), VG1 (parameter No. 14), PG2 (parameter No. 15), VG2 (parameter No. 16), VIC (parameter No. 17)
Interpolation mode	0000	Always estimated	GD2 (parameter No. 12), PG2 (parameter No. 15), VG2 (parameter No. 16), VIC (parameter No. 17)	PG1 (parameter No. 13), VG1 (parameter No. 14)

Tab. 4-14: *Gain setting method*

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For the gain setting please follow the instructions which are given below:

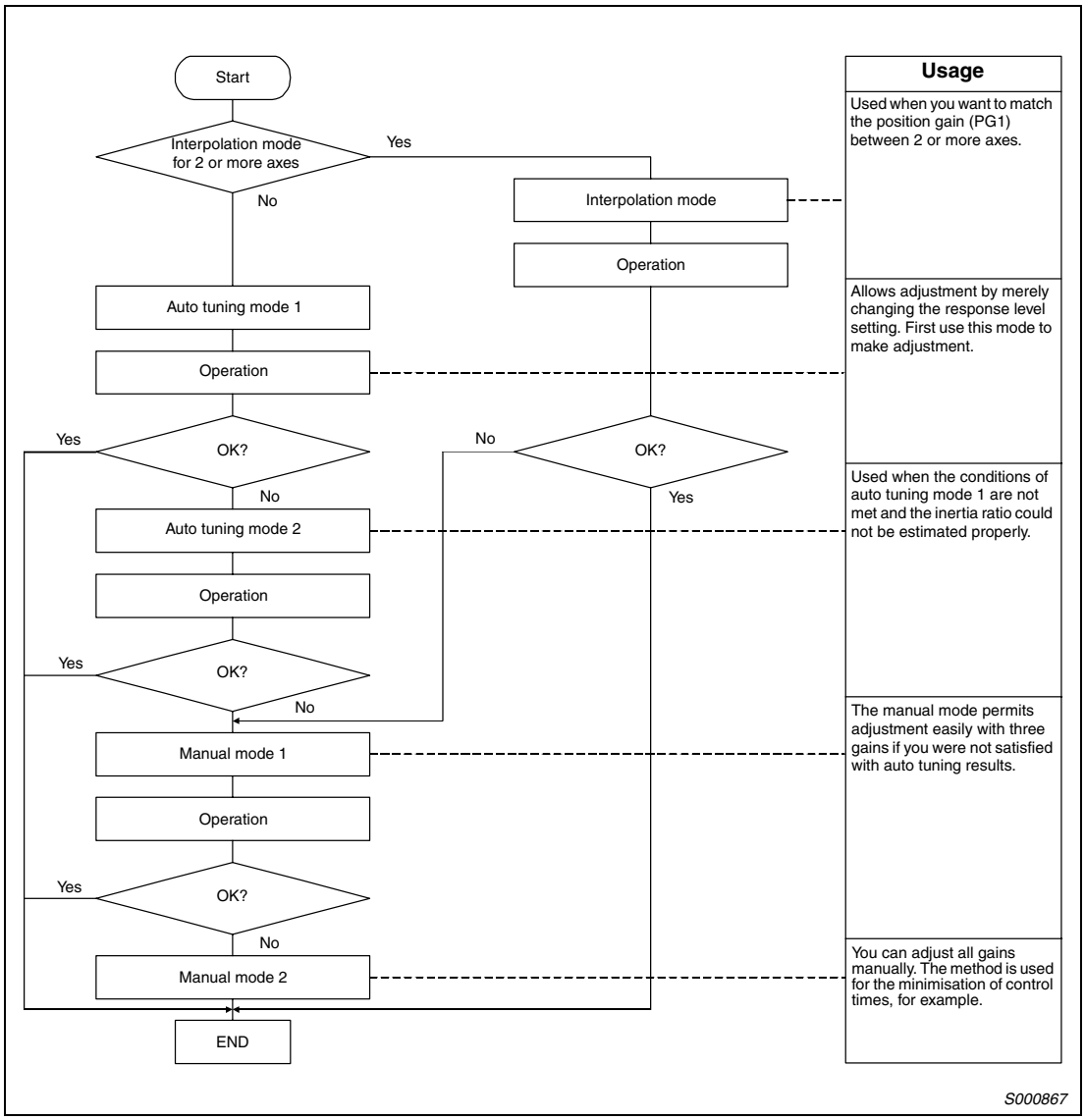


Fig. 4-5: *Adjustment sequence*

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4.6.2 Gain adjustment using setup-software

The following table shows the functions and adjustment when using the setup-software:

Function	Description	Adjustment
Machine analyzer	The characteristic of the whole mechanical system can be registered from the personal computer.	You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter. You can automatically set the optimum gains in response to the machine characteristic. This simple adjustment is suitable for a machine which has large machine resonance and does not require much settling time.
Automatically gain search	For automatic gain setting the optimum gain is determined taking into account the shortest possible control time.	You can automatically set gains which make positioning setting time shortest.
Machine simulation	Response at positioning setting of a machine can be simulated from machine analyzer results on the personal computer.	The optimum gain factors and command chains can be determined.

Tab. 4-15: *Comparison with setup-software*

NOTE When using the machine analyzer, set the servo amplifier's coding switch CS1 to "F".

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4.6.3 Auto tuning

The servo amplifier is equipped with a real-time auto tuning function that constantly optimises the gain factors of the control loops depending on the machine characteristics (inertia of mass ratio). This allows time-consuming settings during start-up to be avoided.

Auto tuning 1

The servo amplifier is factory-set to the auto tuning mode 1. In this mode, the inertia ratio of a machine is always estimated to set the optimum gains automatically.

The following parameters are automatically adjusted in the auto tuning mode 1:

Parameter	Symbol	Name
12	GD2	Ratio of load inertia moment to servo motor inertia moment
13	PG1	Position control gain 1
14	VG1	Speed control gain 1
15	PG2	Position control gain 2
16	VG2	Speed control gain 2
17	VIC	Speed intergral compensation

Tab. 4-16: *Parameter adjusted in the auto tuning mode 1*

The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied:

- Time to reach 2000r/min is the acceleration/deceleration time constant of 5s or less.
- Speed is 150r/min or higher.
- The ratio of load inertia moment to servo motor is not more than 100times.
- The acceleration/deceleration torque is 10% or more of the rated torque.
- Under operating conditions which will impose sudden disturbance torque during acceleration/deceleration or on a machine which is extremely loose, auto tuning may not function properly, either. In such cases, use the auto tuning mode 2 or manual mode 1 or 2 to make gain adjustment.

Auto tuning 2

Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load inertia moment ratio is not estimated in this mode, set this value in parameter No. 12

The following parameters are automatically adjusted in the auto tuning mode 2:

Parameter	Symbol	Name
13	PG1	Position control gain 1
14	VG1	Speed control gain 1
15	PG2	Position control gain 2
16	VG2	Speed control gain 2
17	VIC	Speed intergral compensation

Tab. 4-17: *Parameter adjusted in the auto tuning mode 2*

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Auto tuning mode operation

The block diagram of real-time auto tuning is shown below:

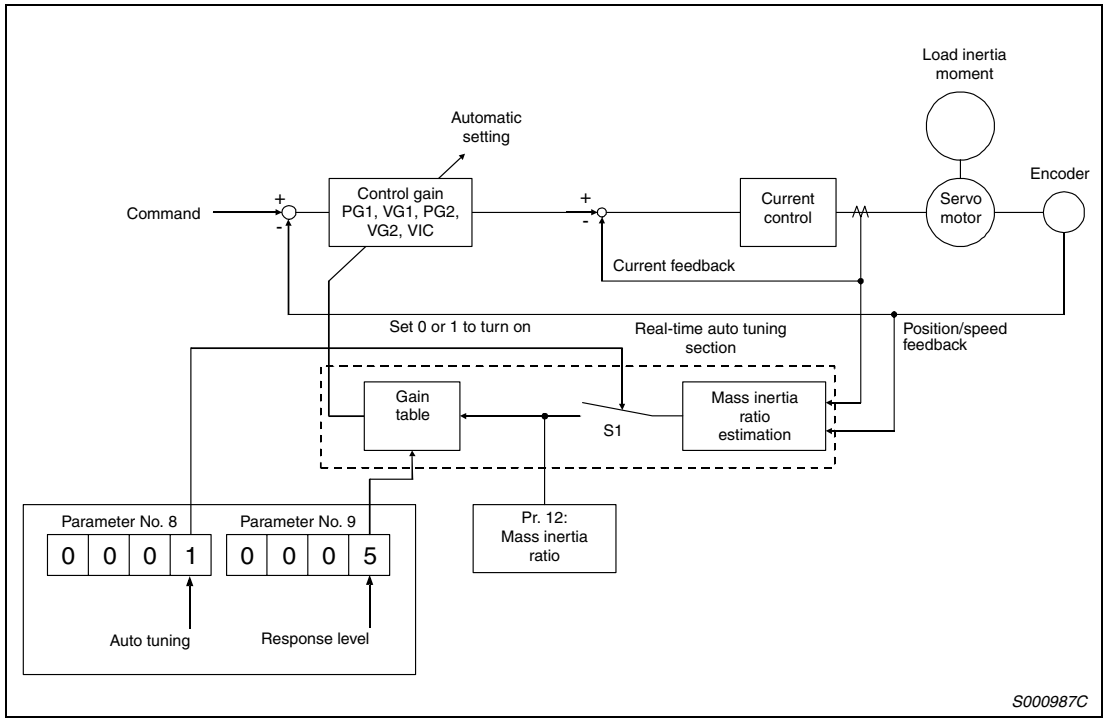


Fig. 4-6: *Block diagram of auto tuning*

When a servo motor is accelerated/decelerated, the inertia ratio estimation section always estimates it from the current and speed of the servo motor. The results of estimation are written to parameter No. 12. These results can be confirmed on the status display screen of setup-software.

If the value of the load inertia moment ratio is already known or if estimation cannot be made properly, choose the "auto tuning mode 2" (parameter No. 8: 0003) and set the load inertia moment ratio (parameter No. 12) manually.

From the preset load inertia moment ratio (parameter No. 12) value and response level (parameter No. 9), the optimum control gains are automatically set on the basis of the internal gain table.

The auto tuning results are saved in the E²PROM of the servo amplifier every 6 minutes since power-on. At power-on, auto tuning is performed with the value of each control gain saved in the E²PROM being used as an initial value.

NOTE

If sudden disturbance torque is imposed during operation, the estimation of the inertia ratio may malfunction temporarily. In such a case, choose the "auto tuning mode 2" (parameter No. 8: 0003) and set the correct load inertia moment ratio in parameter No. 12.

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Adjustment procedure by auto tuning

Auto tuning is the standard selection. In most cases you just need to connect the motor and start up without making any time-consuming settings. Simply turn on the response level of auto tuning in order to carry out the setting procedure.

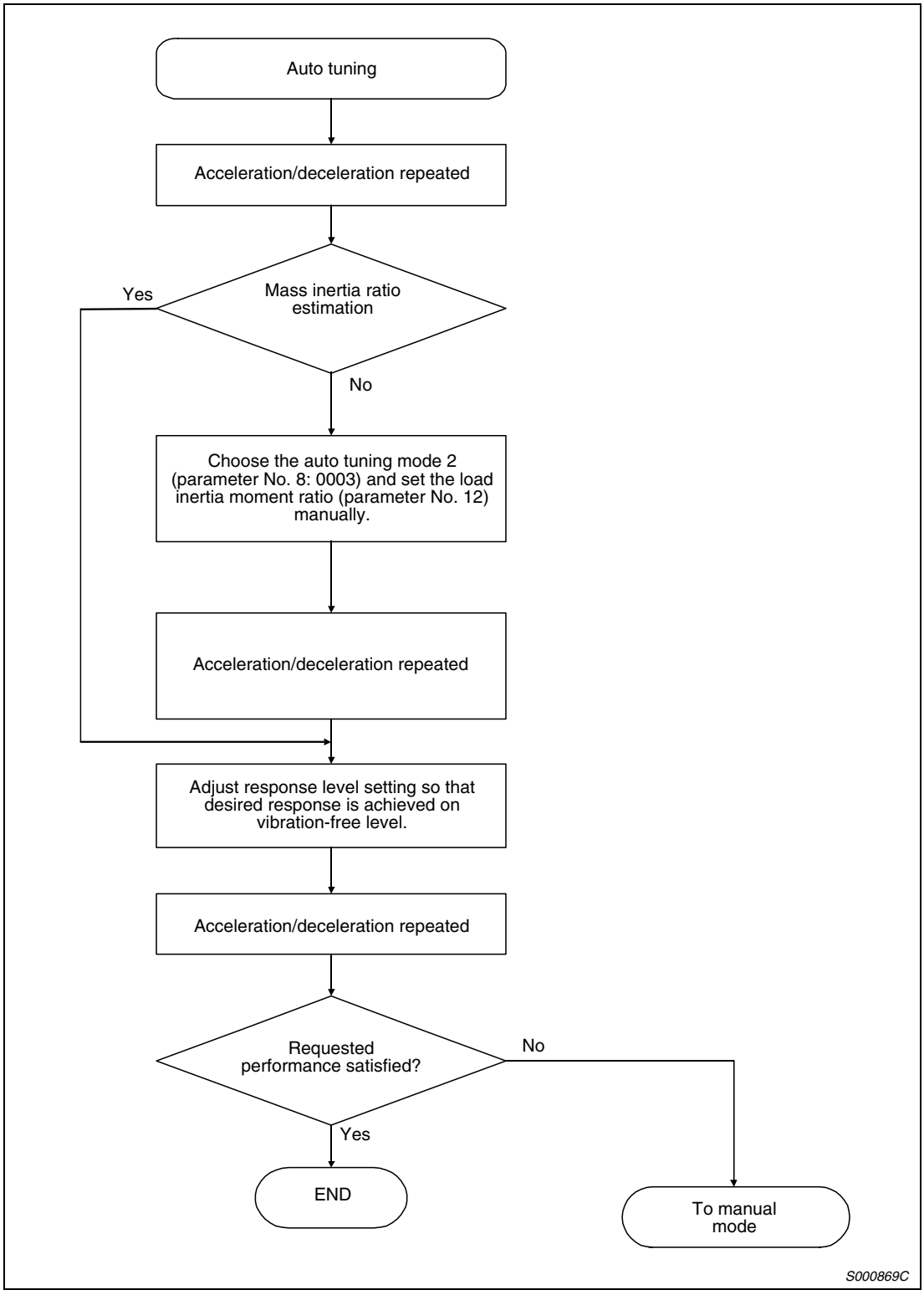


Fig. 4-7: *Adjustment procedure by auto tuning*

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Response level setting in auto tuning mode

Set the response (parameter No. 9) of the whole servo system. As the response level setting is increased, the trackability and positioning time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range.

If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100Hz, adaptive vibration suppression control (parameter No. 25) or machine resonance suppression filter (parameter No. 18) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase.

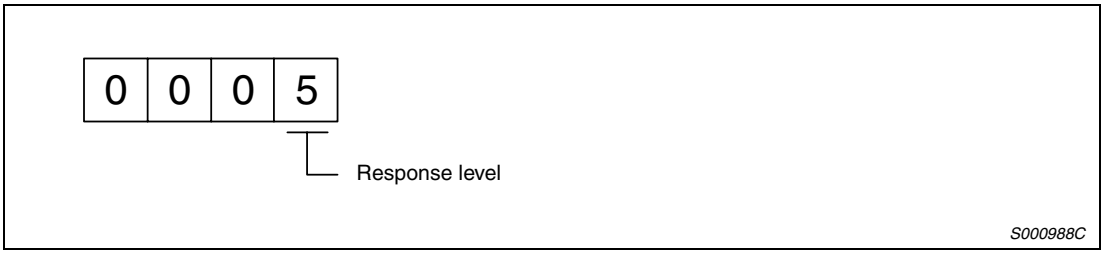
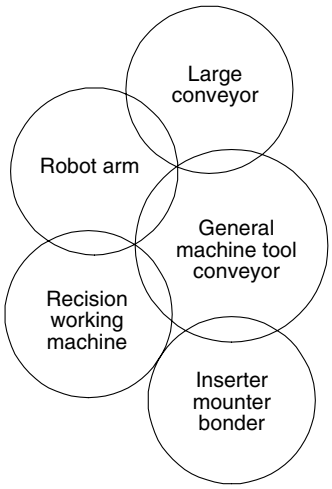


Fig. 4-8: *Parameter 2 setting*

Value	Machine characteristic		
	Response level	Machine resonance	Usage
1	Low	15Hz	
2		20Hz	
3		25Hz	
4		30Hz	
5		35Hz	
6		45Hz	
7		55Hz	
8	Middle	70Hz	
9		85Hz	
A		105Hz	
B		130Hz	
C		160Hz	
D		200Hz	
E		240Hz	
F	High	300Hz	

Tab. 4-18: *Response level setting*

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4.6.4 Manual gain setting

If you are not satisfied with the adjustment of auto tuning, you can make simple manual adjustment with three parameters.

Manual mode 1

In this mode, setting the three gains of position control gain 1 (PG1), speed control gain 2 (VG2) and speed integral compensation (VIC) automatically sets the other gains to the optimum values according to these gains. The setting of the inertia of mass ratio occurs in pr. 12.

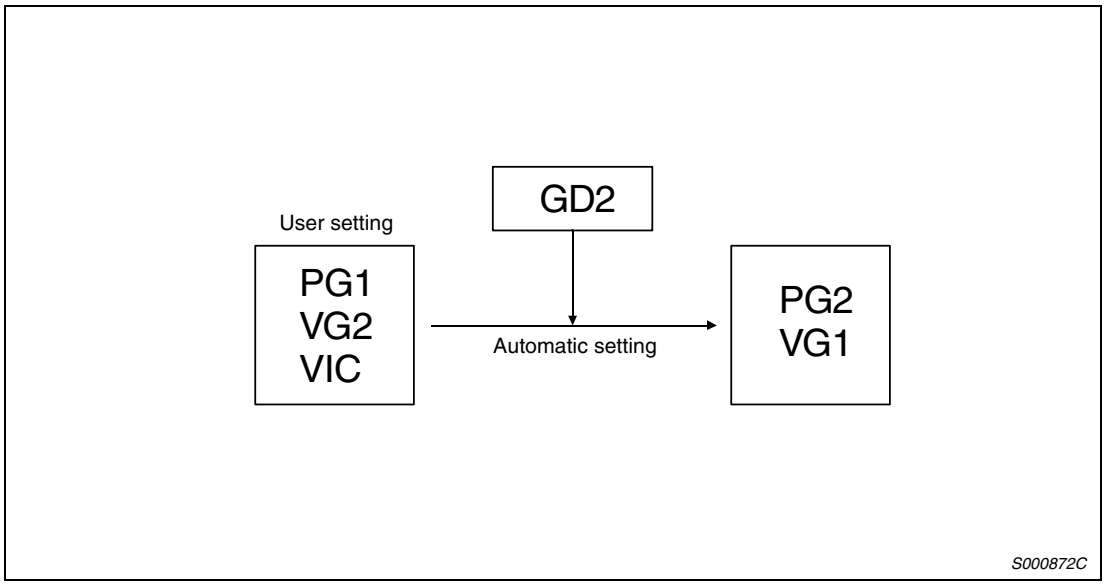


Fig. 4-9: *Manual mode 1*

NOTE If machine resonance occure, adaptive vibration suppression control (pr. 25) or machine resonance suppression filter (pr. 18) may be used to suppress machine resonance.

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● Speed control

The following table gives an overview of the parameters used for rotation speed control for the manual setting of the gain factor.

Parameter	Symbol	Name
12	GD2	Ratio of load inertia moment to servo motor inertia moment
16	VG2	Speed control gain 2
17	VIC	Speed intergral compensation

Tab. 4-19: *Parameter adjusted for speed control*

For the setting please follow the instructions which are given below:

① Set an estimated value to the ratio of inertia (parameter No. 12).

② Set pr. 16 to a low value in the vibration- and noise-free range. Increase the value gradually and reduce it again as soon as vibrations set in. The optimum value is reached shortly before vibrations set in.

③ Set pr. 17 to a value in the vibration- and noise-free range. Decrease the value gradually and increase it again as soon as vibrations set in. The optimum value is reached shortly before vibrations set in.

④ If the gain cannot be increased due to mechanical system resonance and the desired response cannot be achieved used the low-pass filter (parameter No. 25) or the machine resonance suppression filter (parameter No. 18) for executing steps ② and ③.

The response level of the revolution speed control loop is specified via the gain factor VG2 (pr. 16). Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression:

$$\text{speed loop response frequency [Hz]} = \frac{\text{VG2}}{(1 + \text{ratio of inertia}) \times 2\pi}$$

The setting of the I-portion of the speed control loop VIC occurs via pr. 17 and can be calculated as follows:

$$\text{VIC [ms]} \geq \frac{2000 \text{ to } 3000}{\text{VG2} / (1 + \text{ratio of inertia})}$$

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● Position control

The following table gives an overview of the parameters used for position control for the manual setting of the gain factor.

Parameter	Symbol	Name
12	GD2	Ratio of load inertia moment to servo motor inertia moment
13	PG1	Position control gain 1
16	VG2	Speed control gain 2
17	VIC	Speed intergral compensation

Tab. 4-20: *Parameter adjusted for position control*

For the setting please follow the instructions which are given below:

Set an estimated value to the ratio of inertia (parameter No. 12).

Set a slightly smaller value to the position control gain 1 (parameter No. 13).

Set pr. 16 to a low value in the vibration- and noise-free range. Increase the value gradually and reduce it again as soon as vibrations set in. The optimum value is reached shortly before vibrations set in.

Set pr. 17 to a value in the vibration- and noise-free range. Decrease the value gradually and increase it again as soon as vibrations set in. The optimum value is reached shortly before vibrations set in.

⑤ Increase the position control gain 1 (parameter No. 13)

⑥ If the gain cannot be increased due to mechanical system resonance and the desired response cannot be achieved used the low-pass filter (parameter No. 25) or the machine resonance suppression filter (parameter No. 18) for executing steps ③ to ⑤.

⑦ While checking the settling characteristic and rotational status, fine-adjust each gain.

The response level of the position control loop is specified via the gain factor PG1 (pr. 6). Increasing position control gain 1 improves trackability to a position command but a too high value will make overshooting liable to occur at the time of settling. The position control gain PG1 is as indicated in the following expression:

$$PG1 \leq \frac{VG2}{(1 + \text{ratio of inertia})} \times \left(\frac{1}{3} \text{ to } \frac{1}{5}\right)$$

The response level of the revolution speed control loop is specified via the gain factor VG2 (pr. 16). Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The response frequency of the speed loop is as indicated in the following expression:

$$\text{speed loop response frequency [Hz]} = \frac{VG2}{(1 + \text{ratio of inertia}) \times 2\pi}$$

The setting of the I-portion of the speed control loop VIC occurs via pr. 17 and can be calculated as follows:

$$VIC\ [ms] \geq \frac{2000 \text{ to } 3000}{VG2/(1 + GD2)}$$

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4.6.5 Interpolation

The interpolation mode is used to match the position control gains of the axes when performing the interpolation operation of servo motors of two or more axes for an X-Y table or the like. In this mode, the position control gain 1 and speed control gain 1 which determine command trackability are set manually and the other gain adjusting parameters are set automatically.

The following table provides an overview over the parameters, which are set automatically in interpolation mode:

Parameter	Symbol	Name
12	GD2	Ratio of load inertia moment to servo motor inertia moment
15	PG2	Position control gain 2
16	VG2	Speed control gain 2
17	VIC	Speed intergral compensation

Tab. 4-21: *Parameter adjusted for interpolation mode*

The following parameters are adjustable manually:

Parameter	Symbol	Name
13	PG1	Position control gain 1
14	VG1	Speed control gain 1

Tab. 4-22: *Parameter adjusted for manual mode*

For interpolation between several axes the gain factor of the position control loop should be set to the same value for all axes.

For the setting please follow the instructions which are given below:

Choose the auto tuning mode 1 (parameter No. 8: 0001) and set the machine resonance frequency of the response level 1 of 15Hz (parameter No. 9: 0001)

Increase the response level selection (parameter No. 9), and return the setting if vibration occurs. The optimum value is reached shortly before vibrations set in.

Choose the interpolation mode (parameter No. 8: 0000).

Set the highest possible value for pr. 13 and pr. 14.

The value set for pr. 13 in step d corresponds to the upper limiting value of the gain factor for position control loop1. Set pr. 13 to the same value as that for the axis to be interpolated.

The value set for pr. 14 in step corresponds to the upper limiting value of the gain factor for speed control loop1. Check the rotation and set pr. 14 of the axis to be interpolated to a value that is at least three times the value set in step for pr. 13.

Looking at the interpolation characteristic and rotation status, fine-adjust the gains and response level setting.

The response level of the position control loop is specified via the gain factor PG1 (pr. 13). Increasing PG1 improves trackability to a position command but a too high value will make overshooting liable to occur at the time of settling. The droop pulse value is determined by the following expression:

$$\text{droop pulse value [pulsen]} = \frac{\frac{\text{rotation speed [r/min]}}{60} \times 131072\ \text{[pulse]}}{PG1}$$

The response level of speed control loop 1 is specified via the gain factor VG1 (pr. 14). For the response level of the speed control loop the following applies:

$VG1 \geq PG1 \times 3$

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4.6.6 Differences in auto tuning between MR-J2 and MR-J2S

Response level

In comparison to the servo amplifiers of the MR-J2-Series the area for setting response levels has been extended for servo amplifiers of the MR-J2-Super-Series.

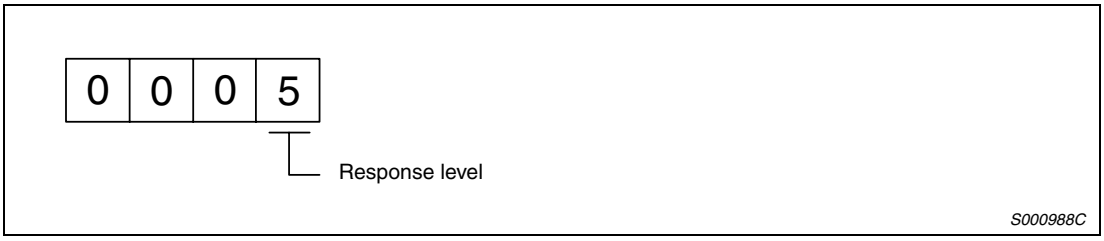


Fig. 4-10: *Response level setting (parameter No. 9)*

MR-J2		MR-J2-Super	
Response level	**Machine resonance**	**Response level**	**Machine resonance**
—	—	1	15Hz
1	20Hz	2	20Hz
—	—	3	25Hz
		4	30Hz
		5	35Hz
2	40Hz	6	45Hz
—	—	7	55Hz
3	60Hz	8	70Hz
4	80Hz	9	85Hz
5	100Hz	A	105Hz
—	—	B	130Hz
		C	160Hz
		D	200Hz
		E	240Hz
		F	300Hz

Tab. 4-23: *Response level comparison*

NOTE

Because of a slight difference in gain adjustment pattern, response may not be the same if the resonance frequency is set to the same value.

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Auto tuning selection

The MR-J2-Super series has an addition of the load inertia moment ratio fixing mode. It also has the addition of the manual mode 1 which permits manual adjustment with three parameters.

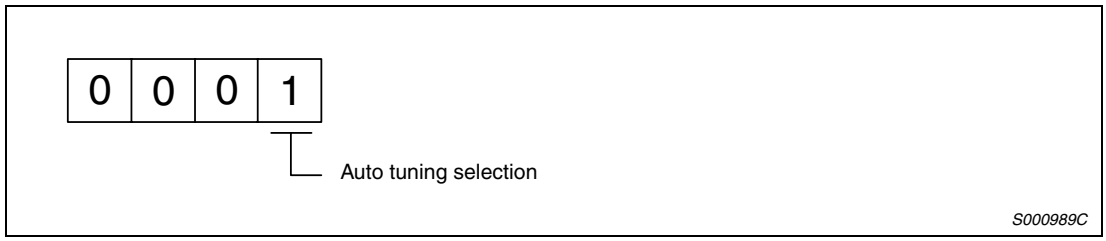


Fig. 4-11: *Auto tuning selection (parameter No. 9)*

Gain adjustment mode		Auto tuning selection		Description
		MR-J2	MR-J2-Super	
Interpolation mode		0	0	Position control gain 1 (PG1) is fixed
Auto tuning	Auto tuning 1	1	1	For speed and position control
	Auto tuning 2	—	3	No estimation of load inertia moment ratio, Response level setting valid
Auto tuning invalid	Manual mode 1	—	4	Simple manual adjustment
	Manual mode 2	2	2	Manual adjustment of all gains

Tab. 4-24: *Auto tuning comparison*

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5 Special adjustment functions

Use the functions given in this chapter, if you are not satisfied with the machine status after making adjustment in the methods in section 4.6.

5.1 Filter functions

The servo amplifier MR-J2-Super have different filter functions:

- Machine resonance suppression filter
- Low-pass filter

If a mechanical system has a natural resonance point, increasing the servo system response level may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency. As a result vibrations or higher levels of noise arise. The filter functions serve to suppress any such resonance that may appear.

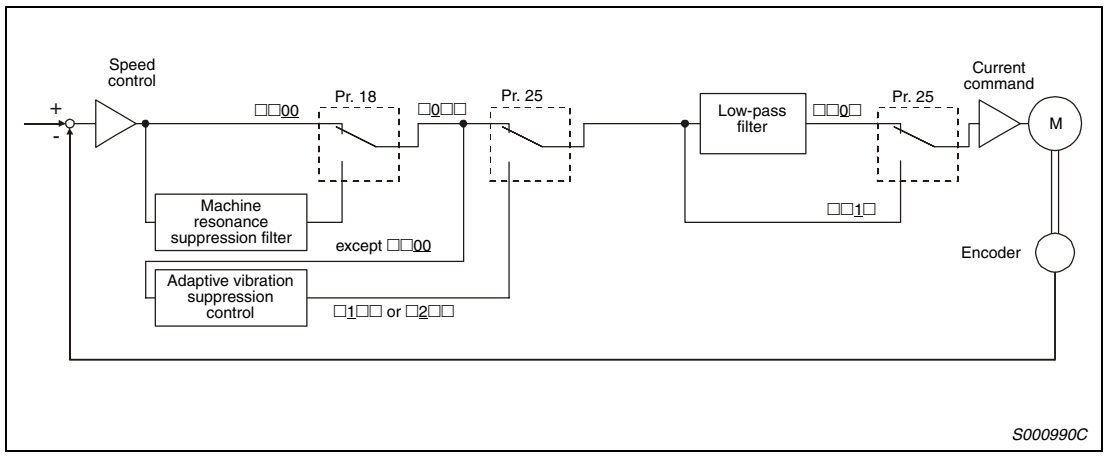


Fig. 5-1: *Filter function block diagram*

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5.1.1 Machine resonance suppression filter

The machine resonance suppression filter is a notch filter. You can set the resonance frequency and notch frequency.

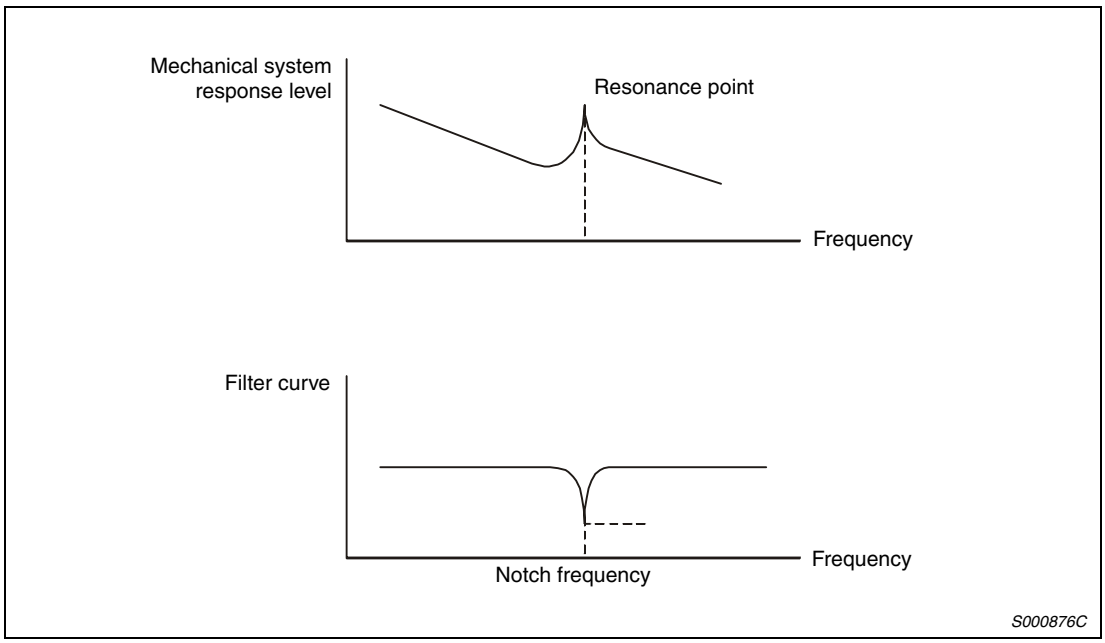


Fig. 5-2: *Mode of operation of the filter for the suppression of machine resonance*

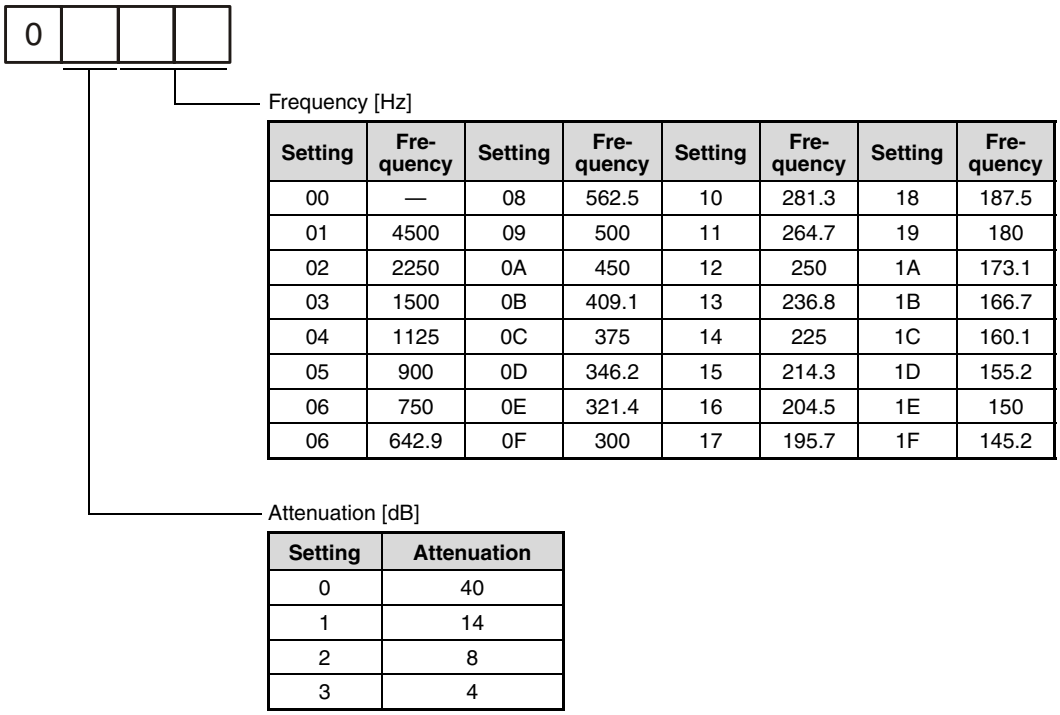
NOTE

The machine resonance suppression filter is a delay factor for the servo system. Hence, vibration may increase if you set a wrong resonance frequency or a too deep notch.

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Parameter

- Machine resonance suppression filter (pr. 18)
  Set the notch frequency and attenuation of the machine resonance suppression filter (parameter No.18).



Setting	Frequency	Setting	Frequency	Setting	Frequency	Setting	Frequency
00	—	08	562.5	10	281.3	18	187.5
01	4500	09	500	11	264.7	19	180
02	2250	0A	450	12	250	1A	173.1
03	1500	0B	409.1	13	236.8	1B	166.7
04	1125	0C	375	14	225	1C	160.1
05	900	0D	346.2	15	214.3	1D	155.2
06	750	0E	321.4	16	204.5	1E	150
06	642.9	0F	300	17	195.7	1F	145.2

Setting	Attenuation
0	40
1	14
2	8
3	4

Fig. 5-3: *Machine resonance suppression filter setting*

NOTES

If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.

A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.

The machine characteristic can be grasped beforehand by the machine analyzer on the setup software). This allows the required notch frequency and attenuation to be determined.

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5.1.2 Adaptive vibration suppression control

Adaptive vibration suppression control is a function in which the servo amplifier detects machine resonance and sets the filter characteristics automatically to suppress mechanical system vibration. Since the filter characteristics (frequency, attenuation) are set automatically, you need not be conscious of the resonance frequency of a mechanical system. Also, while adaptive vibration suppression control is valid, the servo amplifier always detects machine resonance, and if the resonance frequency changes, it changes the filter characteristics in response to that frequency.

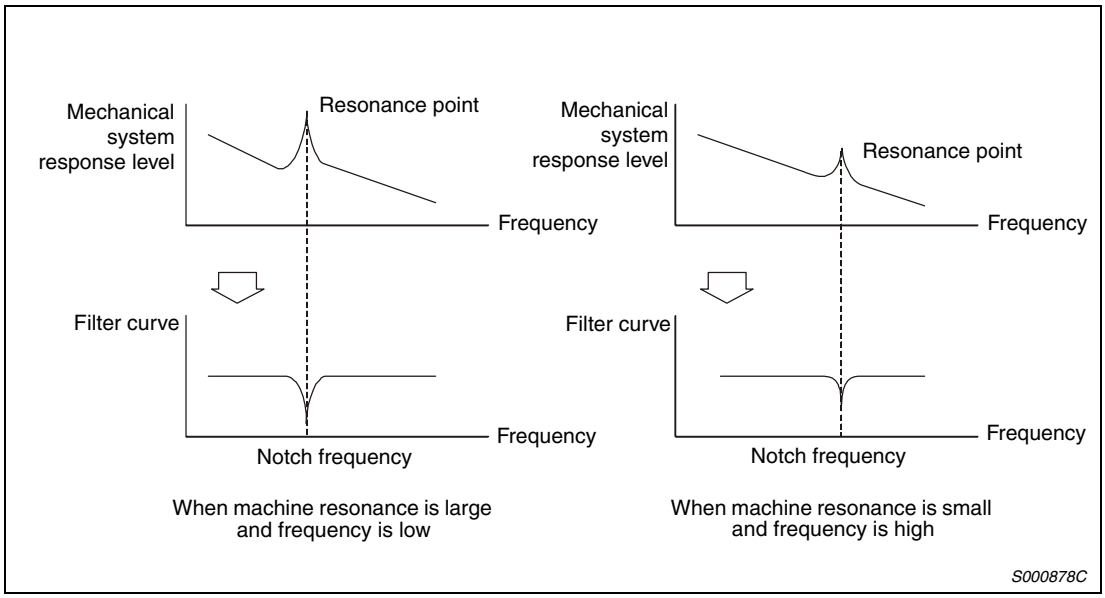


Fig. 5-4: *Mode of operation of adaptive vibration suppression*

NOTES

The machine resonance frequency which adaptive vibration suppression control can respond to is about 150 to 500Hz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range.

Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics or which has too large resonance.

Under operating conditions in which sudden disturbance torque is imposed during operation, the detection of the resonance frequency may malfunction temporarily, causing machine vibration. In such a case, set adaptive vibration suppression control to be "held" (parameter No. 25: "□2□□") to fix the characteristics of the adaptive vibration suppression control filter.

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Parameters

Set the operation of adaptive vibration suppression control at the third digit of parameter 25.

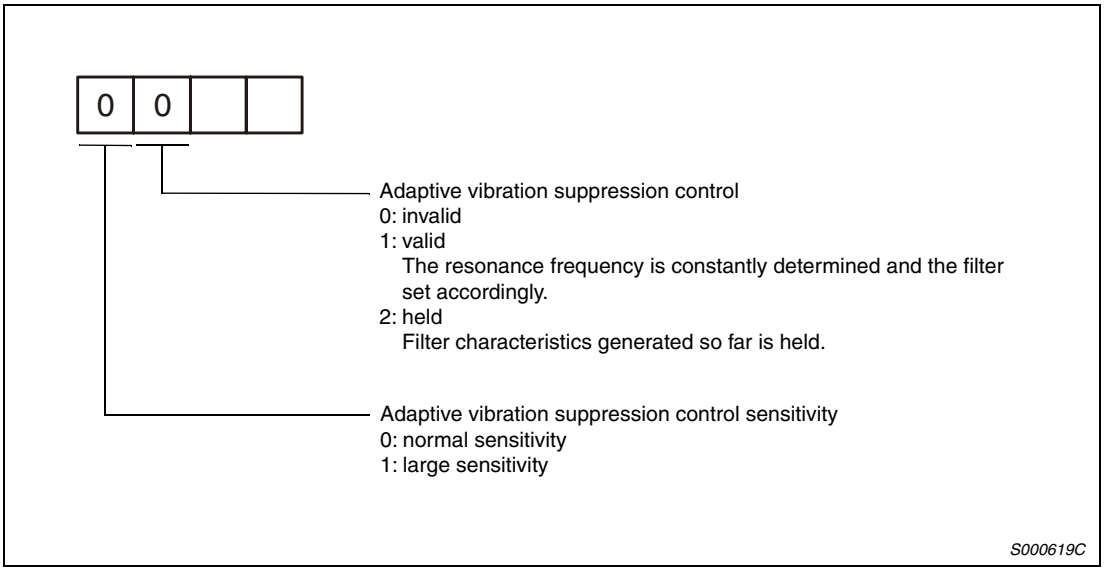


Fig. 5-5: *Adaptive vibration suppression control setting*

NOTES

Adaptive vibration suppression control is factory-set to be "invalid" (parameter No. 25: 0000).

After first switching on the data from the determined filter curves are saved in the controller every 10 s. After switching on again the most recently saved values are used as a start.

The fourth digit of parameter 25 is used for adaptive vibration suppression control sensitivity setting. Selection of "large sensitivity" detects smaller machine resonance and generates a filter to suppress machine vibration. However, since a phase delay will also increase, the response of the servo system may not increase.

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5.1.3 Low-pass filter

When a ballscrew or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is factory-set to be valid for a torque command. The filter frequency of this low-pass filter is automatically adjusted to the value in the following expression:

$$\text{filter frequency [Hz]} = \frac{VG2 \times 10}{2\pi(1 + GD2 \times 0.1)}$$

Parameter

Set the operation of the low-pass filter at the second digit of parameter 25.

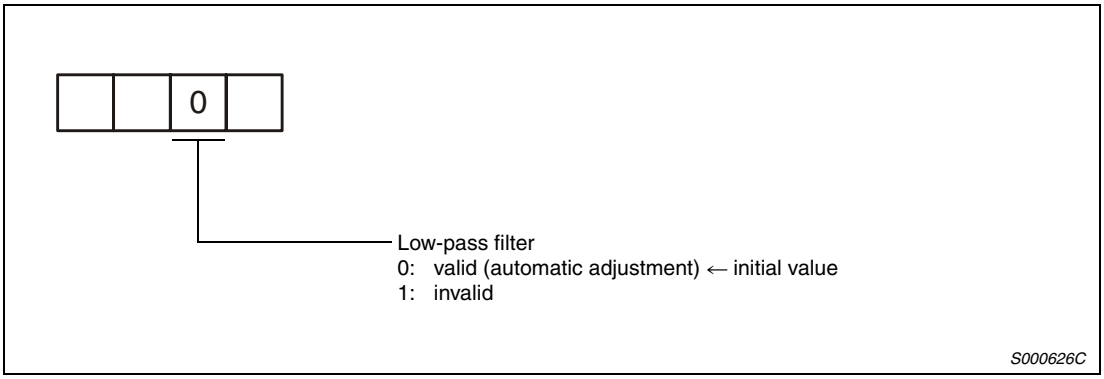


Fig. 5-6: *Low-pass filter setting*

NOTE

In a mechanical system where rigidity is extremely high and resonance is difficult to occur, setting the low-pass filter to be "invalid" may increase the servo system response to shorten the settling time.

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6 Absolute position detection system

6.1 General description



CAUTION:

If an absolute position erase alarm (25) has occurred, always perform home position setting again. Not doing so can cause runaway.

6.1.1 Specifications

Item	Description
System	Electronic battery backup system
Battery	Lithium battery A6BAT or MR-BAT
Maximum revolution range	Reference position ±32767 rev.
Maximum speed at power failure	500r/min
Battery backup time ①	Approx. 10000h
Data holding time during battery replacement ②	2h at delivery, 1h in 5 years after delivery
Battery storage period	Approx. 5 years

Tab. 6-1: *Specification overview*

① Time to hold data by a battery with power off.

② 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.

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6.1.2 System configuration

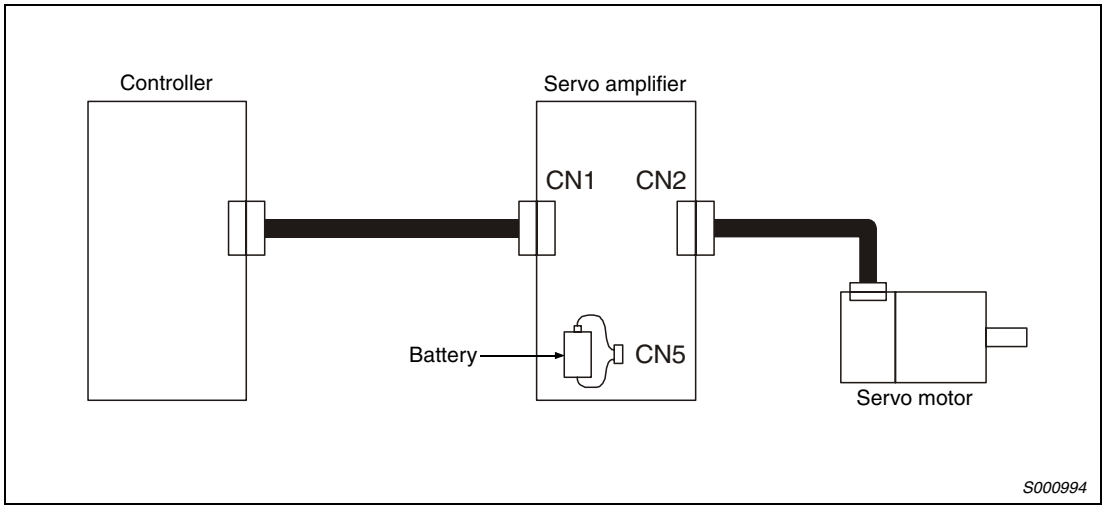


Fig. 6-1: *System configuration*

6.1.3 Communication overview

Block diagram

The encoder consists of a detector designed to detect a position within one revolution and a cumulative revolution counter designed to detect the number of revolutions. The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the servo system controller power is on or off. Therefore, once home position return is made at the time of machine installation, home position return 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 (for data holding time refer tab. 6-1).

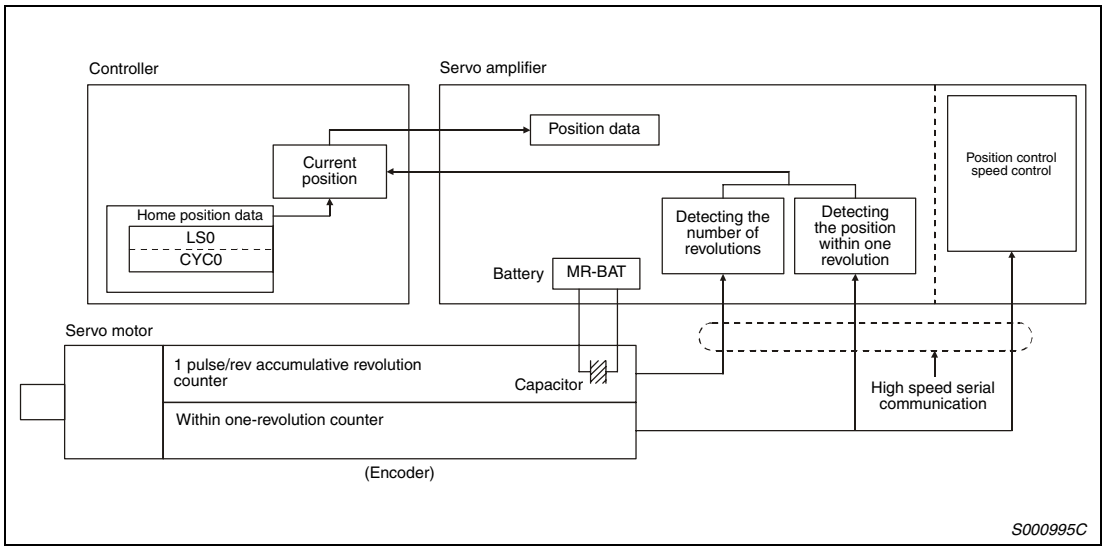


Fig. 6-2: *Communication block diagram*

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6.1.4 Battery installation procedure

CAUTION:

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.***

For battery installation please follow the instructions which are given below:

① Open the operation window. (When the model used is the MR-J2-200B or MR-J2-350B, also remove the front cover.)

② Install the battery in the battery holder.

③ Install the battery connector into CON1 until it clicks.

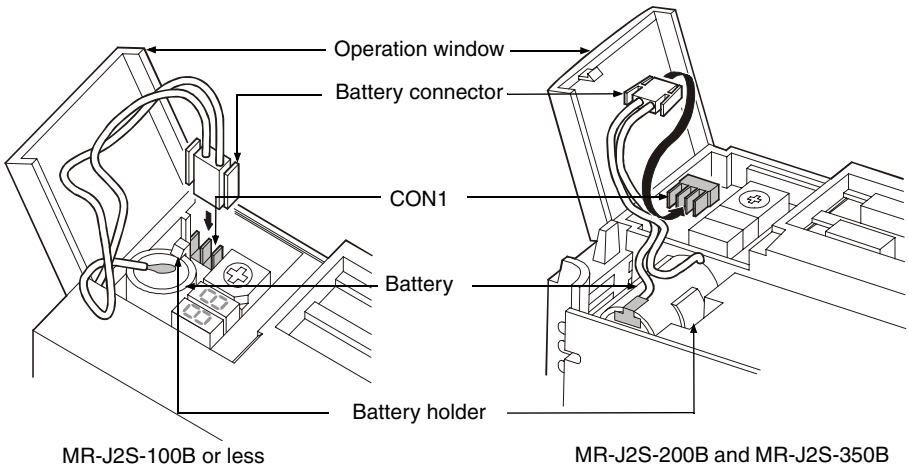


Fig. 6-3: *Battery installation for MR-J2S-350B or less*

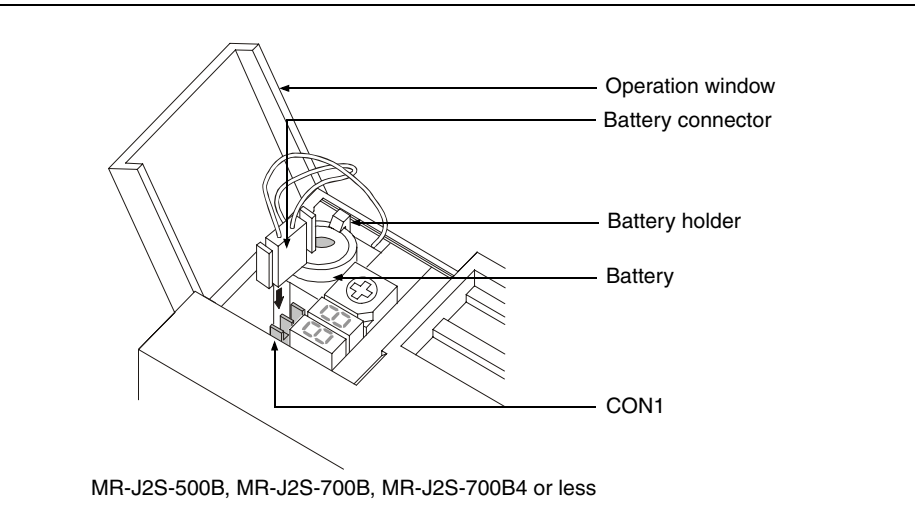


Fig. 6-4: *Battery installation for MR-J2S-500B, MR-J2S-700B, MR-J2S-700B4 or less*

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6.1.5 Parameter setting

Set "0001" in parameter No.1 to make the absolute position detection system valid.

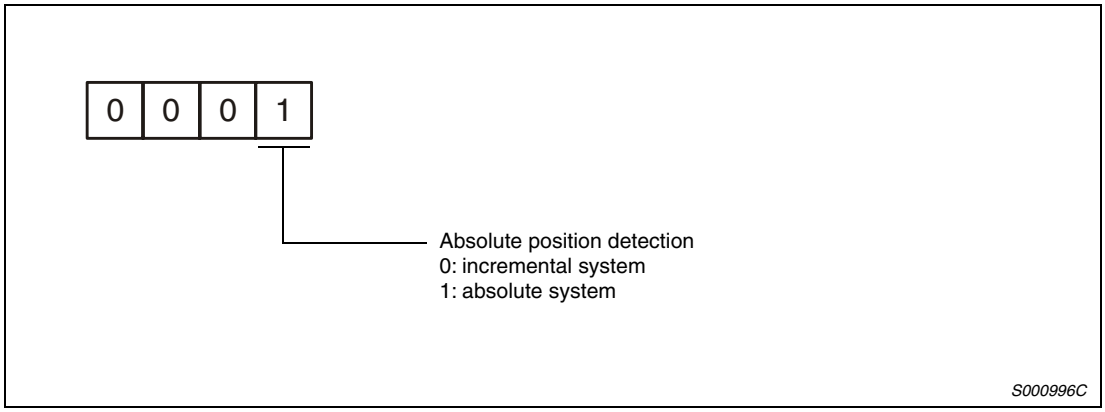


Fig. 6-5: *Parameter No. 1*

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6.1.6 Absolute position detection data

You can display the absolute position data with the setup software. For this function please follow the instruction which are given below:

Clicking "Diagnostics" in the menu.

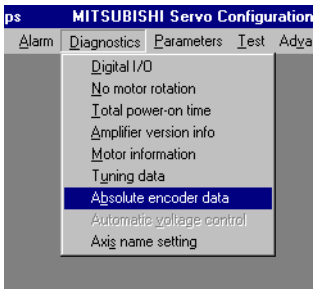
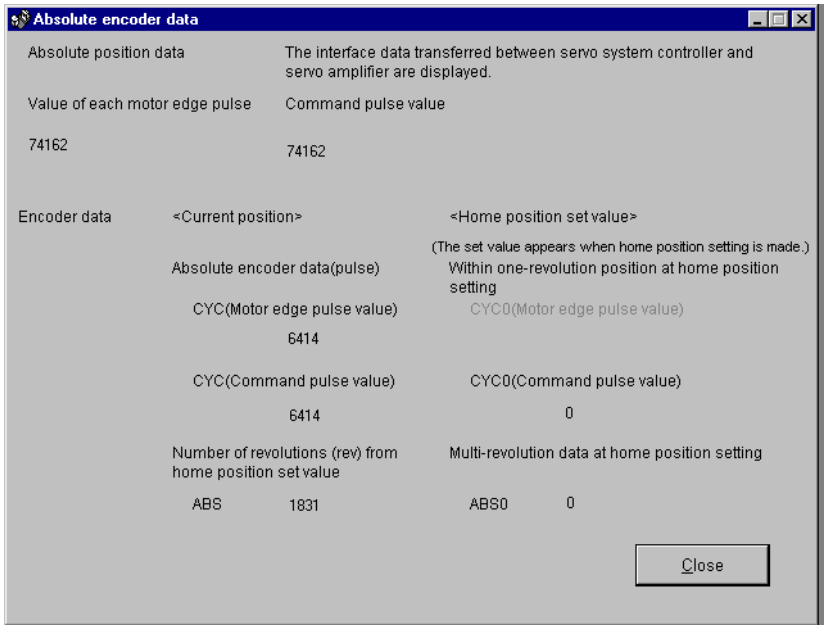


Abb. 6-6:
Open the menu "Diagnostics"

S000999T

By clicking "Absolute Encoder Data" in the sub-menu "Diagnostics", the absolute encoder data display window appears.



S001000T

Fig. 6-7: *Absolute encoder data display window*

Click the "Close" button to close the absolute encoder data display window.

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7 Accessories



DANGER:

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



CAUTION:

Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or overheating of the amplifier or regenerative brake resistor.

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7.1 Optional accessories

7.1.1 Regenerative brake option

CAUTION:

Only use the combinations of regenerative brake options and servo amplifiers, which are listed in the following table. Otherwise, a fire may occur.

Allowable combinations of regenerative brake resistors/servo amplifiers 200V.

Servo amplifier	Regenerative power [W]				
	Built-in regenerative brake resistor	MR-RFH75-40 (40Ω)	MR-RFH220-40 (40Ω)	MR-RFH400-13 (13Ω)	MR-RFH400-6,7 (6.7Ω)
MR-J2S-10B	—	150	—	—	—
MR-J2S-20B	10	150	—	—	—
MR-J2S-40B	10	150	—	—	—
MR-J2S-60B	10	150	—	—	—
MR-J2S-70B	20	150	400	—	—
MR-J2S-100B	20	150	400	—	—
MR-J2S-200B	100	—	—	600	—
MR-J2S-350B	100	—	—	600	—
MR-J2S-500B	130	—	—	600	—
MR-J2S-700B	170	—	—	—	600

Tab. 7-1: *Allowable combinations of brake unit/servo amplifier 200V*

The power values are resistor-generated powers and not rated powers.

Allowable combinations of regenerative brake resistors/servo amplifiers 400V

Servo amplifier	Regenerative power [W]					
	Built-in regenerative brake resistor	MR-PWR-T-150-270 (270Ω)	MR-PWR-T-400-120 (120Ω)	MR-PWR-T-600-80 (80Ω)	MR-PWR-T-600-47 (47Ω)	MR-PWR-T-600-26 (26Ω)
MR-J2S-60B4	30	150	—	—	—	—
MR-J2S-100B4	100	—	400	—	—	—
MR-J2S-200B4	100	—	—	600	—	—
MR-J2S-350B4	100	—	—	—	600	—
MR-J2S-500B4	130	—	—	—	600	—
MR-J2S-700B4	170	—	—	—	—	600

Tab. 7-2: *Allowable combinations of brake unit/servo amplifier 400V*

The power values are resistor-generated powers and not rated powers.

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Selection of the regenerative brake option

- Simple selection method

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

When the servo motor is run without load in the regenerative mode from the running speed to a stop, the permissible duty is as indicated in tab. 10-4, tab. 10-5 and tab. 10-6 in section 10.2.2.

For the servo motor with a load, the permissible duty changes according to the inertia moment of the load and can be calculated by the following formula:

$$\text{permissible duty} = \frac{\text{permissible duty for servo motor with no load (value refer 10.2)}}{(m+1)} \times \left(\frac{\text{rated speed}}{\text{running speed}}\right)^2 [\text{times/min}]$$

$$m = \frac{\text{load inertia moment}}{\text{servo motor inertia moment}}$$

From the permissible duty, find whether the regenerative brake option is required or not. Select the regenerative brake option out of the combinations in tab. 7-1 or tab. 7-2.

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● Regenerative energy calculation

Use the following method (refer tab. 7-3) when regeneration occurs continuously in vertical motion applications or when it is desired to make an in-depth selection of the regenerative brake option.

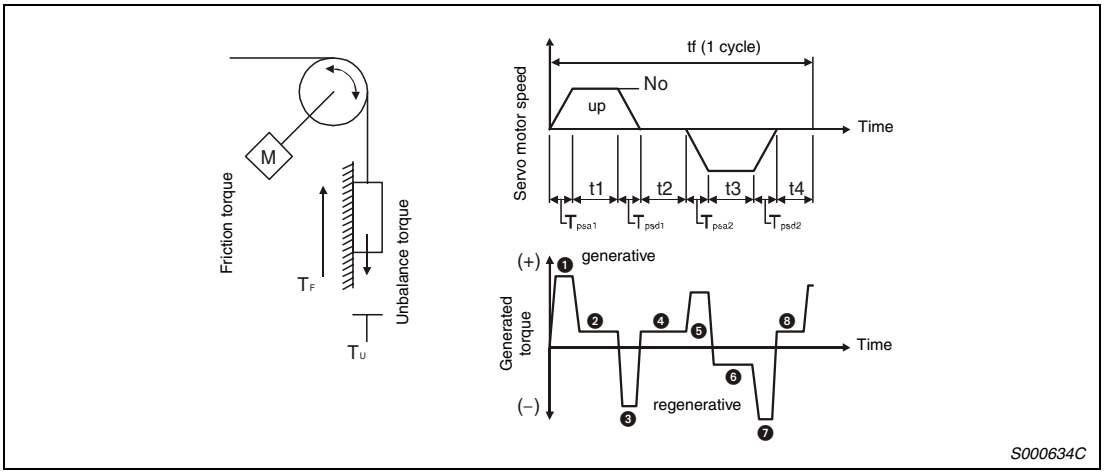


Fig. 7-1: *Regenerative energy*

Regenerative energy	Torque applied to servo motor [Nm]	Energy [J]
❶	$T_1 = \frac{(J_L + J_M) \times N_0}{9.55 \times 10^4} \times \frac{1}{T_{Psa1}} + T_U + T_F$	$E_1 = \frac{0.1047}{2} \times N_0 \times T_1 \times T_{Psa1}$
❷	$T_2 = T_U + T_F$	$E_2 = 0.1047 \times N_0 \times T_2 \times t_1$
❸	$T_3 = \frac{(J_L + J_M) \times N_0}{9.55 \times 10^4} \times \frac{1}{T_{Psd1}} + T_U + T_F$	$E_3 = \frac{0.1047}{2} \times N_0 \times T_3 \times T_{Psd1}$
❹, ❽	$T_4 = T_U$	$E_4 \geq 0$
❺	$T_5 = \frac{(J_L + J_M) \times N_0}{9.55 \times 10^4} \times \frac{1}{T_{Psa2}} - T_U + T_F$	$E_5 = \frac{0.1047}{2} \times N_0 \times T_5 \times T_{Psa2}$
❻	$T_6 = T_U + T_F$	$E_6 = 0.1047 \times N_0 \times T_6 \times t_3$
❼	$T_7 = \frac{(J_L + J_M) \times N_0}{9.55 \times 10^4} \times \frac{1}{T_{Psd2}} - T_U + T_F$	$E_7 = \frac{0.1047}{2} \times N_0 \times T_7 \times T_{Psd2}$
Absolute value of the sum total of negative energies		

Tab. 7-3: *Equations for calculating torque and energy in operation*

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- Power dissipation of servo motor and servo amplifier in regenerative mode

	Servo amplifier	Efficiency [%] regenerative mode	Capacitor charging [J]
Servo amplifier 200V	MR-J2S-10B	55	9
	MR-J2S-20B	70	9
	MR-J2S-40B	85	11
	MR-J2S-60B	85	11
	MR-J2S-70B	80	18
	MR-J2S-100B	80	18
	MR-J2S-200B	85	40
	MR-J2S-350B	85	40
	MR-J2S-500B	90	45
	MR-J2S-700B	90	70
Servo amplifier 400V	MR-J2S-60B4	85	11
	MR-J2S-100B4	80	18
	MR-J2S-200B4	85	40
	MR-J2S-350B4	85	40
	MR-J2S-500B4	90	45
	MR-J2S-700B4	90	70

Tab. 7-4: *Power dissipation of servo motor and servo amplifier*

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

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

The energy E_R consumed by the regenerative brake option is calculated as follows:

$$E_R[J] = \eta \times E_S - E_C$$

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

$$P_R[W] = \frac{E_R}{tf}$$

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● Installation of regenerative brake option

When using the regenerative brake resistor remove the built-in brake resistor and fit the regenerative brake option across P-C. Set parameter No. 2 according to the option to be used.

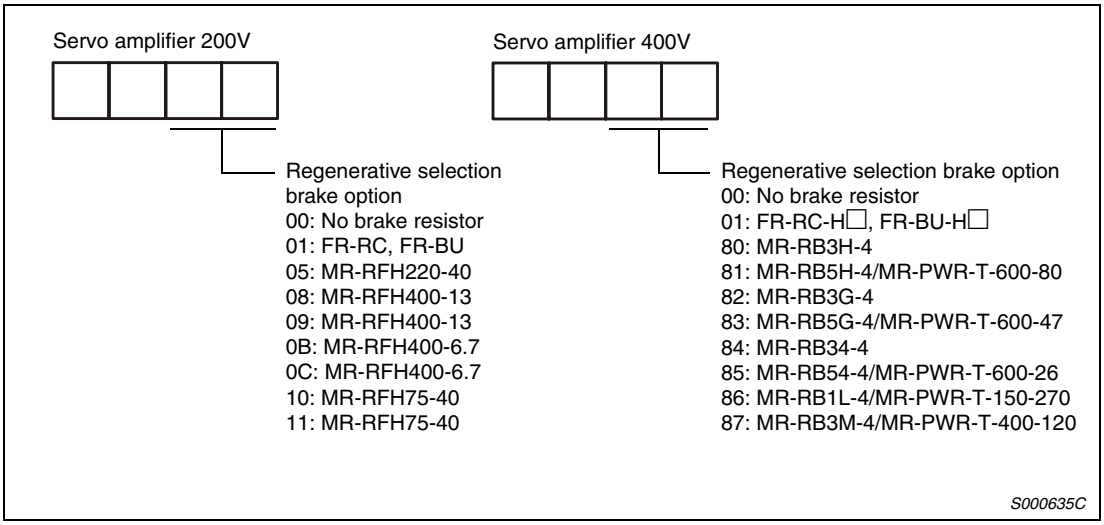


Abb. 7-2: *Parameter No. 2 setting*

The regenerative brake option will cause a temperature rise of 100 degrees relative to the ambient temperature. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant cables and keep them clear of the regenerative brake option body. Always use twisted cables of max. 5m length for connection with the servo amplifier.

For installation of an external brake resistor to the servo amplifiers MR-J2S-350B or less and MR-J2S-200B4 or less always remove the wiring from across P-D and fit the regenerative brake option across P-C.

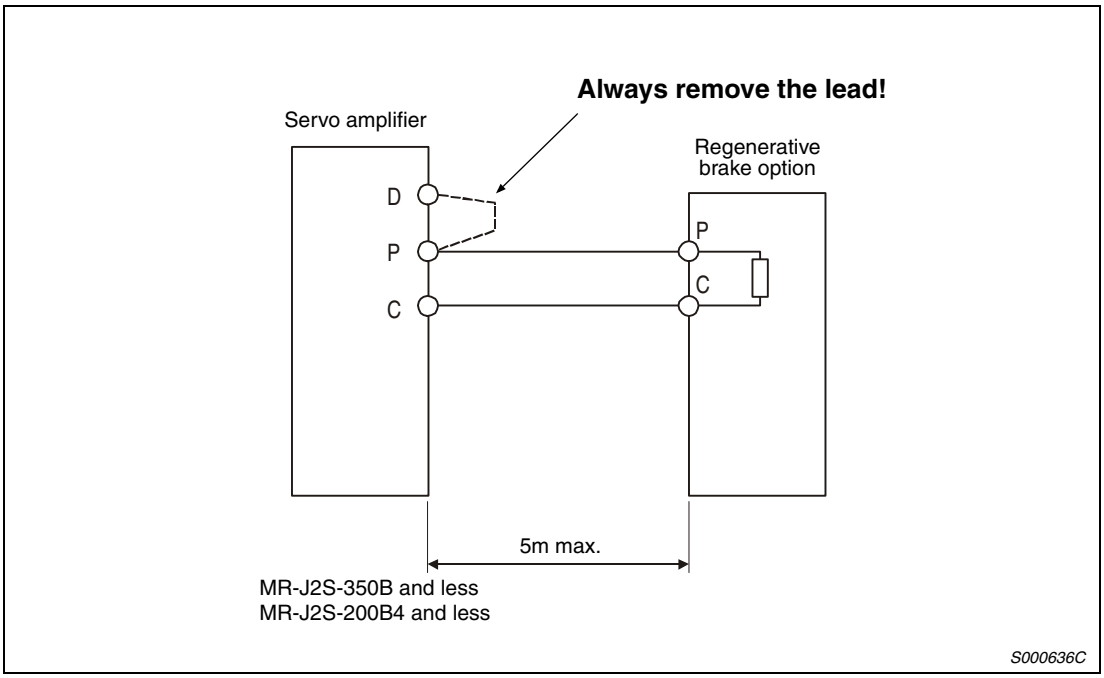


Fig. 7-3: *Brake unit connection for servo amplifiers MR-J2S-350B or less and MR-J2S-200B4 or less*

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For installation of an external brake resistor to the servo amplifiers MR-J2S-500B and MR-J2S-700B and MR-J2S-350B4 to MR-J2S-700B4 always remove the built-in regenerative brake resistor. To do this loosen the cables attached to terminals P and C. Then fasten the cables to the housing of the servo amplifier using the accessory screw (refer fig. 7-5).

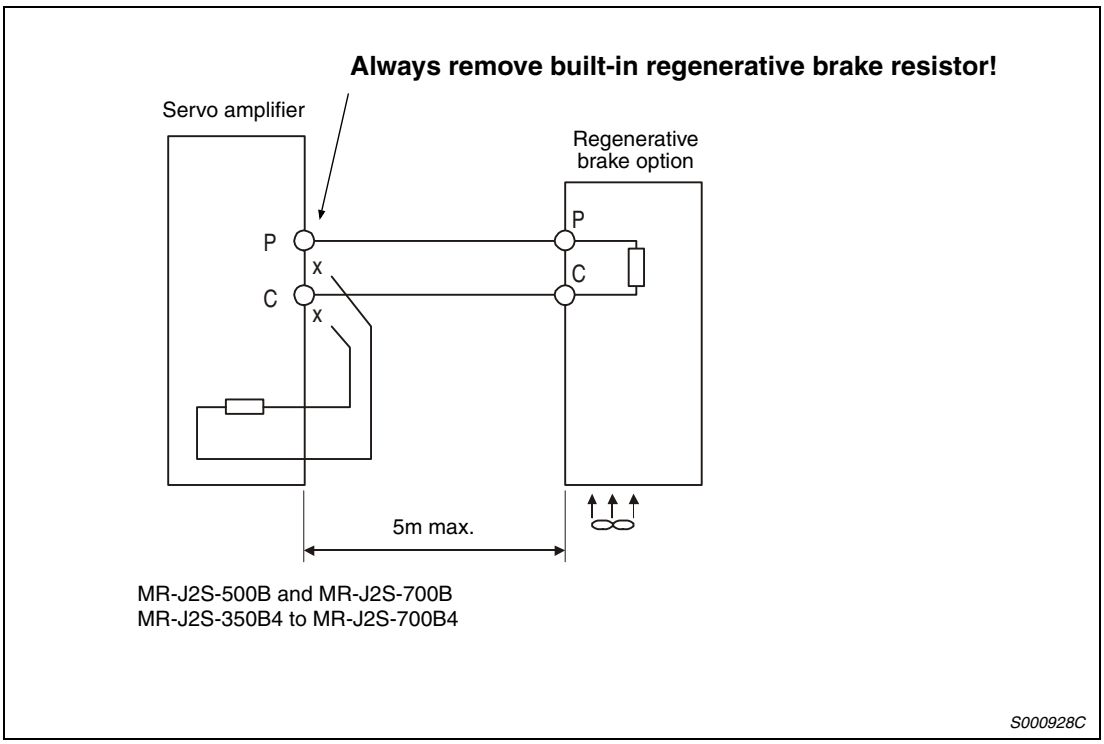


Fig. 7-4: *Brake unit connection for servo amplifiers MR-J2S-500B, MR-J2S-700B and MR-J2S-350B4 to MR-J2S-700B4*

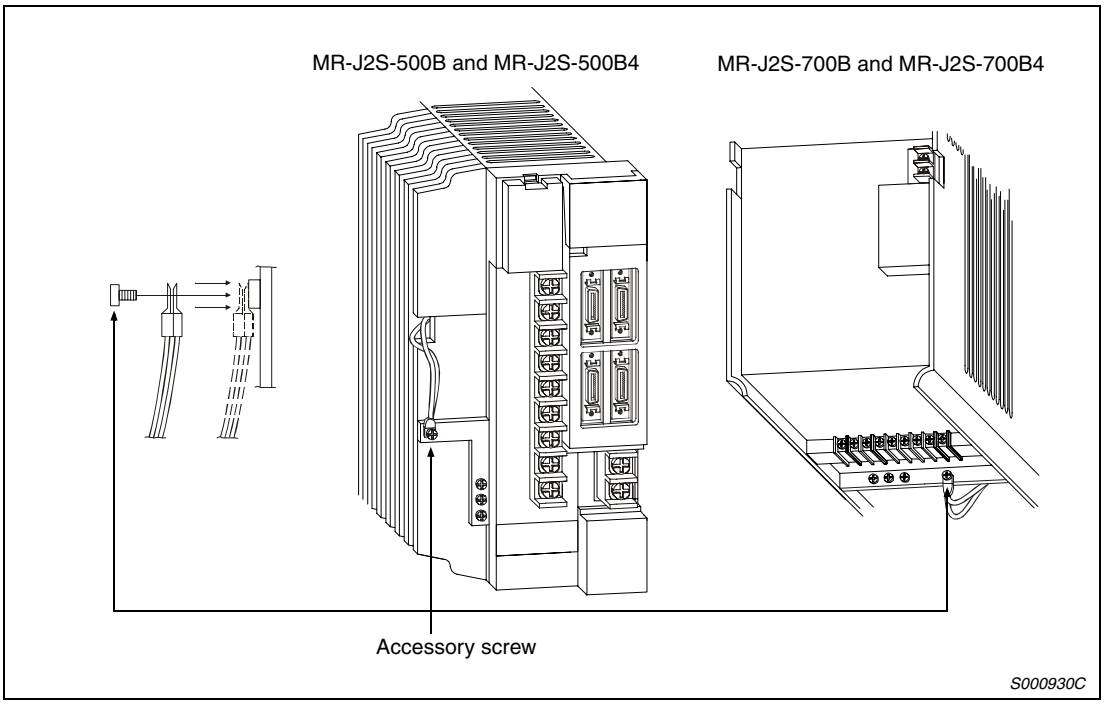


Fig. 7-5: *Mounting method of built-in regenerative brake resistor*

NOTE For dimensions of regenerative brake resistor option refer to chap. 12.

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7.1.2 Cables

Use the following cables for connection of the servo motor and servo amplifier:

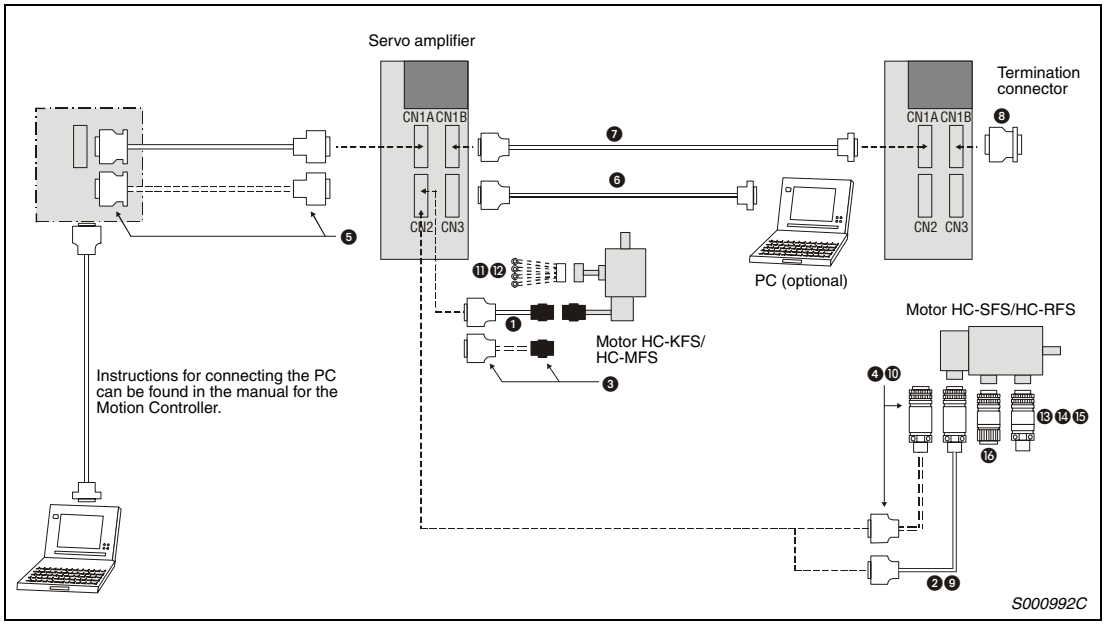


Fig. 7-6: *Connections*

Product			Description
For CN2		Encoder cable for HC-KFS, HC-MFS	MR-JCCBL☐M-L (Standard) Cable length in ☐: 2, 5, 10, 20, 30m
			MR-JCCBL☐M-H (high-flexible) Cable length in ☐: 2, 5, 10, 20, 30m
		Encoder cable for HC-SFS, HC-RFS	MR-JHSCBL☐M-L (Standard) Cable length in ☐: 2, 5, 10, 20, 30m
			MR-JHSCBL☐M-H (high-flexible) Cable length in ☐: 2, 5, 10, 20, 30m
	❾		MR-ENCBL☐M-H Cable length in ☐: 2, 5, 10, 20, 30m
	❸	Encoder connector set for HC-KFS, HC-MFS	MR-J2CNM
	❹	Encoder connector set for HC-SFS, HC-RFS	MR-J2CNS
	❿		MR-ENCNS
For CN1A	❺	Controller to amplifier bus cable	MR-J2HBUS M-A Cable length in : 0.5, 1, 5m
For CN1B	❼	Amplifier to amplifier bus cable	MR-J2HBUS M Cable length in : 0.5, 1, 5m
	❽	Bus-end connector	MR-A-TM
CN3	❻	Personal computer communications cable	MR-CPCATCBL3M Cable length: 3m
	⓫	Power supply connector set for HC-KFS, HC-MFS series motor	MR-PWCNK1
	⓬	Power supply connector set for HC-KFS, HC-MFS series motor with electromagnetic brake	MR-PWCNK2
	⓭	Power supply connector set for HC-SFS52, 102, 252, HC-SFS524, 1024, 1524, HC-RFS103, 153, 203	MR-PWCNS1
	⓮	Power supply connector set for HC-SFS202, 352, 502, HC-SFS2024,3524,5024 HC-RFS353, 503	MR-PWCNS2
	⓯	Power supply connector set for HC-SFS702 HC-SFS7024	MR-PWCNS3
	⓯	Brake connector set for HC-SFS202B, 352B, 502B, 702B HC-SFS2024B, 3524B, 5024B, 7024B	MR-BKCN

Tab. 7-5: *Overview of the prefabricated connecting cables*

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7.1.3 Confection diagram of encoder cables

CAUTION:

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

Encoder cable for HC-KFS and HC-MFS series motor

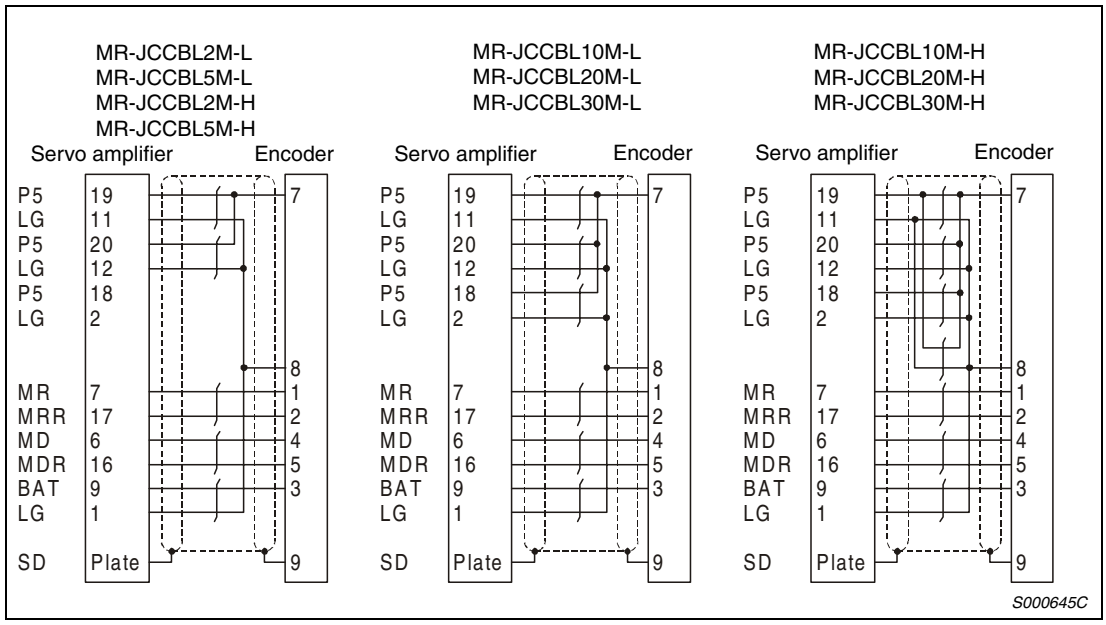


Fig. 7-7: *Pin assignment for HC-KFS and HC-MFS series motor*

Encoder cable for HC-SFS and HC-RFS series motor

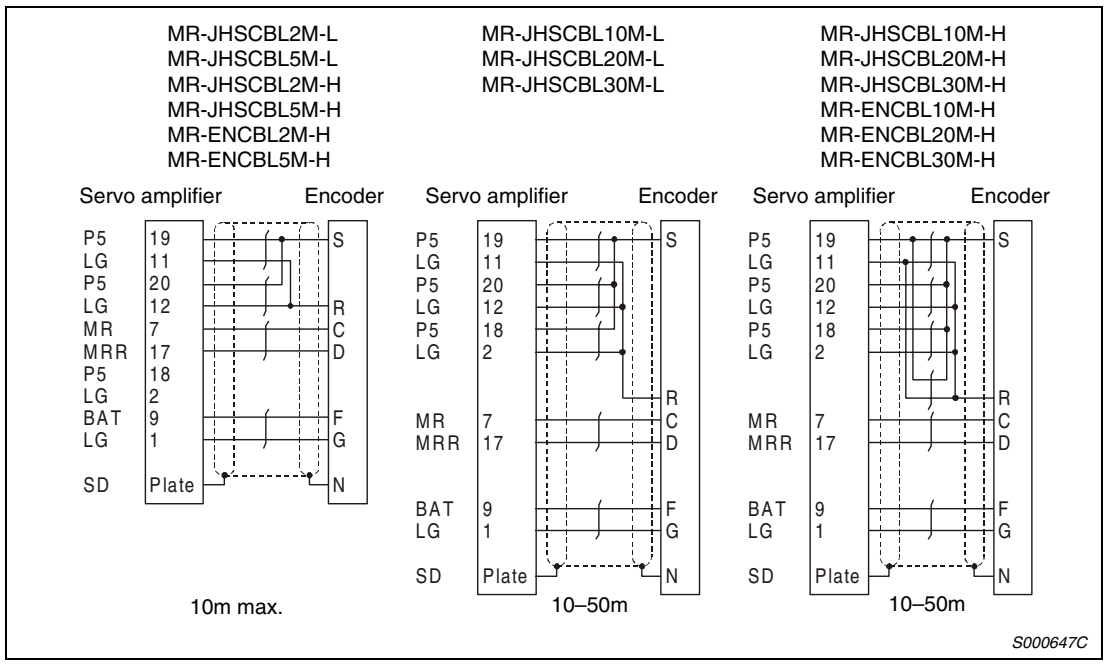


Abb. 7-8: *Pin assignment for HC-SFS and HC-RFS series motor*

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7.1.4 Bus cable

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

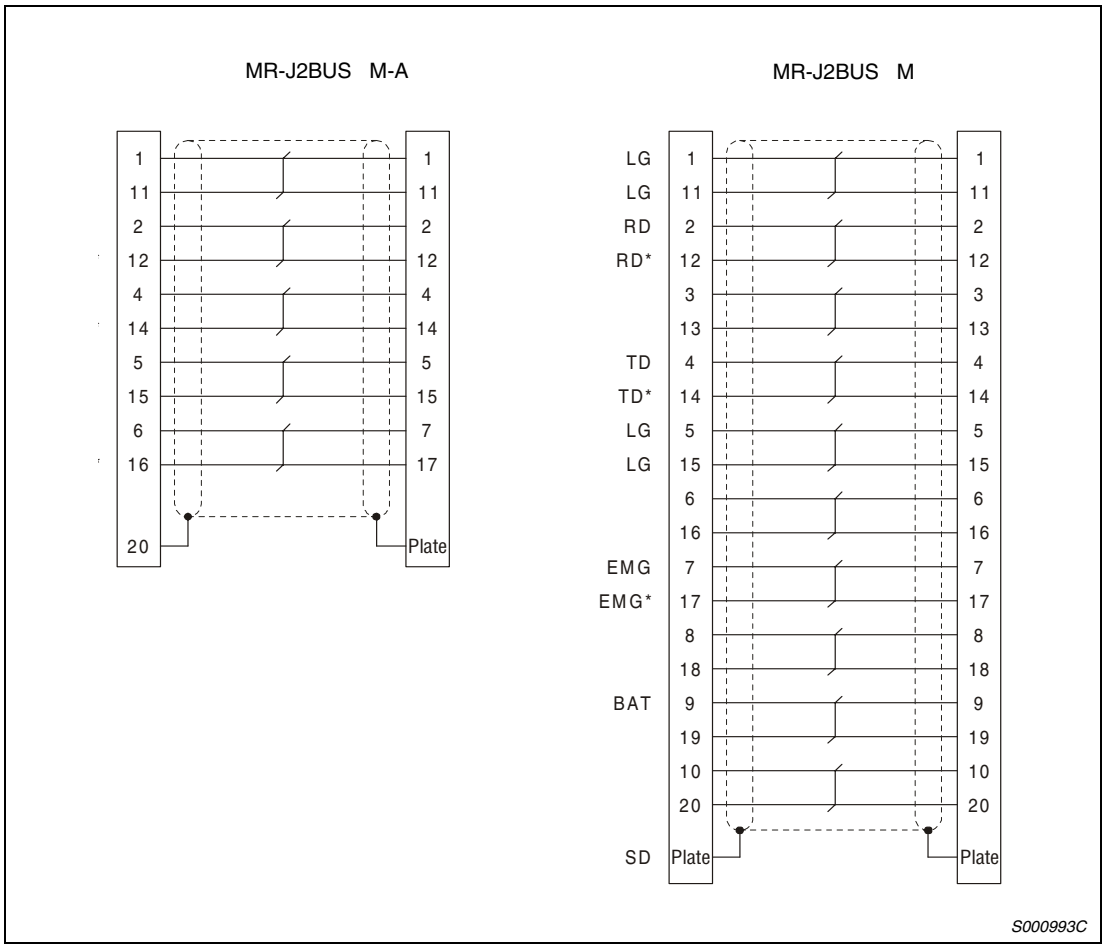


Fig. 7-9: *Connection diagram of bus cable*

NOTE The maximum bus cable legth is 30m.

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7.2 Special accessories

7.2.1 Transformer

Input: 3 × 400V

Output: 3 × 230V

Transformer	Power capacity	ED	Input current	Output current	Terminal cross section	Power dissipation
MT 1.3-60	1.3kVA	60%	2.02A 2.69A	3.26A 4.27A	2.5mm² 2.5mm²	103W 167W
MT 1.7-60	1.7kVA	60%	2.61A 3.89A	4.27A 6.2A	2.5mm² 2.5mm²	110W 199W
MT 2.5-60	2.5kVA	60%	3.80A 5.42A	6.28A 8.78A	2.5mm² 2.5mm²	155W 282W
MT 3.5-60	5.5kVA	60%	5.30A 8.41A	8.78A 13.80A	4mm² 4mm²	170W 330W
MT 5.5-60	5.5kVA	60%	8.26A	13.80A	4mm²	243W
MT 7.5-60	7.5kVA	60%	11.25A	18.82A	4mm²	190W
MT 11-60	11kVA	60%	16.40A	27.61A	4mm²	280W

Tab. 7-6: *Transformer*

NOTE For dimensions of transformer refer to chap. 12.

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8 Maintenance and Inspection

8.1 Inspection

It is recommended to make the following checks periodically:

① Check for loose terminal block screws. Retighten any loose screws.

② Check the servo motor bearings, brake section, etc. for unusual noise.

③ Check the cables and the like for scratches and cracks.

④ At regular intervals check that the various components all function properly.

⑤ Check the servo motor shaft and coupling for misalignment.

8.2 Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. For parts replacement, please contact your sales representative.

Part name		Life guideline
Servo amplifier	Main circuit capacitor	10 years
	Relay	Number of power-on and number of forced stop times: 100000
	Cooling fan	10000 to 30000 hours (2–3 years)
	Absolute position battery	10000 hours
Servo motor	Bearings	20000 to 30000 hours
	Encoder	20000 to 30000 hours
	Oil seal, V ring	5000 hours

Tab. 8-1: *Life of parts*

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9 Troubleshooting

9.1 Alarms and Warnings

9.1.1 Alarms and warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 9.1.2 or section 9.1.3 and take the appropriate action.

	Display	Meaning	Alarm deactivation		
			Power OFF → ON	RESET command	CPU reset
Alarms	10	Undervoltage	✓	✓	✓
	12	Memory error 1	✓	—	—
	13	Clock error	✓	—	—
	15	Memory error 2	✓	—	—
	16	Encoder error 1	✓	—	—
	17	Board error	✓	—	—
	19	Memory error 2	✓	—	—
	1A	Motor combination error	✓	—	—
	20	Encoder error 2	✓	—	—
	24	Main ciruit error	✓	✓	✓
	25	Absolute position erase	✓	—	—
	30	Regenerative error	✓	✓	✓
	31	Overspeed	✓	✓	✓
	32	Overcurrent	✓	✓	✓
	33	Overvoltage	✓	✓	✓
	34	CRC error	✓	✓	✓
	35	Command frequency error	✓	✓	✓
	36	Transfer error	✓	✓	✓
	37	Parameter error	✓	—	✓
	45	Main circuit device overheat	✓	✓	✓
	46	Servo motor overheat	✓	✓	✓
	50	Overload 1	✓ ①	✓ ①	✓ ①
	51	Overload 2	✓ ①	✓ ①	✓ ①
	52	Error excessive	✓	✓	✓
	8E	Serial communication error	✓	✓	✓
	88	Watchdog	✓	—	—

Tab. 9-1: *Alarm and warning overview (1)*

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	Display	Meaning	Alarm deactivation		
			Power OFF ON	RESET command	CPU reset
Alarme	92	Open battery cable warning	Removing the cause of occurrence deactivates the alarm automatically.		
	96	Home position setting warning			
	9F	Battery warning			
	E0	Excessive regenerative warning			
	E1	Overload warning			
	E3	Absolute position counter warning			
	E4	Parameter warning			
	E6	Servo forced stop warning			
	E7	Controller emergency stop warning			
	E9	Main circuit off warning			
	EE	SSCNET error warning			

Tab. 9-1: *Alarm and warning overview (2)*

① Deactivate the alarm about 30 minutes of cooling time for servo amplifier, servo motor and brake unit after removing the cause of occurrence.

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9.1.2 Alarms



DANGER:

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

If an absolute position erase alarm (25) occurred, always make home position setting again. Otherwise, misoperation may occur.

Tab. 9-2

Prcautions at alarm occurrence:



CAUTION:

When any of the following alarms has occurred, always remove its cause and allow about 30 minutes for cooling the servo amplifier, servo motor and brake unit before resuming operation:

- ***Regenerative error (30)***
- ***Overload 1 (50)***
- ***Overload 2 (51)***

If operation is resumed by switching control circuit power off, then on to reset the alarm, the servo amplifier, servo motor and regenerative brake resistor may become faulty.



DANGER:

Brief interruption in power

If there is a loss of power lasting for longer than 60 ms, then power loss alarm (10) is issued. If the loss of power continues for longer than another 20 ms, then the control loop is switched off. If in this situation the voltage comes up again and at the same time a signal "Servo ON" exists, then this would cause the servo motor to restart in an uncontrolled manner. To prevent this from occurring you must provide a circuit arrangement that immediately switches off a "Servo ON" signal if an alarm happens.

NOTE When an alarm occurs, the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No. The setup-software may be used to refer to the cause of alarm.

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Display	Error	Definition	Cause	Action
10	Undervoltage	Power supply voltage dropped to 160V (servo amplifier 200V) and 280V (servo amplifier 400V) or less, respecively.	1. Power supply voltage is low.	Check the power supply
			2. There was an instantaneous control circuit power failure of 60ms or longer.	
			3. The impedance of the power supply is too high.	
			4. Main circuit power switched on within 5s after it had switched off.	
			5. Faulty parts in the servo amplifier	Change the servo amplifier
12	Memory error 1	RAM, memory fault	Faulty parts in the servo amplifier Checking method: Alarm (12–15) occurs if power is switched on after CN1A, CN1Band CN3 connectors are disconnected.	Change the servo amplifier
13	Clock error	Printed board fault		
15	Memory error 2	E²PROM fault		
16	Encoder error 1	Communication error occurred between encoder and servo amplifier	1. Encoder connector (CN2) disconnected.	Connect correctly
			2. Encoder fault	Change the servo motor
			3. Encoder cable faulty (Wire breakage or shorted)	Repair or change cable
17	Board error 2	CPU/parts fault	Faulty parts in the servo amplifier Checking method: Alarm 17 or 19 occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.	Change the servo amplifier
19	Memory error 3	ROM, memory fault		
1A	Motor combination error	Wrong combination of servo amplifier and servo motor.	Wrong combination of servo amplifier and servo motor connected.	Use correct combination
20	Encoder error 2	Communication error occurred between encoder and servo amplifier	1. Encoder connector (CN2) disconnected	Connect correctly
			2. Encoder fault	Change the servo motor
			3. Encoder cable faulty (Wire breakage or shorted)	Repair or change cable
24	Main circuit error	Connection between load circuit and earth potential	1. Power input wires and servo motor output wires are in contact at main circuit terminal block (TE1).	Connect correctly
			2. Too little insulation resistance between cable or motor and earth potential	Change the cable
			3: Main circuit of servo amplifier failed. Checking method: Alarm 24 occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	Change the servo amplifier

Tab. 9-2: *Failure corrective action (1)*

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Display	Error	Definition	Cause	Action
25	Absolute position erase	Absolute position data in error	1. Battery voltage low	Change battery Always make home position setting again
			2. Battery cable or battery is faulty.	
		Power was switched on for the first time in the absolute position detection system.	3. Capacitor of the absolute position encoder is not charged.	After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position setting again.
30	Regenerative error	Permissible regenerative power of the built-in regenerative brake resistor or regenerative brake option is exceeded.	1. Parameter No. 2 setting error	Set correctly
			2. Built-in regenerative brake resistor or regenerative brake option is not connected.	Connect correctly
			3. Short cycle time or continuous regenerative operation caused the permissible regenerative power of the rege-nerative brake option to be exceeded. Checking method: Call the status display and check the regenerative load ratio.	1. Increase the cycle time
				2. Use the regenerative brake option of larger capacity.
				3. Reduce the load.
			4. Power supply voltage rose above 260V (servo amplifier 200V) and 535V (servo amplifier 400V) or more, respecively.	Connect the units to the correct power supply
			5. Built-in regenerative brake resistor or regenerative brake option faulty.	Change servo amplifier or regenerative brake option
		Regenerative transistor fault	6. Regenerative transistor faulty Checking method: 1. The regenerative brake option has overheated abnormally. 2. The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.	Change the servo amplifier
			Built-in regenerative brake resistor or regenerative brake option faulty.	
31	Overspeed	Speed has exceeded the instantaneous permissible speed.	1. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/ deceleration time constant
			2. Servo system is instable to cause overshoot.	Optimise control parameter
			3. Encoder faulty	Change the servo motor

Tab. 9-2: *Failure corrective action (2)*

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Display	Error	Definition	Cause	Action
32	Overcurrent	Current that flew is higher than the permissible current of the servo amplifier.	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring
			2. Transistor of the servo amplifier faulty. Checking method: Alarm (32) occurs if power is switched on after U, V and W are disconnected.	Change the servo amplifier
			3. Low impedance ground fault occurred in servo amplifier output phases U, V and W.	Eliminate earth fault
			4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
33	Overvoltage	Converter bus voltage exceeded 400V (servo amplifier 200V) and 800V (servo amplifier 400V) respecively.	1. Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected.	1. Change lead 2. Connect correctly
			2. Regenerative transistor faulty	Change servo amplifier
			3. Wire breakage of built-in regenerative brake resistor or regenerative brake option	1. Change servo amplifier 2. Change regenerative brake option
			4. The regenerative transistor is broken.	Change servo amplifier
			5. Power supply voltage high	Connect the units to the correct power supply
34	CRC error	Bus cable is faulty.	1. Bus cable disconnected	Connect bus cable correctly
			2. Bus cable fault	Change the bus cable
			3. Noise entered bus cable	Ensure correct cable laying and screening
			4. Termination connector disconnected	Connect termination connector
			5. The same No. exists in the servo amplifier side station setting	Set station number correctly
35	Command frequency error	Input frequency of command pulse is too high.	1. Command given is greater than the maximum speed of the servo motor	Review operation program.
			2. Noise entered bus cable	Ensure correct cable laying and screening
			3. Servo system controller failure	Change the servo system controller
36	Transfer error	Bus cable or printed board is faulty	1. Bus cable is disconnected.	Connect the connector of the bus cable
			2. Bus cable fault	Change the bus cable
			3. Printed board is faulty	Change the servo amplifier
			4. Termination connector disconnected	Connect termination connector

Tab. 9-2: *Failure corrective action (3)*

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Display	Error	Definition	Cause	Action
37	Parameter error	Parameter setting is wrong.	1. Servo amplifier fault caused the parameter setting to be rewritten.	Change the servo amplifier
			2. There is a parameter whose value was set to outside the setting range by the controller	Change the parameter value to within the setting range
45	Main circuit device overheat	Main circuit device overheat.	1. Servo amplifier faulty	Change the servo amplifier
			2. The power supply was turned on and off continuously by overloaded status.	Check control mode
			3. Air cooling fan of servo amplifier stops.	1. Change the servo amplifier or cooling fan 2. Observe max. permitted ambient temperature
46	Servo motor overheat	Servo motor temperature rise actuated the thermal protector.	1. Ambient temperature of servomotor is over 40°C.	When planning the system ensure that the ambient temperature is always between 0 and 40 °C.
			2. Servo motor is overloaded.	1. Reduce load 2. Extended cycle time 3. Use servo motor that provide larger output
			3. Thermal protector in encoder is faulty.	Change servo motor
50	Overload 1	Overload of servo amplifier Load ratio 300%: > 2.5s Load ratio 200%: > 100s	1. The output current exceeds the rated current continuously.	1. Reduce load 2. Extended cycle time 3. Use servo motor that provide larger output
			2. Servo system is unstable.	1. Repeat acceleration/ deceleration to execute auto tuning 2. Change auto tuning response setting 3. Set auto tuning to OFF and make adjustment manually
			3. Mechanical overload	1. Ensure that mechanical components run smoothly 2. Install limit switches
			4. Wrong connection of servo motor. Servo amplifiers output terminals U, V, W do not match servo motors input terminals U, V, W.	Connect correctly
			5. Encoder error	Change the servo motor

Tab. 9-2: *Failure corrective action (4)*

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Display	Error	Definition	Cause	Action
51	Overload 2	Max. output current flow successively for several seconds. Servo motor locked: 1s or more	1. Mechanical overload	1. Ensure that mechanical components run smoothly 2. Install limit switches
			2. Wrong connection of servo motor. Servo amplifiers output terminals U, V, W do not match servo motors input terminals U, V, W.	Connect correctly
			3. Servo system is instable	1. Repeat acceleration/ deceleration to execute auto tuning 2. Change auto tuning response setting 3. Set auto tuning to OFF and make adjustment manually
			4. Encoder faulty	Change the servo motor
52	Error excessive	Contouring error is greater than the value set with parameter 31 (initial value: 8 revolutions).	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/ deceleration time constant
			2. Torque limit value is too small.	Increase the torque limit value
			3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Improve the impedance of the power supply 2. Use servo motor which provides larger output
			4. Position control gain 1 (parameter No.13) value is small.	Increase set value and adjust to ensure proper operation
			5. Servo motor shaft was rotated by external force.	1. When torque is limited, increase the limit value. 2. Reduce load 3. Use servo motor that provides larger output
			6. Mechanical overload	1. Ensure that mechanical components run smoothly 2. Install limit switches
			7. Encoder faulty	Change the servo motor
			8. Wrong connection of servo motor. Servo amplifiers output terminals U, V, W do not match servo motors input terminals U, V, W.	Connect correctly

Tab. 9-2: *Failure corrective action (5)*

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Display	Error	Definition	Cause	Action
8E	Serial communication error	Serial communication error occurred between servo amplifier and personal computer.	1. Communication cable fault (Open cable or short circuit).	Repair or change the cable
			2. Personal computer faulty	Change the personal computer
88	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier Checking method: Alarm (88) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.	Change the servo amplifier

Tab. 9-2: *Failure corrective action (6)*

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9.1.3 Warnings

If E6, E7, E9 or EE occurs, the servo off status is established. If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed. Eliminate the cause of the warning according to this section.

Display	Name	Definition	Cause	Action
92	Open battery cable warning	Absolute position detection system battery voltage is low.	1. Battery cable is open	Repair cable or changed.
			2. Battery voltage dropped to 2.8V or less.	Change battery
96	Home position setting warning	Home position return could not be made in the precise position.	1. Contouring error is greater than the setting range of the “In Position”.	Eliminate the cause of the contouring error
			2. Home position return was executed during operation command.	Reduce speed for home position travel
			3. Speed for home position travel is too high.	
9F	Battery warning	Voltage of battery for absolute position detection system reduced.	Battery voltage fell to 3.2V or less.	Change the battery
E0	Excessive regenerative warning	Pre-warning alarm 30	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative brake resistor or regenerative brake option. Checking method: Call the status display and check regenerative load ratio.	1. Increase the cycle time 2. Change regenerative brake option for the one with larger capacity. 3. Reduce load
E1	Overload warning	Pre-warning alarm 50/51	Load increased to 85% or more of overload alarm 1 or 2 occurrence level.	Refer alarm 50/51
E3	Absolute position counter warning	Absolute position encoder pulses faulty	1. Electromagnetic coupling entered the encoder.	Take electromagnetic coupling suppression measures.
			2. Encoder faulty	Change servo motor
E4	Parameter warning	Parameter outside setting range	Parameter value set from servo system controller is outside setting range	Set it correctly
E6	Servo forced stop warning	EM1 is off.	External forced stop was made valid.	Deactivate external forced stop
E7	Controller emergency stop warning	—	Emergency stop signal was entered in to the servo system controller.	Deactivate emergency stop
E9	Main circuit off warning	Servo-on (SON) was switched on with main circuit power off.	—	Switch on main circuit power
EE	SSCNET error warning	The servo system controller connected is not SSCNET-compatible.	—	—

Tab. 9-3: *Meanings*

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10 Specifications

10.1 Characteristics

10.1.1 Load diagram

An electronic thermal relay is built into the servo amplifier to protect the servo motor and servo amplifier from overloads. The working diagrams for load monitoring are presented in the following figures. Overload 1 alarm (50) occurs if overload operation performed is above the electronic thermal relay protection curve. Overload 2 alarm (51) occurs if the maximum current flowed continuously for several seconds due to machine collision, etc. In the diagrams the area underneath the solid or dotted lines represents the normal working range. The dotted line represents the load curve when the servo motor has stopped. In a machine like the one for vertical lift application where unbalanced torque will be produced, it is recommended to use the machine so that the unbalanced torque is 70% or less of the rated torque.

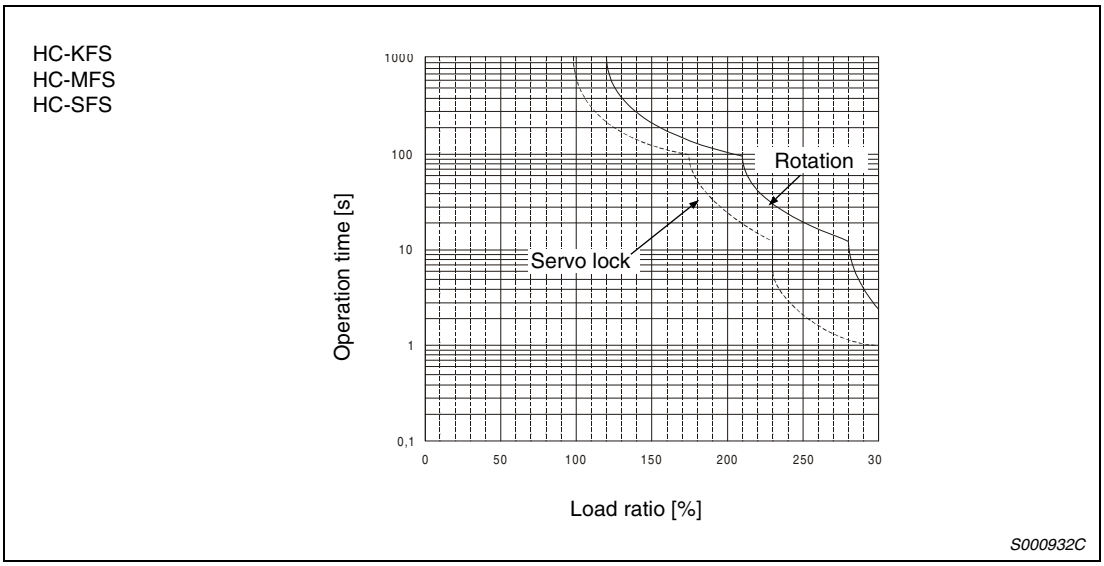


Fig. 10-1: *Load diagrams MR-J2S-10B to MR-J2S-100B, MR-J2S-60B4 and MR-J2S-100B4*

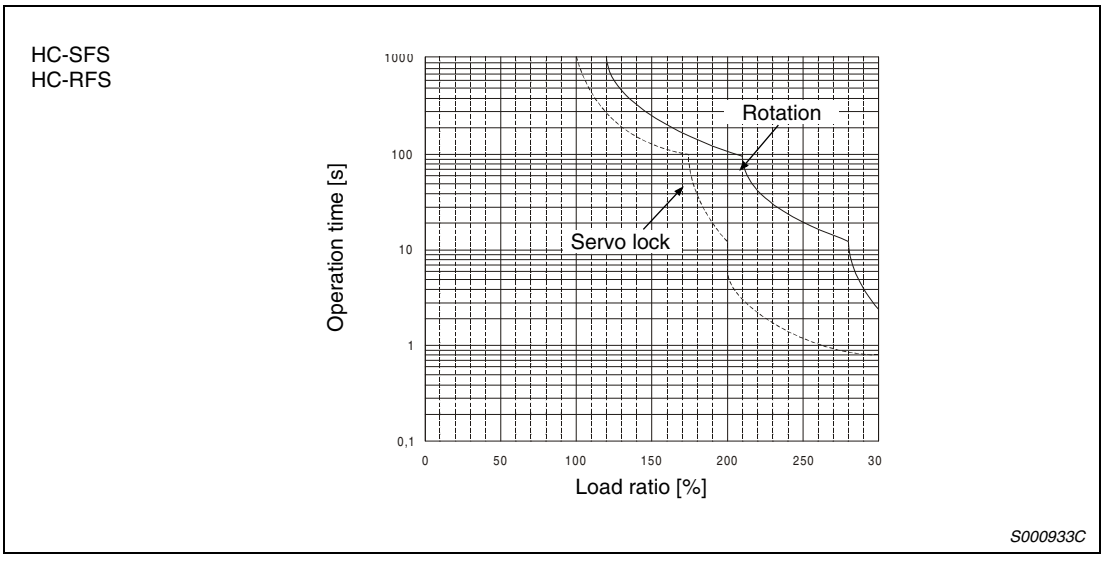


Fig. 10-2: *Load diagrams MR-J2S-200B, MR-J2S-350B, MR-J2S-200B4 and MR-J2S-350B4*

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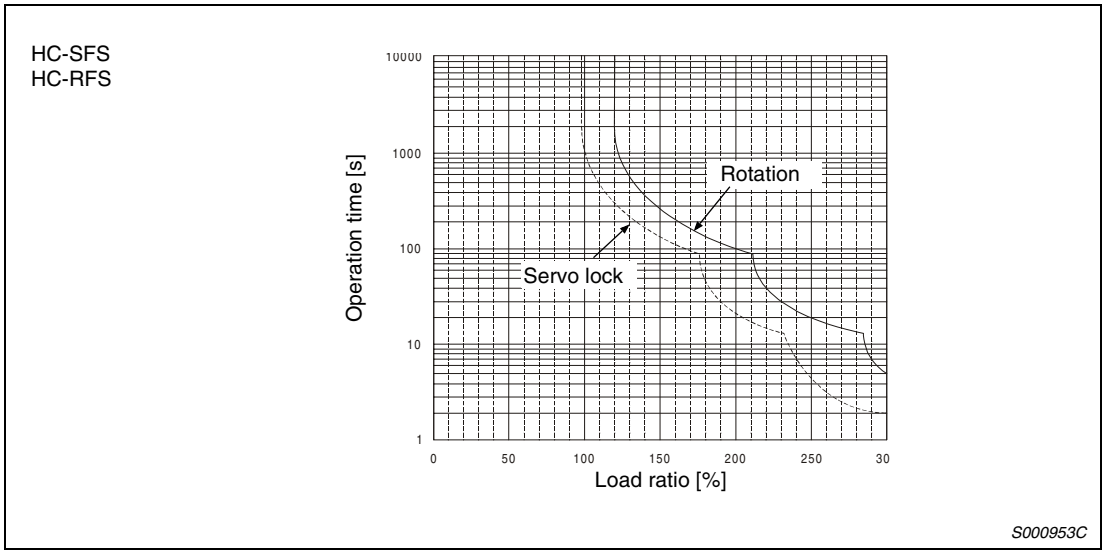


Fig. 10-3: *Load diagrams MR-J2S-500B, MR-J2S-700B, MR-J2S-500B4 and MR-J2S-700B4*

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10.1.2 Heat loss of servo amplifier

Amount of heat generated by the servo amplifier

The following table provides an overview over the power dissipation under rated load:

Servo amplifier		Servo motor	Power dissipation	
			At rated torque [W]	At servo off [W]
Servo amplifier 200V	MR-J2S-10B	HC-KFS053	25	15
		HC-KFS13	25	15
		HC-MFS053	25	15
		HC-MFS13	25	15
	MR-J2S-20B	HC-KFS23	25	15
		HC-MFS23	25	15
	MR-J2S-40B	HC-KFS43	35	15
		HC-MFS43	35	15
	MR-J2S-60B	HC-SFS52	40	15
	MR-J2S-70B	HC-KFS73	50	15
		HC-MFS73	50	15
	MR-J2S-100B	HC-SFS102	50	15
	MR-J2S-200B	HC-SFS152	90	20
		HC-SFS202	90	20
		HC-RFS103	50	15
		HC-RFS153	90	20
	MR-J2S-350B	HC-SFS352	130	20
		HC-RFS203	90	20
	MR-J2S-500B	HC-SFS502	195	25
		HC-RFS353	135	25
		HC-RFS503	195	25
	MR-J2S-700B	HC-SFS702	300	25
Servo amplifier 400V	MR-J2S-60B4	HC-SFS524	40	15
	MR-J2S-100B4	HC-SFS1024	50	15
	MR-J2S-200B4	HC-SFS1524	90	20
		HC-SFS2024	90	20
	MR-J2S-350B4	HC-SFS3524	130	20
	MR-J2S-500B4	HC-SFS5024	195	25
	MR-J2S-700B4	HC-SFS7024	300	25

Tab. 10-1: *Power dissipation under rated load*

NOTE

The amount of heat that is lost during the generating operation is not included in the power dissipation of the servo amplifier in operation. The calculation of the heat loss from the brake resistor is described in section 7.1.1.

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10.1.3 Specifications of electromagnetic brake

CAUTION:

The electromagnetic brake is designed to hold a load. Do not use it for braking a rotating motor.

The characteristics of the electromagnetic brake provided for the servo motor with electromagnetic brake are indicated in the following table:

Item \ Servo motor		HC-MFS Series			HC-SFS Series		HC-RFS Series		HC-KFS Series		
		053B 13B	23B 43B	73B	052B–152B/ 0524B–1524B	202B–702B/ 2024B–7024B	103B–203B	353B 503B	053B 13B	23B 43B	73B
Type ①		Electromagnetic disc brake (electrically ventilated and braking by spring power)									
Rated voltage ④		24VDC, +0%/–10%									
Rated current at 20°C [A]		0.26	0.33	0.42	0.8	1.4	0.8	0.96	0.26	0.33	0.42
Resistance of the excitation coil at 20°C [Ω]		91	73	57	29	16,8	30	25	91	73	57
Capacity [W]		6.3	7.9	10	19	34	19	23	6.3	7.9	10
Inrush current [A]		0.18	0.18	0.2	0.2	0.4	0.25	0.24	0.18	0.18	0.2
Cutoff current [A]		0.06	0.11	0.12	0.08	0.2	0.085	0.10	0.06	0.11	0.12
Static friction torque [Nm]		0.32	1.3	2.4	8.3	43.1	6.8	16.7	0.32	43.1	2.4
Release delay time [s] ②		0.03	0.03	0.03	0.04	0.1	0.03	0.04	0.03	0.1	0.03
Braking delay time [s] ②③	AC off (Fig. 10-4 (a))	0.08	0.1	0.12	0.12	0.12	0.12	0.12	0.08	0.12	0.12
	DC off (Fig. 10-4 (b, c))	0.01	0.02	0.03	0.03	0.03	0.03	0.03	0.01	0.03	0.03
Permissible braking moment [Nm]	per braking	5.6	22.0	64.0	400	4500	400	400	5.6	22.0	64
	per hour	56	220	640	4000	45000	4000	4000	56	220	640
Brake looseness at servo motor shaft [grad]		0.19–2.5	0.12–1.2	0.1–0.9	0.2–0.6	0.2–0.6	0.2–0.6	0.2–0.6	0.19–2.5	0.12–1.2	0.1–0.9
Brake life	Number of braking cycles [times]	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	Work per braking [Nm]	4	15	32	200	1000	200	200	4	15	32

Tab. 10-2: *characteristics of the electromagnetic brake*

There is no manual release mechanism. When it is necessary to hand-turn the servo motor shaft for machine centering, etc., use a separate 24VDC power supply to release the brake electrically.

② The value for initial ON gap at 20°C.

③ The brake gap will increase as the brake lining wears.

④ 24VDC of the internal power output for interface (VDD) cannot be used. Always use a separate power supply.

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Electromagnetic brake power supply

24VDC of the internal power output for interface (VDD) cannot be used. Prepare the following power supply for use with the electromagnetic brake only. Examples for the connection of the brake are shown in the following diagrams:

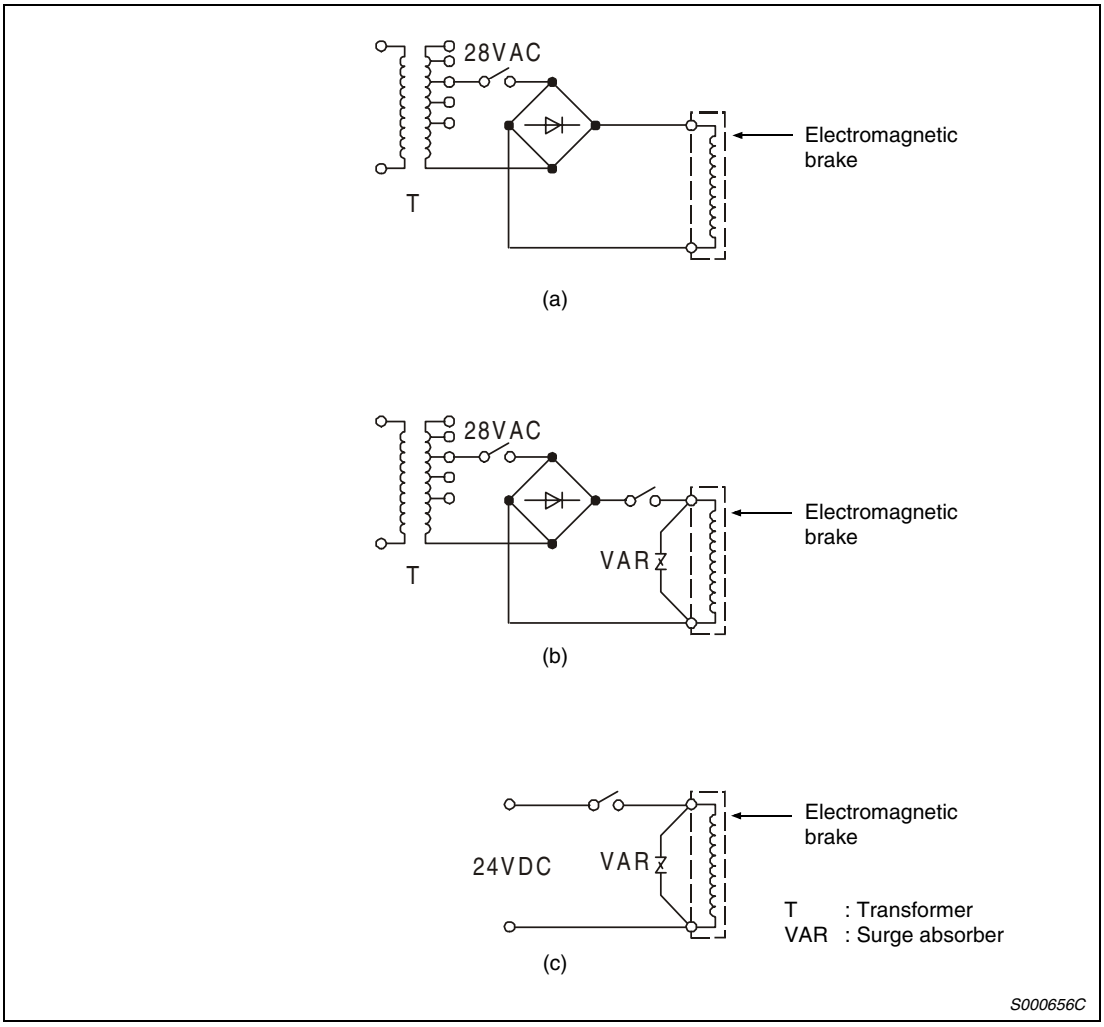


Fig. 10-4: *Brake unit connection*

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10.1.4 Dynamic braking

If an alarm, an EMERGENCY OFF or a loss of power occurs, then the servo motor is switched directly to an integrated dynamic braking unit in the amplifier and is braked. In Fig. 10-5 the delay curve is presented.

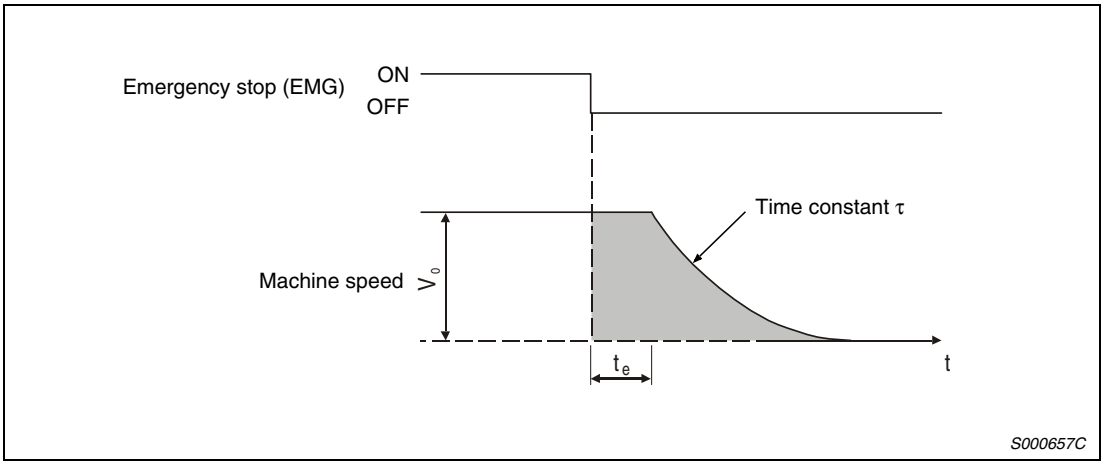


Fig. 10-5: *Dynamic brake operation diagram*

The following formula can be used to calculate the approximate coasting distance:

$$L_{max} = \frac{V_0}{60}\left\{t_e + \tau \times \left(1 + \frac{J_L}{J_M}\right)\right\}$$

L_{max}: Maximum coasting distance [mm]

V_0: Machine's fast feed speed [mm/min]

J_M: Servo motor inertia moment [kgcm^2]

J_L: Load inertia moment converted into equivalent value on servo motor shaft [kgcm^2]

τ: Brake time constant [s]

t_e: Delay time of control section (There is internal relay delay time of about 30ms) [s]

CAUTION:

Use the dynamic brake for the servo amplifiers MR-J2S-10B to MR-J2S-200B and MR-J2S-60B4 to MR-J2S-200B4 only up to a maximum ratio of the mass moment of inertia of 30, for the servo amplifiers MR-J2S-350B and MR-J2S-350B4 up to an inertia of mass ratio of 16 and for the servo amplifiers MR-J2S-500B, MR-J2S-700B, MR-J2S-500B4 and MR-J2S-700B4 up to an inertia of mass ratio of 15. If these figures are exceeded the integrated dynamic brake may overheat (fire risk). If there is a probability that the figure may be exceeded, then please contact your sales representative.

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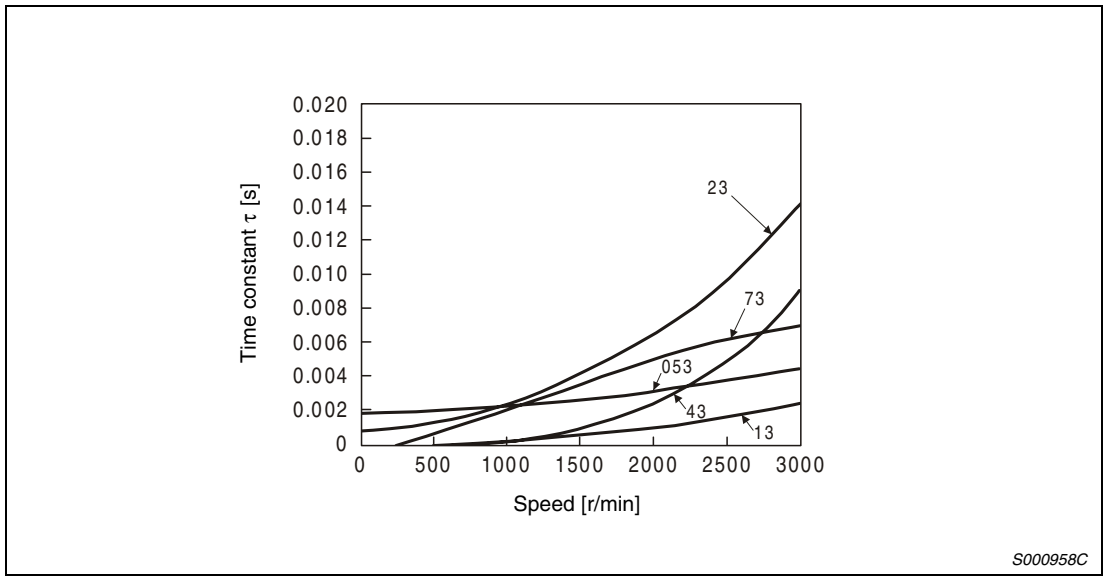


Fig. 10-6: *Dynamic brake time constant HC-MFS*

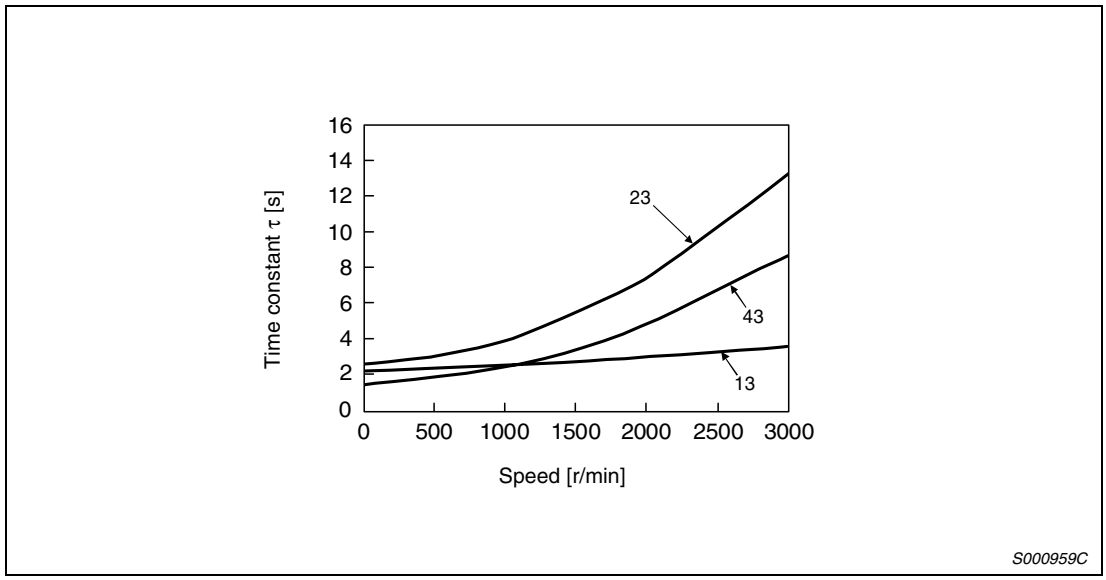


Fig. 10-7: *Dynamic brake time constant HC-KFS*

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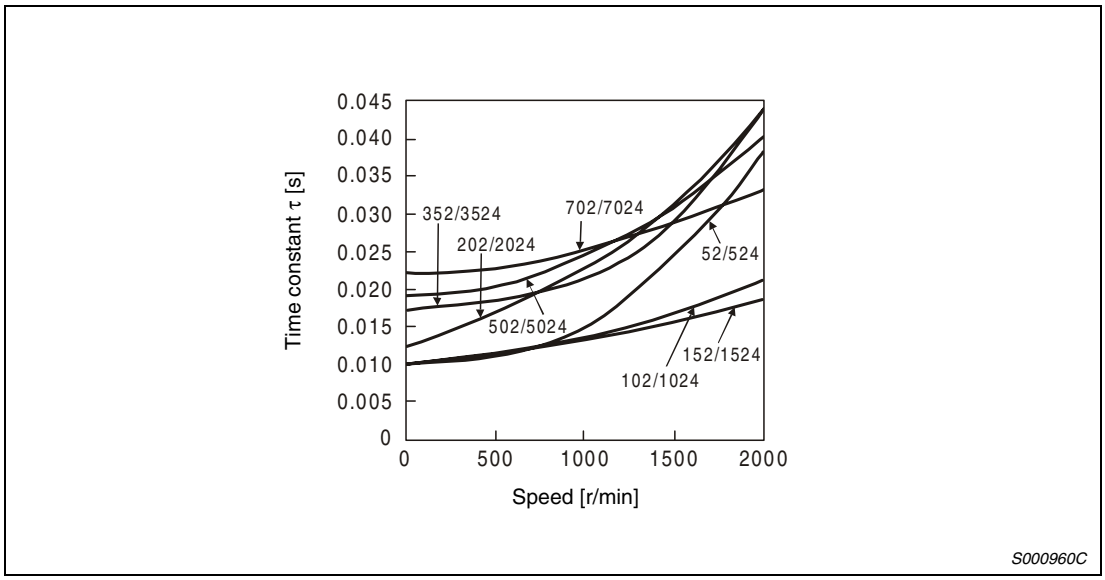


Fig. 10-8: *Dynamic brake time constant HC-SFS*

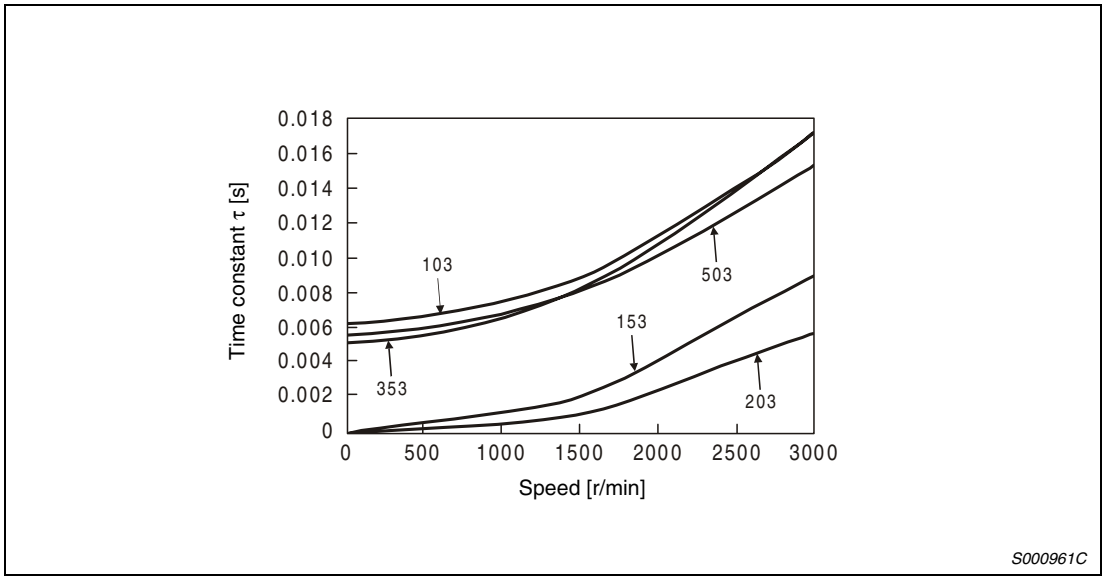


Fig. 10-9: *Dynamic brake time constant HC-RFS*

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10.2 Standard specifications

10.2.1 Servo amplifier

		Servo amplifier MR-J2S-□															
		10B	20B	40B	60B	70B	100B	200B	350B	500B	700B	60B4	100B4	200B4	350B4	500B4	700B4
Main circuit power supply	Voltage/ frequency	3~, 200–230VAC, 50/60Hz 1~, 230VAC, 50/60Hz					3~, 200–230VAC, 50/60Hz					3~, 380–480VAC, 50Hz/60Hz					
	Permissible voltage fluctuation	3~, 170–253VAC 1~, 207–253VAC					3~, 170–253VAC					3~, 323–528VAC, 50Hz/60Hz					
	Permissible frequency fluctuation	±5 %															
Control circuit power supply	Voltage/ frequency	1~, 200–230VAC, 50Hz/60Hz										24VDC					
	Permissible voltage fluctuation	1~, 170–253VAC, 50Hz/60Hz										20.4–27.6VDC					
	Permissible frequency fluctuation	±5%										—					
	Power supply capacity	50W										25W					
Control system		Sine-wave PWM control															
Dynamic brake		Built-in															
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder fault protection, regenerative fault protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection															
Speed frequency response		≥ 550Hz															
Protection type		Open (IP00)															
Environmental conditions		Refer section 2.1															
Weight [kg]		0.7	0.7	1.1	1.1	1.7	1.7	2.0	2.0	4.9	7.2	2.1	2.2	2.2	5.0	5.0	7.2

Tab. 10-3: *Standard specifications of servo amplifiers*

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10.2.2 Servo motor

		Servo motor									
		HC-MFS Series					HC-KFS Series				
		053	13	23	43	73	053	13	23	43	73
Applicable servo amplifier MR-J2S-		10B	10B	20B	40B	70B	10B	10B	20B	40B	70B
Rated output [kW]		0.05	0.1	0.2	0.4	0.75	0.05	0.1	0.2	0.4	0.75
Rated torque [Nm]		0.16	0.32	0.64	1.3	2.4	0.16	0.32	0.64	1.3	2.4
Rated speed [r/min]		3000					3000				
Maximum speed [r/min]		4500					4500				
Instantaneous permissible speed [r/min]		5175					5175				
Maximum torque [Nm]		0.48	0.95	1.9	3.8	7.2	0.48	0.95	1.9	3.8	7.2
Inertia moment J [kg × cm^2] ④		0.019	0.03	0.088	0.143	0.6	0.053	0.084	0.42	0.67	1.51
Recommended ratio of load inertia moment to servo motor shaft inertia moment ③		≤ 30					≤ 10				
Regenerative brake duty cycle [per minute] ①	Servo amplifier's built-in regenerative brake resistor	②	②	②	1010	400	②	②	②	220	190
	MR-RFH75-40	—	—	—	②	2400	②	②	②	2200	940
Power supply capacity [kVA]		0.3	0.3	0.5	0.9	1.3	0.3	0.3	0.5	0.9	1.3
Rated current [A]		0.85		1.5	2.8	5.1	0.83	0.83	1.1	2.3	5.8
Maximum current [A]		2.6		5.0	9.0	18	2.5	2.5	3.4	6.9	18.6
Speed/position detector		Encoder (resolution: 131072 pulse/rev)									
Protection type		IP55									
Cooling		Self-cooled									
Environmental conditions		Refer section 2.1									
Weight [kg] ④		0.4	0.53	0.99	1.45	3.0	0.4	0.53	0.99	1.45	3.0

Tab. 10-4: *Standard specifications of servo motors*

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		Servo motor											
		HC-SFS Series							HC-RFS Series				
		52	102	152	202	352	502	702	103	153	203	353	503
Applicable servo amplifier MR-J2S-		60B	100B	200B	200B	350B	500B	700B	200B	200B	350B	500B	500B
Rated output [kW]		0.5	1.0	1.5	2.0	3.5	5.0	7	1.0	1.5	2.0	3.5	5.0
Rated torque [Nm]		2.39	4.78	7.16	9.55	16.7	23.9	33.4	3.18	4.78	6.37	11.1	15.9
Rated speed [r/min]		2000							3000				
Maximum speed [r/min]		3000			2500		2000		4500				
Instantaneous permissible speed [r/min]		3450			2850		2300		5175				
Maximum torque [Nm]		7.16	14.4	21.6	28.5	50.1	71.6	100	7.95	11.9	15.9	27.9	39.7
Inertia moment J [kg × cm^2]		6.6	13.7	20.0	42.5	82	101	160	1.5	1.9	2.3	8.6	12
Recommended ratio of load inertia moment to servo motor shaft inertia moment		≤ 15							≤ 5				
Regenerative brake duty cycle [per minute]	Servo amplifier's built-in regenerative brake resistor	56	54	136	64	31	39	32	1090	860	710	174	125
	MR-RFH75-40	560	270	—	—	—	—	—	—	—	—	—	—
	MR-RFH220-40	1680	810	—	—	—	—	—	—	—	—	—	—
	MR-RFH400-13	—	—	680	320	158	150	95 (MR-RFH 400-6,7)	5450	4300	3550	669	479 (MR-RFH 400-6,7)
Power supply capacity [kVA]		1.0	1.7	2.5	3.5	5.5	7.5	10	1.7	2.5	3.5	5.5	7.5
Rated current [A]		3.2	6	9	11	17	28	35	6.1	8.8	14	23	28
Maximum current [A]		9.6	18	27	33	51	84	105	18.4	23.4	37	58	70
Speed/position detector		Encoder (resolution: 131072 pulse/rev)											
Protection type		IP65											
Cooling		Self-cooled											
Environmental conditions		Refer section 2.1											
Weight [kg]		5.0	7.0	9.0	12.0	19.0	23	32	3.9	5.0	6.2	12.0	17.0

Tab. 10-5: *Standarddaten des Servomotors*

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		Servo motor						
		HC-SFS Series (400V type)						
		524	1024	1524	2024	3524	5024	7024
Applicable servo amplifier MR-J2S-		60B4	100B4	200B4	200B4	350B4	500B4	700B4
Rated output [kW]		0.5	1.0	1.5	2.0	3.5	5.0	7
Rated torque [Nm]		2.39	4.78	7.16	9.55	16.7	23.9	33.4
Rated speed [r/min]		2000						
Maximum speed [r/min]		3000			2500		2000	
Instantaneous permissible speed [r/min]		3450			2850		2300	
Maximum torque [Nm]		7.16	14.4	21.6	28.5	50.1	71.6	100
Inertia moment J [kg × cm^2]		6.6	13.7	20.0	42.5	82	101	160
Recommended ratio of load inertia moment to servo motor shaft inertia moment		≤ 15						
Regenerative brake duty cycle [per minute]	Servo amplifier's built-in regenerative brake resistor	125	200	136	64	43	39	32
	MR-PWR T150-270	415	—	—	—	—	—	—
	MR-PWR T400-120	—	600			—	—	—
	MR-PWR T600-80	—	—	680	320	—	—	—
	MR-PWR T600-47	—	—	—	—	167	150	—
	MR-PWR T600-26	—	—	—	—	—	—	95
Power supply capacity [kVA]		1.0	1.7	2.5	3.5	5.5	7.5	10
Rated current [A]		1.5	2.8	4.4	5.411	8.6	14	17
Maximum current [A]		4.5	8.4	13.2	16.2	25.8	42	51
Speed/position detector		Encoder (resolution: 131072 pulse/rev)						
Protection type		IP65						
Cooling		Self-cooled						
Environmental conditions		Refer section 2.1						
Weight [kg]		5.0	7.0	9.0	12.0	19.0	23	32

Tab. 10-6: *Standarddaten des Servomotors*

① The figure stated for the number of braking cycles per minute when addressing the braking unit is the permitted figure of braking cycles per minute when the servo motor is braked without any load from the rated speed to a standstill. If the motor is under load, then the figure in the table must be multiplied by 1/(m + 1) (m = load moment of inertia / motor moment of inertia).

② If the recorded torque is within the range of the rated torque, then the number of braking cycles per minute is not restricted.

③ If the ratio of the load inertia moment to the motor shaft inertia moment exceeds the stated value, then please contact your sales representative.

④ If the servo motor is equipped with an electromagnetic brake, please take the relevant figures from tab. 10-2.

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10.2.3 Torque characteristics

NOTE If a load is applied to the stopped servo motor, then the delivered torque should not exceed 70% of the rated torque.

Servo motors 200V

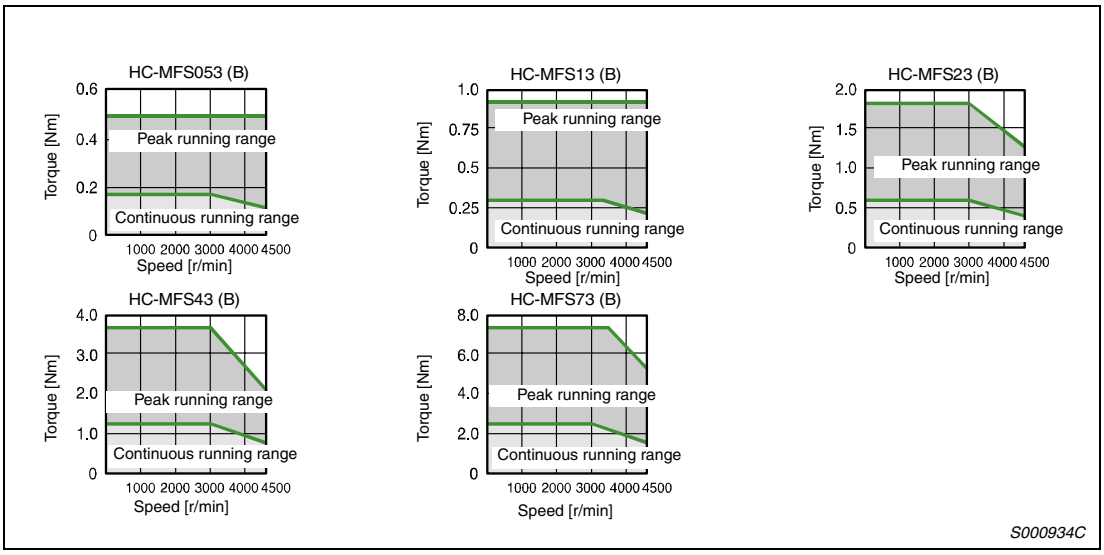


Fig. 10-10: *HC-MFS series servo motor torque characteristics*

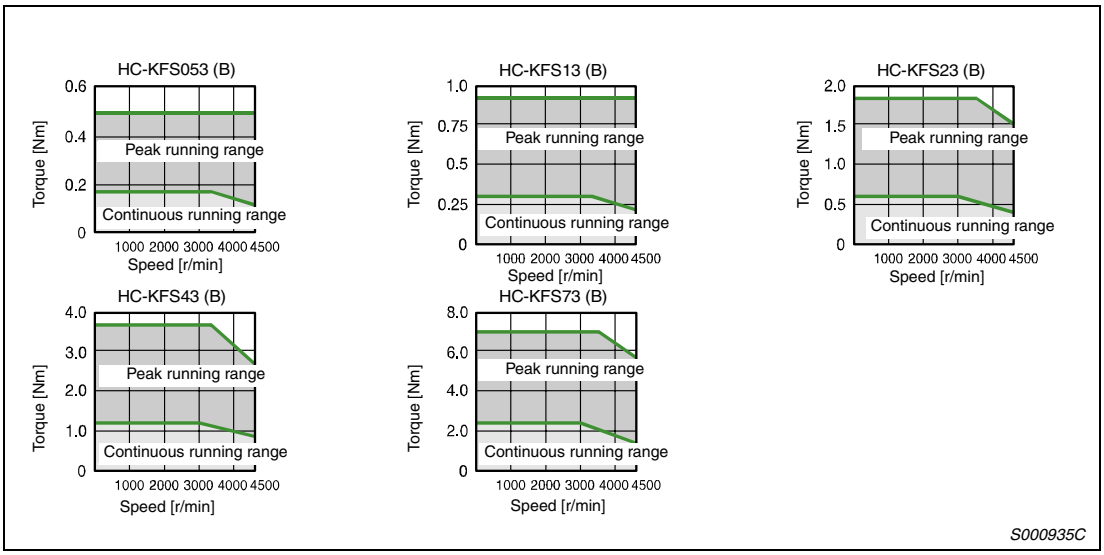


Fig. 10-11: *HC-KFS series servo motor torque characteristics*

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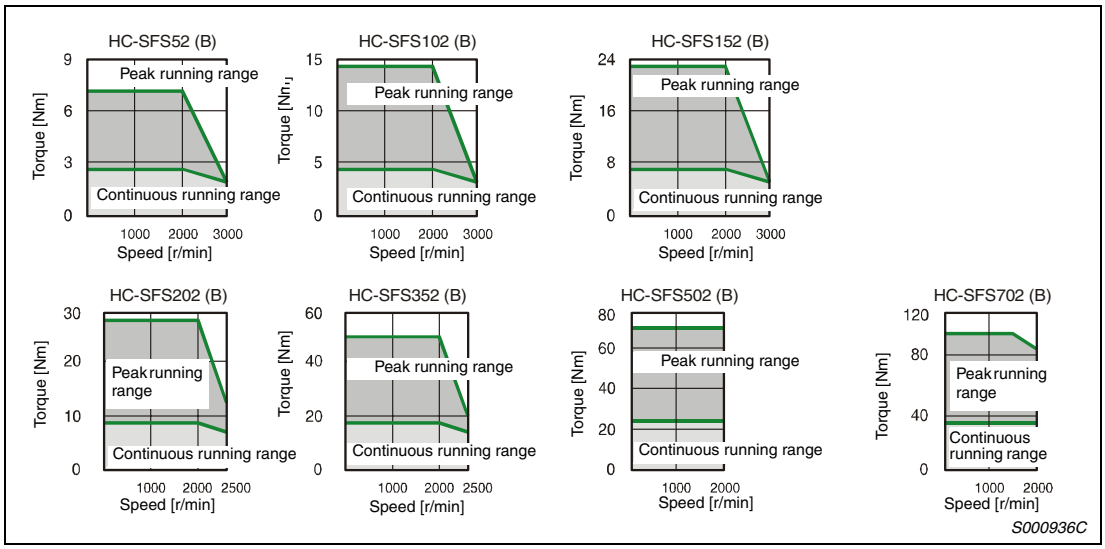


Fig. 10-12: *HC-SFS series servo motor torque characteristics*

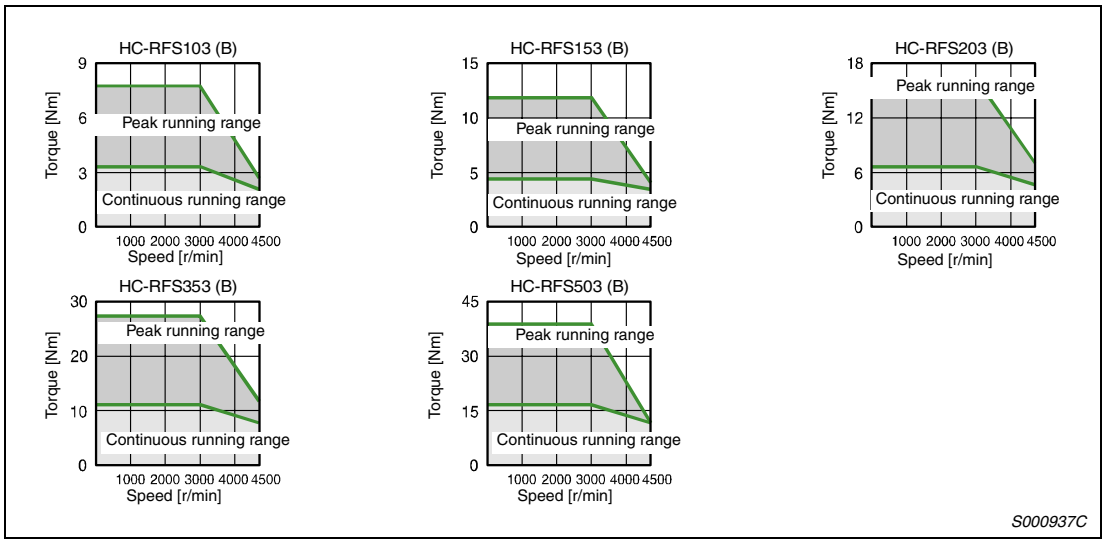


Fig. 10-13: *HC-RFS series servo motor torque characteristics*

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Servo motors 400V

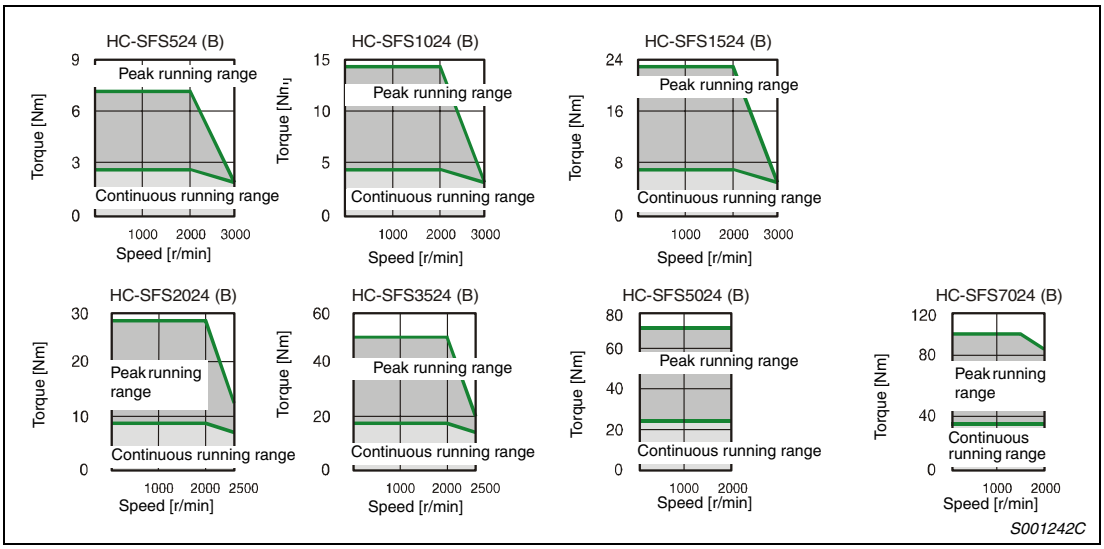


Fig. 10-14: *HC-SFS series servo motor torque characteristics*

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11 EMC Directives

11.1 Requirements

With regard to its electromagnetic compatibility, the servo amplifier MELSERVO J2-Super complies with the requirements of the European Union. In order to comply with these requirements it is necessary to equip the servo amplifier with a radio interference suppression filter as well as installing cabling that conforms to EMC standards.

With the use of a radio interference suppression filter as well as a construction that conforms to EMC standards the following limiting values are maintained:

- For interference emanating from the servo amplifier:
  - EN 61800-3, first environment, meets immunity requirements for interference that is cable related
  - When installed in an earthed control cabinet no interference that is not cable related is to be expected outside the cabinet.
- For the external interference affecting the servo amplifier:
  - EN 50082-2

Installation instructions

- The servo amplifier is designed for installation in the control cabinet. The control cabinet must be well earthed.
- The motor lead must be screened. The screening must be applied on both sides, high frequency and well conducting. Maximum length ≤ 30 m.
- All cables that carry power must be laid well separated from telephone lines, signal lines or similar.
- The earth connection for the servo amplifier should be separate, if possible.
- A minimum distance of ≥ 10 cm should always be maintained between the servo amplifier and other operating units that may be susceptible to electromagnetic interference.

NOTES

Refer to the relevant installation manual for installation and connection instructions for the radio interference suppression filter.

Due to their large number, it is not possible to take into account all the installation and fitting options that may arise in practice. Consequently, in practice, situations may result that deviate from statements made here.

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12 Dimensions

12.1 Servo amplifiers 200V

MR-J2S-10B and MR-J2S-20B

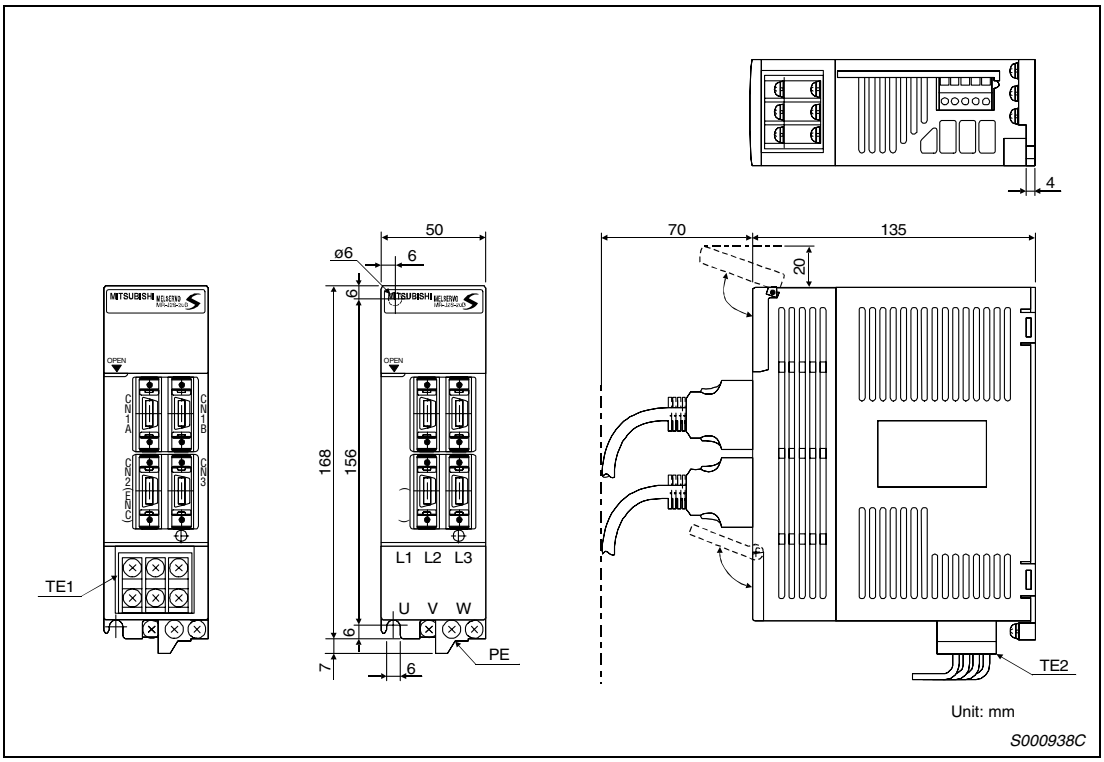


Fig. 12-1: *Outline drawing*

Model	Weight [kg]
MR-J2S-10B	0.7
MR-J2S-20B	

Tab. 12-1: *Dimensioning*

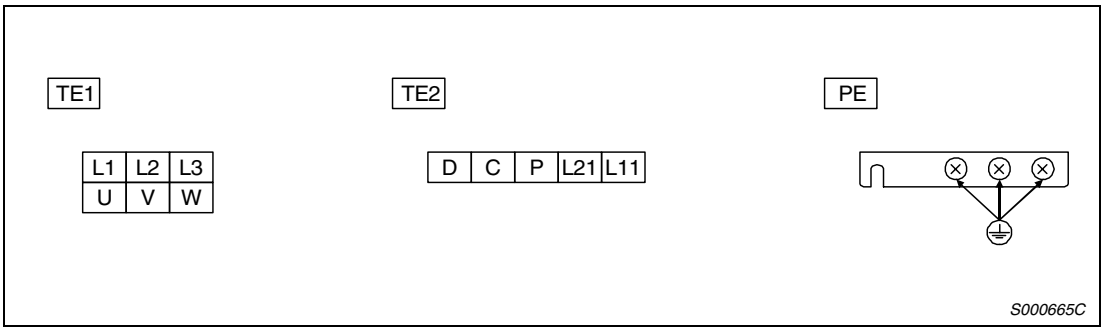


Fig. 12-2: *Terminals*

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MR-J2S-40B and MR-J2S-60B

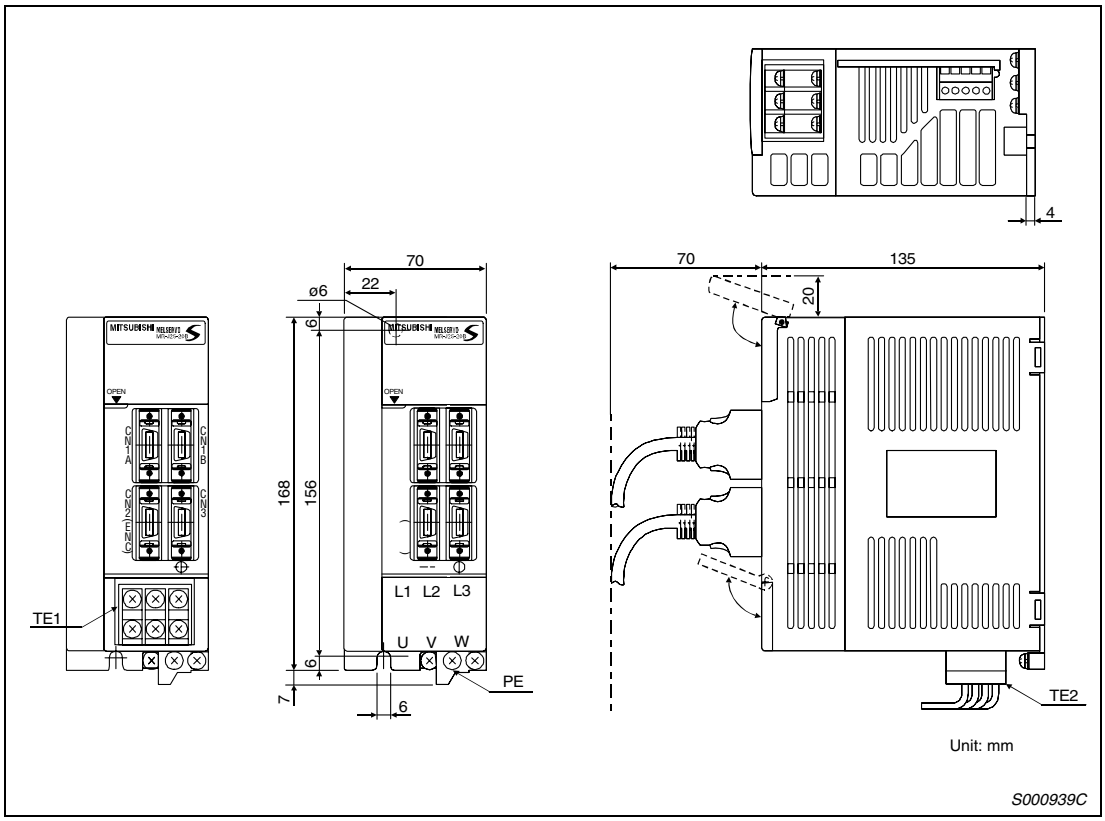


Fig. 12-3: *Outline drawing*

Model	Weight [kg]
MR-J2S-40B	1.1
MR-J2S-60B	

Tab. 12-2: *Dimensioning*

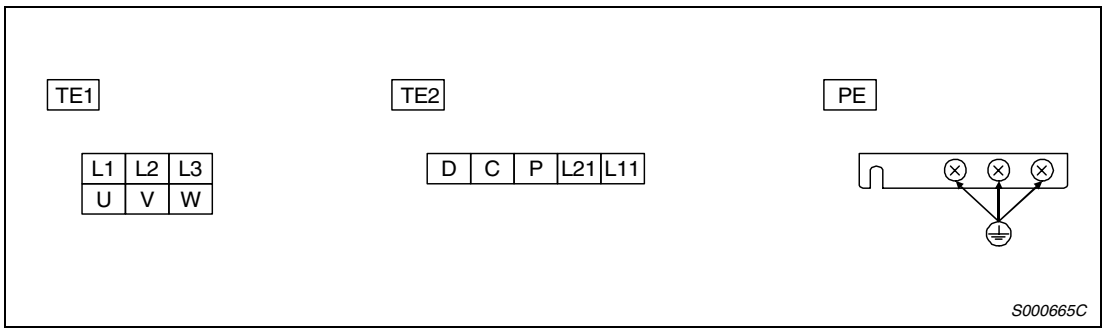


Fig. 12-4: *Terminals*

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MR-J2S-70B and MR-J2S-100B

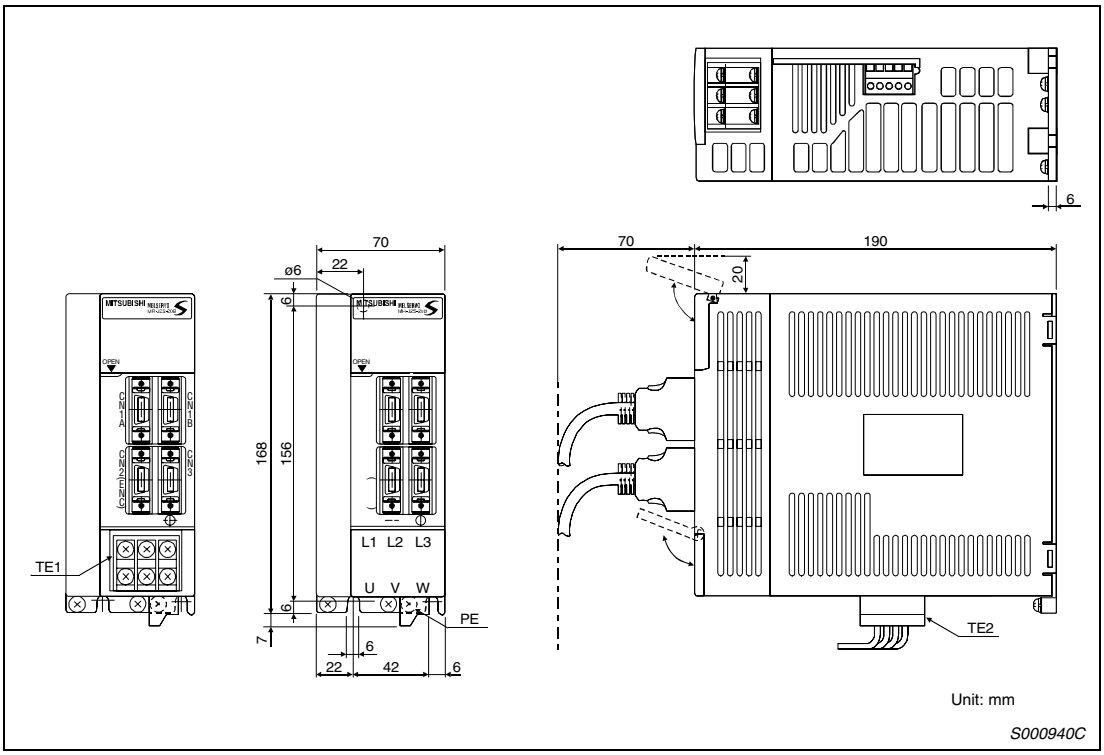


Fig. 12-5: *Outline drawing*

Model	Weight [kg]
MR-J2S-70B	1.7
MR-J2S-100B	

Tab. 12-3: *Dimensioning*

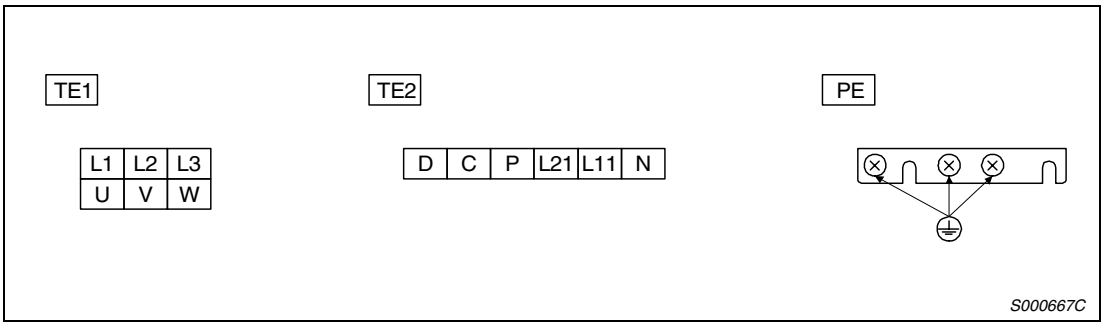


Fig. 12-6: *Terminals*

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MR-J2S-200B and MR-J2S-350B

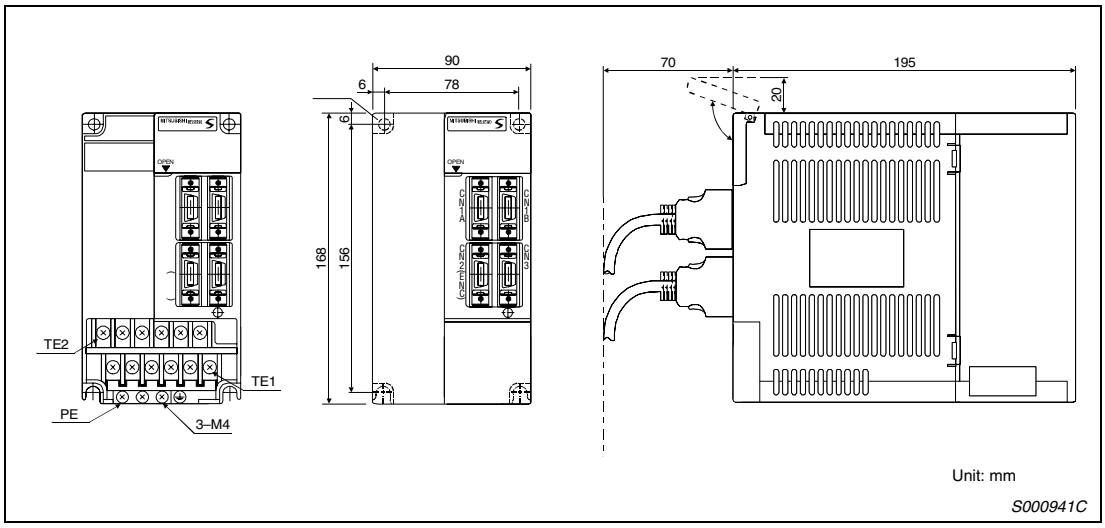


Fig. 12-7: *Outline drawing*

Model	Weight [kg]
MR-J2S-200B	2.0
MR-J2S-350B	

Tab. 12-4: *Dimensioning*

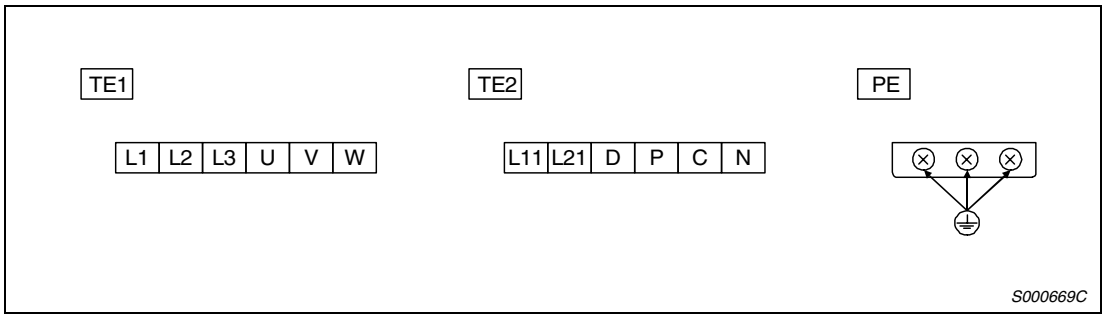


Fig. 12-8: *Terminals*

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MR-J2S-500B

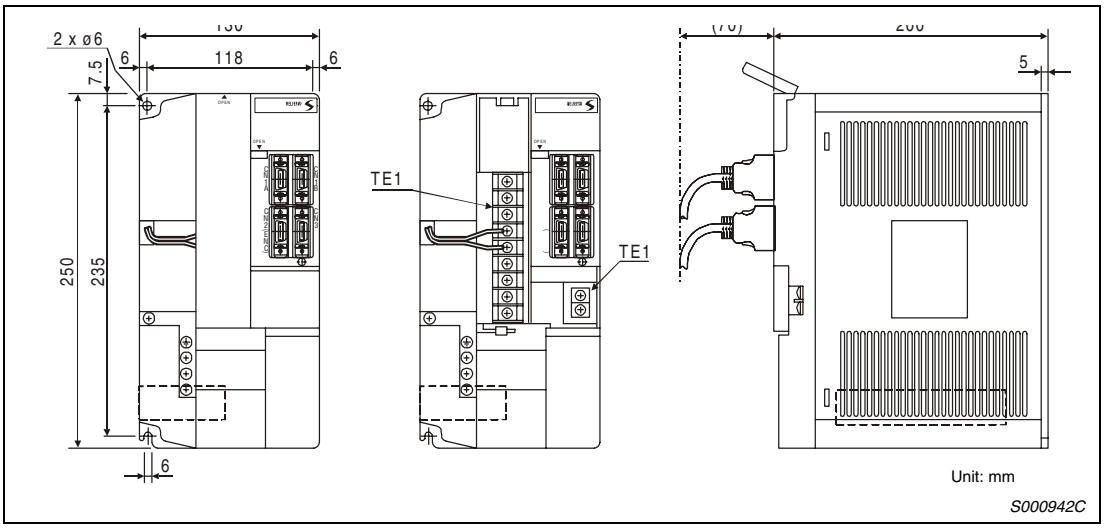


Fig. 12-9: *Outline drawing*

Model	Weight [kg]
MR-J2S-500B	4.9

Tab. 12-5: *Dimensioning*

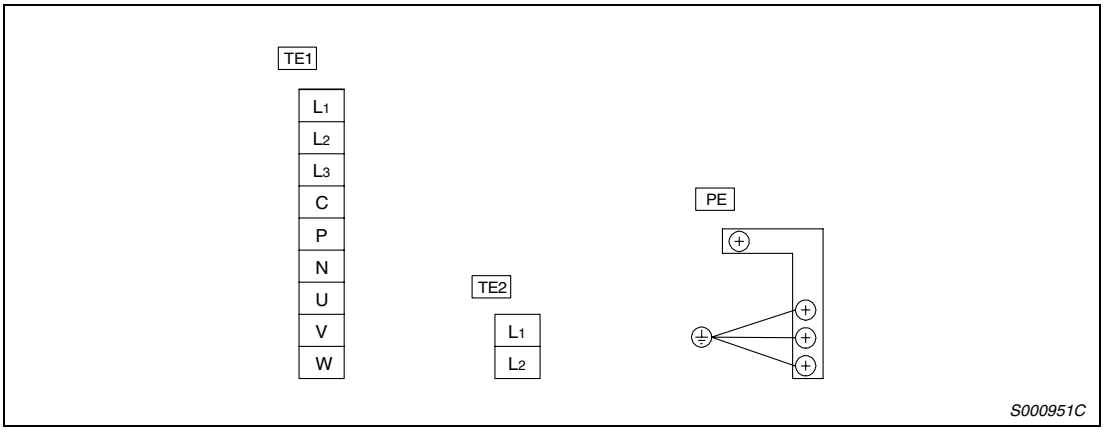


Fig. 12-10: *Terminals*

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MR-J2S-700B

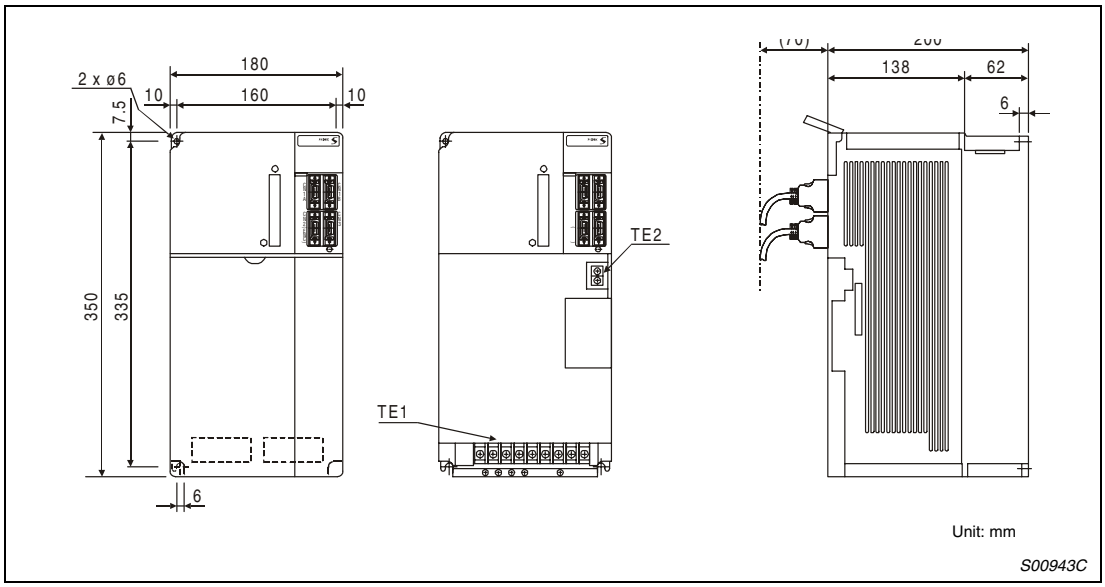


Fig. 12-11: *Outline drawing*

Model	Weight [kg]
MR-J2S-700B	7.2

Tab. 12-6: *Dimensioning*

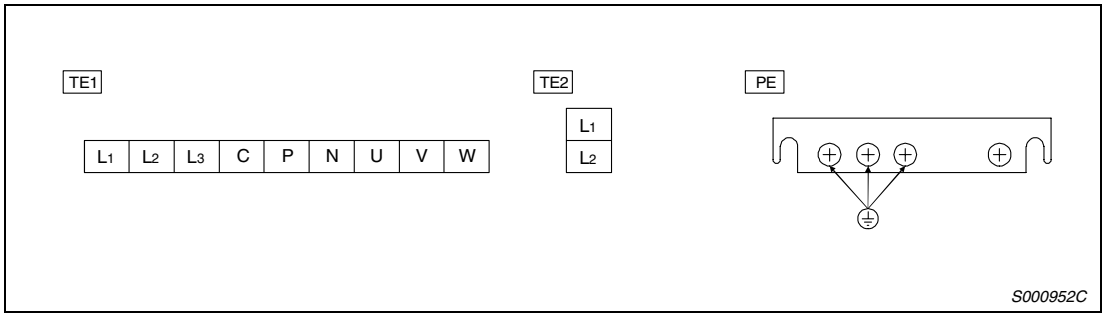


Fig. 12-12: *Terminals*

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12.2 Servo amplifiers 400V

MR-J2S-60B4 to MR-J2S-200B4

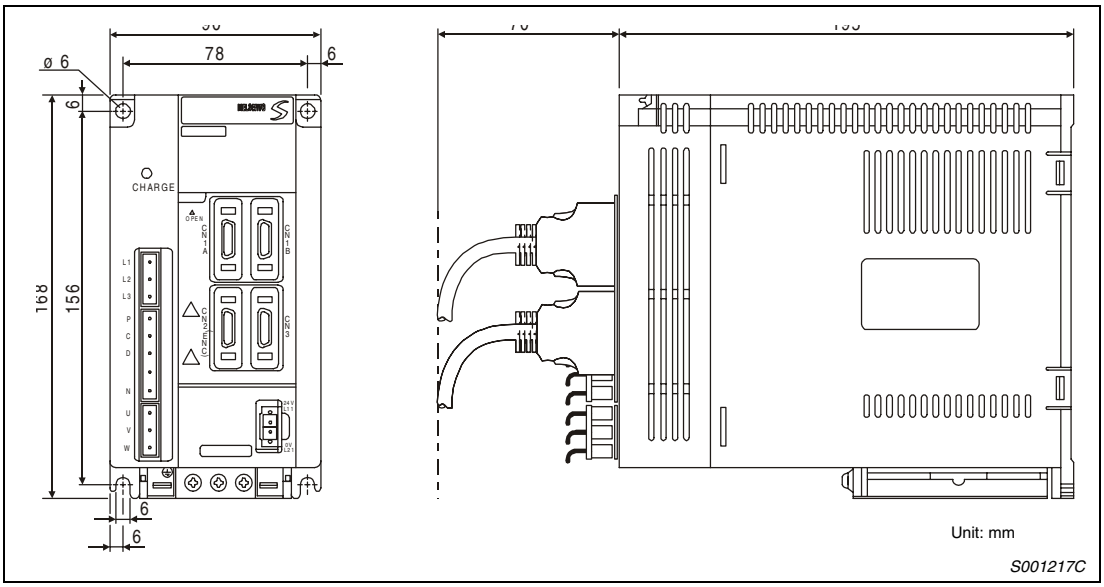


Fig. 12-13: *Outline drawing*

Model	Weight [kg]
MR-J2S-60B4	2.1
MR-J2S-100B4	
MR-J2S-200B4	2.2

Tab. 12-7: *Dimensioning*

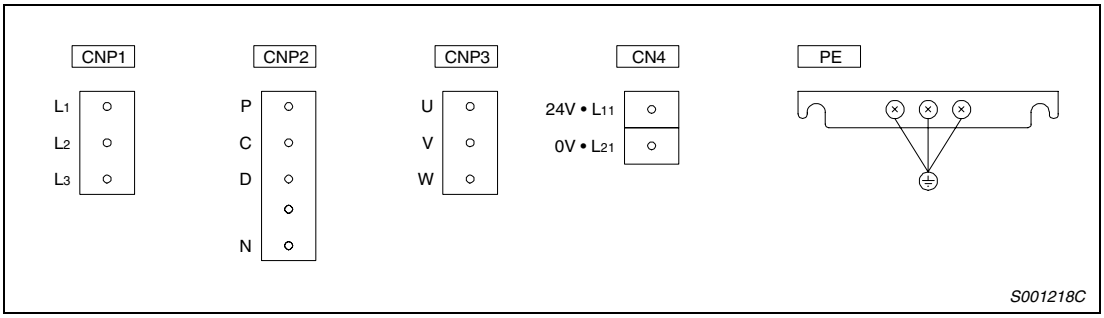


Fig. 12-14: *Terminals*

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MR-J2S-350B4 and MR-J2S-500B4

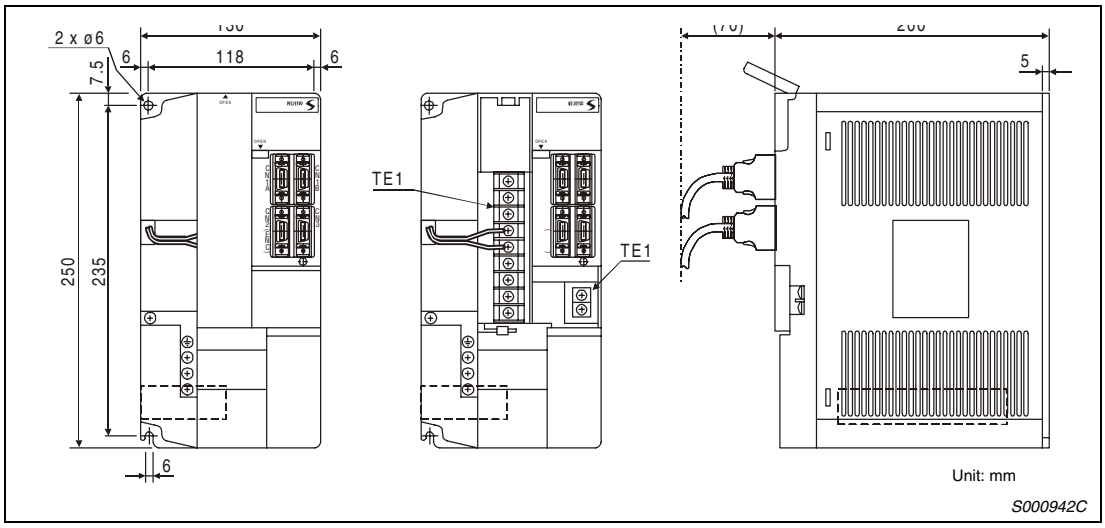


Fig. 12-15: *Outline drawing*

Model	Weight [kg]
MR-J2S-350B4	5
MR-J2S-500B4	

Tab. 12-8: *Dimensioning*

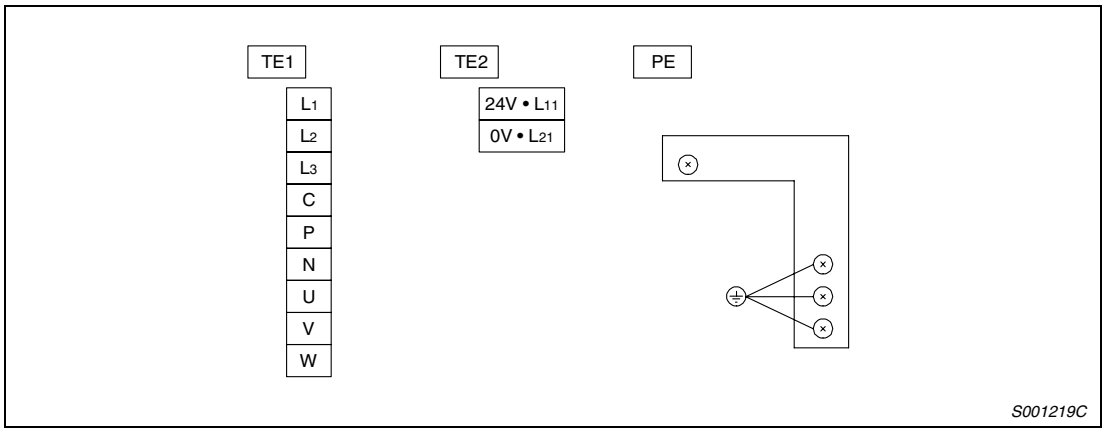


Fig. 12-16: *Terminals*

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MR-J2S-700B4

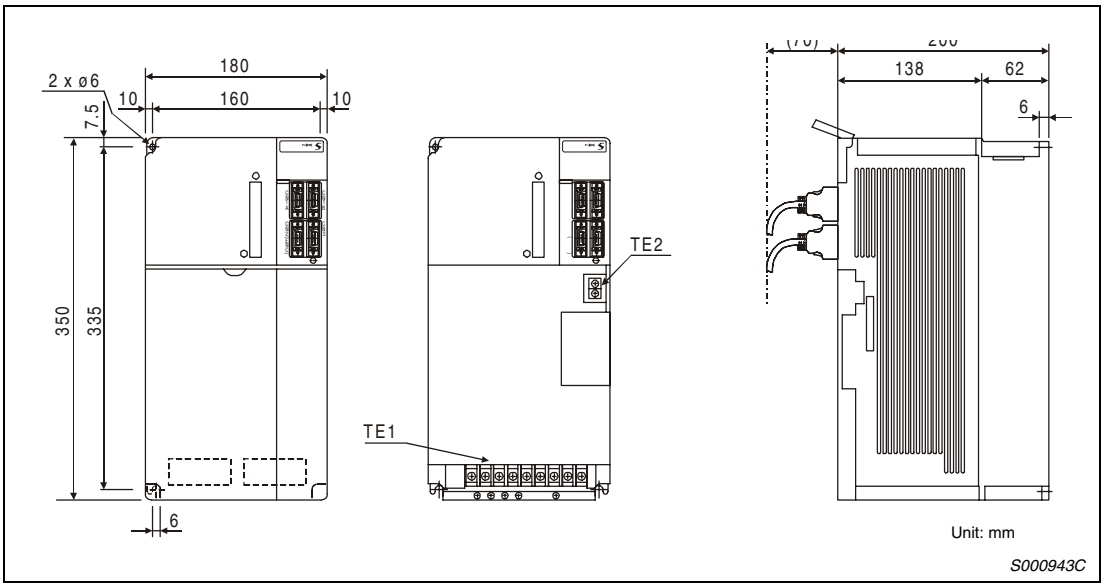


Fig. 12-17: *Outline drawing*

Model	Weight [kg]
MR-J2S-700B4	7.2

Tab. 12-9: *Dimensioning*

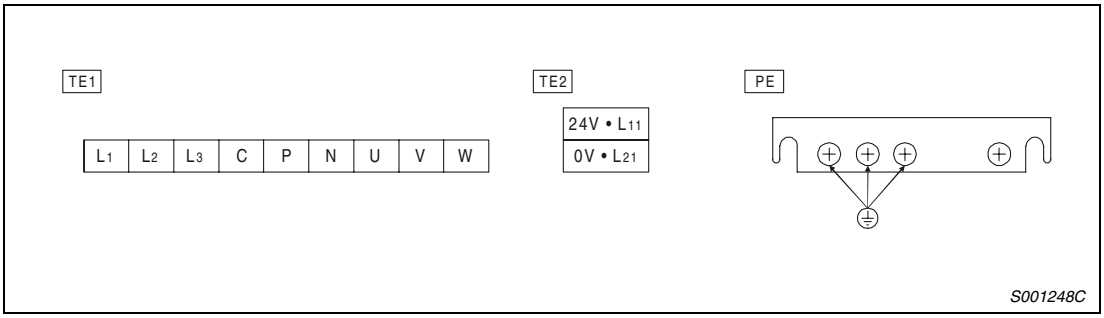


Fig. 12-18: *Terminals*

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12.3 Servo motors

12.3.1 HC-MFS and HC-KFS series

HC-MFS053 (B) and HC-MFS13 (B), HC-KFS053 (B) and HC-KFS13 (B)

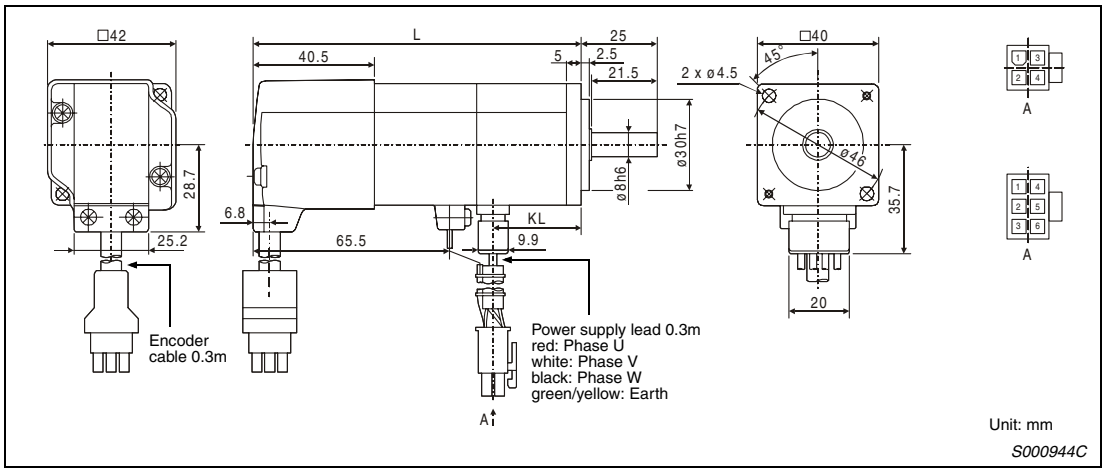


Fig. 12-19: *Outline drawing*

Model	Rated output [W]	L [mm]	KL [mm]	Weight [kg]
HC-MFS053 (B)	50	81.5 (109.5)	29.5	0.4 (0.75)
HC-KFS053 (B)				
HC-MFS13 (B)	100	96.5 (124.5)	44.5	0.53 (0.89)
HC-KFS13 (B)				

Tab. 12-10:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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HC-MFS23 (B) and HC-MFS43 (B),
HC-KFS23 (B) and HC-KFS43 (B)

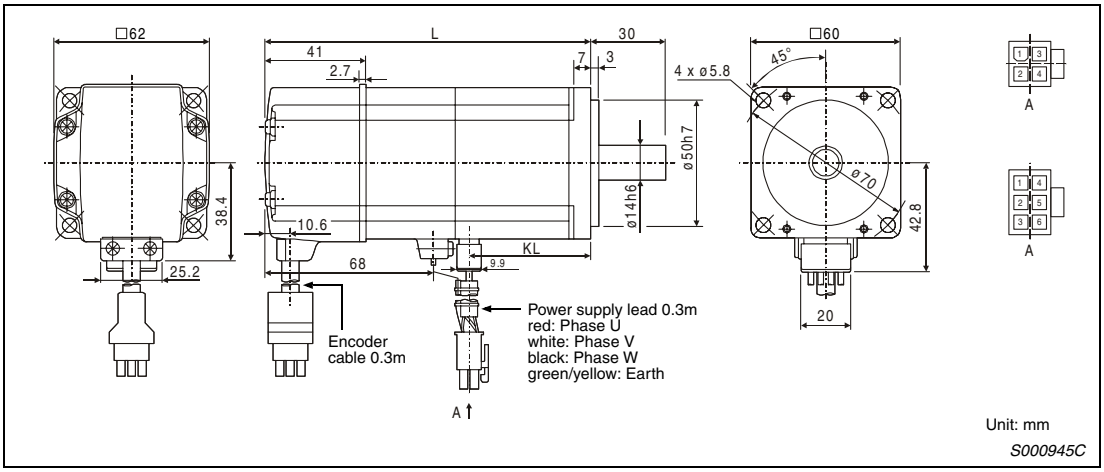


Fig. 12-20: *Outline drawing*

Model	Rated output [W]	L [mm]	KL [mm]	Weight [kg]
HC-MFS23 (B)	200	99.5 (131.5)	49.1	0.99 (1.6)
HC-KFS23 (B)				
HC-MFS43 (B)	400	124.5 (156.5)	72.1	1.45 (2.1)
HC-KFS43 (B)				

Tab. 12-11:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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HC-MFS73 (B),
HC-KFS73 (B)

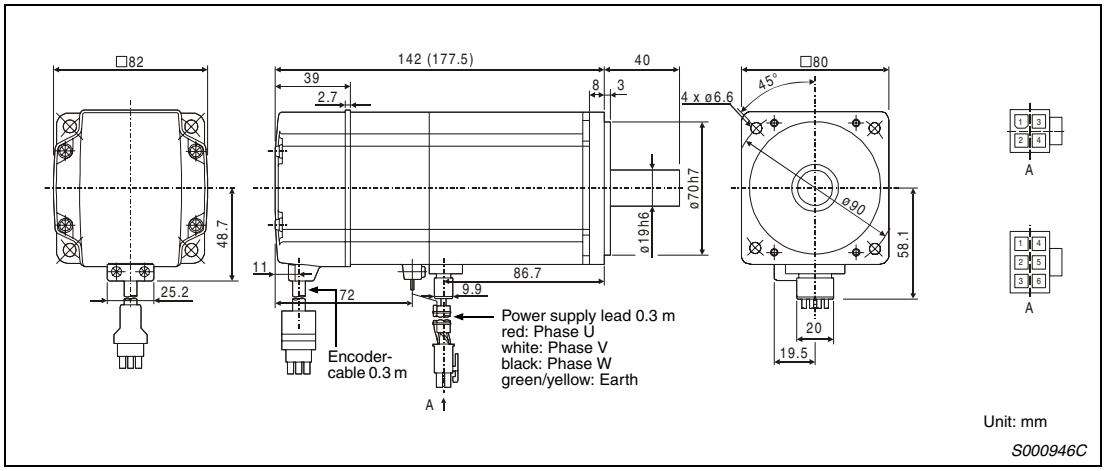


Fig. 12-21: *Outline drawing*

Model	Rated output [W]	Weight [kg]
HC-MFS73 (B)	750	3.0 (4.0)
HC-KFS73 (B)		

Tab. 12-12:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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12.3.2 HC-SFS-Serie

HC-SFS52 (B) to HC-SFS152 (B), HC-SFS524 (B) to HC-SFS1524 (B)

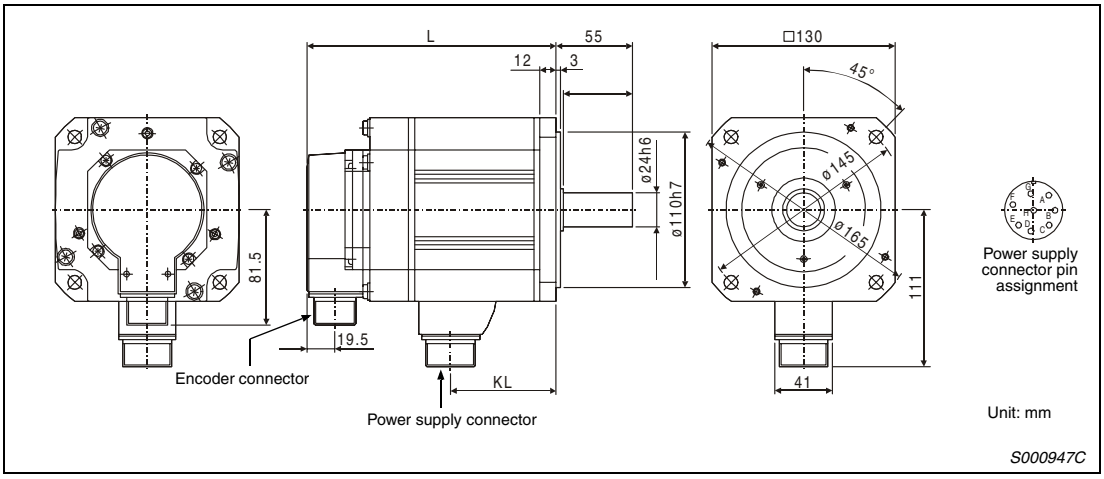


Fig. 12-22: *Outline drawing*

Model	Rated output [kW]	L [mm]	KL [mm]	Weight [kg]
HC-SFS52 (B) HCSFS524 (B)	0.5	120 (153)	51.5	5.0 (7.5)
HC-SFS102 (B) HC-SFS1024 (B)	1.0	145 (178)	76.5	7.0 (9.5)
HC-SFS152 (B) HC-SFS1524 (B)	1.5	170 (203)	101.5	9.0 (11.5)

Tab. 12-13:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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HC-SFS202 (B) to HC-SFS702 (B), HC-SFS2024 (B) to HC-SFS7024 (B)

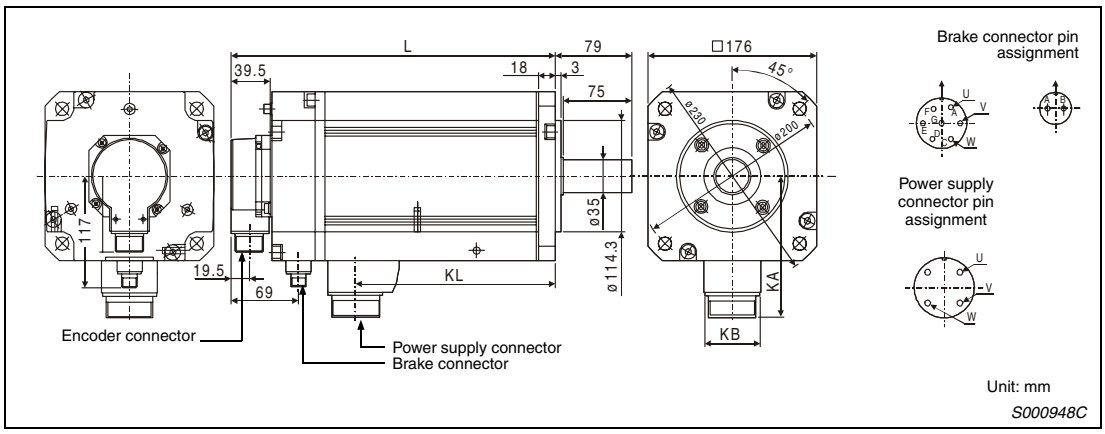


Fig. 12-23: *Outline drawing*

Model	Rated output [kW]	L [mm]	KL [mm]	KA [mm]	KB [mm]	Weight [kg]
HC-SFS202 (B) HC-SFS2024 (B)	2.0	145 (193)	68.5	142	46	12 (18)
HC-SFS352 (B) HC-SFS3524 (B)	3.5	187 (235)	110.5	142	46	19 (25)
HC-SFS502 (B) HC-SFS5024 (B)	5.0	208 (256)	131.5	142	46	23 (29)
HC-SFS702 (B) HC-SFS7024 (B)	7.0	292 (340)	210.5	150	58	32 (38)

Tab. 12-14:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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12.3.3 HC-RFS series

HC-RFS103 (B), HC-RFS153 (B) and HC-RFS203 (B)

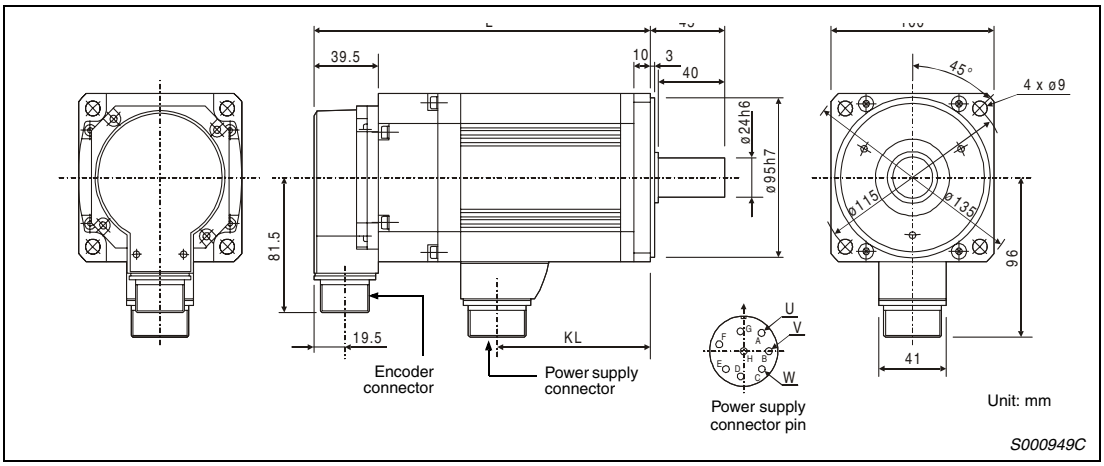


Fig. 12-24: *Outline drawing*

Model	Rated output [kW]	L [mm]	KL [mm]	Weight [kg]
HC-RFS103 (B)	1.0	147 (185)	71	3.9 (6.0)
HC-RFS153 (B)	1.5	172 (210)	96	5.0 (7.0)
HC-RFS203 (B)	2.0	197 (235)	121	6.2 (8.3)

Tab. 12-15:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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HC-RFS353 (B) and HC-RFS503 (B)

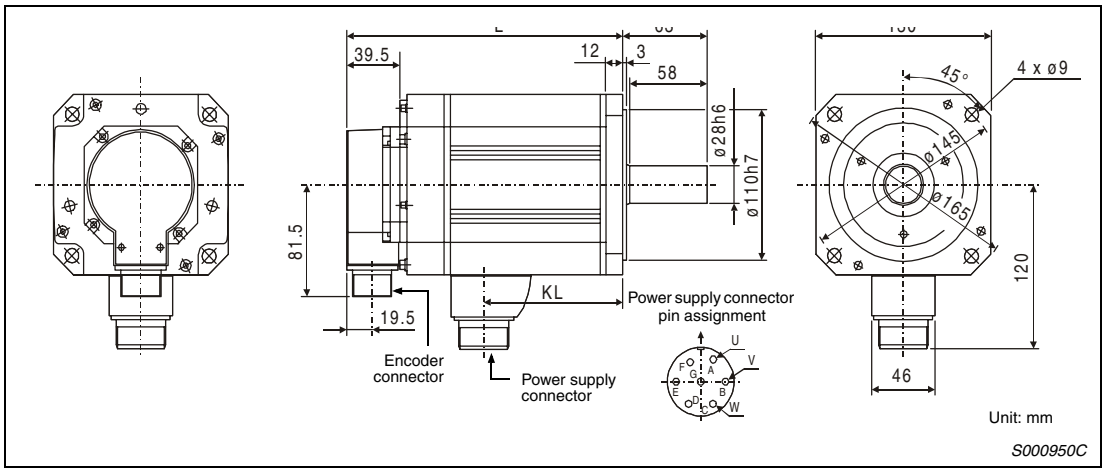


Fig. 12-25: *Outline drawing*

Model	Rated output [kW]	L [mm]	KL [mm]	Weight [kg]
HC-RFS353 (B)	3.5	217 (254)	148	12 (15)
HC-RFS503 (B)	5.0	274 (311)	205	17 (21)

Tab. 12-16:*Dimensioning*

NOTE The figures in brackets apply to models of motor with electromagnetic brake.

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12.4 Regenerative brake resistor option

RFH75 to RFH400 and MR-PWR-T-150 to MR-PWR-T-600

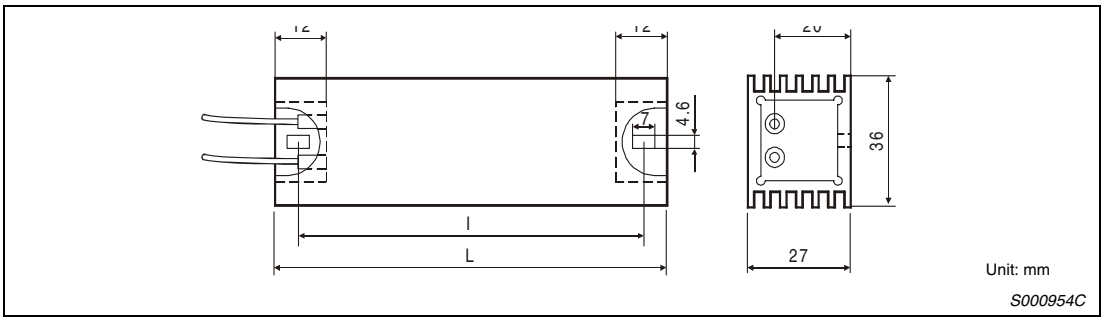


Fig. 12-26: *Outline drawing*

Type	Regenerative power [W]	Resistor [Ω]	L [mm]	l [mm]	Weight [kg]
MR-RFH75-40	150	40	90	79	0.16
MR-RFH220-40	400	40	200	189	0.42
MR-RFH400-13	600	13	320	309	0.73
MR-RFH400-6,7	600	6,7	320	309	0.73
MR-PWR-T-150-270	150	270	90	79	0.18
MR-PWR-T-400-120	400	120	200	189	0.4
MR-PWR-T-600-80	600	80	320	309	0.64
MR-PWR-T-600-47	600	47	320	309	0.64
MR-PWR-T-600-26	600	26	320	309	0.64

Tab. 12-17:*Dimensioning*

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12.5 Transformer

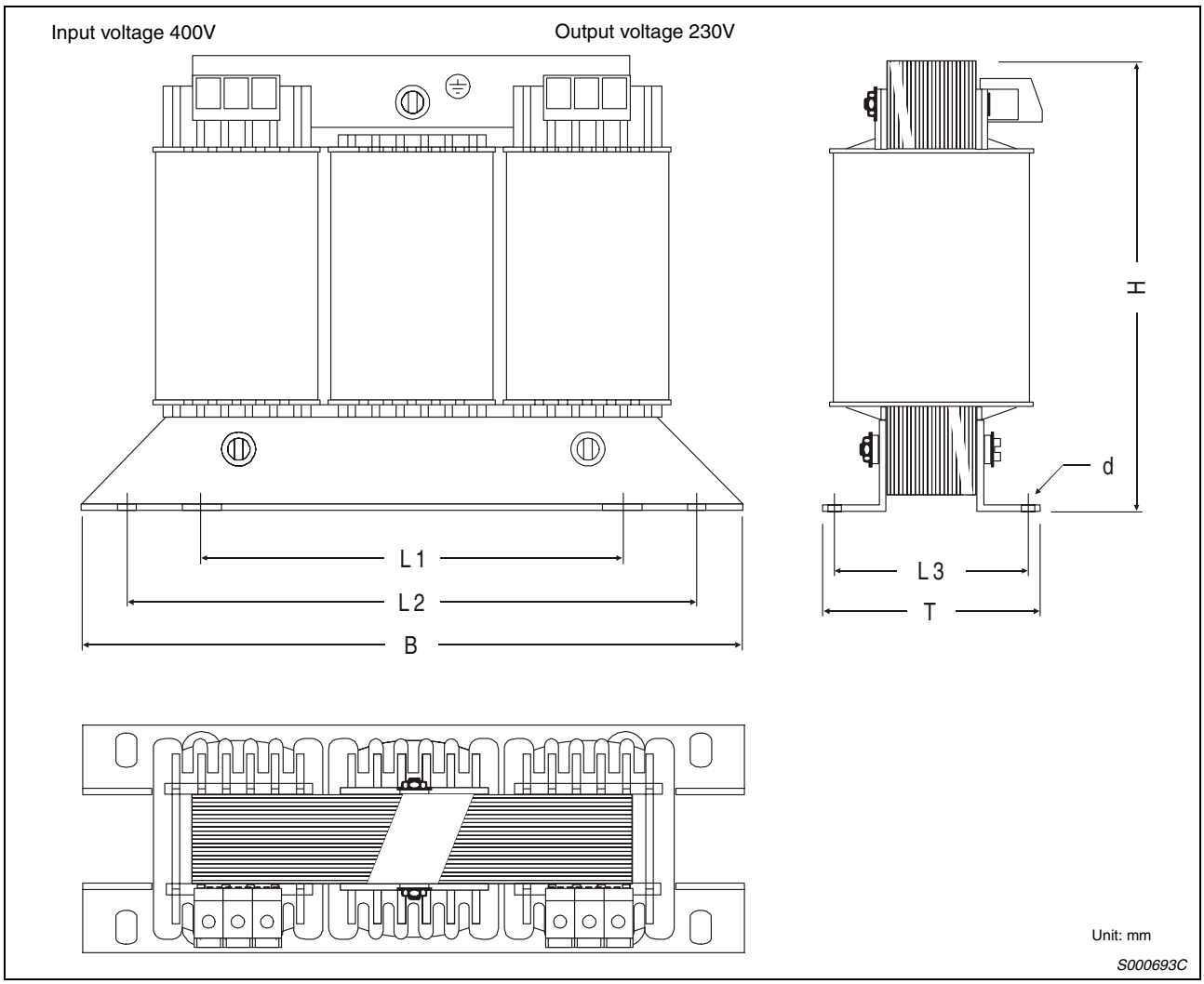


Abb. 12-27: *Outline drawing*

Transformer	Power [kVA]	ED [%]	Input current [A]	Output current [A]	Terminal cross-section [mm²]	Power dissipation [W]	B [mm]	T [mm]	H [mm]	L1 [mm]	L2 [mm]	L3 [mm]	d [mm²]	Weight [kg]
MT 1,3-60	1.3	60	2.02 2.69	3.26 4.27	2.5 2.5	103 167	219	105	163	136	201	71	7 × 12	7.0
MT 1,7-60	1.7	60	2.61 3.89	4.27 6.28	2.5 2.5	110 199	219	125	163	136	201	91	7 × 12	10.7
MT 2,5-60	2.5	60	3.80 5.42	6.28 8.78	2.5 2.5	155 282	267	115	202	176	249	80	7 × 12	16.5
MT 3,5-60	5.5	60	5.30 8.41	8.78 13.80	4 4	170 330	267	139	202	176	249	104	7 × 12	22.0
MT 5,5-60	5.5	60	8.26	13.80	4	243	267	139	202	176	249	104	7 × 12	22.0
MT 7,5-60	7.5	60	11.25	18.82	4	190	316	160	245	200	292	112	10 × 16	28
MT 11-60	11	60	16.40	27.61	4	280	352	165	300	224	328	117	10 × 16	41

Tab. 12-18: *Dimensioning*

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