GE Fanuc Automation

Computer Numerical Control Products

Servo Amplifier αi Series

Descriptions

GFZ-65282EN/05 *March 2003*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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SAFETY PRECAUTIONS

This "Safety Precautions" section describes the precautions which must be observed to ensure safety when using FANUC servo amplifiers (including spindle amplifiers). Users of any control motor amplifier model are requested to read the "Safety Precautions" carefully before first using the amplifier. Users should also read the relevant description in this manual to become fully familiar with the functions of the servo amplifier.
The users are basically forbidden to do any behavior or action not mentioned in the "Safety Precautions." They are invited to ask FANUC previously about what behavior or action is prohibited.

Contents

1.1 DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

> ⚠ **WARNING**
> Applied when there is a danger of the user being injured or when there is a danger of both the user being injured and the equipment being damaged if the approved procedure is not observed.

> ⚠ **CAUTION**
> Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

> **NOTE**
> The Note is used to indicate supplementary information other than Warning and Caution.

- Read this manual carefully, and store it in a safe place.

1.2 WARNINGS AND CAUTIONS RELATING TO MOUNTING

1.2.1 Warning

⚠ WARNING

- **Check the specification code of the amplifier.**
  Check that the delivered amplifier is as originally ordered.

- **Mount a ground fault interrupter.**
  To guard against fire and electric shock, fit the factory power supply or machine with a ground fault interrupter (designed for use with an inverter).

- **Securely ground the amplifier.**
  Securely connect the ground terminal and metal frame of the amplifier and motor to a common ground plate of the power magnetic cabinet.

- **Be aware of the weight of the amplifier and other components.**
  Control motor amplifiers and AC reactors are heavy. When transporting them or mounting them in the cabinet, therefore, be careful not to injured yourself or damage the equipment. Be particularly carefull not to jam your fingers between the cabinet and amplifier.

- **Never ground or short-circuit either the power supply lines or power lines.**
  Protect the lines from any stress such as bending. Handle the ends appropriately.

- **Ensure that the power supply lines, power lines, and signal lines are securely connected.**
  A loose screw, loose connection, or the like will cause a motor malfunction or overheating, or a ground fault.
  Be extremely careful with power supply lines, motor power lines, and DC link connections through which a large amount of current passes, because a loose screw (or poor contact in a connector or poor connection between a connector terminal and a cable) may cause a fire.

- **Insulate all exposed parts that are charged.**

- **Never touch the regenerative discharge resistor or radiator directly.**
  The surface of the radiator and regenerative discharge unit become extremely hot. Never touch them directly. An appropriate structure should also be considered.

⚠ WARNING

- **Close the amplifier cover after completing the wiring.**
  Leaving the cover open presents a danger of electric shock.

- **Do not disassemble the amplifier.**

- **Ensure that the cables used for the power supply lines and power lines are of the appropriate diameter and temperature ratings.**

- **Do not apply an excessively large force to plastic parts.**
  If a plastic section breaks, it may cause internal damage, thus interfering with normal operation. The edge of a broken section is likely to be sharp and, therefore, presents a risk of injury.

1.2.2 Caution

⚠ CAUTION

- **Do not step or sit on the amplifier.**
  Also, do not stack unpacked amplifiers on top of each other.

- **Use the amplifier in an appropriate environment.**
  See the allowable ambient temperatures and other requirements, given in the corresponding descriptions.

- **Protect the amplifier from corrosive or conductive mist or drops of water.**
  Use a filter if necessary.

- **Protect the amplifier from impact.**
  Do not place anything on the amplifier.

- **Do not block the air inlet to the radiator.**
  A deposit of coolant, oil mist, or chips on the air inlet will result in a reduction in the cooling efficiency. In some cases, the required efficiency cannot be achieved. The deposit may also lead to a reduction in the useful life of the semiconductors. Especially, when outside air is drawn in, mount filters on both the air inlet and outlet. These filters must be replaced regularly. So, an easy-to-replace type of filter should be used.

- **Connect the power supply lines and power lines to the appropriate terminals and connectors.**

- **Connect the signal lines to the appropriate connectors.**

- **Before connecting the power supply wiring, check the supply voltage.**
  Check that the supply voltage is within the range specified in this manual, then connect the power supply lines.

- **Ensure that the combination of motor and amplifier is appropriate.**

- **Ensure that valid parameters are specified.**
  Specifying an invalid parameter for the combination of motor and amplifier may not only prevent normal operation of the motor but also result in damage to the amplifier.

- **Ensure that the amplifier and peripheral equipment are securely connected.**
  Check that the magnetic contactor, circuit breaker, and other devices mounted outside the amplifier are securely connected to each other and that those devices are securely connected to the amplifier.

⚠ CAUTION

- **Check that the amplifier is securely mounted in the power magnetic cabinet.**
  If any clearance is left between the power magnetic cabinet and the surface on which the amplifier is mounted, dust entering the gap may build up and prevent the normal operation of the amplifier.

- **Apply appropriate countermeasures against noise.**
  Adequate countermeasures against noise are required to maintain normal operation of the amplifier. For example, signal lines must be routed away from power supply lines and power lines.

1.2.3 Note

NOTE

- **Keep the nameplate clearly visible.**
- **Keep the legend on the nameplate clearly visible.**
- **After unpacking the amplifier, carefully check for any damage.**
- **Mount the amplifier in a location where it can be easily accessed periodic inspection and daily maintenance.**
- **Leave sufficient space around the machine to enable maintenance to be performed easily.**
  Do not place any heavy objects such that they would interfere with the opening of the doors.
- **Keep the parameter table and spare parts at hand.**
  Also, keep the specifications at hand. These items must be stored in a location where they can be retrieved immediately.
- **Provide adequate shielding.**
  A cable to be shielded must be securely connected to the ground plate, using a cable clamp or the like.

1.3 WARNINGS AND CAUTIONS RELATING TO A PILOT RUN

1.3.1 Warning

⚠ WARNING

- **Before turning on the power, check that the cables connected to the power magnetic cabinet and amplifier, as well as the power lines and power supply lines, are securely connected. Also, check that no lines are slack.**

- **Before turning on the power, ensure that the power magnetic cabinet is securely grounded.**

- **Before turning on the power, check that the door of the power magnetic cabinet and all other doors are closed.**
  Ensure that the door of the power magnetic cabinet containing the amplifier, and all other doors, are securely closed. During operation, all doors must be closed and locked.

- **Apply extreme caution if the door of the power magnetic cabinet or another door must be opened.**
  Only a person trained in the maintenance of the corresponding machine or equipment should open the door, and only after shutting off the power supply to the power magnetic cabinet (by opening both the input circuit breaker of the power magnetic cabinet and the factory switch used to supply power to the cabinet). If the machine must be operated with the door open to enable adjustment or for some other purpose, the operator must keep his or her hands and tools well away from any dangerous voltages. Such work must be done only by a person trained in the maintenance of the machine or equipment.

- **When operating the machine for the first time, check that the machine operates as instructed.**
  To check whether the machine operates as instructed, first specify a small value for the motor, then increase the value gradually. If the motor operates abnormally, perform an emergency stop immediately.

- **After turning on the power, check the operation of the emergency stop circuit.**
  Press the emergency stop button to check that the motor stops immediately, and that the power being supplied to the amplifier is shut off by the magnetic contactor.

- **Before opening a door or protective cover of a machine to enable adjustment of the machine, first place the machine in the emergency stop state and check that the motor has stopped.**

1.3.2 Caution

⚠ CAUTION

- **Note whether an alarm status relative to the amplifier is displayed at power-up or during operation.**
  If an alarm is displayed, take appropriate action as explained in the maintenance manual. If the work to be done requires that the door of the power magnetic cabinet be left open, the work must be carried out by a person trained in the maintenance of the machine or equipment. Note that if some alarms are forcibly reset to enable operation to continue, the amplifier may be damaged. Take appropriate action according to the contents of the alarm.

- **Before operating the motor for the first time, mount and adjust the position and speed sensors.**
  Following the instructions given in the maintenance manual, adjust the position and speed sensors for the spindle so that an appropriate waveform is obtained.
  If the sensors are not properly adjusted, the motor may not rotate normally or the spindle may fail to stop as desired.

- **If the motor makes any abnormal noise or vibration while operating, stop it immediately.**
  Note that if operation is continued in spite of there being some abnormal noise or vibration, the amplifier may be damaged. Take appropriate corrective action, then resume operation.

- **Observe the ambient temperature and output rating requirements.**
  The continuous output rating or continuous operation period of some amplifiers may fall as the ambient temperature increases. If the amplifier is used continuously with an excessive load applied, the amplifier may be damaged.

1.4 Warnings and Cautions Relating to Maintenance

1.4.1 Warning

⚠ WARNING

- **Read the maintenance manual carefully and ensure that you are totally familiar with its contents.**
  The maintenance manual describes daily maintenance and the procedures to be followed in the event of an alarm being issued. The operator must be familiar with these descriptions.

- **Notes on replacing a fuse or PC board**
  1) Before starting the replacement work, ensure that the circuit breaker protecting the power magnetic cabinet is open.
  2) Check that the red LED that indicates that charging is in progress is not lit.
     The position of the charging LED on each model of amplifier is given in this manual. While the LED is lit, hazardous voltages are present inside the unit, and thus there is a danger of electric shock.
  3) Some PC board components become extremely hot. Be careful not to touch these components.
  4) Ensure that a fuse having an appropriate rating is used.
  5) Check the specification code of a PC board to be replaced. If a modification drawing number is indicated, contact FANUC before replacing the PC board.
     Also, before and after replacing a PC board, check its pin settings.
  6) After replacing the fuse, ensure that the screws are firmly tightened. For a socket-type fuse, ensure that the fuse is inserted correctly.
  7) After replacing the PC board, ensure that it is securely connected.
  8) Ensure that all power lines, power supply lines, and connectors are securely connected.

- **Take care not to lose any screws.**
  When removing the case or PC board, take care not to lose any screws. If a screw is lost inside the nit and the power is turned on, the machine may be damaged.

⚠ WARNING

- **Notes on replacing the battery of the absolute Pulsecoder**
  Replace the battery only while the power is on. If the battery is replaced while the power is turned off, the stored absolute positioning data will be lost. Some αi series servo amplifier modules have batteries in their servo amplifiers. To replace the battery of any of those models, observe the following procedure: Open the door of the power magnetic cabinet; Leave the control power of the power supply module on; Place the machine in the emergency stop state so that the power being input to the amplifier is shut off; Then, replace the battery. Replacement work should be done only by a person who is trained in the related maintenance and safety requirements. The power magnetic cabinet in which the servo amplifier is mounted has a high-voltage section. This section presents a severe risk of electric shock.

- **Check the number of any alarm.**
  If the machine stops upon an alarm being issued, check the alarm number. Some alarms indicate that a component must be replaced. If the power is reconnected without first replacing the failed component, another component may be damaged, making it difficult to locate the original cause of the alarm.

- **Before resetting an alarm, ensure that the original cause of the alarm has been removed.**

- **Contact FANUC whenever a question relating to maintenance arises.**

- **Notes on removing the amplifier**
  Before removing the amplifier, first ensure that the power is shut off. Be careful not to jam your fingers between the power magnetic cabinet and amplifier.

1.4.2 Caution

⚠ CAUTION

- **Ensure that all required components are mounted.**
  When replacing a component or PC board, check that all components, including the snubber capacitor, are correctly mounted. If the snubber capacitor is not mounted, for example, the IPM will be damaged.

- **Tighten all screws firmly.**

- **Check the specification code of the fuse, PC board, and other components.**
  When replacing a fuse or PC board, first check the specification code of the fuse or PC board, then mount it in the correct position. The machine will not operate normally if a fuse or PC board having other than the correct specification code is mounted, or if a fuse or PC board is mounted in the wrong position.

- **Mount the correct cover.**
  The cover on the front of the amplifier carries a label indicating a specification code. When mounting a previously removed front cover, take care to mount it on the unit from which it was removed.

- **Notes on cleaning the heat sink and fan**
  1) A dirty heat sink or fan results in reduced semiconductor cooling efficiency, which degrades reliability. Periodic cleaning is necessary.
  2) Using compressed air for cleaning scatters the dust. A deposit of conductive dust on the amplifier or peripheral equipment will result in a failure.
  3) To clean the heat sink, do so only after turning the power off and ensuring that the heat sink has cooled to room temperature. The heat sink becomes extremely hot, such that touching it during operation or immediately after power-off is likely to cause a burn. Be extremely careful when touching the heat sink.

- **Unless otherwise specified, do not insert or remove any connector while the power is turned on. Otherwise, the amplifier may fail.**

1.4.3 Note

NOTE

- **Ensure that the battery connector is correctly inserted.**
  If the power is shut off while the battery connector is not connected correctly, the absolute position data for the machine will be lost.

- **Store the manuals in a safe place.**
  The manuals should be stored in a location where they can be accessed immediately it so required during maintenance work.

- **Notes on contacting FANUC**
  Inform FANUC of the details of an alarm and the specification code of the amplifier so that any components required for maintenance can be quickly secured, and any other necessary action can be taken without delay.

TABLE OF CONTENTS

1 CONFIGURATION

1.1 FEATURES OF THE SERVO AMPLIFIER αi SERIES

The servo amplifier α*i* series employs a modular structure, and is thinner, conserves more space, outputs less heat, and saves more energy than the conventional servo amplifier α series.

Compact

(1) By employing a leading-edge low-loss power device and newly developed high-efficient heat sink, the fin depth is reduced to 100 mm for all models to decrease the depth of the amplifier by about 10%.
(2) The amplifier width of boundary models is reduced to the width of models one rank lower. This improvement, together with a reduction in depth, has decreased the mounting space required in the cabinet by about 30% on the average.
(3) The shape of the cable connector is improved to reduce the length of cable projection into the control board.
(4) From the α(HV)*i* series, the capacitor module is removed to reduce the installation area.

Reduction in cabling

(1) Only one cable is now used for connection between modules.
(2) The connection from the motor output terminal block to the flange section is made internally to eliminate an external connection via a cable. (A connection from the top of the flange to the system ground on the control board is required.)

Connector attachment to power lines

(1) Connectors are attached to input power lines and motor power lines. (For the large-capacity models, terminal blocks are used.) The time required for power line attachment to and detachment from the servo amplifier cabinet is substantially reduced.

Improved maintainability

(1) A fan motor can now be replaced in an instant manner, so that the time required to replace a fan motor is reduced substantially.
(2) Connectors are attached to input power lines and motor power lines, so that the time required for servo amplifier replacement is reduced substantially.
(3) The need to perform reference position return operation after servo amplifier replacement is eliminated.
The servo amplifier α*i* series has a built-in backup capacitor in the Absolute Pulsecoder as standard. The capacitor enables absolute position detection operation for about 10 minutes, so that reference position return operation after servo amplifier or feedback cable replacement is unnecessary.

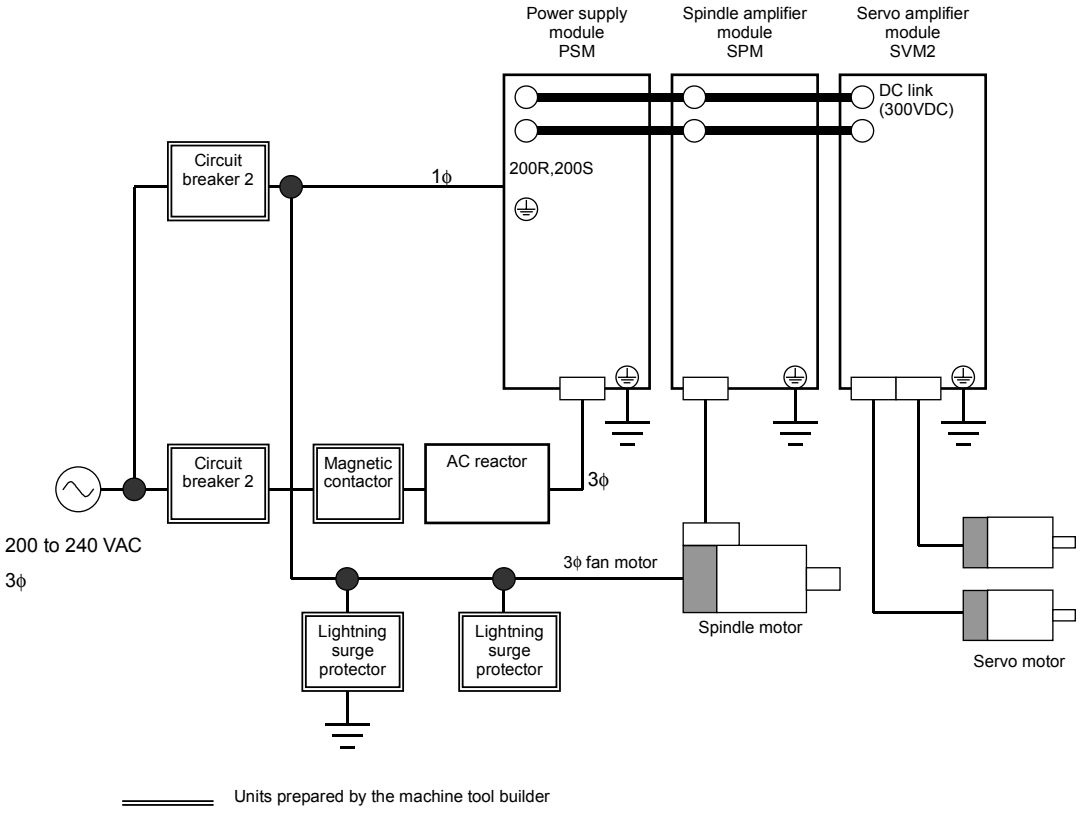
1.2 CONFIGURATION

The FANUC αi series consists of the following units and parts:

1.2.1 200-V Input Series

(1) Power supply module (PSM) ..... (Basic)
(2) Power supply module (PSMR) ..... (Basic)
[register discharge type]
(3) Servo amplifier module (SVM) ..... (Basic)
(4) Spindle amplifier module (SPM) ..... (Basic)
(5) Spindle amplifier module (SPMC) ..... (Basic)
(6) AC reactor ..... (Basic)
(7) Connectors (for connection cables) ..... (Basic)
(8) Fuses ..... (Basic)
(9) Power transformer ..... (Optional)
(10) AC line filter ..... (Basic)
(11) Regenerative discharge unit ..... (Basic)
(12) Dynamic brake module (DBM) ..... (Basic)

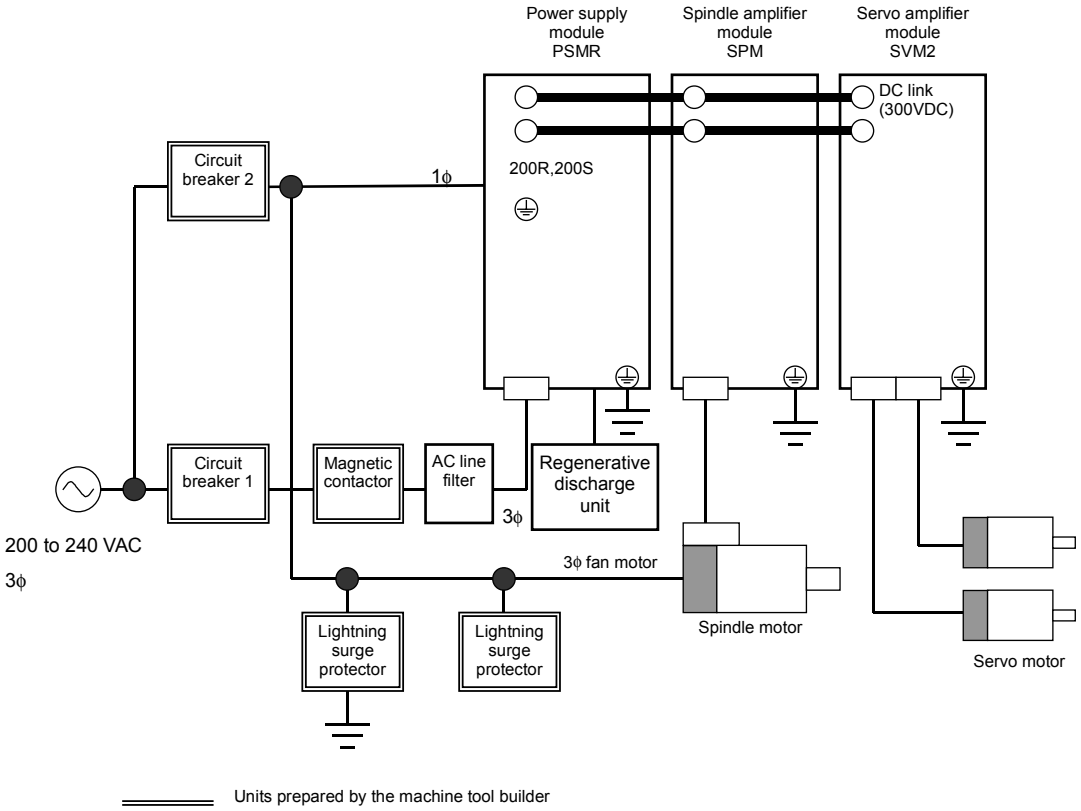
Basic configuration using PSM (example)



NOTE

1 See Chapter 4 for details of how to combine the power supply module, servo amplifier modules, and spindle amplifier modules.
2 A magnetic contactor, AC line filter, and circuit breakers are always required.
3 To protect the unit from surge currents caused by lightning, connect surge absorbers between lines, and between the lines and ground, at the power inlet of the power magnetic cabinet. See APPENDIX A for details.

Basic configuration using PSMR (example)



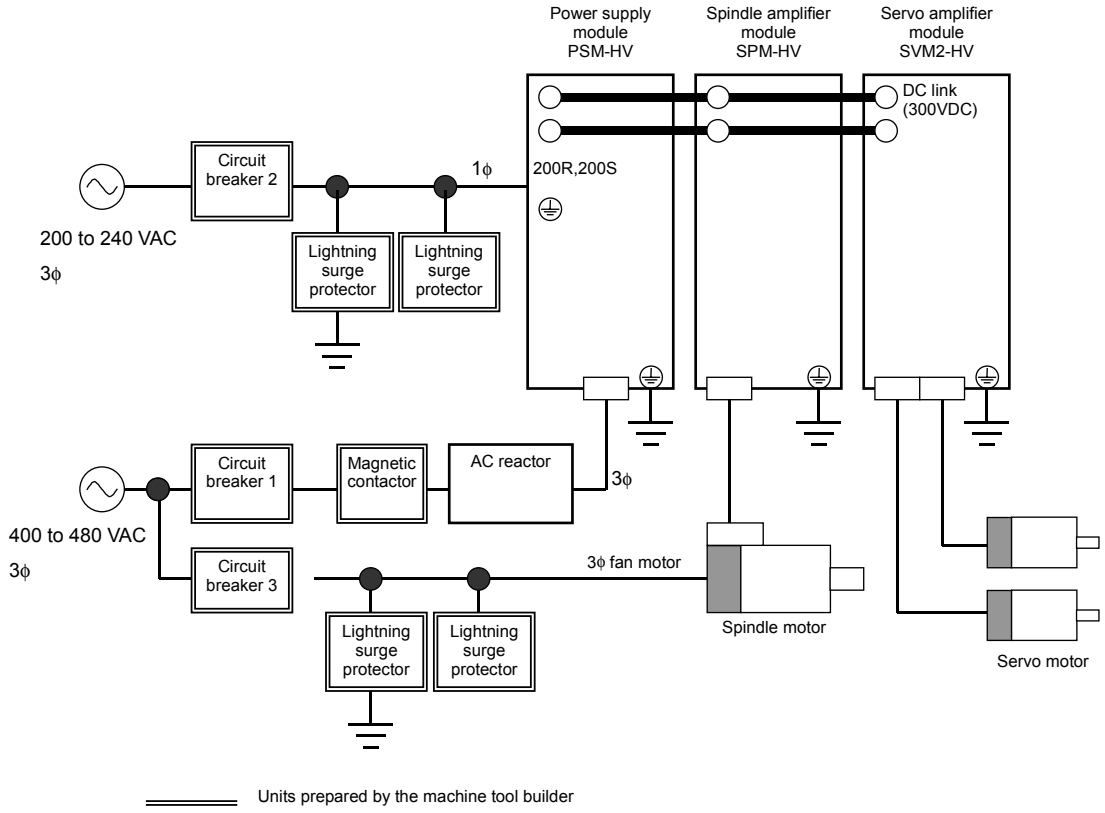
NOTE

1 See Chapter 4 for details of how to combine the power supply module, servo amplifier modules, and spindle amplifier modules.
2 A magnetic contactor, AC line filter, and circuit breakers are always required.
3 To protect the unit from surge currents caused by lightning, connect surge absorbers between lines, and between the lines and ground, at the power inlet of the power magnetic cabinet. See APPENDIX A for details.
4 When an insulating transformer is installed, high-frequency noise to the power supply is reduced, so the AC line filter is not required. If the insulating transformer is installed outside the power magnetic cabinet, and the cable connecting the amplifier is exposed, the cable must be covered with a grounded metal duct, or an AC line filter must be installed.

1.2.2 400-V Input Series

(1) Power supply module (PSM-HV) ..... (Basic)
(2) Servo amplifier module (SVM-HV) ..... (Basic)
(3) Spindle amplifier module (SPM-HV) ..... (Basic)
(4) AC reactor ..... (Basic)
(5) Connectors (for connection cables) ..... (Basic)
(6) Fuses ..... (Basic)
(7) Dynamic brake module (DBM) ..... (Basic)

Basic configuration using PSM-HV (example)



NOTE

1 For the control power supply, single–phase 200VAC is required.
2 See Chapter 4 for details of how to combine the power supply module, servo amplifier modules, and spindle amplifier modules.
3 A magnetic contactor, AC line filter, and circuit breakers are always required.
4 To protect the unit from surge currents caused by lightning, connect surge absorbers between lines, and between the lines and ground, at the power inlet of the power magnetic cabinet. See APPENDIX A for details.
5 Measures must be taken to detect the operation (trip) of circuit breaker 3.

1.3 MODULE NAME

Power supply module (PSM)

The power supply module (PSM) supplies main power for driving motors and supplies control power to other modules. A PSM specification is selected according to the servo motors and spindle motor used.

There are three types of power supply module, as follows:

<1> Power supply module (PSM)

This power supply module is designed to provide a main power supply of 200 to 240 V. The module uses power regeneration that returns energy to the power supply during motor deceleration (regeneration).

<2> Power supply module (PSMR)

This power supply module is designed to provide a main power supply of 200 to 240 V. The module uses resistance regeneration that allows energy to be consumed by resistance during motor deceleration (regeneration).

Regenerative discharge unit

This unit is a resistance used to consume energy during motor deceleration (regeneration). This unit is required whenever the PSMR is used.

<3> Power supply module (PSM-HV)

This power supply module can be connected to a main power supply of 400 to 480V without a transformer. The module uses power regeneration that returns energy to the power supply during motor deceleration (regeneration). It is used together with a servo amplifier module (SVM-HV) and spindle amplifier module (SPM–HV) of the 400-V input series.

PSM - x HV *i*
(A) (B) (C)
(A) Model name: PSM = Power supply module PSMR= Power supply module (register discharge type)
(B) Rated output: Numeric value representing a continuous rating in kW
(C) For an amplifier supporting 400-V input, "HV" is added.

Servo amplifier module (SVM)

The servo amplifier module (SVM) is used to drive servo motors. An SVM is selected according to the servo motor(s) connected to the SVM.

There are two types of servo amplifier module, as follows:

<1> Servo amplifier module (SVM)
This module drives a servo motor of the 200-V input series. Modules for one axis, two axes, and three axes are available.

<2> Servo amplifier module (SVM-HV)
This module drives a servo motor of the 400-V input series. Modules for one axis and two axes are available.

SVM x - x / x / x HV *i*
(A) (B) (C) (D) (E) (F)

(A) Model name: SVM = Servo amplifier module
(B) Number of axes: 1 = One-axis amplifier, 2 = Two-axis amplifier, 3 = Three-axis amplifier
(C) L-axis maximum output current value [Apeak]
(D) M-axis maximum output current value [Apeak]
(E) N-axis maximum output current value [Apeak]
(F) For an amplifier supporting 400-V input, "HV" is added.

Spindle amplifier module (SPM)

The spindle amplifier module (SPM) is used to drive a spindle motor. An SPM is selected according to the spindle motor connected to the SPM.

There are three types of spindle amplifier module, as follows:

<1> Spindle amplifier module (SPM)
This module drives a spindle motor of the 200-V input series.

<2> Spindle amplifier module (SPMC)
This module drives the αC*i* series spindle motor.

<2> Spindle amplifier module (SPM-HV)
This module drives a spindle motor of the 400V input series.

SPM - x HV *i*
(A) (B) (C)

(A) Model name: SPM = Spindle amplifier module
SPMC= Spindle amplifier module applied to spindle motor αC*i* series
(B) Output: Numeric value representing the 30-minutes rating of a matching standard motor (α*i*) in kW
(C) For an amplifier supporting 400-V input, "HV" is added.

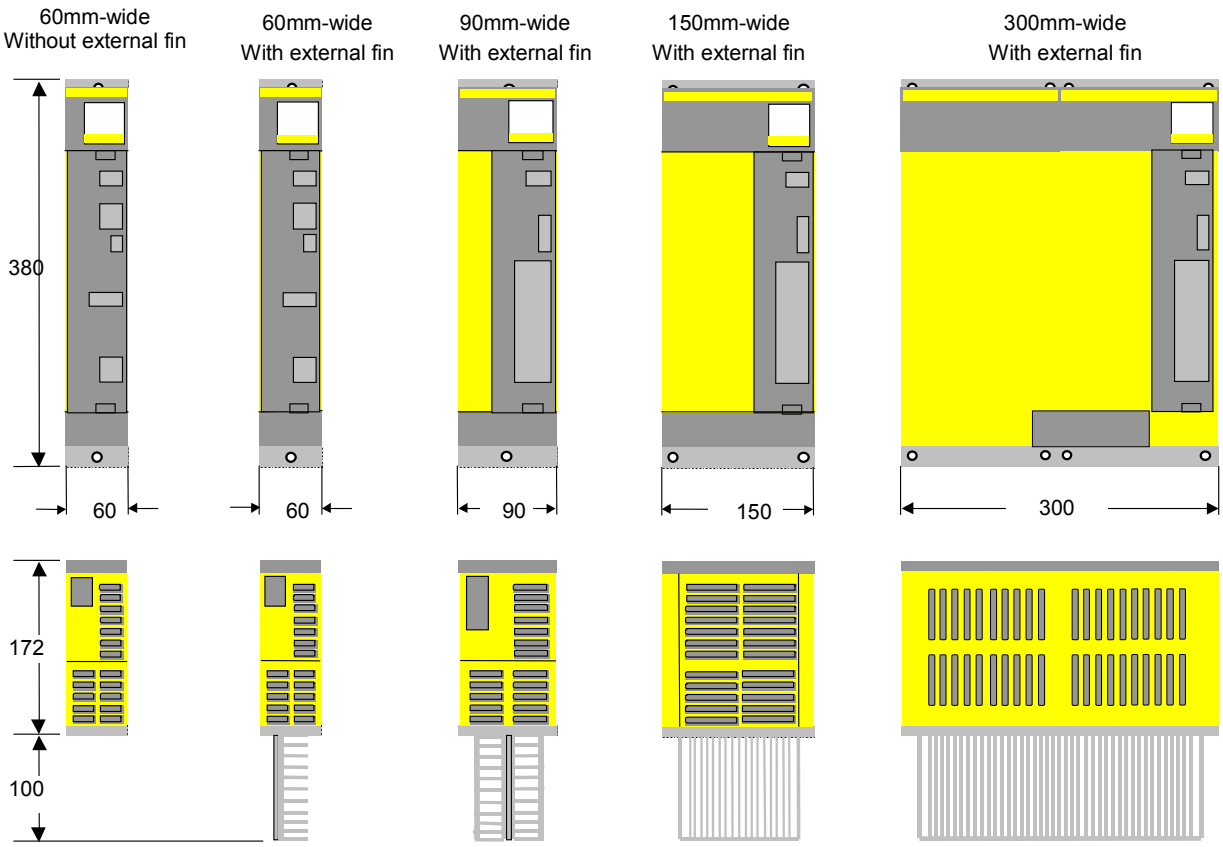
1.4 LINEUP

200-V input type

Size	PSM	PSMR	SPM	SPMC	SVM1	SVM2	SVM3
60mm-wide Without external fin		3*i*			20*i*	4/4*i* 20/20*i*	4/4/4*i* 20/20/20*i*
60mm-wide With external fin	5.5*i*	5.5*i*	2.2*i* 5.5*i*	2.2*i* 5.5*i*	40*i* 80*i* 160*i*	20/40*i* 40/40*i* 40/80*i* 80/80*i*	20/20/40*i*
90mm-wide With external fin	11*i* 15*i*		11*i* 15*i*	11*i* 15*i*		80/160*i* 160/160*i*	
150mm-wide With external fin	26*i* 30*i* 37*i*		22*i* 26*i* 30*i*	22*i*	360*i*		
300mm-wide With external fin	55*i*		45*i* 55*i*				

400-V input type

Size	PSM	SPM	SVM1	SVM2
60mm-wide Without external fin			10HV*i*	10/10HV*i*
60mm-wide With external fin		5.5HV*i*	20HV*i* 40HV*i* 80HV*i*	20/20HV*i*
90mm-wide With external fin	11HV*i* 18HV*i*	11HV*i* 15HV*i*		20/40HV*i* 40/40HV*i* 40/80HV*i* 80/80HV*i*
150mm-wide With external fin	30HV*i* 45HV*i*	30HV*i* 45HV*i*	180HV*i*	
300mm-wide With external fin	75HV*i* 100HV*i*	75HV*i* 100HV*i*	360HV*i*	


60mm-wide
Without external fin
60mm-wide
With external fin
90mm-wide
With external fin
150mm-wide
With external fin
300mm-wide
With external fin
380
60
60
90
150
300
172
100

2 SPECIFICATIONS

2.1 INPUT POWER

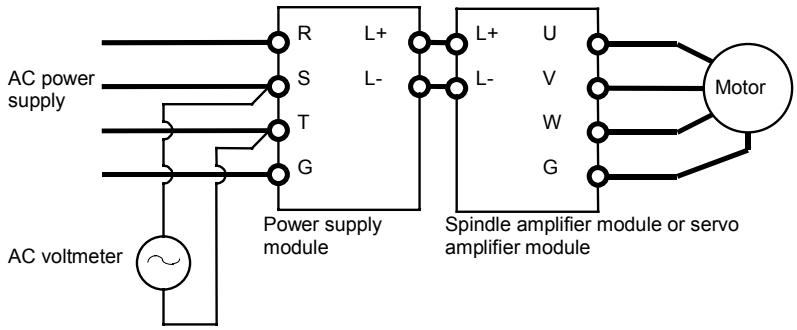
Power supply of 200-V input series

(1) Power specification

Item	Specification
Power supply voltage for the main circuit	Three-phase 200 VAC to 240 VAC
Power supply voltage for the control circuit	Single-phase 200 VAC to 240 VAC (input from connector CX1A)
Allowable voltage deviation	-15% to +10% (including voltage variation due to load)
Power frequency	50/60Hz, ±1Hz
Power supply unbalance	±5% of the rated voltage or less
Power supply impedance (Note)	The voltage variation must be within ±7% when a maximum output is produced for voltage at non-load time (power running and regeneration).

NOTE
When the power supply impedance is high, and the voltage variation exceeds the specified values, a PSM alarm (DC link undervoltage alarm or DC link overvoltage alarm) can be issued, or the output of the motor can decrease.

[Method of checking power supply impedance]



$$\frac{E0-E1}{E0}\times 100(\%) < 7(\%)$$

E0 : Voltage at non-load time
E1 : Voltage at maximum output time (power running and regeneration)

(2) The control circuit power to the power supply module (power input to CX1A) must be turned on before the power to the CNC is turned on or within 500 ms after the power to the CNC is turned on.

(3) It is recommended that a capacitor unit for power-factor improvement not be installed. This is because the capacitor unit for power-factor improvement may adversely affect power regeneration.

(4) The rated output of the motor is guaranteed for the rated input voltage. If the input voltage changes, the rated output may not appear even when the input voltage change is within the allowable range.

(5) When the power supply is used in an area where the input voltage is not within the range of 200 to 240 VAC, a power transformer is required. When a power transformer is to be provided by the user, the power must satisfy the specifications listed below.

(6-1) PSM

Table 2.1(a) Transformer Specifications

	PSM-5.5*i*	**PSM-11*i***	**PSM-15*i***	**PSM-26*i***	**PSM-30*i***	**PSM-37*i***	**PSM-55*i* (45kW output)**	**PSM-55*i* (55kW output)**
Rated capacity (kVA)	9	17	22	37	44	53	64	79
Secondary current (A)	26	48	62	105	130	153	185	230
Secondary output voltage	200 to 240 V							
Secondary voltage regulation	5%							
Secondary voltage deviation	±3%							

(6-2) PSMR

Table 2.1(b) Transformer Specifications

	PSMR-3*i* (2kW output)	**PSMR-3*i* (3kW output)**	**PSMR-5.5*i* (5.5kW output)**	**PSMR-5.5*i* (7.5kW output)**
Rated capacity (kVA)	3.5	5	9	13
Secondary current (A)	10	14	26	38
Secondary output voltage	200 to 240 V			
Secondary voltage regulation	5%			
Secondary voltage deviation	±3%			

(7) Ground

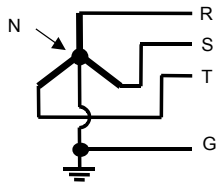
The main circuit and 200V control power supply must be grounded through the neutral point or one phase of the three-phase power supply.

(8) Noise filter

To satisfy the EMC regulation enforced in the EU countries, a noise filter must be installed in the PSM input section.

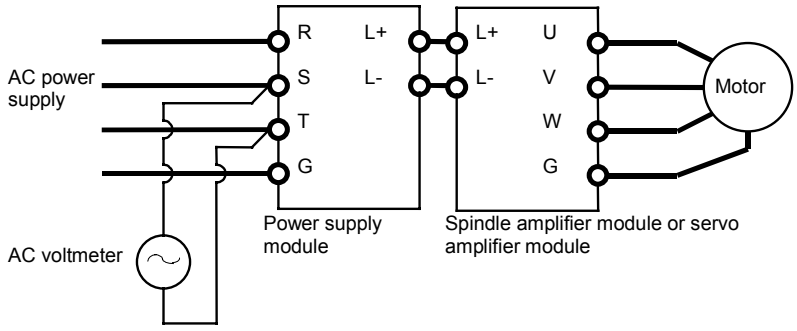
Power supply of 400-V input series

(1) Power specification

Item	Specification
Power supply voltage for the main circuit	Three-phase 400 VAC to 480 VAC Star connection, neutral grounding (For details, see Items (5) and (6).) 
Power supply voltage for the control circuit	Single-phase 200 VAC to 240 VAC (input from connector CX1A) (For details, see Item (7).)
Allowable voltage deviation	-15% to +10% (including voltage variation due to load)
Power frequency	50/60Hz, ±1Hz
Power supply unbalance	±5% of the rated voltage or less
Power supply impedance (Note)	The voltage variation must be within ±7% when a maximum output is produced for voltage at non-load time (power running and regeneration).

NOTE
When the power supply impedance is high, and the voltage variation exceeds the specified values, a PSM alarm (DC link undervoltage alarm or DC link overvoltage alarm) can be issued, or the output of the motor can decrease.

[Method of checking power supply impedance]



$$\frac{E0-E1}{E0}\times 100(\%) < 7(\%)$$

E0 : Voltage at non-load time
E1 : Voltage at maximum output time (power running and regeneration)

(2) The control circuit power to the power supply module (power input to CX1A) must be turned on before the power to the CNC is turned on or within 500 ms after the power to the CNC is turned on.

(3) It is recommended that a capacitor unit for power-factor improvement not be installed. This is because the capacitor unit for power-factor improvement may adversely affect power regeneration.

(4) The rated output of the motor is guaranteed for the rated input voltage. If the input voltage changes, the rated output may not appear even when the input voltage change is within the allowable range.

(5) Power supply voltage for the main circuit

- The power specification of the main circuit for the αHV*i* series servo amplifier is as follows:
  <1> Star connection
  <2> Neutral grounding on the power supply side
  <3> A PE is provided on the power line. (The PE of the amplifier and motor is connected to the PE of the power line.)
  <4> The inter-phase voltage of the power supply is 400 VAC to 480 VAC (-15%, +10%).
- If the power supply does not satisfy the conditions above, the power supply needs to be converted to a power supply for neutral grounding by using a star connection and an isolating-transformer.
- The αHV*i* series servo amplifier is designed in compliance with the safety standard EN50178 to implement insulation design of the pattern and components of the printed circuit board by ensuring that the phase voltage of the power supply and the voltage between grounds connected to the neutral point of the star connection are AC 300 Vrms or below.
  Accordingly, if the power supply does not satisfy the conditions above, the pattern and components of the printed circuit board are poorly insulated. This can cause very dangerous states including a failure in servo amplifier operation and the occurrence of a high voltage at exposed areas.

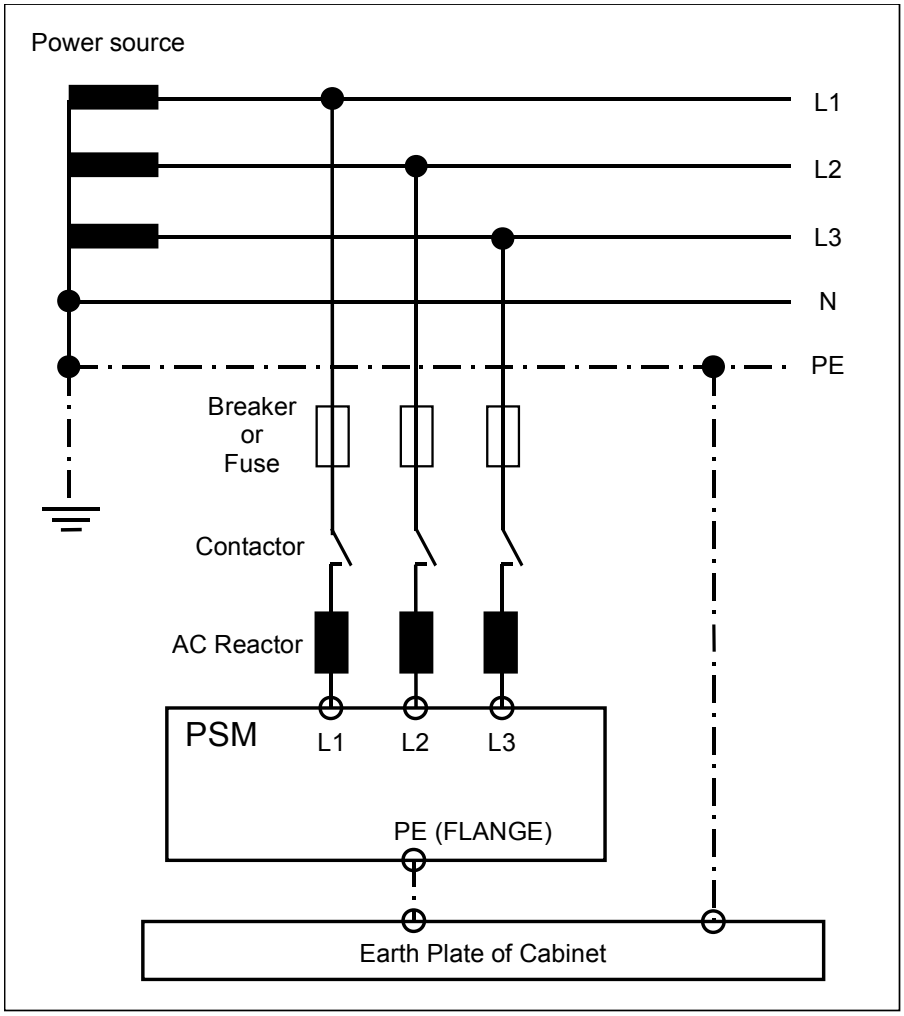
(6) Example of connecting the power supply of the main circuit

No.	Power system	Power specification	Power supply of amplifier
1	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification 400 VAC to 480 VAC (-15%,+10%)	• Directly connectable to the power supply (No transformer is required.)
2	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification Not within the range 400 VAC to 480 VAC (-15%, +10%)	[When the power supply voltage is lower than the specified power supply voltage] The power supply voltage is increased with an auto-transformer. [When the power supply voltage is higher than the specified power supply voltage] The power supply voltage is decreased with an auto-transformer.
3	TN-power system	• Delta connection • Single-phase grounding on the power supply side • PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.
4	TT-power system	• Star connection • Neutral grounding on the power supply side • No PE provided on the power line	
5	TT-power system	• Delta connection • Single-phase grounding on the power supply side • No PE provided on the power line	
6	IT-power system	• Star connection • No direct ground connection made on the power supply side • No PE provided on the power line	
7	IT-power system	• Delta connection • No direct ground connection made on the power supply side • No PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.

* The TN-power system, TT-power system, and IT-power system are based on the DC power distribution system standard IEC60364.

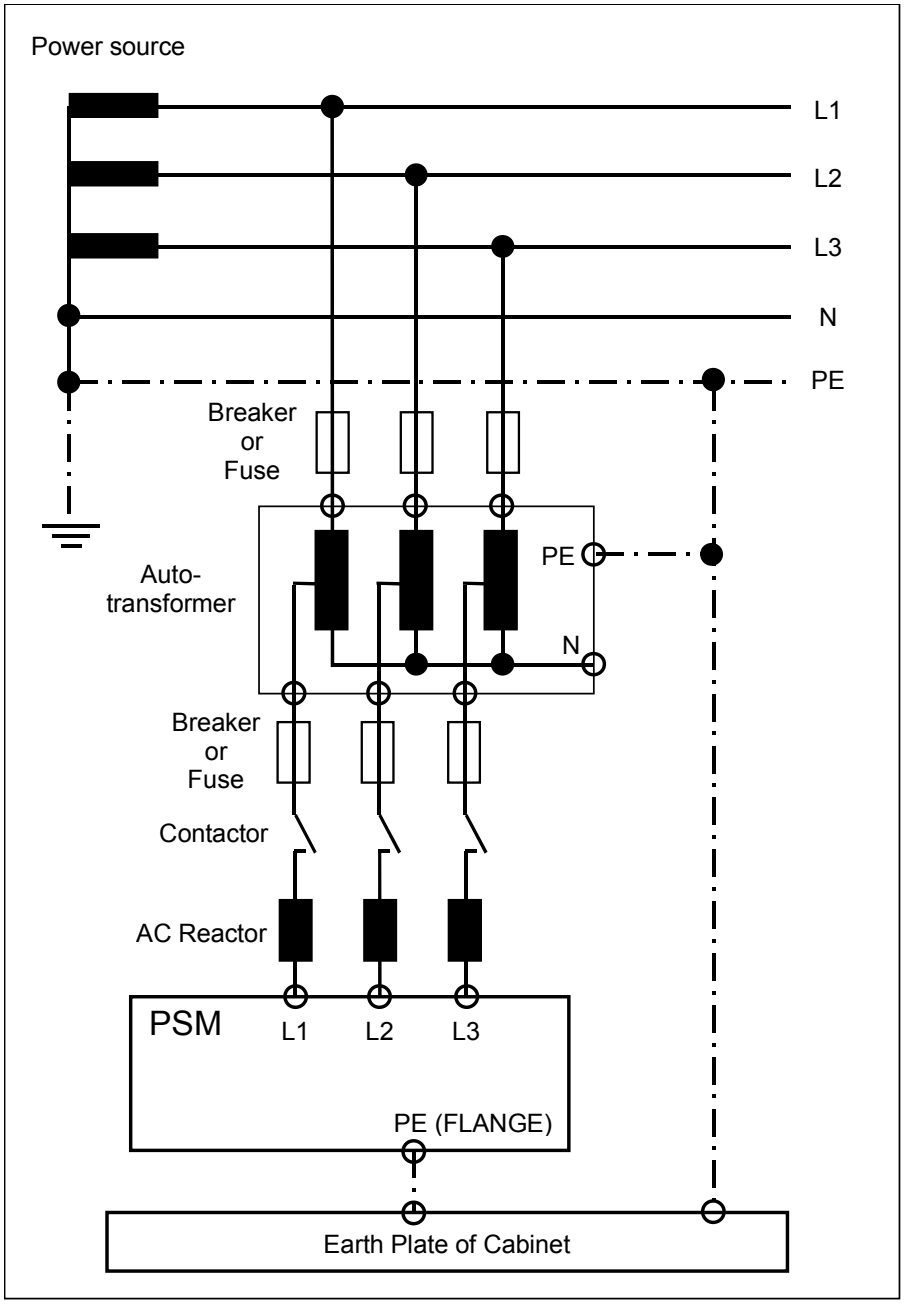
(a) TN-power system

No.	Power system	Power specification	Power supply of amplifier
1	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification 400 VAC to 480 VAC (-15%,+10%)	• Directly connectable to the power supply (No transformer is required.)



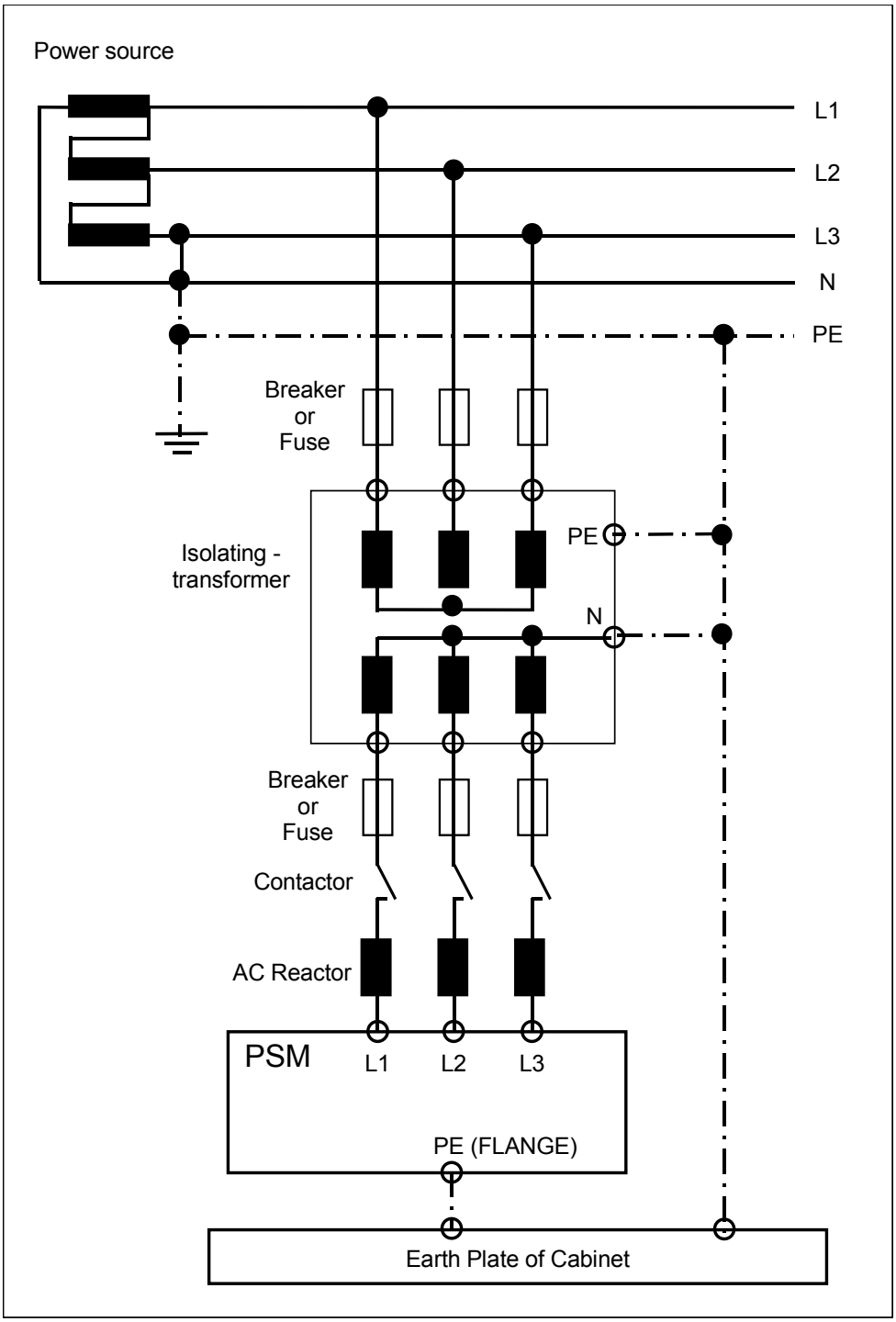
(b) TN-power system

No.	Power system	Power specification	Power supply of amplifier
2	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification 480 VAC or more	• The power supply voltage is decreased with an auto-transformer.



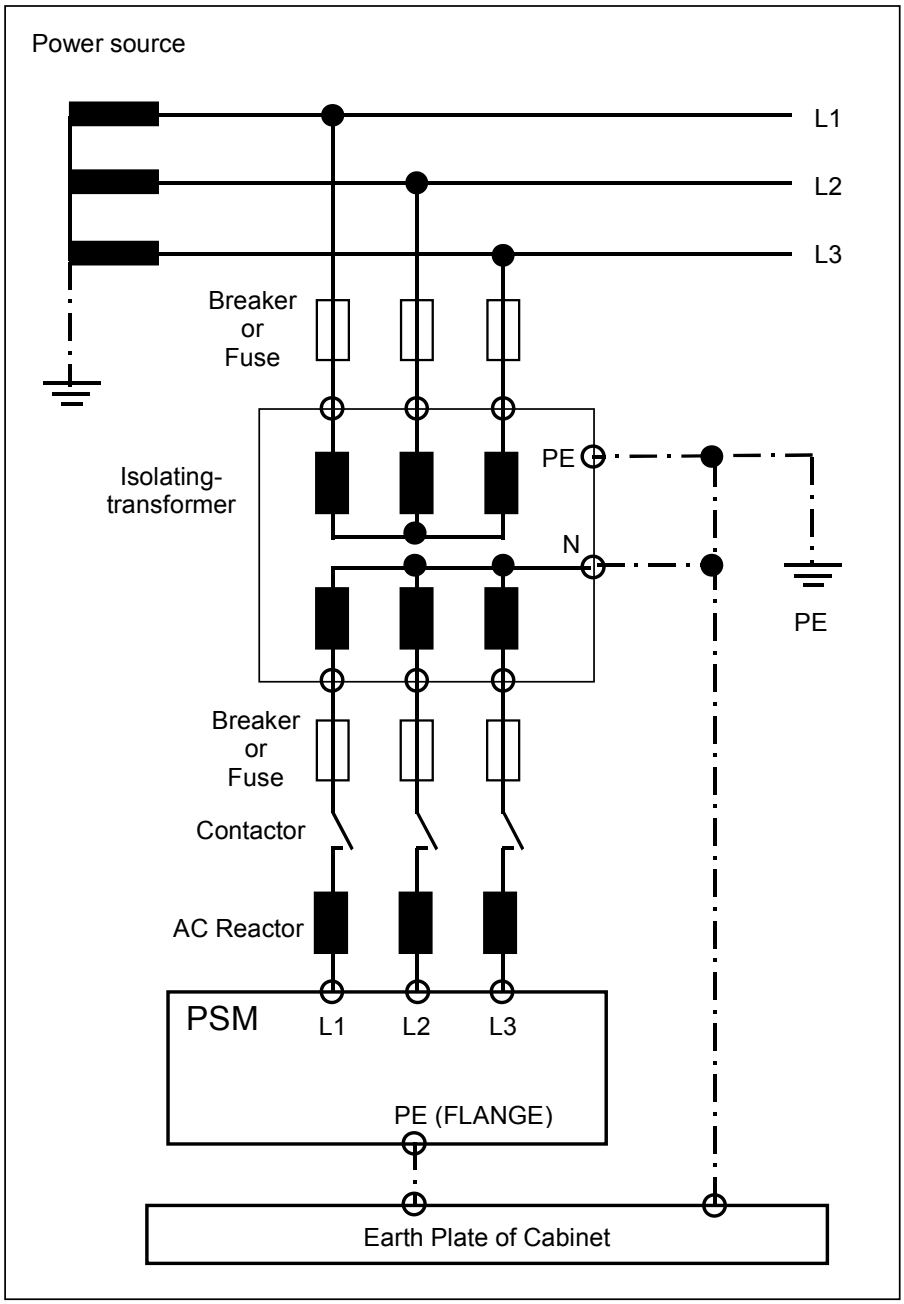
(c) TN-power system

No.	Power system	Power specification	Power supply of amplifier
3	TN-power system	• Delta connection • Single-phase grounding on the power supply side • PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.



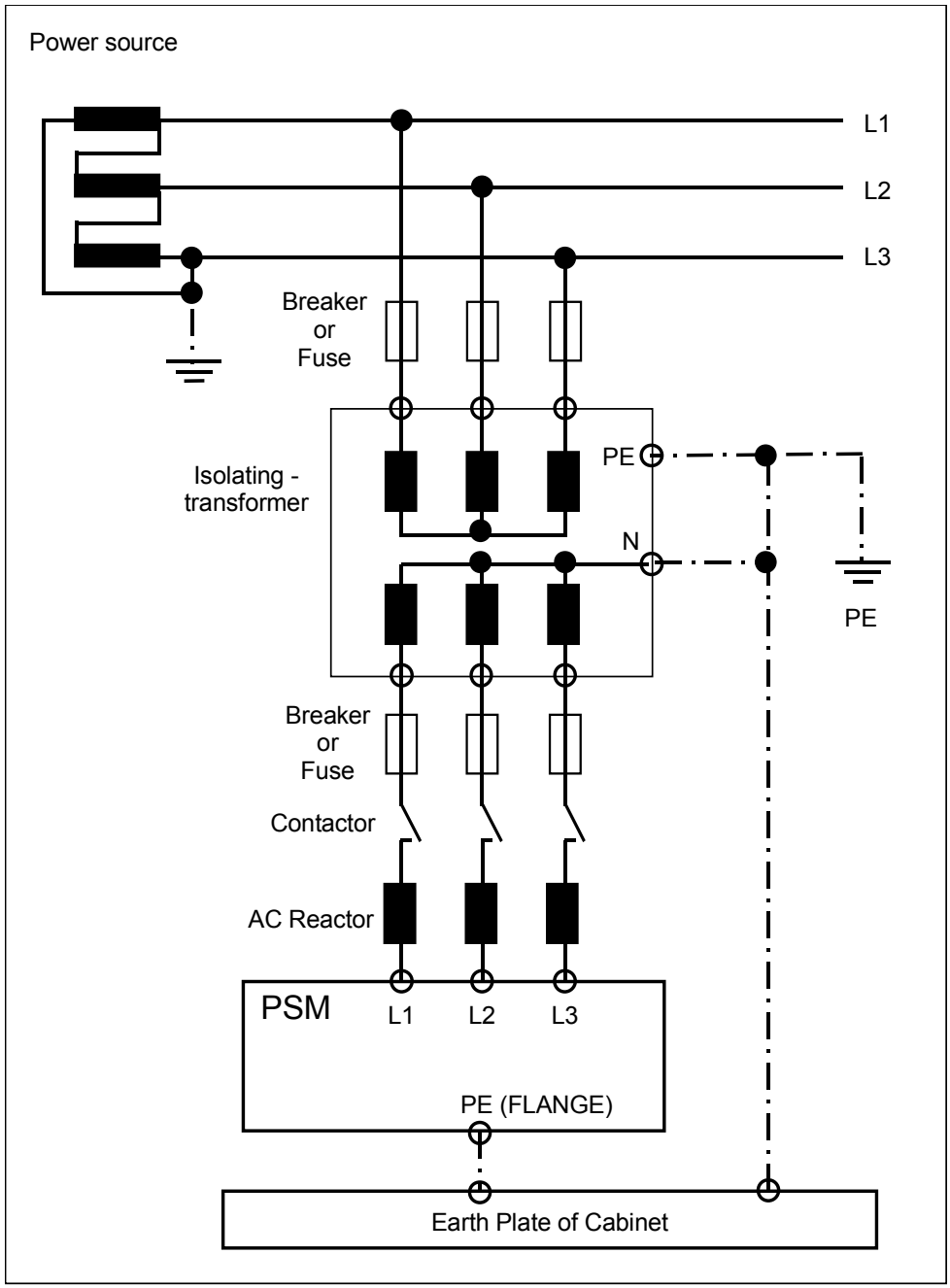
(d) TT-power system

No.	Power system	Power specification	Power supply of amplifier
4	TT-power system	• Star connection • Neutral grounding on the power supply side • No PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.



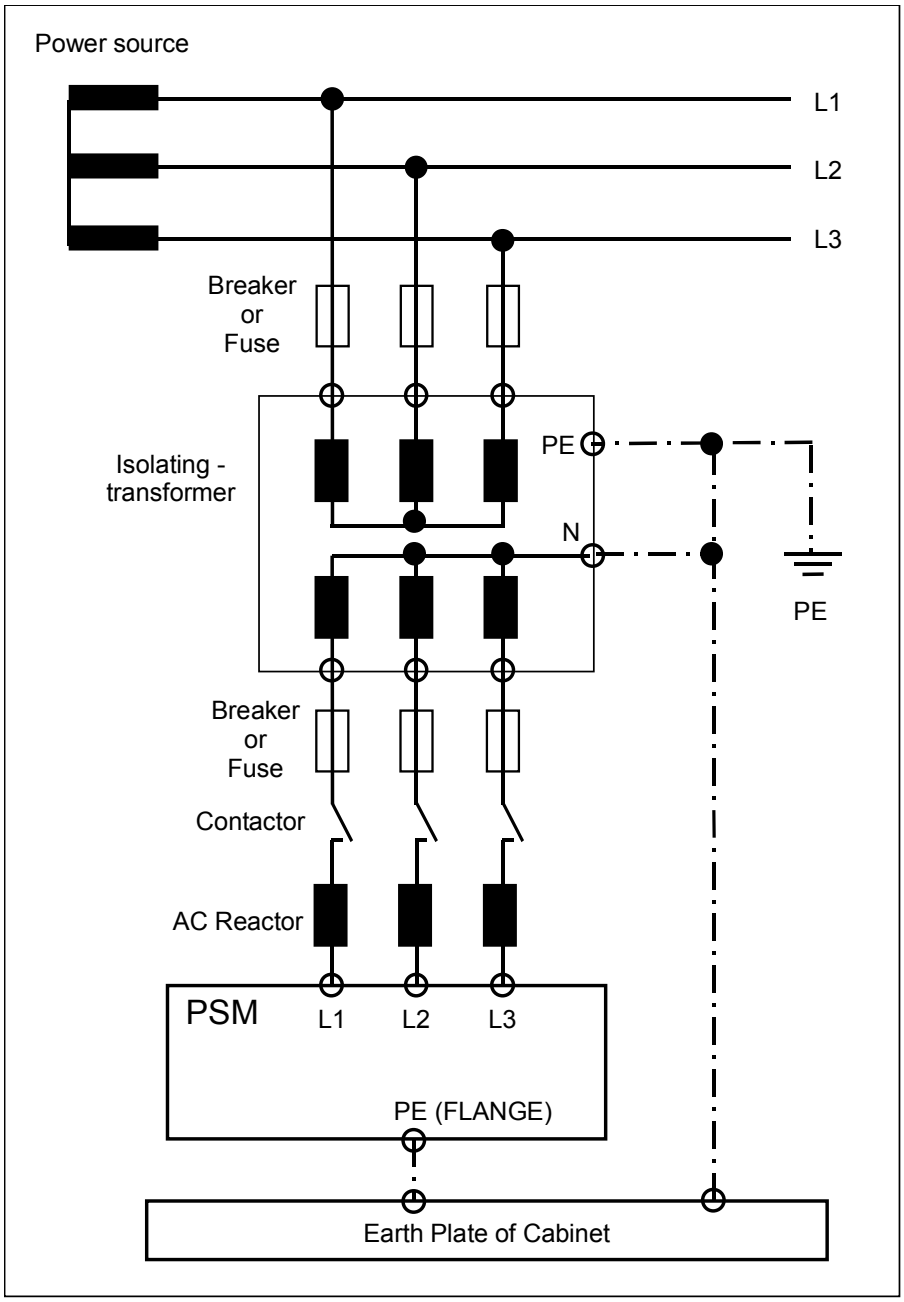
(e) TT-power system

No.	Power system	Power specification	Power supply of amplifier
5	TT-power system	• Delta connection • Single-phase grounding on the power supply side • No PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.



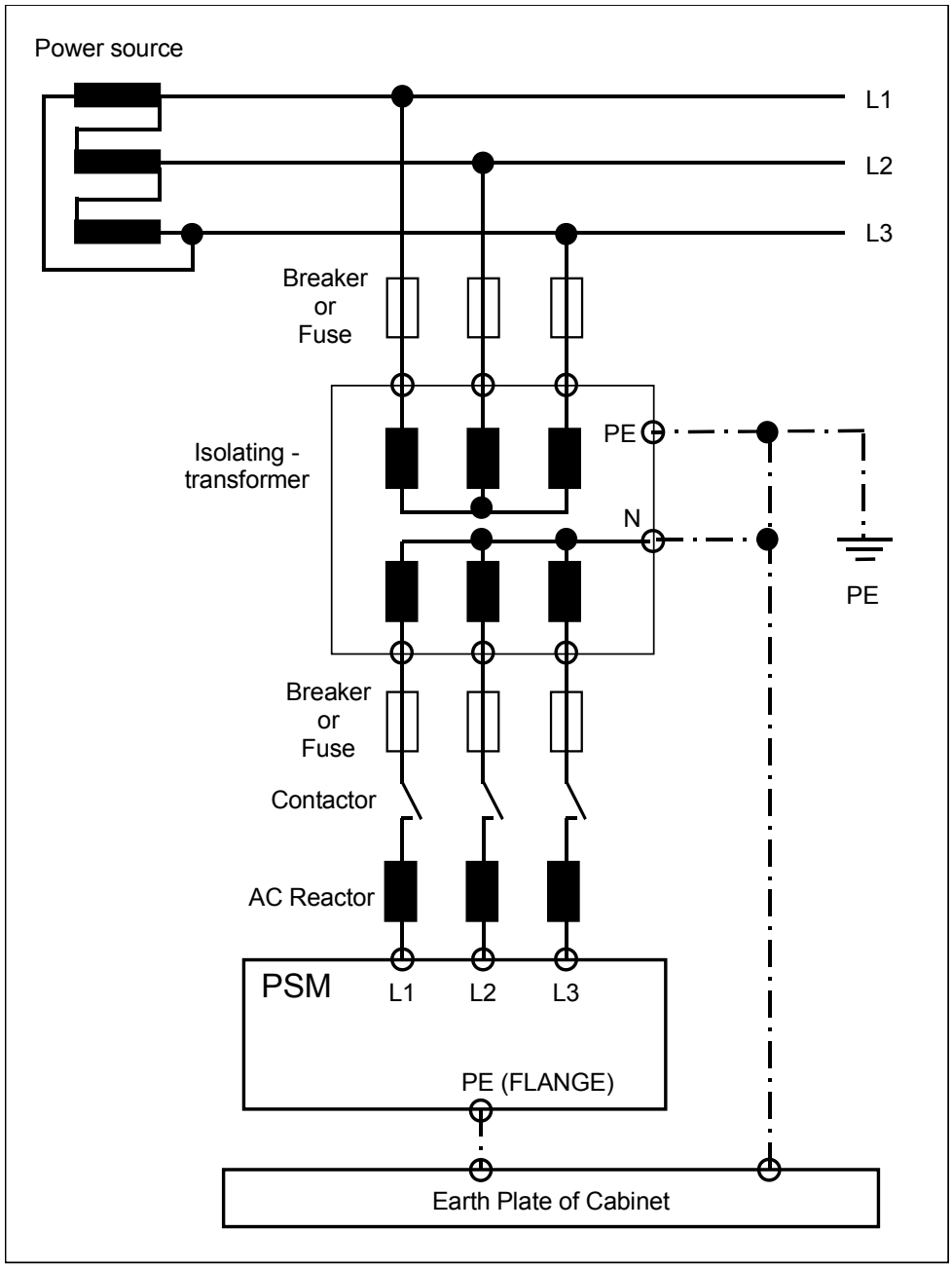
(f) IT-power system

No.	Power system	Power specification	Power supply of amplifier
6	IT-power system	• Star connection • No direct ground connection made on the power supply side • No PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.



(g) IT-power system

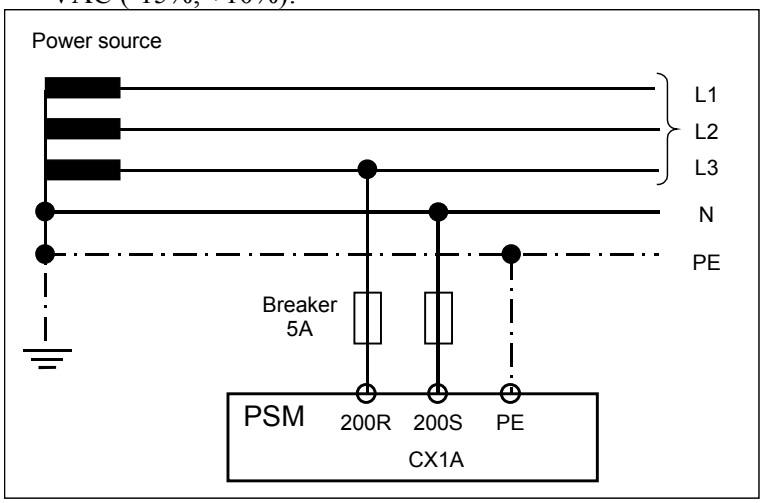
No.	Power system	Power specification	Power supply of amplifier
7	IT-power system	• Delta connection • No direct ground connection made on the power supply side • No PE provided on the power line	• An isolating-transformer is used. • A star connection is made on the secondary side of an isolating-transformer, and the neutral point is grounded.



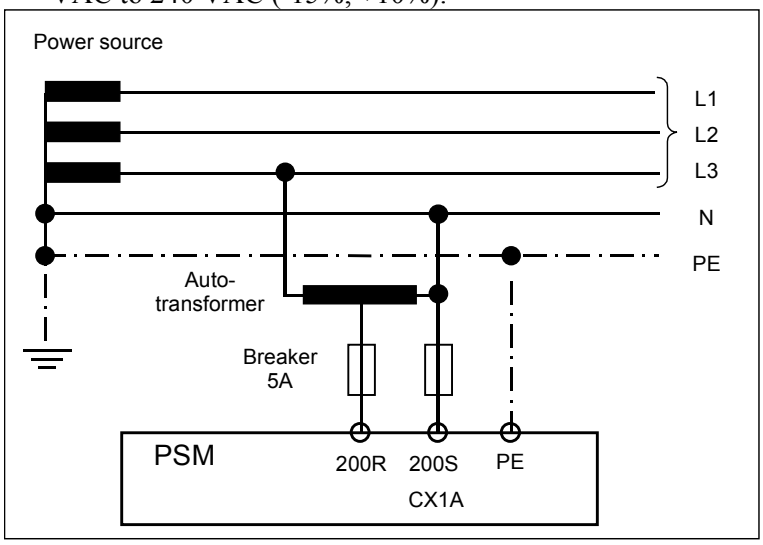
(7) Control power supply connection

- Specification of the control power supply voltage for the αHV*i* series servo amplifier
  Single-phase 200 VAC to 240 VAC (-15%, +10%)
- When the power supply has a neutral point, power can be supplied from the neutral point and phase voltage to the control power supply.
  When an isolating-transformer is used, connect one phase of the control power supply to the neutral point on the secondary side of the isolating-transformer.

(a) Example of connection when the three-phase power supply voltage of the main circuit is 400 VAC
With the following connection, the control power supply voltage can be converted to single-phase 200 VAC to 240 VAC (-15%, +10%):



(b) Example of connection when the three-phase power supply voltage of the main circuit is 460 VAC to 480 VAC
By using an auto-transformer, ensure that the single-phase power supply voltage for the control power supply is 200 VAC to 240 VAC (-15%, +10%).



2.2 ENVIRONMENTAL CONDITIONS

The servo amplifier αi series must be installed in a sealed type cabinet to satisfy the following environmental requirements:

(1) Ambient Temperature
Ambient temperature of the unit :
0 to 55°C (at operation)
-20 to 60°C (at keeping and transportation)
Ambient temperature outside of the cabinet : 0 to 45°C

(2) Humidity
Normally 90% RH or below, and condensation-free

(3) Vibration
In operation : Below 0.5G

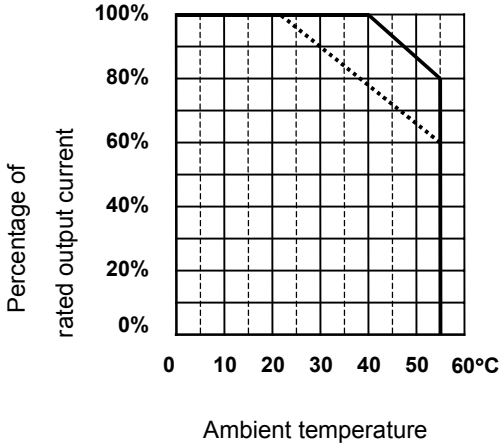
(4) Atmosphere
No corrosive or conductive mists or drops should deposit directly on the electronic circuits.

NOTE
Install the electronic circuits in an environment of contamination level 2 as defined in IEC 60664-1. To achieve contamination level 2 in a severe environment where machine tools are used, electronic circuits generally need to be installed in a cabinet complying with IP54.

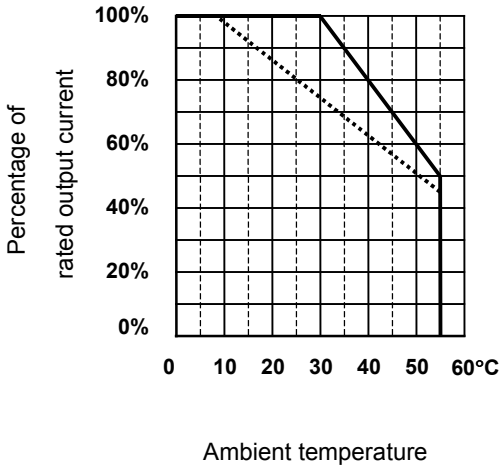
(5) Notes on Installation
The αi series servo amplifier is designed to be installed in the power magnetics cabinet, with its heat sink projecting through the back of the cabinet. This carries away the heat generated by the semi- conductors, thus preventing heat from building up in the cabinet as much as possible. Therefore, note the following when installing the amplifier.
(a) The heat sink must not be subjected to cutting fluid, oil mist, or cutting chips. Otherwise, the cooling efficiency will be reduced so that the characteristics of the amplifier cannot be guaranteed. This may also shorten the life of the semiconductors. When installing the amplifier in a power magnetics cabinet which is designed to draw in air, fit an air filter to the air inlet. In addition, completely seal all cable holes and doors.
(b) No dust or cutting fluid must be able to enter through the exhaust port. The flow of cooling air must not be obstructed.
(c) The amplifier must be installed where it can be easily inspected, removed, and remounted for maintenance.

(d) Current lines and signal lines must be separated and noise must be suppressed. See the section 5.3 and the connection manual for each CNC for details.
(f) Each amplifier must be installed vertically.
(g) Servo amplifiers are to be arranged horizontally. When arranging servo amplifiers vertically from necessity, note the following:
  1) Ensure that cooling air from a lower amplifier does not blow directly against the upper amplifier. Otherwise, radiation performance can degrade and the rated output may not be satisfied.
  2) Ensure that the flow of cooling air of a lower amplifier is not impeded.
(h) Maintenance areas must be reserved for each servo amplifier.

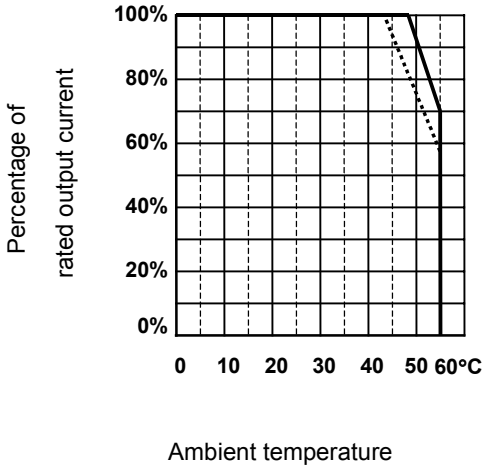
(6) Derating
Consider derating as shown below, according to ambient temperatures. The solid line is a derating line for use when HRV2 is applied, while the dotted line is a derating line for use when HRV3 is applied.
(a) Servo amplifier module
SVM1-40 to 160*i*



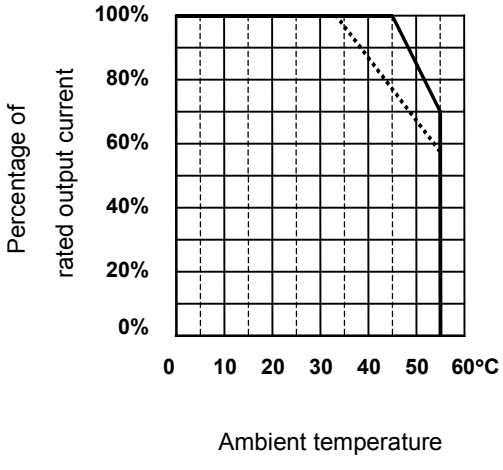
SVM2-20/40*i* to 160/160*i*



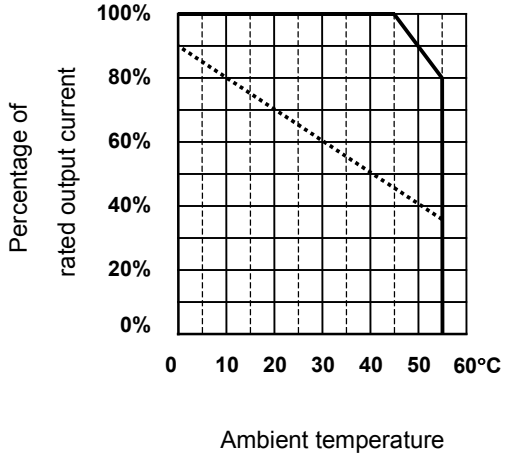
SVM1-4*i* to 20*i*
SVM2-4/4*i* to SVM2-20/20*i*
SVM3-4/4/4*i* to SVM3-20/20/40*i*



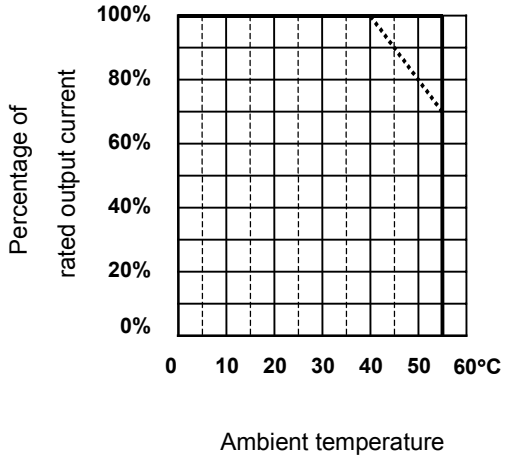
SVM1-360*i*



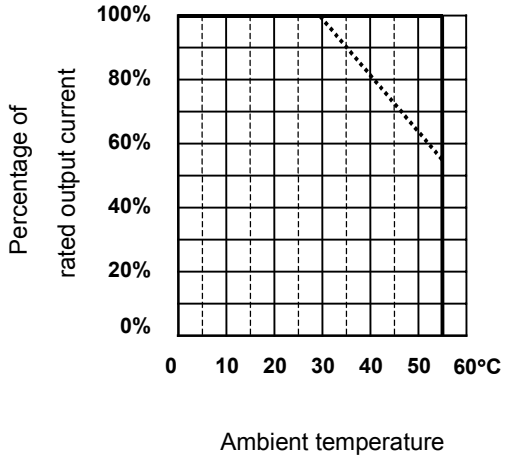
SVM1-10HV*i* to 80HV*i*



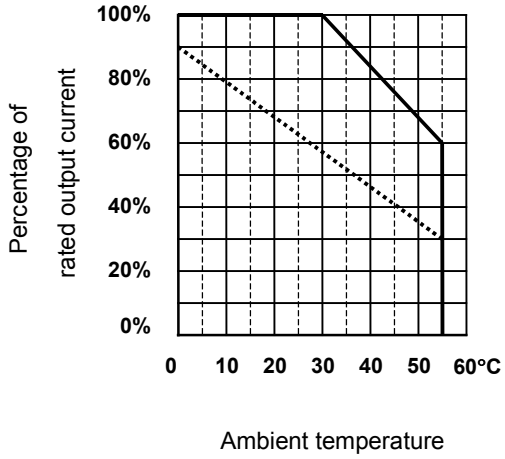
SVM1-180HV*i* to SVM1-360HV*i*



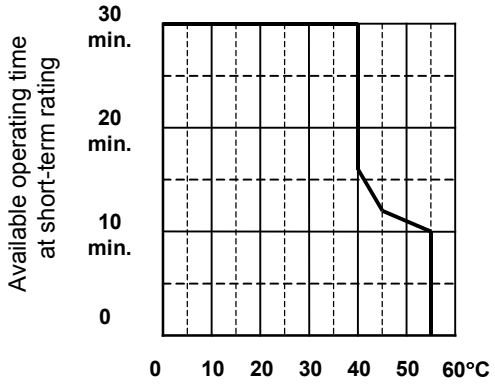
SVM2-10/10HV*i* to 20/20HV*i*



SVM2-20/40HV*i* to 80/80HV*i*



(b) SPindle amplifier module
SPM-2.2*i* to 55*i*
SPM-5.5HV*i* to 100HV*i*



2.3 SPECIFICATIONS OF THE MODULES

2.3.1 Power Supply Module (PSM)

200-V input series - power supply regeneration (PSM)

Item \ Model		PSM-5.5*i*	PSM-11*i*	PSM-15*i*	PSM-26*i*	PSM-30*i*	PSM-37*i*	PSM-55*i*
Power supply (Note)	Main circuit	200 to 240VAC +10%,-15%,3φ 50/60Hz, ±1Hz						
	Control power	200 to 240VAC +10%,-15%,1φ 50/60Hz, ±1Hz						
Power equipment capacity	Main circuit	9kVA	17kVA	22kVA	37kVA	44kVA	53kVA	79kVA
	Control power	0.7kVA						
Rated output capacity		5.5kW	11kW	15kW	26kW	30kW	37kW	55kW
Maximum output capacity		11kW	20kW	28kW	40kW	53kW	70kW	104kW
Peak maximum output capability		20kW	34kW	46kW	66kW	77kW	96kW	174kW
Control method		Regenerative control (power supply regeneration)						

NOTE
A power transformer is necessary for voltages other than those listed in above table.

200-V input series - register discharge (PSMR)

Item \ Model		PSMR-3*i*	PSMR-5.5*i*
Power supply (Note)	Main circuit	200 to 240VAC +10%,-15%,3φ 50/60Hz, ±1Hz	
	Control power	200 to 240VAC +10%,-15%,1φ 50/60Hz, ±1Hz	
Power equipment capacity	Main circuit	5kVA	12kVA
	Control power	0.5kVA	
Rated output capacity		3kW	7.5kW
Maximum output capacity		12kW	20kW
Control method		Regenerative control (register discharge)	

NOTE
1 The PSMR-3*i* and PSMR-5.5*i* require regenerative discharge unit.
2 A power transformer is necessary for voltages other than those listed in above table.

400-V input series - power supply regeneration (SVM)

Item \ Model		PSM-11HV*i*	PSM-18HV*i*	PSM-30HV*i*	PSM-45HV*i*	PSM-75HV*i*	PSM-100HV*i*
Power supply (Note)	Main circuit	400 to 480VAC +10%,-15%,3ϕ 50/60Hz, $\pm$1Hz					
	Control power	200 to 240VAC +10%,-15%,1ϕ 50/60Hz, $\pm$1Hz					
Power equipment capacity	Main circuit	17kVA	26kVA	44kVA	64kVA	107kVA	143kVA
	Control power	0.7kVA					
Rated output capacity		11kW	18kW	30kW	45kW	75kW	100kW
Maximum output capacity		20kW	35kW	60kW	85kW	120kW	150kW
Peak maximum output capability		34kW	58kW	87kW	124kW	175W	200kW
Control method		Regenerative control (power supply regeneration)					

NOTE
A power transformer is necessary for voltages other than those listed in above table.

How to calculate the power equipment capacity

Calculate the power equipment capacity using the formula below.

$$\text{Power supply capacity (kVA)} = \frac{\text{Rated capacity calculated in Section 4.3 (kW)}}{\text{Rated capacity of power supply module (kW)}} \times \text{Power supply capacity of power supply module having rated output (kVA)}$$

NOTE
Select a power supply for which, when the motor is accelerated, the input voltage variation does not exceed 7%.

How to calculate the input current of the PSM

Calculate the input current of the PSM by using the formula below. Refer to the result when selecting the MCC, power cable, and circuit breaker 1, to be connected to the PSM input section.
(Margin for selection: 1 to 1.5 times)

$$\text{PSM input current (Arms)} = \frac{\text{Power equipment capacity (kVA)}}{\sqrt{3} \times 3 \text{ Nominal supply voltage (Vrms)}} \times 1.2 \text{ (margin)}$$

NOTE
Under normal conditions, assume that the nominal supply voltage (Vrms) is 200 Vrms for the 200-V input series or 400 Vrms for the 400-V input series.

2.3.2 Servo Amplifier Module (SVM)

Specifications (common)

Item	Specifications
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge
Applicable CNC	CNC of the *i* series (MODEL B) with the FSSB interface

200-V input series - SVM 1-axis

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
SVM1-20*i*	-	6.5	20
SVM1-40*i*	-	13	40
SVM1-80*i*	-	19	80
SVM1-160*i*	-	45	160
SVM1-360*i*	-	115	360

200-V input series - SVM 2-axis

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
SVM2-4/4*i*	L	1.5	4
	M	1.5	4
SVM2-20/20*i*	L	6.5	20
	M	6.5	20
SVM 2-20/40*i*	L	6.5	20
	M	13	40
SVM2-40/40*i*	L	13	40
	M	13	40
SVM2-40/80*i*	L	13	40
	M	19	80
SVM2-80/80*i*	L	19	80
	M	19	80
SVM2-80/160*i*	L	19	80
	M	39	160
SVM2-160/160*i*	L	39	160
	M	39	160

NOTE
The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.

200-V input series - SVM 3-axis

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
SVM3-4/4/4*i*	L	1.5	4
	M	1.5	4
	N	1.5	4
SVM3-20/20/20*i*	L	6.5	20
	M	6.5	20
	N	6.5	20
SVM3-20/20/40*i*	L	6.5	20
	M	6.5	20
	N	13	40

400-V input series - SVM 1-axis

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
SVM1-10HV*i*	-	3.1	10
SVM1-20HV*i*	-	5.6	20
SVM1-40HV*i*	-	9.1	40
SVM1-80HV*i*	-	18.2	80
SVM1-180HV*i*	-	58	180
SVM1-360HV*i*	-	115	360

400-V input series - SVM 2-axis

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
SVM2-10/10HV*i*	L	3.1	10
	M	3.1	10
SVM2-20/20HV*i*	L	5.6	20
	M	5.6	20
SVM2-20/40HV*i*	L	5.6	20
	M	9.1	40
SVM2-40/40HV*i*	L	9.1	40
	M	9.1	40
SVM2-40/80HV*i*	L	9.1	40
	M	18.2	80
SVM2-80/80HV*i*	L	18.2	80
	M	18.2	80

NOTE
The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.

2.3.3 Spindle Amplifier Module (SPM)

200-V input series

Item \ Model	SPM-2.2*i*	SPM-5.5*i*	SPM-11*i*	SPM-15*i*	SPM-22*i*	SPM-26*i*	SPM-30*i*	SPM-45*i*	SPM-55*i*
Rated output (*1)	13A	27A	48A	63A	95A	111A	133A	198A	250A
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge								
Speed control range	Speed ratio 1:100								
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)								
Applicable motors (typical examples)	α0.5*i* α1*i*	α1.5*i* α2*i* α3*i*	α6*i* α8*i* α12*i*P	α12*i* α15*i*P α18*i*P	α15*i* α18*i* α22*i*P α30*i*P	α22*i* α40*i*P α50*i*P	α60*i*P	α30*i* α40*i*	

400-V input series

Item \ Model	SPM-5.5HV*i*	SPM-11HV*i*	SPM-15HV*i*	SPM-30HV*i*	SPM-45HV*i*	SPM-75HV*i*	SPM-100HV*i*
Rated output (*1)	14A	23A	32A	70A	100A	170A	200A
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge						
Speed control range	Speed ratio 1:100						
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)						
Applicable motors (typical examples)	α0.5HV*i* α1HV*i* α2HV*i* α3HV*i*	α6HV*i* α8HV*i*	α15HV*i*P	α15HV*i* α22HV*i* α40HV*i*P α50HV*i*P	α30HV*i* α40HV*i* α60HV*i*P	α60HV*i* α100HV*i*	

* The values for SPM-45*i* and 55*i*, and SPM-5.5HV*i* to SPM-100HV*i* assume that the spindle HRV1 is used.

Types (A and B) of SPMs and sensors applicable to each type

Either of two SPM models, types A and B, is available for each detector on the spindle to be used. The following lists combinations of an SPM type, applicable sensors, and functions.

			Configuration							Remarks
			1	2	3	4	5	6	7	
Spindle system configuration	SPM	TYPE A	O	O	O	O	O			
		TYPE B						O	O	
	Sensor on the motor	M*i* sensor	O			O	O	O	O	
		MZ*i* sensor		O						
		CZ*i*, BZ*i* sensor (when a built-in motor is used)			O					
	Sensor on the spindle	α position coder				O				*3
		External 1-rotation					O			*3
		CZ*i*, BZ*i* sensor						O		*3
		α position coder S							O	*3
Function	Rigid tapping		O *1	O	O	O	O *2	O	O	
	Orientation by a position coder			O	O	O		O	O	
	Orientation by the external one-rotation signal						O *2			*5
	Spindle synchronization	Velocity synchronization	O *2	O	O	O	O *2	O	O	*4
		Phase synchronization		O	O	O		O	O	*4
	Threading			O	O	O		O	O	
	Cs-axis contour control			O	O			O	O	

*1 The spindle and motor must be interconnected with a timing belt or gear. No orientation is available to adjust the tapping start position.

*2 The spindle and motor must be interconnected with a timing belt or gear.

*3 The spindle and detector must be interconnected in one-to-one connection mode.

*4 Two motor amplifiers are required.

*5 Note that the stop position moves by a backlash between the spindle and motor because of the theory of operation.

SPM and CNC matching

SPM and CNC matching conforms to the CNC *i* series model B.

Other functions

	SPM TYPE A	SPM TYPE B	Remarks
Analog output of load meter and speedometer	O	O	Connector JY1
Analog override input	O	O	Connector JY1
Position coder signal output		O	Connector JX4
Spindle EGB function (Communication function between CNC and SPM)		O	Connector JX4

Sub module SW

By using SPM TYPE A or SPM TYPE B with a sub module SW, the spindle switch function for switching between two motors (main and sub) with one spindle amplifier module can be used.
For details of the sub module SW, see Chapter 10.

2.3.4 αC*i* Spindle Amplifier Module (SPMC)

200-V input series

Model / Item	SPMC-2.2*i*	SPMC-5.5*i*	SPMC-11*i*	SPMC-15*i*	SPMC-22*i*
Rated output	13A	27A	48A	63A	95A
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge				
Speed control range	Speed ratio 1:50				
Speed variation rate	1% or less of maximum speed (load variation: 10% to 100%)				
Applicable motors (typical examples)	αC1*i*	αC1.5*i* αC2*i* αC3*i*	αC6*i* αC8*i*	αC12*i*	αC15*i* αC18*i*

Sensors applicable to SPMC

The following lists combinations of an SPMC, sensor, and function(s).

			Configuration		Remarks
			1	2	
Spindle system configuration	SPMC		O	O	
	Detector on the spindle	α position coder		O	*1
Function	Velocity control		O	O	
	Rigid tapping			O	
	Orientation by a position coder			O	
	Spindle synchronization	Velocity synchronization		O	*2
		Phase synchronization		O	*2
	Thread cutting			O	

*1 The spindle and detector must be interconnected in one-to-one connection mode.

*2 Two motor amplifiers are required.

SPM and CNC matching

SPM and CNC matching conforms to the CNC *i* series model B.

Other functions

	SPMC	Remarks
One-channel analog output of either load meter or speedometer (Selected by parameter setting)	O	Connector JY1
Analog override input	O	Connector JY1

2.4 WEIGHT

PSM

Model	Weight
PSMR-3*i*	2.6kg
PSMR-5.5*i*	4.3kg
PSM-5.5*i*	4.9kg
PSM-11*i*, 15*i*, 11HV*i*, 18HV*i*	6.3kg
PSM-26*i*, 30*i*, 37*i*, 30HV*i*, 45HV*i*	10.7kg
PSM-55*i*, 75HV*i*, 100HV*i*	22.0kg

AC reactor

Model	Weight
A81L-0001-0083#3C (For PSMR-3*i*)	1.1kg
A81L-0001-0101#C (For PSMR-5.5*i*)	3.0kg
A81L-0001-0155 (For PSM-5.5*i*,11*i*)	4.5kg
A81L-0001-0156 (For PSM-15*i*)	6.5kg
A81L-0001-0157 (For PSM-26*i*)	9.5kg
A81L-0001-0158 (For PSM-30*i*)	9.2kg
A81L-0001-0159 (For PSM-37*i*)	16.5kg
A81L-0001-0160 (For PSM-55*i*)	20.0kg
A81L-0001-0163 (For PSM-11HV*i*, 18Hv*i*)	8.0kg
A81L-0001-0164 (For PSM-30HV*i*, 45HV*i*)	14.0kg
A81L-0001-0165 (For PSM-75HV*i*, 100Hv*i*)	26.0kg

SVM

Model	Weight
SVM1-20*i*, 10Hv*i*	2.2Kg
SVM1-40*i*, 80*i*, 160*i* SVM1-20HV*i*, 40HV*i*, 80Hv*i*	3.9Kg
SVM2-4/4*i*, SVM2-20/20*i*, 10/10Hv*i*	2.4Kg
SVM2-20/40*i*, 40/40*i*, 40/80*i*, 80/80*i* SVM2-20/20Hv*i*	4.6Kg
SVM2-80/160*i*, 160/160*i* SVM2-20/40HV*i*, 40/40HV*i*, 40/80HV*i*, SVM2-80/80HV*i*	5.5Kg
SVM3-4/4/4*i*, SVM3-20/20/20*i*	2.6Kg
SVM3-20/20/40*i*	3.8Kg
SVM1-360*i*, 180HV*i*	10.7Kg
SVM1-360HV*i*	22.0Kg
DBM(A06B-6079-H401)	5.4Kg
DBM(A06B-6069-H300)	10.0Kg

SPM

Model	Weight
SPM-2.2*i*, SPMC-2.2*i*	4.9Kg
SPM-5.5*i* , 5.5HV*i*, SPMC-5.5*i*	6.1Kg
SPM-11*i*, 15*i*, 11HV*i*, 15HV*i* SPMC-11*i*, 15*i*,	6.3Kg
SPM-22*i*, 26*i*, 30*i*, 30HV*i*, 45HV*i* SPMC-22*i*	10.7Kg
SPM-45*i*, 55*i*, 75HV*i*, 100HV*i*	22.0Kg

3 ORDERING INFORMATION

3.1 SERVO AMPLIFIER

3.1.1 200-V Input Series

3.1.1.1 Power supply module (PSM)

Category	Ordering number	Name	Remarks
Standard	A06B-6110-H006	PSM-5.5*i*	
	A06B-6110-H011	PSM-11*i*	
	A06B-6110-H015	PSM-15*i*	
	A06B-6110-H026	PSM-26*i*	
	A06B-6110-H030	PSM-30*i*	
	A06B-6110-H037	PSM-37*i*	
	A06B-6110-H055	PSM-55*i*	

NOTE
See Section 4.3 for details of how to select the power supply module (PSM).

3.1.1.2 Power supply module (PSMR)

Category	Ordering number	Name	Remarks
Standard	A06B-6115-H003	PSMR-3*i*	
	A06B-6115-H006	PSMR-5.5*i*	

NOTE
See Section 4.4 for details of how to select the power supply module (PSMR).

3.1.1.3 Servo amplifier module (SVM)

SVM 1-axis

Category	Ordering number	Name	Remarks
Standard	A06B-6114-H103	SVM1-20*i*	
	A06B-6114-H104	SVM1-40*i*	
	A06B-6114-H105	SVM1-80*i*	
	A06B-6114-H106	SVM1-160*i*	
	A06B-6114-H109	SVM1-360*i*	

SVM 2-axis

Category	Ordering number	Name	Remarks
Standard	A06B-6114-H201	SVM2-4/4*i*	
	A06B-6114-H205	SVM2-20/20*i*	
	A06B-6114-H206	SVM2-20/40*i*	
	A06B-6114-H207	SVM2-40/40*i*	
	A06B-6114-H208	SVM2-40/80*i*	
	A06B-6114-H209	SVM2-80/80*i*	
	A06B-6114-H210	SVM2-80/160*i*	
	A06B-6114-H211	SVM2-160/160*i*	

SVM 3-axis

Category	Ordering number	Name	Remarks
Standard	A06B-6114-H301	SVM3-4/4/4*i*	
	A06B-6114-H303	SVM3-20/20/20*i*	
	A06B-6114-H304	SVM3-20/20/40*i*	

Dynamic brake module

Category	Ordering number	Name	Remarks
Standard	A06B-6079-H401	DBM	SVM1-360*i*

NOTE
1 Only the FSSB interface is provided between the SVM and CNC. So, be sure to use the SVM in combination with a CNC of the *i* series that has the FSSB interface.
2 See Section 4.1 for details of how to select the servo amplifier module.
3 For the SVM1-360*i*, a dynamic brake module (DBM) is required.
The dynamic brake module is used to immediately stop the motor at emergency stop. Other SVMs contain a similar function.

3.1.1.4 Spindle amplifier module (SPM)

Ordering numbers depend on the detectors being used (function).

(1) TYPE A (1 spindle sensor input)

Category	Ordering number	Name	Remarks
Standard	A06B-6111-H002#H550	SPM-2.2*i*	
	A06B-6111-H006#H550	SPM-5.5*i*	
	A06B-6111-H011#H550	SPM-11*i*	
	A06B-6111-H015#H550	SPM-15*i*	
	A06B-6111-H022#H550	SPM-22*i*	
	A06B-6111-H026#H550	SPM-26*i*	
	A06B-6111-H030#H550	SPM-30*i*	
	A06B-6111-H045#H550	SPM-45*i*	
	A06B-6111-H055#H550	SPM-55*i*	

(2) TYPE B (2 spindle sensor inputs)

Category	Ordering number	Name	Remarks
Standard	A06B-6112-H002#H550	SPM-2.2*i*	
	A06B-6112-H006#H550	SPM-5.5*i*	
	A06B-6112-H011#H550	SPM-11*i*	
	A06B-6112-H015#H550	SPM-15*i*	
	A06B-6112-H022#H550	SPM-22*i*	
	A06B-6112-H026#H550	SPM-26*i*	
	A06B-6112-H030#H550	SPM-30*i*	
	A06B-6112-H045#H550	SPM-45*i*	
	A06B-6112-H055#H550	SPM-55*i*	

3.1.1.5 Spindle amplifier module (SPMC)

Category	Ordering number	Name	Remarks
Standard	A06B-6116-H002#H560	SPMC-2.2*i*	
	A06B-6116-H006#H560	SPMC-5.5*i*	
	A06B-6116-H011#H560	SPMC-11*i*	
	A06B-6116-H015#H560	SPMC-15*i*	
	A06B-6116-H022#H560	SPMC-22*i*	

NOTE
See Section 4.2 for details of how to select the spindle amplifier module.

3.1.2 400-V Input Series

3.1.2.1 Power supply module (PSM-HV)

Category	Ordering number	Name	Remarks
Standard	A06B-6120-H011	PSM-11HV*i*	
	A06B-6120-H018	PSM-18HV*i*	
	A06B-6120-H030	PSM-30HV*i*	
	A06B-6120-H045	PSM-45HV*i*	
	A06B-6120-H075	PSM-75HV*i*	
	A06B-6120-H100	PSM-100HV*i*	

NOTE
See Section 4.3 for details of how to select the power supply module (PSM).

3.1.2.2 Servo amplifier module (SVM-HV)

SVM 1-axis

Category	Ordering number	Name	Remarks
Standard	A06B-6124-H102	SVM1-10HV*i*	
	A06B-6124-H103	SVM1-20HV*i*	
	A06B-6124-H104	SVM1-40HV*i*	
	A06B-6124-H105	SVM1-80HV*i*	
	A06B-6124-H106	SVM1-180HV*i*	
	A06B-6124-H109	SVM1-360HV*i*	

SVM 2-axis

Category	Ordering number	Name	Remarks
Standard	A06B-6124-H202	SVM2-10/10HV*i*	
	A06B-6124-H205	SVM2-20/20HV*i*	
	A06B-6124-H206	SVM2-20/40HV*i*	
	A06B-6124-H207	SVM2-40/40HV*i*	
	A06B-6124-H208	SVM2-40/80HV*i*	
	A06B-6124-H209	SVM2-80/80HV*i*	

Dynamic brake module

Category	Ordering number	Name	Remarks
Standard	A06B-6079-H401	DBM	SVM1-180HV*i*, SVM1-360HV*i*
	A06B-6069-H300	DBM	SVM1-360HV*i* (To drive the α1000HV*i*)

NOTE
1 Only the FSSB interface is provided between the SVM and CNC. So, be sure to use the SVM in combination with a CNC of the *i* series that has the FSSB interface.
2 See Section 4.1 for details of how to select the servo amplifier module.
2 For the SVM1-180HV*i* and SVM1-360HV*i*, a dynamic brake module (DBM) is required.
The dynamic brake module is used to immediately stop the motor at emergency stop. Other SVMs contain a similar function.

3.1.2.3 Spindle amplifier module (SPM-HV)

Ordering numbers depend on the detectors being used (function).

(1) TYPE A (1 spindle sensor input)

Category	Ordering number	Name	Remarks
Standard	A06B-6121-H006#H550	SPM-5.5HV*i*	
	A06B-6121-H011#H550	SPM-11HV*i*	
	A06B-6121-H015#H550	SPM-15HV*i*	
	A06B-6121-H030#H550	SPM-30HV*i*	
	A06B-6121-H045#H550	SPM-45HV*i*	
	A06B-6121-H075#H550	SPM-75HV*i*	
	A06B-6121-H100#H550	SPM-100HV*i*	

(2) TYPE B (2 spindle sensor inputs)

Category	Ordering number	Name	Remarks
Standard	A06B-6122-H006#H550	SPM-5.5HV*i*	
	A06B-6122-H011#H550	SPM-11HV*i*	
	A06B-6122-H015#H550	SPM-15HV*i*	
	A06B-6122-H030#H550	SPM-30HV*i*	
	A06B-6122-H045#H550	SPM-45HV*i*	
	A06B-6122-H075#H550	SPM-75HV*i*	
	A06B-6122-H100#H550	SPM-100HV*i*	

NOTE
See Section 4.2 for details of how to select the spindle amplifier module.

3.1.3 Others

3.1.3.1 AC reactor

Category	Ordering number	Name	Remarks
Standard	A81L-0001-0155	PSM-5.5*i*, 11*i*	
	A81L-0001-0156	PSM-15*i*	
	A81L-0001-0157	PSM-26*i*	
	A81L-0001-0158	PSM-30*i*	
	A81L-0001-0159	PSM-37*i*	
	A81L-0001-0160	PSM-55*i*	
	A81L-0001-0163	PSM-11HV*i*, 18HV*i*	
	A81L-0001-0164	PSM-30HV*i*, 45HV*i*	
	A81L-0001-0165	PSM-75HV*i*, 100HV*i*	

For the dimensions of the AC reactors, see Section 8.1.2.

3.1.3.2 AC line filter

Category	Ordering number	Name	Remarks
Standard	A81L-0001-0083#3C	PSMR-3*i*	
	A81L-0001-0101#C	PSMR-5.5*i*	

For the dimensions of the AC line filters, see Section 8.1.3.

3.1.3.3 Sub module SW

Category	Ordering number	Name	Remarks
Option	A06B-6111-H401	SPM TYPE A, TYPE B	Main unit
	A06B-6111-K808	SPM 90mm,150mm TYPE A	Connection cable
	A06B-6111-K809	SPM 90mm,150mm TYPE B	Connection cable
	A06B-6111-K810	SPM 60mm, TYPE A	Connection cable
	A06B-6111-K811	SPM 60mm, TYPE B	Connection cable

The sub module SW is 60 mm wide, and enables the spindle switch function when used with SPM TYPE A or SPM TYPE B.

(a) A cable for connecting the switch module with an SPM needs to be prepared.
(b) A metal plate for mounting needs to be prepared.

3.1.3.4 Connectors

The ordering drawing number of the connectors required for connection of input/output signals of each module, and the configuration of each connector, are shown below.
The "Use" column of the table indicates connection symbol K*, which is described in Section 9.3, "CABLE CONNECTION DETAILS."
For the connector dimensions, see Appendix C.

(1) Usable with each module:
Connectors for the PSM interface (between CXA2A and CXA2B)

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6110-K210	Housing: 1 pcs. Contact: 8 pcs.	K69 (Note 1)	Contact crimping tool A06B-6110-K220#D2M
	A06B-6110-K211	Housing: 1 pcs. Contact: 2 pcs.	(Note 2)	Contact crimping tool A06B-6110-K220#D2M

NOTE
1 See Subsection 9.3.1.4.
2 See Subsection 9.3.2.10.

(2) Usable with each module:
Power line connectors for motors and power supplies

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6110-K200 #XXSS	Housing: 1 pcs. (XX key) Contact: 4 pcs. (SS size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K200 #XXS	Housing: 1 pcs. (XX key) Contact: 4 pcs. (S size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5S
	A06B-6110-K200 #XXM	Housing: 1 pcs. (XX key) Contact: 4 pcs. (M size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5M
	A06B-6110-K200 #XXL	Housing: 1 pcs. (XX key) Contact: 4 pcs. (L size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5L
	A06B-6110-K201 #XYSS	Housing: 1 pcs. (XY key) Contact: 4 pcs. (SS size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K201 #XYS	Housing: 1 pcs. (XY key) Contact: 4 pcs. (S size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5S
	A06B-6110-K201 #XYM	Housing: 1 pcs. (XY key) Contact: 4 pcs. (M size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5M
	A06B-6110-K201 #XYL	Housing: 1 pcs. (XY key) Contact: 4 pcs. (L size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5L
	A06B-6110-K202 #YYSS	Housing: 1 pcs. (YY key) Contact: 4 pcs. (SS size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K202 #YYS	Housing: 1 pcs. (YY key) Contact: 4 pcs. (S size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5S
	A06B-6110-K202 #YYM	Housing: 1 pcs. (YY key) Contact: 4 pcs. (M size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5M
	A06B-6110-K202 #YYL	Housing: 1 pcs. (YY key) Contact: 4 pcs. (L size)	K1, K10, K21	Contact crimping tool A06B-6110-K220#D5L

(3) For power supply module (PSM)

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6071-K203	Housing: 1 pcs./module Contact: 7 pcs.	K3, K6, K7	Contact crimping tool A06B-6110-K220#D3L

(4) For servo amplifier module (SVM)

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6078-K225	Case: 1 pcs. Connector: 1 pcs. Solder type	K22	
	A06B-6073-K216	Case: 2 pcs. Connector: 4 pcs.	K24,K25	Contact crimping tool A06B-6110-K220#D3L

(5) For spindle amplifier module (SPM)

Category	Ordering number	Quantity	Use	Use
Standard	A06B-6078-K222	Case: 1 pcs. Connector: 1 pcs. Solder type	K14, K17, K71	
	A06B-6078-K223	Case: 1 pcs. Connector: 1 pcs. Crimp type	K12	Purchase a connector for F130-20S from Hirose Electric.
	A06B-6078-K224	Case: 1 pcs. Connector: 1 pcs. Solder type	K33	
	A06B-6078-K225	Case: 1 pcs. Connector: 1 pcs. Crimp type	K16	

NOTE
1 Some connectors are attached to a cable by crimping or soldering. Be careful when placing an order.
2 When attaching a connector of crimp type, use a dedicated tool prepared by each manufacturer. For the specifications of the tools, see the description of "Connection tools" below.

Connection tools

Connector connection tools are indicated below with their ordering numbers for purchase from FANUC. The connection tools can also be directly purchased from each manufacturer.

(a) Connectors manufactured by Tyco Electronics AMP
D-2100 series (for inter-module interface)

Category	Ordering number	Manufacturer part number	Use
Optional	A06B-6110-K220#D2M	91595-1	M size Contact crimping tool
Optional	A06B-6110-K220#D2R	1276716-1	Contact extractor

D-3000 series (for PSM)

Category	Ordering number	Manufacturer part number	Use
Optional	A06B-6110-K220#D3L	91558-1	L size Contact crimping tool
Optional	A06B-6110-K220#D3R	234168-1	Contact extractor

D-5000 series (for power line)

Category	Ordering number	Manufacturer part number	Use
Optional	A06B-6110-K220#D5SS	91596-1	SS size Contact crimping tool
Optional	A06B-6110-K220#D5S	234170-1	S size Contact crimping tool
Optional	A06B-6110-K220#D5M	234171-1	M size Contact crimping tool
Optional	A06B-6110-K220#D5L	1366044-1	L size Contact crimping tool
Optional	A06B-6110-K220#D5R	409158-1	Contact extractor

(b) Half-pitch 20-pin press-mount connector of Hirose Electric (FI30-20S)

Name	Manufacturer part number
Jig for neat cabling	FI30-20CAT1
Jig for press-mounting	HHP-502, FI30-20GP

(c) Half-pitch 20-pin press-mount connector of Honda Tsushin Kogyo (PCR-E20FA)

Name	Manufacturer part number
Jig for neat cabling	JGPS-015-1/1-20, JGPS-014
Jig for press-mounting	MFC-K1, PCS-K1

Connector configuration

- Configuration of A06B-6110-K210

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CXA2A	AMP Japan, Ltd.	1-1318119-4 (housing)	1	For PSM interface	C(d)
CXA2B		131807-1 (contact)	8		-

- Configuration of A06B-6110-K211

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CXA2A	AMP Japan, Ltd.	1-1318119-4 (housing)	1	For connection to separate battery	C(d)
CXA2B		131807-1 (contact)	2		-

- Configuration of A06B-6110-K200#XXSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2	AMP Japan, Ltd.	1-917807-2 (housing)	1	For motor power	-
CZ2L		1318986-6 (contact)	4		-

- Configuration of A06B-6110-K200#XXS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2	AMP Japan, Ltd.	1-917807-2 (housing)	1	For motor power	-
CZ2L		316040-6 (contact)	4		-

- Configuration of A06B-6110-K200#XXM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ1, CZ2	AMP Japan, Ltd.	1-917807-2 (housing)	1	For input power supply and motor power	-
CZ2L		316041-6 (contact)	4		-

- Configuration of A06B-6110-K200#XXL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2	AMP Japan, Ltd.	1-917807-2 (housing)	1	For motor power	-
CZ2L		1318697-6 (contact)	4		-

- Configuration of A06B-6110-K201#XYSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	AMP Japan, Ltd.	3-917807-2 (housing)	1	For motor power	-
		1318986-6 (contact)	4		-

- Configuration of A06B-6110-K201#XYS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	AMP Japan, Ltd.	3-917807-2 (housing)	1	For motor power	-
		316040-6 (contact)	4		-

- Configuration of A06B-6110-K201#XYM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	AMP Japan, Ltd.	3-917807-2 (housing)	1	For motor power	-
		316041-6 (contact)	4		-

- Configuration of A06B-6110-K201#XYL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	AMP Japan, Ltd.	3-917807-2 (housing)	1	For motor power	-
		1318697-6 (contact)	4		-

- Configuration of A06B-6110-K202#YYSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	AMP Japan, Ltd.	2-917807-2 (housing)	1	For motor power	-
		1318986-6 (contact)	4		-

- Configuration of A06B-6110-K202#YYS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N CZ3	AMP Japan, Ltd.	2-917807-2 (housing)	1	For motor power	-
		316040-6 (contact)	4	PSMR regenerative resistor	-

- Configuration of A06B-6110-K202#YYM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	AMP Japan, Ltd.	2-917807-2 (housing)	1	For motor power	-
		316041-6 (contact)	4		-

- Configuration of A06B-6110-K202#YYL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	AMP Japan, Ltd.	2-917807-2 (housing)	1	For motor power	-
		1318697-6 (contact)	4		-

- Configuration of A06B-6071-K203

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX1A	AMP Japan, Ltd.	1-178128-3 (housing)	1	For control, single-phase 200VAC input	C(a)
		1-175218-2 (contact)	3		C(c)
CX4	AMP Japan, Ltd.	1-178128-3 (housing)	1	For emergency stop signal	C(a)
		1-175218-2 (contact)	2		C(c)
CX3	AMP Japan, Ltd.	2-178128-3 (housing)	1	For ON/OFF control for external MCC	C(b)
		1-175218-2 (contact)	2		C(c)

- Configuration of A06B-6078-K225 (solder type, side cable type)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JFx	Hirose Electric Co., Ltd.	FI40B-2015S (connector)	1	For pulse coder	C(g)
		FI-20-CVS2 (case)	1		C(h)

- Configuration of A06B-6073-K216

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX8	AMP Japan, Ltd.	2-178128-3 (housing)	1	For DB interlock signals	C(b)
		1-175218-2 (contact)	2		C(c)
CX9	AMP Japan, Ltd.	1-178128-3 (housing)	1	For DB driving coil	C(a)
		1-175218-2 (contact)	2		C(c)

- Configuration of A06B-6078-K222 (solder type, side cable type)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JY1 JYA2 JYA3 JYA4	Hirose Electric Co., Ltd.	FI40B-20S (connector)	1	See below.	C(f)
		FI-20-CVS5 (case)	1		C(i)

Use M*i* sensor, MZ*i* sensor, BZ*i* sensor, external one-rotation signal, speedometer, or analog override

- Configuration of A06B-6078-K223 (crimp type, side cable type)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JA7A	Hirose Electric Co., Ltd.	FI30-20S (connector)	1	See below.	C(e)
JA7B		FI-20-CVS2 (case)	1		C(h)

Use JA7A and JA7B : For communication between CNC and SPM or SPMC

- Configuration of A06B-6078-K224 (solder type, side cable type)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JA7A	Hirose Electric Co., Ltd.	FI40B-20S (connector)	1	See below.	C(f)
JA7B		FI-20-CVS2 (case)	1		C(h)

Use JY7B and JY7B : For communication between CNC and SPM or SPMC

- Configuration of A06B-6078-K225 (solder type, side cable type)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JYA3	Hirose Electric Co., Ltd.	FI40B-2015S (connector)	1	See below.	C(g)
JYA4		FI-2015-CVS (case)	1		C(j)

Use JYA3: For α position coder
JYA4: For α position coder S

3.1.3.5 Fuses

The ordering numbers of fuses used with each module (PSM, SVM, SPM) are indicated below.

(1) For control power supply for PSM

Category	Ordering number	Remarks
Optional	A06B-6077-K250	Manufacturer : Daito Communication Apparatus Co., Ltd. Manufacturer part number : DM20, DM50 Specification : 2A/250V, 5A/250V Use : For short-circuit protection of 200VAC

(2) For control power supply for PSMR

Category	Ordering number	Remarks
Optional	A06B-6081-K250	Manufacturer : Daito Communication Apparatus Co., Ltd. Manufacturer part number : DM50 Specification : 5A/250V Use : For short-circuit protection of 200VAC

(3) For control power supply for SVM, SPM, and SPMC

Category	Ordering number	Remarks
Optional	A06B-6073-K250	Manufacturer : Daito Communication Apparatus Co., Ltd. Manufacturer part number : LM32C Specification : 3.2A/48V Use : For short-circuit protection of 24-VDC control power supply

NOTE
1 When a fuse blows, the control circuit may often be faulty. In such a case, replacing the fuse does not correct the trouble. Replace the module.
2 A fuse is installed on the control board of a module, but is not directly accessible for replacement from the outside. When replacing a fuse, extract the control board.

3.1.3.6 Power transformer

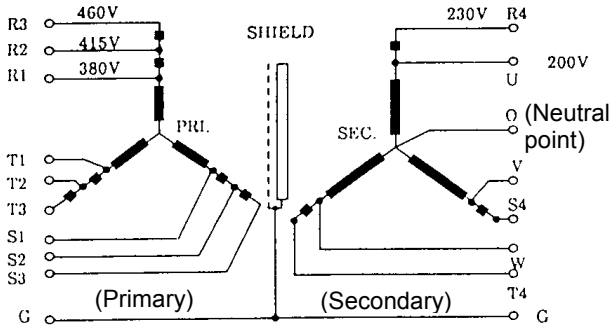
When a power supply module of the 200V input series is used in an area where the input voltage is not within the range of 200 to 230VAC, a power transformer is required. The ordering drawing numbers and specifications of power transformers manufactured by FANUC are listed below. When other than a FANUC power transformers is to be prepared by the user, it must satisfy the transformer specifications indicated Section 2.1.

Ordering drawing numbers of power transformers manufactured by FANUC

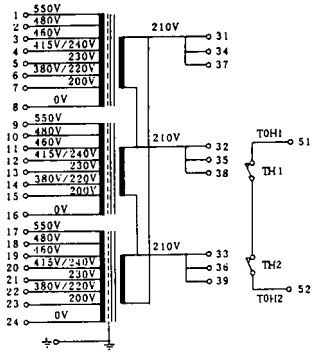
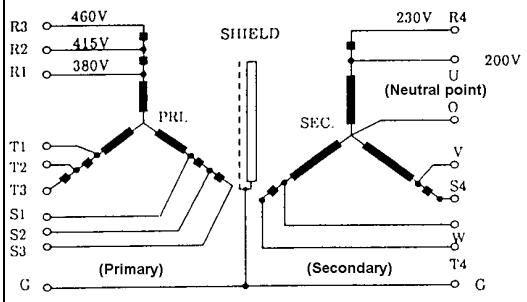
Category	Ordering number	Name	Remarks
Optional	A80L-0024-0006	For PSMR-3*i* (at 2kw output)	
	A80L-0024-0003	For PSMR-3*i* (at 3kw output)	
	A06B-6052-J001	For PSMR-5.5*i* (at 5.5kw output) PSM-5.5*i*	Primary 380/415/460VAC Secondary 200VAC
	A06B-6044-J006	For PSMR-5.5*i* (at 7.5kw output) PSM-11*i*	
	A06B-6044-J007	PSM-15*i*	
	A06B-6044-J010	PSM-26*i*, 30*i*	
	A06B-6044-J015	PSM-37*i* For PSM-55*i* (at 45kw output)	

Specifications of power transformers manufactured by FANUC

Power transformer for PSM

Item \ Model	PSM-5.5*i*	PSM-11*i*	PSM-15*i*	PSM-26*i*, 30*i*	PSM-37*i* PSM-55*i* (at 45kw output)
Ordering drawing number	A06B-6052-J001	A06B-6044-J006	A06B-6044-J007	A06B-6044-J010	A06B-6044-J015
FANUC drawing number	A80L-0001-0496	A80L-0001-0313	A80L-0001-0314	A80L-0001-0352	A80L-0001-0452
Rated capacity	10kVA	20kVA	30kVA	45kVA	64kVA
Rated primary voltage	380/415/460VAC 230VAC (The secondary is used as an autotransformer.) +10% -15%, 50/60±1Hz, 3φ				
Rated primary current	15A (at 380V) 14A (at 415V) 13A (at 460V)	30A (at 380V) 28A (at 415V) 25A (at 460V)	46A (at 380V) 42A (at 415V) 38A (at 460V)	68A (at 380V) 63A (at 415V) 56A (at 460V)	97A (at 380V) 89A (at 415V) 80A (at 460V)
Rated secondary voltage	200/220/230VAC				
Rated primary current	29A	58A	87A	130A	185A
Voltage regulation at the secondary	5%				
Voltage deviation at the secondary	±3%				
Connection	Y-Y connection				
Insulation	Class H (maximum allowable temperature : 180°C)				
Ambient temperature	0 to 45°C				
Allowable temperature rise	135deg				
Relative humidity	Max. 95%RH				
Type	Dry type, natural air cooling type				
Dielectric withstand voltage	2000VAC, for 1 minute				
Weight	Max. 61kg	Max. 115kg	Max. 165kg	Max. 260kg	Max. 375kg
Outline drawing	Fig.8.1.4(a)	Fig.8.1.4(b)	Fig.8.1.4(c)	Fig.8.1.4(d)	Fig.8.1.4(e)
Connection diagram					

Power transformer for PSMR

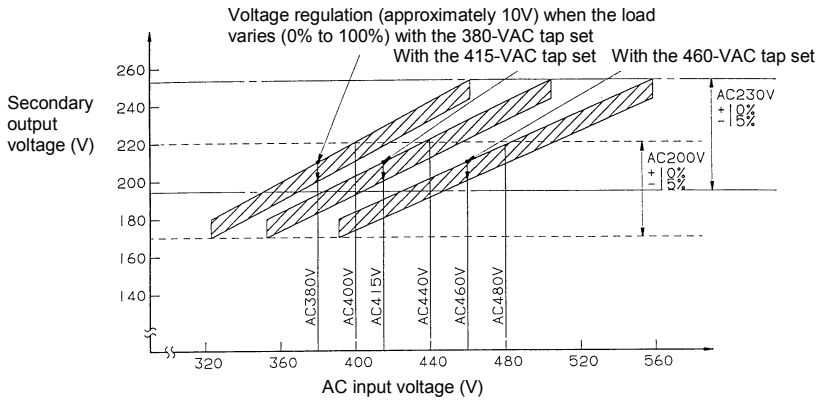
Model / Item	PSMR-3*i* (at 2kw output)	PSMR-3*i* (at 3kw output)	PSMR-5.5*i* (at 5.5kw output)	PSMR-5.5*i* (at 7.5kw output)
Ordering drawing number	A80L-0024-0006	A80L-0026-0003	A06B-6052-J001	A06B-6044-J006
FANUC drawing number	A80L-0024-0006	A80L-0026-0003	A80L-0001-0496	A80L-0001-0313
Rated capacity	3.5kVA	5kVA	10kVA	20kVA
Rated primary voltage	200/220/230/240VAC , Δ connection 380/415/460/480/550VAC , Y connection ±15%, 50/60Hz±2Hz, 3ϕ		380/415/460VAC 230VAC(The secondary is used as an autotransformer.) +10% -15%, 50/60±1Hz, 3ϕ	
Rated primary current	5.3A (at 380V)	7.6A (at 380V)	15A (at 380V) 14A (at 415V) 13A (at 460V)	30A (at 380V) 28A (at 415V) 25A (at 460V)
Rated secondary voltage	210VAC		200VAC	
Rated primary current	9.6A	13.7A	29A	58A
Voltage regulation at the secondary	2%		5%	
Voltage deviation at the secondary	±3%			
Connection	Δ-Δ connection or Y-Δ connection		Y-Y connection	
Insulation	Class B (maximum allowable temperature: 130°C)		Class H (maximum allowable temperature: 180°C)	
Ambient temperature	-20 to 55°C		0 to 45°C	
Allowable temperature rise	135deg			
Thermostat	B contact (operating temperature: 135°C)		None	
Relative humidity	Max. 95%RH			
Type	Dry type, natural air cooling type			
Dielectric withstand voltage	2300VAC, for 1 minute		2000VAC, for 1 minute	
Weight	Max. 27kg	Max. 36kg	Max. 61kg	Max. 115kg
Outline drawing	Fig.8.1.5(e)	Fig.8.1.5(e)	Fig.8.1.5(a)	Fig.8.1.5(b)
Connection diagram				

Connecting a power transformer

Power transformers must be set according to the supply voltage used.

(a) Connection points of power transformers for PSM-5.5*i*, PSM-11*i*, PSM-15*i*, PSM-26*i*, PSM-30*i*, and PSM-37*i*

Supply voltage	Connection points at the primary	Remarks
380 VAC	R - R1, S - S1, T - T1 (380-V tap)	
400 VAC	R - R1, S - S1, T - T1 (380-V tap)	
415 VAC	R - R2, S - S2, T - T2 (415-V tap)	
440 VAC	R - R2, S - S2, T - T2 (415-V tap)	
460 VAC	R - R3, S - S3, T - T3 (460-V tap)	
480 VAC	R - R3, S - S3, T - T3 (460-V tap)	



⚠ CAUTION

1 When installing a transformer in a cabinet, be careful to ensure that the transformer does not thermally affect other equipment. For example, separate the transformer from the other equipment.
2 When installing a transformer outside the cabinet, make sure that the transformer is not directly exposed to cutting chips or coolant.
3 If there is a possibility of the transformer falling, secure the transformer with bolts or similar.

3.1.3.7 Regenerative discharge unit

Whenever a PSMR (resistance regeneration type power supply module) is used, a regenerative discharge unit must be specified. For how to select the regenerative discharge unit, see Subsection 4.4.4.

Category	Name	Ordering number	Remarks
Standard	PSMR-3*i*	A06B-6089-H510	16Ω/100W (at natural cooling)
	PSMR-3*i*, 5.5*i*	A06B-6089-H500	16Ω/200W (at natural cooling)
		A06B-6089-H713	16Ω/800W (forced cooling fan motor is included)
	PSMR-5.5*i*	A06B-6089-H711	8Ω/800W (forced cooling fan motor is included)
		A06B-6089-H712	8Ω/1200W (forced cooling fan motor is included)

See Subsection 8.1.5, "Selecting a Regenerative Discharge Unit" for details of selection.

3.1.3.8 Cables

DC link short bar

Category	Ordering number	Applicable terminal-to-terminal distance
Optional	A06B-6078-K801	90mm (86mm - 94mm)
	A06B-6078-K803	64mm (60mm - 68mm)
	A06B-6078-K840	154mm (150mm - 158mm)
	A06B-6078-K841	300mm (298mm - 302mm)
	A06B-6078-K842	150mm (146mm - 154mm)

See 9.3.1.2 for details.
A06B-6078-K842 is used to connect between a 150-mm wide amplifier (left) and a 300-mm wide amplifier (right).

Cables for connection of modules

Category	Ordering number	Cable length	Applicable amplifier width
Optional	A06B-6110-K801	200mm	150mm width amplifier
	A06B-6110-K802	150mm	90mm width amplifier
	A06B-6110-K803	100mm	60mm width amplifier
	A06B-6110-K804	400mm	300mm width amplifier

NOTE
1 The above table lists the cable for each interface between modules.
For connection of CXA2A and CXA2B
2 The connection cable for the battery of the absolute pulse coder is not included in the cables shown above. For details, see Subsection 9.3.2.10.

Cables for connection of detectors

Category	Ordering number	Use	Remarks
Optional	A06B-6078-K811	For M*i* sensor, MZ*i* sensor or BZ*i* sensor	Cable length : 7m
	A06B-6078-K814	For Positioncoder	Cable length : 7m Connector figure : Straight
	A06B-6078-K815		Cable length : 7m Connector figure : Elbow

Cables for FSSB interface

Category	Ordering number	Cable length	Applicable amplifier width
Optional	A66L-6001-0023#L150R0	150mm	For between SVM and SVM
	A66L-6001-0023#L300R0	300mm	

3.1.3.9 Circuit breaker and magnetic contactor

The circuit breaker and magnetic contactor capacities are determined by the power supply module specifications. The ordering drawing numbers and specifications of the circuit breakers and magnetic contactors are shown below.
When this equipment is to be prepared by the user, it must satisfy the circuit breaker and magnetic contactor specifications indicated below.

Circuit breaker and magnetic contactor specifications

For PSM and PSMR

PSM name	Circuit breaker 1	Circuit breaker 2	Magnetic contactor	Remarks
PSMR-3*i*	20A	5A	20A	
PSMR-5.5*i*	30A		30A	Note 4)
	50A		50A	Note 5)
PSM-5.5*i*	30A		30A	
PSM-11*i*	55A		55A	
PSM-15*i*	70A		70A	
PSM-26*i*	120A		120A	
PSM-30*i*	140A		140A	
PSM-37*i*	175A		175A	
PSM-55*i*	250A		250A	

NOTE
1 For the installation positions of the circuit breakers and magnetic contactor, see Section 1.2.
2 Set the rated voltage of circuit breakers 1 and 2 according to the power supply voltage.
3 The current and voltage of the operation coil of the magnetic contactor must be within the rating of the internal contact [CX3 (MCC)] of the PSM.
For details, see Subsection 9.3.1.5.
4 When the PSMR-5.5 is used at a rated output capacity of 5.5 kW
5 When the PSMR-5.5 is used at a rated output capacity of 7.5 kW

For PSM-HV

PSM name	Circuit breaker 1	Circuit breaker 2	Circuit breaker 3	Magnetic contactor	Remarks
PSM-11HV*i*	20A	3A	3A	20A	
PSM-18HV*i*	45A			30A	
PSM-30HV*i*	75A			55A	
PSM-45HV*i*	125A			70A	
PSM-75HV*i*	200A			120A	
PSM-100HV*i*	250A			140A	

NOTE
1 For the installation positions of the circuit breakers and magnetic contactor, see Section 1.2.
2 Set the rated voltage of circuit breakers 1 and 2 according to the power supply voltage.
3 The current and voltage of the operation coil of the magnetic contactor must be within the rating of the internal contact [CX3 (MCC)] of the PSM.
For details, see Subsection 9.3.1.5.

Recommended parts

Parts manufactured by Fuji Electric Co., Ltd.

PSM name	Circuit breaker 1	Circuit breaker 2	Circuit breaker 3	Magnetic contactor
PSMR-3*i*	EA53B/30	EA33/5	-	SC-5-1
PSMR-5.5*i* PSM-5.5*i*	EA103B/50			SC-1N
PSM-11*i*	EA103B/60			SC-2N
PSM-15*i*	EA103B/75			SC-2SN
PSM-26*i*	EA203B/150			SC-4N
PSM-30*i*	EA203B/150			SC-5N
PSM-37*i*	EA203B/175			SC-7N
PSM-55*i*	EA203B/250			SC-8N
PSM-11HV*i*	EA53B/30	EA33/3	EA33/3	SC-5-1
PSM-18HV*i*	EA103B/50			SC-1N
PSM-30HV*i*	EA103B/75			SC-2SN
PSM-45HV*i*	EA203B/125			SC-4N
PSM-75HV*i*	EA203B/200			SC-7N
PSM-100HV*i*	EA203B/250			SC-8N

NOTE
For details, see the brochures available from Fuji Electric Co., Ltd. Note that the specification of the coil voltage of a magnetic contactor may differ depending on the supply voltage and frequency used.

Ordering drawing numbers of circuit breakers

Category	Model	Ordering number	Outline drawing	Circuit breaker specification	Circuit breaker cover specification
Optional Optional	PSMR-3*i* PSM-11HV*i*	A06B-6077-K101	8.1.7(a)	Fuji Electric EA53B/30	Fuji Electric BZ-TB20B-3
	PSMR-5.5*i* PSM-5.5*i*, 18HV*i*	A06B-6077-K102	8.1.7(b)	Fuji Electric EA103B/50	Fuji Electric BZ-TB20B-3
	PSM-11*i*	A06B-6077-K103	8.1.7(c)	Fuji Electric EA103B/60	Fuji Electric BZ-TB20B-3
	PSM-15*i*, 30HV*i*	A06B-6077-K104	8.1.7(d)	Fuji Electric EA103B/75	Fuji Electric BZ-TB20B-3
	PSM-45HV*i*	A06B-6077-K108	8.1.7(e)	Fuji Electric EA203B/125	Fuji Electric BZ-TB40B
	PSM-26*i*, 30*i*	A06B-6077-K105	8.1.7(f)	Fuji Electric EA203B/150	Fuji Electric BZ-TB40B
	PSM-37*i*	A06B-6077-K110	8.1.7(g)	Fuji Electric EA203B/175	Fuji Electric BZ-TB40B
	PSM-75HV*i*	A06B-6077-K109	8.1.7(h)	Fuji Electric EA203B/225	Fuji Electric BZ-TB40B
	PSM-55*i*, 100HV*i*	A06B-6077-K111	8.1.7(i)	Fuji Electric EA403B/250	Fuji Electric BZ-TB60B
	For control power	A06B-6077-K106	8.1.7(j)	Fuji Electric EA33/5	Fuji Electric BZ-TB10B-503

Ordering drawing numbers of magnetic contactors

Category	Model	Ordering number	Outline drawing	Magnetic contactor specification	Magnetic contactor cover specification
Optional	PSMR-3*i* PSM-11HV*i*	A06B-6077-K121	8.1.8(a)	Fuji Electric SC-5-1	Fuji Electric SZ-JC4
	PSMR-5.5*i* PSM-5.5*i*, 18HV*i*	A06B-6077-K122	8.1.8(b)	Fuji Electric SC-1N	Fuji Electric SZ-1N/T
	PSM-11*i*, 30HV*i*	A06B-6077-K123	8.1.8(b)	Fuji Electric SC-2N	Fuji Electric SZ-1N/T
	PSM-15*i*	A06B-6077-K124	8.1.8(c)	Fuji Electric SC-2SN	Fuji Electric SZ-2SN/T
	PSM-26*i*, 45HV*i*	A06B-6077-K125	8.1.8(d)	Fuji Electric SC-4N	Fuji Electric SZ-4N/T
	PSM-30*i*	A06B-6077-K126	8.1.8(e)	Fuji Electric SC-5N	Fuji Electric Z-5N/T
	PSM-37*i*, 75HV*i*	A06B-6077-K128	8.1.8(g)	Fuji Electric SC-7N	Fuji Electric SZ-5N/T
	PSM-55*i*, 100HV*i*	A06B-6077-K127	8.1.8(f)	Fuji Electric SC-8N	Fuji Electric SZ-8N/T

NOTE
The coil voltage specification of the magnetic contactor is 200VAC.

3.1.3.10 Lightning surge protector

To protect equipment from surge voltages caused by lightning, install a lightning surge protector between lines and between a line and ground. For how to install protectors, see Appendix A.

Lightning surge protector specifications

Category	Ordering number	Specification	Outline drawing	Remarks
Optional	A06B-6077-K142	For line-to-line installation : RAV-781BYZ-2 For line-to-ground installation : RAV-781BXZ-4	8.1.9(a)	Manufactured by Okaya Electric Industries Co., Ltd. For 200VAC line TÜV approved products
	A06B-6077-K143	For line-to-line installation : RAV-152BYZ-2A For line-to-ground installation : RAV-801BXZ-4	8.1.9(b)	Manufactured by Okaya Electric Industries Co., Ltd. For 400VAC line TÜV approved products
	A06B-6077-K144	Integration type for line-to-line installation/line-to-ground installation: RCM-601BUZ-4	8.1.9(c)	Manufactured by Okaya Electric Industries Co., Ltd. For 200VAC line TÜV approved products

3.1.3.11 Noise filter

A noise filter must be installed in the PSM input section to satisfy the requirements of the EMC Directives which are now being enforced in the EU countries.

Category	Model	Ordering number	Outline drawing	Specification
Optional	PSMR-3*i* PSM-5.5*i*, 11HV*i*	A06B-6077-K155	8.1.10	Manufactured by Okaya Electric Industries Co., Ltd. 3SUP-HL30-ER-6
	PSMR-5.5*i* PSM-11*i* ,15*i* PSM-18HV*i*, 30HV*i*	A06B-6077-K156	8.1.10	Manufactured by Okaya Electric Industries Co., Ltd. 3SUP-HL75-ER-6
	PSM-26*i*, 30*i* PSM-45HV*i*	A06B-6077-K157	8.1.10	Manufactured by Okaya Electric Industries Co., Ltd. 3SUP-HL150-ER-6
	PSM-37*i* PSM-75HV*i*	A06B-6077-K158	8.1.10	Manufactured by Okaya Electric Industries Co., Ltd. 3SUP-HL200-ER-6

3.1.3.12 Sensors for spindle

α Positioncoder

Category	Name	Ordering number	Remarks
Optional	α Positioncoder	A860-0309-T302	□68, 10,000min^{-1}
	Connector kit	A06B-6088-K211	Straight type

α Positioncoder S (analog output type)

Category	Name	Ordering number	Remarks
Optional	α Positioncoder S	A860-0309-T352	□68, 10,000min^{-1}
	Connector kit	A06B-6088-K211	Straight type

BZ*i* sensor

Category	Name	Ordering number	Remarks
Optional	BZ*i* sensor 128	A860-2120-T201	128 teeth / 20,000min^{-1}
	BZ*i* sensor 128H	A860-2120-T211	128 teeth / 50,000min^{-1}
	BZ*i* sensor 256	A860-2120-T401	256 teeth / 15,000min^{-1}
	BZ*i* sensor 256H	A860-2120-T411	256 teeth / 30,000min^{-1}
	BZ*i* sensor 384	A860-2120-T511	384 teeth / 15,000min^{-1}
	BZ*i* sensor 512	A860-2120-T611	512 teeth / 10,000min^{-1}

CZ*i* sensor

Category	Name	Ordering number	Remarks
Optional	CZ*i* sensor 512	A860-2140-T411	512 teeth / 15,000min^{-1}
	CZ*i* sensor 768	A860-2140-T511	768 teeth / 10,000min^{-1}
	CZ*i* sensor 1024	A860-2140-T611	1024 teeth / 8,000min^{-1}

3.1.3.13 Power line switch unit

Spindle switch control (Y/Y switch type)
Output switch control (Y/Y switch type, Y/Δ switch type)

Category	Name	Ordering number	Remarks
Optional	Y/Y switch type	A06B-6078-K034	SPM-15*i* or lower model
	Y/Δ switch type	A06B-6078-K035	
	Y/Y switch type	A06B-6078-K036	SPM-30*i* or lower model
	Y/Δ switch type	A06B-6078-K037	

3.1.3.14 Battery for absolute Pulsecoder

For connection of a battery for an absolute Pulsecoder, two methods are available. For each method, options are available.

NOTE
1 A battery needs to be maintained periodically. So, [connection type 1] is recommended because this type uses a battery (consisting of four size D alkaline cells) easily obtainable from the market.
2 A built-in battery used with [connection type 2] is not available on the market, but needs to be purchased from FANUC. So, it is recommended to purchase spare built-in batteries.

[Connection type 1]
Power is fed from one battery to multiple SVMs.
(See Subsection 9.3.2.10.)

Category	Ordering number	Name	Remarks
Optional	A06B-6050-K061	Battery	Four pieces of size D battery
	A06B-6050-K060	Battery case	
	A06B-6110-K211	Battery connection connector	

[Connection type 2]
A battery is built into each SVM.
(See Subsection 9.3.2.10.)

Category	Ordering number	Name	Remarks
Optional	A06B-6073-K001	Built-in battery	One piece of lithium battery
	A06B-6114-K500	Battery case	
	A06B-6114-K501	Battery case	SVM1-360*i* SVM1-180HV*i* SVM1-360HV*i*

4 HOW TO SELECT THE MODULE

4.1 HOW TO SELECT THE SERVO AMPLIFIER MODULE (SVM)

First select a servo motor, based on the machine specifications. Then, select an appropriate servo amplifier module for the selected servo motor.

Table 4.1(a) Specification

No	Specification	Number of connected axes	Input voltage	Interface with CNC
1	A06B-6114-H1xx	1	200V	FSSB
2	A06B-6114-H2xx	2	200V	FSSB
3	A06B-6114-H3xx	3	200V	FSSB
4	A06B-6124-H1xx	1	400V	FSSB
5	A06B-6124-H2xx	2	400V	FSSB

Table 4.1(b) Names

200-V input series for 1 axis	200-V input series for 2 axes	200-V input series for 3 axes	400-V input series for 1 axis	400-V input series for 2 axes
SVM1-20*i*	SVM2-4/4*i*	SVM3-4/4/4*i*	SVM1-10HV*i*	SVM2-10/10HV*i*
SVM1-40*i*	SVM2-20/20*i*	SVM3-20/20/20*i*	SVM1-20HV*i*	SVM2-20/20HV*i*
SVM1-80*i*	SVM2-20/40*i*	SVM3-20/20/40*i*	SVM1-40HV*i*	SVM2-20/40HV*i*
SVM1-160*i*	SVM2-40/40*i*		SVM1-80HV*i*	SVM2-40/40HV*i*
SVM1-360*i*	SVM2-40/80*i*		SVM1-180HV*i*	SVM2-40/80HV*i*
	SVM2-80/80*i*		SVM1-360HV*i*	SVM2-80/80HV*i*
	SVM2-80/160*i*			
	SVM2-160/160*i*			

4.1.1 200-V Input Series

			0.2	0.3	0.4	0.5	1	2	4		8			12		22			30	40	
Motor	αi	Axis					α1 /5000i (20A)	α2 /5000i (20A)		α4 /4000i (40A)		α8 /3000i (40A)			α12 /3000i (80A)		α22 /3000i (80A)		α30 /3000i (160A)	α40 /3000i (160A)	α40 /3000i FAN (160A)
	αis							α2 /5000is (20A)	α4 /5000is (20A)				α8 /4000is (80A)		α12 /4000is (80A)			α22 /4000is (160A)	α30 /4000is (160A)	α40 /4000is (160A)	
	βis		β0.2 /5000is (4A)	β0.3 /5000is (4A)	β0.4 /5000is (20A)	β0.5 /5000is (20A)	β1 /5000is (20A)	β2 /4000is (20A)	β4 /4000is (20A)		β8 /3000is (20A)			β12 /3000is (40A)		β22 /2000is (40A)					
SVM1	SVM1-20 *i*	-			O	O	O	O	O		O										
	SVM1-40 *i*	-								O		O		O		O					
	SVM1-80 *i*	-											O		O		O				
	SVM1-160 *i*	-																O	O	O	O
	SVM1-360 *i*	-																			
	SVM1-360 *i* X2	-																			
SVM2	SVM2-4/4 *i*	L	O	O																	
		M	O	O																	
	SVM2-20/20 *i*	L			O	O	O	O	O		O										
		M			O	O	O	O	O		O										
	SVM2-20/40 *i*	L			O	O	O	O	O		O										
		M								O		O		O		O					
	SVM2-40/40 *i*	L								O		O		O		O					
		M								O		O		O		O					
	SVM2-40/80 *i*	L								O		O		O		O					
		M											O		O		O				
	SVM2-80/80 *i*	L											O		O		O				
		M											O		O		O				
	SVM2-80/160 *i*	L											O		O		O				
		M																O	O	O	
	SVM2-160/160 *i*	L																O	O	O	
		M																O	O	O	
SVM3	SVM3-4/4/4 *i*	L	O	O																	
		M	O	O																	
		N	O	O																	
	SVM3-20/20/20 *i*	L			O	O	O	O	O		O										
		M			O	O	O	O	O		O										
		N			O	O	O	O	O		O										
	SVM3-20/20/40 *i*	L			O	O	O	O	O		O										
		M			O	O	O	O	O		O										
		N								O		O		O		O					

			50	50	100	200	300	500
Motor	αis	Axis	α50 /3000is (360A)	α50 /3000is FAN (360A)	α100 /2500is (360A)	α200 /2500is (360A)	α300 /2000is (360AX2)	α500 /2000is (360AX2)
SVM1	SVM1-360 *i*	-	O	O	O	O		
	SVM1-360 *i* X2	-					O	O

4.1.2 400-V Input Series

			2	3	4	8		12	22		30	40	50	50	100	200	300	500	1000
Motor	α(HV)*i*	Axis			α4 /4000HV*i* (20A)	α8 /3000HV*i* (20A)		α12 /3000HV*i* (40A)	α22 /3000HV*i* (40A)										
	α(HV)*is*		α2 /5000HV*is* (10A)	α4 /5000HV*is* (10A)			α8 /4000HV*is* (40A)	α12 /4000HV*is* (40A)		α22 /4000HV*is* (80A)	α30 /4000HV*is* (80A)	α40 /4000HV*is* (80A)	α50 /3000HV*is* (180A)	α50 /3000HV*is* FAN (180A)	α100 /2500HV*is* (180A)	α200 /2500HV*is* (180A)	α300 /2000HV*is* (360A)	α500 /2000HV*is* (360A)	α1000 /2000HV*is* (360A x 2)
SVM1	SVM1-10HV *i*	-	○	○															
	SVM1-20HV *i*	-			○	○													
	SVM1-40HV *i*	-					○	○	○										
	SVM1-80HV *i*	-								○	○	○							
	SVM1-180HV *i*	-											○	○	○	○			
	SVM1-360HV *i*	-															○	○	
	SVM1-360HV *i* x 2	-																	○
SVM2	SVM2-10/10HV *i*	L	○	○															
		M	○	○															
	SVM2-20/20HV *i*	L			○	○													
		M			○	○													
	SVM2-20/40HV *i*	L			○	○													
		M					○	○	○										
	SVM2-40/40HV *i*	L					○	○	○										
		M					○	○	○										
	SVM2-40/80HV *i*	L					○	○	○										
		M								○	○	○							
	SVM2-80/80HV *i*	L								○	○	○							
		M								○	○	○							

4.2 HOW TO SELECT THE SPINDLE AMPLIFIER MODULE (SPM)

First, select a spindle motor, based on the machine specification. Then, select an appropriate spindle amplifier module for the selected spindle motor.
Spindle amplifier modules and standard motors that can be used together are shown below. When using a built-in motor or a motor with special specifications, refer to relevant specifications, and select a spindle amplifier module accordingly.

Table 4.2(a) Specification

No	Ordering number	Input voltage	Remarks
1	A06B-6111-Hxxx#H550	200V	TYPE A
2	A06B-6112-Hxxx#H550	200V	TYPE B
3	A06B-6116-Hxxx#H560	200V	
4	A06B-6121-Hxxx#H550	400V	TYPE A
5	A06B-6122-Hxxx#H550	400V	TYPE B

Table 4.2(b) Specification

200-V input series	400-V input series	Spindle amplifier for αC*i* (200-V input)
SPM-2.2*i*	SPM-5.5HV*i*	SPMC-2.2*i*
SPM-5.5*i*	SPM-11HV*i*	SPMC-5.5*i*
SPM-11*i*	SPM-15HV*i*	SPMC-11*i*
SPM-15*i*	SPM-30HV*i*	SPMC-15*i*
SPM-22*i*	SPM-45HV*i*	SPMC-22*i*
SPM-26*i*	SPM-75HV*i*	
SPM-30*i*	SPM-100HV*i*	
SPM-45*i*		
SPM-55*i*		

4.2.1 200-V Input Series

continuous rated output		0.55	1.1	1.5		2.2		3.7		5.5	7.5		9	11		15	18.5		22		30	37	45
Motor	αi	α0.5 /10000i	α1 /10000i	α1.5 /10000i		α2 /10000i		α3 /10000i		α6 /12000i	α8 /8000i			α12 /7000i		α15 /7000i	α18 /7000i		α22 /7000i		α30 /6000i	α40 /6000i	α50 /4500i
				α1 /15000i	α1.5 /15000i		α2 /15000i		α3 /12000i	α6 /12000i	α8 /10000i			α12 /10000i		α15 /10000i	α18 /10000i		α22 /10000i				
	αi_P									α12/ 6000i_P		α15/ 6000i_P	α18/ 6000i_P		α22/ 6000i_P	α30/ 6000i_P		α40/ 6000i_P	α50/ 6000i_P	α60/ 4500i_P			
										α12/ 8000i_P		α15/ 8000i_P	α18/ 8000i_P		α22/ 8000i_P								
SPM	SPM-2.2i	O	O																				
	SPM-5.5i			O		O		O															
	SPM-11i								O	O	O												
	SPM-15i				O							O	O	O									
	SPM-22i						O								O	O	O						
	SPM-26i																	O	O				
	SPM-30i																			O			
	SPM-45i																				O	O	
	SPM-55i																						O

4.2.2 400-V Input Series

continuous rated output		0.55	1.1	1.5	2.2	3.7	5.5	7.5		11	15	18.5	22	30		37	60	100
Motor	αi	α0.5 /10000 HVi	α1 /10000 HVi	α1.5 /10000 HVi	α2 /10000 HVi	α3 /10000 HVi	α6 /10000 HVi	α8 /8000 HVi			α15 /7000 HVi		α22 /7000 HVi	α30 /6000 HVi		α40 /6000 HVi	α60 /4500 HVi	α100 /4000 HVi
	αi_P								αP15/ 6000 HVi_P	αP22/ 6000 HVi_P		αP40/ 6000 HVi_P	αP50/ 6000 HVi_P		αP60/ 4500 HVi_P			
SPM	SPM-5.5HVi	O	O	O	O	O												
	SPM-11HVi						O	O										
	SPM-15HVi								O									
	SPM-30HVi									O	O	O	O		O			
	SPM-45HVi													O		O		
	SPM-75HVi																O	O
	SPM-100HVi																	

4.3 HOW TO SELECT THE POWER SUPPLY MODULE (PSM)

Calculate the required output rating, maximum output, and peak output capabilities required of a power supply module (PSM) according to the following calculation method, and select the PSM that meets these requirements.

Table 4.2(a) 200-V input

Item \ Model	PSM-5.5*i*	PSM-11*i*	PSM-15*i*	PSM-26*i*	PSM-30*i*	PSM-37*i*	PSM-55*i*
Rated output capability	5.5kW	11kW	15kW	26kW	30kW	37kW	55kW
Maximum output capability	11kW	20kW	28kW	40kW	53kW	70kW	104kW
Peak output capability	20kW	34kW	46kW	66kW	77kW	96kW	174kW

Table 4.2(a) 400-V input

Item \ Model	PSM-11HV*i*	PSM-18HV*i*	PSM-30HV*i*	PSM-45HV*i*	PSM-75HV*i*	PSM-100HV*i*
Rated output capability	11kW	18kW	30kW	45kW	75kW	100kW
Maximum output capability	20kW	35kW	60kW	85kW	120kW	150kW
Peak output capability	34kW	58kW	87kW	124kW	175kW	200kW

4.3.1 How to Obtain the Power Supply Module Rated Output Capability

Select a power supply module with a rated output not less than the sum of the total continuous rated output of the spindle motors times 1.15, plus the total continuous rated output of the servo motors times 0.6.

Rated output capacity of power supply module ≥ Σ Continuous rated output of spindle motor × 1.15 +Σ Continuous rated output of servo motor × 0.6

When only spindle amplifier module is to be connected to a power supply module, select the power supply module so that the 30-minute rated output of the spindle motor does not exceed the rated output capacity of the power supply module.

Rated output capacity of a power supply module ≥ 30-minute rated output of a spindle motor

Table 4.3 lists the rated output capacities of the power supply modules. Tables 4.5.1(a) to (c) list the continuous rated outputs of the servo motors. Tables 4.5.2(a) and (b) list the continuous rated outputs or 30-minute rated output of the spindle motors.

4.3.2 How to Obtain the Power Supply Module Maximum Output Capability

Select the power supply module whose maximum output capability will not be exceeded by the total of the sum of the maximum acceleration spindle motor outputs and the sum of the maximum acceleration outputs of the servo motors that are accelerated simultaneously and whose acceleration time exceeds 0.3 seconds.

Maximum output of power supply module ≥ Σ Accelerating maximum output of spindle motor + Σ Maximum acceleration-time outputs of the servo motors whose acceleration time exceeds **0.3 seconds**. (on simultaneous acceleration/deceleration axis)

Table 4.3 lists the maximum output capacities of the power supply modules. Tables 4.5.1(a) to (c) list the accelerating maximum outputs of the servo motors. Tables 4.5.2(a) and (b) list the accelerating maximum outputs of the spindle motors.

4.3.3 How to Obtain the Power Supply Module Peak Maximum Output Capability

Select the power supply module whose peak output capability will not be exceeded by the total of the sum of the maximum acceleration spindle motor outputs and the sum of the maximum acceleration outputs of the servo motors that are accelerated simultaneously.

Power supply module peak maximum output capability ≥ Σ spindle motor maximum acceleration outputs + Σservo motor maximum acceleration outputs (on simultaneously accelerated axes)

Table 4.3 lists the peak output capacities of the power supply modules. Tables 4.5.1(a) to (c) list the continuous rated outputs of the servo motors. Tables 4.5.2(a) and (b) list the according maximum outputs of the spindle motors.

4.3.4 Number of Connected Servo Amplifier Modules and Spindle Amplifier Modules

Multiple servo amplifier modules and spindle amplifier modules can be connected to a single power supply module, provided the above output capacity conditions are satisfied.
The table below lists the maximum number of modules which can be connected.

Table 4.3.4 Maximum number of modules that can be connected

SPM	SVM		
SPMC	SVM1	SVM2	SVM3
2	6		
		4	
			3

⚠ CAUTION
1 When different types of servo amplifier modules are connected, the following condition must be satisfied:
$6 \geq$ Number of SVM1s $\times$ 1 + Number of VM2s $\times$ 1.5
$6 \geq$ Number of SVM1s $\times$ 1 + Number of SVM3s $\times$ 2
The maximum number of servo amplifier modules that can be connected is the same when a spindle amplifier module is not used.
2 No SVM3 is available in the 400-V input series.

4.3.5 Notes on αHV*i* Series PSM Selection

When the αHV*i* series is used, a restriction is imposed on the combination with an SPM.

(1) For SPM-30HV*i*, select PSM-30HV*i* or a higher model.
(2) For SPM-45HV*i*, select PSM-45HV*i* or a higher model.
(3) For SPM-75HV*i* and SPM-100HV*i*, select PSM-75HV*i* or a higher model.

4.4 HOW TO SELECT THE POWER SUPPLY MODULE (PSMR)

Select a power supply module that satisfies the rated output capacity and maximum output capacity, calculated as follows :

Table 4.4 200-V input

Item \ Model	PSMR-3*i*	PSMR-5.5*i*
Rated output capability	3kW	7.5kW
Maximum output capability	12kW	20kW

NOTE
No specification is defined for the peak output capability of the PSMRs.

4.4.1 How to Obtain the Power Supply Module Rated Output Capability

Select a power supply module with a rated output not less than the sum of the total continuous rated output of the spindle motors times 1.15, plus the total continuous rated output of the servo motors times 0.6.

Rated output capacity of power supply module ≥ Σ Continuous rated output of spindle motor × 1.15 +Σ Continuous rated output of servo motor × 0.6

When only spindle amplifier module is to be connected to a power supply module, select the power supply module so that the 30-minute rated output of the spindle motor does not exceed the rated output capacity of the power supply module.

Rated output capacity of a power supply module ≥ 30-minute rated output of a spindle motor

Table 4.3 lists the rated output capacities of the power supply modules. Tables 4.5.1(a) to (c) list the continuous rated outputs of the servo motors. Tables 4.5.2(a) and (b) list the continuous rated outputs or 30-minute rated output of the spindle motors.

4.4.2 How to Obtain the Power Supply Module Maximum Output Capability

Select the power supply module whose maximum output capability will not be exceeded by the total of the sum of the maximum acceleration spindle motor outputs and the sum of the maximum acceleration outputs of the servo motors that are accelerated simultaneously and whose acceleration time exceeds 0.3 seconds.

Maximum output of power supply module ≥ Σ Accelerating maximum output of spindle motor + Σ Maximum acceleration-time outputs of the servo motors whose acceleration time exceeds **0.3 seconds**. (on simultaneous acceleration/deceleration axis)

Table 4.4 lists the maximum output capacities of the power supply modules. Tables 4.5.1(a) to (c) list the accelerating maximum outputs of the servo motors. Tables 4.5.2(a) and (b) list the accelerating maximum outputs of the spindle motors.

4.4.3 Number of Connected Servo Amplifier Modules and Spindle Amplifier Modules

Multiple servo amplifier modules and spindle amplifier modules can be connected to a single power supply module, provided the above output capacity conditions are satisfied.
The table below lists the maximum number of modules which can be connected.

Table 4.4.3 Maximum number of modules that can be connected

SPM	SVM		
	SVM1	SVM2	SVM3
0	4		
	1	2	
	2	1	
		1	1
1	2		
	1	1	
			1

4.4.4 Selecting a Regenerative Discharge Unit

In the power supply module (PSMR), the regenerative discharge unit (regenerative resistor) dissipates the energy generated during deceleration of a motor (regeneration).
The amount of heat generated by the regenerative discharge unit varies with the motor type, rotation speed, load inertia, and continuous repetition cycle (duty cycle). Use a regenerative discharge unit of a suitable capacity for the load and operation cycle time.

How to Calculate the Required Capacity for the Regenerative Discharge Unit

Select a regenerative discharge unit having a capacity greater than or equal to the total rotation energy of all the servo motors and the spindle motor.
How to calculate the rotation energy is described in below.

Capacity of regenerative discharge unit ≥Σ Rotation energy of motor

See Table 4.4.4 for details of the capacity of the regenerative discharge unit.

(1) Servo motor (for horizontal movement)
Amount of regenerative discharge (power [W]) when rapid traverse acceleration/deceleration is performed once every F sec

(a) SI unit system

$$w = \frac{1}{F} \times (5.48 \times 10^{-3} \cdot (Jm + JL) \cdot Vm^2 - 5.23 \times 10^{-2} \cdot ta \cdot Vm \cdot TL)\ [W]$$

F : Frequency of rapid traverse acceleration/deceleration [sec/number of times]
Unless otherwise specified, rapid traverse acceleration/deceleration is assumed to be performed about once every 5 seconds.
Jm : Rotor inertia of the motor [kg·m^2]
JL : Motor-shaft-converted inertia of the load [kg·m^2]
Vm : Motor speed at rapid traverse [min^{-1}]
ta : Rapid traverse acceleration/deceleration time [sec]
TL : Machine frictional torque (motor-converted value) [N·m]

(b) CGS unit system

$$w = \frac{1}{F} \times (5.37 \times 10^{-4} \cdot (Jm + JL) \cdot Vm^2 - 5.13 \times 10^{-3} \cdot ta \cdot Vm \cdot TL)\ [W]$$

F : Rapid traverse acceleration/deceleration cycle [s/number of times]
About once every five seconds unless otherwise specified
Jm : Rotor inertia of motor [kg·cm·s^2]
JL : Load inertia (value for motor shaft) [kg·cm·s^2]
Vm : Motor rotation speed for rapid traverse [min^{-1}]
ta : Rapid traverse acceleration/deceleration time [s]
TL : Friction torque of machine (value for motor) [kg·cm]

(2) Servo motor (for vertical movement)
The amount of regenerative discharge (power [W]) when the operation duty for downward rapid traverse is D(%)

(a) SI unit system

$$w = 1.047 \times 10^{-1} \cdot Th \cdot Vm \times \frac{D}{100} \ [W]$$

Th : Upward torque that the motor applies at the time of downward rapid traverse [N·m]
Vm : Motor speed at rapid traverse [min^{-1}]
D : Operation duty [%] for downward rapid traverse
D is set to 50% maximum. Usually, D is less than 50%.

(b) CGS unit system

$$w = 1.026 \times 10^{-2} \cdot Th \cdot Vm \times \frac{D}{100} \ [W]$$

Th : Upward torque of motor during lowering by rapid traverse [kg·cm]
Vm : Motor rotation speed for rapid traverse [min^{-1}]
D : Downward operation duty during lowering by rapid traverse [%]
D is a maximum of 50% and usually less.

(3) Spindle motor

(a) SI unit system

$$w = 5.48 \times 10^{-3} \cdot (Jm + JL) \cdot N^2 \times \frac{1}{Dt} [W]$$

Jm : Rotor inertia of the motor [$kg \cdot m^2$]
JL : Motor-shaft-converted inertia of the load [$kg \cdot m^2$]
N : Motor speed [min^{-1}]
Dt : Duty cycle [sec]

(b) CGS unit system

$$w = 5.37 \times 10^{-2} \cdot (Jm + JL) \cdot N^2 \times \frac{1}{Dt} [W]$$

Jm : Rotor inertia of motor [$kg \cdot cm \cdot s^2$]
JL : Load inertia (value for motor shaft) [$kg \cdot cm \cdot s^2$]
N : Motor rotation speed [min^{-1}]
Dt : Duty cycle [s]

Cautions for selecting a regenerative discharge unit

Table.4.4.4 Required capacity for the Regenerative Discharge unit

Regenerative discharge unit	Capacity			Remarks
	Wind speed			
	0m/sec	2m/sec	4m/sec	
A06B-6089-H510	100W	250W	-	Resistance : 16Ω
A06B-6089-H500	200W	400W	600W	Resistance : 16Ω
A06B-6089-H713	-	-	800W	Forced cooling fan motor is included Resistance : 16Ω
A06B-6089-H711	-	-	800W	Forced cooling fan motor is included Resistance : 8Ω
A06B-6089-H712	-	-	1200W	Forced cooling fan motor is included Resistance : 8Ω

NOTE
1 The "maximum output at acceleration" value is provided only to aid in the selection of a power supply module; this is not a guaranteed value.
2 When a spindle motor with a maximum output of 5kW or more is used, the resistance of the regenerative discharge unit must be 8Ω. If a regenerative discharge unit with a resistance of 16Ω is used for a spindle motor with a maximum output of 5 kW or more , a regeneration excess alarm (alarm No. 08) may be generated in the PSMR when the spindle is decelerated.

4.5 LIST OF MOTOR OUTPUT CAPACITIES FOR POWER SUPPLY SELECTION

4.5.1 Servo Motor Continuous Rated Outputs and Maximum Outputs at Acceleration

This section gives the output data for servo motor. These data are used for selecting a power supply module of the α*is*/α*i* series servo amplifier. See FANUC AC SERVO MOTOR α*is*/α*i* series DESCRIPTIONS (B-65262EN) for details.

(1) Servo motor α*is*/α*i* series (200-V input series)

Table 4.5.1(a)

Motor model	Continuous rated output	Maximum output at acceleration
α1/5000*i*	0.50kW	2.0kW
α2/5000*i*	0.75kW	2.9kW
α4/4000*i*	1.4kW	4.5kW
α8/3000*i*	1.6kW	5.7kW
α12/3000*i*	3.0kW	7.6kW
α22/3000*i*	4.0kW	9.6kW
α30/3000*i*	7.0kW	21kW
α40/3000*i*	6.0kW	18kW
α40/3000*i* with fan	9.0kW	18kW
α2/5000*i*s	0.75kW	2.8kW
α4/5000*i*s	1.0kW	3.1kW
α8/4000*i*s	2.5kW	8.0kW
α12/4000*i*s	2.7kW	12kW
α22/4000*i*s	4.5kW	17kW
α30/4000*i*s	5.5kW	22kW
α40/4000*i*s	5.5kW	24kW
α50/3000*i*s	5kW	39kW
α50/3000*i*s with fan	14kW	39kW
α100/2500*i*s	11kW	38kW
α200/2500*i*s	20kW	48kW
α300/2000*i*s	37kW	96kW
α500/2000*i*s	50kW	104kW

NOTE
There is a possibility to change the data because of under evaluation.

(2) Servo motor β*i*s series (200-V input series)

Table 4.5.1(b)

Motor model	Continuous rated output	Maximum output at acceleration
β0.2/5000*i*s	0.05kW	0.24kW
β0.3/5000*i*s	0.1kW	0.4kW
β0.4/5000*i*s	0.13kW	0.5kW
β0.5/5000*i*s	0.2kW	1.1kW
β1/5000*i*s	0.4kW	1.7kW
β2/4000*i*s	0.5kW	2.3kW
β4/4000*i*s	0.75kW	2.5kW
β8/3000*i*s	1.2kW	2.8kW
β12/3000*i*s	1.8kW	5.4kW
β22/2000*i*s	2.5kW	5.2kW

NOTE
There is a possibility to change the data because of under evaluation.

(3) Servo motor α(HV)*i*s/α(HV)*i* series (400-V input series)

Table 4.5.1(c)

Motor model	Continuous rated output	Maximum output at acceleration
α4/4000HV*i*	1.4kW	4.5kW
α8/3000HV*i*	1.6kW	5.7kW
α12/3000HV*i*	3.0kW	7.5kW
α22/3000HV*i*	4.0kW	9.6kW
α2/5000HV*i*s	0.75kW	2.8kW
α4/5000HV*i*s	1.0kW	3.1kW
α8/4000HV*i*s	2.3kW	8.0kW
α12/4000HV*i*s	2.5kW	12kW
α22/4000HV*i*s	4.5kW	20kW
α30/4000HV*i*s	5.5kW	22kW
α40/4000HV*i*s	5.5kW	24kW
α50/3000HV*i*s	5kW	39kW
α50/3000HV*i*s with fan	14kW	39kW
α100/2500HV*i*s	11kW	38kW
α200/2500HV*i*s	20kW	48kW
α300/2500HV*i*s	37kW	96kW
α500/2000HV*i*s	50kW	104kW
α1000/2000HV*i*s	100kW	189kW

NOTE
There is a possibility to change the data because of under evaluation.

4.5.2 Spindle Motor Continuous Rated Outputs and Maximum Outputs at Acceleration

This section gives the output data for spindle motor. These data are used for selecting a power supply module of the α*i* series servo amplifier. See FANUC AC SPINDLE MOTOR α*i* series DESCRIPTIONS (B-65272EN) for details.

(1) Spindle motor α*i* series (200-V input series)

Table 4.5.2(a)

Motor model	Continuous rated output	30-minute rated output	Maximum output at acceleration
α0.5/10000*i*	0.55kW	1.1kW (15-minute rated)	1.32kW
α1/10000*i*	1.5kW	2.2kW (15-minute rated)	2.64kW
α1/15000*i*	1.5kW	2.2kW (15-minute rated)	5.6kW
α1.5/10000*i*	1.1kW	3.7kW (10-minute rated)	4.44kW
α1.5/15000*i*	1.5kW	2.2kW (15-minute rated)	13kW
α2/10000*i*	2.2kW	3.7kW (15-minute rated)	4.44kW
α2/15000*i*	2.2kW	3.7kW (15-minute rated)	20kW
α3/10000*i*	3.7kW	5.5kW	6.6kW
α3/12000*i*	3.7kW	5.5kW	13kW
α6/10000*i* α6/12000*i*	5.5kW	7.5kW	9kW
α8/8000*i* α8/10000*i*	7.5kW	11kW	13.2kW
α12/7000*i* α12/10000*i*	11kW	15kW	18kW
α15/7000*i* α15/10000*i*	15kW	18.5kW	22.2kW
α18/7000*i* α18/10000*i*	18.5kW	22kW	26.4kW
α22/7000*i* α22/10000*i*	22kW	26kW	31.2kW
α30/6000*i*	30kW	37kW	44.4kW
α40/6000*i*	37kW	45kW	54kW
α50/6000*i*	45kW	55kW	66kW
α12/6000*i*P α12/8000*i*P	5.5kW	7.5kW	12.3kW
α15/6000*i*P α15/8000*i*P	7.5kW	9kW	13.5kW
α18/6000*i*P α18/8000*i*P	9kW	11kW	15.1kW
α22/6000*i*P α22/8000*i*P	11kW	15kW	20kW
α30/6000*i*P	15kW	18.5kW	25kW
α40/6000*i*P	18.5kW	22kW	29kW
α50/6000*i*P	22kW	30kW	35.4kW
α60/4500*i*P	22kW	30kW	36kW

NOTE
There is a possibility to change the data because of under evaluation.

(2) Spindle motor α(HV)*i* series (400-V input series)

Table 4.5.2(b)

Motor model	Continuous rated output	30-minute rated output	Maximum output at acceleration
α0.5/10000HV*i*	0.55kW	1.1kW(15-minute rated)	1.32kW
α1/10000HV*i*	1.5kW	2.2kW(15-minute rated)	2.64kW
α1.5/10000HV*i*	1.1kW	3.7kW(10-minute rated)	4.44kW
α2/10000HV*i*	2.2kW	3.7kW(15-minute rated)	4.44kW
α3/10000HV*i*	3.7kW	5.5kW	6.6kW
α6/10000HV*i*	5.5kW	7.5kW	9kW
α8/8000HV*i*	7.5kW	11kW	13.2kW
α12/7000HV*i*	11kW	15kW	18kW
α15/7000HV*i*	15kW	18.5kW	22.2kW
α22/7000HV*i*	22kW	26kW	31.2kW
α30/6000HV*i*	30kW	37kW	44.4kW
α40/6000HV*i*	37kW	45kW	54kW
α60/4500HV*i*	60kW	75kW	90kW
α100/4000HV*i*	100kW	-	117kW
α15/6000HV*iP*	7.5kW	9kW	13.5kW
α22/6000HV*iP*	11kW	15kW	20kW
α40/6000HV*iP*	18.5kW	22kW	29kW
α50/6000HV*iP*	22kW	30kW	35.4kW
α60/4500HV*iP*	22kW	30kW	36kW

(3) Spindle motor αC*i* series (200-V input series)

Table 4.5.2(c)

Motor model	Continuous rated output	30-minute rated output	Maximum output at acceleration
αC1/6000*i*	1.5kW	2.2kW(15-minute rated)	2.64kW
αC2/6000*i*	2.2kW	3.7kW(15-minute rated)	4.44kW
αC3/6000*i*	3.7kW	5.5kW	6.6kW
αC6/6000*i*	5.5kW	7.5kW	9kW
αC8/6000*i*	7.5kW	11kW	13.2kW
αC12/6000*i*	11kW	15kW	18kW
αC15/6000*i*	15kW	18.5kW	22.2kW

NOTE
There is a possibility to change the data because of under evaluation.

5 INSTALLATION

5.1 LEAKAGE CURRENT

The servo amplifier αi series drives the motor by using the transistor PWM inverter method. This causes a high-frequency leakage current to flow via the ground drift capacitance in the motor winding, power cable, and amplifier. This may cause a device installed on the power supply side, such as a ground fault interrupter or leakage-protection relay, to malfunction.
When a circuit breaker with a ground fault interrupter is used, it must be selected so that the sum of the values calculated according to (a) and (b) described below is not greater than the non-operating current value.

(a) Selection criterion per amplifier
Model : SVM and SPM
Criterion for selection : 2 mA per amplifier (Note 1)

(b) Selection criterion per motor
Criterion for selection : 1 mA per motor (Note 1)

The following example shows how to use selection criteria (a) and (b):
Example :
When the system consists of SMV1×1, SVM3×1 (three motors), and SPM×1
2 mA×3 (for the amplifiers) + 1 mA×5 (for the motors) = 11 mA
→ Select a circuit breaker (Note 2) with a non-operating current of 11 mA or higher. (A general ground fault interrupter that can be used for the above example is the one with a rated sensitivity current of 30 mA and a non-operating current of 15 mA.)

NOTE
1 These criteria are for selecting a circuit breaker with a ground fault interrupter; they do not indicate accurate leakage currents.
2 A circuit breaker may malfunction depending on the frequency characteristic of the ground fault interrupter. Therefore, use a ground fault interrupter supporting the use of inverters.
3 The above criteria are values in the commercial frequency band. Some measuring instruments for measuring leakage current may sense a high frequency band, thus showing a larger value.

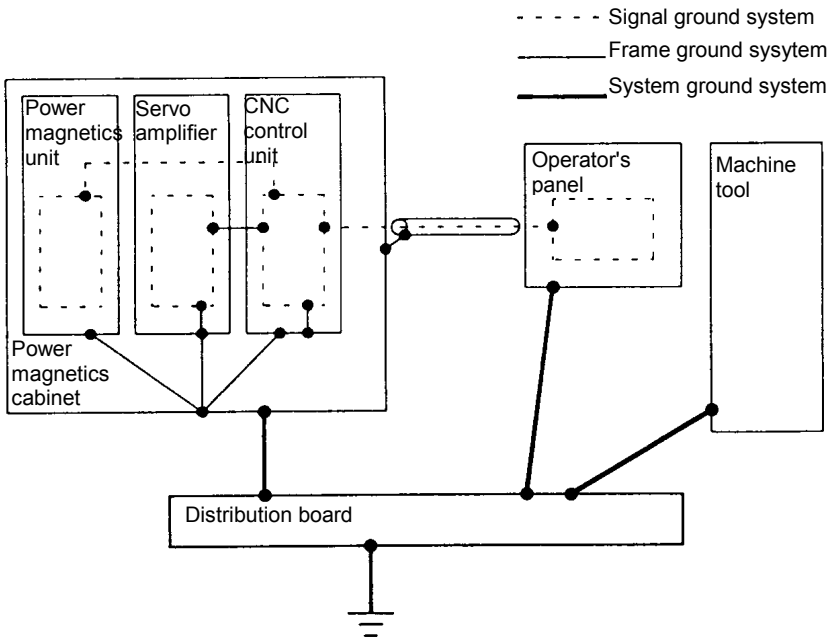
5.2 GROUND

The following ground systems are provided for the CNC machine tool:

(a) Signal ground system (SG)
The signal ground (SG) supplies the reference voltage (0V) of the electrical signal system.

(b) Frame ground system (FG)
The frame ground system (FG) is used for safety, and suppressing external and internal noises. In the frame ground system, the frames, cases of the units, panels, and shields for the interface cables between the units are connected.

(c) System ground system
The system ground system is used to connect the frame ground systems connected between devices or units with the ground.



[Notes on connecting the ground systems]

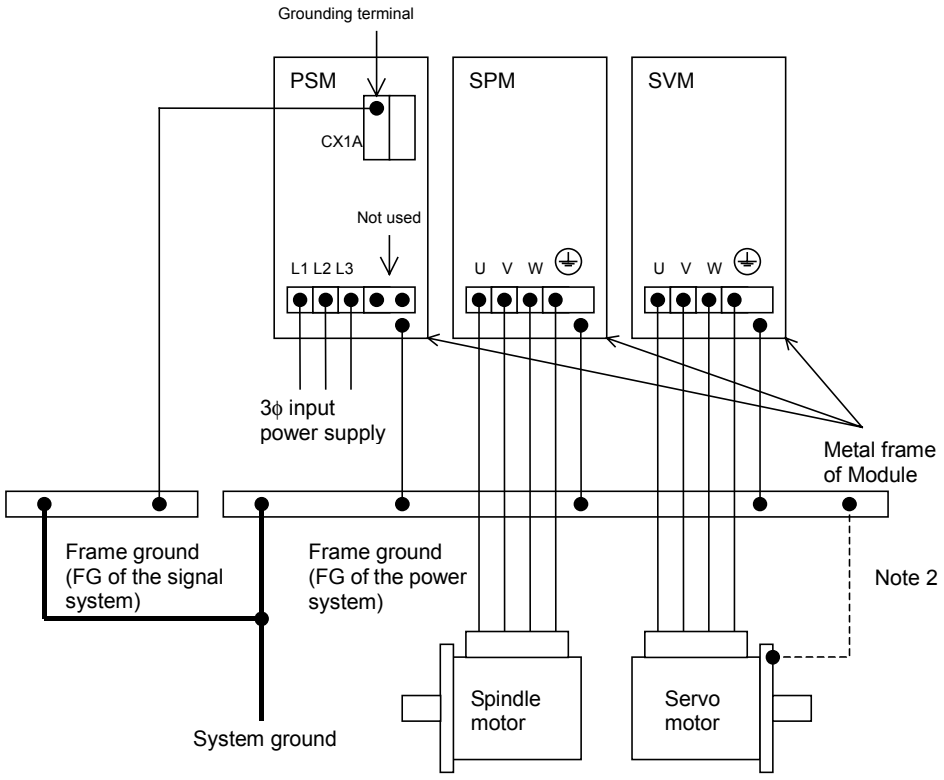
- Connect the signal ground (0V) with the frame ground (FG) at only one place in the power supply module.
- The grounding resistance of the system ground shall be 100 ohms or less (class D grounding).
- The system ground cable must have enough cross-sectional area to safely carry the accidental current flow into the system ground when an accident such as a short circuit occurs. (Generally, it must have the cross-sectional area of the AC power cable or more.)
- Use the cable containing the AC power wire and the system ground wire so that power is supplied with the ground wire connected.

(1) Grounding of each module
Achieve separation between the frame ground (FG) of the power system and that of the signal system. Otherwise, noise may propagate from the power system to the signal system, possibly causing the unit to malfunction.

(a) Power supply module
Connect the ground terminal of connector CX1A to the frame ground. This acts as the signal ground. Connect the ground terminal of the metal frame to the frame ground.

(b) Servo amplifier module and spindle amplifier module
Connect the ground cable of the motor power cable to a ground terminal of the terminal block of the module. Connect the other ground terminal of the terminal block to the frame ground. Connect the ground terminal of the metal frame to the frame ground.

(c) Regenerative discharge unit and DBM
Connect the ground terminal of the metal frame to the frame ground.



NOTE
1 Securing the ground terminal and a cable together is not permitted.
2 The motor flange mounting section may not be able to be connected to the machine mounting section of the power magnetics cabinet via the mechanical unit at sufficiently low impedance in a machine. In this case, a cable of a minimum required length that is at least 1.25 mm^2 thick must be run from the motor flange to the frame ground of the power magnetics cabinet. The cable must also be separated from the motor power line as much as possible.

5.3 NOISE PREVENTION

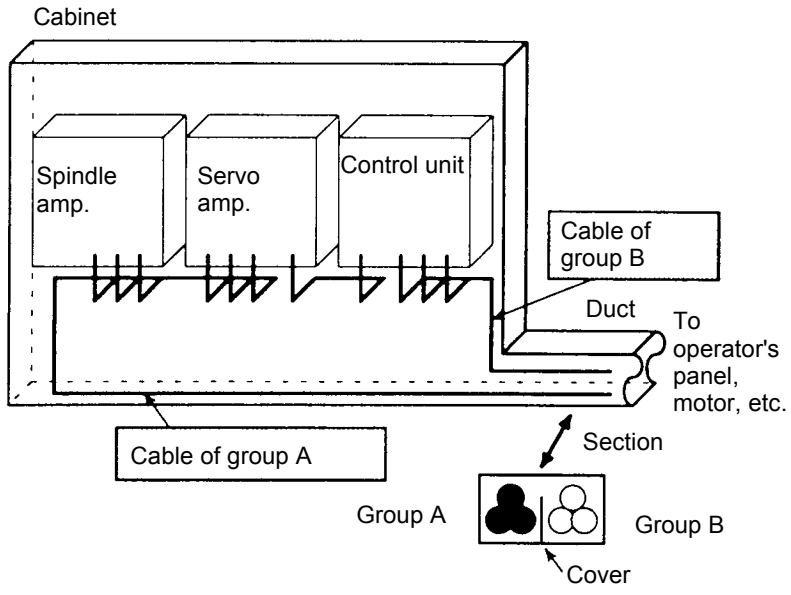
5.3.1 Separation of Signal Lines

If a signal cable is near a power cable, noise may be induced. The signal cables must be separated from the power cables when routed. When power and signal cables cannot possibly be separated from each other, the cables must be run in parallel in the minimum distance. When a conduit is used, it is recommended that the signal cables be separated from the power cables in it.

[Types of cables]

Group	Signal type	Action
A	Amplifier input power line	Separate binding (Note 1) or electromagnetic shielding (Note 2) is necessary for group B cables.
	Motor power line	
	Magnetic contactor driving coil (Note 3)	
B	Cable between CNC and SPM	Separate binding or electromagnetic shielding is necessary for group A cables. All cables must be shielded.
	Cable for position feedback or velocity feedback	
	Cable for Positioncoder	
	Other cable related to sensor	

NOTE
1 The groups must be 10 cm or more apart from one another when binding the cables in each group.
2 The electromagnetic shield refers to shielding between groups with grounded steel plates.
3 Attach a noise suppressor such as a spark killer to the magnetic contactor driving coil.



5.3.2 Cable Clamp and Shield Processing

- Terminal processing of the shield sheaths
  Perform terminal processing of the shield sheaths of the signal cables according to the description in Section 9.3.

- Cable clamp
  The cables that run into the amplifier and which require shield processing, with the exception of K14, K15, K17, K18, K19, K31, and K33, must be clamped as indicated in Fig. 5.3.2(a).

  Clamping secures a cable and also provides shielding. Clamping must always be performed since it is very important for stable system operation.

  Strip part of the cable jacket to expose the shield sheath, as shown in the figure below. Secure that part of the cable to the ground plate by using a clamp. At this time, the ground plate must be in contact with the surface of the shield so that the contact area becomes wide.

  Connect each shield cable to the ground plate installed near the cabinet inlet by using a ground clamp. This prevents noise generated in the panel from being emitted to external devices.

  Connect the cable clamp of the signal cables of SVM connected to common PSM to common the ground plate for signals.

- Grounding
  The ground plate must be created and installed by the user as shown in Figs.5.3.2(b) to (e).

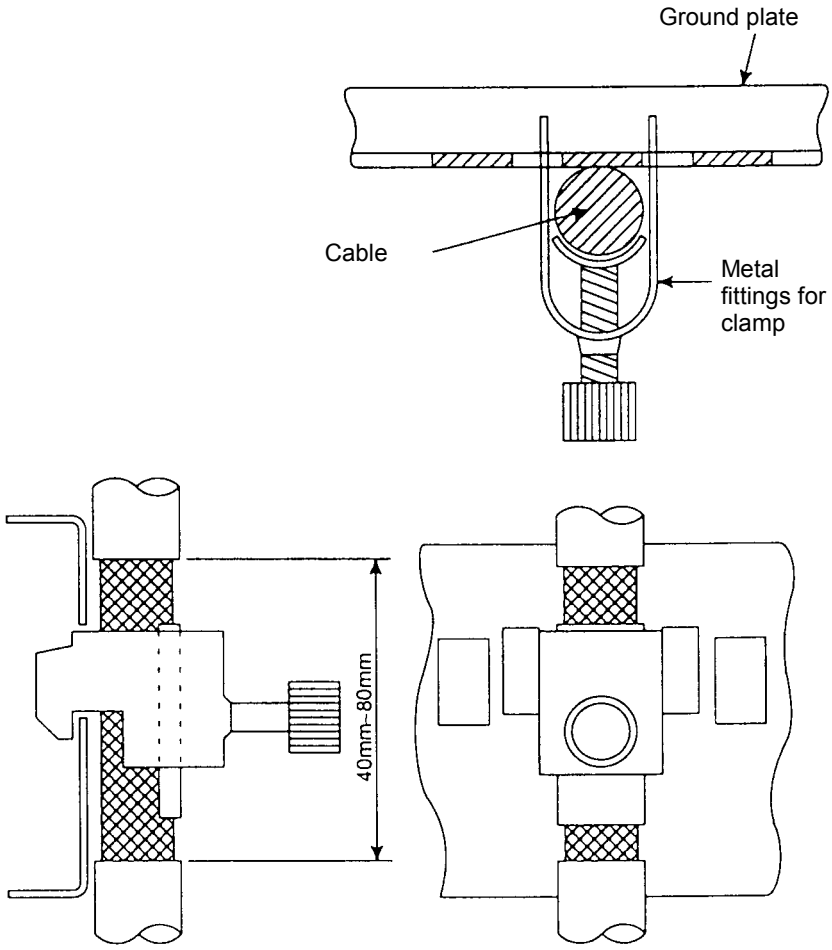


Fig.5.3.2(a) Cable clamp (1)

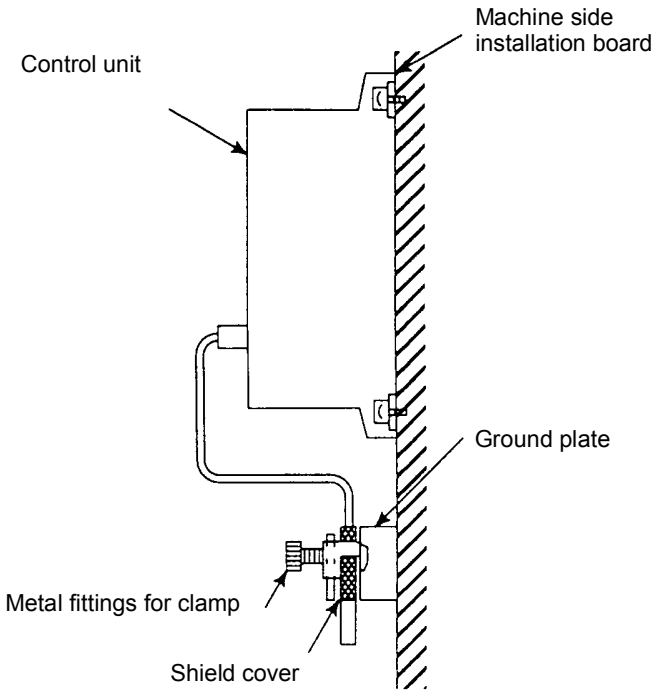


Fig.5.3.2(b) Cable clamp (2)

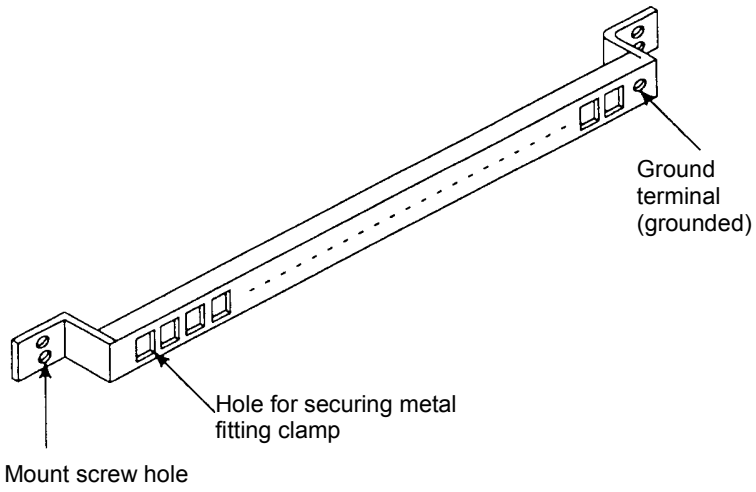


Fig.5.3.2(c) Ground plate

For the ground plate, use a metal plate of 2 mm or thicker, which surface is plated with nickel.

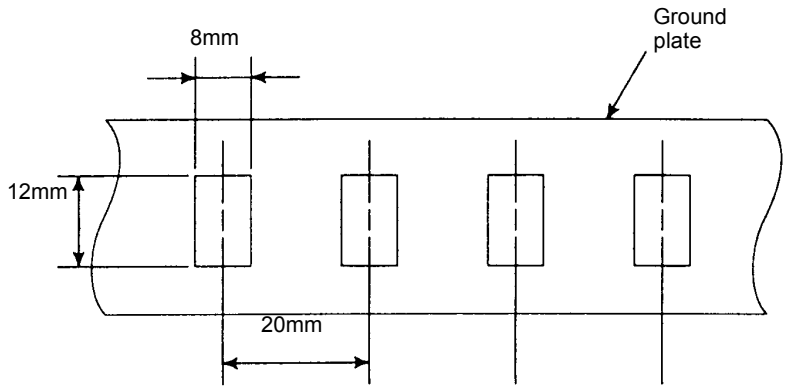


Fig.5.3.2(d) Ground plate holes

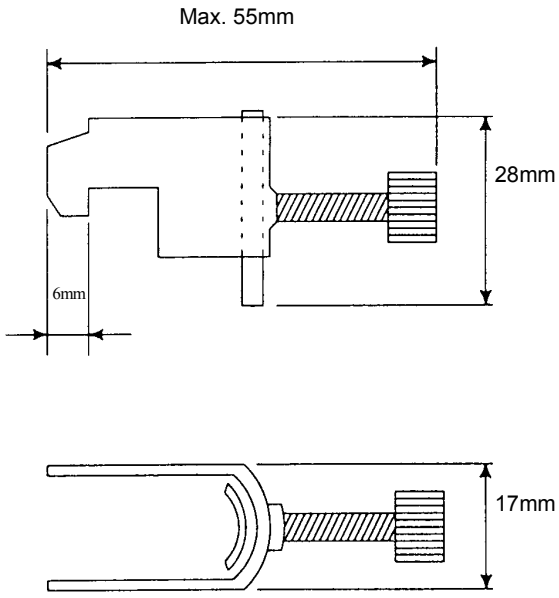


Fig.5.3.2(e) Outer drawings of metal fittings for clamp

5.3.3 Others

Cable length

If a cable is longer than required, a loss of power increases, and the signal line becomes likelier to be affected by noise. Use each cable of the minimum required length.

Use of shield cables

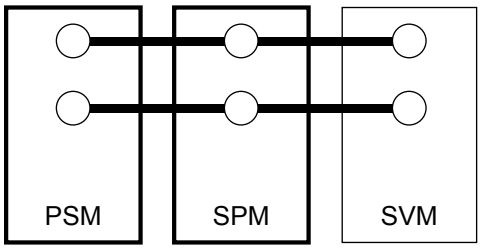
- Satisfying the requirements of the EMC Directives
  To satisfy the requirements of the EMC Directives enforced in Europe, it is recommended that a shield cable be used as a power cable and a double-shield cable be used as a signal cable. If it is difficult to use a shield cable, it is recommended that a conduit having an electromagnetic shielding effect be used.

- Protection against noise
  Noise generated from the shielded wire of a power shield cable may affect signals via the shielded wire of a signal cable. For this reason, separate the ground of the shielded wire of a power cable from that of the shielded wire of a signal cable. Use different ground clamping plates (ground plates) for power cables and signal cables to improve safety.

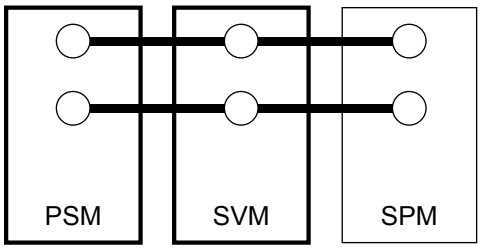
5.4 MODULE INSTALLATION

A restriction is imposed on the order of module installation as described below.

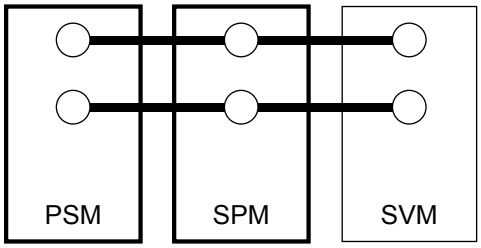
(1) When an SPM-30HV*i*, SPM-45HV*i*, SPM-75HV*i*, or SPM-100HV*i* is used
Install the PSM and SPM close to each other.



(2) When an SVM-360HV*i* is used
Install the PSM and SVM-360HV*i* close to each other.



(3) When an SPM-45*i* or SPM-55*i* is used
Install the PSM and SPM close to each other.



6 HEAT DISSIPATION

6.1 200-V INPUT SERIES

The amount of heat dissipation by each module of the servo amplifier αi series is described below.

6.1.1 Power Supply Module

Table 6.1.1(a) PSM*i*

Name	Ordering number	Rated output	Total amount of heat dissipation	Residual amount of heat in the cabinet
PSM-5.5*i*	A06B-6110-H006	5.5kW	100W	53W
PSM-11*i*	A06B-6110-H011	11kW	158W	53W
PSM-15*i*	A06B-6110-H015	15kW	333W	61W
PSM-26*i*	A06B-6110-H026	26kW	597W	75W
PSM-30*i*	A06B-6110-H030	30kW	681W	79W
PSM-37*i*	A06B-6110-H037	37kW	706W	81W
PSM-55*i*	A06B-6110-H055	45kW	921W	91W
		55kW	1115W	101W

Table 6.1.1(b) AC reactor for PSM*i*

Name	Ordering number	Rated output	Total amount of heat dissipation
For PSM-5.5*i*	A81L-0001-0155	5.5kW	16W
For PSM-11*i*		11kW	38W
For PSM-15*i*	A81L-0001-0156	15kW	50W
For PSM-26*i*	A81L-0001-0157	26kW	70W
For PSM-30*i*	A81L-0001-0158	30kW	65W
For PSM-37*i*	A81L-0001-0159	37kW	55W
For PSM-55*i*	A81L-0001-0160	55kW	79W

Table 6.1.1(c) PSMR*i*

Name	Ordering number	Rated output	Total amount of heat dissipation	Residual amount of heat in the cabinet
PSMR-3*i*	A06B-6115-H006	3kW	60W	60W
PSMR-5.5*i*	A06B-6115-H011	5.5kW	105W	55W
		7.5kW	130W	60W

Table 6.1.1(d) AC line filter for PSMR*i*

Name	Ordering number	Rated output	Total amount of heat dissipation
For PSMR-3*i*	A81L-0001-0083#3C	2.0kW	10W
		3.0kW	15W
For PSMR-5.5*i*	A81L-0001-0101#C	5.5kW	40W
		7.5kW	50W

6.1.2 Servo Amplifier Module

The amount of heat dissipation by the SVM depends on the SVM model and the current that flows through the servo motor. For the current that flows through a servo motor, reference the continuous rated current of each servo motor. (For the continuous rated current of each servo motor, refer to the servo motor descriptions.) As the current that flows through a servo motor, the root-mean-square value of the current that flows through an actual servo motor on a machine can be used. The amount of heat dissipation indicated below assumes the use of HRV2.

(1) Total amount of heat dissipation
The total amount of heat dissipation by the SVM is calculated according to the following expression:

Total amount of heat dissipation
= a + Ka1 × b1 + Ka2 × b2 + Ka3 × b3
a : Amount of heat dissipation determined by the SVM model [W]
Ka1 : Coefficient determined by the SVM [W/Arms]
b1 : Current flowing through the servo motor [Arms]
Ka2 : Coefficient determined by the SVM [W/Arms]
b2 : Current flowing through the servo motor [Arms]
Ka3 : Coefficient determined by the SVM [W/Arms]
b3 : Current flowing through the servo motor [Arms]

SVM 1-axis (Total amount of heat dissipation)

Name	Specification	a [W]	K [W/Arms]
SVM1-20*i*	H103	13	Ka1: 5.0
SVM1-40*i*	H104	13	Ka1: 4.6
SVM1-80*i*	H105	13	Ka1: 4.3
SVM1-160*i*	H106	17	Ka1: 4.7
SVM1-360*i*	H109	25	Ka1: 4.9

SVM 2-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	K [W/Arms]
SVM2-4/4*i*	H201	17	L	Ka1: 5.0
			M	Ka2: 5.0
SVM2-20/20*i*	H205	17	L	Ka1: 5.0
			M	Ka2: 5.0
SVM2-20/40*i*	H206	17	L	Ka1: 5.0
			M	Ka2: 4.6
SVM2-40/40*i*	H207	19	L	Ka1: 4.6
			M	Ka2: 4.6
SVM2-40/80*i*	H208	19	L	Ka1: 4.6
			M	Ka2: 4.3
SVM2-80/80*i*	H209	19	L	Ka1: 4.3
			M	Ka2: 4.3
SVM2-80/160*i*	H210	19	L	Ka1: 4.3
			M	Ka2: 4.7
SVM2-160/160*i*	H211	19	L	Ka1: 4.7
			M	Ka2: 4.7

SVM 3-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	K [W/Arms]
SVM3-4/4/4*i*	H301	21	L	Ka1: 5.0
			M	Ka2: 5.0
			N	Ka3: 5.0
SVM3-20/20/20*i*	H303	21	L	Ka1: 5.0
			M	Ka2: 5.0
			N	Ka3: 5.0
SVM3-20/20/40*i*	H304	21	L	Ka1: 5.0
			M	Ka2: 5.0
			N	Ka3: 4.6

(2) Residual amount of heat in the cabinet
By placing the heat sink section of the SVM outside the cabinet, the residual amount of heat in the cabinet can be calculated according to the expression below.

Residual amount of heat in the cabinet
= a + Kb1 × b1 + Kb2 × b2 + Kb3 × b3
a : Amount of heat dissipation determined by the SVM model [W]
Kb1 : Coefficient determined by the SVM [W/Arms]
b1 : Current flowing through the servo motor [Arms]
Kb2 : Coefficient determined by the SVM [W/Arms]
b2 : Current flowing through the servo motor [Arms]
Kb3 : Coefficient determined by the SVM [W/Arms]
b3 : Current flowing through the servo motor [Arms]

SVM 1-axis

Name	Specification	a [W]	K [W/Arms]
SVM1-20*i*	H103	13	Kb1: 5.0
SVM1-40*i*	H104	13	Kb1: 0.92
SVM1-80*i*	H105	13	Kb1: 0.86
SVM1-160*i*	H106	13	Kb1: 0.47
SVM1-360*i*	H109	18	Kb1: 0.25

SVM 2-axis

Name	Specification	a [W]	Axis	K [W/Arms]
SVM2-4/4*i*	H201	17	L	Kb1: 5.0
			M	Kb2: 5.0
SVM2-20/20*i*	H205	17	L	Kb1: 5.0
			M	Kb2: 5.0
SVM2-20/40*i*	H206	17	L	Kb1: 1.0
			M	Kb2: 0.92
SVM2-40/40*i*	H207	17	L	Kb1: 0.46
			M	Kb2: 0.46
SVM2-40/80*i*	H208	17	L	Kb1: 0.46
			M	Kb2: 0.43
SVM2-80/80*i*	H209	17	L	Kb1: 0.43
			M	Kb2: 0.43
SVM2-80/160*i*	H210	17	L	Kb1: 0.43
			M	Kb2: 0.47
SVM2-160/160*i*	H211	17	L	Kb1: 0.47
			M	Kb2: 0.47

SVM 3-axis

Name	Specification	a [W]	Axis	K [W/Arms]
SVM3-4/4/4*i*	H301	21	L	Kb1: 5.0
			M	Kb2: 5.0
			N	Kb3: 5.0
SVM3-20/20/20*i*	H303	21	L	Kb1: 5.0
			M	Kb2: 5.0
			N	Kb3: 5.0
SVM3-20/20/40*i*	H304	19	L	Kb1: 5.0
			M	Kb2: 5.0
			N	Kb3: 0.92

6.1.3 Spindle Amplifier Module

Table 6.1.3(a) SPM

Name	Ordering number	Rated output (Note 1)	Total amount of heat dissipation	Residual amount of heat in the cabinet
SPM-2.2*i*	A06B-6111-H002#H550	1.5kW	75W	37W
SPM-5.5*i*	A06B-6111-H006#H550	2.2kW	112W	36W
		3.7kW	120W	36W
SPM-11*i*	A06B-6111-H011#H550	5.5kW	171W	41W
		7.5kW	218W	46W
SPM-15*i*	A06B-6111-H015#H550	11kW	273W	45W
SPM-22*i*	A06B-6111-H022#H550	15kW	435W	53W
		18.5kW	515W	57W
SPM-26*i*	A06B-6111-H026#H550	22kW	684W	62W
SPM-30*i*	A06B-6111-H030#H550	26kW	739W	65W
SPM-45*i*	A06B-6111-H045#H550	30kW	911W	75W
		37kW	1123W	85W
SPM-55*i*	A06B-6111-H055#H550	45kW	1360W	98W

NOTE
1 "Rated output" indicates the continuous rated output of the motor.
2 The indicated amounts of heat dissipation assume the use of HRV2.

6.2 400-V INPUT SERIES

The amount of heat dissipation by each module of the servo amplifier α(HV)*i* series is described below.

6.2.1 Power Suplly Module

Table 6.2.1(a) PSM(HV)*i*

Name	Ordering number	Rated output	Total amount of heat dissipation	Residual amount of heat in the cabinet
PSM-11HV*i*	A06B-6120-H011	11kW	136W	51W
PSM-18HV*i*	A06B-6120-H018	18kW	274W	57W
PSM-30HV*i*	A06B-6120-H030	30kW	380W	64W
PSM-45HV*i*	A06B-6120-H045	30kW	394W	64W
		37kW	475W	68W
		45kW	567W	75W
PSM-75HV*i*	A06B-6120-H075	60kW	600W	75W
		75kW	738W	82W
PSM-100HV*i*	A06B-6120-H100	100kW	1380W	110W

Table 6.2.1(b) AC reactor for PSM(HV)*i*

Name	Ordering number	Rated output	Total amount of heat dissipation
For PSM-11HV*i*	A81L-0001-0163	11kW	38W
For PSM-18HV*i*		18kW	70W
For PSM-30HV*i*	A81L-0001-0164	30kW	60W
For PSM-45HV*i*		45kW	100W
For PSM-75HV*i*	A81L-0001-0165	75kW	120W
For PSM-100HV*i*		100kW	180W

6.2.2 Servo Amplifier Module

The amount of heat dissipation by the SVM depends on the SVM model and the current that flows through the servo motor. For the current that flows through a servo motor, reference the continuous rated current of each servo motor. (For the continuous rated current of each servo motor, refer to the servo motor descriptions.) As the current that flows through a servo motor, the root-mean-square value of the current that flows through an actual servo motor on a machine can be used. The amount of heat dissipation indicated below assumes the use of HRV2.

(1) Total amount of heat dissipation
The total amount of heat dissipation by the SVM is calculated according to the following expression:

Total amount of heat dissipation = a + Ka1 × b1 + Ka2 × b2
a : Amount of heat dissipation determined by the SVM model [W]
Ka1 : Coefficient determined by the SVM [W/Arms]
b1 : Current flowing through the servo motor [Arms]
Ka2 : Coefficient determined by the SVM [W/Arms]
b2 : Current flowing through the servo motor [Arms]

SVM 1-axis (Total amount of heat dissipation)

Name	Specification	a [W]	K [W/Arms]
SVM1-10HV*i*	H102	13	Ka1: 8.2
SVM1-20HV*i*	H103	13	Ka1: 8.8
SVM1-40HV*i*	H104	13	Ka1: 8.8
SVM1-80HV*i*	H105	17	Ka1: 9.0
SVM1-180HV*i*	H106	25	Ka1: 8.8
SVM1-360HV*i*	H109	34	Ka1: 7.8

SVM 2axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	K [W/Arms]
SVM2-10/10HV*i*	H202	17	L	Ka1: 8.2
			M	Ka2: 8.2
SVM2-20/20HV*i*	H205	17	L	Ka1: 8.8
			M	Ka2: 8.8
SVM2-20/40HV*i*	H206	17	L	Ka1: 8.8
			M	Ka2: 8.8
SVM2-40/40HV*i*	H207	17	L	Ka1: 8.8
			M	Ka2: 8.8
SVM2-40/80HV*i*	H208	17	L	Ka1: 8.8
			M	Ka2: 9.0
SVM2-80/80HV*i*	H209	17	L	Ka1: 9.0
			M	Ka2: 9.0

(2) Residual amount of heat in the cabinet
By placing the heat sink section of the SVM outside the cabinet, the residual amount of heat in the cabinet can be calculated according to the expression below.

Residual amount of heat in the cabinet
= a + Kb1 × b1 + Kb2 × b2
a : Amount of heat dissipation determined by the SVM model [W]
Kb1 : Coefficient determined by the SVM [W/Arms]
b1 : Current flowing through the servo motor [Arms]
Kb2 : Coefficient determined by the SVM [W/Arms]
b2 : Current flowing through the servo motor [Arms]

SVM 1-axis (Residual amount of heat in the cabinet)

Name	Specification	a [W]	K [W/Arms]
SVM1-10HV*i*	H102	13	Kb1: 8.2
SVM1-20HV*i*	H103	13	Kb1: 1.76
SVM1-40HV*i*	H104	13	Kb1: 1.76
SVM1-80HV*i*	H105	13	Kb1: 0.90
SVM1-180HV*i*	H106	18	Kb1: 0.44
SVM1-360HV*i*	H109	20	Kb1: 0.39

SVM 2-axis

Name	Specification	a [W]	Axis	K [W/Arms]
SVM2-10/10HV*i*	H202	17	L	Kb1: 8.2
			M	Kb2: 8.2
SVM2-20/20HV*i*	H205	17	L	Kb1: 1.76
			M	Kb2: 1.76
SVM2-20/40HV*i*	H206	17	L	Kb1: 0.88
			M	Kb2: 0.88
SVM2-40/40HV*i*	H207	17	L	Kb1: 0.88
			M	Kb2: 0.88
SVM2-40/80HV*i*	H208	17	L	Kb1: 0.88
			M	Kb2: 0.90
SVM2-80/80HV*i*	H209	17	L	Kb1: 0.90
			M	Kb2: 0.90

6.2.3 Spindle Amplifier Module

Table 6.2.3 SPM

Name	Ordering number	Rated output (Note 1)	Total amount of heat dissipation	Residual amount of heat in the cabinet
SPM-5.5HV*i*	A06B-6121-H006#H550	0.55kW	26W	18W
		1.5kW	44W	22W
		2.2kW	59W	24W
		3.7kW	87W	29W
SPM-11HV*i*	A06B-6121-H011#H550	5.5kW	122W	37W
		7.5kW	156W	39W
SPM-15HV*i*	A06B-6121-H015#H550	11kW	189W	40W
SPM-30HV*i*	A06B-6121-H030#H550	15kW	247W	41W
		22kW	349W	45W
SPM-45HV*i*	A06B-6121-H045#H550	30kW	482W	52W
		37kW	588W	57W
SPM-75HV*i*	A06B-6121-H075#H550	60kW	1264W	91W
SPM-100HV*i*	A06B-6121-H100#H550	100kW	2100W	150W

NOTE
1 "Rated output" indicates the continuous rated output of the motor.
2 The indicated amounts of heat dissipation assume the use of HRV2.

7 COOLING

The αi series has a built-in fan for external fin cooling, so that external forced air cooling is unnecessary.
To maintain cooling efficiency, be sure to provide maintenance areas as described in Section 8.1.

8 EXTERNAL DIMENSIONS AND MAINTENANCE AREA

8.1 OUTLINE DRAWINGS

8.1.1 Outline Drawings of Modules, Panel Cut-out, and Maintenance Area

(1) Power supply modules

Model			Outline drawing	Panel cut-out	Maintenance area
Power regeneration type	200-V input series	PSM-5.5*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		PSM-11*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		PSM-15*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		PSM-26*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		PSM-30*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		PSM-37*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		PSM-55*i*	Outline drawing 5	Panel cut-out 5	Maintenance area 4
	400-V input series	PSM-11HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		PSM-18HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		PSM-30HV*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		PSM-45HV*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		PSM-75HV*i*	Outline drawing 5	Panel cut-out 5	Maintenance area 4
		PSM-100HV*i*	Outline drawing 5	Panel cut-out 5	Maintenance area 4
Resistance regeneration type	200-V input series	PSMR-3*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		PSMR-5.5*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1

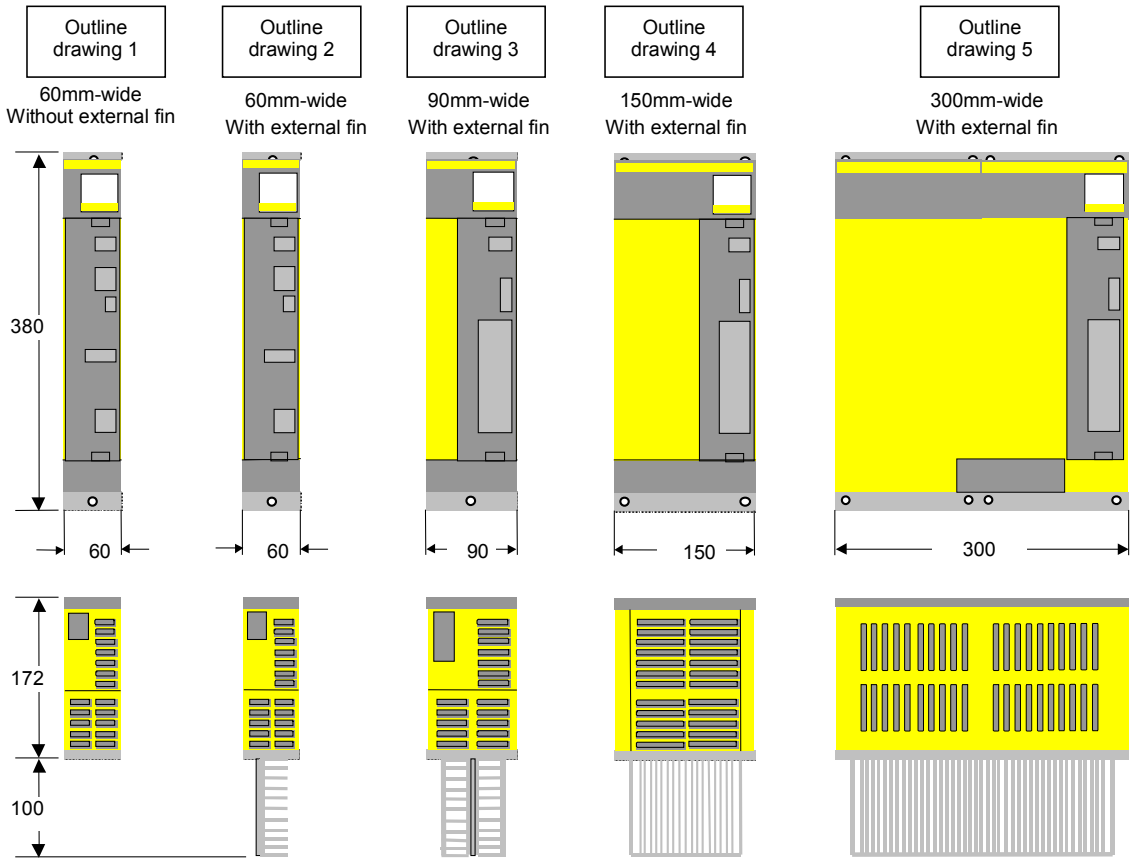
(2) Servo amplifier modules

Model			Outline drawing	Panel cut-out	Maintenance area
200-V input series	1 axis	SVM1-20*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM1-40*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-80*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-160*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-360*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
	2 axes	SVM2-4/4*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM2-20/20*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM2-20/40*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM2-40/40*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM2-40/80*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM2-80/80*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM2-80/160*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SVM2-160/160*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
	3 axes	SVM3-4/4/4*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM3-20/20/20*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM3-20/20/40*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
400-V input series	1 axis	SVM1-10HV*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM1-20HV*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-40HV*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-80HV*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM1-180HV*i*	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SVM1-360HV*i*	Outline drawing 5	Panel cut-out 5	Maintenance area 4
	2 axes	SVM2-10/10HV*i*	Outline drawing 1	Panel cut-out 1	Maintenance area 1
		SVM2-20/20HV*i*	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SVM2-20/40HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SVM2-40/40HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SVM2-40/80HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SVM2-80/80HV*i*	Outline drawing 3	Panel cut-out 3	Maintenance area 2

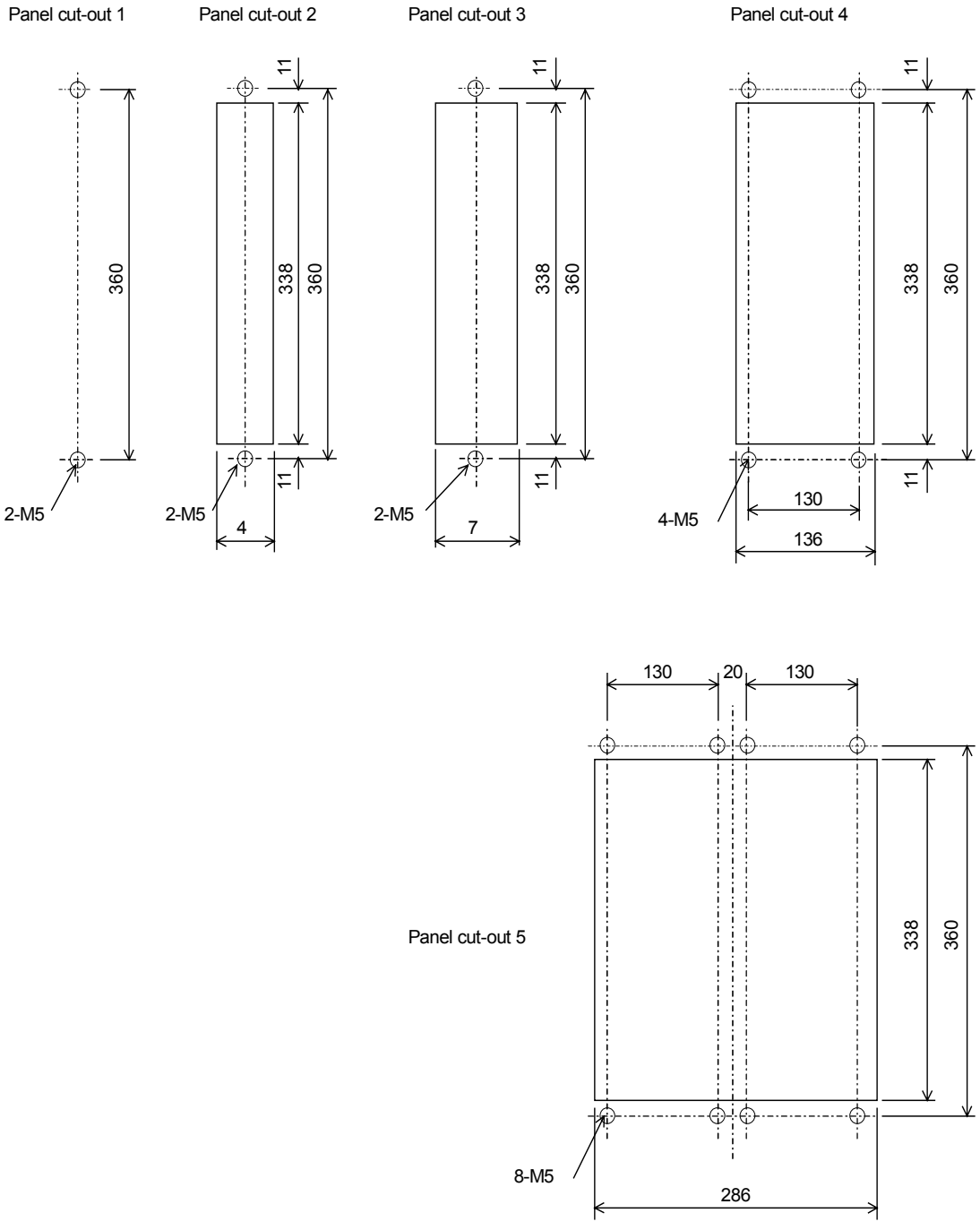
(3) Spindle amplifier modules

Model			Outline drawing	Panel cut-out	Maintenance area
αi series	200-V input series	SPM-2.2i	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SPM-5.5i	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SPM-11i	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPM-15i	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPM-22i	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SPM-26i	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SPM-30i	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SPM-45i	Outline drawing 5	Panel cut-out 5	Maintenance area 4
		SPM-55i	Outline drawing 5	Panel cut-out 5	Maintenance area 4
	400-V input series	SPM-5.5HVi	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SPM-11HVi	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPM-15HVi	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPM-30HVi	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SPM-45HVi	Outline drawing 4	Panel cut-out 4	Maintenance area 3
		SPM-75HVi	Outline drawing 5	Panel cut-out 5	Maintenance area 4
		SPM-100HVi	Outline drawing 5	Panel cut-out 5	Maintenance area 4
αCi series	200-V input series	SPMC-2.2i	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SPMC-5.5i	Outline drawing 2	Panel cut-out 2	Maintenance area 1
		SPMC-11i	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPMC-15i	Outline drawing 3	Panel cut-out 3	Maintenance area 2
		SPMC-22i	Outline drawing 4	Panel cut-out 4	Maintenance area 3

(4) Module outline drawings



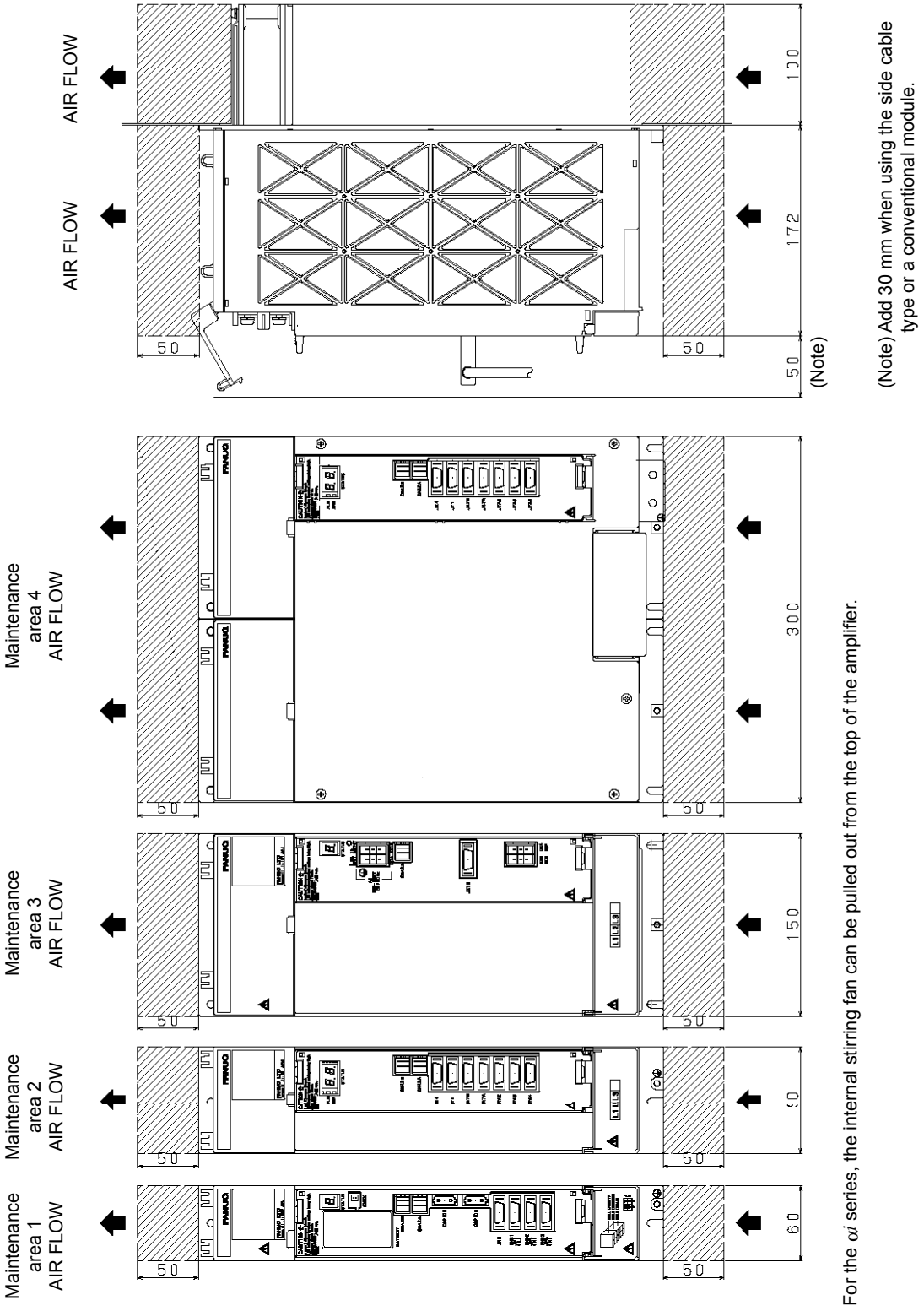
(5) Panel cut-out drawings



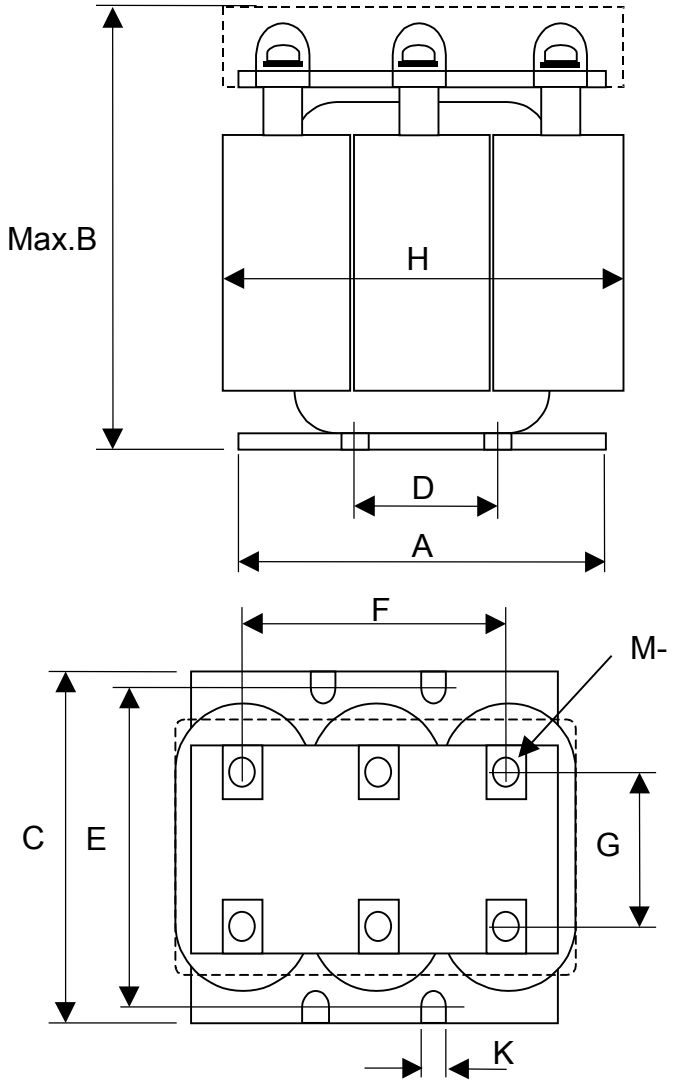
See Section 8.2 for details.

(6) Maintenance area drawings

An amplifier contains a fan motor for internal stirring. To allow air to flow and make replacement of a fan unit easy, be sure to reserve the shaded areas shown in the figure below.



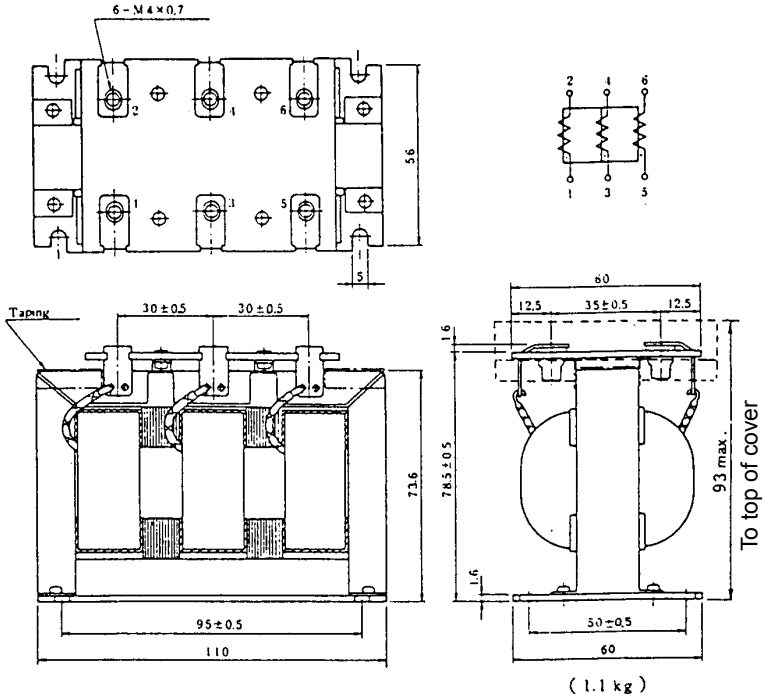
8.1.2 AC Reactor Unit



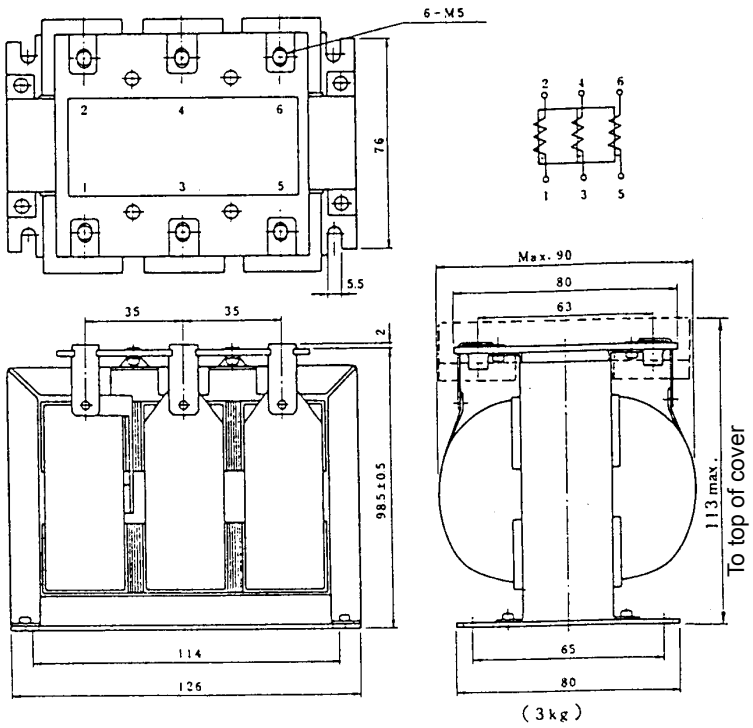
	A	B	C	D	E	F	G	H	K	M-
For PSM-5.5*i*, 11*i*	135	155	82	50	65	89	48	135	5	M5
For PSM-15*i*	135	155	108	42	95	84	66	135	7.2	M5
For PSM-26*i* / **For PSM-30*i***	135	155	165	55	145	84	66	135	7.2	M5
For PSM-37*i*	185	160	145	80	100	124	106	185	7.2	M8
For PSM-55*i*	185	170	165	80	100	124	125	185	7.2	M8
For PSM-11HV*i*, 18Hv*i*	135	155	165	55	145	84	66	135	7	M5
For PSM-30HV*i*, 45HV*i*	185	172	175	70	154	116	106	185	7	M8
For PSM-75HV*i*, 100HV*i*	248	200	238	105	216	155	151	248	7	M10

8.1.3 AC Line Filter

A81L-0001-0083#3C

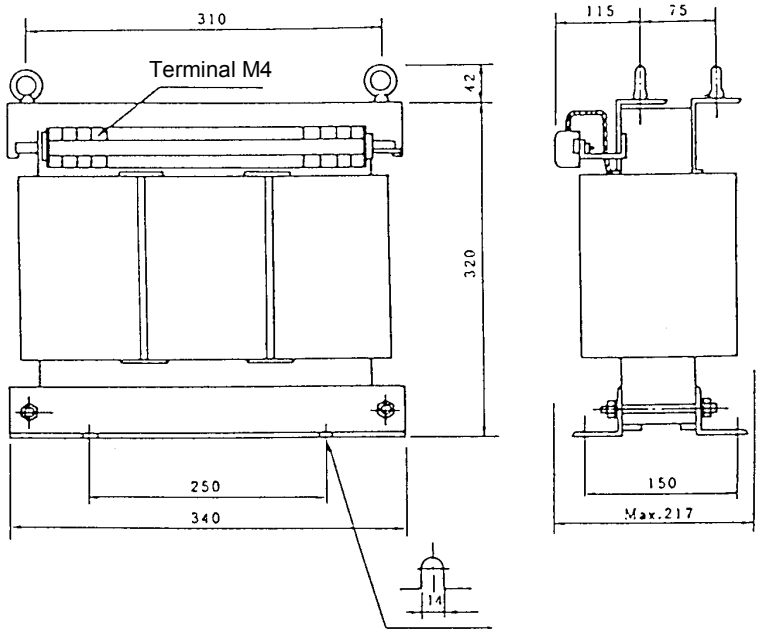


A81L-0001-0101#C

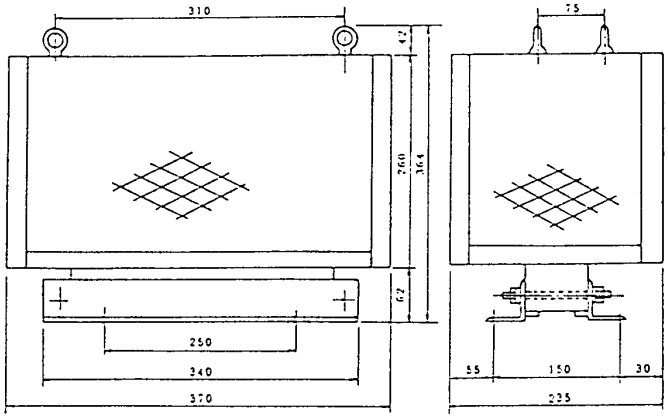


8.1.4 Power Transformer

For PSM-5.5*i*, PSMR-5.5*i* (at 5.5 kW output) (A06B-6052-J001)



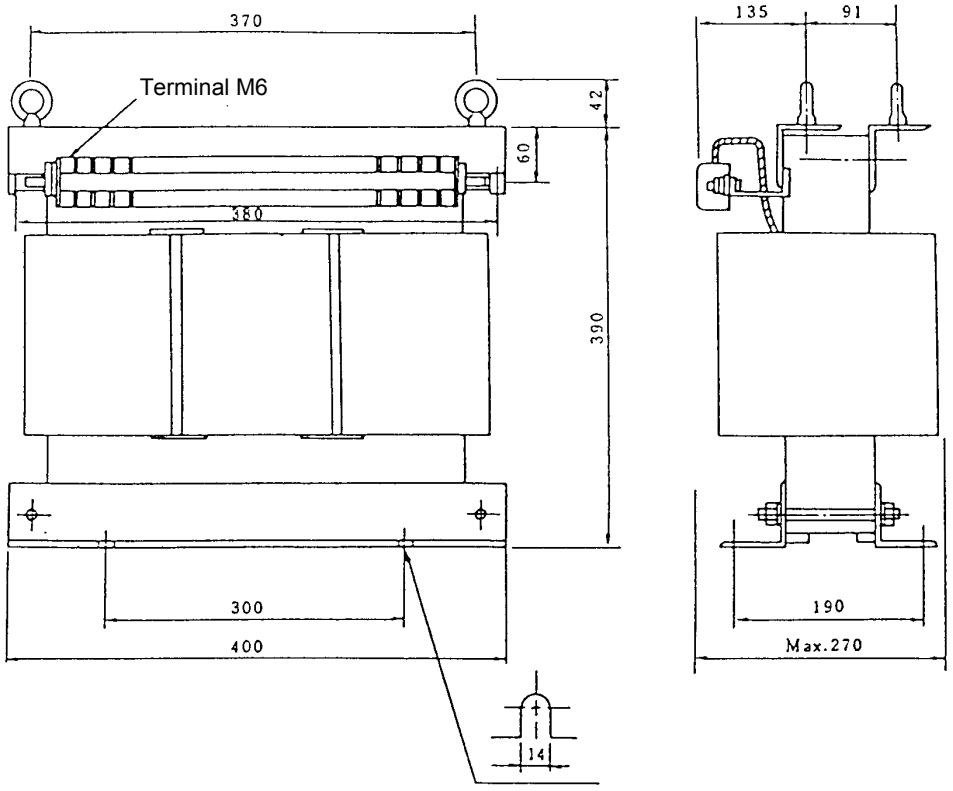
Outline Drawing of Power Transformer with no Cover



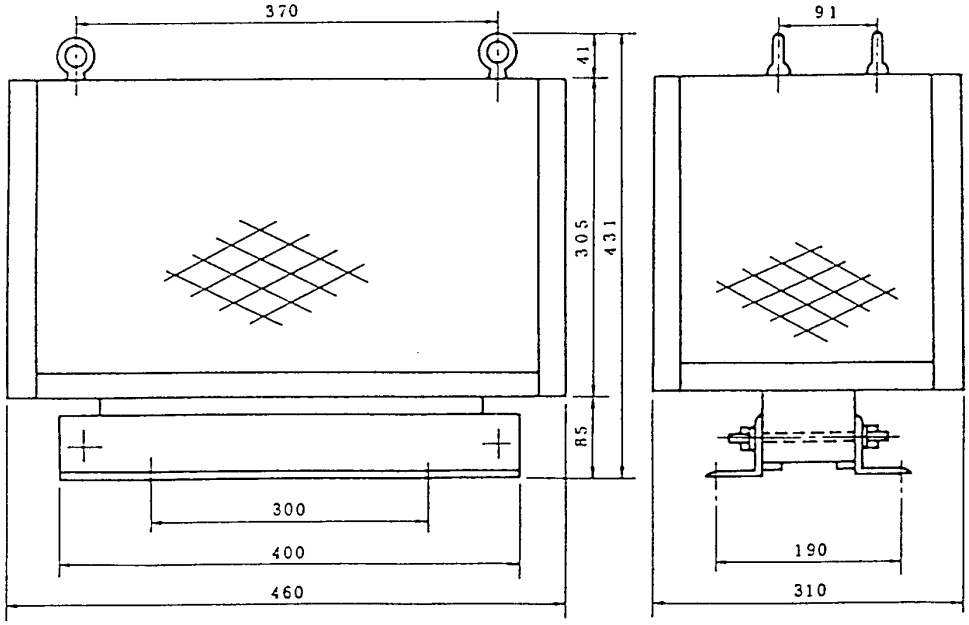
Outline Drawing of Power Transformer with Cover

NOTE
The four side panels are all meshed, while the top is a solid plate.

For PSM-11*i*, PSMR-5.5*i* (at 7.5KW output) (A06B-6044-J006)



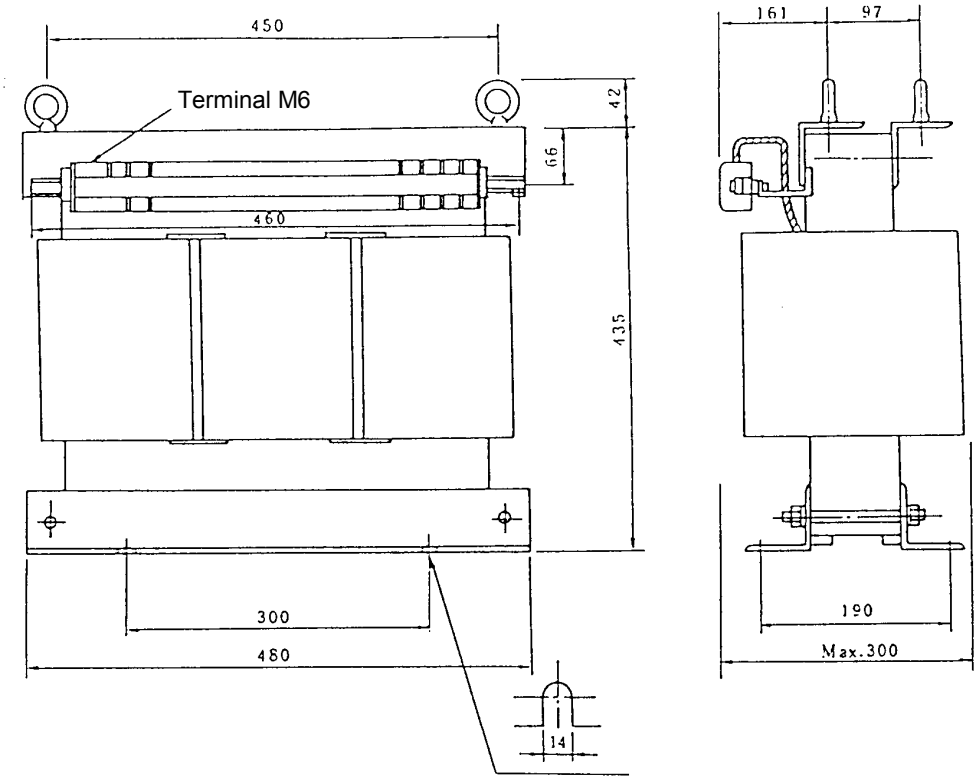
Outline Drawing of Power Transformer with no Cover



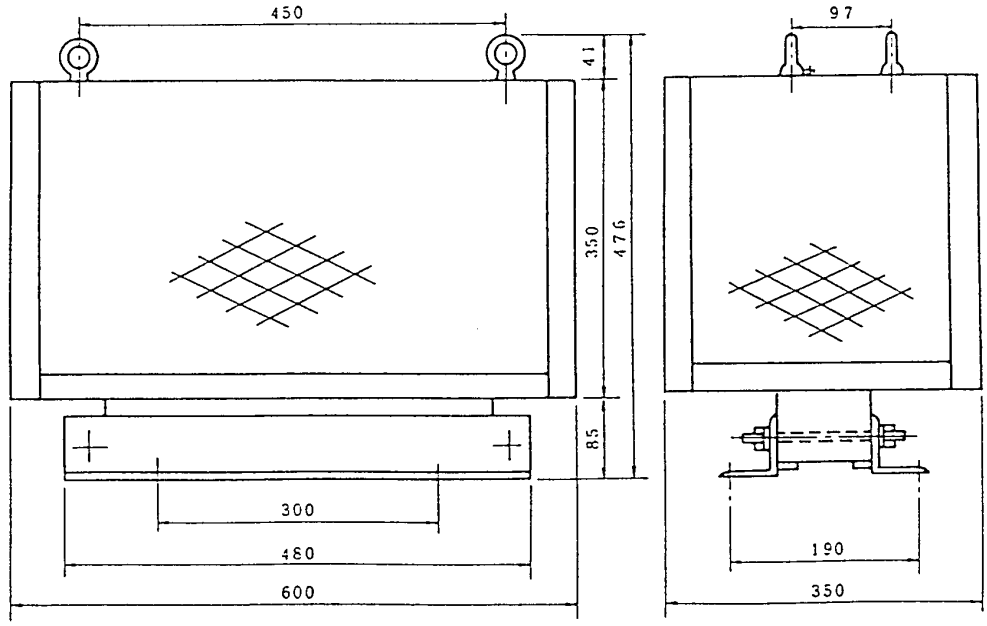
Outline Drawing of Power Transformer with Cover

NOTE
The four side panels are all meshed, while the top is a solid plate.

For PSM-15*i* (A06B-6044-J007)



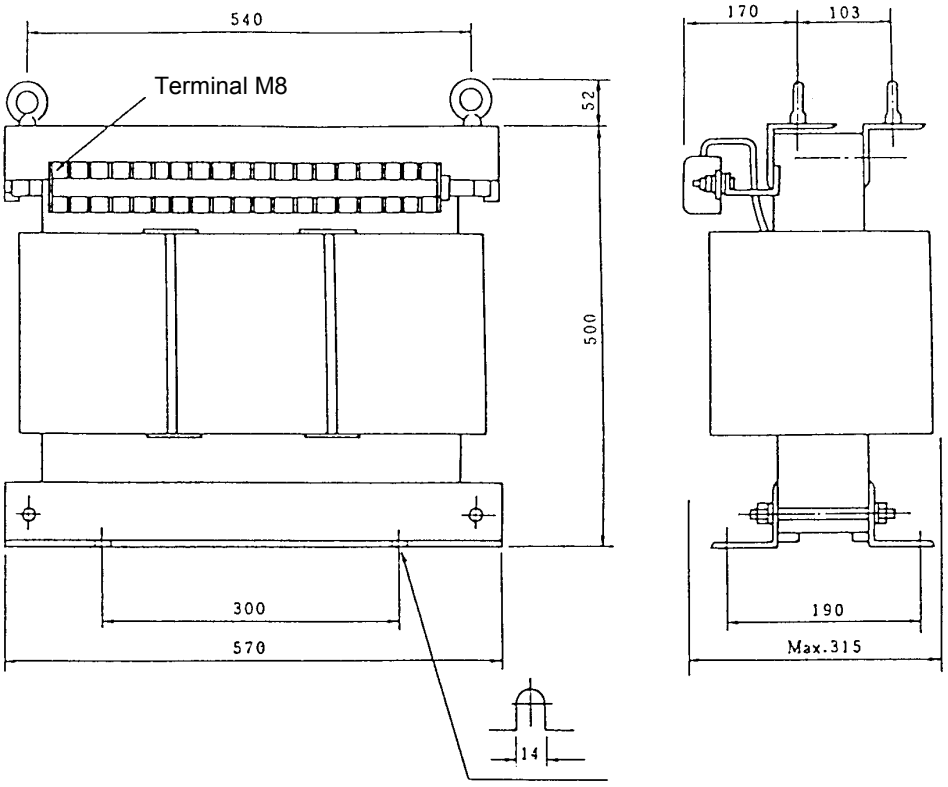
Outline Drawing of Power Transformer with no Cover



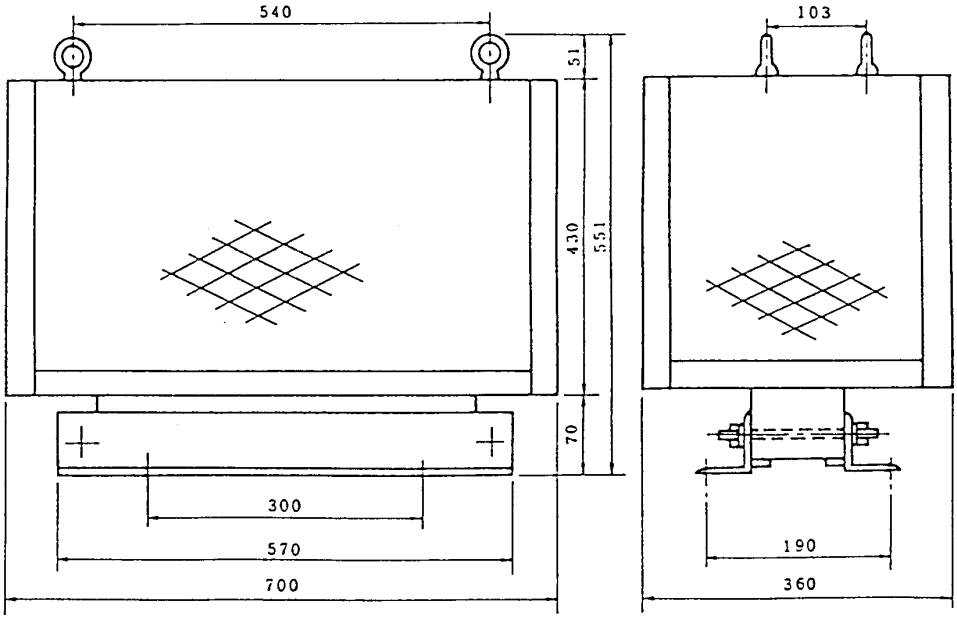
Outline Drawing of Power Transformer with Cover

NOTE
The four side panels are all meshed, while the top is a solid plate.

For PSM-26*i*, 30*i* (A06B-6044-J010)



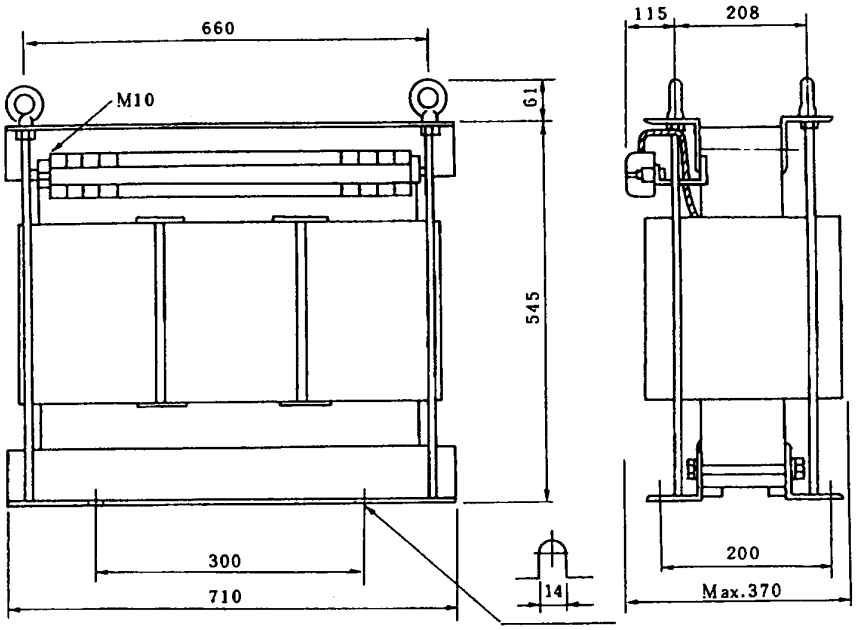
Outline Drawing of Power Transformer with no Cover



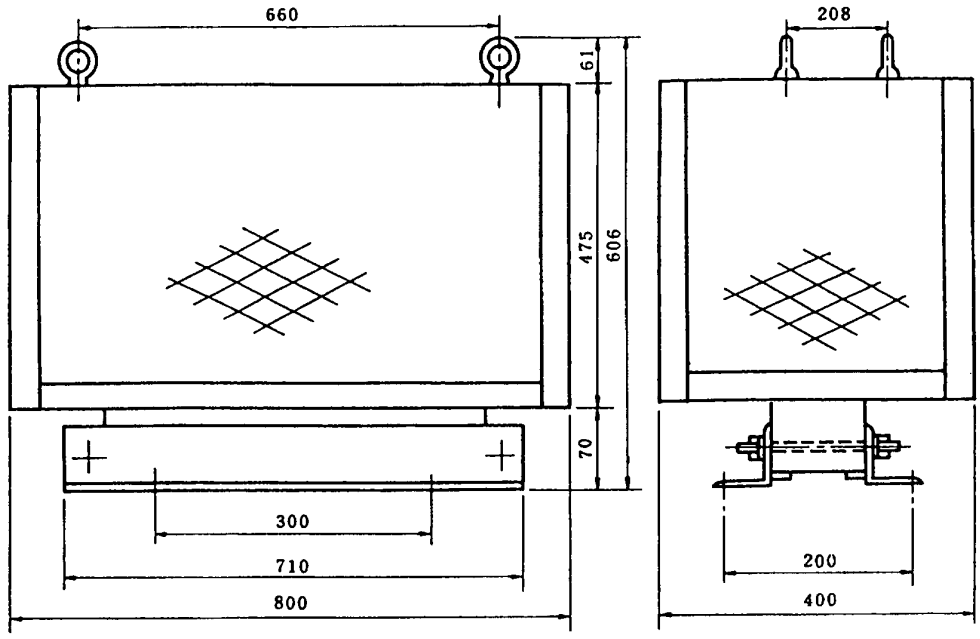
Outline Drawing of Power Transformer with Cover

NOTE
The four side panels are all meshed, while the top is a solid plate.

For PSM-37*i* , 55*i* (at 45kW output) (A06B-6044-J015)



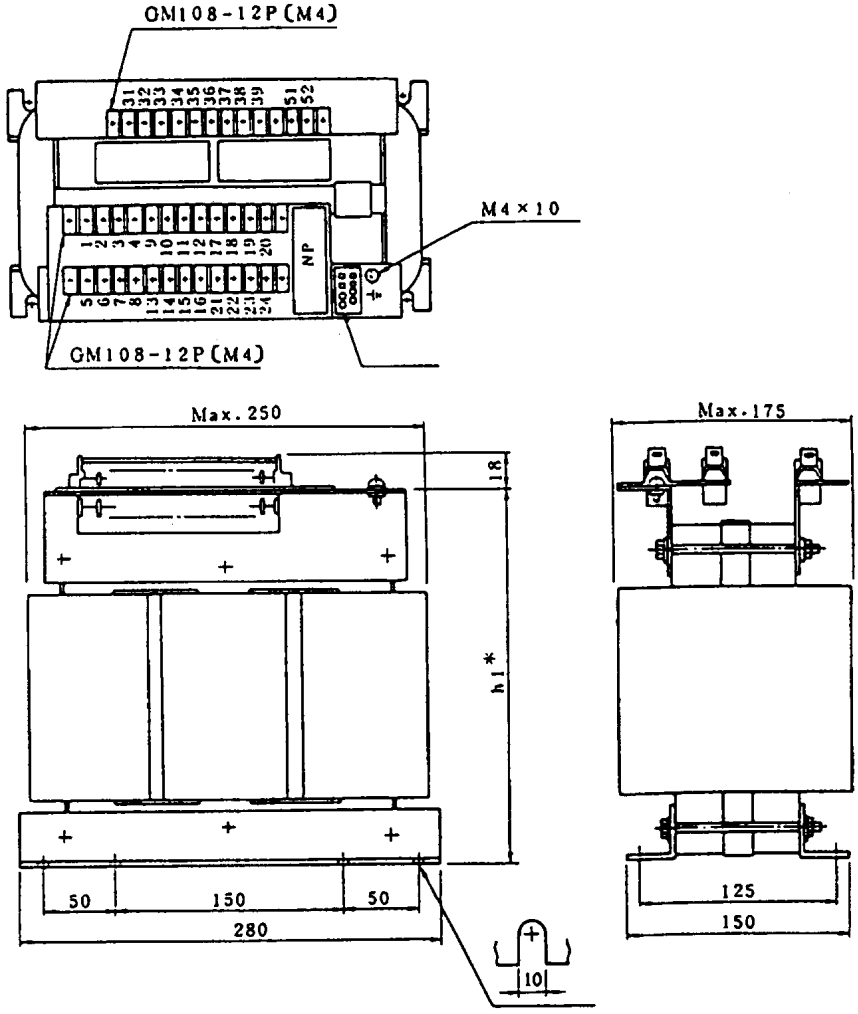
Outline Drawing of Power Transformer with no Cover



Outline Drawing of Power Transformer with Cover

NOTE
The four side panels are all meshed, while the top is a solid plate.

For PSMR-3*i* (2KW output) (A80L-0024-0006), PSMR-3*i* (3KW output) (A80L-0026-0003)

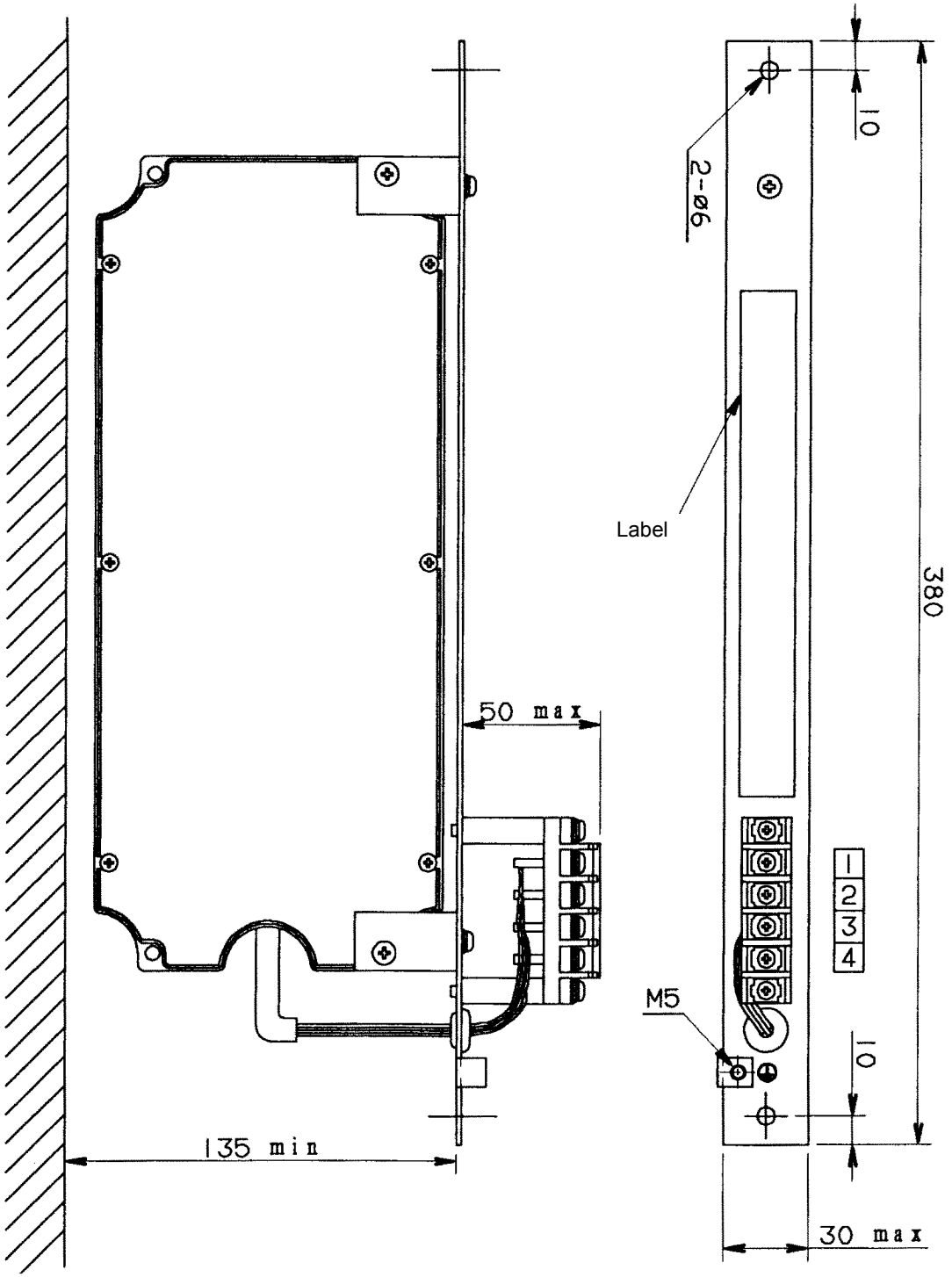


Drawing number	A80L-0024-0006	A80L-0026-0003
Type (name)	SBE	SCE
Weight	27 kg	36 kg
hl* (height of transformer)	217mm max	247mm max

8.1.5 Regenerative Discharge Unit

A06B-6089-H510

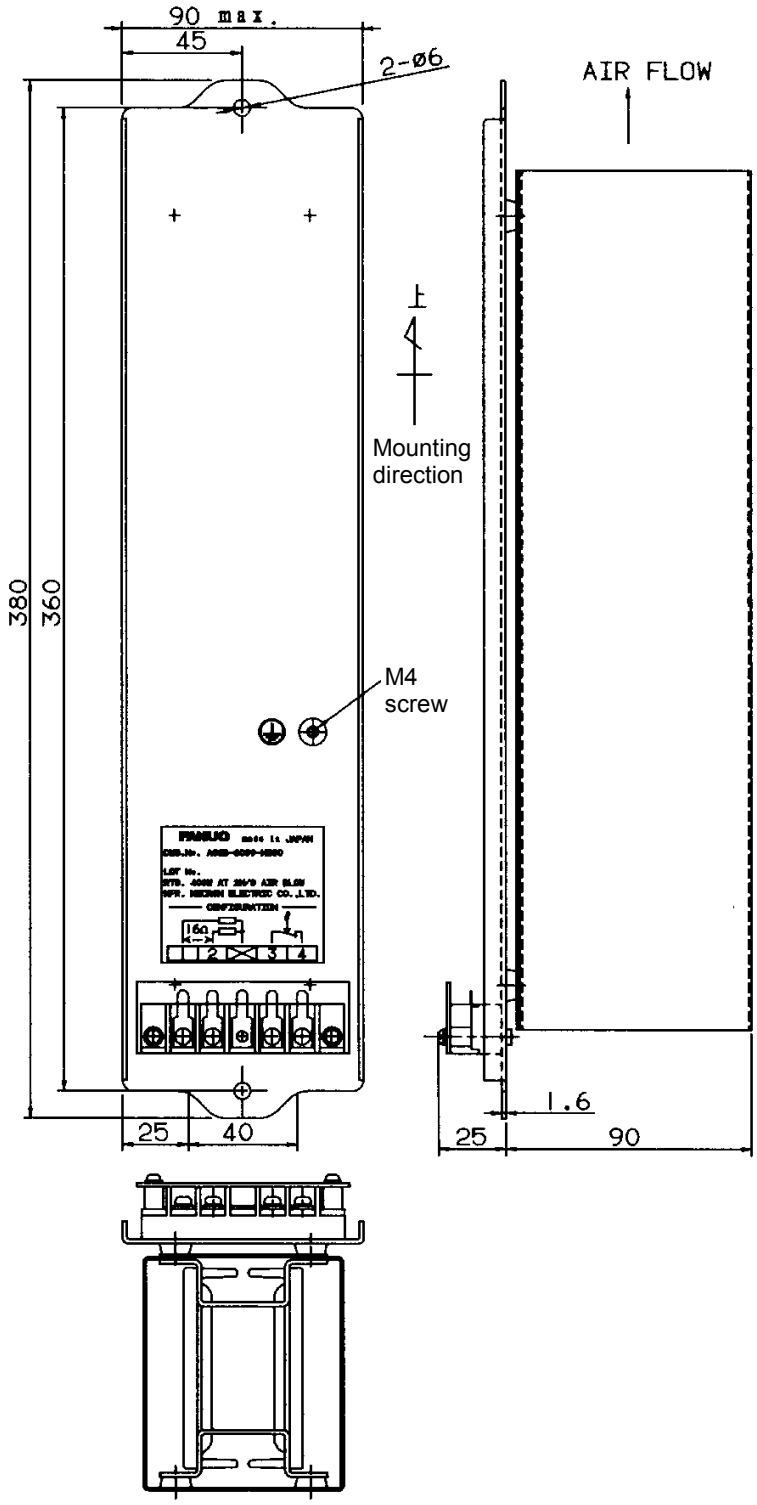
For the panel cut-out drawing, see Section 8.2 (g).



Terminal block: M4 × 4
Weight: 0.8 kg

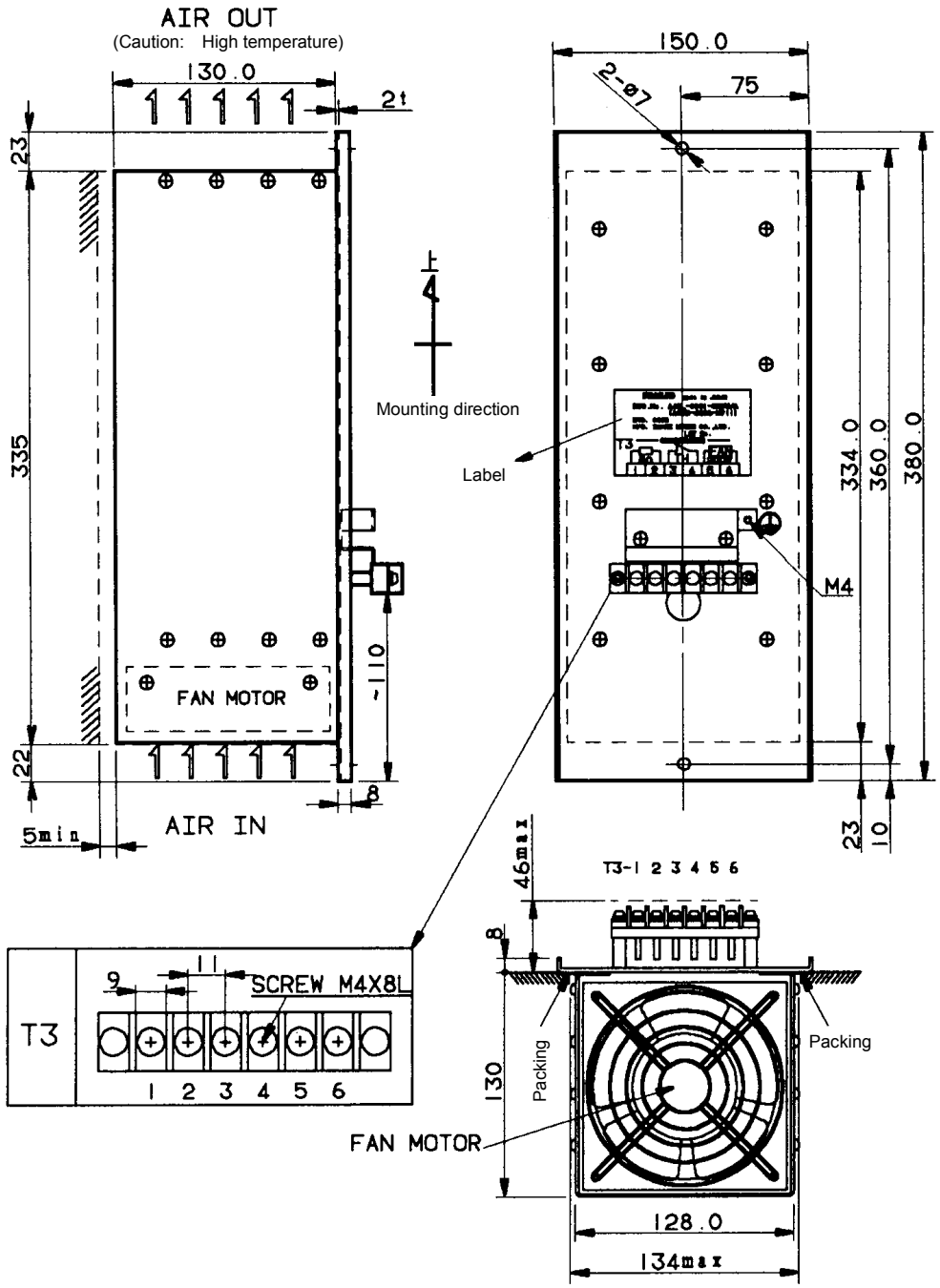
A06B-6089-H500

For the panel cut-out drawing, see Section 8.2 (h).



A06B-6089-H711 to H713

For the panel cut-out drawing, see Section 8.2 (i).)

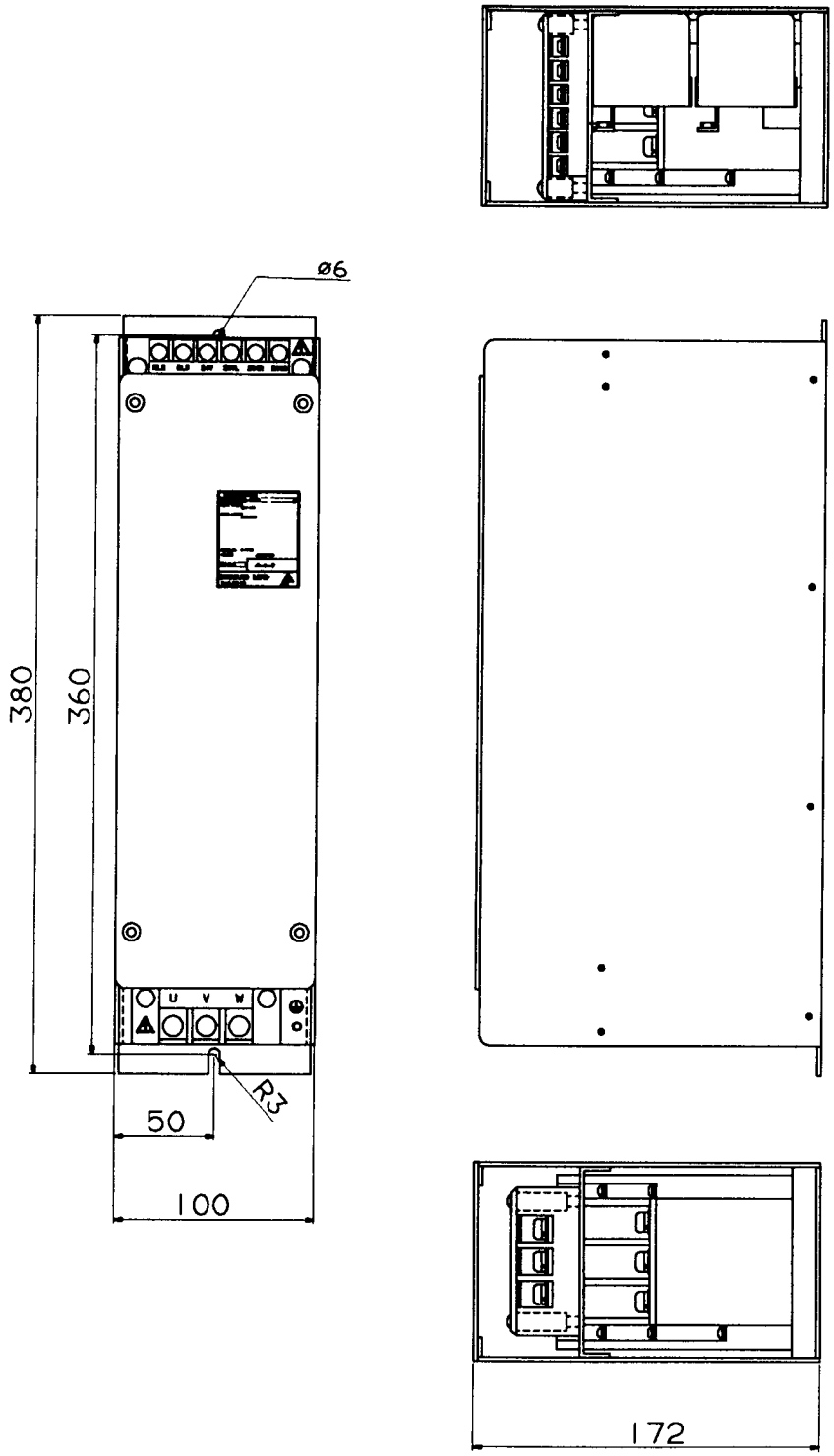


Drawing number	Weight
A06B-6089-H711	5Kg
A06B-6089-H712	6Kg
A06B-6089-H713	5Kg

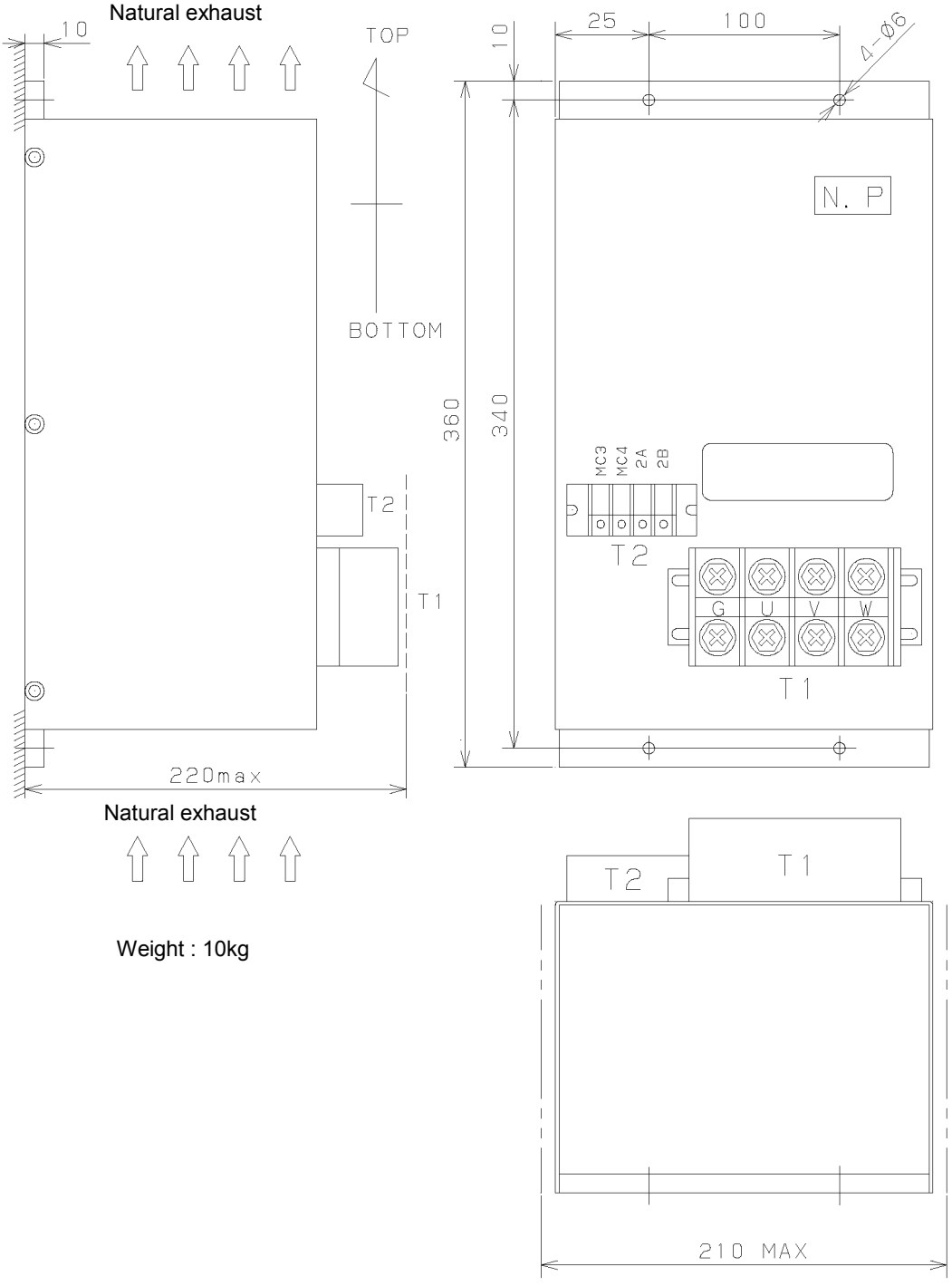
8.1.6 Dynamic Brake Module (DBM)

A06B-6079-H401

For the panel cut-out drawing, see Section 8.2 (j).



A06B-6069-H300

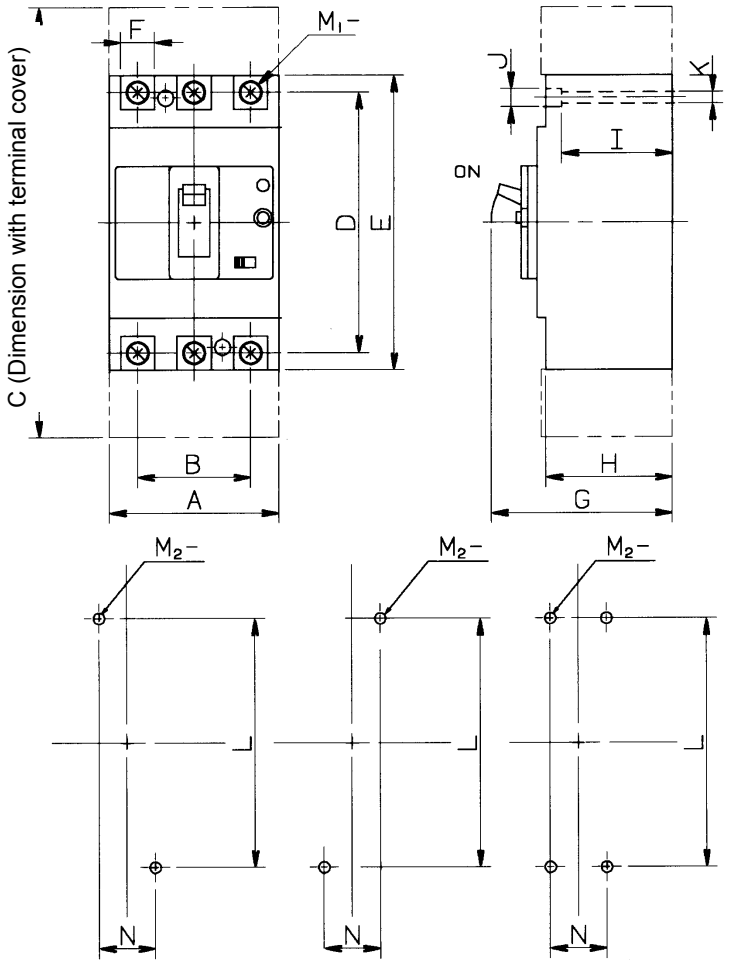


Weight : 10kg

8.1.7 Circuit Breaker

(a) to (j) A06B-6077-K101 to A06B-6077-K110

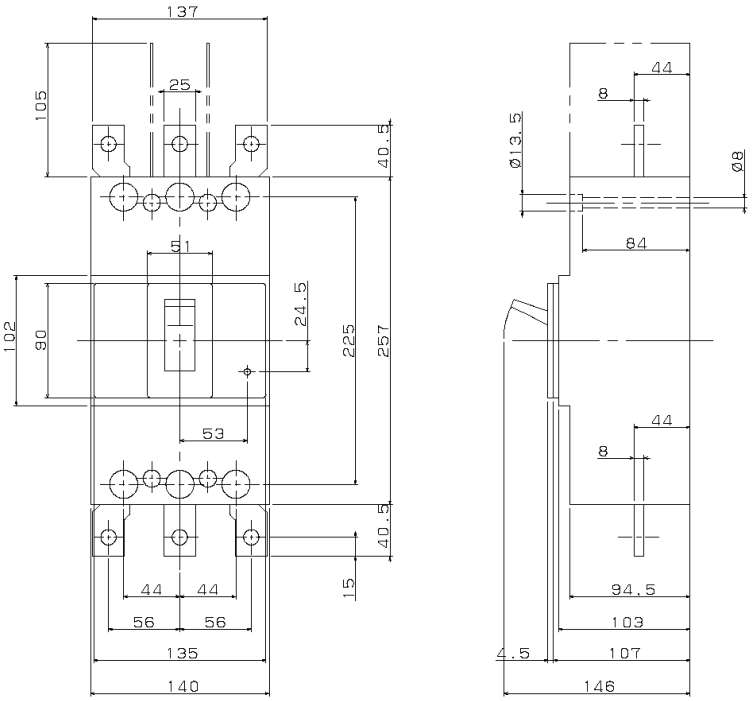
	Ordering drawing number	A	B	C	D	E	M_1	F	G	H	I	J	K	L	M_2	N	Mounting
(a)	A06B-6077-K101	75	50	190	115	130	M5	17	80	56	49	ϕ8	ϕ5	110	M4	25	2 positions (1)
(b)	A06B-6077-K102	75	50	190	115	130	M8	17	80	56	49	ϕ8	ϕ5	110	M4	25	2 positions (1)
(c)	A06B-6077-K103																
(d)	A06B-6077-K104																
(e)	A06B-6077-K108	105	70	265	144	165	M8	25.5	84	56	47	ϕ8.5	ϕ4.5	126	M4	35	4 positions
(f)	A06B-6077-K105																
(g)	A06B-6077-K110																
(h)	A06B-6077-K109																
(i)	A06B-6077-K107																
(j)	A06B-6077-K106	75	50	156	80	96	M5	12.5	80	41	14	ϕ8.5	ϕ4.5	80-84	M4	25	2 positions (2)

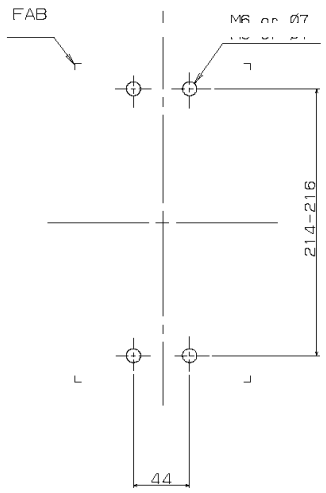


Two mounting holes(1) Two mounting holes(2) Four mounting holes

The circuit breakers have two or four mounting holes.

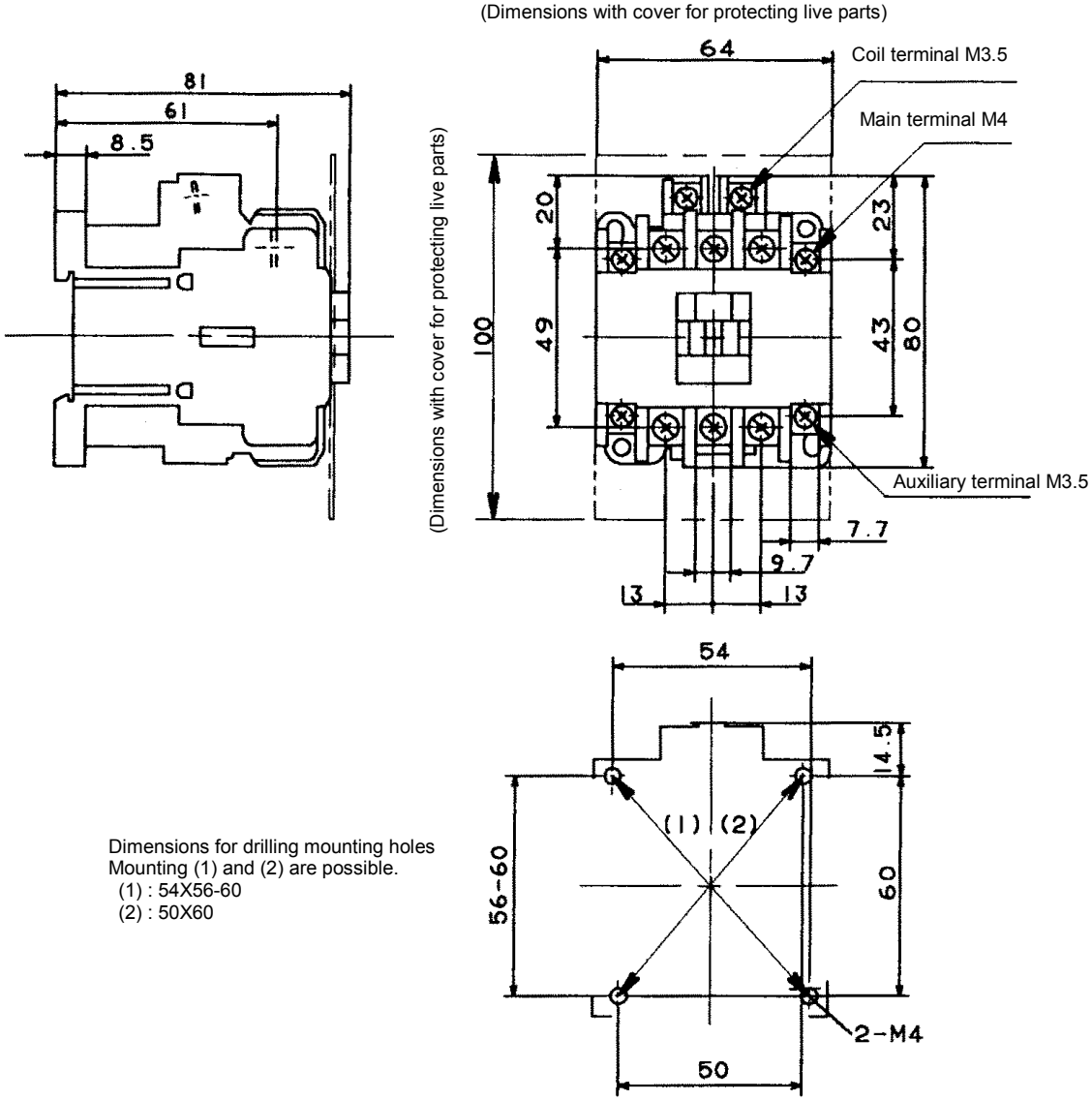
(k) A06B-6077-K111





8.1.8 Magnetic Contactors

A06B-6077-K121

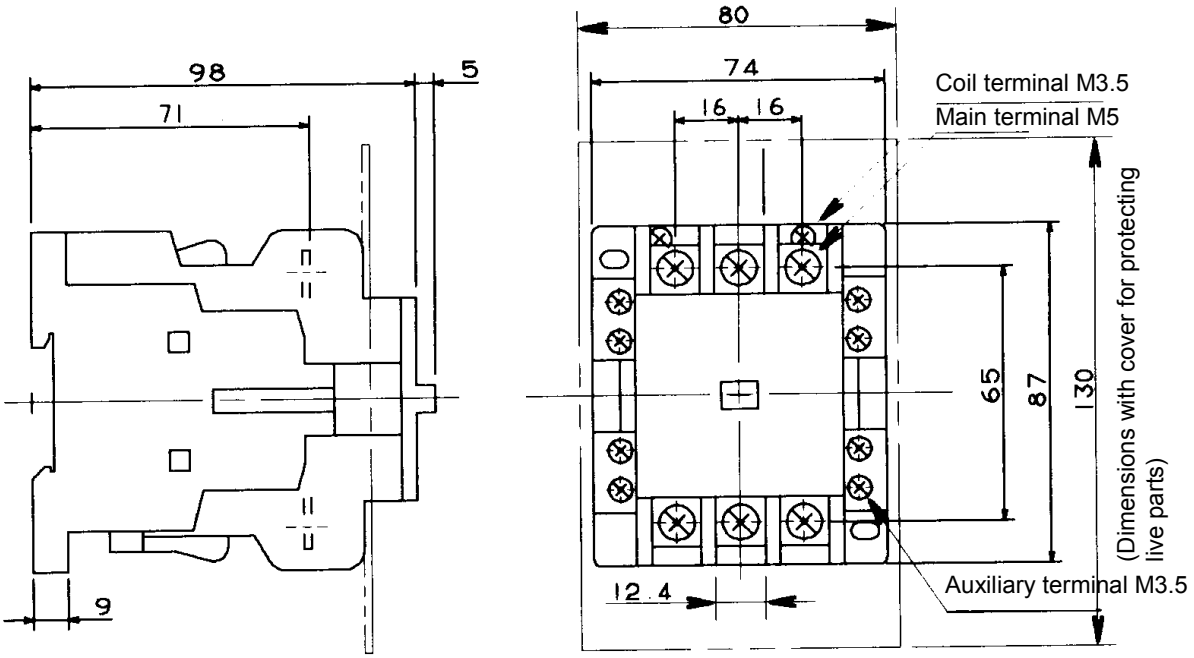


Dimensions for drilling mounting holes
Mounting (1) and (2) are possible.
(1) : 54X56-60
(2) : 50X60

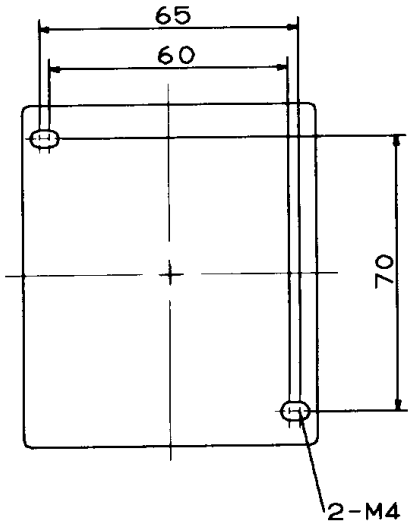
Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K121	SC-5-1	SZ-JC4	200V/50Hz 200-220V/60Hz	1a1b	0.38Kg

A06B-6077-K122, A06B-6077-K123

(Dimensions with cover for protecting live parts)



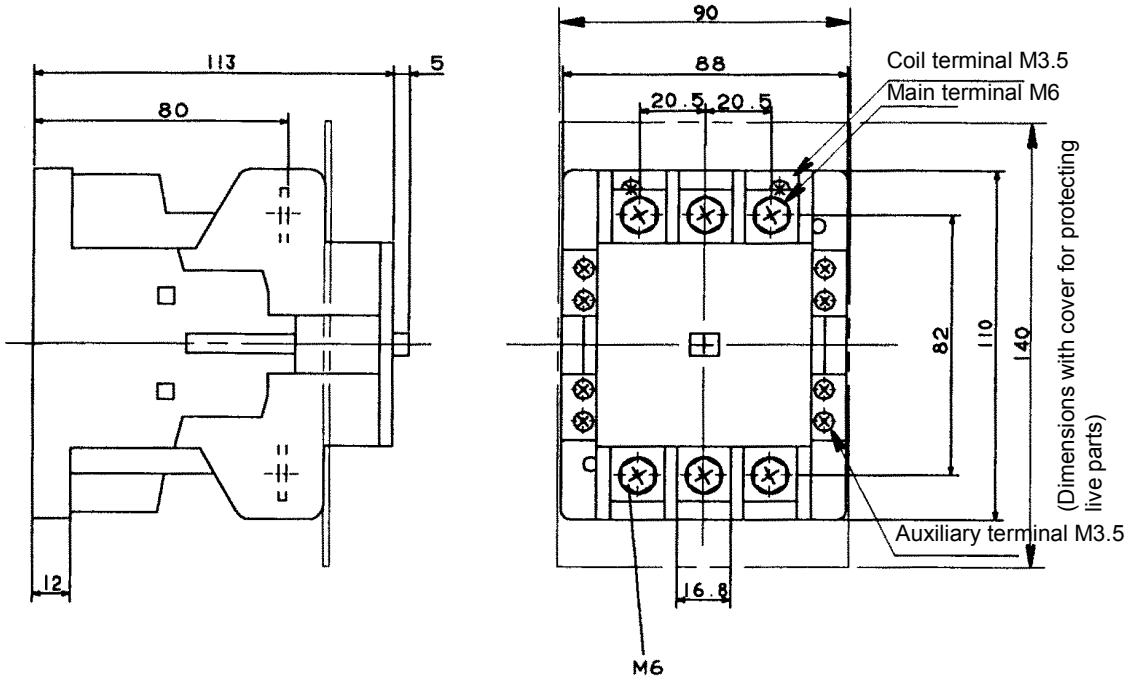
Dimensions for drilling mounting holes



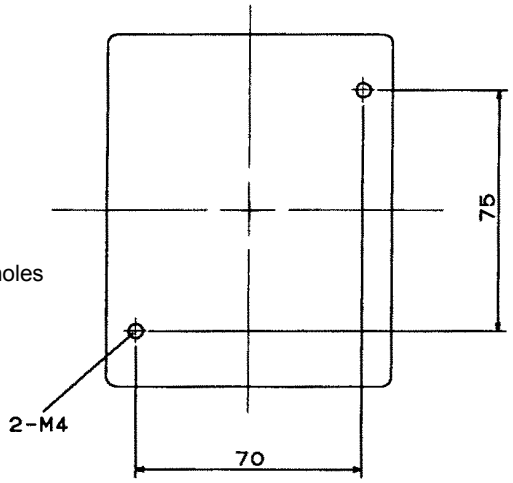
Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K122	SC-1N	SZ-1N/T	200V/50Hz	2a2b	0.68Kg
A06B-6077-K123	SC-2N	SZ-1N/T	200-220V/60Hz		0.68Kg

A06B-6077-K124

(Dimensions with cover for protecting live parts)

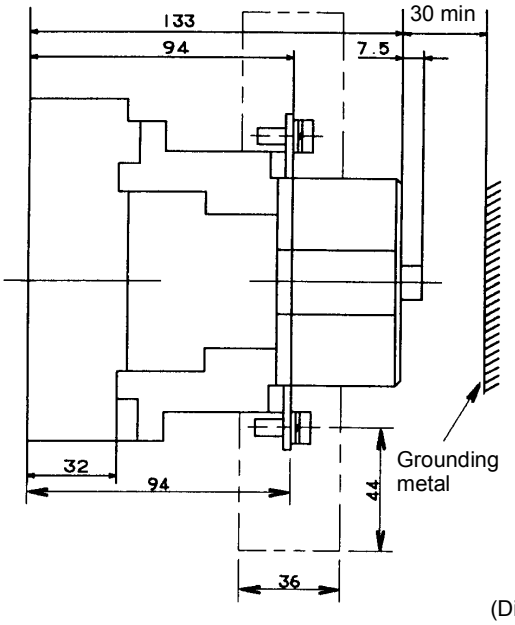


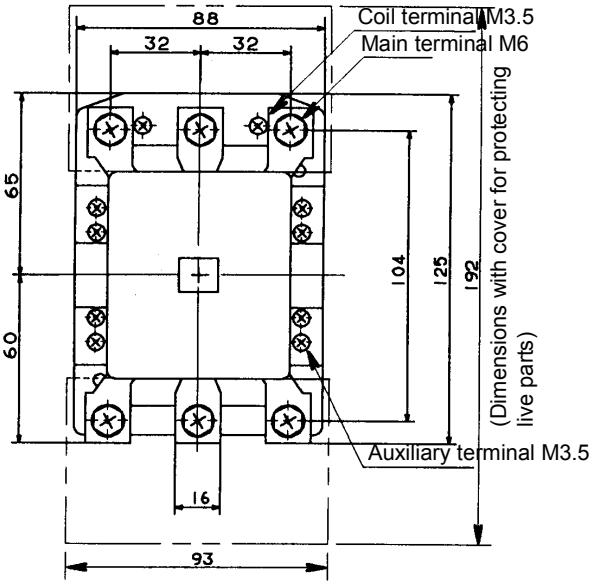
Dimensions for drilling mounting holes



Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K124	SC-2SN	SZ-2SN/T	200V/50Hz 200-220V/60Hz	2a2b	1.3Kg

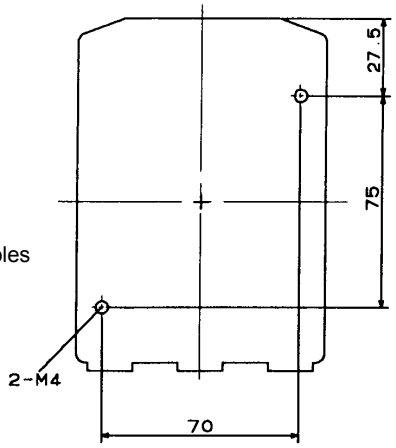
A06B-6077-K125





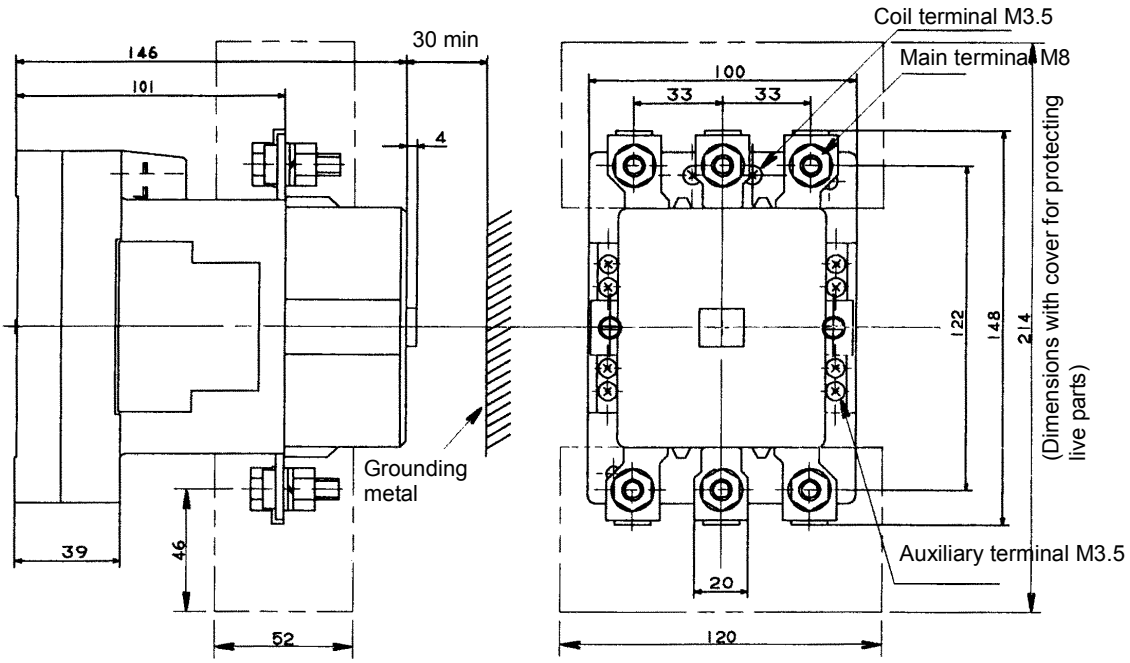
(Dimensions with cover for protecting live parts)

Dimensions for drilling mounting holes



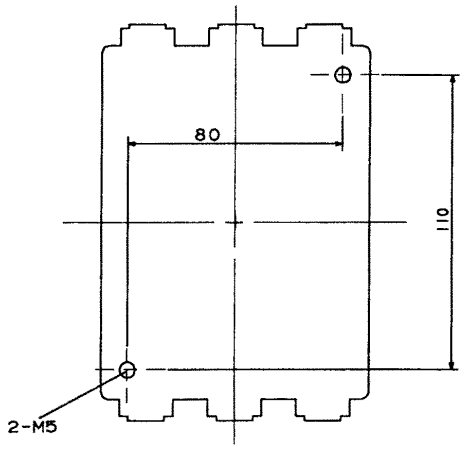
Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K125	SC-4N	SZ-4N/T	200V/50Hz 200-220V/60Hz	2a2b	1.5Kg

A06B-6077-K126



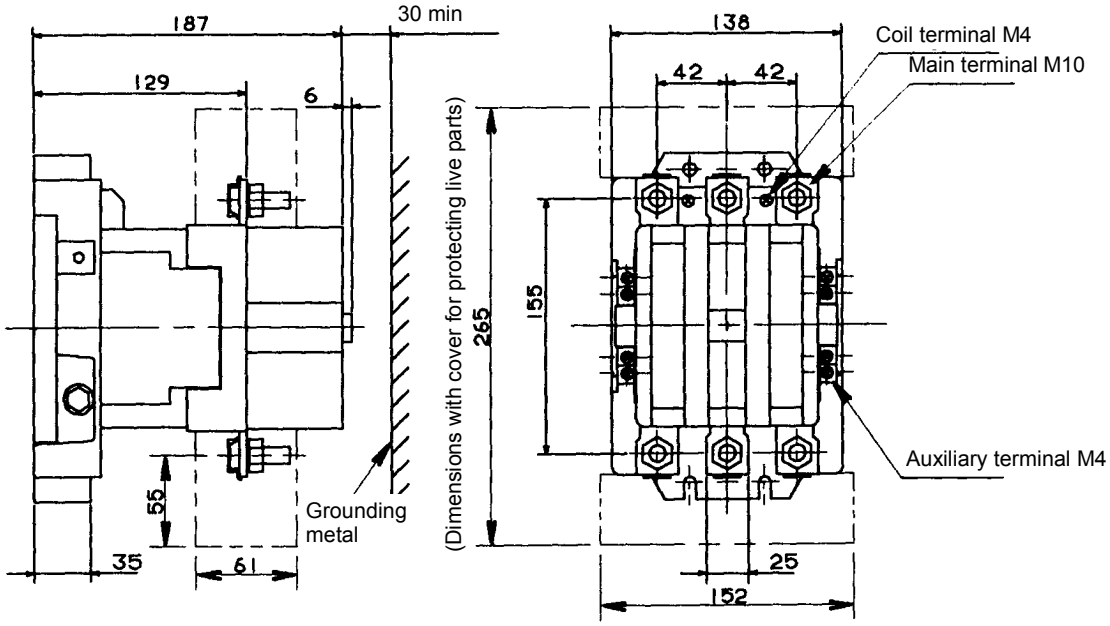
(Dimensions with cover for protecting live parts)

Dimensions for drilling mounting holes

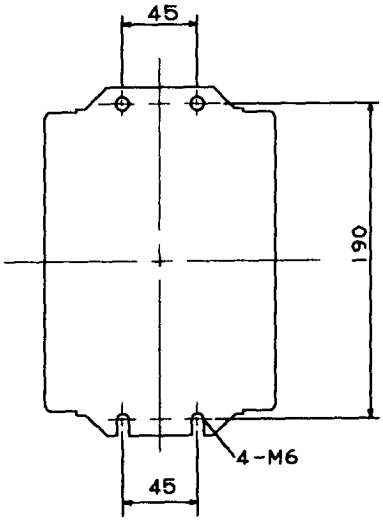


Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K126	SC-5N	SZ-5N/T	200V/50Hz 200-220V/60Hz	2a2b	2.5Kg

A06B-6077-K127



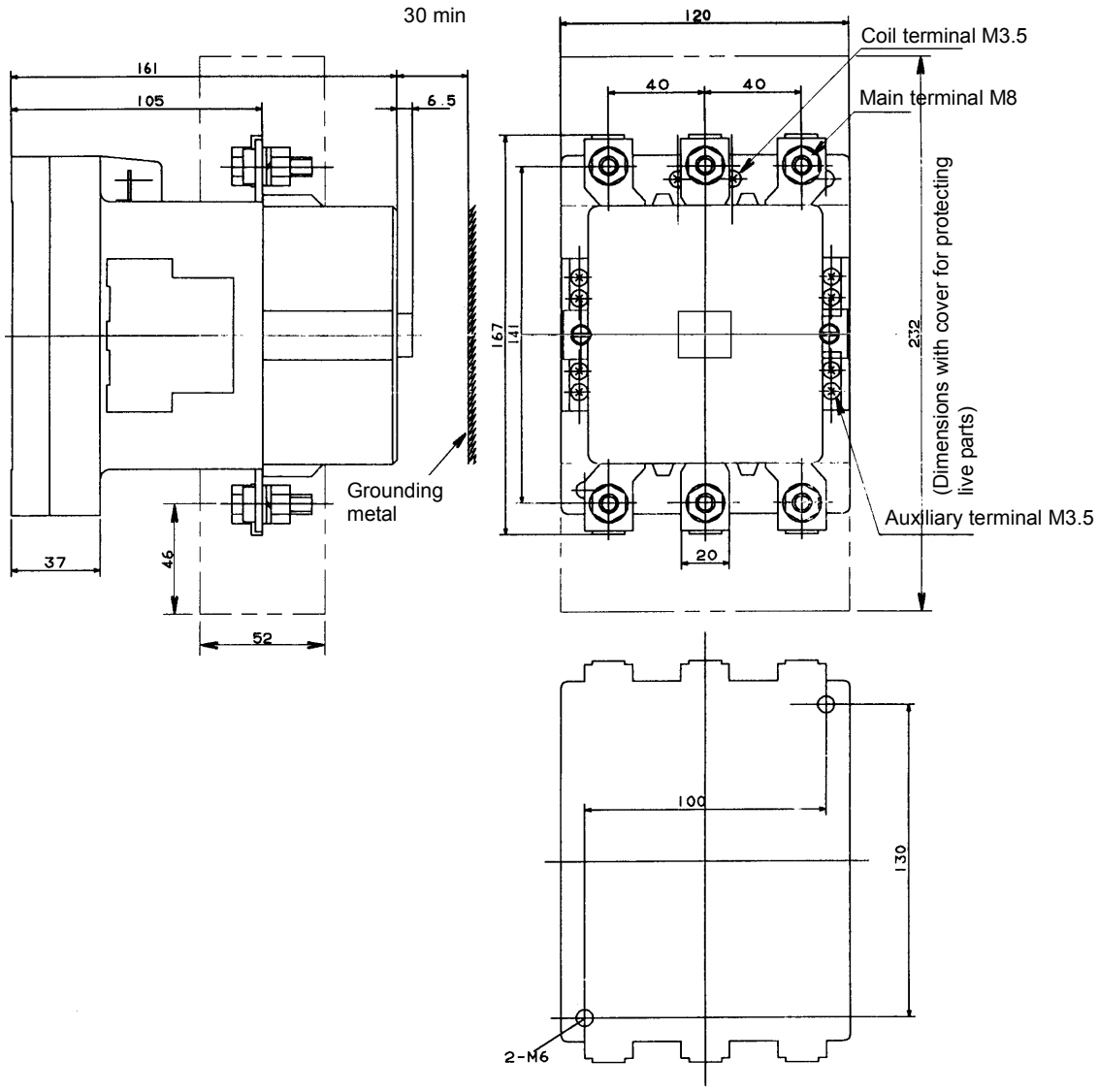
(Dimensions with cover for protecting live parts)



Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K127	SC-8N	SZ-8N/T	200V/50Hz 200-220V/60Hz	2a2b	5.2Kg

A06B-6077-K128

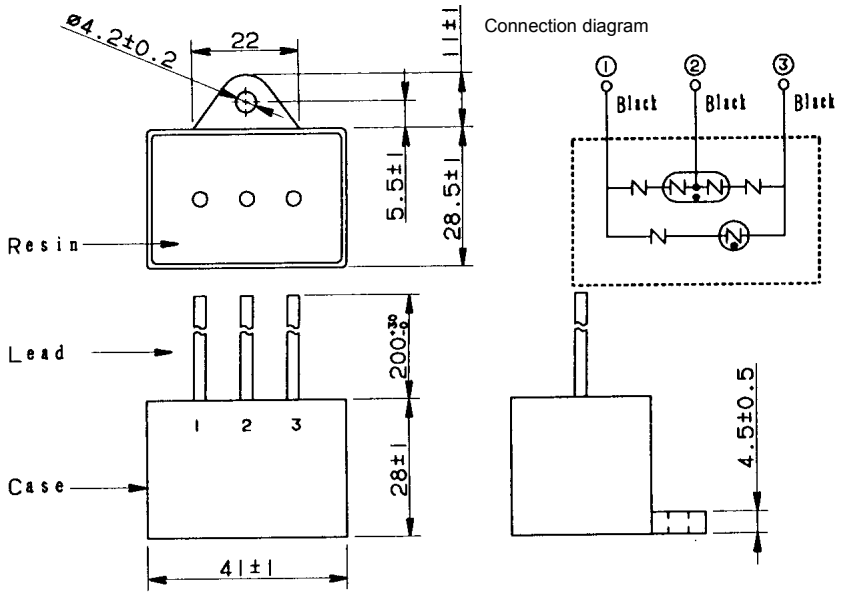
(Dimensions with cover for protecting live parts)



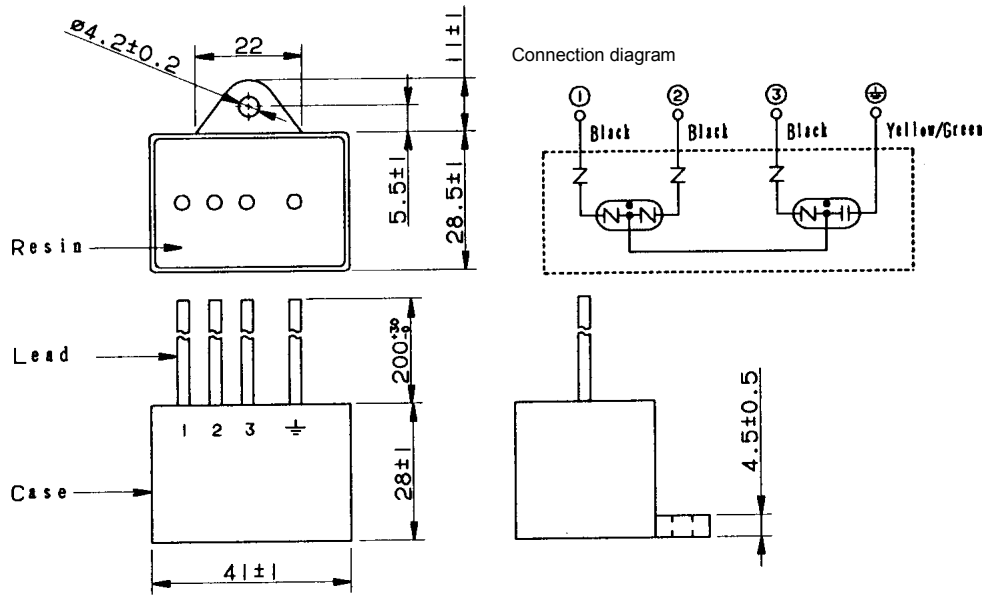
Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K128	SC-7N	SZ-5N/T	200V/50Hz 200-220V/60Hz	2a2b	3.4Kg

8.1.9 Lightning Surge Protector

A06B-6077-K142



(1) For line-to-line installation: RAV-781BYZ-2

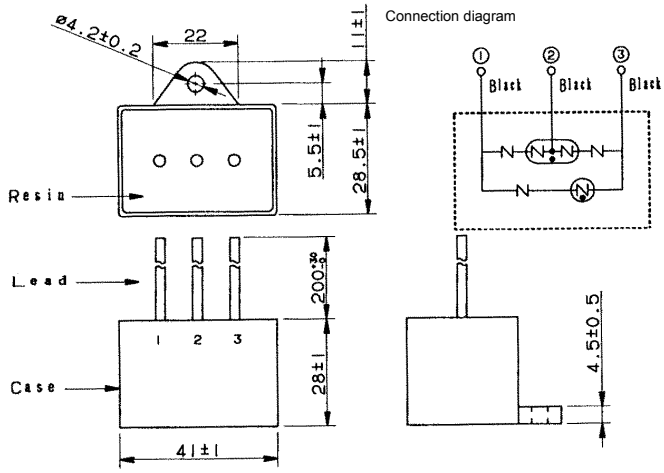


(2) For line-to-ground installation: RAV-781BXZ-4

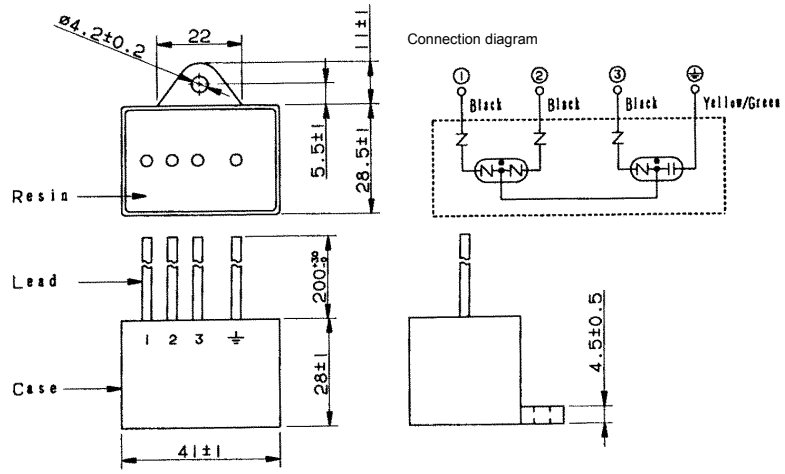
Specification	Rated voltage	Clamp voltage	Surge withstand current	Surge withstand voltage
R·A·V-781BYZ-2	250VAC	783VDC ±10%(V1.0)	2500A(8/20μS)	20kV(1.2/50μS)

Specification	Rated voltage	AC discharge start voltage	Surge withstand current	Maximum surge discharge start voltage
R·A·V-781BXZ-4	line-to-line: 430VAC, line-to-ground: 250VAC	700VAC ±20%(Ua)	2500A(8/20μS)	2.0kV(1.2/50μS)

A06B-6077-K143



(1) For line-to-line installation: RAV-152BYZ-2A



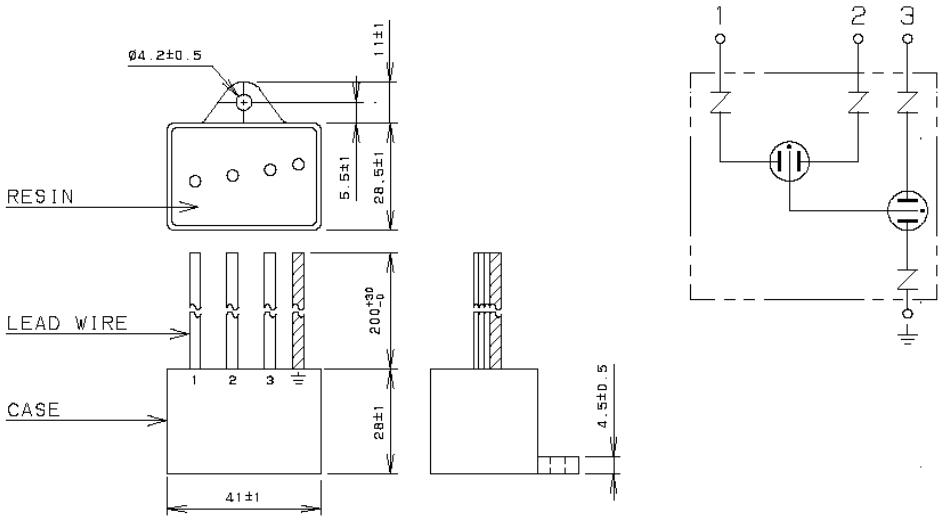
(2) For line-to-ground installation: RAV-801BXZ-4

Specification	Rated voltage	Clamp voltage	Surge withstand current	Surge withstand voltage
R·A·V-152BYZ-2A	460VAC	1470V ±10%(V1.0)	2500A(8/20μS)	20kV(1.2/50μS)

Specification	Rated voltage	AC discharge start voltage	Surge withstand current	Maximum surge discharge start voltage
R·A·V-801BXZ-4	line-to-line: 500VAC, line-to-ground: 290VAC	800VAC ±20%(Ua)	2500A(8/20μS)	2.32kV(1.2/50μS)

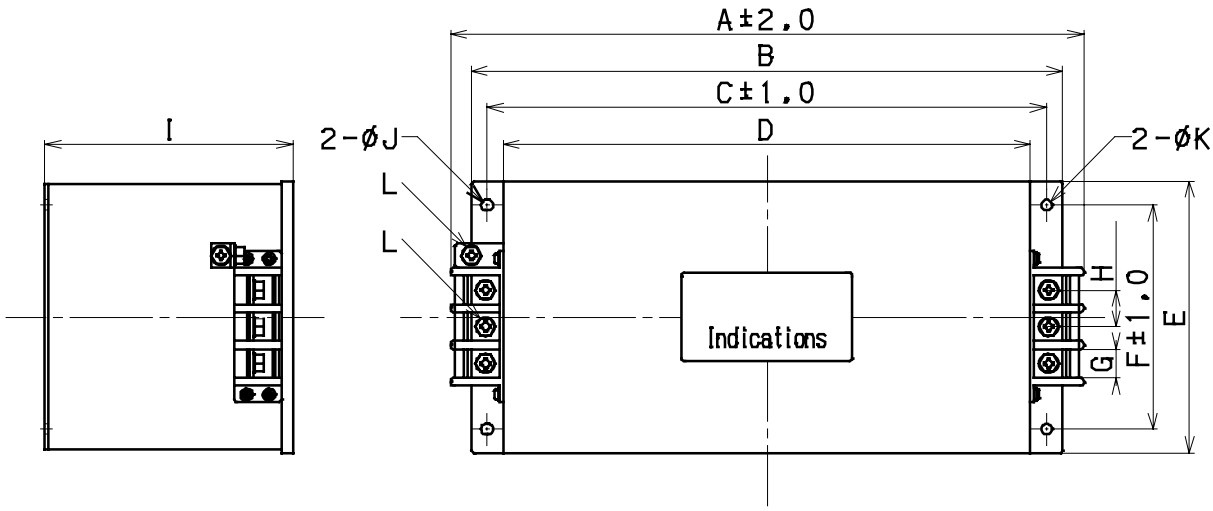
A06B-6077-K144

Connection diagram



Specification	Rated voltage	AC discharge start voltage	Clamp voltage	Surge withstand current	Surge withstand voltage	Maximum surge discharge start voltage
R·C·M-601BUZ-4	250VAC	560VAC ±20%(Ua)	2000V ±10%(V1.0)	2500A (8/20μS)	20kV (1.2/50μS)	2kV (1.2/50μS)

8.1.10 Noise Filter



Unit : mm

General tolerance : ±1.5mm

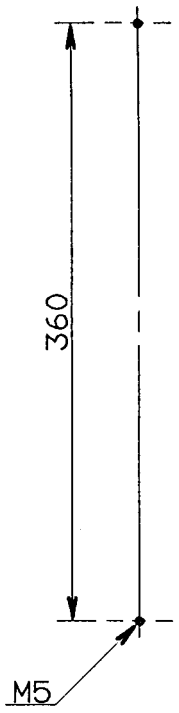
Type	Dimensions (mm)											
	A	B	C	D	E	F	G	H	I	J	K	L
3SUP-HL30-ER-6	246	230	215	200	100	85	13	18	140	4.5×7	4.5	M4
3SUP-HL75-ER-6	396	370	350	330	170	140	18	23	155	6.5×8	6.5	M6
3SUP-HL150-ER-6	484	440	420	400	200	170	30	25	200	6.5×8	6.5	M8
3SUP-HL200-ER-6	484	440	420	400	200	170	30	25	200	6.5×8	6.5	M8

3SUP-HLx-ER-6 : External dimensions of noise filter

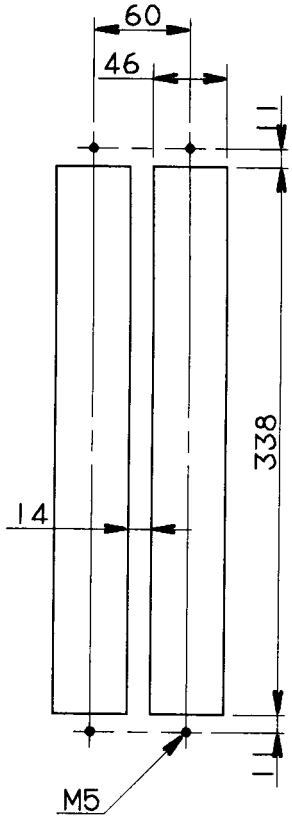
8.2 PANEL CUT-OUT DIAGRAMS

60-mm-wide amplifier

With no external fin



With external fin (when two units are installed side by side)

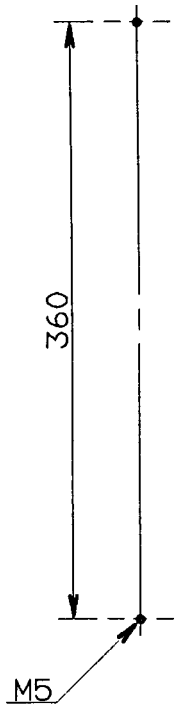


NOTE

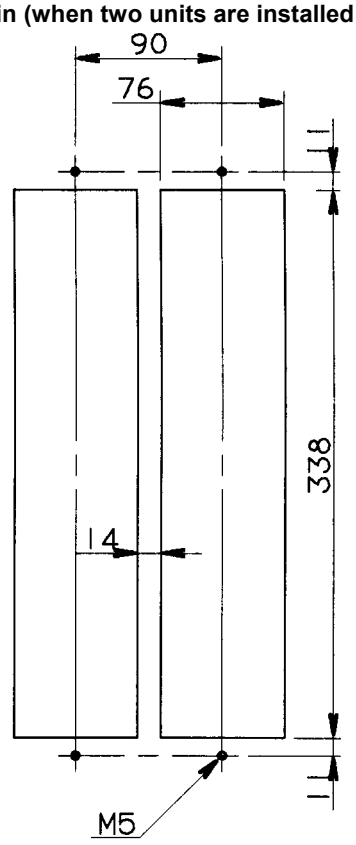
1 When an external fin is provided, attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) to the fin to protect it against oil and dust.
2 Reinforce the right and left sides of the panel cut-out in the power magnetics cabinet by using fittings such as angles to maintain satisfactory contact between the sheet metal of the power magnetics cabinet and the flange of the amplifier.

90-mm-wide amplifier

With no external fin



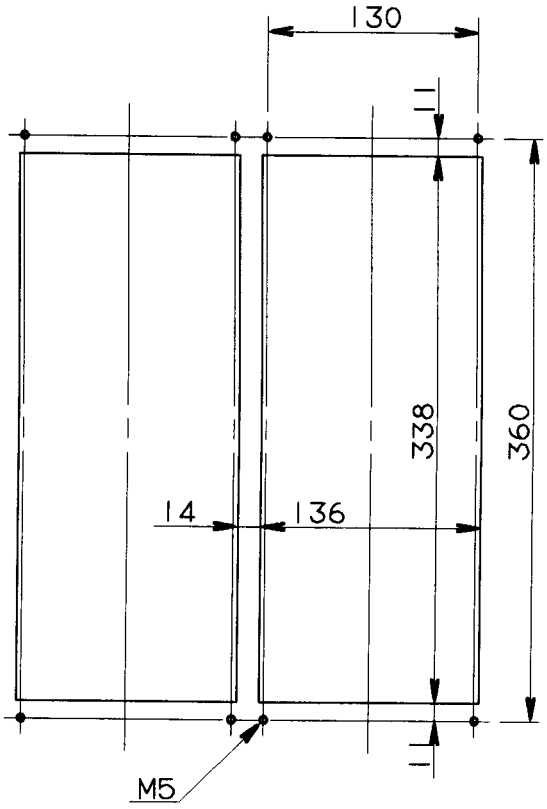
With external fin (when two units are installed side by side)



NOTE

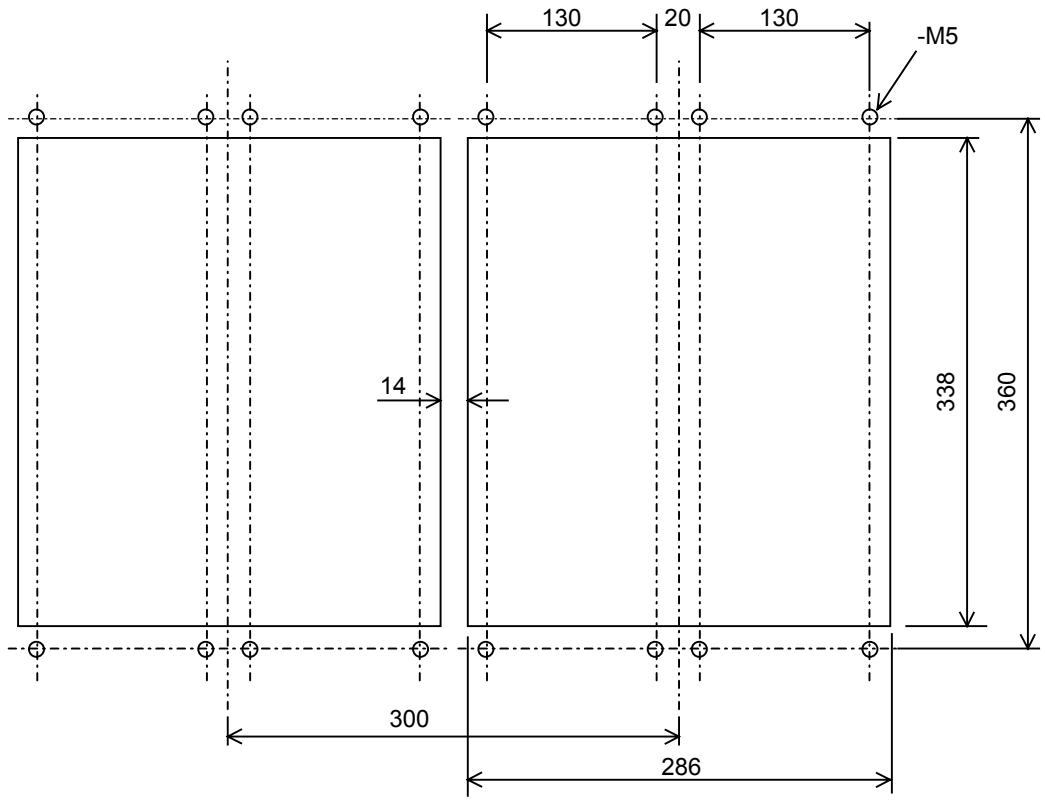
1 When an external fin is provided, attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) to the fin to protect it against oil and dust.
2 Reinforce the right and left sides of the panel cut-out in the power magnetics cabinet by using fittings such as angles to maintain satisfactory contact between the sheet metal of the power magnetics cabinet and the flange of the amplifier.

150-mm-wide amplifier (when two units are installed side-by-side)



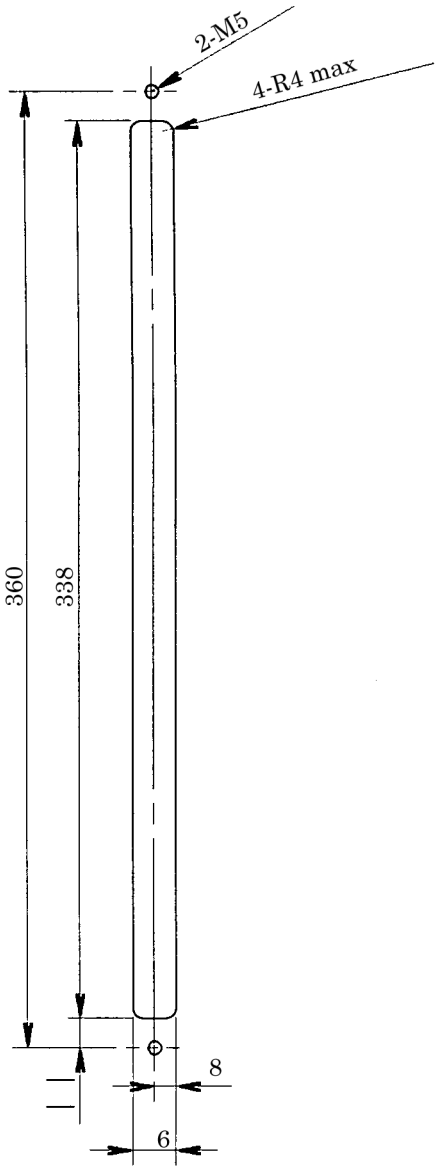
NOTE
1 Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust.
2 Reinforce the right and left sides of the panel cut-out in the power magnetics cabinet by using fittings such as angles to maintain satisfactory contact between the sheet metal of the power magnetics cabinet and the flange of the amplifier.

300-mm-wide amplifier (when two units are installed side-by-side)

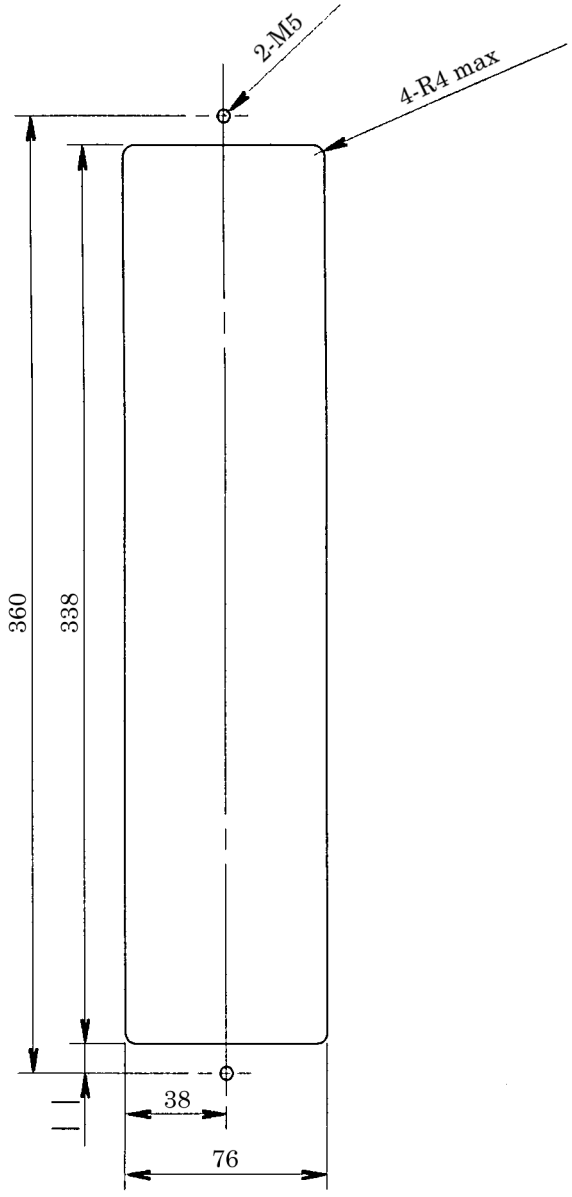


NOTE
1 Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust.
2 Reinforce the right and left sides of the panel cut-out in the power magnetics cabinet by using fittings such as angles to maintain satisfactory contact between the sheet metal of the power magnetics cabinet and the flange of the amplifier.

Regenerative discharge unit (A06B-6089-H510)

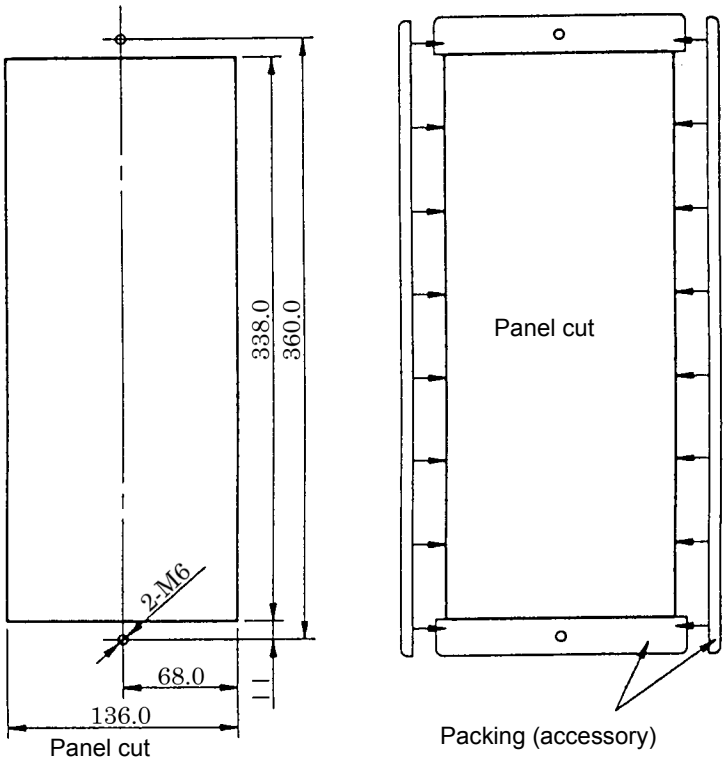


Regenerative discharge unit (A06B-6089-H500)



NOTE
Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust.

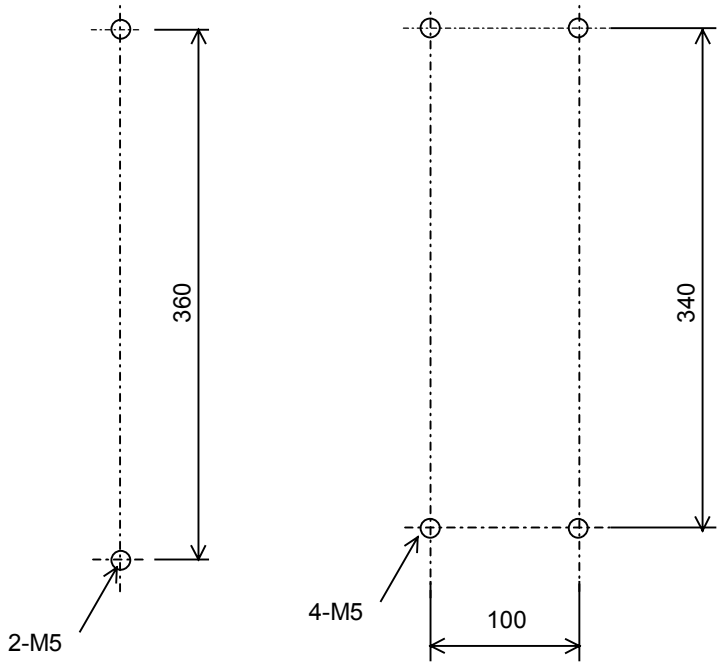
Regenerative discharge unit (A06B-6089-H711 to -H713)



NOTE
Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust.

Dynamic brake module

A06B-6079-H401 **A06B-6069-H300**

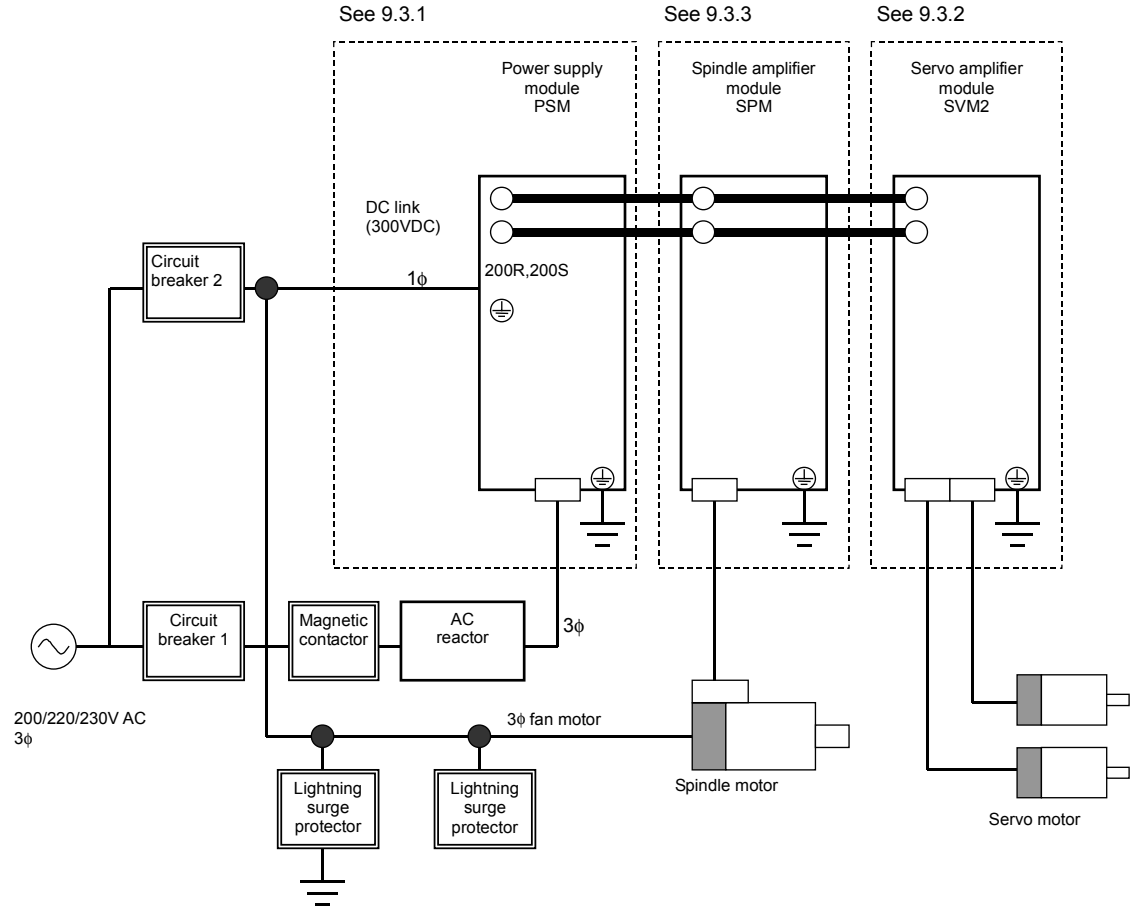


9 CONNECTION

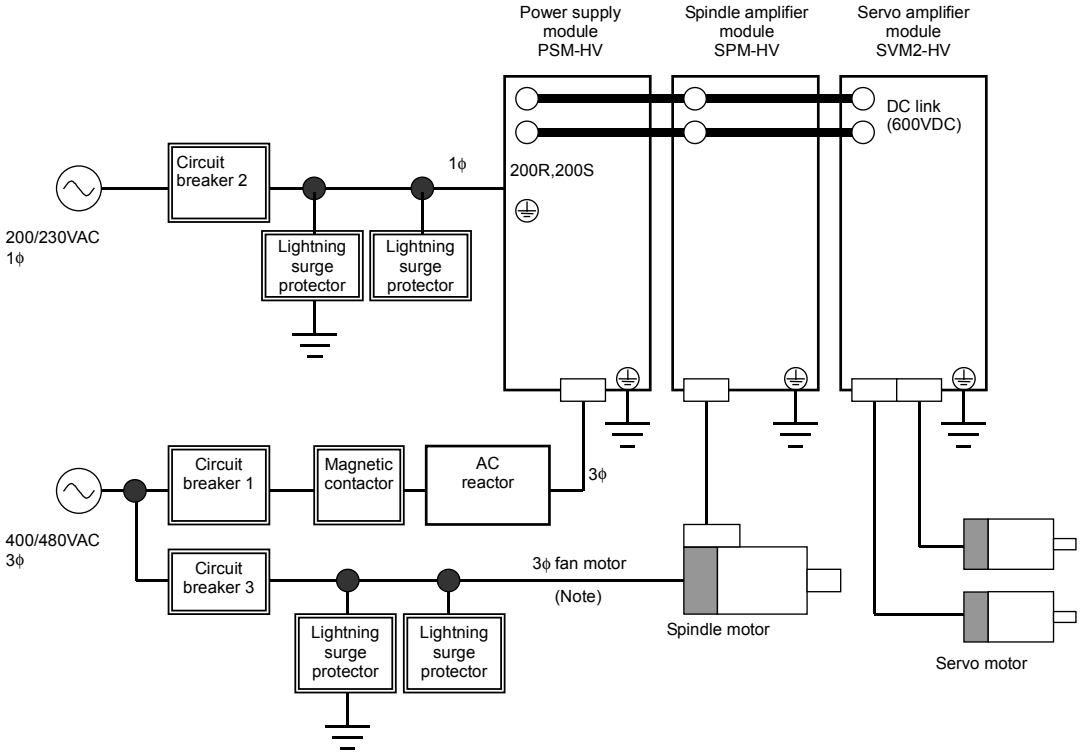
9.1 TOTAL CONNECTION DIAGRAM

The following connection diagram is an example of combining a PSM, SPM, and a 2-axes SVM. For detailed descriptions about how to connect these units, see their respective connection diagrams.

200-V input series



400-V input series



⚠ CAUTION
When the spindle motor model α1HV*i*, α1.5HV*i*, α2HV*i*, α3HV*i*, α1HV*i*T, α2HV*i*T, or α3HV*i*T is used, the specification of the fan motor is below: Single phase, 200/230 VAC

9.2 CONNECTOR LOCATION

9.2.1 Power Supply Module (PSM)

PSM-5.5*i*

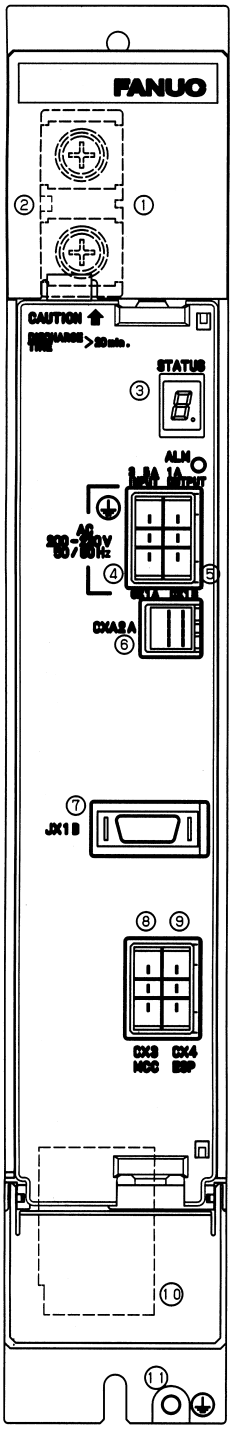


Table.9.2.1(a) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	200VAC input connector	CX1A	
6	Output connector for PSM interface	CXA2A	24VDC power supply
8	Connector for main power MCC control signal	CX3	
9	Connector for ESP signal	CX4	
10	Connector for motor power line	CZ1	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

PSM-11*i*. PSM-15*i*. PSM-11HV*i*, PSM-18HV*i*

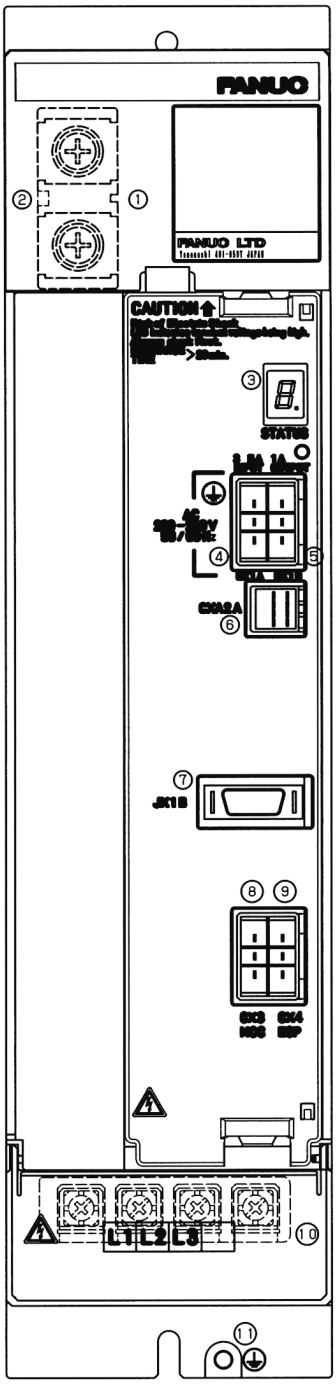


Table.9.2.1(b) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	200VAC input connector	CX1A	
6	Output connector for PSM interface	CXA2A	24VDC power supply
8	Connector for main power MCC control signal	CX3	
9	Connector for ESP signal	CX4	
10	Terminal block for motor power line	TB2	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

PSM-26*i*, PSM-30*i*, PSM-37*i*, PSM-30HV*i*, PSM-45HV*i*

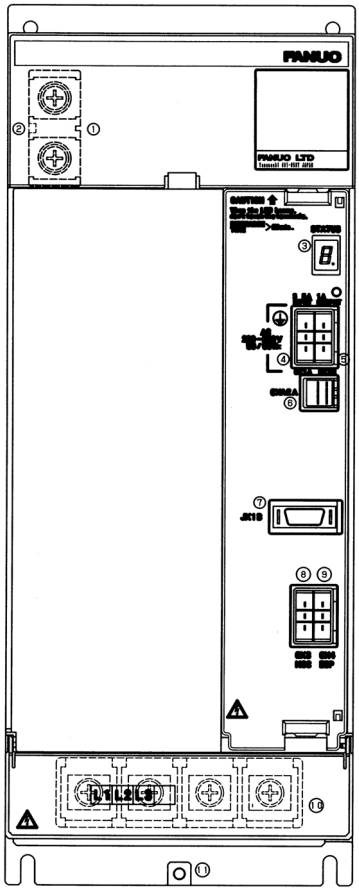


Table.9.2.1(c) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	200VAC input connector	CX1A	
6	Output connector for PSM interface	CXA2A	24VDC power supply
8	Connector for main power MCC control signal	CX3	
9	Connector for ESP signal	CX4	
10	Terminal block for motor power line	TB2	
11	Tapped hole for grounding the flange	⏚	

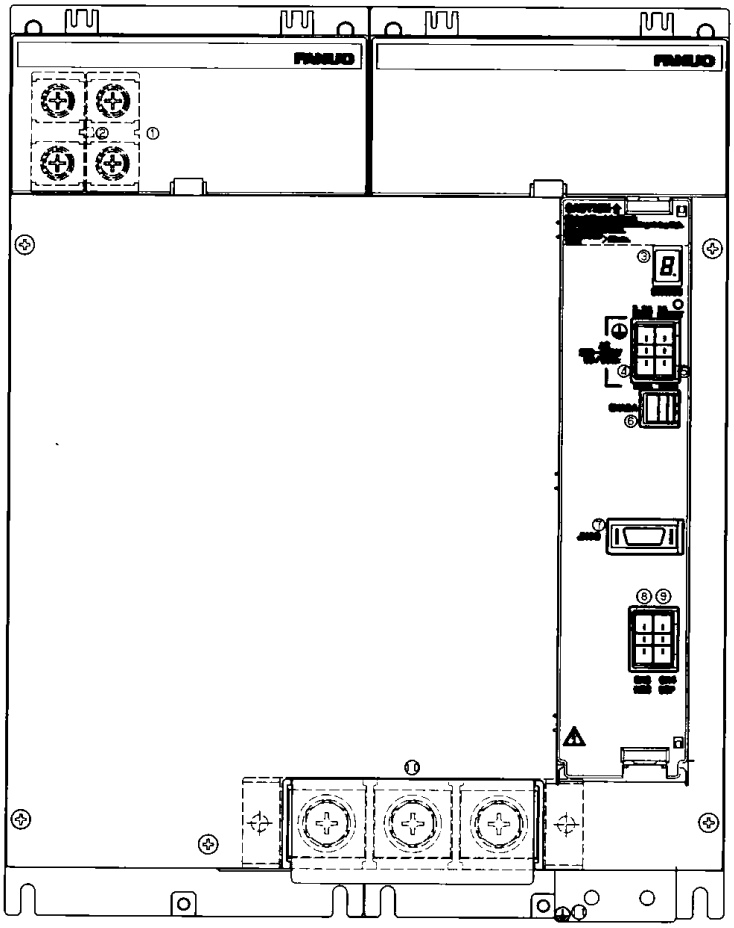
⚠ WARNING
Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

PSM-55*i*, PSM-75HV*i*, PSM-100HV*i*

Table.9.2.1(d) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	200VAC input connector	CX1A	
6	Output connector for PSM interface	CXA2A	24VDC power supply
8	Connector for main power MCC control signal	CX3	
9	Connector for ESP signal	CX4	
10	Terminal block for motor power line	TB2	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.



PSMR-3*i*, PSMR-5.5*i*

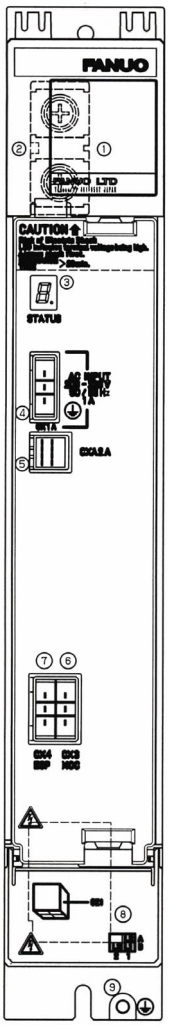


Table.9.2.1(e) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	200VAC input connector	CX1A	
5	Output connector for PSM interface	CXA2A	24VDC power supply
6	Connector for main power MCC control signal	CX3	
7	Connector for ESP signal	CX4	
8-1	Terminal block for motor power line	CZ1	XX key
8-2	Terminal block for regenerative discharge resistor	CZ2	YY key
9	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

9.2.2 Servo Amplifier Module (SVM)

60/90mm-wide SVM

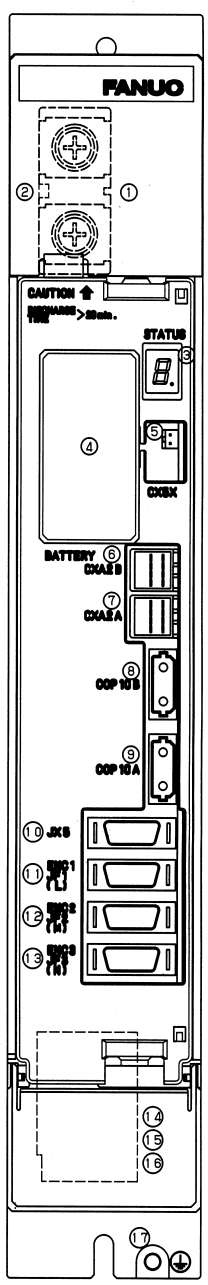


Table.9.2.2(a) Names of connectors and terminal blocks

No.	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Location of the batteries for the SVM built-in-type absolute Pulsecoder	BATTERY	
5	Battery connector for the SVM built-in-type absolute Pulsecoder	CX5X	
6	Input connector for PSM interface	CXA2B	24VDC power supply The interface for the absolute Pulsecoder batteries is included.
7	Output connector for PSM interface	CXA2A	
8	FSSB optical input connector	COP10B	
9	FSSB optical output connector	COP10A	
10	Signal check connector	JX5	Unused
11	Pulsecoder connector : L axis	ENC1/JF1	
12	Pulsecoder connector : M axis	ENC2/JF2	
13	Pulsecoder connector : N axis	ENC3/JF3	
14	Connector for motor power line: L axis	CZ2L	For SVM1, CZ2
15	Connector for motor power line: M axis	CZ2M	
16	Connector for motor power line: N axis	CZ2N	
17	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

SVM1-360*i*, SVM1-180Hv*i*

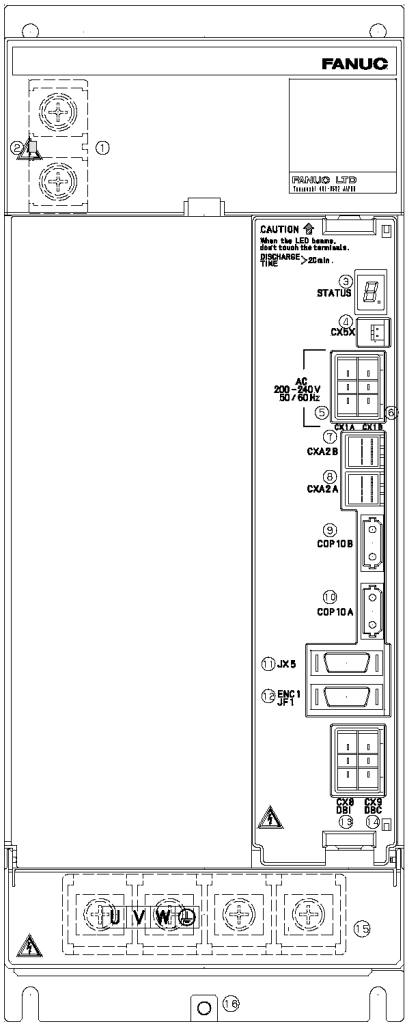


Table.9.2.2(b) Names of connectors and terminal blocks

No.	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Battery connector for the SVM built-in-type absolute Pulsecoder	CX5X	
5	200VAC power supply input connector	CX1A	Power supply for DB
6	200VAC power supply input connector	CX1B	
7	Input connector for PSM interface	CXA2B	24VDC power supply The interface for the absolute Pulsecoder batteries is included.
8	Output connector for PSM interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Signal check connector	JX5	Unused
12	Pulsecoder connector	ENC1/JF1	
13	Dynamic module interface for connector	CX8	
14	Connector for the magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Display the terminal block TB2
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

SVM1-360HV*i*

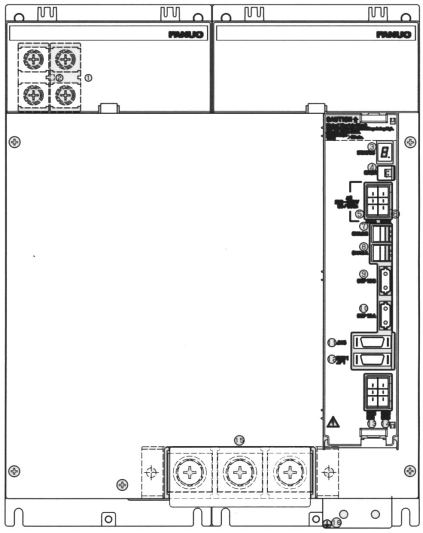


Table.9.2.2(c) Names of connectors and terminal blocks

No.	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Battery connector for the SVM built-in-type absolute Pulsecoder	CX5X	
5	200VAC power supply input connector	CX1A	Power supply for DB
6	200VAC power supply input connector	CX1B	
7	Input connector for PSM interface	CXA2B	24VDC power supply The interface for the absolute Pulsecoder batteries is included.
8	Output connector for PSM interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Signal check connector	JX5	Unused
12	Pulsecoder connector	ENC1/JF1	
13	Dynamic module interface for connector	CX8	
14	Connector for the magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Display the terminal block TB2
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

9.2.3 Spindle Amplifier Module (SPM)

SPM-2.2*i* , SPM-5.5*i* , SPM-5.5HV*i* (TYPE A, B)

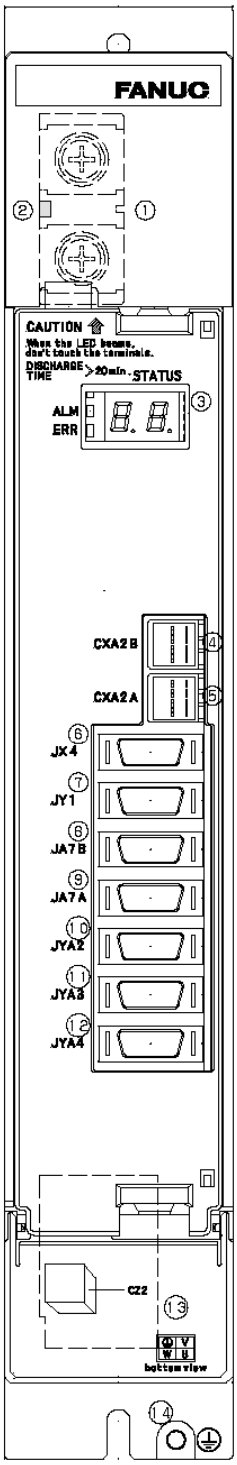


Table.9.2.3(a) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Input connector for PSM interface	CXA2B	24VDC power supply
5	Output connector for PSM interface	CXA2A	
6	Communication connector between Positioncoder signal and SPM	JX4	The signal for the check board is also output.
7	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
8	Input connector for electric serial interface	JA7B	
9	Output connector for electric serial interface	JA7A	
10	Connector for spindle sensor for motor	JYA2	M*i*, MZ*i*, and BZ*i* sensors
11	Connector for Positioncoder and external single rotation signal	JYA3	
12	Connector for separate spindle sensor	JYA4	TYPE B only
13	Connector for motor power line		Display the CZ2
14	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

SPM-11*i* , SPM-15*i*, SPM-11HV*i*, SPM-15HV*i* (TYPE A, B)

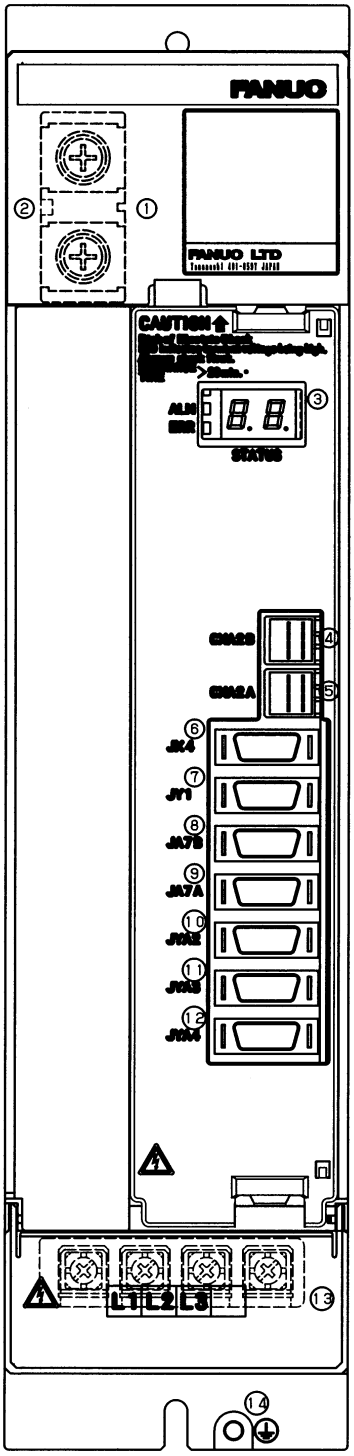


Table.9.2.3 (b) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Input connector for PSM interface	CXA2B	24VDC power supply
5	Output connector for PSM interface	CXA2A	
6	Communication connector between Positioncoder signal and SPM	JX4	The signal for the check board is also output.
7	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
8	Input connector for electric serial interface	JA7B	
9	Output connector for electric serial interface	JA7A	
10	Connector for spindle sensor for motor	JYA2	M*i*, MZ*i*, and BZ*i* sensors
11	Connector for Positioncoder and external single rotation signal	JYA3	
12	Connector for separate spindle sensor	JYA4	TYPE B only
13	Connector for motor power line		Display the TB2
14	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

SPM-22*i*, SPM-26*i*, SPM-30*i*, SPM-30HV*i*, SPM-45HV*i* (TYPE A, B)

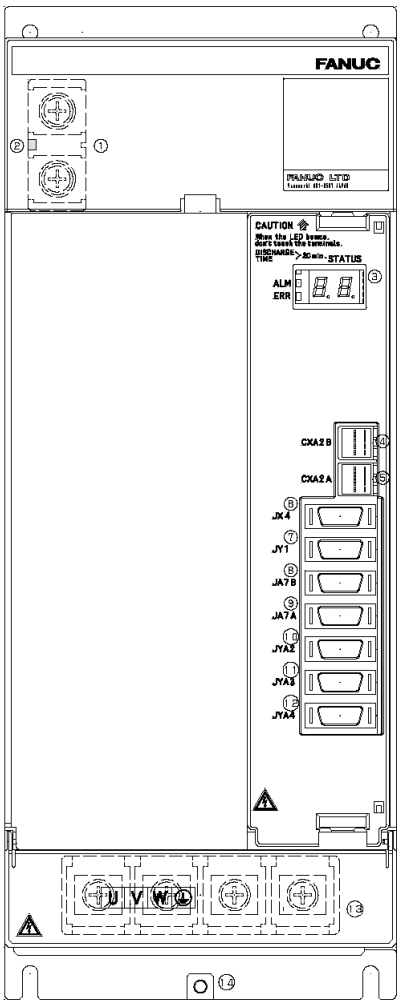


Table.9.2.3 (c) Names of connectors and terminal blocks

	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Input connector for PSM interface	CXA2B	24VDC power supply
5	Output connector for PSM interface	CXA2A	
6	Communication connector between Positioncoder signal and SPM	JX4	The signal for the check board is also output.
7	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
8	Input connector for electric serial interface	JA7B	
9	Output connector for electric serial interface	JA7A	
10	Connector for spindle sensor for motor	JYA2	M*i*, MZ*i*, and BZ*i* sensors
11	Connector for Positioncoder and external single rotation signal	JYA3	
12	Connector for separate spindle sensor	JYA4	TYPE B only
13	Connector for motor power line		Display the TB2
14	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

SPM-45*i*, SPM-55*i*, SPM-75HV*i*, SPM-100HV*i* (TYPE A, B)

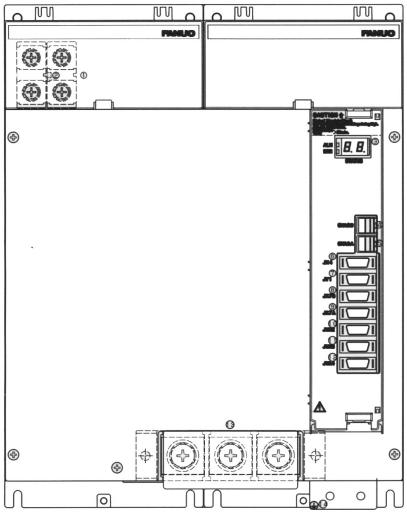


Table.9.2.3 (d) Names of connectors and terminal blocks

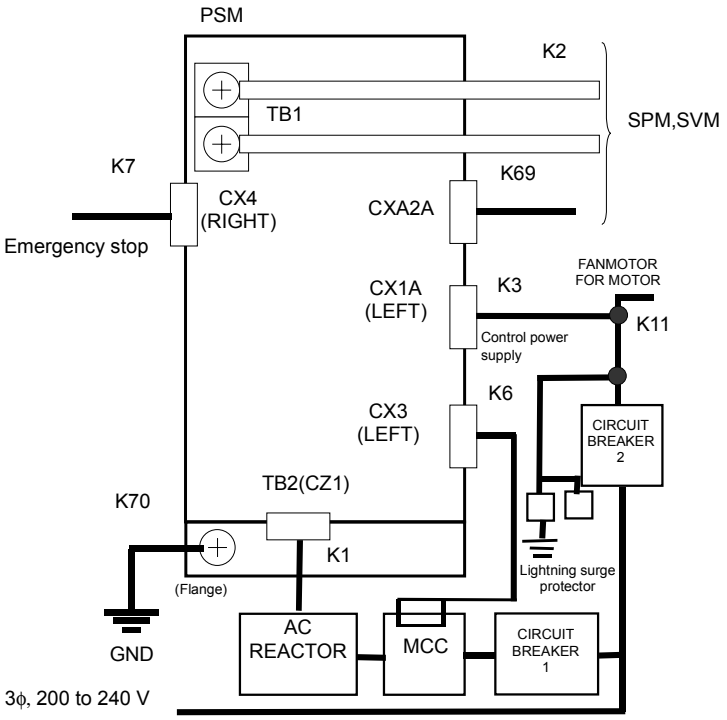
	Names	Display	Remarks
1	DC link terminal block		Display the terminal block TB1
2	DC link charge LED		(Warning)
3	Status LED	STATUS	
4	Input connector for PSM interface	CXA2B	24VDC power supply
5	Output connector for PSM interface	CXA2A	
6	Communication connector between Positioncoder signal and SPM	JX4	The signal for the check board is also output.
7	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
8	Input connector for electric serial interface	JA7B	
9	Output connector for electric serial interface	JA7A	
10	Connector for spindle sensor for motor	JYA2	M*i*, MZ*i*, and BZ*i* sensors
11	Connector for Positioncoder and external single rotation signal	JYA3	
12	Connector for separate spindle sensor	JYA4	TYPE B only
13	Connector for motor power line		Display the TB2
14	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> Do not touch module components or connected cables while this LED is lit. There is a danger of electric shock.

9.3 CABLE CONNECTION DETAILS

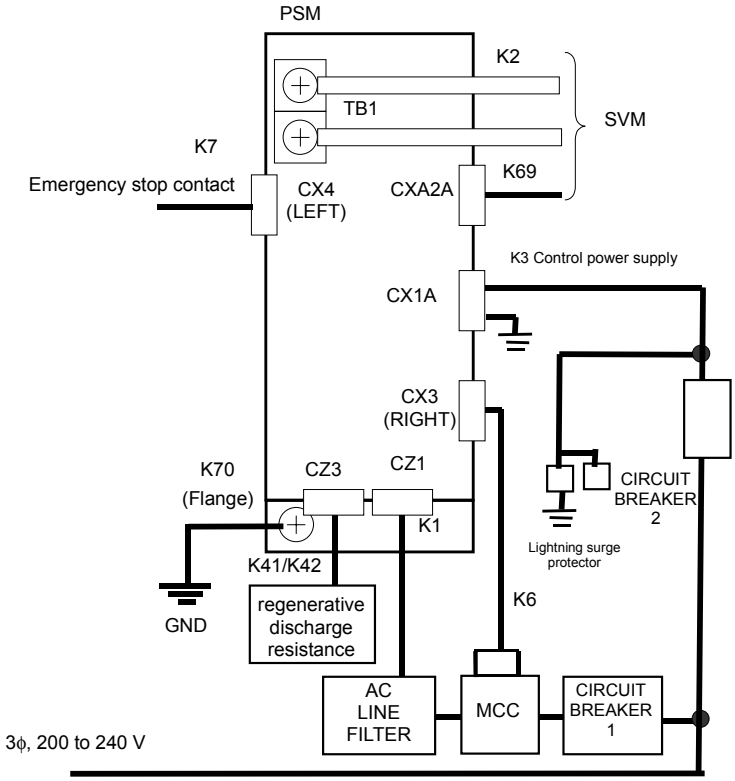
9.3.1 Power Supply Module Connection Diagram

PSM (200-V input series)



NOTE
1. Always install the circuit breakers, magnetic contactor, and AC reactor.
2. To protect the equipment from lightning surge voltages, install a lightning surge protector across each pair of power lines and across each power line and the grounding line at the power inlet of the power magnetics cabinet. See Appendix A for details.
3. Always connect the control power supply cable to the CX1A. If it is connected to the CX1B, fuses inside the unit may below.
4. See Section 5.2 for the type of the cable to be used for making a connection to a frame ground.

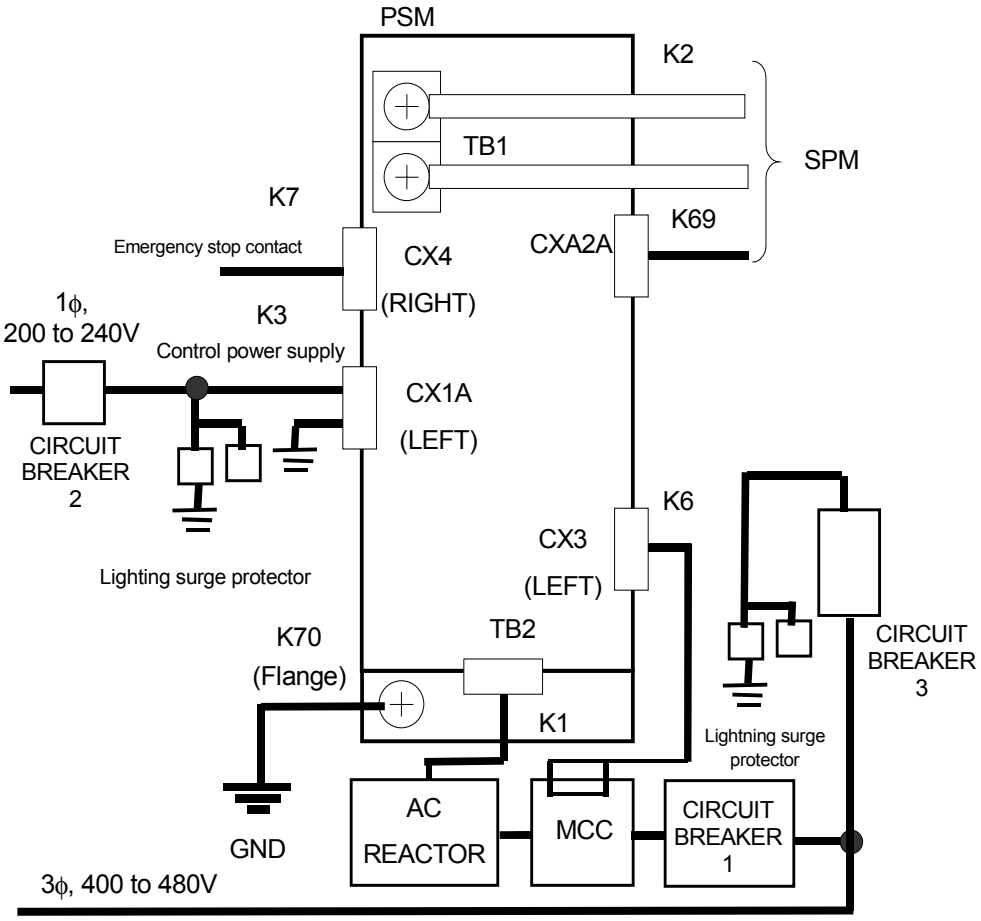
PSMR (200-V input series)



NOTE

1 Always install the circuit breakers, magnetic contactor, and AC reactor.
2 To protect the equipment from lightning surge voltages, install a lightning surge protector across each pair of power lines and across each power line and the grounding line at the power inlet of the power magnetics cabinet. See Appendix A for details.
3 Always connect the control power supply cable to the CX1A. If it is connected to the CX1B, fuses inside the unit may below.

PSM-HV (400-V input series)



NOTE

1 Always install the circuit breakers, magnetic contactor, and AC reactor.
2 To protect the equipment from lightning surge voltages, install a lightning surge protector across each pair of power lines and across each power line and the grounding line at the power inlet of the power magnetics cabinet. See Appendix A for details.
3 Always connect the control power supply cable to the CX1A. If it is connected to the CX1B, fuses inside the unit may below.
4 See Section 5.2 for the type of the cable to be used for making a connection to a frame ground.

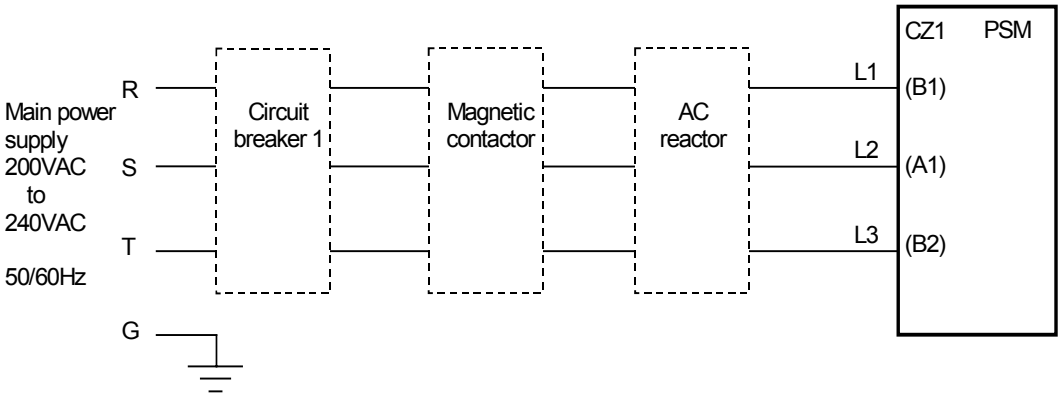
9.3.1.1 Details of cable K1 (power supply line)

Cable K1 is used to supply main power to the power supply module. Make sure that the cable used between the power supply and power supply module satisfies the requirements listed in Table 9.3.1.1.

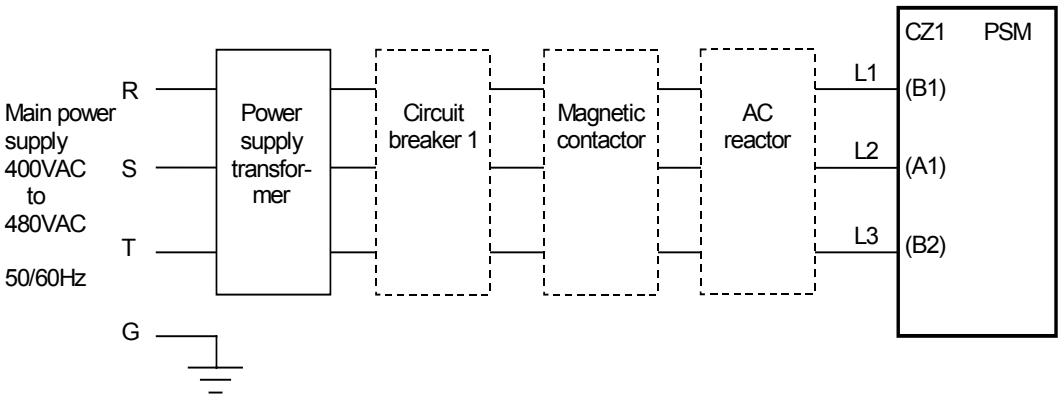
(1) For PSM

- PSM-5.5*i*

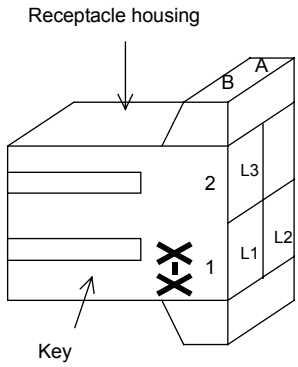
(a) For a power supply voltage of 200 to 240 VAC



(b) For a power supply voltage of 400 to480 VAC



Pin location of CZ1



Cable K1 Specifications

Model	Applicable cable	
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)
PSM-5.5*i*	5.5mm^2	5.5mm^2

NOTE
1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT : heat-resistant 60°C)
2 Fire-retardant polyflex wire (heat-resistant 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.
3 The cross-section area of each cable is determined under the following conditions:
(1) At PSM rated output
(2) Environment temperature of cable : 30°C
(3) Number of harnesses
3 (No current flows through the ground wire during normal operation.)
Select a required cable cross-section area according to the user environment and conditions.

Connector Specifications

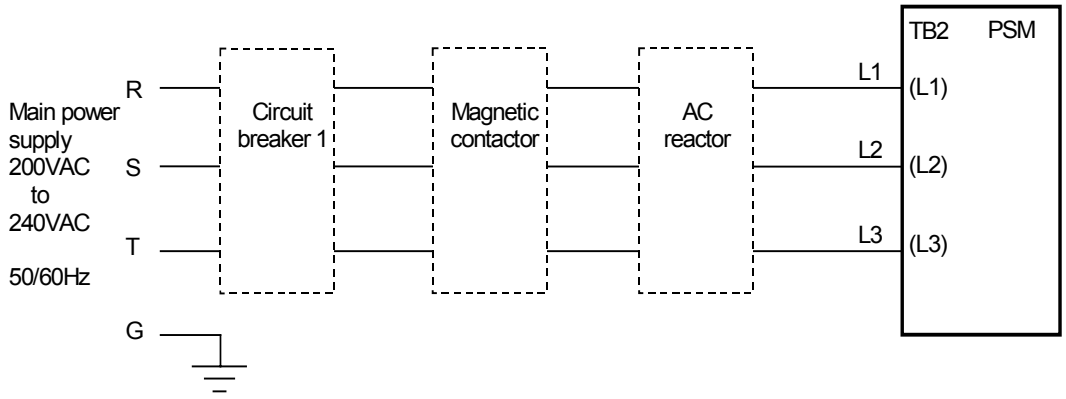
Model	Connector key (Note 1)	Applicable contact (Note 1)
PSM-5.5*i*	XX 1-917807-2	M size 316041-6

See Subsection 9.4 for detailed explanations about the specification of the D-5000.

NOTE
Tyco Electronics AMP D-5000 series
Select a contact size according to the cross-section area of the cable.

- PSM-11*i*

(a) For a power supply voltage of 200 to 240 VAC



(b) For a power supply voltage of 400 to 480 VAC

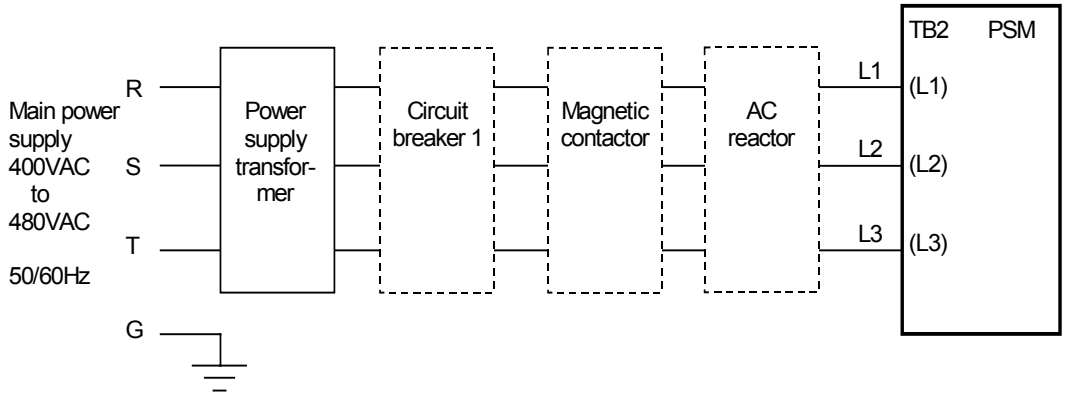


Table.9.3.1.1(a) Cable K1 Specifications

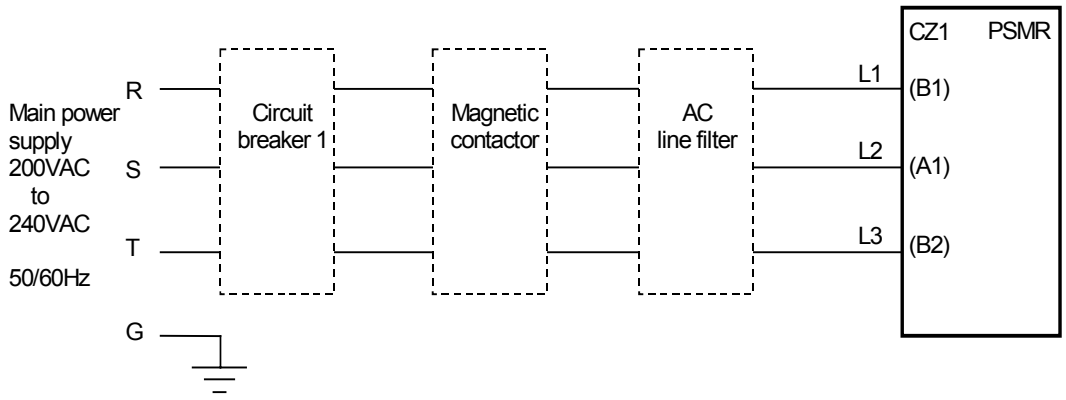
Model	Applicable cable		Terminal screw	Tightening torque
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)		
PSM-11*i*	-	8mm^2 or more	M4	1.1 to 1.5N·m
PSM-15*i*	14 mm^2 or more	14mm^2 or more		
PSM-26*i*	-	22mm^2 or more	M6	3.5 to 4.5N·m
PSM-30*i*	-	22mm^2 or more		
PSM-37*i*	-	38mm^2 or more	M6 (Note 3)	
PSM-55*i*	-	R,S,T: 80mm^2 or more G: 40mm^2 or more	M10 M6	

NOTE

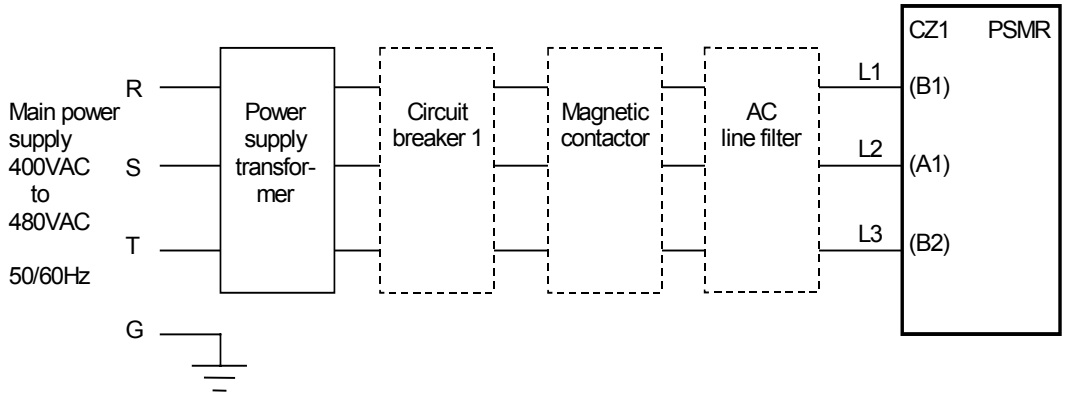
1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT : heat-resistant 60°C)
2 Fire-retardant polyflex wire (heat-resistant 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.
3 Applicable crimp terminal for PSM-37*i* : 38-6S
4 The cross-section area of each cable is determined under the following conditions:
(1) At PSM rated output
(2) Environment temperature of cable : 30°C
(3) Number of harnesses
3 (No current flows through the ground wire during normal operation.)
Select a required cable cross-section area according to the user environment and conditions.

(2) For PSMR

(a) For a power supply voltage of 200 to 240 VAC



(b) For a power supply voltage of 400 to 480 VAC



Cable K1 Specifications

Model	Applicable cable	
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)
PSMR-3*i*	3.5mm^2	3.5mm^2
PSMR-5.5*i*	5.5mm^2	5.5mm^2

NOTE
1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT : heat-resistant 60°C)
2 Fire-retardant polyflex wire (heat-resistant 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.

Connector Specifications

Model	Connector key (Note 1)	Applicable contact (Note 1)
PSMR-3*i*	XX	M size
PSMR-5.5*i*	1-917807-2	316041-6

See Subsection 9.4 for detailed explanations about the specification of the D-5000.

NOTE
Tyco Electronics AMP D-5000 series
Select a contact size according to the cross-section area of the cable.

(3) For PSM-HV

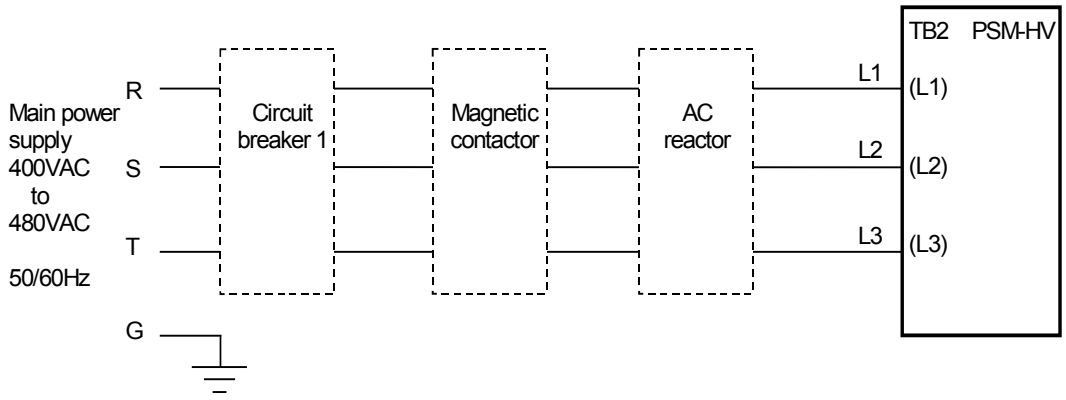


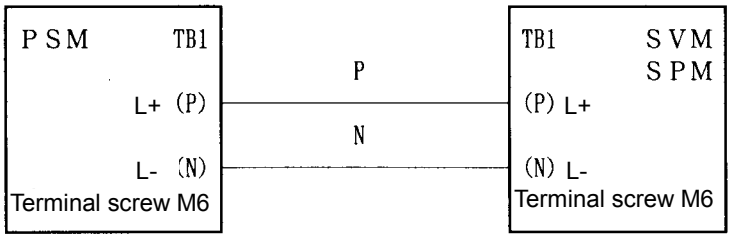
Table.9.3.1.1(b) Cable K1 Specifications

Model	Applicable cable		Terminal screw	Tightening torque
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)		
PSM-11HV*i*	5.5 mm^2 or more	5.5mm^2 or more	M4	1.1 to 1.5Nm
PSM-18HV*i*	-	8mm^2 or more		
PSM-30HV*i*	-	14mm^2 or more	M6	3.5 to 4.5Nm
PSM-45HV*i*	-	22mm^2 or more		
PSM-75HV*i*	-	R,S,T: 38mm^2 or more G: 22mm^2 or more	M10 M6	
PSM-100HV*i*	-	R,S,T: 80mm^2 or more G: 40mm^2 or more	M10 M6	

NOTE
1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT : heat-resistant 60°C)
2 Fire-retardant polyflex wire (heat-resistant 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.
3 The cross-section area of each cable is determined under the following conditions:
(1) At PSM rated output
(2) Environment temperature of cable : 30°C
(3) Number of harnesses
3 (No current flows through the ground wire during normal operation.)
Select a required cable cross-section area according to the user environment and conditions.

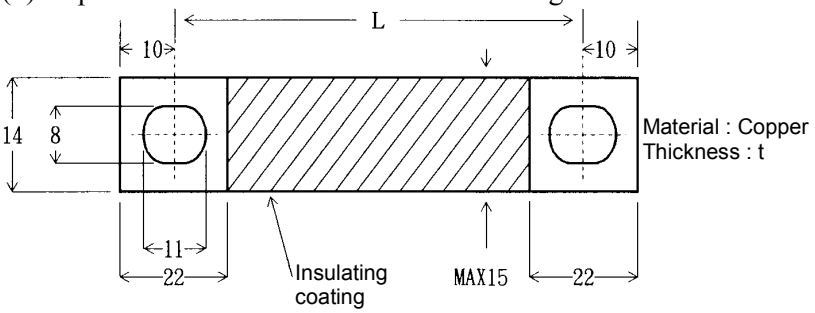
9.3.1.2 Details of short bar K2

Short bar K2 is used to supply the DC link voltage generated in each power supply module to other modules.
When designing a short bar for connecting modules placed close to each other, refer to the "Specifications of short bars for connecting modules placed close to each other."
To determine the length of a short bar to be used for connecting modules placed separately, refer to "Location of terminal board TB1."
Optional short bars are available from FANUC. Refer to the "DC Link Short Bar Specifications."

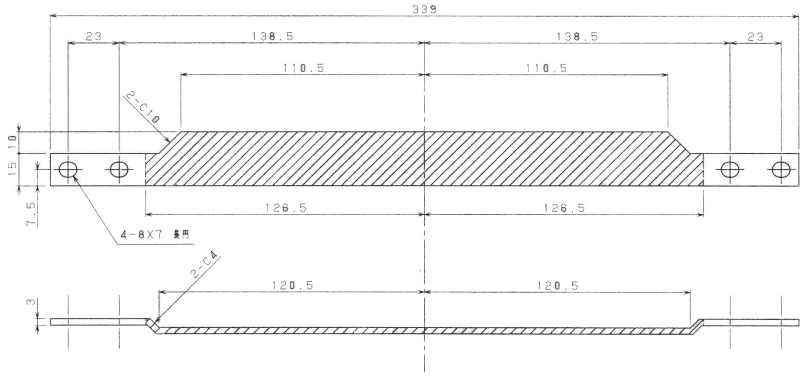


Specifications of short bars for connecting modules placed close to each other

(1) Specifications of short bars for connecting the modules



(2) Specifications of short bars for connecting the modules
(Figure example of short bars for connecting 300-mm-wide modules)



Hatched area: Apply PVC coating.
Thickness : 1t or more

Table.9.3.1.2 Short Bar K2 Specifications

Module location	Short bar length L	Short bar thickness t	Cross-section area (Note)
Unit of 300mm-wide	300mm	3.0mm	50mm^2
Unit of 150mm-wide	150mm	1.5mm	21mm^2
Unit of 90mm-wide	90mm	1.5mm	21 mm^2
Unit of 60mm-wide	60mm	1.5mm	21 mm^2

NOTE

1 Modules need not necessarily be connected with a short bar (copper plate).
If the modules cannot be placed close to each other, however, they cannot help being separated from each other.
If you connect them with a power cable, however, the cable may not be thinner than indicated below and must be insulated with heat-resistant polyvinyl.

2 When the width is 300 mm (SPM-45*i*, SPM-55*i*, PSM-55*i*, SPM-75HV*i*, SPM-100HV*i*, PSM-75HV*i*, PSM-100HV*i*, or SVM1-360HV*i*), cabling needs to be performed using the two screws at P and N. So, use a dedicated short bar (A06B-6078-K841, two each per set).

Location of terminal board TB1 on each module

Fig.9.3.1.2(a) and Fig.9.3.1.2(b) show the location of terminal board TB1 on each module.
If you want to install modules at distances not specified herein, design short bars by referring to the dimensions shown below.
When designing a short bar for connecting 300-mm-wide modules in particular, conform to the above figure specifications and apply the above coating.

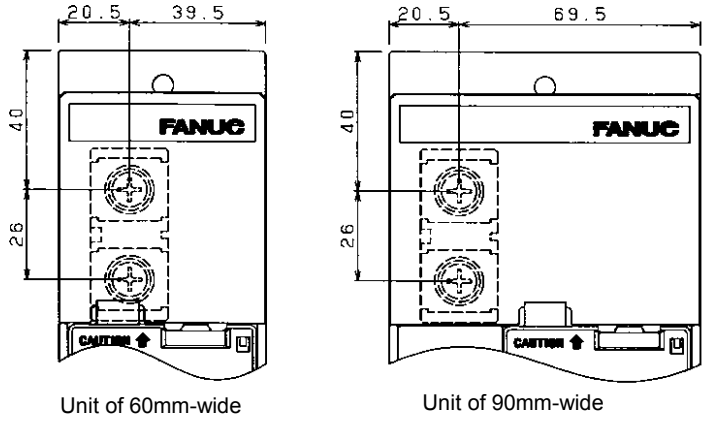


Fig.9.3.1.2(a) Location of Terminal Board TB1 on the units of 60-, 90-, and 150-mm-Wide

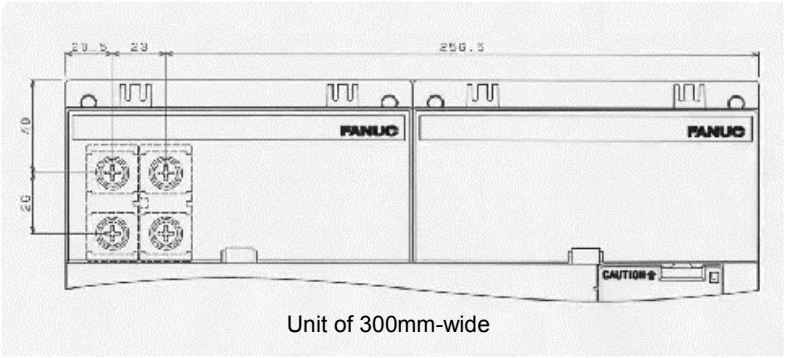
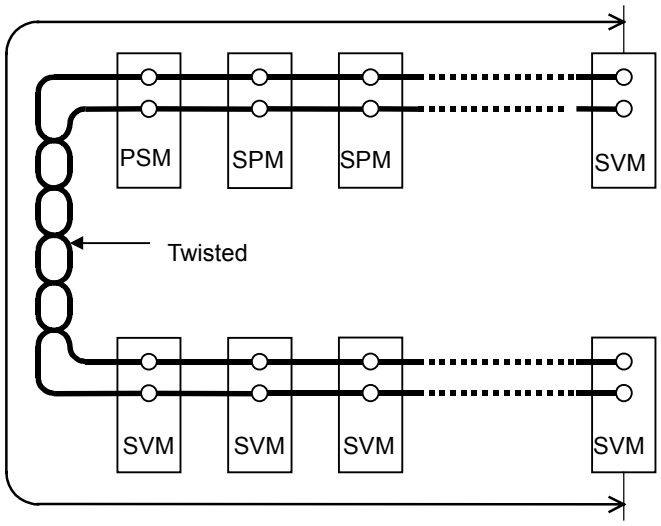


Fig.9.3.1.2(b) Location of Terminal Board TB1 on the units of 300-mm-Wide

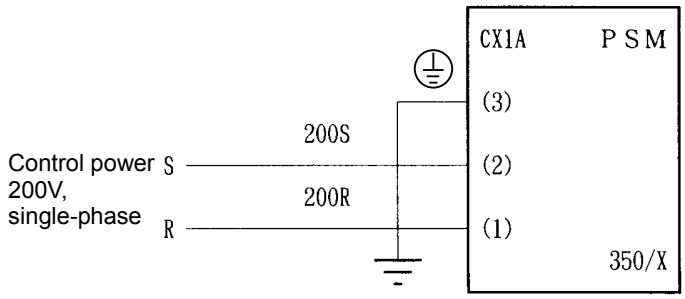
About the length of the DC link cable

Suppress the length of the DC link cable to within 1.5 m. (See the following diagram.)



9.3.1.3 Details of cable K3

Cable K3 is used to supply control power to the power supply module.



Cable specification:

Two-conductor polyvinyl heavy-duty power cable (JIS C3312), conductor size of 1.25 mm^2 (50/0.18),
PVC sheath 9.6 mm in diameter

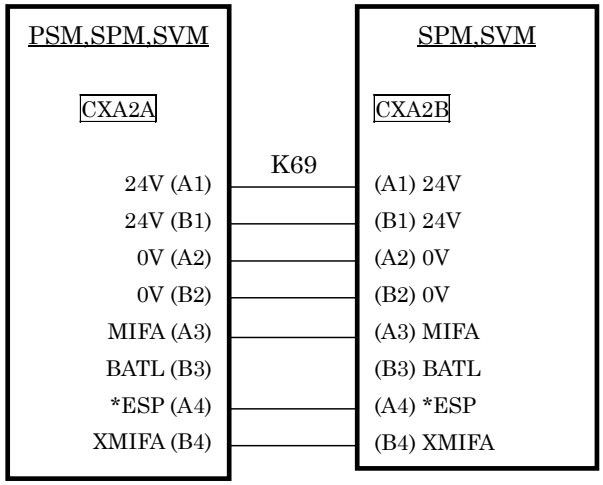
Connector specification:

Tyco Electronics AMP connector with receptacle housing 1-178128-3 and receptacle contact 1-175218-2

NOTE
Always connect cable K3 to the CX1A. If it is connected to the CX1B, fuses inside the unit may blow.

9.3.1.4 Details of cable K69

The cable K69 is used between the PSM, SPM, and SVM.



Connector specification

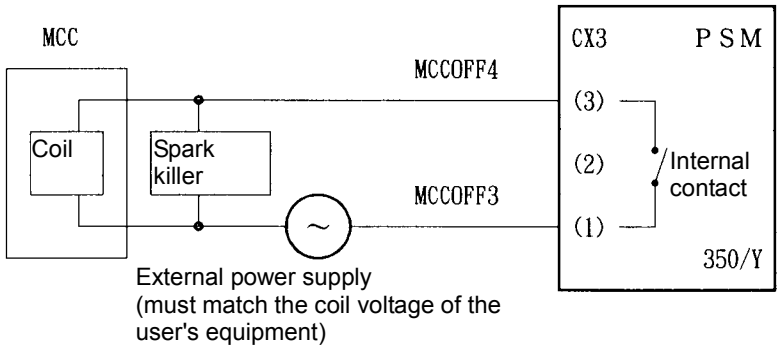
Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing 1-1318119-4 (1 pieces) Contact 1318107-1 (8 pieces) [Ordering information : A06B-6110-K210 connector only]
Conductor size	0.5mm^2, AWG20
Instruction outer diameter	1.08-2.83 mm

NOTE
The (B3)BATL is the interface used to connect the batteries for the absolute Pulsecoder. For details, see the description of battery connection in Subsection 9.3.2.10.

⚠ WARNING
1 When using the built-in battery (A06B-6073-K001), never connect the BATL(B3) of the connector CXA2A/CXA2B.
Otherwise, a short-circuit will occur between the battery output voltages for different SVMs, possibly resulting in the batteries becoming very hot, which is dangerous.
2 Do not connect more than one battery to the same BATL(B3) line. Otherwise, a short-circuit will occur between the output voltages of different batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

9.3.1.5 Details of cable K6

Cable K6 is used to control the magnetic contactor if it is installed outside the unit.



Cable specification:

Two-conductor polyvinyl heavy-duty power cable (JIS C3312), conductor size of 1.25 mm^2 (50/0.18), PVC sheath 9.6 mm in diameter

Connector specification:

Tyco Electronics AMP connector with receptacle housing 2-178128-3 and receptacle contact 1-175218-2

Internal-contact specification:

	Resistive load ($\cos\phi$=1)	**Inductive load ($\cos\phi$=0.4, L/R=7msec)**
Rated load	250VAC, 5A / 30VDC, 5A	250VAC, 2A / 30VDC, 2A
Maximum contact rating	5A	5A

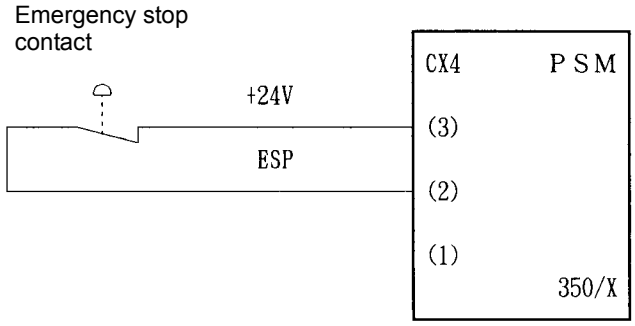
NOTE

Always install a spark killer (CR) that matches the magnetic contactor to protect the internal contacts. The following table lists the recommended capacitances and resistances.

Coil voltage	**C**	**R**
24VDC	0.22μF	22Ω
100 to 230VAC	0.1μF	220Ω

9.3.1.6 Details of cable K7

Cable K7 is used to supply an emergency stop signal to the power supply module.



Cable specification:

Two-conductor polyvinyl heavy-duty power cable (JIS C3312), conductor size of 1.25 mm^2 (50/0.18), PVC sheath 9.6 mm in diameter

Connector specification:

Tyco Electronics AMP connector with receptacle housing 1-178128-3 and receptacle contact 1-175218-2

(1) When the contact is ON (closed), the spindle motor and servo motor are enabled.
When the contact is OFF (open), the external magnetic contactor (MCC) is in the off state, and the spindle motor and servo motor do not operate.

(2) When the contact is set to OFF (open) during motor rotation, the spindle motor decelerates, then stops, and the servo motor is stopped by the dynamic brake.

(3) The contact input signal is specified as follows:
<1> As the external contact capacity, a voltage of at least 30 VDC and a current of at least 100 mA are required.
<2> Significant levels (with the voltage between input pins) when the contactless signal input mode is used:
Low level "logic 0": Up to 2 V
High level "logic 1": At least 20 V

(4) When the PSM main power is turned off for safety in such a case that the machine protection door is open, the contact of the ESP signal (CX4), which is input to the PSM, must be set to OFF (open) within 200 ms after turn-off of the PSM main power.
When the contact of the ESP signal (CX4) remains ON (closed) after the PSM main power is turned off, a DC link low-voltage alarm (alarm No. 4) occurs in the PSM.

9.3.1.7 Details of cable K70

(a) The cable K70 is used to connect the connector CX1A on the power supply module to the frame ground of the cabinet.
Conductor size : 1.25 mm^2

(b) The cable K70 is used to connect the metal frame of the power supply module to the frame ground of the cabinet.

(c) The cable K70 is used to connect the metal frames of the servo amplifier module and spindle amplifier module to the frame ground of the cabinet.

Table 4.3.1.7 Grounding cable conductor diameter

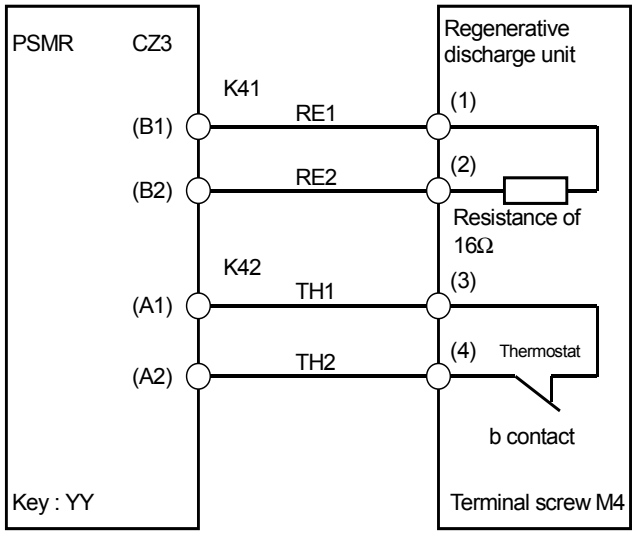
Motor power cable cross-section S (mm^2)	Grounding cable cross-section (mm^2)
$S \leq 5.5$	5.5 or greater
$5.5 < S \leq 16$	S or greater
$16 < S \leq 35$	16 or greater
$35 < S$	S/2 or greater

(d) The cable K70 is used to connect the metal frame of the dynamic brake module (DBM) to the frame ground of the cabinet.
Select the size of the cable according to Table 4.3.1.7. The cross-section size of the motor power cable listed in the table complies with the conductor diameter of the motor power cable used in a unit to which the DBM is connected.

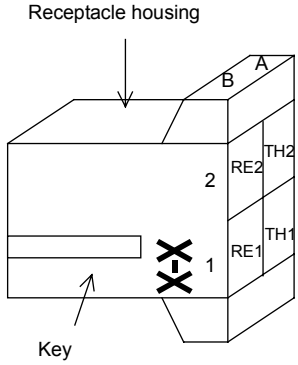
NOTE
The following M5 crimp terminal can be used with a cable having a large conductor diameter.
Nichifu Co., Ltd. CB22-5S
Overall conductor size range : 16.78 to 22.66 mm^2

9.3.1.8 Detailed description of the connection of cables K41 (for regenerative discharge resistance), K42 (for thermostat), and K43 (for fan motor)

Connection for A06B-6089-H510 and A06B-6089-H500



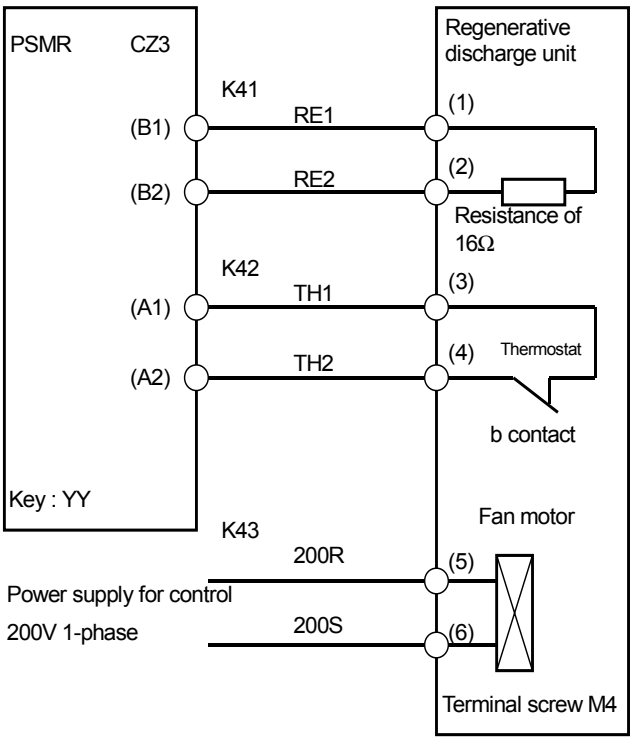
Tyco Electronics AMP D-5000



Cable number	Applicable cable	Connector key (Note 2)	Applicable contact (Note 2)
	VCT(heat resistant 60°C (Note 1)		
K41	2mm^2 Two-conductor polyvinyl heavy-duty power cable (JIS C3312)	YY 2-917807-2	S size 316040-6
K42	1.25mm^2 Two-conductor polyvinyl heavy-duty power cable (JIS C3312)		S size 316040-6

NOTE
1 Run cables K41 and K42 without tying them in a bundle.
2 CZ1 near them is for the power supply. Be careful of the connector key.

Connection for A06B-6089-H711 to -H713

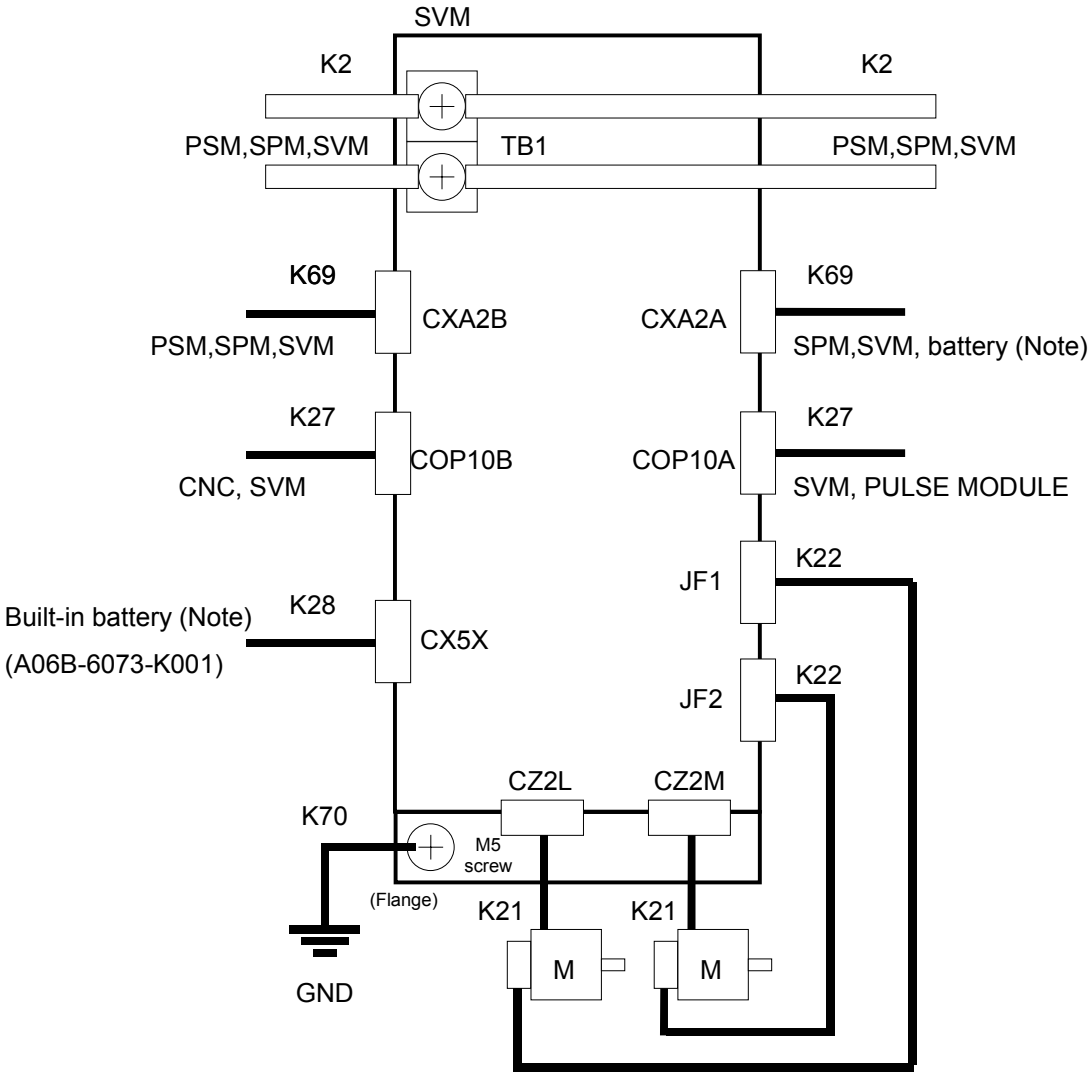


Cable number	Applicable cable VCT(heat resistant 60°C (Note 1)	Connector key (Note 2)	Applicable contact (Note 2)
K41	2mm^2 Two-conductor polyvinyl heavy-duty power cable (JIS C3312)	YY 2-917807-2	S size 316040-6
K42	1.25mm^2 Two-conductor polyvinyl heavy-duty power cable (JIS C3312)		S size 316040-6
K43	2mm^2 Two-conductor polyvinyl heavy-duty power cable (JIS C3312)		

NOTE
1 Run cables K41, K42, and K43 without tying them in a bundle.
2 CZ1 near them is for the power supply. Be careful of the connector key.

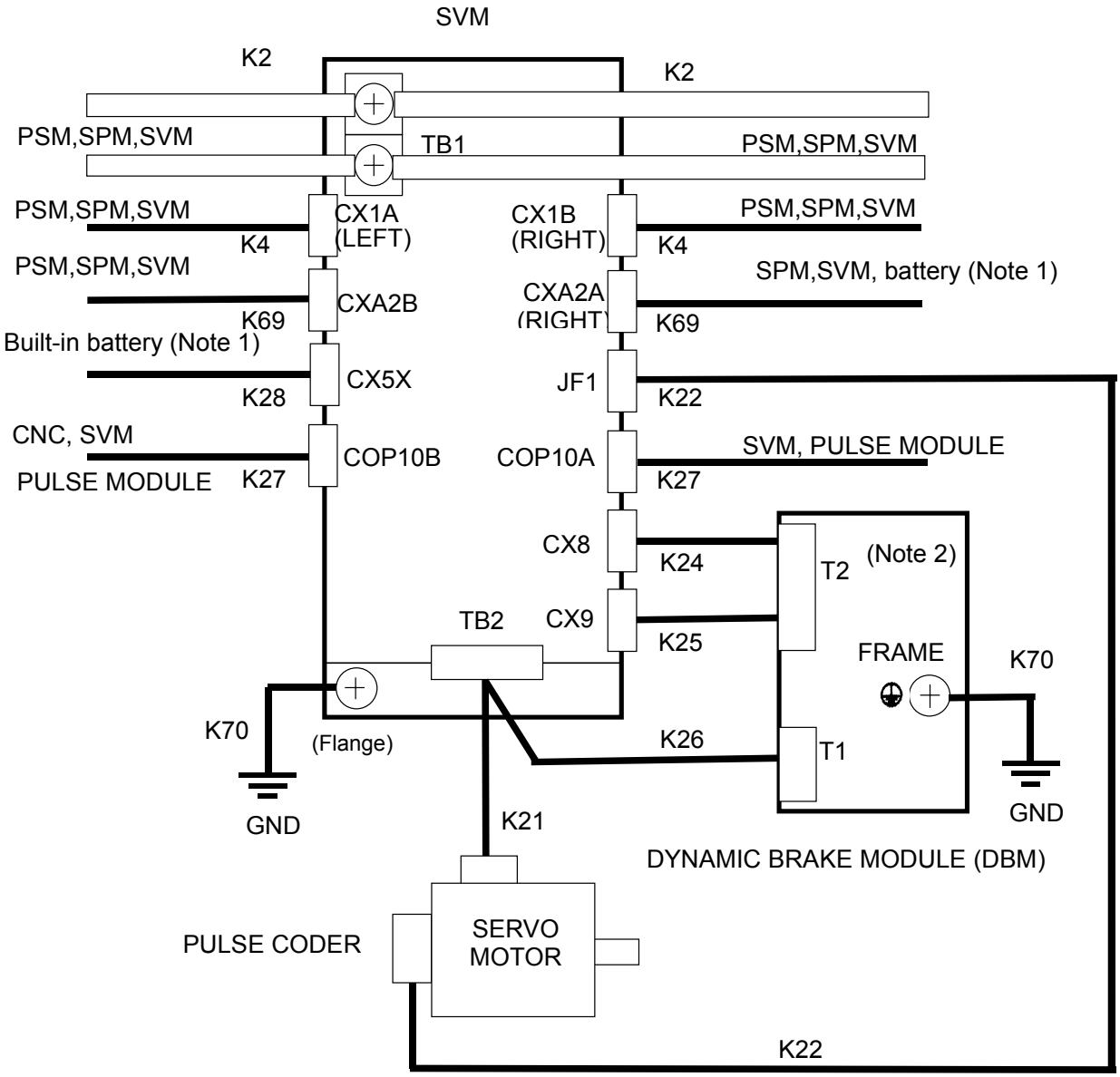
9.3.2 Servo Amplifier Module Connection Diagram

60mm- or 90mm-wide SVM (example : SVM2)
Without connection to dynamic brake module



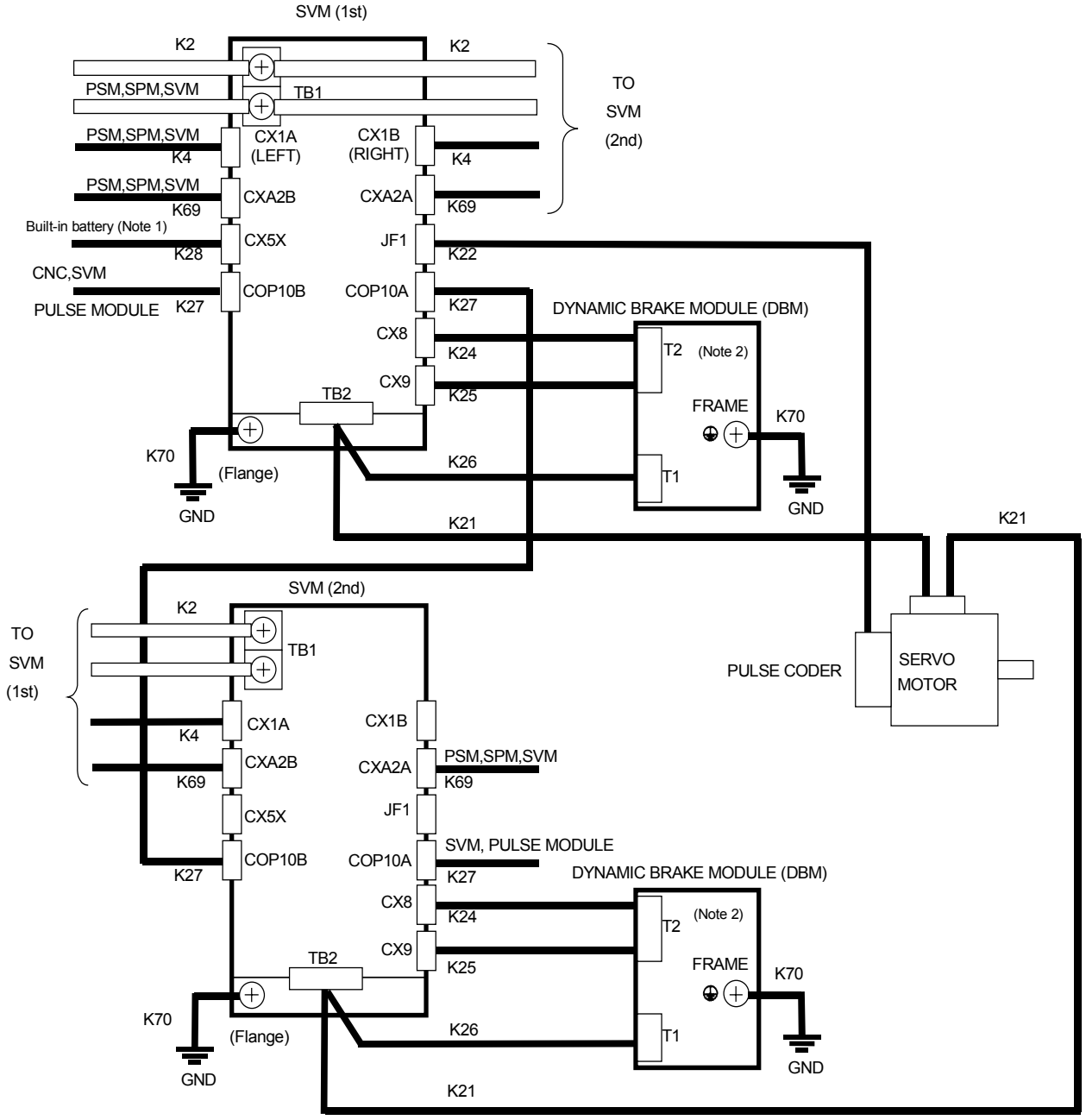
NOTE
See Subsection 9.3.2.10 for connection to the battery or built-in battery.

SVM1-360*i*, SVM1-180HV*i*, SVM1-360HV*i*



NOTE
1 See Subsection 9.3.2.10 for connection to the battery or built-in battery.
2 Connect one dynamic brake module for each servo amplifier.

SVM1-360*i*, SVM1-180HV*i*, SVM1-360HV*i* (Control at single motor and twin amplifier (SMTA))



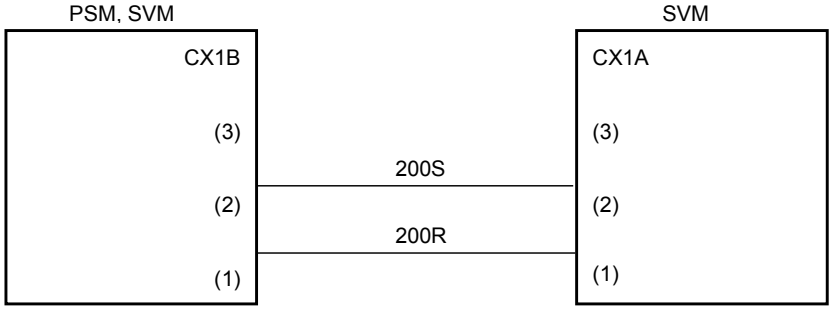
NOTE
1. See Subsection 9.3.2.10 for connection to the battery or built-in battery.
2. Connect one dynamic brake module for each servo amplifier.

9.3.2.1 Details of cable K2

The cable K2 is used to connect the DC link.
See Item 9.3.1.2.

9.3.2.2 Details of cable K4

Cable K4 is a connection cable used to supply power (single phase, 200 VAC) for driving the dynamic brake unit to the SVM.



Example cable :

Two-conductor polyvinyl heavy-duty power cable (JIS C3312)
Conductor size of : 1.25mm^2 (50/0.18)
PVC sheath 9.6 mm in diameter

Connector specification:

Tyco Electronics AMP connector with receptacle housing 1-178128-3 and receptacle contact 1-175218-2

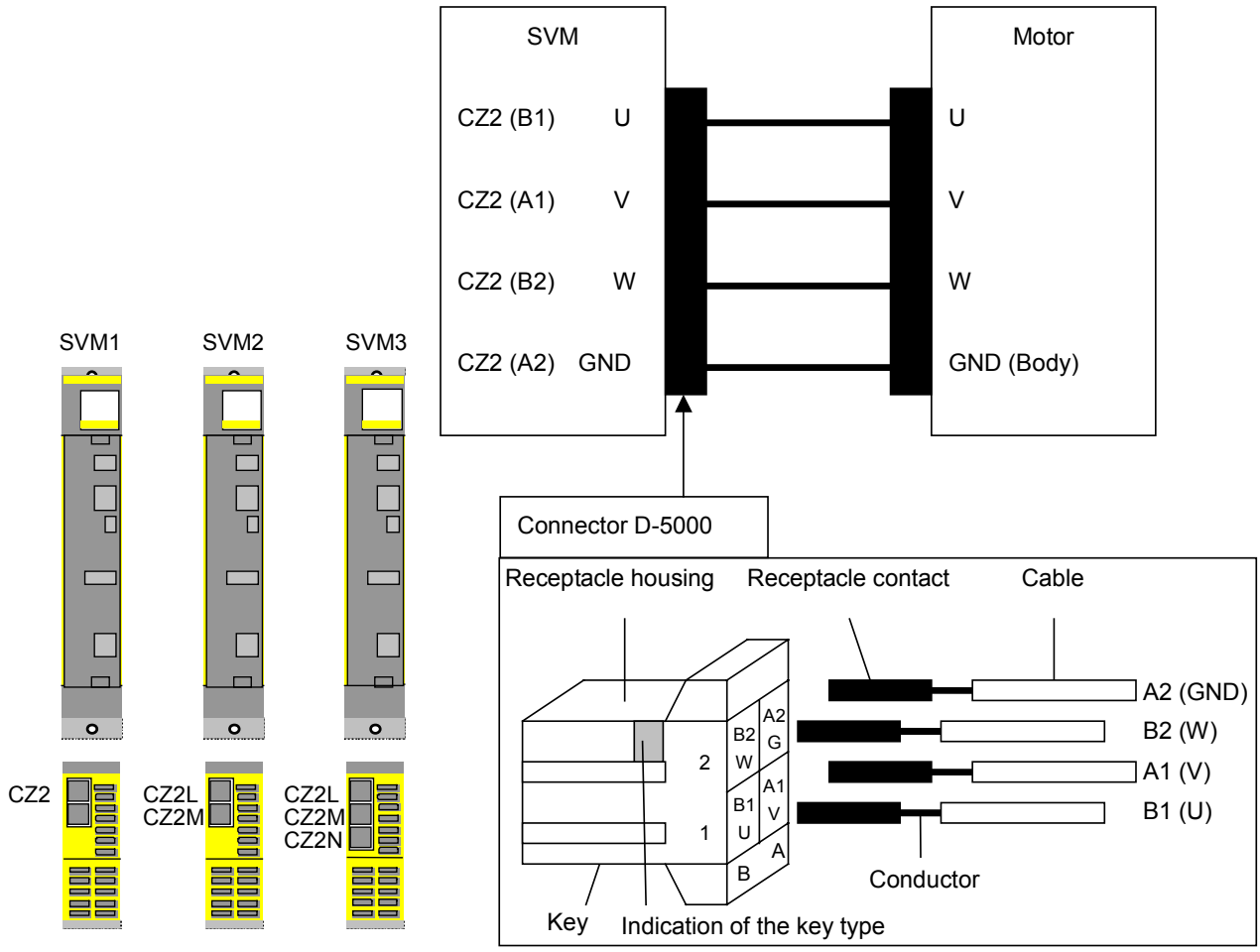
9.3.2.3 Details of cable K69

The cable K69 is a communication cable used between modules.
See Item 9.3.1.4.

9.3.2.4 Details of cable K21

Models other than SVM1-360*i*, SVM1-180HV*i*, and SVM1-360HV*i*

The cable K21 is a power cable used between the SVM and motor. The cable is attached to the SVM through the connector D-5000.



NOTE

When the α(HV)*i* series SVM is used, always mount the motor flange on a cabinet (machine) connected to the system ground. It may be difficult to connect the motor flange to a cabinet (machine) connected to the system ground. In this case, connect the motor flange and frame ground (ground plate of the cabinet) using a cable at least 1.25 mm^2 thick. The cable must be separated from the power lines as much as possible.

About the receptacle housing of the SVM-side connector

The SVM-side connector is a key type. The key is intended to prevent incorrect connection between the axes of multi-axis amplifiers (SVM2 and SVM3). Select the receptacle housing that matches the SVM and its axis that are to be used.
See Subsection 9.4.2 for detailed explanations about the specification of the D-5000.

Specification of the key	Applicable SVM
XX	SVM1, SVM2(L), SVM3(L)
XY	SVM2(M), SVM3(M)
YY	SVM3(N)

About the receptacle contact of the SVM-side connector

Four types receptacle contacts are prepared for the different line diameter of the cable. Please use the receptacle contact which suits the line diameter of the cable.
See Subsection 9.4.2 for detailed explanations about the specification of the D-5000.

About the cable specification

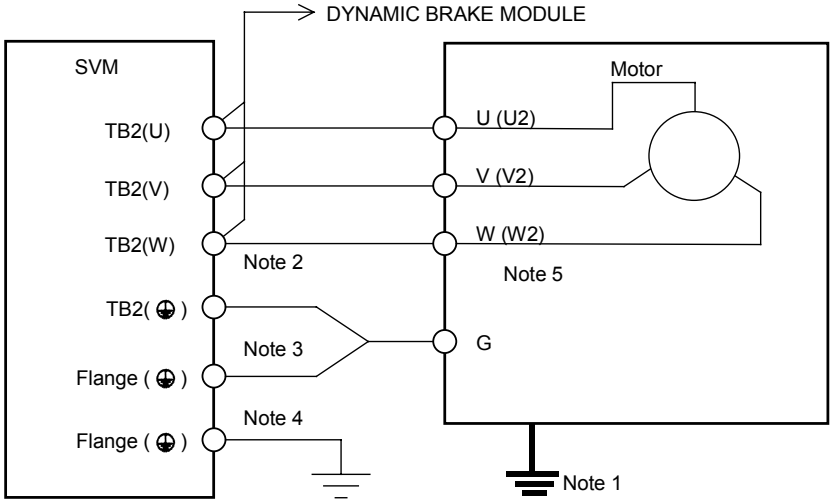
Select the cable specification by considering the following conditions for use.

<1> Motor current rating or current needed in use on a real machine
<2> Cable type (heat resistance temperature, etc.)
<3> Environment in which the cable is installed (operating ambient temperature, etc.)
<4> Need of water proofing (pay attention to the diameter of the applicable cable clamp)
<5> Certification for CE marking (compliance with various safety standards and EMC standard)
<6> Securing insulation space among the cable pins at the time of cabling

About the motor-side connector

The specification of the motor-side connector varies from one motor model to another.
Refer to "FANUC AC SERVO MOTOR $\alpha is/\alpha i$ series Descriptions (B-65262EN)" for explanations about the specification of the motor-side connector.

SVM1-360*i*, SVM1-180HV*i*, and SVM1-360HV*i*



NOTE

1 When the α(HV)*i* series SVM is used, always mount the motor flange on a cabinet (machine) connected to the system ground. It may be difficult to connect the motor flange to a cabinet (machine) connected to the system ground. In this case, connect the motor flange and frame ground (ground plate of the cabinet) using a cable at least 1.25 mm^2 thick. The cable must be separated from the power lines as much as possible.

2 Size of screw for motor power line TB2(U), TB2(V), and TB2(W)
- For SVM1-360*i*, SVM1-180HV*i* : M6
- For SVM1-360HV*i* : M10

3 Connection for motor ground lead
- For SVM1-360*i*, SVM1-180HV*i* :
  Connection to TB2(G) (M6)
- For SVM1-360HV*i* : Connection to flange (M6)

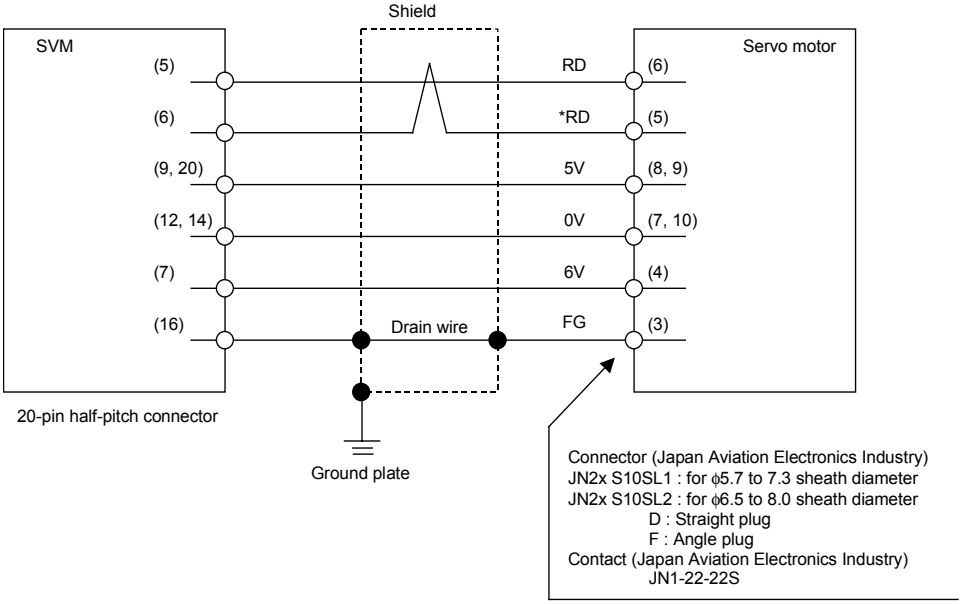
4 Size of screws for connection between flange and ground
- For SVM1-360*i*, SVM1-180HV*i* : M5
- For SVM1-360HV*i* : M6

5 In single-motor twin-amplifier (SMTA) control (in which one motor is driven by two SVMs), connect motor power lines U, V, W, and G to the first SVM and motor power lines U2, V2, W2, and G to the second SVM.

9.3.2.5 Details of cable K22

The cable K22 is used to connect the SVM and Pulsecoder.

For servo motor α*i*, α*i*s, α(HV)*i*, α(HV)*i*s series and Servo motor β*i*s series (β0.4/5000*i*s to β22/2000*i*s)



Using cable conductor

Signal name	Cable length : 28m or less	Cable length : 50m or less
5V, 0V, 6V	0.3mm^2 × 5 (Note 4) Strand configuration 12/0.18 or 60/0.08 Insulation outer diameter ϕ0.8 to ϕ1.5	0.5mm^2 × 5 (Note 4) Strand configuration 20/0.18 or 104/0.08 Insulation outer diameter ϕ0.8 to ϕ1.5
RD, *RD	0.18mm^2 or more Twisted-pair wire Insulation outer diameter ϕ0.8 to ϕ1.5	0.18mm^2 or more Twisted-pair wire Insulation outer diameter ϕ0.8 to ϕ1.5
Drain wire	0.15mm^2 or more	0.15mm^2 or more

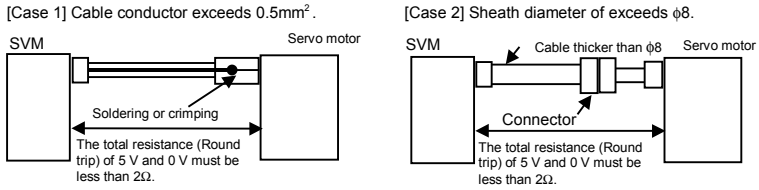
See Subsection 9.4.1 for explanations about the SVM-side connector that matches the recommended cable.
See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE

1 The ground plate to which the shield is connected must be placed as close as possible to the servo amplifier so that distance between the ground plate and the servo amplifier becomes shortest.

2 In case that the cable is prepared by MTB, total resistance of 5V and 0V must be less than 2Ω.

3 Pulsecoder side connector can accept maximum 0.5mm^2 (wire construction 20/0.18 or 104/0.08, diameter ϕ1.5 or less) wire and sheath diameter is ϕ5.7 to ϕ8.0. In case of using thicker wire or cable, take measures described below.



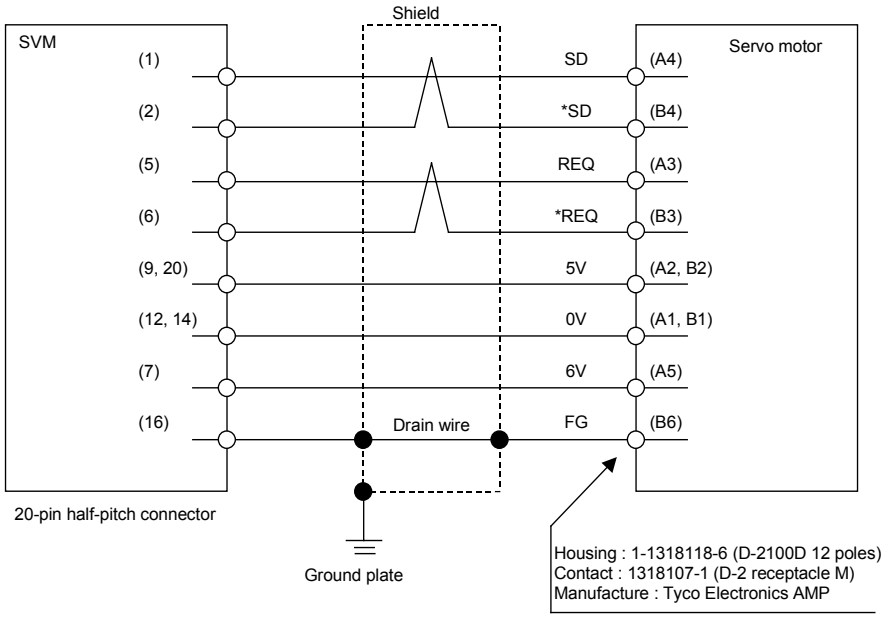
4 In case of incremental Pulsecoder, 6V is not necessary to be connected.

- Crimp tool specification
  A06B-6114-K201/JN1S : For 0.3 mm^2
  A06B-6114-K201/JN1L : For 0.18 mm^2 or 0.5 mm^2

- Connector kit specification
  A06B-6114-K204/S : Straight plug (including a contact)
  A06B-6114-K204/E : Elbow plug (including a contact)

- Recommended cable
  A66L-0001-0460 : Flexible cable 28m or less long
  A66L-0001-0462 : Flexible cable 50m or less long
  A66L-0001-0481 : Fixed cable 28m or less long
  A66L-0001-0491 : Fixed cable 50m or less long

For servo motor β*i*s series (β0.2/5000*i*s, β0.3/5000*i*s)



Using cable conductor

Cable length	Cable length : 20m or less
5V, 0V,6V	0.5mm^2 (AWG21) × 5 (Note 4) Strand configuration 20/0.18 Insulation outer diameter φ0.88 to φ1.5
SD, *SD, REQ, *REQ	0.18mm^2 (AWG25) or more Twisted-pair wireInsulation Strand configuration 7/0.18 Insulation outer diameter φ0.88 to φ1.5
Drain wire	0.15mm^2 or more
Recommended wire	0.5mm^2 × 5 + 0.18mm^2 × two-pair (For a fixed cable) Hitachi Cable, Ltd. : UL20276-SB(0)5x21AWG+2Px25AWG (For a movable cable) Hitachi Cable, Ltd. : UL20276-SB(FLEX)5x20AWG+2Px25AWG

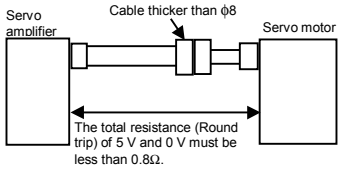
See Subsection 9.4.1 for explanations about the SVM-side connector that matches the recommended cable.

NOTE

1 The ground plate to which the shield is connected must be placed as close as possible to the servo amplifier so that distance between the ground plate and the servo amplifier becomes shortest.

2 In case that the cable is prepared by the user, the total resistance (round trip) of 5 V and 0 V must be less than 0.8Ω.

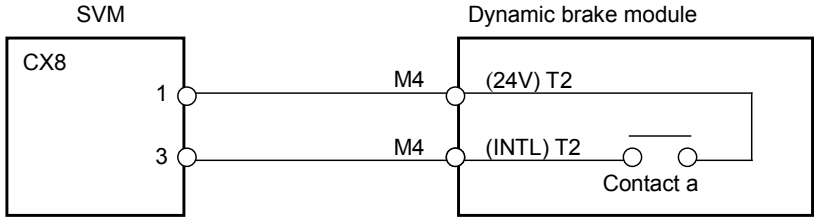
3 The maximum applicable wire diameter of the cable connector on the motor side is 0.5 mm^2 (when crimping tool 1463475-1 is used) or 0.85 mm^2 (when crimping tool 1276654-1 is used).In case of using thicker wire or cable, take measures described below.



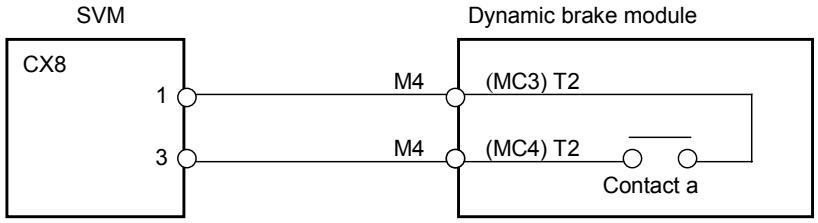
4 In case of incremental Pulsecoder, 6V is not necessary to be connected.

9.3.2.6 Details of cable K24

(1) For A06B-6079-H401



(2) For A06B-6069-H300



Example cable :

Two-conductor polyvinyl heavy-duty power cable (JIS C3312)
Conductor size of : 1.25mm^2 (50/0.18)
PVC sheath 9.6 mm in diameter

Connector specification:

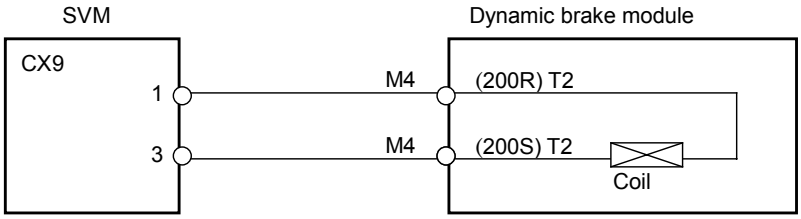
Tyco Electronics AMP connector with receptacle housing
2-178128-3 and receptacle contact 1-175218-2

Crimping terminal :

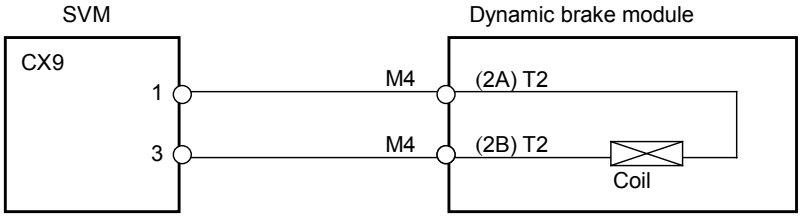
2-4

9.3.2.7 Details of cable K25

(1) For A06B-6079-H401



(2) For A06B-6069-H300



Example cable :

Two-conductor polyvinyl heavy-duty power cable (JIS C3312)
Conductor size of : 1.25mm^2 (50/0.18)
PVC sheath 9.6 mm in diameter

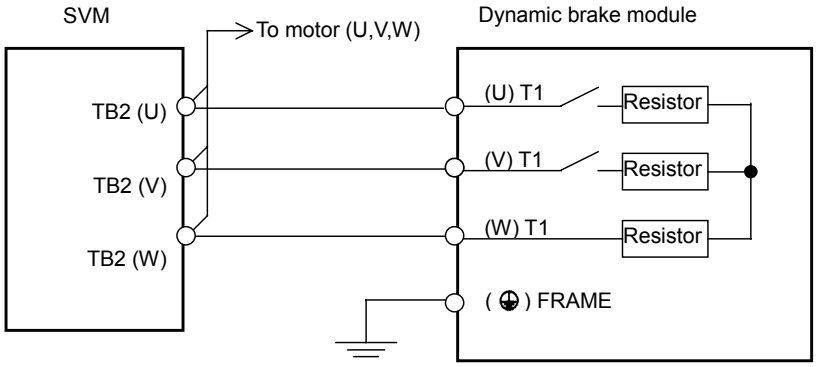
Connector specification:

Tyco Electronics AMP connector with receptacle housing
1-178128-3 and receptacle contact 1-175218-2

Crimping terminal :

2-4

9.3.2.8 Details of cable K26



Example cable :

Fire-retardant polyflex wire (maximum conductor temperature 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd., 5.5 mm^2 or larger

Connector specification:

Tyco Electronics AMP connector with receptacle housing 1-178128-3 and receptacle contact 1-175218-2

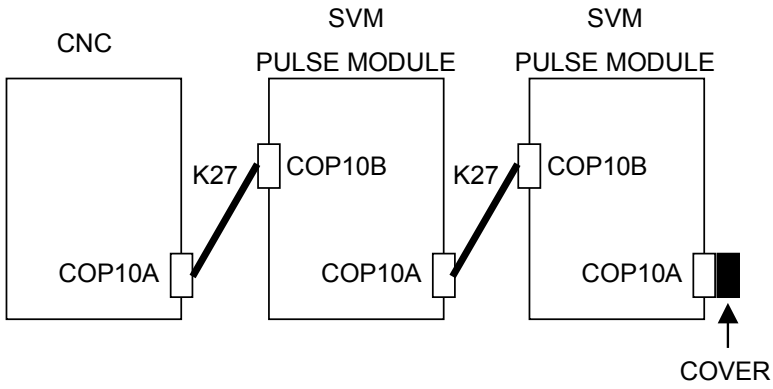
Crimping terminal :

DBM side 5.5-5 (SVM1-360*i*, SVM1-180HV*i*)
5.5-8 (SVM1-360HV*i*)

SVM side 5.5-6 (SVM1-360*i*, SVM1-180HV*i*)
5.5-10 (SVM1-360HV*i*)

9.3.2.9 Details of cable K27

Cable K27 is an optical fiber cable used in the FSSB interface.



- The cable is run from connector COP10A in the CNC, SVM, or pulse module to connector COP10B in the SVM or pulse module.
- Connector COP10A of a module at the end of the cable chain must be covered with the cap supplied with the module.
- Refer to the applicable CNC connection manual for detailed specifications of the optical fiber cable.

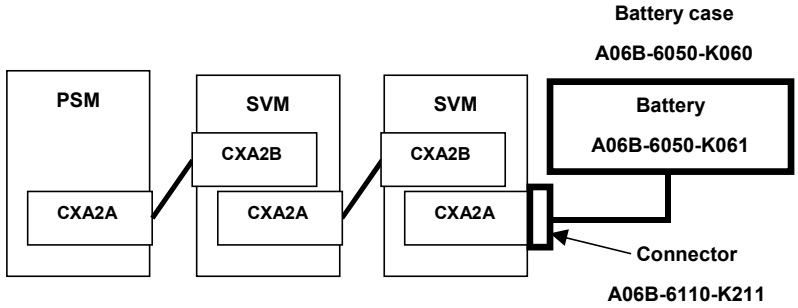
9.3.2.10 Connecting the battery (for the absolute Pulsecoder)

The following two methods can be used to connect the batteries for the absolute Pulsecoder: [connection method 1] and [connection method 2]

NOTE
1 Since the battery is a part that is in need of periodic maintenance by nature, it is recommended to use [connection method 1]. In this case, commercial batteries (four R20 alkaline batteries), which are easy to purchase, can be used.
2 The built-in batteries used in [connection method 2] must be purchased directly from FANUC. It is recommended that spare built-in batteries is purchased.

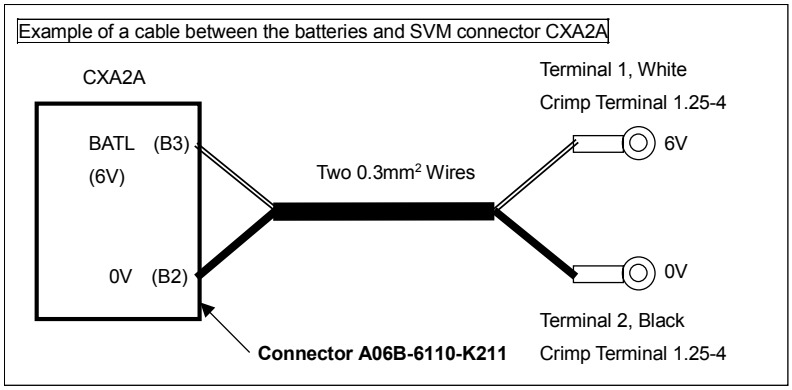
[Connection method 1]

Supplying power from one battery unit to more than one SVM



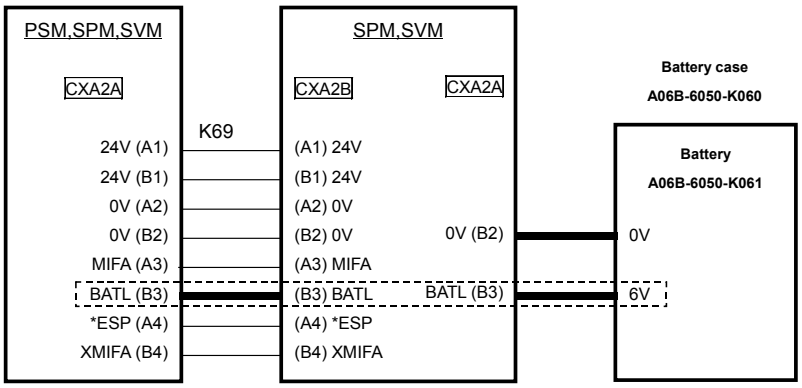
- A battery case (A06B-6050-K060) and four R20 alkaline batteries (A06B-6050-K061) are available as options. Commercial R20 alkaline batteries can also be used.

[Connection between the battery case and module]



- A connector (A06B-6110-K211) for connecting batteries is available as an option.

[Connection between modules]



- The BATL(B3) is an interface for supplying power from one absolute Pulsecoder battery unit to more than one SVM.

- Specification of the connector K69

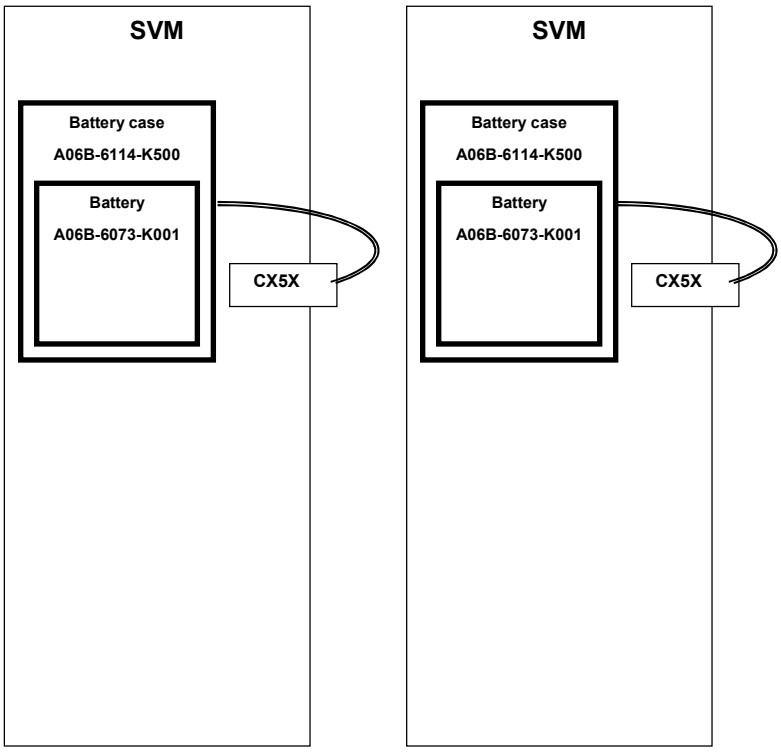
Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing 1-1318119-4 (2 pieces) Contact 1318107-1 (8 pieces) [Ordering information : A06B-6110-K210 connector only]
Conductor size	0.5mm^2, AWG20
Instruction outer diameter	1.08-2.83 mm

NOTE
1 Up to six servo motors can be connected to one battery.
2 The life of the batteries are about two years if they are used for six αi series servo motors and one year if they are used for six α series servo motors.

⚠ **WARNING**
Do not connect more than one battery to the same BATL(B3) line.
Otherwise, a short-circuit will occur between the output voltages of different batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

[Connection method 2]

- Incorporating built-in batteries in each SVM (Models other than SVM1-360*i*, SVM1-180HV*i*, and SVM1-360HV*i*)

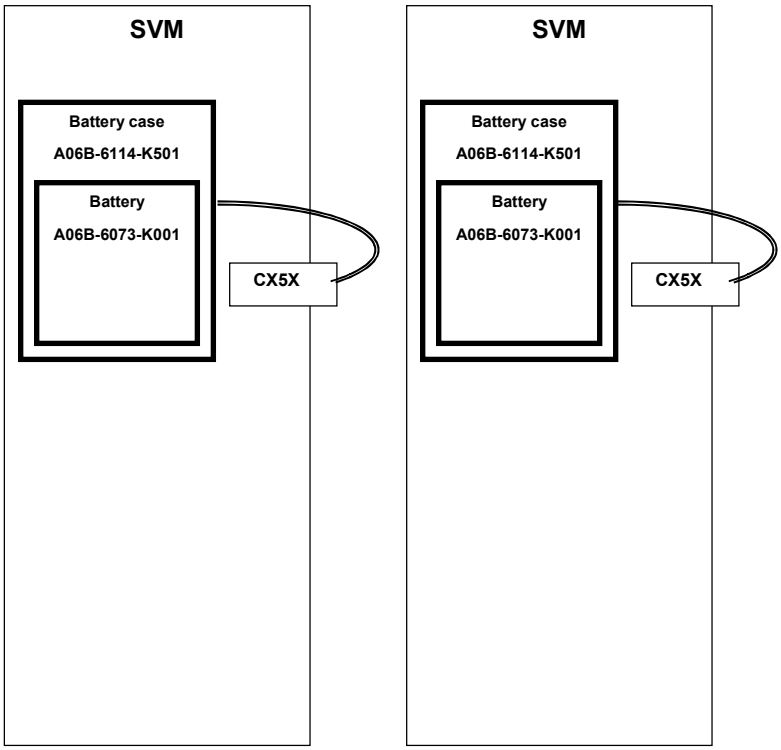


- Using the built-in battery (A06B-6073-K001) requires the battery case (A06B-6114-K500).
  A cover originally mounted at the SVM battery location cannot be used with the battery (A06B-6073-K001).

⚠ WARNING

1 When using the built-in battery (A06B-6073-K001), never connect the BATL(B3) of the connector CXA2A/CXA2B.
  Otherwise, a short-circuit will occur between the output voltages of different SVM batteries, possibly resulting in the batteries becoming very hot, which is dangerous.
2 Do not connect more than one battery to the same BATL(B3) line.
  Otherwise, a short-circuit will occur between the output voltages of different batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

- Incorporating built-in batteries in each SVM (Models SVM1-360*i*, SVM1-180HV*i*, and SVM1-360HV*i*)



- Using the built-in battery (A06B-6073-K001) requires the battery case (A06B-6114-K501).

⚠ WARNING

1 When using the built-in battery (A06B-6073-K001), never connect the BATL(B3) of the connector CXA2A/CXA2B.
Otherwise, a short-circuit will occur between the output voltages of different SVM batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

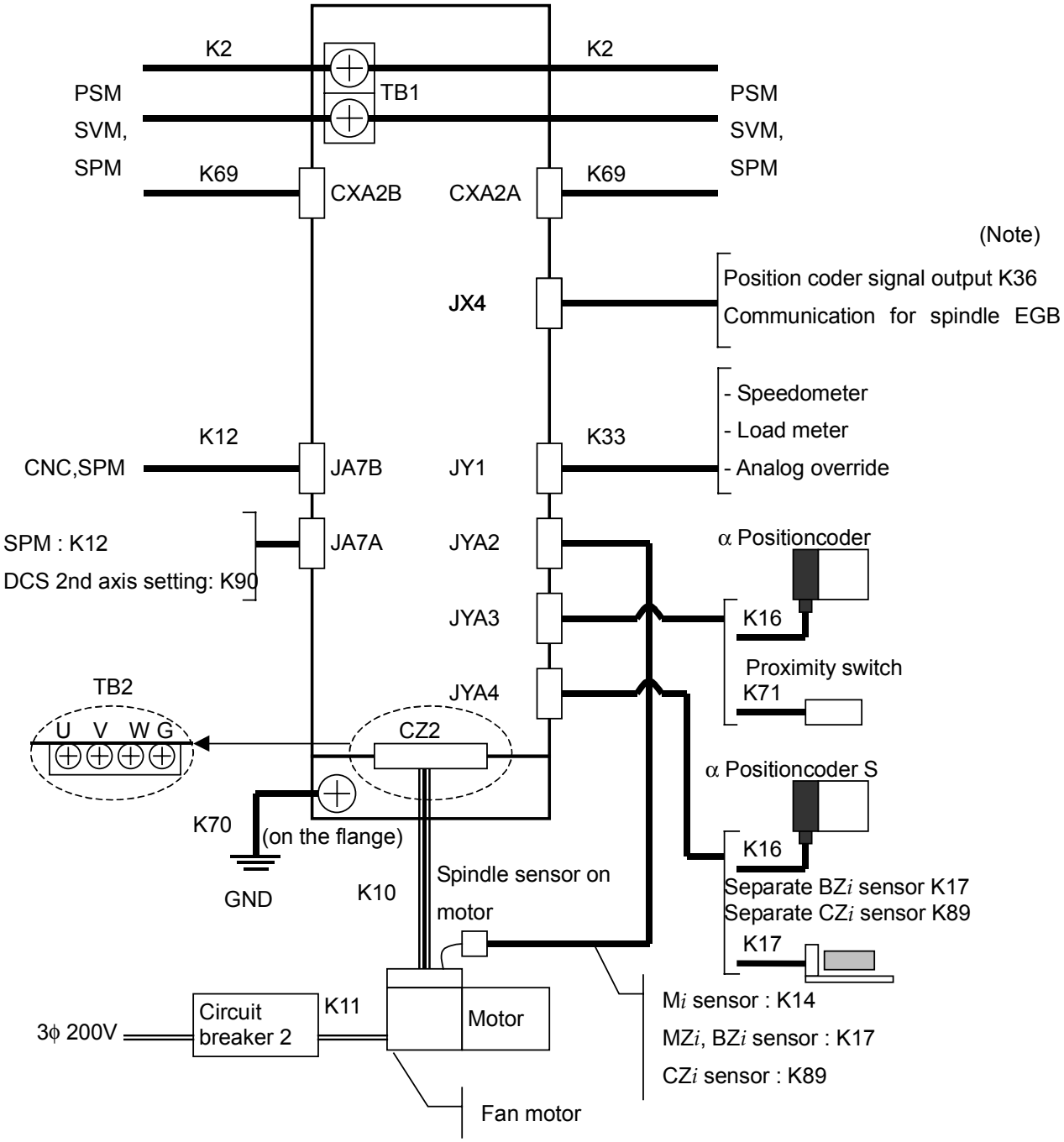
2 Do not connect more than one battery to the same BATL(B3) line.
Otherwise, a short-circuit will occur between the output voltages of different batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

9.3.2.11 Details of cable K70

Connect the SVM flange to the grounding plate through a grounding cable. (Protective ground connection)
See Subsection 9.3.1.7 for detailed descriptions about the K70.

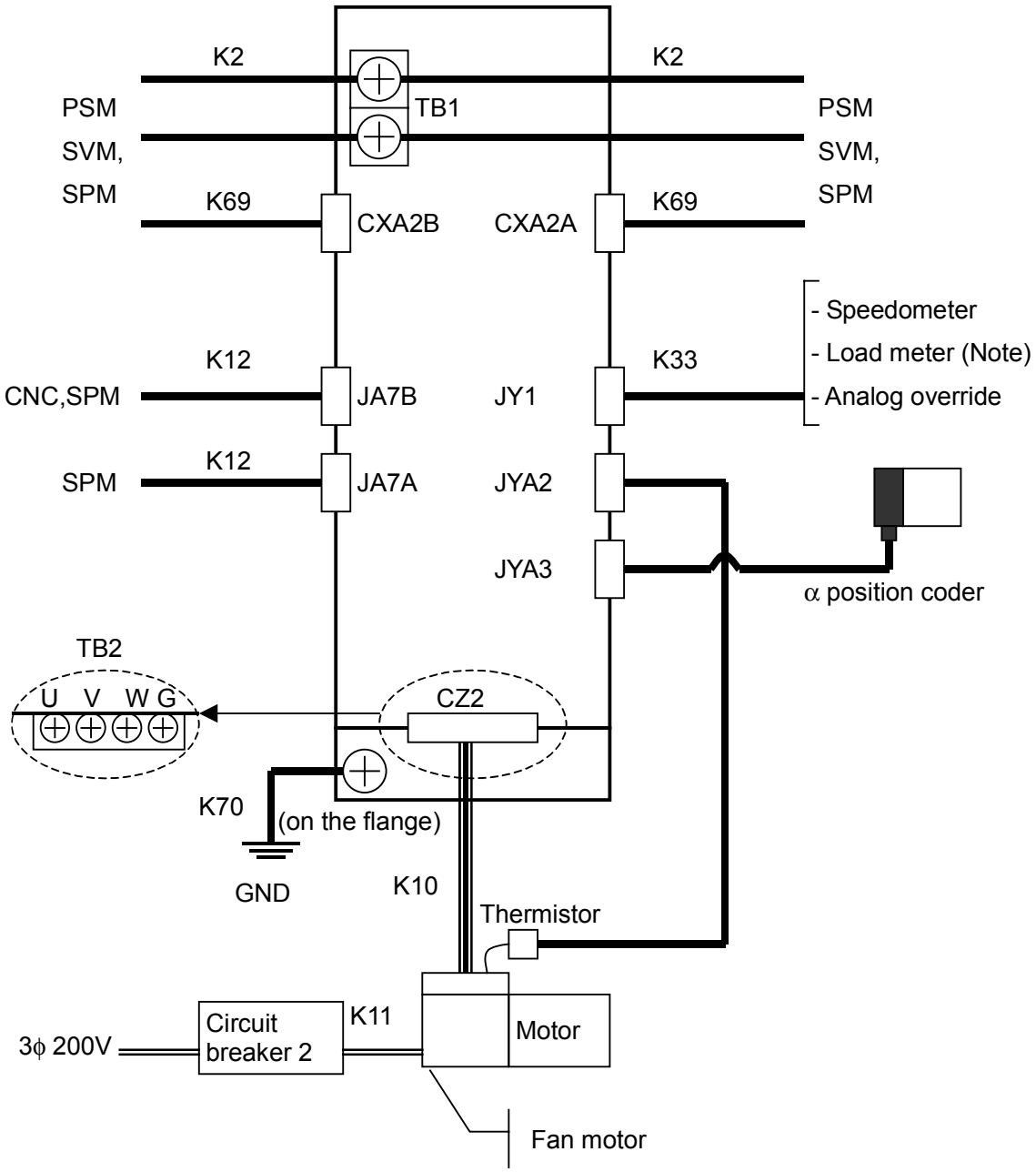
9.3.3 Spindle Amplifier Module Connection Diagram

Spindle amplifier module (SPM)



NOTE
This diagram applies to SPM TYPE B. For TYPE A, neither the JYA4 function nor the JX4 function is provided.

Spindle amplifier module for αC*i* series (SPMC)



NOTE
Only one channel is available for analog output. Select the load meter or speedometer by parameter setting.

9.3.3.1 Details of cable K2

See Item 9.3.1.2.

9.3.3.2 Details of cable K69

See Item 9.3.1.4.

9.3.3.3 Details of cable K10 (power cable)

For the SPM-2.2*i*, SPM-5.5*i*, SPMC-2.2*i,* and SPMC-5.5*i*, a connector (D-5000) is used to attach the SPM motor power cable. For other models (SPM-11*i* and higher), a terminal board is used for connection.

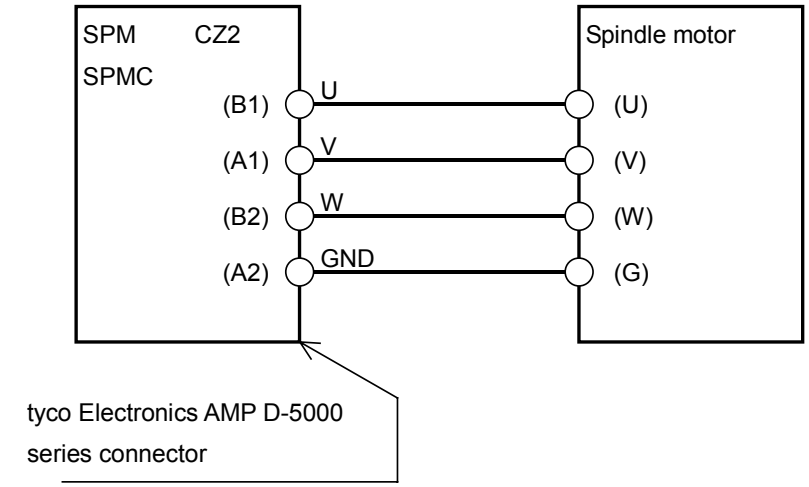
This subsection does not include the dimensions of the crimp terminal or the shape of the motor-side connector.
Refer to "AC SPINDLE MOTOR α*i* series Descriptions (B-65272EN)" for these items.

About the cable specification

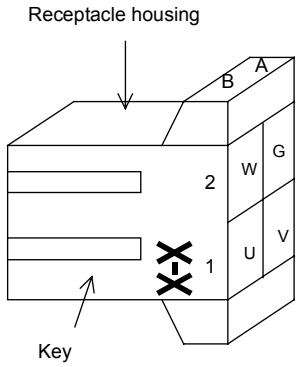
Select the cable specification by considering the following conditions for use.

<1> Motor current rating or current needed in use on a real machine
<2> Cable type (heat resistance temperature, etc.)
<3> Environment in which the cable is installed (operating ambient temperature, etc.)
<4> Need of water proofing (pay attention to the diameter of the applicable cable clamp)
<5> Certification for CE marking (compliance with various safety standards and EMC standard)
<6> Securing insulation space among the cable pins at the time of cabling

Connection through a connector



Location of connector pins

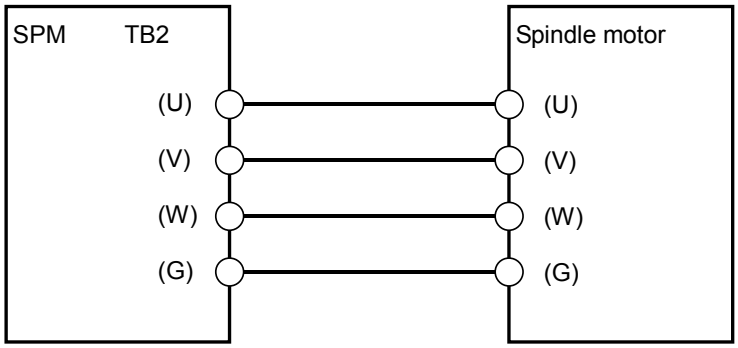


- 200-V input series

Key specification	Applicable models
XX	SPM-2.2*i*, SPM-5.5*i* SPMC-2.2*i*, SPMC-5.5*i* SPM-5.5HV*i*

See Subsection 9.4.2 for details.

Connection through a terminal block



- 200-V input series

Cables should be connected to the SPM or SPMC using crimp terminals as listed in the following table.

Amplifier models	Terminal screw	Rigid torque
SPM-11*i* , SPMC-11*i*	M4	1.1 to 1.5 N·m
SPM-15*i* ,SPMC-15*i*	M4	
SPM-22*i*, SPMC-22*i*	M6	3.5 to 4.5 N·m
SPM-26*i*	M6	
SPM-30*i*	M6	
SPM-45*i*, SPM-55*i*	U V W : M10	15 to 16 N·m
	G : M6	3.5 to 4.5 N·m

- 400-V input series

Cables should be connected to the SPM using crimp terminals as listed in the following table.

Amplifier models	Terminal screw	Rigid torque
SPM-11HV*i*	M4	1.1 to 1.5 N·m
SPM-15HV*i*	M4	
SPM-30HV*i*	M6	3.5 to 4.5 N·m
SPM-45HV*i*	M6	
SPM-75HV*i*, SPM-100HV*i*	U V W : M10	15 to 16 N·m
	G : M6	3.5 to 4.5 N·m

9.3.3.4 Details of cable K70

Connect the SPM flange or SPMC flange to the grounding plate through a grounding cable. (Protective ground connection)
For connection with the SPM or SPMC, use the crimp terminal selected according to the following table.

200-V input series

Amplifier model	Terminal screw	Rigid torque
SPM-2.2*i*, SPM-5.5*i*, SPM-11*i*, SPM-15*i*, SPM-22*i*, SPM-26*i*, SPM-30*i* SPMC-2.2*i*, SPMC-5.5*i*, SPMC-11*i*, SPMC-15*i*, SPMC-22*i*	M5	2 to 2.5Nm
SPM-45*i*, SPM-55*i*	M6	3.5 to 4.5Nm

See Subsection 9.3.1.7. for details of the cable K70.

400-V input series

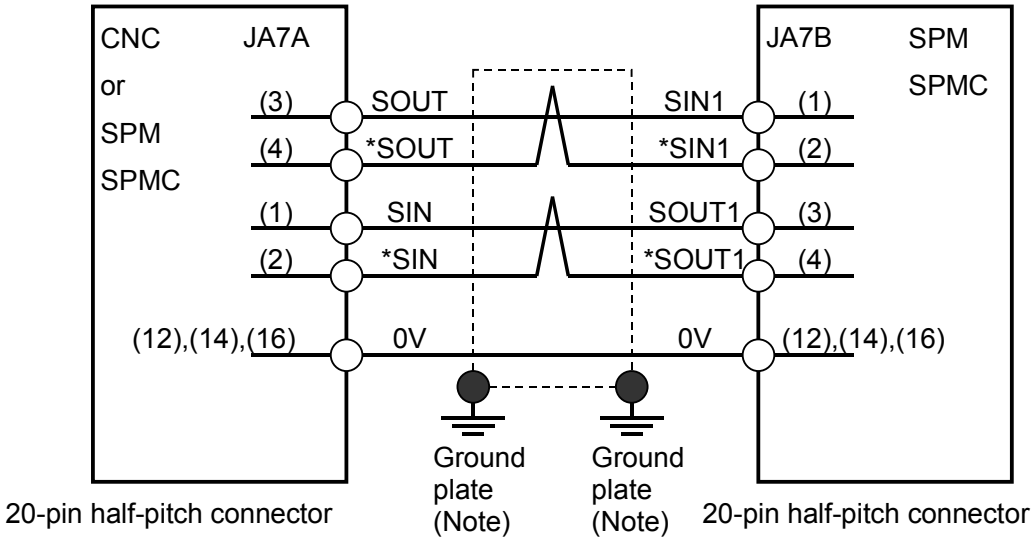
Amplifier model	Terminal screw	Rigid torque
SPM-5.5HV*i*, SPM-11HV*i*, SPM-15HV*i*, SPM-30HV*i*, SPM-45HV*i*	M5	2 to 2.5Nm
SPM-75HV*i*, SPM-100HV*i*	M6	3.5 to 4.5Nm

See Subsection 9.3.1.7. for details of the cable K70.

9.3.3.5 Details of cable K11

See FANUC AC SPINDLE MOTOR α*i* series DESCRIPTIOPNS (B-65272EN) for details of this Subsection.

9.3.3.6 Details of cable K12

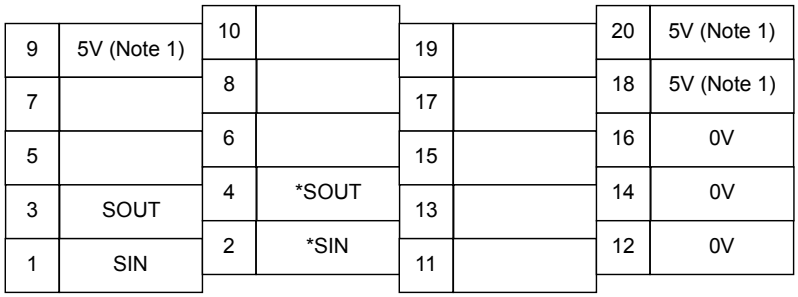


Cable specification: 0.09 mm^2 twisted pair with common shielded
Recommended cable (wire only): A66L-0001-0284#10P
See Section 9.4.1 for details of connectors applied to recommended cable.
See Appendix B for details of cables.

NOTE
If cable K12 is installed near the likes of a power cable, its shielding wire must be connected to a grounding plate. If an SPM or SPMC is installed near the CNC or another SPM or SPMC, however, it is not necessary to connect the shielding wire to a grounding plate.

Connector pin assignment

JA7A and JA7B

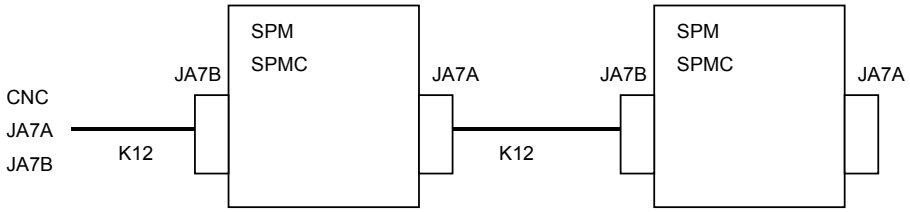


NOTE

1 The +5V pin is intended for optical link transmission based on the optical I/O link adapter. Do not use it when a metal cable is being used; otherwise, the +5 V line of the CNC will be short-circuited with that of the SPM or SPMC.

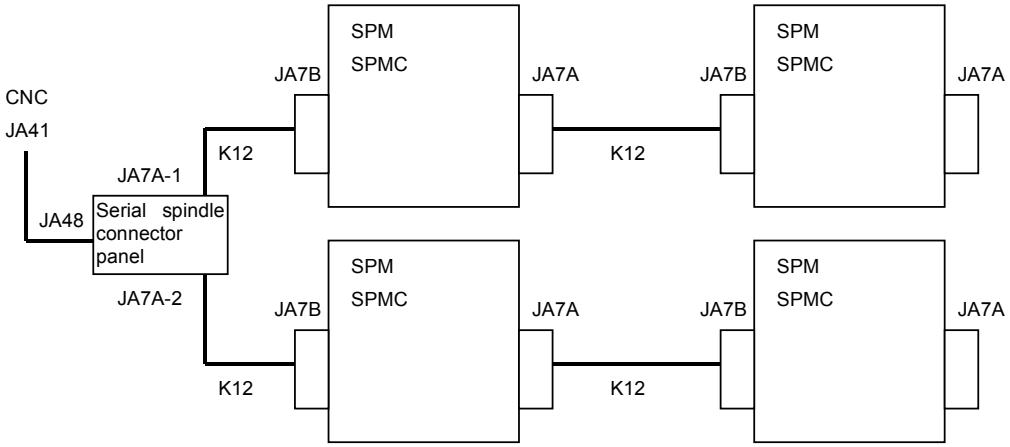
2 SPM or SPMC serial interface connection using an optical fiber cable
The use of an optical I/O link adapter with the SPM or SPMC serial interface extends the maximum allowable length of the optical fiber cable to up to 200 m.
Use optical fiber cables in the following cases:
- When the required cable length is 20 m or longer.
- When the cable must be extended across multiple cabinets, and the cabinets cannot be connected with a grounding wire 5.5 mm^2 or larger.
- The cable may be affected by noise, for example, if the cable is laid near a strong magnetic noise source like a welding machine or in parallel with a power line over a long distance.

- Electrical interface connection between two SPM or SMPC units



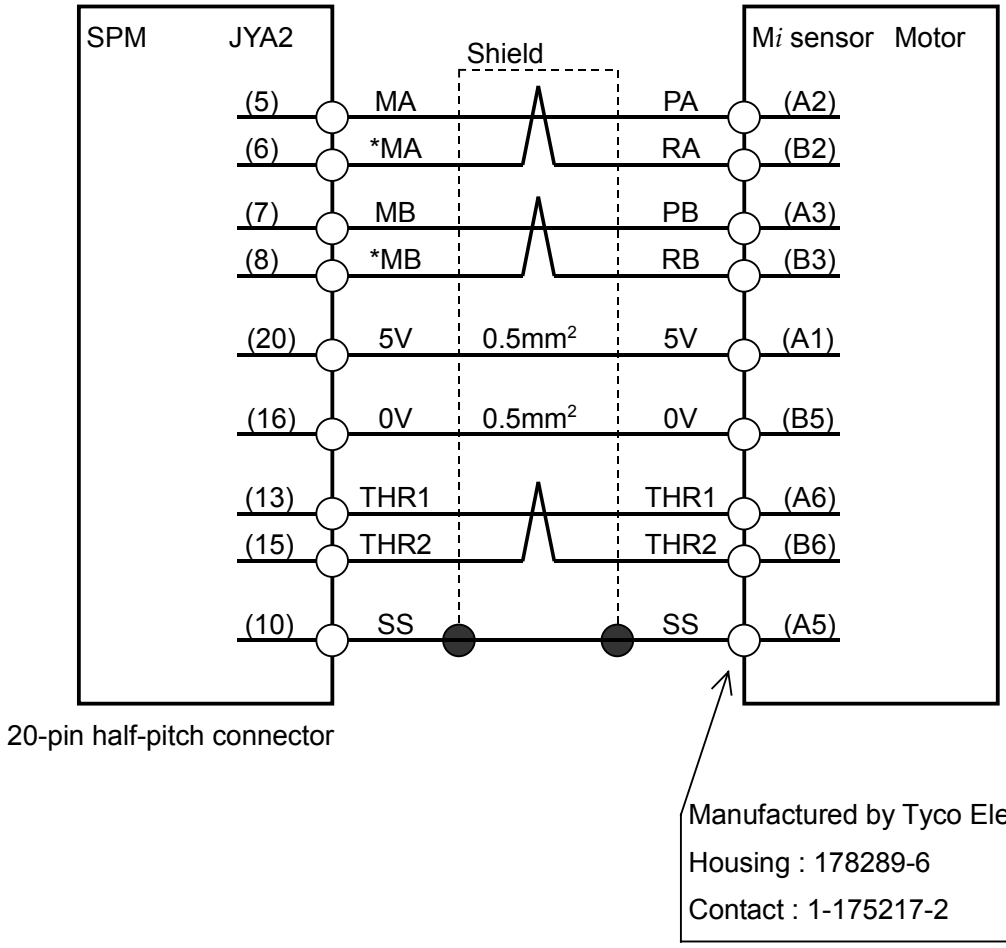
- Electrical interface connection between four SPM or SMPC units in *i* series

Refer to the applicable CNC Connection Manual (Hardware) for a detailed description of the serial spindle connector panel.



9.3.3.7 Details of cable K14

For the motor with M*i* sensor



Cable specification :

6 common shielded cable

(Three 0.18mm^2 twisted pairs + 0.5mm^2 wires)

Recommended cable conductor : A66L-0001-0368

See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE

If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.

- Connector pin assignment

JYA2

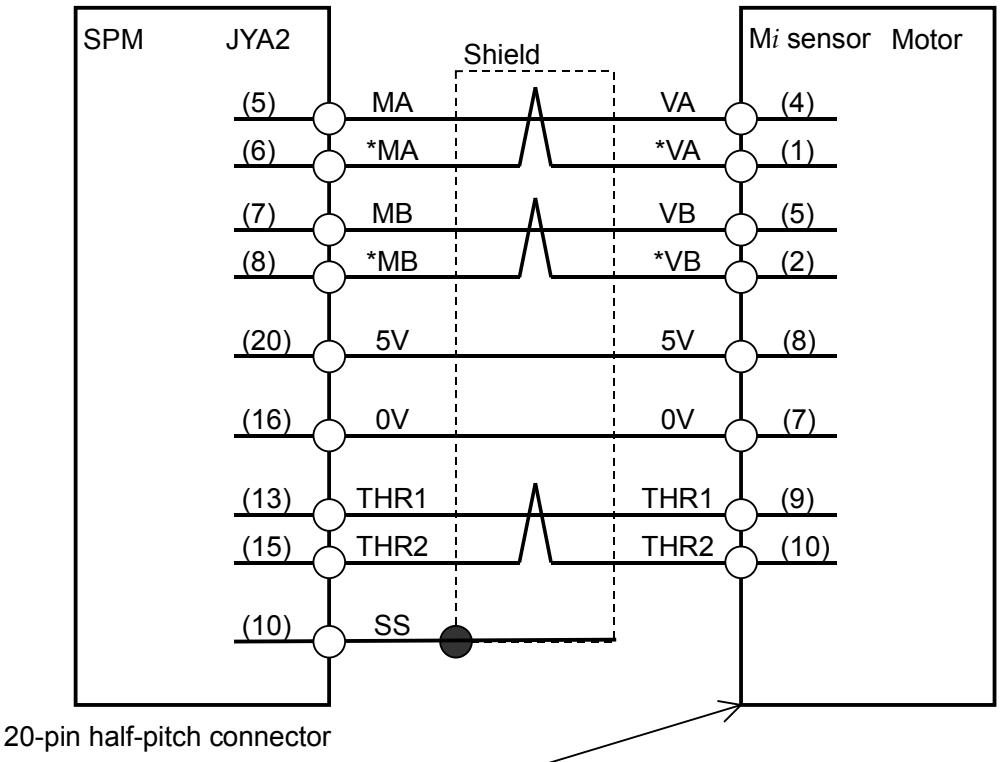
9	5V	10	SS	19	#	20	5V
7	MB	8	*MB	17	#	18	5V
5	MA	6	*MA	15	THR2	16	0V
3	#	4	#	13	THR1	14	0V
1	MZ	2	*MZ	11	#	12	0V

NOTE
Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

Pin arrangement of the connector (manufactured by Tyco Electronics AMP) on the motor side

A1	+5V	B1	
A2	PA	B2	RA
A3	PB	B3	RB
A4		B4	
A5	SS	B5	0V
A6	THR1	B6	THR2

For the α0.5*i* spindle motor with M*i* sensor



Housing (Japan Aviation Electronics Industry)
JN1xS10SL1 : Applicable sheath diameter ϕ5.7 to 7.3
JN1xS10SL2 : Applicable sheath diameter ϕ6.5 to 8.0
D : Straight plug
F : Angle plug
Contact (Japan Aviation Electronics Industry)
JN1-22-22S

Cable specification :
2 common shielded cable
(Three 0.2mm^2 twisted pairs + 0.3mm^2 wires)
Recommended cable conductor : A66L-0001-0482
See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE
Keep the electrical resistance across each of the 5V and 0V lines to within 5.7Ω.
Recommended cable : Up to 41m

Connector pin assignment

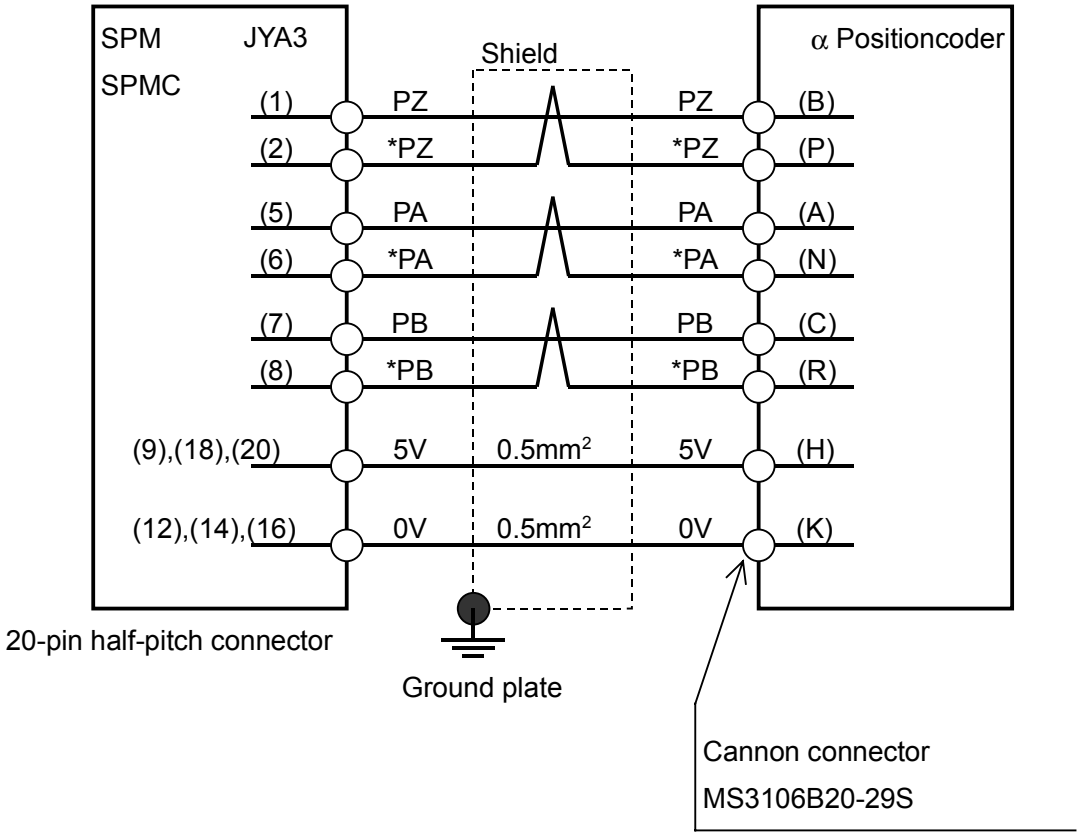
Pin arrangement of the connector (manufactured by Japan Aviation Electronics Industry) on the motor side

1	*VA
2	*VB
3	
4	VA
5	VB
6	
7	0V
8	5V
9	THR1
10	THR2

- Crimp tool specification
  A06B-6114-K201/JN1S
  (Applicable wire diameter : AWG#22 to #24, AWG#26 to #28)

- Connector kit specification
  A06B-6114-K200/S : Straight plug (including a contact)
  A06B-6114-K200/E : Elbow plug (including a contact)

9.3.3.8 Details of cable K16



Cable specification :

6 common shielded cable
(Three 0.18mm^2 twisted pairs + 0.5mm^2 wires)

Recommended cable conductor : A66L-0001-0286

See Section 9.4.1 for explanations about the JYA3-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE

If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.

Connector pin assignment

JYA3

9	5V	10	#	19	#	20	5V
7	PB	8	*PB	17	#	18	5V
5	PA	6	*PA	15	EXTSC	16	0V
3	#	4	#	13	SCCOM	14	0V
1	PZ	2	*PZ	11	24V	12	0V

NOTE
Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

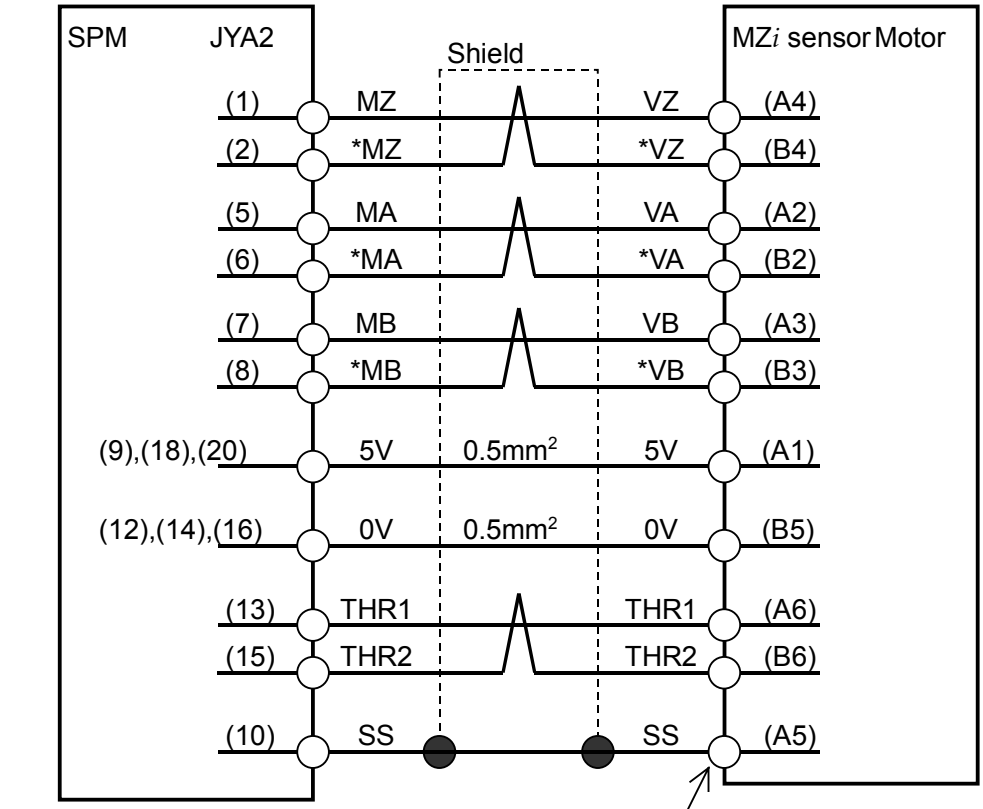
Pin arrangement of the cannon connector on the Positioncoder side

A	PA	B	PZ	C	PB
D		E		F	
G		H	+5V	J	
K	0V	L		M	
N	*PA	P	*PZ	R	*PB
S		T			

9.3.3.9 Details of cable K17

It is unnecessary to wire THR1 and THR2 if the BZ*i* sensor is used as a separate detector (connected to the connector JYA4).

For the motor with MZ*i* sensor



Cable specification :

6 common shielded cable
(Four 0.18mm^2 twisted pairs + 0.5mm^2 wires)

Recommended cable conductor : A66L-0001-0368

See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE

If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.

- Connector pin assignment

JYA2
See Subsection for cable K14.

JYA4

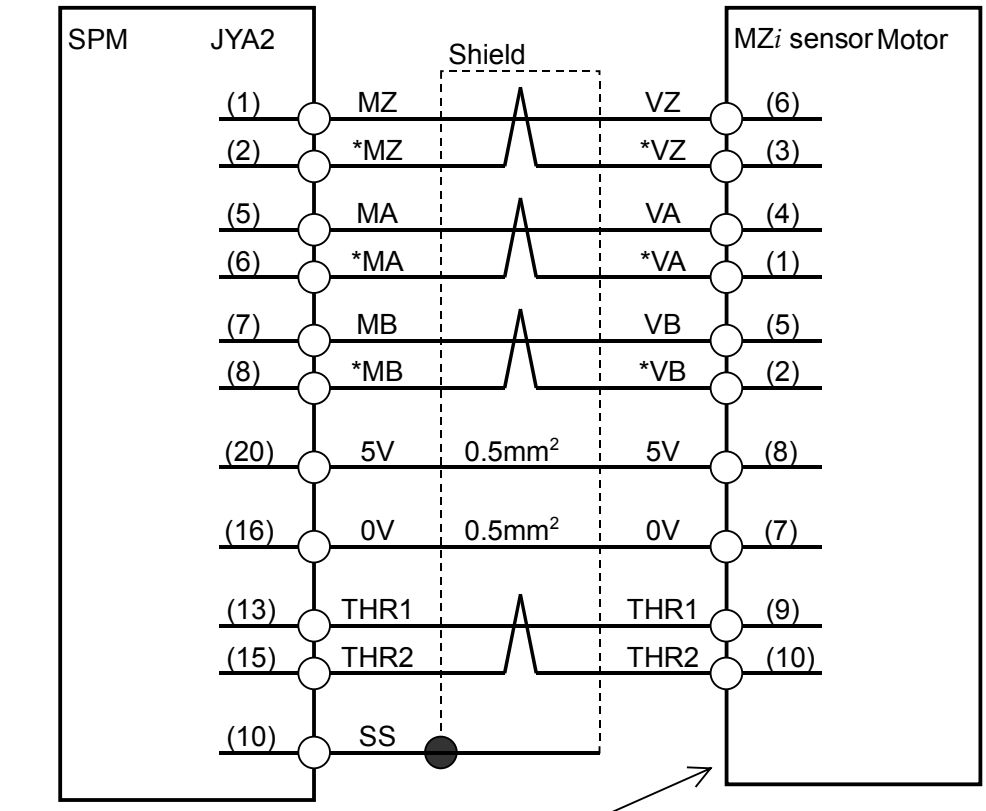
9	5V	10	SS	19	#	20	5V
7	MB	8	*MB	17	#	18	5V
5	MA	6	*MA	15		16	0V
3	#	4	#	13		14	0V
1	MZ	2	*MZ	11	#	12	0V

NOTE
Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

Pin arrangement of the connector (manufactured by Tyco Electronics AMP) on the motor side

A1	+5V	B1	
A2	VA	B2	*VA
A3	VB	B3	*VB
A4	VZ	B4	*VZ
A5	SS	B5	0V
A6	THR1	B6	THR2

For the α0.5*i* spindle motor with MZ*i* sensor



Housing (Japan Aviation Electronics Industry)
JN1xS10SL1 : Applicable sheath diameter ϕ5.7 to 7.3
JN1xS10SL2 : Applicable sheath diameter ϕ6.5 to 8.0
D : Straight plug
F : Angle plug
Contact (Japan Aviation Electronics Industry)
JN1-22-22S

Cable specification :
2 common shielded cable
(Four 0.2mm^2 twisted pairs + 0.3mm^2 wires)
Recommended cable conductor : A66L-0001-0482
See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE
Keep the electrical resistance across each of the 5V and 0V lines to within 4Ω.
Recommended cable : Up to 28m

- Connector pin assignment

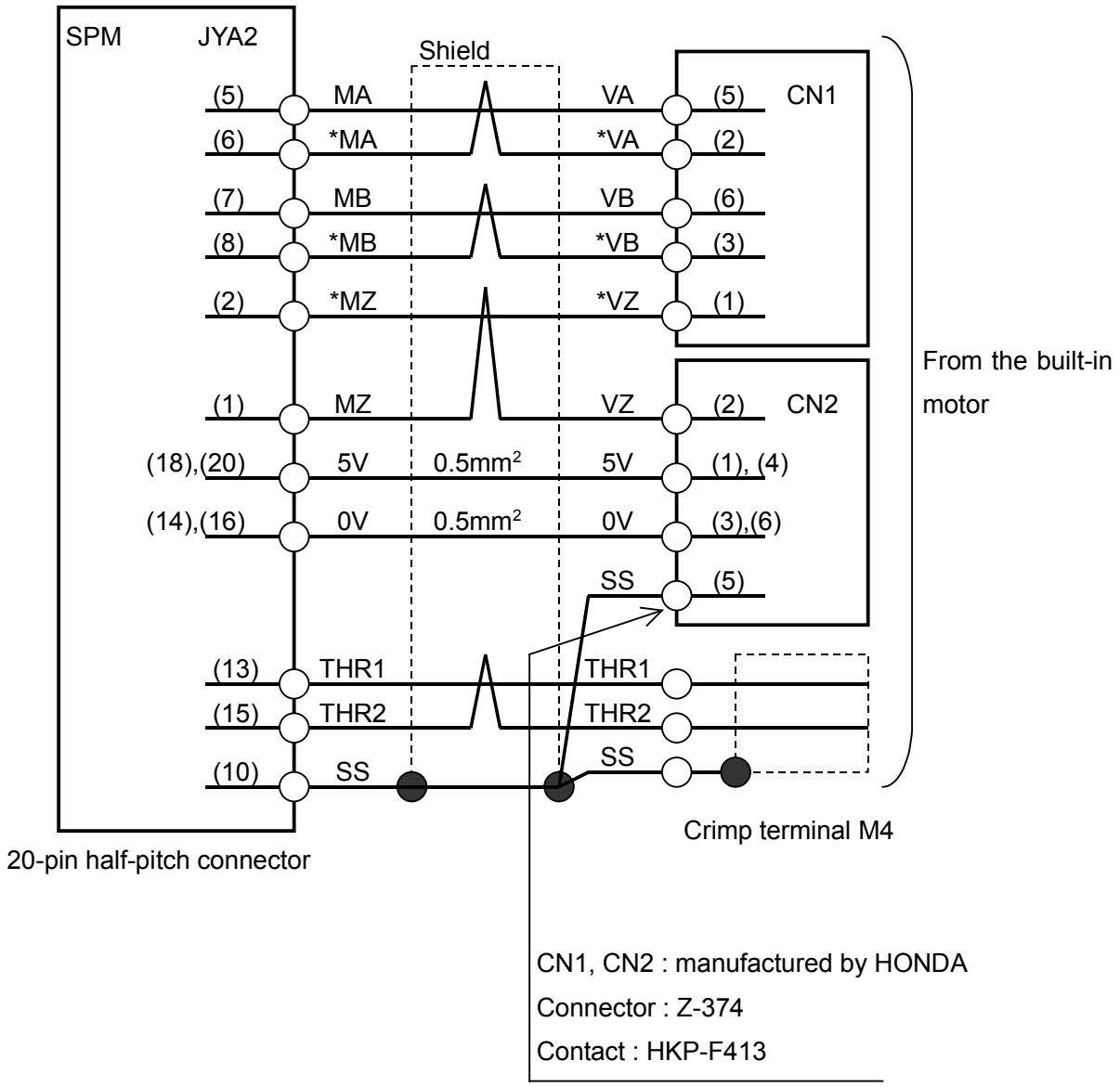
Pin arrangement of the connector (manufactured by Japan Aviation Electronics Industry) on the motor side

1	*VA
2	*VB
3	*VZ
4	VA
5	VB
6	VZ
7	0V
8	5V
9	THR1
10	THR2

- Crimp tool specification
  A06B-6114-K201/JN1S
  (Applicable wire diameter : AWG#22 to #24, AWG#26 to #28)

- Connector kit specification
  A06B-6114-K200/S : Straight plug (including a contact)
  A06B-6114-K200/E : Elbow plug (including a contact)

For the built-in spindle motor (BZ*i* sensor)



Cable specification :
6 common shielded cable
(Four 0.18mm^2 twisted pairs + 0.5mm^2 wires)
Recommended cable conductor : A66L-0001-0368
See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE
If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.

- Connector pin assignment

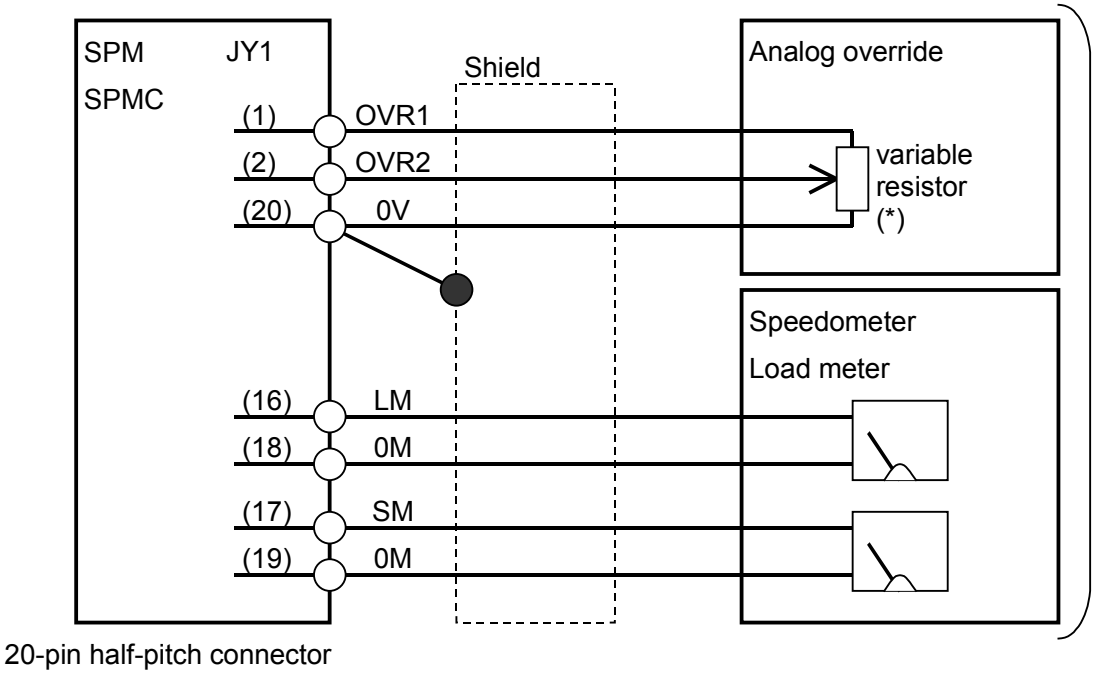
Pin arrangement of the connector CN1 (manufactured by Honda Tsushin Honda Kogyo Co., Ltd.) on the motor side

1	*VZ	4	
2	*VA	5	VA
3	*VB	6	VB

Pin arrangement of the connector CN2 (manufactured by Honda Tsushin Honda Kogyo Co., Ltd.) on the motor side

1	5V	4	5V
2	VZ	5	SS
3	0V	6	0V

9.3.3.10 Details of cable K33



Cable specification :
0.09mm^2 common shielded cable
Recommended cable conductor : A66L-0001-0284#10P
See Section 9.4.1 for explanations about the JYA1-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

NOTE
1 Select such an external resistance such that VR+R1 falls within the range between 2 kΩ and 10 kΩ .
2 The SPMC has no LM output. For the SM output, select the load meter or speedometer by parameter setting.

Connector pin assignment

JY1

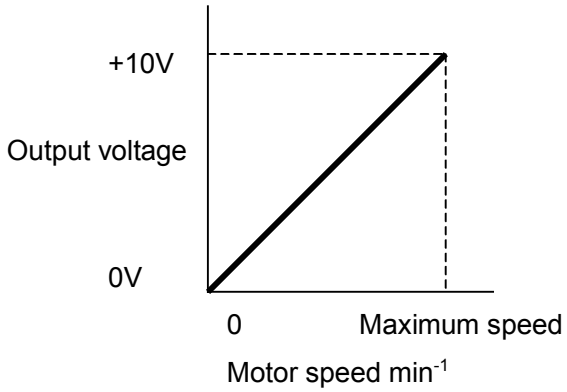
9	#	10	#	19	0M	20	0V
7	#	8	#	17	SM	18	0M
5	#	6	#	15	#	16	LM
3	#	4	#	13	#	14	#
1	OVR1	2	OVR2	11	#	12	#

NOTE
Pins indicated # are intended to input or output signals used on a spindle check board. Do not connect any other signal line to them.

Voltage signal for the speedometer (SM)

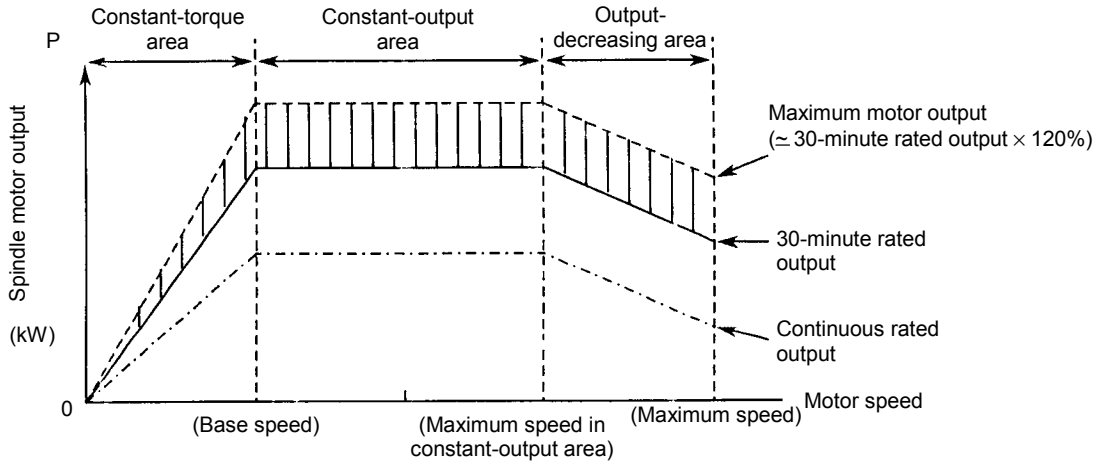
By externally connecting a tachometer, the speed of the spindle motor can be indicated. The voltage (DC) proportional to the speed is output, regardless of the rotation direction of the motor. At the maximum motor speed, +10 V is output.

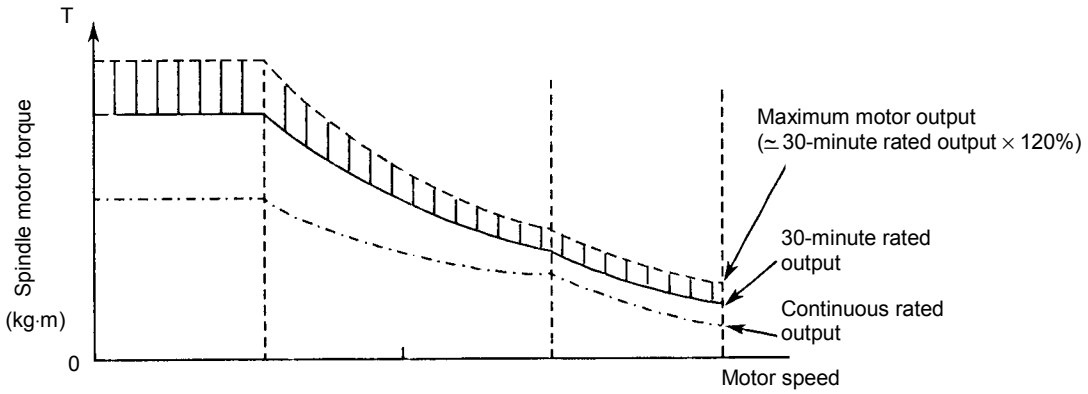
The output voltage of the speedometer in the forward direction and reverse direction is calibrated using a parameter. The precision is ±3% Max.

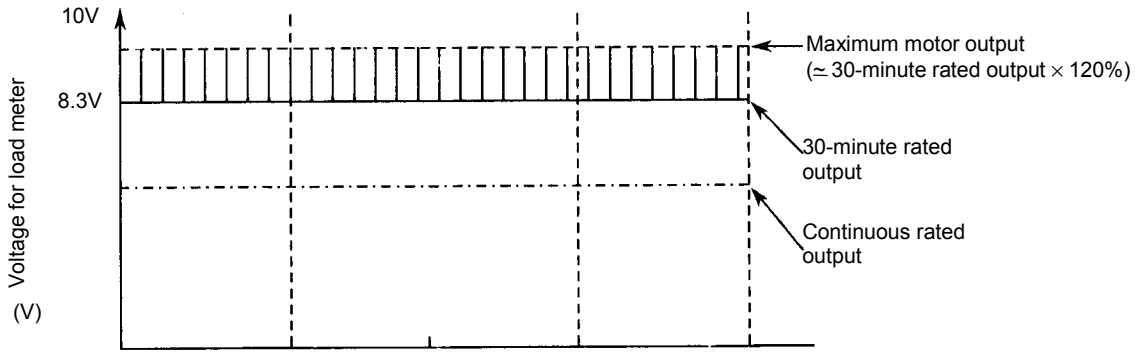


Voltage signal for the load meter (LM)

The load meter indicates a load ratio, that is, the ratio of load at the time of non-load rotation of the machine tool spindle or at the time of cutting to the maximum output of the spindle motor. At the rated input voltage, the relationships of spindle motor output, spindle motor torque, and voltage for the load meter with speed are as described below.



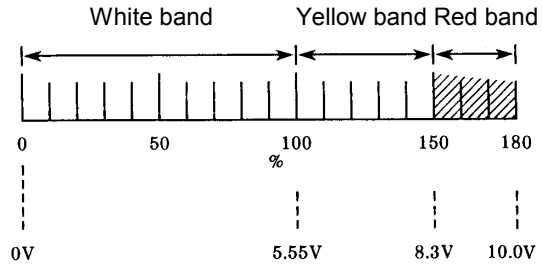
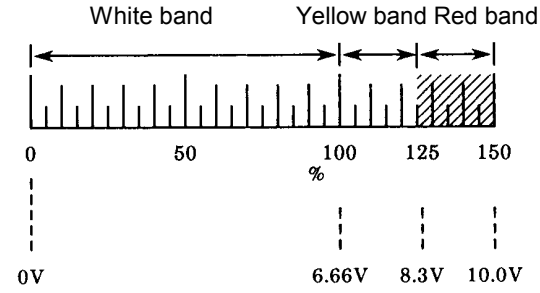
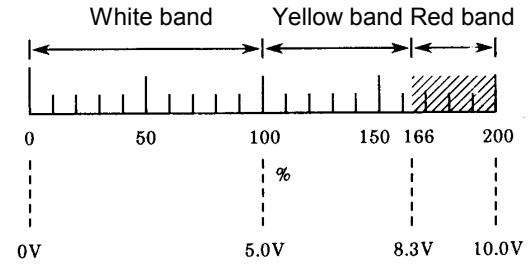
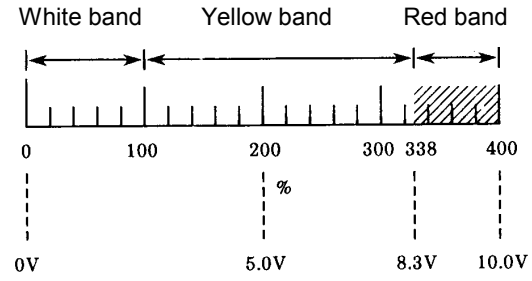
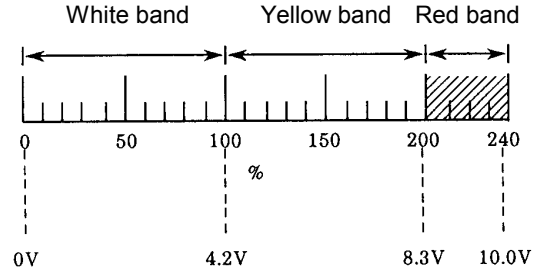




A load meter indication of 100% is provided for the continuous rating of the spindle motor. The table below indicates the relationships between typical spindle motor output values and load meter voltages. From the table below, it is considered that approximately five load meter indications are provided.

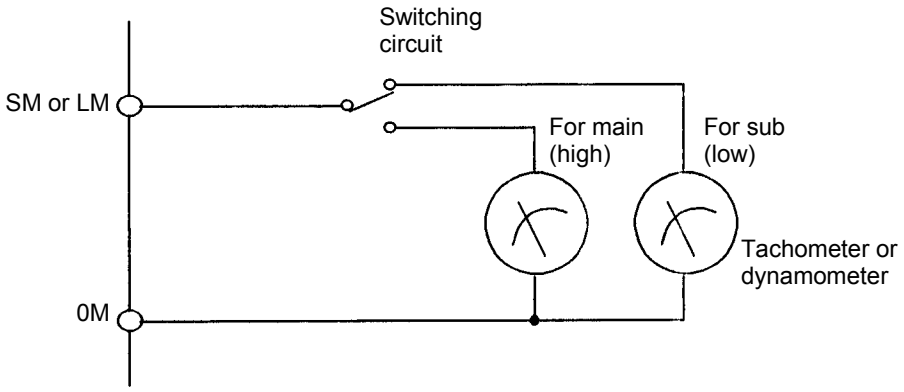
Motor model	Output (kW)	Voltage for load meter (V)(NOTE)	Ratio (%) with 100% indicated for continuous rating	Example of load meter	
				Type of load meter used	Ratio to full scale (%)
α0.5/10000*i*	0.55	4.2	100	E	100
	1.1	8.3	200		200
	1.32	10.0	240		240
α1/10000*i*	1.5	5.7	100	A	102.2
	2.2	8.3	147		150
	2.64	10.0	176		180
α1.5/10000*i*	1.1	2.5	100	D	100
	3.7	8.4	338		338
	4.4	10.0	400		400
α2/10000*i*	2.2	5.0	100	C	101
	3.7	8.3	166		166
	4.4	10.0	200		200
α3/10000*i*	3.7	5.6	100	A	100.8
	5.5	8.3	148		150
	6.6	10.0	178		180
α6/10000*i*	5.5	6.1	100	A	109.8
	7.5	8.3	136		150
	9.0	10.0	164		180
α8/8000*i*	7.5	5.7	100	A	102.6
	11.0	8.3	146		150
	13.2	10.0	175		180
α12/7000*i*	11	6.1	100	A	109.8
	15	8.3	136		150
	18	10.0	164		180
α15/7000*i*	15	6.7	100	B	100.5
	18.5	8.3	124		125
	22.2	10.0	149		150
α18/7000*i*	18.5	7.0	100	B	105
	22.0	8.3	118		125
	26.4	10.0	142		150
α22/7000*i*	22.0	7.0	100	B	105
	26.0	8.3	118		125
	31.2	10.0	142		150
α30/5000*i*	30.0	6.7	100	B	105.5
	37.0	8.3	124		125
	44.4	10.0	149		150
α40/6000*i*	37.0	6.8	100	B	103
	45.0	8.3	122		125
	54.0	10.0	146		150
α50/4500*i*	45.0	6.8	100	B	103
	55.0	8.3	122		125
	66.0	10.0	146		150

NOTE
The precision of load meter voltage depends on the used speed and input voltage. The maximum error is about ±15%.

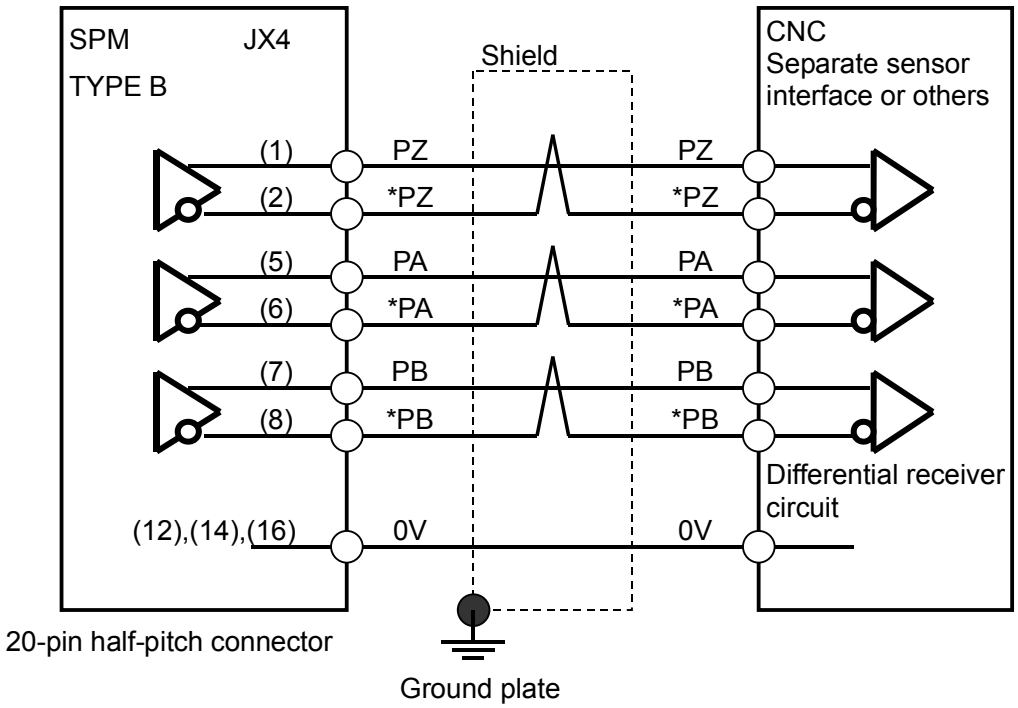
Type	Type	Scale	
A	Color classification Indication Correspondence to voltage		
B	Color classification Indication Correspondence to voltage		
C	Color classification Indication Correspondence to voltage		
D	Color classification Indication Correspondence to voltage		
E	Color classification Indication Correspondence to voltage		

Indication for spindle switching and output switching

The speed indication voltage and dynamometer indication voltage may vary between the main spindle and sub-spindle in spindle switching and between the high winding and low winding in output switching. In such a case, switch the tachometer and dynamometer as shown below.



9.3.3.11 Details of cable K36



Cable specification: 0.09 mm^2 twisted pair with common shielded
Recommended cable (wire only): A66L-0001-0284#10P
See Section 9.4.1 for details of connectors applied to recommended cable.
See Appendix B for details of cables.

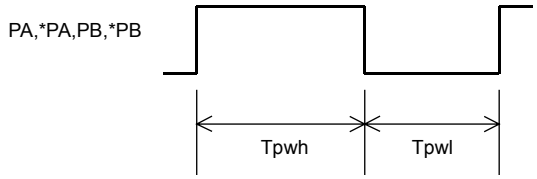
Specification of position coder signal output

Item	Specification
SPM input sensor	α position coder α position coder S MZ*i* sensor BZ*i* sensor CZ*i* sensor
Output signals PA, *PA, PB, *PB	1024 pulses/rotation (*1)
Output signals PZ, *PZ	1 pulse/rotation
Output signal level	Differential driver signal (RS422 compatible)

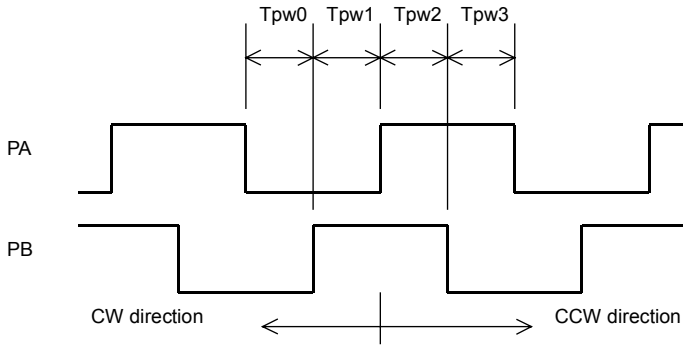
*1 A resolution of 4096 pulses/rotation can be obtained by counting the edges of phases A and B (× 4 circuit).

Phase A/B signal

Width of phase A/B signal



Phase difference between phase A and phase B



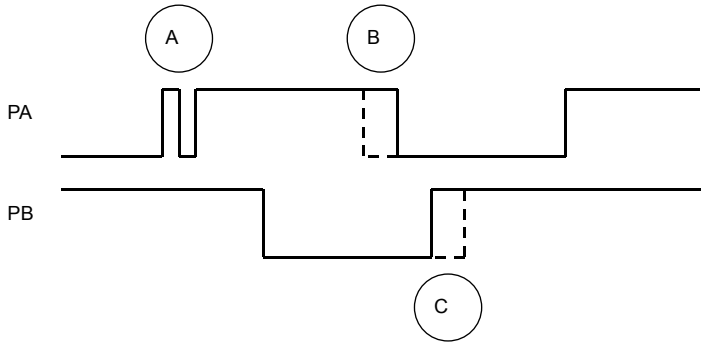
*PA and *PB represent the negative logic signals of PA and PB, respectively.

Symbol	Specification	Remark
Tpwh, Tpwl	Min 636ns	Including a maximum of driver rising/falling delay time skew (30 ns)
Tpw0,1,2,3	Min 636ns	

This specification does not include the effect of the cable capacity and the skew due to delay on the receiver side.

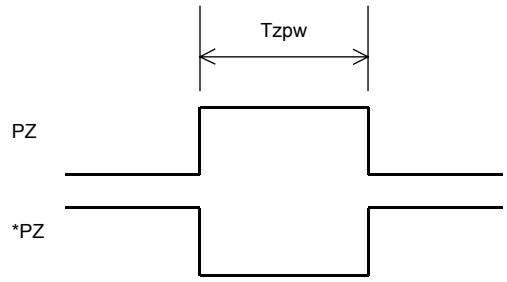
⚠ CAUTION

As shown in state A below, a waveform may be distorted at the edge of phase A or B.
In addition, the edge may be encountered too late or too early as shown in state B or C. Even in these states, the minimum time is defined according to the specifications described on the previous page, such as the pulse width and the difference between phase A and phase B.



Phase Z signal

Width of phase Z signal

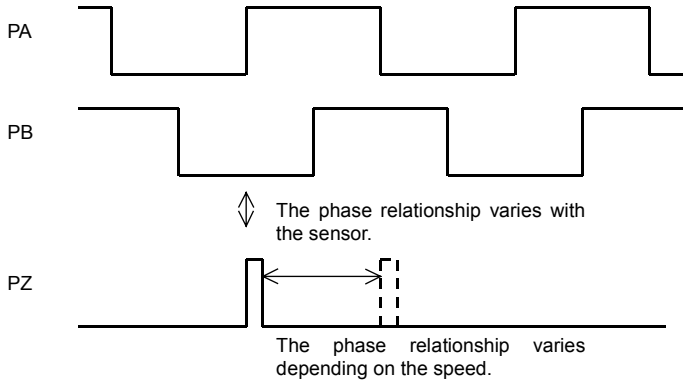


Symbol	Specification
Tzpw	The minimum width is 1/4096 of one rotation.

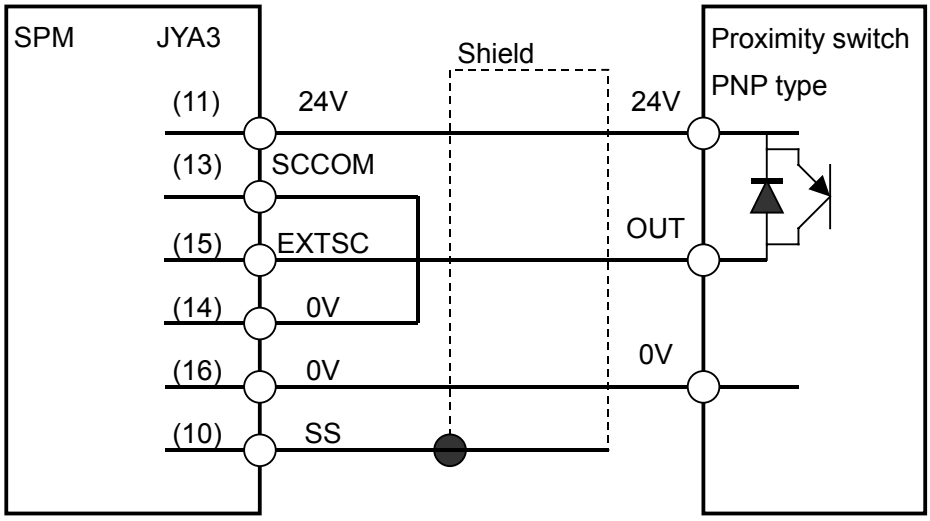
* Edge distortion of signal Z
Note that the edge of signal Z may be distorted.

* Phase relationship between the phase Z signal and the phase A/B signal

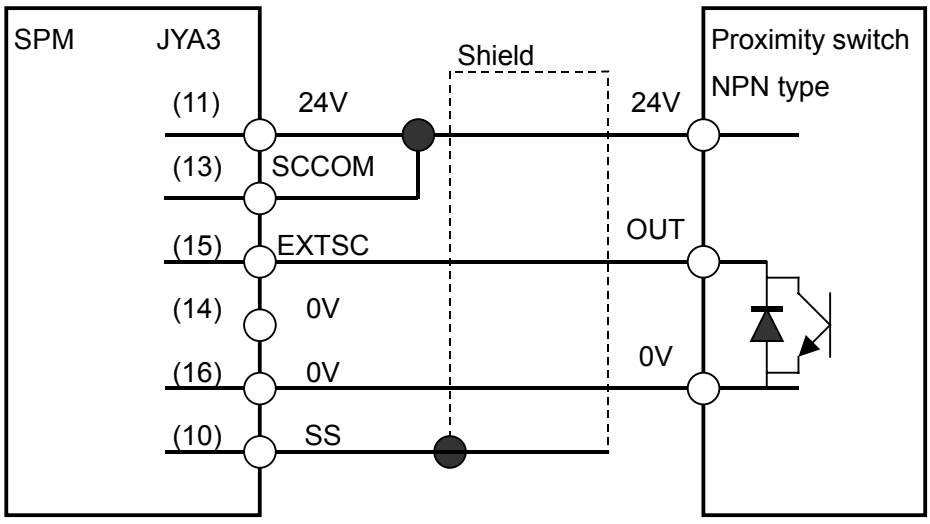
- The phase relationship between the phase Z signal and the phase A/B signal varies with the sensor.
- When the speed changes, the phase relationship between the phase Z signal and the phase A/B signal may vary. The range of variation is approximately (1 p/5000 min-1.



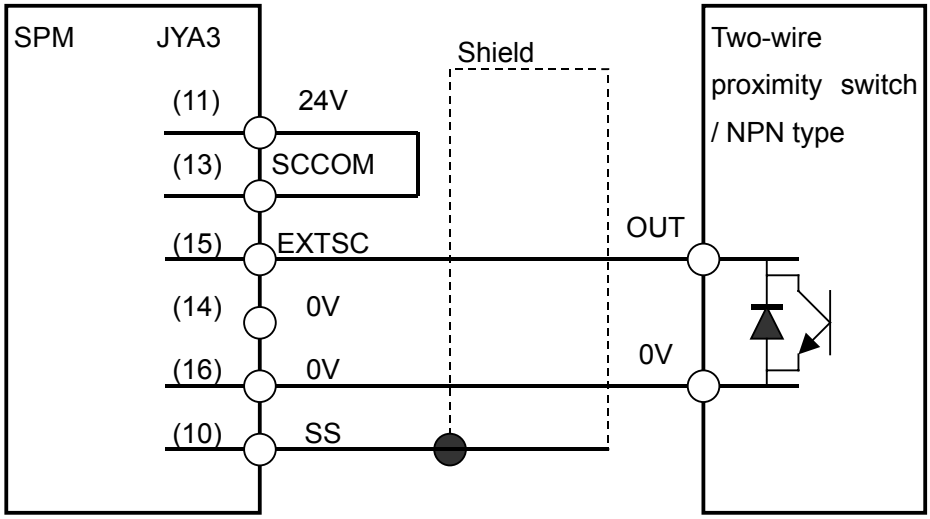
9.3.3.12 Details of cable K71



20-pin half-pitch connector



20-pin half-pitch connector



20-pin half-pitch connector

Cable specification :

0.09mm^2 common shielded cable

Recommended cable conductor : A66L-0001-0284#10P

See Section 9.4.1 for explanations about the JYA3-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

Connector pin assignment

See Subsection “- Connector pin assignment” for the K16.

External one-rotation signal switch (proximity switch)

Use an external one-rotation signal switch (proximity switch) that satisfies the specifications indicated below.

(a) DC two-wire proximity switch

Item	Specification
Supply voltage	24 VDC ±1.5 V (24 VDC is fed from the spindle amplifier module.)
Response frequency	400 Hz or higher
Load current	16 mA or higher
Residual voltage	4 V or higher
Supply (leakage) current	1.5 mA or lower

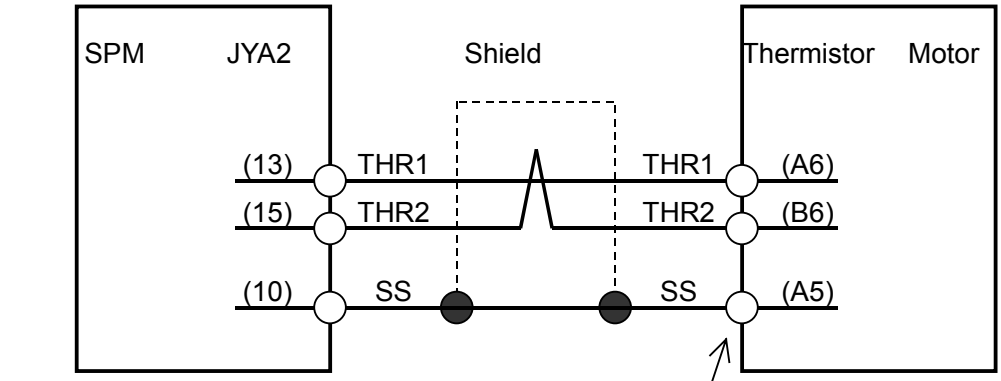
(b) DC three-wire proximity switch

Item	Specification
Supply voltage	24 VDC ±1.5 V (24 VDC is fed from the spindle amplifier module.)
Response frequency	400 Hz or higher
Load current	16 mA or higher
Residual voltage	4 V or higher
Supply current	50mA or lower

NOTE

The location where a proximity switch signal occurs depends on the temperature. So, consider the ambient temperature when selecting a proximity switch.

9.3.3.13 Details of cable K79

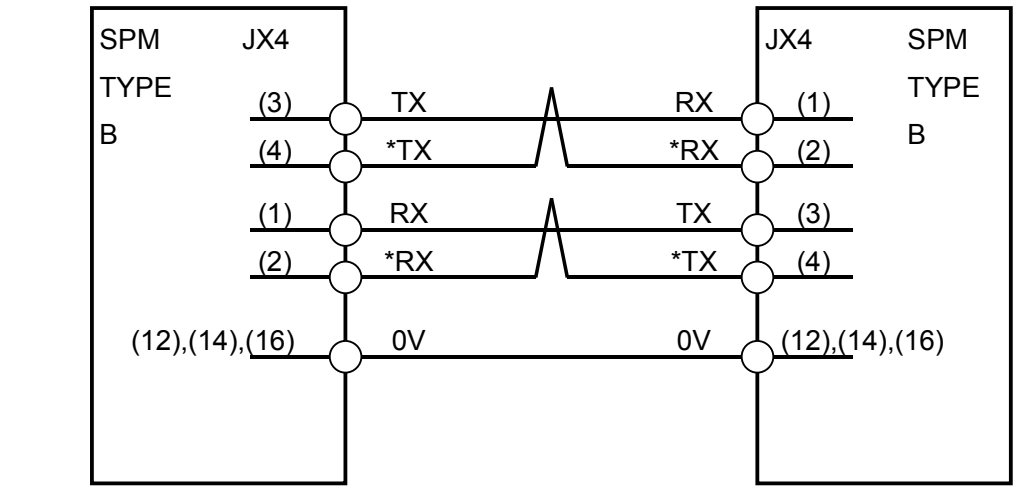


Manufactured by tyco Electronics AMP
Housing : 178289-6
Contact : 1-175217-2

Cable specification :
0.18 mm^2 twisted pair with common shielded
Recommended cable conductor : A66L-0001-0368
See Section 9.4.1 for explanations about the JYA3-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

9.3.3.14 Details of cable K88

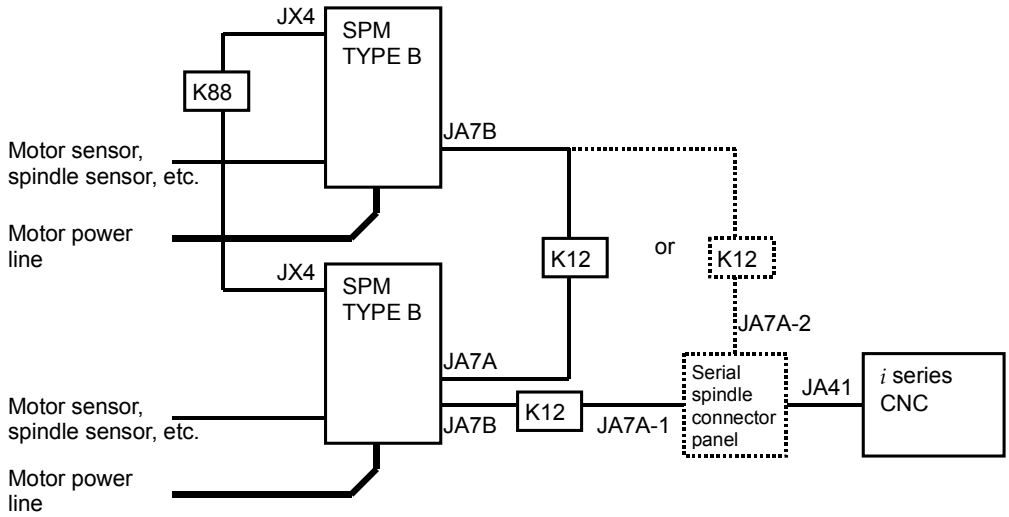
This cable is required when using the spindle EGB function.



20-pin half-pitch connector 20-pin half-pitch connector

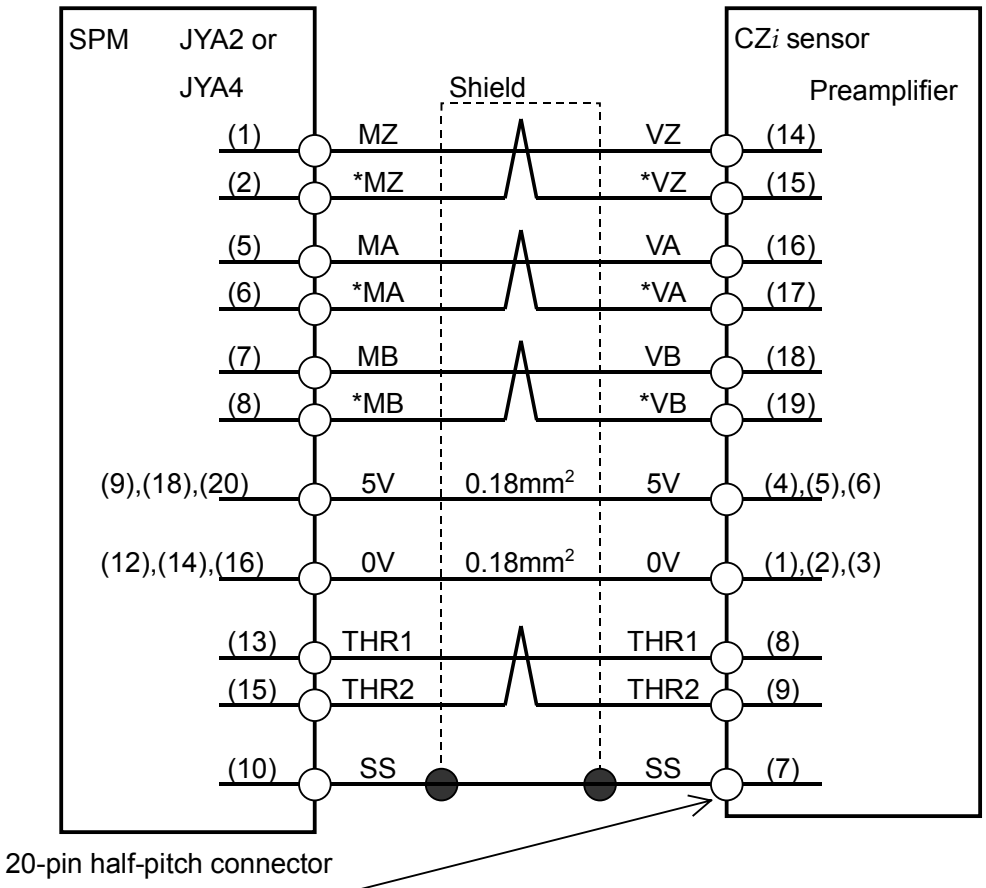
Cable specification: 0.09 mm^2 twisted pair with common shielded
Recommended cable (wire only): A66L-0001-0284#10P
See Section 9.4.1 for details of connectors applied to recommended cable.
See Appendix B for details of cables.

NOTE
1 The length of cable K88 must be 3 m or shorter and run within the same cabinet.
2 The SPMs that use this connection must be connected to the same CNC as shown below.



9.3.3.15 Details of cable K89

When the CZ*i* sensor is used as a separate detector (connected to connector JYA4), wiring for THR1 and THR2 is not required.

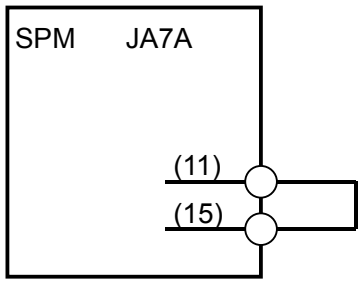


Manufactured by Hirose Electric Co., Ltd.
Crimp type
Crimping pin : HR22-SC-122 (15 pins are required for one connector)
Housing : HR22-12WTPA-20SC
Crimping tool : HR22-TA-2428HC (Hirose Electric Co., Ltd.)
Soldering type
HR22-12WTPA-20S

Cable specification :
6 common shielded cable
(Four 0.18mm^2 twisted pairs + 0.18mm^2 wires)
Recommended cable conductor : A66L-0001-0367
See Section 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable. See Appendix B, "About Cable Conductors," for detailed explanations about the cable.

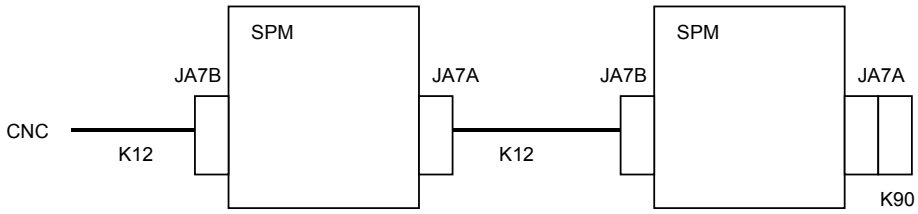
9.3.3.16 Details of cable K90

Only when the dual check safety function is used, this connection is required for the second spindle.



20-pin half-pitch connector

When the dual check safety function is used, connector K90 must be connected to JA7A of the second spindle.



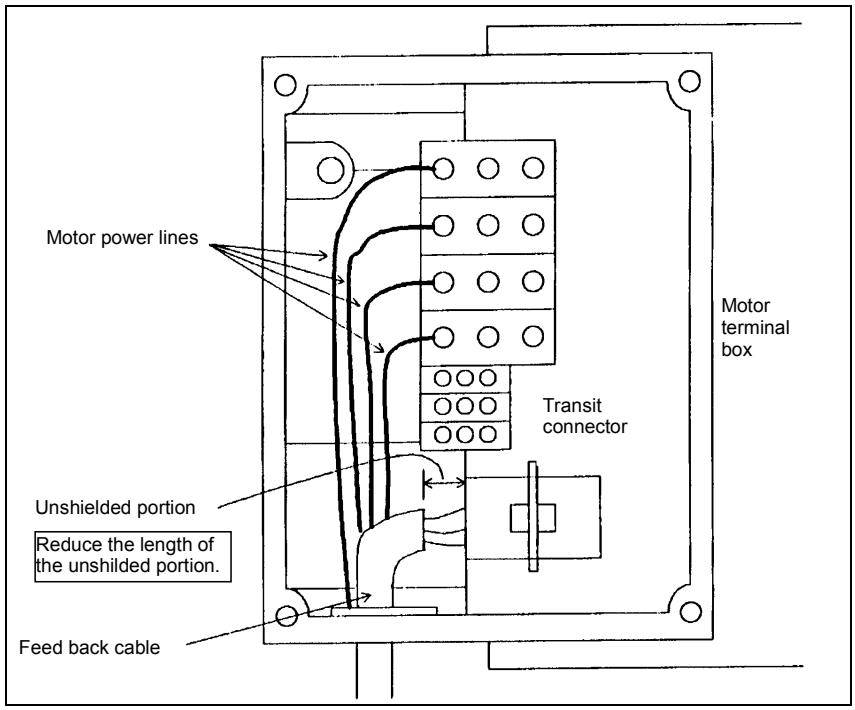
9.3.3.17 Spindle Motor Feedback Cable Connection

The connector of the feedback cable connected to the spindle motor may have the following problems, depending on the wiring in the motor terminal box (transit box for the built-in motor):

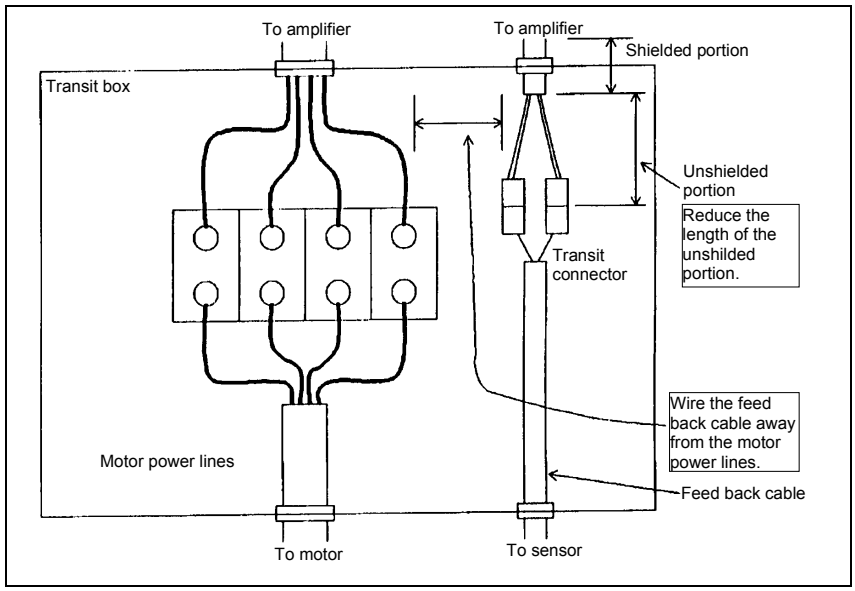
- Variations in low speed become large.
- The alarm lamp indicating a discontinued sensor signal lights improperly.
- The alarm lamp indicating a missing sensor signal position pulse lights improperly (for the M*Zi* and B*Zi* sensors).

Give consideration to wiring so that minimum lengths of non-shielded portions are provided for the connector connecting the cable for SPM and signals output from the spindle motor. (See the examples below.)

(1) Sample wiring in the motor terminal box



(2) Sample wiring in the relay box for the built-in motor



9.4 DETAILS OF CONNECTORS

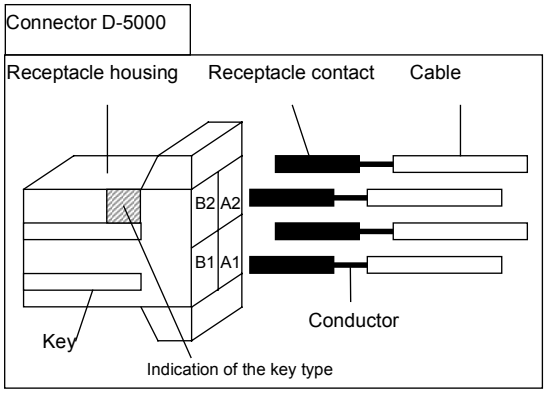
9.4.1 20-Pin Half-Pitch Connectors

The following table lists the 20-pin half-pitch connectors used for the αi series servo amplifier and the recommended cables for these connectors.
Use connectors that match the recommended cables specified on the applicable connection diagram in detail.

Recommended-cable specification	Applicable connector	Connector model number	Housing model number	Connector + housing
A66L-0001-0284#10P	Crimp type	Hirose Electric Co., Ltd. FI30-20S	Sideways cable slot type FI-20-CVS2	Sideways cable slot type FI30-20S-CVS2
		Honda Tsushin Kogyo Co., Ltd. PCR-E20FA	PCR-V20LA	
	Soldering type	Hirose Electric Co., Ltd. FI40B-20S	Sideways cable slot type FI-20-CVS2	Sideways cable slot type FI40B-20S-CVS2
		Honda Tsushin Kogyo Co., Ltd. PCR-E20FS	PCR-V20LA	
A66L-0001-0286 A66L-0001-0460 A66L-0001-0462 A66L-0001-0481 A66L-0001-0491	Soldering type Note that this connector does not have pin No. 11, 13, 15, 17, or 19.	Hirose Electric Co., Ltd. FI40B-2015S	Sideways cable slot type FI-2015-CVS	Sideways cable slot type FI40B-2015S-CVS
A66L-0001-0368	Soldering type	Hirose Electric Co., Ltd. FI40B-20S	Sideways cable slot type FI-20-CVS5	Sideways cable slot type FI40B-20S-CVS5

9.4.2 Tyco Electronics AMP D-5000 Series Connector

The αi series uses the D-5000 series connector (manufactured by Tyco Electronics AMP) for the motor power cable.
The connector is provided with three keys that assure it is inserted in the correct direction. In addition, four types of receptacle contacts are available, from which the user can select the suitable one depending on the amount of current to use (size of the conductor).
Connectors and tools can be ordered directly from Tyco Electronics AMP. FANUC also furnishes options. For details, see Subsection 3.1.3.3, "Connectors."



Receptacle housing

There are three different key types for the receptacle housing. Be sure to select the receptacle housing of the key type that matches the servo axis you use.

Receptacle housing model number	Specification of the key	Applicable servo amplifier
1-917807-2	XX	PSM-5.5*i*, SPM-2.2*i*, SPM-5.5*i* SVM1, SVM2(L), SVM3(L)
3-917807-2	XY	SVM2(M), SVM3(M)
2-917807-2	YY	SVM3(N)

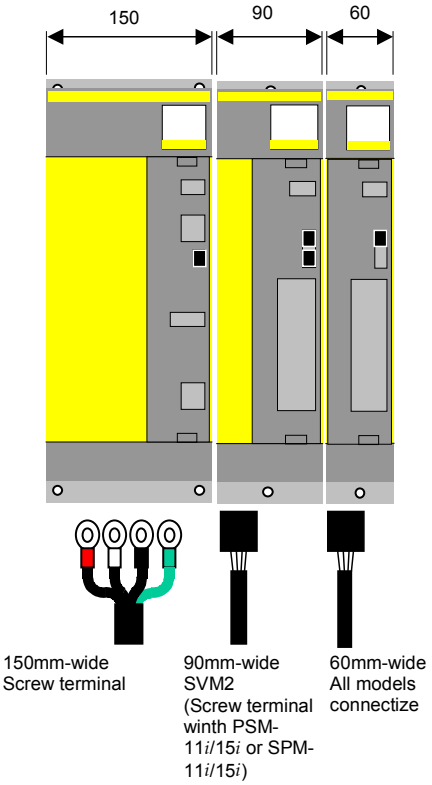
(Reference)

There is a cable-end connectors which are inserted no matter what key is used. Contact the connector manufacturer (Tyco Electronics AMP) for details.

Receptacle contact

Four receptacle contact types are available, so as to support different conductor diameters. Be sure to select the receptacle contact (silver plating) that matches the servo axis you use.

Rectangle contact model number		Conductor size (mm^2)	Conductor size AWG	Insulation outer diameter (mm)	Manual tool model number
SS size	1318986-6	0.50 – 1.42	20/18	1.08-3.23	1366656-1
S size	316040-6	1.23 – 2.27	16/14	3.0-3.8	234170-1
M size	316041-6	3.08 – 5.50	12/10	4.0-5.2	234171-1
L size	1318697-6	7.27 – 8.92	8	4.9-7.8	1366044-1



Applied	Connector key
PSM-5.5i SPM-2.2i SPM-5.5i SVM1 SVM2 (L-axis) SVM3 (L-axis)	XX 1-917807-2
SVM2 (M-axis) SVM3 (M-axis)	XY 3-917807-2
SVM3 (N-axis)	YY 2-917807-2

Contact
SS 1318986-6
S 316040-6
M 316041-6
L 1318697-6

10 SPINDLE-RELATED OPTIONS

10.1 SPINDLE ORIENTATION

Sensor

Sensor	Description
α position coder	Connected to the spindle on a 1:1 basis (directly connected by using a gear or timing belt)
α position coder S	Connected to the spindle on a 1:1 basis (directly connected by using a gear or timing belt)
MZ*i* sensor BZ*i* sensot CZ*i* sensot	Directly connected to the spindle on a 1:1 basis
M*i* sensor Proximity switch	Installed on the spindle. The motor is connected with the spindle by using a gear.

Detection unit and repetitive positioning precision

Sensor	Number of feedback signals	Detection unit	Repetitive positioning precision(NOTE)
α position coder	1024p/rev	0.088°	±0.2°
α position coder S	1024p/rev	0.088°	±0.2°
MZ*i* sensor, BZ*i* sensor	128λ/rev to 512λ/rev	0.088°	±0.2°
CZ*i* sensor	512λ/rev to 1024λ/rev	0.088°	±0.2°
M*i* sensor + proximity switch	128λ/rev to 512λ/rev	0.088°	±0.2° When the gear ratio is 1:1. An error due to gear backlash is excluded.

NOTE
1 The error factors on the machine side are excluded.
2 With the M*i* sensor plus proximity switch method, stop position control is exercised using the M*i* sensor built into the motor, with the proximity switch installed on the spindle used as the reference. So, pay attention to the following mechanical error factors:
- When the gear ratio is higher than 1:1 (on the spindle acceleration side), repetitive positioning precision decreases.
- The stop position can move by a gear backlash.

10.2 POWER LINE SWITCH UNIT

10.2.1 Overview

The switch unit is installed between a spindle amplifier module and spindle motor to exercise spindle switch control and output switch control.

(1) Power switching from one motor to another (spindle switch control)
(2) Power line switching between the two different windings of a motor (output switch control)

NOTE
This switch function cannot be used with the αC*i* series.

10.2.2 Specification

Magnetic contactor specification

FANUC ordering drawing number	A58L-0001-0306 Fuji Electric (SC-3N)		A58L-0001-0312 Fuji Electric (SC-6N)	
Rated voltage	220V		220V	
Rated current	65A		125A	
Closing/breaking current capacity	Closing	780A	Closing	1500A
	Breaking	650A	Breaking	1250A
Open/close frequency	1200 times/hour or more			
Life	Mechanical	5,000,000 times or more		
	Electrical	1,000,000 times or more		
Rating of operating electromagnetic coil	200V/220V 15% to +10% 50/60Hz ±1Hz			
Target spindle amplifier module	Up to SPM-15*i*		Up to SPM-30*i*	

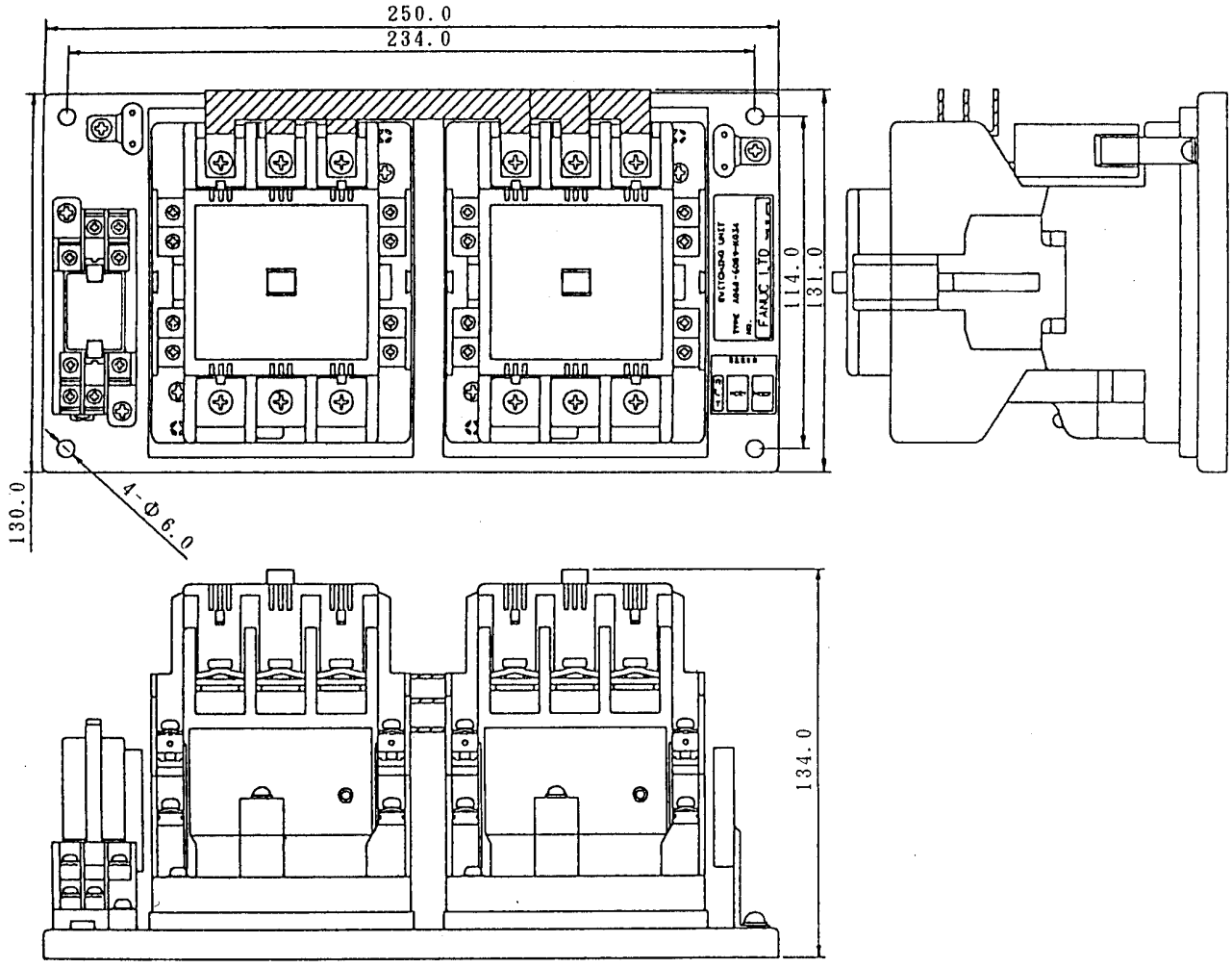
Relay specification

FANUC ordering drawing number	A58L-0001-0307 OMRON (Model LY2-D)
Rated voltage	24V ±10%
Rated current	36.9mA

10.2.3 Outside and Mounting Dimension Diagrams

Outside and mounting dimension diagrams of the switch unit for spindle switch control and output switch control (Y/Y connection)

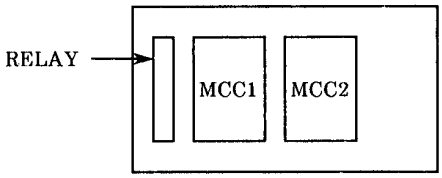
Up to SPM-15*i*



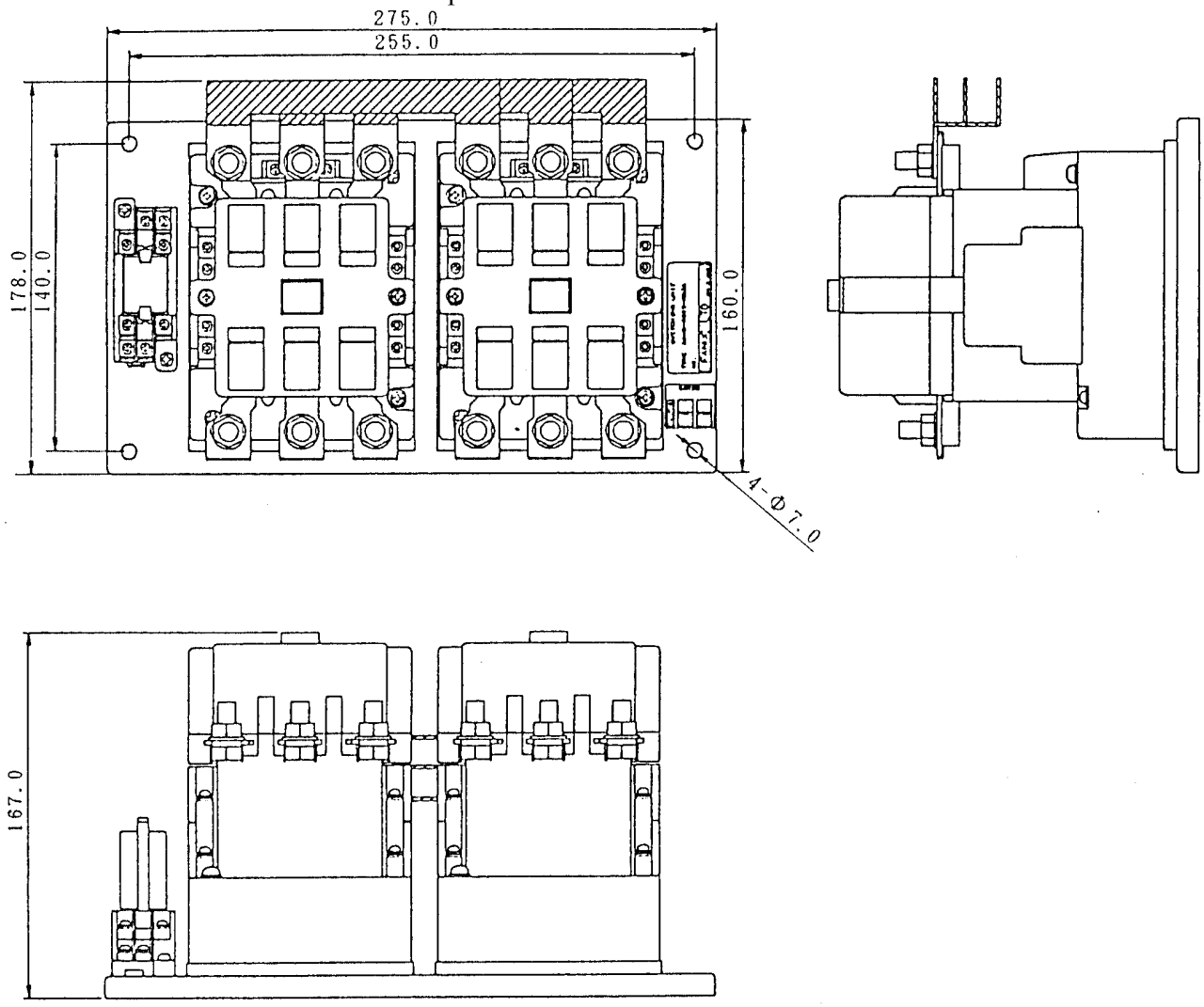
A06B-6078-K034

Fig. A

Mounting diagram



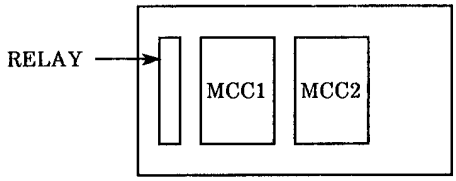
Up to SPM-30*i*



A06B-6078-K036

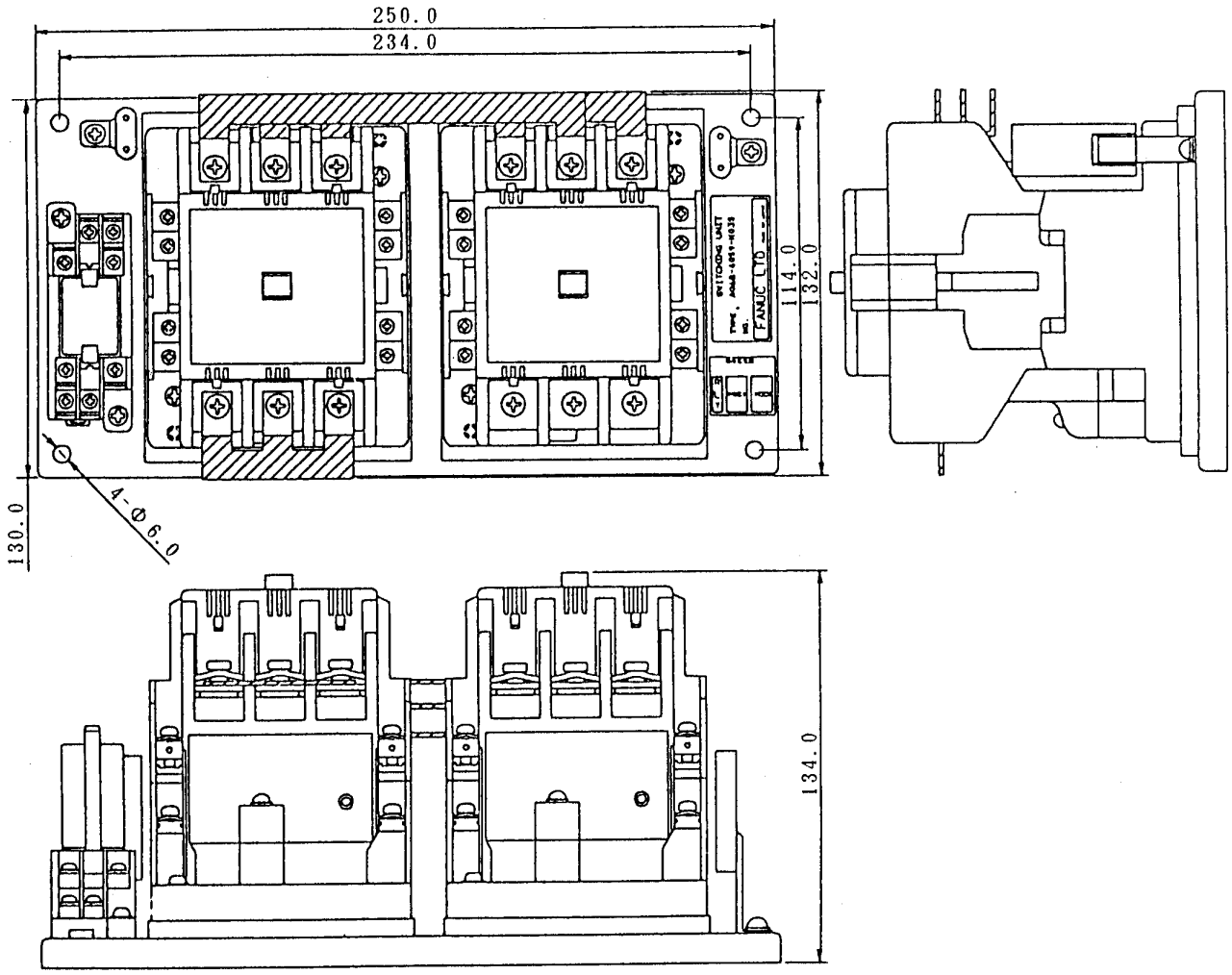
Fig. B

Mounting diagram



Outside and mounting dimension diagrams of the switch unit for output switch control (Y/Δ connection)

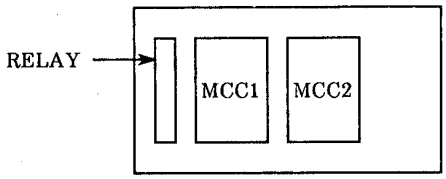
Up to SPM-15*i*



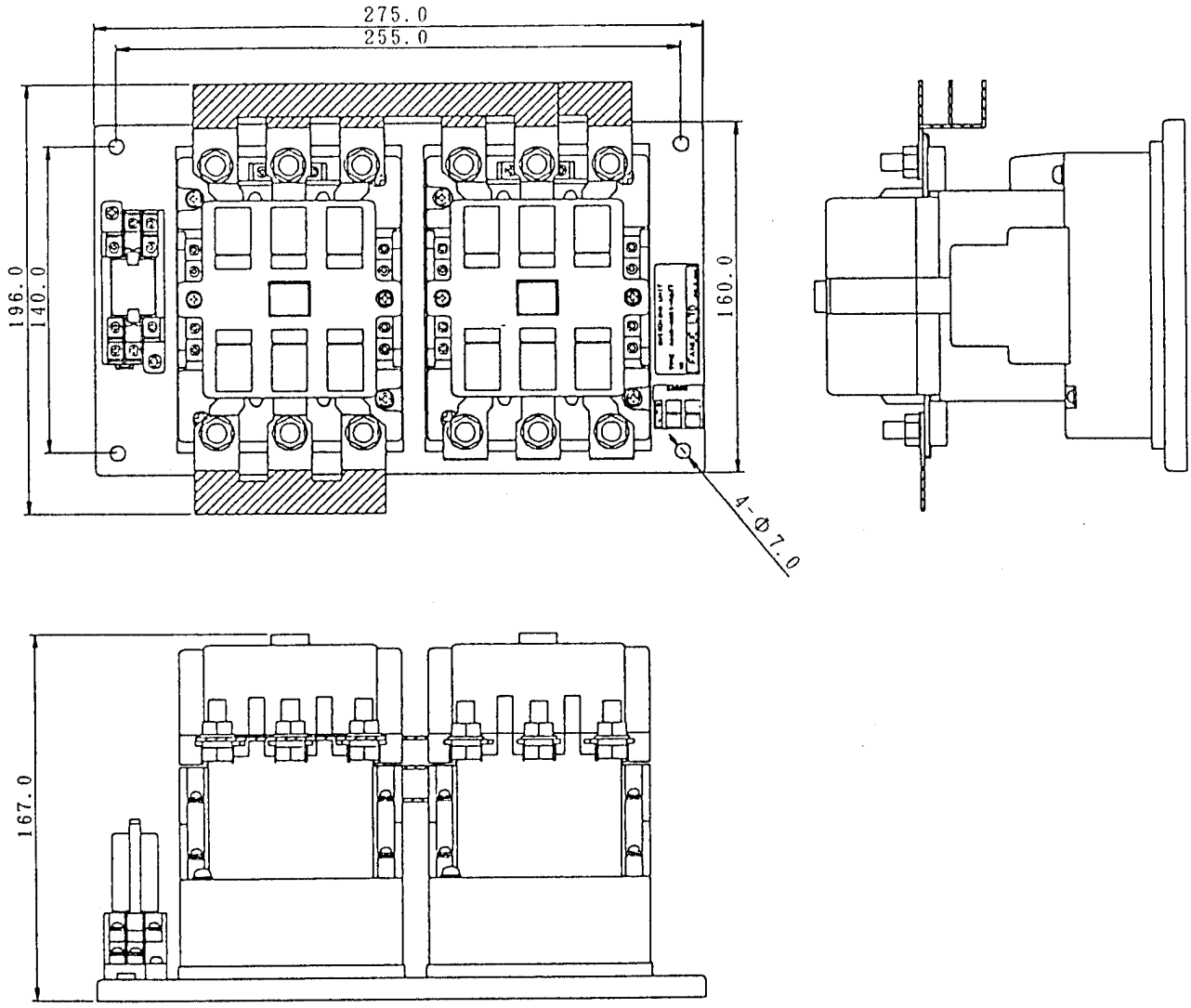
A06B-6078-K035

Fig. A

Mounting diagram



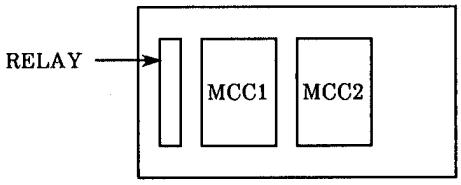
Up to SPM-30*i*



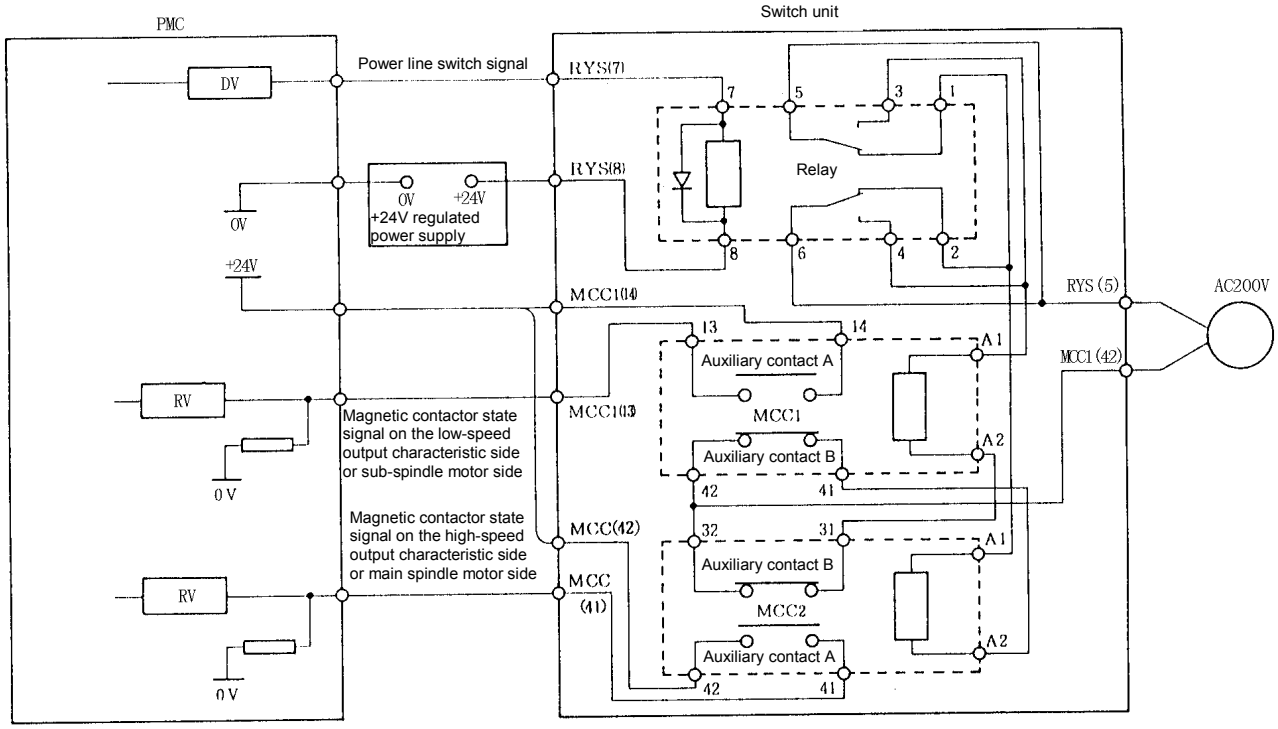
A06B-6078-K037

Fig. B

Mounting diagram



10.2.4 Connection



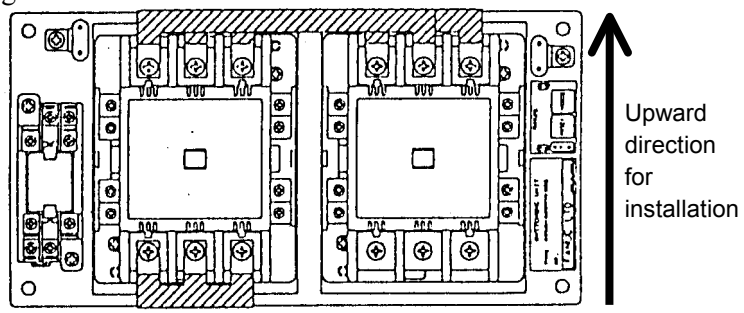
NOTE

Make a connection to the switch unit by direct screwing on the screw terminal of the magnetic contactor and relay socket.

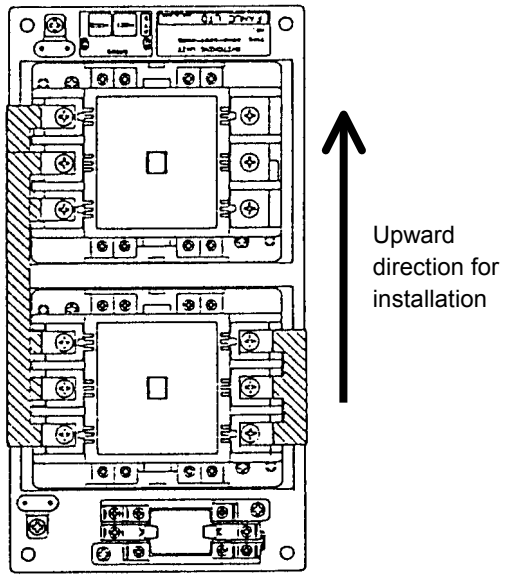
10.2.5 Notes

(1) Install the switch unit under the same conditions as for the spindle amplifier.
Installation conditions
- Ambient temperature
  Ambient temperature of the unit :
  0 to 55°C (at operation)
  0 to 45°C (at keeping and transportation)
- Humidity
  Normally 90% RH or below, and condensation-free
- Vibration
  In operation : Below 0.5G
- Atmosphere
  No corrosive or conductive mists or drops should deposit directly on the electronic circuits.

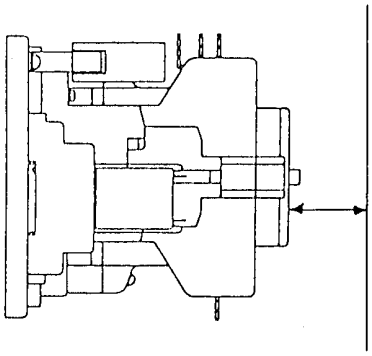
(2) The figure below shows the standard method of installation. However, the switch unit may be tilted up to 15 degrees toward the right or left.



(3) The switch unit may need to be installed horizontally from a viewpoint of cabling or installation (Fig. 11.7.6(b)). In this case, however, the characteristics of the magnetic contactor remain almost the same, but the mechanical life and open/close frequency decrease.



(4) Provide an arc space as shown below.



(5) If the main magnetic contactor unit is installed incorrectly or incompletely, the contact can make an abrupt movement due to a shock upon power-up, or its life can be adversely affected. Moreover, if the electric cable to be connected is not tightened sufficiently, an overheat can occur or the electric cable can come off, resulting in a major accident.

(a) Tightening torque

(i) Magnetic contactor

Location	Tightening torque [kg·cm]	
	A58L-0001-0306	A58L-0001-0312
MCC main terminal	62.0 (M6.0)	84.0 (M8.0)
MCC auxiliary terminal	14.0 (M3.5)	14.0 (M3.5)

(ii) Relay socket

Location	Tightening torque [kg·cm]
Relay socket	14.0 (M3.5)

10.3 SUB MODULE SW

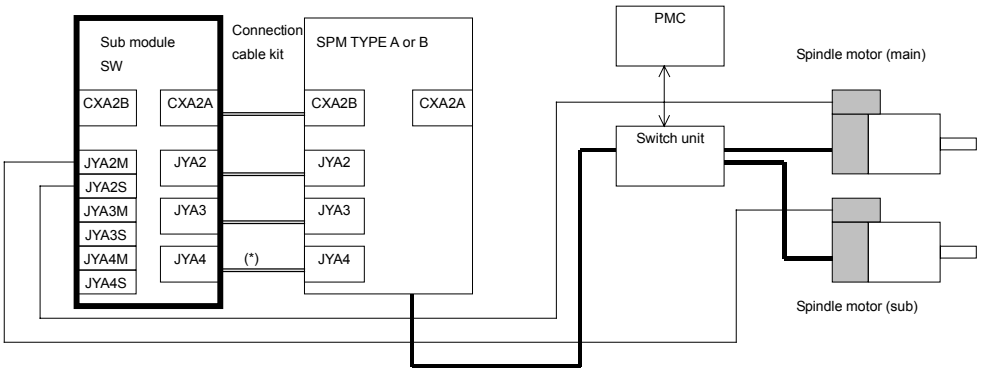
The sub module SW is 60 mm wide. By being combined with SPM TYPE A or SPM TYPE B according to a required function, the sub module SW is used for the spindle switch function to switch between two motors (main and sub) with one spindle amplifier module.

- A cable for connecting the SW module with the SPM needs to be prepared.
- A metal plate for mounting needs to be prepared.

NOTE
The sub module SW cannot be used with the αC*i* series.

For the drawing numbers of the sub module SW and connection cable kit, see Chapter 3.

10.3.1 Configuration



(*) Only when the sub module SW is combined with SPM TYPE B

10.3.2 Specification

By combining the sub module SW with SPM TYPE A or SPM TYPE B, the spindle switch function for switching between two motors (main and sub) with one spindle amplifier module can be used.
The table below indicates allowable combinations of detectors and functions on the main and sub sides of spindle switch control. If the main or sub side of spindle switch control includes a function that requires SPM TYPE B (organization number 6 or 7 indicated below), select TYPE B as an SPM to be combined with the sub module SW.

			Organization on main or sub side							Remarks
			1	2	3	4	5	6	7	
SPM combined with sub module SW		SPM TYPE A	O	O	O	O	O			
		SPM TYPE B						O	O	
Spindle system configuration	Sensor on the motor	M*i* sensor	O			O	O	O	O	
		MZ*i* sensor		O						
		BZ*i* sensor (when a built-in motor is used) CZ*i* sensor (when a built-in motor is used)			O					
	Sensor on the spindle	α position coder				O				*3
		External 1-rotation					O			*3
		BZ*i* sensor, CZ*i* sensor						O		*3
		α position coder S							O	*3
Function	Rigid tapping		O *1	O	O	O	O *2	O	O	
	Orientation by a position coder			O	O	O		O	O	*4
	Orientation by the external one-rotation signal						O *2			
	Spindle synchronization	Velocity synchronization	O *2	O	O	O	O *2	O	O	*5
		Phase synchronization		O	O	O		O	O	*5
	Threading			O	O	O		O	O	
	Cs-axis contour control			O	O			O	O	*5

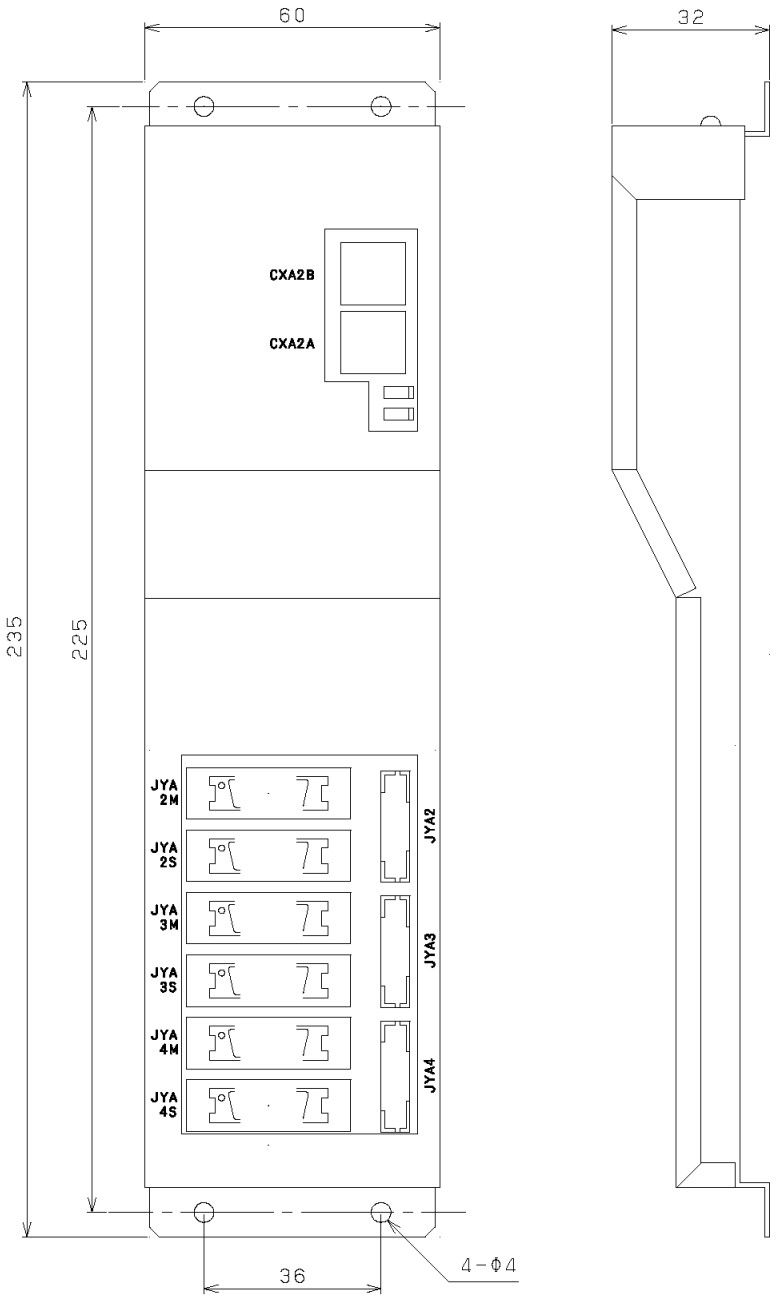
*1 The spindle and motor must be interconnected with a timing belt or gear. No orientation is available to adjust the tapping start position.
*2 The spindle and motor must be interconnected with a timing belt or gear.
*3 The spindle and detector must be interconnected in one-to-one connection mode.
*4 Orientation of external stop position setting type can be used on the main side only.
*5 Two motor amplifiers are required.
*6 Cs contour control can be used on the main side only.

Other notes

Up to two stages of parameter gear switching can be set on the sub side.
With the Power Mate, only Model D and F can use spindle switch control.

10.3.3 External Dimensions

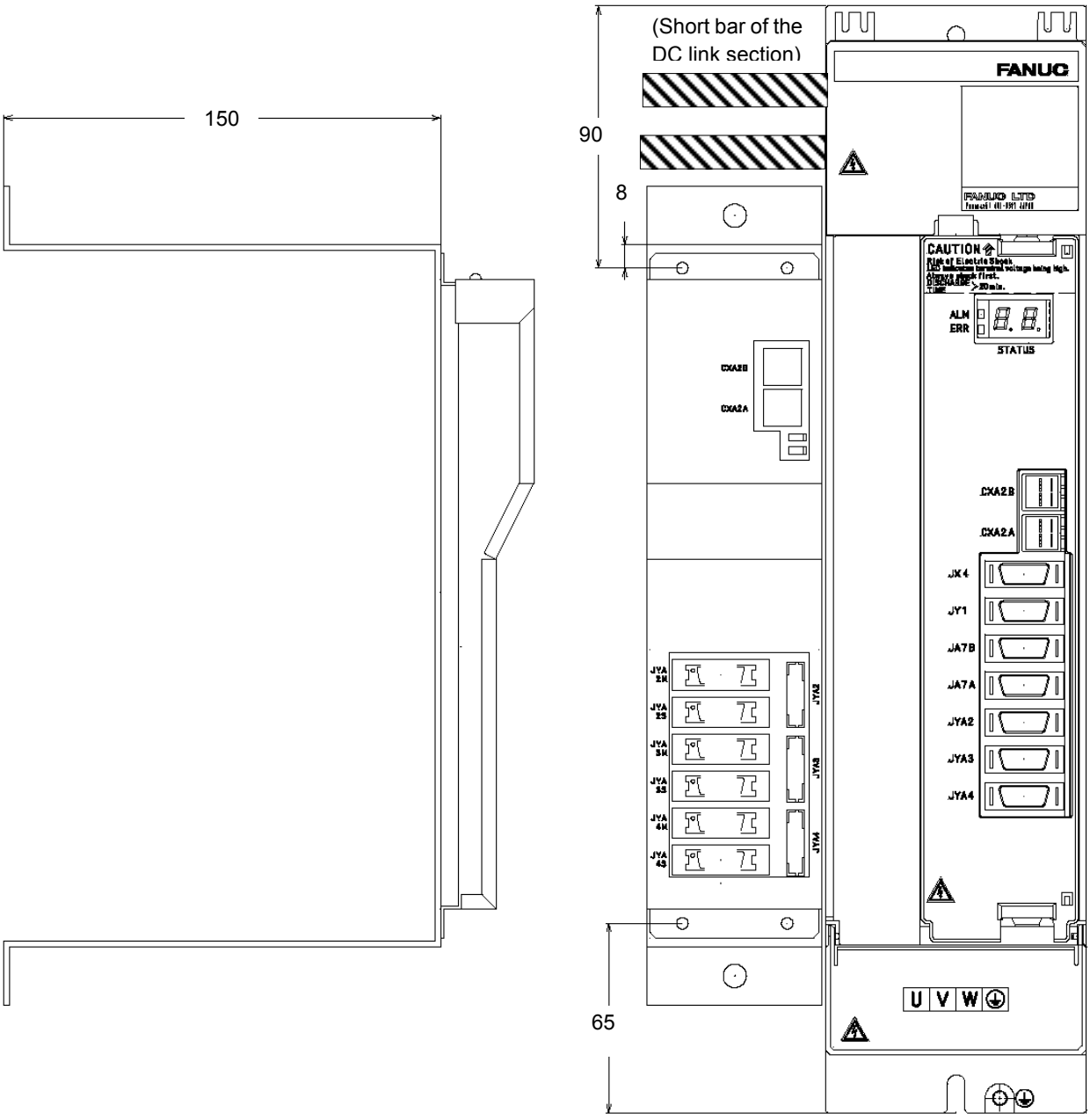
Sub module SW



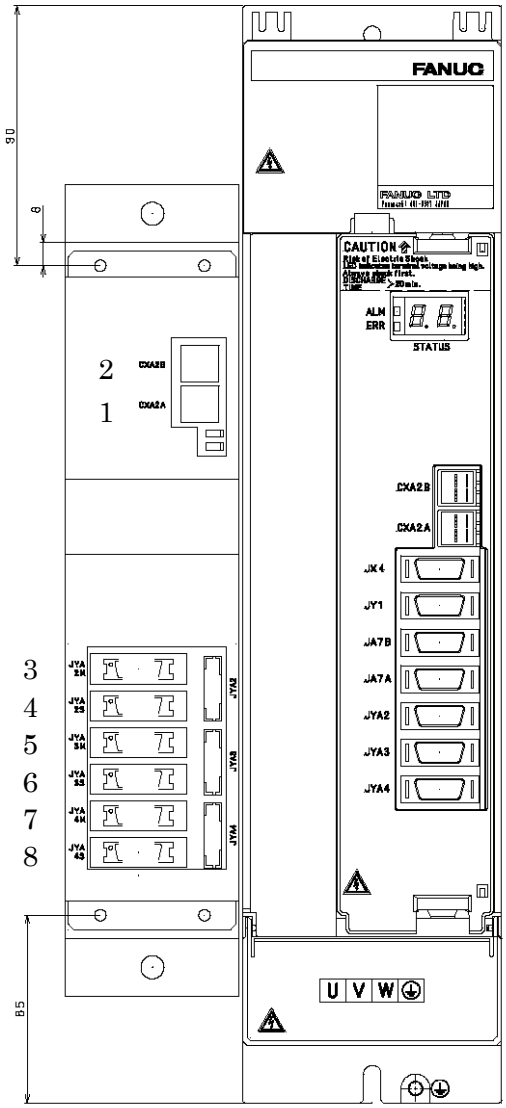
NOTE
A metal plate for mounting the sub module SW needs to be separately prepared.

Installation when the sub module SW is combined with an SPM-15*i* (90 mm wide)

Prepare a metal plate for mounting the sub module SW. The dimensions of a metal plate for mounting the sub module SW are specified to avoid interference with the short bar of the DC link section.



10.3.4 Connector Installation Diagram (for Combination with SPM-15*i*)

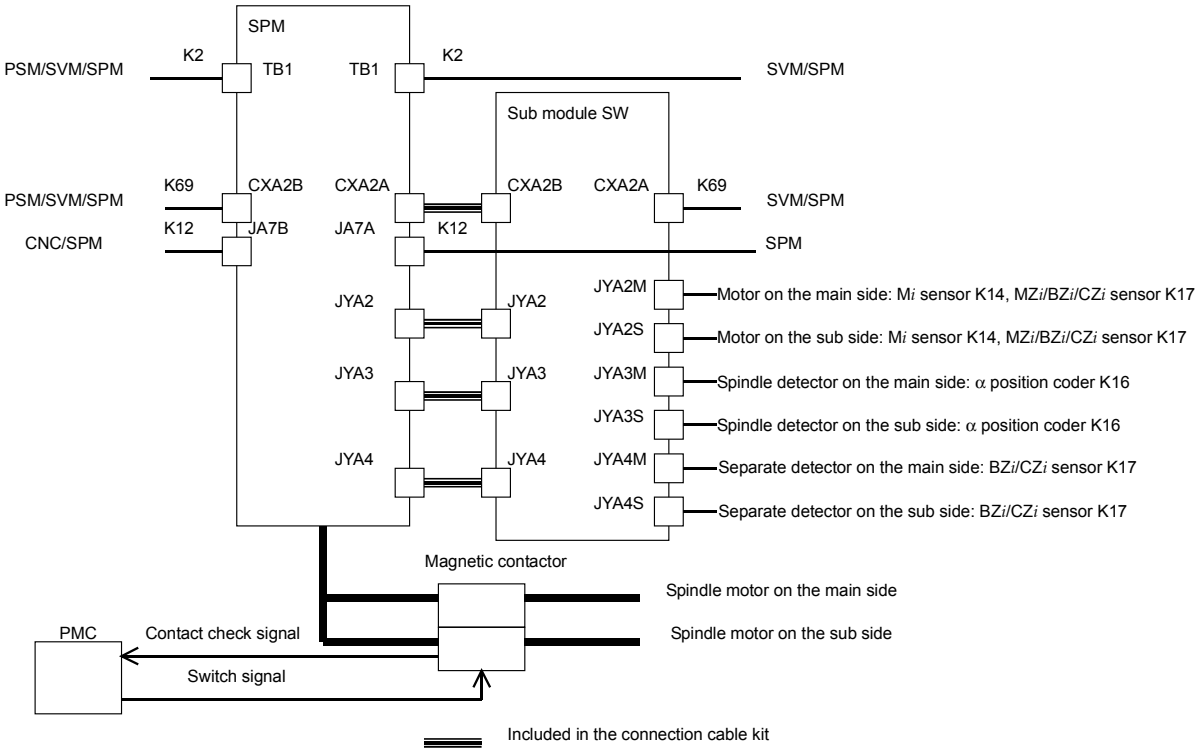


	Name	Indication
1	Connector for PSM interface output	CXA2A
2	Connector for PSM interface input	CXA2B
3	Connector (main side) for spindle sensor connection on motor side	JYA2M
4	Connector (sub side) for spindle sensor connection on motor side	JYA2S
5	Connector for position coder connection and external one-rotation signal connection (main side)	JYA3M
6	Connector for position coder connection and external one-rotation signal connection (sub side)	JYA3S
7	Connector for separate spindle sensor connection (main side)	JYA4M
8	Connector for separate spindle sensor connection (sub side)	JYA4S

NOTE
Install a module 150 mm wide or more (SPM-22*i* and higher, SPM-30HV*i* and higher) on the right side of the SPM.

10.3.5 Connection

Total connection diagram



For details of the connection cables other than the connection cable kit, see the items of relevant K numbers in Chapter 9.

For the drawing number of the connection cable kit, see Chapter 3.

11 SPINDLE-RELATED DETECTORS

11.1 POSITION CODER

11.1.1 α Position Coder

Name and drawing number

Name	Drawing number	Remarks
α position coder	A860-0309-T302	□68 flange mounting, 10,000min^{-1}

Absolute maximum rating

Item	Specification
Power supply voltage	-0.5V to +7.0V
Operating temperature range	0°C to +50°C
Humidity	95%RH or lower

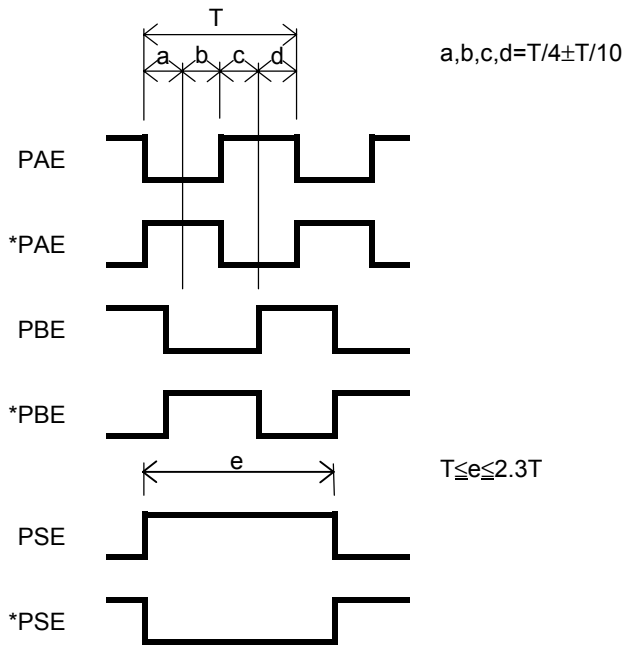
Electric specification

Item		Specification
Power supply voltage		5V±5%
Supply current		350mA or lower
Output signal	PAE,*PAE,PBE,*PBE	1,024 pulses/revolution
	PSE,*PSE	1 pulse/revolution

Mechanical specification

Item	Specification	
Input axis inertia	9.8×10^{-3}kg·m^2 or lower	
Input axis start torque	0.098N·m or lower	
Input axis allowable load	Radial load (operating)	98N
	Thrust load (operating)	49N
Maximum speed	10,000min^{-1}	
Structure	Dust-proof and drip-proof structure (Equivalent to IP55: When a water-proof connector is installed)	
Anti-vibration acceleration	10G	
Weight	Approx. 0.75kg	

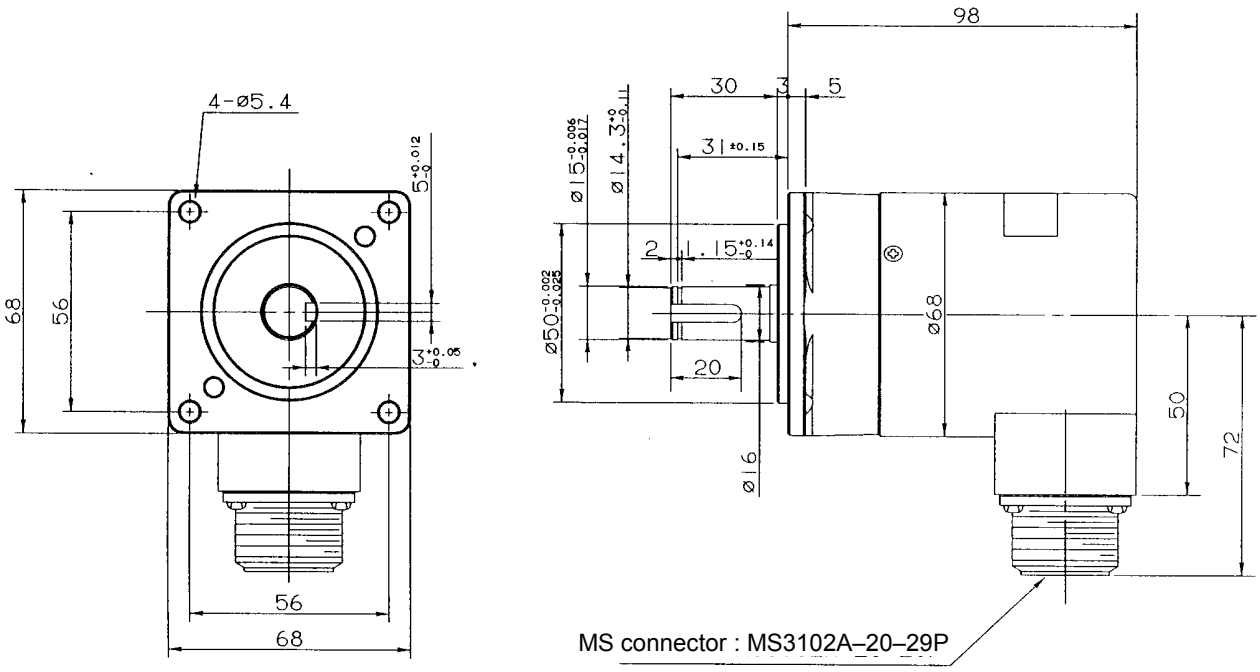
Signal phase relationships (timing chart)



Output pin arrangement

A	B	C	D	E	F	G	H	J
PAE	PSE	PBE					+5V	
K	**L**	**M**	**N**	**P**	**R**	**S**	**T**	
0V			*PAE	*PSE	*PBE			

External dimensions



11.1.2 α Position Coder S

Name and drawing number

Name	Drawing number	Remarks
α position coder S	A860-0309-T352	□68 flange mounting, 10,000min^{-1}

Absolute maximum rating

Item	Specification
Power supply voltage	-0.5V to +7.0V
Operating temperature range	0°C to +50°C
Humidity	95%RH or lower

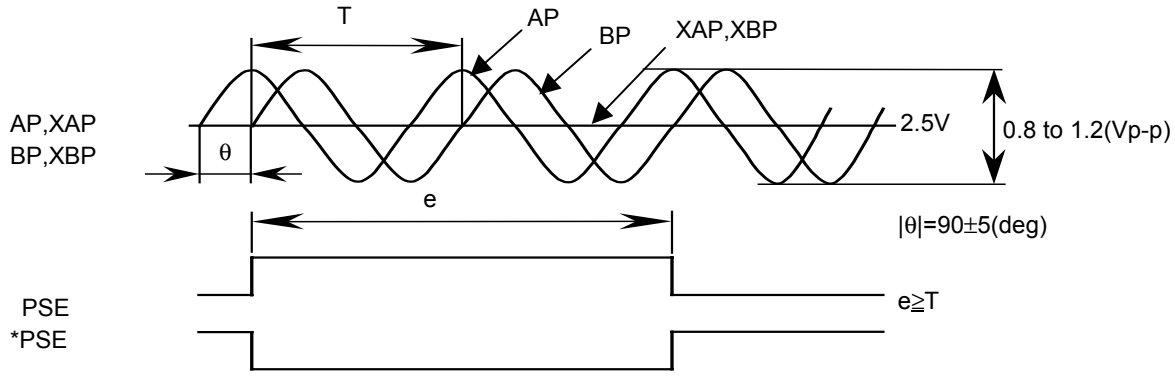
Electric specification

Item		Specification
Power supply voltage		5V±5%
Supply current		350mA or lower
Output signal	AP,BP	1,024 λ/revolution
	PSE,*PSE	1 pulse/revolution

Mechanical specification

Item	Specification	
Input axis inertia	9.8×10^{-3}kg·m^2 or lower	
Input axis start torque	0.098N·m or lower	
Input axis allowable load	Radial load (operating)	98N
	Thrust load (operating)	49N
Maximum speed	10,000min^{-1}	
Structure	Dust-proof and drip-proof structure (Equivalent to IP55: When a water-proof connector is installed)	
Anti-vibration acceleration	10G	
Weight	Approx. 0.75kg	

Signal phase relationships (timing chart)

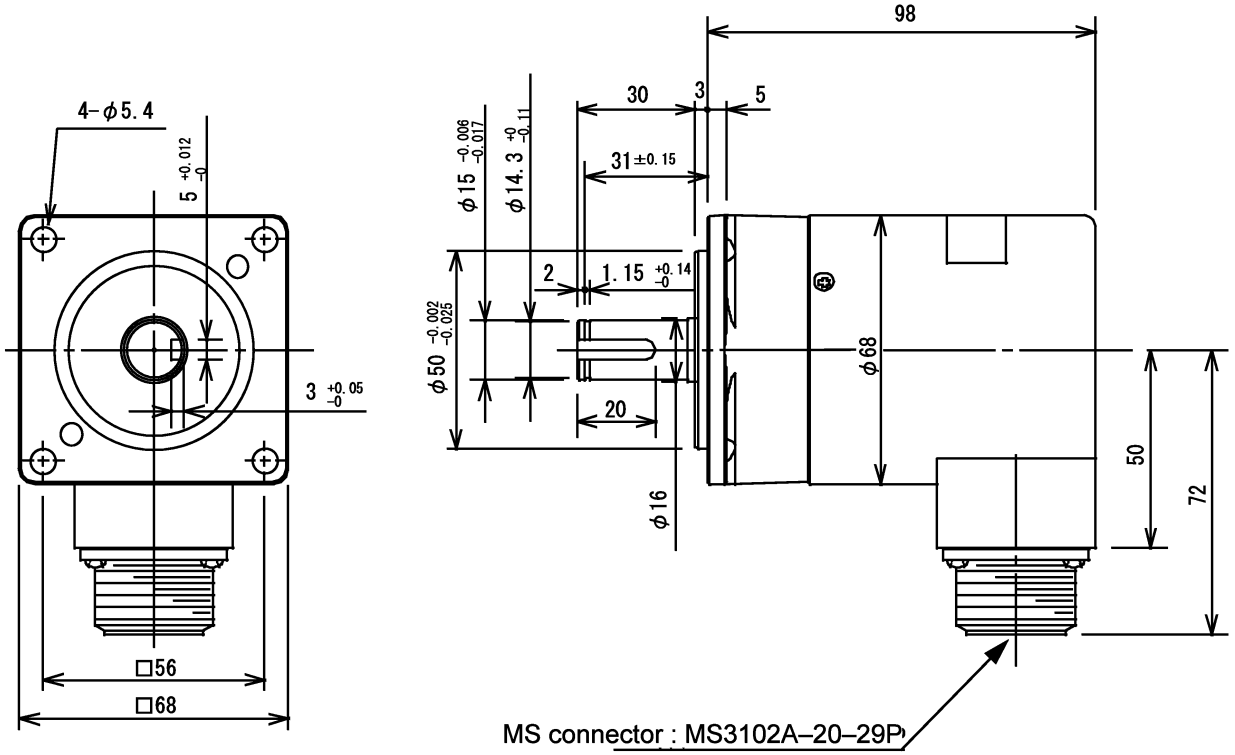


Hi: 2.4V or higher
Lo: 0.4V or lower

Output pin arrangement

A	B	C	D	E	F	G	H	J
AP	PSE	BP					+5V	
K	**L**	**M**	**N**	**P**	**R**	**S**	**T**	
0V			XAP	*PSE	XBP			

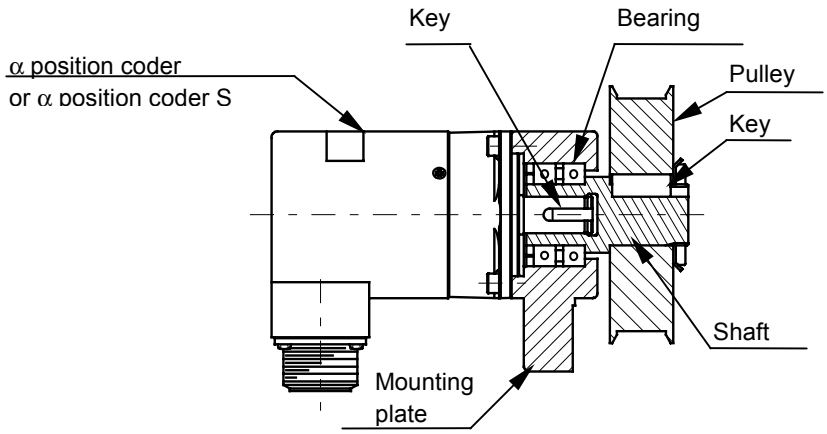
External dimensions



11.1.3 Installation Conditions and Notes

(1) Connection method
Two methods of connecting an α position coder or α position coder S with the spindle are available.

(a) One method connects a position coder to the rear part of the spindle by using a flexible joint. In this case, spindle rotation is transferred to the position coder accurately, so that the positioning precision of the position coder becomes high. In this case, however, the location where the position coder can be installed is limited, so the mechanical section may need to be modified.
(b) With the other method, as shown below, a shaft for holding a pulley is fitted onto the shaft of the position coder, and the shaft is held by two bearings. The pulley of the position coder is connected via a timing belt with the pulley attached to the spindle.



This method is generally used to connect a conventional position coder with the spindle. In this case, however, pay attention to the following:

<1> If there is backlash between the shaft for holding a pulley and the shaft of the position coder, fretting can occur on the shaft of the position coder, or the key can become loose, causing the positioning precision of the position coder to degrade. So, ensure such a fitting tolerance that there is no backlash between the shaft of the position coder and the shaft for holding a pulley and between the key and the key groove.
<2> If the periphery of the pulley of the position coder is eccentric relative to the axis center of the shaft of the position coder, or the periphery of the pulley fitted onto the shaft is eccentric relative to the axis center of the shaft, the positioning precision of the spindle degrades in proportion to the magnitude of eccentricity. So, minimize these eccentricities.

(2) Shock
The position coder is a precision detector. So, be careful not to apply a shock to the shaft.

(3) Atmosphere
The protection grade of the position coder satisfies IP55. However, this standard is applicable to short-time performance. So, ensure that the position coder is not routinely exposed to a coolant and lubricant, and that there is no deposit of oil. If the position coder is exposed to a coolant or lubricant, install a protection cover.

11.2 BZ*i* SENSOR

Name and drawing number

Name	Ordering number	Remarks			
		Number of teeth	Max. speed	Sensor ring	
				Inner diameter	Outer diameter
BZ*i* sensor 128	A860-2120-T201	128	20,000min^{-1}	ϕ40	ϕ52
BZ*i* sensor 128H	A860-2120-T211		70,000min^{-1}		
BZ*i* sensor 256	A860-2120-T401	256	15,000min^{-1}	ϕ82	ϕ103.2
BZ*i* sensor 256H	A860-2120-T411		30,000min^{-1}		
BZ*i* sensor 384	A860-2120-T511	384	15,000min^{-1}	ϕ125	ϕ154.4
BZ*i* sensor 512	A860-2120-T611	512	10,000min^{-1}	ϕ160	ϕ205.6

Absolute maximum rating

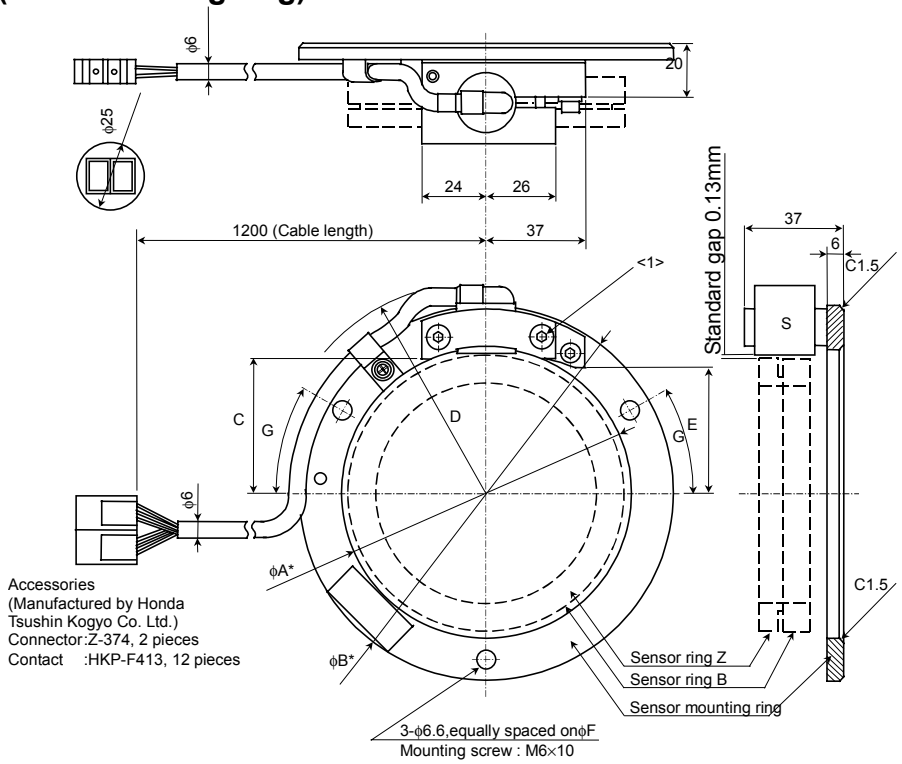
Item	Specification
Power supply voltage	-0.5 to +7.0V
Operating temperature range	0 to +80°C
Humidity	95%RH or less

Electric specification

Item			Specification
Power supply voltage			5V±5%
Supply current			0.05A
Output signals	VA,*VA VB,*VB	BZ*i* sensor 128/128H	128λ/rev.
		BZ*i* sensor 256/256H	256λ/rev.
		BZ*i* sensor 384	384λ/rev.
		BZ*i* sensor 512	512λ/rev.
	VZ,*VZ	Common to all models	1λ/rev.

External dimensions

- BZ*i* sensor (with mounting ring)



Sensor type No.	Sensor ring	Number of teeth	ϕA *	ϕB *	C	D	E	ϕF	G
A860-2120-T201 A860-2120-T211	Ring 1 Ring 2	128	56H6+0.019/-0.0	100h6+0.0/-0.022	25	R57	20	78	10°
A860-2120-T401 A860-2120-T411	Ring 3 Ring 4	256	108+0.040/+0.020	140h6+0.0/-0.025	51	R80	46	124	30°

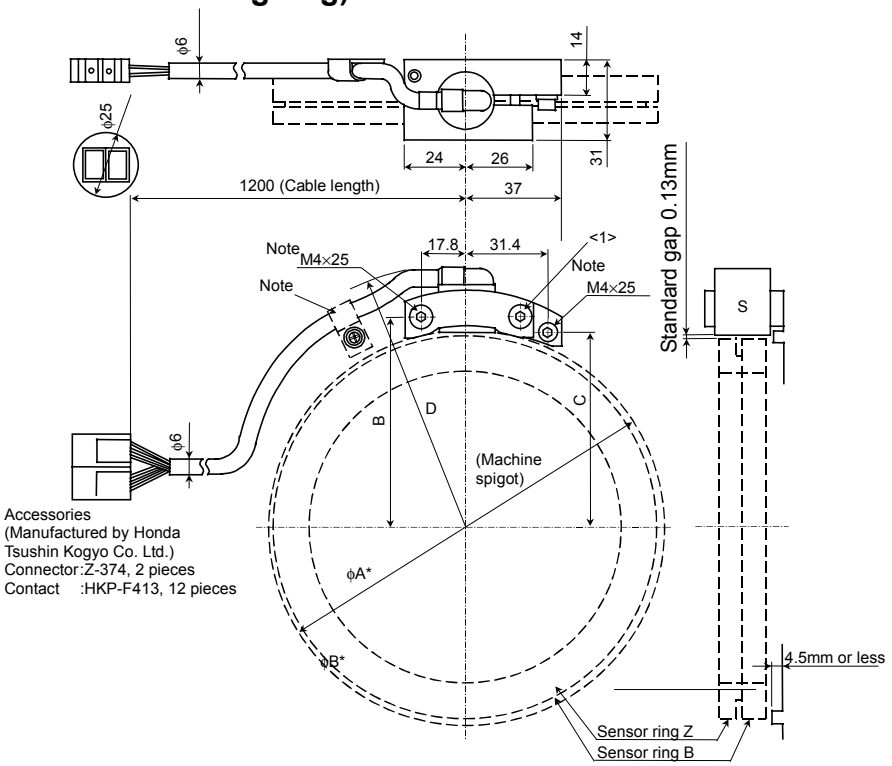
For the outside dimensions of the sensor ring, see "Sensor ring" described later.

NOTE

- Use this sensor under 80°C.
- Handle these precision parts with special care. In particular, never apply external force to part S.
- The sensor consists of electric circuit. Therefore, keep away from dust, oil, and any other harmful things.
- The dimensions marked with asterisk are applied to the fitting diameter. Be sure to install the sensor so that it is aligned with the inner or outer diameter of the guide. Otherwise, the detector may produce incorrect output.
- The gap between sensor and detecting ring is preadjusted. The output signal may not indicate the target value due to a dimensional error of the mounting spigot. When installing a sensor, check the output signal. If the specified value is not satisfied, loosen the screw(*1) and make a gap adjustment.
  *1 The recommended tightening torque of the screw is 1.2 Nm (12 kgfcm) ±10%. After tightening the screw, check, with a gap gauge of 0.1 mm, that a gap of at least 0.1 mm is provided between the sensor and the sensor ring.

  For the gap adjustment output signal level, refer to "II. INSTRUCTION" in "FANUC AC SPINDLE MOTOR αi_B series DESCRIPTIONS (B-65292EN)".
- Connect the shield wire.
- For easy maintenance, mount the sensor at a position where it can be replaced easily.
- Sensor rings with the same specification number can be replaced with each other.
- Sensor rings with different specification numbers cannot be used in combination.
- Mating connectors are provided with the sensor.

- BZ*i* sensor (without mounting ring)



Sensor type No.	Sensor ring	Number of teeth	φA	B	C	D
A860-2120-T511	Ring 5	384	158+0.0/-0.025	84.3	78.3	R110
A860-2120-T611	Ring 6	512	210+0.0/-0.030	110.8	104.8	R140

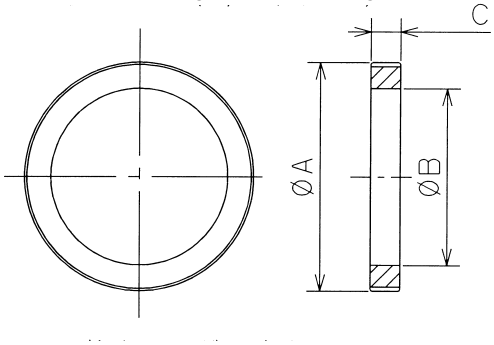
For the outside dimensions of the sensor ring, see "Sensor ring" described later.

NOTE

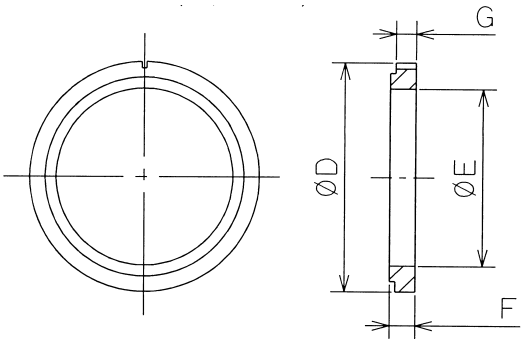
- Use this sensor under 80°C.
- Handle these precision parts with special care. In particular, never apply external force to part S.
- The sensor consists of electric circuit. Therefore, keep away from dust, oil, and any other harmful things.
- Mount the sensor, pressing it against the spigot (dimension φA) on the machine (the height of the spigot on the machine is 4.5 mm or less).
- T The gap between sensor and detecting ring is preadjusted. The output signal may not indicate the target value due to a dimensional error of the mounting spigot. When installing a sensor, check the output signal. If the specified value is not satisfied, loosen the screw(*1) and make a gap adjustment.
  *1 The recommended tightening torque of the screw is 1.2 Nm (12 kgfcm) (10%. After tightening the screw, check, with a gap gauge of 0.1 mm, that a gap of at least 0.1 mm is provided between the sensor and the sensor ring.
  For the gap adjustment output signal level, refer to "II. INSTRUCTION" in "FANUC AC SPINDLE MOTOR αi_B series DESCRIPTIONS (B-65292EN)".
- For installation, use screws of M4×20mm and M4×25mm.
- Fasten the cable at a proper location so that if the cable is pulled, no direct force is applied to the sensor.
- Connect the shield wire.
- For easy maintenance, mount the sensor at a position where it can be replaced easily.
- Sensor rings with the same specification number can be replaced with each other.
- Sensor rings with different specification numbers cannot be used in combination.
- Mating connectors are provided with the sensor.

Sensor ring

Sensor ring (phase A/B ring)



Sensor ring (phase Z ring)



Dimensions

	Phase A/B ring)			Phase Z ring			
	ϕA	ϕB	C	ϕD	ϕE	F	G
Ring 1, 2	52+0.0/-0.020	40+0.016/-0.0	10±0.1	52+0.0/-0.020	40+0.016/-0.0	8.6±0.1	6.7
Ring 3, 4	103.2+0.0/-0.020	82+0.0/-0.018	10±0.1	103.2+0.0/-0.020	82+0.0/-0.018	8.6±0.1	6.7
Ring 5	154.4+0.0/-0.020	125+0.025/-0.0	10±0.1	154.4+0.0/-0.020	125+0.025/-0.0	8.6±0.1	6.7
Ring 6	205.6+0.0/-0.020	160+0.020/-0.005	10±0.1	205.6+0.0/-0.020	160+0.020/-0.005	8.6±0.1	6.7

For the outside dimensions of the sensor, see "BZi sensor" described earlier.

NOTE
- Press fit the rings on a sleeve, then install the sleeve on the spindle shaft.
- Used ring can be recycled only one time.
- The circumference has special teeth. Therefore carefully protect against deformation and chipping due to external force.
- Check the feedback signal after mounting the sensor. For output signal adjustment, refer to "II. ASSEMBLY" in "FANUC AC SPINDLE MOTOR αi_B series DESCRIPTIONS (B-65292EN)".

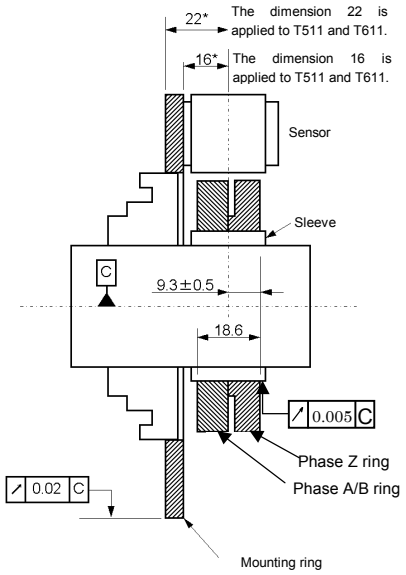
Allowable maximum speed

	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5	Ring 6
Sensor type No.	T201	T211	T401	T411	T511	T611
Number of teeth	128	128	256	256	384	512
Max. speed (min^{-1})	20,000	70,000	15,000	30,000	15,000	10,000

NOTE
- Interference for shrink fitting of the rings is changed according to the maximum speed of spindle. Refer to "Tightening allowance" described later.

BZ*i* sensor installation

As shown below, install ring A and ring B.



- Press the rings through the sleeve, then press the sleeve into the shaft. Ensure that the A/B phase ring and the Z phase ring are joined closely with each other.
- Ensure that a displacement between the middle point (9.3 mm) of the thickness of the A/B phase ring plus the Z phase ring and the center of the sensor lies within ±0.5 mm.
- Ensure that the swing of the sleeve relative to the center of the shaft lies within 0.005 mm.
- Ensure that the swing of the mounting ring relative to the center of the shaft lies within 0.02 mm.

Tightening allowance

The table below indicates the shrink fitting allowance for each sensor ring at maximum speed.

Unit : μm

Max. speed (min^{-1})	T201	T211	T401	T411	T511	T611
	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5	Ring 6
3000					ϕ8 to ϕ43	ϕ11 to ϕ41
3500			ϕ7 to ϕ35	ϕ7 to ϕ35	ϕ9 to ϕ44	ϕ13 to ϕ43
4500					ϕ11 to ϕ46	ϕ19 to ϕ49
6000	ϕ6 to ϕ32	ϕ6 to ϕ32	ϕ9 to ϕ37	ϕ9 to ϕ37	ϕ15 to ϕ50	ϕ29 to ϕ59
8000			ϕ11 to ϕ39	ϕ11 to ϕ39	ϕ24 to ϕ59	ϕ47 to ϕ77
10000			ϕ14 to ϕ42	ϕ14 to ϕ42	ϕ35 to ϕ70	ϕ71 to ϕ101
12000	ϕ7 to ϕ33	ϕ7 to ϕ33	ϕ18 to ϕ46	ϕ18 to ϕ46	ϕ47 to ϕ82	
15000	ϕ8 to ϕ34	ϕ8 to ϕ34	ϕ26 to ϕ54	ϕ26 to ϕ54	ϕ71 to ϕ106	
20000	ϕ10 to ϕ36	ϕ10 to ϕ36		ϕ41 to ϕ69		
25000		ϕ12 to ϕ38		ϕ62 to ϕ90		
30000		ϕ15 to ϕ41		ϕ87 to ϕ115		
40000		ϕ23 to ϕ49				
50000		ϕ33 to ϕ59				
60000		ϕ43 to ϕ69				
70000		ϕ57 to ϕ83				

NOTE
1 Select a tightening allowance from the table above according to the maximum speed and type of a ring used. A failure to satisfy a tightening allowance indicated above can cause idle running or damage.
2 Each ring cannot be used at a speed higher than the indicated speeds. For the maximum allowable speed of each ring, see "Sensor ring" described earlier.

Compatibility

The BZ*i* sensor is compatible with the BZ sensor. For details, see the list below.

BZ sensor drawing number	BZ*i* sensor drawing number
A860-0392-T012	A860-2120-T201
A860-0392-T082	A860-2120-T211
A860-0392-T011	A860-2120-T401
A860-0392-T081	A860-2120-T411
A860-0392-T018	A860-2120-T511
A860-0392-T013	A860-2120-T611

11.3 CZ*i* SENSOR

Name and drawing number

Name	Ordering number	Remarks			
		Number of teeth	Max. speed	Sensor ring	
				Inner diameter	Outer diameter
CZ*i* sensor 512	A860-2140-T411	512	15,000min^{-1}	ϕ82	ϕ102.8
CZ*i* sensor 768	A860-2140-T511	768	10,000min^{-1}	ϕ125	ϕ154
CZ*i* sensor 1024	A860-2140-T611	1024	8,000min^{-1}	ϕ160	ϕ205.2

Absolute maximum rating

Item	Specification
Power supply voltage	-0.5 to +7.0V
Operating temperature range	0 to +50°C
Humidity	95%RH or less

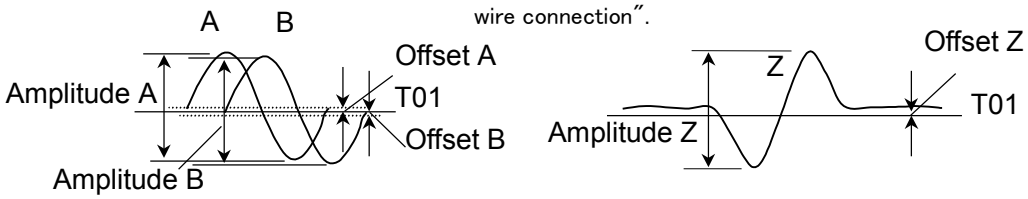
Electric specification

Item			Specification
Power supply voltage			5V±5%
Supply current			150mA or less
Output signals	VA,*VA VB,*VB	CZ*i* sensor 512	512λ/rev.
		CZ*i* sensor 768	768λ/rev.
		CZ*i* sensor 1024	1024λ/rev.
	VZ,*VZ	Common to all models	1λ/rev.

(Preamplifier output at ordinary temperatures and 500 min^{-1}.)

Signal name	Check pin	Output amplitude	Offset
Phase A Phase B	A (T01 reference) B (T01 reference)	1000±100mVp-p	±50mV
Phase Z	Z (T01 reference)	660 to 1650mVp-p	±50mV

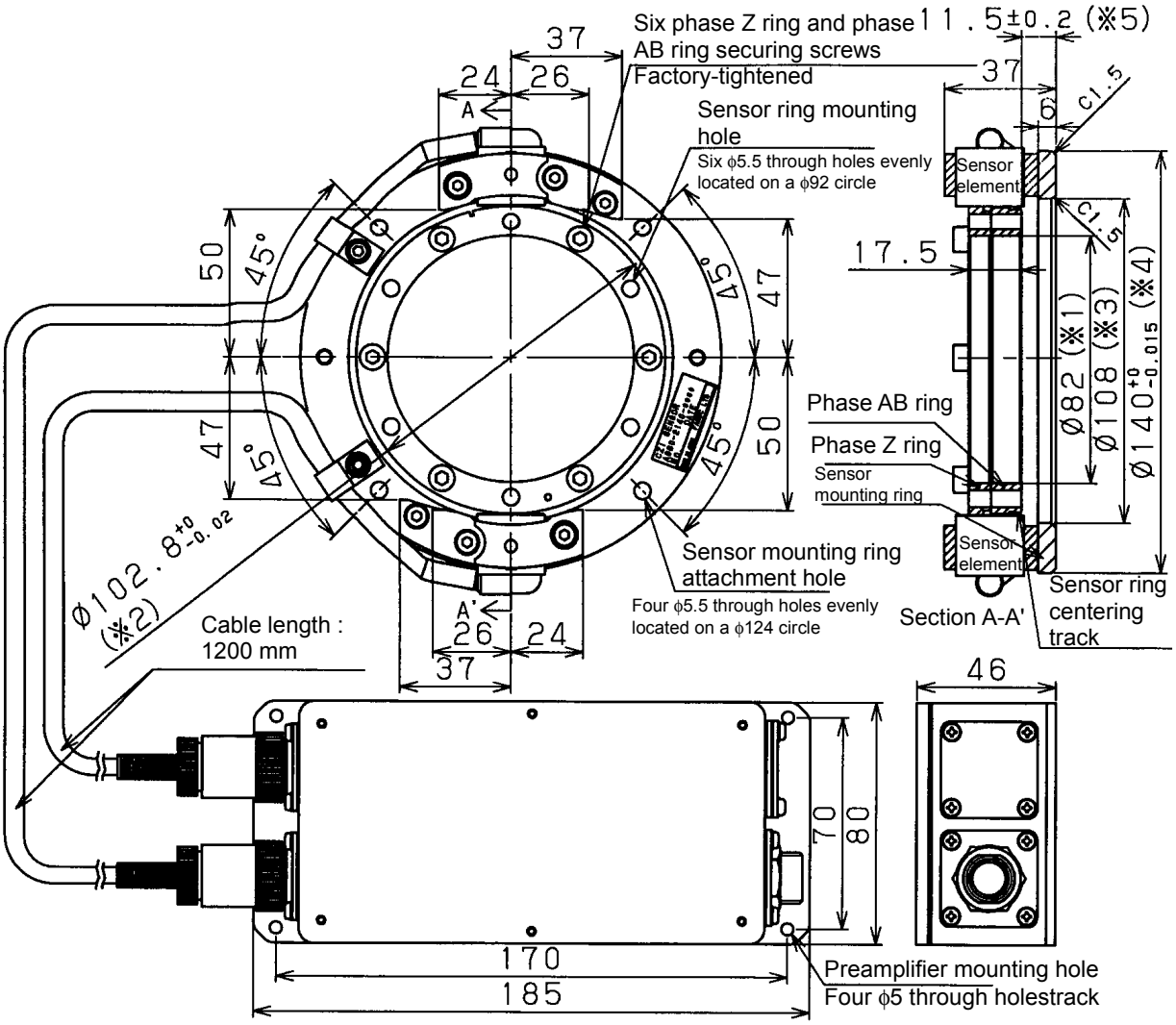
For information on connector pins, see "Specification of wire connection".



External dimensions

CZ*i* sensor 512

A860-2140-T411

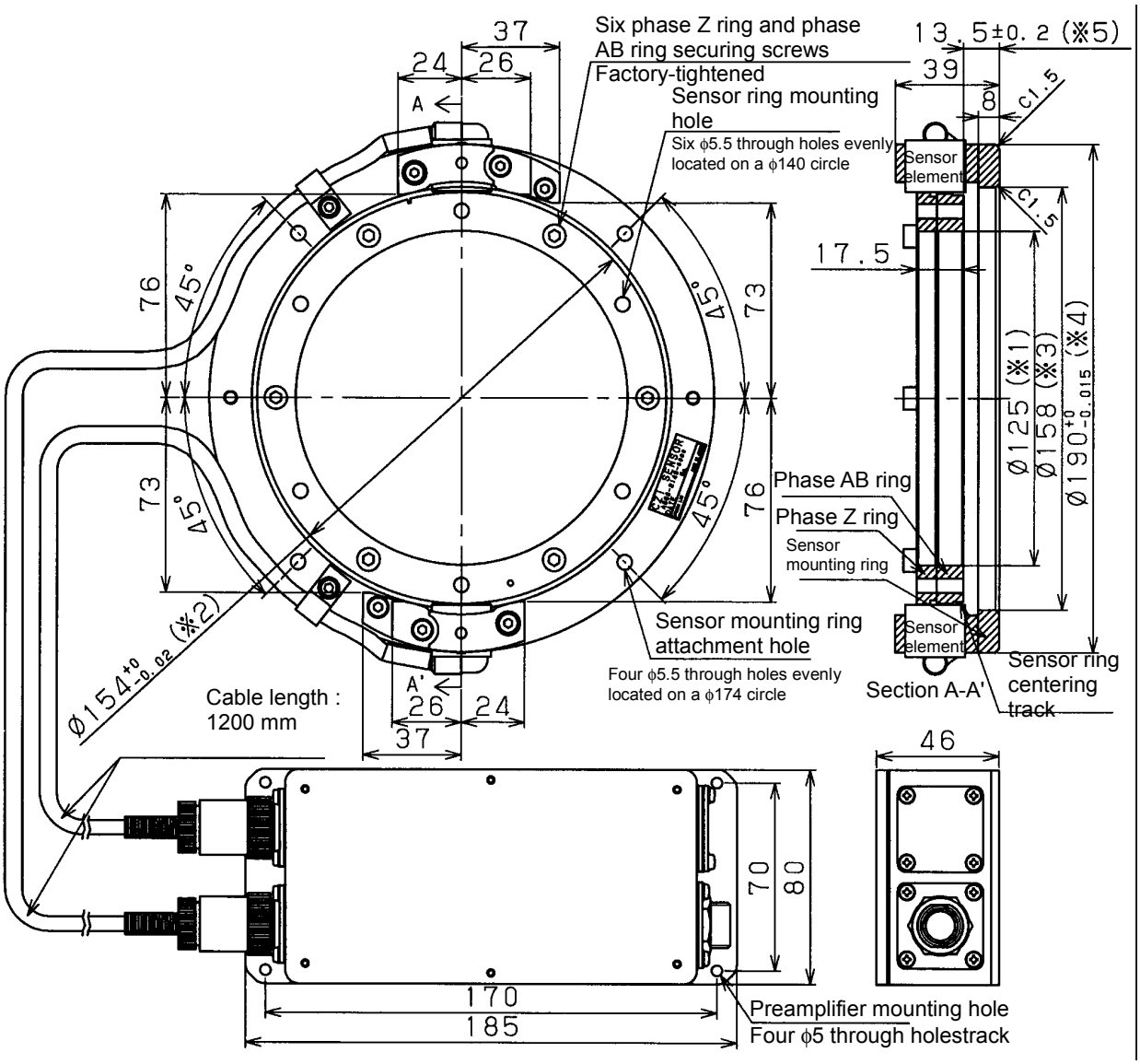


For details on mounting, see "Installation".

NOTE

- (*1) A positive tolerance is set for the inside diameter of the sensor ring.
  (*2) This value represents the outside diameter of the teeth surface of the sensor ring.
- (*3) A positive tolerance is set for the inside diameter of the sensor mounting ring.
  (*4) This value represents the outside diameter of the sensor mounting ring.
- (*5) This value represents the distance from the bottom of the sensor mounting ring to the bottom of the sensor ring.
- This equipment must be used at temperatures up to 50°C.
- Since the CZ*i* sensor is set in advance in combination with the ring and, sensor, and preamplifier, it must be treated as a integrated set.
- Since these are precision components, extreme caution must be taken to use them. In particular, do not apply external forces to the sensor elements.
- The detector is an electronic component. Dustproof and dripproof actions must be taken on the machine side to prevent chippings, oil, water, or other deleterious substances from being attached.
- The preamplifier box has water resistance equivalent to IP55. If cutting fluid is splashed continuously or it remains wet for an extended period of time, it may fail. Be careful to prevent cutting fluid from being splashed.
- Do not apply a vibration more that 1 G to the preamplifier box.
- Be sure to connect the shield cable. Ground the preamplifier box to a grounding terminal or the machine body.
- The detector must be installed in an easy-to-replace location to enhance maintainability.

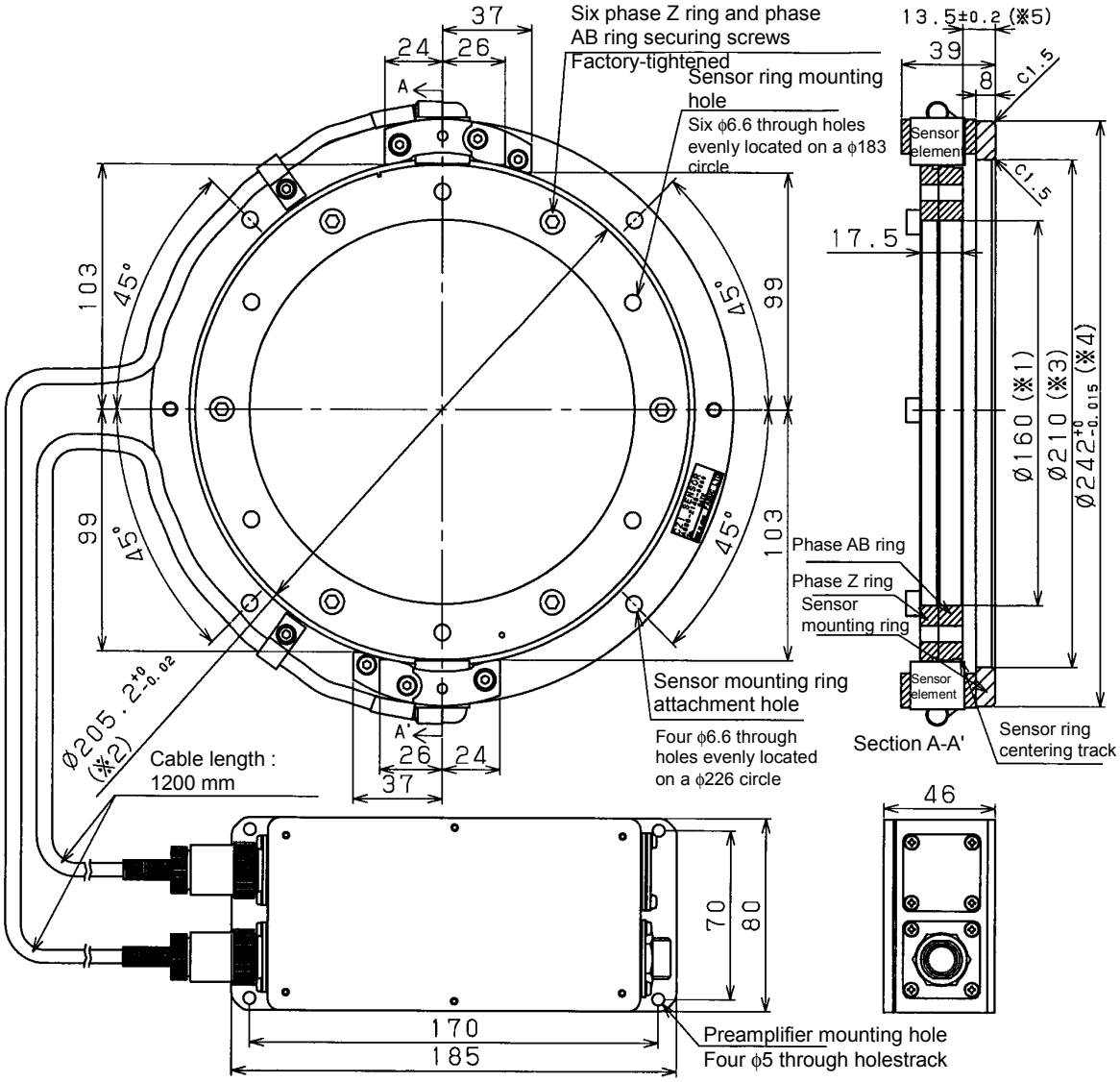
CZ*i* sensor 768
A860-2140-T511



For details on mounting, see "Installation".

NOTE
- (*1) A positive tolerance is set for the inside diameter of the sensor ring.
  (*2) This value represents the outside diameter of the teeth surface of the sensor ring.
- (*3) A positive tolerance is set for the inside diameter of the sensor mounting ring.
  (*4) This value represents the outside diameter of the sensor mounting ring.
- (*5) This value represents the distance from the bottom of the sensor mounting ring to the bottom of the sensor ring.
- This equipment must be used at temperatures up to 50°C.
- Since the CZ*i* sensor is set in advance in combination with the ring and, sensor, and preamplifier, it must be treated as a integrated set.
- Since these are precision components, extreme caution must be taken to use them. In particular, do not apply external forces to the sensor elements.
- The detector is an electronic component. Dustproof and dripproof actions must be taken on the machine side to prevent chippings, oil, water, or other deleterious substances from being attached.
- The preamplifier box has water resistance equivalent to IP55. If cutting fluid is splashed continuously or it remains wet for an extended period of time, it may fail. Be careful to prevent cutting fluid from being splashed.
- Do not apply a vibration more that 1 G to the preamplifier box.
- Be sure to connect the shield cable. Ground the preamplifier box to a grounding terminal or the machine body.
- The detector must be installed in an easy-to-replace location to enhance maintainability.

CZ*i* sensor 1024
A860-2140-T611

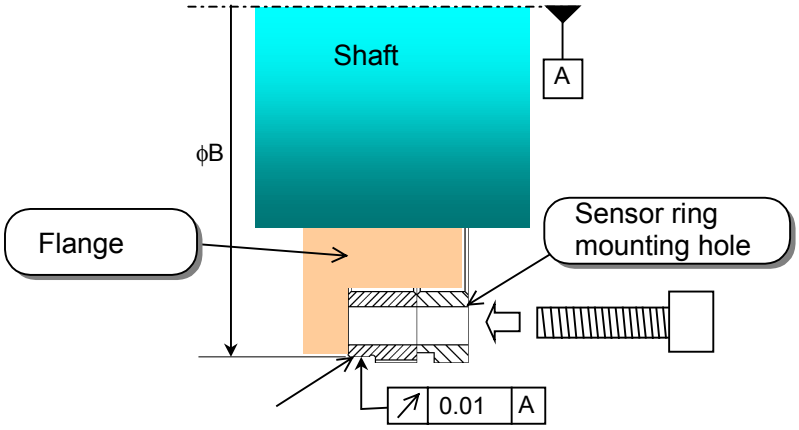


For details on mounting, see "Installation".

NOTE
- (*1) A positive tolerance is set for the inside diameter of the sensor ring.
  (*2) This value represents the outside diameter of the teeth surface of the sensor ring.
- (*3) A positive tolerance is set for the inside diameter of the sensor mounting ring.
  (*4) This value represents the outside diameter of the sensor mounting ring.
- (*5) This value represents the distance from the bottom of the sensor mounting ring to the bottom of the sensor ring.
- This equipment must be used at temperatures up to 50°C.
- Since the CZ*i* sensor is set in advance in combination with the ring and, sensor, and preamplifier, it must be treated as a integrated set.
- Since these are precision components, extreme caution must be taken to use them. In particular, do not apply external forces to the sensor elements.
- The detector is an electronic component. Dustproof and dripproof actions must be taken on the machine side to prevent chippings, oil, water, or other deleterious substances from being attached.
- The preamplifier box has water resistance equivalent to IP55. If cutting fluid is splashed continuously or it remains wet for an extended period of time, it may fail. Be careful to prevent cutting fluid from being splashed.
- Do not apply a vibration more that 1 G to the preamplifier box.
- Be sure to connect the shield cable. Ground the preamplifier box to a grounding terminal or the machine body.

Attachment
Attaching the sensor ring

Provide a flange on the shaft side and then attach the sensor ring in the axis direction using the sensor ring attachment hole. Secure it after performing centering so that the swing relative to the rotation center is 10 μm or less by using the centering track.

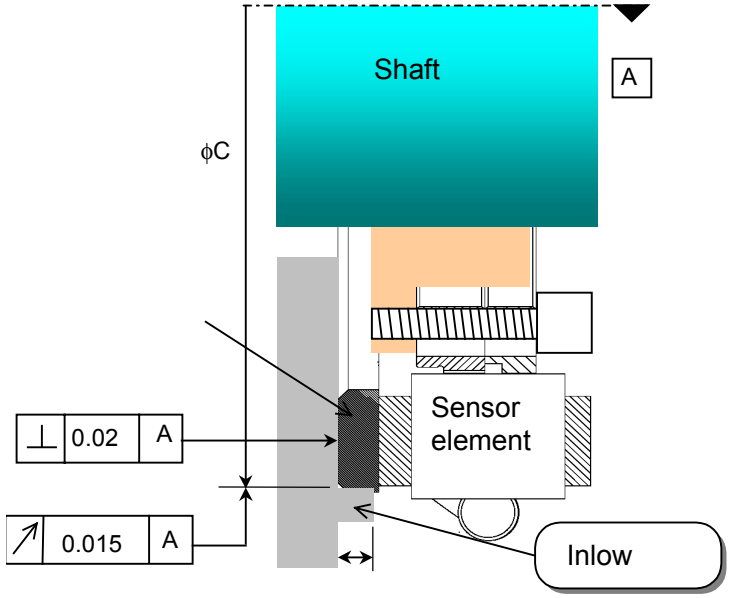


Specification	Outside diameter of the centering track (ϕB)	Sensor ring mounting hole position	Screw
A860-2140-T411	ϕ101	Six ϕ5.5 through holes evenly located on a ϕ92 circle	M5
A860-2140-T511	ϕ152.2	Six ϕ5.5 through holes evenly located on a ϕ140 circle	M5
A860-2140-T611	ϕ203.4	Six ϕ6.6 through holes evenly located on a ϕ183 circle	M6

NOTE
- Make design in such a way that the clearance between the outer surface of the flange and the inner diameter of the sensor ring is approximately 0.1 mm for centering.
- Secure the sensor ring using end face screwing instead of shrinkage fitting.
- The sensor ring consists of the phase Z ring and phase AB ring. Since it is secured by screws in advance, do not remove them. Since a countersunk hole is not provided, a machine must be designed so that the head of a screw is out of the way of it.
- To perform centering, be sure to use the centering track. (The outer surface of the phase Z ring and the teeth pitch circle do not have the same axis.) For centering, use a plastic hammer to prevent the teeth of a gear being damaged.
- Magnetic dust attached on the gear teeth may cause a detection error. Perform air blowing or the like upon completion of centering.

Attaching the sensor mounting ring

Provide an inlow on the machine side and then attach the sensor mounting ring by engaging the outer surface of the sensor mounting ring in the inner surface of the inlow. (The sizes related to the inlow parts on the machine side must meet the conditions shown below so that the detection accuracy is not degraded.) When securing it by screws, push the mounting ring from the CN1 sensor side against the inlow and then secure it as shown in the following figure. After securing it, use a feeler gage or other tool to verify that the gap between the sensor ring and the sensor is greater than 0.08 mm.

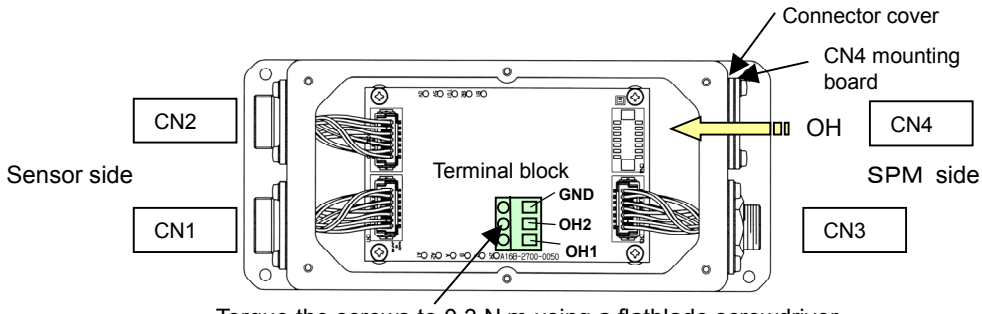


Specification	Outside diameter of the sensor mounting ring	Inside diameter of the inlow (ϕC)	Height of the inlow (D)	Distance from the bottom of the sensor mounting ring to the bottom of the sensor ring (E)
A860-2140-T411	$\phi 140^{+0}_{-0.015}$	$\phi 140^{+0.015}_{-0}$	5.5 or less	11.5±0.2
A860-2140-T511	$\phi 190^{+0}_{-0.015}$	$\phi 190^{+0.015}_{-0}$	7.5 or less	13.5±0.2
A860-2140-T611	$\phi 242^{+0}_{-0.015}$	$\phi 242^{+0.015}_{-0}$	7.5 or less	13.5±0.2

NOTE
- Provide an inlow, if possible, on the machine side and engage the sensor mounting ring to the inlow. Do not tap the outer surface of the sensor mounting ring for centering.

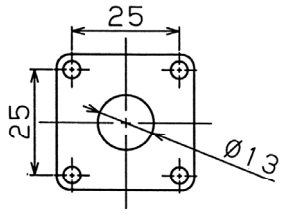
Connecting an OH cable

Open the lid of the preamplifier box and then remove the connector cover on the CN4 side. Draw the OH cable from the CN4 side and then connect it to the terminal block on the printed circuit board.



Torque the screws to 0.3 N·m using a flatblade screwdriver.

The cable clamp for an OH cable must be prepared by the user. To fix the cable clamp, use the CN4 connector attachment board.
Recommended cable clamp: SKINTOP ST-7 of LAPP CABLE
Outside diameter of an OH cable: ϕ5.2±0.3
Diameter of the holes in the CN4 connector attachment board: ϕ13



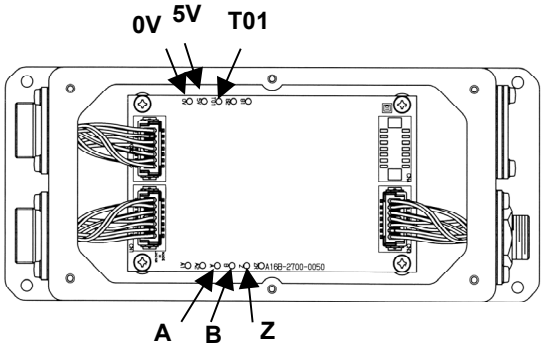
CN4 connector attachment

NOTE
- Since the sensor, preamplifier, and sensor ring are integrally adjusted, these components must be treated as a single component. In addition, since the variable resistor on the board within the preamplifier is adjusted in advance, the resistor value must not be changed.
- "CN1" (black) and "CN2" (blue) is marked in the connector section on the sensor side. The appropriate connectors must be connected as shown in the figure above.

Checking output signals

When checking output signals, see "Electric specification" (output signals do not need to be adjusted).

- When checking a waveform without connecting to the SPM, supply power to the 0 V and 5 V pins.
- The shape of the lissajous for A/B phase output signals is a perfect circle



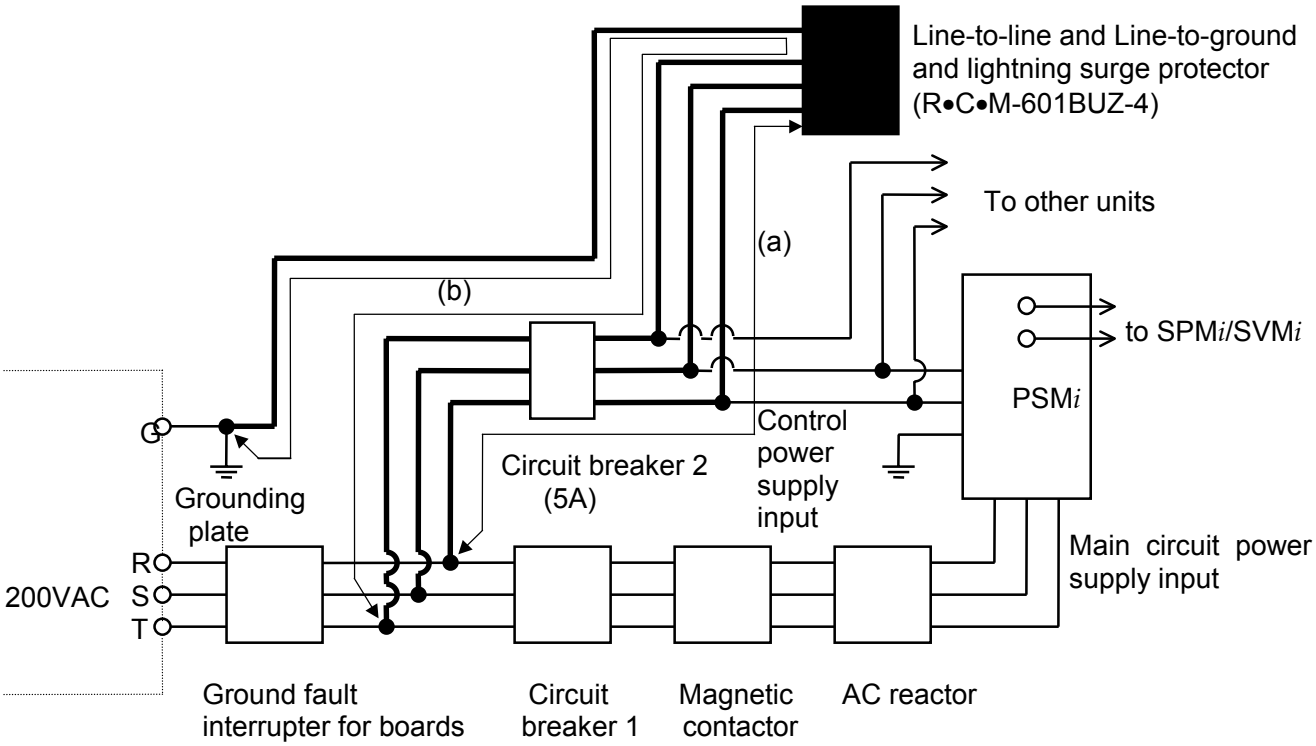
APPENDIX

A FITTING A LIGHTNING SURGE PROTECTION DEVICE

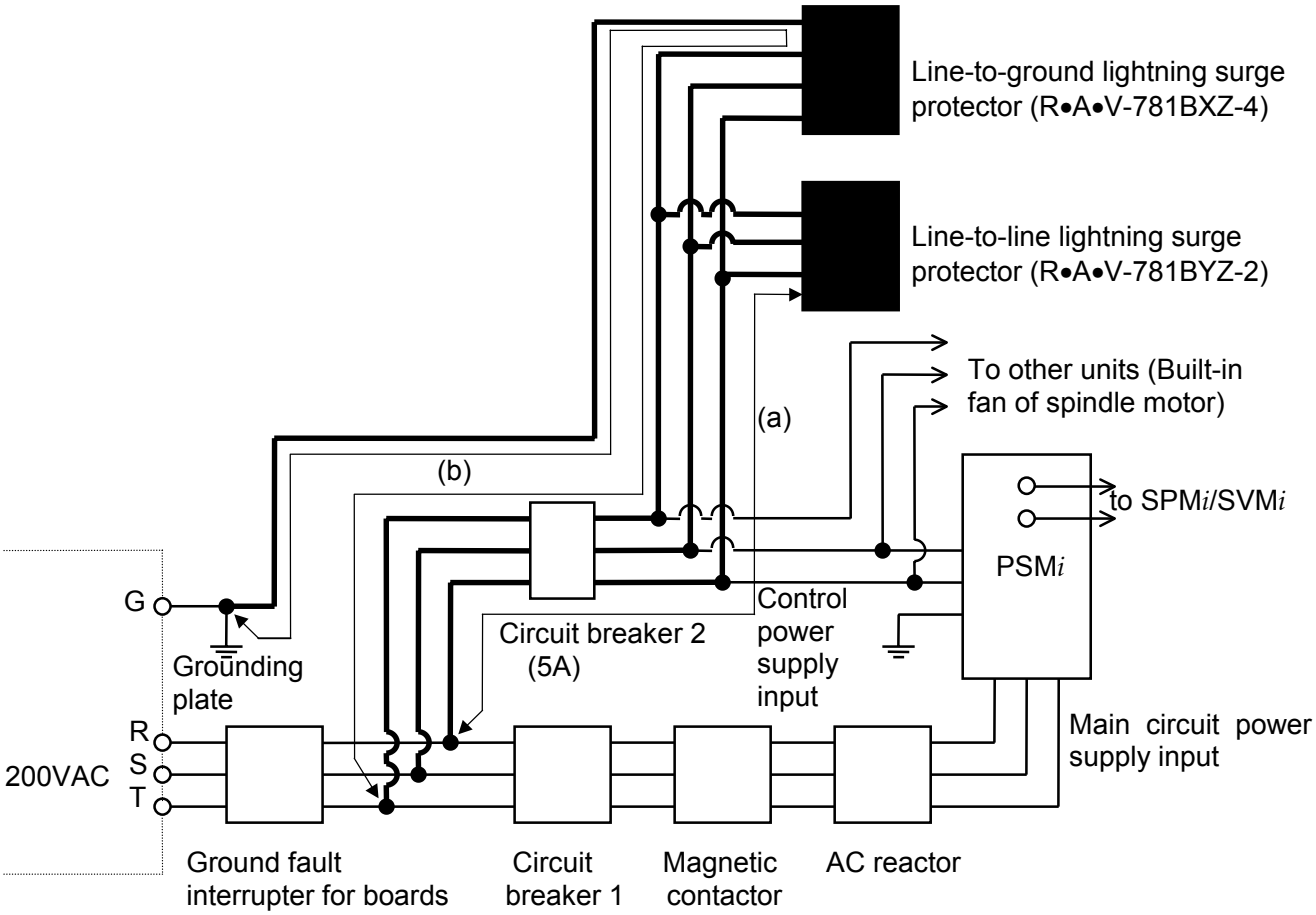
This appendix describes how to install a lightning surge protector and provides notes on installation.

A.1 200-V INPUT SERIES POWER SUPPLY

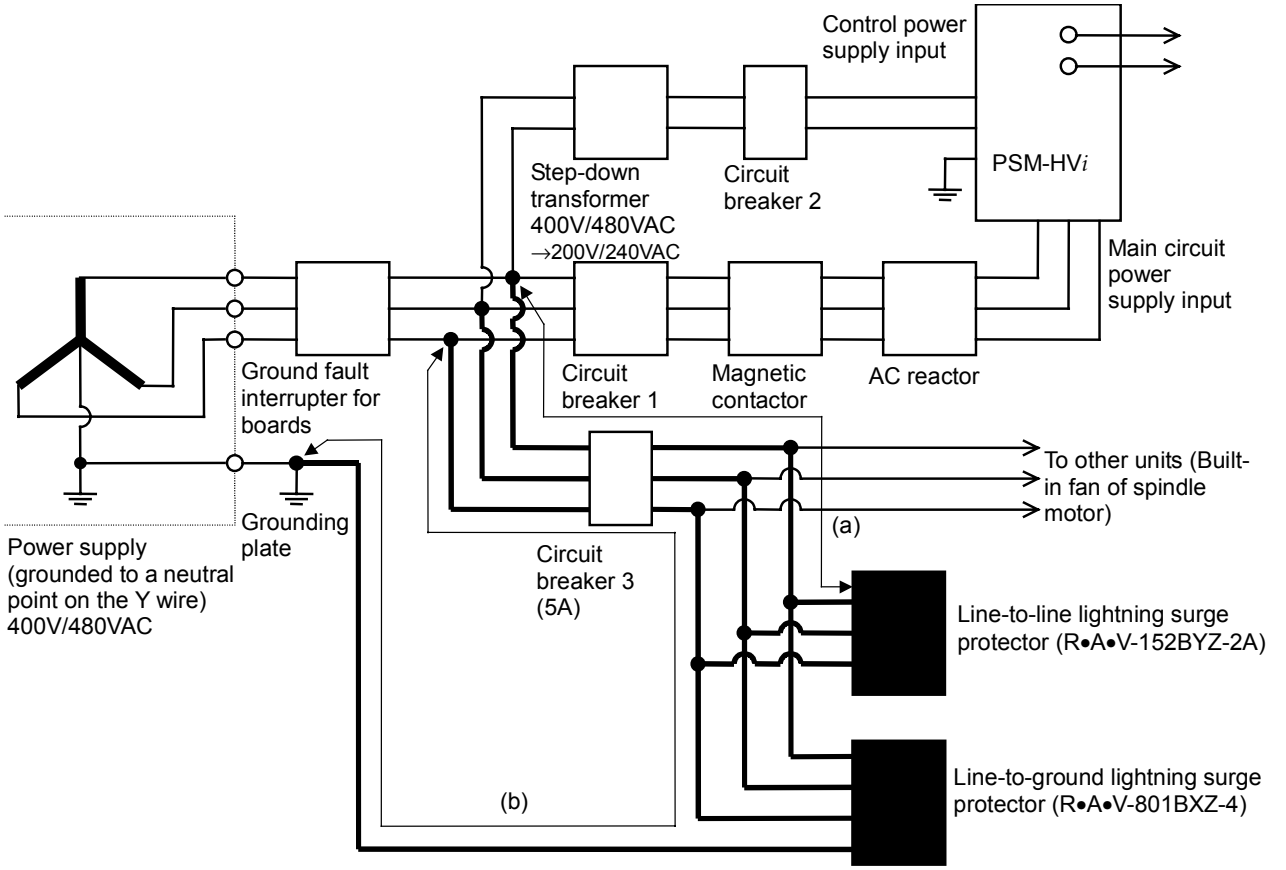
When a line-to-line and line-to-ground lightning surge protector is used



When line-to-line and line-to-ground lightning surge protectors are individually used



A.2 400-V INPUT SERIES POWER SUPPLY



> ⚠ **CAUTION**
> When the spindle motor α1HV*i*, α1.5HV*i*, α2HV*i*, or α3HV*i* is used, specification of the fan motor for αT1HV*i*, αT2HV*i*, and αT3HV*i* is below :
> 1ϕ 200/230VAC

A.3 CAUTIONS

(1) To increase the efficiency of lightning surge absorption, the wires indicated by bold lines should be as short as possible.
Wire cross-sectional area : 2 mm^2 or more
Wire length :
The total length of the cables used for line-to-line lightning surge protector (a) and that used for line-to-ground lightning surge protector (b) must not exceed 2 m.

(2) When performing a dielectric strength test by applying an overvoltage to the power line, line-to-ground lightning surge protector must be removed to enable the applied voltage to be maintained.

(3) The circuit breaker 2 (5A) or circuit breaker 3 (5A) works for line protection when the lightning surge absorber is short-circuited because of a surge higher than its rating being applied.

(4) Because current does not flow through lightning surge protector in a normal state, the circuit breaker 2 (5A) or circuit breaker 3 (5A) can be used together with the surge absorbers as well as with other equipment.

B CABLES

This appendix describes the cables used for the 20-pin interface connectors.
The cables are basically the same as those used for the FS16/18.
The table below lists the cables we have developed for interface connectors.
Contact the manufacturers as required.

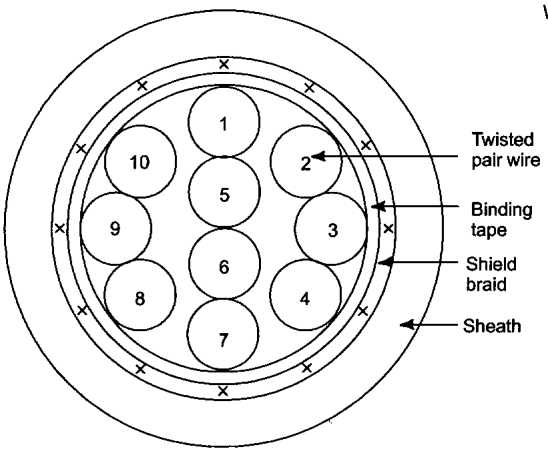
Cable name	Purpose		Configuration	FANUC specification	Manufacturer	Manufacturer specification
10-pair cable	For general use		0.09mm^2 10 pairs	A66L-0001-0284#10P	Hitachi Electric Cable Co., Ltd.	UL20276-SB(0) 10P×28AWG(7/0.127)
					Oki Electric Cable Co., Ltd.	7/0.127 10P VX10-SV
Composite 7-core cable	For Pulsecoder	28m or less Flexible	0.3mm^2 5 cables 0.20mm^2 1 pairs	A66L-0001-0460	Hitachi Electric Cable Co., Ltd.	UL20276-SB(FLEX) 5×23AWG+1P×25AWG
		50m or less Flexible	0.5mm^2 5 cables 0.20mm^2 1 pairs	A66L-0001-0462	Hitachi Electric Cable Co., Ltd.	UL20276-SB(FLEX) 5×20AWG+1P×25AWG
		28m or less Fixed	0.3mm^2 5 cables 0.18mm^2 1 pairs	A66L-0001-0481	Hitachi Electric Cable Co., Ltd.	UL20276-SB(0) 5×23AWG+1P×25AWG
		50m or less Fixed	0.5mm^2 5 cables 0.18mm^2 1 pairs	A66L-0001-0491	Hitachi Electric Cable Co., Ltd.	UL20276-SB(0) 5×20AWG+1P×25AWG
Composite 10-core cable	For M*i* sensor(for α0.5*i*) For MZ*i* sensor(for α0.5*i*)		0.3mm^2 2 cables 0.2mm^2 4 pairs	A66L-0001-0482	Hitachi Electric Cable Co., Ltd.	UL20276-SB(FLEX) 2×23AWG+4P×25AWG
Composite 12-core cable	For α positioncoder For α positioncoder S		0.5mm^2 6 cables 0.18mm^2 3 pairs	A66L-0001-0286	Hitachi Electric Cable Co., Ltd.	F-CO-VV(0)-SB 6×0.5SQ+3P×0.18SQ
					Oki Electric Cable Co., Ltd.	MIX12C(7/0.18, 20/0.18)HRS-SV
10-pair cable	For CZ*i* sensor		0.18mm^2 10 pairs	A66L-0001-0367	Shinko Electric Industries Co., Ltd.	FNC-019
Composite 16-core cable	For M*i* sensor For MZ*i* sensor For BZ*i* sensor		0.5mm^2 6 cables 0.18mm^2 5 pairs	A66L-0001-0368	Shinko Electric Industries Co., Ltd.	FNC-021

B.1 10-PAIR CABLE

Specifications

Item		Unit	Specifications
Product No.		–	A66L-0001-0284#10P
Manufacturer		–	Hitachi Cable,Ltd. Oki Electric Cable, Co.,Ltd.
Rating		–	60°C, 30V:UL2789 80°C, 30V:UL80276
Material	Conductor	–	Stranded wire of tinned annealed copper (ASTM B-286)
	Insulator	–	Cross-linked vinyl
	Shield braid	–	Tinned annealed copper wire
	Sheath	–	Heat-resistant oilproof vinyl
Number of pairs		Pairs	10
Conductor	Size	AWG	28
	Structure	Conductors/ mm	7/0.127
	Outside diameter	mm	0.38
Insulator	Thickness	mm	0.1 (Thinnest portion : 0.08(3. 1mils))
	Outside diameter (approx.)	mm	0.58
	Core style (rating)	mm	UL15157(80°C, 30V)
Twisted pair	Outside diameter (approx.)	mm	1.16
	Pitch	mm	20 or less
Lay		–	Collect the required number of twisted pairs into a cable, then wrap binding tape around the cable. To make the cable round, apply a cable separator as required.
Lay diameter (approx.)		mm	3.5
Drain wire		Conductors/ mm	Hitachi Cable : Not available Oki Electric Cable : Available,10/0.12
Shield braid	Element wire diameter	mm	0.12
	Braid density	%	85 or more
Sheath	Color	–	Black
	Thickness	mm	1.0
	Outside diameter (approx.)	mm	6.2
Standard length		mm	200
Packing method		mm	Bundle
Electrical performance	Resistance of conductor (20°C)	Ω/km	233 or less
	Insulation resistance (20°C)	MΩ-km	10 or less
	Dielectric strength (AC)	V/min	300
Flame resistance		–	Shall pass flame resistance test VW-1SC of UL standards.

Cable structure

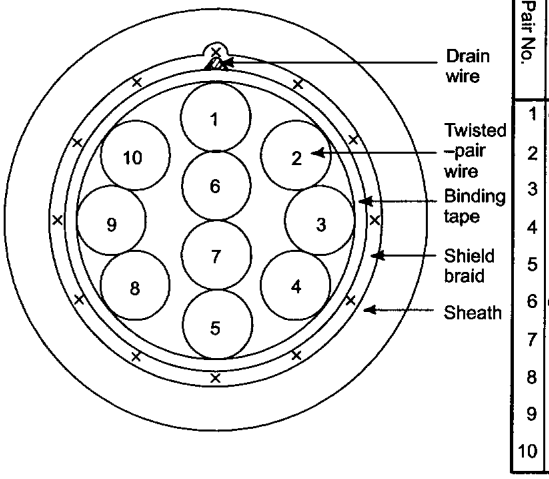


Wire identification table (Hitachi)

Wire No.	Insulator color	
	First wire	Second wire
1	Blue	White
2	Yellow	White
3	Green	White
4	Red	White
5	Purple	White
6	Blue	Brown
7	Yellow	Brown
8	Green	Brown
9	Red	Brown
10	Purple	Brown

The numbers assigned to the wires correspond to the numbers in the table at right.

Fig.B.1(a) Cable made by Hitachi Electric Cable



Wire identification table (Oki)

Pair No.	Insulator color	Dot mark (1 pitch)	Dot mark color	
			First wire	Second wire
1	Orange	—	Red	Black
2	Gray	—	Red	Black
3	White	—	Red	Black
4	Yellow	—	Red	Black
5	Pink	—	Red	Black
6	Orange	— —	Red	Black
7	Gray	— —	Red	Black
8	White	— —	Red	Black
9	Yellow	— —	Red	Black
10	Pink	— —	Red	Black

The numbers assigned to the wires correspond to the numbers in the table at right.

Fig.B.2(b) Cable made by Oki Electric Cable

B.2 COMPOSITE 7-CORE CABLE

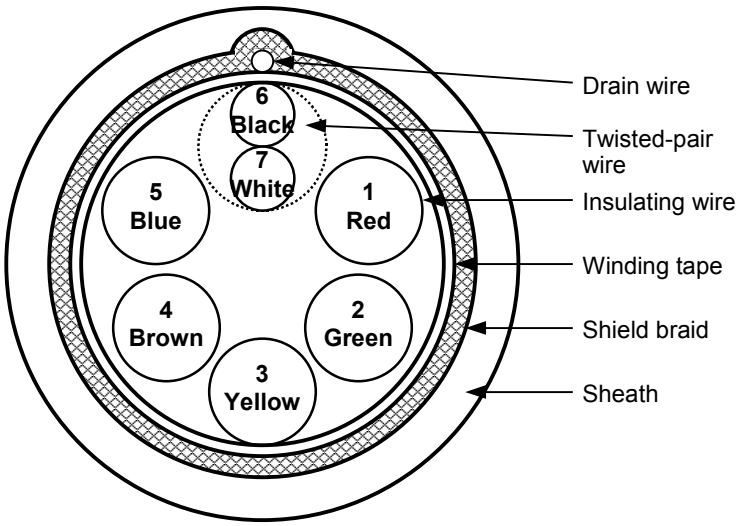
A66L-0001-0460

- Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0460	
Manufacturer		–	Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor,braid-shielded wire,drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Fluorine plastics (ETFE)	
	Sheath	–	Oilproof, heat-resistant vinyl	
Number of wires (wire nos.)		Cores	5 (1 to 5)	2 (one pair) (6 to 7)
Conductor	Size	mm^2	0.3	0.20
	Structure	Conductors /mm	60/0.08	40/0.08
	Conductors	mm	0.72	0.58
Insulator	Standard thickness	mm	0.15	0.15
	Outside diameter	mm	1.02	0.88
Twisted pair	Outside diameter	mm	–	1.76
	Pitch (approx.)	mm	–	13
Lay diameter (approx.)		mm	3.4	
Drain wire	Size	mm^2	0.15	
	Structure	Wires/mm	30/0.08	
	Outside diameter	mm	0.51	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	4.2	
Sheath Sheath	Color	–	Black	
	Standard thickness	mm	1.0	
	Standard outside diameter (approx.)	mm	6.2	
	Outside diameter allowance	mm	5.7 to 7.3 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	69.5 or less (1 to 5)	109 or less (6 to 7)
	Insulation resistance (20°C)	MΩ-km	100 or more	
	Dielectric strength (AC)	–	500VAC for 5 minutes	
Flame resistance		–	Shall pass flame resistance test VW-1 of UL standards.	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

- Cable structure



The colors in the figure indicate the colors of insulators.

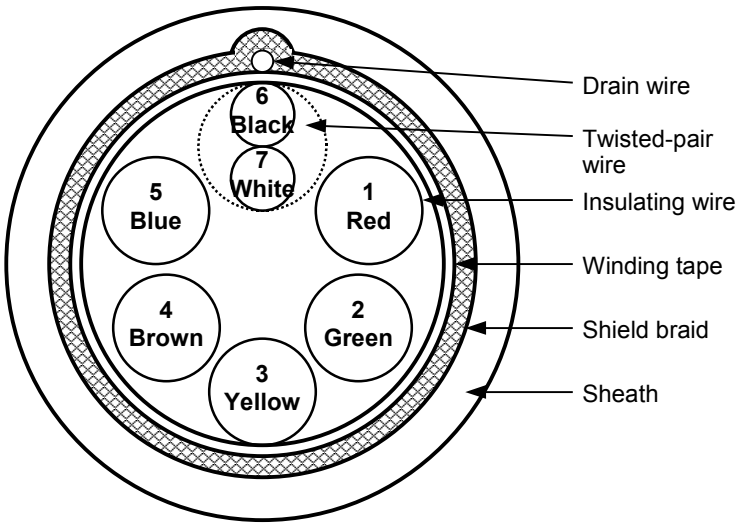
A66L-0001-0462

- Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0462	
Manufacturer		–	Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor,braid-shielded wire,drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Fluorine plastics (ETFE)	
	Sheath	–	Oilproof, heat-resistant vinyl	
Number of wires (wire nos.)		Cores	5 (1 to 5)	2 (one pair) (6 to 7)
Conductor	Size	mm^2	0.5	0.20
	Structure	Conductors /mm	104/0.08	40/0.08
	Conductors	mm	0.94	0.58
Insulator	Standard thickness	mm	0.2	0.15
	Outside diameter	mm	1.34	0.88
Twisted pair	Outside diameter	mm	–	1.76
	Pitch (approx.)	mm	–	13
Lay diameter (approx.)		mm	4.2	
Drain wire	Size	mm^2	0.15	
	Structure	Wires/mm	30/0.08	
	Outside diameter	mm	0.51	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	5.0	
Sheath	Color	–	Black	
	Standard thickness	mm	1.0	
	Standard outside diameter (approx.)	mm	7.0	
	Outside diameter allowance	mm	6.5 to 8.0 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	40.1 or less (1 to 5)	109 or less (6 to 7)
	Insulation resistance (20°C)	MΩ-km	100 or more	
	Dielectric strength (AC)	–	500VAC for 5 minutes	
Flame resistance		–	Shall pass flame resistance test VW-1 of UL standards.	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

- Cable structure



The colors in the figure indicate the colors of insulators.

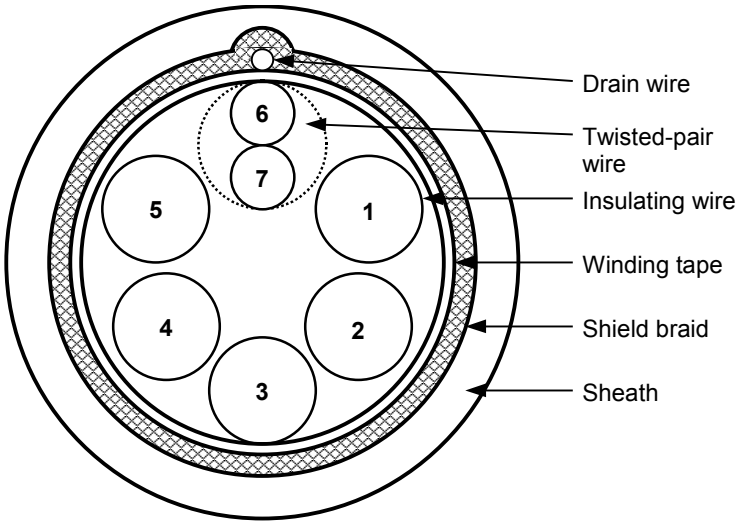
A66L-0001-0481

- Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0481	
Manufacturer		–	Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor,braid-shielded wire,drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant vinyl	
	Sheath	–	Oilproof, heat-resistant vinyl	
Number of wires (wire nos.)		Cores	5 (1 to 5)	2 (one pair) (6 to 7)
Conductor	Size	mm^2	0.3	0.18
	Structure	Conductors /mm	12/0.18	7/0.18
	Conductors	mm	0.72	0.54
Insulator	Standard thickness	mm	0.25	0.25
	Outside diameter	mm	1.22	0.94
Twisted pair	Outside diameter	mm	–	1.88
	Pitch (approx.)	mm	–	20
Lay diameter (approx.)		mm	3.9	
Drain wire	Size	mm^2	0.18	
	Structure	Wires/mm	7/0.18	
	Outside diameter	mm	0.54	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	4.6	
Sheath	Color	–	Black	
	Standard thickness	mm	0.8	
	Standard outside diameter (approx.)	mm	6.2	
	Outside diameter allowance	mm	5.7 to 7.3 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	65.7 or less (1 to 5)	113 or less (6 to 7)
	Insulation resistance (20°C)	MΩ-km	15 or more	
	Dielectric strength (AC)	–	500VAC for 5 minutes	
Flame resistance		–	Shall pass flame resistance test VW-1 of UL standards.	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

- Cable structure



The numbers assigned to the wires correspond to the numbers in the table below.

Wire No.	Insulator color	Dot mark color
1	Yellow	--
2	Yellow	Black
3	Yellow	Red
4	Bright green	Black
5	Bright green	Red
6	Light brown	Black
7	Light brown	Red

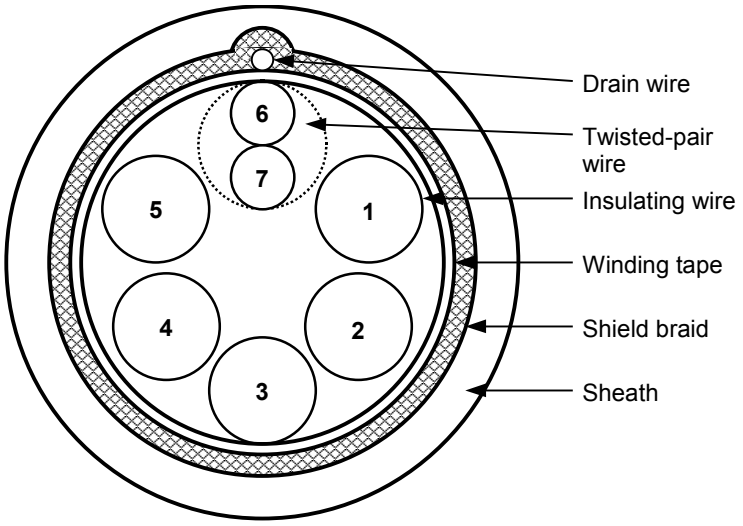
A66L-0001-0491

- Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0491	
Manufacturer		–	Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor,braid-shielded wire,drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant vinyl	
	Sheath	–	Oilproof, heat-resistant vinyl	
Number of wires (wire nos.)		Cores	5 (1 to 5)	2 (one pair) (6 to 7)
Conductor	Size	mm^2	0.5	0.18
	Structure	Conductors /mm	20/0.18	7/0.18
	Conductors	mm	0.93	0.54
Insulator	Standard thickness	mm	0.25	0.25
	Outside diameter	mm	1.43	0.94
Twisted pair	Outside diameter	mm	–	1.88
	Pitch (approx.)	mm	–	23
Lay diameter (approx.)		mm	4.4	
Drain wire	Size	mm^2	0.18	
	Structure	Wires/mm	7/0.18	
	Outside diameter	mm	0.54	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	5.1	
Sheath	Color	–	Black	
	Standard thickness	mm	0.55	
	Standard outside diameter (approx.)	mm	6.2	
	Outside diameter allowance	mm	5.7 to 7.3 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	39.4 or less (1 to 5)	113 or less (6 to 7)
	Insulation resistance (20°C)	MΩ-km	15 or more	
	Dielectric strength (AC)	–	500VAC for 5 minutes	
Flame resistance		–	Shall pass flame resistance test VW-1 of UL standards.	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

- Cable structure



The numbers assigned to the wires correspond to the numbers in the table below.

Wire No.	Insulator color	Dot mark color
1	Light brown	--
2	Yellow	--
3	Yellow	Black
4	Yellow	Red
5	Bright green	--
6	Light brown	Black
7	Light brown	Red

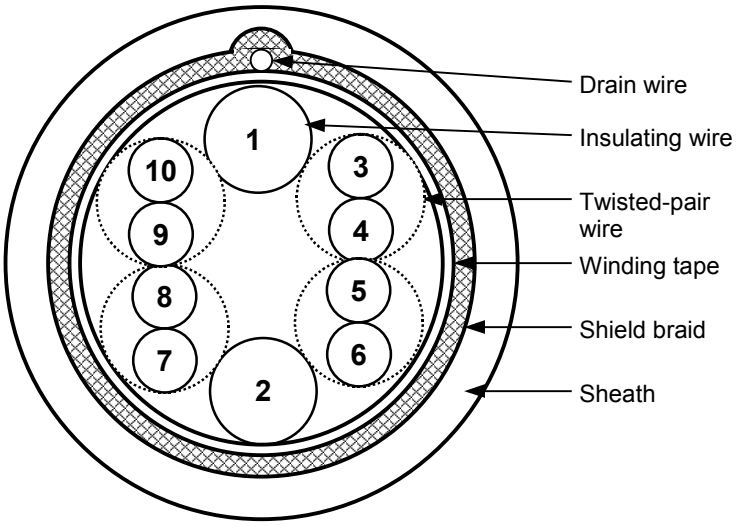
B.3 COMPOSITE 10-CORE CABLE

Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0482	
Manufacturer		–	Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant vinyl	
	Sheath	–	Oilproof, heat-resistant vinyl	
Number of wires (wire nos.)		Cores	2	8 (four pairs)
Conductor	Size	mm^2	0.3	0.2
	Structure	Conductors /mm	60/0.08	40/0.08
	Conductors	mm	0.72	0.58
Insulator	Standard thickness	mm	0.25	0.2
	Outside diameter	mm	1.22	0.98
Twisted pair	Outside diameter	mm	–	1.96
	Pitch (approx.)	mm	–	
Lay diameter		mm	5.0	
Drain wire	Size	mm^2	0.15	
	Structure	Wires/mm	30/0.08	
	Outside diameter	mm	0.51	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	5.7	
Sheath	Color	–	Black	
	Standard thickness	mm	0.65	
	Standard outside diameter (approx.)	mm	7.0	
	Outside diameter allowance	mm	6.5 to 8.0 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	69.5 or less	109 or less
	Insulation resistance (20°C)	MΩ-km	15 or more	
	Dielectric strength (AC)	–	500VAC for 5 minutes	
Flame resistance		–	Shall pass flame resistance test VW-1 of UL standards.	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

Cable structure



The numbers assigned to the wires correspond to the numbers in the table below.

Wire No.	Insulator color	Dot mark color
1	Light brown	--
2	Yellow	--
3	Light brown	Black
4	Light brown	Red
5	Yellow	Black
6	Yellow	Red
7	Bright green	Black
8	Bright green	Red
9	Gray	Black
10	Gray	Red

B.4 COMPOSITE 12-CORE CABLE

Specifications

Item		Unit	Specifications	
Product No.		–	A66L-0001-0286	
Manufacturer		–	Hitachi Electric Cable Co., Ltd. Oki Cable, Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant flame-retardant vinyl	
	Sheath	–	Oilproof, heat-resistant, flame-retardant vinyl	
Number of wires (wire nos.)		Cores	6 (1 to 6)	6 (three pairs) (7 to 9)
Conductor	Size	mm^2	0.5	0.18
	Structure	Conductors /mm	20/0.18	7/0.18
	Conductors	mm	0.94	0.54
Insulator	Standard thickness (The minimum thickness is at least 80% of the standard thickness.)	mm	0.25	0.2
	Outside diameter	mm	1.50	0.94
Twisted pair	Outside diameter	mm		1.88
	Direction of lay	–		Left
	Pitch	mm		20 or less
Lay		–	Twist the wires at an appropriate pitch so the outermost layer is right-twisted, and wrap tape around the outermost layer. Apply a cable separator as required.	
Lay diameter		mm	5.7	
Drain wire	Size	mm^2	0.3	
	Structure	Wires/mm	12/0.18	
	Outside diameter	mm	0.72	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	70	
	Outside diameter	mm	6.3	
Sheath	Color	–	Black	
	Standard thickness (The minimum thickness is at least 85% of the standard thickness.)	mm	1.1	
	Outside diameter	mm	8.5Max.9.0(1)	
Standard length		m	100	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (at 20°C) (wire nos.)	Ω/km	39.4 (1 to 6)	113 (7 to 9)
	Insulation resistance (20°C)	MΩ-km	15	
	Dielectric strength (AC)	V/min	500	
Flame resistance		–	Shall pass flame resistance test VW-1SC of UL standards.	

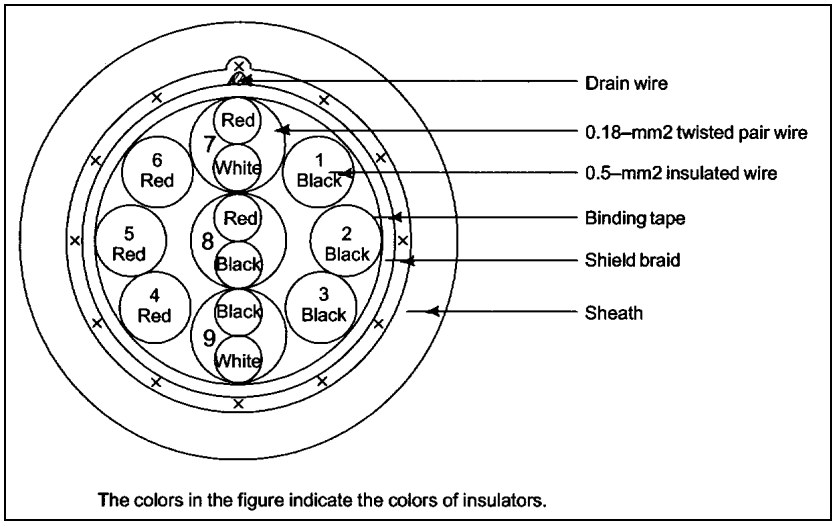
NOTE
The maximum outside diameter applies to portions other than the drain wire.

Markings on cable

(i) Name or symbol of the manufacturer
(ii) Manufacturing year

Cable structure

The cable structure is shown below.

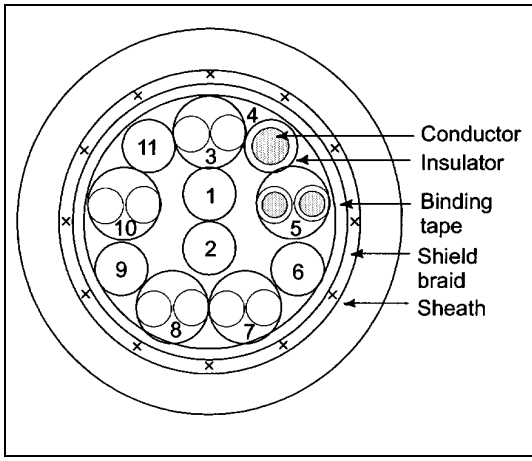


B.5 COMPOSITE 16-CORE CABLE

Specifications

Item			Unit	Specifications	
Product No.				A66L-0001-0368(FNC-021)	
Manufacturer				Shinko Electric Industries Co., Ltd.	
Rating				80°C, 60V	
Material	Conductor			Stranded wire of tinned annealed copper (JIS C 3152)	
	Insulator			Heat-resistant polivinyl chioride	
	Shield braid			Tinned annealed copper wire	
	Sheath			Heat-resistant, oil-resistance, flame-retardent polivinyl chioride (S-3)	
Number of pairs			Pairs	6	10 (5-pair)
Conductor	Nominal cross-sectional area		mm^2	0.5	0.18
	Structure		Conductors /mm	20/0.18	7/0.18
	Outside diameter (approx.)		mm	0.9	0.54
Insulator	Thickness		mm	0.25 (Average thickness : 90% or more)	0.2 (Average thickness : 90% or more)
	Outside diameter (approx.)		mm	1.5	0.94
Twisted pair	Outside diameter (approx.)		mm	–	1.88 (pitch : 20 mm or less)
Lay	Diameter (approx.)		mm	6.5	
Tape-wound wire	Diameter (approx.)		mm	6.6	
Drain wire	Structure		Conductors /mm	12/0.18	
Shield	Element wire diameter		mm	0.12 (Braid density : 70% or more)	
Sheath	Color			Black	
	Thickness		mm	1.0 (Average thickness : 90% or more)	
	Outside diameter		mm	9.2 ± 0.3	
Electrical performance	Electric resistance	$0.18mm^2$	Ω/km	113 or less (20°C JIS C 3005 6)	
		$0.5mm^2$		39.4 or less (20°C JIS C 3005 6)	
	Dielectricstrength		V/min	AC500(JIS C 3005 8 (2))	
	Insulation resistance		MΩ-km	15 or more (20°C JIS C 3005 9.1)	

Cable structure



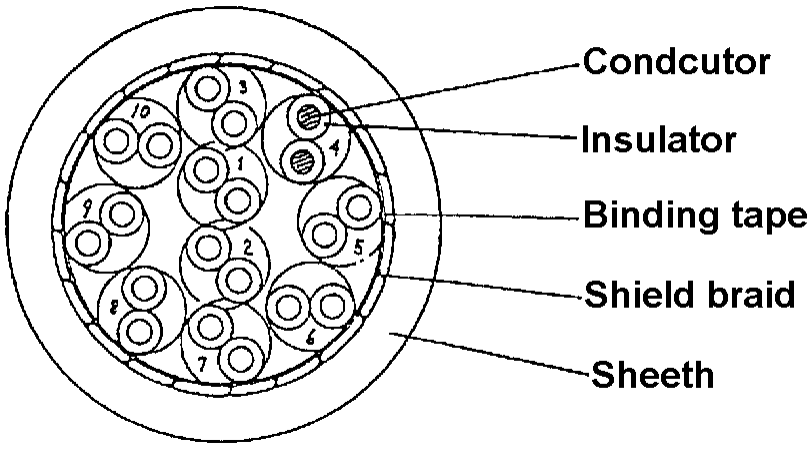
Pair No.	Dot mark color	Size mm^2
1	Red	0.5
2	Red	0.5
3	White/Yellow	0.18
4	Black	0.5
5	White/Green	0.18
6	Black	0.5
7	White/Gray	0.18
8	Black/Orange	0.18
9	Black	0.5
10	Black/Brown	0.18
11	Red	0.5

B.6 10-PAIR CABLE

Specifications

Item		Unit	Specifications
Product No.			A66L-0001-0367(FNC-019)
Manufacturer			Shinko Electric Industries Co., Ltd.
Rating			80°C, 60V
Material	Conductor		Stranded wire of tinned annealed copper (JIS C 3152)
	Insulator		Heat-resistant polivinyl chioride
	Shield braid		Tinned annealed copper wire
	Sheath		Heat-resistant, oil-resistance, flame-retardent polivinyl chioride (S-3)
Number of pairs		Pairs	20 (10-pair)
Conductor	Nominal cross-sectional area	mm^2	0.18
	Structure	Conductors /mm	7/0.18
	Outside diameter (approx.)	mm	0.54
Insulator	Thickness	mm	0.25 (Average thickness : 90% or more)
	Outside diameter (approx.)	mm	1.04
Twisted pair	Outside diameter (approx.)	mm	2.08 (pitch : 25 mm or less)
Lay	Diameter (approx.)	mm	6.5
Tape-wound wire	Diameter (approx.)	mm	6.6
Shield	Element wire diameter	mm	0.12 (Braid density : 70% or more)
Sheath	Color		Black
	Thickness	mm	1.0 (Average thickness : 90% or more)
	Outside diameter	mm	9.2 ± 0.3
Electrical performance	Electric resistance	Ω/km	110 or less (20°C JIS C 3005 6)
	Dielectricstrength	V/min	AC500(JIS C 3005 8 (2))
	Insulation resistance	MΩ-km	15 or more (20°C JIS C 3005 9.1)

Cable structure



Pair number	Dot mark color
1	Black/Orange
2	Black/Gray
3	White/Yellow
4	White/Green
5	White/Brown
6	White/Orange
7	White/Gray
8	Black/Yellow
9	Black/Green
10	Black/Brown

C EXTERNAL DIMENSIONS OF EACH CONNECTOR

Manufacture : Tyco Electronics AMP
Type : 1-178128-3

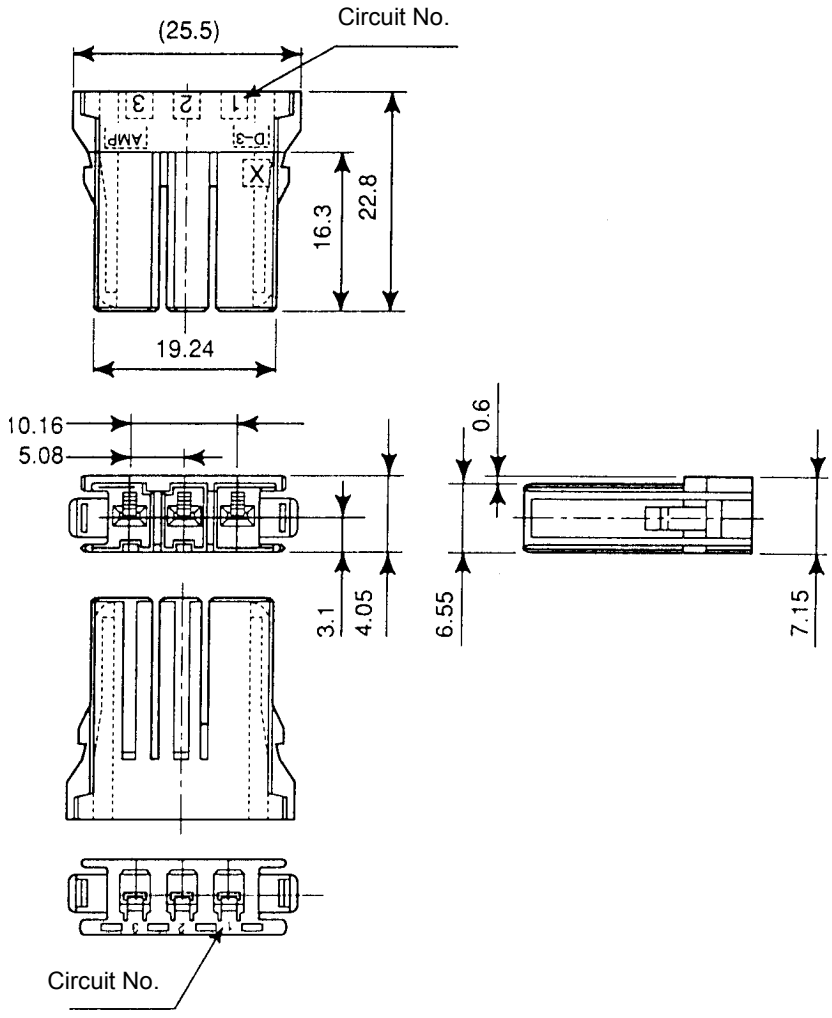


Fig.C(a) Tyco Electronics AMP connector (1)

Manufacture : Tyco Electronics AMP
Type : 2-178128-3

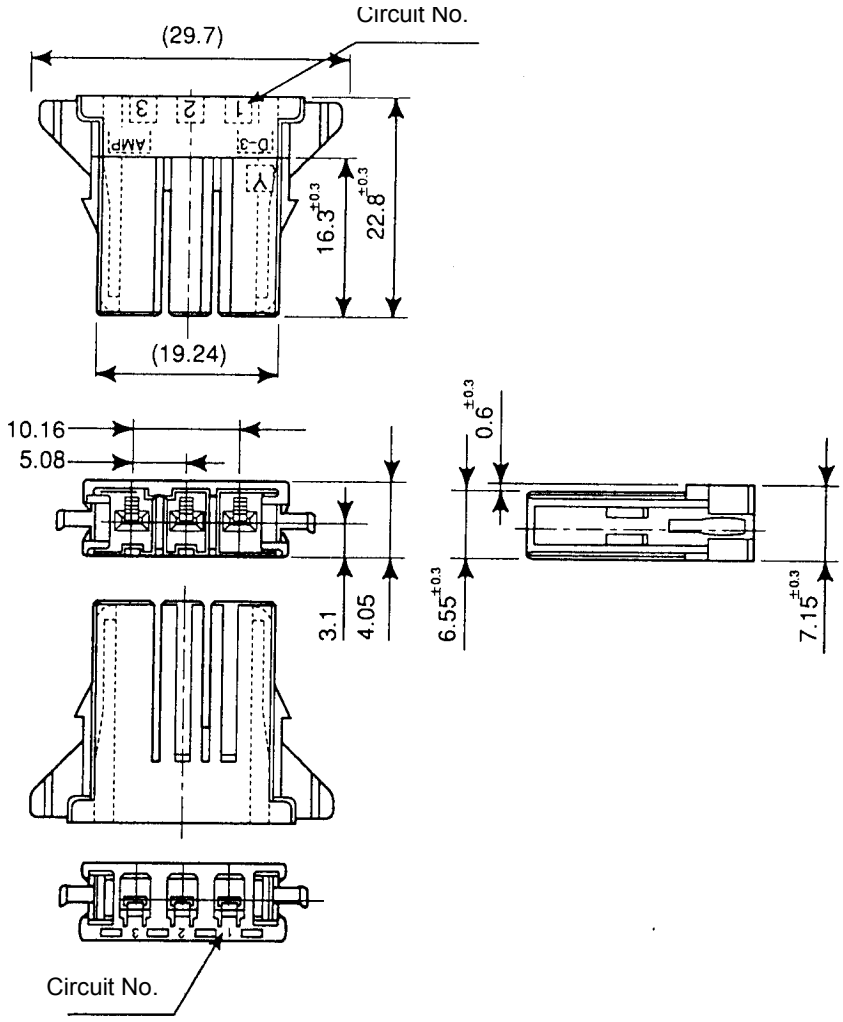


Fig.C(b) Tyco Electronics AMP connector (2)

Manufacture	:	Tyco Electronics AMP
Type	:	1-175218-2
Cable	:	AWG16, 18, 20

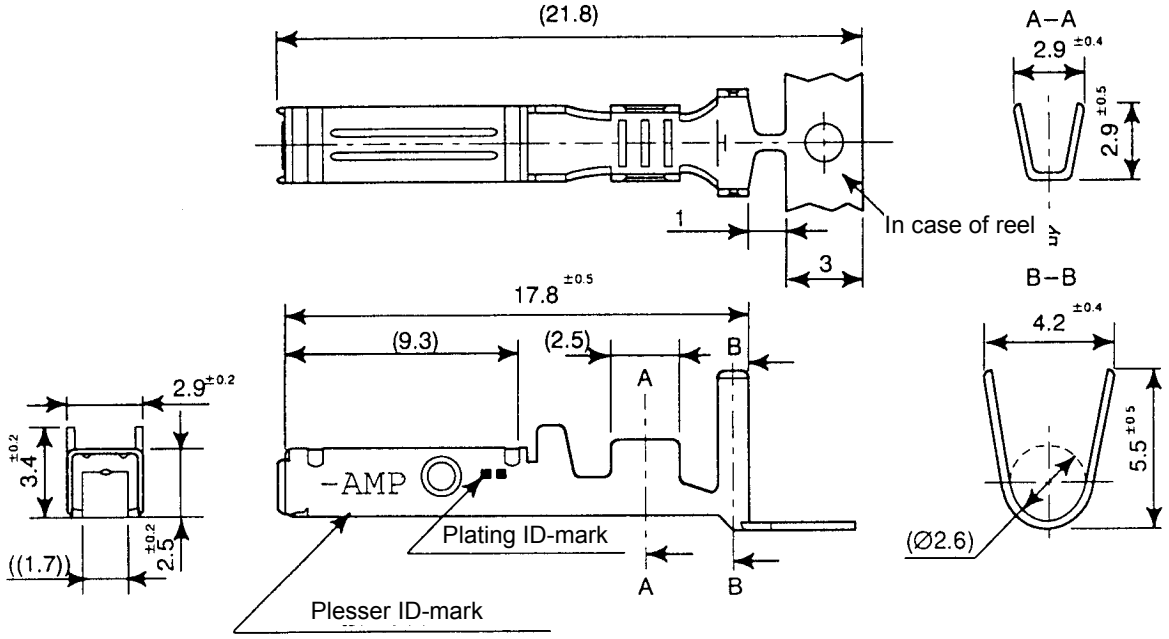


Fig.C(c) Contact for Tyco Electronics AMP connector

Manufacture : Tyco Electronics AMP
Type : 1-1318119-4

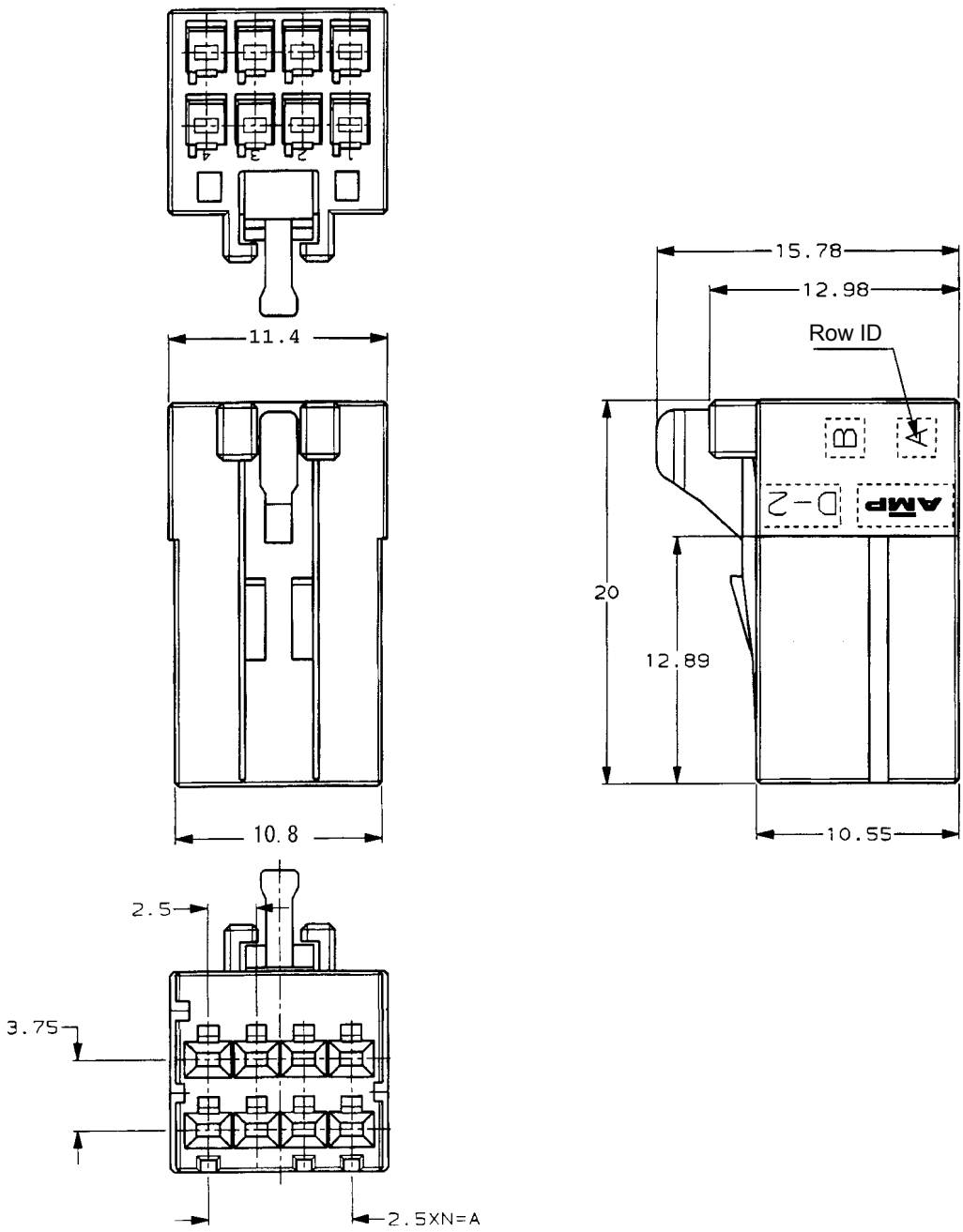


Fig.C(d) Contact for Tyco Electronics AMP connector

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI30-20S (crimp type)
Housing	:	FI-20-CVS2 (plastic)

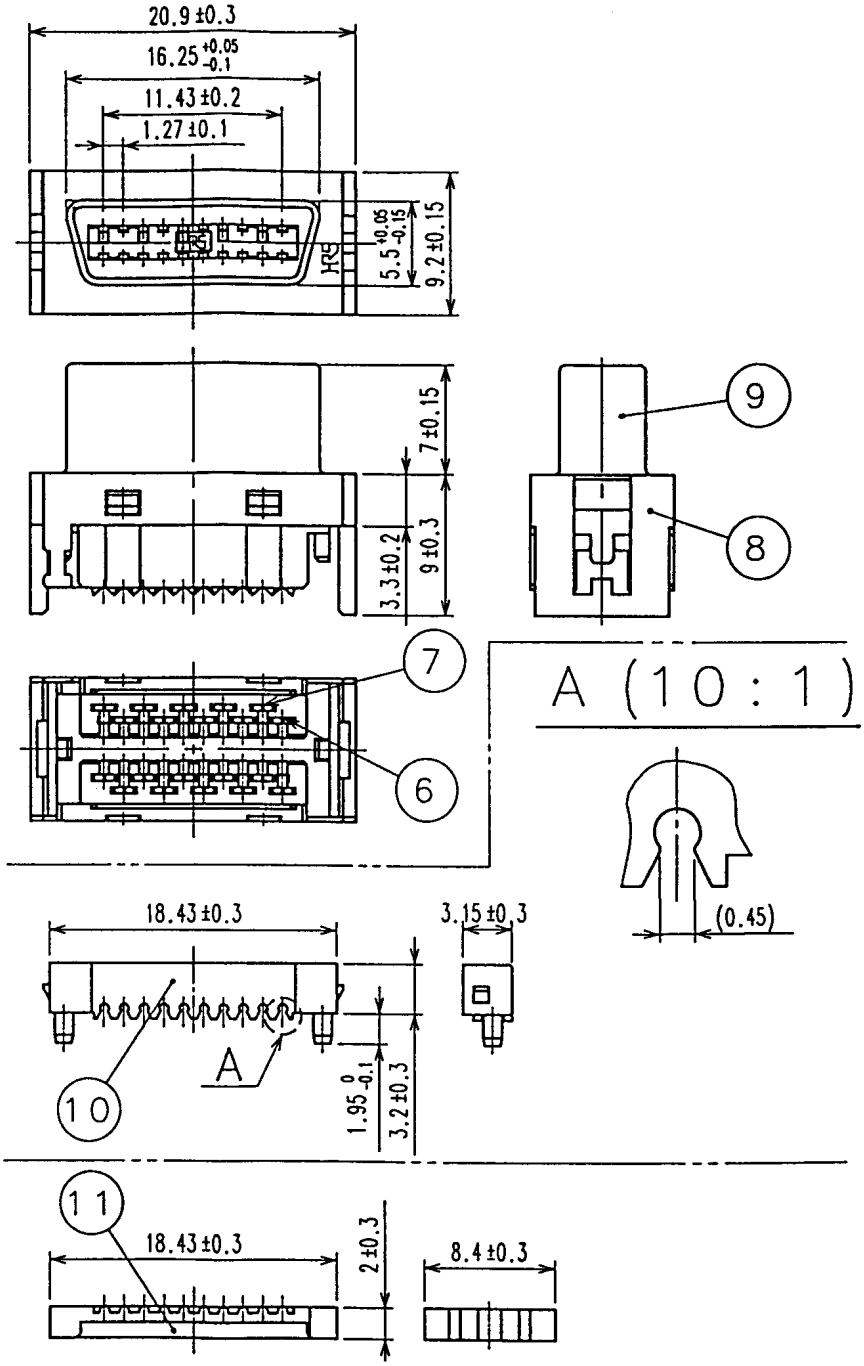


Fig.C(e) Connector for interface (Crimp type)

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI40-20S (solder type)
Housing	:	FI-20-CVS5 (plastic)

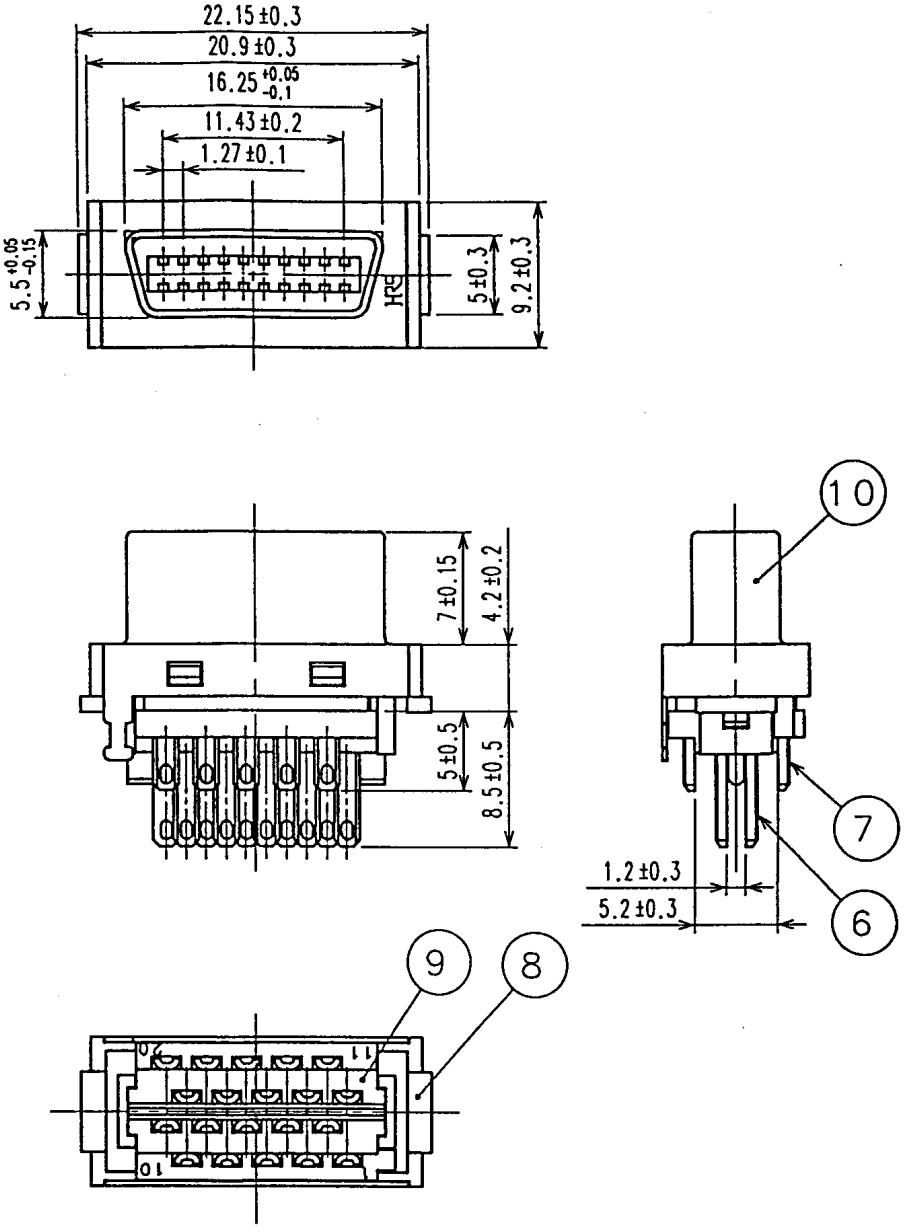


Fig.C(f) Connector for interface (Solder type)

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI40B-2015S (solder type)
Housing	:	FI-2015-CVS (plastic)

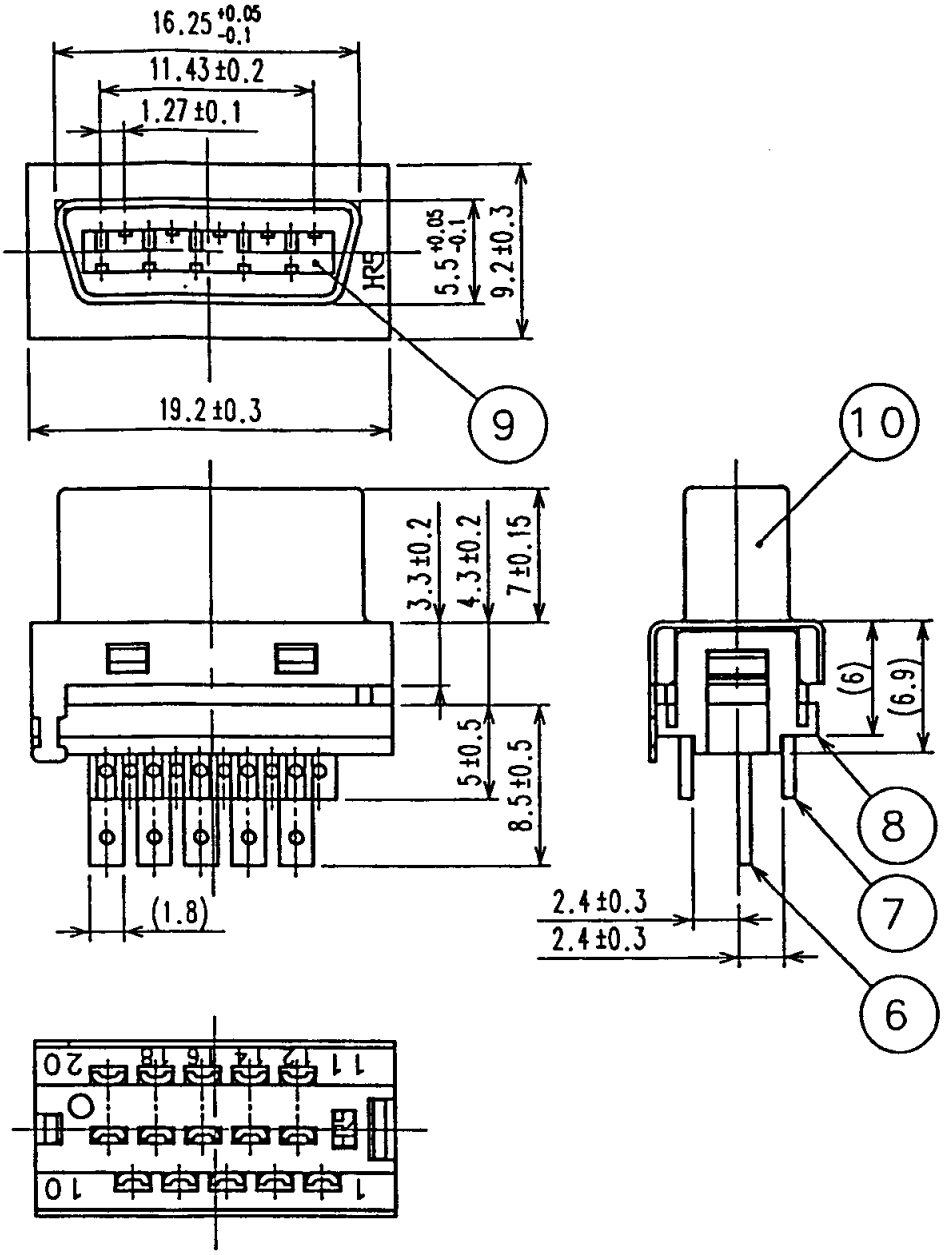


Fig.C(g) Connector for interface (Solder type)

NOTE
This connector does not contact locations 11, 13, 15, 17, and 19.

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI-20-CVS2
Connector	:	FI30-20S

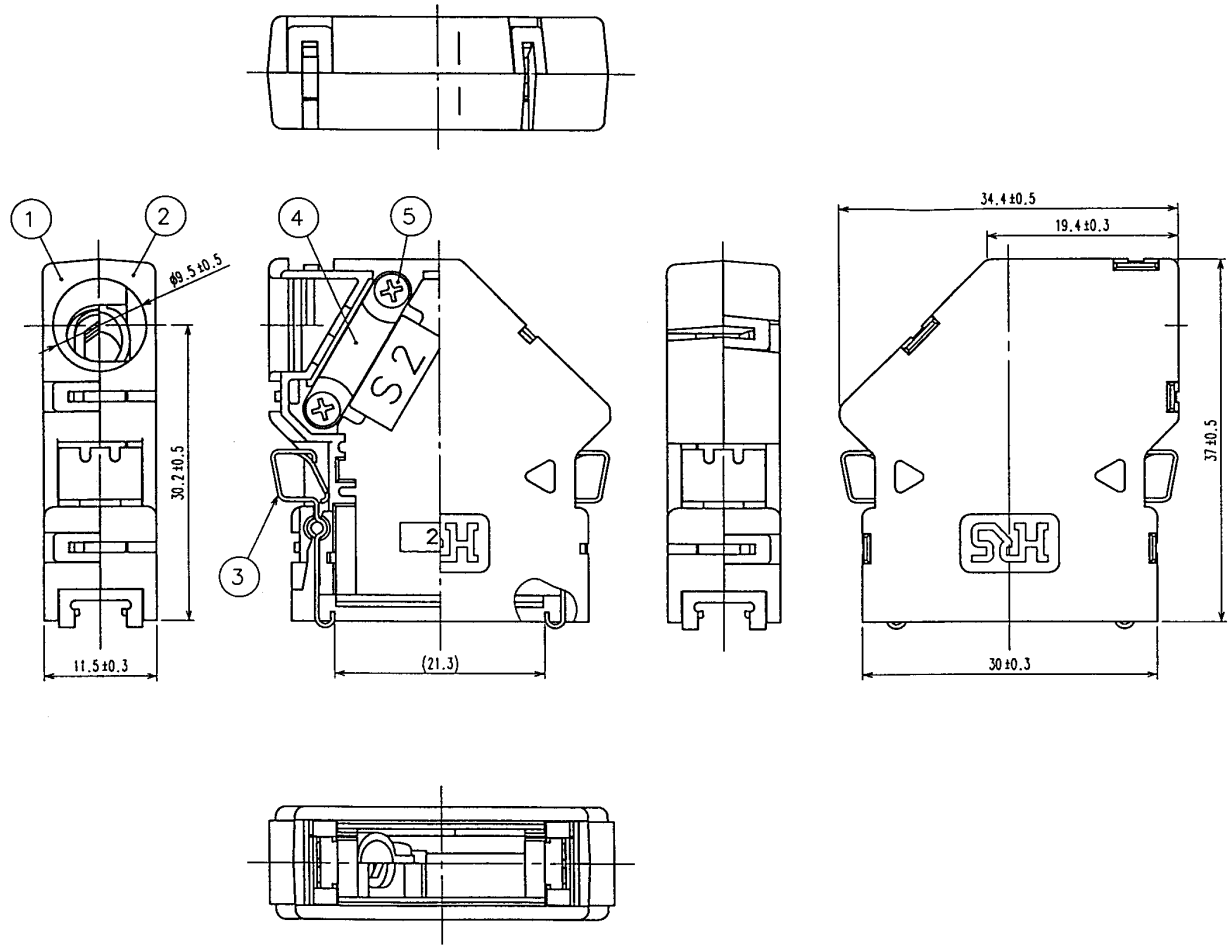


Fig.C(h) Connector housing (Side cable type)

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI-20-CVS5
Connector	:	FI40B-20S

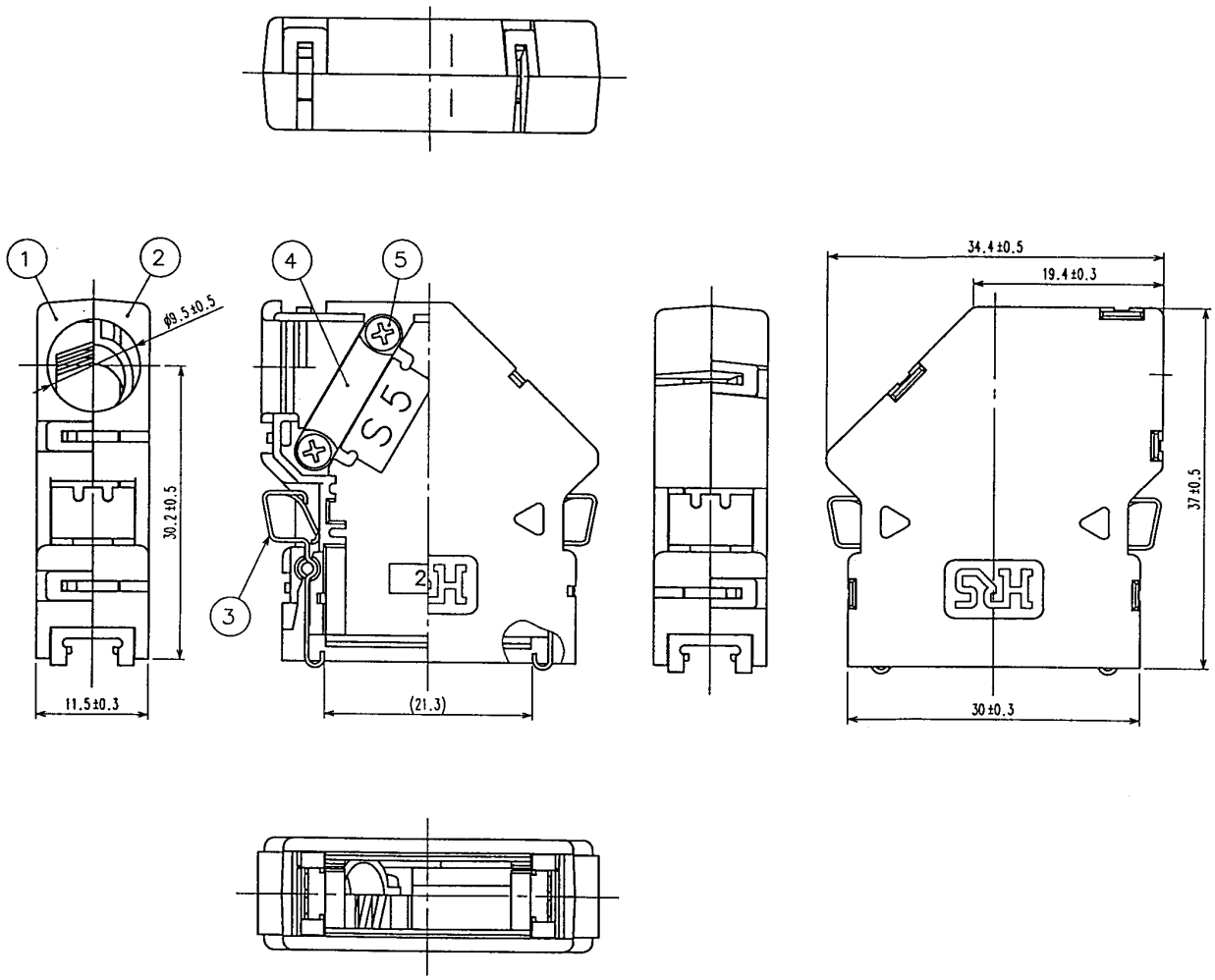


Fig.C(i) Connector housing (Side cable type)

Manufacture	:	HIROSE ELECTRIC CO., LTD.
Type	:	FI-2015-CVS
Connector	:	FI40B-2015S

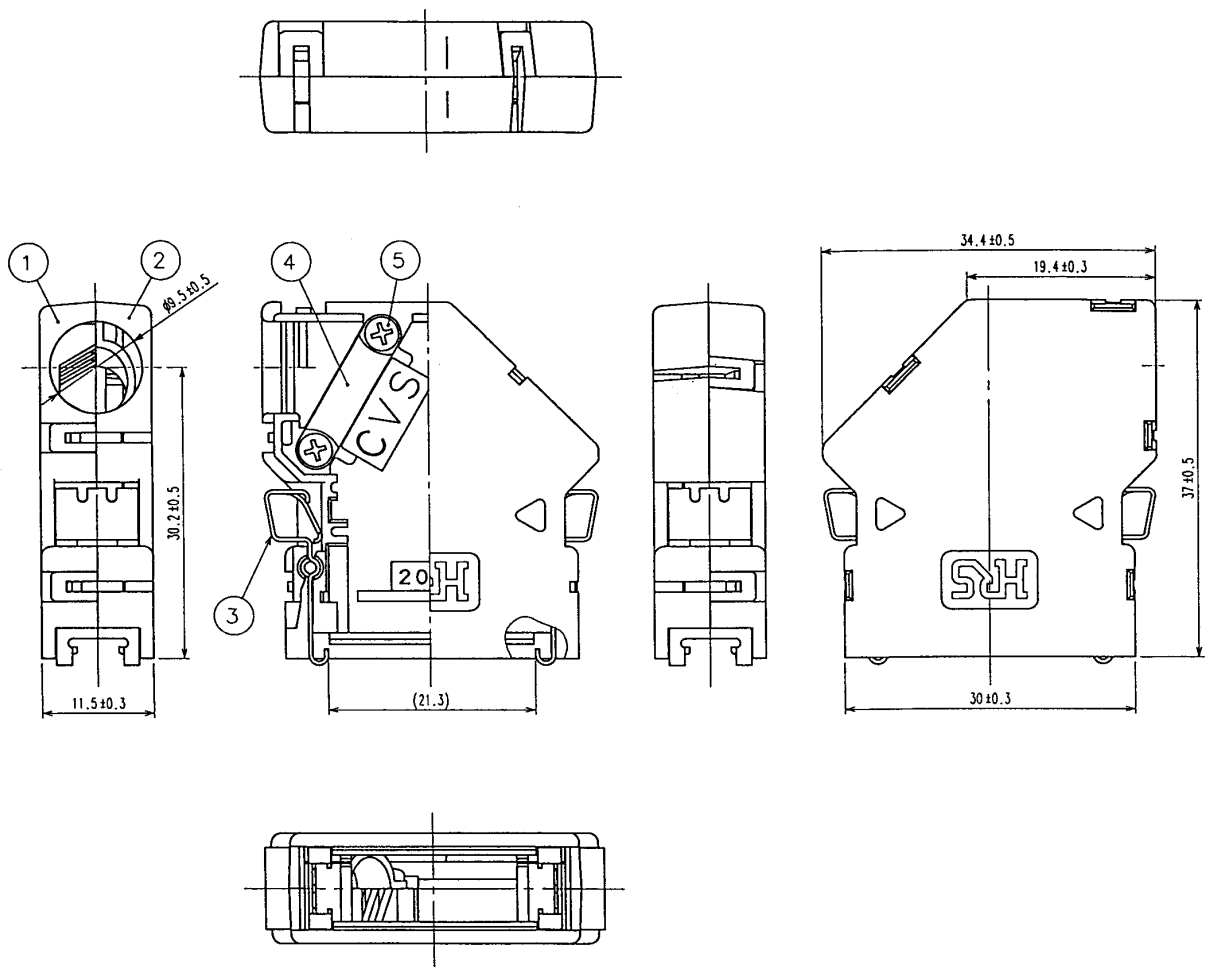


Fig.C(j) Connector housing (Side cable type)

D FEEDBACK CABLE LENGTH

D.1 SPINDLE CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)

Detector	Recommended cable	Cable structure	Maximum cable length
M*i* sensor	A66L-0001-0368	0.5mm^2, 6 conductors (for power supply) 0.18mm^2, 5 pairs (for signals)	72m When one power line is used
MZ*i* sensor, BZ*i* sensor	A66L-0001-0368	0.5mm^2, 6 conductors (for power supply) 0.18mm^2, 5 pairs (for signals)	50m When one power line is used
M*i* sensor (for α0.5*i*)	A66L-0001-0482	0.3mm^2, 2 conductors (for power supply) 0.2mm^2, 3 pairs (for signals)	41m
MZ*i* sensor (for α0.5*i*)	A66L-0001-0482	0.3mm^2, 2 conductors (for power supply) 0.2mm^2, 4 pairs (for signals)	28m
CZ*i* sensor	A66L-0001-0367	0.18mm^2, 10 pairs (for signals and power supply)	18m When three power lines is used
α positioncoder	A66L-0001-0286	0.5mm^2, 6 conductors (for power supply) 0.18mm^2, 3 pairs (for signals)	7m When one power line is used
α positioncoder S	A66L-0001-0286	0.5mm^2, 6 conductors (for power supply) 0.18mm^2, 3 pairs (for signals)	7m When one power line is used

When a cable other than one of the recommended cables above is used, the voltage drop in the cable must be within 0.2 V for a +5 V power supply.

(Tip)

Maximum cable length L can be found from the following formula:

$L[m] \leq 0.2[V] \times n[line] \div 2 \div I[A] \div R[\Omega/m]$

n : Number of power lines (number of +5V or +15V lines)

I : Current consumption of the detector

R : Resistance of a wire used for a power line

Detector	Current consumption
M*i* sensor (pulse generator)	0.035A
MZ*i* sensor, BZ*i* sensor (built-in sensor)	0.05A
CZ*i* sensor	0.15A
α Positioncoder	0.35A
α Positioncoder S	0.35A

D.2 SERVO CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)

Recommended cable	Cable structure	Maximum cable length
A66L-0001-0460	0.3mm^2, 5 conductors (for power supply) 0.20mm^2, 1 pair (for signals)	28m
A66L-0001-0462	0.5mm^2, 5 conductors (for power supply) 0.20mm^2, 1 pair (for signals)	50m
A66L-0001-0481	0.3mm^2, 5 conductors (for power supply) 0.18mm^2, 1 pair (for signals)	28m
A66L-0001-0491	0.5mm^2, 5 conductors (for power supply) 0.18mm^2, 1 pair (for signals)	50m

When a cable other than recommended cable is used, ensure that the sum of the resistances of 0 V and 5 V is 2 ohms or less.

E POWER LINE FOR SERVO MOTOR AND AMPLIFIER

E.1 SELECTING A POWER CABLE

Select the cable specification by considering the following conditions for use:

<1> Motor current rating or current needed in use on a real machine
<2> Cable type (heat resistance temperature, etc.)
<3> Environment in which the cable is installed (operating ambient temperature, etc.)
<4> Need of water proofing (pay attention to the diameter of the applicable cable clamp)
<5> Certification for CE marking (compliance with various safety standards and EMC standard)
<6> Insulation distance between the cable and terminal is secured at the time of wiring.

Examples of selecting a heavy-duty power cable are shown below. Fully check the cable specifications based on the actual use conditions and use an example below.
The cable diameters are determined based on JCS No. 168 D (1980), "Allowable Currents for Power Cables (1)."

Selection example of power line (reference)

[Selection example 1]

- Heavy-duty power cable specification :
  Maximum allowable conductor temperature 60°C
- Environment temperature : 30°C

Cable diameter [mm^2]	Allowable current value [Arms]	Receptacle contact specification
0.75	Up to 11	SS size 1318986-6
1.25	Up to 15	S size 316040-6
2	Up to 19	S size 316040-6
3.5	Up to 27	M size 316041-6
5.5	Up to 35	M size 316041-6
8	Up to 43	L size 1318697-6

[Selection example 2]

- Heavy-duty power cable specification :
  Maximum allowable conductor temperature 80°C
- Environment temperature : 55°C

Cable diameter [mm^2]	Allowable current value [Arms]	Receptacle contact specification
0.75	Up to 9.2	SS size 1318986-6
1.25	Up to 12.7	S size 316040-6
2	Up to 16.3	S size 316040-6
3.5	Up to 23.4	M size 316041-6
5.5	Up to 31.2	M size 316041-6
8	Up to 38.3	L size 1318697-6

[Selection example 3]

- Fire-retardant polyflex wire or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.:
  Maximum allowable conductor temperature 105°C
- Environment temperature : 30°C

Cable diameter [mm^2]	Allowable current value [Arms]
0.75	Up to 12
1.25	Up to 16
2	Up to 21
3.5	Up to 32
5.5	Up to 43
8	Up to 55
14	Up to 79
22	Up to 113
30	Up to 137

[Selection example 2]

- Fire-retardant polyflex wire or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.:
  Maximum allowable conductor temperature 105°C
- Environment temperature : 55°C

Cable diameter [mm^2]	Allowable current value [Arms]
0.75	Up to 10
1.25	Up to 13
2	Up to 17
3.5	Up to 26
5.5	Up to 35
8	Up to 44
14	Up to 64
22	Up to 92
30	Up to 112
38	Up to 131

E.2 SAMPLE POWER CABLES SELECTED FOR SERVO MOTORS (REFERENCE)

Examples of selections when a heavy-duty power cord is used

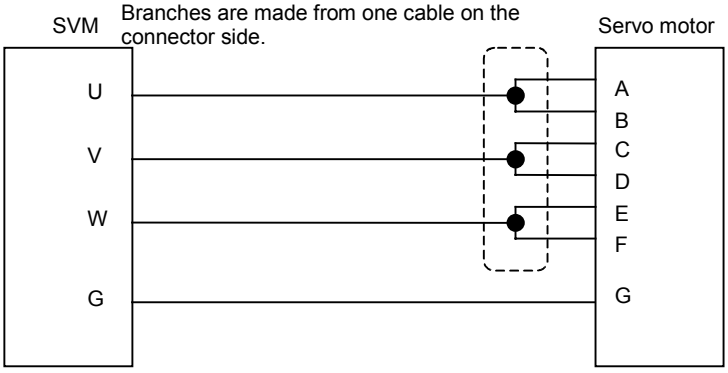
Servo motor	Continuous rated current [Arms] (reference value)	Environment temperature 30°C Cable diameter [mm^2]	Environment temperature 55°C Cable diameter [mm^2]
α1/5000*i*	2.7	0.75	0.75
α2/5000*i*s	3.3	0.75	0.75
α2/5000*i*	3.5	0.75	0.75
α4/5000*i*s	6.1	0.75	0.75
α4/4000*i*	7.7	0.75	0.75
α8/3000*i*	8.4	0.75	0.75
α8/4000*i*s	11.1	0.75	1.25
α12/4000*i*s	13.4	1.25	2
α12/3000*i*	18.1	2	3.5
α22/3000*i*	18.4	2	3.5
α22/4000*i*s	27.9	5.5	5.5
α30/4000*i*s	31.7	5.5	5.5
α40/3000*i*	32.3	5.5	8
α40/4000*i*s	36.2	8	8
α30/3000*i*	39	8	8

Example of selection when a fire-retardant polyflex wire equivalent to LMFC of The Furukawa Electric Co., Ltd. is used

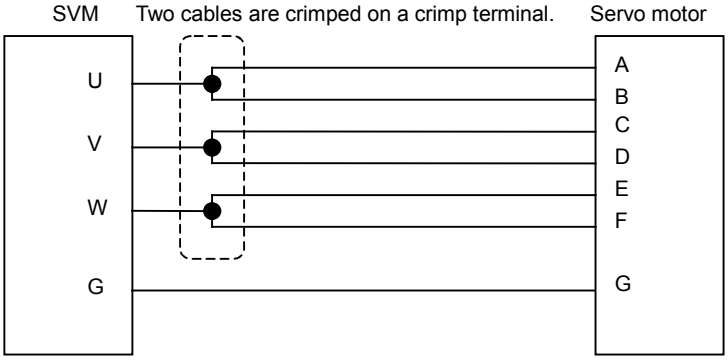
Servo motor	Continuous rated current [Arms] (reference value)	Environment temperature 30°C Cable diameter [mm^2]	Environment temperature 55°C Cable diameter [mm^2]
α50/3000HV*i*s	28	3.5	5.5
α100/2500HV*i*s	40	5.5	8
α50/3000*i*s with fan	79	8×2 (Note 1)	
α100/2500*i*s	79	14	22
α300/2000HV*i*s	96	22	30
α500/2000HV*i*s	115	30	38
α1000/2000HV*i*s	110×2 (Note 2)	22	30

NOTE
1 The power line connector for α50/3000*i*s has seven pins. See connection example 1 and connection example 2.
2 One motor is driven by two servo amplifiers. In this case, the current that flows on the power line per servo amplifier is a half of the motor current.

Connection example 1:



Connection example 2:



E.3 SAMPLE POWER CABLES SELECTED FOR SPINDLE MOTORS (REFERENCE)

Environment temperature:30°C

SPM model	Motor model		Applicable cable		Terminal size	
	αi, α(HV)i	αiP	Heat-resistant 60°C (Note 1)	Heat-resistant 105°C (Note 2)	Amplifier side	Motor side
SPM-2.2i	α0.5i		0.75mm^2		Connector	Connector
	α1i		2mm^2		Connector	M5
SPM-5.5i	α1.5i α2i		3.5mm^2		Connector	M5
	α3i		5.5 mm^2		Connector	M5
SPM-11i	α6i	α12iP	14 mm^2	3.5 mm^2	M4	M5
	α8i		14 mm^2	5.5mm^2	M4	M5
SPM-15i		α15iP	14 mm^2	5.5mm^2	M4	M5
	α12i	α18iP	14 mm^2	8mm^2	M4	M5
SPM-22i	α15i	α22iP		14mm^2	M6	M5
	α18i	α30iP		14mm^2	M6	M6
SPM-26i	α22i	α40iP α50iP		22mm^2	M6	M6
SPM-30i		α60iP		22mm^2	M6	M6
SPM-45i	α30i			30mm^2	M10	M10
	α40i			38mm^2	M10	M10
SPM-55i	α50i			50mm^2	M10	M10
SPM-5.5HVi	α0.5HVi			0.75mm^2	Connector	Connector
	α1HVi α1.5HVi α2HVi α3HVi			0.75mm^2	Connector	M5
SPM-11HVi	α6HVi			2.0 mm^2	M4	M5
	α8HVi			2.0 mm^2	M4	M5
SPM-15HVi	α12HVi			3.5 mm^2	M4	M5
SPM-30HVi	α15HVi			5.5mm^2	M6	M5
	α22HVi			8mm^2	M6	M6
SPM-45i	α30HVi			14mm^2	M6	M10
	α40HVi			22mm^2	M6	M10
SPM-75HVi	α60HVi α100HVi			38mm^2	M10	M10
SPM-100HVi				50mm^2	M10	M10

NOTE
1 Equivalent to four-conductor polyvinyl heavy-duty power cable (JIS C3312)
2 Fire-retardant polyflex wire or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.

Environment temperature:55°C

SPM model	Motor model		Applicable cable		Terminal size	
	αi	αi_P	Heat-resistant 60°C (Note 1)	Heat-resistant 105°C (Note 2)	Amplifier side	Motor side
SPM-2.2i	α0.5i		0.75mm^2		Connector	Connector
	α1i		1.25mm^2		Connector	M5
SPM-5.5i	α1.5i α2i		3.5mm^2		Connector	M5
	α3i		5.5 mm^2		Connector	M5
SPM-11i	α6i	α12i_P	8 mm^2	5.5 mm^2	M4	M5
	α8i		14 mm^2	8mm^2	M4	M5
SPM-15i		α15i_P	14 mm^2	8mm^2	M4	M5
	v12i	α18i_P	14 mm^2	8mm^2	M4	M5
SPM-22i	α15i	α22i_P		14mm^2	M6	M5
	α18i	α30i_P		22mm^2	M6	M6
SPM-26i	α22i	α40i_P α50i_P		22mm^2	M6	M6
SPM-30i		α60i_P		22mm^2	M6	M6
SPM-45i	α30i			38mm^2	M10	M10
	α40i			50mm^2	M10	M10
SPM-55i	α50i			60mm^2	M10	M10
SPM-5.5HVi	α0.5HVi			0.75mm^2	Connector	Connector
	α1HVi α1.5HVi α2HVi			0.75mm^2	Connector	M5
	α3HVi			1.25mm^2	Connector	M5
SPM-11HVi	α6HVi			3.5 mm^2	M4	M5
	α8HVi			3.5 mm^2	M4	M5
SPM-15HVi	α12HVi			5.5 mm^2	M4	M5
SPM-30HVi	α15HVi			5.5mm^2	M6	M5
	α22HVi			14mm^2	M6	M6
SPM-45i	α30HVi			22mm^2	M6	M10
	α40HVi			22mm^2	M6	M10
SPM-75HVi	α60HVi α100HVi			50mm^2	M10	M10
SPM-100HVi				60mm^2	M10	M10

NOTE
1 Equivalent to four-conductor polyvinyl heavy-duty power cable (JIS C3312)
2 Fire-retardant polyflex wire or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.

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Revision Record

FANUC SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN)

Edition	Date	Contents	Edition	Date	Contents
05	Mar., 2003	- Addition and correction of following contents in the Chapter 9 CONNECTION Pulsecoder connection and cables around SPM - Addition of CZi sensor - Addition and Correction of αiS,βi,αiP,αiT series			
04	Sep., 2002	- Addition of following chapter Chapter 10 SPINDLE-RELATED OPTIONS Chapter 11 SPINDLE-RELATED DETECTORS - Addition of data in the Chapter 6 HEAT DISSIPATION - Correction of errors			
03	Dec., 2001	- Correction of errors			
02	Nov., 2001	- Addition of α(HV)i series Amplifier - Addition of PSMR(register discharge type) - Addition of Spindle Amplifier Module (SPMC) for αCi series - Addition of Models (PSM-55i, SPM-45/55i, SVM1-360i, SVM2-4/4i, SVM3-4/4/4i)			
01	Apr., 2001	———————————————			