FANUC SERVO AMPLIFIER αi-B series

DESCRIPTIONS

B-65412EN/02

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- All specifications and designs are subject to change without notice.

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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible."

General Safety Precautions

- When an abnormality such as an alarm or a hardware failure occurs, the operations described in the specifications are not guaranteed unless otherwise specifically noted. When action corresponding to the abnormality is specifically described, take the action. When no action is described, please contact FANUC.
- The signals and functions described in the specifications cannot be used separately for safety functions unless otherwise described as being usable for the safety functions. Their specifications are not assumed to be used as the safety functions in this case, an unexpected danger may be caused. For information about the safety functions, please contact FANUC.

  Generally, the safety functions represent functions that protect the operators from machine danger.
- A wrong device connection or setting can lead to unpredictable operation. When starting to operate the machine for the first time after assembling the machine, replacing components, or modifying parameter settings, exercise the greater care by, for example, reducing the torque limit value, error detection level, or operating speed or by operating the machine in such a way that an emergency stop can be made quickly.

SAFETY PRECAUTIONS

This "Safety Precautions" section describes the precautions which must be observed to ensure safety when using FANUC amplifiers (Power Supplies, servo amplifiers and spindle amplifiers). Users of any servo 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.

This chapter consists of the following.

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.

WARNINGS AND CAUTIONS RELATING TO MOUNTING

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 magnetics cabinet.

- **Be aware of the weight of the amplifier and other components.**
  Servo 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 careful 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. Securely tighten each target screw with the specified tightening torque.

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

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

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

- **Confirm that the input voltage meets the specifications of the amplifier before making connection.**
  If the input voltage exceeds the specified value (for example, if the input voltage for a 200 V input amplifier is 400 V), an internal component may be damaged and burnt out.

- **Prevent conductive, flammable, or corrosive foreign matters, mists, or water droplets from entering the unit.**
  If conductive or flammable foreign matters enter the unit, explosion or corruption may be caused.
  If corrosive or conductive mist or water droplets are attached to an electric circuit, unexpected operation may be caused in the circuit.
  The electronic circuit portion must be installed in an environment of pollution level 2 specified by IEC60664-1. To achieve pollution level 2 in a severe machine tool environment, it is generally necessary to install the portion in a power magnetics cabinet that satisfies IP54.

⚠ WARNING

- **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.

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 this manual.

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

- **Do not block the air inlet to the radiator.**

- **Take appropriate measures to prevent coolant, oil mist, or chips from being adhered to the radiator and fan motors that are exposed to the outside of the power magnetics cabinet.**
  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 fan motors and 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.

- **Check that the amplifier is securely mounted in the power magnetics cabinet.**
  If any clearance is left between the power magnetics 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.

⚠ CAUTION

- **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.

- **Notes relating to this product storage, transportation and environment**
  This servo amplifier uses electronic parts corroded by the halogen (fluorine, chlorine, bromine, iodine, etc.)
  Do not storage or transport or use this servo amplifier in the halogen (fluorine, chlorine, bromine, iodine, etc.) atmosphere.
  Fumigant and industrial cleaning solvent, and pesticide might contain the halogen.

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.

WARNINGS AND CAUTIONS RELATING TO A PILOT RUN

Warning

⚠ WARNING

- **Before turning on the power, check that the cables connected to the power magnetics 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 magnetics cabinet is securely grounded.**

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

⚠ WARNING

- **Apply extreme caution if the door of the power magnetics 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 magnetics cabinet (by opening both the input circuit breaker of the power magnetics 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.**

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 magnetics 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 specified 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.

WARNINGS AND CAUTIONS RELATING TO MAINTENANCE

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 magnetics 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.

- **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 amplifiers 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 magnetics cabinet; Leave the control power on; Place the machine in the emergency stop state so that the power being input to the amplifier is shut off. Replacement work should be done only by a person who is trained in the related maintenance and safety requirements. The power magnetics cabinet in which the servo amplifier is mounted has a high-voltage section. This section presents a severe risk of electric shock.

- **Check the alarm number.**
  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 magnetics cabinet and amplifier.

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 power element will be damaged.

- **Securely tighten each target screw with the specified tightening torque.**

- **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.**

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.

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APPENDIX

1 CONFIGURATION

Chapter 1, "CONFIGURATION," consists of the following sections:

1.1 FEATURES OF THE α*i*-B SERIES SERVO AMPLIFIER

The α*i*-B series servo amplifier (hereinafter called the "α*i*-B amplifier") employs a modular structure, and is thinner, conserves more space, outputs less heat, and saves more energy.

Compact

(1) A latest low-loss power device and a newly developed highly-efficient radiator are used to provide compact servo amplifiers.
(2) The shape of the cable connector is improved to reduce the length of cable projection into the cabinet.

Energy saving

(1) All models from small- to large-capacity ones use power regeneration as standard to save energy.
(2) A latest low-loss power device is used to output less heat.

Reduction in cabling

(1) Spindle amplifiers are made available with FSSB to enable both servo and spindle amplifiers to be connected to the CNC only with optical fiber cables.
(2) Amplifiers can be connected with one cable.
(3) A ground connection from the motor output terminal block to the flange is included, so external cabling for this connection is no longer required. (A connection from the top of the flange to the system ground on the power magnetics cabinet 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 power magnetics cabinet of servo amplifier is substantially reduced.

Improved maintainability

(1) A radiator cooling fan motor can now be replaced without removing the unit from the power magnetics cabinet.
(2) The smart trouble shooting function allows you to check diagnostic information useful for locating the cause of a servo or spindle alarm on the CNC screen.
(3) The input voltage of the Power Supply can now be monitored, which makes it easier to locate the cause of an alarm issued due to an abnormality in the input power supply.
(4) Connectors are attached to the input power lines and motor power lines, which makes it easier to replace a servo amplifier with another one.
(5) 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.

Preventive maintenance

(1) A leakage detection function is included, which can detect any sign of insulation degradation of a motor or power line automatically with a high degree of accuracy.

Enhanced lineup

(1) The 60 mm-wide model without external fin is added to the α*i*PS-B 200 V input model.
(2) The 300 mm-wide model is added to the α*i*PS-B 400 V input model.
(3) The 3-axis servo amplifier is added to the α*i*SV-B 400 V input model.
(4) The α*i*SVP-B series is added, which is optimum for automatic lathe.

1.2 DIFFERENCES FROM THE α*i* AMPLIFIERS

There are following differences in connection and installation of the α*i*-B amplifier from the conventional α*i* amplifiers.
For details of each difference, see the relevant chapter in this manual.

Item		Differences from the α*i* amplifiers	Reference
Lineup		• Addition of following models; α*i*PS 3-B α*i*SV 10/20HV-B, α*i*SV 10/10/10HV-B, α*i*SV 10/10/20HV-B, α*i*SV 20/20/20HV-B α*i*SVP 20/20/20-5.5-B, α*i*SVP 10/10/10-5.5HV-B • Spindle amplifiers Types A and B are integrated into the one type functionally same as Type B.	Chapter 3
External dimensions	External dimensions	• Same • The width of the following servo amplifiers is changed from 90 mm to 60 mm: α*i*SV 20/40HV-B, α*i*SV 40/40HV-B	Chapter 8
	Panel cut-out	• Same (Note: Dimensional tolerance is changed.)	
	Maintenance area	• Same	
Connection	DC link	• The DC link terminal block is moved about 4 mm to the right. • The distance between modules is the same. Same DC link short bars can be used.	Chapter 9
	Power cable	• Same	
	Servo motor feedback signal cable	• Same	
	Spindle sensor cable	• Shield sheaths can be connected to the ground by clamping the cable. • When a standard motor is not used, connection of the motor temperature protection device (thermostat) is changed.	
	Power supply monitor	• New feature in α*i*-B amplifier	
	Ground cable	• The connection destination of the control ground cable is changed. (To CX8 on the Power Supply)	
Control power supply		• α*i* amplifier: 200 VAC supply • α*i* -B amplifier: 24 VDC supply	Chapter 9

> **NOTE**
> It is not allowed to use the α*i*-B amplifiers with the α*i* amplifiers.

1.3 DIFFERENCES BETWEEN THE LEVEL-UP α*i*-B AMPLIFIER AND THE α*i*-B AMPLIFIER

The Level-up α*i*-B amplifier has several additional functions and a broader lineup while maintaining compatibility with the α*i*-B amplifier. The following table shows differences between the Level-up α*i*-B amplifier and the α*i*-B amplifier. For details of each item, see the relevant sections of this manual.

Item		Differences from the α*i*-B amplifier	Reference
Lineup		• Addition of following models; α*i*PS 125HV-B α*i*SV 80/80/80-B, α*i*SV 180HVS-B, α*i*SV 40/40/40HV-B α*i*SP 60HV-B, α*i*SP 100HV(SiC)-B α*i*SVP 20/20/20-2.2-B, α*i*SVP 40/40/40-2.2-B	Chapter 3
External dimensions	External dimensions	• Same	
	Panel cut-out	• Same	
	Maintenance area	• Same	
Connection	Connection with power failure backup module model B	• Connection with power failure backup module model B (PFB-R, PFB-C) is available.	APPENDIX J
	Connection with the sub module SM	• α*i*SV-B can be connected with the sub module SM. (Single-axis servo amplifiers only.)	Chapter 9
Protection functions		• Overheat protection is provided for the power supply transformer and other equipment.	Chapter 9
		• Overheat protection is provided for the α*i*PSs input filter.	APPENDIX K
Safe Torque Off function		• α*i*SV-B (all axes) supports the Safe Torque Off function. • α*i*SP-B supports the Safe Torque Off function. • α*i*SVP-B supports the Safe Torque Off function.	Chapter 14

> **NOTE**
> Level-up α*i*SP-B cannot be connected with 0*i*-D.

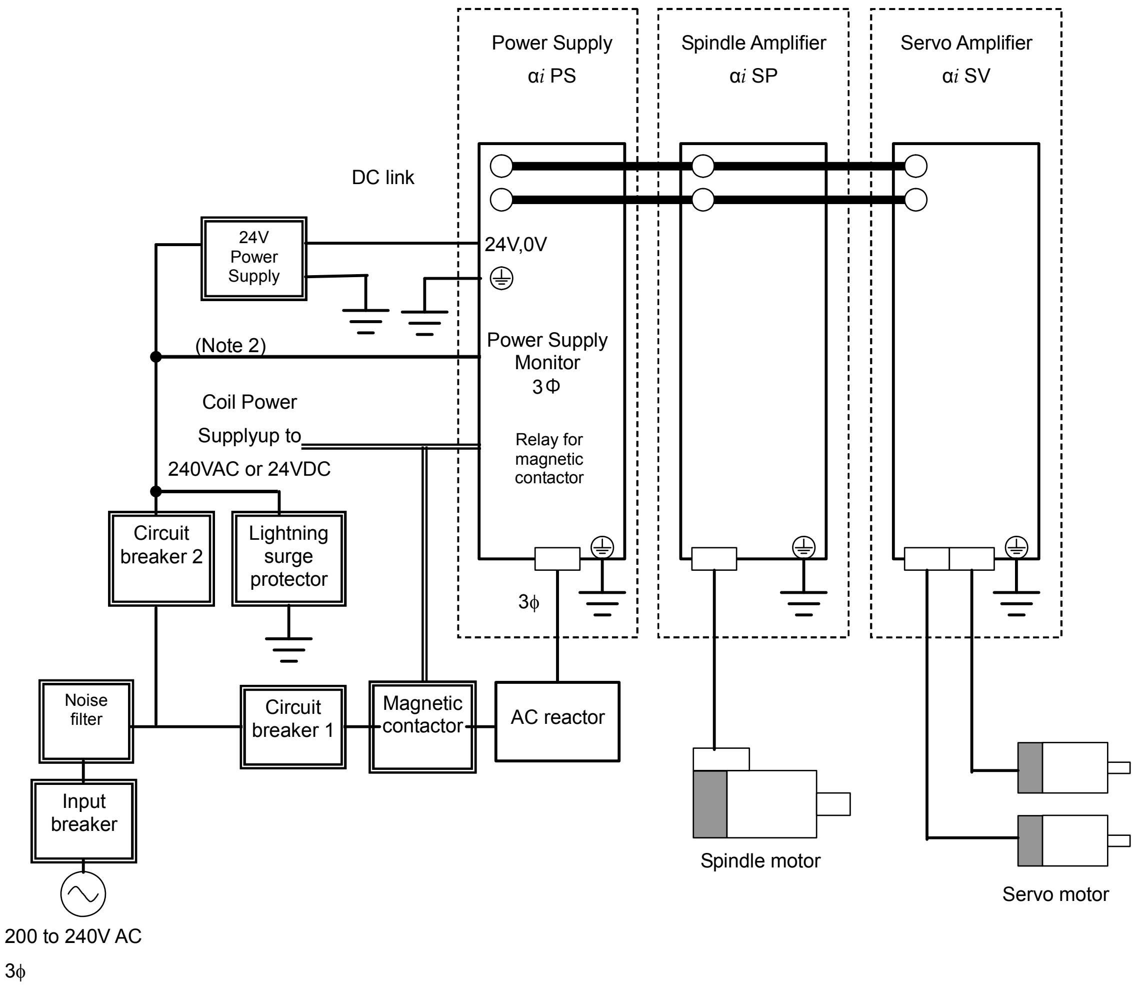
1.4 CONFIGURATION

The α*i*-B amplifier consists of the following units and parts:

1.4.1 200 V Input Series

(1) α*i*PS-B series (Power Supply)
(2) α*i*SV-B series (Servo Amplifier)
(3) α*i*SP-B series (Spindle Amplifier)
(4) α*i*SVP-B series (Servo/spindle multi-axis amplifier)
(5) AC reactor
(6) Connectors (for connection cables)
(7) Fuses
(8) DBM (Dynamic brake module)

Basic configuration of the 200 V input series (example)



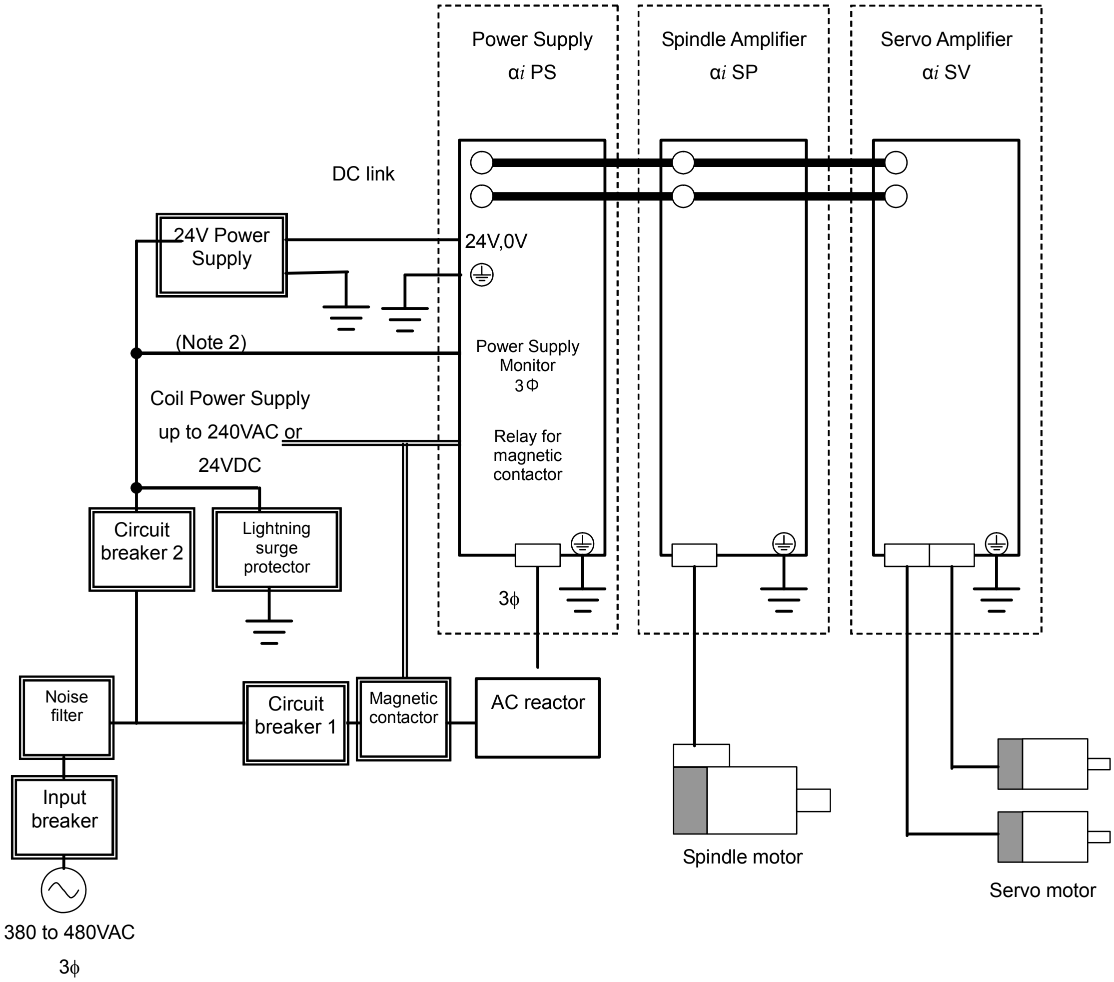
NOTE

1 It is not allowed to use the α*i*-B amplifier with the α*i* amplifiers.
2 Connect the cable of the power supply monitor following circuit breaker 2 (fuse is also available) for cable protection.
3 For how to select the α*i*PS-B, α*i*SV-B, and α*i*SP-B models, see Chapter 4, "HOW TO SELECT THE AMPLIFIER."
4 A circuit breaker 1, circuit breaker 2, magnetic contactor, and AC line filter are always required.
5 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, "FITTING A LIGHTNING SURGE PROTECTION DEVICE" for details.
6 When a 3ϕ fan motor is used for a spindle motor, circuit breaker 2 can be shared as long as the capacity of circuit breaker 2 is not exceeded.

1.4.2 400 V Input Series

(1) α*i*PS-B series (Power Supply)
(2) α*i*SV-B series (Servo Amplifier)
(3) α*i*SP-B series (Spindle Amplifier)
(4) α*i*SVP-B series (Servo/spindle multi-axis amplifier)
(5) AC reactor
(6) Connectors (for connection cables)
(7) Fuses
(8) DBM (Dynamic brake module)

Basic configuration of the 400 V input series (example)



NOTE

1 It is not allowed to use the αi-B amplifier with the αi amplifiers.
2 Connect the cable of the power supply monitor following circuit breaker 2 (fuse is also available) for cable protection.
3 For how to select the αiPS-B, αiSV-B, and αiSP-B models, see Chapter 4, "HOW TO SELECT THE AMPLIFIER."
4 A circuit breaker 1, circuit breaker 2, magnetic contactor, and AC line filter are always required.
5 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, "FITTING A LIGHTNING SURGE PROTECTION DEVICE" for details.
6 To use a power supply with up to 240 VAC for the coil of the magnetic contactor, the voltage must be decreased with a transformer.
7 When a 3ϕ fan motor (400 V power supply support type) is used for a spindle motor, circuit breaker 2 can be shared as long as the capacity of circuit breaker 2 is not exceeded.

1.5 SERVO AMPLIFIERS

α*i*PS-B series (Power Supply)

The α*i*PS-B series Power Supplies are used for supplying the main power of motor power. Select an appropriate Power Supply according to the output levels of the servo motor and spindle motor used.

There are two types of α*i*PS-B series, as follows:

<1> 200 V input series
This Power Supply 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).
It is used together with a α*i*SV-B series and α*i*SP-B series of the 200 V input series.

<2> 400 V input series
This Power Supply can be connected to a main power supply of 380 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 α*i*SV-B series and α*i*SP-B series of the 400 V input series.

α*i*PS □ HV-B
(A) (B) (C)

(A) Model name: PS=Power Supply
(B) Continuous rated output: Numeric value representing a continuous rated output in kW
(C) For a power supply supporting 400 V input series, "HV" is added.

α*i*SV-B series (Servo Amplifier)

The α*i*SV-B series servo amplifiers are used to drive a servo motor. Select an appropriate amplifier according to the servo motor connected.

There are two types of α*i*SV-B series, as follows:

<1> 200 V input series
This servo amplifier drives a servo motor of the 200 V input series.
Servo amplifiers for one axis, two axes, and three axes are available.

<2> 400 V input series
This servo amplifier drives a servo motor of the 400 V input series.
Servo amplifiers for one axis, two axes, and three axes are available.

α*i*SV □ / □ / □ HV-B
(A) (B) (C) (D) (E)

(A) Model name: SV = Servo amplifier
(B) L-axis maximum output current value [Apeak]
(C) M-axis maximum output current value [Apeak]
(D) N-axis maximum output current value [Apeak]
(E) For a servo amplifier supporting 400 V input, "HV" is added.

α*i*SP-B series (Spindle Amplifier)

The α*i*SP-B series spindle amplifiers are used to drive a spindle motor. Select an appropriate amplifier according to the spindle motor connected.

There are two types of α*i*SP-B series, as follows:

<1> 200 V input series
This spindle amplifier drives a spindle motor of the 200 V input series.

<2> 400 V input series
This spindle amplifier drives a spindle motor of the 400 V input series.

```
αiSP □ HV-B
 (A) (B)  (C)
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(A) Model name: SP = Spindle amplifier
(B) Output: 30-minute rating in kW of the spindle motor (α*i* series) that can be driven
(C) For a spindle amplifier supporting 400 V input, "HV" is added.

α*i*SVP-B series (Servo/Spindle multi-axis Amplifier)

The α*i*SVP-B series amplifiers are multi-axis amplifiers that can drive a 3-axis servo motor and 1-axis spindle motor.
There are two types of α*i*SVP-B series, as follows:

<1> 200 V input series
This servo/spindle multi-axis amplifier drives a servo motor and spindle motor of the 200 V input series.

<2> 400 V input series
This servo/spindle multi-axis amplifier drives a servo motor and spindle motor of the 400 V input series.

```
αiSVP □ / □ / □ — □ HV-B
 (A)  (B) (C)  (D) (E) (F)
```

(A) Model name: SVP = Servo/spindle multi-axis amplifier
(B) Servo L-axis maximum output current value [Apeak]
(C) Servo M-axis maximum output current value [Apeak]
(D) Servo N-axis maximum output current value [Apeak]
(E) Output: Numeric value representing the 30-minutes rating of a matching spindle motor (α*i*) in kW
(F) For a servo/spindle amplifier supporting 400 V input, "HV" is added.

1.6 LINEUP

Size	Input power supply	αiPS-B	αiSP-B	αiSV-B			αiSVP-B
60mm-wide Without external fin	200V			4, 20	4/4, 4/20 20/20	4/4/4 20/20/20	
	400V			10HV	10/10HV	10/10/10HV	
60mm-wide With external fin	200V	7.5	2.2, 5.5	40, 80 160	20/40, 40/40 40/80, 80/80	20/20/40 40/40/40	20/20/20-2.2, 40/40/40-2.2
	400V		5.5HV	20HV 40HV 80HV	10/20HV 20/20HV 20/40HV 40/40HV	10/10/20HV 20/20/20HV	
90mm-wide With external fin	200V	11, 15	11, 15		80/160 160/160	80/80/80	20/20/20-5.5
	400V	11HV, 18HV	11HV, 15HV	180HVS	40/80HV 80/80HV	40/40/40HV	10/10/10-5.5HV
150mm-wide With external fin	200V	26, 30, 37	22, 26, 30, 37	360			
	400V	30HV, 45HV 60HV	22HV, 30HV, 45HV 60HV	180HV			
300mm-wide With external fin	200V	55	45, 55				
	400V	75HV, 100HV	75HV, 100HV 100HV(SiC)	360HV 540HV			

2 SPECIFICATIONS

Chapter 2, "SPECIFICATIONS," consists of the following sections:

2.1 INPUT POWER

(1) Power supply of 200 V input series

(1) Power specification

Item	Specification
Input power supply voltage range	200VAC -15% to 240VAC +10% (including voltage variation during acceleration/deceleration)
Input power supply frequency	47Hz to 63Hz
Power supply unbalance	±2% or less
Instantaneous power failure guarantee time	Power supply voltage drop to 0 V: 3 ms
Power system	TN-power system (star connection): Directly connectable TN-power system (delta connection): Connectable only to a 200 V system TT-power system, IT-power system: Connectable via an isolating-transformer

NOTE

1. Ground the power supply through the neutral point or one phase of the three-phase power supply.
2. The rated output of the motor is guaranteed for the input voltage (200 to 240 VAC). When the input voltage fluctuates even within the allowable range, the rated output of the motor may not be achieved.
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. To satisfy the EMC regulation enforced in the EU countries, a noise filter must be installed in the power supply input section.

(2) Power supply of 400 V input series

(1) Power specification

Item	Specification
Input power supply voltage range	380VAC -10% to 480VAC +10% (including voltage variation during acceleration/deceleration)
Input power supply frequency	47Hz to 63Hz
Power supply unbalance	±2% or less
Instantaneous power failure guarantee time	Power supply voltage drop to 0 V: 3 ms
Power system	TN-power system (star connection): Directly connectable TN-power system (delta connection), TT-power system, IT-power system: Connectable via an isolating-transformer

NOTE

1 Ground the power supply through the neutral point of the three-phase power supply.
2 The rated output of the motor is guaranteed for the input voltage (400 to 480 VAC). When the input voltage fluctuates even within the allowable range, the rated output of the motor may not be achieved.
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 To satisfy the EMC regulation enforced in the EU countries, a noise filter must be installed in the power supply input section.
5 The 400 V input αi 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.

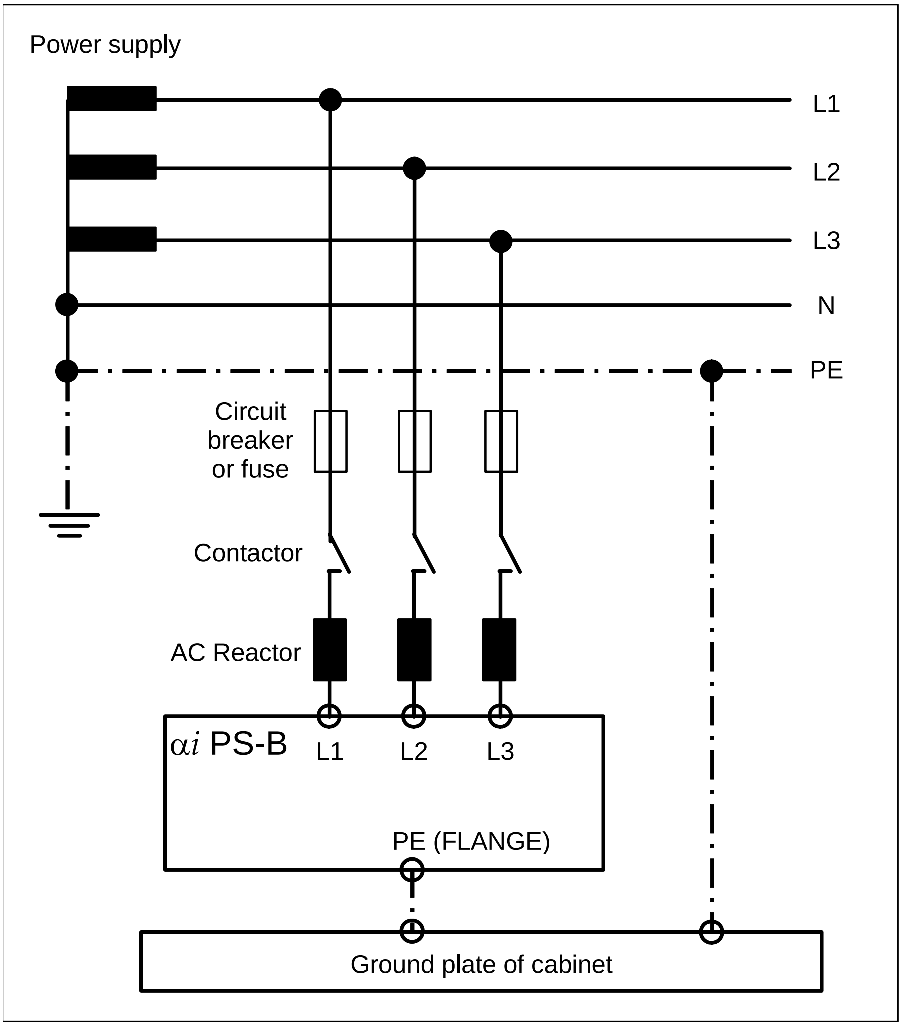
Example of connecting the Power supply of the main circuit

No.	Power system	Power specification	Power supply of servo amplifier
1	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification 380 to 480VAC(-10%,+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 380 VAC to 480 VAC (-10%, +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. Before starting to use the power supply, check that it conforms to the relevant safety standards.
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.

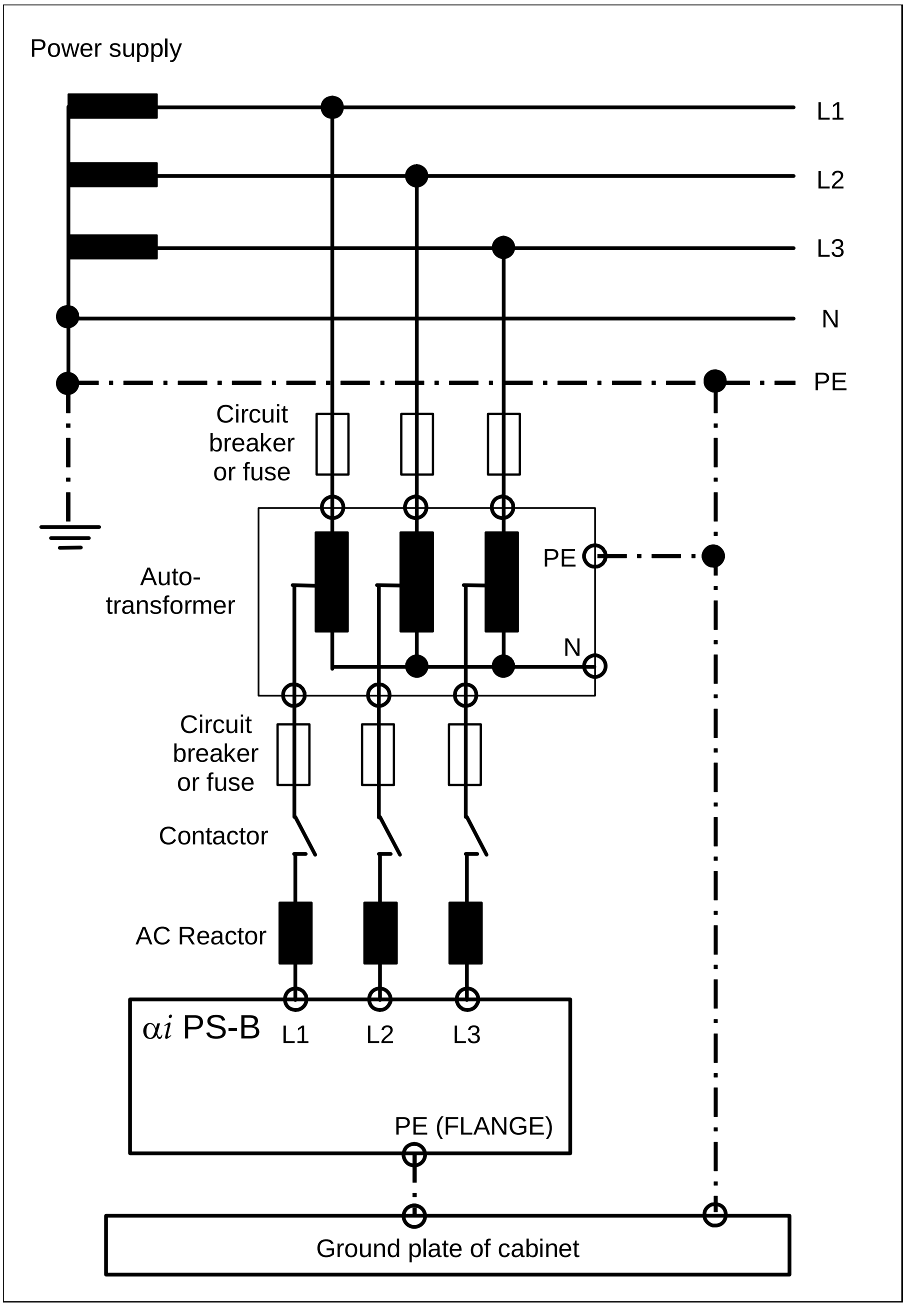
(a) TN-power system

No.	Power system	Power specification	Power supply of servo amplifier
1	TN-power system	• Star connection • Neutral grounding on the power supply side • PE provided on the power line • Power supply voltage specification 380 to 480VAC (-10%,+10%)	• Directly connectable to the power supply (No transformer is required.)



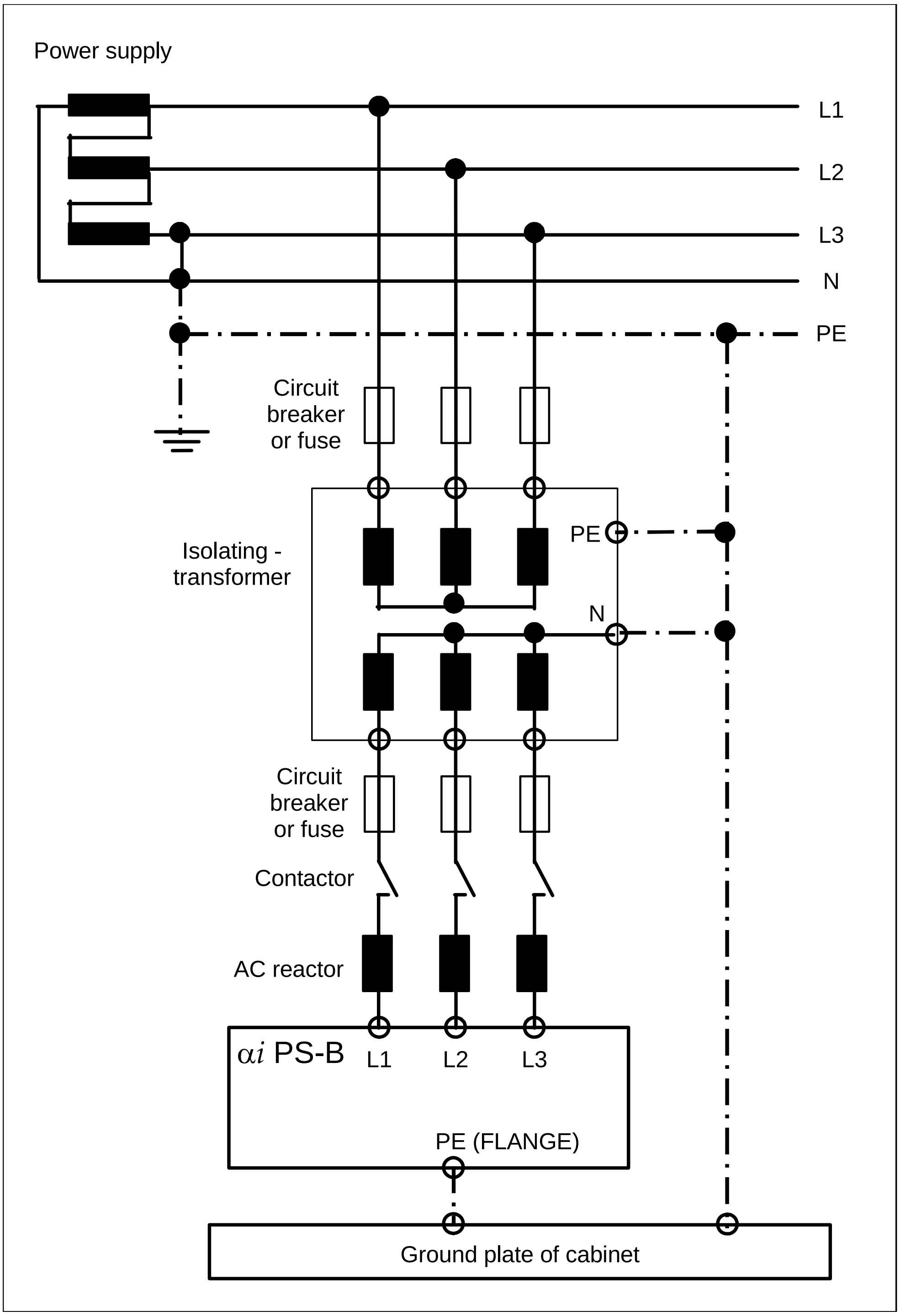
(b) TN-power system

No.	Power system	Power specification	Power supply of servo amplifier
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 380 VAC to 480 VAC (-10%, +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. Before starting to use the power supply, check that it conforms to the relevant safety standards.



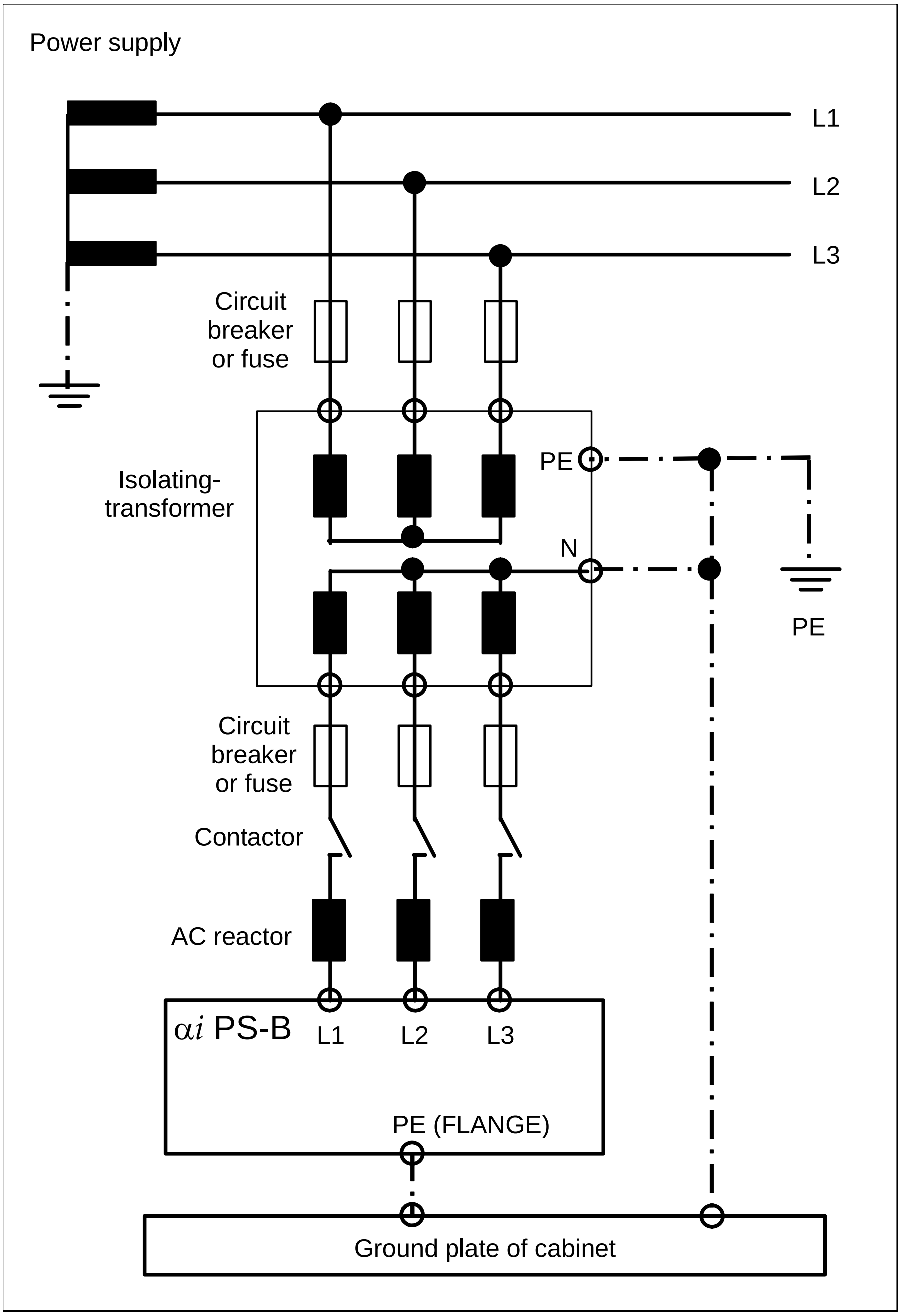
(c) TN-power system

No.	Power system	Power specification	Power supply of servo 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.



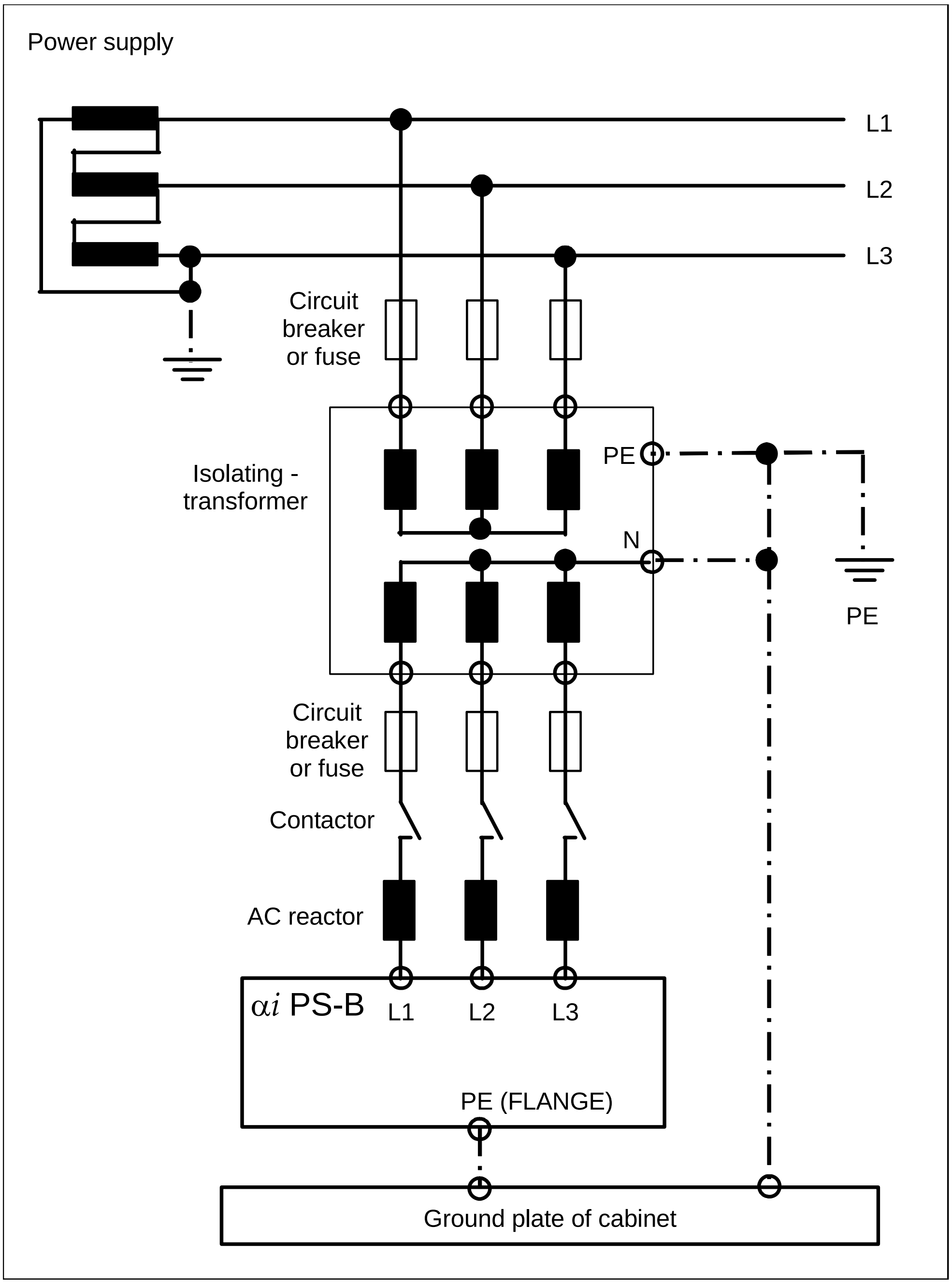
(d) TT-power system

No.	Power system	Power specification	Power supply of servo 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.



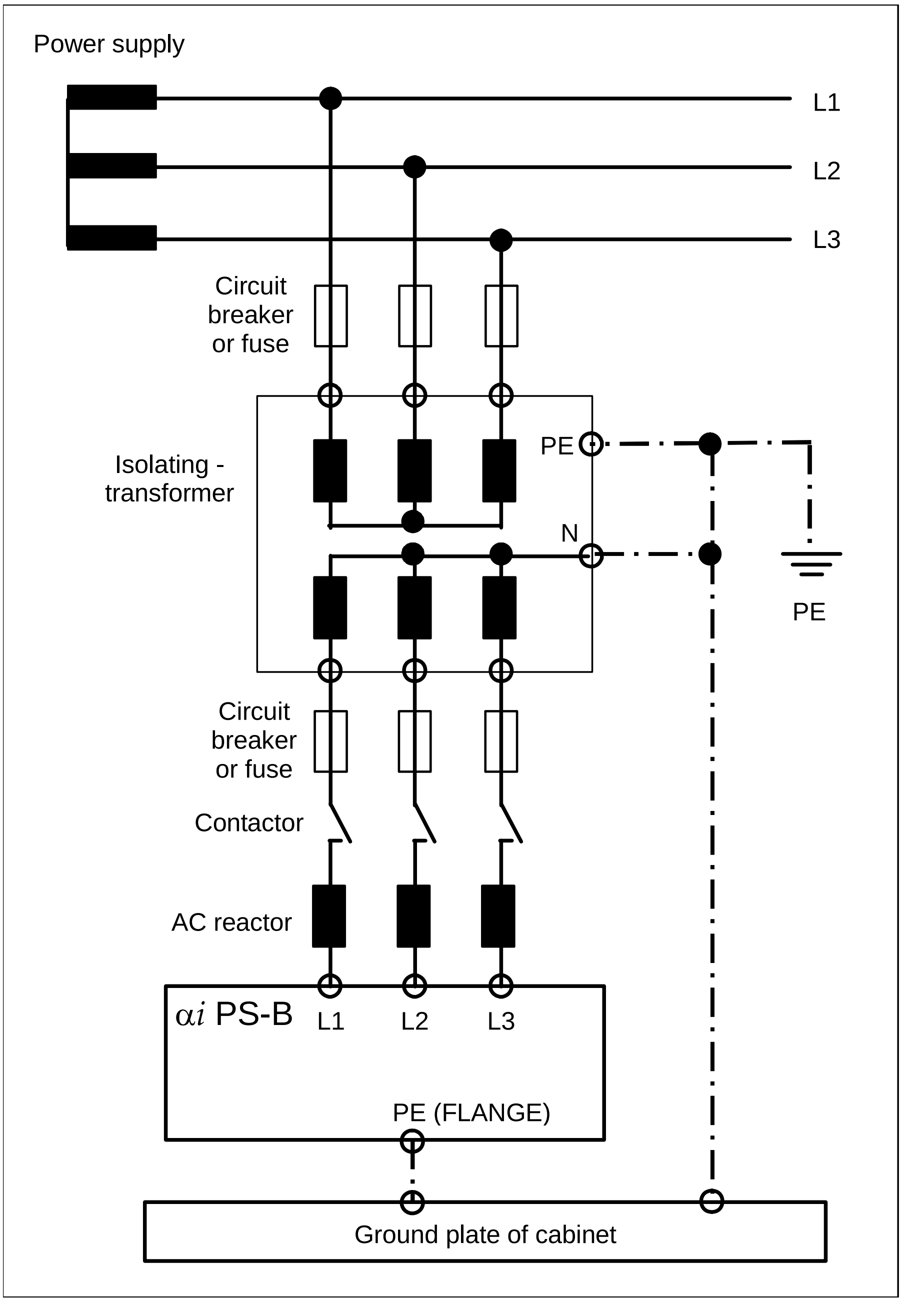
(e) TT-power system

No.	Power system	Power specification	Power supply of servo 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.



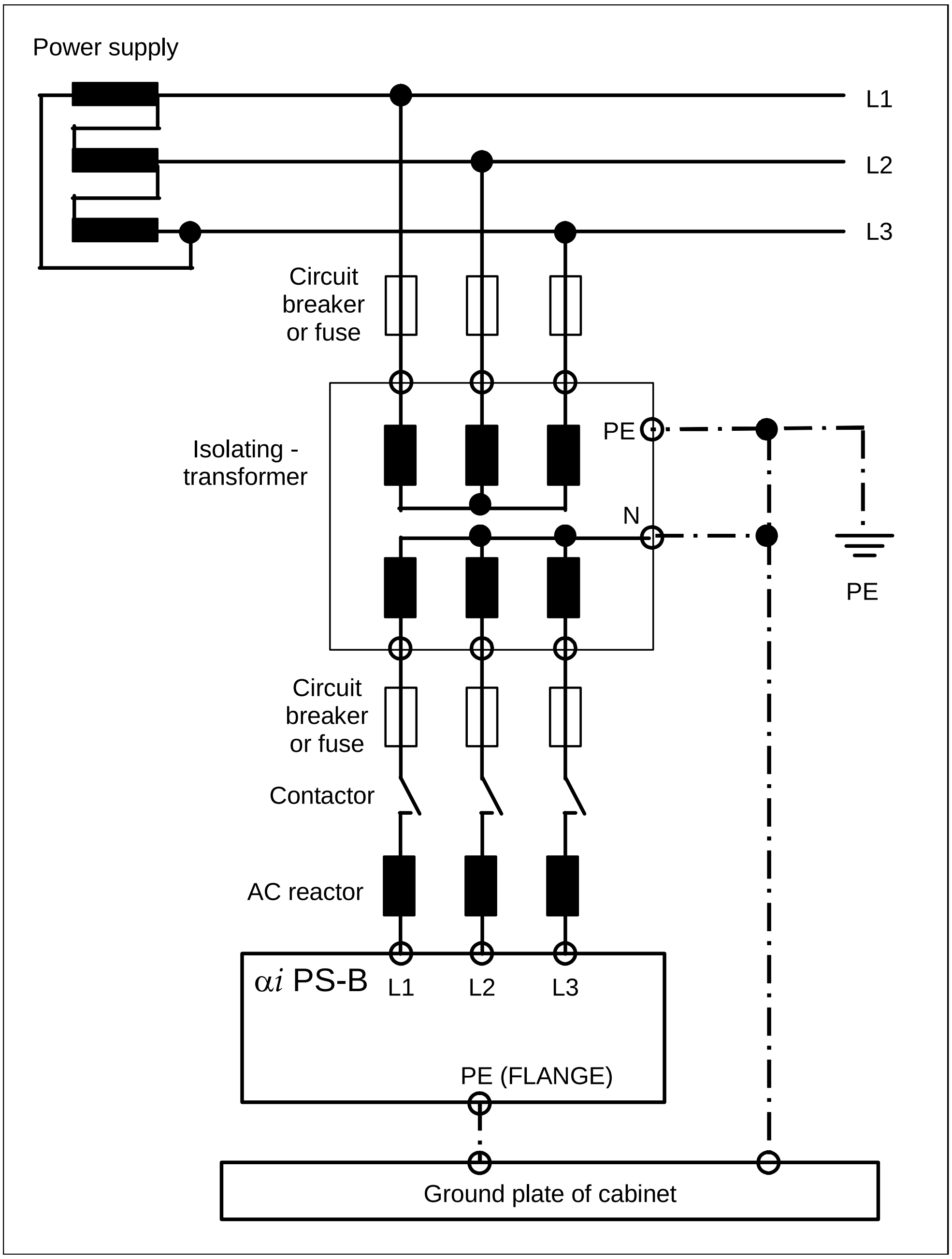
(f) IT-power system

No.	Power system	Power specification	Power supply of servo 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 servo 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.



2.2 ENVIRONMENTAL CONDITIONS

The α*i*-B amplifier must be installed in a completely sealed type cabinet to satisfy the following environmental requirements. For how to design such a cabinet, see APPENDIX G, "EXAMPLES OF RECOMMENDED POWER MAGNETICS CABINETS FOR SERVO AMPLIFIER INSTALLATION."

(1) Ambient temperature
Ambient temperature of the servo amplifier :
0 to 55°C (at operation)
-20 to 60°C (at keeping and transportation)

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

(3) Vibration
In operation : Below 0.5G

(4) Atmosphere
Prevent conductive, flammable, or corrosive foreign matter, mist, or water droplets from entering the unit.

(5) Altitude
1,000m or less

⚠ WARNING
If conductive or flammable foreign matters enter the unit, explosion or corruption may be caused.
If corrosive or conductive mists or water droplets are attached to an electronic circuit, unexpected operation may be caused in the circuit.
The electronic circuit portion must be installed in an environment of pollution level 2 specified by IEC60664-1. To achieve pollution level 2 in a severe machine tool environment, it is necessary to install the portion in a cabinet that satisfies IP54.

NOTE
If the servo amplifier is installed 1000 m or higher above sea level, the allowable upper ambient temperature of the servo amplifier in the cabinet is changed as follows. Assume that the allowable upper ambient temperature of the servo amplifier in the cabinet installed 1000 m or higher above sea level decreases by 1.0°C for every 100 m rise in altitude.
If the altitude exceeds 2000 m, contact FANUC.

(6) Notes on Installation
The α*i*-B 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 semiconductors, thus preventing heat from building up in the cabinet as much as possible. Therefore, note the following when installing the servo amplifier.
(a) Take appropriate measures to prevent coolant, oil mist, or chips from being adhered to the radiator and fan motors. A deposit of coolant, oil mist, or chips on the radiator or fan motors can lower the cooling efficiency. In some cases, the servo amplifier specifications cannot sometimes be satisfied. The deposit may also reduce the service life of the fan motors or semiconductors.

When outside air is drawn in to the radiator, mount an air filter on the air inlet. In addition, ensure to seal doors and parts where cables are drawn in and out.

(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 servo 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, "NOISE PREVENTION" and the connection manual for each CNC for details.

(e) Each servo amplifier must be installed vertically.

(f) 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 servo amplifier does not blow directly against the upper servo amplifier. If radiation performance degrades, the specified output may not be obtained.

2) Ensure that the flow of cooling air of a lower servo amplifier is not impeded.

(g) Maintenance areas must be reserved for each servo amplifier.

(7) Notes relating to this product storage, transportation and environment

This servo amplifier uses electronic parts corroded by the halogen (fluorine, chlorine, bromine, iodine, etc.)

Do not storage or transport or use this servo amplifier in the halogen (fluorine, chlorine, bromine, iodine, etc.) atmosphere.

Fumigant and industrial cleaning solvent, and pesticide might contain the halogen.

(8) Derating

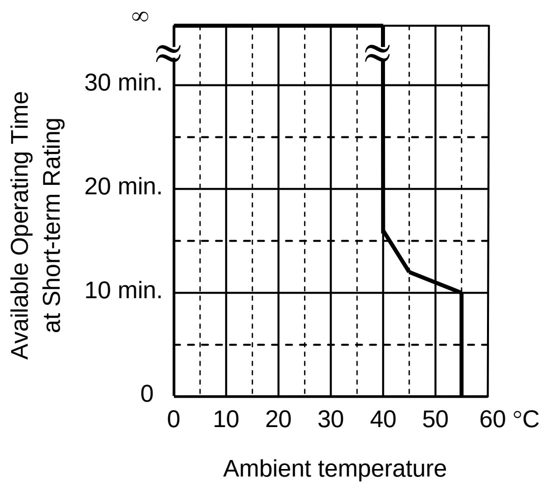
Consider derating as shown below, according to ambient temperatures.

(a) α*i* Power Supply series

α*i*PS 3-B to 55-B

α*i*PS 11HV-B to 125HV-B

AC reactor

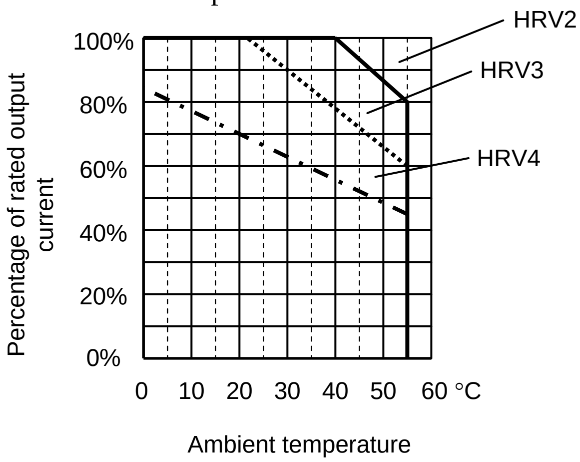


(b) α*i*SV-B series

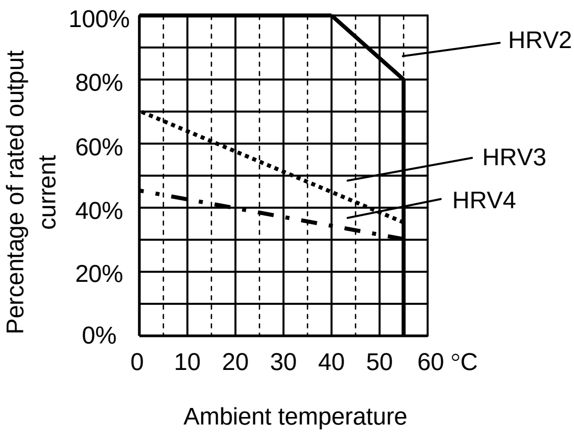
Servo axes of the α*i*SVP-B series

The solid line indicates derating when HRV2 is applied, the dotted line indicates derating when HRV3 is applied, and the dot-dash line indicates derating when HRV4 is applied.

- 200 V input series servo amplifier

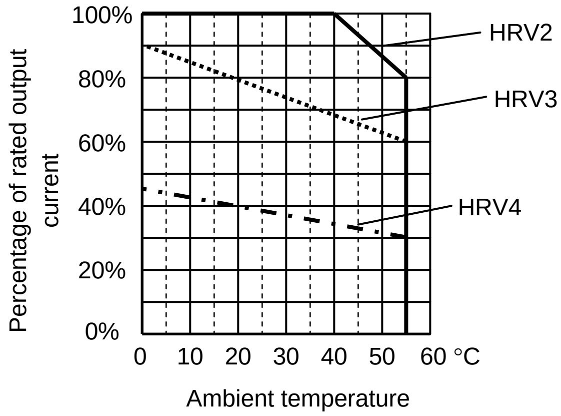


- 400 V input series servo amplifier
  α*i*SV 10HV-B, α*i*SV 10/10HV-B, and α*i*SV 10/10/10HV-B



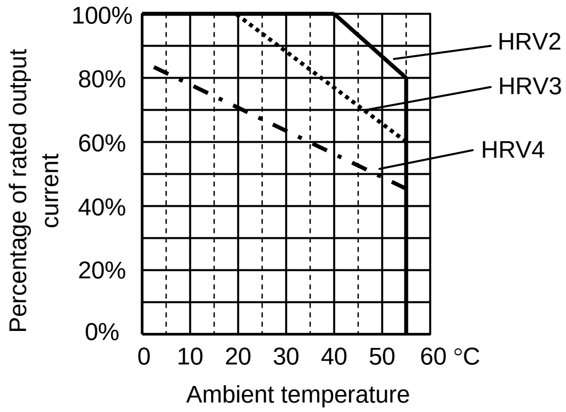
⚠ **CAUTION**
HRV4 cannot be applied to α*i*SV 10/10HV-B and α*i*SV 10/10/10HV-B.

Servo axes of the α*i*SV 20HV-B to 180HV-B, 180HVS-B, α*i*SV 10/20HV-B to 80/80HV-B, and
α*i*SV 10/10/20HV-B to 40/40/40HV-B
α*i*SVP 10/10/10-5.5HV-B



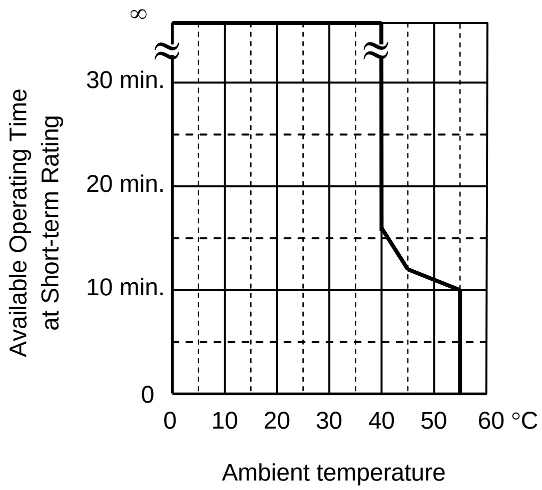
> ⚠ **CAUTION**
> HRV4 is not applicable to the servo axes of the α*i*SV 180HVS-B and α*i*SVP 10/10/10-5.5HV-B.

α*i*SV 360HV-B and α*i*SV 540HV-B



> ⚠ **CAUTION**
> HRV2 can be applied to α*i*SV 540HV-B. HRV3 and HRV4 cannot be applied to α*i*SV 540HV-B.

(c) α*i*SP-B series
α*i*SP 2.2-B to 55-B
α*i*SP 5.5HV-B to 100HV-B
Spindle axes of the α*i*SVP-B series



2.3 SPECIFICATIONS OF THE SERVO AMPLIFIERS

2.3.1 α*i*PS-B Series

200 V input series

Item \ Model		α*i*PS 3-B	α*i*PS 7.5-B	α*i*PS 11-B	α*i*PS 15-B	α*i*PS 26-B	α*i*PS 30-B	α*i*PS 37-B	α*i*PS 55-B
Power supply	Main circuit	200 to 240VAC, +10%,-15%,3ϕ, 47 to 63Hz							
	Control power	24VDC ±10%							
Power equipment capacity	Main circuit	5KVA	12kVA	16kVA	22kVA	38kVA	44kVA	54kVA	80kVA
	Control power	0.5A				0.8A			1.4A
Continuous rated output		3KW	7.5kW	11kW	15kW	26kW	30kW	37kW	55kW
30-minute rated output		3.7kW	11kW	15kW	18.5kW	30kW	37KW	45kW	60KW
Peak maximum output		12kW	27kW	40kW	54kW	83kW	96kW	118kW	192kW
Control method		Regenerative control (power source generation)							

NOTE
1 A power transformer is required when the main circuit voltage is not within the above voltage range.
2 The capacity of the power equipment for the main circuit assumes that the Power Supply operates at the continuous rated output.
3 Derating is applied for the Power Supply and AC reactor according to ambient temperatures. See Section 2.2.

400 V input series

Item \ Model		αiPS 11HV-B	αiPS 18HV-B	αiPS 30-BHV	αiPS 45HV-B	αiPS 60HV-B	αiPS 75HV-B	αiPS 100HV-B	αiPS 125HV-B
Power supply	Main circuit	380 to 480VAC, +10%,-10%,3ϕ, 47 to 63Hz							
	Control power	24VDC ±10%							
Power equipment capacity	Main circuit	16kVA	26kVA	44kVA	65kVA	87KVA	108kVA	144kVA	159 kVA
	Control power	0.5A		0.8A		1.4A		1.7A	
Continuous rated output		11kW	18kW	30kW	45kW	60kW	75kW	100kW	125kW
30-minute rated output		15kW	22kW	37kW	55kW	70KW	100kW	120KW	150KW
Peak maximum output		40kW	65kW	96kW	144kW	180kW	193kW	220kW	250kW
Control method		Regenerative control (power source generation)							

NOTE

1. A power transformer is required when the main circuit voltage is not within the above voltage range.
2. The capacity of the power equipment for the main circuit assumes that the Power Supply operates at the continuous rated output.
3. Derating is applied for the Power Supply and AC reactor according to ambient temperatures. See Section 2.2.

How to calculate the power equipment capacity (common specifications)

Calculate the power equipment capacity using the formula below.

$$\text{Power supply capacity}(kVA) = \frac{\text{Rated capacity calculated in Subsections 4.4 and 4.5 } (kW) \times \text{Power supply capacity of } \alpha\text{iPS-B having rated output } (kVA)}{\text{Number of iPS-B units Rated capacity of } \alpha\text{iPS-B } (kW)}$$

<Calculation example 1>

- Rated capacity calculated in Section 4.4 or 4.5: 200[kW];
- When the number and model of the α*i*PS-B used are four α*i*PS-B75HVs,

the capacity of the power equipment is calculated as follows:

$$\text{Power supply capacity }(kVA) = \frac{200(kW) \times 108(kVA)}{4 \times 75(kW)} = 72(kVA)$$

When selecting a device installed in the input section (e.g., transformer, breaker, magnetic contactor) based on the calculated power equipment capacity, see Sections 4.7 and 4.8.

2.3.2 α*i*SV-B Series

Common specifications

Item	Specifications
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge
Servo output frequency range	0Hz to 550Hz
Applicable CNC	30*i* /31*i* /32*i* /35*i* -B /Power Motion *i* -A /0*i* -D

200 V input series: 1-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 4-B	-	2.5	4
α*i*SV 20-B	-	6.5	20
α*i*SV 40-B	-	13	40
α*i*SV 80-B	-	22.5	80
α*i*SV 160-B	-	45	160
α*i*SV 360-B	-	130	360

NOTE
1. The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2. Derating is applied for the servo amplifier according to ambient temperatures. See Section 2.2 for details.

200 V input series: 2-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 4/4-B	L	2.5	4
	M	2.5	4
α*i*SV 4/20-B	L	2.5	4
	M	6.5	20
α*i*SV 20/20-B	L	6.5	20
	M	6.5	20
α*i*SV 20/40-B	L	6.5	20
	M	13	40
α*i*SV 40/40-B	L	13	40
	M	13	40
α*i*SV 40/80-B	L	13	40
	M	22.5	80
α*i*SV 80/80-B	L	22.5	80
	M	22.5	80
α*i*SV 80/160-B	L	22.5	80
	M	45	160
α*i*SV 160/160-B	L	45	160
	M	45	160

NOTE
1. The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2. Derating is applied for the servo amplifier according to ambient temperatures. See Section 2.2 for details.

200 V input series: 3-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 4/4/4-B	L	2.5	4
	M	2.5	4
	N	2.5	4
α*i*SV 20/20/20-B	L	6.5	20
	M	6.5	20
	N	6.5	20
α*i*SV 20/20/40-B	L	6.5	20
	M	6.5	20
	N	13	40
α*i*SV 40/40/40-B	L	13	40
	M	13	40
	N	13	40
α*i*SV 80/80/80-B	L	22.5	80
	M	22.5	80
	N	22.5	80

NOTE
1 The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2 Derating is applied for the servo amplifier according to ambient temperatures. See Section 2.2 for details.

400 V input series: 1-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 10HV-B	-	3.2	10
α*i*SV 20HV-B	-	6.5	20
α*i*SV 40HV-B	-	11.5	40
α*i*SV 80HV-B	-	22.5	80
α*i*SV 180HVS-B		40	180
α*i*SV 180HV-B	-	65	180
α*i*SV 360HV-B	-	130	360
α*i*SV 540HV-B	-	160	540

NOTE
1 The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2 HRV4 is not applicable to α*i*SV 540HV-B.
3 Neither HRV3 nor HRV4 is applicable to α*i*SV 540HV-B.
4 Derating is applied for the servo amplifier according to ambient temperatures. See Section 2.2 for details.
5 HRV4 is not applicable to α*i*SV 180HVS-B.

400 V input series: 2-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 10/10HV-B	L	3.2	10
	M	3.2	10
α*i*SV 10/20HV-B	L	3.2	10
	M	6.5	20
α*i*SV 20/20HV-B	L	6.5	20
	M	6.5	20
α*i*SV 20/40HV-B	L	6.5	20
	M	11.5	40
α*i*SV 40/40HV-B	L	11.5	40
	M	11.5	40
α*i*SV 40/80HV-B	L	11.5	40
	M	22.5	80
α*i*SV 80/80HV-B	L	22.5	80
	M	22.5	80

NOTE
1 The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2 HRV4 is not applicable to the α*i*SV 10/10HV-B.
3 Derating is applied for the servo amplifier according to ambient temperatures. See Section 2.2 for details.

400 V input series: 3-axis servo amplifier

Name	Axis	Rated output current [Arms]	Nominal current limit [Apeak]
α*i*SV 10/10/10HV-B	L	3.2	10
	M	3.2	10
	N	3.2	10
α*i*SV 10/10/20HV-B	L	3.2	10
	M	3.2	10
	N	6.5	20
α*i*SV 20/20/20HV-B	L	6.5	20
	M	6.5	20
	N	6.5	20
α*i*SV 40/40/40HV-B	L	11.5	40
	M	11.5	40
	N	11.5	40

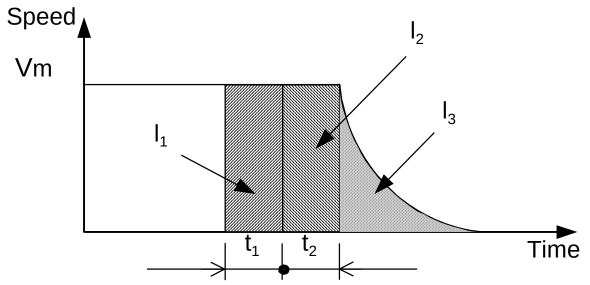
NOTE
1 The current limit (peak value) is a standard value. It varies by about ±10%, depending on the circuit constants.
2 HRV4 is not applicable to the α*i*SV 10/10/10HV-B.

Dynamic brake module

Specifications	Driving power supply capacity	Remarks
A06B-6079-H401	220VA (when DBM is turned on) 22VA (after DBM is turned on)	Driven on 200VAC
A06B-6079-H403	0.92A	Driven on 24VDC
A06B-6069-H300	220VA (when DBM is turned on) 22VA (after DBM is turned on)	Driven on 200VAC
A06B-6069-H301	0.92A	Driven on 24VDC

Dynamic brake

The dynamic brake stop distance can be calculated using the formula below.



Vm : Rapid traverse rate, mm/sec or [deg /sec]
l_1 : Coasting distance due to delay time t_1 of receiver
l_2 : Coasting distance due to deceleration time t_2 of magnetic contactor (MCC)
l_3 : Coasting distance by dynamic braking after magnetic contactor has been operated
(t_1+t_2) is usually about 0.05 [sec].

$$\text{Coasting distance due} = Vm \times (t_2 + t_2) + (J_M + J_L) \times (A \times No + B \times No^3) \times L$$

$[mm]$ *or* [deg]

- J_M : Motor inertia [kg·m^2] [kgf·cm·s^2]
- J_L : Load inertia [kg·m^2] [kgf·cm·s^2]
- N_O : Motor speed at rapid traverse [min^{-1}]
- L : Machine movement on one-rotation of motor [mm/rev] or [deg/rev] $(N_O/60 \times L = V_m)$
- A : Coefficient A for calculating the dynamic brake stop distance
- B : Coefficient B for calculating the dynamic brake stop distance

For details of A and B, see the table on the next item.
For J_M, see the data sheet of each motor in the Chapter 6, "SPECIFICATIONS" in the DESCRIPTIONS (B-65262EN or B-65302EN).

Coefficients for calculating the dynamic brake stop distance

The following table lists coefficients for calculating the dynamic brake stop distance when combined with the α*i*-B amplifier.
For synchronous built-in servo motors and linear motors, see individual descriptions manual.

α*i*S series (200 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
α*i*S2/5000 (Note)	1.9×10^{-1}	1.9×10^{-1}	1.9×10^{-2}	8.8×10^{-9}
α*i*S2/6000 (Note)	2.9×10^{-1}	2.9×10^{-1}	2.8×10^{-2}	1.3×10^{-8}
α*i*S4/5000 (Note)	7.6×10^{-2}	7.6×10^{-2}	7.4×10^{-3}	5.2×10^{-9}
α*i*S4/6000 (Note)	1.1×10^{-1}	1.1×10^{-1}	1.1×10^{-2}	8.2×10^{-9}
α*i*S8/4000	1.8×10^{-1}	1.8×10^{-1}	1.8×10^{-2}	1.1×10^{-9}
α*i*S8/6000	4.2×10^{-1}	4.2×10^{-1}	4.1×10^{-2}	4.3×10^{-10}
α*i*S12/4000	1.1×10^{-1}	1.1×10^{-1}	1.1×10^{-2}	4.0×10^{-10}
α*i*S12/6000	1.2×10^{-1}	1.2×10^{-1}	1.2×10^{-2}	3.5×10^{-10}
α*i*S22/4000	5.8×10^{-2}	5.8×10^{-2}	5.7×10^{-3}	5.1×10^{-10}
α*i*S22/6000	1.2×10^{-1}	1.2×10^{-1}	1.2×10^{-2}	2.9×10^{-10}
α*i*S30/4000	4.0×10^{-2}	4.0×10^{-2}	3.9×10^{-3}	3.0×10^{-10}
α*i*S40/4000	2.9×10^{-2}	2.9×10^{-2}	2.8×10^{-3}	2.2×10^{-10}
α*i*S50/2000	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-3}	2.2×10^{-10}
α*i*S60/2000	1.0×10^{-2}	1.0×10^{-2}	9.9×10^{-4}	1.6×10^{-10}
α*i*S50/3000 with fan	2.1×10^{-2}	2.1×10^{-2}	2.0×10^{-3}	1.4×10^{-10}
α*i*S60/3000 with fan	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-3}	1.4×10^{-10}
α*i*S100/2500	1.1×10^{-2}	1.1×10^{-2}	1.0×10^{-3}	2.2×10^{-10}
α*i*S100/2500 with fan	1.1×10^{-2}	1.1×10^{-2}	1.0×10^{-3}	2.2×10^{-10}
α*i*S200/2500	5.8×10^{-3}	5.8×10^{-3}	5.7×10^{-4}	1.1×10^{-10}
α*i*S200/2500 with fan	5.8×10^{-3}	5.8×10^{-3}	5.7×10^{-4}	1.1×10^{-10}
α*i*S300/2000	4.4×10^{-3}	4.4×10^{-3}	4.3×10^{-4}	7.8×10^{-11}
α*i*S500/2000	2.3×10^{-3}	2.3×10^{-3}	2.2×10^{-4}	4.9×10^{-11}

NOTE

For models α*i*S2/5000, α*i*S2/6000, and α*i*S4/5000, use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier α*i*SV 20/40-B or the L/M-axis of servo amplifier α*i*SV 20/20/40-B for the 30*i*-B series.

Model	SI unit		Gravitational system of units	
	A	B	A	B
α*i*S2/5000	4.6×10^{-1}	3.7×10^{-8}	4.5×10^{-2}	3.6×10^{-9}
α*i*S2/6000	6.9×10^{-1}	5.6×10^{-8}	6.8×10^{-2}	5.5×10^{-9}
α*i*S4/5000	3.1×10^{-1}	1.3×10^{-8}	3.0×10^{-2}	1.3×10^{-9}
α*i*S4/6000	4.6×10^{-1}	2.1×10^{-8}	4.5×10^{-2}	2.0×10^{-9}

α*i*S series (400 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
α*i*S2/5000HV (Note)	1.9×10^{-1}	9.0×10^{-8}	3.8×10^{-2}	4.4×10^{-10}
α*i*S2/6000HV (Note)	2.9×10^{-1}	14×10^{-8}	5.8×10^{-2}	6.8×10^{-10}
α*i*S4/5000HV (Note)	8.4×10^{-2}	4.9×10^{-8}	2.5×10^{-2}	1.5×10^{-9}
α*i*S4/6000HV (Note)	1.3×10^{-1}	8.1×10^{-8}	3.8×10^{-2}	2.6×10^{-9}
α*i*S8/4000HV	1.4×10^{-1}	1.4×10^{-8}	1.4×10^{-2}	1.4×10^{-9}
α*i*S8/6000HV	3.2×10^{-1}	5.8×10^{-9}	3.1×10^{-2}	5.6×10^{-10}

Model	SI unit		Gravitational system of units	
	A	B	A	B
αiS12/4000HV	8.4×10^{-2}	5.3×10^{-9}	8.2×10^{-3}	5.2×10^{-10}
αiS12/6000HV	2.1×10^{-1}	2.1×10^{-9}	2.0×10^{-2}	2.1×10^{-10}
αiS22/4000HV	1.2×10^{-1}	2.5×10^{-9}	1.2×10^{-2}	2.5×10^{-10}
αiS22/6000HV	2.1×10^{-1}	1.7×10^{-9}	2.1×10^{-2}	1.7×10^{-10}
αiS30/4000HV	6.7×10^{-2}	1.8×10^{-9}	6.6×10^{-3}	1.8×10^{-10}
αiS40/4000HV	4.9×10^{-2}	1.3×10^{-9}	4.8×10^{-3}	1.3×10^{-10}
αiS50/2000HV	2.2×10^{-2}	1.3×10^{-9}	2.2×10^{-3}	1.3×10^{-10}
αiS60/2000HV	1.7×10^{-2}	9.8×10^{-10}	1.7×10^{-3}	9.6×10^{-11}
αiS50/3000HV with fan	6.3×10^{-3}	4.5×10^{-9}	6.2×10^{-4}	4.4×10^{-10}
αiS60/3000HV with fan	3.8×10^{-3}	4.4×10^{-9}	3.7×10^{-4}	4.3×10^{-10}
αiS100/2500HV	3.0×10^{-3}	8.1×10^{-9}	2.9×10^{-4}	7.9×10^{-10}
αiS100/2500HV with fan	3.0×10^{-3}	8.1×10^{-9}	2.9×10^{-4}	7.9×10^{-10}
αiS200/2500HV	1.6×10^{-3}	4.1×10^{-9}	1.6×10^{-4}	4.0×10^{-10}
αiS200/2500HV with fan	1.6×10^{-3}	4.1×10^{-9}	1.6×10^{-4}	4.0×10^{-10}
αiS300/2000HV	2.1×10^{-3}	1.7×10^{-9}	2.0×10^{-4}	1.7×10^{-10}
αiS300/3000HV	2.9×10^{-3}	1.2×10^{-9}	2.8×10^{-4}	1.2×10^{-10}
αiS500/2000HV	1.1×10^{-3}	1.0×10^{-9}	1.1×10^{-4}	1.0×10^{-10}
αiS500/3000HV	1.6×10^{-3}	7.1×10^{-10}	1.5×10^{-4}	7.0×10^{-11}
αiS1000/2000HV (A06B-0098-B010)	6.6×10^{-4}	1.2×10^{-9}	6.4×10^{-5}	1.1×10^{-10}
αiS1000/3000HV	8.8×10^{-4}	7.1×10^{-10}	8.6×10^{-5}	6.9×10^{-11}
αiS2000/2000HV	3.3×10^{-4}	1.3×10^{-10}	3.2×10^{-5}	1.3×10^{-11}
αiS3000/2000HV	1.7×10^{-4}	7.4×10^{-11}	1.6×10^{-5}	7.3×10^{-12}

NOTE

For models αiS2/5000HV, αiS2/6000HV, αiS4/5000HV, and αiS4/6000HV, use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier αiSV 10/20HV-B or the L/M-axis of servo amplifier αiSV 10/10/20HV-B for the 30*i*-B series.

Model	SI unit		Gravitational system of units	
	A	B	A	B
αiS2/5000HV	3.9×10^{-1}	4.4×10^{-8}	3.8×10^{-2}	4.4×10^{-10}
αiS2/6000HV	5.9×10^{-1}	6.7×10^{-8}	5.8×10^{-2}	6.8×10^{-10}
αiS4/5000HV	2.6×10^{-1}	1.6×10^{-8}	2.5×10^{-2}	1.5×10^{-9}
αiS4/6000HV	3.8×10^{-1}	2.6×10^{-8}	3.8×10^{-2}	2.6×10^{-9}

αiF series (200 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
αiF1/5000 (Note)	5.0×10^{-1}	2.6×10^{-7}	4.9×10^{-2}	2.5×10^{-8}
αiF2/5000 (Note)	1.8×10^{-1}	1.6×10^{-7}	1.7×10^{-2}	1.6×10^{-8}
αiF4/5000	4.5×10^{-1}	2.8×10^{-8}	4.4×10^{-2}	2.8×10^{-9}
αiF8/3000	1.4×10^{-1}	1.7×10^{-8}	1.4×10^{-2}	1.7×10^{-9}
αiF8/4000	2.5×10^{-1}	9.9×10^{-9}	2.4×10^{-2}	9.7×10^{-10}
αiF12/4000	1.9×10^{-1}	1.7×10^{-8}	1.9×10^{-2}	1.7×10^{-9}
αiF22/3000	6.0×10^{-2}	9.9×10^{-9}	5.9×10^{-3}	9.7×10^{-10}
αiF22/4000	7.3×10^{-2}	8.2×10^{-9}	7.1×10^{-3}	8.0×10^{-10}
αiF30/4000	5.8×10^{-2}	3.9×10^{-9}	5.7×10^{-3}	3.8×10^{-10}
αiF40/3000	2.6×10^{-2}	6.0×10^{-9}	2.5×10^{-3}	5.8×10^{-10}
αiF40/3000 with fan	2.6×10^{-2}	6.0×10^{-9}	2.5×10^{-3}	5.8×10^{-10}

> **NOTE**
> For models α*i*F1/5000 and α*i*F2/5000, use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier α*i*SV 20/40-B or the L/M-axis of servo amplifier α*i*SV 20/20/40-B.

Model	SI unit		Gravitational system of units	
	A	B	A	B
α*i*F1/5000	1.2	1.1×10^{-7}	1.2×10^{-1}	1.0×10^{-8}
α*i*F2/5000	4.9×10^{-1}	5.8×10^{-8}	4.8×10^{-2}	5.7×10^{-9}

α*i*F series (400 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
α*i*F4/5000HV	3.9×10^{-1}	3.3×10^{-8}	3.8×10^{-2}	3.2×10^{-9}
α*i*F8/3000HV	1.1×10^{-1}	2.2×10^{-8}	1.1×10^{-2}	2.2×10^{-9}
α*i*F8/4000HV	1.9×10^{-1}	1.3×10^{-8}	1.8×10^{-2}	1.3×10^{-9}
α*i*F12/4000HV	1.5×10^{-1}	2.3×10^{-8}	1.4×10^{-2}	2.2×10^{-9}
α*i*F22/3000HV	4.5×10^{-2}	1.3×10^{-8}	4.4×10^{-3}	1.3×10^{-9}
α*i*F22/4000HV	1.2×10^{-1}	4.8×10^{-9}	1.2×10^{-2}	4.7×10^{-10}
α*i*F30/4000HV	1.0×10^{-1}	2.3×10^{-9}	9.8×10^{-3}	2.2×10^{-10}
α*i*F40/3000HV	4.4×10^{-2}	3.6×10^{-9}	4.3×10^{-3}	3.5×10^{-10}
α*i*F40/3000HV with fan	4.4×10^{-2}	3.6×10^{-9}	4.3×10^{-3}	3.5×10^{-10}

β*i*S series (200 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*S 0.2/5000	8.3	5.8×10^{-7}	8.1×10^{-1}	5.7×10^{-8}
β*i*S 0.3/5000	3.4	4.6×10^{-7}	3.4×10^{-1}	4.5×10^{-8}
β*i*S 0.4/5000	2.3	4.6×10^{-7}	2.3×10^{-1}	4.5×10^{-8}
β*i*S 0.5/6000	9.0×10^{-1}	2.1×10^{-7}	8.8×10^{-2}	2.0×10^{-8}
β*i*S 1/6000	3.8×10^{-1}	8.8×10^{-8}	3.7×10^{-2}	8.7×10^{-9}
β*i*S 2/4000 β*i*Sc 2/4000	2.1×10^{-1}	8.1×10^{-8}	2.1×10^{-2}	7.9×10^{-9}
β*i*S 4/4000 β*i*Sc 4/4000	8.7×10^{-2}	4.1×10^{-8}	8.5×10^{-3}	4.0×10^{-9}
β*i*S 8/3000 β*i*Sc 8/3000	3.9×10^{-2}	5.3×10^{-8}	3.8×10^{-3}	5.2×10^{-9}
β*i*S 12/2000 β*i*Sc 12/2000	1.7×10^{-2}	2.7×10^{-8}	1.7×10^{-3}	2.6×10^{-9}
β*i*S 12/3000	1.0×10^{-1}	4.5×10^{-9}	1.0×10^{-2}	4.4×10^{-10}
β*i*S 22/2000	4.0×10^{-2}	7.0×10^{-9}	3.9×10^{-3}	6.8×10^{-10}
β*i*S 22/3000	6.7×10^{-2}	4.0×10^{-9}	6.6×10^{-3}	3.9×10^{-10}
β*i*S 30/2000	4.0×10^{-2}	2.8×10^{-9}	3.9×10^{-3}	2.7×10^{-10}
β*i*S 40/2000	2.3×10^{-2}	2.6×10^{-9}	2.2×10^{-3}	2.5×10^{-10}

> **NOTE**
> For models β*i*S2/4000, β*i*Sc2/4000, β*i*S4/4000, β*i*Sc4/4000, β*i*S8/3000, β*i*Sc8/3000, β*i*S12/2000, and β*i*Sc12/2000, use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier α*i*SV 20/40-B or the L/M-axis of servo amplifier α*i*SV 20/20/40-B.

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*S 2/4000 β*i*Sc 2/4000	4.8×10^{-1}	3.6×10^{-8}	4.7×10^{-2}	3.6×10^{-8}
β*i*S 4/4000 β*i*Sc 4/4000	2.6×10^{-1}	1.4×10^{-8}	2.6×10^{-2}	1.3×10^{-9}
β*i*S 8/3000 β*i*Sc 8/3000	1.1×10^{-1}	1.8×10^{-8}	1.1×10^{-2}	1.8×10^{-9}
β*i*S 12/2000 β*i*Sc 12/2000	5.5×10^{-2}	8.5×10^{-9}	5.4×10^{-3}	8.3×10^{-10}

β*i*S series (400 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*S 2/4000HV (Note)	2.2×10^{-1}	8.0×10^{-8}	2.1×10^{-2}	7.8×10^{-9}
β*i*S 4/4000HV (Note)	8.9×10^{-2}	4.0×10^{-8}	8.7×10^{-3}	4.0×10^{-9}
β*i*F 8/3000HV (Note)	3.7×10^{-2}	5.6×10^{-8}	3.6×10^{-3}	5.5×10^{-9}
β*i*S 12/3000HV	8.1×10^{-2}	5.8×10^{-9}	8.0×10^{-3}	5.7×10^{-10}
β*i*S 22/2000HV	3.1×10^{-2}	9.8×10^{-9}	3.0×10^{-3}	9.6×10^{-10}
β*i*S 22/3000HV	5.1×10^{-2}	5.1×10^{-9}	5.0×10^{-3}	5.0×10^{-10}
β*i*S 30/2000HV	3.0×10^{-2}	3.7×10^{-9}	2.9×10^{-3}	3.6×10^{-10}
β*i*S 40/2000HV	1.7×10^{-2}	3.4×10^{-9}	1.7×10^{-3}	3.3×10^{-10}

NOTE

For models β*i*S2/4000HV, β*i*S4/4000HV, and β*i*S8/3000HV use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier α*i*SV 10/20HV-B or the L/M-axis of servo amplifier α*i*SV 10/10/20HV-B for the 30*i*-B series.

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*S 2/4000HV (Note)	4.2×10^{-1}	4.2×10^{-8}	4.1×10^{-2}	4.1×10^{-9}
β*i*S 4/4000HV (Note)	2.2×10^{-1}	1.6×10^{-8}	2.2×10^{-2}	1.6×10^{-9}
β*i*F 8/3000HV (Note)	9.3×10^{-2}	2.2×10^{-8}	9.1×10^{-3}	2.2×10^{-9}

β*i*F series (200 V system)

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*F 4/3000	9.0×10^{-2}	1.4×10^{-7}	8.9×10^{-3}	1.4×10^{-8}
β*i*F 8/2000	3.0×10^{-2}	8.2×10^{-8}	2.9×10^{-3}	8.0×10^{-9}
β*i*F 12/2000	1.8×10^{-2}	1.7×10^{-7}	1.8×10^{-3}	1.6×10^{-8}
β*i*F 22/2000	3.9×10^{-2}	1.5×10^{-8}	3.8×10^{-3}	1.5×10^{-9}
β*i*F 30/1500	2.2×10^{-2}	1.1×10^{-8}	2.1×10^{-3}	1.1×10^{-9}

NOTE

For models β*i*F4/3000, β*i*F8/2000, and β*i*F12/2000, use the coefficients listed below as the values for A and B when the dynamic brake is driven for the L-axis of servo amplifier α*i*SV 20/40-B or the L/M-axis of servo amplifier α*i*SV 20/20/40-B.

Model	SI unit		Gravitational system of units	
	A	B	A	B
β*i*F 4/3000	1.9×10^{-1}	6.7×10^{-8}	1.9×10^{-2}	6.5×10^{-9}
β*i*F 8/2000	7.9×10^{-2}	3.1×10^{-8}	7.7×10^{-3}	3.0×10^{-9}
β*i*F 12/2000	4.7×10^{-2}	6.4×10^{-8}	4.6×10^{-3}	6.2×10^{-9}

The values of A and B are calculated by assuming that the resistance of the power line is 0.05Ω per phase.

Notes on the dynamic brake
To protect the servo amplifier, use the dynamic brake with a load inertia not exceeding the allowable value listed below according to the used maximum speed.

	Motor model	Speed during use	Allowable load inertia (reflected to motor shaft) * Inertia of the motor itself not included
1	α*i*F 22/4000HV	0 to 4000min^{-1}	0.0360 kgm^2 (Up to 3.0 times the motor inertia)
2	α*i*F 30/4000HV	Higher than 3000min^{-1}	0.0340 kgm^2 (Up to 2.0 times the motor inertia)
		0 to 3000min^{-1}	0.0510 kgm^2 (Up to 3.0 times the motor inertia)
3	α*i*S 22/6000HV	0 to 6000min^{-1}	0.0158 kgm^2 (Up to 3.0 times the motor inertia)
4	α*i*S 500/3000HV	0 to 3000min^{-1}	0.3810 kgm^2 (Up to 3.0 times the motor inertia)
5	Other models than above models	0 to maximum motor speed	Up to 5.0 times the motor inertia

⚠ CAUTION

1 If exceeding the above condition, contact FANUC.
2 Calculate and certainly confirm the dynamic brake stop distance by using coefficients for calculating the dynamic brake distance if it is within the assumption on the machine.
3 Applying the quick stop functions are recommended for shortening the stop distance at emergency stop or power failure.
As for the detail of this functions, refer to the FANUC AC SERVO MOTOR PARAMETER MANUAL B-65270EN.
For certain working of the quick stop functions at the power failure, keep the control power supply (24VDC) for CNC and servo amplifier by using the uninterruptible power supply (UPS) for example.
4 If some alarms occur, the stop distance will not be short because the quick stop functions does not operate effectively.
5 It should be certainly confirmed at the actual machine that the stop distance is shortened at emergency stop or power failure when the quick stop functions are applied.

⚠ WARNING

1 If the motor stops from its maximum rotational speed with greater than the allowable load inertia ratio, the inside of the servo amplifier may become abnormally hot, possibly causing damage to the servo amplifier.
Make no mistakes in the calculations of load inertia.
2 If load inertia exceed the allowable condition, and any alarms or power failure (with the condition quick stop functions ineffective) occur among the rapid traverse, take 30 minutes intervals after power failure because of the protection of the servo amplifier.
If the stopping motion by the dynamic brake is continuously repeated within the 30 minutes, the inside of the servo amplifier may become abnormally hot and possibly being damaged.

2.3.3 α*i*SP-B Series

Common specifications

α*i*SP-B series spindle amplifiers are functionally same as Type B of the conventional α*i*SP-B series.

Item	Specifications
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge
Available frequency	1 to 1.5kHz
Speed variation rate	0.1% or less of maximum speed (load variation: 10 to 100%)
Applicable CNC	30*i* /31*i* /32*i* /35*i*-B /0*i*-F

200 V input series

Item \ Model	α*i*SP 2.2-B	α*i*SP 5.5-B	α*i*SP 11-B	α*i*SP 15-B	α*i*SP 22-B
Rated output (HRV1) (HRV2)	18Arms 13Arms	29Arms 27Arms	56Arms 48Arms	74Arms 64Arms	109Arms 96Arms

Item \ Model	α*i*SP 26-B	α*i*SP 30-B	α*i*SP 37-B	α*i*SP 45-B	α*i*SP 55-B
Rated output (HRV1) (HRV2)	128Arms 114Arms	148Arms 133Arms	165Arms 140Arms	222Arms 197Arms	271Arms 241Arms

NOTE
1. Derating is applied for the spindle amplifier according to ambient temperatures. See Section 2.2.
2. Level-up α*i*SP-B cannot be connected with 0*i*-D.

400 V input series

Item \ Model	α*i*SP 5.5HV-B	α*i*SP 11HV-B	α*i*SP 15HV-B	α*i*SP 22HV-B	α*i*SP 30HV-B
Rated output (HRV1) (HRV2)	18Arms 14Arms	26Arms 23Arms	36Arms 30Arms	52Arms 44Arms	71Arms 60Arms

Item \ Model	α*i*SP 45HV-B	α*i*SP 60HV-B	α*i*SP 75HV-B	α*i*SP 100HV-B	α*i*SP 100HV(SiC)-B
Rated output (HRV1) (HRV2)	107Arms 77Arms	110Arms 100Arms	178Arms 150Arms	205Arms 183Arms	205Arms 183Arms

NOTE
1. Derating is applied for the spindle amplifier according to ambient temperatures. See Section 2.2.
2. Level-up α*i*SP-B cannot be connected with 0*i*-D.

2.3.4 α*i*SVP-B Series

Common specifications

The spindle part of α*i*SVP-B series amplifiers are functionally same as Type B of the α*i*SP-B series for the 30*i*-A series.

Item	Specifications
Main circuit control method	Sine-wave PWM control with transistor (IGBT) bridge
Applicable CNC	30*i* /31*i* /32*i* /35*i*-B /0*i*-F

200 V input series

Model	α*i*SVP20/20/20-5.5-B
Servo axis specifications	
Rated output	L axis: 6.5Arms, M axis: 6.5Arms, N axis: 6.5Arms
Maximum current	L axis: 20Ap, M axis: 20Ap, N axis: 20Ap
Servo output enable frequency range	0 to 550Hz
Spindle axis specifications	
Available frequency	1 to 1.5kHz
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)
Rated output	29Arms (HRV1), 27Arms (HRV2)

Model	α*i*SVP20/20/20-2.2-B
Servo axis specifications	
Rated current	L axis: 6.5Arms, M axis: 6.5Arms, N axis: 6.5Arms
Maximum current	L axis: 20Ap, M axis: 20Ap, N axis: 20Ap
Servo output enable frequency range	0Hz to 550Hz
Spindle axis specifications	
Available frequency	1Hz to 1.5kHz
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)
Rated current	18Arms (HRV1), 13Arms (HRV2)

Model	α*i*SVP40/40/40-2.2-B
Servo axis specifications	
Rated current	L axis: 13Arms, M axis: 13Arms, N axis: 13Arms
Maximum current	L axis: 40Ap, M axis: 40Ap, N axis: 40Ap
Servo output enable frequency range	0Hz to 550Hz
Spindle axis specifications	
Available frequency	1Hz to 1.5kHz
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)
Rated current	18Arms (HRV1)、13Arms (HRV2)

400 V input series

Model	α*i*SVP10/10/10-5.5HV-B
Servo axis specifications	
Rated output	L axis: 3.2Arms, M axis: 3.2Arms, N axis: 3.2Arms
Maximum current	L axis: 10Ap, M axis: 10Ap, N axis: 10Ap
Servo output enable frequency range	0 to 550Hz
Spindle axis specifications	
Available frequency	1 to 1.5kHz
Speed variation rate	0.1% or less of maximum speed (load variation: 10% to 100%)
Rated output	14Arms (for both HRV1 and HRV2)

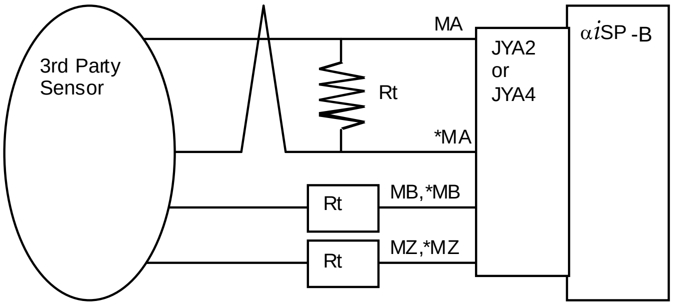
Sensors applicable to the αiSP-B

The following table lists combinations of applicable sensors and functions.

		Configuration	Combination of sensors and functions											Remarks
			1	2	3	4	5	6	7	8	9	10	11	
Sensor	Sensor on the motor	αiM sensor	O					O	O	O	O	O	O	
		αiMZ sensor		O										
		αiBZ sensor (*8) (when a built-in motor is used)			O									
		αiCZ sensor I (when a built-in motor is used) See next page.				O								
		3rd party sensor (*9)					O							
	Sensor on the spindle	αi position coder						O						*3
		External 1-rotation							O					*3
		αiBZ sensor (*8)								O				*3
		αiCZ sensor IS See next page.									O			
		α position coder S										O		*3
		3rd party sensor (*9)											O	*3
Function	Rigid tapping		O*1	O	O	O	O	O	O*2	O	O	O	O	
	Orientation by a position coder			O*6	O	O	O	O		O	O	O	O	
	Orientation by the external one-rotation signal								O*2					*5
	Spindle synchronization	Velocity synchronization	O*2	O*6	O	O	O*6	O	O*2	O	O	O	O	*4
		Phase synchronization		O*6	O	O	O*6	O	O*7	O	O	O	O	*4
	Threading			O*6	O	O	O*6	O		O	O	O	O	
	Cs-axis contour control			O*6	O		O*6		O*10	O	O	O	O	

*1 The spindle and motor must be interconnected directly or 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 motors and two spindle amplifiers are required.
*5 Note that the stop position moves by a backlash between the spindle and motor because of the theory of operation.
*6 The spindle and motor must be interconnected directly or with a timing belt or gear in one-to-one connection mode.
*7 Before specifying spindle synchronization, perform orientation to detect the 1-rotation signal (PC1DT=1).
*8 Same for αiCZ analog output type sensors.
*9 FANUC spindle amplifiers are designed specifically for FANUC sensors, so use FANUC sensors. You can use a 3rd party sensor only when FANUC spindle sensors are not applicable. There are the following restrictions, however.

1) FANUC α*i*SP-B has no built-in terminating resistor (120 Ω).
To match the specification of sensor output and spindle amplifier input, consider terminating resistance. If the input phase A/B waveform is not within the range between 0.5 V and 1.2 Vp-p defined in Subsection 4.3.4 in "FANUC SERVO AMPLIFIER α*i* series MAINTENANCE MANUAL (B-65285EN)," install a terminating resistor required by the sensor manufacturer outside the spindle amplifier.
Level-up α*i*SP-B and Level-up α*i*SVP-B include a terminating resistor (120 Ω), and enable/disable of their respective terminating resistors (120 Ω) can be set using the following parameters.



Rt is defind in specification of 3rd party sensor.

[JYA2] No.4004#6=0: Disables 120Ω-terminating resistor, No.4004#6=1: Enables 120Ω-terminating resistor [JYA4] No.4004#7=0: Disables 120Ω-terminating resistor, No.4004#7=1: Enables 120Ω-terminating resistor

Note: The aforementioned parameters are valid only for Level-up α*i*SP-B and Level-up α*i*SVP-B.

2) For details of the waveform, see Section 11.3, "3RD PARTY SPINDLE SENSORS."

*10 The spindle axis and each motor axis must be connected with a timing belt or gear.
Positional accuracy depends on responsiveness to the external single rotation signal, gear accuracy, backlash and so on.

Other functions

O: Applicable

	α*i*SP-B	α*i*SVP-B	Remarks
Analog output of load meter and speedometer	○	○	Connector JY1
Analog override input	○	○	Connector JY1
Excitation off monitor signal output	○	○	Connector JX4
Synchronization between servo axis and spindle axis (via FSSB)	○	○	
Position coder signal output (*1)	○	○	Connector JX4
Spindle EGB function (Inter-SP communication function)	○	○	Connector JX4
Safe Torque Off function	○ (*2)	○ (*2)	α*i*SP-B: JX17 α*i*SVP-B: CX63

*1 The α*i*CZ sensor I and α*i*CZ sensor IS are excluded.
*2 The Safe Torque Off function is supported by Level-up α*i*SP-B and Level-up α*i*SVP-B only.

Sub module SW

By applying the sub module SW for α*i*SP-B or α*i*SVP-B, the spindle switch function to switch and control two motors (main and sub) with one spindle amplifier can be applied. (*2)

*2 The α*i*CZ sensor I and α*i*CZ sensor IS are excluded.

> ⚠ **CAUTION**
> Order a sub module SW for α*i*SP-B (A06B-6220-H401).

Sub module SM

By applying the sub module SM for α*i*SP-B or α*i*SVP-B, the synchronous built-in spindle motor B*i*S series is supported.

24-V power supply unit

The 24-V power supply unit supplies 24 VDC power to α*i*PS-B

Item	Specifications	
	A06B-6200-K502	**A06B-6200-K503**
Output voltage	24VDC ±10%	
Maximum output current (at ambient temperature of 55°C)	4.6A	11.2A
Input power supply voltage range	1ϕ 85 to 264VAC	1ϕ 85 to 132VAC 1ϕ 170 to 264VAC (Selected by switch)
Input power supply frequency	47 to 450Hz	
Input current	3.5A or less (At 100 VAC input) 2.1A or less (At 200 VAC input)	8.0A or less (At 100 VAC input) 4.5A or less (At 200 VAC input)
Startup time	500msec or less	650msec or less
Instantaneous power failure guarantee time	20msec or more	

2.4 WEIGHT

α*i*PS-B

Model	Weight
α*i*PS 3-B	2kg
α*i*PS 7.5-B	4kg
α*i*PS 11-B, 15-B, 11HV-B, 18HV-B	5.5kg
α*i*PS 26-B, 30-B, 37-B, 30HV-B, 45HV-B, 60HV-B	8.5kg
α*i*PS 55-B, 75HV-B, 100HV-B, 125HV-B	18kg

α*i*SV-B

Model	Weight
α*i*SV 4-B, 20-B, 10HV-B	2.0kg
α*i*SV 4/4-B, 4/20-B, 20/20-B, 10/10HV-B	2.2kg
α*i*SV 4/4/4-B, 20/20/20-B, 10/10/10HV-B	2.5kg
α*i*SV 40-B, 80-B, 160-B α*i*SV 20/40-B, 40/40-B, 40/80-B, 80/80-B α*i*SV 20/20/40-B, 40/40/40-B α*i*SV 20HV-B, 40HV-B, 80HV-B α*i*SV 10/20HV-B, 20/20HV-B, 20/40HV-B, 40/40HV-B α*i*SV 10/10/20HV-B, 20/20/20HV-B	4.0kg
α*i*SV 180HVS-B,80/160-B, 160/160-B, 40/80HV-B, 80/80HV-B, 80/80/80-B, 40/40/40HV-B	5.5kg
α*i*SV 360-B, 180HV-B	8.5kg
α*i*SV 360HV-B, 540HV-B	18.0kg

α*i*SP-B

Model	Weight
α*i*SP 2.2-B	4.0kg
α*i*SP 5.5-B, 5.5HV-B, α*i*SVP 20/20/20-2.2-B	4.0kg
α*i*SVP 40/40/40-2.2-B	4.4kg
α*i*SP 11-B, 15-B, 11HV-B, 15HV-B	5.5kg

Model	Weight
αiSVP 20/20/20-5.5-B, αiSVP 10/10/10-5.5HV-B	
αiSP 22-B, 26-B, 30-B, 37-B, 22HV-B,30HV-B, 45HV-B, 60HV-B	8.5kg
αiSP 45-B, 55-B, 75HV-B, 100HV-B, 100HV(SiC)-B	18.0kg

AC reactor

Model	Weight
A81L-0001-0184	4.5kg
A81L-0001-0185	6.5kg
A81L-0001-0186	8.0kg
A81L-0001-0187	8.0kg
A81L-0001-0188	9.5kg
A81L-0001-0189	12.5kg
A81L-0001-0190	7.7kg
A81L-0001-0191	13.5kg
A81L-0001-0192	25kg
A81L-0001-0193	26kg
A81L-0001-0194	26kg
A81L-0001-0199	4.3kg
A81L-0001-0216	56kg

Noise filter

Model	Weight
A06B-6077-K155	5.2kg
A06B-6077-K156	12.0kg
A06B-6077-K157	23.5kg
A06B-6077-K158	24.5kg
A06B-6200-K160	0.7kg
A06B-6200-K161	1.1kg
A06B-6200-K162	2.6kg
A06B-6200-K163	2.7kg
A06B-6200-K164	4.3kg
A06B-6200-K165	6.9kg
A06B-6200-K166	8.1kg

3 ORDERING INFORMATION

Chapter 3, "ORDERING INFORMATION," consists of the following sections:

3.1 ORDERING INFORMATION
- 3.1.1 200 V Input Series
  - 3.1.1.1 α*i*PS-B series
  - 3.1.1.2 Level-up α*i*PS-B series
  - 3.1.1.3 α*i*SV-B series
  - 3.1.1.4 α*i*SP-B series
  - 3.1.1.5 Level-up α*i*SP-B series
  - 3.1.1.6 α*i*SVP-B series
  - 3.1.1.7 Level-up α*i*SVP-B series
- 3.1.2 400 V Input Series
  - 3.1.2.1 α*i*PS-B series
  - 3.1.2.2 Level-up α*i*PS-B series
  - 3.1.2.3 α*i*SV-B series
  - 3.1.2.4 α*i*SP-B series
  - 3.1.2.5 Level-up α*i*SP-B series
  - 3.1.2.6 α*i*SVP-B series
  - 3.1.2.7 Level-up α*i*SVP-B series
- 3.1.3 Others
  - 3.1.3.1 AC reactor
  - 3.1.3.2 Sub module SW
  - 3.1.3.3 Sub module SM
  - 3.1.3.4 Connectors
  - 3.1.3.5 Fuses
  - 3.1.3.6 Cables
  - 3.1.3.7 Circuit breaker and magnetic contactor
  - 3.1.3.8 Lightning surge protector
  - 3.1.3.9 Noise filter
  - 3.1.3.10 Sensors for servo
  - 3.1.3.11 Sensors for spindle
  - 3.1.3.12 Power line switch unit
  - 3.1.3.13 Battery for absolute Pulsecoder
  - 3.1.3.14 24-V power supply unit

3.1 ORDERING INFORMATION

3.1.1 200 V Input Series

3.1.1.1 α*i*PS-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6200-H003	α*i*PS 3-B	
	A06B-6200-H008	α*i*PS 7.5-B	
	A06B-6200-H011	α*i*PS 11-B	
	A06B-6200-H015	α*i*PS 15-B	
	A06B-6200-H026	α*i*PS 26-B	
	A06B-6200-H030	α*i*PS 30-B	
	A06B-6200-H037	α*i*PS 37-B	
	A06B-6200-H055	α*i*PS 55-B	

3.1.1.2 Level-up α*i*PS-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6202-H003	α*i*PS 3-B	
	A06B-6202-H008	α*i*PS 7.5-B	
	A06B-6202-H011	α*i*PS 11-B	
	A06B-6202-H015	α*i*PS 15-B	
	A06B-6202-H026	α*i*PS 26-B	
	A06B-6202-H030	α*i*PS 30-B	
	A06B-6202-H037	α*i*PS 37-B	
	A06B-6202-H055	α*i*PS 55-B	

NOTE
See Sections 4.4 and 4.5 for details of how to select the α*i*PS-B.

3.1.1.3 α*i*SV-B series

1-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6240-H101	α*i*SV 4-B	
	A06B-6240-H103	α*i*SV 20-B	
	A06B-6240-H104	α*i*SV 40-B	
	A06B-6240-H105	α*i*SV 80-B	
	A06B-6240-H106	α*i*SV 160-B	
	A06B-6240-H109	α*i*SV 360-B	DBM required
	A06B-6240-H121	α*i*SV 4-B	Connection to SSM supported
	A06B-6240-H123	α*i*SV 20-B	Connection to SSM supported
	A06B-6240-H124	α*i*SV 40-B	Connection to SSM supported
	A06B-6240-H125	α*i*SV 80-B	Connection to SSM supported
	A06B-6240-H126	α*i*SV 160-B	Connection to SSM supported
	A06B-6240-H129	α*i*SV 360-B	DBM required Connection to SSM supported

2-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6240-H201	α*i*SV 4/4-B	
	A06B-6240-H203	α*i*SV 4/20-B	
	A06B-6240-H205	α*i*SV 20/20-B	
	A06B-6240-H206	α*i*SV 20/40-B	
	A06B-6240-H207	α*i*SV 40/40-B	
	A06B-6240-H208	α*i*SV 40/80-B	
	A06B-6240-H209	α*i*SV 80/80-B	
	A06B-6240-H210	α*i*SV 80/160-B	
	A06B-6240-H211	α*i*SV 160/160-B	

3-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6240-H301	α*i*SV 4/4/4-B	
	A06B-6240-H305	α*i*SV 20/20/20-B	
	A06B-6240-H306	α*i*SV 20/20/40-B	
	A06B-6240-H308	α*i*SV 40/40/40-B	
	A06B-6240-H321	α*i*SV 4/4/4-B	STO3 axis available
	A06B-6240-H325	α*i*SV 20/20/20-B	STO3 axis available
	A06B-6240-H326	α*i*SV 20/20/40-B	STO3 axis available
	A06B-6240-H328	α*i*SV 40/40/40-B	STO3 axis available
	A06B-6240-H331	α*i*SV 80/80/80-B	STO3 axis available

Dynamic brake module

Category	Ordering number	Name	Remarks
Standard	A06B-6079-H401	DBM	α*i*SV 360-B, driven on 200VAC
	A06B-6079-H403	DBM	α*i*SV 360-B, driven on 24VDC

NOTE

1 See Section 4.1 for details of how to select the α*i*SV-B.

2 For the α*i*SV 360-B, a dynamic brake module (DBM) is required. The dynamic brake module is used to immediately stop the motor at emergency stop. Other α*i*SV-B models contain a similar function.

3 To use a machine protection function at a power failure, a DBM driven on 24 VDC (A06B-6079-H403 or A06B-6069-H301) is recommended.

3.1.1.4 α*i*SP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6220-H002#H600	α*i*SP 2.2-B	
	A06B-6220-H006#H600	α*i*SP 5.5-B	
	A06B-6220-H011#H600	α*i*SP 11-B	
	A06B-6220-H015#H600	α*i*SP 15-B	
	A06B-6220-H022#H600	α*i*SP 22-B	
	A06B-6220-H026#H600	α*i*SP 26-B	
	A06B-6220-H030#H600	α*i*SP 30-B	
	A06B-6220-H037#H600	α*i*SP 37-B	
	A06B-6220-H045#H600	α*i*SP 45-B	
	A06B-6220-H055#H600	α*i*SP 55-B	

NOTE
See Section 4.2 for details of how to select the α*i*SP-B.

3.1.1.5 Level-up α*i*SP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6222-H002#H610	α*i*SP 2.2-B	
	A06B-6222-H006#H610	α*i*SP 5.5-B	
	A06B-6222-H011#H610	α*i*SP 11-B	
	A06B-6222-H015#H610	α*i*SP 15-B	
	A06B-6222-H022#H610	α*i*SP 22-B	
	A06B-6222-H026#H610	α*i*SP 26-B	
	A06B-6222-H030#H610	α*i*SP 30-B	
	A06B-6222-H037#H610	α*i*SP 37-B	
	A06B-6222-H045#H610	α*i*SP 45-B	
	A06B-6222-H055#H610	α*i*SP 55-B	

NOTE
See Section 4.2 for details of how to select the α*i*SP-B.

3.1.1.6 α*i*SVP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6230-H001#H600	α*i*SVP 20/20/20- 5.5-B	

NOTE
See Section 4.3 for details of how to select the α*i*SVP-B.

3.1.1.7 Level-up α*i*SVP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6232-H001#H610	α*i*SVP 20/20/20- 5.5-B	
	A06B-6232-H003#H610	α*i*SVP 20/20/20- 2.2-B	
	A06B-6232-H004#H610	α*i*SVP 40/40/40- 2.2-B	

NOTE
See Section 4.3 for details of how to select the α*i*SVP-B.

3.1.2 400 V Input Series

3.1.2.1 α*i*PS-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6250-H011	α*i*PS 11HV-B	
	A06B-6250-H018	α*i*PS 18HV-B	
	A06B-6250-H030	α*i*PS 30HV-B	
	A06B-6250-H045	α*i*PS 45HV-B	
	A06B-6250-H060	α*i*PS 60HV-B	
	A06B-6250-H075	α*i*PS 75HV-B	
	A06B-6250-H100	α*i*PS 100HV-B	

3.1.2.2 Level-up α*i*PS-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6252-H011	α*i*PS 11HV-B	
	A06B-6252-H018	α*i*PS 18HV-B	
	A06B-6252-H030	α*i*PS 30HV-B	
	A06B-6252-H045	α*i*PS 45HV-B	
	A06B-6252-H060	α*i*PS 60HV-B	
	A06B-6252-H075	α*i*PS 75HV-B	
	A06B-6252-H100	α*i*PS 100HV-B	
	A06B-6252-H125	α*i*PS 125HV-B	

NOTE
See Sections 4.4 and 4.5 for details of how to select the α*i*PS-B.

3.1.2.3 α*i*SV-B series

1-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6290-H102	α*i*SV 10HV-B	
	A06B-6290-H103	α*i*SV 20HV-B	
	A06B-6290-H104	α*i*SV 40HV-B	
	A06B-6290-H105	α*i*SV 80HV-B	
	A06B-6290-H106	α*i*SV 180HV-B	DBM required
	A06B-6290-H109	α*i*SV 360HV-B	DBM required
	A06B-6290-H110	α*i*SV 540HV-B	DBM required Only HRV2 is applicable.
	A06B-6290-H122	α*i*SV 10HV-B	Connection to SSM supported
	A06B-6290-H123	α*i*SV 20HV-B	Connection to SSM supported
	A06B-6290-H124	α*i*SV 40HV-B	Connection to SSM supported
	A06B-6290-H125	α*i*SV 80HV-B	Connection to SSM supported
	A06B-6290-H126	α*i*SV 180HV-B	DBM required Connection to SSM supported
	A06B-6290-H129	α*i*SV 360HV-B	DBM required Connection to SSM supported
	A06B-6290-H130	α*i*SV 540HV-B	DBM required Only HRV2 applicable Connection to SSM supported
	A06B-6290-H166	α*i*SV 180HVS-B	HRV4 not supported Connection to SSM supported

2-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6290-H202	α*i*SV 10/10HV-B	HRV4 not supported
	A06B-6290-H204	α*i*SV 10/20HV-B	
	A06B-6290-H205	α*i*SV 20/20HV-B	
	A06B-6290-H206	α*i*SV 20/40HV-B	
	A06B-6290-H207	α*i*SV 40/40HV-B	
	A06B-6290-H208	α*i*SV 40/80HV-B	
	A06B-6290-H209	α*i*SV 80/80HV-B	

3-axis amplifier

Category	Ordering number	Name	Remarks
Standard	A06B-6290-H302	α*i*SV 10/10/10HV-B	HRV4 not supported
	A06B-6290-H303	α*i*SV 10/10/20HV-B	
	A06B-6290-H305	α*i*SV 20/20/20HV-B	
	A06B-6290-H322	α*i*SV 10/10/10HV-B	HRV4 not supported STO3 axis available
	A06B-6290-H323	α*i*SV 10/10/20HV-B	STO3 axis available
	A06B-6290-H325	α*i*SV 20/20/20HV-B	STO3 axis available
	A06B-6290-H328	α*i*SV 40/40/40HV-B	STO3 axis available

Dynamic brake module

Category	Ordering number	Name	Remarks
Standard	A06B-6079-H401	DBM	α*i*SV 180HV-B, α*i*SV 360HV-B, α*i*SV 540HV-B Driven on 200VAC
	A06B-6079-H403	DBM	α*i*SV 180HV-B, α*i*SV 360HV-B, α*i*SV 540HV-B Driven on 24VDC (Note 3)
	A06B-6069-H300	DBM	α*i*SV 360HV-B Driven on 200VAC (Note 4)
	A06B-6069-H301	DBM	α*i*SV 360HV-B Driven on 24VDC (Note 3) (Note 4)

NOTE

1 See Section 4.1 for details of how to select the α*i*SV-B.

2 For the α*i*SV 180HV-B, α*i*SV 360HV-B, and α*i*SV 540HV-B, a dynamic brake module (DBM) is required.
The dynamic brake module is used to immediately stop the motor at emergency stop. Other α*i*SV-B models contain a similar function. However, the DBM does not need to be connected when connected to SSM.

3 To use a machine protection function at a power failure, a DBM driven on 24 VDC is recommended.

4 A06B-6069-H300 or A06B-6069-H301 is used when the servo motor is the α*i* S1000HV, 2000HV, or 3000HV.

3.1.2.4 α*i*SP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6270-H006#H600	α*i*SP 5.5HV-B	
	A06B-6270-H011#H600	α*i*SP 11HV-B	
	A06B-6270-H015#H600	α*i*SP 15HV-B	
	A06B-6270-H022#H600	α*i*SP 22HV-B	
	A06B-6270-H030#H600	α*i*SP 30HV-B	
	A06B-6270-H045#H600	α*i*SP 45HV-B	
	A06B-6270-H075#H600	α*i*SP 75HV-B	
	A06B-6270-H100#H600	α*i*SP 100HV-B	

NOTE
See Section 4.2 for details of how to select the α*i*SP-B.

3.1.2.5 Level-up α*i*SP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6272-H006#H610	α*i*SP 5.5HV-B	
	A06B-6272-H011#H610	α*i*SP 11HV-B	
	A06B-6272-H015#H610	α*i*SP 15HV-B	
	A06B-6272-H022#H610	α*i*SP 22HV-B	
	A06B-6272-H030#H610	α*i*SP 30HV-B	
	A06B-6272-H045#H610	α*i*SP 45HV-B	
	A06B-6272-H060#H610	α*i*SP 60HV-B	
	A06B-6272-H075#H610	α*i*SP 75HV-B	
	A06B-6272-H100#H610	α*i*SP 100HV-B	
	A06B-6272-H100#H610#S	α*i*SP 100HV(SiC)-B	

NOTE
See Section 4.2 for details of how to select the α*i*SP-B.

3.1.2.6 α*i*SVP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6280-H001#H600	α*i*SVP 10/10/10- 5.5HV-B	Servo HRV4 not supported

NOTE
See Section 4.3 for details of how to select the α*i*SVP-B.

3.1.2.7 Level-up α*i*SVP-B series

Category	Ordering number	Name	Remarks
Standard	A06B-6282-H001#H610	α*i*SVP 10/10/10-5.5HV-B	Servo HRV4 not supported

NOTE
See Section 4.3 for details of how to select the α*i*SVP-B.

3.1.3 Others

3.1.3.1 AC reactor

Category	Ordering number	Applicable models	Remarks
Standard	A81L-0001-0199	α*i*PS 3-B	Protection level of conductive part: Equivalent to IP2X
	A81L-0001-0184	α*i*PS 7.5-B, 11-B	
	A81L-0001-0185	α*i*PS 15-B	
	A81L-0001-0186	α*i*PS 26-B	
	A81L-0001-0187	α*i*PS 30-B	
	A81L-0001-0188	α*i*PS 37-B	
	A81L-0001-0189	α*i*PS 55-B	
	A81L-0001-0190	α*i*PS 11HV-B, 18HV-B	
	A81L-0001-0191	α*i*PS 30HV-B, 45HV-B	
	A81L-0001-0192	α*i*PS 60HV-B	
	A81L-0001-0193	α*i*PS 75HV-B	
	A81L-0001-0194	α*i*PS 100HV-B	
	A81L-0001-0216	α*i*PS 125HV-B	

For the outside dimensions, see Subsection 8.1.3, "AC Reactor Unit." For the tightening torque, see Subsection 9.3.1.1, "Details of cable K1 (Common power supply line)."

3.1.3.2 Sub module SW

Category	Ordering number	Applicable models	Function	Remarks
Optional	A06B-6220-H401	α*i*SP-B and α*i*SVP-B series		Sub module SW main unit
	A06B-6111-K808	α*i*SP-B 90-, 150-, and 300-mm-wide models	TYPE A	Connection cable set
	A06B-6111-K809		TYPE B	
	A06B-6111-K810	α*i*SP-B 60-mm-wide model	TYPE A	
	A06B-6111-K811		TYPE B	

(a) To use the spindle switch function with a spindle amplifier for the 30*i*-B series, the main unit of the sub module SW for the 30*i*-B series is necessary.

(b) Each connection cable set is the same as for the corresponding conventional model. Specify a connection cable set appropriate for the width and function of the spindle amplifier you use. Spindle amplifiers for the 30*i*-B series are not classified into TYPES A and B by function and are integrated into the one type functionally same as TYPE B. Specify a connection cable set for TYPE A when you use a function corresponding to TYPE A (connector JYA4 is not used) or a connection cable set for TYPE B when you use a function corresponding to TYPE B (connector JYA4 is used).

(c) See Section 10.3 to prepare a metal fitting for mounting the sub module SW.

3.1.3.3 Sub module SM

Category	Ordering number	Name	Applicable models	Remarks
Optional	A06B-6111-H403	SSM-100	α*i*SP-B, α*i*SVP-B series	
	A06B-6111-H404	SSM-200	α*i*SP-B, α*i*SVP-B series	

A sub module SM is used with the α*i*SP-B to drive a synchronous spindle motor.
It is also used with α*i*SV-B to drive some synchronous built-in servo motor models.
For details of the sub module SM selection, see the specification descriptions for synchronous built-in spindle motors, "FANUC SYNCHRONOUS BUILT-IN SPINDLE MOTOR B*i*S SERIES DESCRIPTIONS" (B-65342EN/02).

3.1.3.4 Connectors

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

(1) Usable with each amplifier : Connectors for inter-amplifier communication (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, "Details of cable K69" as for the detailed connection of K69.
2. See Subsection 9.3.2.9, "Connecting the battery" as for the connection of battery.

(2) Usable with each amplifier : 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)	K10, K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K200 #XXS	Housing: 1 pcs. (XX key) Contact: 4 pcs. (S size)	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)	K10, K21	Contact crimping tool A06B-6110-K220#D5L
	A06B-6110-K201 #XYSS	Housing: 1 pcs. (XY key) Contact: 4 pcs. (SS size)	K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K201 #XYS	Housing: 1 pcs. (XY key) Contact: 4 pcs. (S size)	K21	Contact crimping tool A06B-6110-K220#D5S
	A06B-6110-K201 #XYM	Housing: 1 pcs. (XY key) Contact: 4 pcs. (M size)	K21	Contact crimping tool A06B-6110-K220#D5M
	A06B-6110-K201 #XYL	Housing: 1 pcs. (XY key) Contact: 4 pcs. (L size)	K21	Contact crimping tool A06B-6110-K220#D5L
	A06B-6110-K202 #YYSS	Housing: 1 pcs. (YY key) Contact: 4 pcs. (SS size)	K21	Contact crimping tool A06B-6110-K220#D5SS
	A06B-6110-K202 #YYS	Housing: 1 pcs. (YY key) Contact: 4 pcs. (S size)	K21	Contact crimping tool A06B-6110-K220#D5S
	A06B-6110-K202 #YYM	Housing: 1 pcs. (YY key) Contact: 4 pcs. (M size)	K21	Contact crimping tool A06B-6110-K220#D5M
	A06B-6110-K202 #YYL	Housing: 1 pcs. (YY key) Contact: 4 pcs. (L size)	K21	Contact crimping tool A06B-6110-K220#D5L

(3) For α*i*PS-B

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6200-K200	Housing: 1 pcs. for each Contact: 7 pcs.	K6, K7, K73, K124	Contact crimping tool A06B-6110-K220#D3L A06B-6110-K220#D2M
Standard	A06B-6130-K201	Housing: 1 pcs. Contact: 6 pcs.	K100	Contact crimping tool A06B-6110-K220#D2M

(4) For α*i*SV-B

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6078-K225	Case: 1 pcs. Connector: 1 pcs. Solder type	K22	
Standard	A06B-6073-K216	Case: 2 pcs. Connector: 4 pcs	K24,K25	Contact crimping tool A06B-6110-K220#D3L
Standard	A06B-6089-K202	Case: 1 pcs. Connector: 2 pcs	K4	

(5) For α*i*SP-B

Category	Ordering number	Quantity	Use	Connection tool
Standard	A06B-6078-K222	Case: 1 pcs. Connector: 1 pcs. Solder type	K14, K17, K71	
	A06B-6078-K224	Case: 1 pcs. Connector: 1 pcs. Solder type	K33	
	A06B-6078-K225	Case: 1 pcs. Connector: 1 pcs. Solder 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 tool

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) Connector manufactured by Tyco Electronics Japan G.K.
D-2100 series (for α*i*PS-B 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 α*i*PS-B)

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 CXA2B	Tyco Electronics Japan G.K.	1-1318119-4(housing)	1	For αiPS-B interface	C(d)
		131807-1(contact)	8		-

Configuration of A06B-6110-K211

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CXA2A CXA2B	Tyco Electronics Japan G.K.	1-1318119-4(housing)	1	For connection to separated battery	C(d)
		131807-1(contact)	2		-

Configuration of A06B-6093-K303 (connector with lock mechanism)

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX5X	Japan Aviation Electronics Industry, Ltd.	IL-L2S-S3L-B (N)	1	For connection to separated battery	-
		IL-C2-1-00001	2		-

Configuration of A06B-6110-K200#XXSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2, CZSP CZ2L	Tyco Electronics Japan G.K.	1-917807-2(housing)	1	For L-axis motor power	-
		1318986-6(contact)	4	Wire diameter: 0.75 mm^2 max.	-

Configuration of A06B-6110-K200#XXS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2, CZSP CZ2L	Tyco Electronics Japan G.K.	1-917807-2(housing)	1	For L-axis motor power Wire diameter: 2.0 mm^2 max.	-
		316040-6(contact)	4		-

Configuration of A06B-6110-K200#XXM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ1, CZ2	Tyco Electronics Japan G.K.	1-917807-2(housing)	1	For input power supply and L-axis motor power Wire diameter: 5.5 mm^2 max.	-
CZSP,CZ2L		316041-6(contact)	4		-

Configuration of A06B-6110-K200#XXL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2,CZSP CZ2L	Tyco Electronics Japan G.K.	1-917807-2(housing)	1	For L-axis motor power Wire diameter: 8.0 mm^2 max.	-
		1318697-6(contact)	4		-

Configuration of A06B-6110-K201#XYSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	Tyco Electronics Japan G.K.	3-917807-2(housing)	1	For M-axis motor power Wire diameter: 0.75 mm^2 max.	-
		1318986-6(contact)	4		-

Configuration of A06B-6110-K201#XYS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	Tyco Electronics Japan G.K.	3-917807-2(housing)	1	For M-axis motor power Wire diameter: 2.0 mm^2 max.	-
		316040-6(contact)	4		-

Configuration of A06B-6110-K201#XYM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	Tyco Electronics Japan G.K.	3-917807-2(housing)	1	For M-axis motor power Wire diameter: 5.5 mm^2 max.	-
		316041-6(contact)	4		-

Configuration of A06B-6110-K201#XYL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2M	Tyco Electronics Japan G.K.	3-917807-2(housing)	1	For M-axis motor power Wire diameter: 8.0 mm^2 max.	-
		1318697-6(contact)	4		-

Configuration of A06B-6110-K202#YYSS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	Tyco Electronics Japan G.K.	2-917807-2(housing)	1	For N-axis motor power Wire diameter: 0.75 mm^2 max.	-
		1318986-6(contact)	4		-

Configuration of A06B-6110-K202#YYS

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	Tyco Electronics Japan G.K.	2-917807-2(housing)	1	For N-axis motor power Wire diameter: 2.0 mm^2 max.	-
		316040-6(contact)	4		-

Configuration of A06B-6110-K202#YYM

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	Tyco Electronics Japan G.K.	2-917807-2(housing)	1	For N-axis motor power Wire diameter: 5.5 mm^2 max.	-
		316041-6(contact)	4		-

Configuration of A06B-6110-K202#YYL

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CZ2N	Tyco Electronics Japan G.K.	2-917807-2(housing)	1	For N-axis motor power Wire diameter: 8.0 mm^2 max.	-
		1318697-6(contact)	4		-

Configuration of A06B-6200-K200

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX48	Tyco Electronics Japan G.K.	3-178128-3(housing)	1	Main power supply input for power supply monitor	C(a)
		1-175218-2 (contact)	3		C(c)
CX4	Tyco Electronics Japan G.K.	1-178128-3(housing)	1	For emergency stop signal	C(a)
		1-175218-2(contact)	3		C(c)
CX3	Tyco Electronics Japan G.K.	2-178128-3(housing)	1	For ON/OFF control for external MCC	C(b)
		1-175218-2(contact)	2		C(c)
CXA2D	Tyco Electronics Japan G.K.	1-1318119-4(housing)	1	24-VDC input for control	C(b)
		1318107-1(contact)	4		C(c)

Configuration of A06B-6130-K201

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX37	Tyco Electronics Japan G.K.	1-1318119-3(housing)	1	For power failure detection output	-
		1318107-1(contact)	6		-

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

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
JF□ JX8	Hirose Electric Co., Ltd.	FI40B-2015S(connector)	1	For Pulsecoder For Safe Torque Off	C(g)
		FI-20-CVS2(case)	1		C(h)

Configuration of A06B-6073-K216

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

Configuration of A06B-6089-K202

Connector name	Manufacturer	Part number	Quantity	Use	Dimensions
CX1A CX1B	Tyco Electronics Japan G.K.	1-178128-3(housing)	1	For inputting DB power supply	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 α*i* M sensor, α*i* MZ sensor, α*i* BZ sensor, external one-rotation signal, speedometer, or analog override

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

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

Use JYA3: For α*i* Positioncoder
JYA4: For α*i* Positioncoder S

3.1.3.5 Fuses

The ordering numbers of fuses used with each amplifier (α*i*PS-B, α*i*SV-B, α*i*SP-B, α*i*SVP-B) are indicated below.

(1) For control power supply for α*i*PS-B, α*i*SV-B, α*i*SP-B, and α*i*SVP-B

Category	Ordering number	Remarks
Standard	A06B-6073-K250	Manufacturer: DAITO TSUSHIN KOGYO Ltd. Manufacturer part number: LM32C Specification: 3.2A/48V Use: For short-circuit protection of 24-VDC control power supply

(2) For control power supply for α*i*SV 360-B, 180HV-B, 360HV-B, and 540HV-B

Category	Ordering number	Remarks
Standard	A06B-6240-K250	Manufacturer: DAITO TSUSHIN KOGYO Ltd. Manufacturer part number: LM32C, DM20 Specification: 3.2A/48V, 2A/250V Use: For short-circuit protection of 24-VDC control power supply and power supply for dynamic brake

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 amplifier.
2. A fuse is installed on the control board of an amplifier, but is not directly accessible for replacement from the outside. When replacing a fuse, extract the control board.

3.1.3.6 Cables

- DC link short bar

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

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

- Cables for inter-amplifier communication

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 cables for communication between amplifiers. (for connection of CXA2A and CXA2B)
2 The connection cable for the battery of the absolute Pulsecoder is not included in the cables shown above. For details, see Subsection 9.3.2.9.

- Cables for connection of detectors

Category	Ordering number	Use	Remarks
Optional	A06B-6078-K811	For αiM sensor, αiMZ sensor	Cable length : 7m
	A06B-6078-K814	For αi Positioncoder	Cable length : 7m Connector figure : Straight
	A06B-6078-K815		Cable length : 7m Connector figure : Elbow

- Cables for FSSB interface

Category	Ordering number	Use	Remarks
Optional	A06B-6110-K809	For units 60 mm wide	For between αiSV-B and αiSV-B For between αiSV-B and αiSP-B For between αiSP-B and αiSP-B For between αiSV-B and αiSVP-B For between αiSP-B and αiSVP-B
	A06B-6110-K810	For units 90 mm wide	
	A06B-6110-K811	For units 150 mm wide	
	A06B-6110-K812	For units 300 mm wide	

3.1.3.7 Circuit breaker and magnetic contactor

The circuit breaker and magnetic contactor capacities are determined by the specifications α*i*PS-B series. 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 Machine Tool Builder, it must satisfy the circuit breaker and magnetic contactor specifications indicated below.

- Circuit breaker and magnetic contactor specifications

For α*i*PS-B

PS name	Circuit breaker 1	Circuit breaker 2	Circuit breaker 3	Magnetic contactor	Remarks
α*i*PS 3-B	20A	15A or less (Note 3)	3A (Note 6)	20A	
α*i*PS 7.5-B	50A			50A	
α*i*PS 11-B	55 to 75A			55A	
α*i*PS 15-B	70 to 100A			70A	
α*i*PS 26-B	120 to 150A			120A	
α*i*PS 30-B	140 to 200A			140A	
α*i*PS 37-B	175 to 225A			175A	
α*i*PS 55-B	250A			250A	

NOTE
1. For the installation positions of the circuit breakers and magnetic contactor, see Section 1.3, "CONFIGURATION."
2. Set the rated voltage of circuit breaker 1 according to the power supply voltage.
3. When circuit breaker 2 is also used as a protection circuit breaker for a failure due to a short-circuit in the lightning surge protector, apply 5 A or less.
4. 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 α*i*PS-B. For details, see Subsection 9.3.1.5.
5. When the circuit breaker trips, the contact of the magnetic contactor may be melted. Therefore, before turning on the circuit breaker again, check to make sure that the contact of the magnetic contactor is not melted.
6. The rated voltage of circuit breaker 3 varies from motor model to motor model. For details, see Section 9.1.

For 400 V input series of α*i*PS-B

PS name	Circuit breaker 1	Circuit breaker 2	Circuit breaker 3	Magnetic contactor	Remarks
α*i*PS 11HV-B	30A	15A or less (Note 3)	3A (Note 6)	30A	
α*i*PS 18HV-B	45A			45A	
α*i*PS 30HV-B	75A			75A	
α*i*PS 45HV-B	125A			125A	
α*i*PS 60HV-B	150A			150A	
α*i*PS 75HV-B	200A			200A	
α*i*PS 100HV-B	250A			250A	
α*i*PS 125HV-B	300A			300A	

NOTE

1. For the installation positions of the circuit breakers and magnetic contactor, see Section 1.4, "CONFIGURATION."
2. Set the rated voltage of circuit breaker 1 according to the power supply voltage.
3. When circuit breaker 2 is also used as a protection circuit breaker for a failure due to a short-circuit in the lightning surge protector, apply 5 A or less.
4. 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 α*i*PS-B. For details, see Subsection 9.3.1.5.
5. When the circuit breaker trips, the contact of the magnetic contactor may be melted. Therefore, before turning on the circuit breaker again, check to make sure that the contact of the magnetic contactor is not melted.
6. The rated voltage of circuit breaker 3 varies from motor model to motor model. For details, see Section 9.1.

- Ordering drawing numbers of circuit breakers

Category	Applicable models	Ordering number	Outline drawing	Rated current of circuit breaker
Optional	α*i*PS 3-B, 11HV-B	A06B-6077-K101	8.1.4(a)	30A
	α*i*PS 7.5-B, 18HV-B	A06B-6077-K102	8.1.4 (c)	50A
	α*i*PS 11-B	A06B-6077-K103	8.1.4 (d)	60A
	α*i*PS 15-B, 30HV-B	A06B-6077-K104	8.1.4 (e)	75A
	α*i*PS 45HV-B	A06B-6077-K108	8.1.4 (f)	125A
	α*i*PS 26-B, 30-B, 60HV-B	A06B-6077-K105	8.1.4 (g)	150A
	α*i*PS 37-B	A06B-6077-K110	8.1.4 (h)	175A
	α*i*PS 75HV-B	A06B-6077-K109	8.1.4 (i)	200A
	α*i*PS 55-B, 100HV-B	A06B-6077-K111	8.1.4 (i)	250A
	α*i*PS 125HV-B	A06B-6077-K112	8.1.4 (i)	300A
	For surge absorber For voltage monitor	A06B-6077-K106	8.1.4 (b)	5A

- Ordering drawing numbers of magnetic contactors

Category	Applicable models	Ordering number	Outline drawing	Magnetic contactor specification	Magnetic contactor cover specification
Optional	α*i*PS 3-B, 11HV-B	A06B-6077-K121	8.1.5(a)	Fuji Electric SC-5-1	Fuji Electric SZ-JC4
	α*i*PS 7.5-B, 18HV-B	A06B-6077-K122	8.1.5(b)	Fuji Electric SC-N1	Fuji Electric SZ-N1J
	α*i*PS 11-B	A06B-6077-K123	8.1.5(b)	Fuji Electric SC-N2	Fuji Electric SZ-N1J
	α*i*PS 15-B, 30HV-B	A06B-6077-K124	8.1.5(c)	Fuji Electric SC-N2S	Fuji Electric SZ-N2SJ
	α*i*PS 26-B, 45HV-B	A06B-6077-K125	8.1.5(d)	Fuji Electric SC-N4	Fuji Electric SZ-N4J
	α*i*PS 30-B, 60HV-B	A06B-6077-K126	8.1.5(e)	Fuji Electric SC-N5	Fuji Electric SZ-N4J
	α*i*PS 37-B, 75HV-B	A06B-6077-K128	8.1.5(f)	Fuji Electric SC-N7	Fuji Electric SZ-N7J
	α*i*PS 55-B, 100HV-B	A06B-6077-K127	8.1.5(g)	Fuji Electric SC-N8	Fuji Electric SZ-N8J
	α*i*PS 125HV-B	A06B-6077-K129	8.1.5(h)	Fuji Electric SC-N11	Fuji Electric SZ-N11J

NOTE
The coil voltage specification of the magnetic contactor for the above ordering number is 200 VAC.

3.1.3.8 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, "FITTING A LIGHTNING SURGE PROTECTION DEVICE."

- Lightning surge protector specifications

Category	Ordering number	Specification	Outline drawing	Remarks
Optional	A06B-6200-K141	Integration type for line-to-line installation / line-to-ground installation: RSPD-250-U4	Subsection 8.1.6	Manufactured by Okaya Electric Industries Co., Ltd. For 200VAC line TÜV approved products
	A06B-6200-K140	Integration type for line-to-line installation / line-to-ground installation: RSPD-500-U4	Subsection 8.1.6	Manufactured by Okaya Electric Industries Co., Ltd. For 400VAC line TÜV approved products

⚠ **CAUTION**
Be sure to insert a 5 A or less circuit breaker between the power supply and surge absorber because if the lightning surge protector is broken due to a short-circuit, explosion may be caused.

3.1.3.9 Noise filter

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

For power supply grounded through one phase

Category	Applicable models	Ordering number	Outline drawing	Rated output	Specification
Optional	α*i*PS 3-B	A06B-6077-K155	Subsection 8.1.7	30A	3SUP-HL30-ER-6 : Okaya Electric Industries Co., Ltd.
	α*i*PS-B7.5, 11-B, 15-B	A06B-6077-K156		75A	3SUP-HL75-ER-6 : Okaya Electric Industries Co., Ltd.
	α*i*PS 26-B, 30-B	A06B-6077-K157		150A	3SUP-HL150-ER-6 : Okaya Electric Industries Co., Ltd.
	α*i*PS 37-B	A06B-6077-K158		200A	3SUP-HL200-ER-6 : Okaya Electric Industries Co., Ltd.

For power supply grounded through neutral point

Category	Applicable models	Ordering number	Outline drawing	Rated output	Specification
Optional	α*i*PS 11HV-B	A06B-6200-K160	Subsection 8.1.7	30A	NF3030C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 18HV-B	A06B-6200-K161		40A	NF3040C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 30HV-B	A06B-6200-K162		80A	NF3080C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 45HV-B	A06B-6200-K163		100A	NF3100C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 60HV-B	A06B-6200-K164		150A	NF3150C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 75HV-B	A06B-6200-K165		200A	NF3200C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 100HV-B	A06B-6200-K166		250A	NF3250C-SVB : Soshin Electric Co., Ltd.
	α*i*PS 125HV-B	A06B-6200-K167		300A	NF3300C-SVB : Soshin Electric Co., Ltd.

⚠ **WARNING**

Use the noise filters specified with ordering numbers A06B-6077-K155 to K158 only for a 200 V power supply grounded through one phase. Do not use them for any 400 V power supply.
If any of them is used for a 400 V power supply, an abnormal heat, smoke, short-circuit, or the like may occur in the noise filter.

NOTE

1 The noise filters specified with ordering numbers A06B-6200-K160 to K167 cannot be used for any power supply grounded through one phase.
2 Subsection 3.1.3.9 provides a guideline for selecting a noise filter. Load currents of the CNC, amplifier, and other devices flow through the noise filter. Obtain these load currents, and select a noise filter so that the obtained load currents do not exceed the rated current of the noise filter.
3 For a 200 V Power Supply grounded through the neutral point, a filter for neutral grounding can be used.
However, at present, FANUC does not obtain any standard certification on a combination of a 200 V Power Supply and noise filter for neutral grounding. So, a noise test must be conducted for each machine.

3.1.3.10 Sensors for servo

α*i*CZ sensor (separate detector)

Category	Name	Ordering number	Remarks
Optional	α*i*CZ sensor 512AS	A860-2164-T411	512 teeth / 3,000min^{-1}
	α*i*CZ sensor 768AS	A860-2164-T511	768 teeth / 2,000min^{-1}
	α*i*CZ sensor 1024AS	A860-2164-T611	1024 teeth / 1,500min^{-1}

3.1.3.11 Sensors for spindle

αi Positioncoder

Category	Name	Ordering number	Remarks
Optional	αi Positioncoder	A860-2109-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

αi BZ sensor (For spindles and built-in spindle motors)

Category	Name	Ordering number		Remarks
		Waterproof connector specification	Non-waterproof connector specification	
Optional	αiBZ sensor 96	A860-2150-T111	A860-2155-T111	96 teeth /80,000min^{-1}
	αiBZ sensor 128	A860-2150-T201	A860-2155-T201	128 teeth /20,000min^{-1}
	αiBZ sensor 128H	A860-2150-T211	A860-2155-T211	128 teeth /70,000min^{-1}
	αiBZ sensor 192	A860-2150-T301	A860-2155-T301	192 teeth /20,000min^{-1}
	αiBZ sensor 192H	A860-2150-T311	A860-2155-T311	192 teeth / 40,000min^{-1}
	αiBZ sensor 256	A860-2150-T401	A860-2155-T401	256 teeth / 15,000min^{-11}
	αiBZ sensor 256S	A860-2150-T404	A860-2155-T404	256 teeth / 15,000min^{-1} / large inside diameter
	αiBZ sensor 256H	A860-2150-T411	A860-2155-T411	256 teeth / 30,000min^{-1}
	αiBZ sensor 384	A860-2150-T511	A860-2155-T511	384 teeth / 15,000min^{-1}
	αiBZ sensor 512	A860-2150-T611	A860-2155-T611	512 teeth / 10,000min^{-1}
	αiBZ sensor 640	A860-2150-T711	A860-2155-T711	640 teeth / 6,000min^{-1}
	αiBZ sensor 768	A860-2150-T811	A860-2155-T811	768 teeth / 5,000min^{-1}
	αiBZ sensor 1024	A860-2150-T911	A860-2155-T911	1024 teeth / 3,000min^{-1}

αiCZ sensor (for spindle axis)

Category	Name	Ordering number	Remarks
Optional	αiCZ sensor 512 IS	A860-2163-T411	512 teeth / 15,000min^{-1}
	αiCZ sensor 768 IS	A860-2163-T511	768 teeth / 10,000min^{-1}
	αiCZ sensor 1024 IS	A860-2163-T611	1024 teeth / 8,000min^{-1}

3.1.3.12 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	Note
	Y/Δ switch type	A06B-6078-K035	
	Y/Y switch type	A06B-6078-K036	
	Y/Δ switch type	A06B-6078-K037	

NOTE
Select one type depending on the peak rated current of a spindle motor to be applied. For details, see Subsection 10.2.3.

3.1.3.13 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 α*i*SV-B or α*i*SVP-B models.
(For details, see Subsection 9.3.2.9.)

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 α*i*SV-B or α*i*SVP-B.
(For details, see Subsection 9.3.2.9.)

Category	Ordering number	Name	Remarks
Optional	A06B-6114-K504	Built-in battery	Lithium battery
Optional	A06B-6114-K505	Battery case	For α*i*SV-B 60/90 mm wide
Optional	A06B-6114-K506	Battery case	For α*i*SV-B 150/300 mm wide
Optional	A06B-6230-K500	Battery case	For α*i*SVP-B
Optional	A06B-6230-K501	Battery case	For Level-up α*i*SVP-B

3.1.3.14 24-V power supply unit

A 24-V power supply unit is used to supply 24-V control power.

Category	Ordering number	Name	Remarks
Optional	A06B-6200-K502	24-V power supply unit	Maximum current: 4.6A
	A06B-6200-K503	24-V power supply unit	Maximum current: 11.2A

4 HOW TO SELECT THE AMPLIFIER

Chapter 4, "HOW TO SELECT THE AMPLIFIER," consists of the following sections:

4.1 HOW TO SELECT THE α*i*SV-B SERIES (SERVO AMPLIFIER)

Select an appropriate α*i*SV-B module for the selected servo motor. The following table lists combinations with standard motors. Select a synchronous built-in servo motor and a linear motor referring to individual descriptions manual.

Table 4.1(a) Specification

No.	Specification	Number of connected axes	Input voltage	Interface with CNC
1	A06B-6240-H1□□	1	200V	FSSB
2	A06B-6240-H2□□	2	200V	FSSB
3	A06B-6240-H3□□	3	200V	FSSB
4	A06B-6290-H1□□	1	400V	FSSB
5	A06B-6290-H2□□	2	400V	FSSB
6	A06B-6290-H3□□	3	400V	FSSB

4.1.1 200 V Input Series

	Amplifier model 200V type	Outline	Group A	Group B	Group C	Group D	Group E	Group F	Group G
1 axis	α*i*SV 4-B	TYPE Ⅰ	○						
	α*i*SV 20-B			○					
	α*i*SV 40-B	TYPE Ⅱ			○				
	α*i*SV 80-B					○			
	α*i*SV 160-B						○		
	α*i*SV 360-B	TYPE Ⅳ						○	
	α*i*SV 360-B x2								○(*1)
2 axis	α*i*SV 4/4-B	TYPE Ⅰ	L/M						
	α*i*SV 4/20-B		L	M					
	α*i*SV 20/20-B			L/M					
	α*i*SV 20/40-B	TYPE Ⅱ		L	M				
	α*i*SV 40/40-B				L/M				
	α*i*SV 40/80-B				L	M			
	α*i*SV 80/80-B					L/M			
	α*i*SV 80/160-B	TYPE Ⅲ				L	M		
	α*i*SV 160/160-B						L/M		
3 axis	α*i*SV 4/4/4-B	TYPE Ⅰ	L/M/N						
	α*i*SV 20/20/20-B			L/M/N					
	α*i*SV 20/20/40-B	TYPE Ⅱ		L/M	N				
	α*i*SV 40/40/40-B				L/M/N				
	α*i*SV 80/80/80-B	TYPE Ⅲ				L/M/N			

Group A : β*i*S 0.2/5000, β*i*S 0.3/5000
Group B : α*i*S 2/5000, α*i*S 2/6000, α*i*S 4/5000, α*i*S 4/6000
α*i*F 1/5000, α*i*F 2/5000
β*i*S 0.4/5000, β*i*S 0.5/6000, β*i*S 1/6000
β*i*S 2/4000, β*i*S 4/4000, β*i*S 8/3000, β*i*S 12/2000
β*i*Sc 2/4000, β*i*Sc 4/4000, β*i*Sc 8/3000, β*i*Sc 12/2000
β*i*F 4/3000, β*i*F 8/2000, β*i*F 12/2000
Group C : α*i*F 4/5000, α*i*F 8/3000, β*i*S 12/3000, β*i*S 22/2000
β*i*F 22/2000
Group D : α*i*S 8/4000, α*i*S 8/6000, α*i*S 12/4000
α*i*F 8/4000, α*i*F 12/4000, α*i*F 22/3000
β*i*S 22/3000, β*i*S 30/2000, β*i*S 40/2000
β*i*F 30/1500
Group E : α*i*S 12/6000, α*i*S 22/4000, α*i*S 22/6000, α*i*S 30/4000, α*i*S 40/4000
α*i*S 50/2000, α*i*S 60/2000
α*i*F 22/4000, α*i*F 30/4000, α*i*F 40/3000, α*i*F 40/3000 with fan
Group F : α*i*S 50/3000 with fan, α*i*S 60/3000 with fan,
α*i*S 100/2500, α*i*S 100/2500 with fan, α*i*S 200/2500, α*i*S 200/2500 with fan
Group G : α*i*S 300/2000, α*i*S 500/2000

*1) Two servo amplifiers are necessary to drive one motor.

4.1.2 400 V Input Series

Amplifier model 400V type		Outline	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Group H	Group I	Group J
1 axis	α*i*SV 10HV-B	TYPE Ⅰ	○									
	α*i*SV 20HV-B			○								
	α*i*SV 40HV-B	TYPE Ⅱ			○							
	α*i*SV 80HV-B					○						
	α*i*SV 180HVS-B	TYPE Ⅲ					○ (*1)					
	α*i*SV 180HV-B	TYPE Ⅳ					○	○				
	α*i*SV 360HV-B	TYPE Ⅴ							○			
	α*i*SV 360HV-B x2									○ (*2)		
	α*i*SV 360HV-B x4										○ (*3)	
	α*i*SV 540HV-B											○ (*4)
2 axis	α*i*SV 10/10HV-B	TYPE Ⅰ	L/M									
	α*i*SV 10/20HV-B	TYPE Ⅱ	L	M								
	α*i*SV 20/20HV-B			L/M								
	α*i*SV 20/40HV-B			L	M							
	α*i*SV 40/40HV-B				L/M							
	α*i*SV 40/80HV-B	TYPE Ⅲ			L	M						
	α*i*SV 80/80HV-B					L/M						
3 axis	α*i*SV 10/10/10HV-B	TYPE Ⅰ	L/M/N									
	α*i*SV 10/10/20HV-B	TYPE Ⅱ	L/M	N								
	α*i*SV 20/20/20HV-B			L/M/N								
	α*i*SV 40/40/40HV-B	TYPE Ⅲ			L/M/N							

Group A : α*i*S 2/5000HV, α*i*S 2/6000HV, α*i*S 4/5000HV, α*i*S 4/6000HV
β*i*S 2/4000HV, β*i*S 4/4000HV, β*i*S 8/3000HV
Group B : α*i*F 4/5000HV, α*i*F 8/3000HV
β*i*S 12/3000HV, β*i*S 22/2000HV
Group C : α*i*S 8/4000HV, α*i*S 8/6000HV, α*i*S 12/4000HV
α*i*F 8/4000HV, α*i*F 12/4000HV, α*i*F 22/3000HV
β*i*S 22/3000HV, β*i*S 30/2000HV, β*i*S 40/2000HV
Group D : α*i*S 12/6000HV, α*i*S 22/4000HV, α*i*S 22/6000HV, α*i*S 30/4000HV, α*i*S 40/4000HV
α*i*S 50/2000HV, α*i*S 60/2000HV
α*i*F 22/4000HV, α*i*F 30/4000HV, α*i*F 40/3000HV, α*i*F 40/3000HV with fan
Group E : α*i*S 50/3000HV, α*i*S 50/3000HV with fan, αiS 60/3000HV αiS 60/3000HV with fan
Group F α*i*S 100/2500HV, α*i*S 100/2500HV with fan, α*i*S 200/2500HV, α*i*S 200/2500HV with fan
Group G : α*i*S 300/2000HV, α*i*S 500/2000HV
Group H: α*i*S 1000/2000HV
Group I: α*i*S 1000/3000HV, α*i*S 2000/2000HV, α*i*S 3000/2000HV
Group J: α*i*S 300/3000HV, α*i*S 500/3000HV

*1) At rotation speed of 23 rpm or less, the maximum current is limited to 90 Apeak.
*2) Two servo amplifiers are necessary to drive one motor.
*3) Three servo amplifiers are necessary to drive one motor.
*4) Only HRV2 is available.

4.1.3 How to Select the Dynamic Brake Module (DBM)

When the α*i*SV 360-B, α*i*SV 180HV-B, α*i*SV 360HV-B, or α*i*SV 540HV-B is used, an external dynamic brake module (DBM) is required. This module stops the motor immediately at, for example, emergency stop time. The other α*i*SV-B models include a feature similar to this module.
Select a dynamic brake module based on the following table:

Dynamic brake module

Category	Ordering number	Name	Remarks
Standard	A06B-6079-H401	DBM	Driven on 200VAC α*i*SV 360-B, α*i*SV 180HV-B α*i*SV 360HV-B(*1), α*i*SV 540HV-B(*1)
	A06B-6079-H403	DBM	Driven on 24VDC α*i*SV 360-B, α*i*SV 180HV-B α*i*SV 360HV-B(*1), α*i*SV 540HV-B(*1)
	A06B-6069-H300	DBM	Driven on 200VAC α*i*SV 360HV-B (*2)
	A06B-6069-H301	DBM	Driven on 24VDC α*i*SV 360HV-B (*2)

(*1) When the α*i*S 300HV or α*i*S 500HV is driven
(*2) When the α*i*S 1000HV, α*i*S 2000HV, or α*i*S S3000HV is driven

For the allowable load inertia, see "Notes on the dynamic brake" in Subsection 2.3.2.

4.2 HOW TO SELECT THE α*i*SP-B SERIES (SPINDLE AMPLIFIER)

Select an appropriate α*i*SP-B series for the selected spindle motor.
α*i*SP-B series amplifiers 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 an α*i*SP-B series accordingly.

Table 4.2(a) Specification

No.	Specification	Input voltage	Remarks
1	A06B-6220-H□□□#H600	200V	
2	A06B-6222-H□□□#H610		
3	A06B-6270-H□□□#H600	400V	
4	A06B-6272-H□□□#H610		

4.2.1 200 V Input Series

Amplifier model 200V type	Outline	Motor model
α*i*SP 2.2-B	TYPE Ⅱ	α*i*I 0.5/10000, α*i*I 0.5/10000 (Power up model), α*i*I 0.5/15000 (Power up model), α*i*I 1/10000, α*i*I 1/10000 (Power up model)
α*i*SP 5.5-B		α*i*I 1.5/10000, α*i*I 1.5/10000 (Power up model), α*i*I 2/10000, α*i*I 3/10000, α*i*I 1/15000, β*i*I 3/12000
α*i*SP 11-B	TYPE III	α*i*I 2/10000 (Power up model), α*i*I 3/10000 (Power up model), α*i*I 6/10000, α*i*I 6/10000 (Power up model), α*i*I 8/8000, α*i*I 3/12000, α*i*I 6/12000, α*i*I 8/10000, α*i*I$_P$ 12/8000, α*i*I$_P$ 12/8000 (Power up model), α*i*I$_T$ 3/12000, α*i*I$_T$ 6/12000 (Power up model), β*i*I 3/12000 (Power up model), β*i*I 6/12000, β*i*I 8/12000, β*i*I$_P$ 12/6000, β*i*I$_P$ 15/8000, β*i*I$_P$ 18/8000
α*i*SP 15-B		α*i*I 8/8000 (Power up model), α*i*I 12/8000, α*i*I 12/8000 (Power up model), α*i*I 1.5/20000, α*i*I 8/10000 (Power up model), α*i*I 8/12000, α*i*I 8/12000 (Power up model), α*i*I 12/12000, α*i*I 12/12000 (Power up model), α*i*I$_P$ 15/8000, α*i*I$_P$ 15/8000 (Power up model), α*i*I$_P$ 18/8000, α*i*I$_P$ 18/8000 (Power up model), α*i*I$_T$ 1.5/20000, α*i*I$_T$ 6/12000, α*i*I$_T$ 6/12000 (Power up model), α*i*I$_T$ 8/12000, α*i*I$_T$ 8/12000 (Power up model), α*i*I$_T$ 12/12000 (Power up model), β*i*I 6/12000 (Power up model), β*i*I 8/12000 (Power up model), β*i*I 12/10000, β*i*I 12/10000 (Power up model), β*i*I$_P$ 22/8000, β*i*I$_T$ 12/10000, β*i*I$_T$ 12/10000 (Power up model),
α*i*SP 22-B	TYPE IV	α*i*I 1/24000, α*i*I 1.5/20000 (Power up model), α*i*I 2/20000 (Power up model) α*i*I 3/12000, α*i*I 3/150000, α*i*I 6/15000, α*i*I 15/8000, α*i*I 15/8000 (Power up model), α*i*I 18/8000, α*i*I 18/8000 (Power up model), α*i*I 2/20000, α*i*I 15/12000, α*i*I 15/12000 (Power up model), α*i*I 18/12000, α*i*I 18/12000 (Power up model), α*i*I$_P$ 22/8000, α*i*I$_P$ 22/8000 (Power up model), α*i*I$_P$ 30/6000, α*i*I$_P$ 30/6000 (Power up model), α*i*I$_T$ 1/24000 (Power up model), α*i*I$_T$ 1.5/20000 (Power up model), α*i*I$_T$ 2/20000, α*i*I$_T$ 2/20000 (Power up model), α*i*I$_T$ 3/12000 (Power up model), α*i*I$_T$ 3/15000 (Power up model), α*i*I$_T$ 15/10000, α*i*I$_T$ 15/10000 (Power up model), β*i*I 15/8000, β*i*I 15/8000 (Power up model), β*i*I$_P$ 30/8000, β*i*I$_P$ 40/6000, β*i*I$_T$ 15/8000, β*i*I$_T$ 15/8000 (Power up model)
α*i*SP 26-B		α*i*I 22/8000, α*i*I 22/8000 (Power up model), α*i*I 22/12000, α*i*I 22/12000 (Power up model), α*i*I$_P$ 40/6000, α*i*I$_P$ 40/6000 (Power up model), α*i*I$_P$ 50/6000, α*i*I$_P$ 50/6000 (Power up model), α*i*I$_T$ 8/15000, α*i*I$_T$ 22/10000 α*i*I$_T$ 22/10000 (Power up model)
α*i*SP 30-B		α*i*I$_P$ 60/5000, α*i*I$_T$ 15/15000, α*i*I$_T$ 15/15000 (Power up model), α*i*I$_L$ 8/20000, α*i*I$_L$ 15/15000, α*i*I$_L$ 26/15000
α*i*SP 37-B		α*i*I 30/6000, α*i*I 30/7000 (Power up model)
α*i*SP 45-B	TYPE V	α*i*I 40/6000, α*i*I 40/7000 (Power up model)
α*i*SP 55-B		α*i*I 50/5000, α*i*I 50/5000 (Power up model)

*3) "SP" of α*i*SP-B means "SPindle".

4.2.2 400 V Input Series

Amplifier model 400V type	Outline	Motor model
αiSP 5.5HV-B	TYPE II	αiI 0.5/10000HV, αiI 1/10000HV, αiI 1.5/10000HV, αiI 2/10000HV, αiI 3/10000HV
αiSP 11HV-B	TYPE III	αiI 6/10000HV, αiI 6/10000HV (Power up model), αiI 8/8000HV, αiI$_T$ 3/12000HV, βiI 8/12000HV
αiSP 15HV-B		αiI 8/8000HV (Power up model), αiI 12/8000HV, αiI 12/8000HV (Power up model), αiI$_P$ 15/8000HV, αiI$_T$ 1.5/20000HV, αiI$_T$ 6/12000HV, αiI$_T$ 8/12000HV βiI 8/12000HV (Power up model), βiI 12/10000HV
αiSP 22HV-B	TYPE IV	αiI 15/8000HV, αiI 15/8000HV (Power up model), αiI$_P$ 22/8000HV βiI 12/10000HV (Power up model)
αiSP 30HV-B		αiI 22/8000HV, αiI 22/8000HV (Power up model), αiI$_P$ 40/6000HV, αiI$_P$ 50/6000HV, αiI$_P$ 60/5000HV, αiI$_T$ 2/20000HV, αiI$_T$ 8/15000HV, αiI$_T$ 15/10000HV, αiI$_T$ 15/15000HV, αiI$_T$ 15/15000HV (Power up model), αiI$_T$ 22/10000HV
αiSP 45HV-B		αiI 30/6000HV, αiI 30/7000HV (Power up model), αiI 40/6000HV, αiI 50/5000HV, αiI$_L$ 8/20000HV, αiI$_L$ 15/15000HV, αiI$_L$ 26/15000HV
αiSP 60HV-B		*5)
αiSP 75HV-B	TYPE V	αiI 40/7000HV (Power up model), αiI 60/5000HV, αiI 75/5000HV
αiSP 75HV-B x2 *4)		αiI 150/5000HV
αiSP 100HV-B		αiI 100/5000HV
αiSP 100HV(SiC)-B		*5)

*3) "SP" of αiSP-B means "SPindle."
*4) Driven by two amplifiers.
*5) Built-in spindle motor series is applied.

4.3 HOW TO SELECT THE α*i*SVP-B SERIES (SERVO/SPINDLE MULTI-AXIS AMPLIFIER)

Select an appropriate α*i*SVP-B module for the selected servo motor and spindle motor. When a synchronous built-in servo motor or a linear motor is connected to and driven by α*i*SVP-B, the maximum load inertia, maximum payload, output power, and so forth may be limited. Please be sure to contact FANUC and check if there will be no problem in driving by α*i*SVP-B.

Table 4.3(a) Specification

No.	Specification	Input voltage	Remarks
1	A06B-6230-H001#H600	200V	
2	A06B-6232-H00□#H610		
3	A06B-6280-H001#H600	400V	
4	A06B-6282-H001#H610		

			Servo motor		
Amplifier model	Input voltage	Outline	Group A	Group B	Group C
α*i*SVP20/20/20-5.5-B	200V	TYPE III	L/M/N		
α*i*SVP20/20/20-2.2-B		TYPE II	L/M/N		
α*i*SVP40/40/40-2.2-B				L/M/N	
α*i*SVP10/10/10-5.5HV-B	400V	TYPE III			L/M/N

			Spindle motor		
Amplifier model	Input voltage	Outline	Group D	Group E	Group F
α*i*SVP20/20/20-5.5-B	200V	TYPE III		○	
α*i*SVP20/20/20-2.2-B		TYPE II	○		
α*i*SVP40/40/40-2.2-B			○		
α*i*SVP10/10/10-5.5HV-B	400V	TYPE III			○

[Servo motor]

Group A: α*i*S 2/5000, α*i*S 2/6000, α*i*S 4/5000, α*i*S 4/6000
α*i*F 1/5000, α*i*F 2/5000
β*i*S 0.4/5000, β*i*S 0.5/6000, β*i*S 1/6000, β*i*S 2/4000, β*i*S 4/4000, β*i*S 8/3000, β*i*S 12/2000
β*i*Sc 2/4000, β*i*Sc 4/4000, β*i*Sc 8/3000, β*i*Sc 12/2000
β*i*F 4/3000, β*i*F 8/2000, β*i*F 12/2000

Group B: α*i*F 4/5000, α*i*F 8/3000, β*i*S 12/3000, β*i*S 22/2000, β*i*F 22/2000

Group C: α*i*S 2/5000HV, α*i*S 2/6000HV, α*i*S 4/5000HV, α*i*S 4/6000HV
β*i*S 2/4000HV, β*i*S 4/4000HV, β*i*S 8/3000HV

[Spindle motor]

Group D: α*i*I 0.5/10000, α*i*I 0.5/10000 (Power up model), α*i*I 0.5/15000 (Power up model),
α*i*I 1/10000, α*i*I 1/10000 (Power up model)

Group E α*i*I 1.5/10000, α*i*I 1.5/10000 (Power up model), α*i*I 2/10000, α*i*I 3/10000, α*i*I 1/15000,
β*i*I 3/12000

Group F: α*i*I 0.5/10000HV, α*i*I 1/10000HV, α*i*I 1.5/10000HV, α*i*I 2/10000HV, α*i*I 3/10000HV

4.4 HOW TO SELECT THE αiPS-B SERIES (POWER SUPPLY) FOR A MACHINE WITH A SPINDLE

αi PS-B has two methods of selecting a Power Supply: One is based on the motor driving conditions, the other is based on the motor output specification. When the selection method based on the motor driving conditions is applied, a lower grade Power Supply model may be available compared to a Power Supply model selected based on the motor output specification.
Selection method based on the motor driving conditions: Select a module according to the instructions described in Subsection 4.4.1.
Selection method based on the motor driving conditions: Select according to Subsection 4.4.1.
Selection method based on the motor output specification: Select according to Subsection 4.4.2.
(If any selection condition required in Subsection 4.4.1 is unknown, apply the selection method based on the motor output specification (Subsection 4.4.2).)

Select a Power Supply that satisfies all of the following output capacities:

- Continuous rated output
- 30-minute rated output
- Peak maximum output

4.4.1 Selecting a Power Supply Based on the Motor Driving Conditions

NOTE
If any selection condition described below is unknown, make a selection according to Subsection 4.4.2.

4.4.1.1 How to obtain the continuous rated output capacity

Select a Power Supply with a continuous rated output of not less than the sum of the continuous rated output of spindle motors, the sum of the feed axis motors, and the sum of the synchronous built-in servo motors and linear motors.

The maximum speed of a cutting axis driven by a feed axis motor is determined according to the combined cutting feedrate. So, use a formula considering the number of axes concurrently controlled for cutting.
Calculate the output capacity for each peripheral axis (such as for a tool changer or loader) while assuming intermittent operation and using the operation duty cycle. Assume a rotation axis used in, for example, a 5-axis machine as a cutting axis.

Continuous rated output capacity of a Power Supply
≧∑ Continuous rated output of spindle motors
+ ∑ Continuous rated output of feed axis motors
+ ∑ Power Supply selection data for continuous rated output of synchronous built-in servo motors
+ ∑ Power Supply selection data for continuous rated output of linear motors

Σ Continuous rated output of feed axis motors

= ∑ Continuous torque of cutting axis motors (Nm) × Speed for maximum cutting feedrate (min^{-1}) × 1.05×10^{-4} ×

√N(Number of concurrently controlled axes)

+ ∑ Continuous rated output of peripheral axis motors (kW) × Operation duty cycle (Dt)

N: Number of concurrently controlled axes. N = 2 when two linear axes (X and Y) are used. N = 3 when three or more axes are used.

Dt: Operation duty cycle. Obtained by dividing the average speed by the maximum speed. The minimum value is 10%. If it is unknown, assume 60%.

4.4.1.2 How to obtain the 30-minute rated output capacity

Select a Power Supply with a 30-minute rated output of not less than the sum of 30-minute rated output of spindle motors, the sum of continuous rated output of feed axis motors, and the sum of continuous rated output of synchronous built-in servo motors and linear motors.

30-minute rated output capacity of a Power Supply
≧Σ 30-minute rated output of spindle motors (Note)
+ Σ Continuous rated output of feed axis motors (as stated above)
+ Σ Power Supply data for continuous rated output of synchronous built-in servo motors
+ Σ Power Supply selection data for continuous rated output of linear motors

NOTE

For motors that have no 30-minute rated output specified, use the rated output for operating time less than and closest to 30 minutes (e.g., 15-minute rated output or 10-minute rated output).
If these output values are not defined, the value of S3 25% value may substitute it. If more detailed consideration is required, please contact FANUC.

4.4.1.3 How to obtain the peak maximum output capacity

a) With Spindle Smart Acc./Dec.

Spindle control software series 9DAA edition E(05) and later, as well as series 9DB0 edition C(03) and later enable Spindle Smart Acc./Dec. by default without parameter setting.
When using an edition of spindle control software other than the above to apply Spindle Smart Acc./Dec., set "1" to the following parameter.
For details, see "4.9 SPINDLE SMART ACC./DEC."

0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4671	4671								PSOSLM

PSOSLM Spindle Smart Acc./Dec. function bit
0: Disables Spindle Smart Acc./Dec.
1: Enables Spindle Smart Acc./Dec.

When applying Spindle Smart Acc./Dec., select a Power Supply with a peak maximum output of not less than the sum of the maximum acceleration-time output of spindle motors accelerated concurrently multiplied by 0.2, the sum of maximum acceleration-time output of feed axis motors, and the sum of maximum acceleration-time output of synchronous built-in motors and linear motors.
Compare the result of the above calculation with the maximum acceleration-time output of spindle motors, and adopt the larger value.

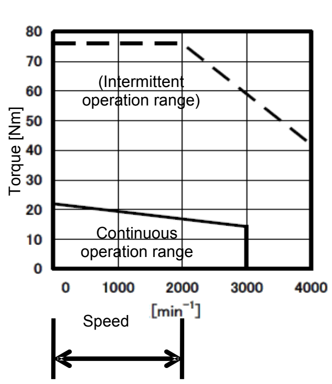
> **NOTE**
> Spindle Smart Acc./Dec. is not applicable to spindle motors falling under one of the following conditions:
> - Spindle motors to which velocity tandem control is applied;
> - Spindle motors to which spindle synchronous control is applied; or
> - Spindle motors which are slave axis for spindle electronic gear box function
>
> When a spindle motor falling under one of the above is used with spindle control software that enables Spindle Smart Acc./Dec. by default, Spindle Smart Acc./Dec. is automatically disabled for that spindle motor. The peak maximum output capacity of such spindles should be calculated according to "b) Without Spindle Smart Acc./Dec." in the following paragraph.
> When a spindle motor falling under one of the above is used with conventional spindle control software which does not enable Spindle Smart Acc./Dec. by default, parameters must be set to disable Spindle Smart Acc./Dec.
> In such a case, the peak maximum output capacity should also be calculated according to "b) Without Spindle Smart Acc./Dec." in the following paragraph.

With Spindle Smart Acc./Dec.

Peak maximum output capacity of a Power Supply ≧max (Σ Maximum acceleration-time outputs of spindle motors × 0.2 + Σ Maximum acceleration-time outputs of feed axis motors(concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for linear motors (concurrently accelerated/decelerated axes) , ∑ Maximum acceleration-time output of spindle motors)

Σ Maximum acceleration-time outputs of feed axis motors (concurrently accelerated/decelerated axes) =
Σ Maximum torque of cutting axis motors (speed for rapid traverse) (Nm) × Speed for rapid traverse (min^{-1}) × 1.05 × 10^{-4}

Note) For the axis of which rapid traverse speed exceeds the speed with constant torque (intermittent operation range), use the motor's maximum acceleration-time output specification value.



Speed with constant torque

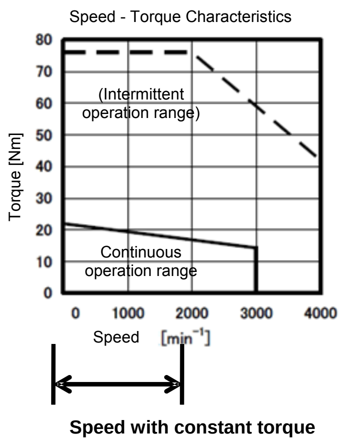
b) Without Spindle Smart Acc./Dec.

Select a Power Supply with a peak maximum output of not less than the sum of the maximum acceleration-time output of spindle motors accelerated concurrently, the sum of maximum acceleration-time output of feed axis motors, and the sum of maximum acceleration-time output of synchronous built-in motors and linear motors.

Peak maximum output capacity of a Power Supply ≧ ∑ Maximum acceleration-time output of spindle motors + ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for linear motors (concurrently accelerated/decelerated axes)

∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes) =
∑ Maximum torque of cutting axis motors (speed for rapid traverse) (Nm) × Speed for rapid traverse (min^{-1} × 1.05 × 10^{-4}

Note) For the axis of which rapid traverse speed exceeds the speed with constant torque (intermittent operation range), use the motor's maximum acceleration-time output specification value.



4.4.2 Selecting a Power Supply for a Machine with a Spindle (Selection Similar to the Conventional One)

If any selection condition required for (Subsection 4.4.1) is unknown, apply the selection method that is described below.

4.4.2.1 How to obtain the continuous rated output capacity

Select a Power Supply with a continuous rated output of not less than the sum of the continuous rated output of spindle motors, the sum of continuous rated output of feed axis motors multiplied by a coefficient of 0.3, and the sum of continuous rated output of synchronous built-in servo motors and linear motors multiplied by a coefficient of 1.0.

Continuous rated output capacity of a Power Supply
≧ ∑ Continuous rated output of spindle motors
+ ∑ Continuous rated output of feed axis motors × 0.3
+ ∑ Continuous rated output of Power Supply selection data for synchronous built-in servo motors × 1.0
+ ∑ Continuous rated output of Power Supply selection data for linear motors × 1.0

4.4.2.2 How to obtain the 30-minute rated output capacity

Select a Power Supply with a 30-minute rated output of not less than the sum of the 30-minute rated output of spindle motors, the sum of continuous rated output of feed axis motors multiplied by a coefficient of 0.3, and the sum of continuous rated output of synchronous built-in servo motors and linear motors multiplied by a coefficient of 1.0.

30-minute rated output capacity of a Power Supply
≧ ∑ 30-minute rated output of spindle motors
+ ∑ Continuous rated output of feed axis motors × 0.3
+ ∑ Continuous rated output of Power Supply selection data for synchronous built-in servo motors × 1.0
+ ∑ Continuous rated output of Power Supply selection data for linear motors × 1.0

NOTE

For motors that have no 30-minute rated output specified, use the rated output for operating time less than and closest to 30 minutes (e.g., 15-minute rated output or 10-minute rated output).
If these output values are not defined, the value of S3 25% value may substitute it. If more detailed consideration is required, please contact FANUC.

4.4.2.3 How to obtain the peak maximum output capacity

a) With Spindle Smart Acc./Dec.

Spindle control software series 9DAA edition E(05) and later, as well as series 9DB0 edition C(03) and later enable Spindle Smart Acc./Dec. by default without parameter setting.
When using an edition of spindle control software other than the above to apply Spindle Smart Acc./Dec., set "1" to the following parameter.
For details, see "4.9 SPINDLE SMART ACC./DEC."

0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4671	4671								PSOSLM

PSOSLM Spindle Smart Acc./Dec. function bit
0: Disables Spindle Smart Acc./Dec.
1: Enables Spindle Smart Acc./Dec.

Select a Power Supply with a peak maximum output of not less than the sum of the maximum acceleration-time output of spindle motors accelerated concurrently multiplied by 0.2, the sum of maximum acceleration-time output of feed axis motors, and the sum of maximum acceleration-time output of synchronous built-in motors and linear motors.
Compare the result of the above calculation with the maximum acceleration-time output of spindle motors, and adopt the larger value.

NOTE

Spindle Smart Acc./Dec. is not applicable to spindle motors falling under one of the following conditions:
- Spindle motors to which velocity tandem control is applied;
- Spindle motors to which spindle synchronous control is applied; or
- Spindle motors which are slave axis for spindle electronic gear box function

When a spindle motor falling under one of the above is used with spindle control software that enables Spindle Smart Acc./Dec. by default, Spindle Smart Acc./Dec. is automatically disabled for that spindle motor. The peak maximum output capacity of such spindles should be calculated according to "b) Without Spindle Smart Acc./Dec." in the following paragraph.

When a spindle motor falling under one of the above is used with conventional spindle control software which does not enable Spindle Smart Acc./Dec. by default, parameters must be set to disable Spindle Smart Acc./Dec.
In such a case, the peak maximum output capacity should also be calculated according to "b) Without Spindle Smart Acc./Dec." in the following paragraph.

With Spindle Smart Acc./Dec.

Peak maximum output capacity of a Power Supply ≧max (∑ Maximum acceleration-time output of spindle motors × 0.2 + ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for linear motors (concurrently accelerated/decelerated axes) , ∑ Maximum acceleration-time output of spindle motors)

b) Without Spindle Smart Acc./Dec.

Select a Power Supply with a peak maximum output of not less than the sum of the maximum acceleration-time output of spindle motors accelerated concurrently, the sum of maximum acceleration-time output of feed axis motors, and the sum of maximum acceleration-time output of synchronous built-in motors and linear motors.

Peak maximum output capacity of a Power Supply ≧ ∑ Maximum acceleration-time output of spindle motors + ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes) + ∑ Maximum acceleration-time output of Power Supply selection data for linear motors (concurrently accelerated/decelerated axes)

4.5 HOW TO SELECT THE αiPS-B SERIES (POWER SUPPLY) FOR A MACHINE WITH NO SPINDLE

4.5.1 How to Obtain the Continuous Rated Output Capacity

Select a Power Supply with a continuous rated output of not less than the sum of the continuous rated output of feed axis motors multiplied by a coefficient of 0.6 and the sum of the continuous rated output of synchronous built-in servo motors and linear motors multiplied by a coefficient of 1.0.

Continuous rated output capacity of a Power Supply
≧ ∑ Continuous rated output of feed axis motors × 0.6
+ ∑ Continuous rated output of Power Supply selection data for synchronous built-in servo motors × 1.0
+ ∑ Continuous rated output of Power Supply selection data for linear motors × 1.0

NOTE
In the following cases, calculate by multiplying the continuous rated output of feed axis motors by a coefficient of 1.0.
- Where only one motor is connected to one Power Supply; or
- Where multiple motors connected to one Power Supply always operate synchronously.

4.5.2 How to Obtain the Peak Maximum Output Capacity

Select a Power Supply with a continuous rated output of not less than the sum of the maximum acceleration-time output of feed axis motors accelerated concurrently and the sum of the maximum acceleration-time output of synchronous built-in servo motors and linear motors.

Peak maximum output capacity of a Power Supply
≥ ∑ Maximum acceleration-time outputs of feed axis motors
+ ∑ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors
+ ∑ Maximum acceleration-time output of Power Supply selection data for linear motors

4.6 SELECTION EXAMPLE

An example of selecting a Power Supply for a machine with a spindle is shown below (one spindle + four feed axes + one peripheral axis).
<Selection conditions>

Axis	Motor model	Maximum speed for cutting feed	Maximum speed for rapid traverse	Continuous rated torque of a motor	Maximum torque of a motor (*1)	Continuous rated output of a motor	Motor's maximum acceleration-time output	Operation duty cycle	Remarks
X	α*i*S22 /4000	600 min^{-1}	4000 min^{-1}	22Nm	76Nm	4.5kW	17kW	–	Concurrently controlled axes (*2)
Y	α*i*S22 /4000	600 min^{-1}	4000 min^{-1}	22Nm	76Nm	4.5kW	17kW	–	Concurrently controlled axes (*2)
Z	α*i*S22 /4000	800 min^{-1}	2000 min^{-1}	22Nm	76Nm	4.5kW	17kW	–	Concurrently controlled axes (*2)
C	D*i*S150 /300 (Liquid cooling)	30 min^{-1}	150 min^{-1}	170Nm	380Nm	2.4kW	9.8kW	–	Concurrently controlled axes (*2)
ATC	β*i*S4 /4000	1000 min^{-1}	1000 min^{-1}	3.5Nm	10Nm	0.75kW	2.5kW	10% or less	Peripheral axis

*1 Torque at the maximum speed for rapid traverse
*2 N = 3 (because the number of concurrently controlled axes is 4 (i.e., ≥ 3))

Axis	Motor	Continuous rated output	30-minute rated output	Maximum acceleration-time output
Spindle	α*i*I22/8000	22kW	26kW	42kW

4.6.1 Selecting a Power Supply Based on the Motor Driving Conditions

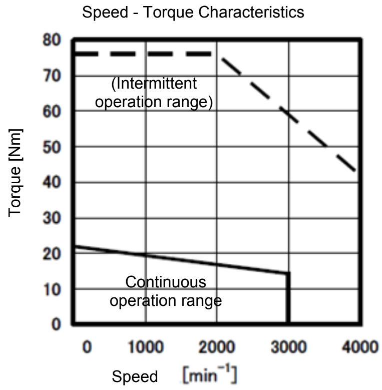
(1) Obtain the continuous rated output capacity.
Σ Continuous rated outputs of feed axis motors
= Σ Continuous torque of cutting axis motors (Nm) × Speed for maximum cutting feedrate (min^{-1}) × $1.05 \times 10^{-4} \div \sqrt{N}$(Number of concurrently controlled axes)
+ ∑ Continuous rated outputs of peripheral axis motors (kW) × Operation duty cycle (Dt)

$= 22Nm \times 600\ min^{-1} \times 1.05 \times 10^{-4} \div \sqrt{3}$
$+ 22Nm \times 600\ min^{-1} \times 1.05 \times 10^{-4} \div \sqrt{3}$
$+ 22Nm \times 800\ min^{-1} \times 1.05 \times 10^{-4} \div \sqrt{3}$
$+ (0.75kW \times 0.1)$
$= 2.7kW$

Continuous rated output of a Power Supply
≥ ∑ Continuous rated outputs of spindle motors
+ Σ Continuous rated outputs of feed axis motors
+ ∑ Continuous rated output of Power Supply selection data for synchronous built-in servo motors
= 22kW＋2.7kW +2.4kW = <u>27.1kW</u> · · · · · (1)

(2) Obtain the 30-minute rated output capacity.
30-minute rated output capacity of a Power Supply
≥ ∑ 30-minute rated outputs of spindle motors
+ Σ Continuous rated outputs of feed axis motors
+ ∑ Continuous rated output of Power Supply selection data for synchronous built-in servo motors
= 26kW＋2.7kW +2.4kW= 31.1kW · · · · · (2)

(3) Obtain the peak maximum output capacity.
a) With Spindle Smart Acc./Dec.
The motor's maximum acceleration-time output specification value is used for X-axis and Y-axis because their rapid traverse speed is faster than the speed with constant torque.



Speed-Torque Characteristics of α*i*S22/4000

30-minute rated output capacity of a Power Supply
∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes)
= 17kW(X-axis) + 17kW(Y-axis) + 76Nm × 2000min^{-1} × 1.05 × 10^{-4}(Z-axis)
= 49.9kW

Multiply the maximum acceleration-time output of spindle motors by 0.2.

Peak maximum output of a Power Supply
≧ max (
≥ ∑ Maximum acceleration-time outputs of spindle motors × 0.2
+ ∑ Maximum acceleration-time outputs of feed axis motors (concurrently accelerated/decelerated axes)
+ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes)
, Maximum acceleration-time output of spindle motors)
= max (42kW × 0.2 + 49.9kW + 9.8kW, 42kW) = 68.1kW · · · ·(3a)

b) Without Spindle Smart Acc./Dec.

Peak maximum output of a Power Supply
≧ ∑ Maximum acceleration-time output of spindle motors
+ ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes)
+ Maximum acceleration-time output of Power Supply selection data for synchronous built-in servo motors (concurrently accelerated/decelerated axes)
= 42kW + 49.9kW + 9.8kW = 101.7kW · · · ·(3b)

(4) Result of the selection

a) With Spindle Smart Acc./Dec.

According to the data listed in the table below, the α*i*PS30-B is selected.

	(1) Continuous rated output	(2) 30-minute rated output	(3) Maximum output
Calculation result	27.1kW	31.1kW	68.1kW
Specifications of α*i*PS30-B	30kW	37kW	96kW

b) Without Spindle Smart Acc./Dec.

α*i*PS37-B is selected.

	(1) Continuous rated output	(2) 30-minute rated output	(3) Maximum output
Calculation result	27.1kW	31.1kW	101.7kW
αSpecifications of α*i*PS37-B	37kW	45kW	118kW

4.6.2 Selecting a Power Supply Based on the Motor Output Conditions

(1) Calculate the continuous rated output capacity.

Continuous rated output of a Power Supply
≧ ∑ Continuous rated output of spindle motors
+ ∑ Continuous rated output of feed axis motors × 0.3
+ ∑ Continuous rated output of synchronous built-in servo motors × 1.0
= 22kW + (4.5 kW + 4.5kW + 4.5kW + 0.75kW) ×0.3 + (2.4kW) ×1.0 = 28.7kW · · · · ·(1)

(2) Calculate the 30-minute rated output capacity.

30-minute rated output capacity of a Power Supply
≧ ∑ 30-minute rated output of spindle motors
+ ∑ Continuous rated output of feed axis motors × 0.3
+ ∑ Continuous rated output of synchronous built-in servo motors × 1.0
= 26kW + (4.5 kW + 4.5kW + 4.5kW + 0.75kW) × 0.3 + (2.4kW) × 1.0 = 32.7kW · · · · ·(2)

(3) Calculate the peak maximum output capacity.

a) With Spindle Smart Acc./Dec.

Peak maximum output of a Power Supply
≧max (
∑ Maximum acceleration-time output of spindle motors × 0.2
+ ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes)
+ ∑ Maximum acceleration time output of synchronous built-in servo motors (concurrently accelerated/decelerated axes), Maximum acceleration-time output of spindle motors)
= max (42kW×0.2 + 17 kW + 17kW + 17kW + 9.8kW, 42kW) = 69.2kW · · · · ·(3a)

b) Without Spindle Smart Acc./Dec.
Peak maximum output of a Power Supply
≧ ∑ Maximum acceleration-time output of spindle motors
+ ∑ Maximum acceleration-time output of feed axis motors (concurrently accelerated/decelerated axes)
+∑ Maximum acceleration-time output of synchronous built-in servo motors (concurrently accelerated/decelerated axes)
= 42kW + 17 kW + 17kW + 17kW + 9.8kW = 102.8kW · · · · ·(3b)

(4) Result of the selection
a) With Spindle Smart Acc./Dec.
αiPS30-B is selected.

	(1) Continuous rated output	(2) 30-minute rated output	(3) Maximum output
Calculation result	28.7kW	32.7kW	69.2kW
Specifications of αiPS30-B	30kW	37kW	96kW

b) Without Spindle Smart Acc./Dec.
αiPS37-B is selected.

	(1) Continuous rated output	(2) 30-minute rated output	(3) Maximum output
Calculation result	28.7kW	32.7kW	102.8kW
Specifications of αiPS37-B	37kW	45kW	118kW

4.7 HOW TO SELECT TRANSFORMER

Select a transformer using the following formula, based on the output capacity calculated for Power Supply selection in previous sections. This may allow you to select a transformer with a smaller rated capacity.

$$\text{Rated capacity of transformer } (kVA)$$
$$\geq \max\Big($$
$$\frac{\text{Continuous rated output capacity calculated when selecting a Power Supply } (kW)}{\text{Rated output capacity of Power Supply } (kW)} \times \text{Power supply capacity at rated output (Power Supply) } (kVA),$$
$$\frac{\text{Peak maximum output capacity calculated when selecting a Power Supply } (kW) \times \frac{1}{3}}{\text{Rated output capacity of Power Supply } (kW)} \times \text{Power supply capacity at rated output (Power Supply) } (kVA)$$
$$\Big)$$

Transformer selection examples are given below, taking the results of the selection in Subsection 4.6.1 as examples.

<Results of Power Supply selection>

	Continuous rated output	Peak maximum output	Power Supply	Rated output	Power supply capacity at rated output
With Spindle Smart Acc./Dec.	27.1kW	68.1kW	α*i*PS30-B	30kW	44kVA
Without Spindle Smart Acc./Dec.	27.1kW	101.7kW	α*i*PS 37-B	37kW	54kVA

Examples of transformer capacity calculation that uses a result shown in the "With Spindle Smart Acc./Dec." column are given below.

1) Calculating a transformer capacity from continuous rated output

$$\text{Rated capacity } (kVA) = \frac{\text{Continuous rated output } (kW)}{\text{Rated output of Power Supply } (kW)} \times \text{Power supply capacity at rated output (Power Supply) } (kVA) \ldots (1)$$

$$= \frac{27.1(kW)}{30(kW)} \times 44(kVA) = 40(kVA)$$

2) Calculating a transformer capacity from peak maximum output × 1/3

$$\text{Rated capacity } (kVA) = \frac{\text{Peak maximum output capacity } (kW) \times \frac{1}{3}}{\text{Rated output of Power Supply } (kW)} \times \text{Power supply capacity at rated output (Power Supply) } (kVA) \ldots (2)$$

$$= \frac{68.1(kW) \times \frac{1}{3}}{30(kW)} \times 44(kVA) = 33(kVA)$$

The results for "Without Spindle Smart Acc./Dec." calculated in the same manner is shown in the following table.

<Results of the transformer selection>

	Result obtained from formula ①	Result obtained from formula ②	Result of the selection (larger of the results ① and ②)
With Spindle Smart Acc./Dec.	40kVA	33kVA	40kVA
Without Spindle Smart Acc./Dec.	40kVA	49kVA	49kVA

By applying Spindle Smart Acc./Dec., the transformer capacity can be reduced to 40 kVA.

4.8 HOW TO SELECT DEVICES INSTALLED IN THE INPUT SECTION (CIRCUIT BREAKER, MAGNETIC CONTACTOR)

An example of device selection installed in the input section (circuit breaker, magnetic contactor) is given below, considering the result of selection in Subsection 4.6.1.

	Continuous rated output
Calculation result in Subsection 4.6.1	27.1kW

	Model	Continuous rated output	Power supply capacity at rated output
Specifications of Power Supply	αiPS30-B	30kW	44kVA

1) Calculate the required power equipment capacity based on the continuous rated output calculated in Subsection 4.6.1.

$$\text{Power equipment capacity } (kVA) = \frac{\text{Rated output of Power calculated in 4.6.1 } (kW)}{\text{Rated output of Power Supply } (kW)} \times \text{Power supply capacity at rated output (Power Supply) } (kVA)$$

$$= \frac{27.1(kW)}{30(kW)} \times 44(kVA) = 40(kVA)$$

2) Calculate the input current of the Power Supply. (Assume that power supply voltage of 200 Vrms is used.)

$$\text{Input current of Power Supply } (Arms) = \frac{\text{Power equipment capacity calculated in 1) } (kVA) \times 1000}{\sqrt{3} \times \text{Power supply voltage used } (Vrms)}$$

$$= \frac{40(kVA) \times 1000}{\sqrt{3} \times 200(Vrms)} = 115(A)$$

Calculate the input current using the power equipment capacity (44 kVA) at the rated output of αiPS30-B in the same manner. The result is shown in the following table.

<Result of the selection>

	Input current to αiPS30-B	Current value of the device installed in the input section (Note)
When calculated assuming the power equipment capacity is 40 kVA	115A	125A
When calculated assuming the power equipment capacity is 44 kVA	127A	150A

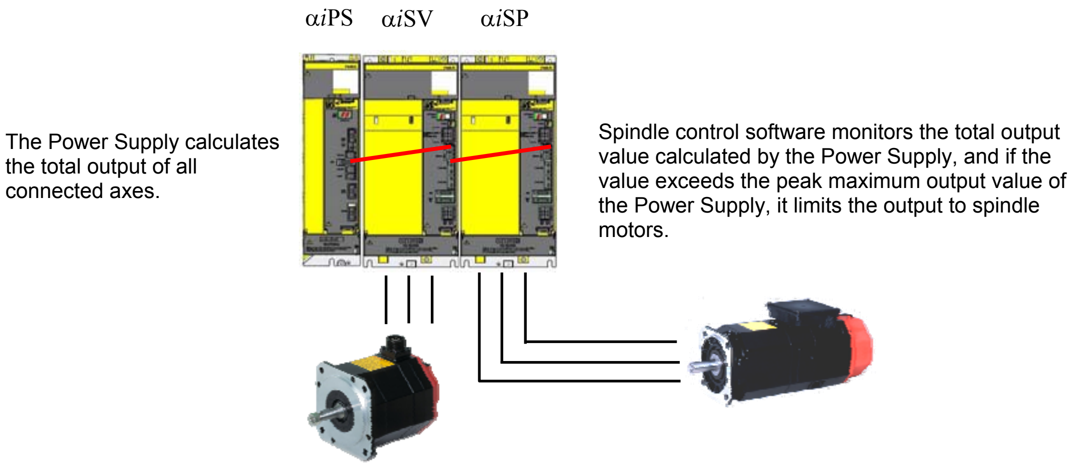
NOTE

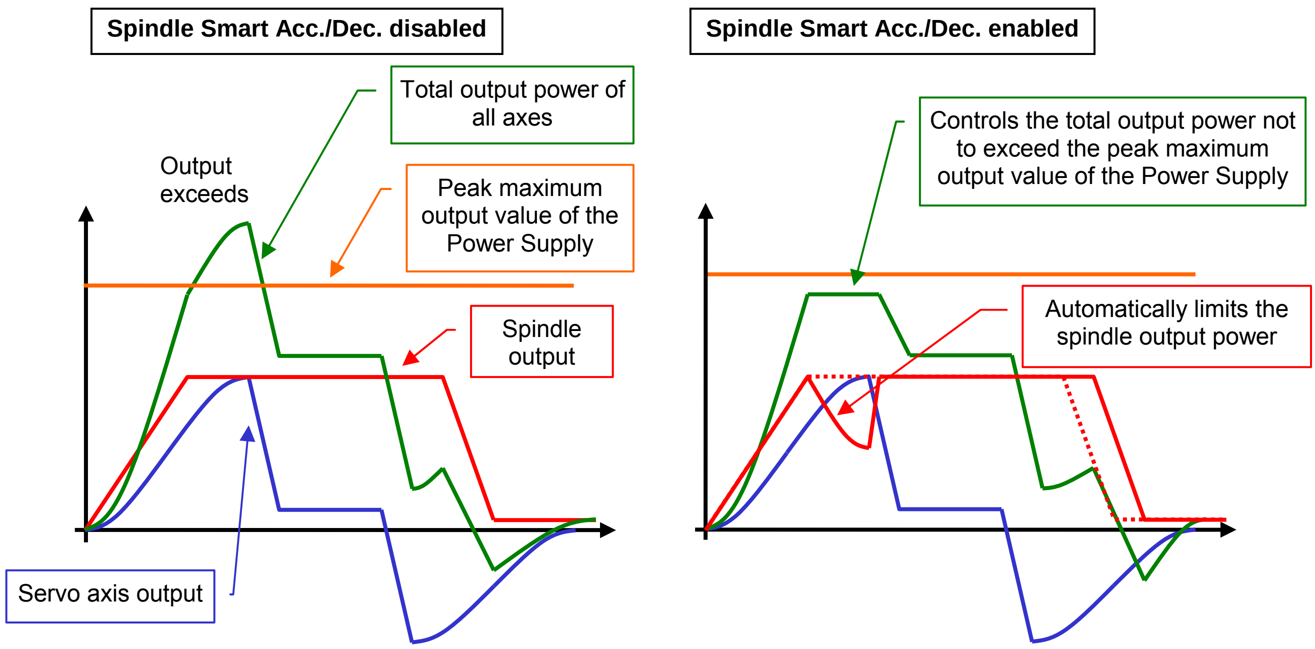
Select a device to be installed in the input section, which has the current value closest to the input current value calculated for the Power Supply so that it is properly current protected.

The current value of the device to be installed in the input section can be reduced by calculating from the required power equipment capacity.

4.9 SPINDLE SMART ACC./DEC.

This function monitors the current output value of the Power Supply using spindle control software, and if the value exceeds the peak maximum output value of the Power Supply, it automatically limits the output power for acceleration/deceleration of spindle motors. If operation exceeding the peak maximum output of the Power Supply is requested, this function enables continuous operation while protecting the Power Supply.





* When the spindle output power is limited, acceleration/deceleration for the portion will take longer.

* When Spindle Smart Acc./Dec. is used, the maximum acceleration-time output of the spindle motors must be less than the peak maximum output of the Power Supply.

This function can be used in the following spindle control software series/editions and the Power Supply software series/editions.

Amplifier (α*i*SP-B) spec. No.	Spindle control software		Compatible CNC
	Series	Edition	
A06B-6220-Hxxx#H600 (200 V series) A06B-6230-Hxxx#H600 (200 V series) A06B-6270-Hxxx#H600 (400 V series) A06B-6280-Hxxx#H600 (400 V series)	Series 9DA0 Series 9DAA	Edition X(24) or later Edition A(01) or later	FS30*i* /31*i* /32*i* /35*i* –B FS0*i*-D FS0*i*-F

Power Supply spec. No.	Power Supply software		Compatible CNC
	Series	Edition	
A06B-6200-Hxxx (200 V series) A06B-6250-Hxxx (400 V series)	Series 9G00	Edition 11.0 or later	FS30*i* /31*i* /32*i* /35*i* –B FS0*i*-D FS0*i*-F

Amplifier (β*i*SVSP-B) spec. No.	Spindle control software		Compatible CNC
	Series	Edition	
A06B-6320-Hxxx (200 V series)	Series 9DB0	Edition A(01) or later	FS30*i* /31*i* /32*i* /35*i* –B FS0*i*-F

Note 1) When using this function, unify all servo amplifiers (PS/SP/SV) to the α*i*-B amplifier (A06B-62xx-Hxxx), or use the β*i*SVSP-B.

Note 2) This function can also be used with the FS0*i*-D. However, as mentioned above, α*i*-B amplifiers are required. (β*i*SVSP (without "-B") amplifiers are not compatible with this function.)

NOTE

Please note that whether this function is enabled/disabled differs according to the edition of spindle control software.
Spindle control software series 9DAA edition E (05) and later, as well as series 9DB0 edition C (03) and later enable Spindle Smart Acc./Dec. by default (independent of No.4671#0 below).
Spindle Smart Acc./Dec. is not applicable to spindle motors to which velocity tandem control is applied, spindle motors to which spindle synchronous control is applied, and spindle motors which are slave axes for the spindle electronic gear box function.
Using such functions automatically makes software to turn OFF the Spindle Smart Acc./Dec. The Power Supply should be selected assuming that Spindle Smart Acc./Dec. is not used.

If one of spindle control software series 9DA0 edition X (24) or later, series 9DAA editions A to D (01 to 04) or series 9DB0 editions A to B (01 to 02) is used, set the following parameters to enable Spindle Smart Acc./Dec.

0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4671	4671								PSOSLM

PSOSLM Spindle Smart Acc./Dec. function bit
0: Disables Spindle Smart Acc./Dec.
1: Enables Spindle Smart Acc./Dec.

[Precautions for setting No.4671#0]

Precaution 1) Do not apply this function to 2-axis servo amplifiers to which velocity tandem control is applied.

Precaution 2) Setting this parameter does not make this function work if the 2-axis servo amplifier is operating in spindle synchronous control.

Precaution 3) When applying this function to a 2-axis servo amplifier to which the spindle electronic gear box function is applied, set this parameter only to the master axis.

Precaution 4) When two or more spindle amplifiers are connected to one Power Supply, this function may be set to such multiple spindles.

4.9.1 Alarm

If the parameter for Spindle Smart Acc./Dec. is set to enable this function (No.4671#0=1) while the function is not supported by the series/edition of Power Supply software, an illegal parameter setting alarm (SP9068) will be detected. The detailed cause of the illegal parameter setting alarm is displayed in Diagnosis No. 710. If the above condition occurs, Diagnosis No. 710 shows "65."
When this function is enabled by default, the alarm is not output even if the function is not supported by the series/edition of Power Supply software. In this case, note that this function does not work and the spindle output is not limited.

4.9.2 Precautions

This function works only during acceleration/deceleration of non-cutting operation in velocity control mode. In the following cases, this function does not limit the spindle output.

- While constant velocity is maintained in velocity control mode
- During rigid tapping
- While controlling Cs contour
- While threading
- While controlling constant surface speed
- The period between the detection of a one-rotation signal and stop of spindles during orientation (Spindle output can be limited until the one-rotation signal is detected.)

When spindles decelerate and stop due to emergency stop, this function is able to limit the spindle output.

4.10 PRECAUTIONS FOR SELECTION

4.10.1 Number of Connected α*i*SV-B Amplifiers and α*i*SP-B Amplifiers

Multiple α*i*SV-B models and α*i*SP-B models can be connected to a single α*i*PS-B, provided the above output capacity conditions are satisfied.
Up to 15 α*i*SV-B and α*i*SP-B models can be connected. One α*i*SVP-B model is assumed to be two modules. The number of models that can be connected may be restricted by 24-VDC control power supplied to the amplifiers, however. For details, see Subsection 9.3.1.3.

4.10.2 Notes on Selecting a 400 V Input α*i*PS-B series

There are the following restrictions on 400 V input α*i*PS-B models according to the combined α*i*SP-B model:

(1) For the α*i*SP 45HV-B, α*i*SP 60HV-B, select the α*i*PS 45HV-B or higher model.
(2) For the α*i*SP 75HV-B, α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B, select the α*i*PS 75HV-B or higher model.

4.11 LIST OF MOTOR OUTPUT CAPACITIES FOR α*i*PS-B SELECTION

4.11.1 Continuous Rated Output and Maximum Acceleration-time Output of Servo Motors

This section gives the output data for servo motor. These data are used for selecting an α*i*PS-B. See FANUC AC SERVO MOTOR α*i*s/α*i* series DESCRIPTIONS (B-65262EN) for details. For information about motors not listed in this section, refer to individual descriptions manual.

(1) α*i* servo motor series (200 V input series)

Table 4.11.1(a)

Motor model	Continuous rated output	Maximum output at acceleration
α*i*F 1/5000	0.50kW	2.0kW
α*i*F 2/5000	0.75kW	2.9kW
α*i*F 4/5000	1.4kW	4.5kW
α*i*F 8/3000	1.6kW	5.7kW
α*i*F 8/4000	2.2kW	9.0kW
α*i*F 12/4000	3.0kW	7.6kW
α*i*F 22/3000	4.0kW	9.6kW
α*i*F 22/4000	4.0kW	17kW
α*i*F 30/4000	7.0kW	21kW/3000rpm, 23kW/4000rpm
α*i*F 40/3000	6.0kW	18kW
α*i*F 40/3000+FAN	9.0kW	18kW
α*i*S 2/5000	0.75kW	2.8kW
α*i*S 2/6000	1.0kW	2.4kW
α*i*S 4/5000	1.0kW	3.1kW
α*i*S 4/6000	1.0kW	2.9kW
α*i*S 8/4000	2.5kW	8.0kW
α*i*S 8/6000	2.2kW	11kW
α*i*S 12/4000	2.7kW	12kW
α*i*S 12/6000	2.2kW	20kW
α*i*S 22/4000	4.5kW	17kW
α*i*S 22/6000	4.5kW	21kW
α*i*S 30/4000	5.5kW	22kW
α*i*S 40/4000	5.5kW	24kW
α*i*S 50/2000	4kW	21kW
α*i*S 50/3000	5kW	39kW
α*i*S 50/3000+FAN	14kW	39kW
α*i*S 60/2000	5kW	25kW
α*i*S 60/3000+FAN	14kW	40kW
α*i*S 100/2500	11kW	38kW
α*i*S 100/2500+FAN	22kW	38kW
α*i*S 200/2500	16kW	48kW
α*i*S 200/2500+FAN	30kW	48kW
α*i*S 300/2000	52kW	96kW
α*i*S 500/2000	60kW	104kW

NOTE
The continuous rated output and maximum output at acceleration may be changed.

(2) β*i* servo motor series (200 V input series)

Table 4.11.1(b)

Motor model	Continuous rated output	Maximum output at acceleration
β*i*F 4/3000	0.75kW	2.3kW
β*i*F 8/2000	1.2kW	3.2kW
β*i*F 12/2000	1.4kW	2.6kW
β*i*F 22/2000	2.5kW	5.7kW
β*i*F 30/1500	3.0kW	8.7kW
β*i*S 0.2/5000	0.05kW	0.24kW
β*i*S 0.3/5000	0.1kW	0.4kW
β*i*S 0.4/5000	0.13kW	0.5kW
β*i*S 0.5/6000	0.35kW	1.3kW
β*i*S 1/6000	0.5kW	2.3kW
β*i*S 2/4000	0.5kW	2.3kW
β*i*S 4/4000	0.75kW	2.5kW
β*i*iS 8/3000	1.2kW	2.8kW
β*i*S 12/2000	1.4kW	2.8kW
β*i*S 12/3000	1.8kW	5.4kW
β*i*S 22/2000	2.5kW	5.2kW
β*i*S 22/3000	3.0kW	8.8kW
β*i*S 30/2000	3.0kW	11kW
β*i*S 40/2000	3.0kW	11kW
β*i*Sc 2/4000	0.5kW	2.3kW
β*i*Sc 4/4000	0.75kW	2.5kW
β*i*Sc 8/3000	1.2kW	2.8kW
β*i*Sc 12/2000	1.4kW	2.8kW

NOTE
The continuous rated output and maximum output at acceleration may be changed.

(3) α*i* servo motor series (400 V input series)

Table 4.11.1(c)

Motor model	Continuous rated output	Maximum output at acceleration
α*i*F 4/5000HV	1.4kW	4.5kW
α*i*F 8/3000HV	1.6kW	5.7kW
α*i*F 8/4000HV	2.2kW	9.0kW
α*i*F 12/4000HV	3.0kW	7.5kW
α*i*F 22/3000HV	4.0kW	9.6kW
α*i*F 22/4000HV	4.0kW	17kW
α*i*F 30/4000HV	5.0kW	21kW/3000rpm, 23kW/4000rpm
α*i*F 40/3000HV	6.0kW	18kW
α*i*F 40/3000HV+FAN	9kW	18kW
α*i*S 2/5000HV	0.75kW	2.8kW
α*i*S 2/6000HV	1.0kW	2.4kW
α*i*S 4/5000HV	1.0kW	3.1kW
α*i*S 4/6000HV	1.0kW	2.9kW
α*i*S 8/4000HV	2.3kW	8.0kW
α*i*S 8/6000HV	2.2kW	11kW
α*i*S 12/4000HV	2.5kW	12kW
α*i*S 12/6000HV	2.2kW	20kW
α*i*S 22/4000HV	4.5kW	19kW
α*i*S 22/6000HV	4.5kW	21kW
α*i*S 30/4000HV	5.5kW	22kW

Motor model	Continuous rated output	Maximum output at acceleration
α*i*S 40/4000HV	5.5kW	24kW
α*i*S 50/2000HV	4kW	21kW
α*i*S 50/3000HV	5kW	39kW
α*i*S 50/3000HV+FAN	14kW	39kW
α*i*S 60/2000HV	5kW	25kW
α*i*S 60/3000HV+FAN	14kW	40kW
α*i*S 100/2500HV	11kW	38kW
α*i*S 100/2500HV+FAN	22kW	38kW
α*i*S 200/2500HV	16kW	48kW
α*i*S 200/2500HV+FAN	30kW	48kW
α*i*S 300/2000HV	52kW	96kW
α*i*S 300/3000HV	55kW	143kW
α*i*S 500/2000HV	60kW	104kW
α*i*S 500/3000HV	60kW	160kW
α*i*S 1000/2000HV	125kW	198kW
α*i*S 1000/3000HV	170kW	350kW
α*i*S 1500/2000HV	200kW	600kW
α*i*S 2000/2000HV	200kW	400kW
α*i*S 3000/2000HV	220kW	690kW

NOTE
The continuous rated output and maximum output at acceleration may be changed.

(4) β*i* servo motor series (400 V input series)

Table 4.11.1(d)

Motor model	Continuous rated output	Maximum output at acceleration
β*i*S 2/4000HV	0.5kW	2.3kW
β*i*S 4/4000HV	0.75kW	2.5kW
β*i*S 8/3000HV	1.2kW	2.8kW
β*i*S 12/3000HV	1.8kW	5.4kW
β*i*S 22/2000HV	2.5kW	5.2kW
β*i*S 22/3000HV	3.0kW	8.8kW
β*i*S 30/2000HV	3.0kW	11kW
β*i*S 40/2000HV	3.0kW	11kW

NOTE
The continuous rated output and maximum output at acceleration may be changed.

4.11.2 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 Power Supply module of the α*i*PS-B See FANUC AC SPINDLE MOTOR α*i* series DESCRIPTIONS (B-65272EN) for details.

(1) α*i* spindle motor series (200 V input series)

Table 4.11.2(a)

Motor model	Continuous rated output	30-minute rated output	S3 25% rated output	Maximum output at acceleration
α*i* I 0.5/10000 (Power up model)	0.55kW	1.1kW (15-minute rated output)	1.5kW	1.8kW
α*i* I 0.5/15000 (Power up model)	0.55kW	1.1kW (15-minute rated output)	1.5kW	1.8kW
α*i* I 1/10000 (Power up model)	1.5kW	2.2kW (15-minute rated output)	3.7kW	4.44kW
α*i* I 1/15000	1.5kW	2.2kW (15-minute rated output)		5.6kW
α*i* I 1/24000 (Power up model)	2.2kW	3.7kW (15-minute rated output)	11kW (S3 15% rated output)	20kW
α*i* I 1.5/10000 (Power up model)	2.2kW	3.7kW (15-minute rated output)	5.5kW	6.6kW
α*i* I 1.5/20000 (Power up model)	2.2kW	3.7kW (15-minute rated output)	9kW (S3 15% rated output)	20kW
α*i* I 2/10000 (Power up model)	2.2kW	3.7kW(15minute rated output)	5.5kW	6.6kW
α*i* I 2/20000 (Power up model)	3.7kW	5.5kW (15-minute rated output)	9kW	20kW
α*i* I 3/10000 (Power up model)	3.7kW	5.5kW	7.5kW	9kW
α*i* I 3/12000 (Power up model)	3.7kW	5.5kW	13kW (S3 15% rated output)	22kW
α*i* I 3/15000 (Power up model)	5.5kW	7.5kW	15kW (S3 15% rated output)	18kW
α*i* I 6/10000 (Power up model)	5.5kW	7.5kW	11kW	13.2kW
α*i* I 6/12000 (Power up model)	5.5kW	7.5kW	11kW	13.2kW
α*i* I 6/15000 (Power up model)	7.5kW	11kW	18kW (S3 15% rated output)	30kW
α*i* I 8/8000 (Power up model)	7.5kW	11kW	15kW	18kW
α*i* I 8/10000 (Power up model)	7.5kW	11kW	15kW	18kW
α*i* I 8/12000 (Power up model)	7.5kW	11kW	15kW	18kW
α*i* I 12/8000 (Power up model)	11kW	15kW	18.5kW	22.2kW
α*i* I 12/12000 (Power up model)	11kW	15kW	18.5kW	22.2kW
α*i* I 15/8000 (Power up model)	15kW	18.5kW	25kW	30kW
α*i* I 15/12000 (Power up model)	15kW	18.5kW	25kW	30kW

Motor model	Continuous rated output	30-minute rated output	S3 25% rated output	Maximum output at acceleration
αi I 18/8000 (Power up model)	18.5kW	22kW	30kW	36kW
αi I 18/12000 (Power up model)	18.5kW	22kW	30kW	36kW
αi I 22/8000 (Power up model)	22kW	26kW	35kW	42kW
αi I 22/12000 (Power up model)	22kW	26kW	35kW	42kW
αi I 30/7000 (Power up model)	30kW	37kW	45kW	54kW
αi I 40/7000 (Power up model)	37kW	45kW	55kW	66kW
αi I 50/5000 (Power up model)	45kW	55kW	65kW	78kW
αi I_P 12/8000 (Power up model)	5.5kW	7.5kW	9kW	10.8kW
αi I_P 15/8000 (Power up model)	7.5kW	9kW	12kW	14.4kW
αi I_P 18/8000 (Power up model)	9kW	11kW	15kW	18kW
αi I_P 22/8000 (Power up model)	11kW	15kW	18.5kW	22.2kW
αi I_P 30/6000 (Power up model)	15kW	18.5kW	22kW	26.4kW
αi I_P 40/6000 (Power up model)	18.5kW	22kW	26kW	31.2kW
αi I_P 50/6000 (Power up model)	22kW	30kW	37kW	44.4kW
αi I_P 60/5000	22kW	30kW		36kW

NOTE

The continuous rated output, 30-minute rated output, S3 25% rated output, and maximum output at acceleration may be changed.

(2) αi spindle motor series (400 V input series)

Table 4.11.2(b)

Motor model	Continuous rated output	30-minute rated output	S3 25% rated output	Maximum output at acceleration
αi I 0.5/10000HV	0.55kW	1.1kW (15-minute rated output)		1.32kW
αi I 1/10000HV	1.5kW	2.2kW (15-minute rated output)		2.64kW
αi I 1.5/10000HV	1.1kW	3.7kW (10-minute rated output)		4.44kW
αi I 2/10000HV	2.2kW	3.7kW (15-minute rated output)		4.44kW
αi I 3/10000HV	3.7kW	5.5kW		6.6kW
αi I 6/10000HV (Power up model)	5.5kW	7.5kW	11kW	13.2kW
αi I 8/8000HV (Power up model)	7.5kW	11kW	15kW	18kW
αi I 8/12000HV	7.5kW	11kW		13.2kW
αi I 12/8000HV (Power up model)	11kW	15kW	18.5kW	22.2kW
αi I 15/8000HV (Power up model)	15kW	18.5kW	25kW	30kW
αi I 15/10000HV	15kW	18.5kW		22.2kW

Motor model	Continuous rated output	30-minute rated output	S3 25% rated output	Maximum output at acceleration
αi I 22/8000HV (Power up model)	22kW	26kW	35kW	42kW
αi I 22/10000HV	22kW	26kW		31.2kW
αi I 30/7000HV (Power up model)	30kW	37kW	45KW	54kW
αi I 40/7000HV (Power up model)	37kW	45kW	70kW	84kW
αi I 50/5000HV	45kW	55kW		66kW
αi I 60/5000HV	60kW	75kW		90kW
αi I 75/5000HV	75kW	90kW		108kW
αi I 100/5000HV	100kW	120kW		144kW
αi I 150/5000HV	150kW	180kW		216kW
αi IP 15/8000HV	7.5kW	9kW		13.5kW
αi IP 22/8000HV	11kW	15kW		20kW
αi IP 40/6000HV	18.5kW	22kW		29kW
αi IP 50/6000HV	22kW	30kW		35.4kW
αi IP 60/5000HV	22kW	30kW		36kW

NOTE
The continuous rated output, 30-minute rated output, S3 25% rated output, and maximum acceleration-time output may be changed.

(3) β*i* spindle motor series (200 V input series)

Table 4.11.2(c)

Motor model	Continuous rated output	15-minute rated output	S3 15% rated output	Maximum output at acceleration
βi I 3/12000 (Power up model)	3.7kW	5.5kW	7.5kW	8.3kW
βi I 6/12000 (Power up model)	5.5kW	7.5kW	11kW	12.1kW
βi I 8/12000 (Power up model)	7.5kW	11kW	15kW	16.5kW
βi I 12/10000 (Power up model)	11kW	15kW	18.5kW	20.4kW
βi I 15/8000 (Power up model)	15KW	18.5kW	22kW	24.2kW
βi IP 12/8000	5.5kW	7.5kW		8.3kW
βi IP 15/8000	7.5kW	9kW		9.9kW
βi IP 18/8000	9kW	11kW		12.1kW
βi IP 22/8000	11kW	15kW		16.5kW
βi IP 30/8000	15kW	18.5kW		20.3kW

NOTE
The continuous rated output, 15-minute rated output, S3 15% rated output, and maximum acceleration-time output may be changed.

(4) β*i* spindle motor series (400 V input series)

Table 4.11.2(d)

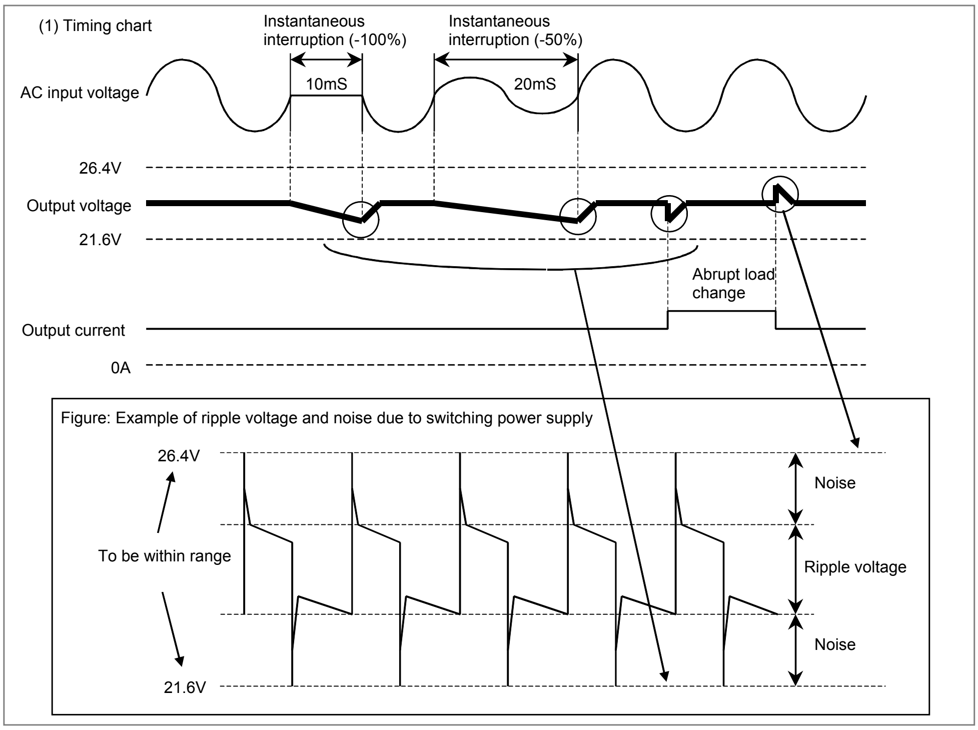
Motor model	Continuous rated output	15-minute rated output	S3 15% rated output	Maximum output at acceleration
β*i* I 8/12000HV (Power up model)	7.5kW	11kW	15kW	16.5kW
β*i* I 12/10000HV (Power up model)	11kW	15kW	18.5kW	20.4kW

NOTE
The continuous rated output, 15-minute rated output, S3 15% rated output, and maximum acceleration-time output may be changed.

4.12 SELECTING A CONTROL POWER SUPPLY

Requirements for 24-VDC power supply

No.	Item	Specification	Remarks
1	Power supply voltage	+24V±10%	Including ripple voltage and noise
2	Input current	Depends on the amplifier. See Tables 4.6 (a) and (b).	
3	24-V retention time at instantaneous AC input interruption	10ms (For -100%) 20ms (For -50%)	
4	Startup time	Less than 500 ms after CNC power is turned on	If the power is turned off within 500 ms before the power to the CNC is turned off, alarm information may be recorded in the CNC.



NOTE
1 The maximum number of SV and SP models that can be connected to one Power Supply is 15.
2 The power cable wiring method differs depending on whether the total of power supply currents supplied to the amplifiers exceeds 9 A. For details, see Subsection 9.3.1.3.
3 For notes on sharing the power supply with the CNC, see Subsection 9.3.1.3.

Table 4.12.1 Current supplied from each 24-VDC power supply to each amplifier (for selecting a 24-V power supply)

200 V input series

Type	Model	Specification number	Current supplied from 24-V power supply
α*i*PS-B	α*i*PS 3-B	A06B-6200-H003	0.5A
		A06B-6202-H003	
	α*i*PS 7.5-B	A06B-6200-H008	
		A06B-6202-H008	
	α*i*PS 11-B	A06B-6200-H011	
		A06B-6202-H011	
	α*i*PS 15-B	A06B-6200-H015	
		A06B-6202-H015	
	α*i*PS 26-B	A06B-6200-H026	0.8A
		A06B-6202-H026	
	α*i*PS 30-B	A06B-6200-H030	
		A06B-6202-H030	
	α*i*PS 37-B	A06B-6200-H037	
		A06B-6202-H037	
	α*i*PS 55-B	A06B-6200-H055	1.4A
		A06B-6202-H055	
α*i*SP-B	α*i*SP 2.2-B	A06B-6220-H002#H600	0.6A
		A06B-6222-H002#H610	
	α*i*SP 5.5-B	A06B-6220-H006#H600	0.7A
		A06B-6222-H006#H610	
	α*i*SP 11-B	A06B-6220-H011#H600	0.8A
		A06B-6222-H011#H610	
	α*i*SP 15-B	A06B-6220-H015#H600	
		A06B-6222-H015#H610	
	α*i*SP 22-B	A06B-6220-H022#H600	1.3A
		A06B-6222-H022#H610	
	α*i*SP 26-B	A06B-6220-H026#H600	
		A06B-6222-H026#H610	
	α*i*SP 30-B	A06B-6220-H030#H600	
		A06B-6222-H030#H610	
	α*i*SP 37-B	A06B-6220-H037#H600	1.5A
		A06B-6222-H037#H610	
	α*i*SP 45-B	A06B-6220-H045#H600	1.8A
		A06B-6222-H045#H610	
	α*i*SP 55-B	A06B-6220-H055#H600	2.2A
		A06B-6222-H055#H610	

Type	Model	Specification number	Current supplied from 24-V power supply
αiSV-B 1-axis	αiSV 4-B	A06B-6240-H101 A06B-6240-H121	0.7A
	αiSV 20-B	A06B-6240-H103 A06B-6240-H123	
	αiSV 40-B	A06B-6240-H104 A06B-6240-H124	
	αiSV 80-B	A06B-6240-H105 A06B-6240-H125	
	αiSV 160-B	A06B-6240-H106 A06B-6240-H126	0.9A
	αiSV 360-B	A06B-6240-H109 A06B-6240-H129	1.3A
αiSV-B 2-axis	αiSV 4/4-B	A06B-6240-H201	0.9A
	αiSV 4/20-B	A06B-6240-H203	
	αiSV 20/20-B	A06B-6240-H205	
	αiSV 20/40-B	A06B-6240-H206	
	αiSV 40/40-B	A06B-6240-H207	1.0A
	αiSV 40/80-B	A06B-6240-H208	
	αiSV 80/80-B	A06B-6240-H209	
	αiSV 80/160-B	A06B-6240-H210	
	αiSV 160/160-B	A06B-6240-H211	
αiSV-B 3-axis	αiSV 4/4/4-B	A06B-6240-H301 A06B-6240-H321	1.3A
	αiSV 20/20/20-B	A06B-6240-H305 A06B-6240-H325	
	αiSV 20/20/40-B	A06B-6240-H306 A06B-6240-H326	1.4A
	αiSV 40/40/40-B	A06B-6240-H308 A06B-6240-H328	1.5A
	αiSV 80/80/80-B	A06B-6240-H331	1.5A
αiSVP-B	αiSVP 20/20/20-5.5-B	A06B-6230-H001#H600 A06B-6232-H001#H610	1.5A
	αiSVP 20/20/20-2.2-B	A06B-6232-H003#H610	1.4A
	αiSVP 40/40/40-2.2-B	A06B-6232-H004#H610	1.5A

Table 4.12.2 Current supplied from each 24-VDC power supply to each amplifier (for selecting a 24-V power supply)

400 V input series

Type	Model	Specification number	Current supplied from 24-V power supply
αiPS-B	αiPS 11HV-B	A06B-6250-H011 A06B-6252-H011	0.5A
	αiPS 18HV-B	A06B-6250-H018 A06B-6252-H018	
	αiPS 30HV-B	A06B-6250-H030 A06B-6252-H030	0.8A
	αiPS 45HV-B	A06B-6250-H045 A06B-6252-H045	
	αiPS 60HV-B	A06B-6250-H060 A06B-6252-H060	
	αiPS 75HV-B	A06B-6250-H075 A06B-6252-H075	1.4A
	αiPS 100HV-B	A06B-6250-H100 A06B-6252-H100	
	αiPS 125HV-B	A06B-6252-H125	1.7A

Type	Model	Specification number	Current supplied from 24-V power supply
α*i*SP-B	α*i*SP 5.5HV-B	A06B-6270-H006#H600	0.8A
		A06B-6272-H006#H610	
	α*i*SP 11HV-B	A06B-6270-H011#H600	
		A06B-6272-H011#H610	
	α*i*SP 15HV-B	A06B-6270-H015#H600	
		A06B-6272-H015#H610	
	α*i*SP 22HV-B	A06B-6270-H022#H600	1.3A
		A06B-6272-H022#H610	
	α*i*SP 30HV-B	A06B-6270-H030#H600	
		A06B-6272-H030#H610	
	α*i*SP 45HV-B	A06B-6270-H045#H600	1.5A
		A06B-6272-H045#H610	
	α*i*SP 60HV-B	A06B-6272-H060#H610	
	α*i*SP 75HV-B	A06B-6270-H075#H600	1.8A
		A06B-6272-H075#H610	
	α*i*SP 100HV-B	A06B-6270-H100#H600	2.2A
		A06B-6272-H100#H610	
	α*i*SP 100HV(SiC)-B	A06B-6272-H100#H610#S	
α*i*SV-B 1-axis	α*i*SV 10HV-B	A06B-6290-H102 A06B-6290-H122	0.7A
	α*i*SV 20HV-B	A06B-6290-H103 A06B-6290-H123	
	α*i*SV 40HV-B	A06B-6290-H104 A06B-6290-H124	
	α*i*SV 80HV-B	A06B-6290-H105 A06B-6290-H125	0.9A
	α*i*SV 180HVS-B	A06B-6290-H166	1.0A
	α*i*SV 180HV-B	A06B-6290-H106 A06B-6290-H126	1.3A
	α*i*SV 360HV-B	A06B-6290-H109 A06B-6290-H129	1.9A
	α*i*SV 540HV-B	A06B-6290-H110 A06B-6290-H130	
α*i*SV-B 2-axis	α*i*SV 10/10HV-B	A06B-6290-H202	0.9A
	α*i*SV 10/20HV-B	A06B-6290-H204	
	α*i*SV 20/20HV-B	A06B-6290-H205	
	α*i*SV 20/40HV-B	A06B-6290-H206	1.0A
	α*i*SV 40/40HV-B	A06B-6290-H207	
	α*i*SV 40/80HV-B	A06B-6290-H208	
	α*i*SV 80/80HV-B	A06B-6290-H209	
α*i*SV-B 3-axis	α*i*SV 10/10/10HV-B	A06B-6290-H302 A06B-6290-H322	1.3A
	α*i*SV 10/10/20HV-B	A06B-6290-H303 A06B-6290-H323	1.4A
	α*i*SV 20/20/20HV-B	A06B-6290-H305 A06B-6290-H325	1.5A
	α*i*SV 40/40/40HV-B	A06B-6290-H328	1.5A
α*i*SVP-B	α*i*SVP 10/10/10-5.5HV-B	A06B-6280-H001#H600	1.5A
		A06B-6282-H001#H610	

Table 4.12.3 Power supply units

Ordering number	Remarks
A06B-6200-K502	Specify this model when the total of currents supplied from 24-V power supply is 4.6 A or less.
A06B-6200-K503	Specify this model when the total of currents supplied from 24-V power supply is 11.2 A or less.

5 INSTALLATION

Chapter 5, "INSTALLATION," consists of the following sections:

5.1 LEAKAGE CURRENT

The α*i*-B amplifiers drive 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 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 : α*i*PS-B, α*i*SV-B, α*i*SP-B, α*i*SVP-B
Criterion for selection : 2mA per amplifier (Note 1)

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

The following example shows how to use selection criteria (a) and (b):
Example)
When the system consists of α*i*PS-B×1, α*i*SV-B 1-axis×1, α*i*SV-B 3-axis×1 (three motors), and α*i*SP-B×1
<u>2mA×4 (for the amplifiers) + 1mA×5 (for the motors) = 13mA</u>
→ 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 13 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

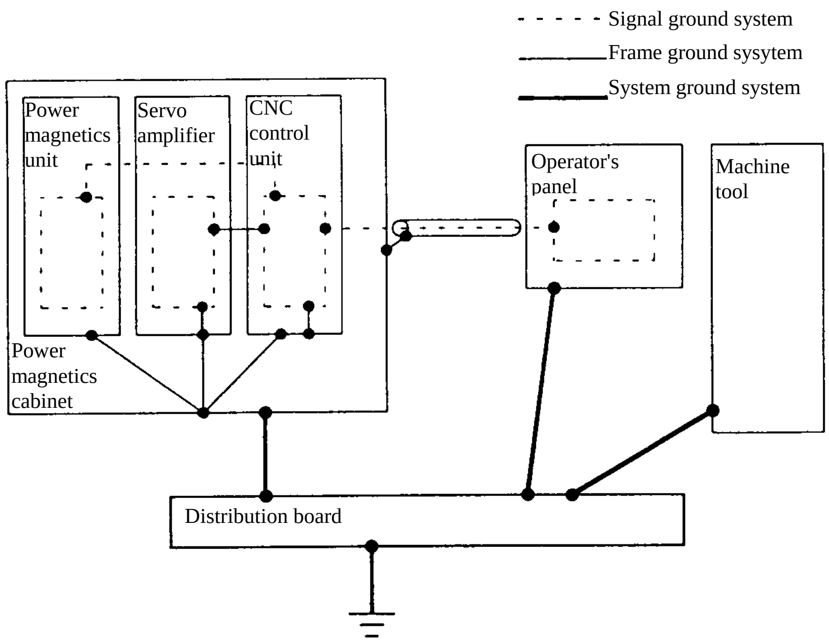
5.2.1 Ground Systems

There are three ground systems for CNC system grounding.

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

(2) 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, panels, and shields for the interface cables between the units are connected.

(3) System ground system (PE)
In the system ground system (PE), frame ground provided for each device or among units is connected systematically to ground at one place.



5.2.2 Grounding Method

Generally, noise that causes problems is high-frequency noise. Grounding each device with a low impedance (Note) is a key to suppression of high-frequency noise. Methods of grounding for this purpose are explained below.

> **NOTE**
> In addition to a resistance component, which converts current to heat, impedance contains a reactance component, which prevents the flow of AC current at a certain frequency.

(1) Multi-point grounding
If a metal plate of a power magnetics cabinet is grounded with sufficiently low impedance, the metal plate of the power magnetics cabinet is used as a ground plate, and each device is grounded nearby. This method allows grounding to a low-impedance metal plate of the power magnetics cabinet over a shortest distance, and can therefore effectively suppress high-frequency noise. On the other hand, because a metal plate of a power magnetics cabinet is used as a ground plate, noise suppression

efficiency depends on the structure of the power magnetics cabinet. For power magnetics cabinets, see Subsection 5.3.3. Fig. 1 shows a cabling schematic.
When the multi-point grounding method is used, units can be grounded with a low impedance, and the lengths of ground cables can also be reduced, so cabling can be simplified.

> ⚠ **CAUTION**
> If a metal plate of a power magnetics cabinet is not configured to show low impedance, a noise problem may arise between the power ground line and signal ground line.

(2) Single-point grounding
Signal lines and power lines are grounded separately, and grounding is performed at a single point to suppress noise from a power line to signal line. With this method, the length of a cable for grounding a unit tends to be long. So, to suppress high-frequency noise sufficiently, the cable diameter must be increased, or more than one connection cable must be used. Fig. 5.2.2 (b) shows a cabling schematic.

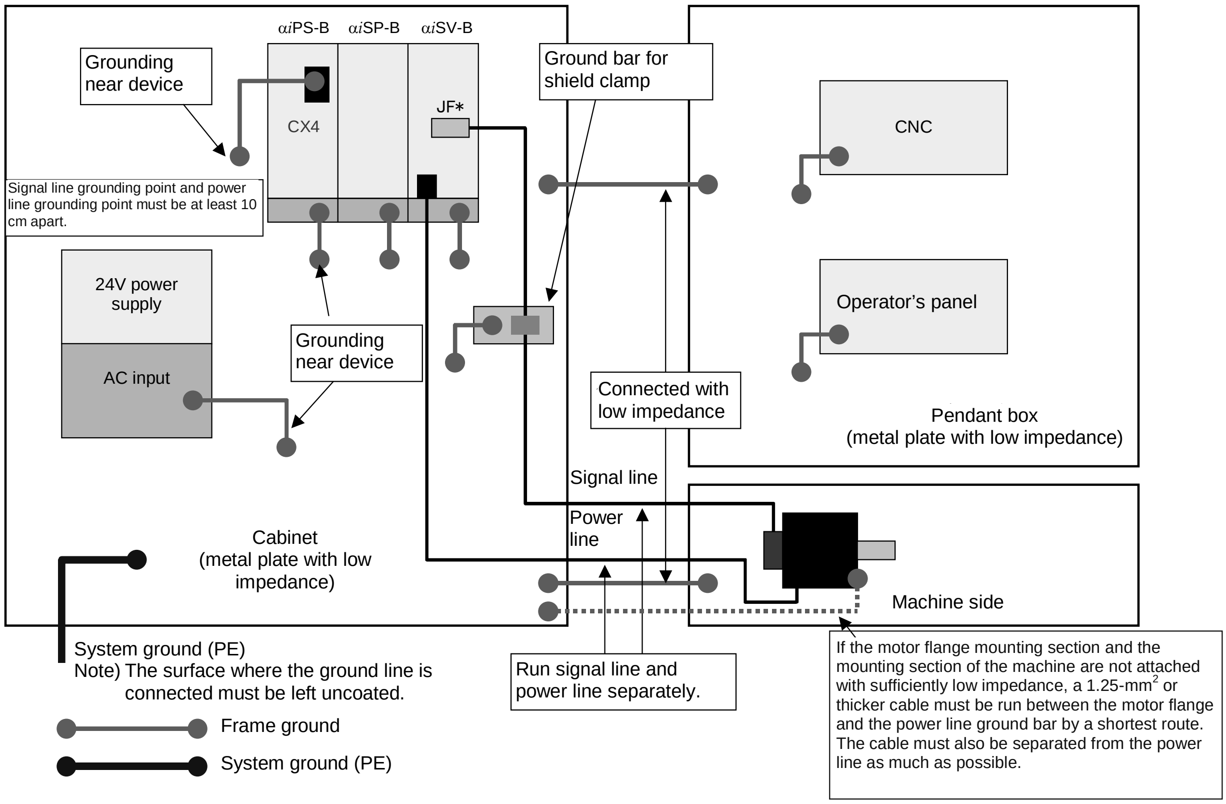


Fig. 5.2.2 (a) Schematic of multi-point grounding

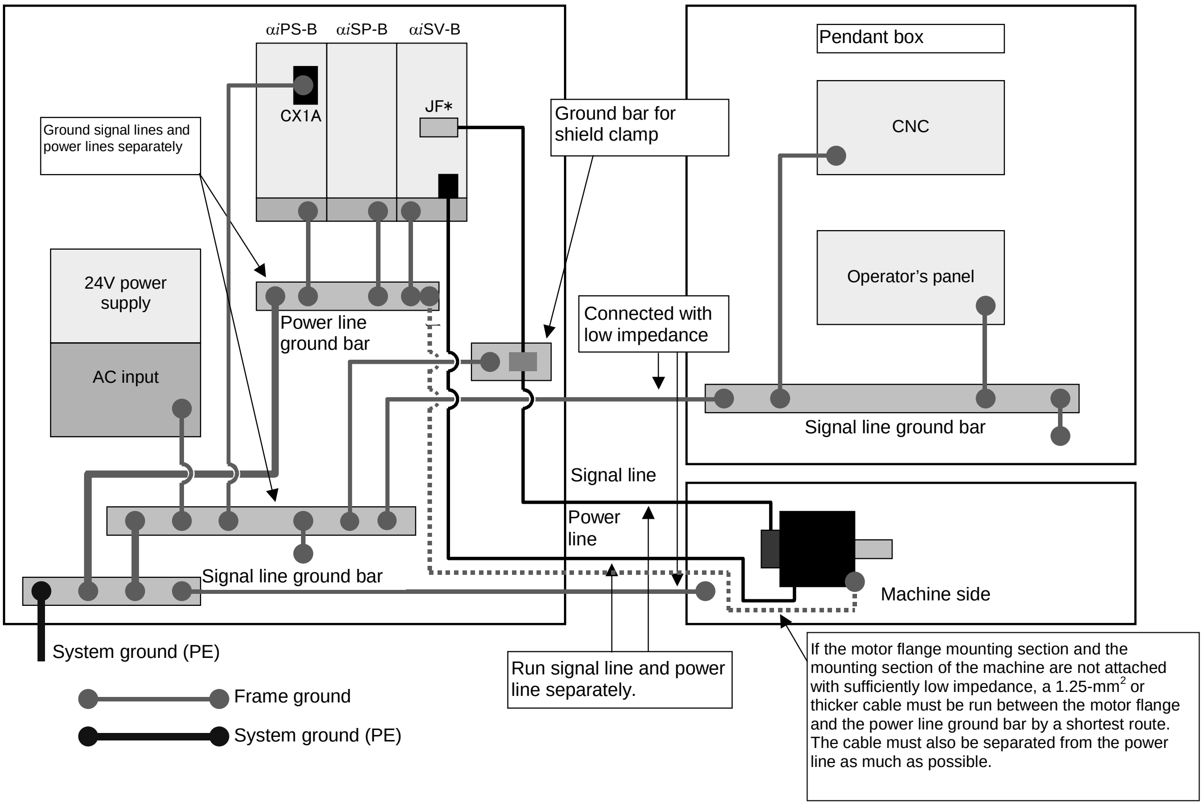


Fig. 5.2.2 (b) Schematic of single-point grounding

5.2.3 Notes on Connecting

- Connect the signal ground (0V) with the frame ground (FG) at only one place in the α*i*PS-B.
- The grounding resistance of the system ground shall be 100 Ω or less (class D grounding) for the 200 V line or 10 Ω or less (class C grounding) for the 400 V line.
- 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.

NOTE

1. Securing the ground terminal and a cable together is not permitted.
2. Depending on the machine, it may be impossible to establish connection between the machine's motor flange mounting section and the machine mounting section in the power magnetics cabinet via the mechanical unit such that impedance is sufficiently low. In this case, establish connection between the motor flange and the frame ground of the power magnetics cabinet via a cable with a minimum required length and with a cross sectional area of not less than 1.25 mm^2. When laying the aforementioned cable, ensure the maximum possible distance between the cable and the motor power line.

5.3 NOISE PREVENTION

5.3.1 Separation of Signal Lines

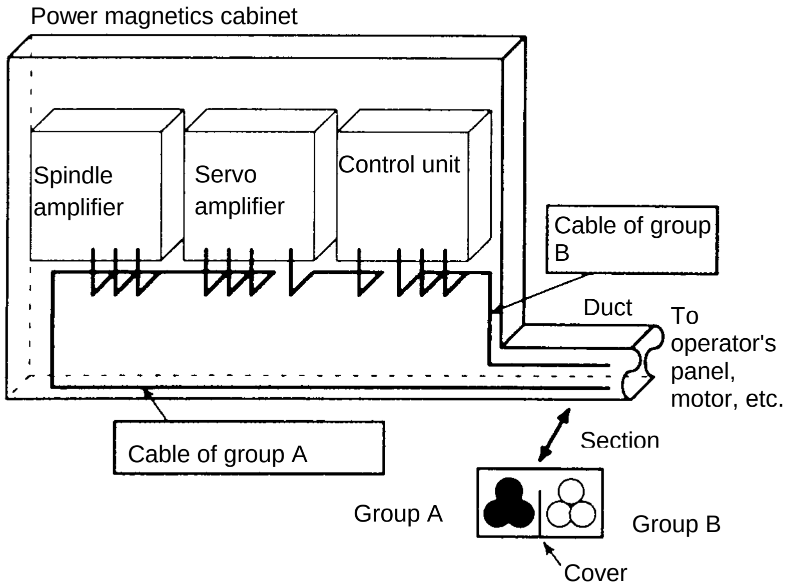
If a signal cable is near a power cable, noise may be induced. The signal cables must be separated from the power cables when routed. When power and signal cables cannot possibly be separated from each other, the cables must be run in parallel in the minimum distance. When a conduit is used, it is recommended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

Basically, signal lines require shield clamping. Correct shield clamping can suppress noise from the outside.
Strip part of the cable jacket to expose the shield sheath, and secure that part of the cable to the ground bar by using a clamp. At this time, the ground bar must be in contact with the surface of the shield so that the contact area becomes wide. (See the figure.)
When using the multi-point grounding method, remove the coating of the part where the shield clamp ground bar is connected to the power magnetics cabinet, to allow surface contact.

- 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 CONNECTION DETAILS."

- Cable clamp
  The cables that run into the amplifier and which require shield processing, with the exception of 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.

  Connect the cable clamp of the signal cables of α*i*SV-B connected to common α*i*PS-B to common the ground plate for signals.

- Grounding
  Please prepare a ground plate and then install it as shown in Figs. 5.3.2 (b) to 5.3.2 (e).

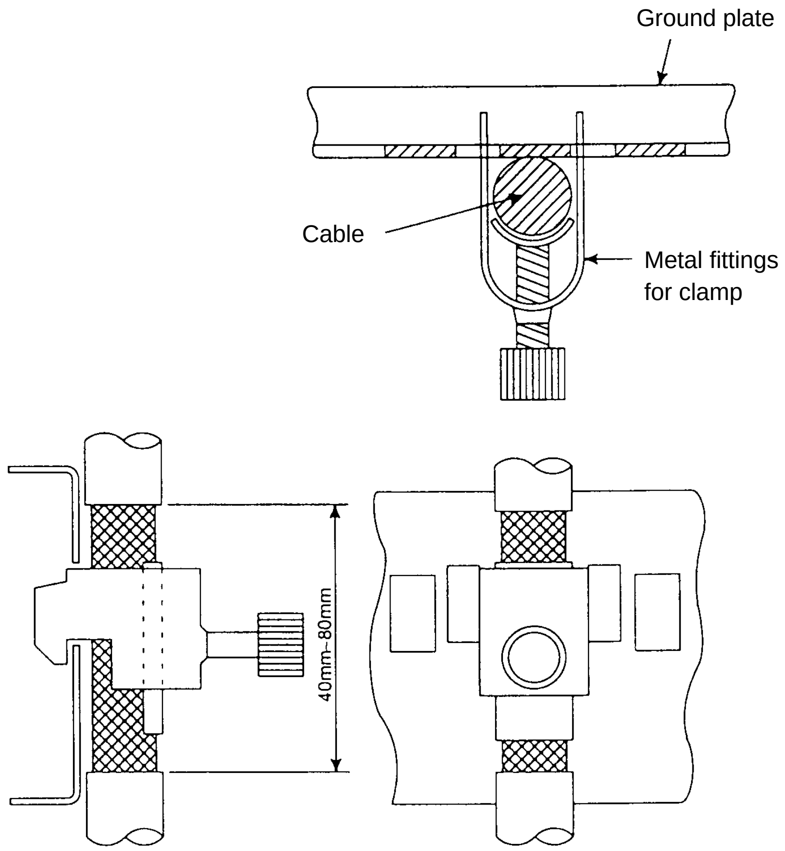


Fig. 5.3.2 (a) Cable clamp (1)

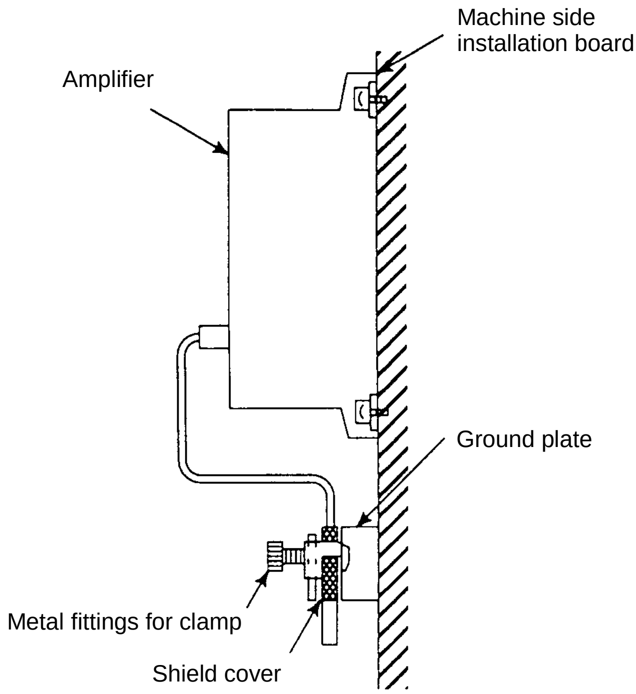


Fig. 5.3.2 (b) Cable clamp (2)

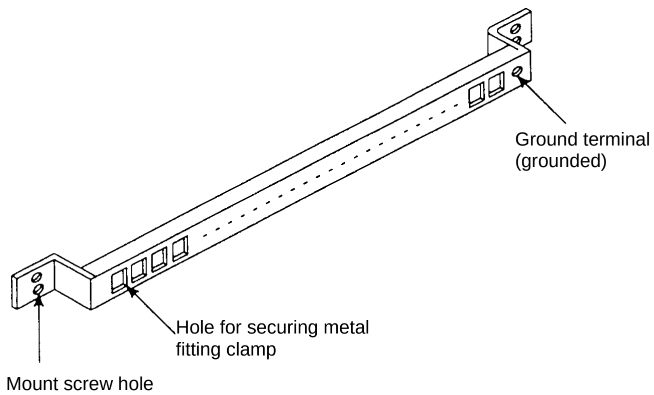


Fig. 5.3.2 (c) Ground plate

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

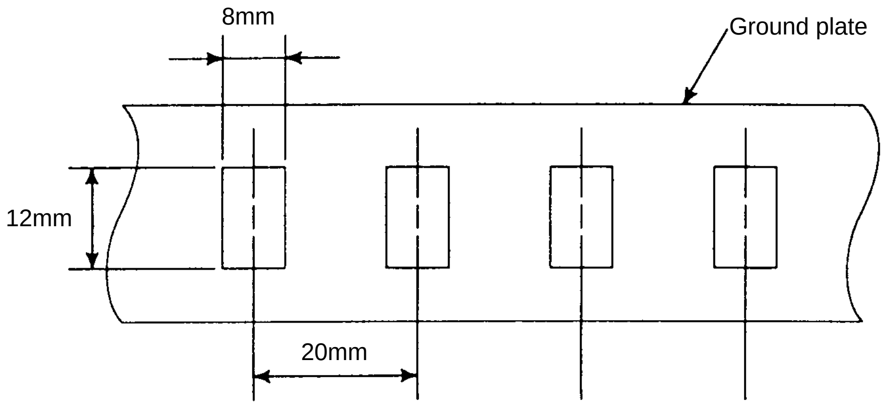


Fig.5.3.2 (d) Ground plate holes

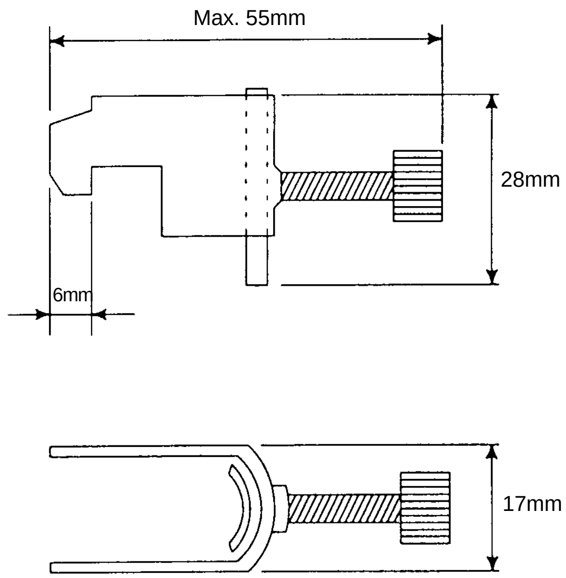
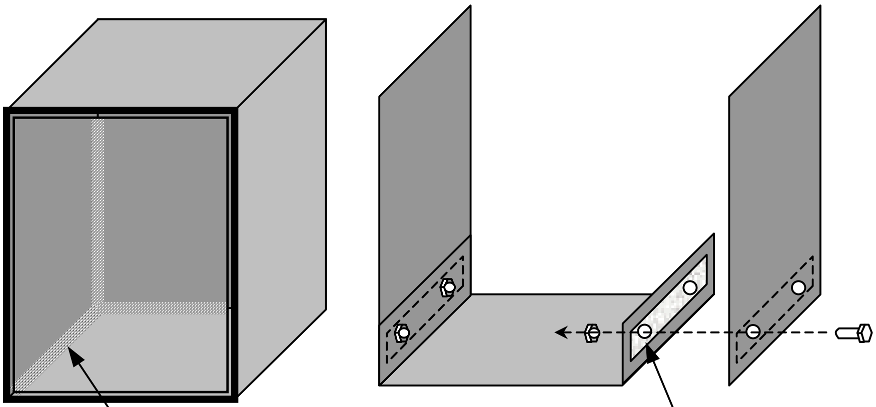


Fig.5.3.2 (e) Outer drawings of metal fittings for clamp

5.3.3 Power Magnetics Cabinet

A power magnetics cabinet is a key element for improving noise resistance and suppressing radiation noise.
One factor of noise resistance and radiation noise problems is insufficient electrical conductivity between metal plates of a power magnetics cabinet. Generally, noise that causes problems is high-frequency noise. Therefore, a power magnetics cabinet needs to be designed considering high-frequency noise.

(1) Basic structure of a power magnetics cabinet
Basically, power magnetics cabinets should be made of metal.
To improve noise resistance, the metal plates of the side walls, top plate, and bottom plate of a power magnetics cabinet must be electrically low-impedance conductive. So, welding is recommended for the power magnetics cabinet.
Bead (continuous) welding, rather than spot welding, should be applied to the power magnetics cabinet to achieve lower-impedance electrical conductivity among the metal plates.
When the power magnetics cabinet uses a built-up structure, joint part of each metal plate must be left uncoated, so that the plates come in direct contact with each other to provide electrical conductivity.
When metal plates are connected only via cables because of structural restrictions, it becomes more difficult to achieve low-impedance connection than when the metal plates are welded or are in direct contact. It is necessary to ensure large sectional areas of the cables used, sufficient conductivity of the connection parts, and large contact areas.

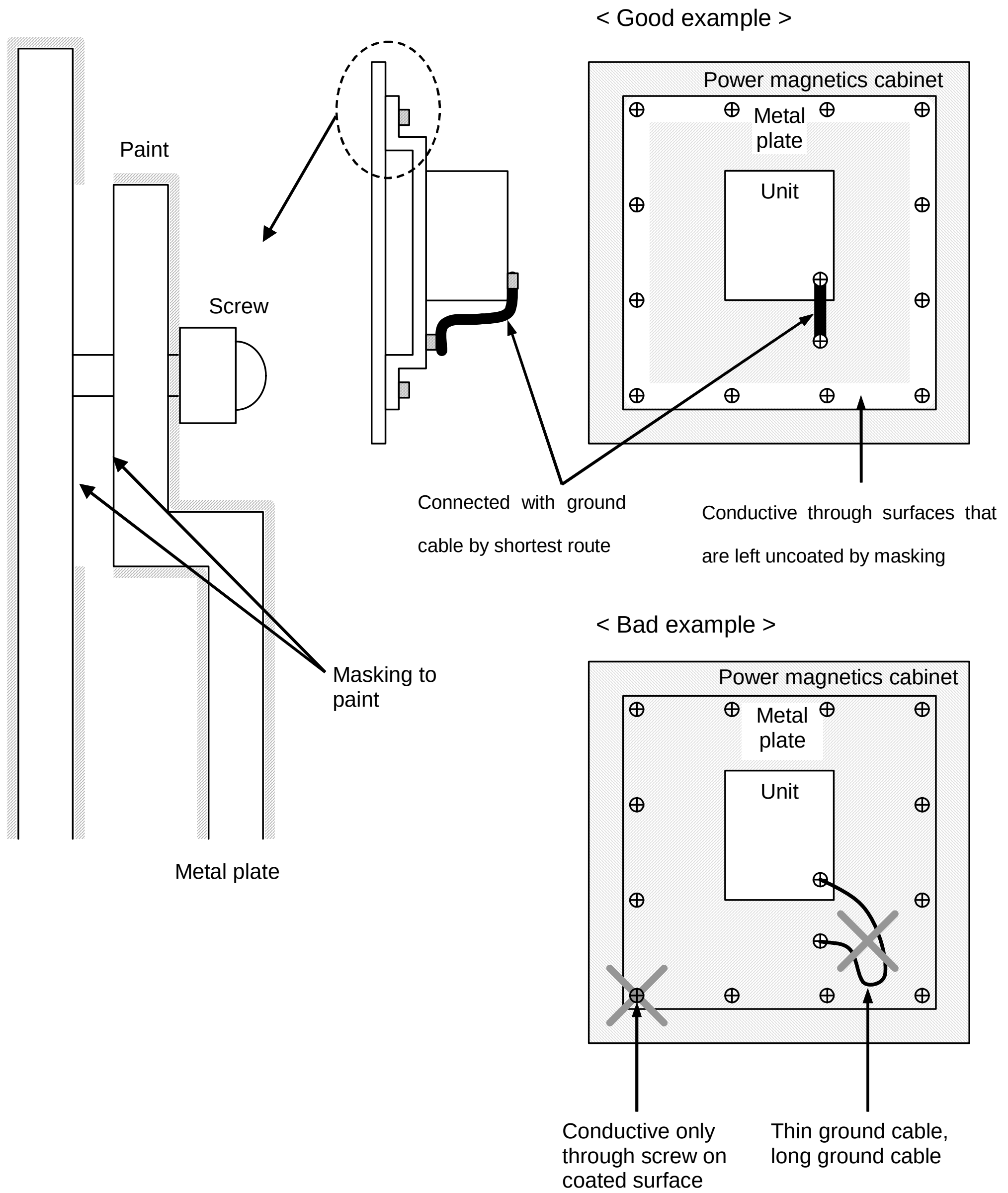


NOTE

The purpose of the description in this subsection is to provide a power magnetics cabinet with low-impedance electric conductivity to improve noise resistance. To implement a protection circuit, a cable having an appropriate sectional area for the AC input power capacity of the unit mounted on each metal plate needs to be used to connect the metal plates to perform protective grounding.

(2) Installing a unit in a power magnetics cabinet

Ground the unit so that the ground cable's length is minimized. If the diameter of the ground cable's conductor is small, impedance to high-frequency noise is particularly high, hindering fully effective grounding from being achieved. For the position of the ground terminal of each unit, see the relevant manual. When a metal plate is installed in the power magnetics cabinet after a unit is attached to the metal plate, the following method should be used. Attach the metal plate to the power magnetics cabinet so that their wide areas left uncoated by masking come in contact with each other. It is not advisable to provide electrical conductivity only via screws as such a method does not allow impedance to high frequencies to be fully reduced.



5.3.4 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

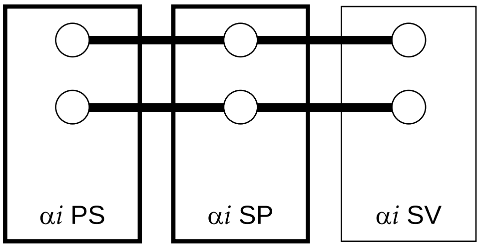
- Satisfying the requirements of the EMC Directives
  For details, refer to "Satisfying the Requirements of the EMC Directive" (A-72937EN).

- 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.

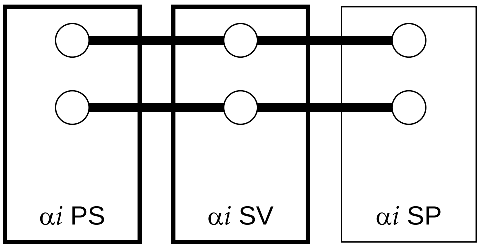
5.4 AMPLIFIER INSTALLATION

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

(1) When an α*i*SP 45HV-B, α*i*SP 60HV-B, α*i*SP 75HV-B, or α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B is used
Install the α*i*PS-B and α*i*SP-B close to each other.



(2) When an α*i*SV 360HV-B or α*i*SV 540HV-B is used
Install the α*i*PS-B, α*i*SV 360HV-B, and α*i*SV 540HV-B close to each other.



5.5 AMPLIFIER INSTALLATION NOTES RELATING TO SAFETY STANDARDS

The α*i*-B amplifiers are designed to meet the following safety standards:
EN61800 -5-1
UL508C Second Edition or Third Edition
To verify the conformity to these standards, the amplifiers are certified by TÜV Rheinland, a third certification organization, and UL.
When performing the CE Marking or UL Marking process, in design of the power magnetics cabinet, pay special attention to the installation conditions described in this section.

5.5.1 Requirements of EN and IEC Standards

5.5.1.1 Classification in standards on insulation design

(1) Insulation between circuits and between a circuit and protective ground
According to EN61800-5-1 4.3, insulation design of the amplifier conforms to the related standards in IEC60664 Part 1.

- The primary (the power supply and main circuit side) and the secondary (control circuit side) are separated by enforced insulation to ensure safety.
- Basic insulation is applied to the protective ground side.

Basic insulation is also applied between the main circuit of the power supply and the aluminum flanges (integrated with the heat sink), so connect a protective ground cable to the ground terminal of the lower aluminum flange.

(2) Installation category (overvoltage category)
In EN61800-5-1 4.3.6.1.3, power supply facilities are classified according to the impulse voltage to ground, included in the power supply to which the amplifier is connected.
This amplifier is designed to fall into installation category (overvoltage category) III.

Space distance is designed on the assumption that the rated impulse withstanding voltage (impulse voltage to ground) that appears in the power supply to which the amplifier is connected is 4.0 kV or less. If an impulse to ground that is higher than the assumed value appears in the power supply, it needs to be suppressed.

(3) Pollution degree of the installation environment and protection class of the power magnetics cabinet.
EN61800-5-1 4.3.6.1.2 requires that when the machine is installed in the environment of ordinary plants, the class of protection against dust, coolant, chips, and so on be IP54 or higher.
If the power magnetics cabinet satisfies this requirement, the degree of pollution inside the power magnetics cabinet is considered to be class 2.

Insulation design of this amplifier assumes that the amplifier is installed in an environment with pollution degree 2.
When the amplifier is used in a general machine installation environment, install the amplifier in a power magnetics cabinet that satisfies protection class IP54 or higher.
The IP level, however, is determined by the environment (atmosphere) in which the machine is installed. So, the protection class of the power magnetics cabinet should be selected according to the environment.
When an external heat sink cooling type amplifier of which heat sink fin protrudes behind the mounting flange is used, the section must be in a cooling area (duct) conforming to around IP22 to IP33, and must be protected from being exposed to direct splashes of coolant, chips, and so forth.

5.5.1.2 Protection against electric shock

(1) Protection against direct contact with charged parts (EN61800-5-1 4.3.3.3)
The electric shock protection level of this amplifier after it is installed is equivalent to IP2X (finger protection), which requires protection against unintentional or careless contact.

This amplifier must be installed in a power magnetics cabinet. In addition, while the amplifier is energized, the power magnetics cabinet must be locked to prevent persons, except specialized servicing personnel and persons who are well-trained in electric shock prevention and authorized to carry out maintenance work, from opening the power magnetics cabinet, as stipulated in Subsection 6.2.1, "Electric Shock Protection by Power Magnetics Cabinets," in EN 60204-1.

If the operator of the machine needs to open the power magnetics cabinet for some operations, the operator must be given thorough safety training, or a protection cover must be provided to prevent the operator from touching the amplifier.

(2) Confirmation of discharge of the electrolytic capacitor (EN61800-5-1 4.3.11)
This amplifier includes a large-capacity electrolytic capacitor for the power smoothing circuit. Even after the power supply input circuit is shut off, this capacitor remains charged for a while.

When it becomes necessary to touch the amplifier to do maintenance work or for other purposes, wait until the discharge time indicated on the face plate of the amplifier is passed, or start work after ensuring safety by measuring the residual voltage of the DC link section with a volt-ohm meter and checking that the LED (red) indicating charging is turned off.

(3) Leakage current to the protective ground cable (EN61800-5-1 4.3.5.5.2)
The motor is controlled by changing the average amplitude and frequency of voltage by pulse duration modulation and applying the modulated voltage to the armature. To do this, chopper voltage at a frequency of several kilohertz, which is the carrier frequency for the pulse duration modulation, is applied to the power line of the motor.

Ground stray capacitance mainly between the motor winding and casing and between the power line and protective ground line of the motor power cable causes leakage current to flow through the protective ground line of the motor power cable and machine ground, part of which flows also to the protective ground line of the machine.
The resultant leakage current value is around 1 to 2 mA per motor axis at the commercial power frequency component (50/60Hz). However, with the measurement circuit defined by EN61800-5-1 4.3.5.5.2, the sensitivity of high-frequency components cannot be reduced sufficiently, so a value greatly exceeding 3.5 mA is sometimes observed.

If the machine is not grounded, making contact with the machine can result in electric shock. Therefore, provide sufficient protection against electric shock by taking one of the following measures:
(a) Use a protective ground cable with a copper wire having a sectional area of 10 mm^2 or more.
(b) Install a ground-fault circuit interrupter to shut off power as soon as a ground fault occurs.
(c) Add a protective ground terminal to the power magnetics cabinet to duplicate protective ground cable connection.
(d) When installing an RCD unit, use RCD type B.

When using a ground-fault circuit interrupter, select an electromagnetic type with low high-frequency component sensitivity or an electronic type supporting inverters to prevent troubles due to high-frequency components. Measure (a) or (d), which can detect leakage current, is recommended.

5.5.1.3 Protective grounding

The amplifier has several protective ground terminals (marked according to 417-IEC-5019). These terminals are used not only for protection against electric shock due to dielectric breakdown but also for functional grounding to prevent noise.
Connect all of the protective ground terminals to the protective ground (PE) terminal in the power magnetics cabinet.

For how to connect a protective ground cable and its cable diameter, refer to Section 5.2, "GROUND", and Subsection 9.3.1.9, "Details of cable K70".
Note that connecting a cable terminal to a protective ground point is not permitted.

5.5.1.4 EMC

For CE Marking, the EMC Directive must be observed. FANUC's products have obtained certificates of conformance to EN61000 6.2:2005 and EN55011:2009+A1 (EMC Directive (EC Directive 89/336/EEC) from a third certification organization.
In addition, EMC of the machine and system units must be evaluated according to the above EU and (or) other requirements.

5.5.1.5 Notes on the emergency stop circuit configuration

The power system in the amplifier is shut off by IGBT (transistor) and not by electro-mechanical means. When configuring an emergency stop circuit, therefore, be sure to insert a line contactor to the power input line of Power Supply for power feeding to allow electro-mechanical shut-off operation, so that voltage is applied to the control coil of the contactor via the contactor control output of Power Supply.

If the amplifier fails, even when the emergency stop command input (*ESP) of the amplifier is driven low, the output relay of Power Supply cannot sometimes be turned off, disabling the line contactor from being shut off.

To surely shut off power, besides the shut-off feature of the amplifier, the emergency stop circuit must have a redundant circuit structure that has an independent route for directly shutting off the line contactor when a command is issued from the emergency stop switch.

When a spindle amplifier module is used, if the power line is shut off during spindle rotation, the power regeneration function may not be able to stop the spindle immediately, allowing the spindle to coast for a long time. So, the redundant circuit mentioned above must have a delay feature using an off-delay timer with a normal stop time taken into account.

5.5.1.6 Reduction of load ratio to ambient temperature

Some servo amplifier models have been approved as products conforming to standards with a load reduction ratio described below set.
If the load ratio is exceeded during use, the permissible temperature range of a part used may be exceeded, which can result in the issuance of an overheat alarm or decrease of the life of the part. So, the amplifier must be used so that the reduction characteristic is not exceeded.
For the load reduction ratio, refer to "(8) Derating" in Section 2.2.

5.5.1.7 Overload protection

An overload protection feature is provided as follows:
In the α*i*SP-B, the protection feature works when the maximum output continues for 30 s or longer.
In the α*i*SV-B, the protection feature works when the current level becomes 1.3 times as high as the rated current of the motor.

5.5.1.8 External overload protection device

The servo amplifier is not equipped with a special protection device. To protect conductors, pay attention to the specifications of the power supply unit.

5.5.1.9 Over-speed protection

The α*i*-B amplifiers are not equipped with an over-speed protection device.

5.5.1.10 Screw tightening torque

The screws of the servo amplifier are tightened with the following torque:

Screw size	Tightening torque (Nm)
M4	1.1 to 1.5
M5	2.0 to 2.5
M6	3.5 to 4.5

Screw size	Tightening torque (Nm)
M10	15 to 16

5.5.1.11 Warning label

The following warning label is supplied with the Power Supply. After installing the amplifier, attach the warning label at a prominent location inside the cabinet.

A370-3094-0003

下のラベルをアンプ設置後にロッカ内の見やすい場所に貼付下さい。
Please put the following label on a visible location in the cabinet after the installation of amplifiers.

ファナックのアンプに関する注意事項

ＡＣ２００Ｖ入力サーボアンプは電源電圧２４０Ｖにて電流８５，０００Ａｒｍｓに制限された回路でＵＬ短絡試験を実施しており、短絡電流がこの値を超えない電源回路に適合しています。
ＡＣ４００Ｖ入力サーボアンプは電源電圧４８０Ｖにて短絡電流が８５，０００Ａｒｍｓを超えない電源回路に適合しています。

注意　感電の恐れがあります

１．主回路電源以外に制御電源にも高電圧が印加されている部分がありますので、アンプの保守作業の前には、全ての電源を遮断して下さい。
２．電源遮断後、主回路のコンデンサの放電には２０分以上かかります。放電を完了するまでは充電部に触れないで下さい。

警告　やけどの恐れがあります

１．アンプの保守作業の前には、全ての電源を遮断した後、少なくとも５分間は放熱器に触れないで下さい。

NOTICE ON FANUC AMPLIFIERS

"Suitable for use on a circuit capable of delivering not more than 85,000 rms symmetrical amperes, 240 V maximum." For models rated 200 V class only.
"Suitable for use on a circuit capable of delivering not more than 85,000 rms symmetrical amperes, 480 V maximum." For models rated 400 V class only.

CAUTION - RISK of Electric Shock

1.More than one disconnect switch may be required to deenergize the equipment before servicing.
2.Capacitor discharge time is at least 20 min.

WARNING HOT SURFACE - RISK of Burn

1.Please do not touch the heat sink for 5 min. at least after cutting off the power of the equipment in servicing.

Fig. 5.5.1.11 (a) Warning label

5.5.2 Requirements of UL Standards

5.5.2.1 Classification in standards on insulation design

(1) Insulation between circuits and between a circuit and protective ground (UL508C 36)
According to UL508C, insulation design of the amplifier conforms to the requirements of UL840. Connect a protective ground cable to the ground terminal of the lower aluminum flange.

(2) Installation category (overvoltage category)
According to UL508C 36.9.4.(C), this amplifier is designed to fall into installation category (overvoltage category) III, so a surge absorber must be installed in the power input section of the machine. (UL-compliant product, clamp voltage: 6 kV or lower between phases) For details of the installation of a surge absorber, see Appendix A.

(3) Pollution degree of the installation environment and protection class of the power magnetics cabinet

UL508C requires that when the machine is installed in the environment of ordinary plants, the power magnetics cabinet in which this amplifier is to be installed meet pollution degree class 2.
The α*i*-B amplifiers are open type devices that are not equipped with a complete enclosure. If the power magnetics cabinet satisfies the above requirement, the degree of pollution inside the cabinet is considered to be class 2.
Insulation design of this amplifier assumes that the amplifier is installed in an environment with pollution degree 2.

When an amplifier has an external heat sink cooling type protruding backward from the mounting flange, the heat sink must be a cooling area (duct) conforming to IP22 to IP33, and consideration must be given to avoid direct contact with cutting fluid, chips and so forth.

5.5.2.2 Protection against electric shock

(1) Protection against direct contact with charged parts
This amplifier must be installed in a power magnetics cabinet. While the amplifier is energized, the power magnetics cabinet must be locked to prevent persons, except specialized servicing personnel and persons who are well-trained in electric shock prevention and authorized to carry out maintenance work, from opening the power magnetics cabinet.

If the operator of the machine needs to open the power magnetics cabinet for some operations, the operator must be given thorough safety training, or a protection cover must be provided to prevent the operator from touching the amplifier.

(2) Confirmation of discharge of the electrolytic capacitor (UL508C 21)
This amplifier includes a large-capacity electrolytic capacitor for the power smoothing circuit. Even after the power supply input circuit is shut off, this capacitor remains charged for a while.
When it becomes necessary to touch the amplifier to do maintenance work or for other purposes, wait until the discharge time indicated on the face plate of the amplifier is passed, or start work after ensuring safety by measuring the residual voltage of the DC link section with a volt-ohm meter and checking that the LED (red) indicating charging is turned off.

5.5.2.3 Protective grounding

Connect all of the protective ground terminals to the protective ground (PE) terminal in the power magnetics cabinet.
For how to connect a protective ground cable and its cable diameter, refer to Section 5.2, "GROUND" and Subsection, "Details of cable K70."
Note that connecting a cable terminal to a protective ground point is not permitted.

5.5.2.4 Overload protection

The α*i*SP-B and α*i*SV-B are equipped with an overload protection feature.
In the α*i*SP-B, the protection feature works when the maximum output continues for 30 s or longer.
In the α*i*SV-B, the protection feature works when the current level becomes 1.3 times as high as the rated current of the motor.

5.5.2.5 External overload protection device

The servo amplifier is not equipped with a special protection device. To protect conductors, pay attention to the specifications of the power supply unit.

5.5.2.6 Short-circuit protection

The 200 V input α*i*-B amplifiers are suitable for use with a power supply facility with 85,000 Arms or less/240 V (max).
The 400 V input α*i*-B amplifiers are suitable for use with a power supply facility with 85,000 Arms or less/480V (max).

5.5.2.7 Over-speed protection

The α*i*-B amplifiers are not equipped with an over-speed protection device.

5.5.2.8 Overheat protection

Motor over-temperature sensing is not provided by the drive.

5.5.2.9 Screw tightening torque

The screws of the servo amplifier are tightened with the following torque:

Screw size	Tightening torque (Nm)
M4	1.1 to 1.5
M5	2.0 to 2.5
M6	3.5 to 4.5
M10	15 to 16

5.6 NOTES ON COOLANT (REFERENCE)

Cutting fluid containing highly active sulfur, oil-free cutting fluid called synthetic cutting fluid, or highly alkaline, water-soluble cutting fluid in particular significantly affect the CNC, motor or amplifier. Even when these components are protected from direct spraying of cutting fluid, problems as described below may arise. So special care should be taken.

- Cutting fluid containing highly active sulfur
  Some of cutting fluids containing sulfur include extremely highly active sulfur. If such a cutting fluid penetrates into the CNC, motor, or amplifier, it can corrode copper, silver, and other metallic materials of components, therefore resulting in component failures.

- Synthetic cutting fluid with high permeability
  Some synthetic type cutting fluids that use polyalkylene glycol (PAG) as a lubricant have extremely high permeability. Such cutting fluids easily penetrate into a motor even if it is well closed. When this type of cutting fluid penetrates into the CNC, motor, or amplifier, it can lead to insulation degrading and component failures.

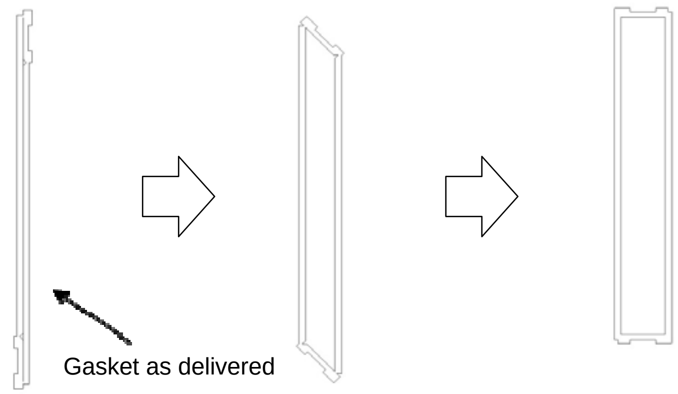
- Highly alkaline, water-soluble cutting fluid
  Some cutting fluids that strengthen pH by alkanolamine show strong alkalinity of pH10 or higher when diluted to the standard level. If such a cutting fluid penetrates into the CNC, motor, or amplifier, it can cause a chemical reaction with plastic or other materials, therefore degrading the materials.

5.7 HOW TO ATTACH THE SERVO AMPLIFIER GASKET

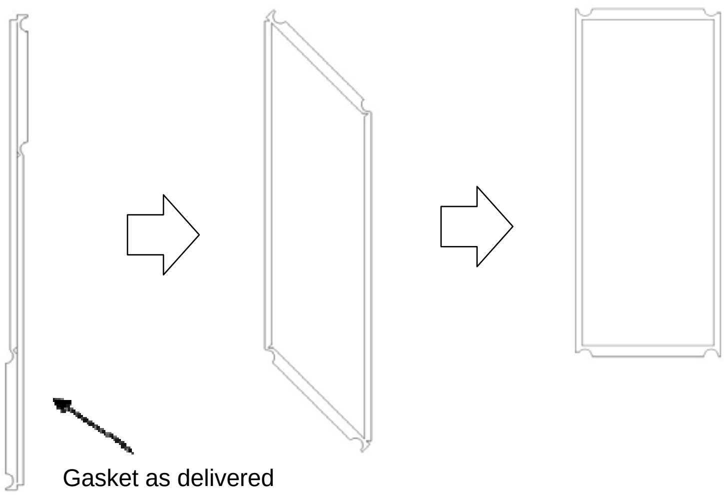
5.7.1 Preparation

This section describes the procedures and precautions for attaching the gasket that is used to install a servo amplifier in a power magnetics cabinet. Please read the following description before installing your servo amplifier.

Before installing your servo amplifier, unfold the gasket supplied with the servo amplifier into a rectangle, as illustrated in Fig. 5.7.1 (a). This gasket is intended to ensure seal-up. If the gasket is cut to separate each side from others, seal-up will be impaired. Therefore, be sure to use the gasket without separating the four sides from each other. There is no distinction between the top and bottom of the gasket.



Gasket for 60 mm-wide servo amplifiers



Gasket for 150 mm-wide servo amplifiers

Fig. 5.7.1 (a) How to unfold the gasket

5.7.2 How to Attach the Gasket to the Panel Cut-out of the Power Magnetics Cabinet

Attach the gasket so that the gasket's inner edge aligns with the edge of the panel cut-out, as illustrated in Fig. 5.7.2 (a) or 5.7.2 (b).
If the backing paper on the back of the gasket is peeled off at one time, a part of the gasket may stick to another part of the gasket, or the gasket may be elongated. Peeling off the backing paper step by step improves workability. Workability improves also by positioning the gasket by attaching the top and bottom sides first.

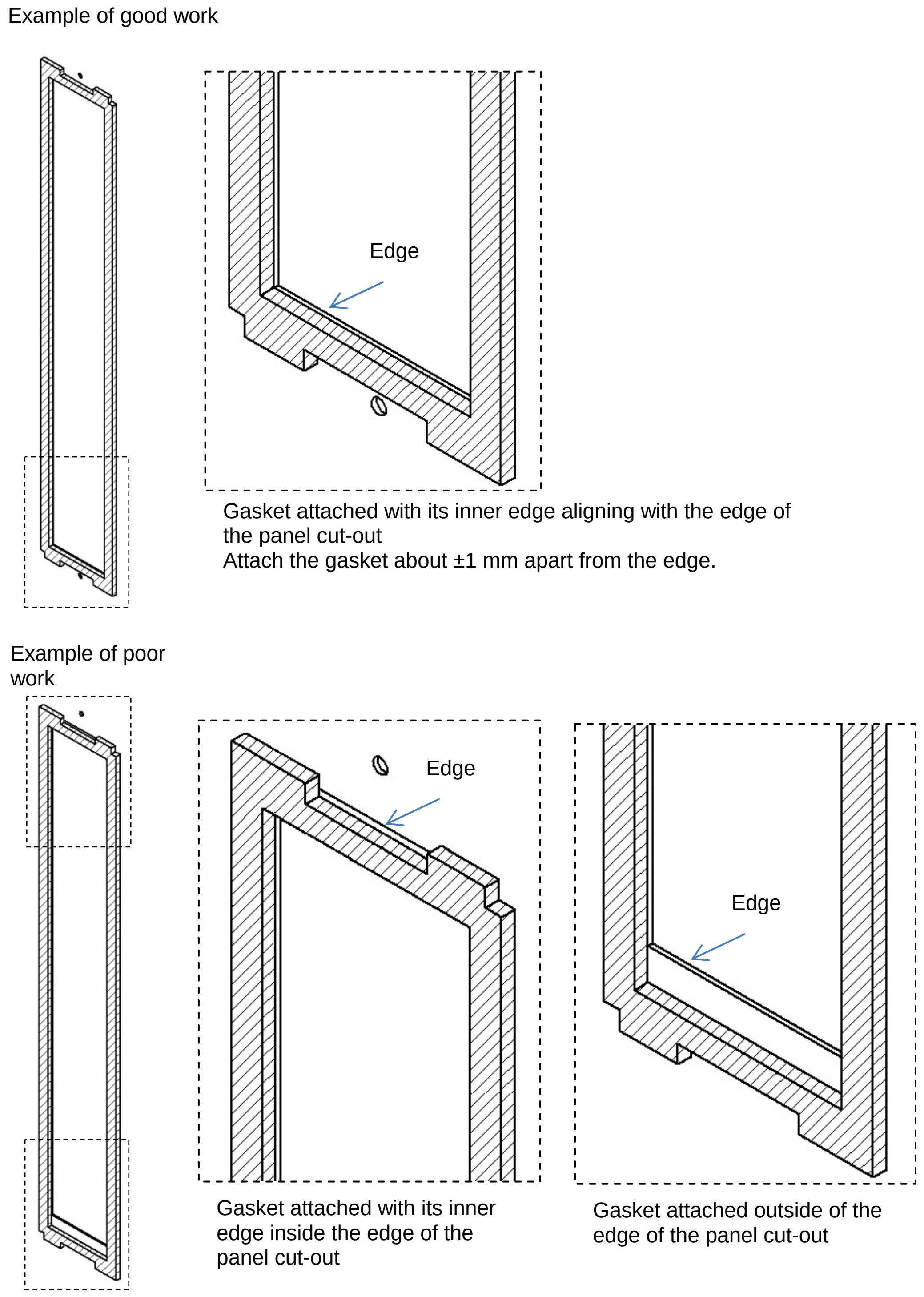
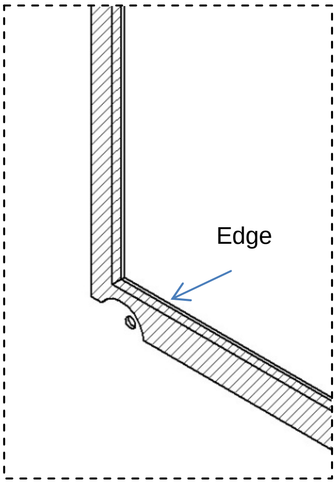


Fig. 5.7.2 (a) How to attach the gasket to the power magnetics cabinet
Gasket for 60 mm-wide servo amplifiers (or gasket for 90 mm-wide servo amplifiers)

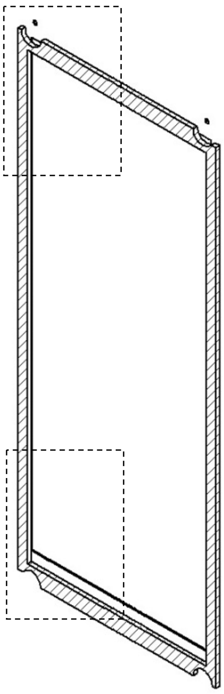
Example of good work

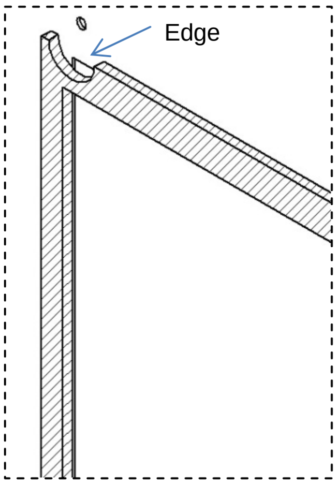


Gasket attached with its inner edge aligning with the edge of the panel cut-out

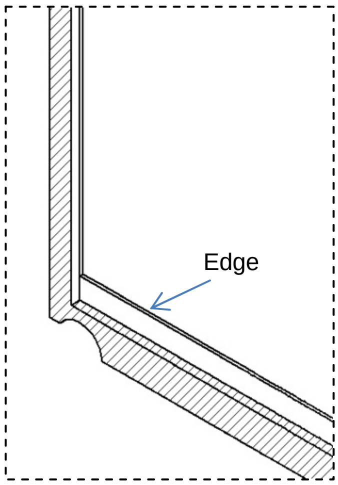
Attach the gasket about ±1 mm apart from the edge.

Example of poor work





Gasket attached with its inner edge inside the edge of the panel cut-out

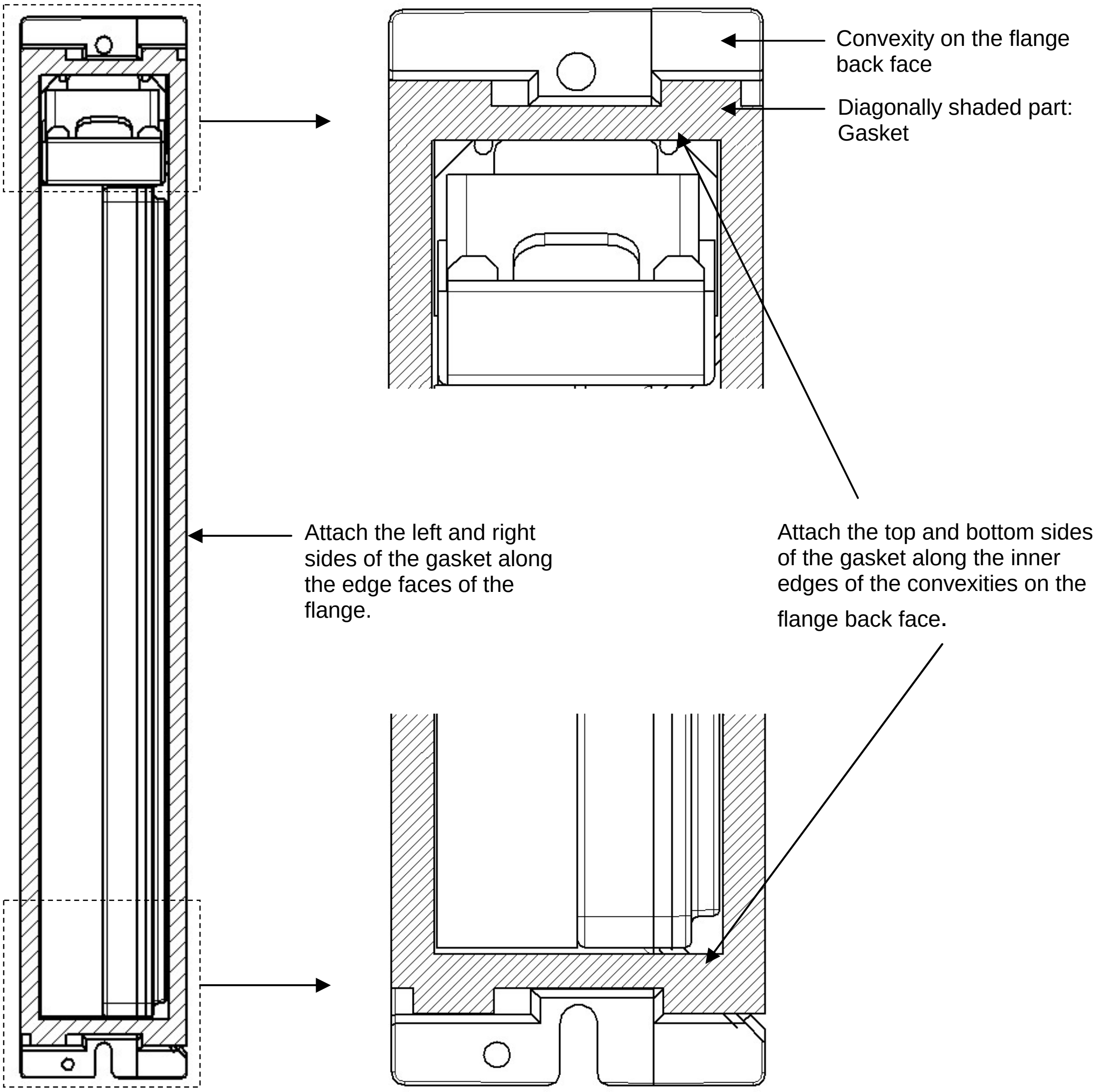


Gasket attached outside of the edge of the panel cut-out.

Fig. 5.7.2 (b) How to attach the gasket to the power magnetics cabinet
Gasket for 150 mm-wide servo amplifiers (or gasket for 300 mm-wide servo amplifiers)

5.7.3 How to Attach the Gasket to the Servo Amplifier

Convexities are provided at the top and bottom of the back face of the servo amplifier flange in order to maintain appropriate gasket thickness. Attach the top and bottom sides of the gasket along the inner edges of these convexities, as illustrated in Fig. 5.7.3 (a) or 5.7.3 (b). When performing this work, be careful for the gasket not to get on these convexities. The left and right sides of the gasket should be attached along the edge faces of the flange.
If the backing paper on the back of the gasket is peeled off at one time, a part of the gasket may stick to another part of the gasket, or the gasket may be elongated. Peeling off the backing paper step by step improves workability. Workability can be improved also by positioning the gasket by attaching the top and bottom sides first.



It is recommended, however, that the gasket should be attached to the power magnetics cabinet, rather than the servo amplifier, to ensure the positional accuracy of attachment.

Fig. 5.7.3 (a) How to attach the gasket to the servo amplifier
Gasket for 60 mm-wide servo amplifiers (or 90 mm-wide servo amplifiers)

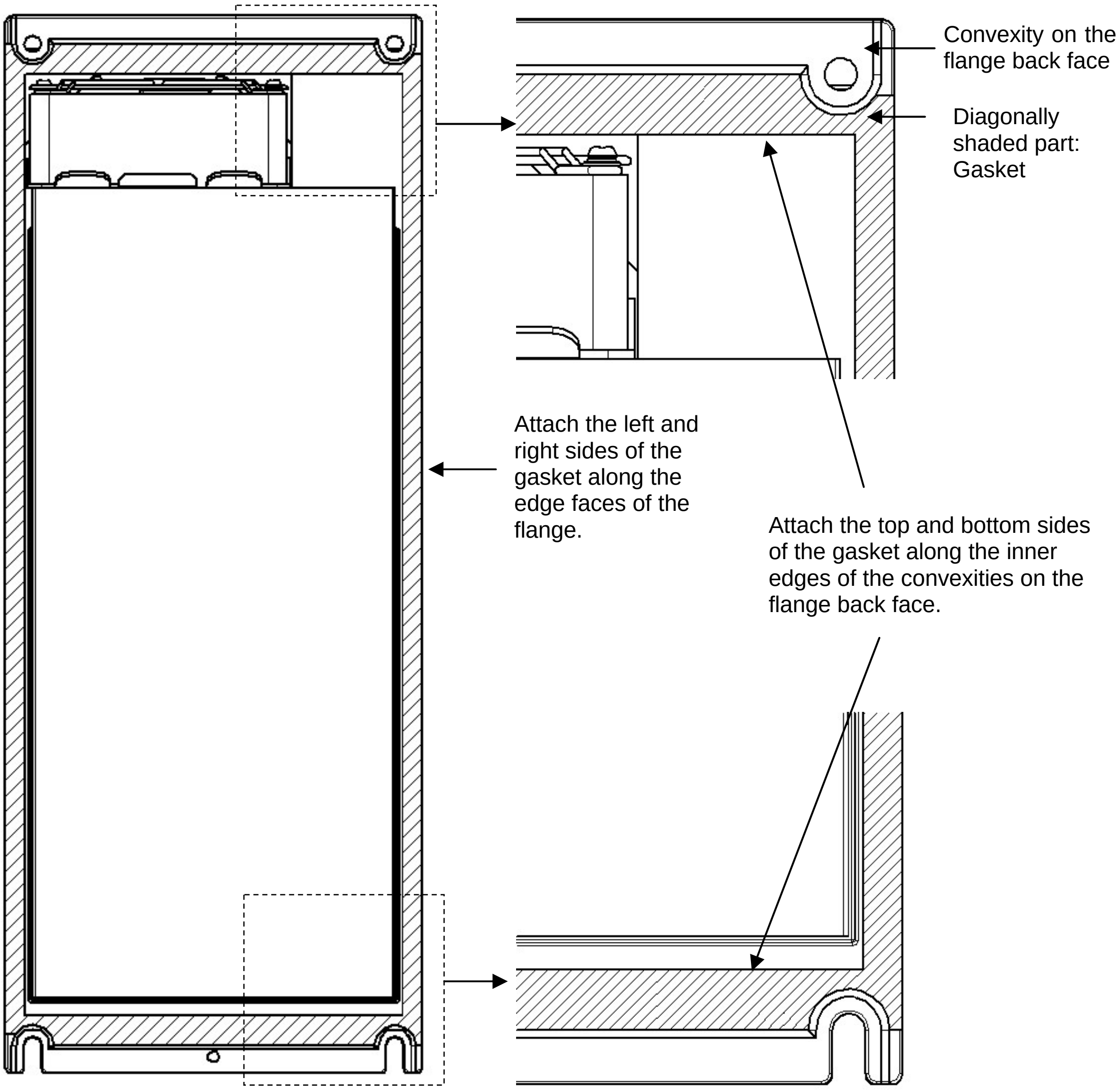


Fig. 5.7.3 (b) How to attach the gasket to the servo amplifier
Gasket for 150 mm-wide servo amplifiers (or gasket for 300 mm-wide servo amplifiers)

6 HEAT DISSIPATION

Chapter 6, "HEAT DISSIPATION," consists of the following sections:

6.1 200 V INPUT SERIES

The amount of heat dissipation by each amplifier of the 200 V input series is described below.

6.1.1 α*i*PS-B Series

The amount of heat dissipation by the α*i*PS-B depends on the α*i*PS-B model you use and the motor output (continuous rated output capacity obtained in Section 4.4).

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*PS-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka × b

- a : Amount of heat dissipation determined by the α*i*PS-B model [W]
- Ka : Coefficient determined by the α*i*PS-B [W/kW]
- b : Continuous rated output capacity obtained for selecting an α*i*PS-B model (Section 4.4) [kW]

Name	a [W]	Ka [W/kW]
α*i*PS 3-B	12	13
α*i*PS 7.5-B	12	15
α*i*PS 11-B	12	15
α*i*PS 15-B	12	16
α*i*PS 26-B	13	13
α*i*PS 30-B	13	13
α*i*PS 37-B	13	13
α*i*PS 55-B	17	22

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*PS-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Total amount of heat dissipation = a + Kb × b

a : Amount of heat dissipation determined by the α*i*PS-B model [W]

Kb : Coefficient determined by the α*i*PS-B [W/kW]

b : Continuous rated output capacity obtained for selecting an α*i*PS-B model (Section 4.4) [kW]

Name	a [W]	Kb [W/kW]
α*i*PS 3-B	14	12.9
α*i*PS 7.5-B	16	2.25
α*i*PS 11-B	16	1.50
α*i*PS 15-B	16	1.57
α*i*PS 26-B	21	0.64
α*i*PS 30-B	21	0.64
α*i*PS 37-B	21	0.62
α*i*PS 55-B	48	1.08

(3) Total amount of heat dissipation and residual amount of heat in the power magnetics cabinet at continuous rated output (calculation results of (1) and (2))

Table 6.1.1(a) α*i*PS-B

Name	Continuous rated output	Total amount of heat dissipation	Residual amount of heat in the power magnetics cabinet
α*i*PS 3-B	3kW	50W	50W
α*i*PS 7.5-B	7.5kW	124W	28W
α*i*PS 11-B	11kW	176W	28W
α*i*PS 15-B	15kW	247W	35W
α*i*PS 26-B	26kW	345W	29W
α*i*PS 30-B	30kW	397W	32W
α*i*PS 37-B	37kW	471W	36W
α*i*PS 55-B	55kW	1199W	75W

(4) Total amount of heat dissipation by each AC reactor

The total amount of heat dissipation by AC reactors for α*i*PS-B is calculated according to the expression below.

Total amount of heat dissipation = Kr × b

Kr : Coefficient dependent on the AC reactor model [W/kW]

b : Continuous rated output capacity calculated for the selection of α*i*PS-B (Section 4.4) [kW]

Table 6.1.1(b) AC reactors for the α*i*PS-B

Name	Kr [W/kW]	Total amount of heat dissipation at continuous rated output [W]
For α*i*PS 3-B	11.5	34.5
For α*i*PS 7.5-B	6.67	50.0
Forα*i*PS 11-B	8.18	90.0
Forα*i*PS 15-B	6.67	100
Forα*i*PS 26-B	6.92	180
Forα*i*PS 30-B	4.52	136
Forα*i*PS 37-B	2.60	96.3
Forα*i*PS 55-B	2.04	112

6.1.2 α*i*SV-B Series

The amount of heat dissipation by the α*i*SV-B depends on the α*i*SV-B 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. For servo motors, the continuous rated current is referred to as the stall current.) 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.

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*SV-B 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 α*i*SV-B model [W]
Ka1 : Coefficient determined by the α*i*SV-B (L-axis) [W/Arms]
b1 : Current flowing through the L-axis servo motor [Arms]
Ka2 : Coefficient determined by the α*i*SV-B (M-axis) [W/Arms]
b2 : Current flowing through the M-axis servo motor [Arms]
Ka3 : Coefficient determined by the α*i*SV-B (N-axis) [W/Arms]
b3 : Current flowing through the N-axis servo motor [Arms]

α*i*SV-B 1-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4-B	H101 H121	12	L	4.4	5.6	8.2
α*i*SV 20-B	H103 H123	12	L	4.4	5.6	8.2
α*i*SV 40-B	H104 H124	12	L	4.3	5.6	8.1
α*i*SV 80-B	H105 H125	12	L	4.2	5.3	7.7
α*i*SV 160-B	H106 H126	17	L	4.1	5.3	7.6
α*i*SV 360-B	H109 H129	31	L	4.2	5.4	7.9

α*i*SV-B 2-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4/4-B	H201	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 4/20-B	H203	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 20/20-B	H205	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 20/40-B	H206	18	L	4.4	5.6	8.2
			M	4.3	5.6	8.1
α*i*SV 40/40-B	H207	20	L	4.3	5.6	8.1
			M	4.3	5.6	8.1
α*i*SV 40/80-B	H208	20	L	4.2	5.3	7.7
			M	4.2	5.3	7.7

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 80/80-B	H209	20	L	4.2	5.3	7.7
			M	4.2	5.3	7.7
α*i*SV 80/160-B	H210	21	L	4.2	5.3	7.7
			M	4.1	5.3	7.6
α*i*SV 160/160-B	H211	21	L	4.1	5.3	7.6
			M	4.1	5.3	7.6

α*i*SV-B 3-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4/4/4-B	H301 H321	20	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
			N	4.4	5.6	8.2
α*i*SV 20/20/20-B	H305 H325	20	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
			N	4.4	5.6	8.2
α*i*SV 20/20/40-B	H306 H326	20	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
			N	4.3	5.6	8.1
α*i*SV 40/40/40-B	H308 H328	24	L	4.3	5.6	8.1
			M	4.3	5.6	8.1
			N	4.3	5.6	8.1
α*i*SV 80/80/80-B	H331	23	L	4.4	5.5	7.9
			M	4.4	5.5	7.9
			N	4.4	5.5	7.9

(2) Residual amount of heat in the power magnetics cabinet

By placing the heat sink section of the α*i*SV-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Residual amount of heat in the power magnetics cabinet = a + Kb1× b1 + Kb2 × b2 + Kb3 × b3

- a : Amount of heat dissipation determined by the α*i*SV-B model [W]
- Kb1 : Coefficient determined by the α*i*SV-B (L-axis) [W/Arms]
- b1 : Current flowing through the L-axis servo motor [Arms]
- Kb2 : Coefficient determined by the α*i*SV-B (M-axis) [W/Arms]
- b2 : Current flowing through the M-axis servo motor [Arms]
- Kb3 : Coefficient determined by the α*i*SV-B (N-axis) [W/Arms]
- b3 : Current flowing through the N-axis servo motor [Arms]

α*i*SV-B 1-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	Kb [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4-B	H101 H121	12	L	4.4	5.6	8.2
α*i*SV 20-B	H103 H123	12	L	4.4	5.6	8.2
α*i*SV 40-B	H104 H124	12	L	0.9	1.1	1.6
α*i*SV 80-B	H105 H125	12	L	0.8	1.1	1.5
α*i*SV 160-B	H106 H126	12	L	0.6	0.8	1.1

Name	Specification	a [W]	Axis	Kb [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 360-B	H109 H129	19	L	0.2	0.3	0.4

α*i*SV-B 2-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	K [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4/4-B	H201	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 4/20-B	H203	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 20/20-B	H205	18	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
α*i*SV 20/40-B	H206	18	L	0.9	1.1	1.6
			M	0.9	1.1	1.6
α*i*SV 40/40-B	H207	18	L	0.9	1.1	1.6
			M	0.9	1.1	1.6
α*i*SV 40/80-B	H208	18	L	0.6	0.8	1.2
			M	0.6	0.8	1.2
α*i*SV 80/80-B	H209	18	L	0.6	0.8	1.2
			M	0.6	0.8	1.2
α*i*SV 80/160-B	H210	18	L	0.4	0.5	0.8
			M	0.4	0.5	0.8
α*i*SV 160/160-B	H211	18	L	0.4	0.5	0.8
			M	0.4	0.5	0.8

α*i*SV-B 3-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	K [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 4/4/4-B	H301 H321	20	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
			N	4.4	5.6	8.2
α*i*SV 20/20/20-B	H305 H325	20	L	4.4	5.6	8.2
			M	4.4	5.6	8.2
			N	4.4	5.6	8.2
α*i*SV 20/20/40-B	H306 H326	20	L	0.9	1.1	1.6
			M	0.9	1.1	1.6
			N	0.9	1.1	1.6
α*i*SV 40/40/40-B	H308 H328	20	L	0.7	0.8	1.2
			M	0.7	0.8	1.2
			N	0.7	0.8	1.2
α*i*SV 80/80/80-B	H331	20	L	0.4	0.6	0.8
			M	0.4	0.6	0.8
			N	0.4	0.6	0.8

6.1.3 α*i*SP-B Series

The amount of heat dissipation by the α*i*SP-B depends on the α*i*SP-B model and the current that flows through the spindle motor. For the current that flows through a spindle motor, reference the continuous rated current of each spindle motor. (For the continuous rated current of each spindle motor, refer to the spindle motor descriptions.)

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*SP-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka × b

a : Amount of heat dissipation determined by the α*i*SP-B model [W]
Ka : Coefficient determined by the α*i*SP-B [W/Arms]
b : Current flowing through the spindle motor [Arms]

α*i*SP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Ka [W/Arms]	
			HRV1	HRV2
α*i*SP 2.2-B	H002	12	4.1	5.3
α*i*SP 5.5-B	H006	14	4.6	5.7
α*i*SP 11-B	H011	18	4.4	4.1
α*i*SP 15-B	H015	18	4.2	4.3
α*i*SP 22-B	H022	26	4.6	4.4
α*i*SP 26-B	H026	26	4.3	5.2
α*i*SP 30-B	H030	26	4.1	5.0
α*i*SP 37-B	H037	30	4.2	5.1
α*i*SP 45-B	H045	44	4.3	5.9
α*i*SP 55-B	H055	51	4.3	6.0

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*SP-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Residual amount of heat in the power magnetics cabinet = a + Kb × b

a : Amount of heat dissipation determined by the α*i*SP-B model [W]
Kb : Coefficient determined by the α*i*SP-B [W/Arms]
b : Current flowing through the spindle motor [Arms]

α*i*SP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Kb [W/Arms]	
			HRV1	HRV2
α*i*SP 2.2-B	H002	12	0.83	0.97
α*i*SP 5.5-B	H006	12	0.69	0.80
α*i*SP 11-B	H011	14	0.44	0.39
α*i*SP 15-B	H015	14	0.42	0.41
α*i*SP 22-B	H022	18	0.23	0.21
α*i*SP 26-B	H026	18	0.21	0.25
α*i*SP 30-B	H030	18	0.20	0.24
α*i*SP 37-B	H037	18	0.21	0.25
α*i*SP 45-B	H045	27	0.22	0.28
α*i*SP 55-B	H055	27	0.21	0.29

6.1.4 α*i*SVP-B Series

The amount of heat dissipation by the α*i*SVP-B depends on the current that flows through the servo motors and spindle motor you use. For the current that flows through a servo motor or spindle motor, reference the continuous rated current of each motor. (For the continuous rated current of each motor, refer to the servo motor descriptions and spindle motor descriptions.)

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*SVP-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka1 × b1 + Ka2 × b2 + Ka3 × b3+ Ka4 × b4

- a : Amount of heat dissipation determined by the α*i*SVP-B model [W]
- Ka1 : Coefficient determined by the α*i*SVP-B [W/Arms]
- b1 : Current flowing through the spindle motor [Arms]
- Ka2 : Coefficient determined by the α*i*SVP-B [W/Arms]
- b2 : Current flowing through the servo motor [Arms]
- Ka3 : Coefficient determined by the α*i*SVP-B [W/Arms]
- b3 : Current flowing through the servo motor [Arms]
- Ka4 : Coefficient determined by the α*i*SVP-B [W/Arms]
- b4 : Current flowing through the servo motor [Arms]

SP section of α*i*SVP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Ka1 [W/Arms]	
			HRV1	HRV2
α*i*SVP-B 20/20/20-5.5-B	H001	26	4.5	5.2
α*i*SVP-B 20/20/20-2.2-B	H003	24	4.3	5.0
α*i*SVP-B 40/40/40-2.2-B	H004	26	4.3	5.0

SV section of α*i*SVP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka2,3,4 [W/Arms]		
				HRV2	HRV3	HRV4
α*i*SV 20/20/20-5.5-B	H001	-	L	4.8	6.2	9.0
			M	4.8	6.2	9.0
			N	4.8	6.2	9.0
α*i*SV 20/20/20-2.2-B	H003		L	4.8	6.2	9.0
			M	4.8	6.2	9.0
			N	4.8	6.2	9.0
α*i*SV 40/40/40-2.2-B	H004		L	4.2	5.3	7.6
			M	4.2	5.3	7.6
			N	4.2	5.3	7.6

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*SP-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Residual amount of heat in the power magnetics cabinet = a + Kb1 × b1 + Kb2 × b2 + Kb3 × b3 + Kb4 × b4

- a : Amount of heat dissipation determined by the α*i*SVP-B model [W]
- Kb1 : Coefficient determined by the α*i*SVP-B [W/Arms]

b1 : Current flowing through the spindle motor [Arms]
Kb2 : Coefficient determined by the αiSVP-B [W/Arms]
b2 : Current flowing through the servo motor [Arms]
Kb3 : Coefficient determined by the αiSVP-B [W/Arms]
b3 : Current flowing through the servo motor [Arms]
Kb4 : Coefficient determined by the αiSVP-B [W/Arms]
b4 : Current flowing through the servo motor [Arms]

SP section of αiSVP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	K [W/Arms]	
			HRV1	HRV2
αiSVP 20/20/20-5.5-B	H001	26	0.68	0.78
αiSVP 20/20/20-2.2-B	H003	24	0.65	0.75
αiSVP 20/20/20-5.5-B	H001	26	0.65	0.75

SV section of αiSVP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	K [W/Arms]		
				HRV2	HRV3	HRV4
αiSVP-B 20/20/20-5.5-B	H001	-	L	0.5	0.62	0.9
			M	0.5	0.62	0.9
			N	4.8	6.2	9.0
αiSVP-B 20/20/20-2.2-B	H003	-	L	0.72	0.93	1.35
			M	0.72	0.93	1.35
			N	4.7	6.2	9.0
αiSVP-B 40/40/40-2.2-B	H001	-	L	0.63	0.8	1.14
			M	0.63	0.8	1.14
			N	1.89	2.39	3.42

6.2 400 V INPUT SERIES

The amount of heat dissipation by each amplifier of the 400 V input series is described below.

6.2.1 αiPS-B Series

The amount of heat dissipation by the αiPS-B depends on the αiPS-B model you use and the motor output (continuous rated output capacity as calculated in Section 4.4 or 4.5).

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

Total amount of heat dissipation = a + Ka × b
a : Amount of heat dissipation determined by the αiPS-B model [W]
Ka : Coefficient determined by the αiPS-B [W/kW]
b : Continuous rated output capacity obtained for selecting an αiPS-B model (Section 4.4 or 4.5) [kW]

Name	a [W]	Ka [W/kW]
αiPS 11HV-B	13	10.2
αiPS 18HV-B	13	9.5
αiPS 30HV-B	14	8.5
αiPS 45HV-B	14	7.8

Name	a [W]	Ka [W/kW]
α*i*PS 60HV-B	14	7.9
α*i*PS 75HV-B	18	13.3
α*i*PS 100HV-B	18	13.3
α*i*PS 125HV-B	18	13.3

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*PS-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Total amount of heat dissipation = a + Kb × b
- a : Amount of heat dissipation determined by the α*i*PS-B model [W]
- Kb : Coefficient determined by the α*i*PS-B [W/kW]
- b : Continuous rated output capacity obtained for selecting an α*i*PS-B model (Section 4.4 or 4.5) [kW]

Name	a [W]	Kb [W/kW]
α*i*PS 11HV-B	13	1.02
α*i*PS 18HV-B	13	0.95
α*i*PS 30HV-B	14	0.43
α*i*PS 45HV-B	14	0.39
α*i*PS 60HV-B	14	0.40
α*i*PS 75HV-B	18	0.67
α*i*PS 100HV-B	18	0.67
α*i*PS 125HV-B	18	0.67

(3) Total amount of heat dissipation and residual amount of heat in the power magnetics cabinet at continuous rated output (calculation results of (1) and (2))

Table 6.1.1(a) α*i*PS-B

Name	Continuous Rated output	Total amount of heat dissipation	Residual amount of heat in the power magnetics cabinet
α*i*PS 11HV-B	11kW	125W	24W
α*i*PS 18HV-B	18kW	184W	30W
α*i*PS 30HV-B	30kW	269W	27W
α*i*PS 45HV-B	45kW	365W	31W
α*i*PS 60HV-B	60kW	488W	38W
α*i*PS 75HV-B	75kW	1015W	67W
α*i*PS 100HV-B	100kW	1348W	84W
α*i*PS 125HV-B	125kW	1680W	101W

(4) Total amount of heat dissipation by each AC reactor
The total amount of heat dissipation by AC reactors for α*i*PS-B is calculated according to the expression below.

Total amount of heat dissipation = Kr × b
- Kr : Coefficient dependent on the AC reactor model [W/kW]
- b : Continuous rated output capacity calculated for the selection of α*i*PS-B (Section 4.4 or 4.5) [kW]

Table 6.2.1(b) AC reactors for the α*i*PS-B

Name	Kr [W/kW]	Total amount of heat dissipation at continuous rated output [W]
For α*i*PS 11HV-B	7.66	84.3

Name	Kr [W/kW]	Total amount of heat dissipation at continuous rated output [W]
For αiPS 18HV-B	9.09	164
For αiPS 30HV-B	3.46	104
For αiPS 45HV-B	4.27	192
For αiPS 60HV-B	5.14	308
For αiPS 75HV-B	2.40	180
For αiPS 100HV-B	3.00	300
For αiPS 125HV-B	1.74	217

6.2.2 αiSV-B Series

The amount of heat dissipation by the αiSV-B depends on the αiSV-B 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.

(1) Total amount of heat dissipation
The total amount of heat dissipation by the αiSV-B 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 αiSV-B model [W]
Ka1 : Coefficient determined by the αiSV-B (L-axis) [W/Arms]
b1 : Current flowing through the L-axis servo motor [Arms]
Ka2 : Coefficient determined by the αiSV-B (M-axis) [W/Arms]
b2 : Current flowing through the M-axis servo motor [Arms]
Ka3 : Coefficient determined by the αiSV-B (N-axis) [W/Arms]
b3 : Current flowing through the N-axis servo motor [Arms]

αiSV-B 1-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10HV-B	H102 H122	16	L	8.3	12.8	22.0
αiSV 20HV-B	H103 H123	16	L	7.6	11.9	20.4
αiSV 40HV-B	H104 H124	16	L	7.6	11.6	19.7
αiSV 80HV-B	H105 H125	20	L	7.7	11.9	20.2
αiSV 180HVS-B	H166	24	L	7.5	11.9	-
αiSV 180HV-B	H106 H126	33	L	8.2	12.7	23.0
αiSV 360HV-B	H109 H129	45	L	8.2	12.7	23.0
αiSV 540HV-B	H110 H130	54	L	7.75	-	-

αiSV-B 2-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10/10HV-B	H202	21	L	8.3	12.8	-
			M	8.3	12.8	-
αiSV 10/20HV-B	H204	21	L	8.3	12.8	22.0
			M	7.6	11.9	20.4
αiSV 20/20HV-B	H205	23	L	7.6	11.9	20.4
			M	7.6	11.9	20.4
αiSV 20/40HV-B	H206	23	L	7.6	11.9	20.4
			M	6.7	10.3	17.4
αiSV 40/40HV-B	H207	23	L	6.7	10.3	17.4
			M	6.7	10.3	17.4
αiSV 40/80HV-B	H208	24	L	6.7	10.3	17.4
			M	7.7	11.9	20.2
αiSV 80/80HV-B	H209	24	L	7.7	11.9	20.2
			M	7.7	11.9	20.2

αiSV-B 3-axis (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10/10/10HV-B	H302 H322	23	L	8.3	12.8	-
			M	8.3	12.8	-
			N	8.3	12.8	-
αiSV 10/10/20HV-B	H303 H323	23	L	8.3	12.8	22.0
			M	8.3	12.8	22.0
			N	7.6	11.9	20.4
αiSV 20/20/20HV-B	H305 H325	28	L	7.6	11.9	20.4
			M	7.6	11.9	20.4
			N	7.6	11.9	20.4
αiSV 40/40/40HV-B	H328	27	L	7.9	12.1	20.7
			M	7.9	12.1	20.7
			N	7.9	12.1	20.7

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

Residual amount of heat in the power magnetics cabinet = a + Kb1 × b1 + Kb2 × b2 + Kb3 × b3

- a : Amount of heat dissipation determined by the αiSV-B model [W]
- Kb1 : Coefficient determined by the αiSV-B (L-axis) [W/Arms]
- b1 : Current flowing through the L-axis servo motor [Arms]
- Kb2 : Coefficient determined by the αiSV-B (M-axis) [W/Arms]
- b2 : Current flowing through the M-axis servo motor [Arms]
- Kb3 : Coefficient determined by the αiSV-B (N-axis) [W/Arms]
- b3 : Current flowing through the N-axis servo motor [Arms]

αiSV-B 1-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	Kb [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10HV-B	H102 H122	16	L	8.3	12.8	22.0
αiSV 20HV-B	H103 H123	16	L	1.5	2.4	4.1

Name	Specification	a [W]	Axis	Kb [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 40HV-B	H104 H124	16	L	1.5	2.3	3.9
αiSV 80HV-B	H105 H125	20	L	1.2	1.8	3.0
αiSV 180HVS-B	H166	22	L	0.8	1.2	-
αiSV 180HV-B	H106 H126	21	L	0.4	0.6	1.2
αiSV 360HV-B	H109 H129	28	L	0.4	0.6	1.2
αiSV 540HV-B	H110 H130	30	L	0.4	-	-

αiSV-B 2-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	Kb [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10/10HV-B	H202	21	L	8.3	12.8	-
			M	8.3	12.8	-
αiSV 10/20HV-B	H204	21	L	1.7	2.6	4.4
			M	1.5	2.4	4.1
αiSV 20/20HV-B	H205	21	L	1.1	1.8	3.1
			M	1.1	1.8	3.1
αiSV 20/40HV-B	H206	21	L	1.0	1.5	2.6
			M	1.0	1.5	2.6
αiSV 40/40HV-B	H207	21	L	1.0	1.5	2.6
			M	1.0	1.5	2.6
αiSV 40/80HV-B	H208	21	L	0.7	1.0	1.7
			M	0.8	1.2	2.0
αiSV 80/80HV-B	H209	21	L	0.8	1.2	2.0
			M	0.8	1.2	2.0

αiSV-B 3-axis (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	Ka [W/Arms]		
				HRV2	HRV3	HRV4
αiSV 10/10/10HV-B	H302 H322	23	L	8.3	12.8	-
			M	8.3	12.8	-
			N	8.3	12.8	-
αiSV 10/10/20HV-B	H303 H323	23	L	1.7	2.6	4.4
			M	1.7	2.6	4.4
			N	1.5	2.4	4.1
αiSV 20/20/20HV-B	H305 H325	23	L	1.1	1.8	3.1
			M	1.1	1.8	3.1
			N	1.1	1.8	3.1
αiSV 40/40/40HV-B	H328	23	L	0.8	1.3	2.1
			M	0.8	1.3	2.1
			N	0.8	1.3	2.1

6.2.3 α*i*SP-B Series

The amount of heat dissipation by the α*i*SP-B depends on the α*i*SP-B model and the current that flows through the spindle motor. For the current that flows through a spindle motor, reference the continuous rated current of each spindle motor. (For the continuous rated current of each spindle motor, refer to the spindle motor descriptions.)

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*SP-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka × b
a : Amount of heat dissipation determined by the α*i*SP-B model [W]
Ka : Coefficient determined by the α*i*SP-B [W/Arms]
b : Current flowing through the spindle motor [Arms]

α*i*SP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Ka [W/Arms]	
			HRV1	HRV2
α*i*SP 5.5HV-B	H006	16	6.7	10.0
α*i*SP 11HV-B	H011	16	7.0	9.6
α*i*SP 15HV-B	H015	16	6.7	9.6
α*i*SP 22HV-B	H022	32	7.2	10.5
α*i*SP 30HV-B	H030	32	7.2	10.4
α*i*SP 45HV-B	H045	35	7.4	10.8
α*i*SP 60HV-B	H060	34	7.2	8.7
α*i*SP 75HV-B	H075	48	7.5	11.2
α*i*SP 100HV-B	H100	55	7.5	11.5
α*i*SP 100HV(SiC)-B	H100#S	52	7.1	10.3

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*SP-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Residual amount of heat in the cabinet = a + Kb × b
a : Amount of heat dissipation determined by the α*i*SP-B model [W]
Kb : Coefficient determined by the α*i*SP-B [W/Arms]
b : Current flowing through the spindle motor [Arms]

α*i*SP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Ka [W/Arms]	
			HRV1	HRV2
α*i*SP 5.5HV-B	H006	12	1.0	1.42
α*i*SP 11HV-B	H011	12	0.70	0.93
α*i*SP 15HV-B	H015	12	0.67	0.94
α*i*SP 22HV-B	H022	23	0.36	0.5
α*i*SP 30HV-B	H030	23	0.36	0.51
α*i*SP 45HV-B	H045	23	0.37	0.53
α*i*SP 60HV-B	H060	22	0.36	0.43
α*i*SP 75HV-B	H075	31	0.37	0.55
α*i*SP 100HV-B	H100	31	0.38	0.56
α*i*SP 100HV(SiC)-B	H100#S	28	0.36	0.50

6.2.4 α*i*SVP-B Series

The amount of heat dissipation by the α*i*SVP-B depends on the current that flows through the servo motors and spindle motor you use. For the current that flows through a servo motor or spindle motor, reference the continuous rated current of each motor. (For the continuous rated current of each motor, refer to the servo motor descriptions and spindle motor descriptions.)

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*SVP-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka1 × b1 + Ka2 × b2 + Ka3 × b3+ Ka4 × b4

a : Amount of heat dissipation determined by the α*i*SVP-B model [W]
Ka1 : Coefficient determined by the α*i*SVP-B [W/Arms]
b1 : Current flowing through the spindle motor [Arms]
Ka2 : Coefficient determined by the α*i*SVP-B [W/Arms]
b2 : Current flowing through the servo motor [Arms]
Ka3 : Coefficient determined by the α*i*SVP-B [W/Arms]
b3 : Current flowing through the servo motor [Arms]
Ka4 : Coefficient determined by the α*i*SVP-B [W/Arms]
b4 : Current flowing through the servo motor [Arms]

SP section of α*i*SVP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Ka1 [W/Arms]	
			HRV1	HRV2
αiSVP 10/10/10-5.5HV-B	H001	39	7	10.3

SV section of α*i*SVP-B (Total amount of heat dissipation)

Name	Specification	a [W]	Axis	Ka2,3,4 [W/Arms]	
				HRV2	HRV3
α*i*SVP 10/10/10-5.5HV-B	H001	-	L	8.2	14.8
			M	8.2	14.8
			N	8.2	14.8

(2) Residual amount of heat in the power magnetics cabinet
By placing the heat sink section of the α*i*SP-B outside the power magnetics cabinet, the residual amount of heat in the power magnetics cabinet can be calculated according to the expression below.

Residual amount of heat in the power magnetics cabinet = a + Kb1 × b1 + Kb2 × b2 + Kb3 × b3 + Kb4 × b4

a : Amount of heat dissipation determined by the α*i*SVP-B model [W]
Kb1 : Coefficient determined by the α*i*SVP-B [W/Arms]
b1 : Current flowing through the spindle motor [Arms]
Kb2 : Coefficient determined by the α*i*SVP-B [W/Arms]
b2 : Current flowing through the servo motor [Arms]
Kb3 : Coefficient determined by the α*i*SVP-B [W/Arms]
b3 : Current flowing through the servo motor [Arms]
Kb4 : Coefficient determined by the α*i*SVP-B [W/Arms]
b4 : Current flowing through the servo motor [Arms]

SP section of αiSVP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Kb1 [W/Arms]	
			HRV1	HRV2
αiSVP 10/10/10-5.5HV-B	H001	39	0.7	1.0

SV section of αiSVP-B (Residual amount of heat in the power magnetics cabinet)

Name	Specification	a [W]	Axis	Kb2,b3,b4 [W/Arms]	
				HRV2	HRV3
αiSVP 10/10/10-5.5HV-B	H001	-	L	0.82	1.48
			M	0.82	1.48
			N	8.2	14.8

7 COOLING

The αi-B amplifiers have 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 Subsection 8.1.1.

8 EXTERNAL DIMENSIONS AND MAINTENANCE AREA

Chapter 8 "EXTERNAL DIMENSIONS AND MAINTENANCE AREA," consists of the following sections:

8.1 OUTLINE DRAWINGS

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

(1) α*i*PS-B series

Model		Outline drawing	Panel cut-out	Maintenance area	Internal fan	External fan
200 V input series	α*i*PS 3-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
	α*i*PS 7.5-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
	α*i*PS 11-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*PS 15-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*PS 26-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 30-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 37-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 55-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
400 V input series	α*i*PS 11HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*PS 18HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*PS 30HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 45HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 60HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*PS 75HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	α*i*PS 100HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	α*i*PS 125HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided

(2) α*i*SV-B series

Model			Outline drawing	Panel cut-out	Maintenance area	Internal fan	External fan
200 V input series	1-axis	α*i*SV 4-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 40-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 80-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 160-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 360-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	2-axis	α*i*SV 4/4-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 4/20-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20/20-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20/40-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 40/40-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 40/80-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 80/80-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 80/160-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
		α*i*SV 160/160-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	3-axis	α*i*SV 4/4/4-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20/20/20-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20/20/40-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 40/40/40-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 80/80/80-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
400 V input series	1-axis	α*i*SV 10HV-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 20HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 40HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 80HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 180HVS-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
		α*i*SV 180HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
		α*i*SV 360HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
		α*i*SV 540HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	2-axis	α*i*SV 10/10HV-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 10/20HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 20/20HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 20/40HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 40/40HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 40/80HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
		α*i*SV 80/80HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	3-axis	α*i*SV 10/10/10HV-B	Outline drawing 1	Panel cut-out 1	Maintenance area 1	Provided	-
		α*i*SV 10/10/20HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	-
		α*i*SV 20/20/20HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
		α*i*SV 40/40/40HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided

(3) α*i*SP-B series

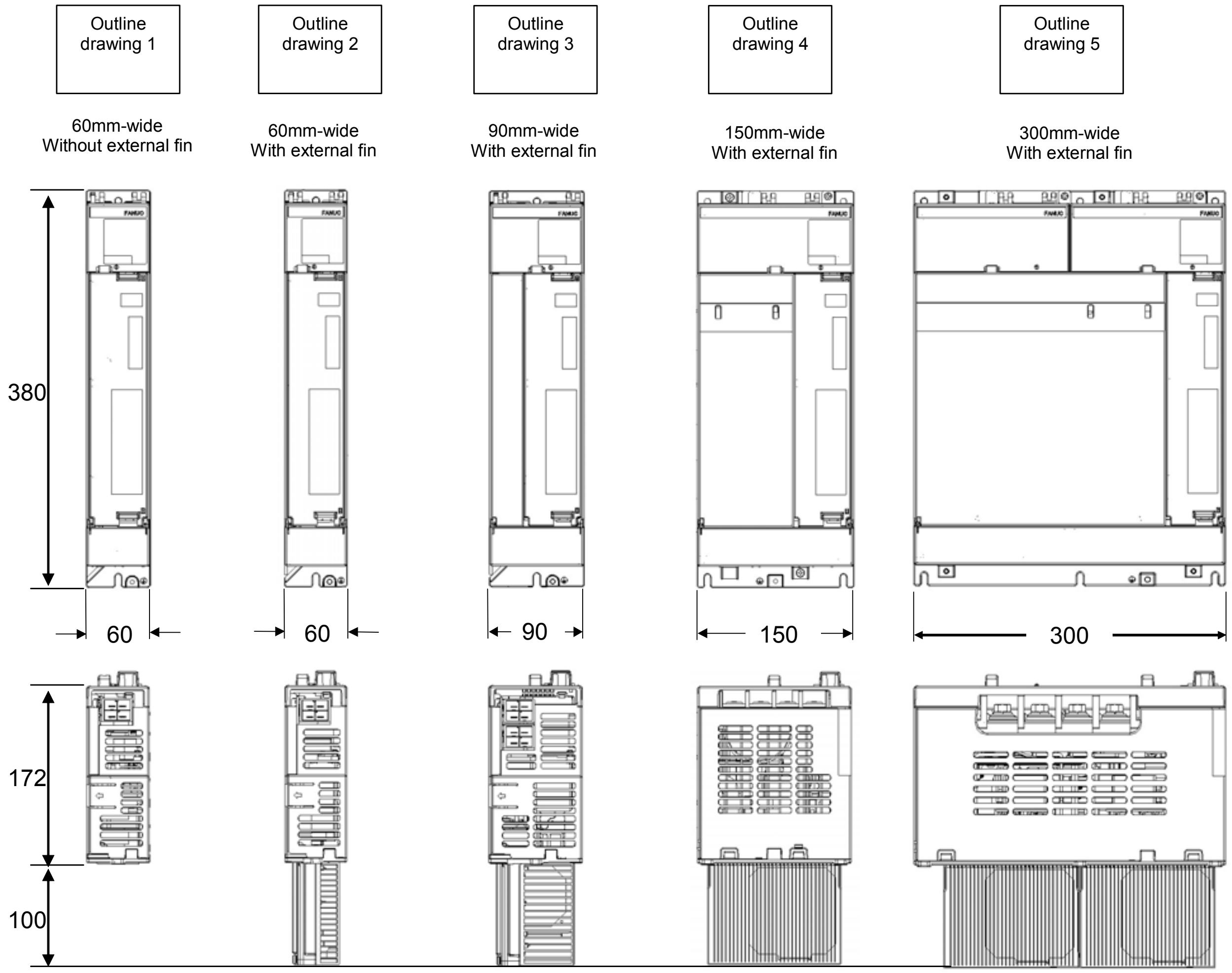
Model		Outline drawing	Panel cut-out	Maintenance area	Internal fan	External fan
200 V input series	α*i*SP 2.2-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided (Not provided)	-
	α*i*SP 5.5-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided (Not provided)	Provided
	α*i*SP 11-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*SP 15-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*SP 22-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 26-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 30-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 37-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 45-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	α*i*SP 55-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
400 V input series	α*i*SP 5.5HV-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided (Not provided)	Provided
	α*i*SP 11HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided (Not provided)	Provided
	α*i*SP 15HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided (Not provided)	Provided
	α*i*SP 22HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 30HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 45HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 60HV-B	Outline drawing 4	Panel cut-out 4	Maintenance area 3	Provided	Provided
	α*i*SP 75HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	α*i*SP 100HV-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided
	α*i*SP 100HV(SiC)-B	Outline drawing 5	Panel cut-out 5	Maintenance area 4	Provided	Provided

*1: The specification in parentheses applies to the Level-up α*i*SP-B series.

(4) α*i*SVP-B series

Model		Outline drawing	Panel cut-out	Maintenance area	Internal fan	External fan
200 V input series	α*i*SVP 20/20/20-5.5-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided
	α*i*SVP 20/20/20-2.2-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
	α*i*SVP 40/40/40-2.2-B	Outline drawing 2	Panel cut-out 2	Maintenance area 1	Provided	Provided
400 V input series	α*i*SVP 10/10/10-5.5HV-B	Outline drawing 3	Panel cut-out 3	Maintenance area 2	Provided	Provided

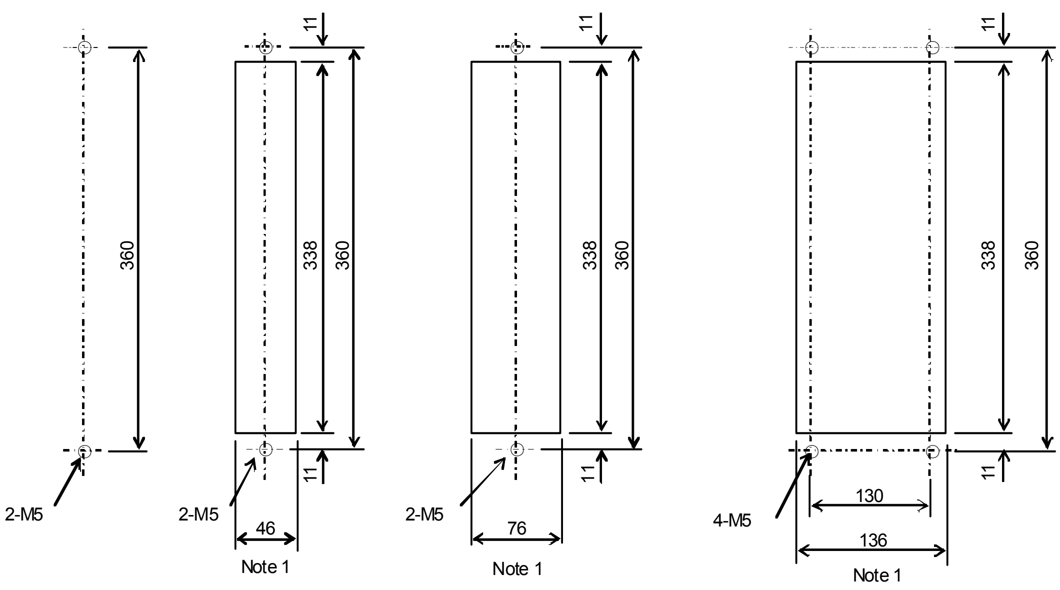
(5) αi -B amplifiers (αi PS-B, αi SV-B, αi SP-B, αi SVP-B)



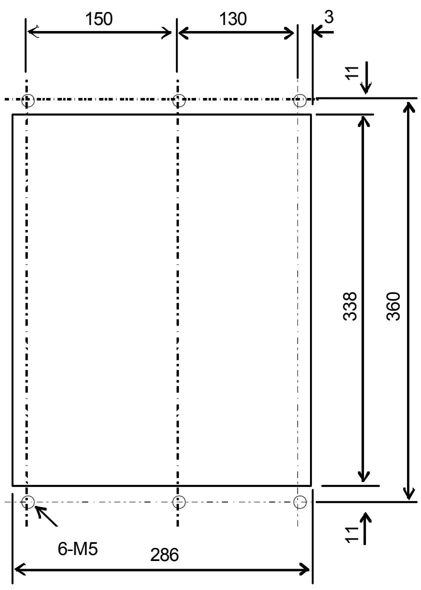
(6) Panel cut-out drawings

Panel cut-out drawings are shown below.
For details, see Section 8.2.

Panel cut-out 1 Panel cut-out 2 Panel cut-out 3 Panel cut-out 4



Panel cut-out 5



NOTE

1 The dimensional tolerance of each panel cut-out in the amplifier width direction is as follows:
   - Panel cut-out 2: 46 (-0, +0.5) mm
   - Panel cut-out 3: 76 (-0, +0.5) mm
   - Panel cut-out 4: 136 (-0, +0.5) mm
   - Panel cut-out 5: 286 (-0, +0.5) mm

2 When the size of a created panel cut-out in the amplifier width direction is smaller than the size indicated in the specifications (for example, 46 mm for panel cut-out 2), it may be felt hard to attach and remove the amplifier depending on the dimensional tolerance in the size of the amplifier.

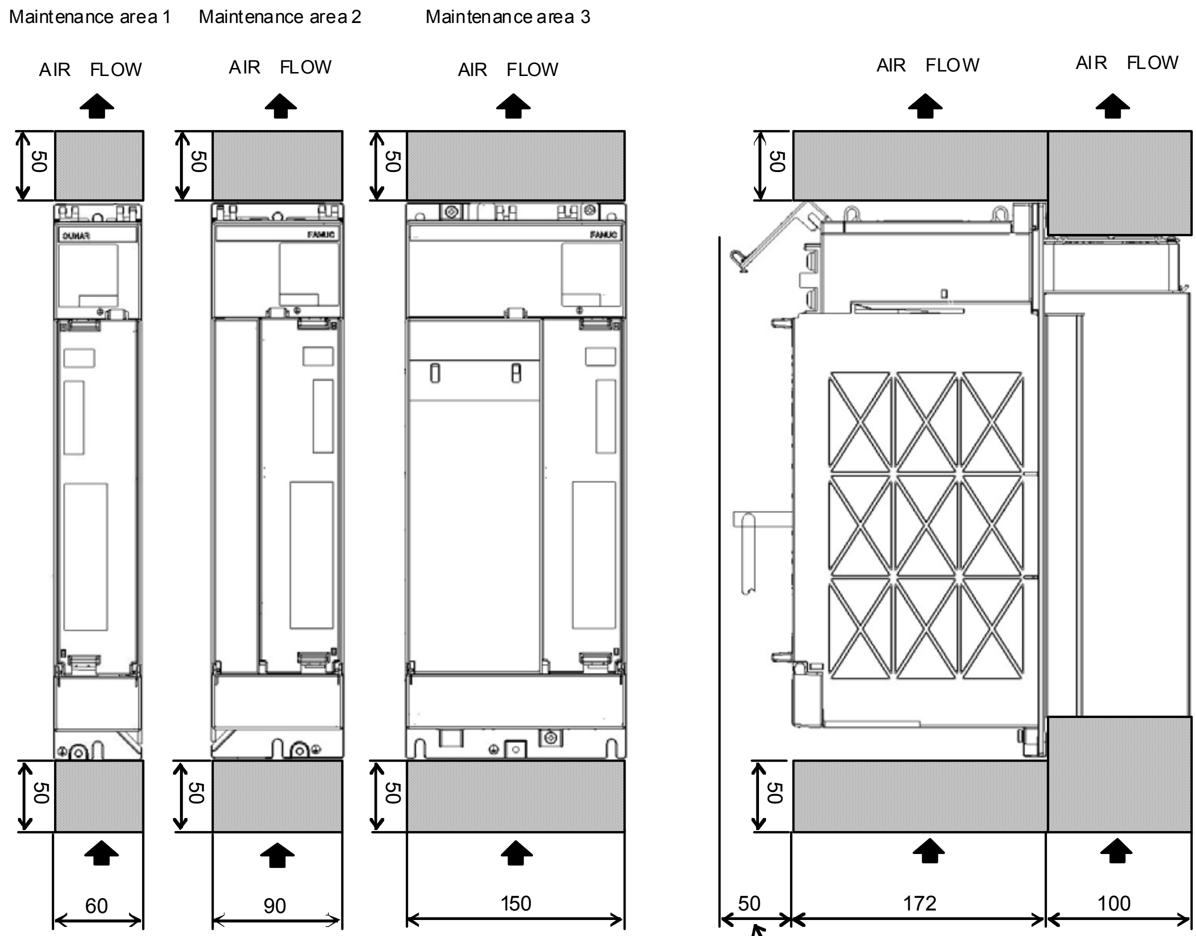
3 For panel cut-outs 2, 3, 4, and 5, attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust. For information about how to attach the packing, see Section 5.7.

4 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.

(7) Maintenance area drawings

An amplifier contains an internal cooling fan motor. To allow air to flow and make it easy to replace a fan unit, be sure to allocate the shaded areas shown in the figure below.

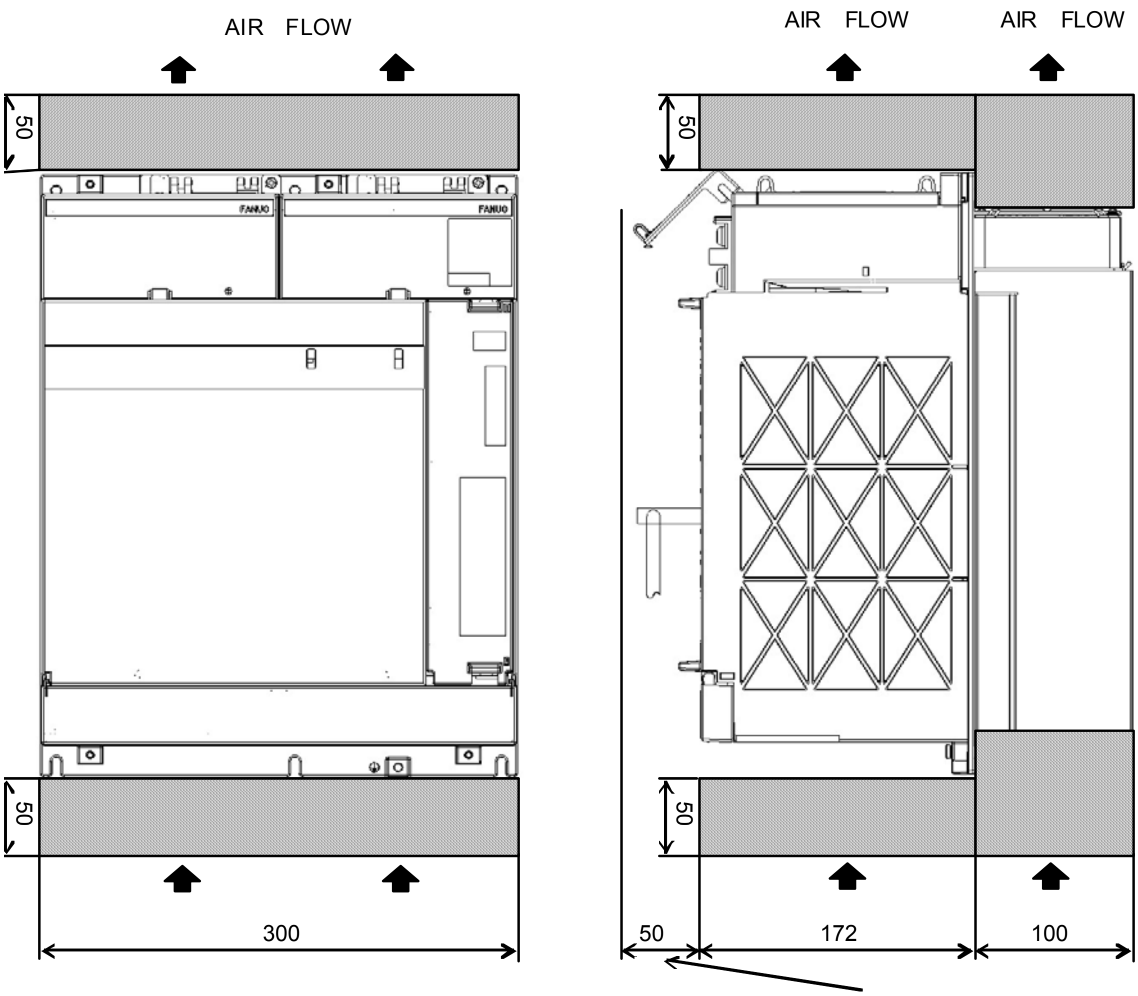
Allocate at least 50 mm of the maintenance area above the amplifier as shown in the figure. To improve the workability to maintain a fan motor, it is desirable to allocate an area of at least 80 mm.



For the αi series, you can pull out the internal cooling fan from the top of the amplifier. In addition, the cooling fan of the external heat radiator can be pulled out toward the front of the amplifier.

(Note) Add 30 mm when using the conventional connector instead of side cable type connector.

Maintenance area 4

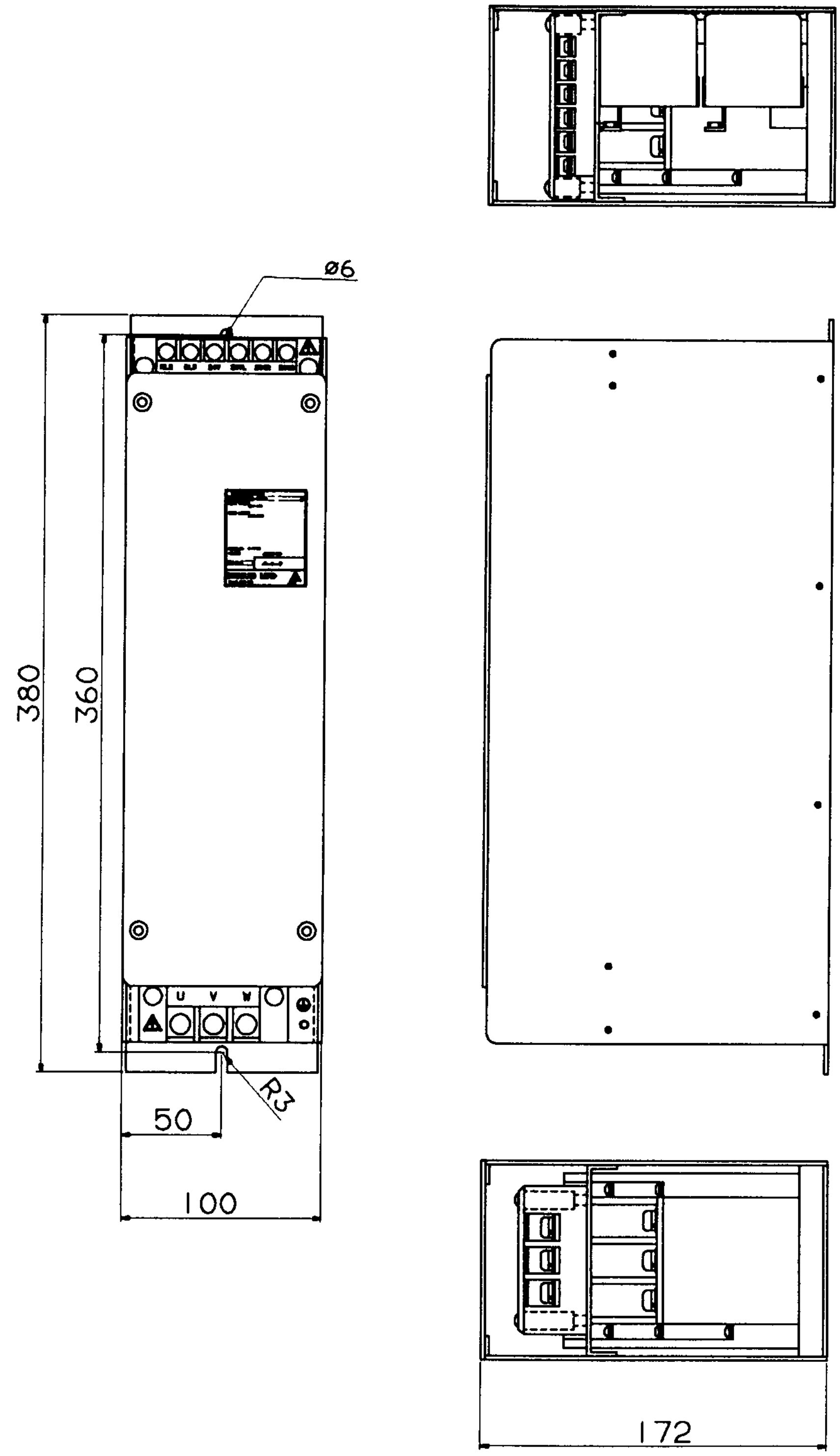


For the αi series, you can pull out the internal cooling fan from the top of the amplifier.
In addition, the cooling fan of the external heat radiator can be pulled out toward the front of the amplifier.

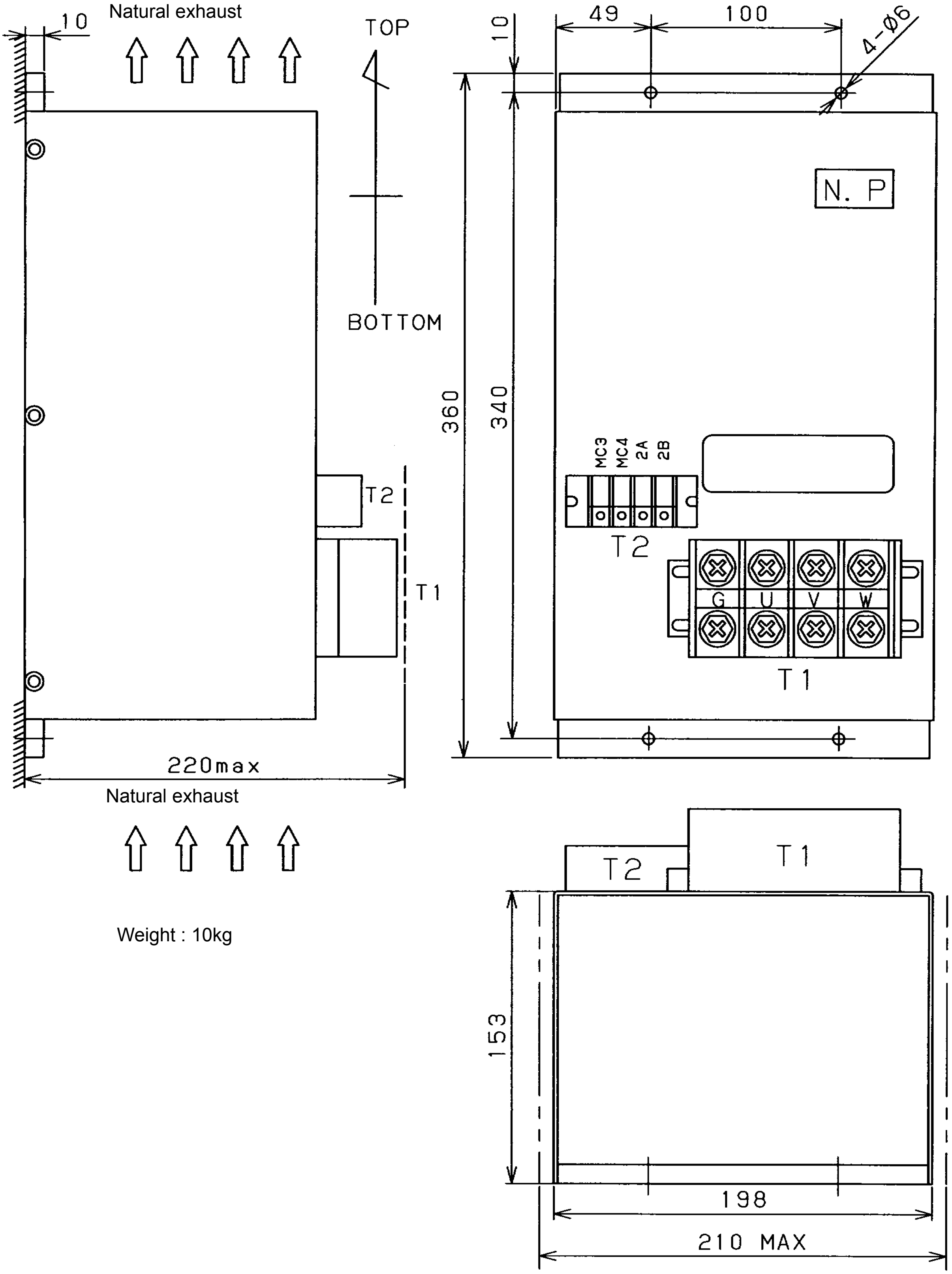
(Note) Add 30 mm when using the conventional connector instead of side cable type connector.

8.1.2 Dynamic Brake Module (DBM)

(For the panel cut-out drawing, see Fig. 8.2 (e).)
(a) A06B-6079-H401, H403



(b) A06B-6069-H300, H301

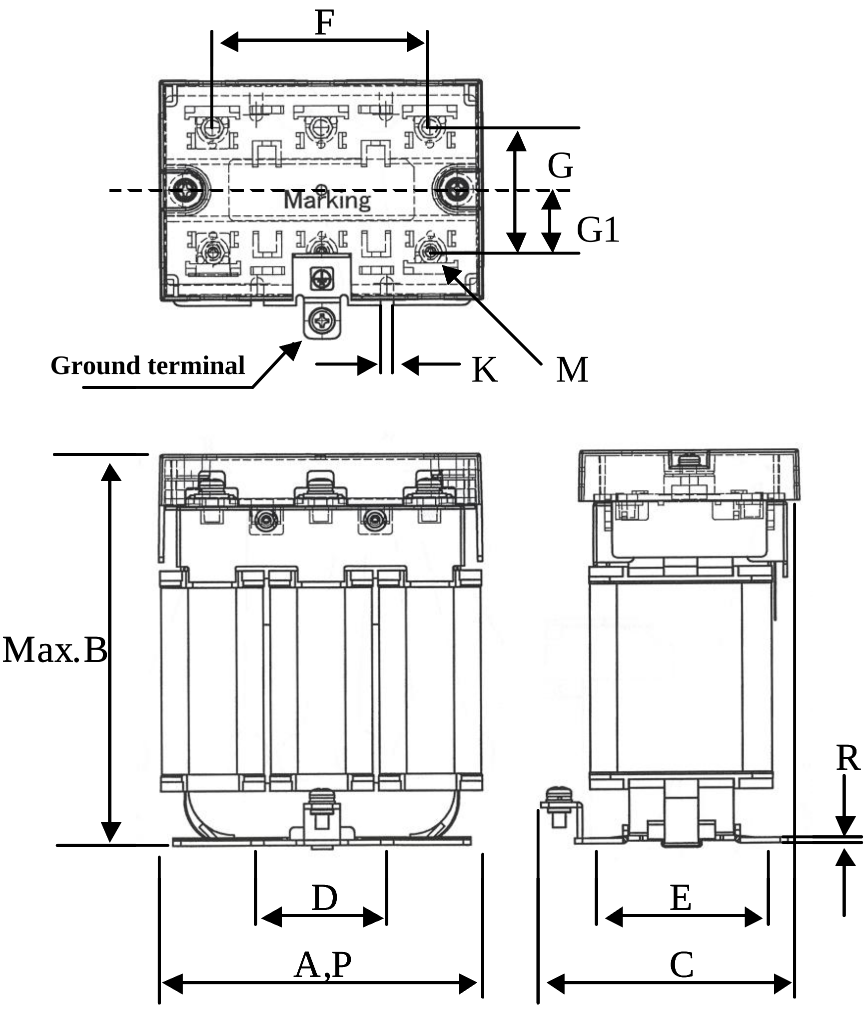


Weight : 10kg

8.1.3 AC Reactor Unit

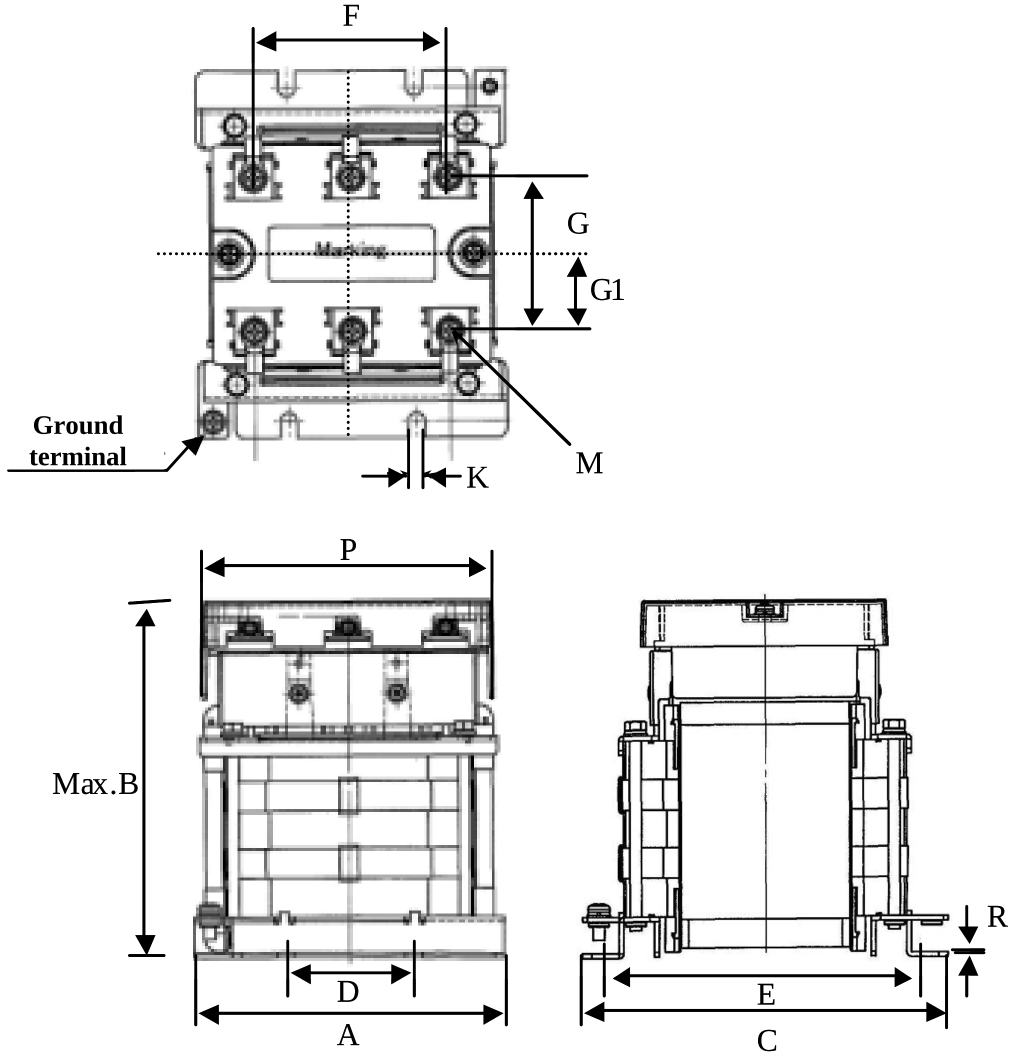
8.1.3.1 Outline drawing

(1) A81L-0001-0199, A81L-0001-0184, A81L-0001-0185



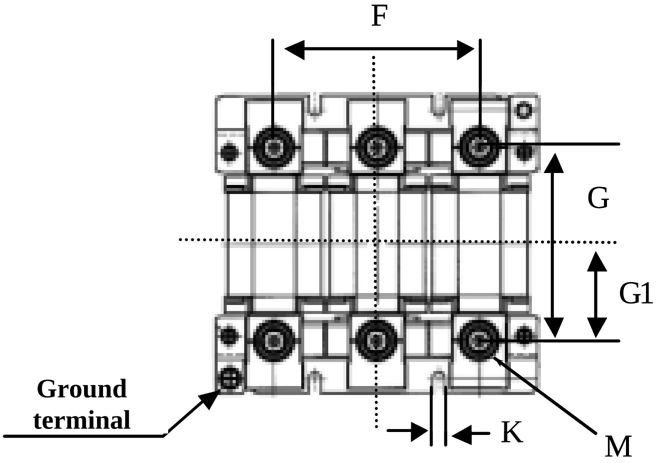
Reactor	A	B	C	D	E	F	G	G1	K	P	R	M	Ground terminal
A81L-0001-0199	135	155	103	50	65	84	48	24	5	135	2	M5(+)	M5
A81L-0001-0184	135	155	103	50	65	84	48	24	5	135	2	M5(+)	M5
A81L-0001-0185	135	155	132	42	95	84	66	33	7.2	135	2	M5(+)	M5

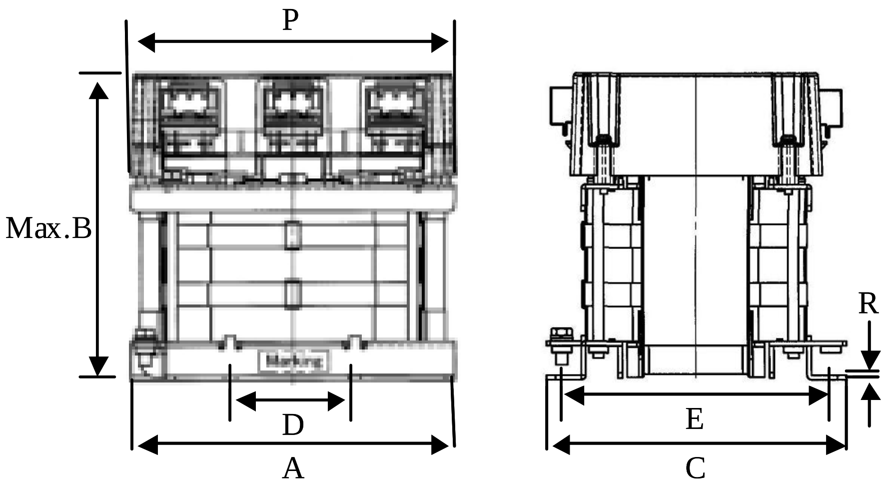
(2) A81L-0001-0186, A81L-0001-0187, A81L-0001-0190



Reactor	A	B	C	D	E	F	G	G1	K	P	R	M	Ground terminal
A81L-0001-0186	135	155	165	55	145	84	66	33	7.2	135	2	M5(+)	M5
A81L-0001-0187	135	155	165	55	145	84	66	33	7.2	135	2	M5(+)	M5
A81L-0001-0190	135	155	165	55	145	84	66	33	7.2	135	2	M5(+)	M5

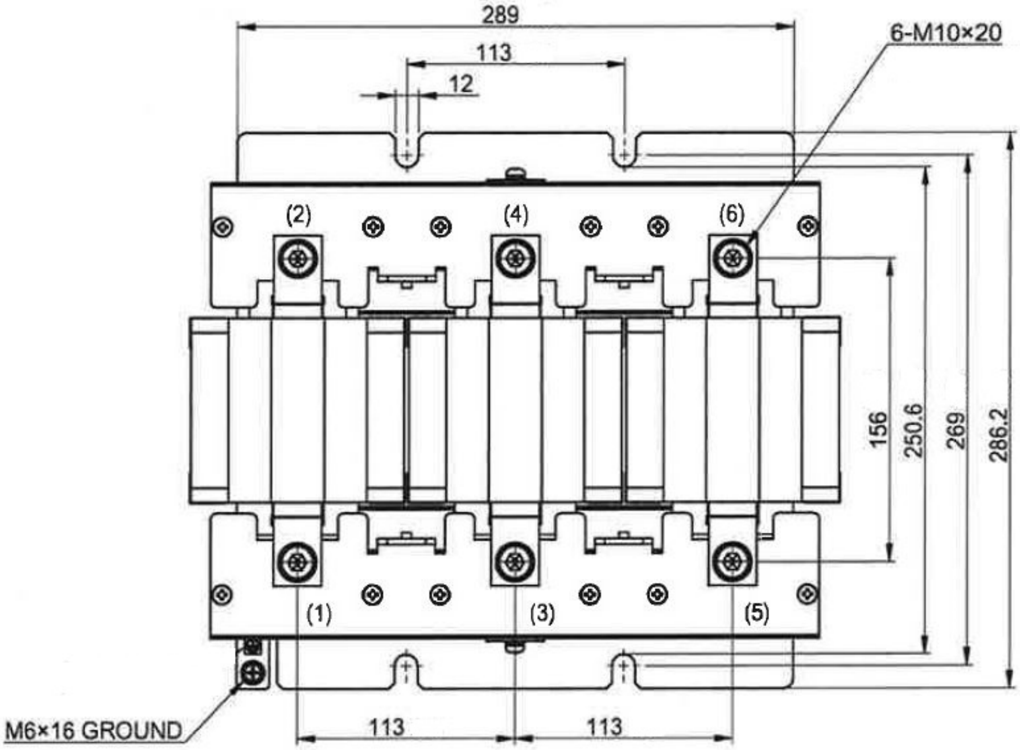
(3) A81L-0001-0188, A81L-0001-0189, A81L-0001-0191, A81L-0001-0192, A81L-0001-0193, A81L-0001-0194

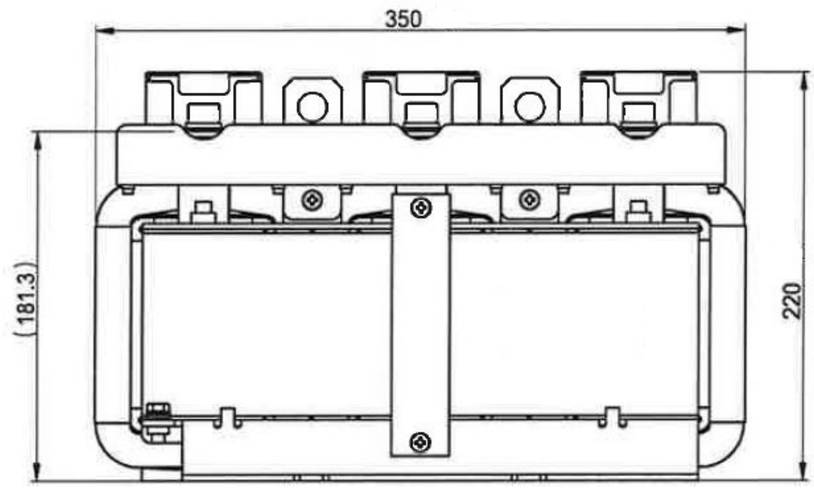




Reactor	A	B	C	D	E	F	G	G1	K	P	R	M	Ground terminal
A81L-0001-0188	185	147	175	70	154	116	106	53	7	185	2.5	M8	M6
A81L-0001-0189	185	172	175	70	154	116	106	53	7	185	2.5	M8	M6
A81L-0001-0191	185	177	175	70	154	116	106	53	7	185	2.5	M8	M6
A81L-0001-0192	248	200	238	105	216	155	151	75.5	7	248	2.5	M10	M6
A81L-0001-0193	248	205	238	105	216	155	151	75.5	7	248	2.5	M10	M6
A81L-0001-0194	248	205	238	105	216	155	151	75.5	7	248	2.5	M10	M6

(4) A81L-0001-0216



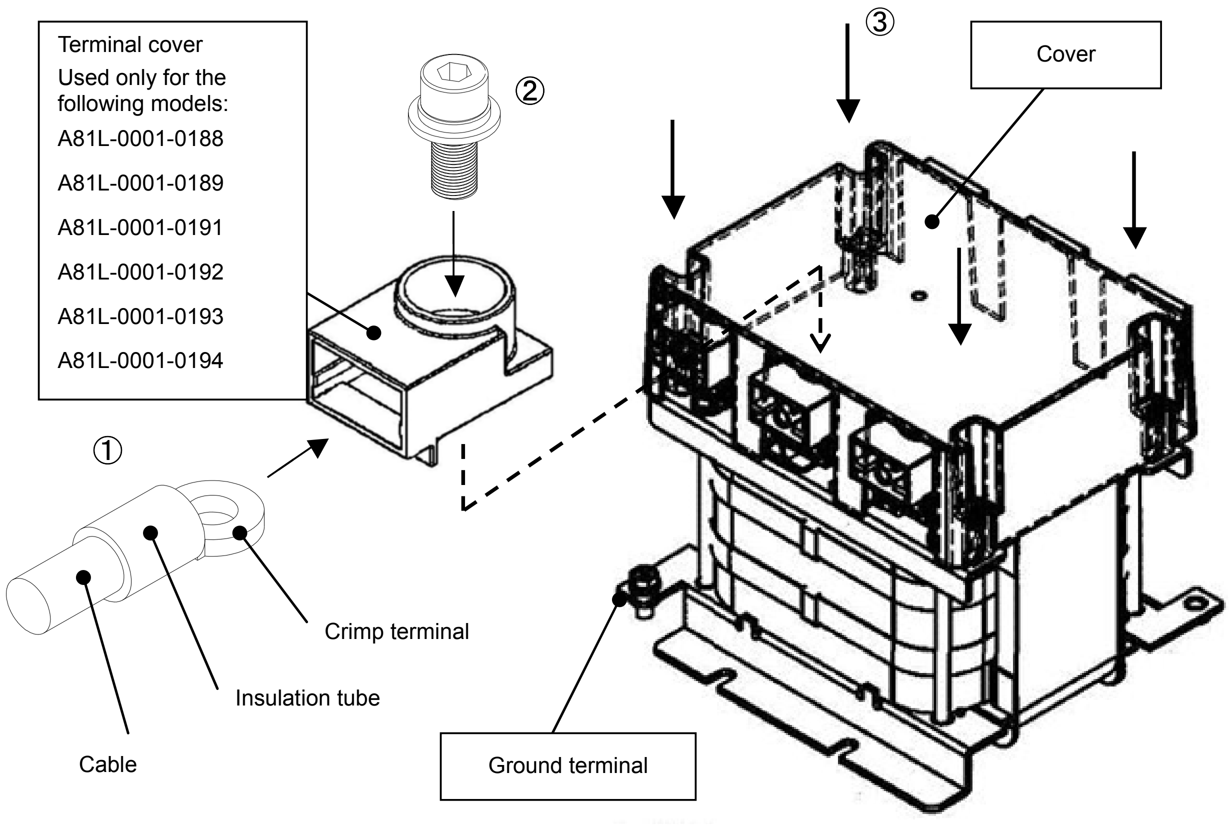


8.1.3.2 Terminal connection

Procedures for wire connection and cover attachment vary from AC reactor to AC reactor.
Be sure to connect the grounding cable to the dedicated ground terminal.

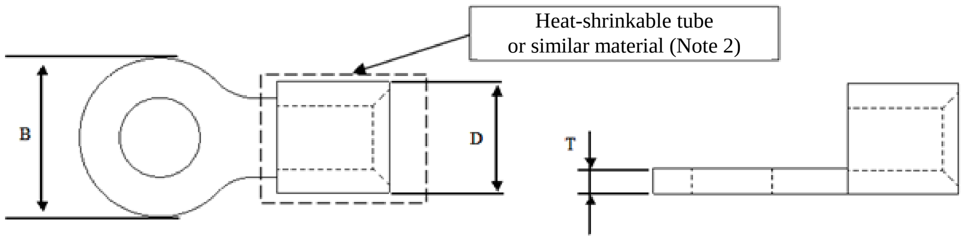
(1) A81L-0001-0184, 0185, 0186, 0187, 0190, 0199
Step 1) Screw cover #1.

(2) A81L-0001-0188, 0189, 0191, 0192, 0193, 0194
Step 1) Insert the cable equipped with a crimp terminal in the terminal cover.
Step 2) Screw the terminal cover onto the AC reactor.
Step 3) Screw cover #1.



8.1.3.3 Crimp terminals

The following table lists the maximum dimensions of available crimp terminal configuration.



For 200 V input power supplies

Ordering number	B max. [mm]	D max. (Note 3) [mm]	T max. [mm]	Terminal screw	Recommended crimp terminal (Note 4)
A81L-0001-0184	19	10	2	M5	R8
A81L-0001-0185	19	12.5	2	M5	R22
A81L-0001-0186	19	16	2	M5	R38
A81L-0001-0187	19	16	2	M5	R38
A81L-0001-0188	28	17	3	M8	R60
A81L-0001-0189	28	26	3	M8	R80

For 400 V input power supplies

Ordering number	B max. [mm]	D max. (Note 3) [mm]	T max. [mm]	Terminal screw	Recommended crimp terminal (Note 4)
A81L-0001-0190	19	10	2	M5	R8
A81L-0001-0191	28	15	3	M8	R22, R38
A81L-0001-0192	25	21	3	M10	R22, R38, R60, R70
A81L-0001-0193	25	21	3	M10	R22, R38, R60, R70
A81L-0001-0194	29.5	26.5	3	M10	R80, R100
A81L-0001-0216	29.5	26.5	3	M10	R80, R100

NOTE

1. When selecting a crimp terminal, pay attention to the maximum dimensions of crimp terminal configuration to avoid interference of the selected crimp terminal with the reactor cover or the terminal cover.
2. Insulate the part in which a cable is crimped with a heat-shrinkable tube or a similar material.
3. D indicates the dimension after a cable is crimped.
4. Depending on the crimp terminal type, the connection may be unable to meet IP2X. Check that the actual crimp terminal meets IP2X.
   We have confirmed that crimp terminals from the following manufacturers meet IP2X.
   Crimp terminal manufacturers: J.S.T. Mfg. Co., Ltd., Daido Solderless Terminal Mfg. Co., Ltd.

8.1.3.4 Finger protection

AC reactors support finger protection IP2x, which is a level of protection against contact with the conductive part, and meet the following standards.

Standard	Remarks
IEC60529	The IEC60529 standard stipulates levels of protection against contact.
IEC61800-5-1	The IEC61800-5-1 standard relates to the provisions of the Low Voltage Directive that are applicable to motor drives. This standard assumes that power may be turned ON while the control board protection door, inside of which equipment is placed, is open and requires that the level of IP protection for a conductive part should be clarified as a safety measure to be taken during the setup and maintenance of equipment.
UL508C	The UL508C standard relates to motor drives.

Whereas current versions of AC reactors support IP2x (finger protection), earlier versions of AC reactors support IP1x (hand protection). The following table shows correspondence between earlier versions and current versions of AC reactors. For information about major changes, see the following notes.

For 200 V input

Power Supply	Earlier version (supports IP1x)	Current version (supports IP2x)
α*i* PS3-B	-	A81L-0001-0199
α*i* PS7.5-B	A81L-0001-0155	A81L-0001-0184 (Note 1)
α*i* PS11-B	A81L-0001-0155	A81L-0001-0184 (Note 1)
α*i* PS15-B	A81L-0001-0156	A81L-0001-0185
α*i* PS26-B	A81L-0001-0157	A81L-0001-0186
α*i* PS30-B	A81L-0001-0158	A81L-0001-0187
α*i* PS37-B	A81L-0001-0159	A81L-0001-0188 (Note 2) (Note 3)
α*i* PS55-B	A81L-0001-0160	A81L-0001-0189 (Note 2) (Note 3)

For 400 V input

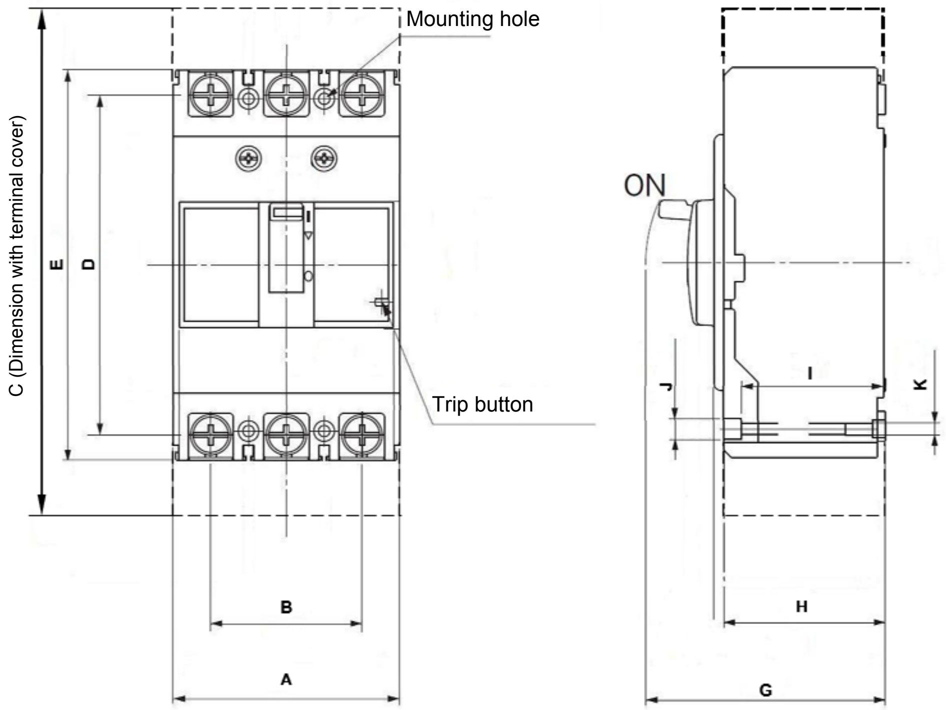
Power Supply	Earlier version (supports IP1x)	Current version (supports IP2x)
α*i* PS11HV-B, α*i* PS18HV-B	A81L-0001-0163	A81L-0001-0190
α*i* PS30HV-B, α*i* PS45HV-B	A81L-0001-0164	A81L-0001-0191 (Note 3)
α*i* PS60HV-B	A81L-0001-0179	A81L-0001-0192 (Note 3)
α*i* PS75HV-B	A81L-0001-0165	A81L-0001-0193 (Note 3)
α*i* PS100HV-B	A81L-0001-0165	A81L-0001-0194 (Note 3)
α*i* PS125HV-B	-	A81L-0001-0216

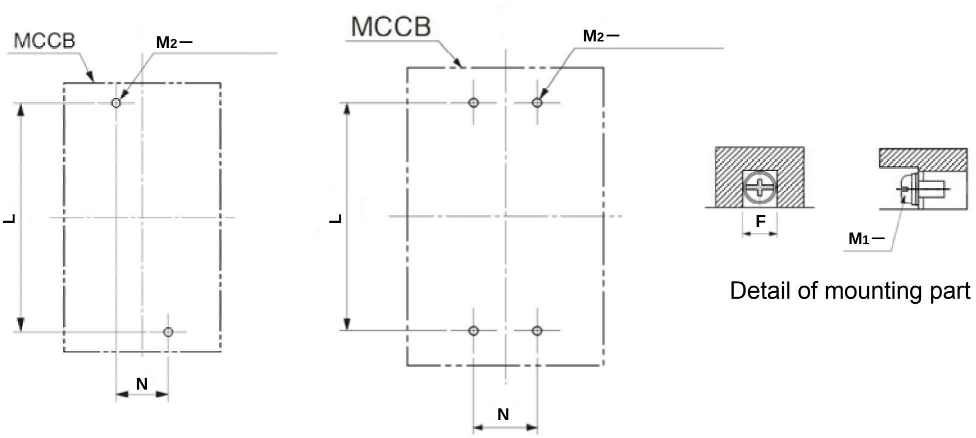
NOTE

1 Due to the addition of the dedicated ground terminal, the external dimensions differ from those of the earlier version.
2 The external dimensions and the positions of mounting holes differ from those of the earlier version.
3 The terminal cover has been added to fill the gap between the conductive part and the cover.
4 General
  - Dedicated ground terminals have been added.
  - Screw positions of the main and ground terminals slightly differ from those of earlier versions.
  - Securing screws have been added to the covers to prevent the conductive parts from being accidentally touched.
  - Small-diameter openings have been added to the covers to facilitate the checking of power supply voltage.

8.1.4 Circuit Breaker

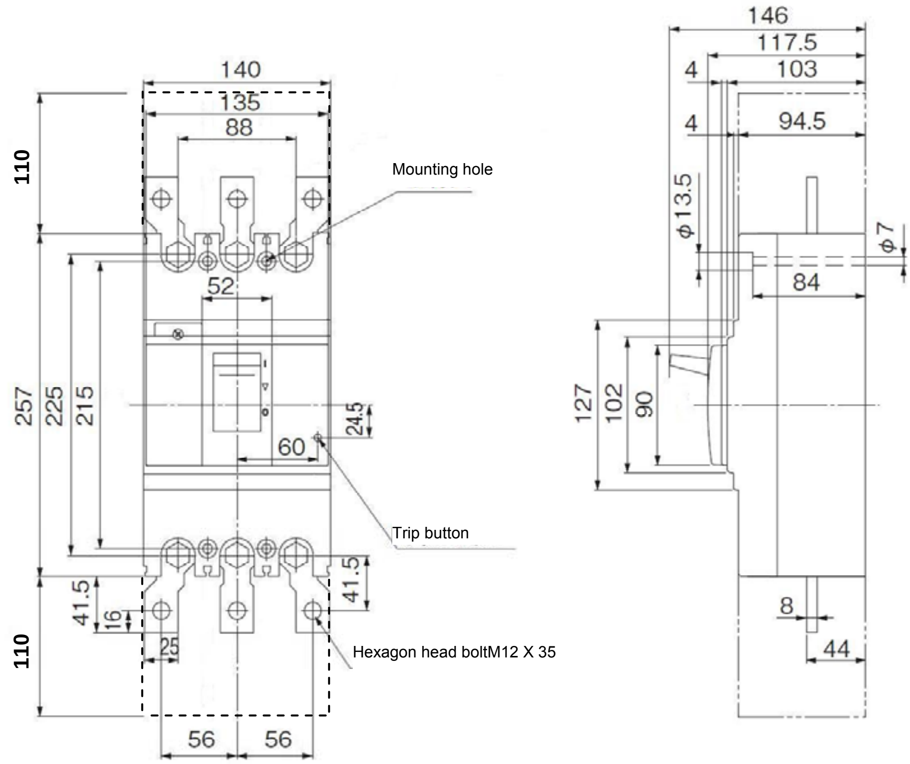
	Ordering drawing number	A	B	C	D	E	M1-	F	G	H	I	J	K	L	M2-	N	Mounting
(a)	A06B-6077-K101	75	50	180	82	100	M5	17	84	51	43	ϕ7.8	ϕ4.9	84	M4	25	2 positions
(b)	A06B-6077-K106																
(c)	A06B-6077-K102	75	50	180	82	100	M8	17	84	51	43	ϕ7.8	ϕ4.9	84	M4	25	2 positions
(d)	A06B-6077-K103																
(e)	A06B-6077-K104																
(f)	A06B-6077-K108	105	70	265	144	165	M8	25.5	95	64	57	ϕ8.2	ϕ4.5	126	M4	35	4 positions
(g)	A06B-6077-K105																
(h)	A06B-6077-K110																
(i)	A06B-6077-K109																

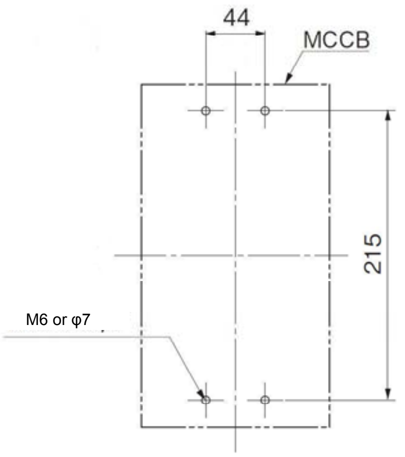




Detail of mounting part

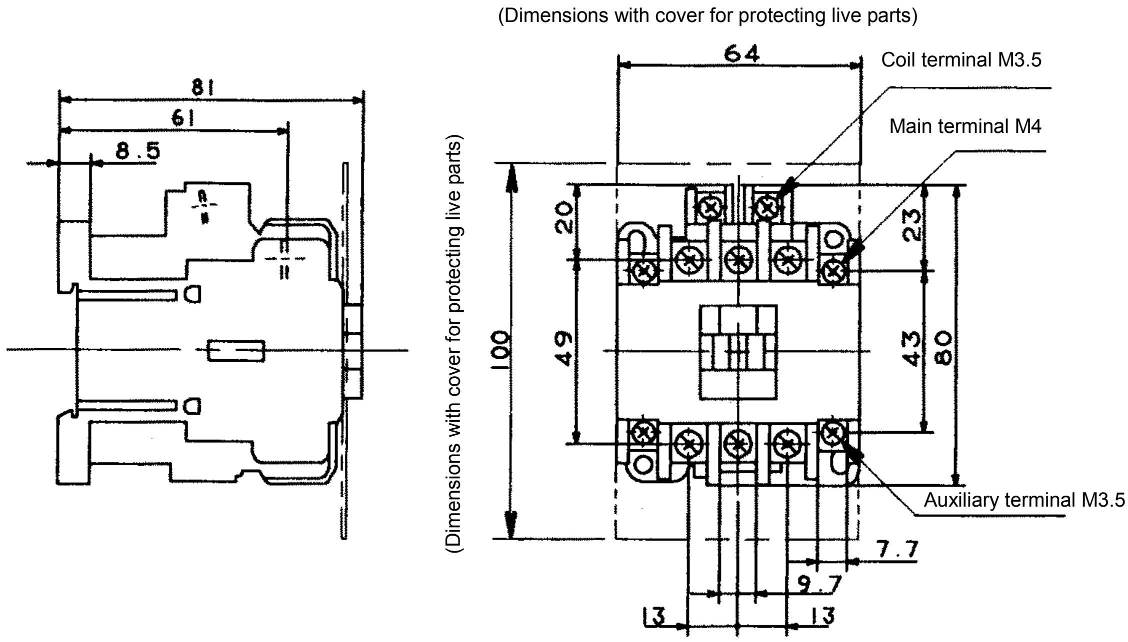
(J) A06B-6077-K111, A06B-6077-K112



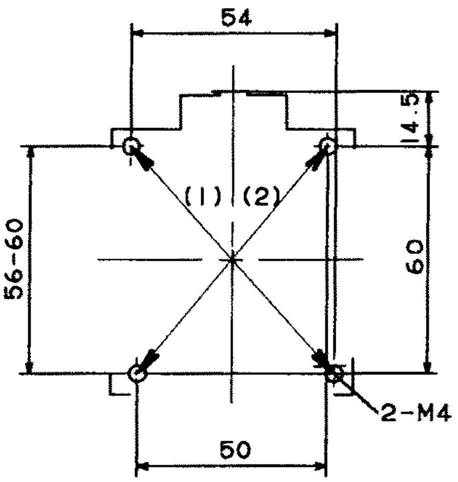


8.1.5 Magnetic Contactors

(a) A06B-6077-K121

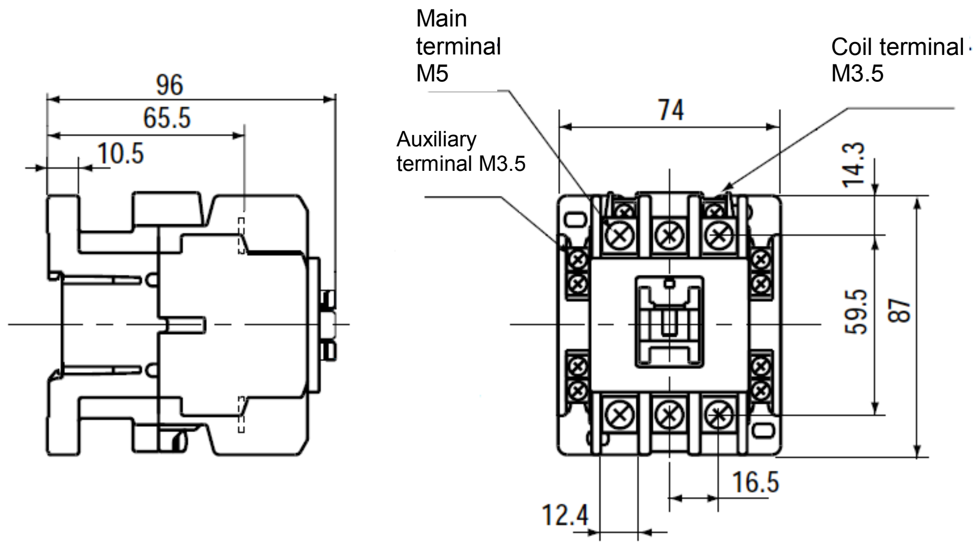


Dimensions for drilling mounting holes
Mounting (1) and (2) are possible.
(1) : 54X56-60
(2) : 50X60

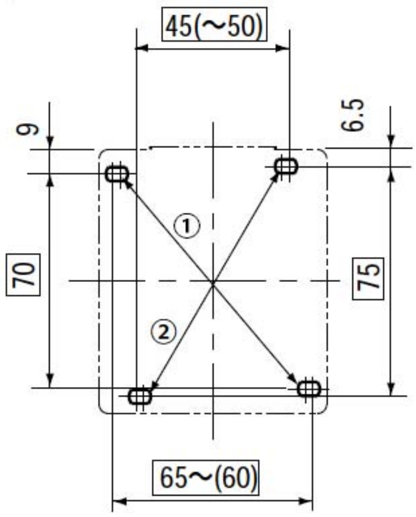


Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K121	SC-5-1	SZ-JC4	200V/50Hz 200-220V/60Hz	1a1b	0.38Kg

(b) A06B-6077-K122, A06B-6077-K123



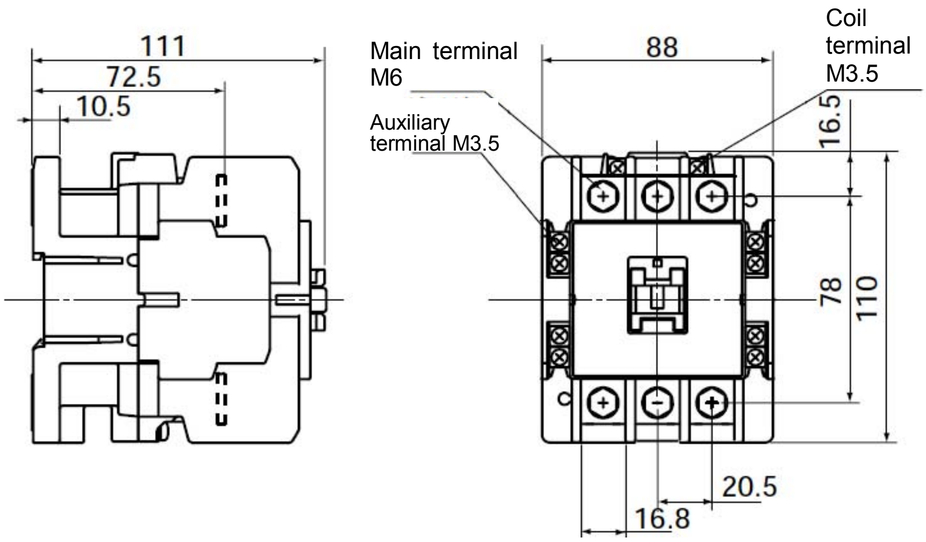
Dimensions for drilling mounting holes



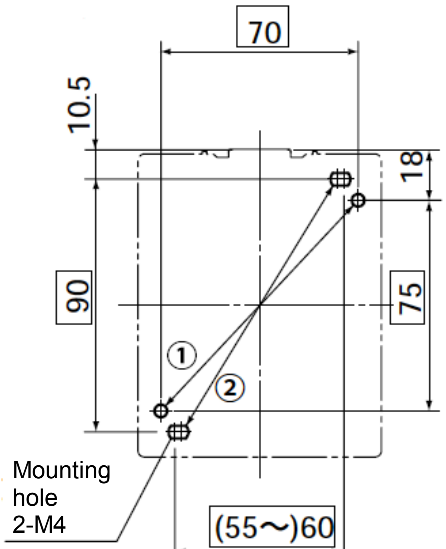
- Mounting dimensions: Holes <1> or <2> can be used for mounting.
  <1>: (60 to) 65 × 70 (compatible with SC-1N and SC-2N)
  <2>: 45 (to 50) × 75
- Mounting screw: 2-M4
  Install a screw at two mounting holes located diagonally.

Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K122	SC-N1	SZ-N1J	200V/50Hz	2a2b	0.59Kg
A06B-6077-K123	SC-N2	SZ-N1J	200-220V/60Hz		0.59Kg

(c) A06B-6077-K124



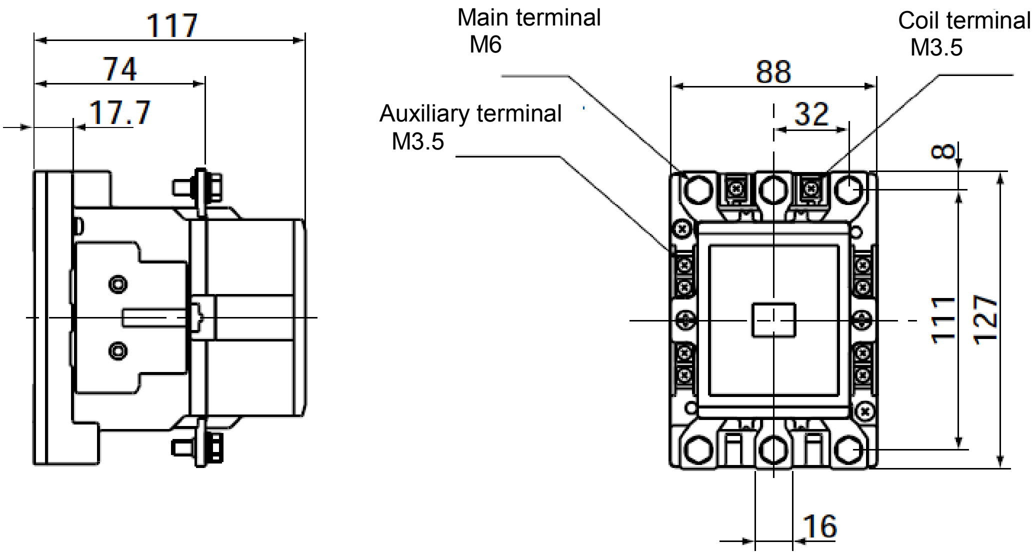
Dimensions for drilling mounting holes



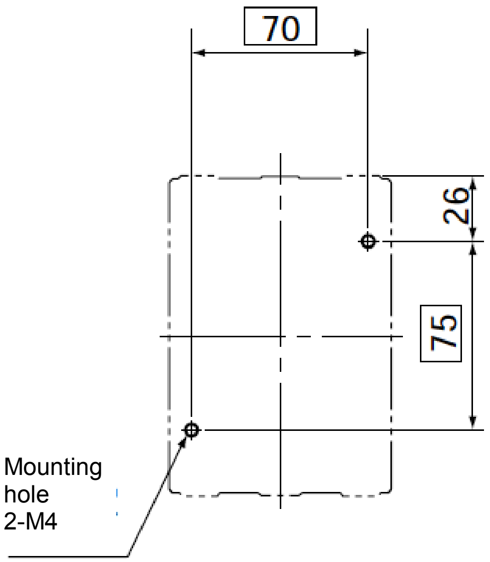
- Mounting dimensions: Holes <1> or <2> can be used for mounting.
  <1>: 70 × 75 (compatible with SC-1N and SC-2N)
  <2>: (55 to) 60 × 90
- Mounting screw: 2-M4
  Install a screw at two mounting holes located diagonally.

Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K124	SC-N2S	SZ-N2SJ	200V/50Hz 200-220V/60Hz	2a2b	1.1Kg

(d) A06B-6077-K125

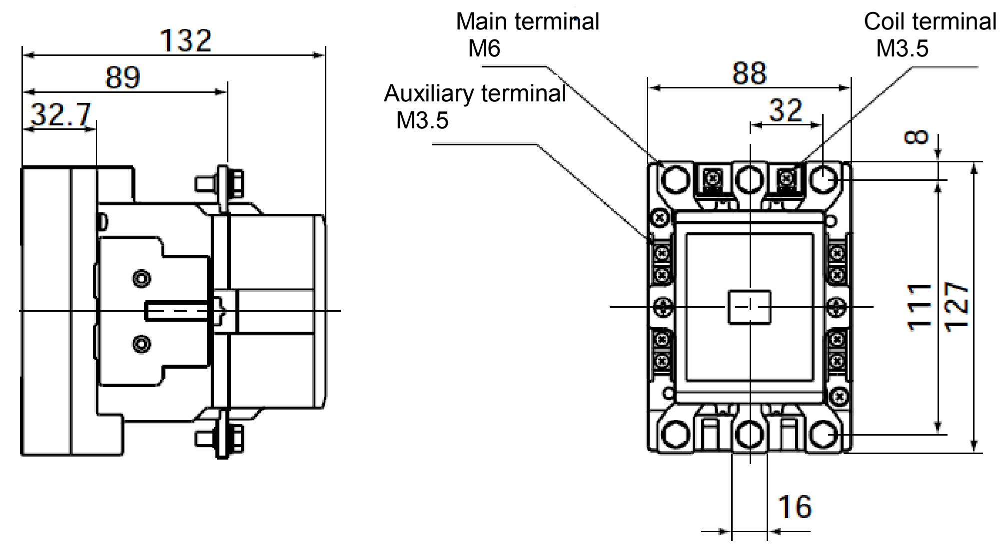


Dimensions for drilling mounting holes

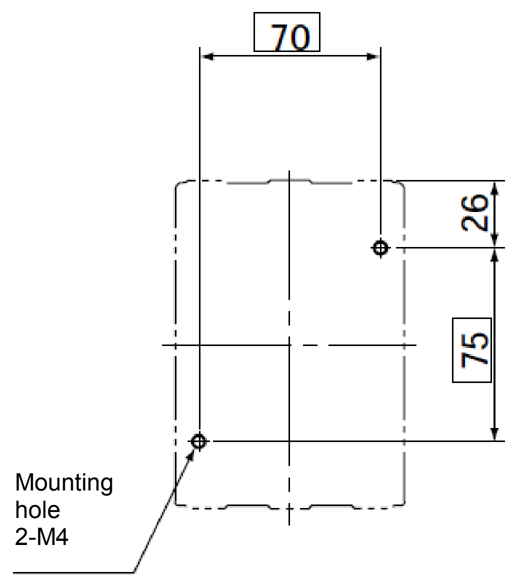


Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K125	SC-N4	SZ-N4J	200V/50Hz 200-220V/60Hz	2a2b	1.5Kg

(e) A06B-6077-K126

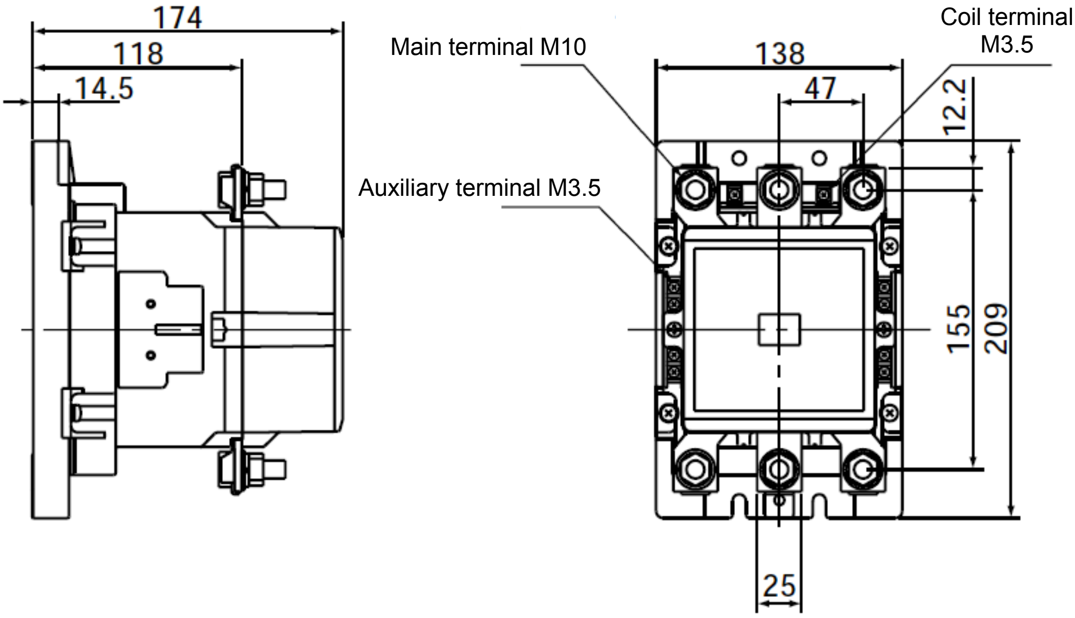


Dimensions for drilling mounting holes

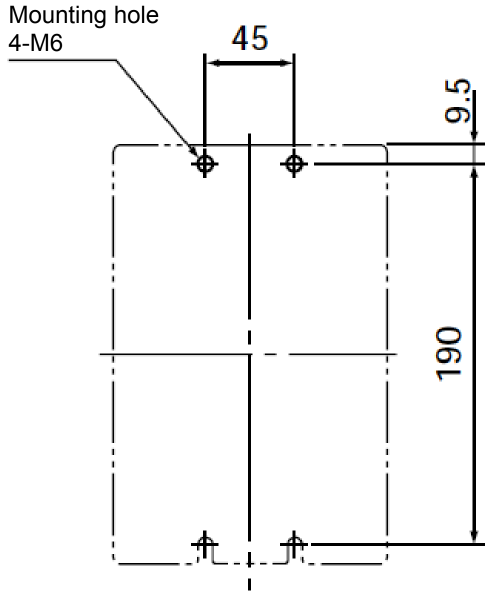


Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K126	SC-N5	SZ-N4J	200V/50Hz 200-220V/60Hz	2a2b	1.8Kg

(f) A06B-6077-K127

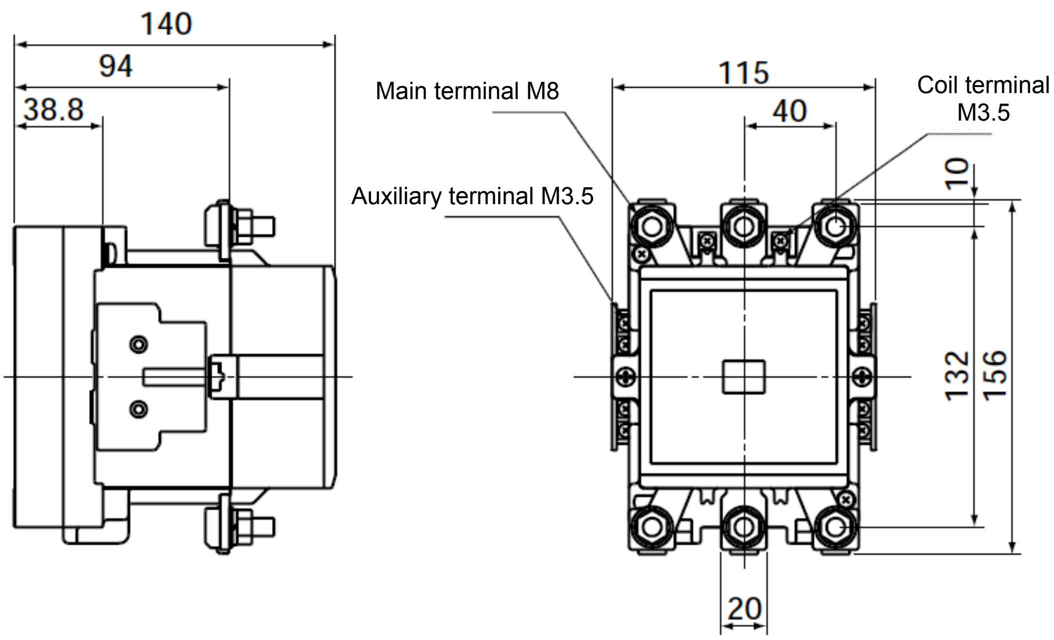


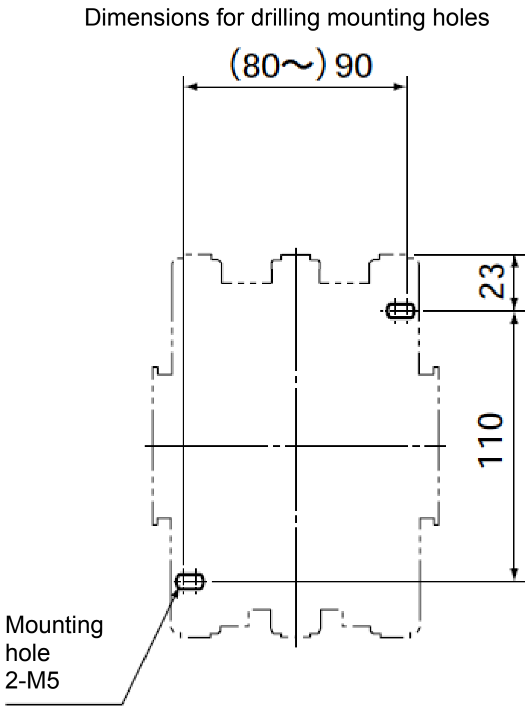
Dimensions for drilling mounting holes



Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K127	SC-N8	SZ-N8J	200V/50Hz 200-220V/60Hz	2a2b	4.9Kg

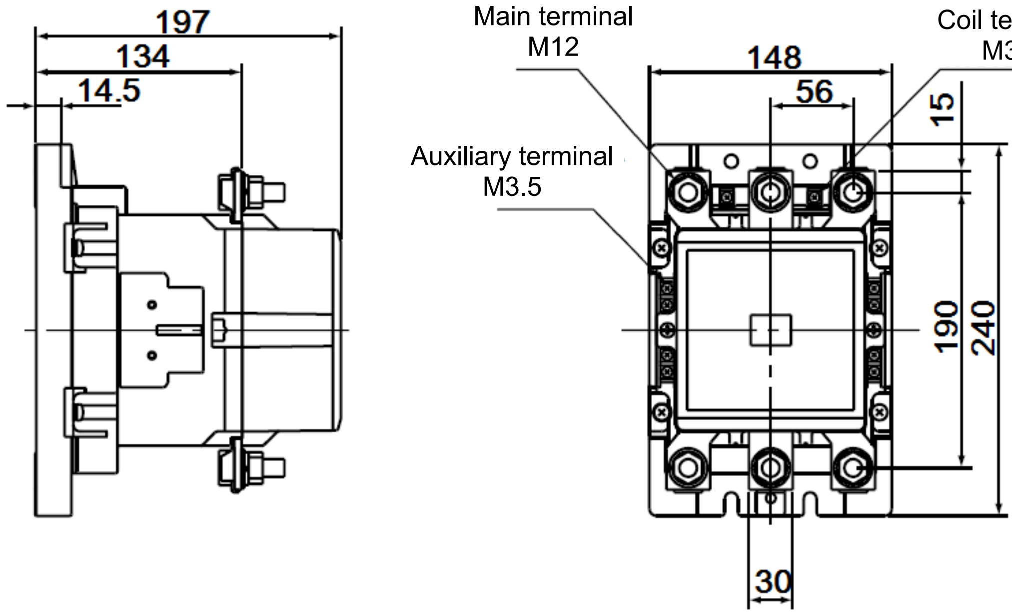
(g) A06B-6077-K128



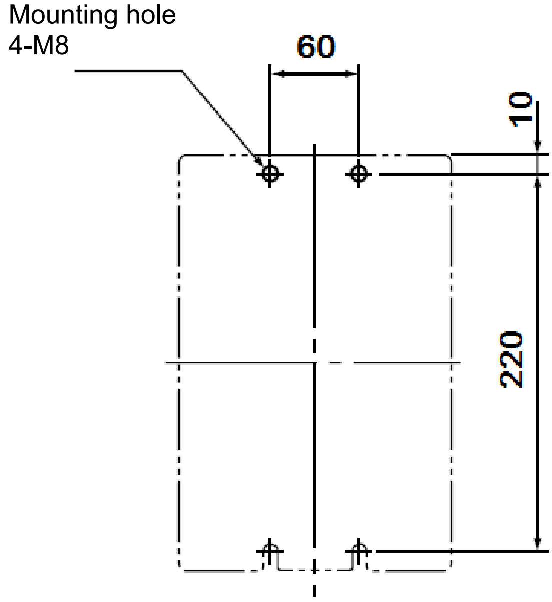


Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K128	SC-N7	SZ-N7J	200V/50Hz 200-220V/60Hz	2a2b	2.7Kg

(h) A06B-6077-K129



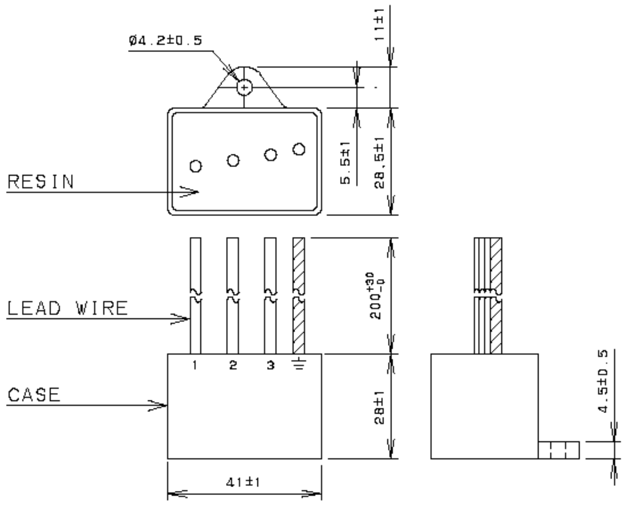
Dimensions for drilling mounting holes



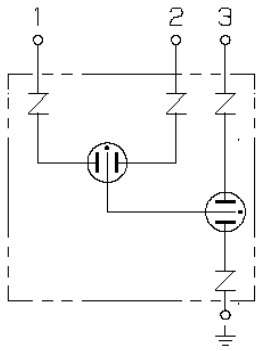
Ordering drawing number	Fuji Electric part number		Operation coil voltage	Auxiliary contact structure	Weight
	Body	Cover			
A06B-6077-K129	SC-N11	SZ-N11J	200V/50Hz 200-220V/60Hz	2a2b	7.8Kg

8.1.6 Lightning Surge Protector

(a) A06B-6200-K141, A06B-6200-K140



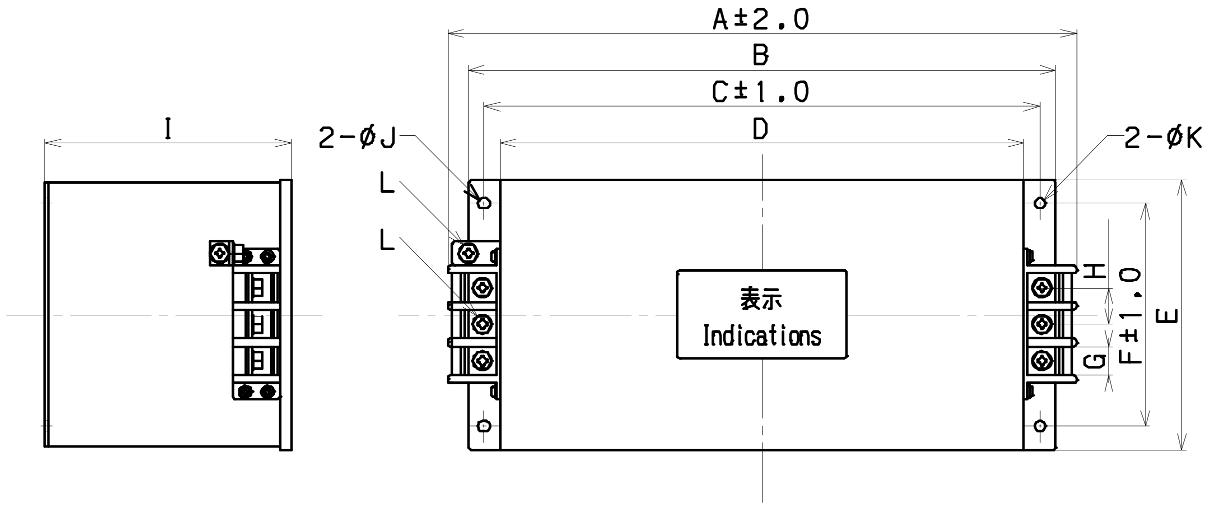
Connection diagram



Ordering number	Specification	Rated voltage
A06B-6200-K141	RSPD-250-U4	250VAC
A06B-6200-K140	RSPD-500-U4	500VAC

8.1.7 Noise Filter

(a) A06B-6077-K155 to -K158



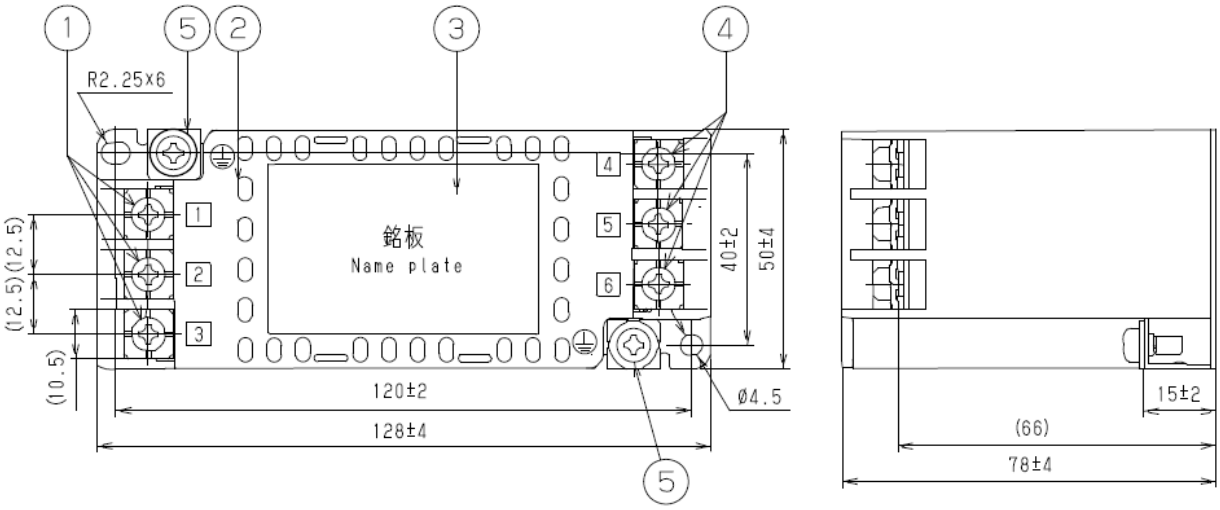
Unit : mm

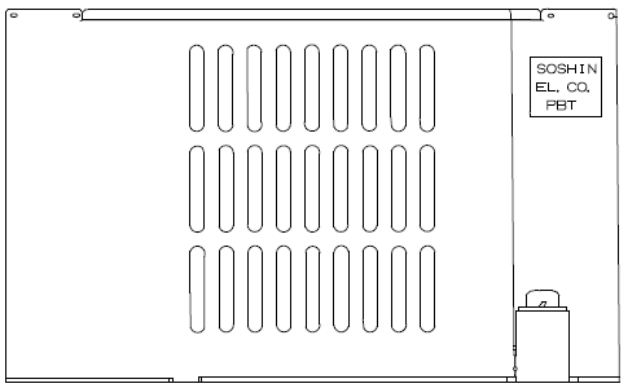
General tolerance : ±1.5mm

Type	Dimensions (mm)											
	A	B	C	D	E	F	G	H	I	J	K	L
A06B-6077-K155 (3SUP-HL30-ER-6)	246	230	215	200	100	85	13	18	140	4.5×7	4.5	M4
A06B-6077-K156 (3SUP-HL75-ER-6)	396	370	350	330	170	140	18	23	155	6.5×8	6.5	M6
A06B-6077-K157 (3SUP-HL150-ER-6)	484	440	420	400	200	170	30	25	200	6.5×8	6.5	M8
A06B-6077-K158 (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

(b) A06B-6200-K160



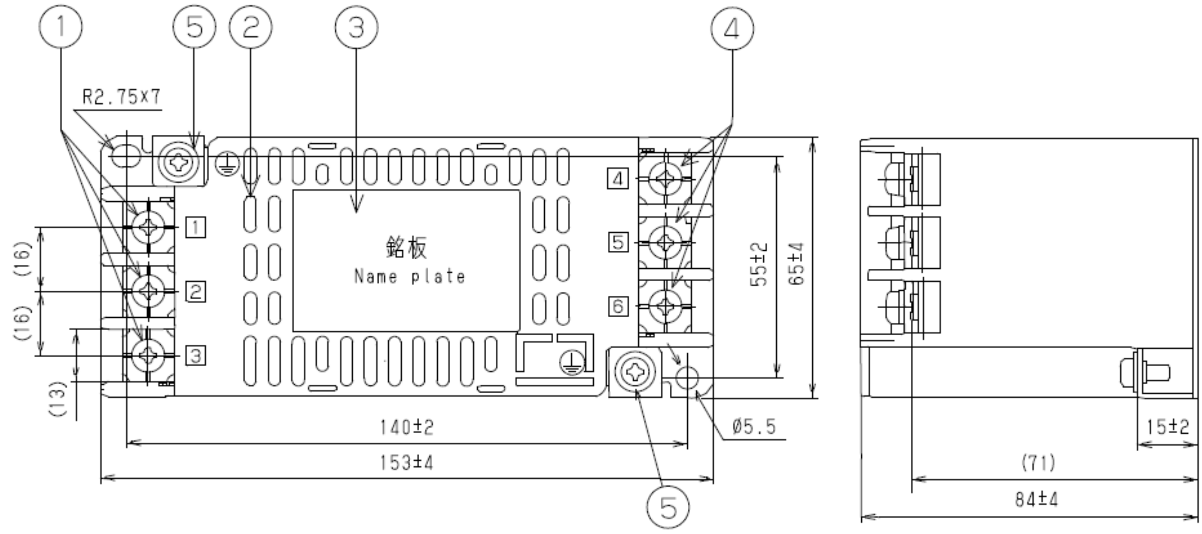


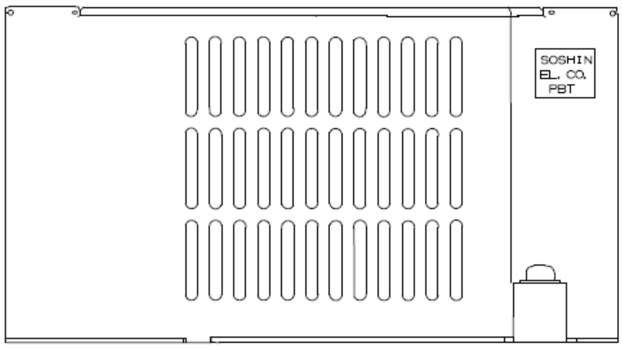
No	名称 Item	仕様 Specification
1	入力端子 Input terminal	M4
2	ケース Case	PBT
3	銘板 Name plate	
4	出力端子 Output terminal	M4
5	接地端子 Earthing terminal	M4

注）付属の端子ネジ以外のネジは使用しないで下さい
Note:Use only an attached screw.

NF3030C-SVB: External dimensions of noise filter

(c) A06B-6200-K161



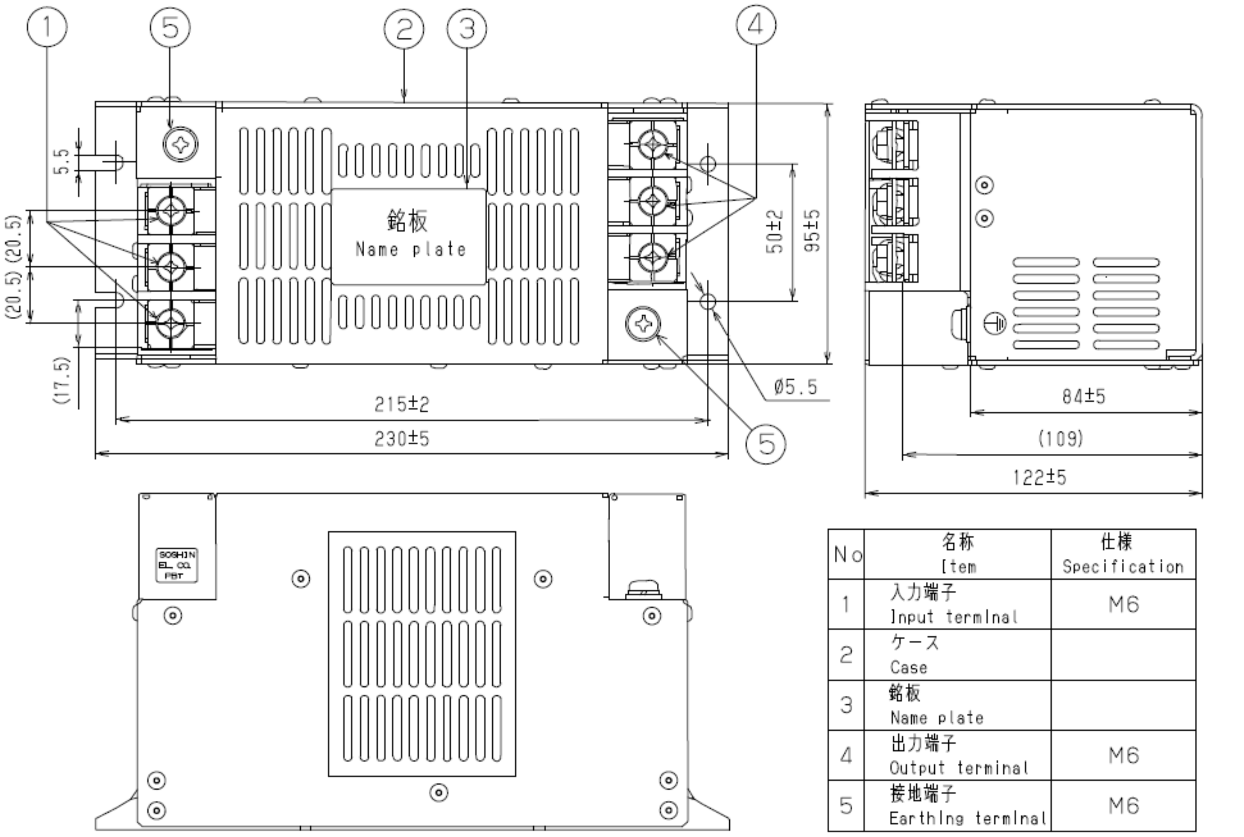


No	名称 Item	仕様 Specification
1	入力端子 Input terminal	M5
2	ケース Case	PBT
3	銘板 Name plate	
4	出力端子 Output terminal	M5
5	接地端子 Earthing terminal	M4

注）付属の端子ネジ以外のネジは使用しないで下さい
Note:Use only an attached screw.

NF3040C-SVB: External dimensions of noise filter

(d) A06B-6200-K162, K163

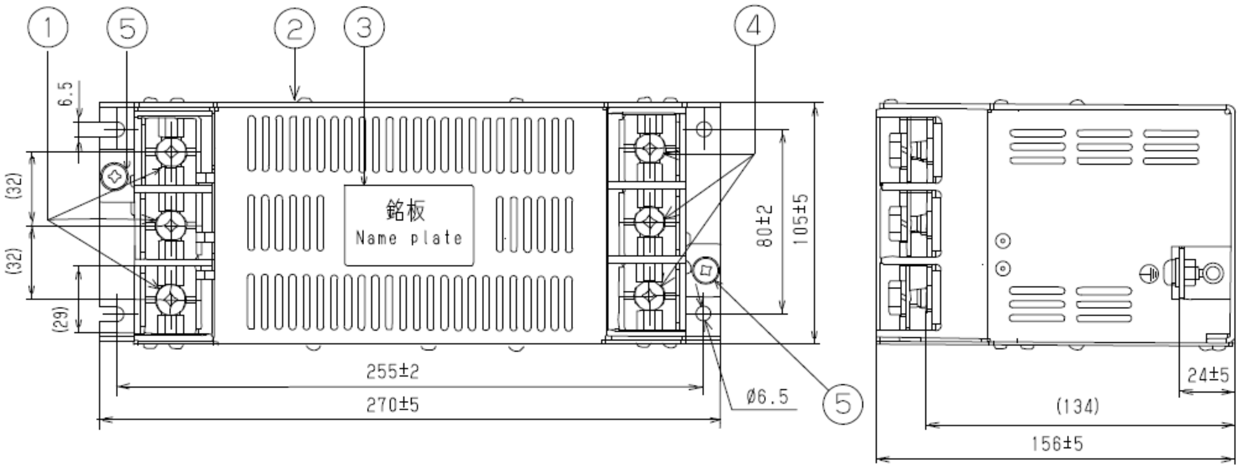


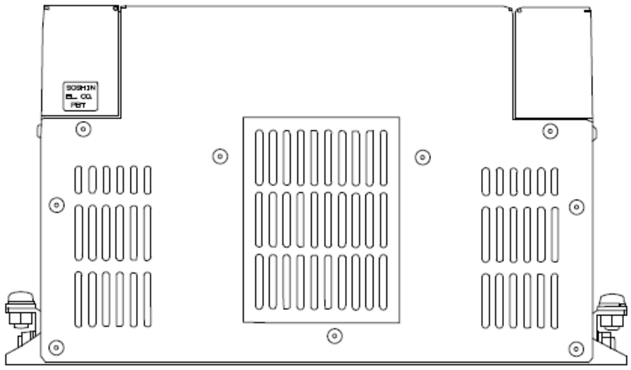
No	名称 Item	仕様 Specification
1	入力端子 Input terminal	M6
2	ケース Case	
3	銘板 Name plate	
4	出力端子 Output terminal	M6
5	接地端子 Earthing terminal	M6

注）付属の端子ネジ以外のネジは使用しないで下さい
Note:Use only an attached screw.

NF3080C/3100C-SVB: External dimensions of noise filter

(e) A06B-6200-K164



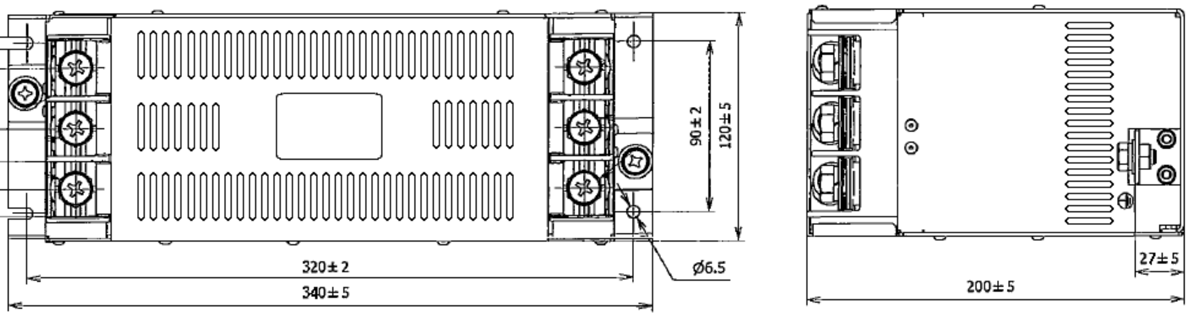


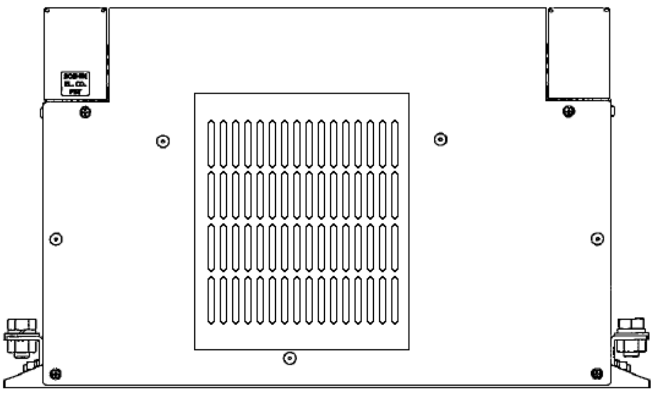
No	名称 Item	仕様 Specification
1	入力端子 Input terminal	M8
2	ケース Case	
3	銘板 Name plate	
4	出力端子 Output terminal	M8
5	接地端子 Earthing terminal	M6

注）付属の端子ネジ以外のネジは使用しないで下さい
Note:Use only an attached screw.

NF3150C-SVB: External dimensions of noise filter

(f) A06B-6200-K165, A06B-6200-K166, A06B-6200-K167





No	名称 Item	仕様 Specification
1	入力端子 Input terminal	M10
2	ケース Case	
3	銘板 Name plate	
4	出力端子 Output terminal	M10
5	接地端子 Earthing terminal	M8

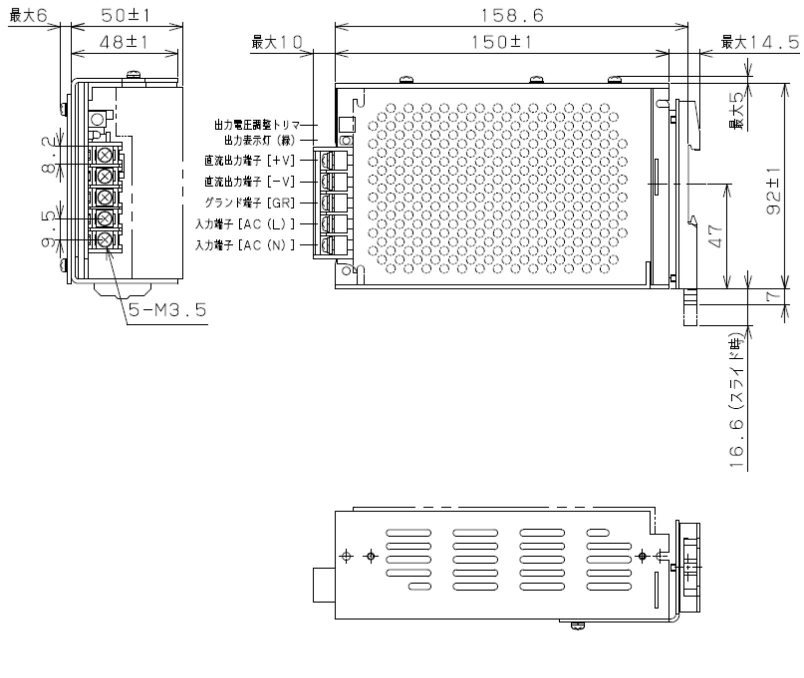
注）付属の端子ネジ以外のネジは使用しないで下さい
Note:Use only an attached screw.

NF3200C-SVB, NF3250C-SVB. and NF3300C-SVB: External dimensions of noise filter

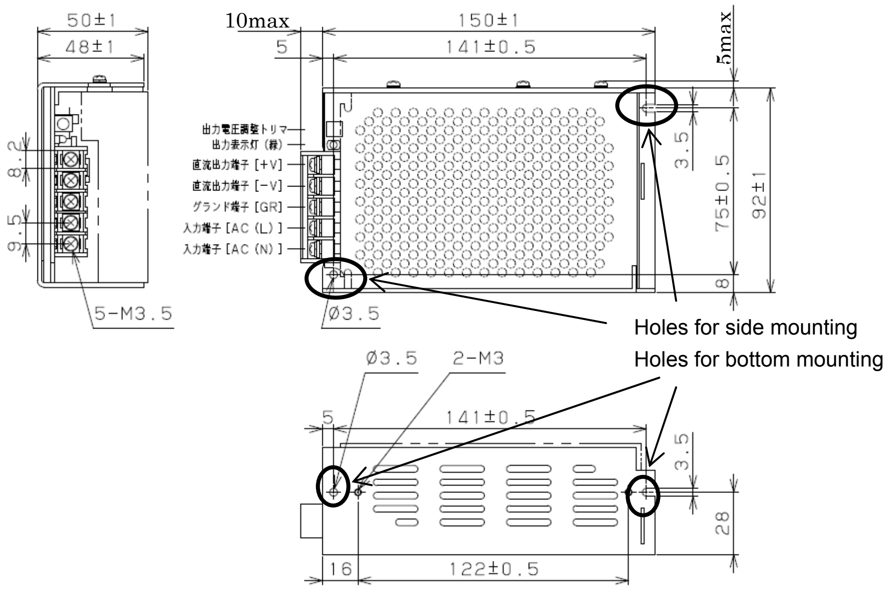
8.1.8 24-V Power Supply Unit

(a) A06B-6200-K502

(a-1) Outline drawing of the 24-V power supply unit with a DIN rail attachment plate

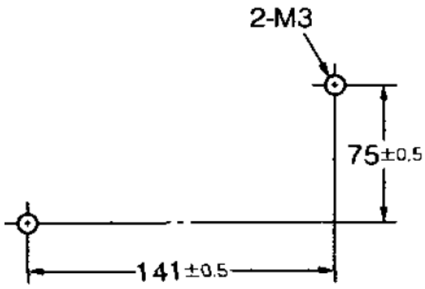


(a-2) Outline drawing of the 24-V power supply unit with no DIN rail attachment plate (for side mounting and bottom mounting)

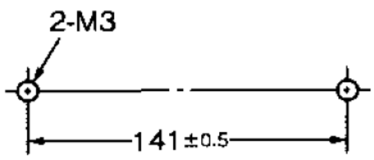


(a-3) Dimensions of panel mounting holes

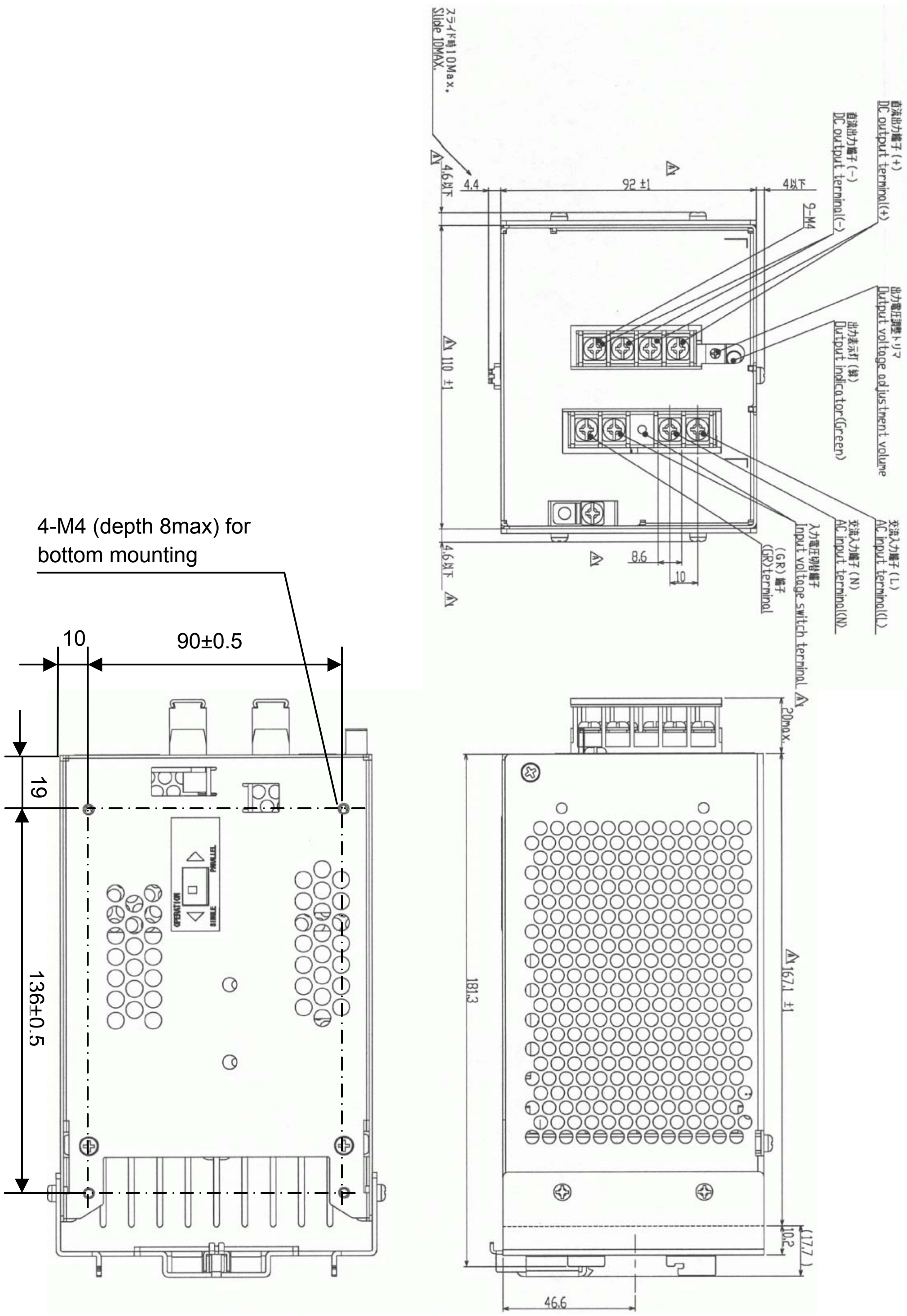
(a-3a) For side mounting



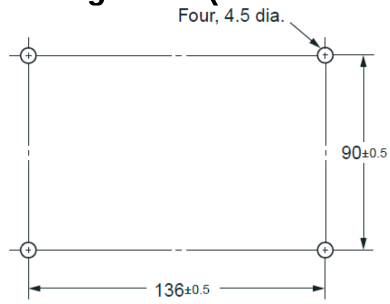
(a-3b) For bottom mounting



(b) A06B-6200-K503
(b-1) Outline drawing



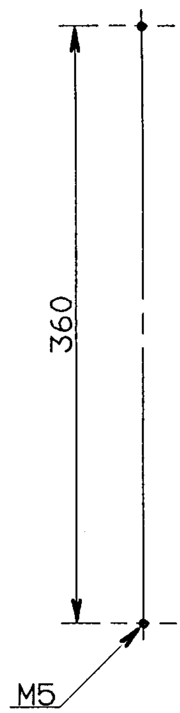
(b-2) Dimensions of panel mounting holes (for bottom mounting)



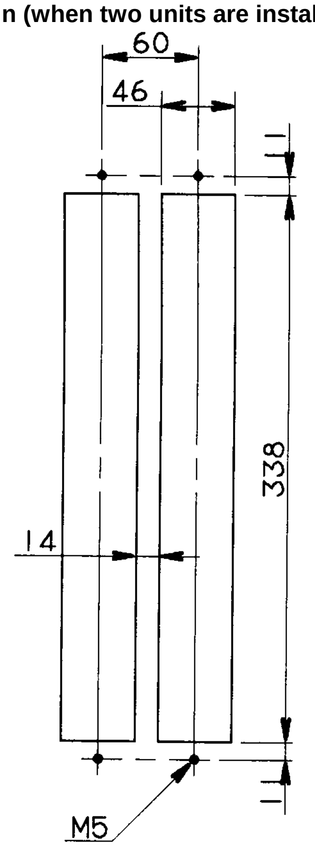
8.2 PANEL CUT-OUT DIAGRAMS

(a) 60-mm-wide amplifier

With no external fin



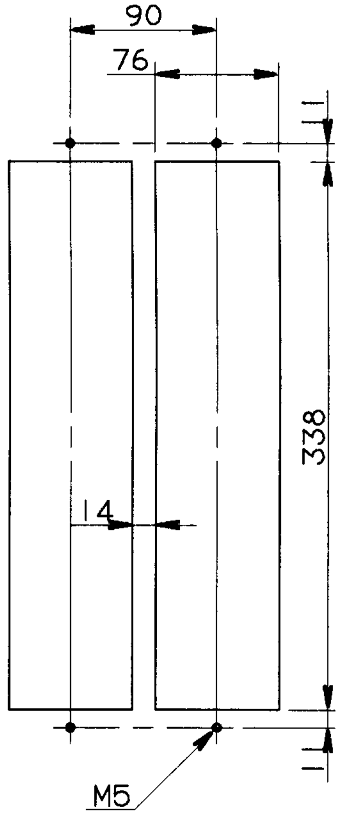
With external fin (when two units are installed side by side)



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.
   For information about how to attach the packing, see Section 5.7.
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.
3. The dimensional tolerance of the panel cut-out in the amplifier width direction shall be 46 (-0, +0.5).

(b) 90-mm-wide amplifier

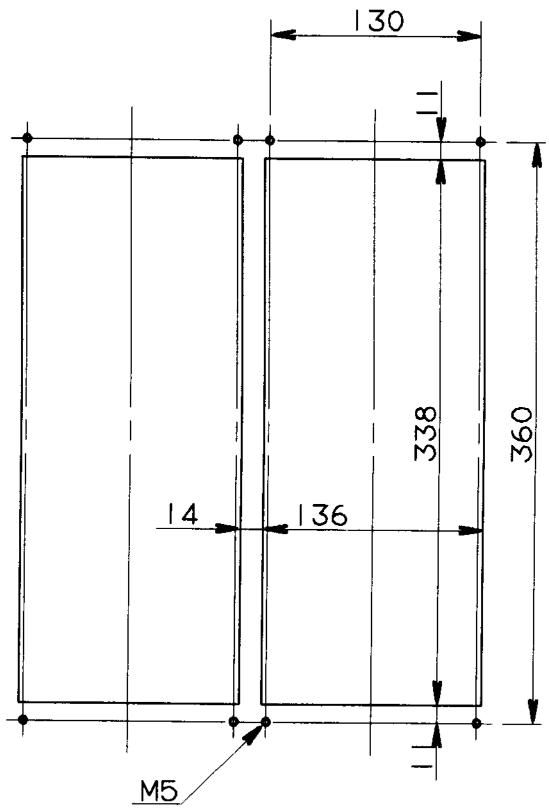
With external fin (when two units are installed side by side)



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.
For information about how to attach the packing, see Section 5.7.
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.
3 The dimensional tolerance of the panel cut-out in the amplifier width direction shall be 76 (-0, +0.5).

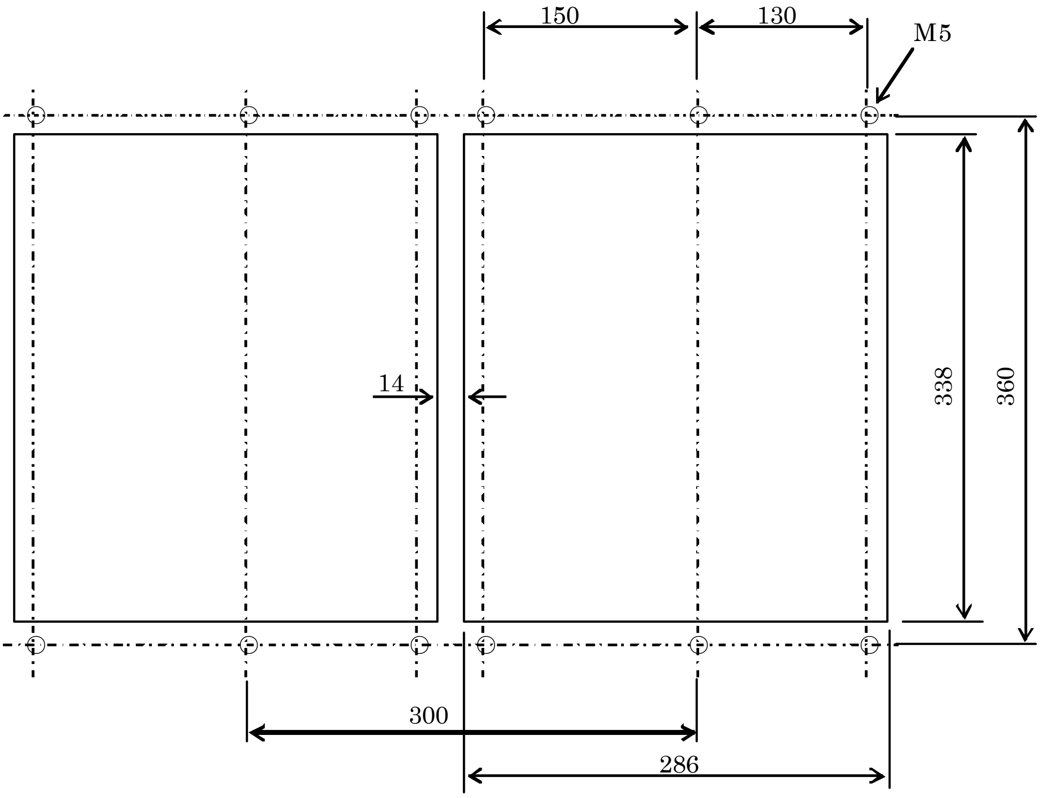
(c) 150-mm-wide amplifier (when two units are installed side-by-side)



NOTE

1. Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust. For information about how to attach the packing, see Section 5.7.
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.
3. The dimensional tolerance of the panel cut-out in the amplifier width direction shall be 136 (-0, +0.5).

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

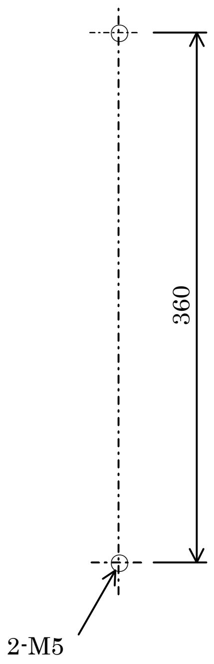


NOTE

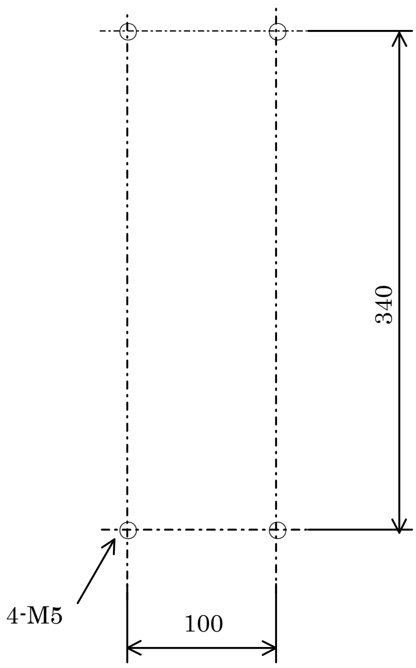
1. Attach a packing (acrylonitrile-butadiene rubber, NBR [soft type]) for protection against oil and dust. For information about how to attach the packing, see Section 5.7.
2. Reinforce the right and left sides of the panel cut-out in the power magnetics cabinet by using fittings such as angles to maintain satisfactory contact between the sheet metal of the power magnetics cabinet and the flange of the amplifier.
3. The dimensional tolerance of the panel cut-out in the amplifier width direction shall be 286 (-0, +0.5).

(e) Dynamic brake module

A06B-6079-H401, H403



A06B-6069-H300, H301

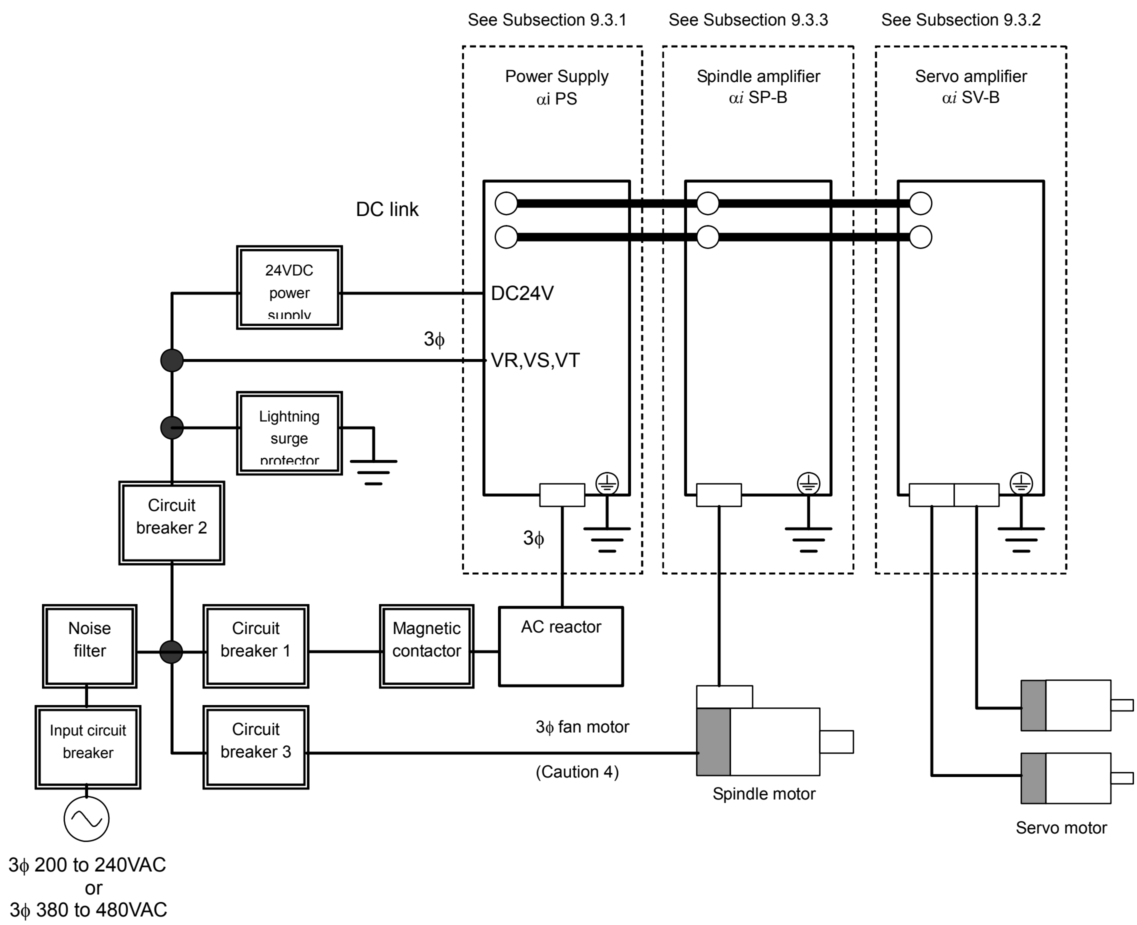


9 CONNECTION

Chapter 9, "CONNECTION," consists of the following sections:

9.1 TOTAL CONNECTION DIAGRAM

The following connection diagram is an example of combining an α*i*PS-B + a α*i*SP-B + a 2-axis α*i*SV-B. For detailed descriptions about how to connect these amplifiers, see their respective connection diagrams.



⚠ CAUTION

1. To meet the EMC Directive operating in EU countries, a noise filter must be installed.
2. Install the noise filter more nearer to the power supply than the magnetic contactor.
3. When the circuit breaker trips, the contact of the magnetic contactor may be melted. Before turning on the circuit breaker, make sure that the contact is not melted.

⚠ **CAUTION**

4 When spindle motor model αi I 1HV, αi I 1.5HV, αi I 2HV, αi I 3HV, αi I_T 1.5HV, αi I_T 2HV, or αi I_T 3HV is used, the specification of the fan motor is single phase, 200/230 VAC.

5 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, "FITTING A LIGHTNING SURGE PROTECTION DEVICE" for details.

9.2 CONNECTOR LOCATION

9.2.1 α*i*PS-B Series

(a) α*i*PS 3-B, α*i*PS 7.5-B

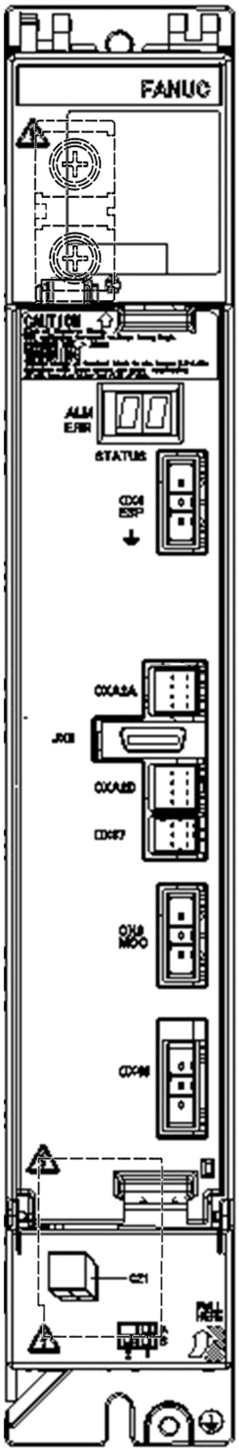


Table 9.2.1(a) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
5	Connector for connecting power failure backup module	JX9	
6	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
7	Connector for power failure detection output	CX37	D2100 6P-X
8	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
9	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
10	Connector for connecting main power supply	CZ1	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) α*i*PS 11-B, α*i*PS 15-B, α*i*PS 11HV-B, α*i*PS 18HV-B

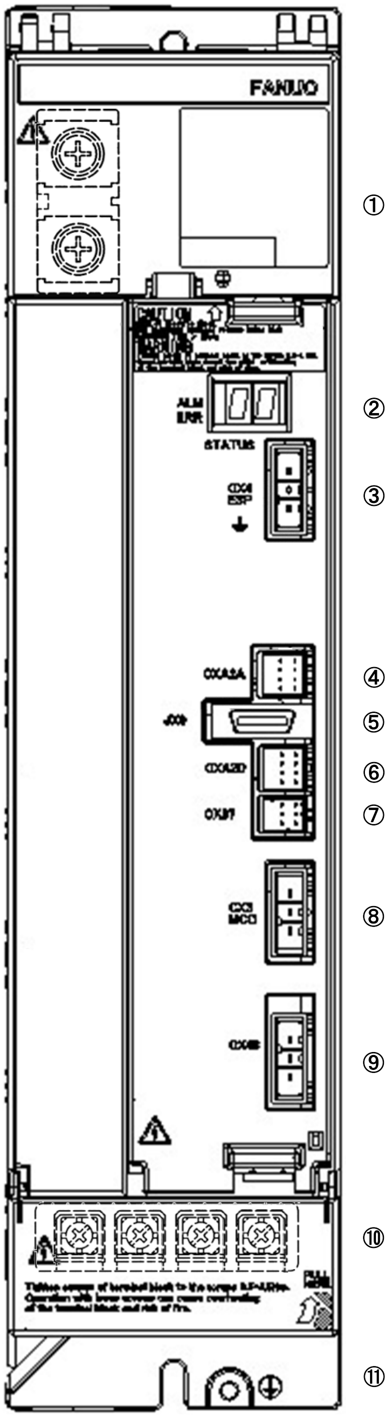


Table 9.2.1(b) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
5	Connector for connecting power failure backup module	JX9	
6	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
7	Connector for power failure detection output	CX37	D2100 6P-X
8	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
9	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
10	Terminal block for connecting main power supply	CZ1	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*PS 26-B, α*i*PS 30-B, α*i*PS 37-B, α*i*PS 30HV-B, α*i*PS 45HV-B, α*i*PS 60HV-B

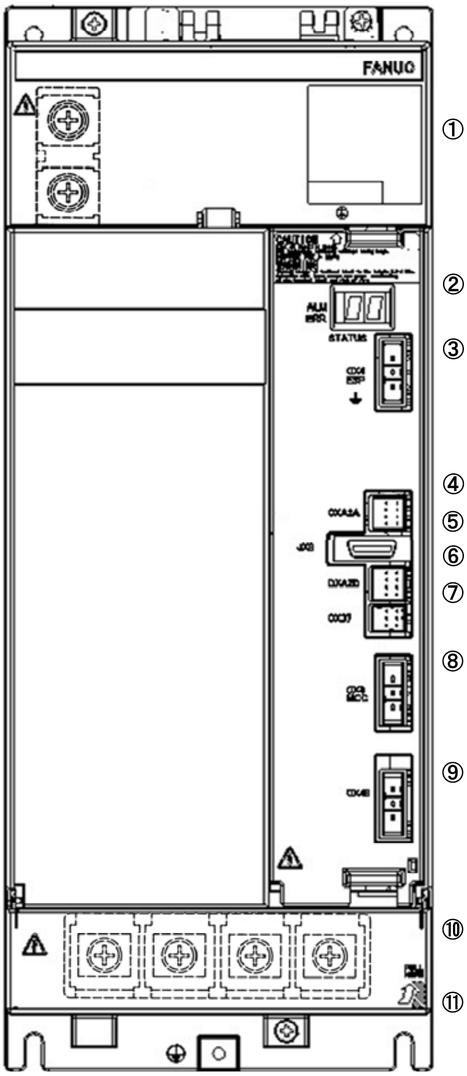


Table 9.2.1(c) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
5	Connector for connecting power failure backup module	JX9	
6	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
7	Connector for power failure detection output	CX37	D2100 6P-X
8	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
9	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
10	Terminal block for connecting main power supply	CZ1	
11	Tapped hole for grounding the flange	⏚	

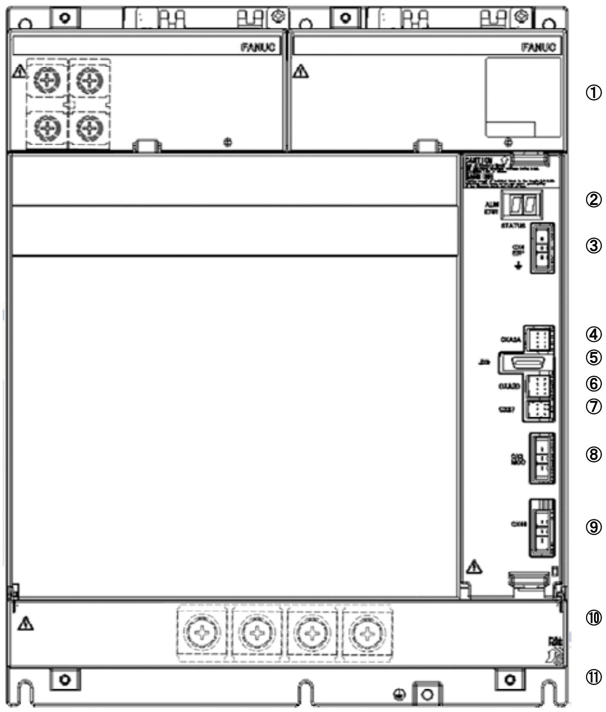
> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(d) α*i*PS 55-B, α*i*PS 75HV-B, α*i*PS 100HV-B

Table 9.2.1(d) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
5	Connector for connecting power failure backup module	JX9	
6	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
7	Connector for power failure detection output	CX37	D2100 6P-X
8	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
9	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
10	Terminal block for connecting main power supply	CZ1	
11	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



9.2.2 Level-up α*i*PS-B Series

(a) α*i*PS 3-B, α*i*PS 7.5-B

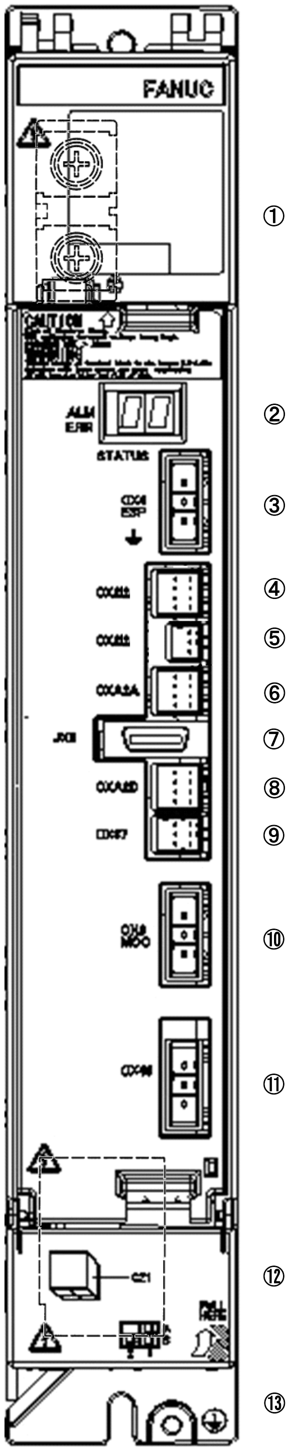


Table 9.2.2(a) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for protecting input filters for α*i*PSs against overheat	CX62	D2100 8P-Y
5	Connector for protecting external devices against overheat	CX61	D2100 3P-Y
6	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
7	Connector for connecting power failure backup module	JX9	
8	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
9	Connector for power failure detection output	CX37	D2100 6P-X
10	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
11	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
12	Connector for connecting main power supply	CZ1	
13	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) α*i*PS 11-B, α*i*PS 15-B, α*i*PS 11HV-B, α*i*PS 18HV-B

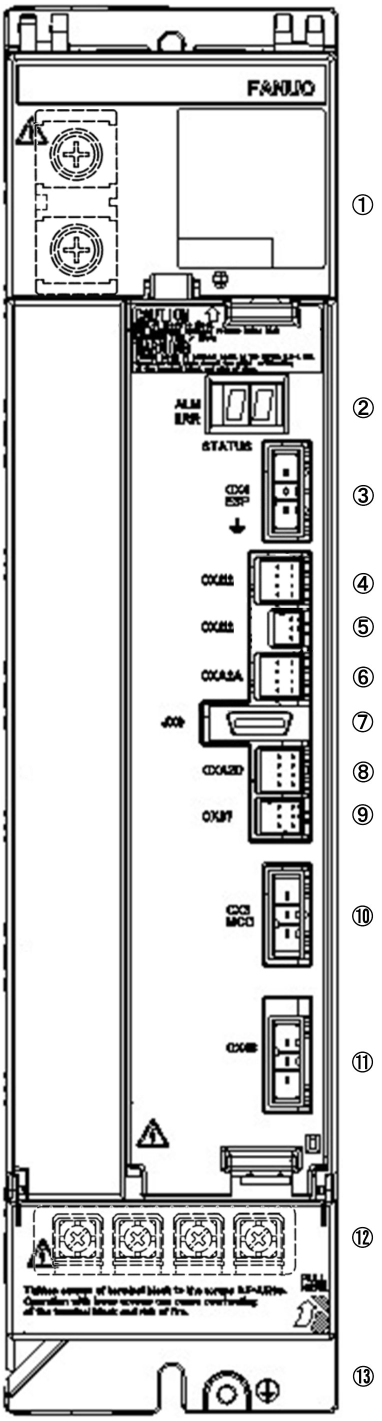


Table 9.2.2(b) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for protecting input filters for α*i*PSs against overheat	CX62	D2100 8P-Y
5	Connector for protecting external devices against overheat	CX61	D2100 3P-Y
6	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
7	Connector for connecting power failure backup module	JX9	
8	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
9	Connector for power failure detection output	CX37	D2100 6P-X
10	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
11	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
12	Terminal block for connecting main power supply	CZ1	
13	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*PS 26-B, α*i*PS 30-B, α*i*PS 37-B, α*i*PS 30HV-B, α*i*PS 45HV-B, α*i*PS 60HV-B

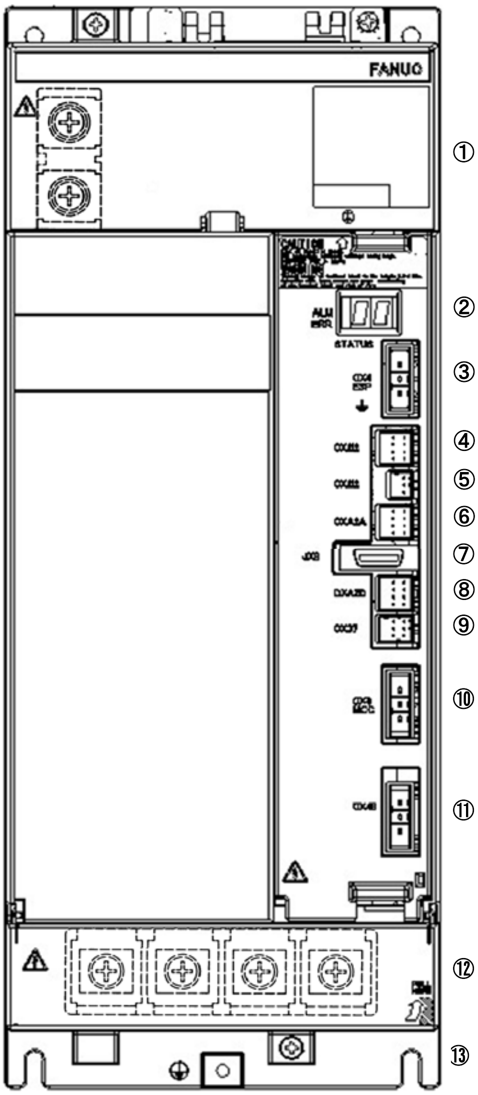


Table 9.2.2(c) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for protecting input filters for α*i*PSs against overheat	CX62	D2100 8P-Y
5	Connector for protecting external devices against overheat	CX61	D2100 3P-Y
6	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
7	Connector for connecting power failure backup module	JX9	
8	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
9	Connector for power failure detection output	CX37	D2100 6P-X
10	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
11	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
12	Terminal block for connecting main power supply	CZ1	
13	Tapped hole for grounding the flange	⏚	

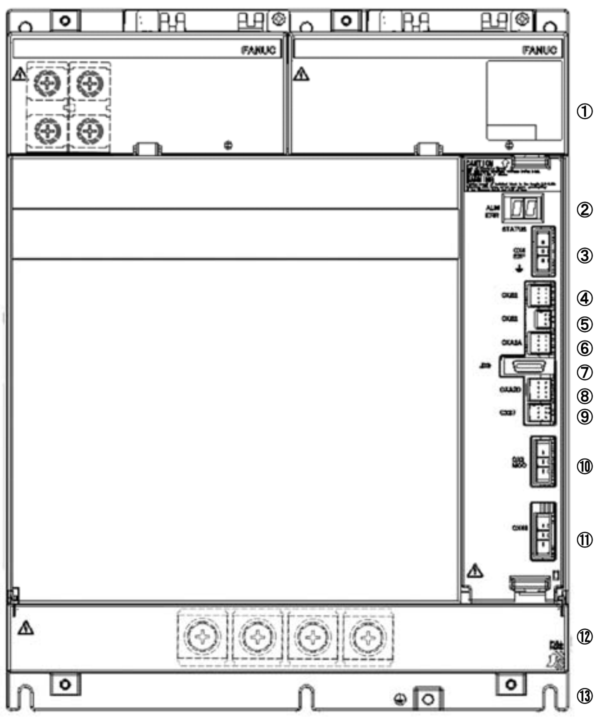
> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(d) α*i*PS 55-B, α*i*PS 75HV-B, α*i*PS 100HV-B, α*i*PS 125HV-B

Table 9.2.2(d) Names of connectors and terminal blocks

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
4	Connector for protecting input filters for α*i*PSs against overheat	CX62	D2100 8P-Y
5	Connector for protecting external devices against overheat	CX61	D2100 3P-Y
6	Connector for inter-amplifier communication/ 24 VDC power supply output	CXA2A	D2100 8P-X
7	Connector for connecting power failure backup module	JX9	
8	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
9	Connector for power failure detection output	CX37	D2100 6P-X
10	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
11	Connector for input power supply monitor	CX48	200V/400V 3φ D3200 3P-Z
12	Terminal block for connecting main power supply	CZ1	
13	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



9.2.3 α*i*SV-B Series

(a) α*i*SV-B series (60/90-mm width)

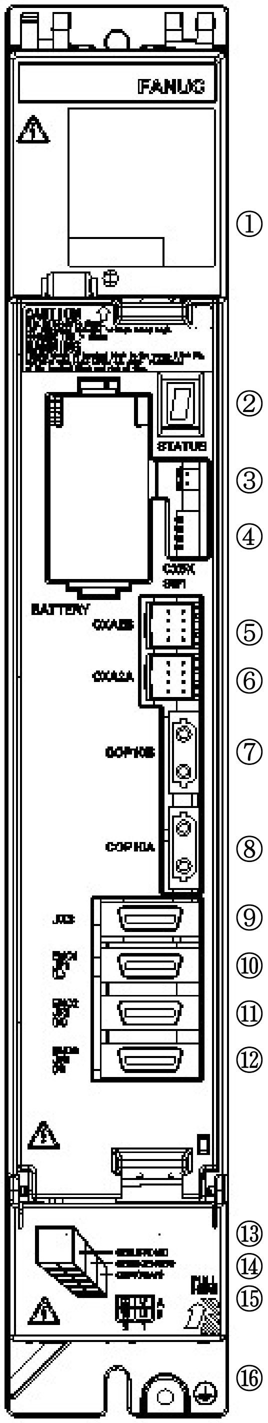


Table 9.2.3(a) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Battery connector of the α*i*SV-B built-in type for absolute Pulsecoder	CX5X	
4	Safe Torque Off switch	SW1	
5	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply The interface for the absolute Pulsecoder batteries is included.
6	Output connector for α*i*PS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	Safe Torque Off I/O connector	JX8	
10	Pulsecoder connector: L axis	ENC1/JF1	
11	Pulsecoder connector: M axis	ENC2/JF2	
12	Pulsecoder connector: N axis	ENC3/JF3	
13	Connector for motor power line: L axis	CZ2L	For α*i*SV-B 1-axis, CZ2
14	Connector for motor power line: M axis	CZ2M	
15	Connector for motor power line: N axis	CZ2N	
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) α*i*SV 360-B, α*i*SV 180HV-B

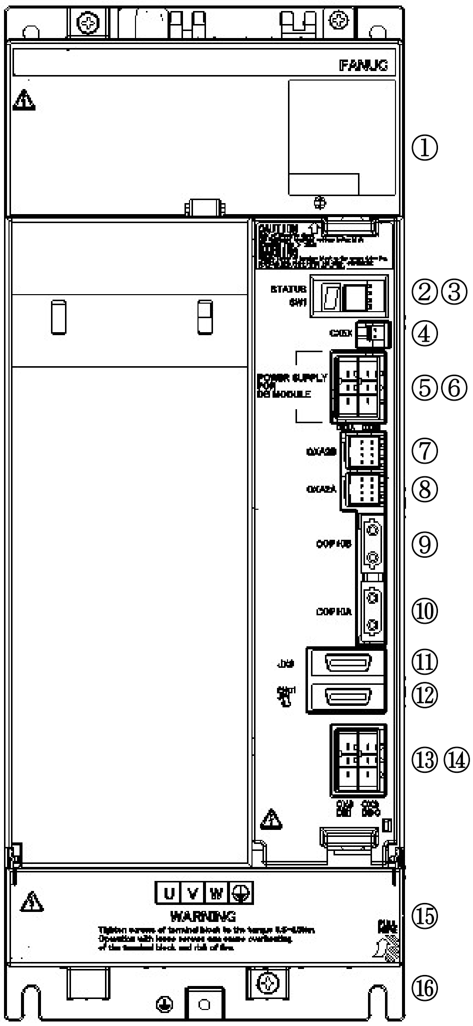


Table 9.2.3(b) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Safe Torque Off switch	SW1	
4	Battery connector of the α*i*SV-B built-in type for absolute Pulsecoder	CX5X	
5	Power input connector for dynamic brake module	CX1A	
6	Power output connector for dynamic brake module	CX1B	
7	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply The interface for the absolute Pulsecoder batteries is included.
8	Output connector for α*i*PS-B interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Safe Torque Off I/O connector	JX8	
12	Pulsecoder connector	ENC1/JF1	
13	Connector for dynamic brake module interface	CX8	
14	Connector for magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Displayed as terminal block TB2
16	Tapped hole for grounding the flange	⏚	

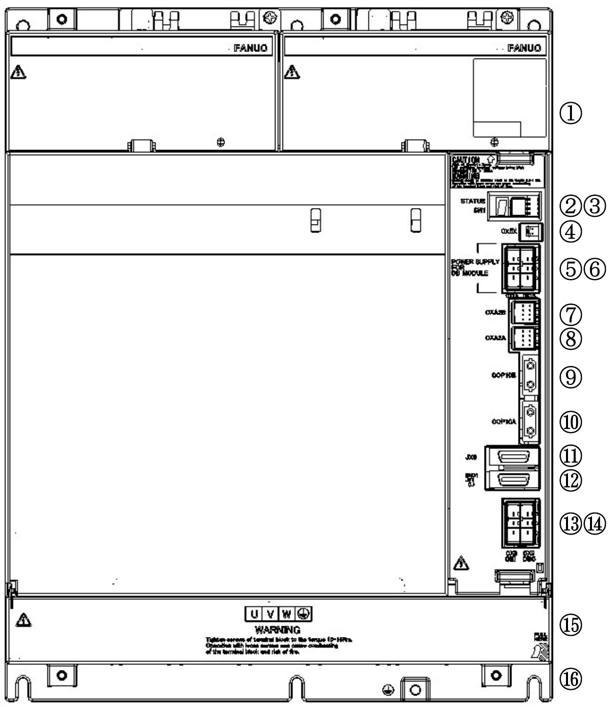
⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*SV 360HV-B, α*i*SV 540HV-B

Table 9.2.3(c) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Safe Torque Off switch	SW1	
4	Battery connector of the α*i*SV-B built-in type for absolute Pulsecoder	CX5X	
5	Power input connector for dynamic brake module	CX1A	
6	Power output connector for dynamic brake module	CX1B	
7	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply. The interface for the absolute Pulsecoder batteries is included.
8	Output connector for α*i*PS-B interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Safe Torque Off I/O connector	JX8	
12	Pulsecoder connector	ENC1/JF1	
13	Connector for dynamic brake module interface	CX8	
14	Connector for magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Displayed as terminal block TB2
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



9.2.4 Level-up αiSV-B Series

(a) αiSV-B series (60/90-mm width)

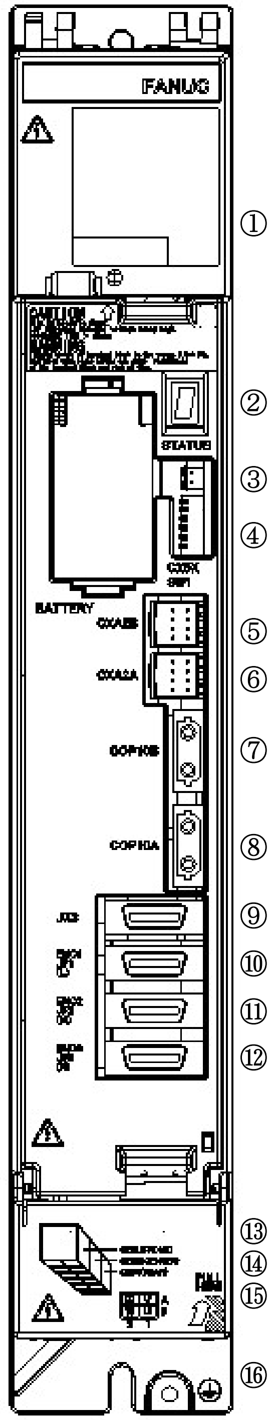
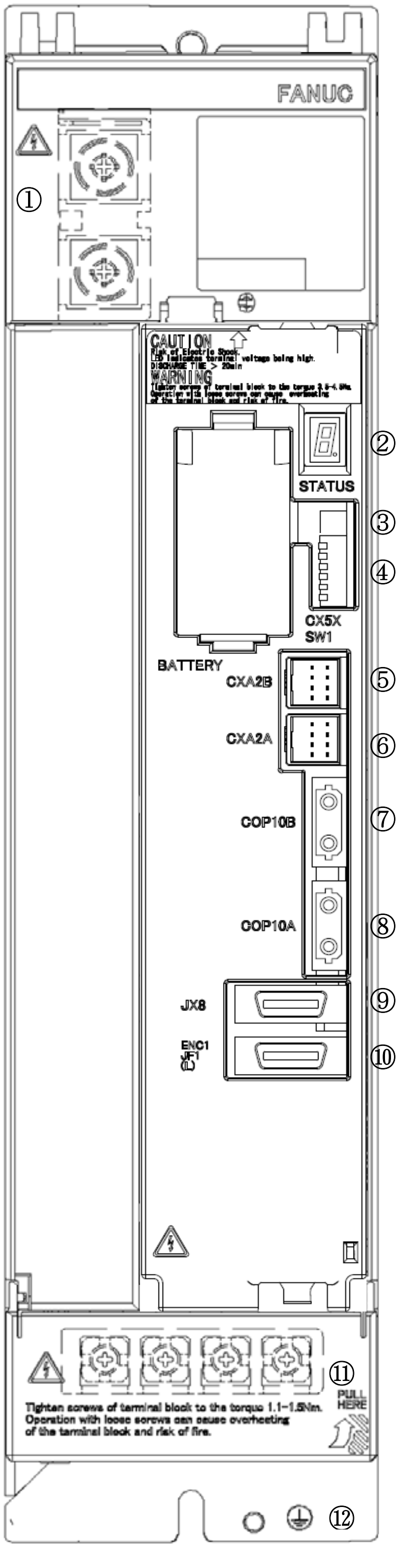


Table 9.2.4(a) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Battery connector of the αiSV-B built-in type for absolute Pulsecoder	CX5X	
4	Safe Torque Off switch	SW1	
5	Input connector for αiPS-B interface	CXA2B	24 VDC power supply The interface for the absolute Pulsecoder batteries is included.
6	Output connector for αiPS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	Safe Torque Off I/O connector	JX8	
10	Pulsecoder connector: L axis	ENC1/JF1	
11	Pulsecoder connector: M axis	ENC2/JF2	
12	Pulsecoder connector: N axis	ENC3/JF3	
13	Connector for motor power line: L axis	CZ2L	For αiSV-B 1-axis, CZ2
14	Connector for motor power line: M axis	CZ2M	
15	Connector for motor power line: N axis	CZ2N	
16	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



(b) αiSV 180HVS-B

Table 9.2.4(b) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Battery connector of the αiSV-B built-in type for absolute Pulsecoder	CX5X	
4	Safe Torque Off switch	SW1	
5	Input connector for αiPS-B interface	CXA2B	24 VDC power supply The interface for the absolute Pulsecoder batteries is included.
6	Output connector for αiPS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	Safe Torque Off I/O connector	JX8	
10	Pulsecoder connector	ENC1/JF1	
11	Terminal block for connection to motor power line		Displayed as terminal block TB2.
12	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*SV 360-B, α*i*SV 180HV-B

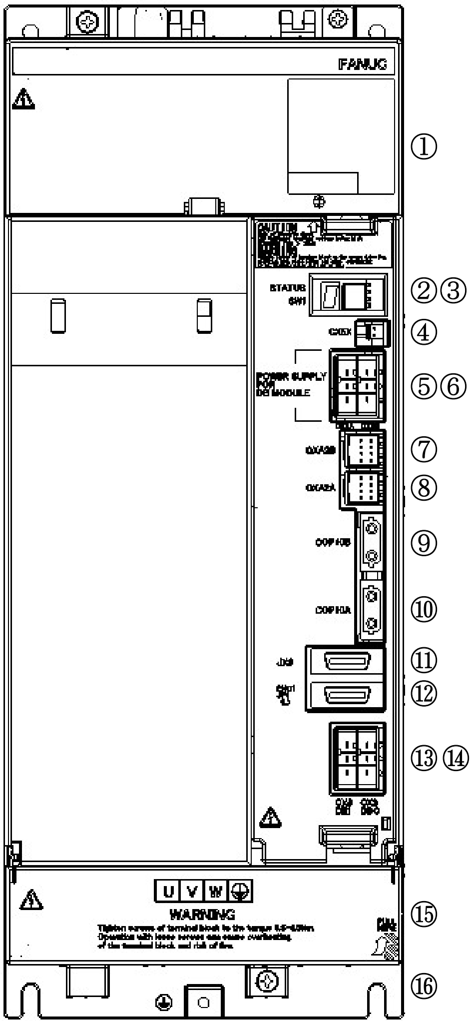


Table 9.2.4(c) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Safe Torque Off switch	SW1	
4	Battery connector of the α*i*SV-B built-in type for absolute Pulsecoder	CX5X	
5	Power input connector for dynamic brake module	CX1A	
6	Power output connector for dynamic brake module	CX1B	
7	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply The interface for the absolute Pulsecoder batteries is included.
8	Output connector for α*i*PS-B interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Safe Torque Off I/O connector	JX8	
12	Pulsecoder connector	ENC1/JF1	
13	Connector for dynamic brake module interface	CX8	
14	Connector for magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Displayed as terminal block TB2.
16	Tapped hole for grounding the flange	⏚	

⚠ WARNING

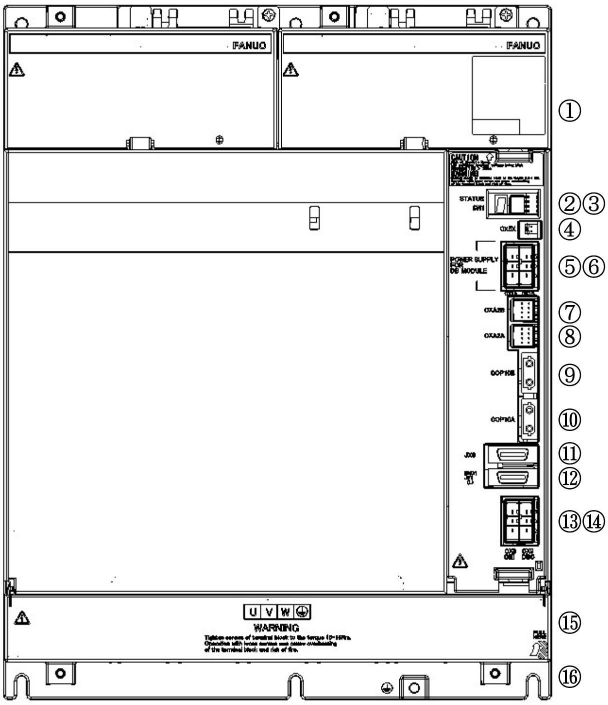
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(d) α*i*SV 360HV-B, α*i*SV 540HV-B

Table 9.2.4(d) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Safe Torque Off switch	SW1	
4	Battery connector of the α*i*SV-B built-in type for absolute Pulsecoder	CX5X	
5	Power input connector for dynamic brake module	CX1A	
6	Power output connector for dynamic brake module	CX1B	
7	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply. The interface for the absolute Pulsecoder batteries is included.
8	Output connector for α*i*PS-B interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Safe Torque Off I/O connector	JX8	
12	Pulsecoder connector	ENC1/JF1	
13	Connector for dynamic brake module interface	CX8	
14	Connector for magnetic contactor drive coil of the dynamic brake module	CX9	
15	Terminal block for connection to motor power line		Displayed as terminal block TB2.
16	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



9.2.5 α*i*SP-B Series

(a) α*i*SP 2.2-B, α*i*SP 5.5-B , α*i*SP 5.5HV-B

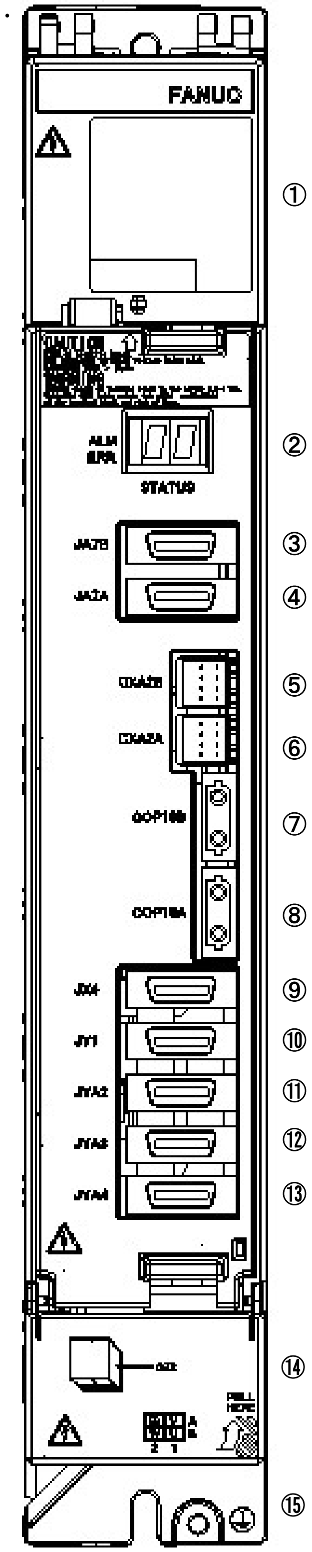


Table 9.2.5(a) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Input connector for electric serial interface	JA7B	Unused
4	Output connector for electric serial interface	JA7A	Unused
5	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
6	Output connector for α*i*PS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
10	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
11	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
12	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
13	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
14	Connector for motor power line		Displayed as CZ2.
15	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) α*i*SP 11-B , α*i*SP 15-B , α*i*SP 11HV-B , α*i*SP 15HV-B

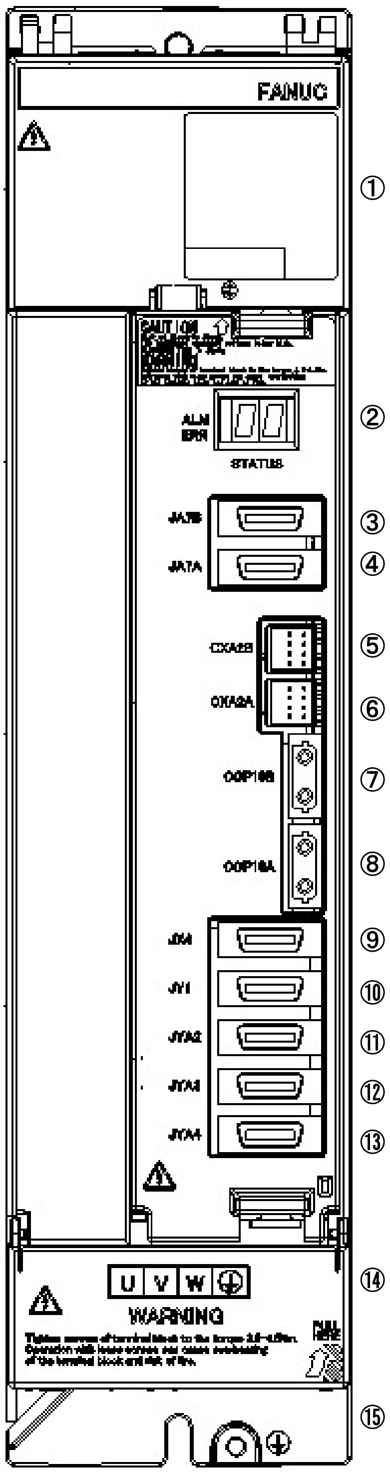


Table 9.2.5(b) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Input connector for electric serial interface	JA7B	Unused
4	Output connector for electric serial interface	JA7A	Unused
5	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
6	Output connector for α*i*PS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
10	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
11	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
12	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
13	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
14	Connector for motor power line		Displayed as TB2.
15	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*SP 22-B, α*i*SP 26-B, α*i*SP 30-B, α*i*SP 37-B, α*i*SP 22HV-B, α*i*SP 30HV-B, α*i*SP 45HV-B

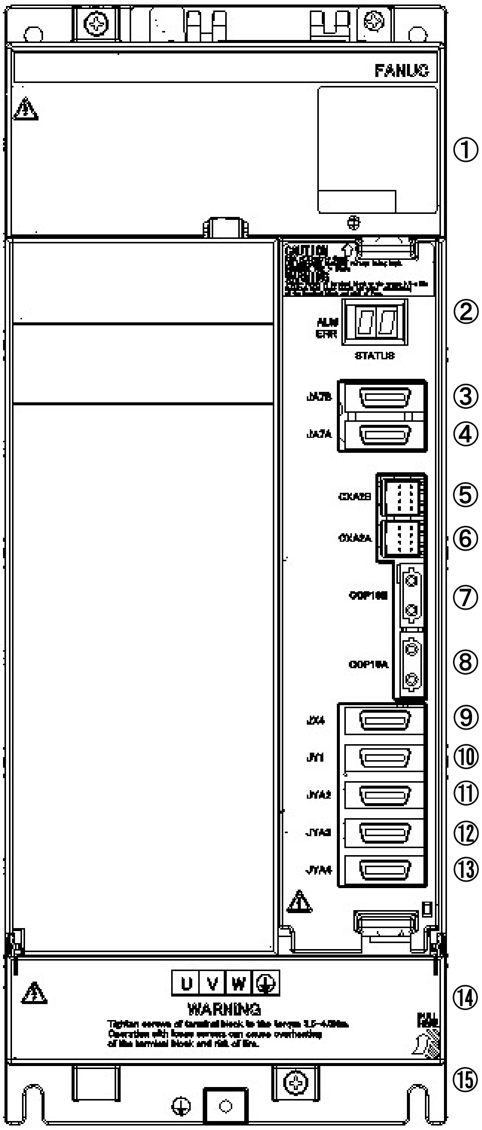


Table 9.2.5(c) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Input connector for electric serial interface	JA7B	Unused
4	Output connector for electric serial interface	JA7A	Unused
5	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
6	Output connector for α*i*PS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
10	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
11	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
12	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
13	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
14	Connector for motor power line		Displayed as TB2.
15	Tapped hole for grounding the flange	⏚	

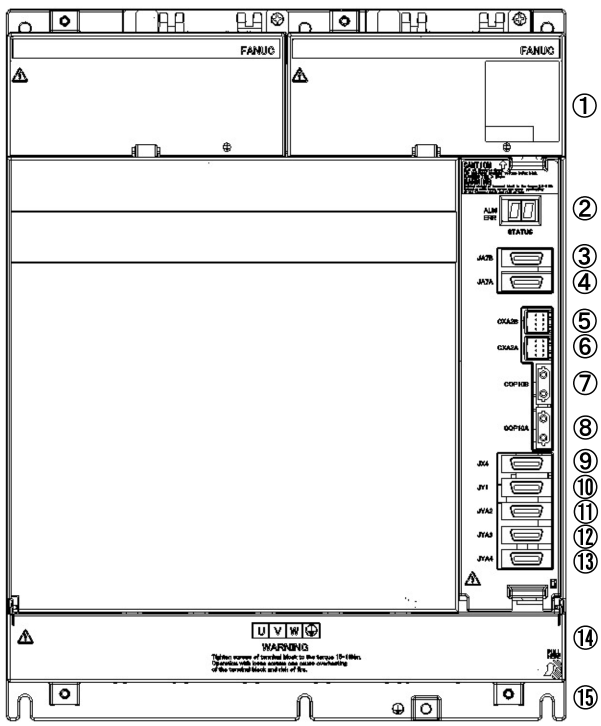
⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(d) α*i*SP 45-B, α*i*SP 55-B, α*i*SP 75HV-B, α*i*SP 100HV-B

Table 9.2.5(d) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Status LED	STATUS	
3	Input connector for electric serial interface	JA7B	Unused
4	Output connector for electric serial interface	JA7A	Unused
5	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
6	Output connector for α*i*PS-B interface	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
10	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
11	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
12	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
13	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
14	Connector for motor power line		Displayed as TB2.
15	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



9.2.6 Level-up α*i*SP-B Series

(a) α*i*SP 2.2-B, α*i*SP 5.5-B , α*i*SP 5.5HV-B

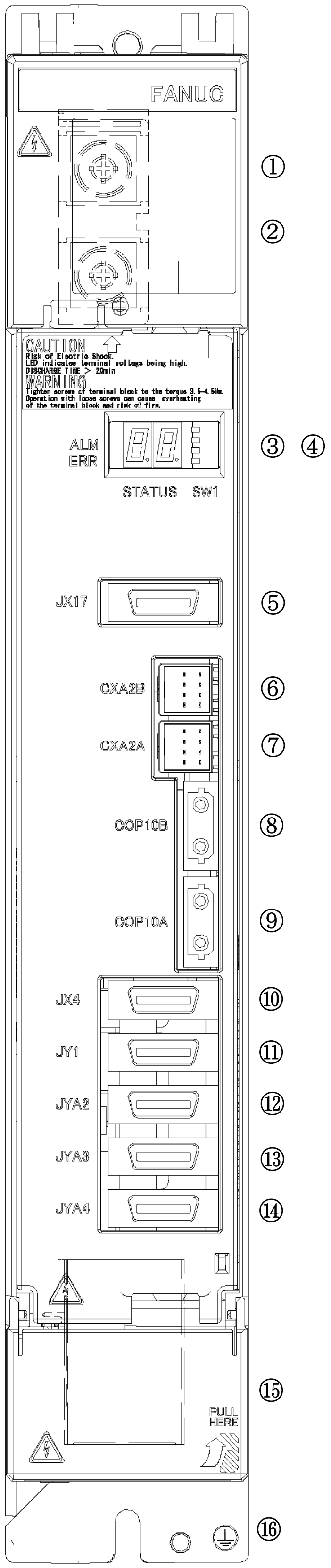


Table 9.2.6(a) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Safe Torque Off switch	SW1	
5	Safe Torque Off I/O connector	JX17	
6	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
7	Output connector for α*i*PS-B interface	CXA2A	
8	FSSB optical input connector	COP10B	
9	FSSB optical output connector	COP10A	
10	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
11	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
12	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
13	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
14	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
15	Connector for motor power line		Displayed as CZ2.
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) αiSP 11-B, αiSP 15-B , αiSP 11HV-B , αiSP 15HV-B

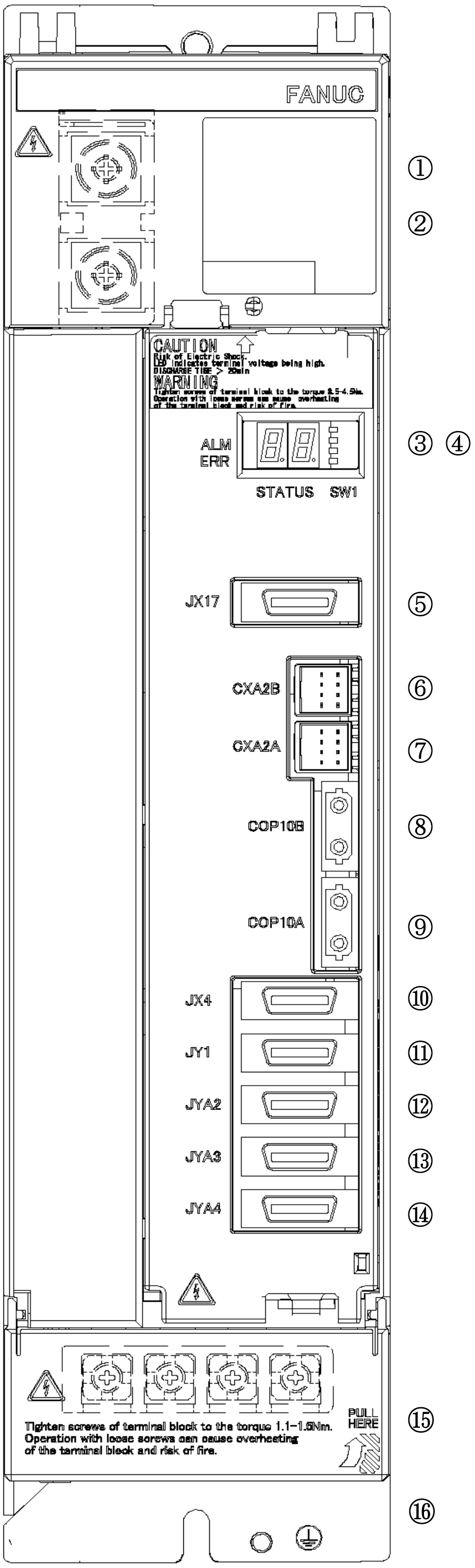


Table 9.2.6(b) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Safe Torque Off switch	SW1	
5	Safe Torque Off I/O connector	JX17	
6	Input connector for αiPS-B interface	CXA2B	24 VDC power supply
7	Output connector for αiPS-B interface	CXA2A	
8	FSSB optical input connector	COP10B	
9	FSSB optical output connector	COP10A	
10	POSITIONCODER signal Signal for communication between αiSP-B Excitation off signal	JX4	
11	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
12	Connector for spindle sensor for motor	JYA2	αiM/MZ sensor, αiBZ sensor
13	Connector for POSITIONCODER and external single-rotation signal	JYA3	αiCZ sensor
14	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
15	Terminal block for connection to motor power line		Displayed as terminal block TB2.
16	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(c) α*i*SP 22-B, α*i*SP 26-B, α*i*SP 30-B, α*i*SP 37-B, α*i*SP 22HV-B, α*i*SP 30HV-B, α*i*SP 45HV-B, α*i*SP 60HV-B

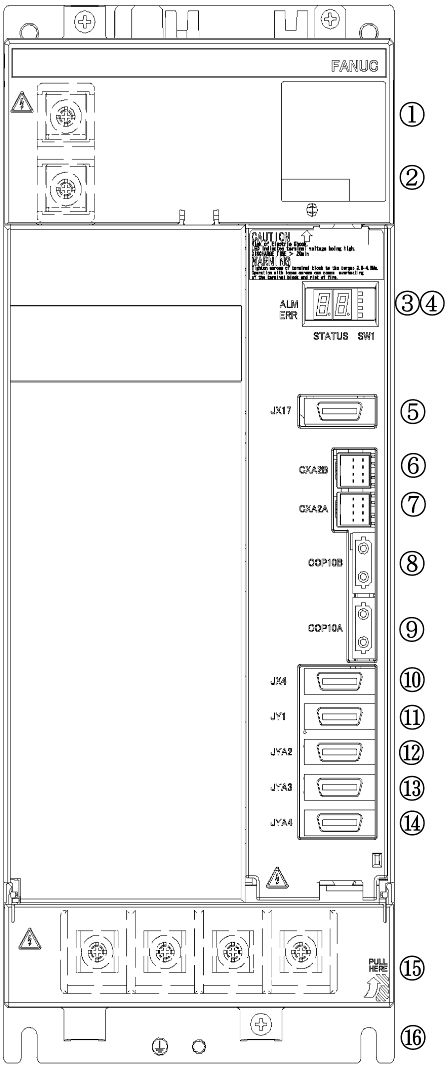


Table 9.2.6(c) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Safe Torque Off switch	SW1	
5	Safe Torque Off I/O connector	JX17	
6	Input connector for α*i*PS-B interface	CXA2B	24 VDC power supply
7	Output connector for α*i*PS-B interface	CXA2A	
8	FSSB optical input connector	COP10B	
9	FSSB optical output connector	COP10A	
10	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
11	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
12	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
13	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
14	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
15	Terminal block for connection to motor power line		Displayed as terminal block TB2.
16	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(d) α*i*SP 45-B, α*i*SP 55-B, α*i*SP 75HV-B, α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B

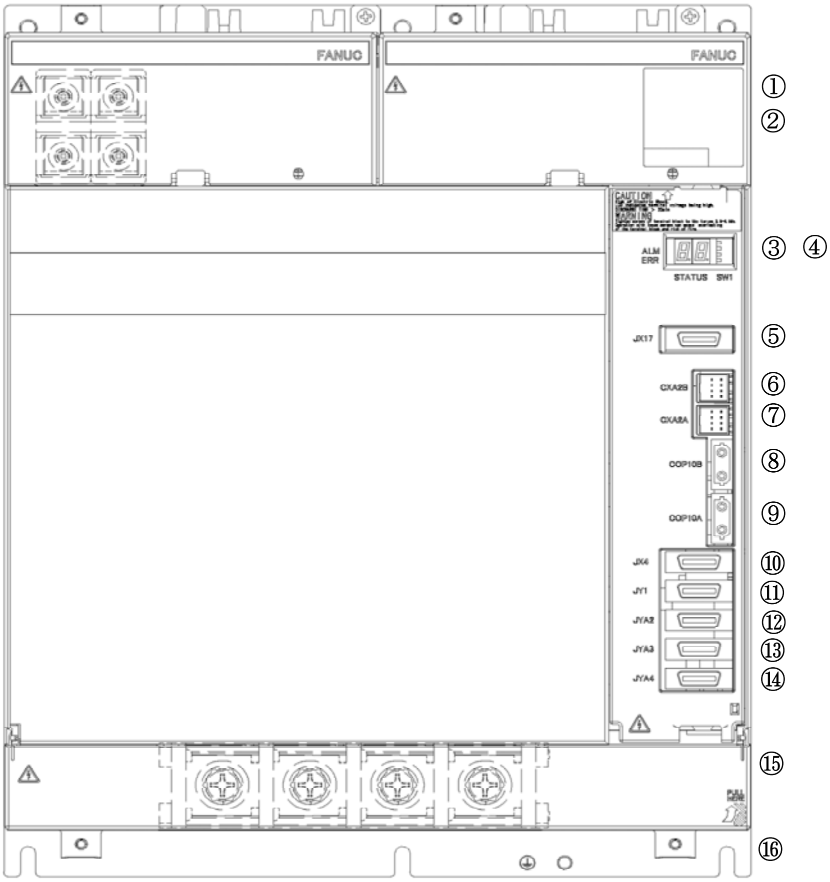


Table 9.2.6(d) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Safe Torque Off switch	SW1	
5	Safe Torque Off I/O connector	JX17	
6	α*i*PS-B Interface input connector	CXA2B	24 VDC power supply
7	α*i*PS-B Interface output connector	CXA2A	
8	FSSB optical input connector	COP10B	
9	FSSB optical output connector	COP10A	
10	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
11	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
12	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
13	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
14	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
15	Terminal block for connection to motor power line		Displayed as TB2.
16	Tapped hole for grounding the flange	⏚	

⚠ **WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

9.2.7 α*i*SVP-B Series

(a) α*i*SVP 20/20/20-5.5-B, α*i*SVP 10/10/10-5.5HV-B

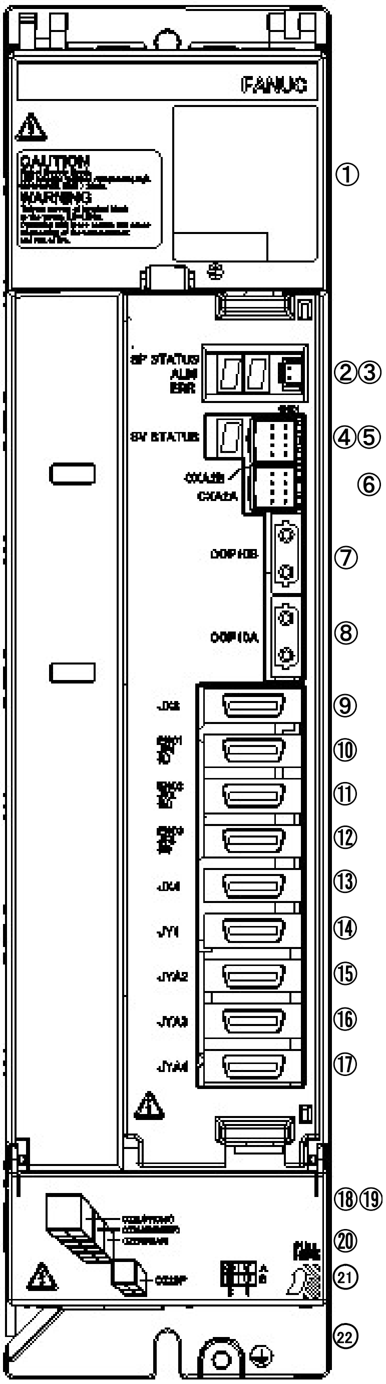


Table 9.2.7(a) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Spindle status LED	STATUS	
3	Battery connector for absolute Pulsecoder	CX5X	
4	Servo status LED	STATUS	
5	Input connector for α*i*PS-B interface Connector	CXA2B	24 VDC power supply
6	Output connector for α*i*PS-B interface Connector	CXA2A	
7	FSSB optical input connector	COP10B	
8	FSSB optical output connector	COP10A	
9	Signal check connector	JX8	Unused
10	Pulsecoder connector: L axis	ENC1/JF1	
11	Pulsecoder connector: M axis	ENC2/JF2	
12	Pulsecoder connector: N axis	ENC3/JF3	
13	POSITIONCODER signal Signal for communication between α*i*SP-B Excitation off signal	JX4	
14	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
15	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
16	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
17	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
18	Connector for motor power line: L axis	CZ2L	
19	Connector for motor power line: M axis	CZ2M	
20	Connector for motor power line: N axis	CZ2N	
21	Connector for motor power line: spindle	CZ2SP	
22	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

9.2.8 Level-up αiSVP-B Series

(a) αiSVP 20/20/20-2.2-B, αiSVP 40/40/40-2.2-B

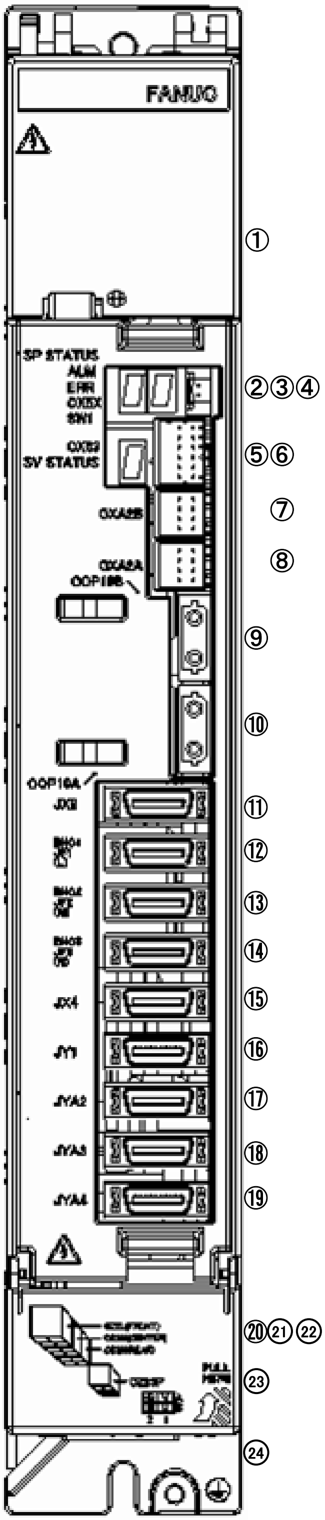


Table 9.2.8(a) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Spindle status LED	STATUS	
3	Battery connector for absolute Pulsecoder	CX5X	
4	Safe Torque Off switch	SW1	
5	Servo status LED	STATUS	
6	Safe Torque Off I/O connector	CX63	
7	Input connector for αiPS interface	CXA2B	24 VDC power supply
8	Output connector for αiPS interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Signal check connector	JX8	Unused
12	Pulsecoder connector: L axis	ENC1/JF1	
13	Pulsecoder connector: M axis	ENC2/JF2	
14	Pulsecoder connector: N axis	ENC3/JF3	
15	POSITIONCODER signal Signal for communication between αiSP Excitation off signal	JX4	
16	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
17	Connector for spindle sensor for motor	JYA2	αiM/MZ sensor, αiBZ sensor
18	Connector for POSITIONCODER and external single-rotation signal	JYA3	αiCZ sensor
19	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
20	Connector for motor power line: L axis	CZ2L	
21	Connector for motor power line: M axis	CZ2M	
22	Connector for motor power line: N axis	CZ2N	
23	Connector for motor power line: spindle	CZ2SP	
24	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(b) α*i*SVP 20/20/20-5.5-B, α*i*SVP 10/10/10-5.5HV-B

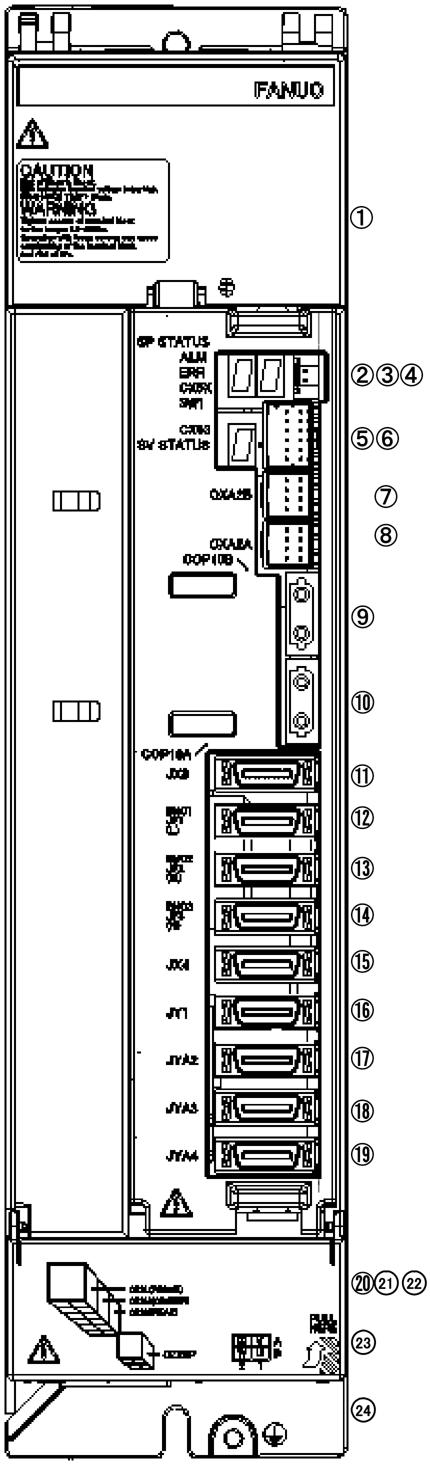


Table 9.2.8(b) Names of connectors, terminal blocks and the like

	Name	Display	Remarks
1	DC link terminal block		Displayed as terminal block TB1. Including DC link charge LED See the following warning.
2	Spindle status LED	STATUS	
3	Battery connector for absolute Pulsecoder	CX5X	
4	Safe Torque Off switch	SW1	
5	Servo status LED	STATUS	
6	Safe Torque Off I/O connector	CX63	
7	Input connector for α*i*PS interface	CXA2B	24 VDC power supply
8	Output connector for α*i*PS interface	CXA2A	
9	FSSB optical input connector	COP10B	
10	FSSB optical output connector	COP10A	
11	Signal check connector	JX8	Unused
12	Pulsecoder connector: L axis	ENC1/JF1	
13	Pulsecoder connector: M axis	ENC2/JF2	
14	Pulsecoder connector: N axis	ENC3/JF3	
15	POSITIONCODER signal Signal for communication between α*i*SP Excitation off signal	JX4	
16	Connector for load meter and speedometer	JY1	The signal for the check board is also output.
17	Connector for spindle sensor for motor	JYA2	α*i*M/MZ sensor, α*i*BZ sensor
18	Connector for POSITIONCODER and external single-rotation signal	JYA3	α*i*CZ sensor
19	Connector for separate spindle sensor	JYA4	α POSITIONCODER S
20	Connector for motor power line: L axis	CZ2L	
21	Connector for motor power line: M axis	CZ2M	
22	Connector for motor power line: N axis	CZ2N	
23	Connector for motor power line: spindle	CZ2SP	
24	Tapped hole for grounding the flange	⏚	

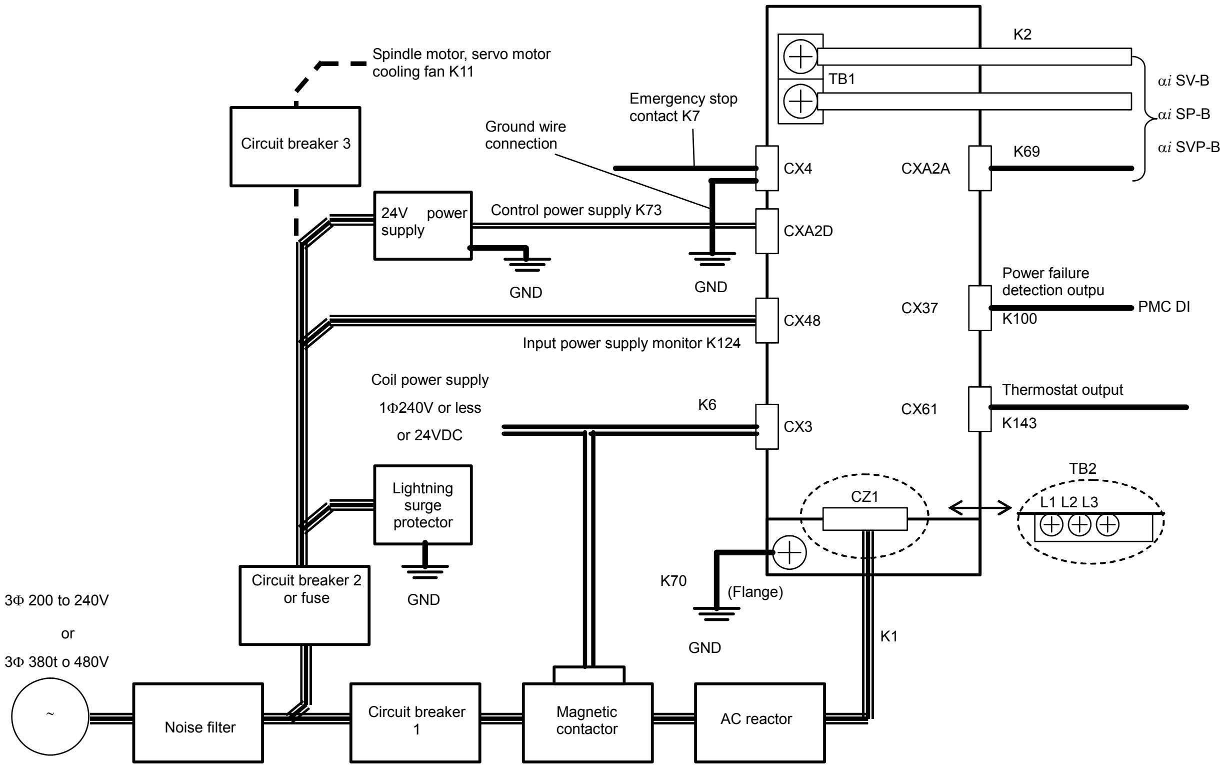
⚠ **WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

9.3 CABLE CONNECTION DETAILS

9.3.1 αiPS-B Series Connection Diagram

(a) αiPS-B (200 V, 400 V input series)



> ⚠ **CAUTION**
> 1. Always install the circuit breakers, magnetic contactor, and AC reactor.
> 2. Install a noise filter more nearer to the power supply than the magnetic contactor for the αiPS-B.
> 3. Connect a circuit breaker or fuse rated 5 A or less in the input section of the lightning surge protector to prevent the protector from being burnt out due to a short-circuit when a surge voltage higher than its rating is applied. For details, see Appendix A, "FITTING A LIGHTNING SURGE PROTECTION DEVICE."

> **NOTE**
> 1. Connect the cable of the input power supply monitor (CX48) following circuit breaker 2 or fuse for cable protection.
> 2. The phase order of the cable of the input power supply monitor (CX48) must be consistent with the phase order of CZ1 or TB1. For details, See Subsection 9.3.1.7.
> 3. Be sure to connect ground wiring from the ground terminal for safe system operation. For details, See Subsection 9.3.1.6.

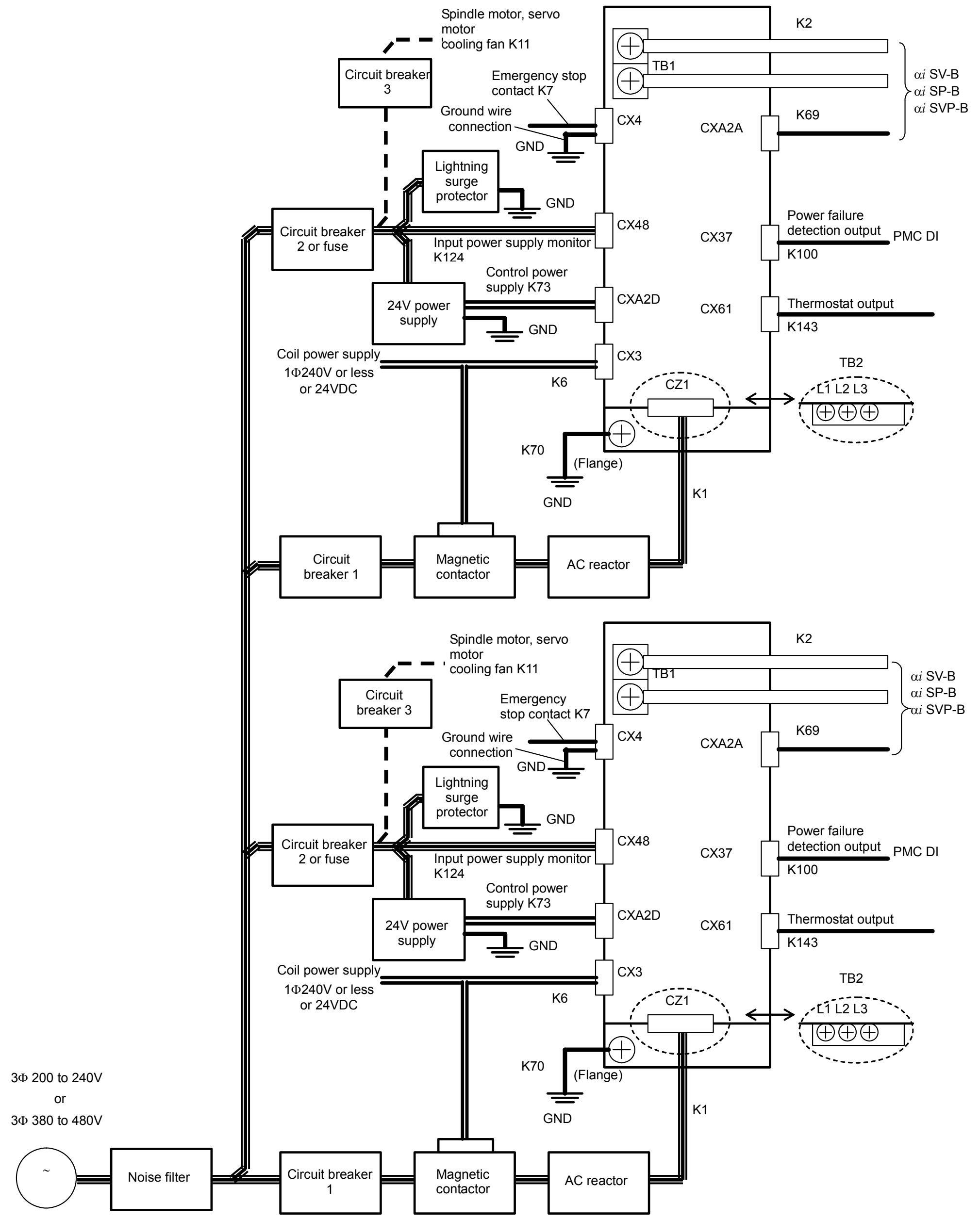
NOTE

4 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. For details, see Appendix A, "FITTING A LIGHTNING SURGE PROTECTION DEVICE."

5 If the circuit breaker at the input section of the lightning surge protector trips, the lightning surge protector is disabled. It is necessary to detect the trip and issue a warning.

6 A cooling fan motor has been added to some spindle motor and servo motor models. Select an appropriate circuit breaker 3 by checking the specifications of the cooling fan described in the specification descriptions of servo motors and spindle motors (B-65262, B-65272).

- Connection on using two αiPS-B series amplifiers (200 V, 400 V input)

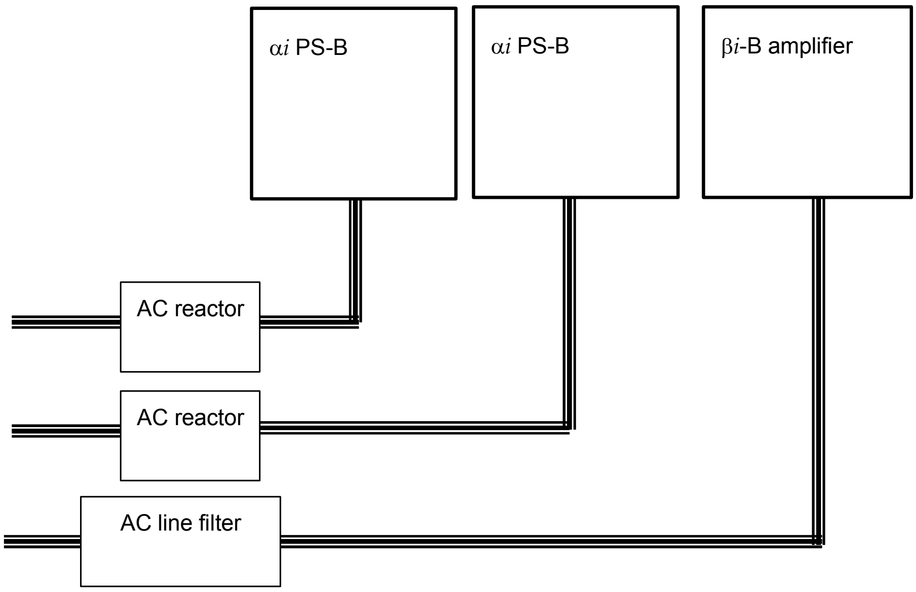


> ⚠ **CAUTION**
> Circuit breaker 1, the magnetic contactor, and the AC reactor cannot be shared among α*i*PS-B. For each α*i*PS-B, select and use these devices having appropriate capacitance specifications.

> **NOTE**
> 1 To share circuit breaker 2, select a circuit breaker with a rated current not greater than the total current consumption of the connected devices and the total overload strength current of all connected devices and wiring. For details, See Subsection 9.3.1.7.
> 2 Ensure that the length of the cable used for the lightning surge protection device does not exceed 2 m. For details, see Appendix A, "FITTING A LIGHTNING SURGE PROTECTION DEVICE."
> 3 The 24V power supply can be shared.
> 4 A load current equivalent to the sum of the load current of the respective α*i*PS-B amplifiers runs through the noise filter. Calculate these load current and select amplifiers so that the total load current does not exceed the rated current of the noise filter.
> 5 A cooling fan motor has been added to some spindle motor and servo motor models.
> Select an appropriate circuit breaker 3 by checking the specifications of the cooling fan described in the specification descriptions of servo motors and spindle motors (B-65262, B-65272).

- **Notes on using multiple α*i*PS-B series and β*i* series amplifiers**

(a) An AC reactor for the α*i*PS-B cannot be used as an AC line filter of the β*i* series amplifier. Connect devices as follows:

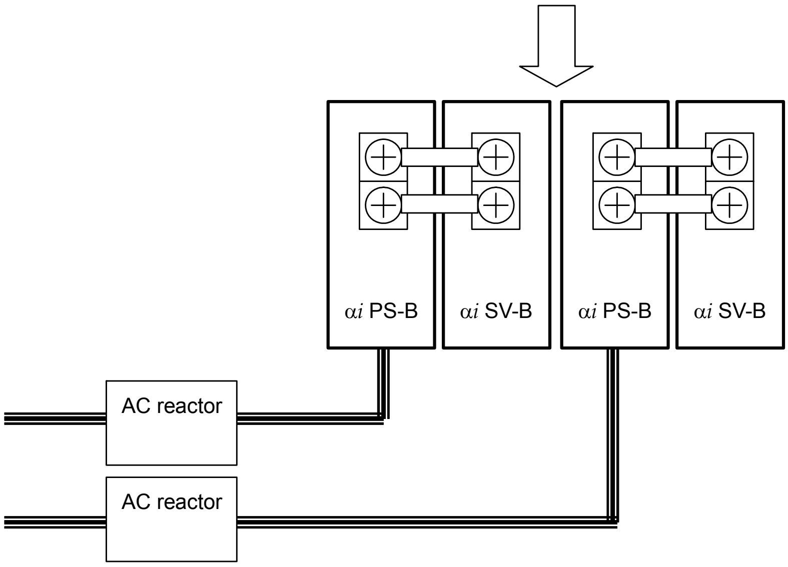


⚠ CAUTION

When multiple αiPS-B and βi-B amplifiers are used, sharing an AC reactor or AC line filter among these amplifiers can result in an alarm or can damage these amplifiers.

- Note on using multiple αiPS-B series units

(a) Be careful not to connect DC links of multiple αiPS-B amplifiers incorrectly.



⚠ CAUTION

When multiple αiPS-B are used, connecting their DC links can result in an alarm or can damage these amplifiers.

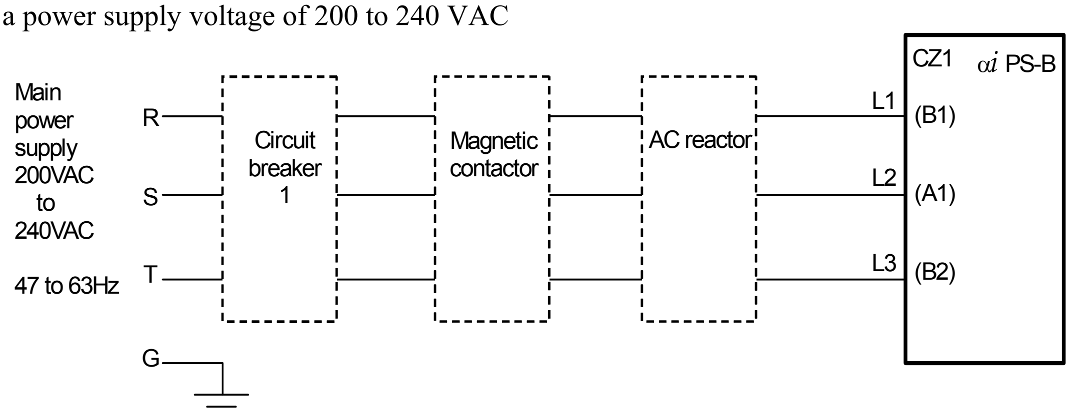
9.3.1.1 Details of cable K1 (power supply line)

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

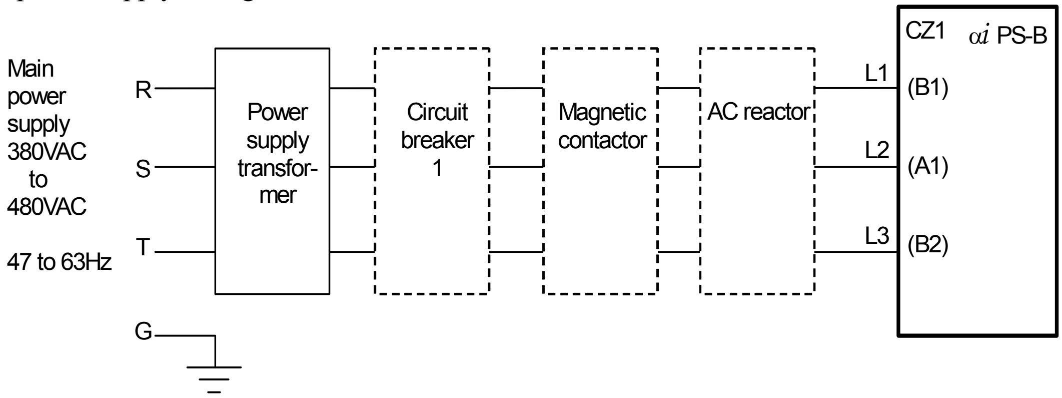
(1) For αiPS-B

- αiPS 3-B, αiPS 7.5-B

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



(b) For a power supply voltage other than 200 to 240 VAC



Pin location of CZ1

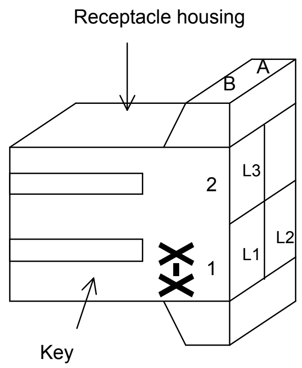


Table 9.3.1.1(a) Cable K1 Specifications (α*i*PS3-B, α*i*PS-B7.5)

Model	Applicable cable		
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)	Cable conforming to UL standard
α*i*PS 3-B	3.5mm^2	3.5mm^2	AWG10 or larger
α*i*PS 7.5-B	7.5mm^2	7.5mm^2	AWG8 or larger

NOTE

1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT: heat-resistant 60°C)

2 The cross-section area of each cable is determined under the following conditions:
  (1) At α*i*PS-B continuous 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 specification

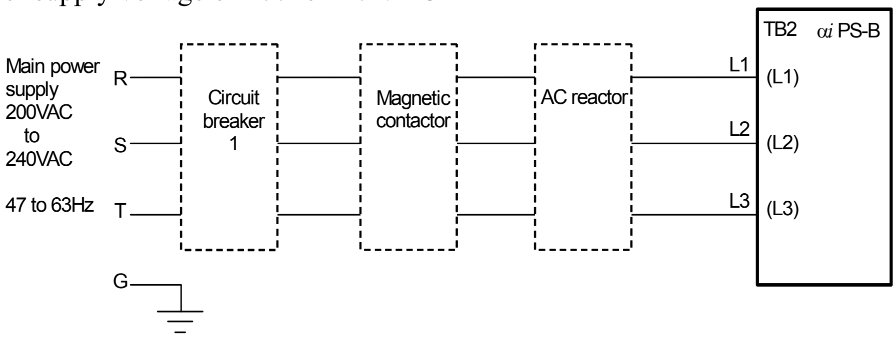
Model	Connector key (Note)	Applicable contact (Note)
α*i*PS 3-B, α*i*PS 7.5-B	XX 1-917807-2	M size 316041-6

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

> **NOTE**
> D-5000 series manufactured by Tyco Electronics Japan G.K.
> Select a contact size according to the cross-section area of the cable.

- α*i*PS 11-B or higher model

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



(b) For a power supply voltage other than 200 to 240 VAC

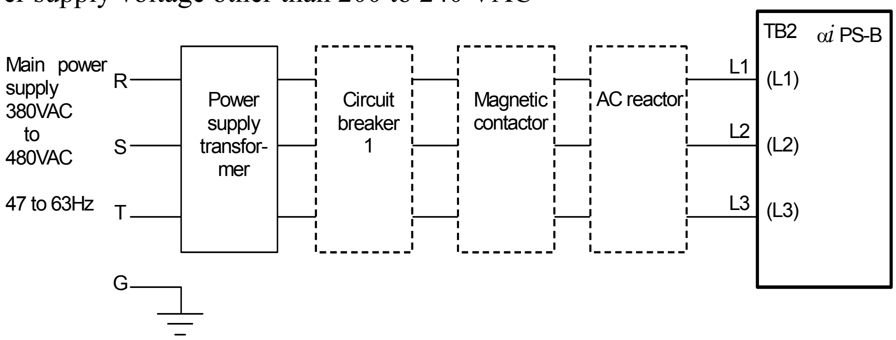


Table 9.3.1.1(b) Cable K1 Specifications, screw tightening torque (α*i*PS11-B to α*i*PS55-B)

Model	Applicable cable			α*i*PS-B side		Reactor side	
	Heavy-duty power cable (Note 1)	Heat-resistant cable (Note 2)	Cable conforming to UL standard	Terminal screw	Tightening torque	Terminal screw	Tightening torque
α*i*PS 11-B	-	8mm^2 or more	AWG8 or higher	M4 (Note 3)	1.1 to 1.5Nm	M5	2.0 to 2.5Nm
α*i*PS 15-B	14 mm^2 or more	14mm^2 or more	AWG4 or higher				
α*i*PS 26-B	-	22mm^2 or more	AWG2 or higher	M6	3.5 to 4.5Nm		
α*i*PS 30-B	-	22mm^2 or more	AWG2 or higher				
α*i*PS 37-B	-	38mm^2 or more	AWG1 or higher	M6 (Note 3)		M8	8.5 to 9.5Nm
α*i*PS 55-B	-	G: 40mm^2 or more	AWG1 or higher	M6	3.5 to 4.5Nm		
		R,S,T: 80mm^2 or more	AWG3/0 or higher	M10	15 to 16Nm		

* The AC reactor does not have polarity, so input and output may be connected to either side of the reactor.

NOTE

1. Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT : heat-resistant 60°C)
2. Fire-retardant polyflex wire (heatproof temperature 105°C) equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.
3. Applicable crimp terminal
   for αiPS 15-B: 22-S5 (manufactured by J.S.T. Mfg. Co., Ltd.);
   for αiPS 37-B: 38-6S (manufactured by J.S.T. Mfg. Co., Ltd.)
4. The cross-section area of each cable is determined under the following conditions:
   (1) At αiPS-B continuous 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.

(3) For αiPS-B 400 V input series

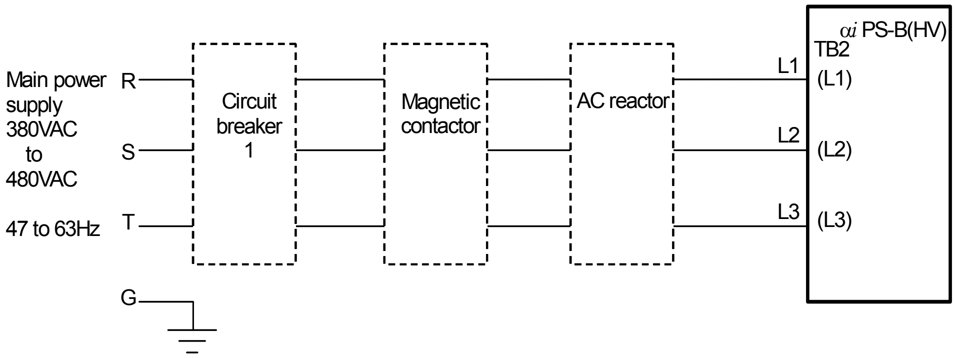


Table 9.3.1.1(d) Cable K1 Specifications

<table>
<tr><th rowspan="2">Model</th><th colspan="3">Applicable cable</th><th colspan="2">αiPS-B side</th><th colspan="2">Reactor side</th></tr>
<tr><th>Heavy-duty power cable (Note 1)</th><th>Heat-resistant cable (Note 2)</th><th>Cable conforming to UL standard</th><th>Terminal screw</th><th>Tightening torque</th><th>Terminal screw</th><th>Tightening torque</th></tr>
<tr><td>αiPS 11HV-B</td><td>5.5mm^2 or more</td><td>5.5mm^2 or more</td><td>AWG8 or higher</td><td rowspan="2">M4</td><td rowspan="2">1.1 to 1.5Nm</td><td rowspan="2">M5</td><td rowspan="2">2.0 to 2.5Nm</td></tr>
<tr><td>αiPS 18HV-B</td><td>-</td><td>8mm^2 or more</td><td>AWG8 or higher</td></tr>
<tr><td>αiPS 30HV-B</td><td>-</td><td>14mm^2 or more</td><td>AWG4 or higher</td><td rowspan="3">M6</td><td rowspan="3">3.5 to 4.5Nm</td><td rowspan="2">M8</td><td rowspan="2">8.5 to 9.5Nm</td></tr>
<tr><td>αiPS 45HV-B</td><td>-</td><td>22mm^2 or more</td><td>AWG2 or higher</td></tr>
<tr><td>αiPS 60HV-B</td><td>-</td><td>22mm^2 or more</td><td>AWG2 or higher</td><td rowspan="5">M10</td><td rowspan="5">15 to 16Nm</td></tr>
<tr><td rowspan="2">αiPS 75HV-B</td><td rowspan="2">-</td><td>G: 22mm^2 or more</td><td>AWG2 or higher</td><td>M6</td><td>3.5 to 4.5Nm</td></tr>
<tr><td>R, S, T: 38mm^2 or more</td><td>AWG1 or higher</td><td>M10</td><td>15 to 16Nm</td></tr>
<tr><td rowspan="2">αiPS 100HV-B
αiPS 125HV-B</td><td rowspan="2">-</td><td>G: 40mm^2 or more</td><td>AWG1 or higher</td><td>M6</td><td>3.5 to 4.5Nm</td></tr>
<tr><td>R, S, T: 80mm^2 or more</td><td>AWG3/0 or higher</td><td>M10</td><td>15 to 16Nm</td></tr>
</table>

* The AC reactor does not have polarity, so input and output may be connected to either side of the reactor.

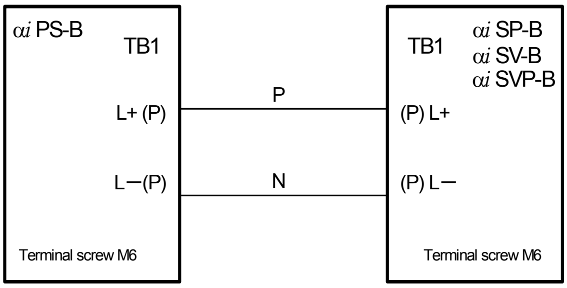
NOTE

1 Four-conductor polyvinyl heavy-duty power cable (JIS C3312) (VCT: heat-resistant 60°C)

2 The cross-section area of each cable is determined under the following conditions:
(1) At αiPS-B continuous 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.

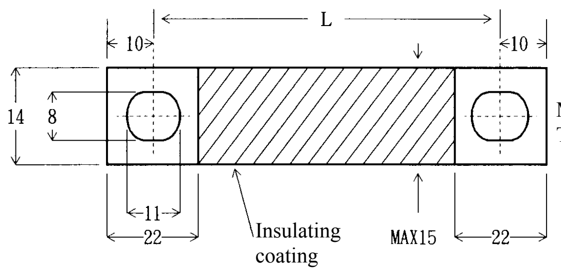
9.3.1.2 Details of short bar K2

Short bar K2 supplies DC link voltage generated by the αiPS-B to individual 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. See the Subsection 3.1.3.6, "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)

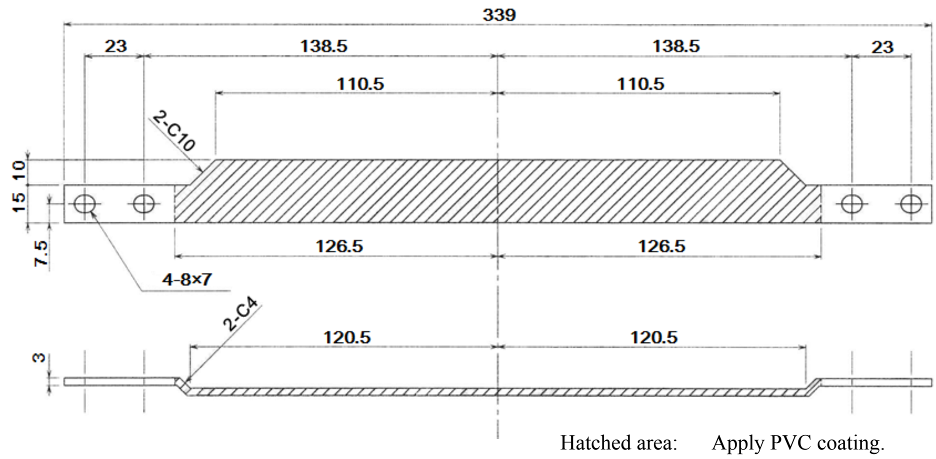


Table 9.3.1.2 Short Bar K2 Specifications

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	21mm^2
Unit of 60mm-wide	60mm	1.5mm	21mm^2

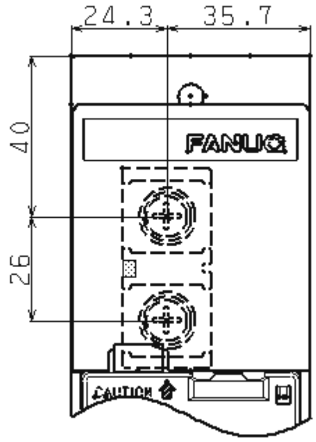
NOTE

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.

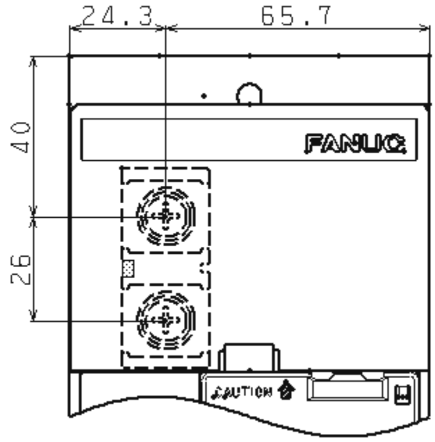
2 When the width is 300 mm (α*i*SP 45-B, α*i*SP 55-B, α*i*PS 55-B, α*i*SP 75HV-B, α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B, α*i*PS 75HV-B, α*i*PS 100HV-B, α*i*PS 125HV, α*i*SV 360HV-B, or α*i*SV 540HV-B), cabling needs to be performed using the two screws at P and N. So, use a dedicated short bar (A06B-6078-K841, two each per set).

- Location of terminal block TB1 on each module

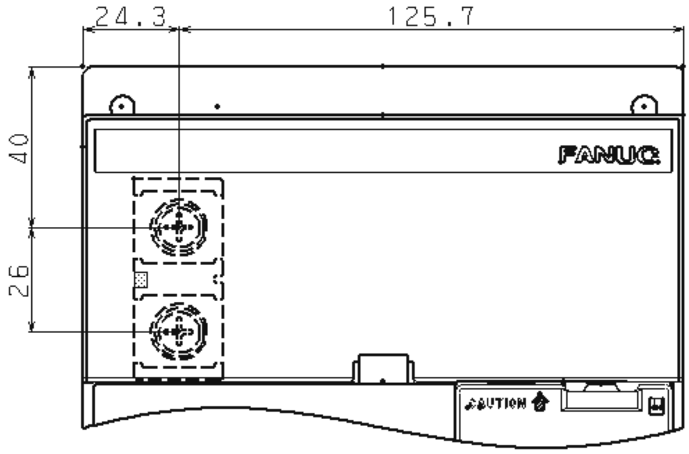
Fig. 9.3.1.2 (a) and Fig. 9.3.1.2 (b) show the location of terminal board TB1 on each module.
If you want to install modules at distances not specified herein, design short bars by referring to the dimensions shown below.
When designing a short bar for connecting 300-mm-wide modules in particular, conform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



Unit of 60mm-wide

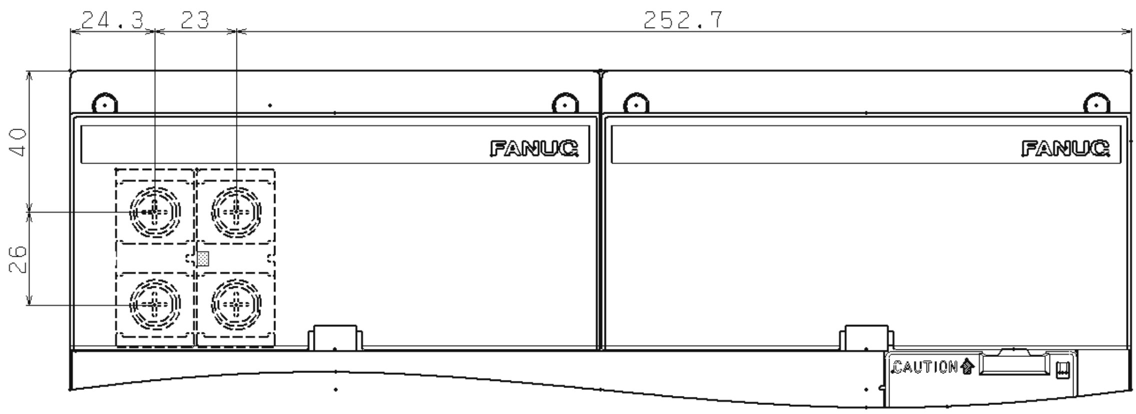


Unit of 90mm-wide



Unit of 150mm-wide

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

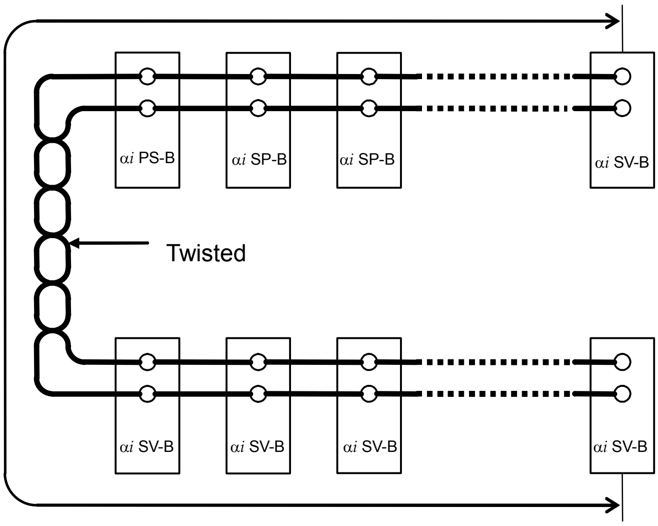


Unit of 300mm-wide

Fig. 9.3.1.2(b) Location of Terminal Block TB1 on the units of 300-mm-wide amplifiers

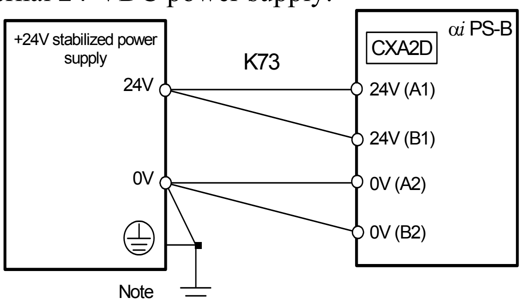
- About the length of the DC link cable

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



9.3.1.3 Details of cable K73

Cable K73 is used to supply control power to the servo amplifier.
Supply the power from an external 24-VDC power supply.

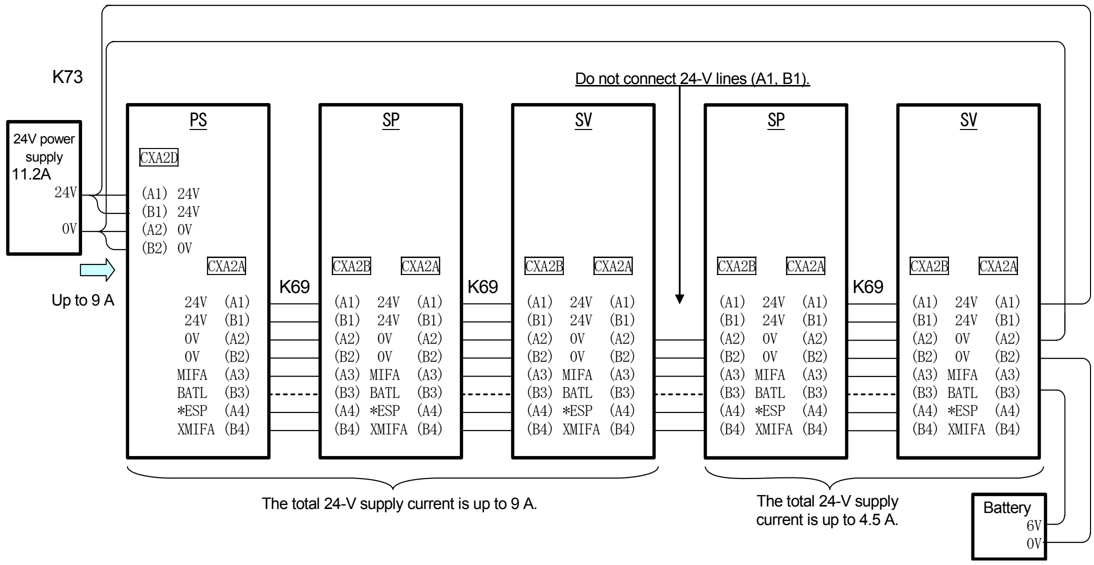


> **NOTE**
> Connect the power via an external wiring since the ground terminal in the stabilized power supply may not be connected to the 0-V pin.

Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-2100 series Housing 1-1318119-4 (1 piece) Contact 1318107-1 (4 pieces)
Conductor size	0.5mm^2, AWG20
Instruction outer diameter	1.11-1.87 mm

Up to 9 A of current can be input via connector CXA2D. If the total current consumption of all the servo amplifiers, including the Power Supply, exceeds 9 A, connect the modules as shown in the figure below so that 24 VDC is supplied also from connector CXA2A on the terminal servo amplifier. Up to 4.5 A of current can be input via the connector CXA2A on the terminal servo amplifier. In this connection, the number of servo amplifiers connectable to one Power Supply is limited. Please check the number with FANUC beforehand.

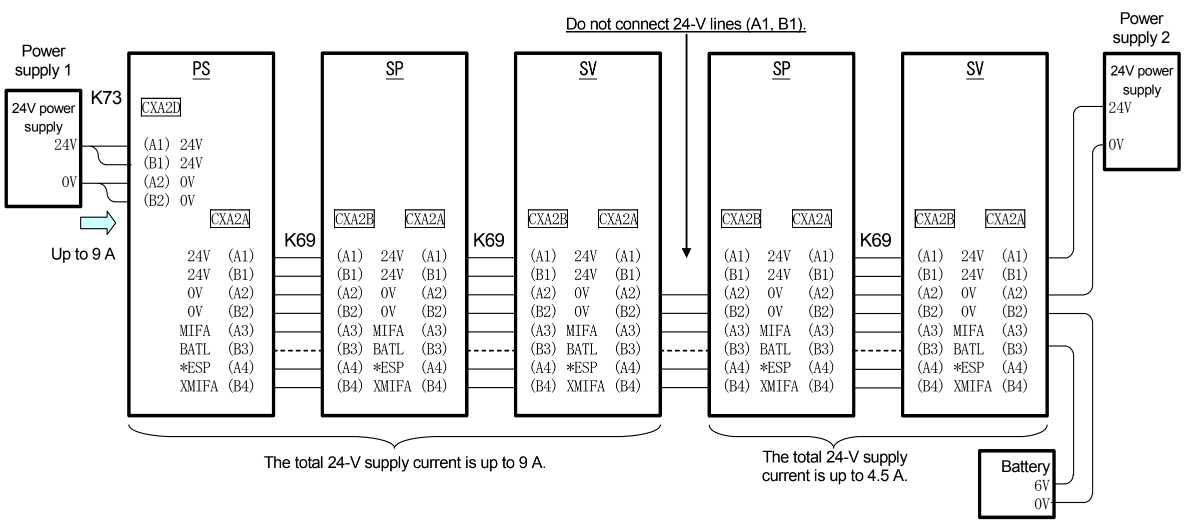


> **NOTE**
> Do not connect between 24 VDC connected via connector CXA2D and 24 VDC connected via connector CXA2A on the terminal servo amplifier. (Do not connect 24 V (A1, B1) between "SV1" and "SP2" in the above figure.)

- Precautions required when supplying 24 VDC to the servo amplifiers with two 24V power supplies

If one 24V power supply does not have sufficient capacity to cover the current consumption of the servo amplifiers, including αiPS-B, connect two 24V power supplies as shown in the figure below. In this case, the maximum current that can be input to the servo amplifier at the terminal via connector CXA2A is 1.5 A. The number of servo amplifiers connected to one αiPS-B is limited. Please consult with FANUC in advance.

An alarm may occur in the servo amplifiers if two 24V power suppliers do not turn on at the same time. Connect them so that they turn on at the same time. If it is difficult to do so, connect the 24V power supplies so that the 24V power supply connected to connector CXA2D (power supply 1 in the figure below) turns on before the power supply connected to connector CXA2A of the servo amplifier at the terminal (power supply 2 in the figure below) turns on.



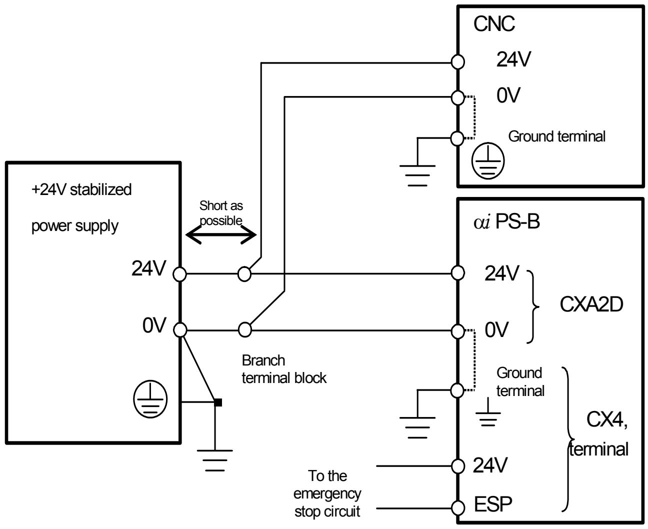
NOTE

Do not connect between 24 VDC connected via connector CXA2D and 24 VDC connected via connector CXA2A on the terminal servo amplifier. (Do not connect 24 V (A1, B1) between "SV1" and "SP2" in the above figure.)

- Notes on sharing the 24-V power supply for servo amplifiers with other devices

The 24-V power supply can be shared with CNC and I/O modules. The power supply shall not be shared with devices which may cause large noise or large load change, including motor brake coils, dynamic brake module coils, and magnetic contactor coils.

To avoid noise from a servo amplifier to the CNC and other modules, connect a branch terminal block near the 24-V power supply and connect CNC and other modules, and servo amplifiers to the branch terminal block.

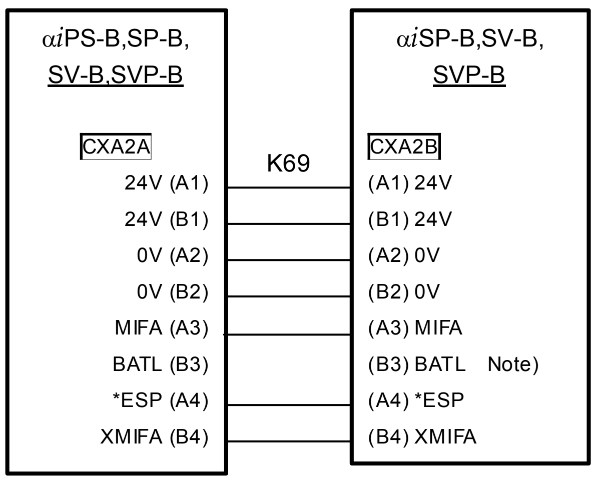


NOTE

Be sure to connect the ground wire from the ground terminal for each device including the 24-V power supply for stable system operation.

9.3.1.4 Details of cable K69

The cable K69 is used between the α*i*PS-B, α*i*SP-B, α*i*SV-B, and α*i*SVP-B.



Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-2100 series Housing 1-1318119-4 (1 piece) Contact 1318107-1 (8 pieces) [Ordering information : A06B-6110-K210 connector only]
Conductor size	0.5mm^2, AWG20
Instruction outer diameter	1.11-1.87

NOTE

The (B3)BATL is the interface used to connect the batteries for the absolute Pulsecoder. For details, see Subsection 9.3.2.9, "Connecting the battery."

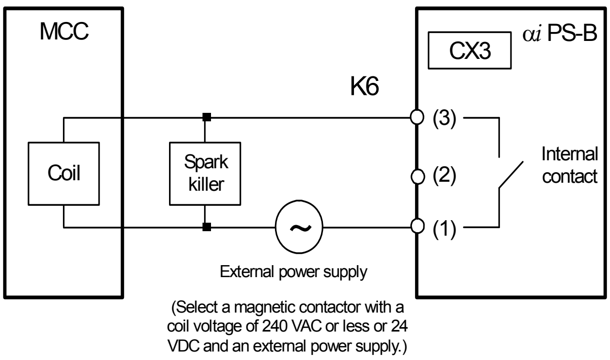
⚠ **WARNING**

1 When using the built-in battery (A06B-6114-K504), never connect the BATL(B3) of the connector CXA2A/CXA2B.
Otherwise, a short-circuit will occur between the battery output voltages for different αiSV-Bs, 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.



Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-3200 series Housing (Y key) 2-178128-3 (1 piece) Contact (M size) 1-175218-2 (2 pieces)
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

Internal-contact specification of αiPS-B

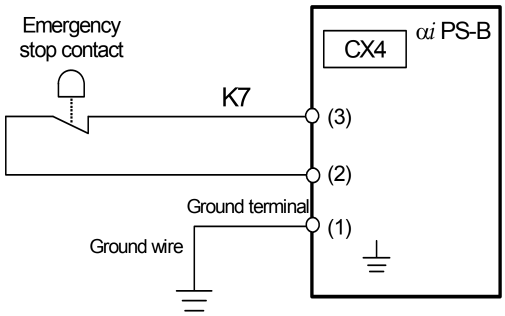
	Resistive load ($\cos\phi = 1$)	**Inductive load ($\cos\phi = 0.4$, L / R = 7msec)**
Rated load	250VAC, 5A / 30VDC, 5A	250VAC, 2A / 30VDC, 2A
Maximum contact rating	5A	5A

> **NOTE**
> Always install a spark killer (CR) that matches the magnetic contactor to protect the internal contacts. Some magnetic contactor manufacturers have a lineup of spark killers suitable for their respective magnetic contactors (CR). For details, please contact the manufacturer of the magnetic contactor.

> **NOTE**
> If you want to use a 24-VDC power supply for the magnetic contactor coil, connect the coil and power supply as follows:
> - Connect a diode or spark killer (CR) to both ends of the coil to suppress the surge generated at the ends.
> - Separate the 24-VDC power supply to be used for the coil from the control power supply.

9.3.1.6 Details of cable K7

Cable K7 is used to input an emergency stop signal and ground cable to the α*i*PS-B.



Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-3200 series Housing (X key) 1-178128-3 (1 piece) Contact (M size) 1-175218-2 (3 pieces)
Cable specification	Conductor size of 1.25 mm^2 (50/0.18), PVC sheath 9.6 mm in diameter

(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 α*i*PS-B 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 α*i*PS-B, must be set to OFF (open) within 200 ms after turn-off of the α*i*PS-B main power.

When the contact of the ESP signal (CX4) remains ON (closed) after the αiPS-B main power is turned off, a DC link low-voltage alarm (alarm No. 4) occurs in the αiPS-B.

⚠ **WARNING**

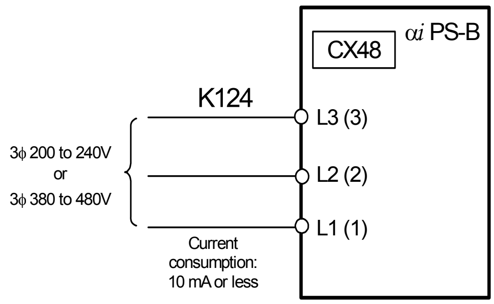
1 The spindle free-runs as a result of a power failure, an alarm, or a command from the ladder (MPOFA signal). During free running, the spindle does not stop even when an emergency stop is applied.
2 Note that even when the power is off, the spindle might be free-running.
3 When an amplifier requires an external dynamic brake module, but no dynamic brake module is connected to the amplifier, applying an emergency stop causes the servo axis to coast.
4 The ESP signal receive circuit of the amplifier is implemented by an electronic circuit. This means that input of the ESP signal to the amplifier due to an electronic circuit failure may not stop the motor.
5 It is desirable to create a ladder program which stops the motors for other axes in the control mode if an alarm occurs for a servo axis or spindle.

NOTE

Be sure to connect the ground wire to the ground terminal for stable system operation.

9.3.1.7 Details of cable K124

Cable K124 is used to monitor the input power supply voltage on the αiPS-B.



For cable K124, be sure to connect the phases connected to the main αiPS-B circuit in the order shown in the figure sequence (L1 = (1), L2 = (2), L3 = (3)). Connect cable K124 through a circuit breaker or fuse to CX48 to protect the circuit if a short-circuit occurs in the cable, where the input current of CX48 is 10 mA or less.

Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-3200 series Housing (Z key) 3-178128-3 (1 piece) Contact (L size) 1-175218-2 (3 pieces)
Cable specification	Conductor size of 1.25 mm^2 (50/0.18), Tolerant voltage: 600 V

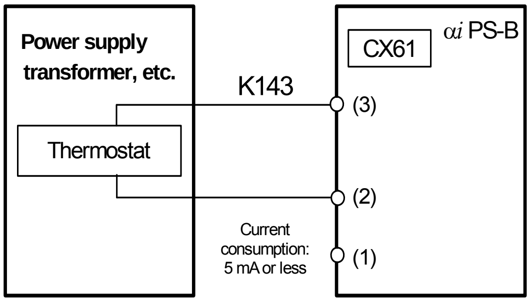
An overcurrent protective device to protect a 1.25-mm^2 cable is shown below:

Fuse: Up to 15 A
Circuit breaker: Up to 15 A

NOTE

The overcurrent protective device can be shared with other devices (such as a 24-V control power supply) as long as the total current consumption does not exceed the above value. When the overcurrent protective device is shared with other devices, the overload strength of all devices connected to the overcurrent protective device and wiring shall be at least the overload strength of the overcurrent protective device.

9.3.1.8 Details of cable K143



Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-2100 series Housing 1-1318120-3 (1 piece) Contact 1318107-1 (2 pieces)
Cable specification	Conductor: 0.5 mm^2 AWG20

Use a thermostat that meets the following specifications.

Contact capacity	24 V +10%, 10 mA or more
Minimum current value	5 mA or less
Contact	Contact B (always closed)
Inter-contact voltage drop during circuit closure	2 V or less (including cable voltage drop)

Example)

Manufacturer	Uchiya Thermostat Co., Ltd.
Model name	UP72G

When using the overheat protection function for external devices (e.g., power supply transformer), set the following parameters.

CNC parameter number		bit	Setting	Applicable software series/edition
PS control axis				
SV	SP			
P2572	P4672	#3	0: Unused 1: Used	Series 9G10 edition 01.0 or later

NOTE

1 For information about the PS control axis, see Subsection 15.3.1, "PS Control Axis" in the DESCRIPTIONS (B-65412EN/02).
2 For information about how to confirm the series/edition of Power Supply software, see Section 15.4, "CHECKING THE SERIES AND EDITION OF POWER SUPPLY SOFTWARE" in the DESCRIPTIONS (B-65412EN/02).

When using the overheat protection function for external devices (e.g., power supply transformer), use the following edition of CNC.

CNC model	Edition
Series 30*i*/31*i*/32*i*-MODEL B	Edition 49.0
Series 30*i*/31*i*-LB	Edition 21.0
Series 30*i*/31*i*-PB	Edition 22.0
Series 35*i*-MODEL B	Edition 13.0
Power Motion *i*-A	Edition 08.0

When the target device becomes overheated and the thermostat is activated, the following alarm is generated.

- Servo alarm

Alarm No.	Indication of Power Supply LED display	Alarm description
SV0040	25	The PS external input device is abnormal.

- Servo alarm

Alarm No.	Indication of Power Supply LED display	Alarm description
SP9213	25	The PS external input device is abnormal.

NOTE

1. This function cannot be used with FANUC series 0*i*-D because the series does not support the setting of the Power Supply parameter.
2. Earlier editions of software/earlier editions of CNCs that do not support this function do not support alarm display. Therefore, correct alarm is not displayed on the CNC screen when the alarm is generated ("PS SUB MODULE ERROR 1" is displayed).
3. Even if no external devices become overheated, this alarm is output in the following cases.
   Cable K143 is disconnected or connected incorrectly.
   Thermostat is connected with the parameter set to "0: Unused."

9.3.1.9 Details of cable K70

See Table 9.3.1.3, and determine the cable to be used for connecting the metal frames of the α*i*PS-B, α*i*SP-B, α*i*SV-B, α*i*SVP-B, and dynamic brake module (DBM) to the frame ground of the power magnetics cabinet.

Table 9.3.1.3 Grounding cable cross-section

Power cable cross-section S (mm^2)	Grounding cable cross-section (mm^2)
$S \le 5.5$	5.5 or more
$5.5 < S \le 16$	S or more
$16 < S \le 35$	16 or more
$35 < S$	S/2 or more

NOTE

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

Based on the tables below, select a crimp terminal used for connection to the α*i*PS-B.

200V models

Amplifier model	Terminal screw*	Tightening torque
α*i*PS 3-B, α*i*PS 7.5-B, α*i*PS 11-B, α*i*PS 15-B, α*i*PS 26-B, α*i*PS 30-B, α*i*PS 3-B7-B	M5	2 to 2.5Nm
α*i*PS 55-B	M6	3.5 to 4.5Nm

400V models

Amplifier model	Terminal screw*	Tightening torque
α*i*PS 11HV-B , α*i*PS 18HV-B, α*i*PS 30HV-B, α*i*PS 45HV-B, α*i*PS 60HV-B	M5	2 to 2.5Nm
α*i*PS 75HV-B, α*i*PS 100HV-B, α*i*PS 125HV-B	M6	3.5 to 4.5Nm

* Use a washer or a screw with washer.

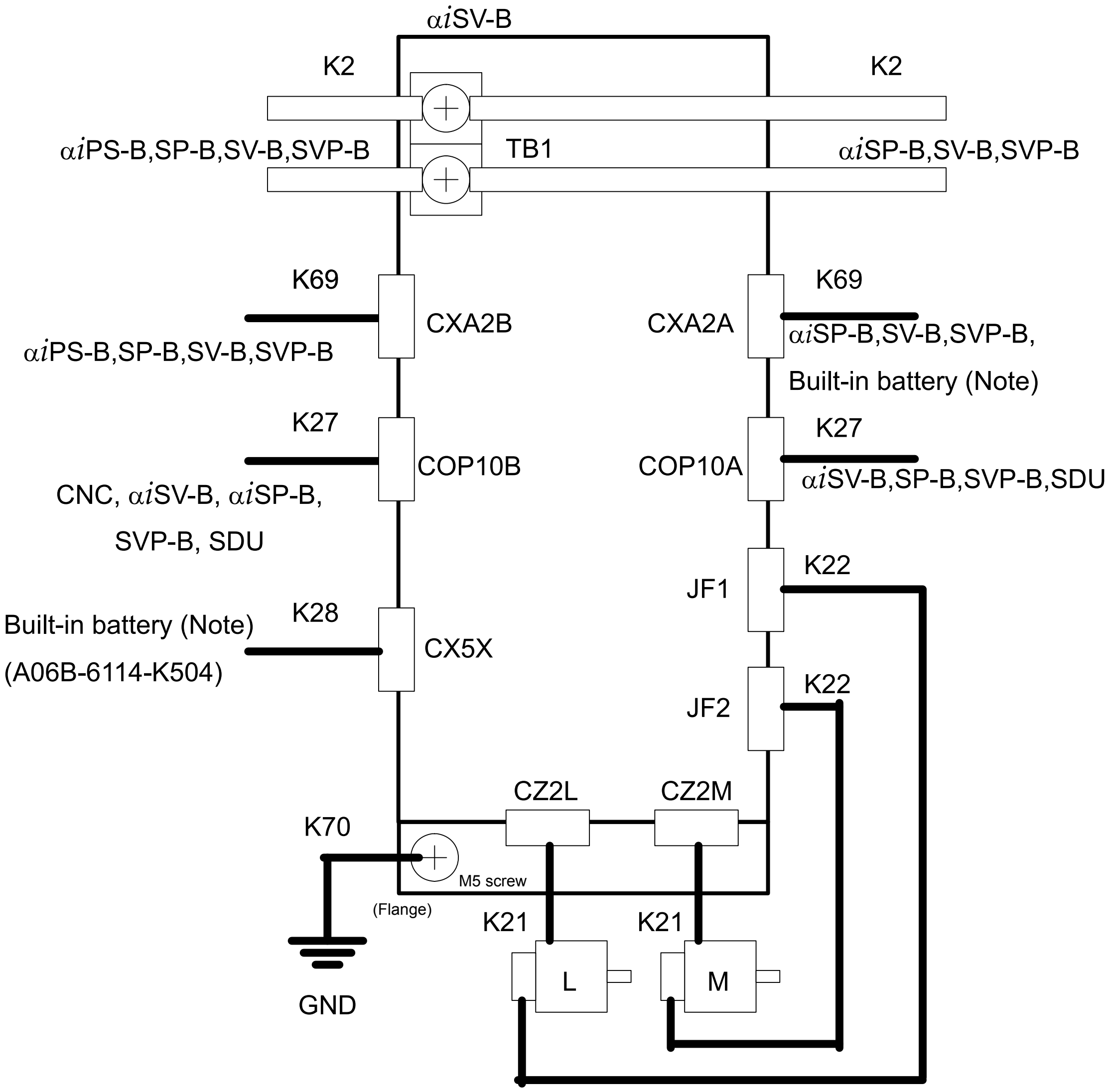
9.3.1.10 Details of cable K100 (for power failure detection output)

Cable K100 is used for the function for preventing the vertical axis from falling at the time of power failure. For details, see Chapter 13, "POWER FAILURE DETECTION FUNCTION."

9.3.2 α*i*SV-B Series Connection Diagram

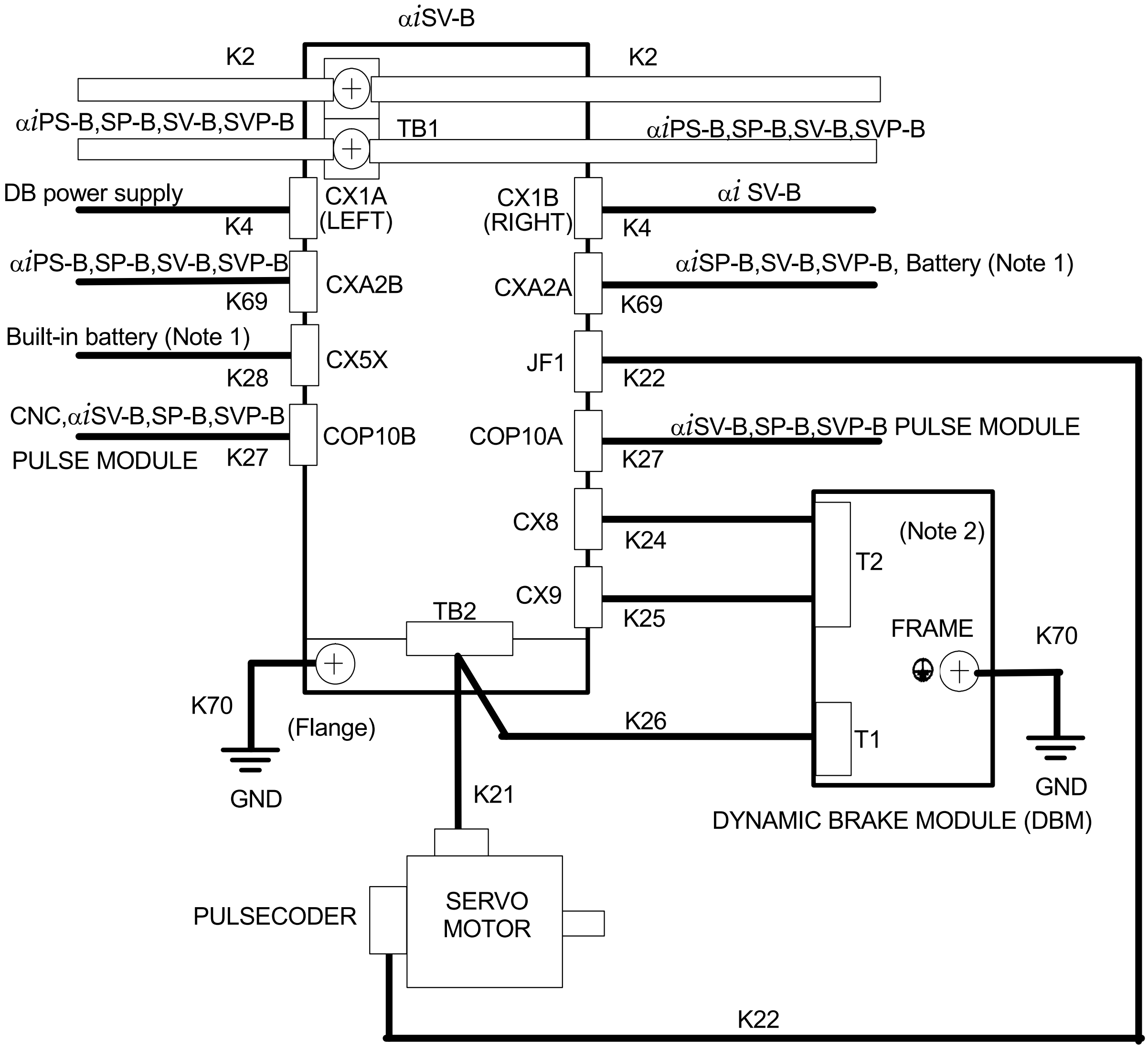
α*i*SV-B series connection

(a) 60/90mm-wide α*i*SV-B (Example: α*i*SV-B 2-axis)
Without connection to dynamic brake module



> **NOTE**
> See Subsection 9.3.2.9, "Connecting the battery" for connection to the battery or built-in battery.

(b) α*i*SV 360-B, α*i*SV 180HV-B, α*i*SV 360HV-B, α*i*SV 540HV-B

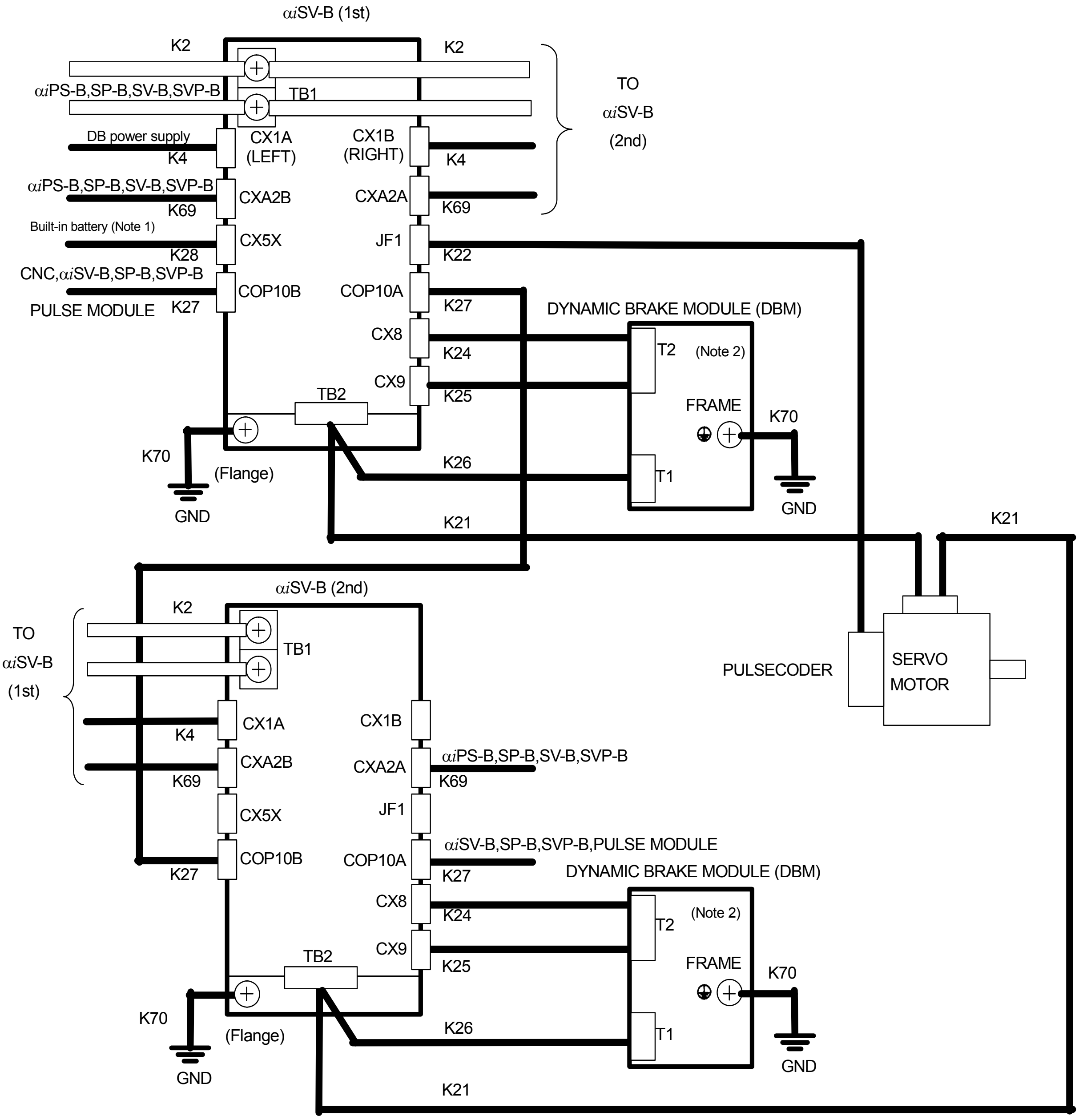


NOTE

1 See Subsection 9.3.2.9, "Connecting the battery" for connection to the battery or built-in battery.

2 Connect one dynamic brake module for each servo amplifier.

(c) α*i*SV 360-B, α*i*SV 180HV-B, α*i*SV 360HV-B, α*i*SV 540HV-B
When a servo motor with two windings is driven by two amplifiers



> **NOTE**
> 1 See Subsection 9.3.2.9, "Connecting the battery" for connection to the battery or built-in battery.
> 2 Connect one dynamic brake module for each servo amplifier.

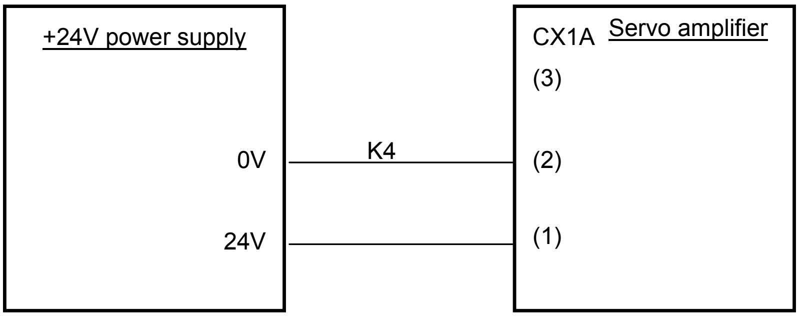
9.3.2.1 Details of cable K2

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

9.3.2.2 Details of cable K4

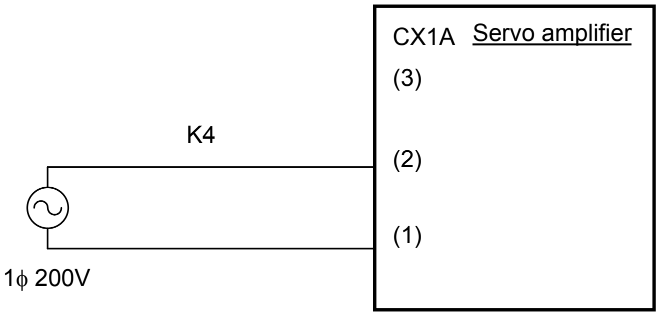
Cable K4 is a connection cable used to supply power for driving the dynamic brake unit to the α*i*SV-B.

(a) When a DB module of the 24-VDC type is used



Example cable	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	Connector manufactured by Tyco Electronics Japan G.K. Receptacle housing: 1-178128-3 Receptacle contact: 1-175218-2

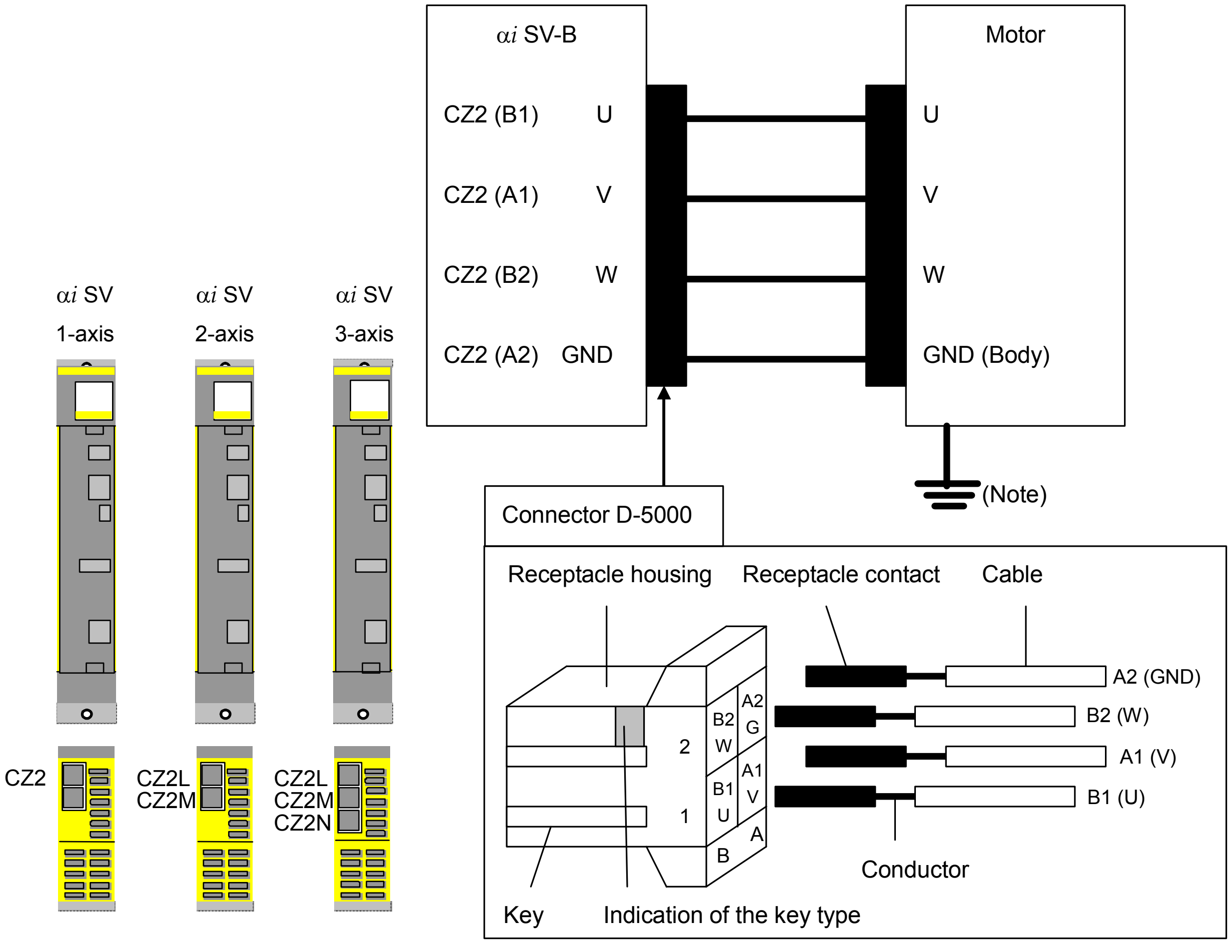
(b) When a DB module of the 200 VAC type is used



Example cable	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	Connector manufactured by Tyco Electronics Japan G.K. Receptacle housing: 1-178128-3 Receptacle contact: 1-175218-2

9.3.2.3 Details of cable K21

The cable K21 is a power cable used between the α*i*SV-B and motor. The cable is attached to the α*i*SV-B through the connector D-5000 excluding α*i*SV 360-B, α*i*SV 180HVS-B, α*i*SV 180HV-B, α*i*SV 360HV-B, and α*i*SV 540HV-B.



> **NOTE**
> When the α*i*SV 40-B 0-V input series 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 power magnetics cabinet) using a cable at least 1.25 mm^2 thick. The cable must be separated from the power lines as much as possible.

> ⚠ **WARNING**
> 1 If the phase order of the power lines is incorrect, an unpredictable motor operation may occur.
> 2 If the power lines are connected to wrong axes (L/M/N), an unpredictable motor operation may occur.

- About the receptacle housing of the α*i*SV-B-side connector
  The α*i*SV-B uses key-type power cable connectors to prevent incorrect connection between the axes of multi-axis amplifiers. Select the receptacle housing that matches the α*i*SV-B and its axis that are to be used.
  See Subsection 9.4.2 for detailed explanations about the specification of the D-5000 manufactured by Tyco Electronics Japan G.K.

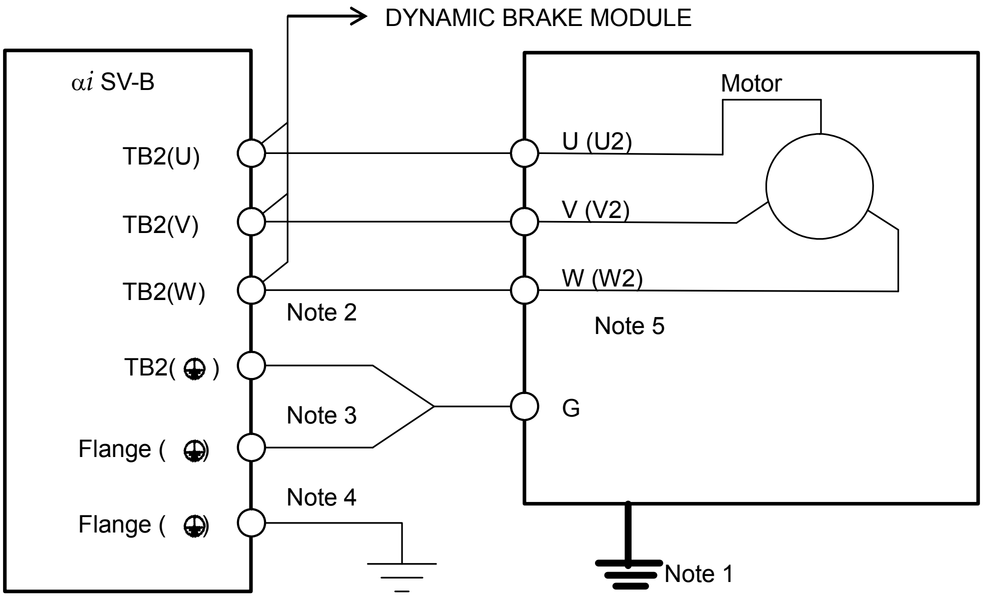
Specification of the key	Applicable α*i*SV-B
XX	L axis of a 1-axis/2-axis amplifier, L axis of a 3-axis amplifier
XY	M axis of a 2-axis amplifier, M axis of a 3-axis amplifier
YY	N axis of a 3-axis amplifier

- About the receptacle contact of the α*i*SV-B-side connector
  Four types receptacle contacts are prepared for the different line cross-sectional area of the cable. Please use the receptacle contact which suits the line cross-sectional area of the cable.
  See Subsection 9.4.2 for detailed explanations about the specification of the D-5000 manufactured by Tyco Electronics Japan G.K.

- 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 α*i* series Descriptions (B-65262EN)" for explanations about the specification of the motor-side connector.

α*i*SV 360-B, α*i*SV 180HVS-B, α*i*SV 180HV-B, α*i*SV 360HV-B, α*i*SV 540HV-B



NOTE

1 When the αiSV 40-B 0-V input series is used, always mount the motor flange on a power magnetics cabinet (machine) connected to the system ground. It may be difficult to connect the motor flange to a power magnetics 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 lines TB2(U), TB2(V), TB2(W), and TB2(G)
- For αiSV 180HVS-B: M4
- For αiSV 360-B and αiSV 180HV-B: M6
- For αiSV 360HV-B and αiSV 540HV-B: M10

3 Size of screws for connection between flange and ground
- For αiSV 360-B, αiSV180HVS-B, and αiSV 180HV-B: M5
- For αiSV 360HV-B and αiSV 540HV-B: M6

4 To drive a motor with multiple windings by using two αiSV-B amplifiers, connect motor power lines (U, V, W, and G) to the first αiSV-B amplifier, and connect motor power lines (U2, V2, W2, and G) to the second αiSV-B amplifier.

5 The αiSV 180HVS-B does not need connection to the dynamic brake module.

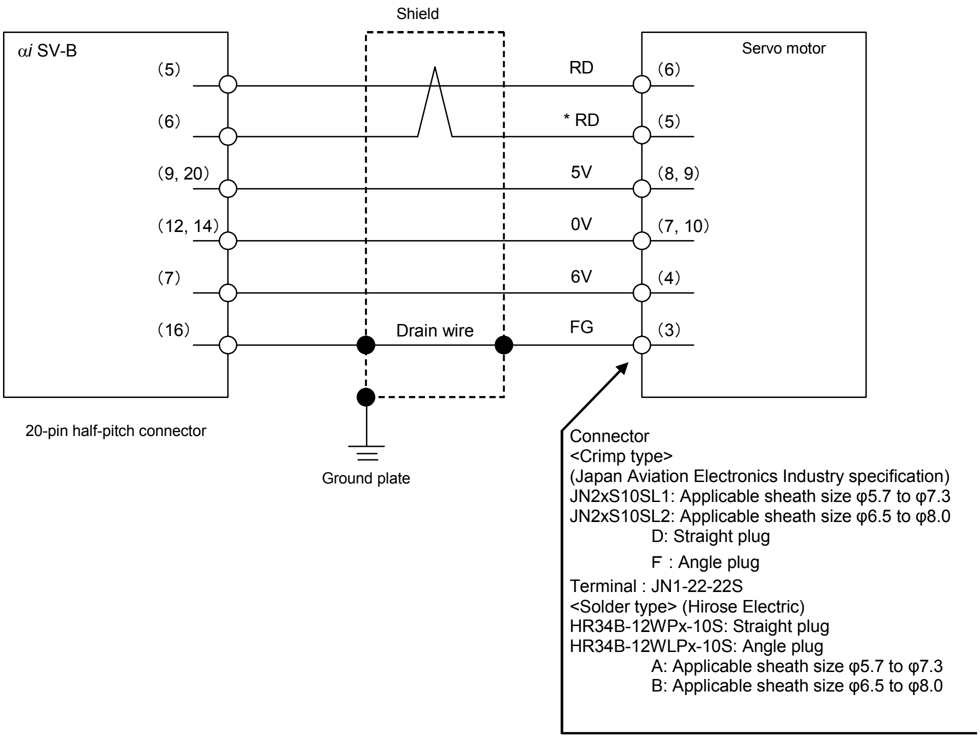
9.3.2.4 Details of cable K22

The cable K22 is used to connect the αiSV-B and Pulsecoder.

⚠ **WARNING**

If the connector (JF1, 2, or 3) of the Pulsecoder is connected incorrectly, an unpredictable motor operation may occur.

For servo motor αiF, αiS series and Servo motor βiS series (βiS 0.4/5000 to βiS 22/2000)



Using cable conductor

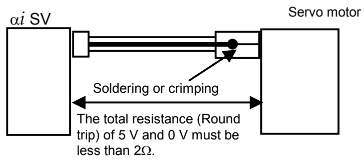
Signal name	Cable length : 28m or less	Cable length : 50m or less
5V, 0V, 6V	$0.3mm^2 \times 5$ (Note 4) Strand configuration: 12/0.18 or 60/0.08 Insulation outer diameter: ϕ0.8 to ϕ1.5	$0.5mm^2 \times 5$ (Note 4) Strand configuration: 20/0.18 or 104/0.08 Insulation outer diameter: ϕ0.8 to ϕ1.5
RD, *RD	$0.18mm^2$ 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 for α*i*SV-B connector that matches the recommended cable.
See Appendix B, "ABOUT CABLE CONDUCTORS," for detailed explanations about the cable.

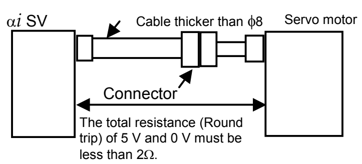
NOTE

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 a wire with cross-sectional area of not more than 0.5 mm^2 (wire construction 20/0.18 or 104/0.08, diameter ϕ1.5 or less) and sheath diameter is ϕ5.7 to ϕ8.0. In case of using thicker wire or cable, take measures described below.

[Case 1] Cable conductor exceeds $0.5mm^2$.



[Case 2] Sheath diameter of exceeds ϕ8.



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

- Crimp tool specification

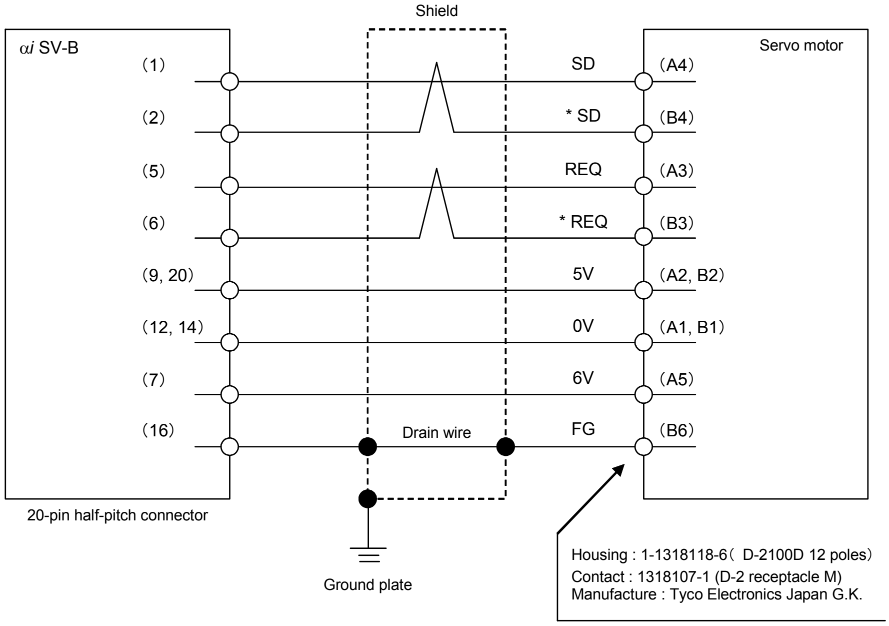
FANUC specification	Japan Aviation Electronics Industry specification	Applicable cross-sectional area
A06B-6114-K201/JN1E	CT150-2-JN1-E	21AWG ($0.5mm^2$:20/0.18) 23AWG ($0.3mm^2$) 25AWG ($0.18mm^2$)
A06B-6114-K201/JN1D	CT150-2-JN1-D	20AWG ($0.5mm^2$:104/0.08) 21AWG ($0.5mm^2$:20/0.18) 25AWG ($0.18mm^2$)

- Recommended cable

Recommended cable specification	Description	Crimp tool specification
A66L-0001-0460	Flexible cable 28m or less	A06B-6114-K201/JN1E (FANUC specification) CT150-2-JN1-E (Japan Aviation Electronics Industry specification)
A66L-0001-0481	Fixed cable 28m or less	
A66L-0001-0462	Flexible cable 50m or less	A06B-6114-K201/JN1D (FANUC specification) CT150-2-JN1-D (Japan Aviation Electronics Industry specification)
A66L-0001-0491	Fixed cable 50m or less	

- Connector kit specification
  <Crimp type>
    A06B-6114-K204/S: Straight plug (including a contact)
    A06B-6114-K204/E: Elbow plug (including a contact)
  <Solder type>
    A06B-6114-K205/S: Straight plug
    A06B-6114-K205/E: Elbow plug

For servo motor β*i*S series (β*i*S 0.2/5000, β*i*S 0.3/5000)



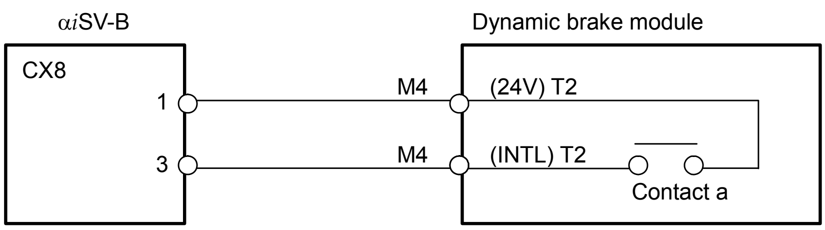
Using cable conductor

Signal name	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 wire 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 Metals, Ltd.: UL20276-SB(0)5X21AWG+2PX25AWG (For a flexible cable) Hitachi Metals, Ltd.: UL20276-SB(FLEX)5X20AWG+2PX25AWG

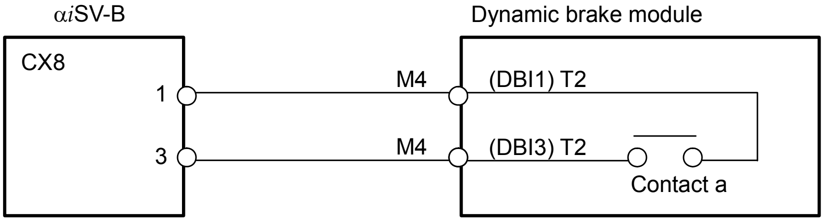
See Subsection 9.4.1 for explanations about the α*i*SV-B-side connector that matches the recommended cable.

9.3.2.5 Details of cable K24

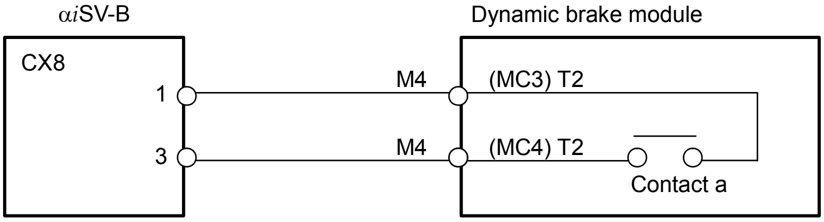
(1) For A06B-6079-H401



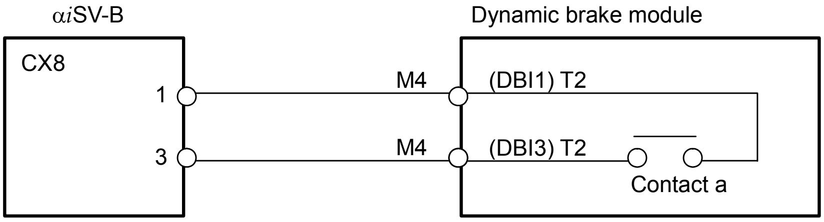
(2) For A06B-6079-H403



(3) For A06B-6069-H300



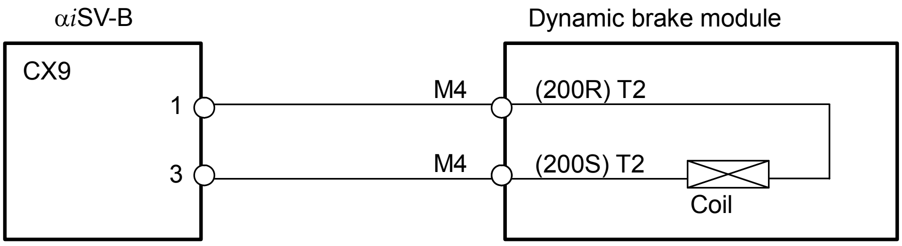
(4) For A06B-6069-H301



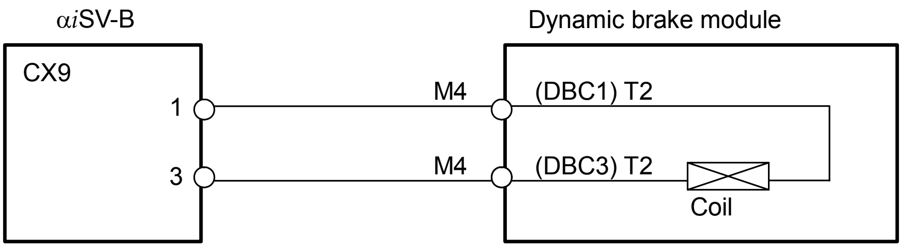
Example cable Two-conductor polyvinyl heavy-duty power cable (JIS C3312)
Conductor size of : 1.25mm^2 (50/0.18), PVC sheath 9.6 mm in diameter
Connector specification Connector manufactured by Tyco Electronics Japan G.K.
Receptacle housing: 2-178128-3
Receptacle contact: 1-175218-2
Crimping terminal 2-4

9.3.2.6 Details of cable K25

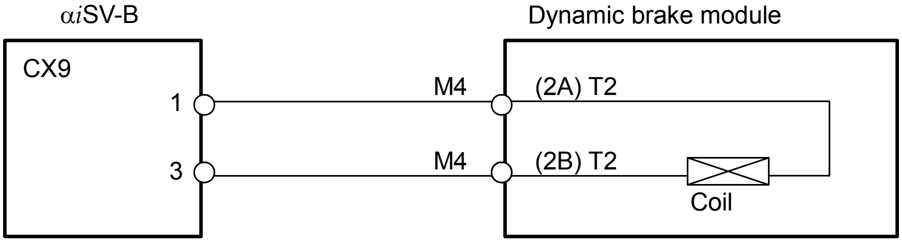
(1) For A06B-6079-H401



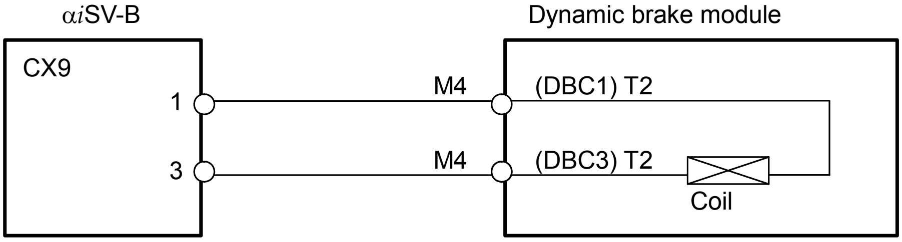
(2) For A06B-6079-H403



(3) For A06B-6069-H300

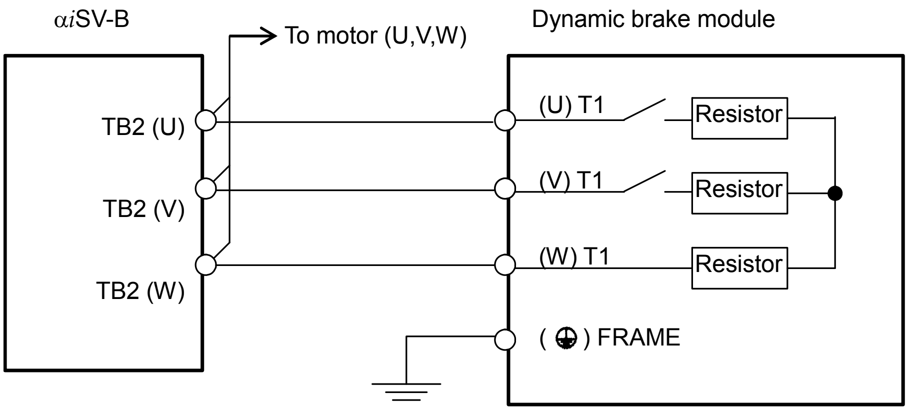


(3) For A06B-6069-H301



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	Connector manufactured by Tyco Electronics Japan G.K. Receptacle housing: 1-178128-3 Receptacle contact: 1-175218-2
Crimping terminal	2-4

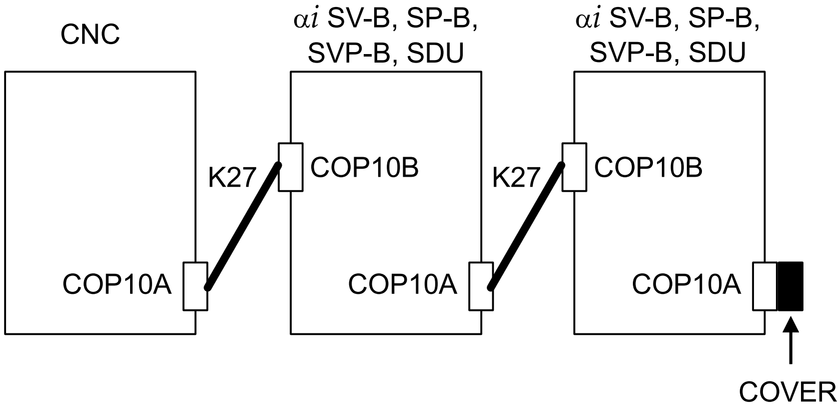
9.3.2.7 Details of cable K26



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	
Crimping terminal	DBM side	5.5-5 (A06B-6079-H401, H403) 5.5-8 (A06B-6069-H300)
	α*i*SV-B side	5.5-6 (α*i*SV 360-B, α*i*SV 180HV-B) 5.5-10 (α*i*SV 360HV-B, α*i*SV 540HV-B)

9.3.2.8 Details of cable K27

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



- The cable is connected from connector COP10A in the CNC, α*i*SV-B, α*i*SP-B, α*i*SVP-B, separated detection module (SDU) to connector COP10B in the α*i*SV-B, α*i*SP-B, or pulse module
- Connector COP10A of a servo amplifier at the end of the cable chain must be covered with the cap supplied with the amplifier.
- Refer to the applicable CNC connection manual for detailed specifications of the optical fiber cable.

9.3.2.9 Connecting the battery (for the absolute Pulsecoder)

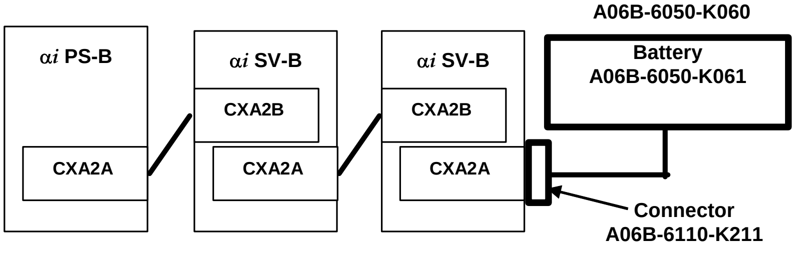
The following two methods can be used to connect the batteries for the absolute Pulsecoder: [connection method 1] and [connection method 2]

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.
3. Do not use both [connection method 1] and [connection method 2] at the same time. Otherwise, multiple batteries are connected to the same BATL(B3) line, and a short-circuit will occur between the output voltages of different batteries, possibly resulting in the batteries becoming very hot, which is dangerous.

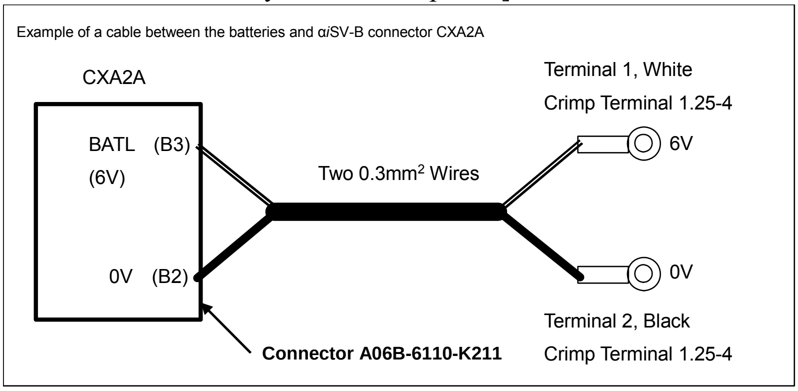
[Connection method 1]

(1) Supplying power from one battery unit to more than one α*i*SV-B (1)



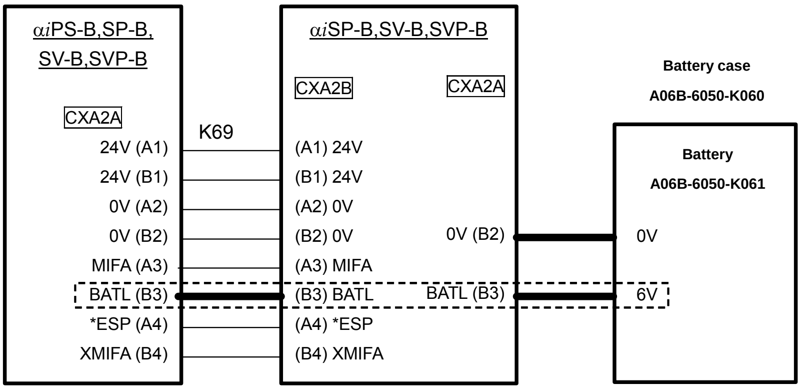
- A battery case (A06B-6050-K060) and four R20 alkaline batteries (A06B-6050-K061) are available as options. Commercial R20 alkaline batteries can also be used.

[Connection between the battery case and amplifier]



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

[Connection between amplifiers]



- The BATL(B3) is an interface for supplying power from one absolute Pulsecoder battery unit to more than one α*i*SV-B.

- Specification of the connector

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

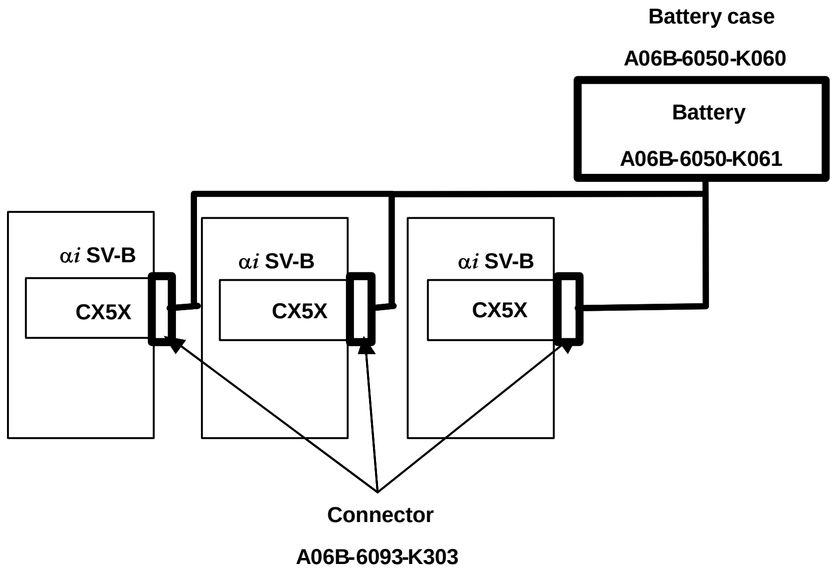
NOTE

1 Up to six servo motors can be connected to one battery.
2 The battery service life is about two years for the α*i* series servo motor.

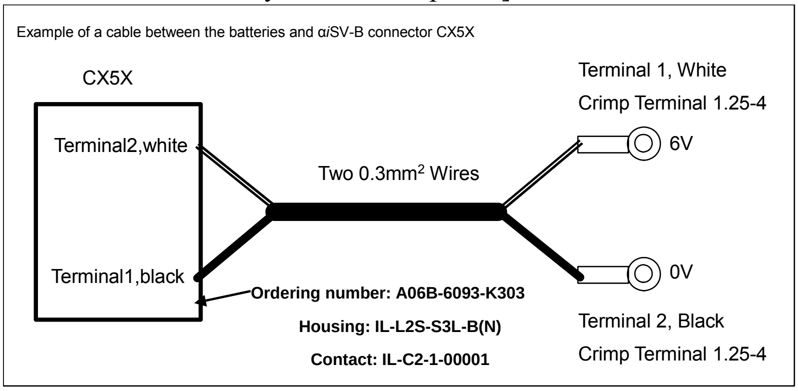
⚠ WARNING

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.

(2) Supplying power from one battery unit to more than one αiSV-B (2)



[Connection between the battery case and amplifier]



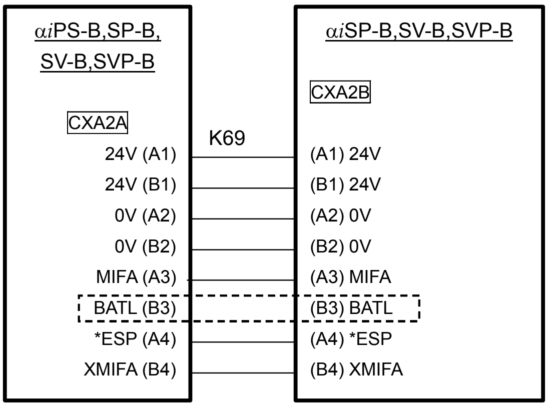
- Specification of the connector

Drawing No.	A06B-6093-K303
Manufacturer	Japan Aviation Electronics Industry, Ltd.
Manufacturer part number	Housing: IL-L2S-S3L-B(N), Quantity: 1 Contact: IL-C2-1-00001, Quantity: 2

To connect the contacts to the cable, a special crimping tool is required. Contact the manufacturer (Japan Aviation Electronics Industry Ltd.).

- A battery case (A06B-6050-K060) and four size-D alkaline dry cells (A06B-6050-K061) are available as options. Size-D alkaline dry cells are commercially available.

[Connection between amplifiers]



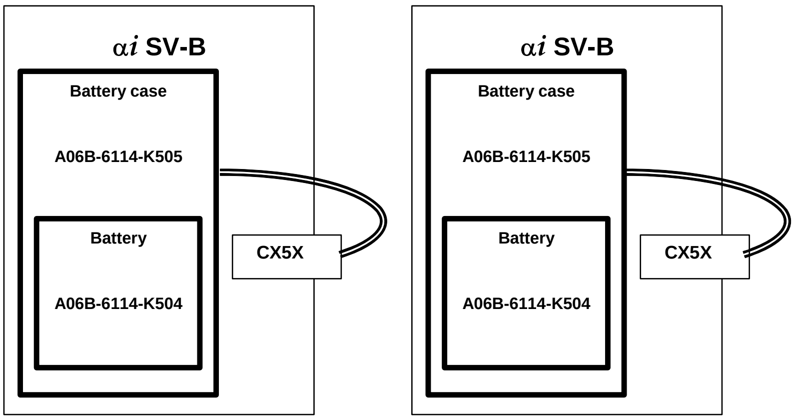
Leave BATL(B3) open.

NOTE
1 Up to six servo motors can be connected to one battery.
2 The battery service life is about two years for the αi series servo motor.

⚠ **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]

(1) Incorporating built-in batteries in each α*i*SV-B
(Models other than α*i*SV 360-B, α*i*SV 180HV-B, α*i*SV 360HV-B, and α*i*SV 540HV-B)



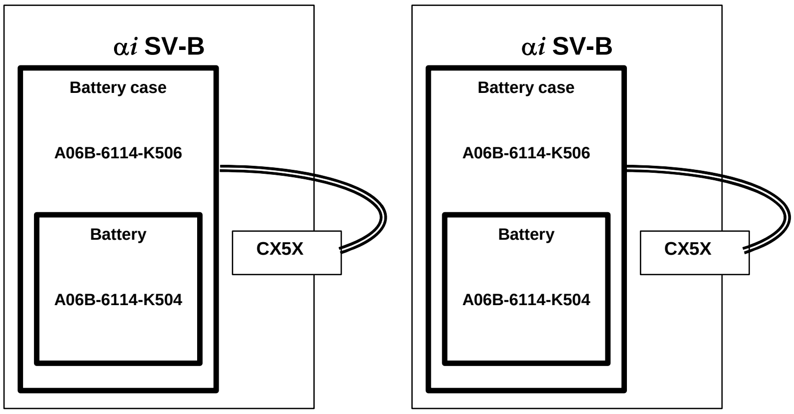
- Using the built-in battery (A06B-6114-K504) requires the battery case (A06B-6114-K505).
  A cover originally mounted at the α*i*SV-B battery location cannot be used with the battery.

⚠ **WARNING**

1 When using the built-in battery, never connect the BATL(B3) of the connector CXA2A/CXA2B.
Otherwise, a short-circuit will occur between the output voltages of different α*i*SV-B 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.

(2) Incorporating built-in batteries in each α*i*SV-B
For the α*i*SV 360-B, α*i*SV 180HV-B, α*i*SV 360HV-B, and α*i*SV 540HV-B



- Using the built-in battery (A06B-6114-K504) requires the battery case (A06B-6114-K506).

⚠ **WARNING**

1 When using the built-in battery, never connect the BATL(B3) of the connector CXA2A/CXA2B.
Otherwise, a short-circuit will occur between the output voltages of different α*i*SV-B 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.

Battery life

When the αi series servo motor is used, the batteries need to be replaced periodically as follows:

Battery ordering specification	Standard backup life	Remarks
A06B-6050-K061	2 years/6 axes	Size D alkaline dry cell × 4
A06B-6114-K504	1 year/3 axes	Lithium battery

9.3.2.10 Details of cable K70

Connect the α*i*SV-B flange to the grounding plate through a grounding cable. (Protective ground connection)
See Subsection 9.3.1.8, "Details of cable K70" for detailed descriptions about the K70.

9.3.2.11 Connection with the SSM of the α*i*SV-B

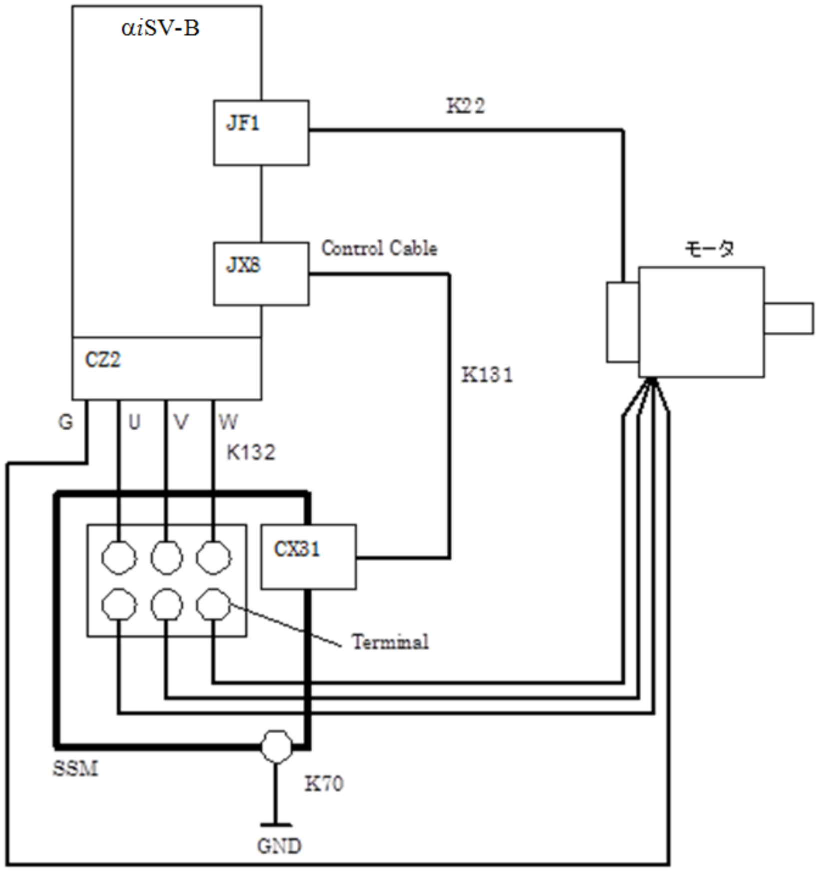
(1) Overview

1-axis amplifiers of the Level-up α*i*SV-B can connect the SSM. By connecting the SSM, it becomes possible to drive devices, such as high-speed rotation type synchronous built-in servo motors. For details of the SSM, see Section 10.4, "SUB MODULE SM."

(2) Compatible CNC and servo control software editions

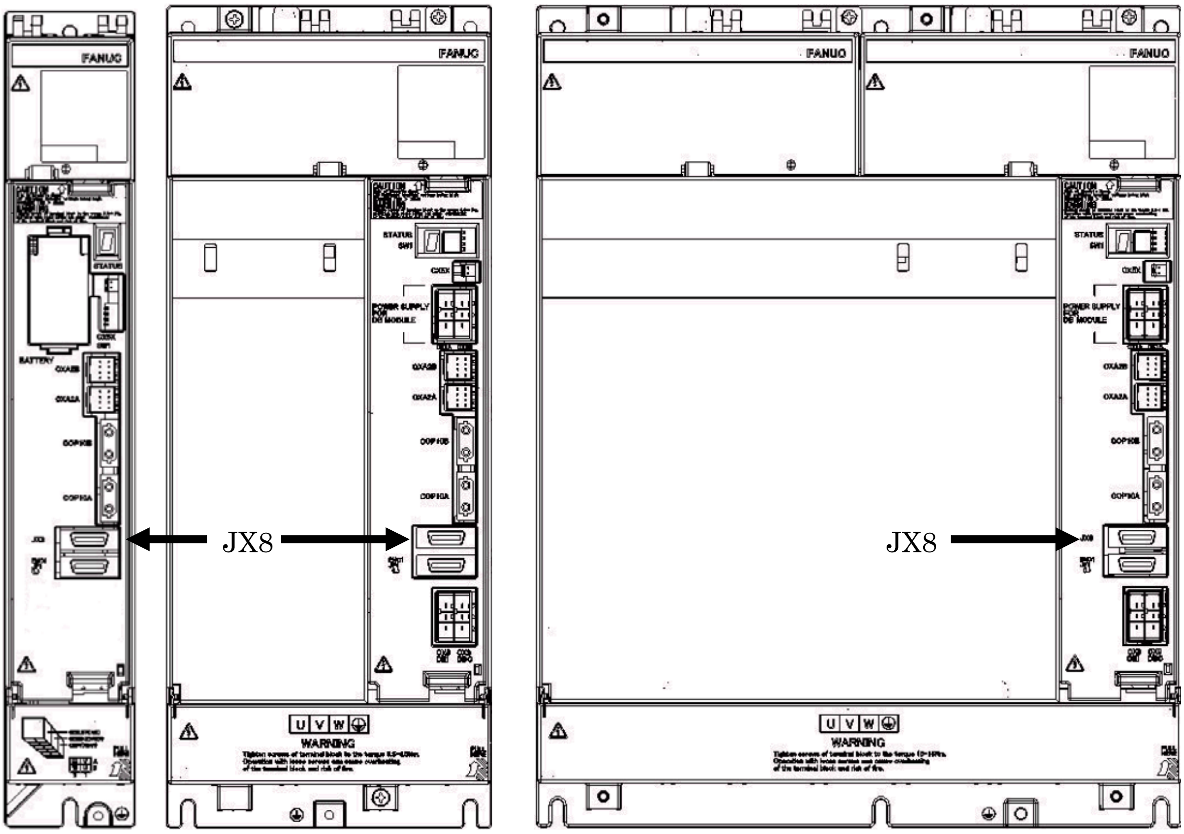
CNC model	Servo control software editions
30*i*/31*i*/32*i*/35*i*-B	Series 90G0 edition 03.0 or later, Series 90G3 edition 01.0 or later Series 90J0 edition 01.0 or later, Series 90J3 edition 01.0 or later Series 90K0 edition 01.0 or later
Power Motion *i*-A	Series 90G0 edition 03.0 or later, Series 90J0 edition 01.0 or later Series 90GP edition 02.0 or later, Series 90JP edition 01.0 or later
0*i*-F	Series 90M0 edition 02.0 or later, Series 90M8 edition 02.0 or later Series 90L0 edition 01.0 or later, Series 90L8 edition 01.0 or later
DSA-B	Series 90J0 edition 02.0 or later Series 90JP edition 01.0 or later
0*i*-D	Series 90C8 edition 06.0 or later, Series 90E8 edition 06.0 or later
0*i*Mate-D	Series 90H0 edition 02.0 or later

(3) Connection diagram



> ⚠**WARNING**
> To ensure safety, do not insert switches and the like on power lines connecting to the αiSV-B, SSM or motors.
> When the switch or similar is turned OFF while the motor is rotating, overvoltage arising from the motor cannot be prevented and the motor and the SSM may be damaged.

(4) Connectors to be used for connection with the SSM
Use "JX8" connectors for input and output of the SSM control signal.



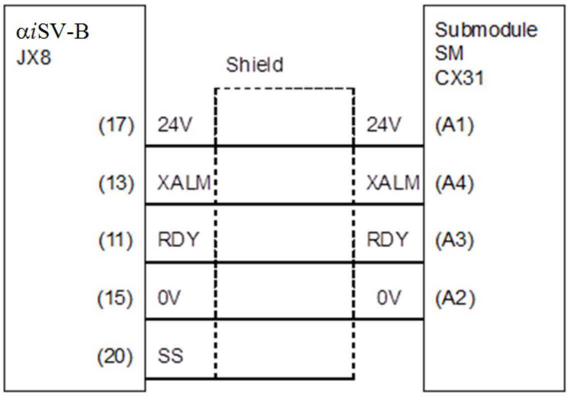
- Servo amplifier-side connector (JX8)

Manufacturer		Hirose Electric Co., Ltd.
Manufacturer part number	Connector	FI40B-20S (solder type)
	Case	FI-20-CVS2 (plastic)

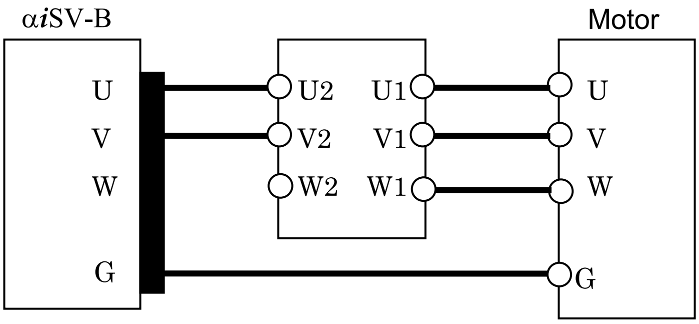
- SSM-side connector (CX31)

Manufacturer		Tyco Electronics Japan G.K.
Manufacturer part number	Housing	1-1318119-4 (D2100 series, 8 pins)
	Contact	1318107-1 (required quantity: 4)

(5) Details of the cable used for connection with the SSM
The cable must be up to 3 m long. To ensure noise resistance, install the α*i*SV-B and the SSM on the same control board.



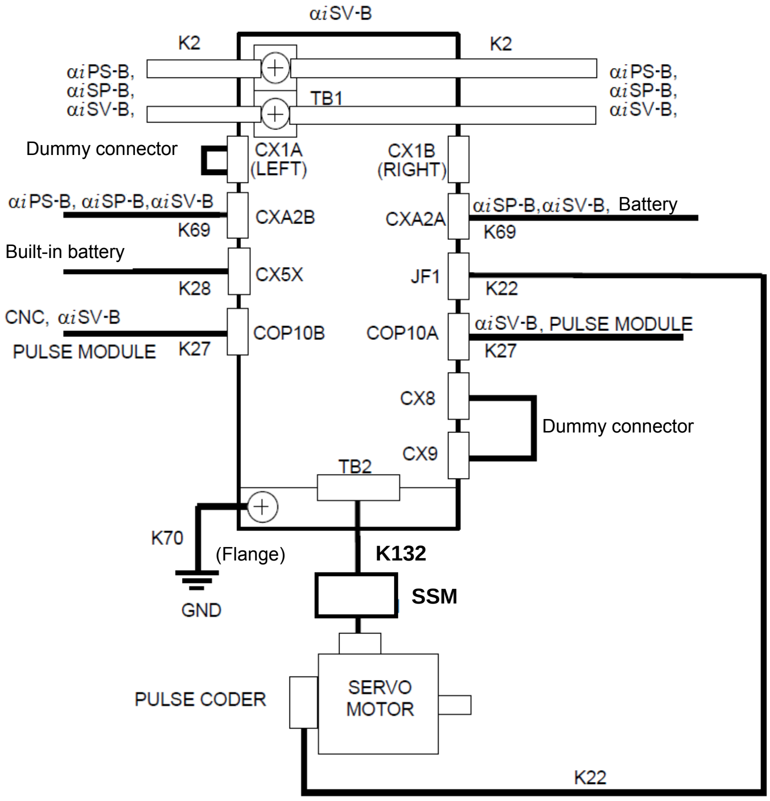
Cable specification: 0 V, 24 V, XALM, RDY: 0.5 mm^2 (AWG20 or smaller), common shielded cable



SSM-side terminal block: Size M10

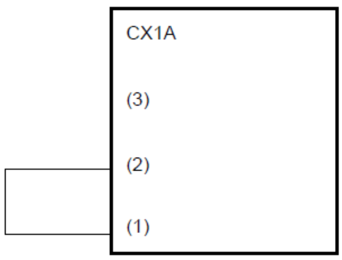
(6) Connection of dummy connectors

To connect the α*i*SV360-B, α*i*SV180HV-B, α*i*SV360HV-B, or α*i*SV540-B with the SSM, connect dummy connectors to CX1A, CX8, and CX9, as illustrated in the following figure.

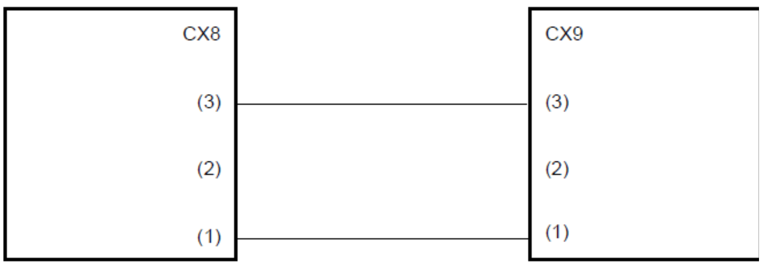


CAUTION
Do not connect 200 VAC or 24 VDC to CX1A or CX1B. If connected, the servo amplifier will be damaged.

(7) Details of dummy connectors



Example cable	Conductor cross-sectional area: 1.25 mm^2
Connector specification	Connector manufactured by Tyco Electronics Japan G.K.
	Receptacle housing: 1-178128-3
	Receptacle contact: 1-175218-2



Example cable	Conductor cross-sectional area: 1.25 mm^2
Connector specification	Connector manufactured by Tyco Electronics Japan G.K.
For CX8	Receptacle housing: 2-178128-3
	Receptacle contact: 1-175218-2
For CX9	Receptacle housing: 1-178128-3
	Receptacle contact: 1-175218-2

(8) Parameter setting
To use the SSM, the following parameters must be set.

Parameter No.	Setting	Remarks
No.2559#3	1	If this parameter is set using a servo amplifier that does not drive the SSM, SV0659 "Invalid SSM setting" will be generated.
No.11809#1	1	Enable output to the general purpose DO signal.

(9) SSM alarms
Upon occurrence of one of the three circumstances listed in the following table, an SSM-related alarm is generated.

No.	Description	Information displayed on CNC Display	Information displayed on servo amplifier	Operation performed upon alarm generation	Troubleshooting
1	The parameter has been set while connection with the SSM is not supported by the servo amplifier.	SV0659 "Invalid SSM setting"	"–"	Unable to start up the servo amplifier.	Replace the servo amplifier with another servo amplifier that supports connection with the SSM.
2	The parameter has not been set while the SSM is connected to the servo amplifier.	DS0653 "SSM abnormality"	"7 (flicker)"	Unable to start up the servo amplifier.	Check parameter setting.
3	Discrepancy occurred between the XALM signal (signal to activate the SSM) and the RDY signal (signal transmitted while the SSM is in operation).	DS0653 "SSM abnormality"	"7 (flicker)"	Feed hold stop	(1) The SSM connection cable may be defective (disconnected, short-circuited or ground fault). Check the SSM connection cable using a tester, and replace it if defective. (2) The SSM may be defective. Replace it. (3) The servo amplifier may be defective. Replace it.

(10) Precautions

Perform a self-test on the SSM at least once a day to ensure proper operation of the SSM.
Upon release of emergency stop, a self-check is automatically performed. Check that no SSM alarms are generated.
Perform the following test at least once after installation of the SSM and check that SSM's self-check function properly operates. If this test is omitted, SSM's protective function may be lost and the amplifiers and motors may be damaged.

(Procedure)
(1) Turn OFF the machine.
(2) Remove connector CX3 on the Power Supply connecting to the servo amplifier connected to the SSM and connector CX31 on the SSM to prevent the motors from being accidentally energized during the test.
(3) Turn ON the machine.
(4) When the CNC has been started, release emergency stop.
(5) If the SSM alarm is displayed upon release of emergency stop, there are no problems. If the alarm is not displayed, cable, parameter or servo amplifier has abnormality.
(6) Turn OFF the machine, and connect connectors CX3 and CX31.

If SSM abnormality occurs while motors are in operation, the CNC generates DS0653, decelerates and stops. At the same time, "1" is output to the SSM abnormality signal SVDOQ1 to 8<Fn690>.

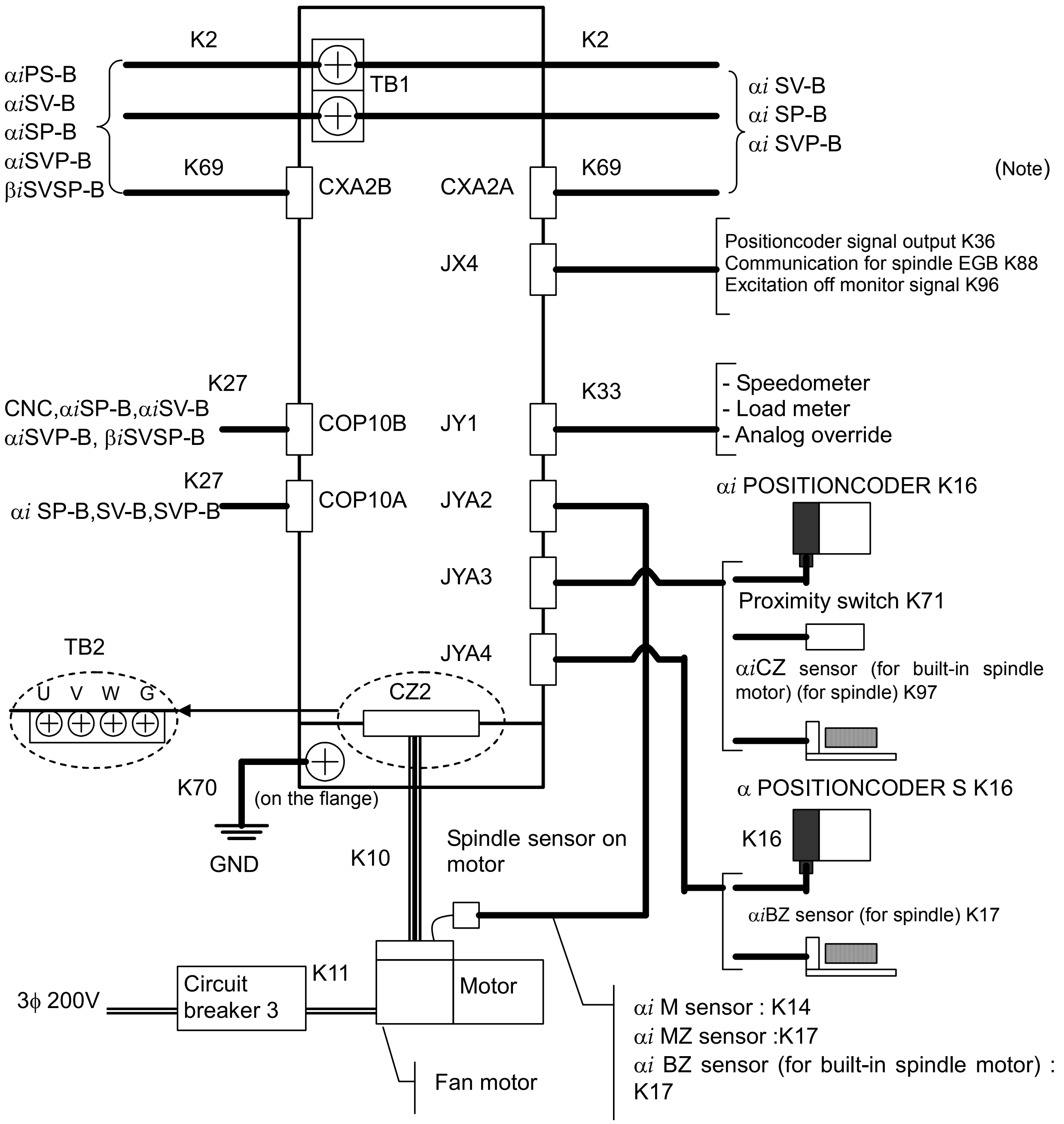
NOTE

1. Servo motors that operate according to PMC axis control do not decelerate and stop. In this case, interpret the SVDOQ1 to 8<Fn690> signal and decelerate and stop the axis where SSM abnormality occurred.
2. If the "SSM abnormality" alarm (DS0653) occurs during manual operation, deceleration and stop is not performed. In this case, decelerate and stop the control axis using the external reset signal ERS<Gn008.7> or the like.

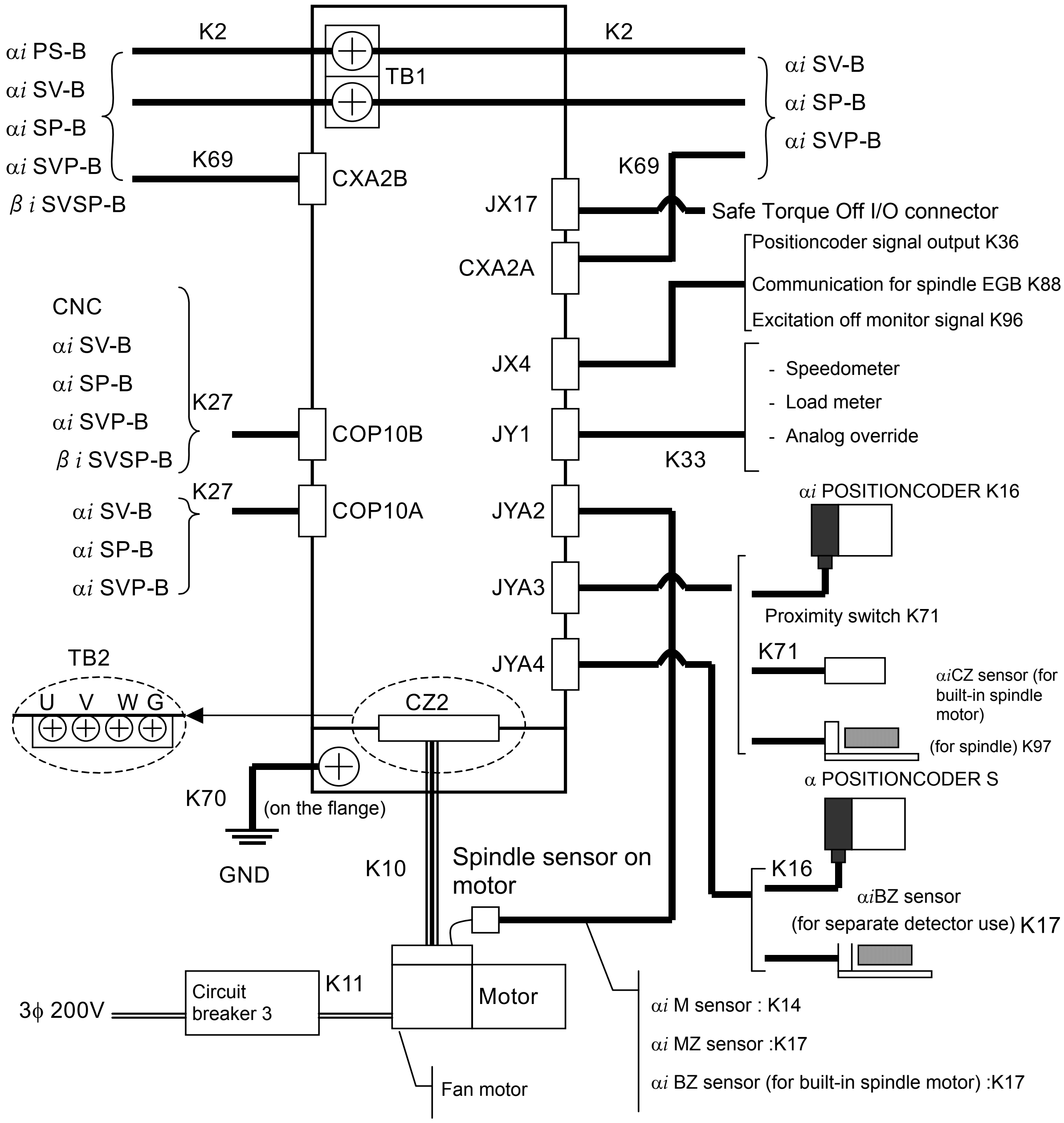
While the power supply is ON, do not insert or remove servo amplifier connector JX8 or connector CX31 on the SSM. This may damage the servo amplifier or the SSM.

9.3.3 α*i*SP-B Series Connection Diagram

(a) α*i*SP-B series



(b) Level-up α*i*SP-B series



9.3.3.1 Details of cable K2

See Subsection 9.3.1.2.

9.3.3.2 Details of cable K69

See Subsection 9.3.1.4.

9.3.3.3 Details of cable K10 (power cable)

For the α*i*SP 2.2-B, 5.5-B, and 5.5HV-B, a connector (D-5000) is used to attach the α*i*SP-B motor power cable. For other models, a terminal block is used for connection.

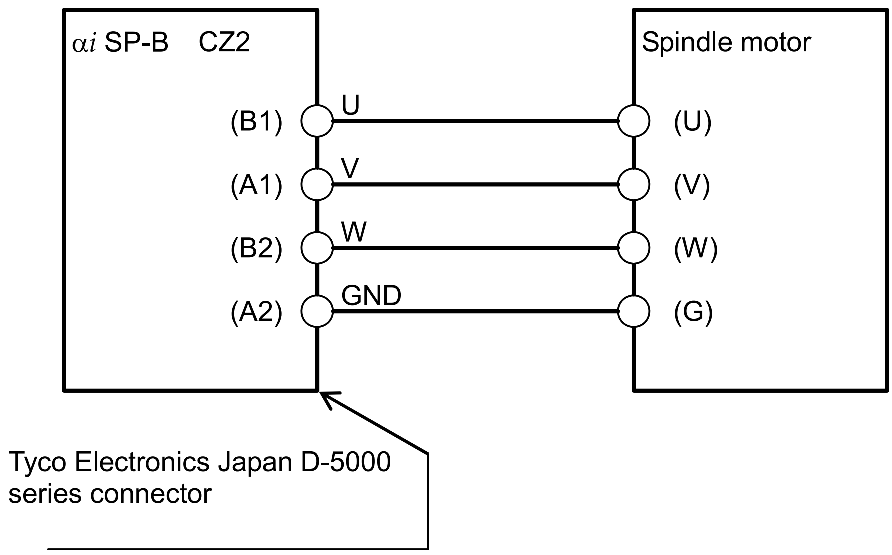
This subsection does not include the dimensions of the crimp terminal or the shape of the motor-side connector. Refer to "AC SPINDLE MOTOR α*i* series Descriptions (B-65272EN)" for these items.

About the cable specification

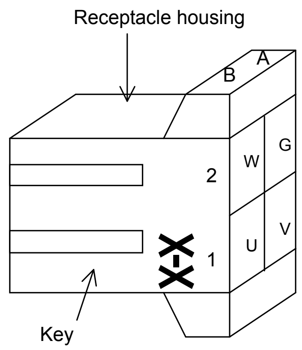
Select the cable specification by considering the following conditions for use.
(1) Motor current rating or current needed in use on a real machine
(2) Cable type (heat resistance temperature, etc.)
(3) Environment in which the cable is installed (operating ambient temperature, etc.)
(4) Need of water 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

> ⚠ **WARNING**
> If the phase order of the power lines is incorrect, an unpredictable motor operation may occur.

Connection through a connector



Location of connector pins

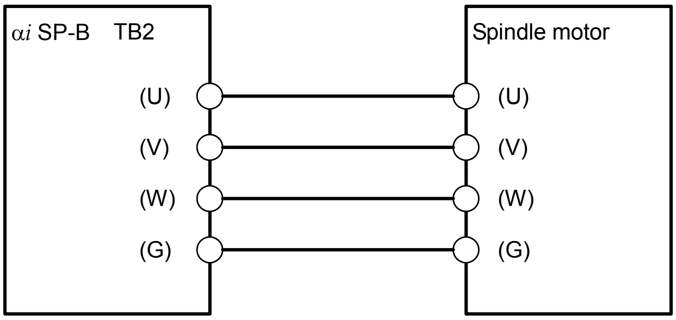


200V models

Key specification	Applicable models
XX	α*i*SP 2.2-B, α*i*SP 5.5-B α*i*SP 5.5HV-B

For details, see Subsection 9.4.2, "D-5000 Series Connector Manufactured by Tyco Electronics Japan G.K."

Connection through a terminal block



200V models

Cables should be connected to the α*i*SP-B using crimp terminals as listed in the following table.

Amplifier models	Terminal screw	Tightening torque
α*i*SP 11-B	M4	1.1 to 1.5Nm
α*i*SP 15-B	M4	
α*i*SP 22-B	M6	3.5 to 4.5Nm
α*i*SP 26-B	M6	
α*i*SP 30-B	M6	
α*i*SP 37-B	M6	
α*i*SP 45-B, α*i*SP 55-B	M10	15 to 16Nm

400V models

Cables should be connected to the α*i*SP-B using crimp terminals as listed in the following table.

Amplifier models	Terminal screw	Tightening torque
α*i*SP 11HV-B	M4	1.1 to 1.5Nm
α*i*SP 15HV-B	M4	
α*i*SP 22HV-B	M6	3.5 to 4.5Nm
α*i*SP 30HV-B	M6	
α*i*SP 45HV-B	M6	
α*i*SP 60HV-B	M6	
α*i*SP 75HV-B, α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B	M10	15 to 16Nm

9.3.3.4 Details of cable K70

Connect the α*i*SP-B flange to the grounding plate through a grounding cable. (Protective ground connection)
For connection with the α*i*SP-B, use the crimp terminal selected according to the following table.

200V models

Amplifier models	Terminal screw	Tightening torque
α*i*SP 2.2-B, α*i*SP 5.5-B, α*i*SP 11-B, α*i*SP 15-B, α*i*SP 22-B, α*i*SP 26-B, α*i*SP 30-B, α*i*SP 37-B	M5	2 to 2.5Nm
α*i*SP 45-B, α*i*SP 55-B	M6	3.5 to 4.5Nm

See Subsection 9.3.1.8, "Details of cable K70" for details of the cable K70.

400V models

Amplifier models	Terminal screw	Tightening torque
α*i*SP 5.5HV-B, α*i*SP 11HV-B, α*i*SP 15HV-B, α*i*SP 22HV-B, α*i*SP 30HV-B, α*i*SP 45HV-B, α*i*SP 60HV-B	M5	2 to 2.5Nm
α*i*SP 75HV-B, α*i*SP 100HV-B, α*i*SP 100HV(SiC)-B	M6	3.5 to 4.5Nm

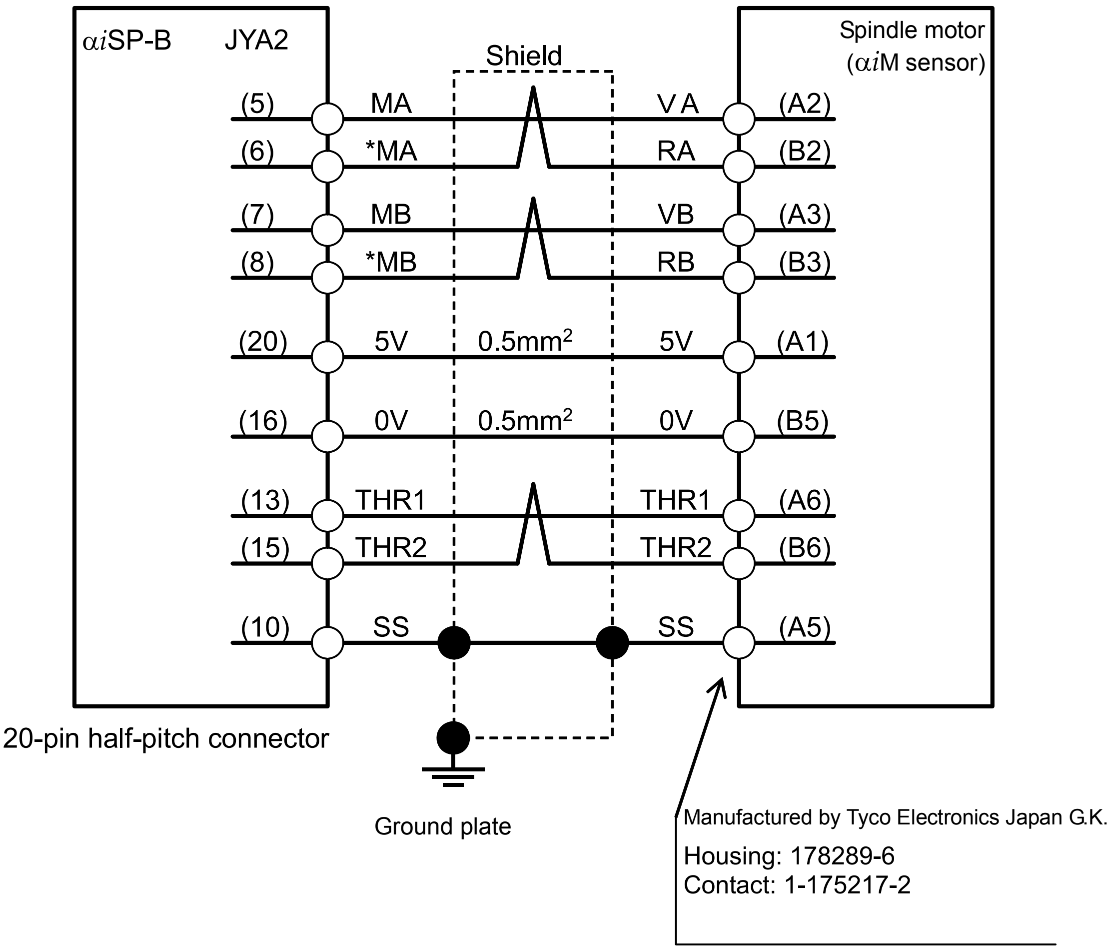
See Subsection 9.3.1.8, "Details of cable K70" for details of the cable K70.

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 K14

(1) For the spindle motor with α*i*M sensor (other than model α*i*I 0.5, when a thermistor is used)



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

NOTE

1. If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2. Recommended cable : Up to 72m
3. When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 5 Ω.
4. Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

Location of connector pins

JYA2

		10	SS			20	5V
9	5V			19	#		
		8	*MB			18	5V
7	MB			17	#		
		6	*MA			16	0V
5	MA			15	THR2		
		4	OH2			14	0V
3	OH1			13	THR1		
		2	*MZ			12	0V
1	MZ			11	#		

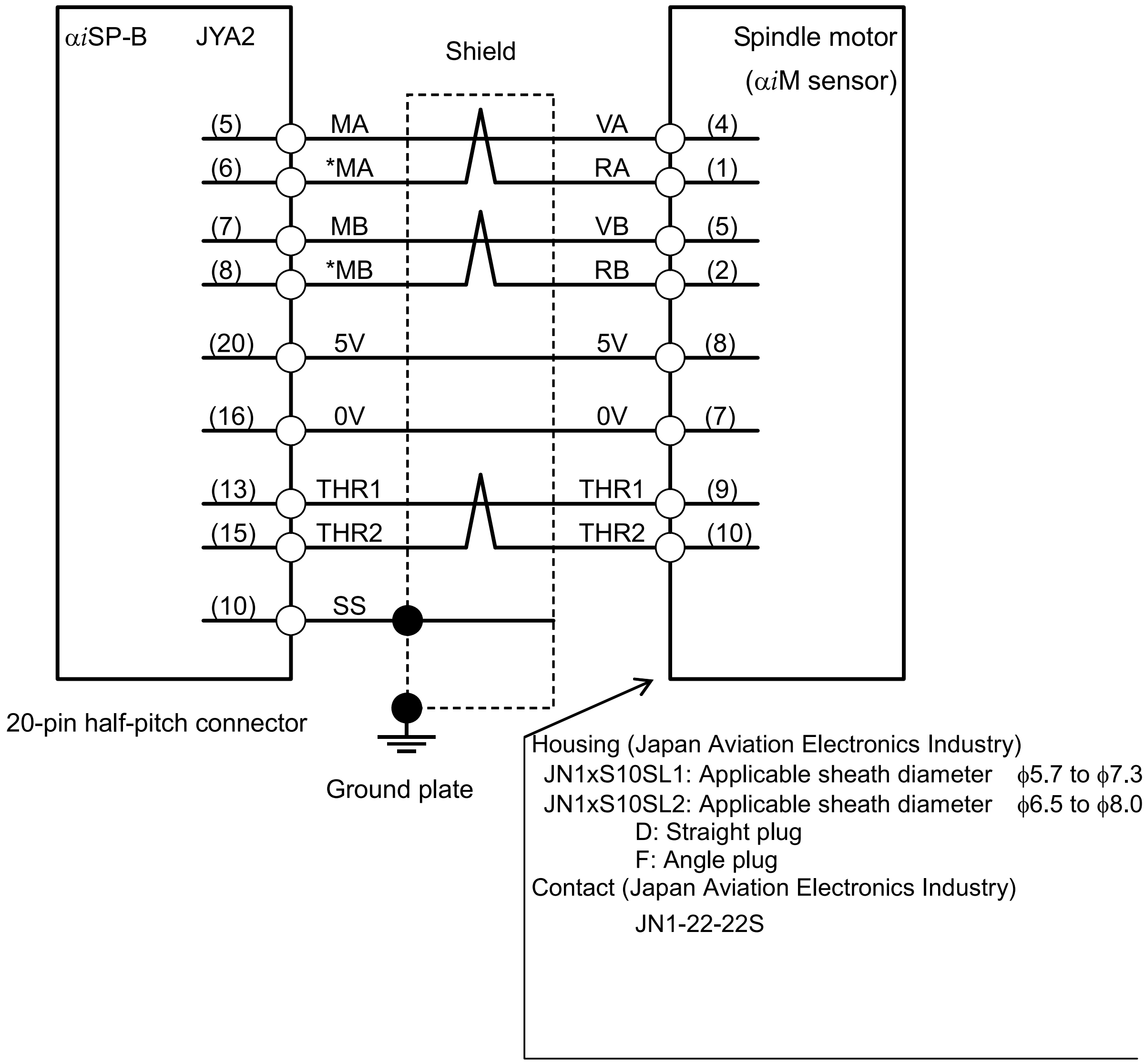
NOTE

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 Japan G.K.) on the motor side

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

(2) For the spindle motor with α*i*M sensor (model α*i*I 0.5, when a thermistor is used)



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

NOTE

1 If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 Recommended cable : Up to 41m
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 5 Ω.
4 Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

Location of connector pins

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

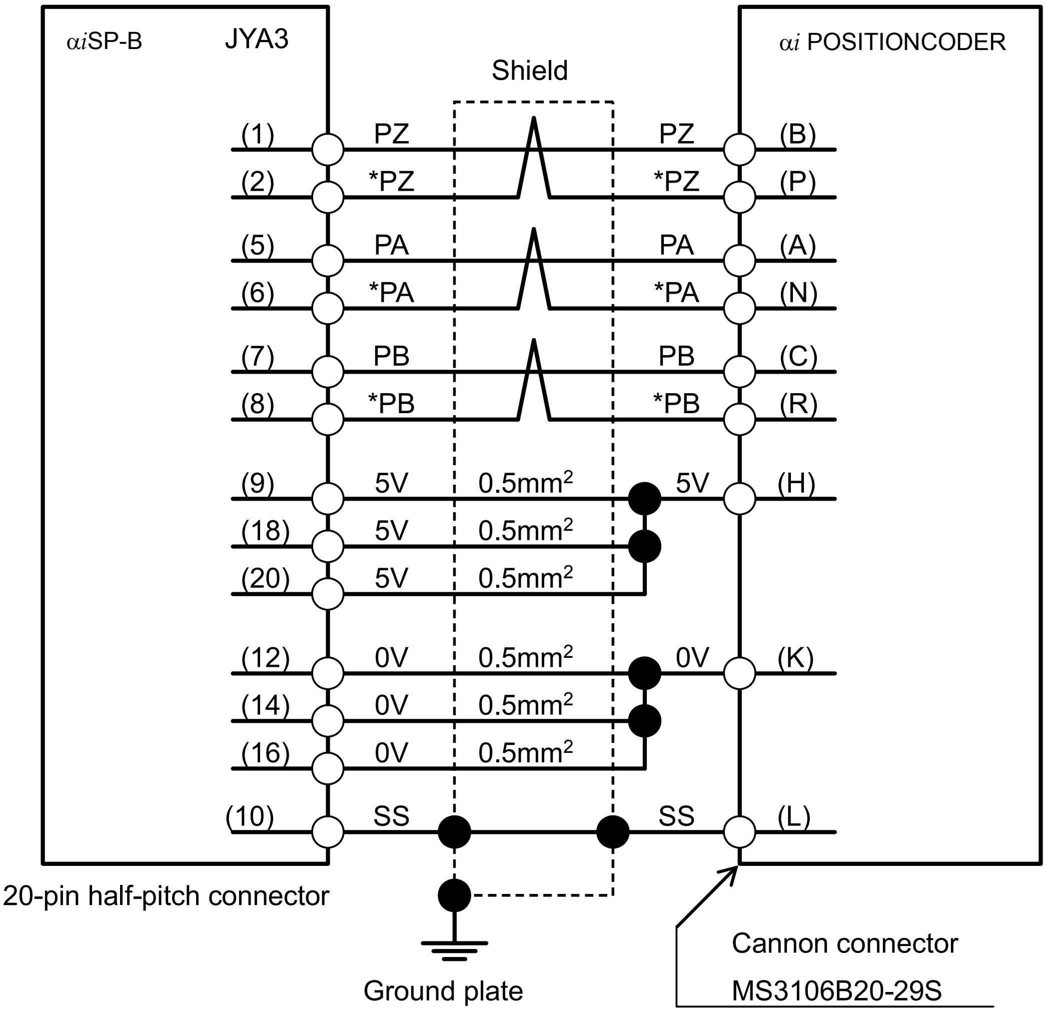
1	RA
2	RB
3	
4	VA
5	VB
6	
7	0V
8	5V
9	THR1
10	THR2

- Crimp tool specification
  A06B-6114-K201/JN1S (Applicable cross-sectional area: 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)

9.3.3.7 Details of cable K16

(1) For αi POSITIONCODER



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, "CABLES," for detailed explanations about the cable.

NOTE

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

- Location of connector pins

JYA3

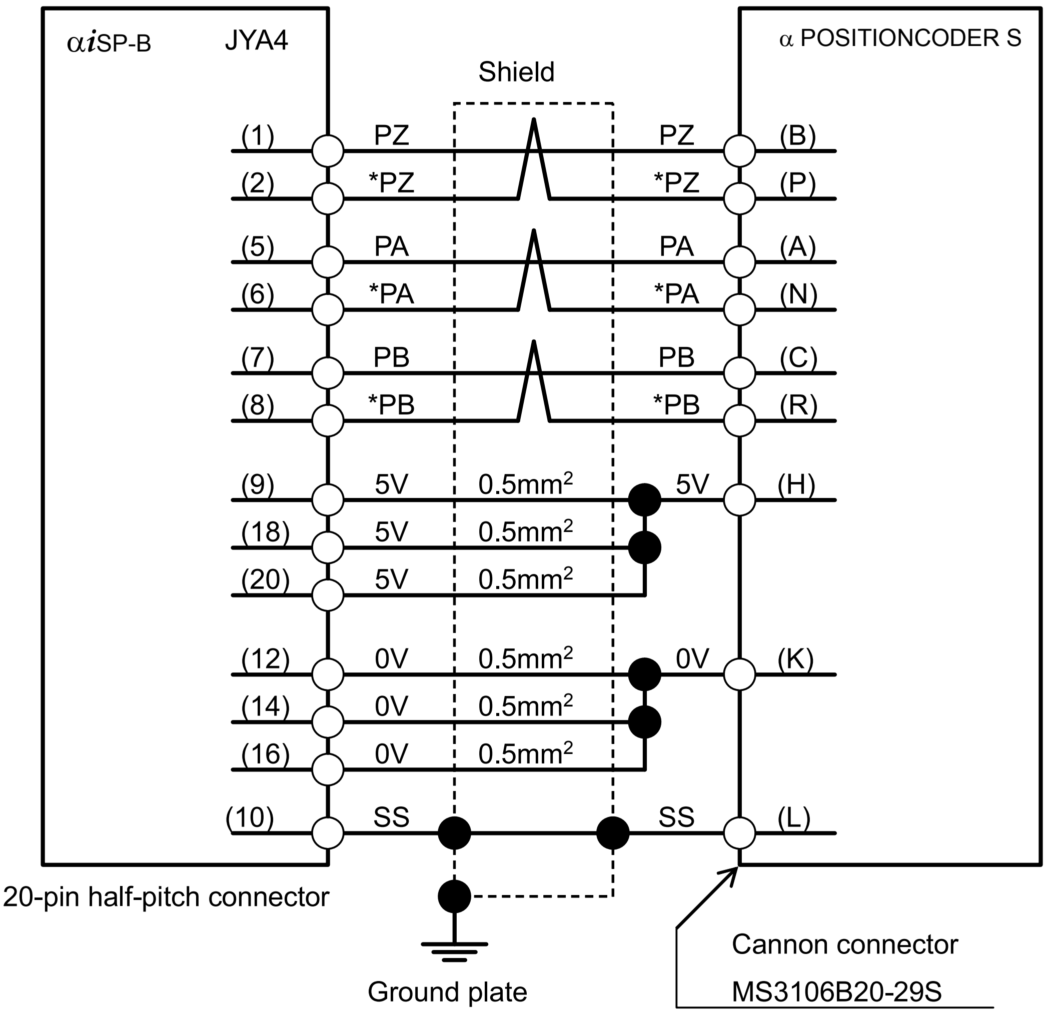
		10	#			20	5V
9	5V	8	*PB	19	#	18	5V
7	PB	6	*PA	17	#	16	0V
5	PA	4	#	15	EXTSC	14	0V
3	#	2	*PZ	13	SCCOM	12	0V
1	PZ			11	24V		

> **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			

(2) For α POSITIONCODER S



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 JYA4-side connector that matches the recommended cable.
See Appendix B, "CABLES," for detailed explanations about the cable.

NOTE

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

- Location of connector pins

JYA4

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

NOTE

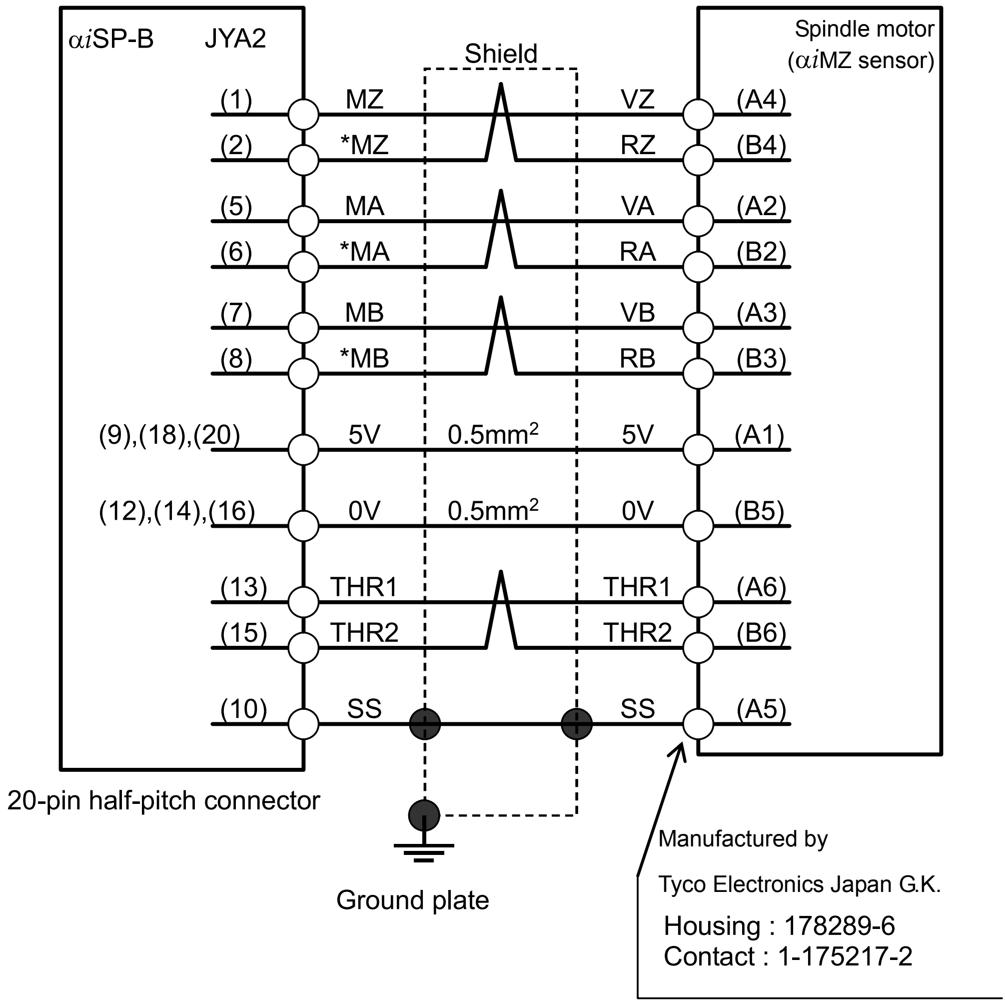
Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

Pin arrangement of the 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			

9.3.3.8 Details of cable K17

(1) For the spindle motor with αiMZ sensor (other than model αiI 0.5, when a thermistor is used)



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

NOTE

1. If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2. Recommended cable : Up to 50m
3. When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 4 Ω.
4. Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

- Location of connector pins

JYA2

See Subsection 9.3.3.6, "Details of 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

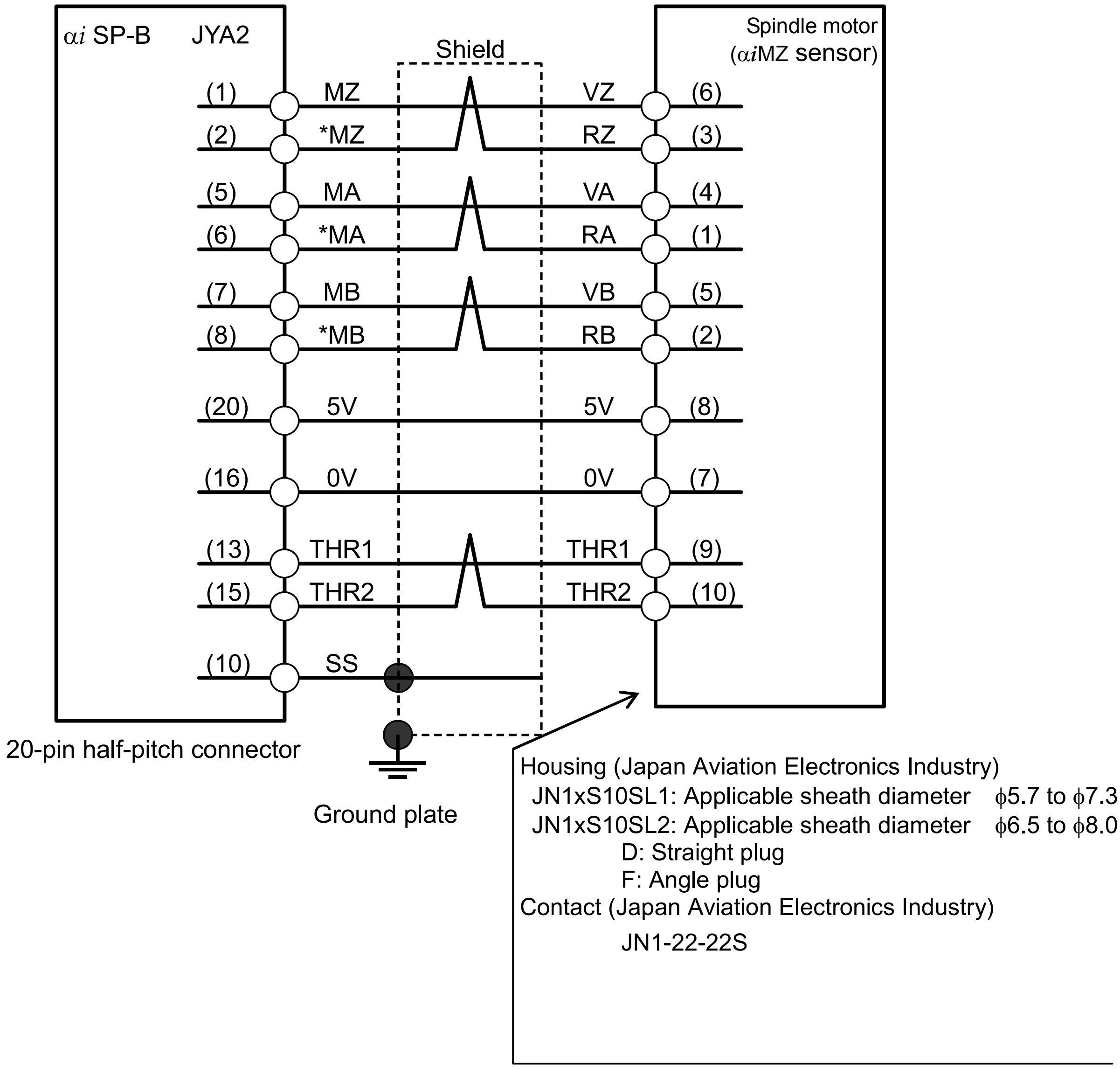
NOTE

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 Japan G.K.) on the motor side

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

(2) For the spindle motor with αiMZ sensor (model αiI 0.5, when a thermistor is used)



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

NOTE

1. If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2. Recommended cable : Up to 28m
3. When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 4Ω.
4. Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

- Location of connector pins

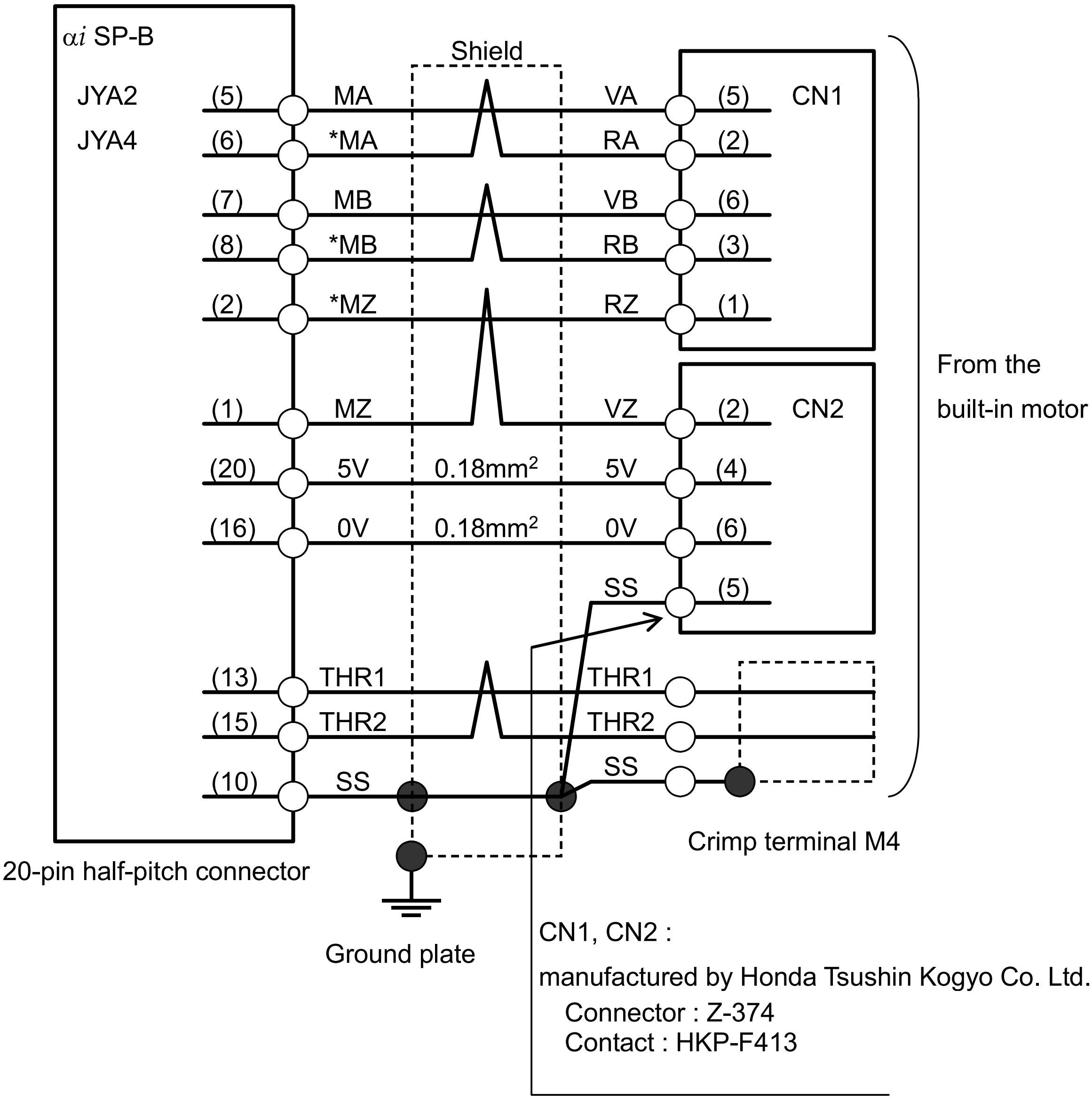
Pin arrangement of the connector (manufactured by Japan Aviation Electronics Industry) on the motor side

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

- Crimp tool specification
  A06B-6114-K201#JN1S (Applicable cross-sectional area: 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)

(3) For αiBZ sensor (A860-2155-T***) (when a thermistor is used)



Cable specification: 4 common shielded cable (Four 0.18mm^2 twisted pairs + 0.18mm^2 wires)
Recommended cable conductor : A66L-0001-0367
See Subsection 9.4.1 for explanations about the JYA2-side connector that matches the recommended cable.
See Appendix B, "CABLES," for detailed explanations about the cable.

NOTE

1 If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 Recommended cable : Up to 28m
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 4 Ω.
4 Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.
5 When the α*i*BZ sensor is used as a spindle sensor (connected to connector JYA4), THR1 and THR2 need not be wired.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

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

NOTE

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

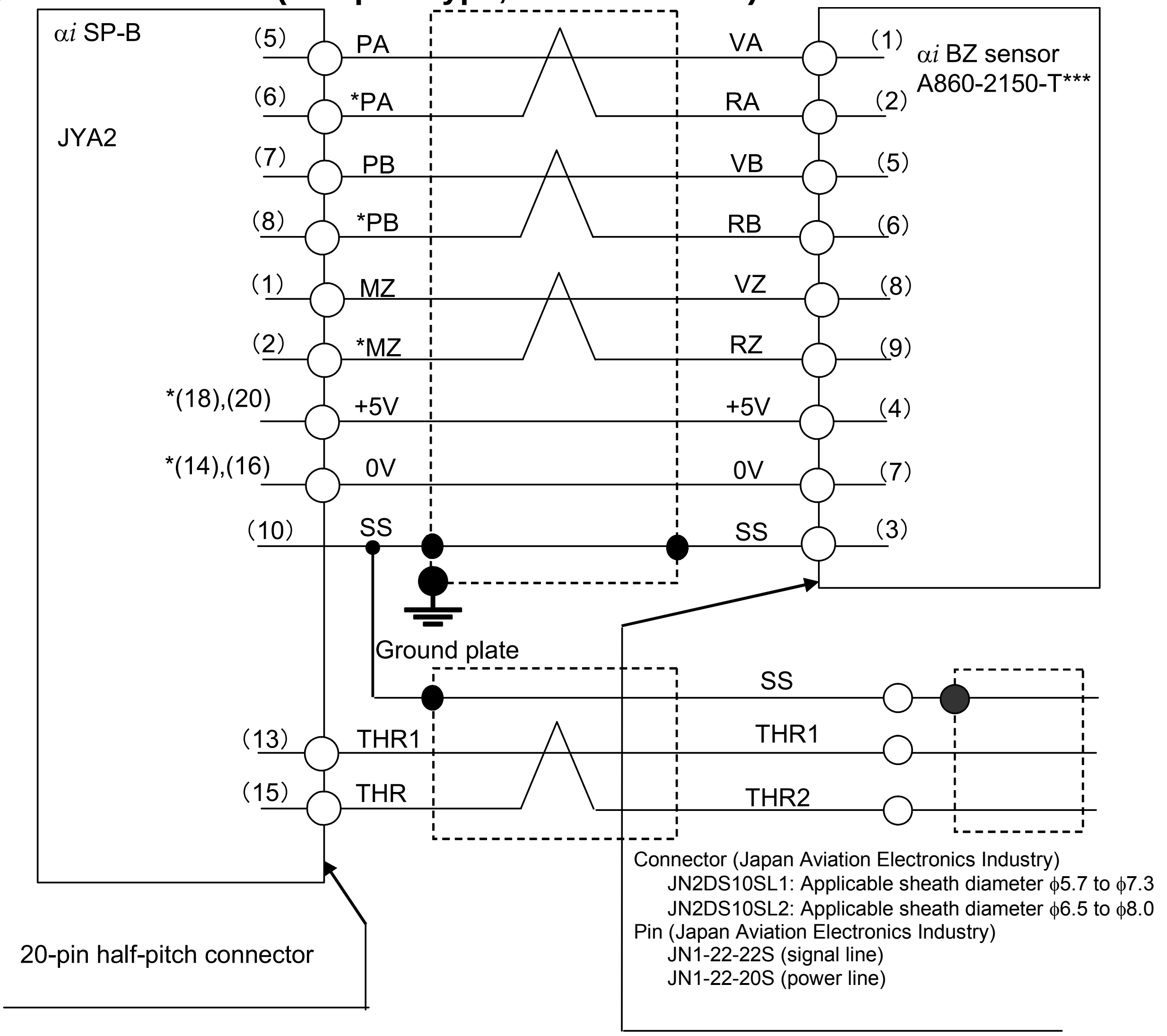
Pin arrangement of the connector CN1 (manufactured by Honda Tsushin Kogyo Co., Ltd.) on the motor side

1	RZ	4	
2	RA	5	VA
3	RB	6	VB

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

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

(4) For αiBZ sensor (compact type, A860-2150-T***)



Recommended cable conductor: A66L-0001-0482

Cable length	28m or less
5V, 0V	$0.3mm^2$ (Connected to one of the pins marked *)
VA,RA,VB,RB,VZ,RZ	$0.2mm^2$ twisted pair × 3

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

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

NOTE

1 If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 Recommended cable : Up to 28m
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 4 Ω.
4 Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.
5 When the α*i*BZ sensor is used as a spindle sensor (connected to connector JYA4), THR1 and THR2 need not be wired.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

- Location of connector pins

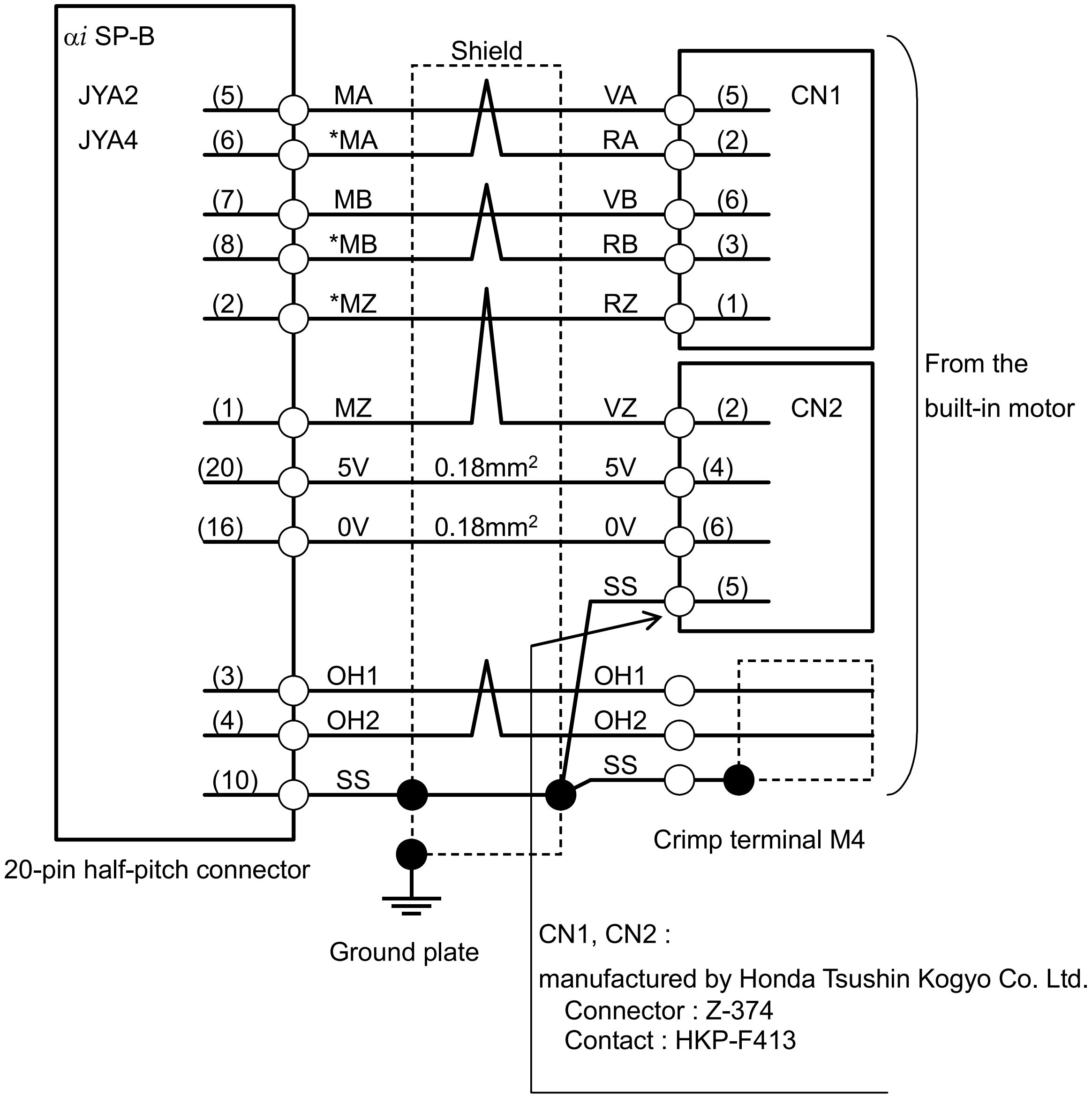
α*i*BZ sensor head side: Connector manufactured by Japan Aviation Electronics Industry

1	VA
2	RA
3	SS
4	5V
5	VB
6	RB
7	0V
8	VZ
9	RZ
10	

When a thermostat is used as the motor temperature protection device (cables K14 and K17)

When a thermostat is used as the motor temperature protection device, the connection for the thermostat differs from that for a thermistor. Connect the thermostat to OH1(3) and OH2(4) as shown below.
Connection when the α*i*BZ sensor is used is shown below as a typical example.

(3) For α*i*BZ sensor (A860-2155-T***) (when a thermostat is used)



NOTE

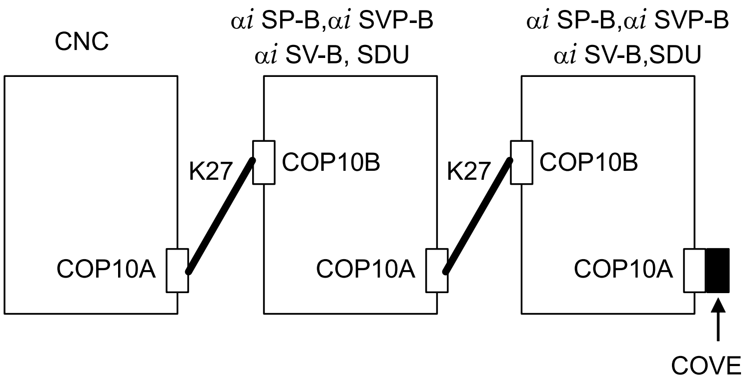
1 If only one 5 V line and only one 0 V line are used, use pins 20 or 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 Recommended cable: Up to 28 m
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 4Ω.
4 Impacts of noise on the feedback signals from the spindle sensors can be effectively avoided by grounding the shield wire of the feedback cable. If servo equipment is poorly shielded, however, noise from the servo equipment may be diffracted and enter the spindle signals. When grounding the spindle-side feedback cables, check that the servo-side feedback cables have been grounded. In this connection, locate the ground plate close to the servo amplifier to minimize the distance between the ground plate and the servo amplifier.
5 When the α*i*BZ sensor is used as a spindle sensor (connected to connector JYA4), OH1 and OH2 need not be wired.

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

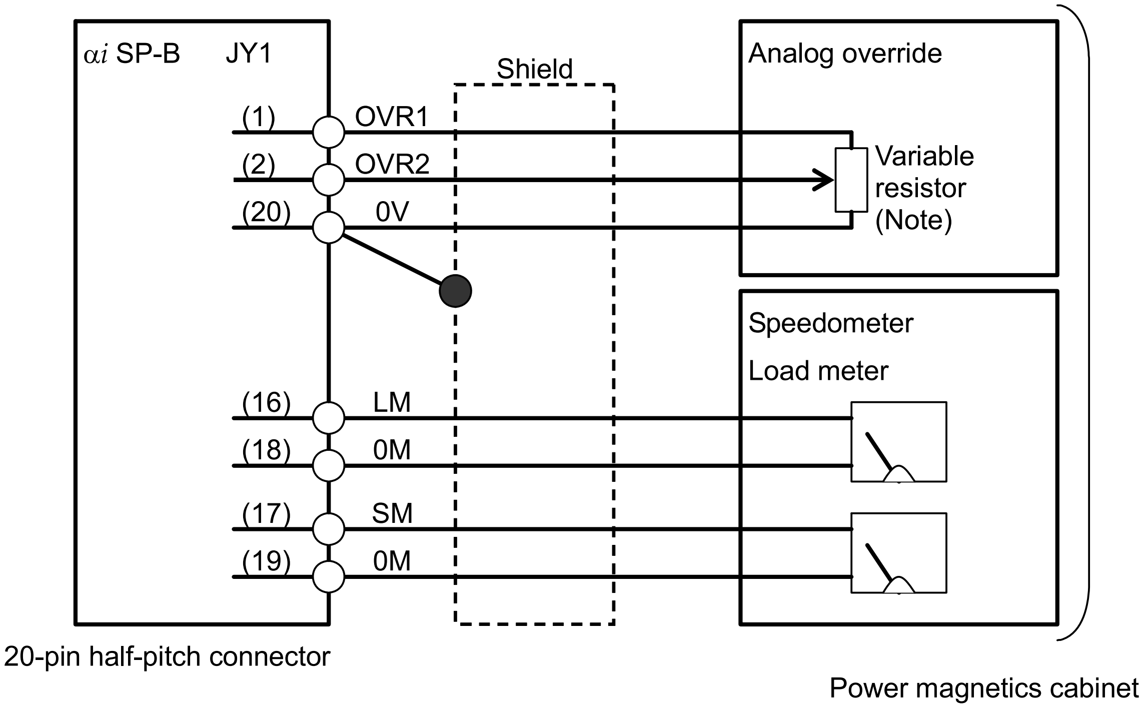
9.3.3.9 Details of cable K27

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



- The cable is connected from connector COP10A in the CNC, α*i*SV-B, α*i*SVP-B, α*i*SV-B, or separated detection module (SDU) to connector COP10B in the α*i*SV-B, α*i*SVP-B, α*i*SV-B, or separated detection module (SDU).
- 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.

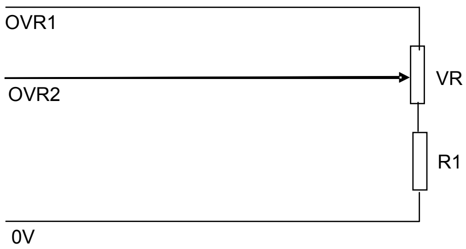
9.3.3.10 Details of cable K33



Cable specification: 0.09mm^2 common shielded cable
Recommended cable conductor : A66L-0001-0284#10P
See Subsection 9.4.1 for explanations about the JY1-side connector that matches the recommended cable.
See Appendix B, "CABLES," for detailed explanations about the cable.

NOTE

Select an external resistor so that VR+R1 falls within a range between 2 kΩ.and 10 kΩ.



Location of connector pins

JY1

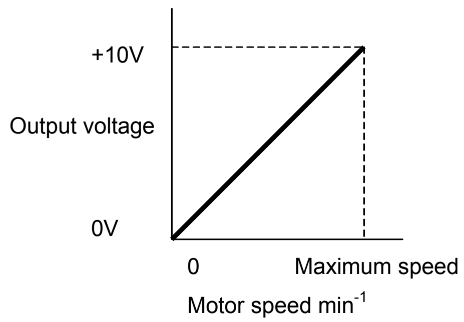
9		10		19	0M	20	0V
7		8		17	SM	18	0M
5		6		15		16	LM
3		4		13		14	
1	OVR1	2	OVR2	11		12	

> **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)

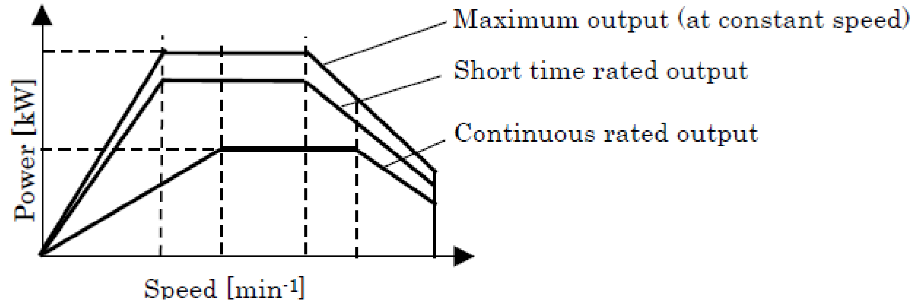
By externally connecting a tachometer, the speed of the spindle motor can be indicated. The voltage (DC) proportional to the speed is output, regardless of the rotation direction of the motor. At the maximum motor speed, +10 V is output.

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

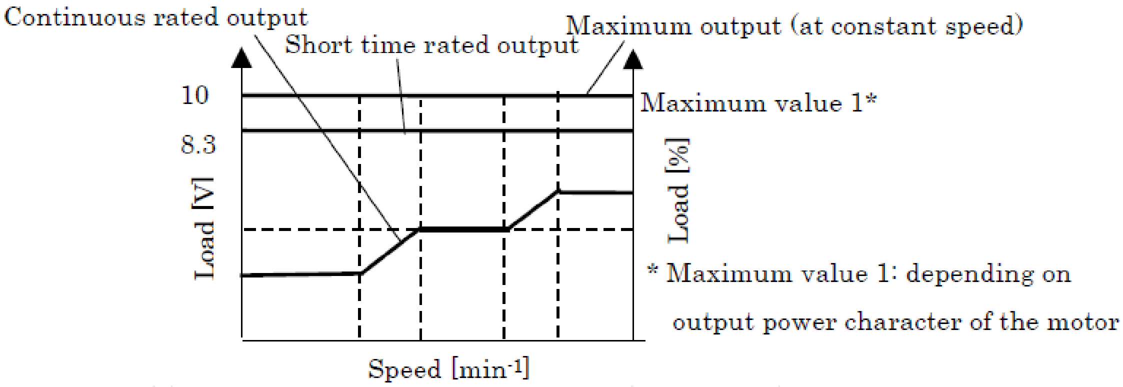


Voltage signal for the load meter (LM)

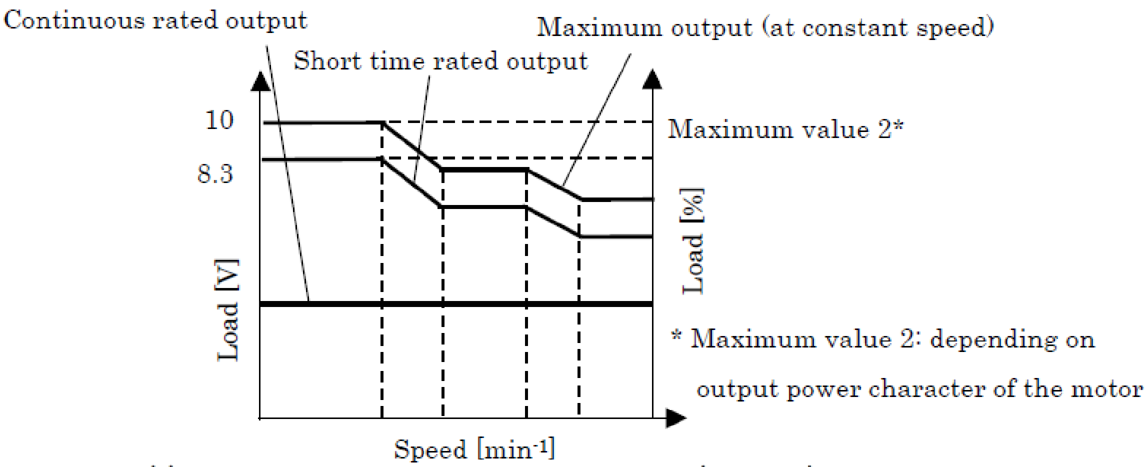
The load meter indicates a load ratio, that is, the ratio of load on the machine tool spindle during no-load rotation or cutting to the output of the spindle motor. The following two types of load meter indications are available: the new type of load meter which is normalized by continuous rated output and the existing load meter which is normalized by maximum output.
It's possible to select appropriate type in two types.
Existing load meter normalized by max. output shows the character that load meter value becomes constant at maximum output in all speed. It is suited to watch the margin to the maximum output. (The example of this type load meter is shown as Fig.(b) when the motor output character is Fig.(a).)
New load meter normalized by cont. rated output shows the character that load meter value becomes constant at continuous rated output in all speed. It is suited to watch the margin to the continuous rated output. (The example of this type load meter is shown as Fig.(c) when the motor output character is Fig.(a).)



(a) Output power character of spindle motor



(b) Load meter normalized by max. output (existing type)

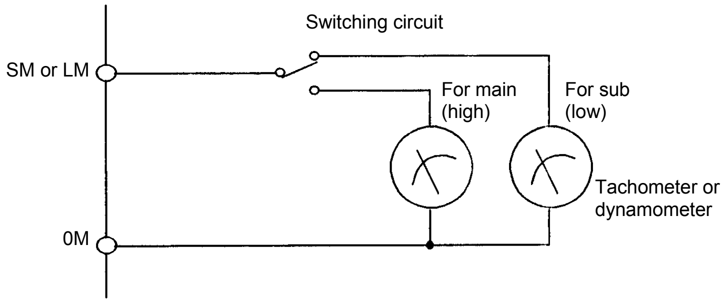


(c) Load meter normalized by cont. rated output (new type)

Fig 1. Output power character and Load meter

Indication for spindle switching and output switching

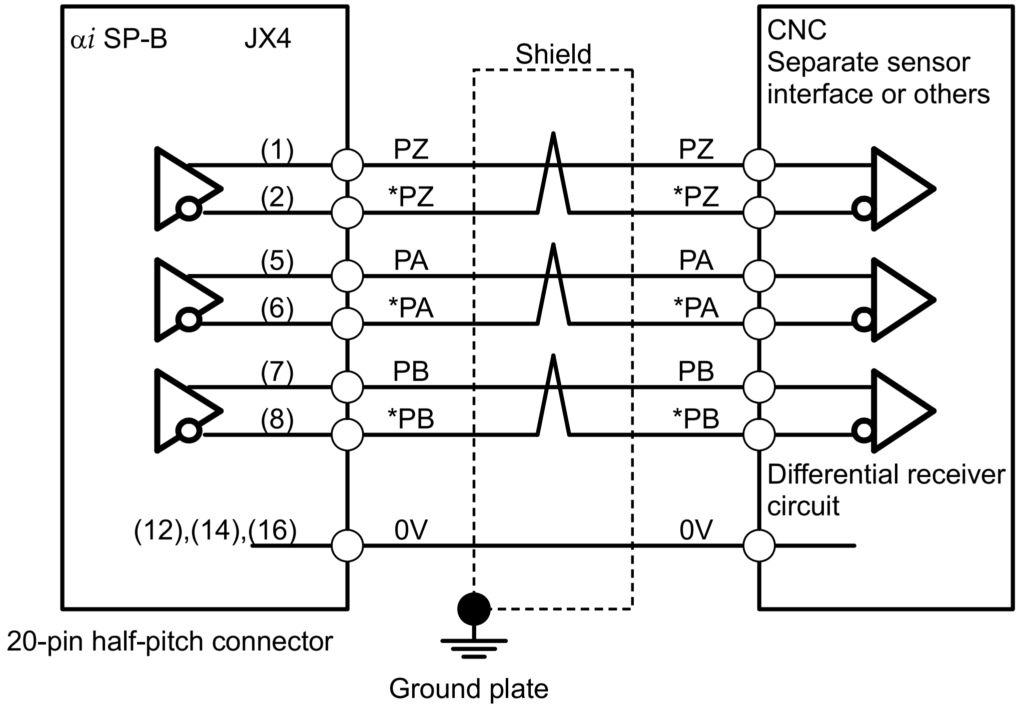
The speed indication voltage and dynamometer indication voltage may vary between the main spindle and sub-spindle in spindle switching and between the high winding and low winding in output switching. In such a case, switch the tachometer and dynamometer as shown below.



NOTE

1 The maximum output based load meter and continuous output based load meter are mutually exclusive.
2 Different load meter types cannot be selected for the main and sub sides of spindle switching.

9.3.3.11 Details of cable K36



Cable specification : 0.09 mm^2 twisted pair with common shielded
Recommended cable conductor : A66L-0001-0284#10P
See Subsection 9.4.1 for details of connectors applied to recommended cable.
See Appendix B, "CABLES," for detailed explanations about the cable.

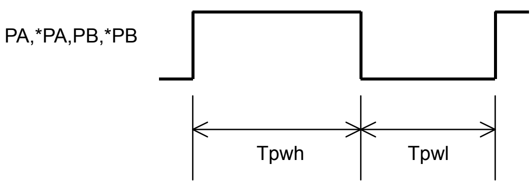
Specification of position coder signal output

Item	Specification
αiSP-B input sensor	αi POSITIONCODER α POSITIONCODER S αi MZ sensor αi BZ 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)

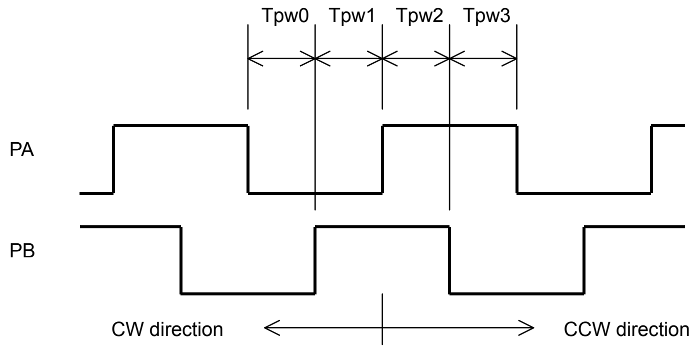
*1 A resolution of 4096 pulses/rotation can be obtained by counting the edges of phases A and B (× 4 circuit).

Phase A/B signal

Width of phase A/B signal



Phase difference between phase A and phase B

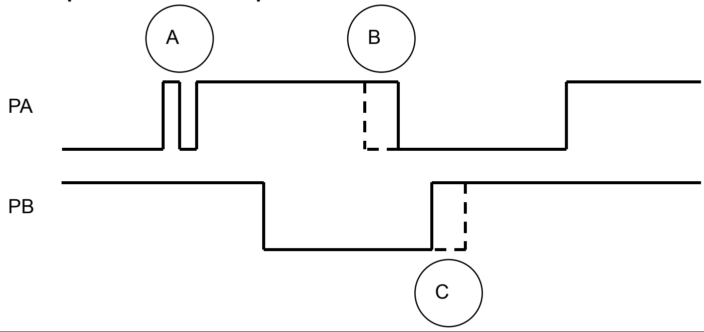


*PA and *PB represent the negative logic signals of PA and PB, respectively.

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

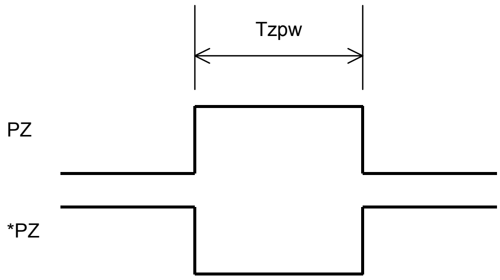
This specification does not include the effect of the cable capacity and the skew due to delay on the receiver side.

> ⚠ **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

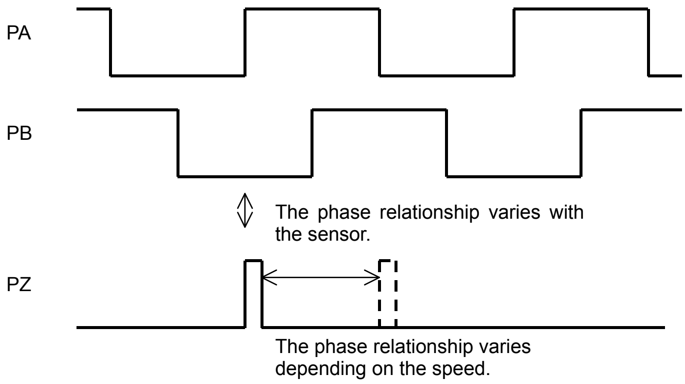


Symbol	Specification
Tzpw	The minimum width is 1/4096 of one rotation.

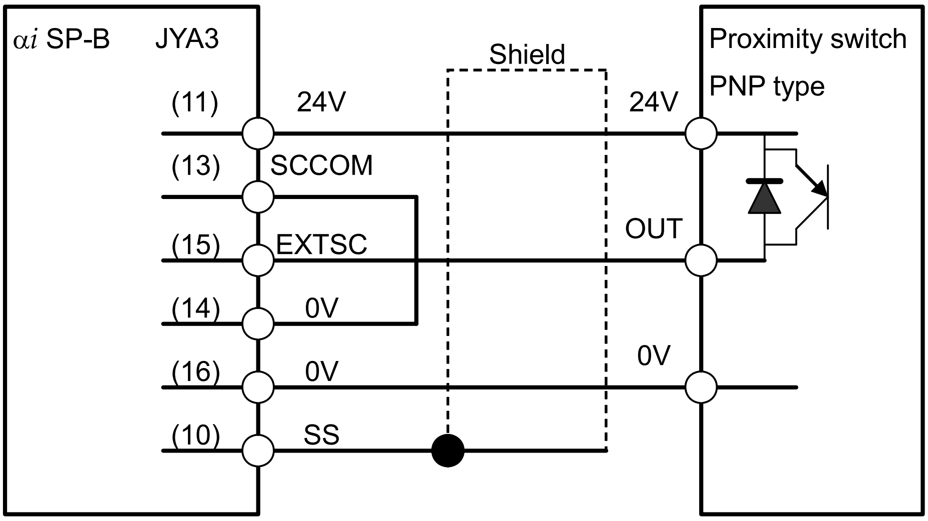
* Edge distortion of signal Z
  Note that the edge of signal Z may be distorted.

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

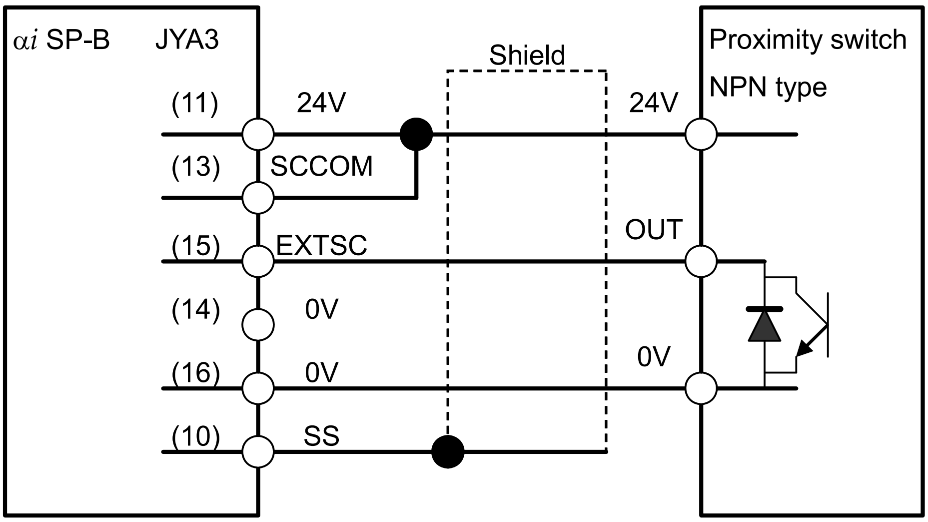
- The phase relationship between the phase Z signal and the phase A/B signal varies with the sensor.
- When the speed changes, the phase relationship between the phase Z signal and the phase A/B signal may vary. The range of variation is approximately ±1 p/5000 min^{-1}.



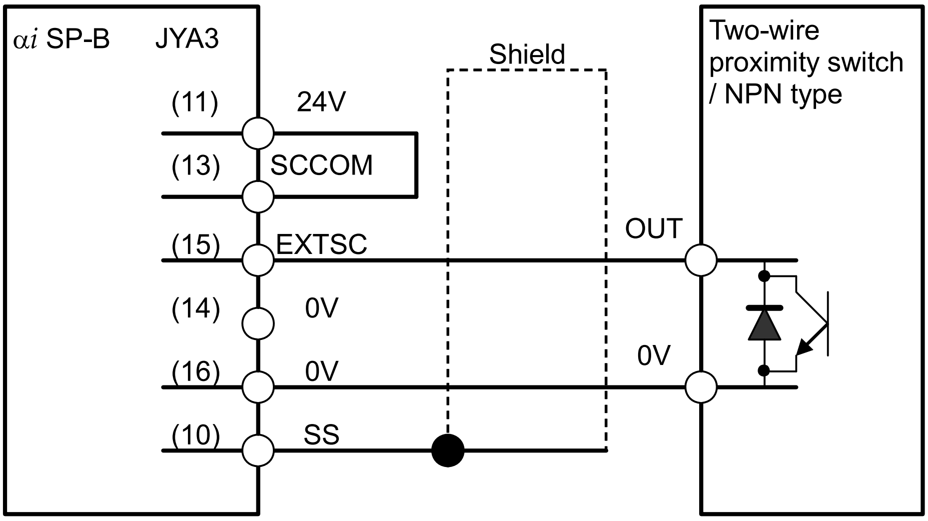
9.3.3.12 Details of cable K71



20-pin half-pitch connector



20-pin half-pitch connector



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, "CABLES," for detailed explanations about the cable.

Connector pin assignment

See Subsection 9.3.3.7, "Details of cable K16."

External 1-rotation signal switch (proximity switch)

Use an external 1-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	4V or lower
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	4V or lower
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.

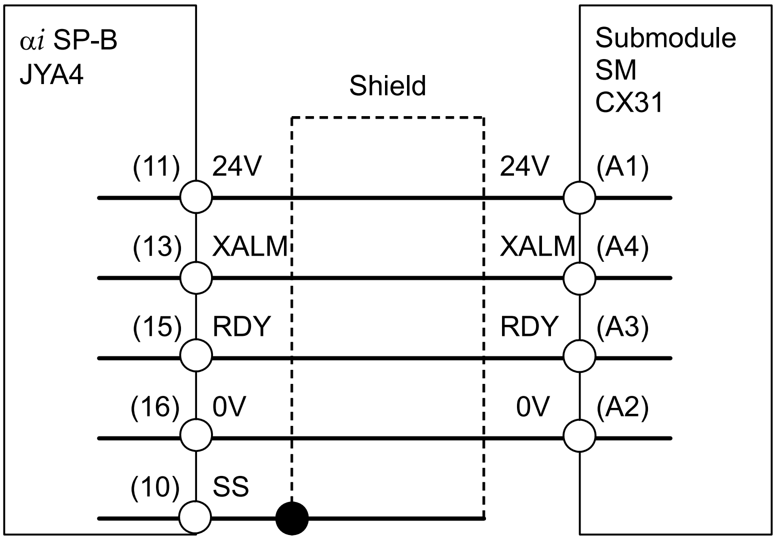
Input signal specification (EXTSC input section)

Item	Specification
High level	20V or higher
Low level	4V or lower
Minimum signal width	100 us

NOTE
In design, the width of the signal to be detected should have a sufficient margin by considering variations in proximity switch on/off time.

9.3.3.13 Details of cable K86

Cable K86 must be up to 3 m long. To ensure noise resistance, install the α*i*SP-B and submodule SM on the same control board.

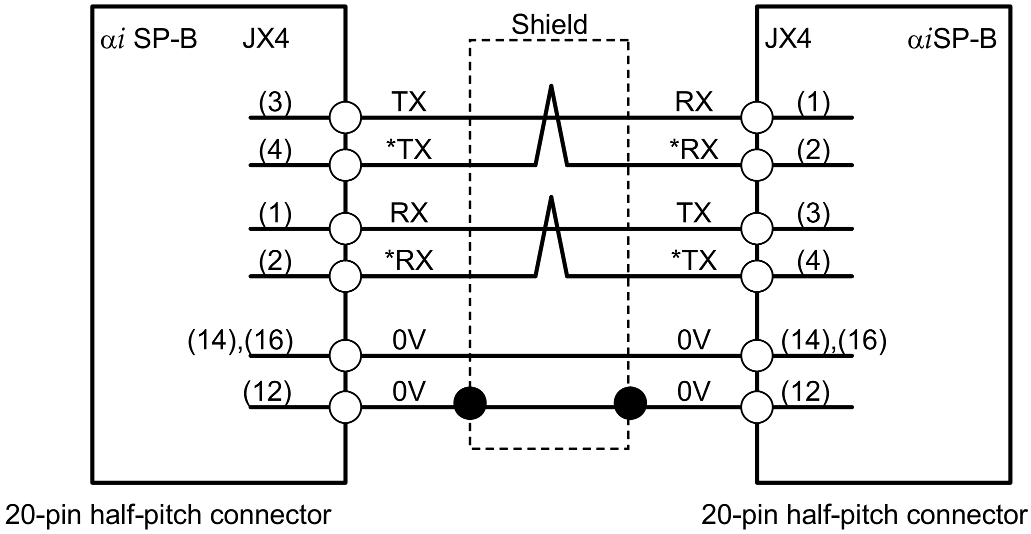


Applicable connector:

JYA4 : Solder type connector: FI40B20S,
Housing:FI-20-CVS5 manufactured by Hirose Electric Co., Ltd.
CX31 : D2100 series 8 pins, manufactured by Tyco Electronics Japan G.K.
Housing 1-1318119-4, contact: 1318107-1 (4 contacts required)
Cable specification : 0V, 24V, XALM, RDY: 0.5mmSQ(AWG20 or smaller),
Common shield cable

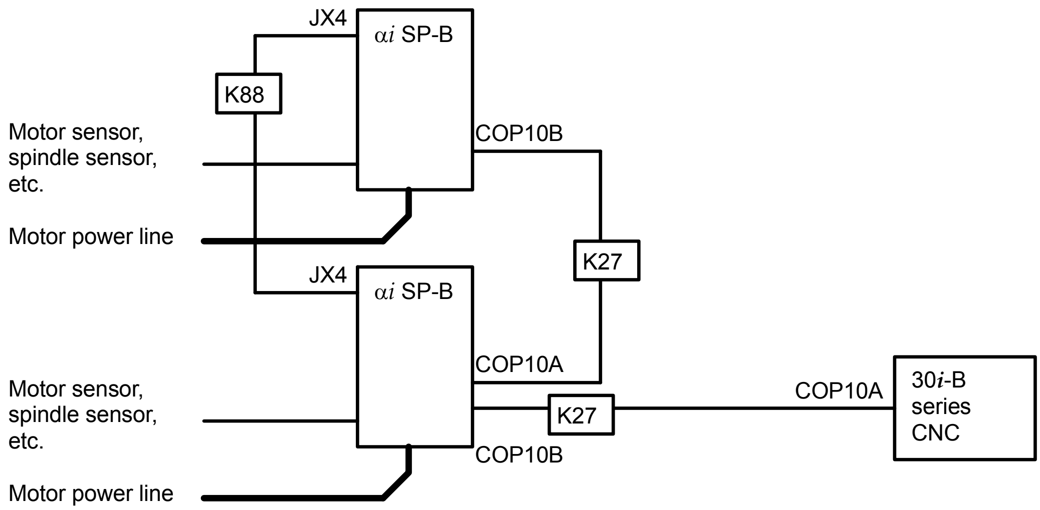
9.3.3.14 Details of cable K88

This cable is required when using the spindle EGB function.



Cable specification : 0.09 mm^2 twisted pair with common shielded
Recommended cable conductor : A66L-0001-0284#10P
See Subsection 9.4.1 for details of connectors applied to recommended cable.
See Appendix B, "CABLES," for detailed explanations about the cable.

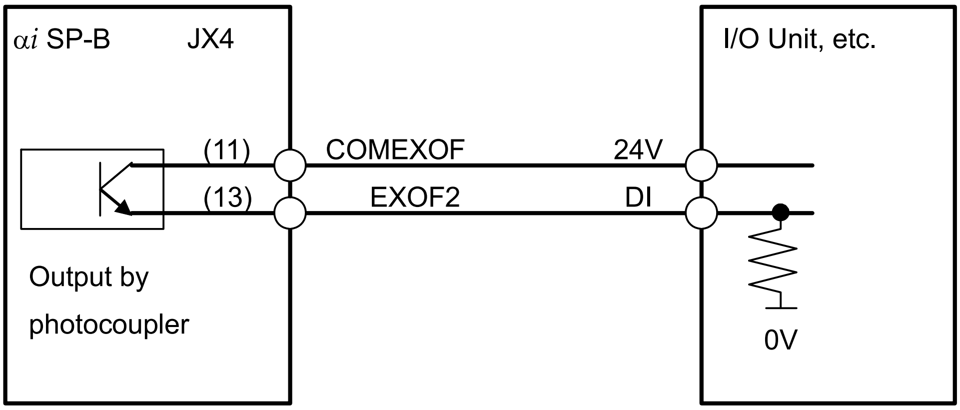
NOTE
1 The length of cable K88 must be 3 m or shorter and run within the same power magnetics cabinet.
2 The αiSP-Bs that use this connection must be connected to the same CNC as shown below.



9.3.3.15 Details of cable K96

This signal is used to externally monitor the excitation status of the spindle amplifier and implement a safety circuit for the safety spindle stop function of dual check safety.

For how to configure a safety circuit with this signal, refer to the following section in "Dual Check Safety Connection Manual" of your CNC:
Section 3.21, "SAFE SPINDLE STOP FUNCTION WITH PROTECTION DOOR OPEN"
For Series 30i/31i/32i/35i-MODEL B, Power Motion i-MODEL A (B-64483EN-2)



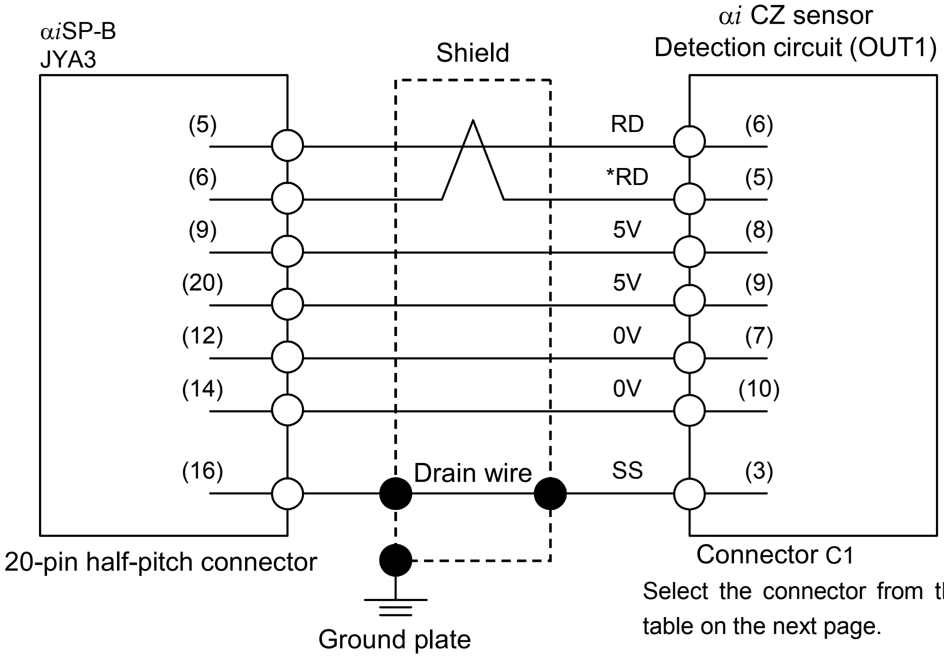
20-pin half-pitch connector

α*i*SP-B contact output specifications
Circuit type: Polar photo coupler
Rated voltage: 30 VDC or less
Output current: DC 40 mA or less
Saturation voltage: 1.5 V or less (at output current of 40 mA)

Open contact: Excitation on
Closed contact: Excitation off

> ⚠ **CAUTION**
> If the connector is connected incorrectly, externally supplied 24 V can damage the internal circuit of the α*i*SP-B.

9.3.3.16 Details of cable K97



Select the connector from the table on the next page.

Using cable conductor

Signal name	Cable length : 28m or less	Cable length : 50m or less
5V, 0V, 6V	$0.3mm^2 \times 5$ Strand configuration: 12/0.18 or 60/0.08 [strands/mm] Insulation outer diameter: 1.5mm or less	$0.5mm^2 \times 5$ Strand configuration: 20/0.18 or 104/0.08 [strands/mm] Insulation outer diameter: 1.5mm or less
RD, *RD	$0.18mm^2$ or more Twisted-pair wire Insulation outer diameter: 1.5mm or less	$0.18mm^2$ or more Twisted-pair wire Insulation outer diameter: 1.5mm or less
Drain wire	$0.15mm^2$ or more	$0.15mm^2$ or more

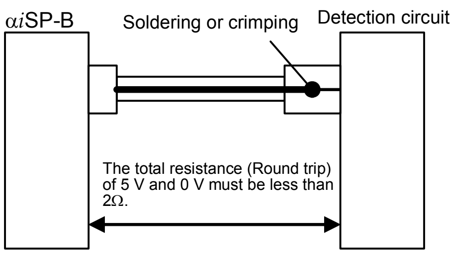
Recommended cable conductor

Specification number	Use	Structure	Cable sheath outer diameter
A66L-0001-0460	For moving parts, 28m or less	$0.3mm^2 \times 5$ $0.20mm^2 \times 1$ pair	ϕ5.7 to 7.3mm
A66L-0001-0481	For fixed parts, 28m or less	$0.3mm^2 \times 5$ $0.18mm^2 \times 1$ pair	ϕ5.7 to 7.3mm
A66L-0001-0462	For moving parts, 50m or less	$0.5mm^2 \times 5$ $0.20mm^2 \times 1$ pair	ϕ6.5 to 8.0mm
A66L-0001-0491	For fixed parts, 50m or less	$0.5mm^2 \times 5$ $0.18mm^2 \times 1$ pair	ϕ5.7 to 7.3mm

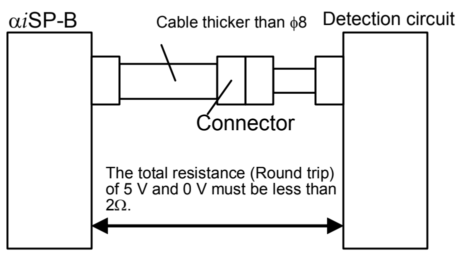
NOTE

1 Please prepare cable K97 by yourself. No connectors for the cable are included with your product. Please order the connectors separately.
2 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 2 Ω.
3 The ground plate to which the shield is connected must be placed near the α*i*SP-B to minimize the distance between the α*i*SP-B and the ground plate.
4 Make sure that the power line and signal line do not run in parallel.
5 See Appendix B, "CABLES," for details of the recommended cable.
6 The maximum cable cross-sectional area applicable to the connector on the detection circuit side is 0.5 mm^2 (strand configuration: 20/0.18 or 104/0.08, insulation outer diameter: ϕ1.5 or less), and sheath diameter is ϕ5.7 to ϕ8.0. When using a wire or cable thicker than the above size is used, take measures as shown below.

[Case 1] Cable conductor exceeds 0.5mm^2



[Case 2] Sheath diameter of exceeds ϕ8



Connector C1

Connection type	Manufacturer	Connector type	Connector specification (manufacturer)	Terminal specification (manufacturer)	Connector kit specification (FANUC)
Crimp type	Japan Aviation Electronics Industry, Ltd.	Straight plug	JN2DS10SL☐ (☐: 1 or 2; Note 1)	JN1-22-22S	A06B-6114-K204#S (including terminals)
		Angle plug	JN2FS10SL☐ (☐: 1 or 2; Note 1)		A06B-6114-K204#E (including terminals)
	Hirose Electric Co., Ltd.	Straight plug	HR34B-12WP△-10SC (△: A or B; Note 2)	HR34B-SC1	--------------------------
		Angle plug	HR34B-12WLP△-10SC (△: A or B; Note 2)		--------------------------
Solder type	Hirose Electric Co., Ltd.	Straight plug	HR34B-12WP△-10S (△: A or B; Note 2)	----------------	A06B-6114-K205#S
		Angle plug	HR34B-12WLP△-10S (△: A or B; Note 2)		A06B-6114-K205#E

NOTE

1 The value for ☐ is determined based on the outer diameter of the cable sheath.
 1: Outer diameter of compatible cable: ϕ5.7 to ϕ7.3
 2: Outer diameter of compatible cable: ϕ6.5 to ϕ8.0
2 The value for △ is determined based on the outer diameter of the cable sheath.
 A: Outer diameter of compatible cable: ϕ5.7 to ϕ7.3
 B: Outer diameter of compatible cable: ϕ6.5 to ϕ8.0
3. For the assembly of a crimp connector, jigs and tools specifically provided from its manufacturer are required. See the table below.

Jigs and tools for the assembly of crimp connectors

Manufacturer		Manufacturer specification	FANUC specification	Applicable cross-sectional area
Japan Aviation Electronics Industry, Ltd.	Crimping tool	CT150-2-JN1-E	A06B-6114-K201#JN1E	21AWG(0.5mm^2: 20/0.18) 23AWG(0.3mm^2) 25AWG(0.18mm^2)
		CT150-2-JN1-D	A06B-6114-K201#JN1D	20AWG(0.5mm^2: 104/0.08) 21AWG(0.5mm^2: 20/0.18) 25AWG(0.18mm^2)
	Extractor	ET-JN1	A06B-6114-K201#JN1R	-----------------------------
Hirose Electric Co., Ltd.	Crimping tool	HT102/HR34B-1	-------------------------------	-----------------------------
	Extractor	RP6-SC-TP	-------------------------------	-----------------------------

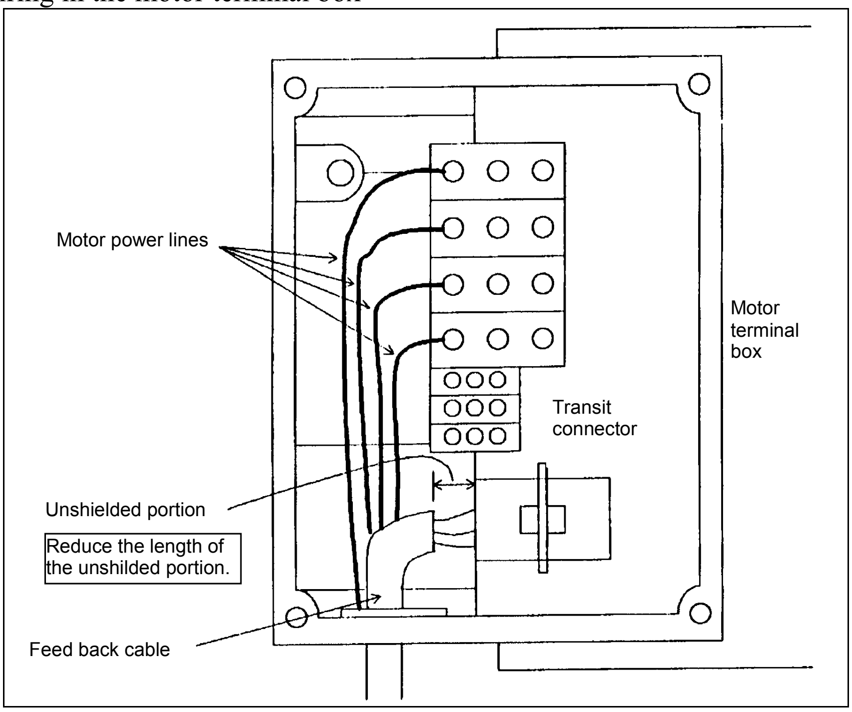
9.3.3.17 Spindle Motor Feedback Cable Connection

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):

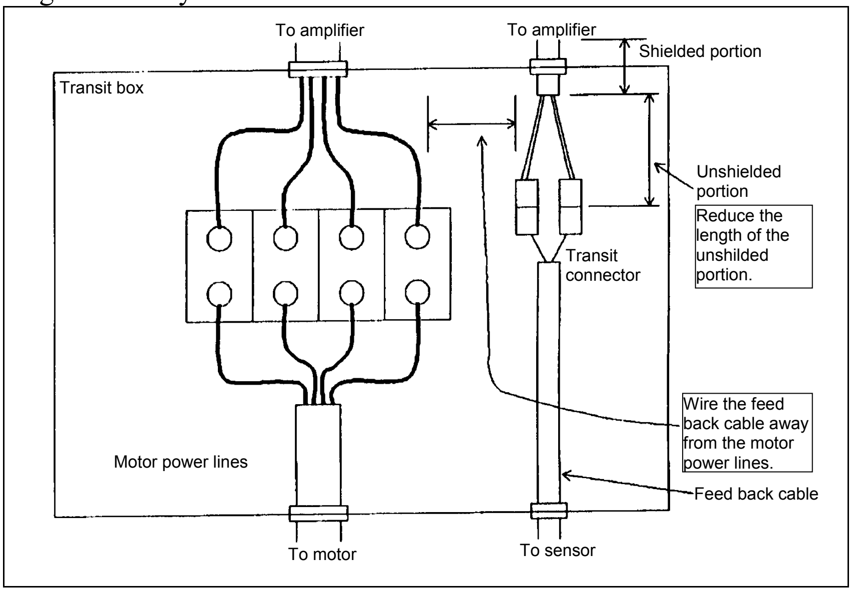
- Variations in low speed become large.
- Sensor signal disconnection alarm (alarm 9073) detected incorrectly
- Sensor signal abnormality alarm (alarm 9083) detected incorrectly

Give consideration to wiring so that minimum lengths of non-shielded portions are provided for the connector connecting the cable for α*i*SP-B and signals output from the spindle motor. (See the examples below.)

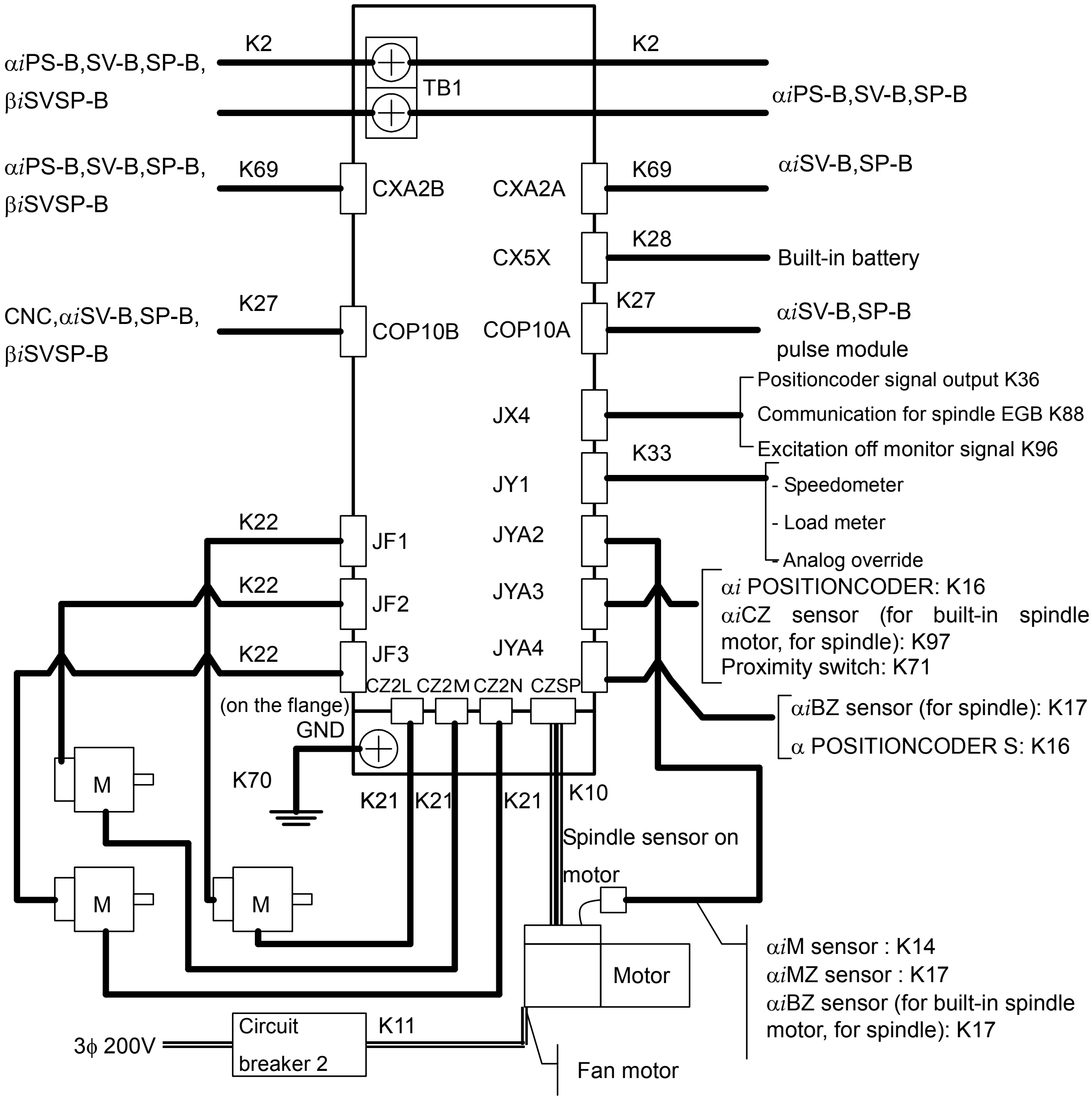
(1) Sample wiring in the motor terminal box



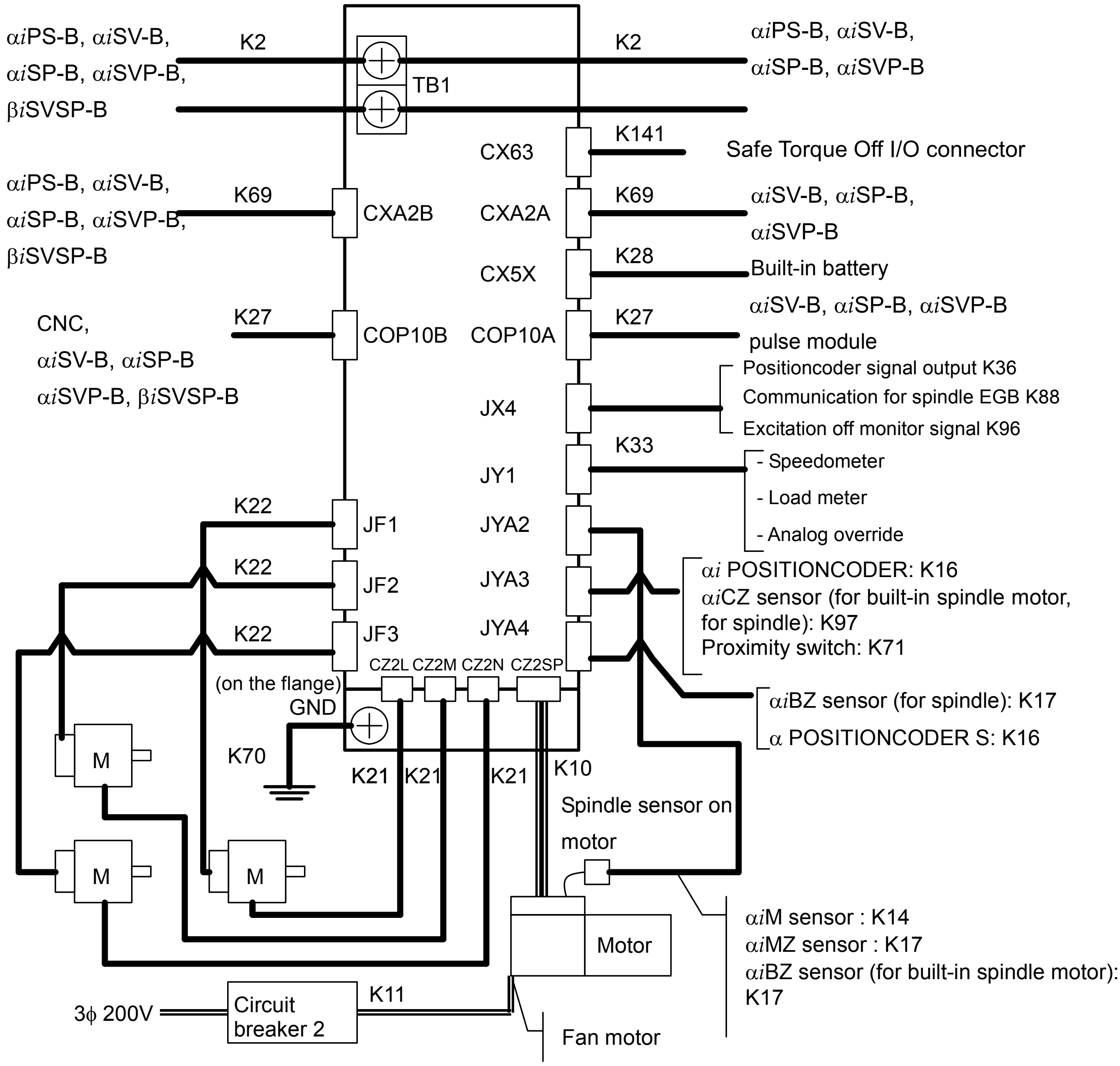
(2) Sample wiring in the relay box for the built-in motor



9.3.4 α*i*SVP-B Series Connection Diagram



(b) Level-up αiSVP-B series



9.3.4.1 Details of cable K2

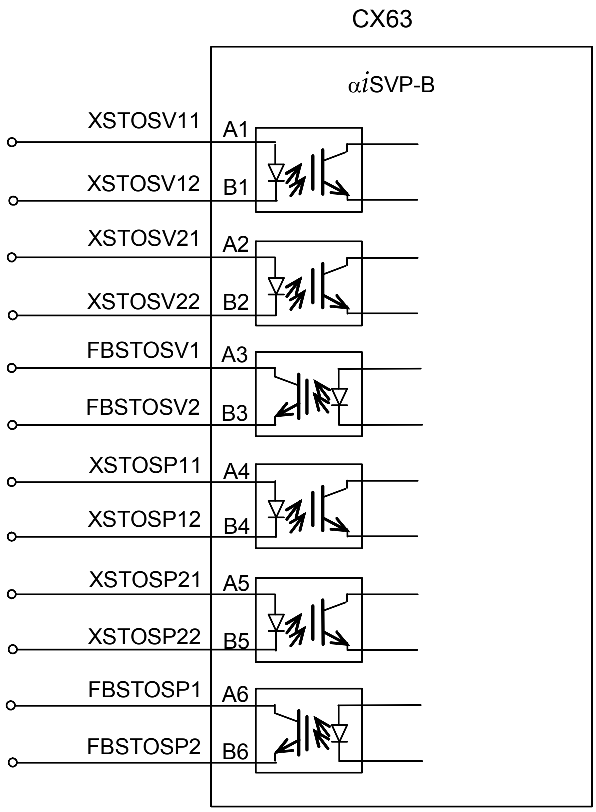
See Subsection 9.3.1.2.

9.3.4.2 Details of cable K69

See Subsection 9.3.1.4.

9.3.4.3 Details of cable K141

Cable K141 is a cable for the STO (Safe Torque Off) I/O signal. For details on the STO function, see Chapter 14, "SAFE TORQUE OFF FUNCTION."



Connector and cable specifications

Manufacturer	Tyco Electronics Japan G.K.
Connector specification	D-2100 series Housing (X key) 1-1318118-6 (1 piece) Contact (M size) 1318107-1 (12 pieces) (FANUC ordering information: A06B-6320-K200)
Cable specification	Conductor size: 0.5mm^2, AWG20 Insulation outer diameter: 1.08 to 2.83 mm

9.3.4.4 Details of cable K10 (power cable)

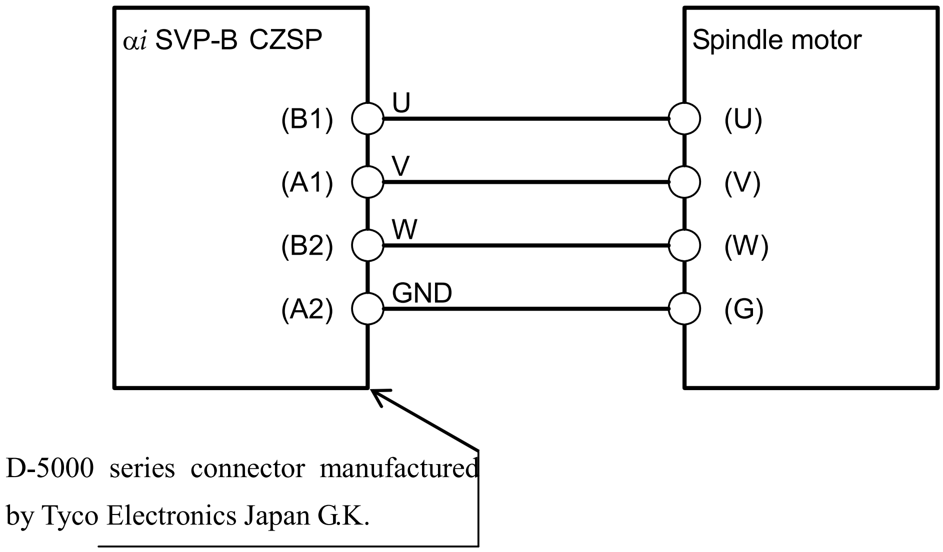
A connector (D-5000) is used to attach the αiSVP-B power cable.
This subsection does not include the dimensions of the crimp terminal or the shape of the motor-side connector.
Refer to "AC SPINDLE MOTOR αi series Descriptions (B-65272EN)" for these items.
For CZ2L, CZ2M, and CZ2N, see Subsection 9.3.2.4.

About the cable specification

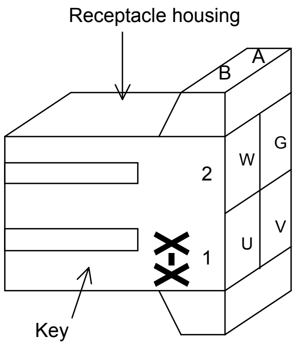
Select the cable specification by considering the following conditions for use.
(1) Motor current rating or current needed in use on a real machine
(2) Cable type (heat resistance temperature, etc.)
(3) Environment in which the cable is installed (operating ambient temperature, etc.)
(4) Need of water 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

> ⚠ **WARNING**
> If the phase order of the power lines is incorrect, an unpredictable motor operation may occur.

Connection through a connector



Location of connector pins



Key specification	Applicable models
XX	αiSVP 20/20/20- 5.5-B αiSVP 10/10/10- 5.5HV-B

For details, see Subsection 9.4.2, "D-5000 Series Connector Manufactured by Tyco Electronics Japan G.K."

9.3.4.5 Details of other cables

For details of other cables, see Subsections 9.3.2 and 9.3.3.

9.4 DETAILS OF CONNECTORS

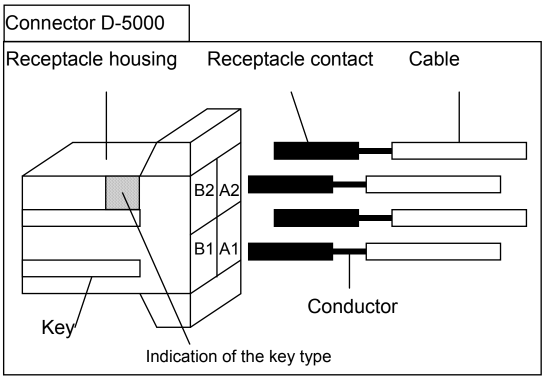
9.4.1 20-pin Half-Pitch Connectors

The following table lists the 20-pin half-pitch connectors used for the αi-B amplifiers 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 model number
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 D-5000 Series Connector Manufactured by Tyco Electronics Japan G.K.

The αi series uses the D-5000 series connector (manufactured by Tyco Electronics Japan G.K.) 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 Japan G.K. FANUC also furnishes options. For details, see Subsection 3.1.3.5, "Connectors."



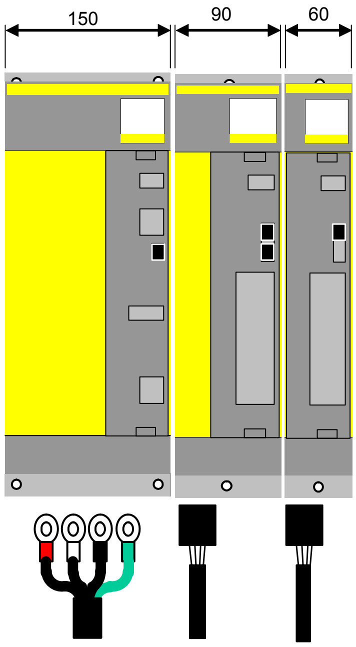
[Receptacle housing]
There are three different key types for the receptacle housing. Be sure to select the receptacle housing of the key type that matches the servo axis you use.

Receptacle housing model number	Key specification	Applicable models
1-917807-2	XX	αiPS 5.5-B, αiSP 2.2-B, αiSP 5.5-B, αiSV-B 1-axis, αiSV-B 2-axis(L), αiSV-B 3-axis(L)
3-917807-2	XY	αiSV-B 2-axis(M), αiSV-B 3-axis(M)
2-917807-2	YY	αiSV-B 3-axis(N)

(Reference)
There is a cable-end connectors which are inserted no matter what key is used. Contact the connector manufacturer (Tyco Electronics Japan G.K.) for details.

[Receptacle contact]
Four receptacle contact types are available, so as to support different conductor cross-sectional area. 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



150mm-wide
Screw
terminal

90mm-wide
αi SV 2
(Screw terminal
winth
αi PS 11/15-B or
αi SP 11/15-B)

60mm-wide
All models
connectize

Applied models	Connector key
αi PS 5.5-B αi SP 2.2-B αi SP 5.5-B αi SV-B 1 αi SV-B 2 (L-axis) αi SV-B 3 (L-axis)	X 1-917807-2
αi SV-B 2 (M-axis) αi SV-B 3 (M-axis)	X 3-917807-2
αi SV-B 3 (N-axis)	Y Y 2-917807-2

Contact
SS 1318986-6
S 316040-6
M 316041-6
L 1318697-6

10 SPINDLE-RELATED OPTIONS

Chapter 10, "SPINDLE-RELATED OPTIONS," consists of the following sections:

10.1 SPINDLE ORIENTATION

Sensor

Sensor	Description
αi Positioncoder	Connected to the spindle on a 1:1 basis (directly connected by using a gear or timing belt)
α Positioncoder S	Connected to the spindle on a 1:1 basis (directly connected by using a gear or timing belt)
αi MZ sensor αi BZ sensor αi CZ sensor	Directly connected to the spindle on a 1:1 basis
αi M sensor+ Proximity switch	Installed on the spindle. The motor is connected with the spindle by using a gear.

Detection unit and repetitive positioning precision

See Section 11.2, "SENSOR FOR THE SPINDLE."

NOTE

1 The error factors on the machine side are excluded.

2 With the αi M sensor plus proximity switch method, stop position control is exercised using the αi M 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 CIRCUIT

10.2.1 Overview

The power line switch circuit is installed between an αiSP-B and spindle motor to exercise spindle switch control and output switch control.

(1) Switching between power lines for two motors (spindle switch control)

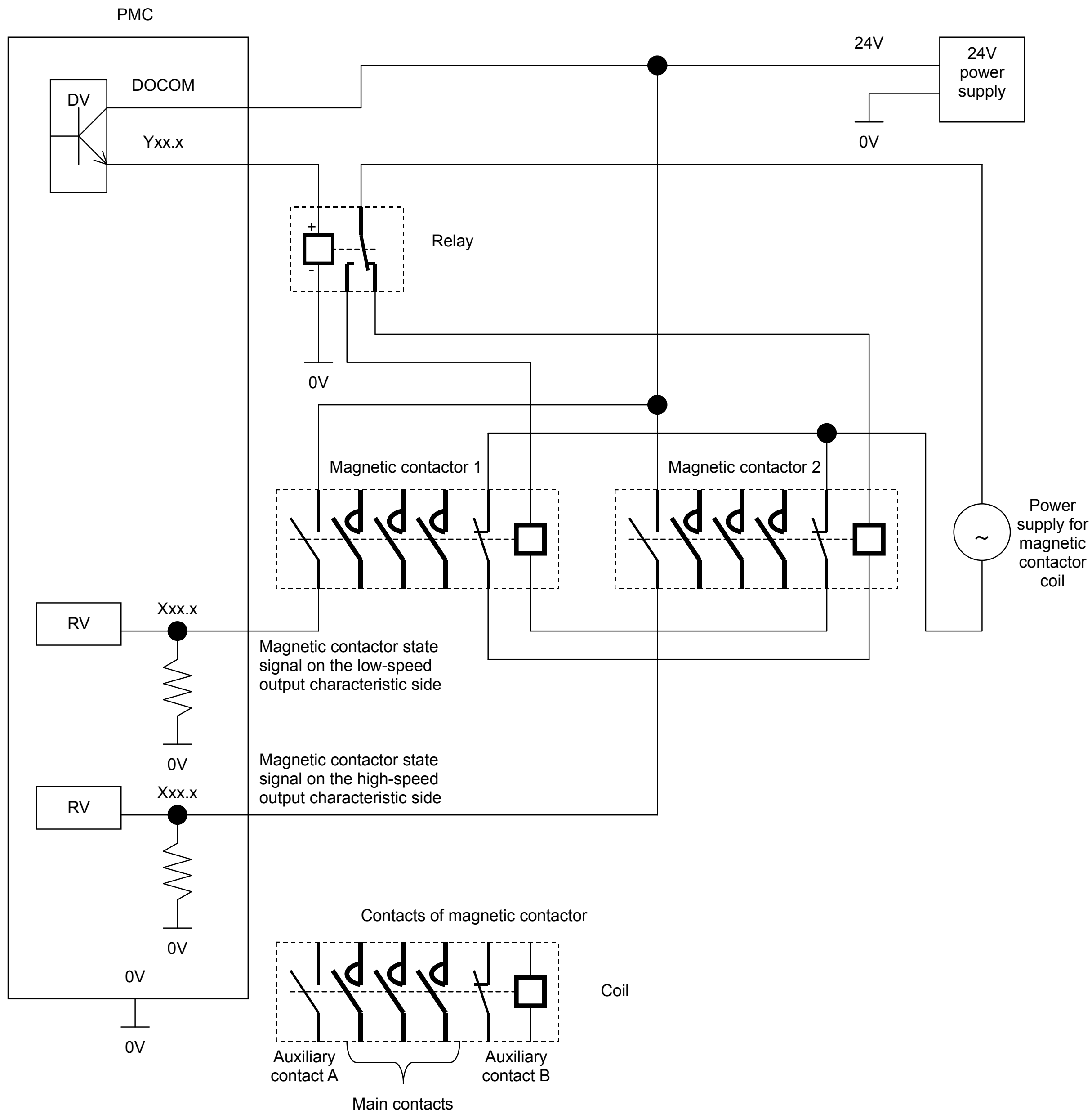
(2) Power line switching between the two different windings of a motor (output switch control)

FANUC provides a power line switch unit for performing power line switching.
The customer can also configure a switch circuit by using magnetic contactors and a relay.

10.2.2 Switch Circuit Configuration

The switch circuit is configured as follows:

- The diagram given below shows connections of the coils of magnetic contactors.
- For the PMC sequence, refer to Section 5.1, "Output Switch Control," or Section 5.2, "Spindle Switch Control," in Chapter 5, "Function Description," in "FANUC AC SPINDLE MOTOR αi Series Parameter Manual" (B-65280EN).
- For the connection of the main contacts in output switch control, refer to the relevant spindle motor descriptions.
- Select magnetic contactors so that the rated contact current of the main contacts is at least the short-time rated current of the spindle motor.



10.2.3 Power Line Switch Unit

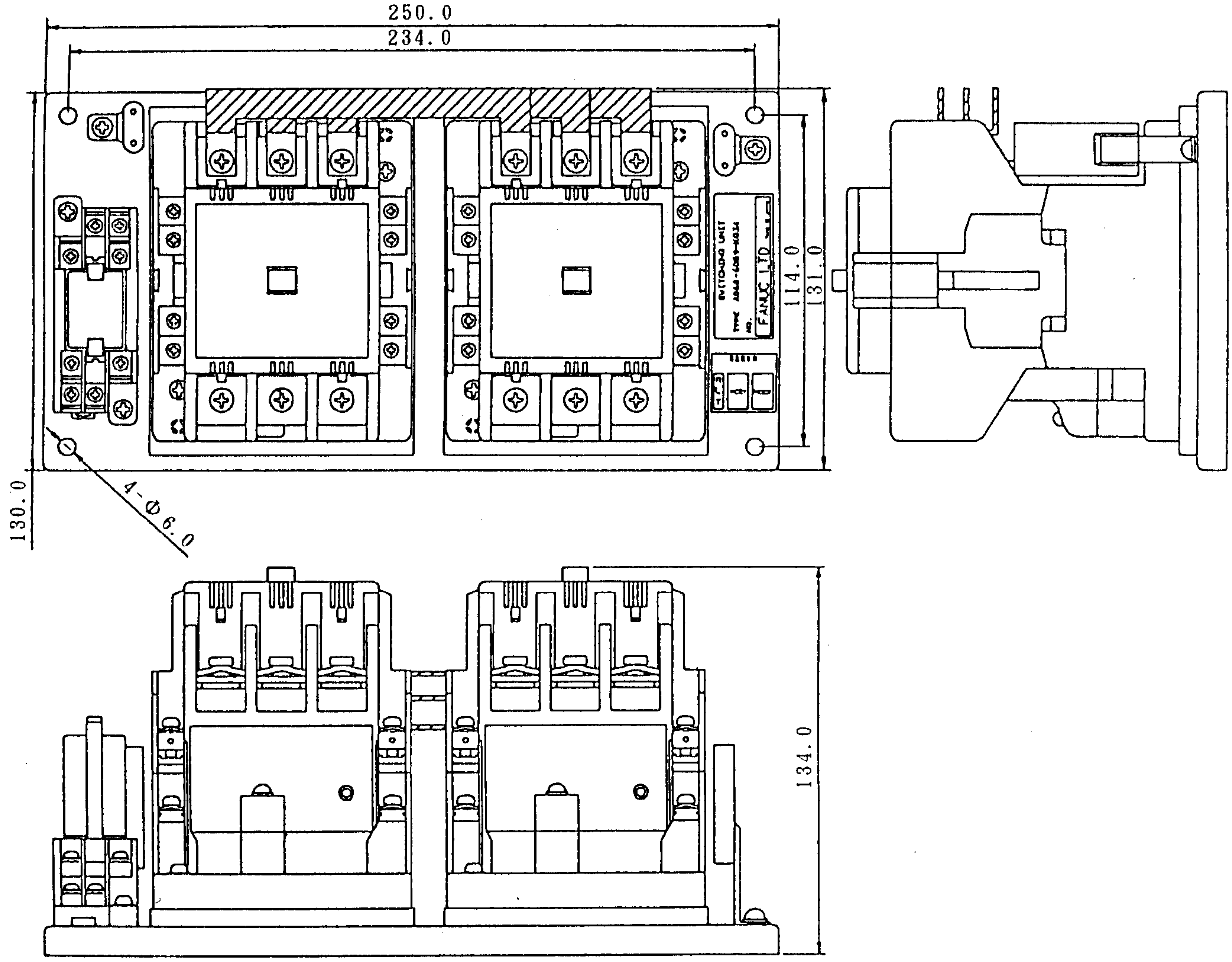
10.2.3.1 Specification

Ordering specification drawing number	A06B-6078-K034 (Y/Y connection) A06B-6078-K035 (Y/Δ connection)	A06B-6078-K036 (Y/Y connection) A06B-6078-K037 (Y/Δ connection)
Magnetic contactor specification	Fuji Electric (SC-N3)	Fuji Electric (SC- N6)
Rated contact current *1	100A	150A
Rating of operating electromagnetic coil	200V/220V 15% to +10% 50/60Hz ±1Hz	
Relay specification	OMRON (type LY2-D)	
Rated voltage	24V±10%	
Rated current	36.9mA	

*1 Select a power line switch unit so that the peak rated current of the spindle motor used is equal to or less than this value.

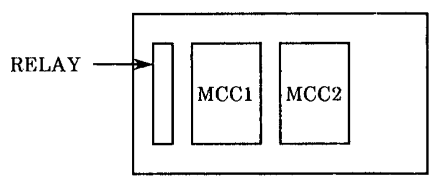
10.2.3.2 Outside and Mounting Dimension Diagrams

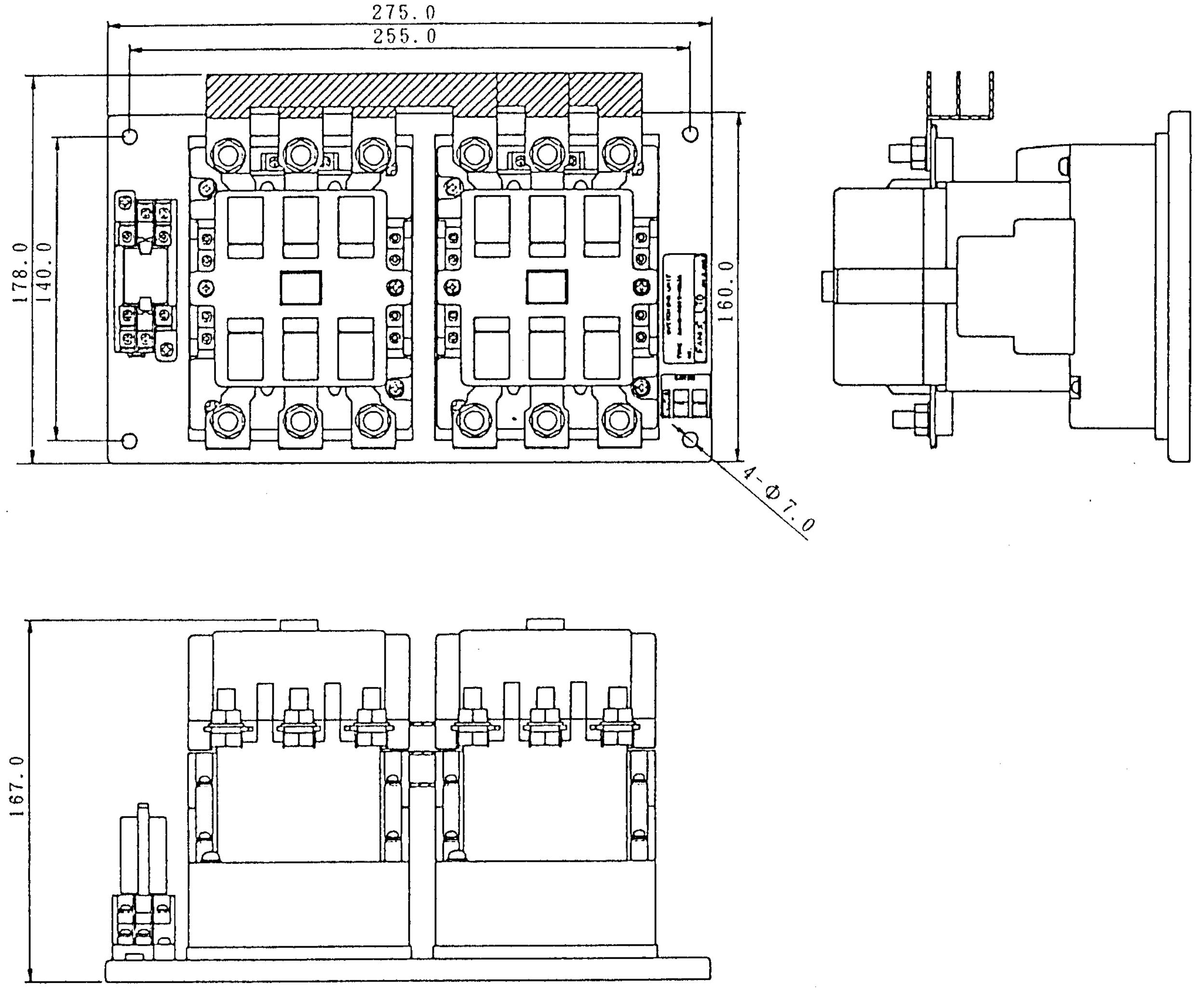
Outside and mounting dimension diagrams of the switch unit for spindle switch control and output switch control (Y/Y connection)



A06B-6078-K034

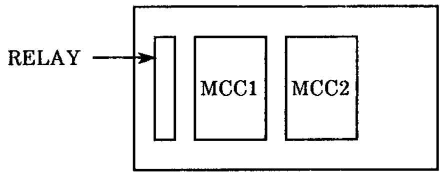
Mounting diagram



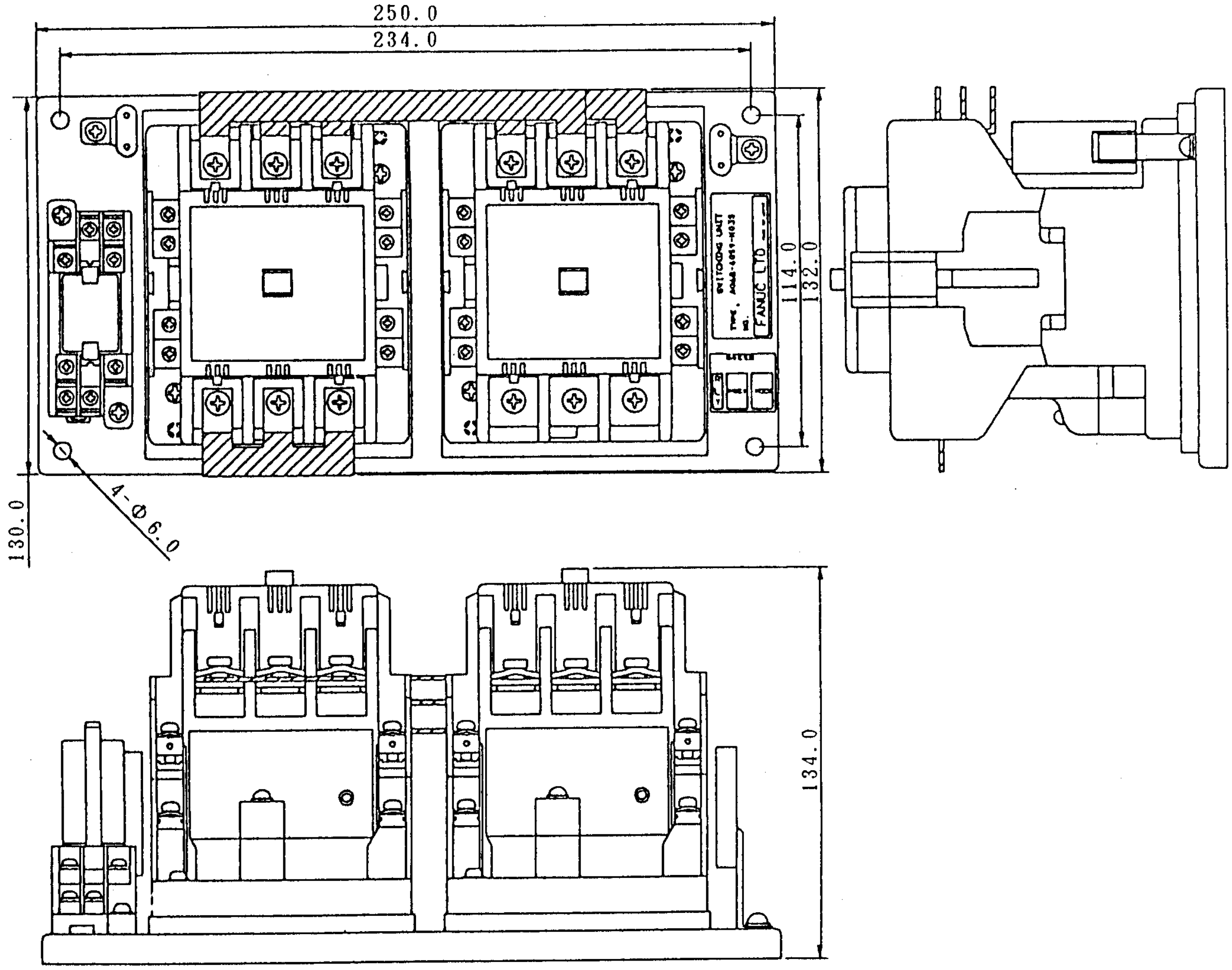


A06B-6078-K036

Mounting diagram

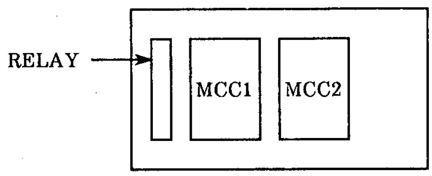


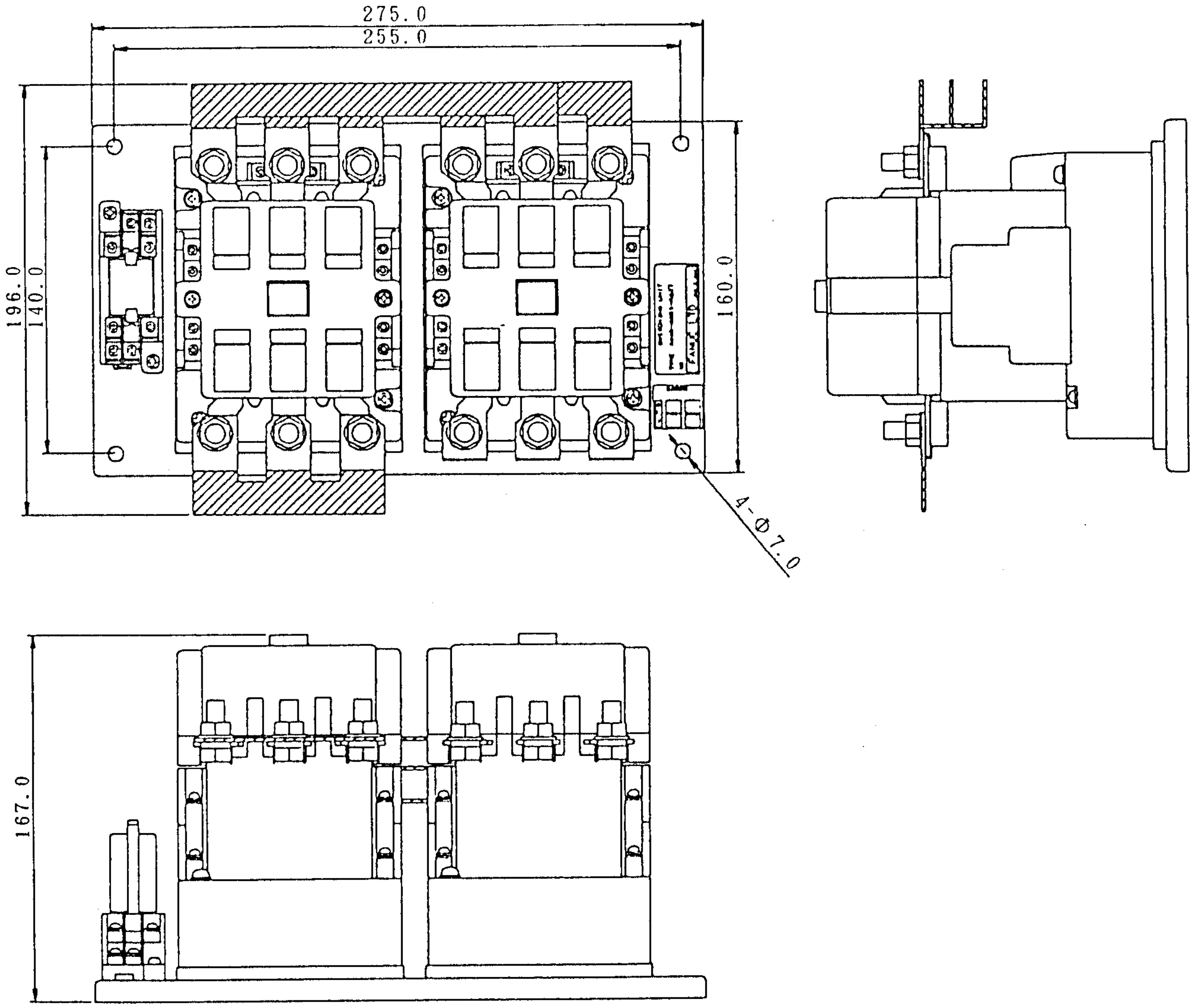
Outside and mounting dimension diagrams of the switch unit for output switch control (Y/Δ connection)



A06B-6078-K035

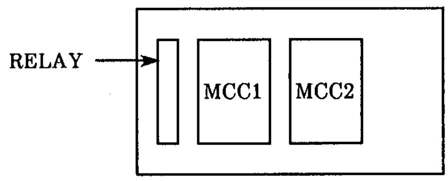
Mounting diagram



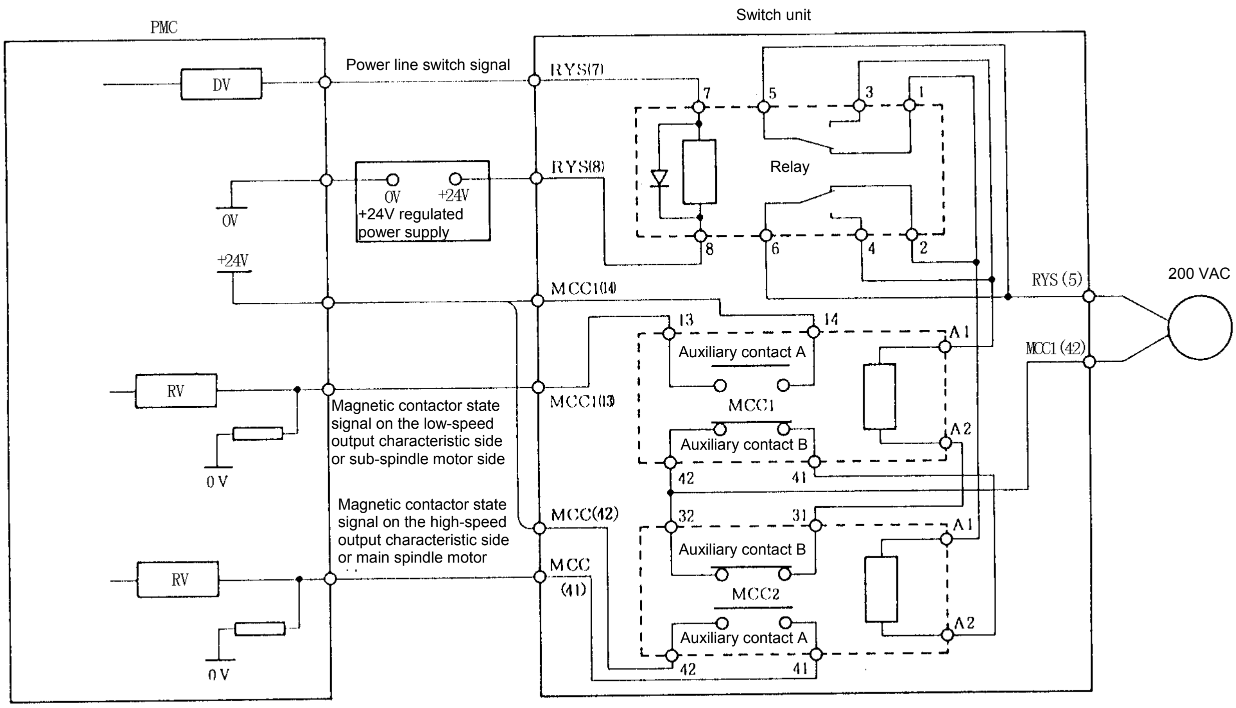


A06B-6078-K037

Mounting diagram



10.2.3.3 Connection



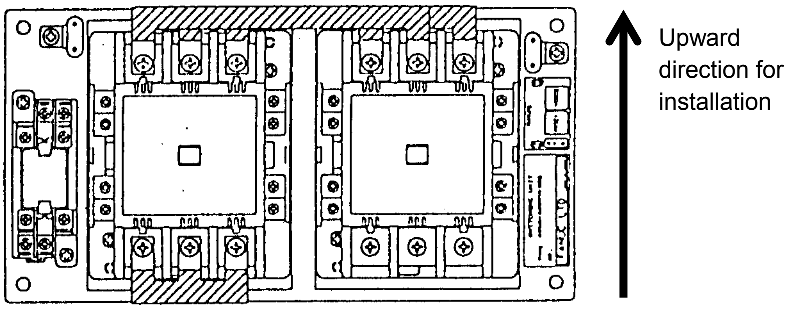
> **NOTE**
> Make a connection to the switch unit by direct screwing on the screw terminal of the magnetic contactor and relay socket.

10.2.3.4 Notes

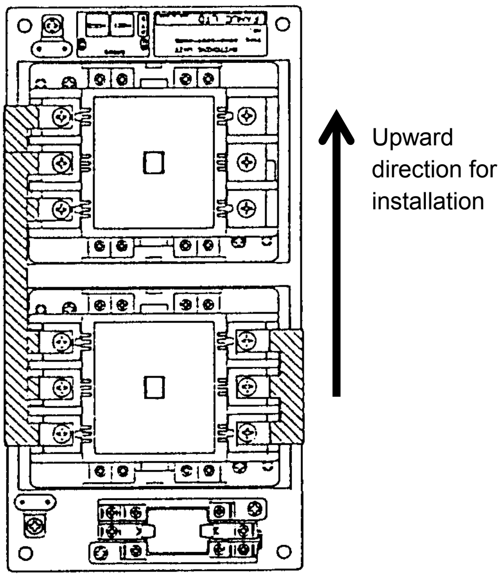
(1) Install the switch unit under the same conditions as for the α*i*SP-B.
Installation conditions

- Ambient temperature
  Ambient temperature of the unit : 0 to 55°C
  Ambient temperature of the power magnetics cabinet : 0 to 45°C
- Humidity
  Normally 90% RH or below, and condensation-free
- Vibration
  In operation : Below 0.5G
  In idle (including during storage and transportation) : Below 1.0G
- Atmosphere
  No corrosive or conductive mists or drops should deposit directly on the electronic circuits.

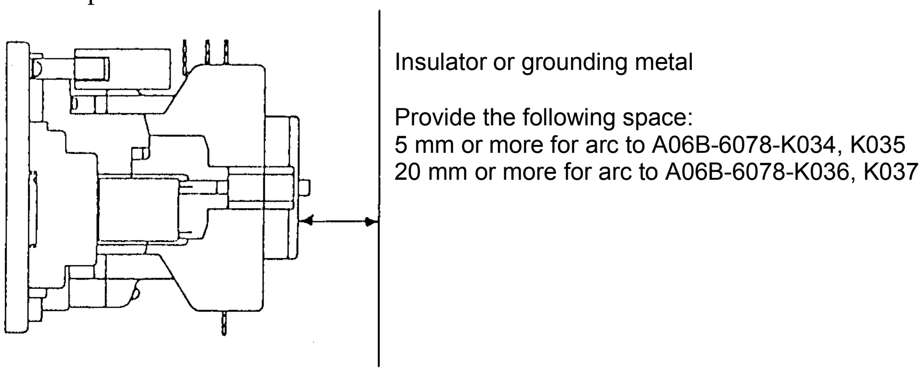
(2) The figure below shows the standard method of installation. However, the switch unit may be tilted up to 15 degrees toward the right or left.



(3) If the switch unit is horizontally installed, as illustrated below, due to limitations of cabling or space, the electrical characteristics of the magnetic contactor is only slightly affected, but its mechanical life is shortened.



(4) Provide an arc space as shown below.



(5) Impacts due to contact making in incomplete installation of the main magnetic contactor unit may vibrate the contact or adversely affect the life of contact. Moreover, insufficient tightening of cable connections may cause major accidents such as overheat of the connection or drop off of the cable.

(a) Tightening torque

(i) Magnetic contactor

Location	Tightening torque [kg·cm]	
	A06B-6078-K034 A06B-6078-K035	A06B-6078-K036 A06B-6078-K037
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

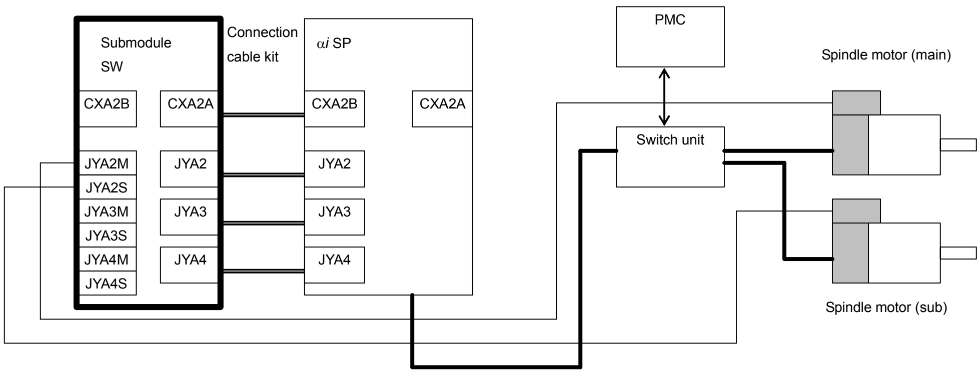
The sub module SW is used for the "spindle switch function" to switch and control two motors (main and sub) by one α*i*SP-B.

- A cable for connecting the power line switch unit with the α*i*SP-B needs to be prepared.
- You need to prepare a metal plate used to mount the sub module SW.

Be sure to order a sub module SW for α*i*SP-B (A06B-6220-H401). The conventional sub module SW (A06B-6111-H401) cannot be used with a spindle amplifier for the α*i*SP-B.

For the drawing numbers of the sub module SW and connection cable kit, see Chapter 3.

10.3.1 Configuration



10.3.2 Specification

By combining the α*i*SP-B with a sub module SW, the spindle switch function for switching between two motors (main and sub) with one α*i*SP-B unit can be used.
The table below indicates allowable combinations of detectors and functions on the main and sub sides of spindle switch control.

			Organization on main or sub side							Remarks
			1	2	3	4	5	6	7	
α*i*SP-B to be combined with sub module SW		α*i*SP-B	○	○	○	○	○	○	○	
Spindle system configuration	Sensor on the motor	α*i* M sensor	○			○	○	○	○	
		α*i* MZ sensor		○						
		α*i* BZ sensor (when a built-in motor is used) (*10)			○					
	Sensor on the spindle	α*i* Positioncoder				○				*3
		External 1-rotation					○			*3
		α*i* BZ sensor						○		*3
		α Positioncoder S							○	*3
Function	Rigid tapping		○*1	○*2	○	○	○*2	○	○	
	Orientation by a position coder			○*8	○	○		○	○	*4
	Orientation by the external one-rotation signal						○*2			*7
	Spindle synchronous control	Velocity synchronization	○*2	○*8	○	○	○*2	○	○	*5
		Phase synchronization		○*8	○	○	○*9	○	○	*5
	Threading			○*8	○	○		○	○	
	Cs-axis contour control			○*8	○		○*11	○	○	*6

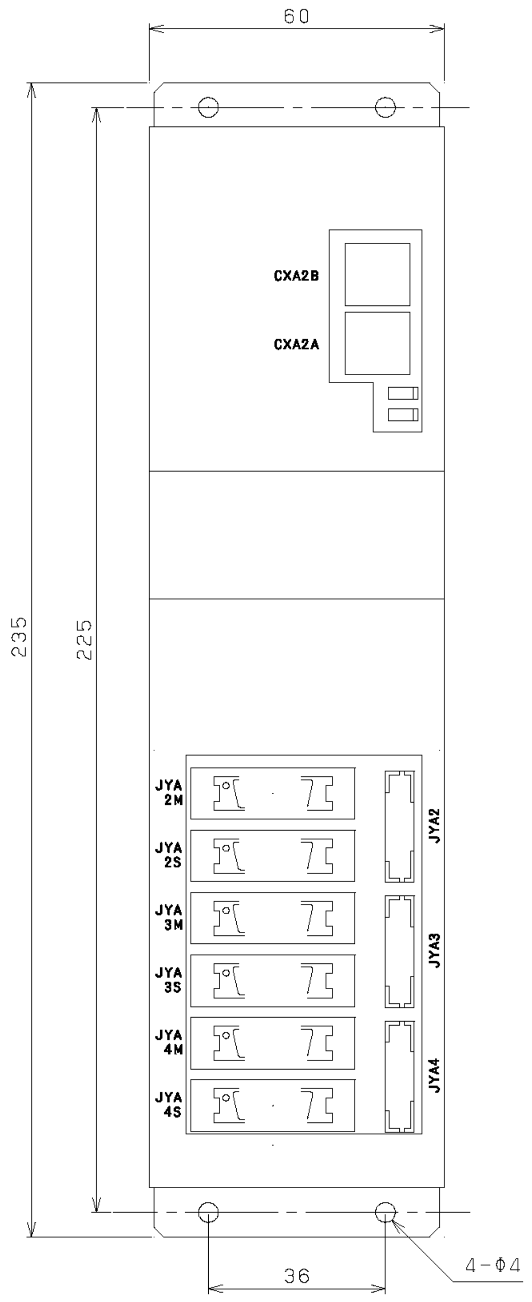
*1 The spindle and motor must be interconnected with a timing belt or gear. No orientation is available to adjust the tapping start position.
*2 The spindle and motor must be interconnected with a timing belt or gear.
*3 The spindle and detector must be interconnected in one-to-one connection mode.
*4 Orientation of external stop position setting type can be used on the main side only.
*5 Spindle synchronous control can be used on the main side only. Two motors and two amplifiers are required.
*6 Cs contour control can be used on the main side only.
*7 Note that the stop position moves by a backlash between the spindle and motor because of the theory of operation.
*8 The spindle and motor must be interconnected directly or with a timing belt or gear in one-to-one connection mode.
*9 Before specifying spindle synchronization, perform orientation to detect the one-rotation signal (PC1DT=1).
*10 The analog output type α*i*CZ sensor is also applicable.
*11 The spindle and motor must be interconnected with a timing belt or gear.
Positional accuracy depends on responsiveness to the external single rotation signal, gear accuracy, backlash and so on.

<u>Other notes</u>

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

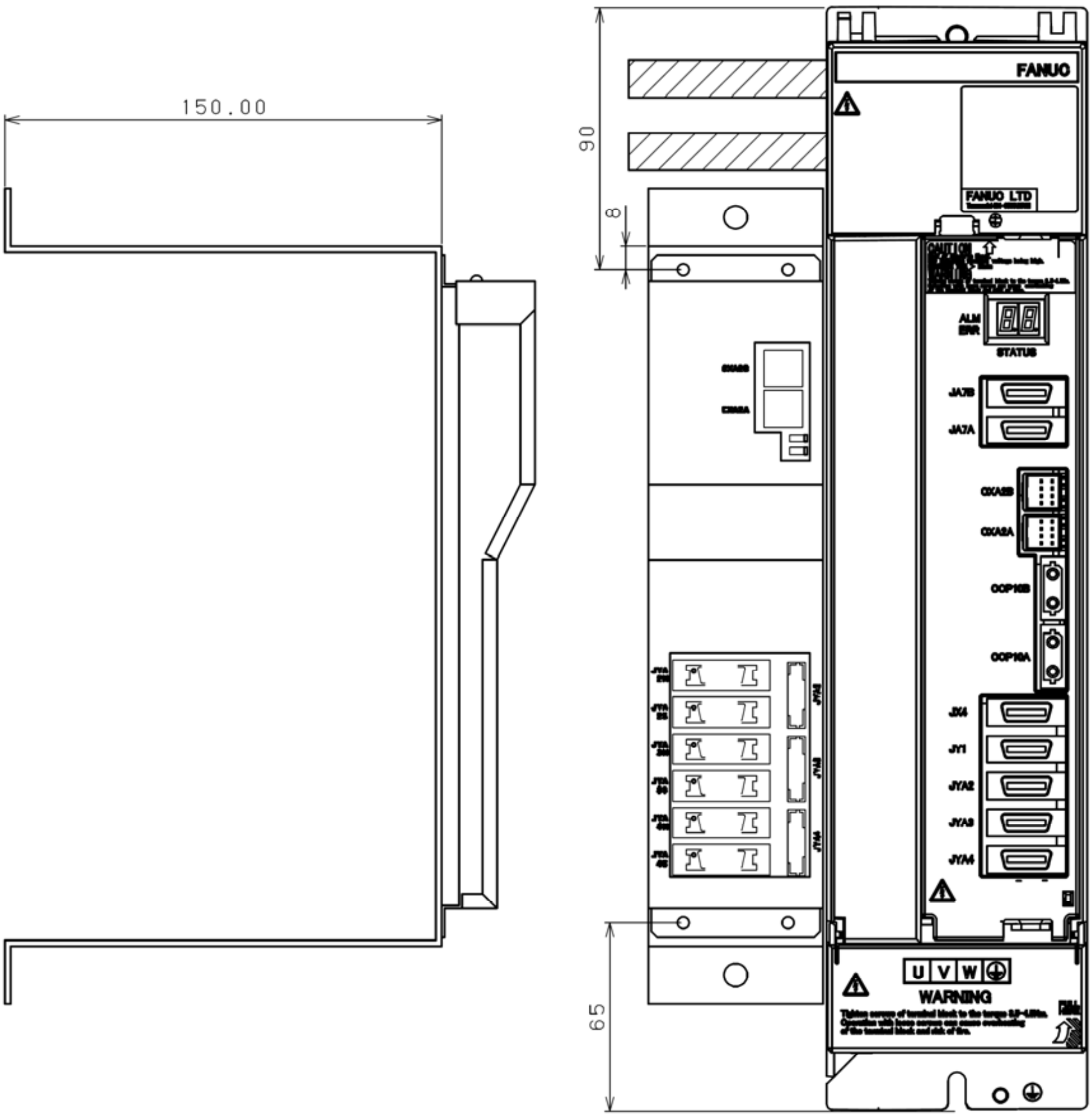
Sub module SW



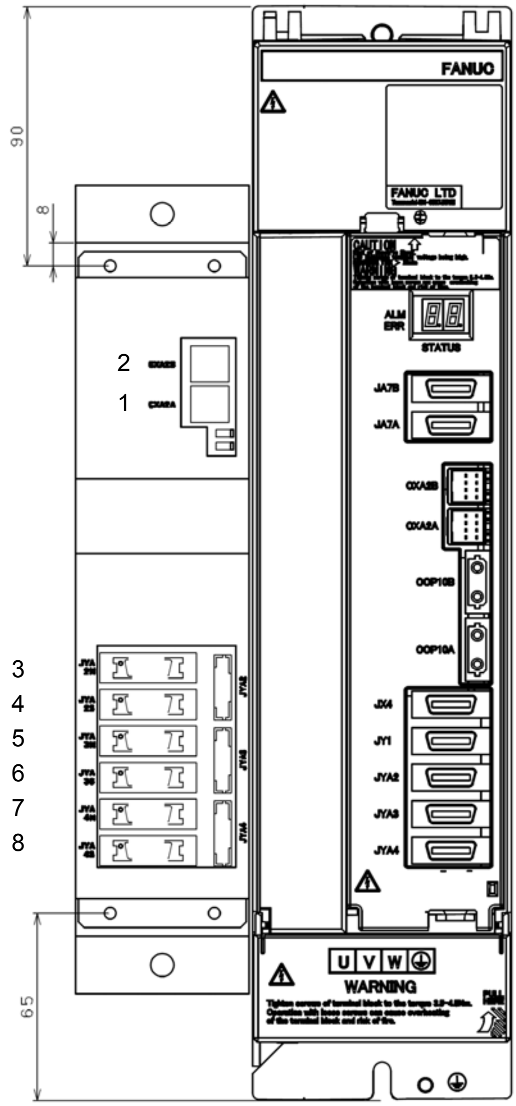
NOTE
A metal plate for mounting the sub module SW needs to be separately prepared.

Installation when the sub module SW is combined with an αiSP 15-B (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 αiSP 15-B)

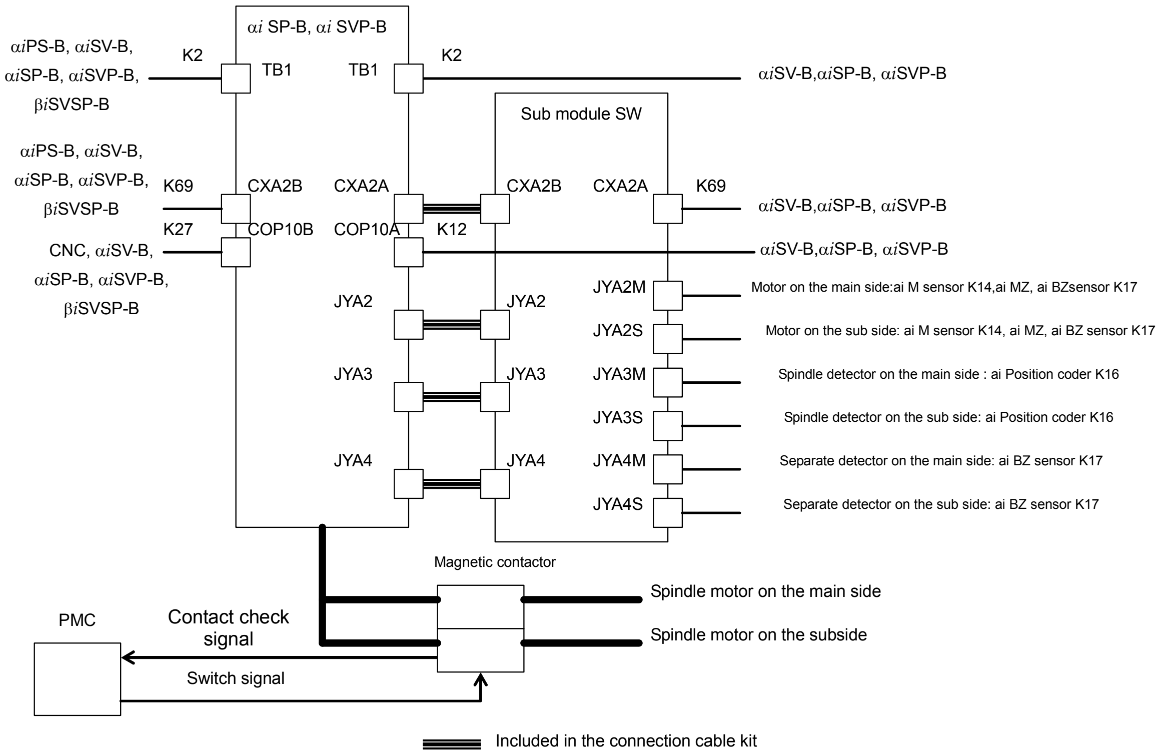


	Name	Indication
1	Connector for αiPS-B interface output	CXA2A
2	Connector for αiPS-B interface input	CXA2B
3	Connector (main side) for spindle sensor connection on motor side	JYA2M
4	Connector (sub side) for spindle sensor connection on motor side	JYA2S
5	Connector for position coder connection and external 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
In order to reduce the cable length between the sub module SW and αiSP-B, install sub module SW on the right side of αiSP-B when αiSP-B is 150 mm or more wide (αiSP22-B or wider, αiSP 22HV-B or wider)

10.3.5 Connection

Total connection diagram



The α*i*CZ sensor analog output type can be used in the same way as the α*i*BZ sensor.

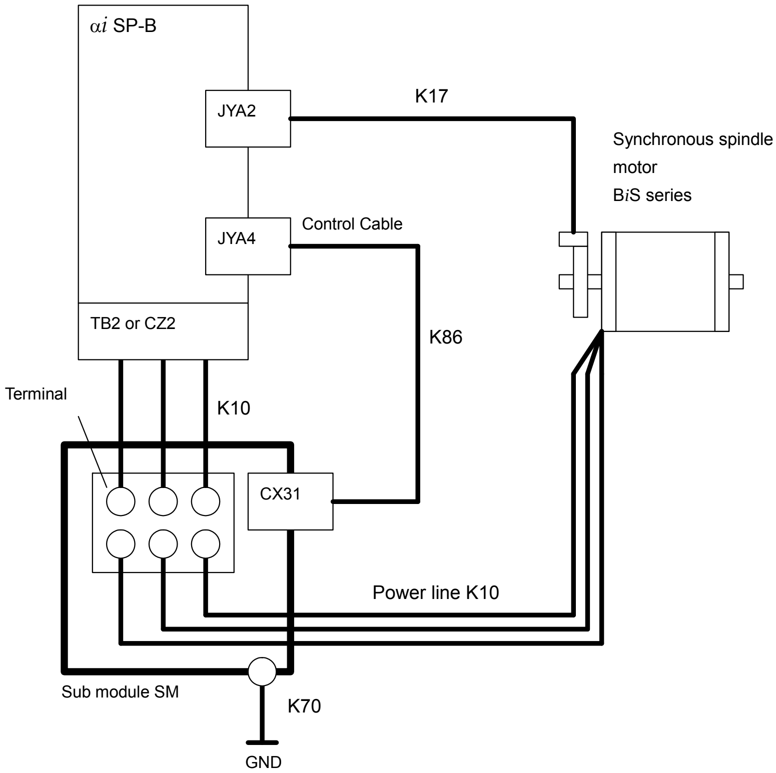
For details of the connection cables other than the connection cable kit, see the items of relevant K numbers in Chapter 9.

For the drawing number of the connection cable kit, see Chapter 3.

10.4 SUB MODULE SM

When used with the αiSP-B, the sub module SM is used to drive the synchronous built-in spindle motor B*i*S series.

Overall connection



> ⚠ **WARNING**
> To ensure safety, avoid inserting switches to the power lines connected to the αiSP-B, sub module SM, and motor. If a switch connected to such a power line is turned off during motor rotation, overvoltage generated from the motor cannot be blocked, possibly damaging the motor and sub module SM.

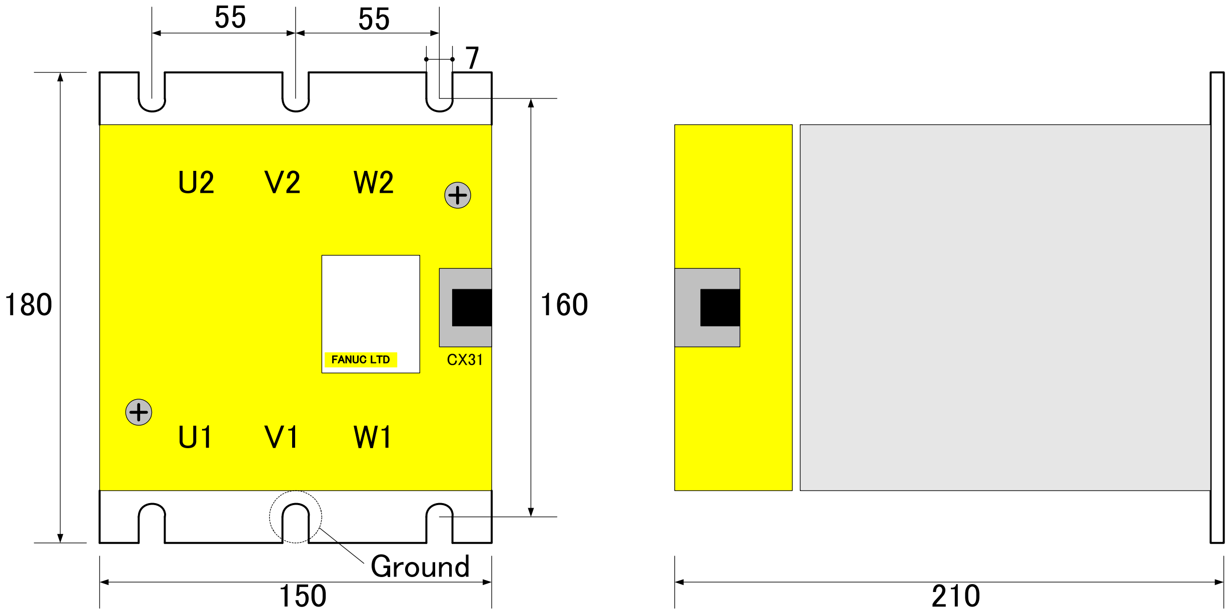
10.4.1 Specifications

Model name	SSM-100	SSM-200
Short-circuit current	100Arms (within 120 sec)	200Arms (within 120 sec)
Rated input voltage	200 to 480VAC	
Applicable spindle amplifier	αiSP-B αiSVP-B	
Weight	6kg	6.5kg
Power consumption (normal operation without alarm	3W	6W

> ⚠ **CAUTION**
> Apply sub module SM unit edition B or later.

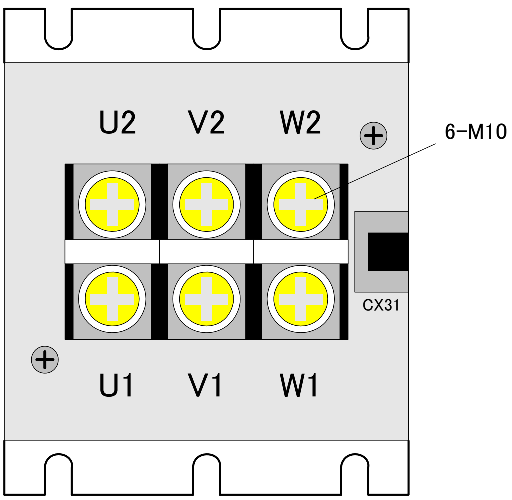
10.4.2 Outline Drawing

With the protective cover
Installed with two M4 screws

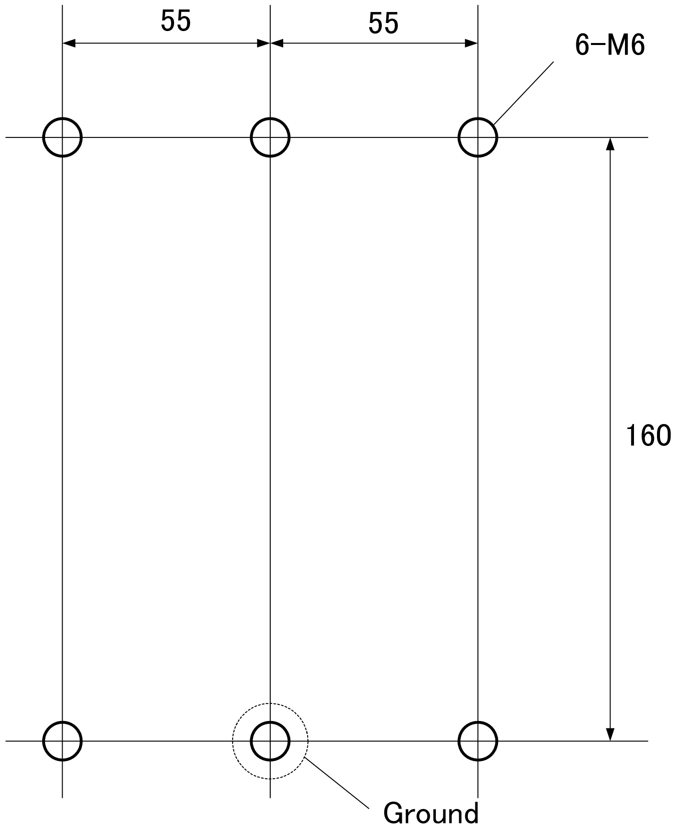


(Unit = mm)

Without the protective cover



10.4.3 Panel Cut-out



(Unit = mm)

10.4.4 Connection

Details of cables K10, K17, K70, and K86

For details of cables K10, K17, K70, and K86, see Subsection 9.2.3 and Appendix E.

10.4.5 Connection with α*i*SV-B

Sub module SM is used with α*i*SV-B to drive some models of synchronous built-in servo motors.
For details, see Subsection 9.3.2.11 of this document.

11 SENSOR

Chapter 11, "SENSOR," consists of the following sections:

11.1 SENSOR FOR THE SERVO SYSTEM
11.2 SENSOR FOR THE SPINDLE
11.3 SPINDLE SENSORS BY OTHER MANUFACTURERS

11.1 SENSOR FOR THE SERVO SYSTEM

11.1.1 Absolute αiCZ SENSOR (for separate detector use)

This manual describes the specifications and handling of the absolute αiCZ SENSOR for angular displacement detection.
This sensor can be used as a separate sensor when high-accuracy angular displacement detection is required as in the case of a round table configured as a full-closed system using a servo motor and worm gear.
For this sensor, the FANUC serial interface is used. This sensor can be directly connected to the separate detection interface unit.

11.1.1.1 Specification

Names and specification numbers

Names and specification numbers

Name	Specification number	Remarks	
		Number of teeth	Maximum rotation speed
αiCZ SENSOR 512AS	A860-2164-T411	512	3000min^{-1}
αiCZ SENSOR 768AS	A860-2164-T511	768	2000min^{-1}
αiCZ SENSOR 1024AS	A860-2164-T611	1024	1500min^{-1}

Environmental conditions

Environmental conditions (applicable to all specifications)

Item	Specification
Operating temperature range	0 to +70°C
Humidity	95%RH or less

Mechanical and electrical specifications

Mechanical and electrical specifications (applicable to all specifications)

Item	Specification
Power supply voltage	$5V^{+5\%}_{-10\%}$
Current consumption	In normal state: 150mA At battery backup time: 0.3mA (Note)
Water and dust proof class	Equivalent to IP67 (when connector is mated)

NOTE
1 The current consumption at battery backup time is about 3 times larger than that of the αi PULSECODER. So, it is recommended to use 4 pieces of alkaline batteries (size D).
2 Use a battery case (A06B-6050-K060) and 4 alkaline batteries (A06B-6050-K061). Commercially-available size D alkaline batteries may be used.

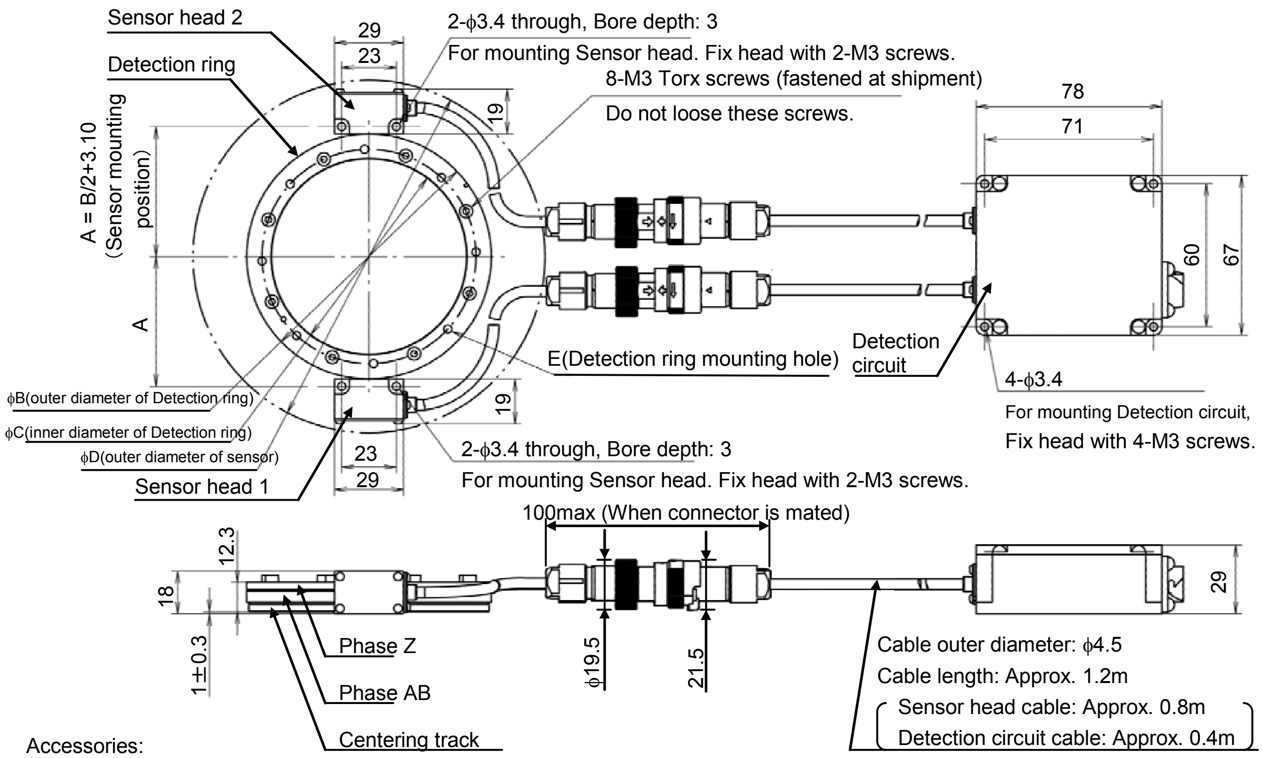
Resolution and accuracy

Resolution and accuracy

Name	Resolution	Positioning accuracy		Repetition accuracy
		Typ.	Max.	Typ.
αiCZ SENSOR 512AS	3,600,000 / revolution (See Note)	±4”	±8”	±1”
αiCZ SENSOR 768AS		±3”	±6”	
αiCZ SENSOR 1024AS		±2”	±4”	

NOTE
The resolution is achieved with connection to a CNC unit of 30i-B series.
1 The following settings are applied to the flexible feed gear (FFG) when the resolution at a rotation speed of 3,600,000 revolutions is used as the positional feedback for a CNC unit of 30i-B series.
αiCZ SENSOR 512AS $FFG = \frac{36}{5}$
αiCZ SENSOR 768AS $FFG = \frac{24}{5}$
αiCZ SENSOR 1024AS $FFG = \frac{18}{5}$
See B-65270EN/09 for other parameters.
2 Resolutions achieved by connection to older types of CNC units than 30i-B series (including 0i-D series) are as follows:
αiCZ SENSOR 512AS 500,000/revolution
αiCZ SENSOR 768AS 750,000/revolution
αiCZ SENSOR 1024AS 1,000,000/revolution

11.1.1.2 Dimensions



Accessories:

Parallel pin (JIS B 1354-1988, class A, normal diameter of ϕ3, normal length of 6) × 4

Thickness gauge (t =0.1mm) × 1

Unit: mm

Sensor type number	Number of teeth	Dimensions				
		Sensor mounting position A	Outer diameter of Detection ring ϕB	Inner diameter of Detection ring ϕC	Outer diameter of sensor ϕD	Detection ring mounting hole E
A860-2164-T411	**512**	54.5	102.8+0/-0.02	82+0.02/-0	148	8-ϕ3.4 through, equally spaced on ϕ90 circumference
A860-2164-T511	**768**	80.1	154+0/-0.02	125+0.02/-0	198	8-ϕ4.5 through, equally spaced on ϕ134 circumference
A860-2164-T611	**1024**	105.7	205.2+0/-0.02	160+0.02/-0	249	8-ϕ5.5 through, equally spaced on ϕ170 circumference

NOTE

1. The sensor is a precision part. Use special care in handling. Particularly, do not apply external force to the Sensor head.
2. Take dust protection measures to prevent foreign matter such as chips from being attached to the sensor.

NOTE

3 The waterproof class of the SENSOR is equivalent to IP67 when the connector is mated. However, the waterproof performance indicated in IP is valid only for water and for a short period of time. The performance is not guaranteed. If the sensor is continuously exposed to cutting fluid, for example, the sensor can fail. Provide highest-level water protection to prevent the sensor from being exposed to cutting fluid or the like.

4 For easy maintenance, mount the sensor at a position where it can be replaced easily.

5 Ensure that no vibration greater than 1 G is applied to the Detection circuit.

6 Ground the Detection circuit. Grounding can be performed simply by screwing the Detection circuit as the bottom of the circuit is not coated.

7 Fasten the cables to the machine near the Sensor heads lest direct stress is applied to the Sensor heads.

8 All of the cables used for the sensor are flexible cables.

11.1.1.3 Usage with consideration of environmental resistance of αiCZ SENSOR

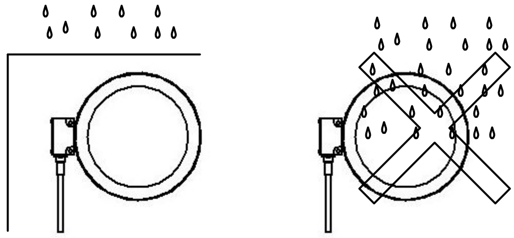
Overview

Sensors are electric components. They may be adversely affected by exposure to cutting fluid or lubricant. Cutting fluid on the sensor surface significantly increases the risk of the damage as the resin or rubber sealing parts are deteriorated, which in turn leads a large amount of cutting fluid entering into the sensor. When using the sensor, note the points described below.

Sensor installation conditions

If the sensor is used in an environment in which it is exposed to the cutting fluid or lubricant, the cutting fluid or lubricant may adversely affect the sensor sealing parts or cables and enter the inside of the sensor, resulting in damage to these sensor. When using the sensor, note the points described below.

- Make sure that the sensor surface is never wet with the cutting fluid or lubricant, and also make sure that no cutting fluid or lubricant builds up around the sensor. If there is a possibility of the surface being wet, a cover is required.

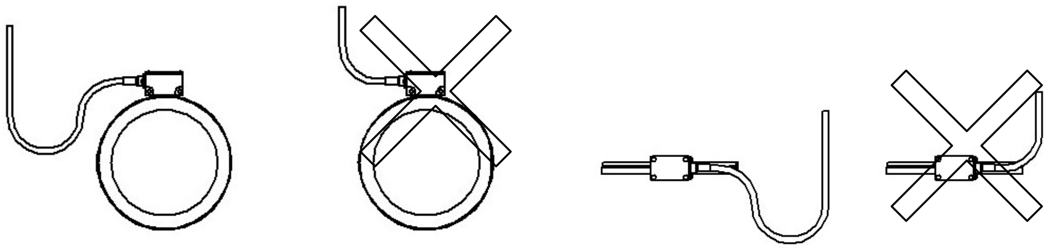


- If the cutting fluid or lubricant is misted, it may form condensation in the inside of the cover and fall on the sensor. Make sure that no dew drops of the cutting fluid or lubricant fall on the sensor.
- Completely separate the sensor area from the machining area.

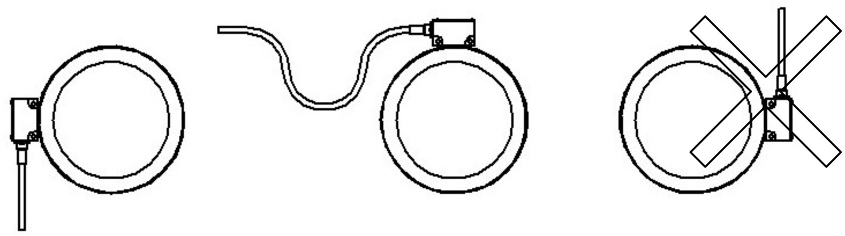
Cable layout

When using the sensor, note the points described below.

- Make sure that no cutting fluid or lubricant is led to the sensor via any cable. When a horizontal cable outlet is used, a slack can be formed in the cable to prevent the cutting fluid or lubricant from being led to the sensor.



- When an upward cable outlet is used, the cutting fluid or lubricant collects around the sensor connector. Use a horizontal or downward cable outlet whenever possible.

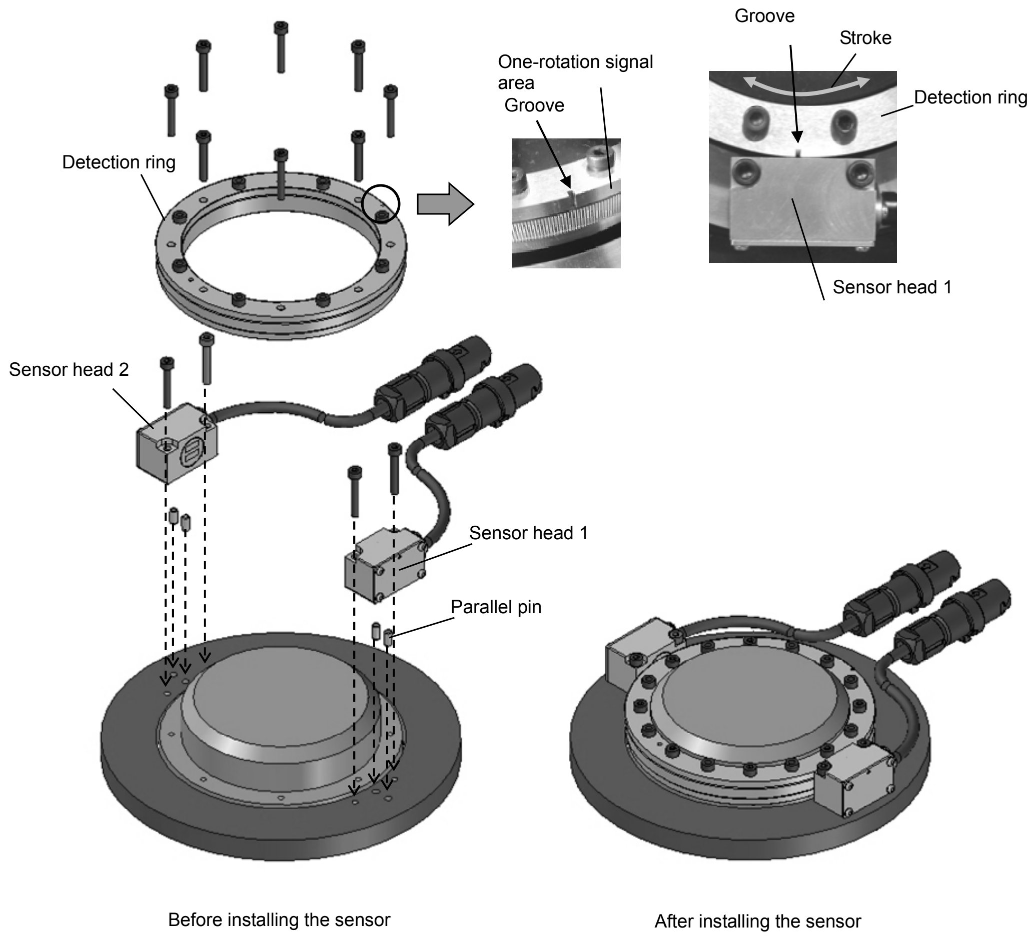


11.1.1.4 Installing the sensor

Installation procedure (overview)

Install the sensor according to the procedure below. See the following sections for details in each step.

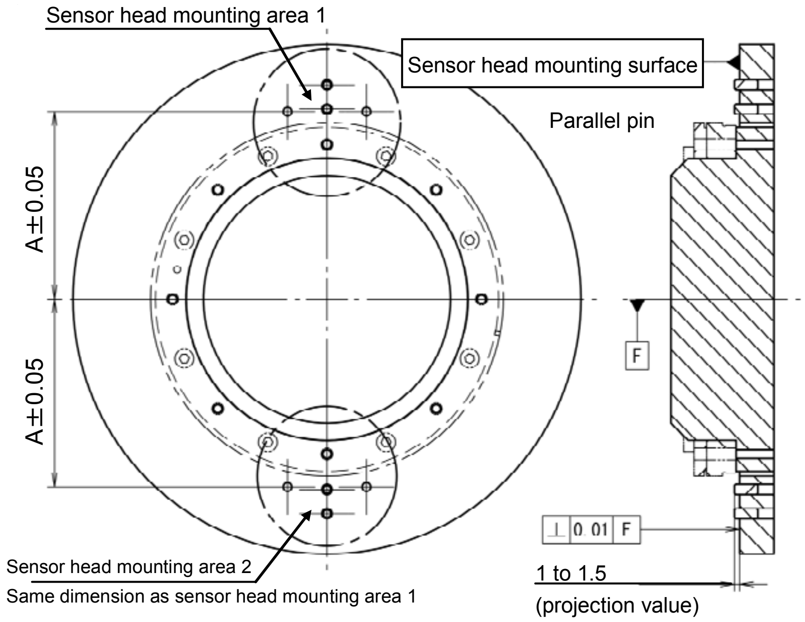
- Machine the sensor mounting surface as necessary then insert the parallel pins.
- Mount the Detection ring onto the shaft or sleeve of the machine, center, and fix with screws.
- Adjust the gap between the Sensor heads and Detection ring, and then mount the Sensor heads onto the machine.

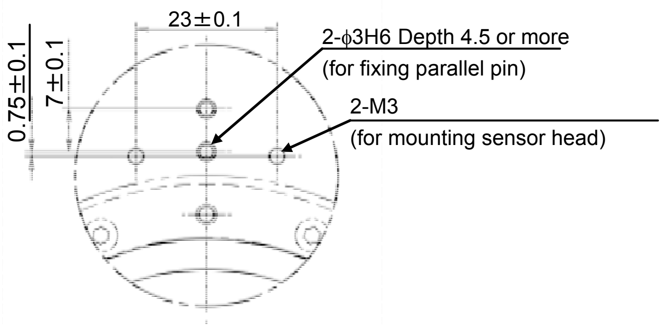


> **NOTE**
> Ensure that the groove of the one-rotation signal area of the Detection ring passes Sensor head 1 within the stroke.

Sensor head mounting surface

Machine the sensor head mounting surface as shown in the figure below and insert the supplied parallel pins in the 2-ϕ3H6 holes. The parallel pins serve as a guide for gap adjustment of the Sensor head.



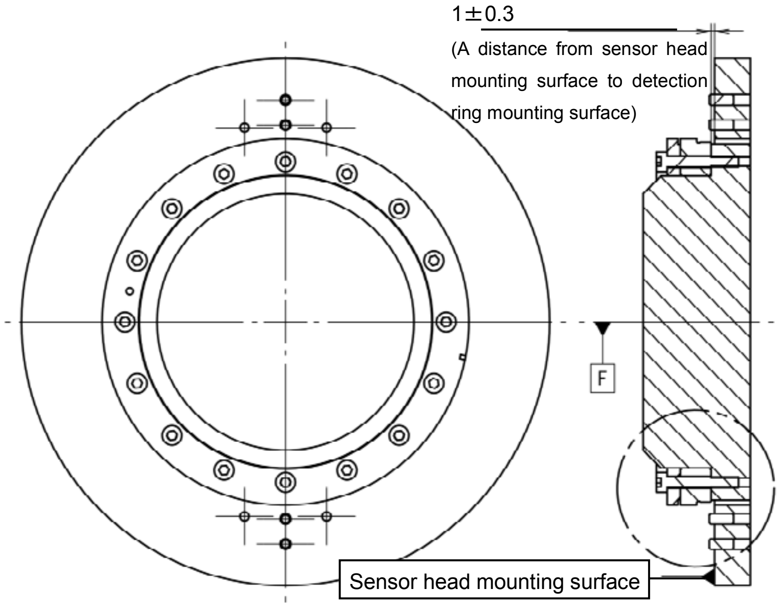


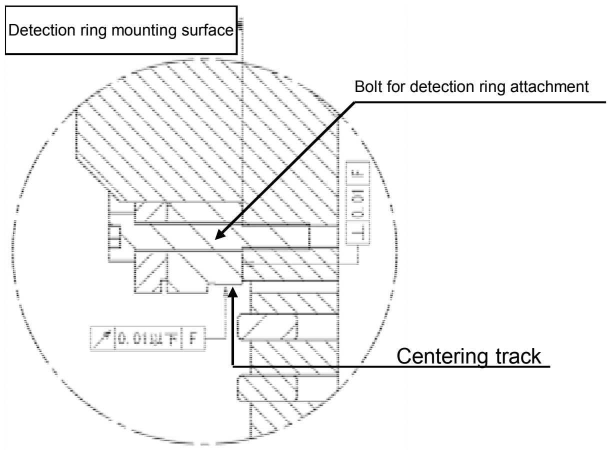
Details of sensor head mounting surface 1

> **NOTE**
> 1 See "Dimensions" above for dimension A.
> 2 The design should ensure that the required dimensions are satisfied by the positions of the threaded holes for mounting the Sensor heads after assembly rather than by the components with their mounting surface.

Installing the Detection ring

Center the Detection ring by using the centering track so that the runout to the rotation center is 0.01 mm or less, and install it. Moreover, design so that the Detection ring mounting surface is 1 ± 0.3 mm apart from the Sensor head mounting surface in the direction of the shaft. Ensure that the perpendicularity of the Detection ring mounting surface is within 0.01 mm from the rotation center. Apply a thread locker or the like to the screws to prevent the screws from becoming loose.





Specification	Outer diameter of centering track (mm)	Positions of Detection ring mounting holes	Mounting screw	Recommended tightening torque for screws (Nm)
A860-2164-T411	ϕ101	8-ϕ3.4 through, equally spaced on ϕ90 circumference	M3	1.5±5%
A860-2164-T511	ϕ152.2	8-ϕ4.5 through, equally spaced on ϕ134 circumference	M4	3.0±5%
A860-2164-T611	ϕ203.4	8-ϕ5.5 through, equally spaced on ϕ170 circumference	M5	6.0±5%

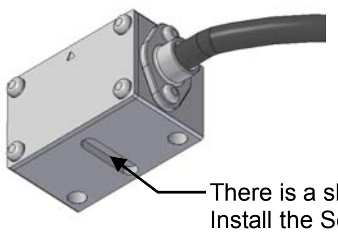
NOTE

1. For centering, the outer diameter of the shaft or sleeve must be designed to leave a gap of at least 0.1 mm from the inner diameter of the Detection ring on each side.
2. Screw the Detection ring on end face. Do not mount the ring by means of heat shrink fitting.
3. The Detection ring consists of the phase Z ring and phase AB ring. They are fastened together with screws before the shipment of the sensor. Never detach the screws. Spot facing is not provided to the screw portion of the Detection ring. So, at the time of machine design, make sure that the machine does not interfere with the screw heads.
4. Centering must be performed on the centering track. The outer diameter of the phase Z ring and the teeth pitch circle are not coaxial. Use a tool such as a plastic hammer for centering in order not to damage the gear teeth.
5. Magnetic matter attached to gear teeth can lead to a detection error. When centering is completed, remove such foreign matter by air blowing.
6. If the Detection ring's fixing screws are tightened with excessive torque, the Detection ring may be deformed elastically, resulting in reduced detection accuracy. Apply the recommended tightening torque for mounting the Detection ring.
7. Inadequately fastened Detection ring may result in an unexpected behavior. Make sure to fix the Detection ring to the rotary axis.

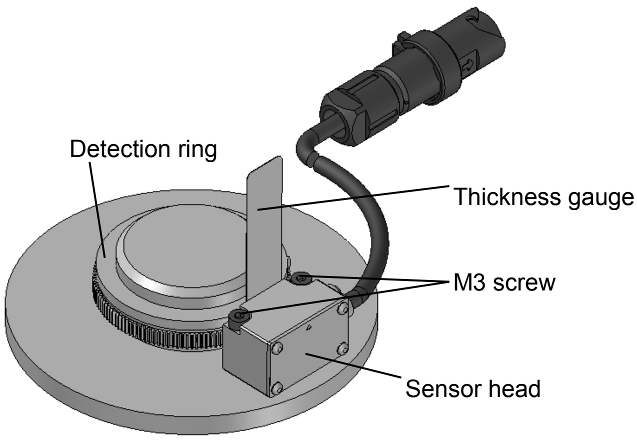
Installing the Sensor heads

Install the Sensor heads according to the procedure below. The same procedure applies to Sensor head 1 and Sensor head 2.

- Place the Sensor head on the sensor mounting surface so that the parallel pins are positioned in the slot on the bottom of the Sensor head, and fasten the Sensor head temporarily. The magnet in the Sensor head and the Detection ring attract each other. When installing the Sensor head, be careful not to hit the Sensor head against the Detection ring. Impact can damage elements in the Sensor head.



■ Insert the thickness gauge (supplied as an accessory, t = 0.1 mm) between the Detection ring and the Sensor head, and while lightly pressing the Sensor head against the thickness gauge, tighten the screws (recommended tightening torque: 1.3 N·m ± 10%). Apply a thread locker or the like to the sensor mounting screws to prevent them from becoming loose.

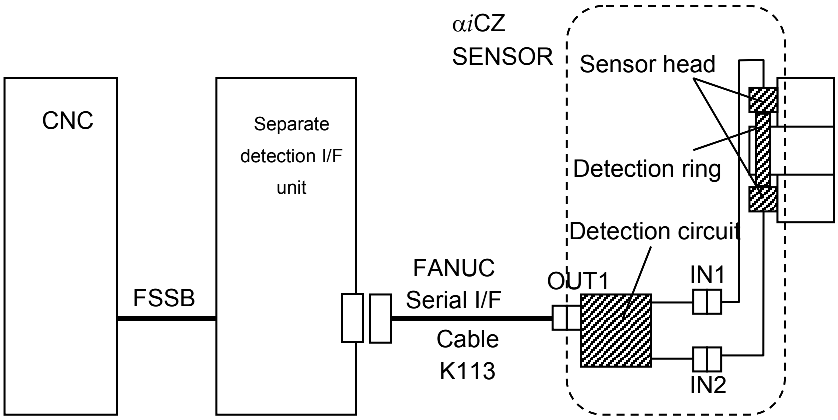


■ Pull out the thickness gauge, and slowly turn the shaft to ensure that the Detection ring and the Sensor head do not touch each other.

11.1.1.5 Connection

Connection diagram (overview)

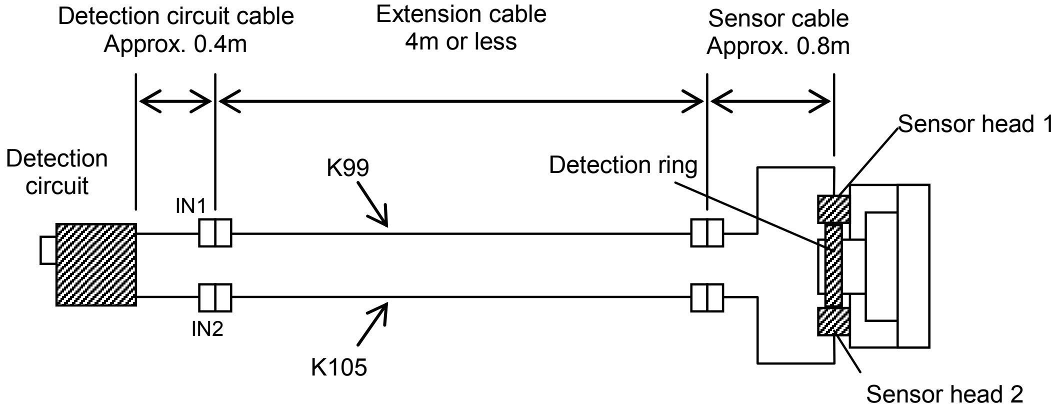
If α*i*CZ SENSOR is used, connect as the following figure.



> **NOTE**
> Prepare cable K113 by yourself. No connectors for the cable are included with your product. Please order the connectors separately. See "Details of cable K113" below for details on the connection.

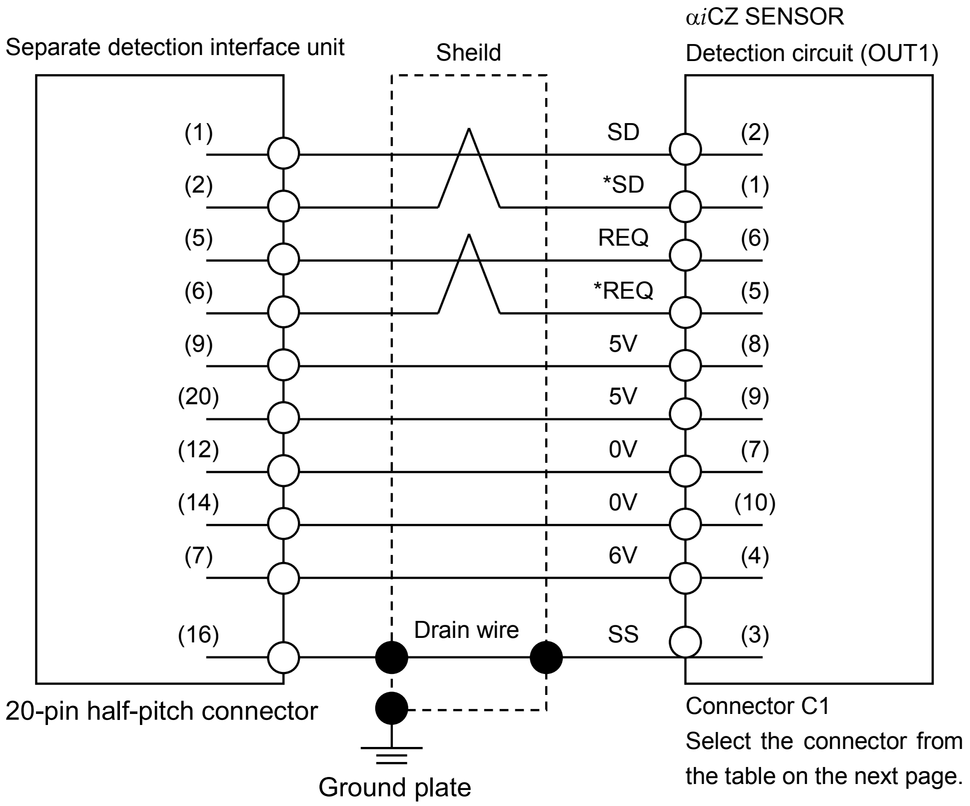
Method of extending the sensor cables

The sensor cables from the Sensor heads to the Detection circuit can be extended up to 4 m as shown in the figure below.



> **NOTE**
> Prepare cable K99 and cable K105 by yourself. No connectors for the cable are included with your product. Please order the connectors separately. See "Details of cable K99" and "Details of cable K105" below for details on the connection.

Details of cable K113



Using cable conductor

Signal name	Cable length : 28m or less	Cable length : 50m or less
5V, 0V, 6V	0.3mm^2 × 5 Strand configuration: 12/0.18 or 60/0.08/mm Insulation outer diameter: ϕ1.5mm or less	0.5mm^2 × 5 Strand configuration: 20/0.18 or 104/0.08/mm Insulation outer diameter: ϕ1.5mm or less

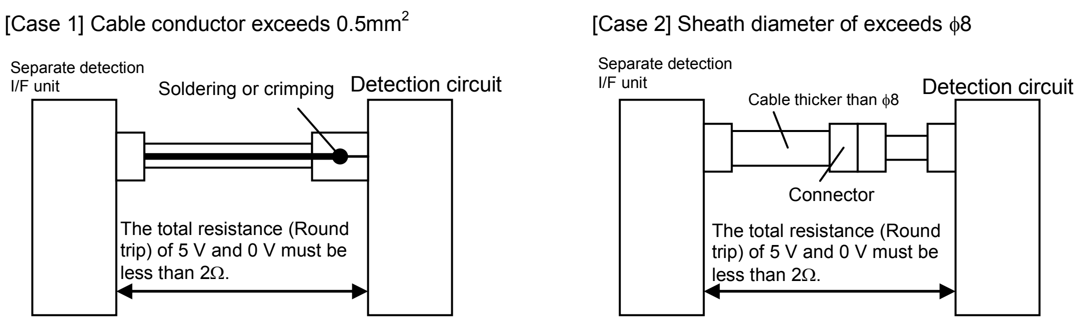
Signal name	Cable length : 28m or less	Cable length : 50m or less
SD, *SD, REQ, *REQ	0.18mm² or more Twisted-pair wire Insulation outer diameter: ϕ1.5mm or less	0.18mm² or more Twisted-pair wire Insulation outer diameter: ϕ1.5mm or less
Drain wire	0.15mm² or more	0.15mm² or more

Recommended cable

Specification number	Use
A66L-0001-0479	Flexible 28 m or less
A66L-0001-0488	Flexible 50 m or less

NOTE

1 Prepare cable K113 by yourself. No connectors for the cable are included with your product. Please order the connectors separately.
2 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 2 Ω.
3 The ground plate for connecting the shield must be placed as close as possible to the Separate Detector Interface Unit.
4 Make sure that the power line and signal line do not run in parallel.
5 For details of the recommended cable, refer to APPENDIX B, "CABLES."
6 The maximum cable diameter applicable to the connector on the detection circuit side is 0.5 mm^2 (strand configuration: 20/0.18 or 104/0.08, insulation outer diameter: ϕ1.5 or less), and sheath diameter is ϕ5.7 to ϕ8.0. When using a wire or cable thicker than the above size is used, take measures as shown below.



Connector C1

Connection type	Manufacture	Connector type	Connector specification (manufacturer)	Terminal specification (manufacturer)	Connector kit specification (FANUC)
Crimp type	Japan Aviation Electronics Industry, Limited	Straight plug	JN2DS10SL□ (□: 1 or 2; Note 1)	JN1-22-22S	A06B-6114-K204#S (including terminals)
		Angle plug	JN2FS10SL□ (□: 1 or 2; Note 1)		A06B-6114-K204#E (including terminals)
	Hirose Electric Co., Ltd.	Straight plug	HR34B-12WP△-10SC (△: A or B; Note 2)	HR34B-SC1	--------------------------
		Angle plug	HR34B-12WLP△-10SC (△: A or B; Note 2)		--------------------------
Solder type	Hirose Electric Co., Ltd.	Straight plug	HR34B-12WP△-10S (△: A or B; Note 2)	----------------	A06B-6114-K205#S
		Angle plug	HR34B-12WLP△-10S (△: A or B; Note 2)		A06B-6114-K205#E

NOTE

1 The value for □ is determined based on the outer diameter of the cable sheath.
   1: Outer diameter of compatible cable: ϕ5.7 to ϕ7.3
   2: Outer diameter of compatible cable: ϕ6.5 to ϕ8.0

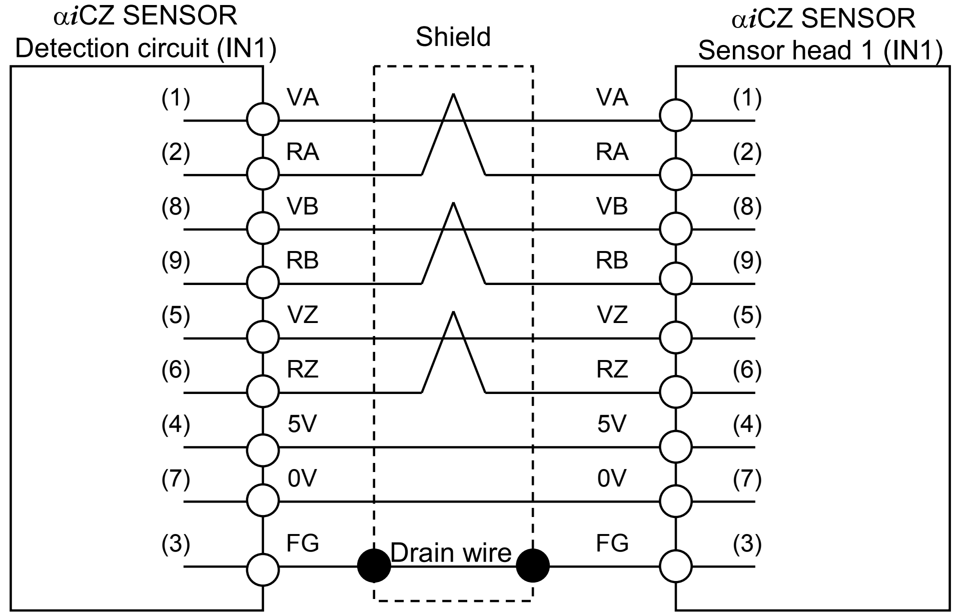
2 The value for △ is determined based on the outer diameter of the cable sheath.
   A: Outer diameter of compatible cable: ϕ5.7 to ϕ7.3
   B: Outer diameter of compatible cable: ϕ6.5 to ϕ8.0

3 For the assembly of a crimp connector, jigs and tools specifically provided from its manufacturer are required. See the table below.

Jigs and tools for the assembly of crimp connectors

Manufacture		Manufacturer specification	FANUC specification	Applicable cable thickness
Japan Aviation Electronics Industry, Limited	Crimping tool	CT150-2-JN1-E	A06B-6114-K201#JN1E	21AWG(0.5mm^2: 20/0.18) 23AWG(0.3mm^2) 25AWG(0.18mm^2)
		CT150-2-JN1-D	A06B-6114-K201#JN1D	20AWG(0.5mm^2: 104/0.08) 21AWG(0.5mm^2: 20/0.18) 25AWG(0.18mm^2)
	Extractor specification	ET-JN1	A06B-6114-K201#JN1R	------------------------------
Hirose Electric Co., Ltd.	Crimping tool	HT102/HR34B-1	--------------------------------	------------------------------
	Extractor specification	RP6-SC-TP	--------------------------------	------------------------------

- Details of cable K99



Connector for relay (Crimp type, Manufacture: Japan Aviation Electronics Industry, Limited):
JN1HS10PL□: Relay type
(□: 1 or 2; See NOTE.)
Terminal : JN1-22-22P

Connector kit specification (FANUC):
A06B-6114-K206 (including terminals)

Plug connector (Crimp type, Manufacture: Japan Aviation Electronics Industry, Limited):
JN1DS10SL□: Straight plug
JN1FS10SL□: Angle plug
(□: 1 or 2; See NOTE.)
Terminal : JN1-22-22S

Connector kit specification (FANUC):
A06B-6114-K200#S: Straight plug
A06B-6114-K200#E: Angle plug

Applicable cables

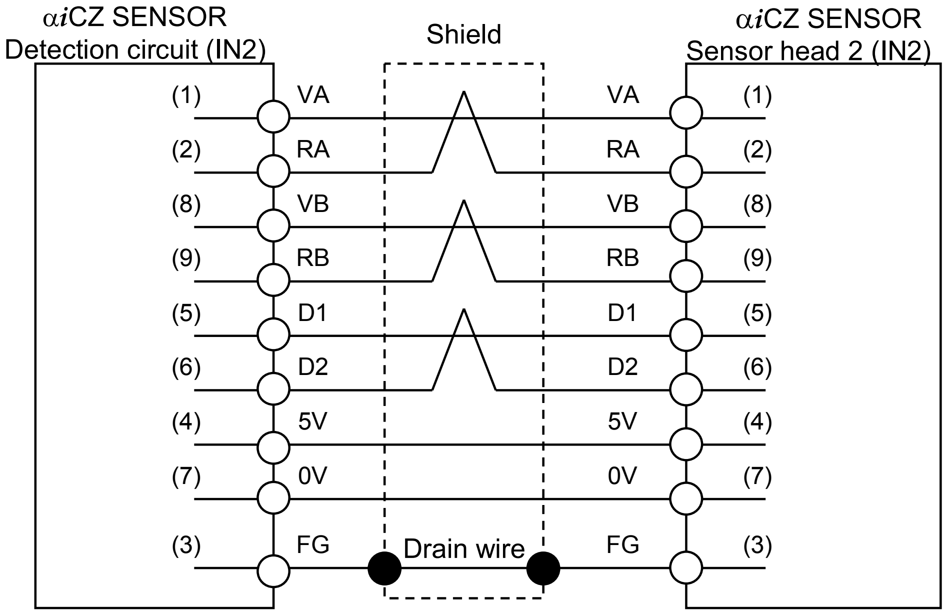
Signal name	Configuration
5V, 0V	0.5mm^2 or more x 2
VA, RA, VB, RB, VZ, RZ	0.2mm^2 or more, Twisted-pair cable
Drain wire	0.15mm^2 or more

Recommended cable conductor

Specification number	Use
A66L-0001-0482	4m or less

NOTE
1 Prepare the extension cable K99 by yourself. No connectors for the cable are included with your product. Please order the connectors separately.
2 Determine □ based on the outer diameter of the cable sheath to be used.
1: Outer diameter of compatible cable ϕ5.7 to ϕ7.3
2: Outer diameter of compatible cable ϕ6.5 to ϕ8.0
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 2 Ω.
4 For details of the recommended cable, refer to APPENDIX B, "CABLES."
5 Take care to distinguish cable K99 from cable K105.
6 For the assembly of a crimp connector, jigs and tools specifically provided from its manufacturer are required. See "Details of cable K113" above.

- Details of cable K105



Connector for relay (Crimp type, Manufacture: Japan Aviation Electronics Industry, Limited):
JN1HS10PL□: Relay type
(□: 1 or 2; See NOTE.)
Terminal : JN1-22-22P

Connector kit specification (FANUC): A06B-6114-K206 (including terminals)

Plug connector (Crimp type, Manufacture: Japan Aviation Electronics Industry, Limited):
JN1DS10SL□: Straight plug
JN1FS10SL□: Angle plug
(□: 1 or 2; See NOTE.)
Terminal : JN1-22-22S

Connector kit specification (FANUC): A06B-6114-K200#S: Straight plug A06B-6114-K200#E: Angle plug

Applicable cables

Signal name	Configuration
5V, 0V	0.5mm^2 or more x 2
VA, RA, VB, RB, D1, D2	0.2mm^2 or more, Twisted-pair cable
Drain wire	0.15mm^2 or more

Recommended cable conductor

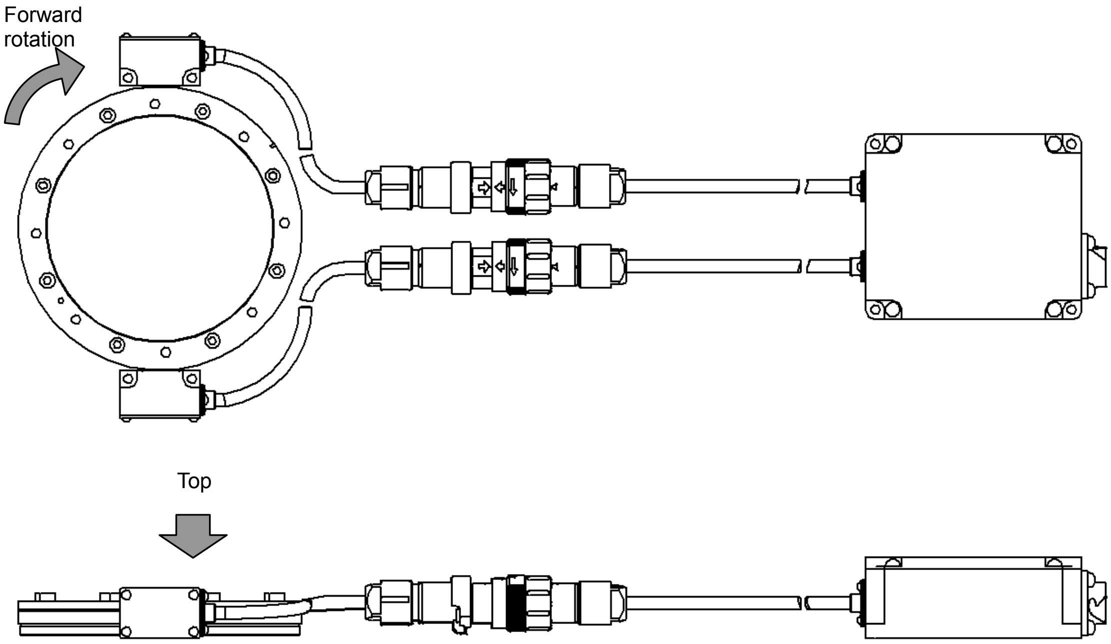
Specification number	Use
A66L-0001-0482	4m or less

NOTE

1 Prepare the extension cable K99 by yourself. No connectors for the cable are included with your product. Please order the connectors separately.
2 Determine □ based on the outer diameter of the cable sheath to be used.
  1: Outer diameter of compatible cable ϕ5.7 to ϕ7.3
  2: Outer diameter of compatible cable ϕ6.5 to ϕ8.0
3 When using a cable not recommended, ensure that the sum of the resistance values between 5 V and 0 V does not exceed 2 Ω.
4 For details of the recommended cable, refer to APPENDIX B, "CABLES."
5 Take care to distinguish cable K99 from cable K105.
6 For the assembly of a crimp connector, jigs and tools specifically provided from its manufacturer are required. See "Details of cable K113" above.

11.1.1.6 Rotation direction

When the sensor is viewed from the top as shown in the following figure, clockwise rotation of the Detection ring is referred to as forward rotation:



11.1.1.7 Start-up procedure

The start-up procedure is summarized as follows.

Installation

↓

Cable connection

↓

CNC power-on

↓

Parameter setting

↓

Interpolation error learning
(Rotate the sensor one or more turns at 30 min^{-1} (recommended).)

> **NOTE**
> 1 The method of checking output signals is described in Subsection, "Output signal check method" below.
> 2 If the fixed position of the Sensor head is changed after power on, initialize the Detection circuit. For details of the procedure, see Subsection "Procedure for initializing the Detection circuit" below.
> 3 If it is difficult to rotate the sensor at least one turn for interpolation error learning, repeat forward and reverse rotations under the above rotation conditions until the sum of angular displacements in one direction becomes one turn or more.

11.1.1.8 Interpolation error learning

αi CZ SENSOR incorporates a circuit to automatically learn from interpolation errors and make necessary corrections. Although detection conditions vary depending on specifications, the recommended value is 30 min^{-1} which is common for all specifications. Each time the sensor is turned on, rotate under the following conditions and make correction for interpolation errors.

Detection conditions for interpolation errors
αiCZ SENSOR 512AS : 25 to 105min^{-1}, constant speed, one or more turns
αiCZ SENSOR 768AS : 20 to 70min^{-1}, constant speed, one or more turns
αiCZ SENSOR 1024AS : 15 to 50min^{-1}, constant speed, one or more turns

Recommended detection conditions
Common to three models : 30min^{-1}, constant speed, one or more turns

> **NOTE**
> 1 When the αiCZ SENSOR is operated for the first time after installed on the machine or when the Sensor head is moved after power on to initialize the Detection circuit as described below, interpolation error learning is performed. For interpolation error learning, rotate the sensor under the conditions above.
> 2 Detected data is backed up in the Detection circuit by the battery.
> 3 If it is difficult to rotate the sensor at least one turn, repeat forward and reverse rotations under the above rotation speed condition to achieve at least one turn in total.
> 4 Corrections are automatically performed when the above-described detection conditions are satisfied.

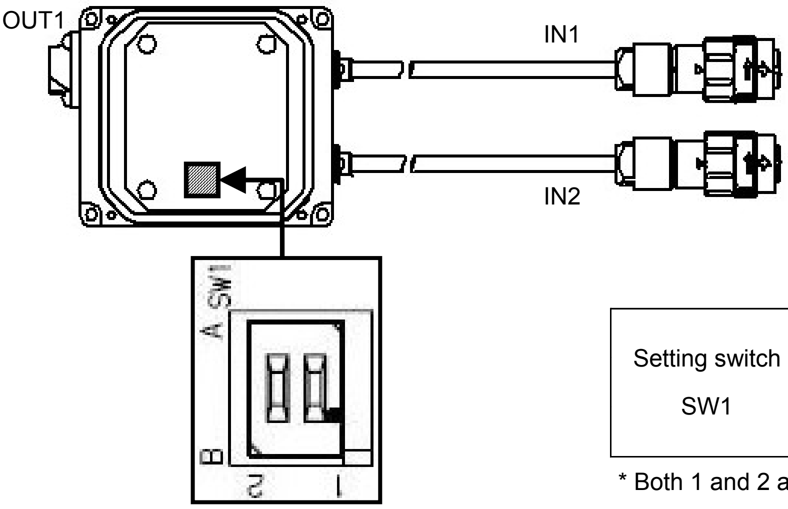
11.1.1.9 Function for detecting the disconnection of the Sensor head cable

The Detection circuit A860-2164-V203 has a function which can detect the disconnection of the sensor head cable of Sensor head 2 detecting the absolute position during backup operation in the NC power-off state also when the power to the NC is off.
To use this function, the following conditions must be satisfied. If this function cannot be used since either of the following conditions is not satisfied, this function can be disabled with the setting switch in the Detection circuit and the sensor can be used.

<Conditions for using the function>
(1) Sensor head 2 of the current specification (A860-2162-V012) is required.
(This function cannot be used with the old specification of Sensor head 2 (A860-2162-V011).)

(2) To use this function with the sensor head cable extended, the extension cable described above is required.

<Setting switch>

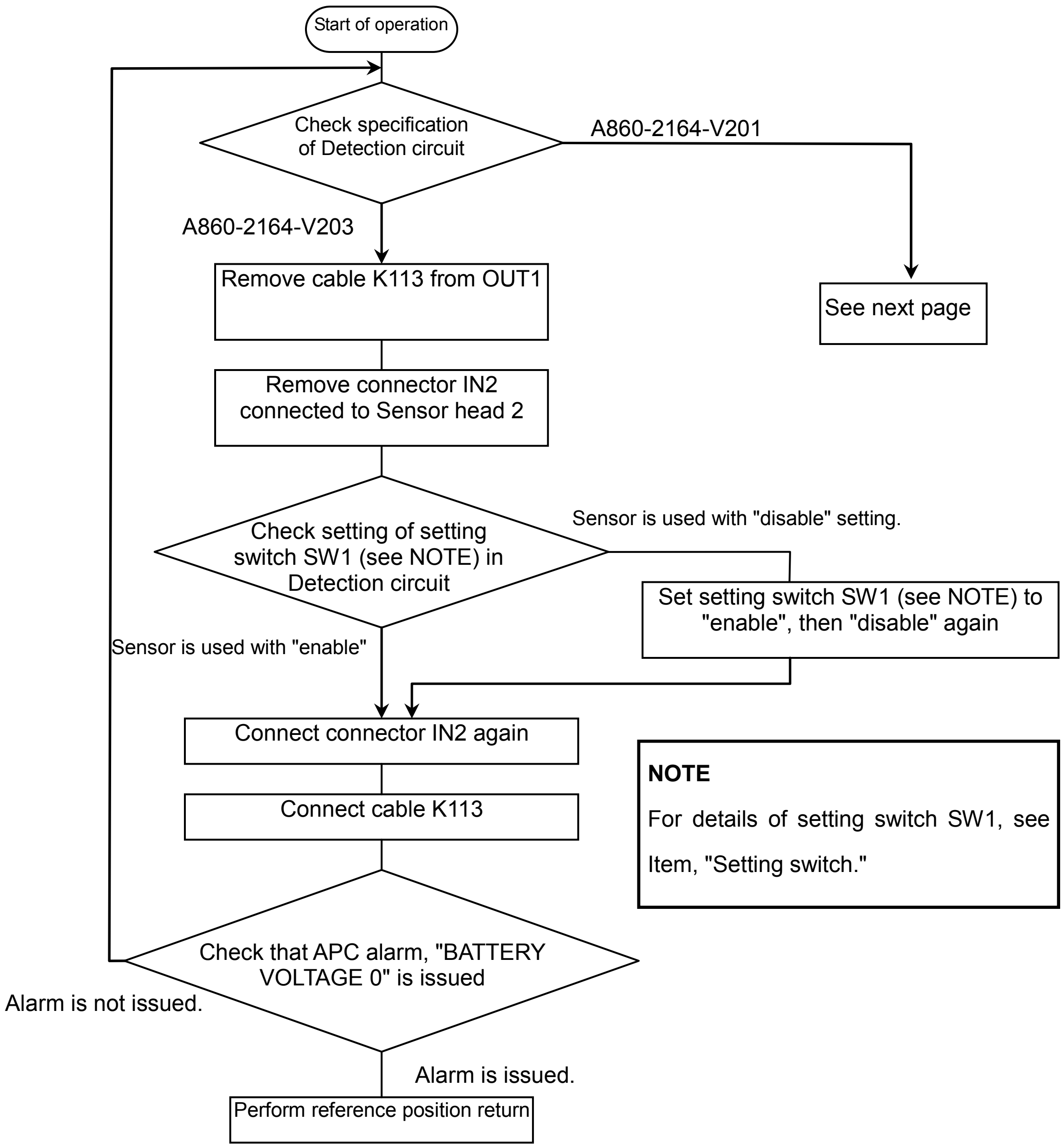


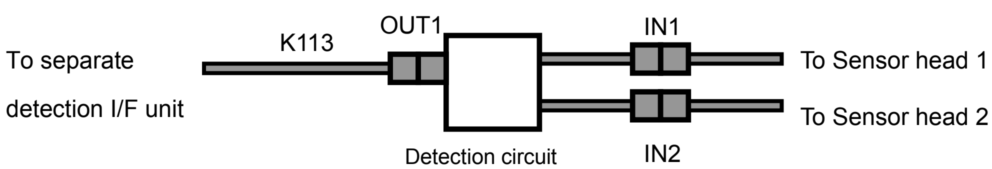
Setting switch SW1	1	A	Enable
		B	Disable
	2	Not used	

* Both 1 and 2 are set to A at shipment.

11.1.1.10 Procedure for initializing the Detection circuit

The Detection circuit needs to be initialized according to the following procedure after replacement of Sensor head, Detection ring, or Detection circuit, or movement of Sensor head after the head is energized. Proper initialization triggers an APC alarm "Battery voltage 0." After confirming the alarm, perform reference position return again.

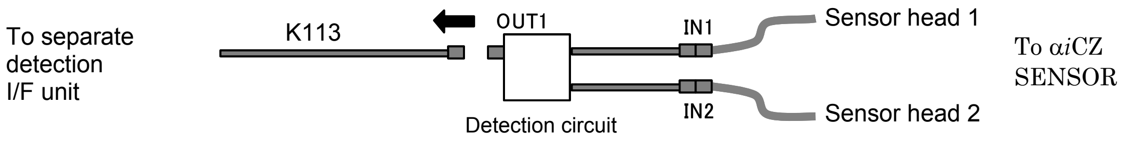




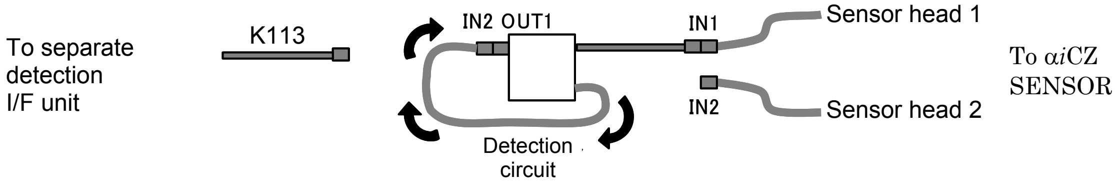
Procedure for initializing the Detection circuit A860-2164-V201

The Sensor head, Detection ring, and Detection circuit can be individually replaced. After replacement, follow the procedure below and trigger an APC alarm "Battery voltage 0." Then, perform reference position return.

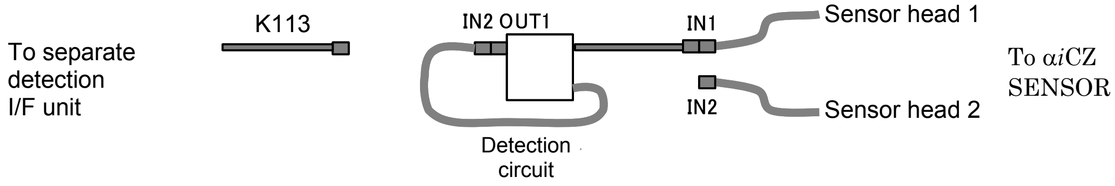
1. Remove cable K113 from connector OUT1.



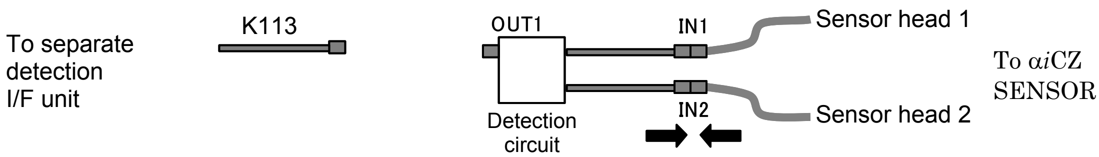
2. Connect connector IN2 to connector OUT1.
   (Connector IN1 and connector IN3 may remain connected.)



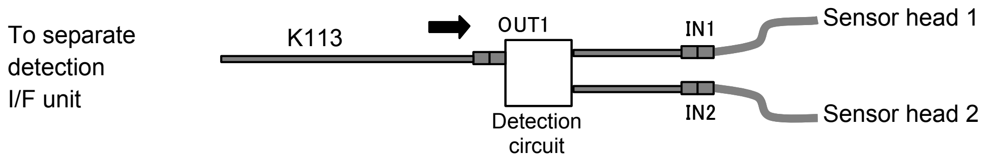
3. Leave the connection for 10 seconds or more.



4. Properly reconnect the cables other than cable K113.



5. Connect cable K113.



6. Confirm the APC alarm "Battery voltage 0." If no alarm was issued, return to 1.

7. Perform reference position return.

11.1.1.11 Operating precautions

Sensor head

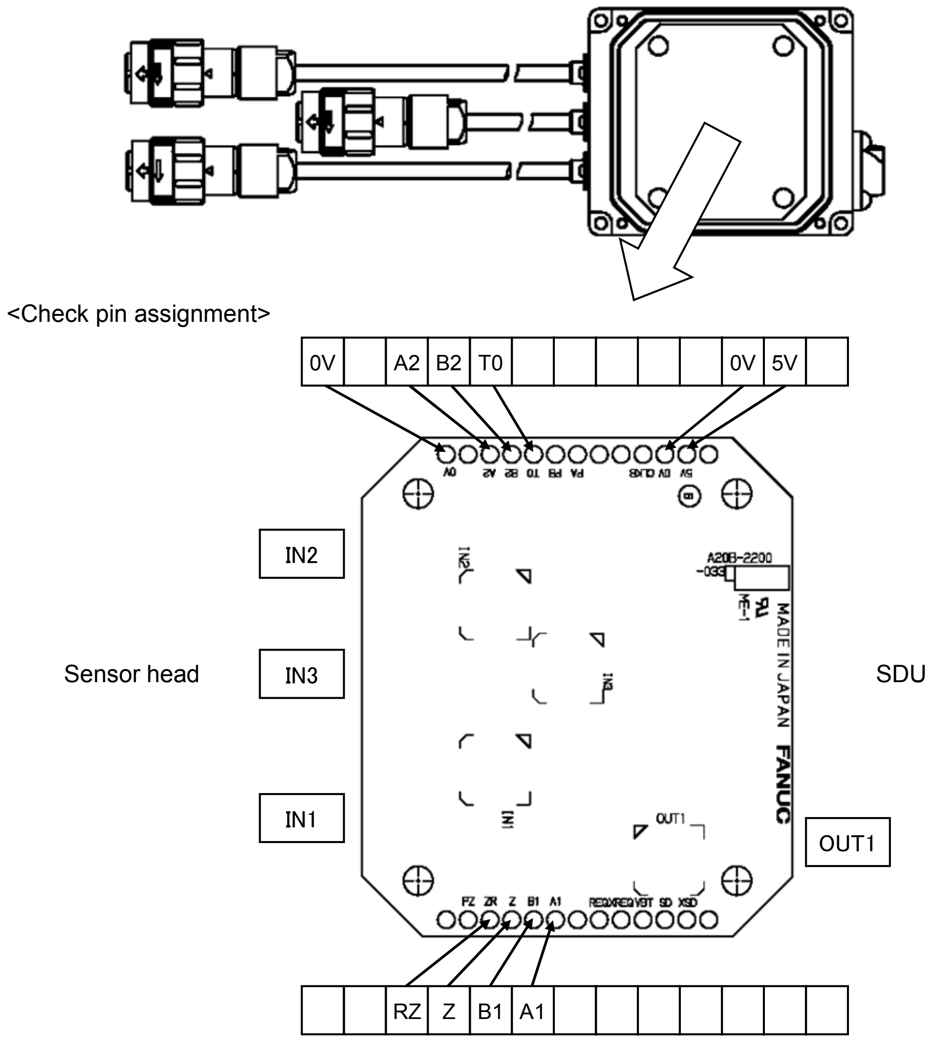
The Detection circuit memorizes the initial conduction state. So, do not move the Sensor head afterward. If the Sensor head is moved after the initial conduction state, the reference position may be displaced. Moreover, a pulse error alarm may be issued. Issue the battery zero alarm and perform reference position return operation according to Subsection 11.1.1.7, "Procedure for initializing the Detection circuit" below.

Magnetic powder attached to the Detection ring

The α*i*CZ SENSOR detects an angular displacement according to a change in magnetic flux density between the Sensor heads and Detection ring. So, if magnetic powder is attached to any location on the Detection ring, the magnetic flux density at that location changes locally, deteriorating the accuracy of detection. This accuracy deterioration occurs each time the location to which magnetic powder is attached passes Sensor head 1 and 2, that is, at every 180°. This deterioration leads to an increased positioning error, torque command variation, abnormal sound, vibration, and so forth.
After installing the sensor, blow the sensor ring by air. Moreover, to prevent magnetic powder and chips from being attached to the Detection ring and Sensor heads during operation, provide protection against dust and water on the machine side.
If nonmagnetic matter (such as aluminum, austenitic stainless steel, resin, and oil) is attached to the Detection ring or Sensor head, such accuracy deterioration as described above does not occur. However, foreign matter caught between the Detection ring and a Sensor head can mechanically damage the Sensor head. So, prevent foreign matter, even if nonmagnetic, from being attached to the Detection ring.

11.1.1.12 Output signal check method

When checking the signal waveform directly, check with the check pins in the Detection circuit. See the illustration below for arrangement of the check pins.

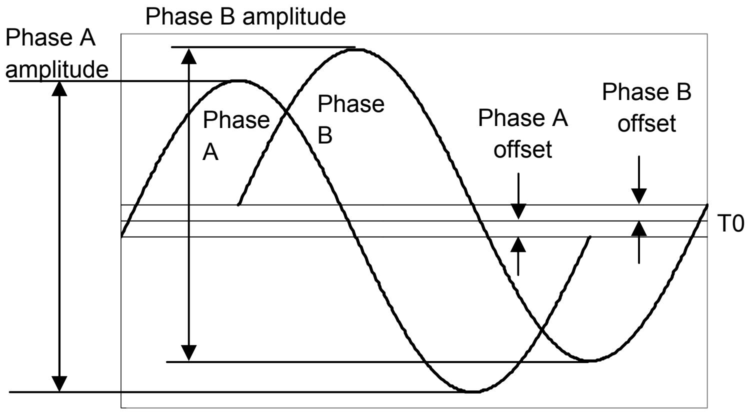


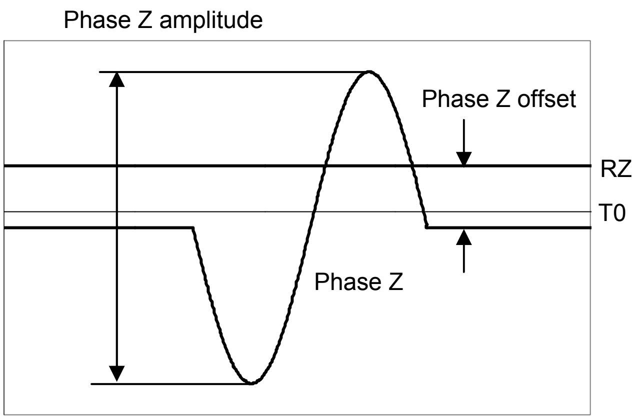
> **NOTE**
> 1 Firmly close the cover of the Detection circuit after checking the signal waveform.
> 2 In order to check without connection with a separate detection interface unit, supply power to 0-V and 5-V check pins.
> 3 The Lissajous' waveform of the phase A/B output signal is an exact circle.

Phase A/B and phase Z signal waveforms (measured by check pins on the Detection circuit at room temperature and 500 min^{-1})

Signal name	Check pin (Reference: T0)	Output amplitude	Offset
Phase A of Sensor head 1 (after amplification) Phase B of Sensor head 1 (after amplification)	A1 B1	1,300 to 3,000mVp-p	±180mV
Phase A of Sensor head 2 (after amplification) Phase B of Sensor head 2 (after amplification)	A2 B2	1,300 to 3,000mVp-p	±180mV
Phase Z of Sensor head 1	Z	400 to 900mVp-p	70 to 150mV*
RZ of Sensor head 1	RZ		

* Measure the DC components of Z and RZ. The difference becomes the offset.





The check pins used with the α*i*CZ SENSOR fit in the following housing and crimp terminals:

Housing : HKP-13FS01 (Honda Tsushin Kogyo specification)

Crimp terminal: HKP-F113 (Honda Tsushin Kogyo specification), AWG#24 to 28 (ϕ1.0 to 1.5mm)
HKP-F213 (Honda Tsushin Kogyo specification), AWG#28 to 32 (ϕ0.5 to 0.8mm)

Crimping tool : KP309D (Honda Tsushin Kogyo specification)

11.2 SENSOR FOR THE SPINDLE

11.2.1 αi POSITIONCODER

11.2.1.1 Specification

Names and specification numbers

Name	Specification number	Remarks
αi POSITIONCODER	A860-2109-T302	□68 flange mounting, 10,000min^{-1}

Environmental conditions for use

Item	Specification
Operating temperature range	0 to +50°C
Humidity	95%RH or less

Electrical specifications

Item		Specification
Power supply voltage		$5V^{+5\%}_{-10\%}$
Current consumption		200mA or less
Output signal	PAE,*PAE,PBE,*PBE	1,024 pulses / revolution
	PSE,*PSE	1 pulse / revolution

Mechanical specifications

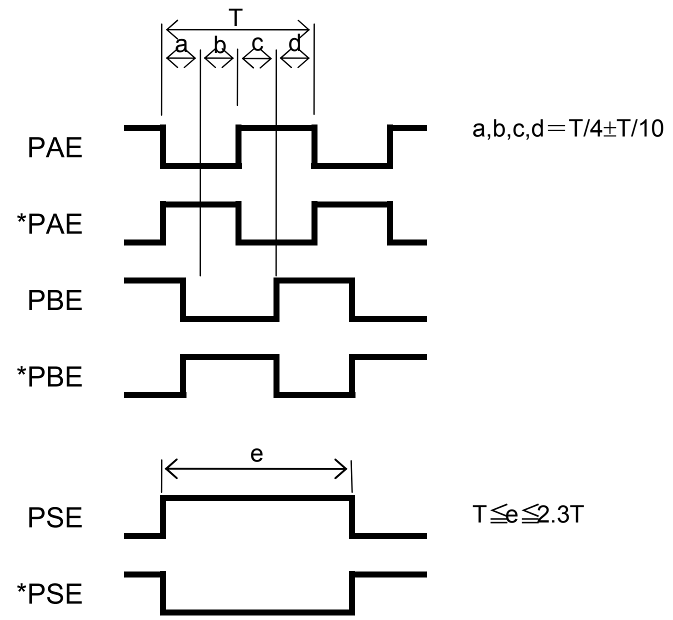
Item	Specification	
Input axis inertia	9.8×10^{-3}kg·m^2 or less	
Input axis start torque	0.098N·m or less	
Allowable input axis load	Radial load (operating)	98N
	Thrust load (operating)	49N
Maximum rotation speed	10,000min^{-1}	
Structure	Water and dust proof (equivalent to IP55 when waterproof connector is mated)	
Tolerable vibration acceleration	10G	
Weight	Approx.0.75kg	

Resolution and precision

Name	Resolution	Accuracy (Max.)
αi POSITIONCODER	4,096 / revolution	40/1000° (Note)

NOTE
The accuracy listed in the above table does not include the error due to resolution (360/4096 = 88/1000°). It does not also include the error caused by the pulley or timing belt when the POSITIONCODER is connected to the spindle with a belt.

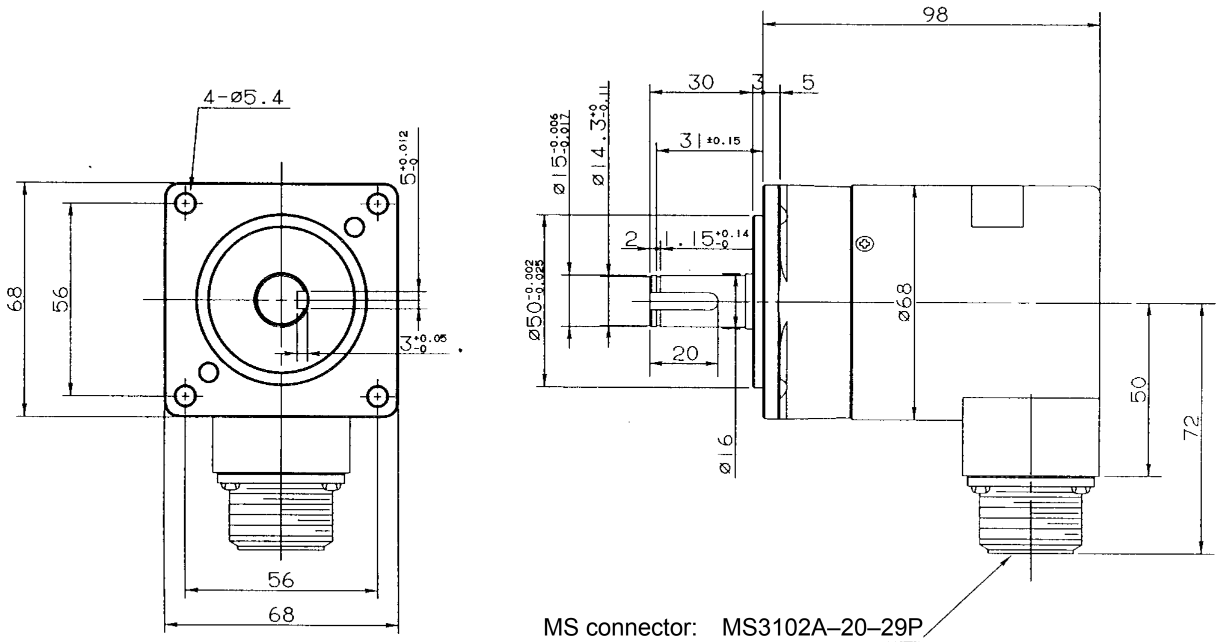
11.2.1.2 Signal phase relationships (timing chart)



Output pin arrangement

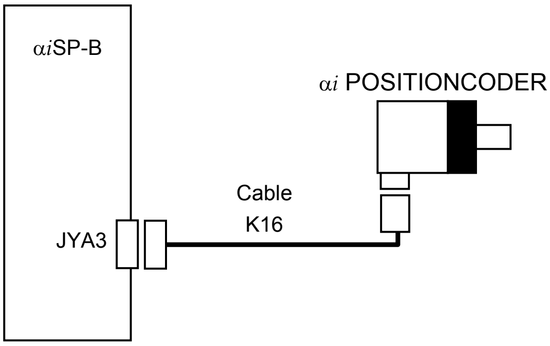
A	B	C	D	E	F	G	H	J
PAE	PSE	PBE					+5V	
K	**L**	**M**	**N**	**P**	**R**	**S**	**T**	
0V			*PAE	*PSE	*PBE			

11.2.1.3 Dimensions



11.2.1.4 Connection

Connection diagram (overview)



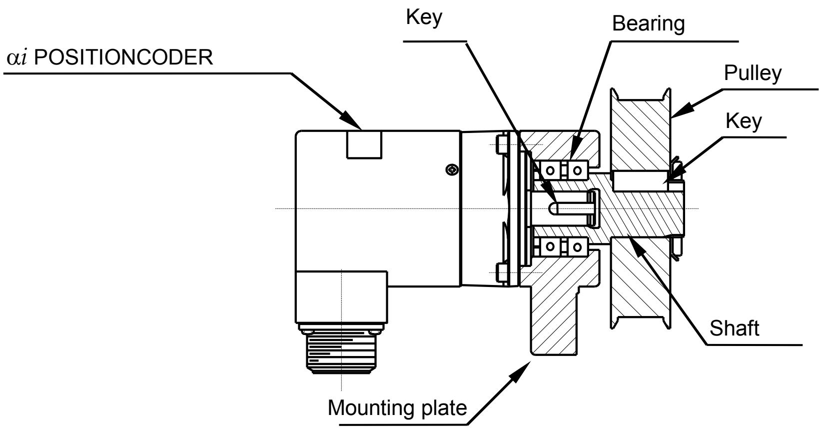
11.2.1.5 Installation conditions and notes

Connection methods

Two methods of connecting the α*i* POSITIONCODER and the spindle are available as described below.

(1) With one method, the POSITIONCODER is connected to the rear part of the spindle by using a flexible joint
In this case, the rotation of the spindle is transported accurately to the POSITIONCODER, resulting in a higher accuracy in POSITIONCODER positioning. However, the POSITIONCODER installation location is limited, so that the mechanical section may need to be modified.

(2) Connection with a timing belt
With the other method, a shaft for holding a pulley is fitted into the shaft of the POSITIONCODER and is held by two bearings as shown below. In this case, a timing belt is used to connect the pulley of the POSITIONCODER to the pulley attached to the spindle.



This commonly used method requires attention to the following points.

<1> If there is a clearance between the shaft for holding the pulley and the shaft of the POSITIONCODER, the shaft of the POSITIONCODER can suffer from fretting or loosening of the key of the shaft, resulting in a degraded accuracy in POSITIONCODER positioning. So, specify tolerances for good fitting so that there is no clearance between the shaft of the POSITIONCODER and the shaft for holding the pulley and between the key and key groove.

<2> If the outer diameter center of the pulley of the POSITIONCODER is not aligned with the axis center of the shaft of the POSITIONCODER, or if the outer diameter center of the pulley fitted around the spindle is not aligned with the axis center of the spindle, the spindle positioning accuracy is degraded in proportion to the magnitude of eccentricity. For this reason, try to minimize these eccentricities.

Impact

The POSITIONCODER is a precision sensor. So, be careful not to apply a shock to the shaft.

Atmosphere

The protection of the POSITIONCODER satisfies class IP55. Note, however, that the waterproof performance indicated in IP is valid only for water and for a short period of time. The performance is not guaranteed. Continuous exposure of the POSITIONCODER to cutting fluid or the like and continuous damp condition may lead to a failure of the POSITIONCODER. Make sure to attach a cover or another protection of the machine so that as little cutting fluid as possible may drip on the POSITIONCODER.

11.2.2 α POSITIONCODER S

11.2.2.1 Specification

Names and specification numbers

Name	Specification number	Remarks
α POSITIONCODER S	A860-0309-T352	□68 flange mounting, 10,000min^{-1}

Environmental conditions for use

Item	Specification
Operating temperature range	0 to +50°C
Humidity	95%RH or less

Electrical specifications

Item		Specification
Power supply voltage		$5V^{+5\%}_{-10\%}$
Current consumption		200mA or less
Output signal	PAE,*PAE,PBE,*PBE	1,024λ / revolution
	PSE,*PSE	1 pulse / revolution

Mechanical specifications

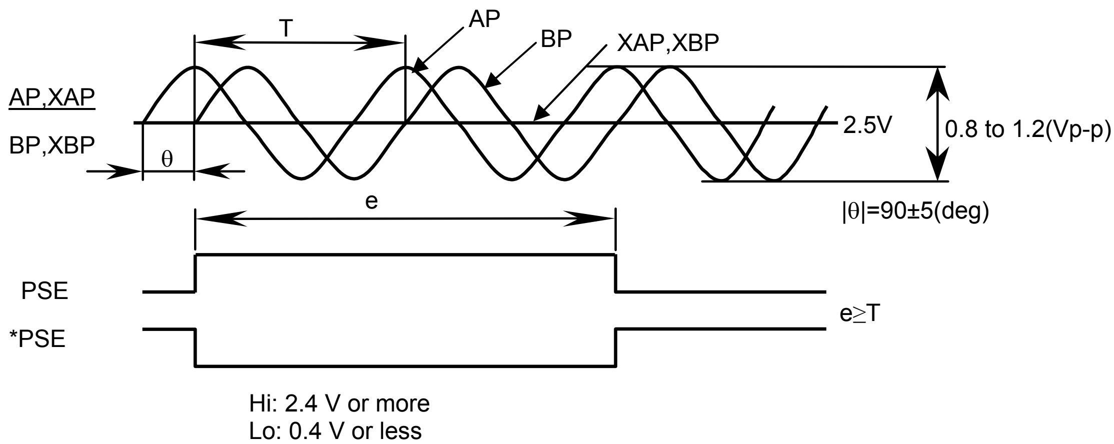
Item	Specification	
Input axis inertia	9.8×10^{-3}kg·m^2 or less	
Input axis start torque	0.098N·m or less	
Allowable input axis load	Radial load (operating)	98N
	Thrust load (operating)	49N
Maximum rotation speed	10,000min^{-1}	
Structure	Water and dust proof (equivalent to IP55 when waterproof connector is mated)	
Tolerable vibration acceleration	10G	
Weight	Approx. 0.75kg	

Resolution and precision

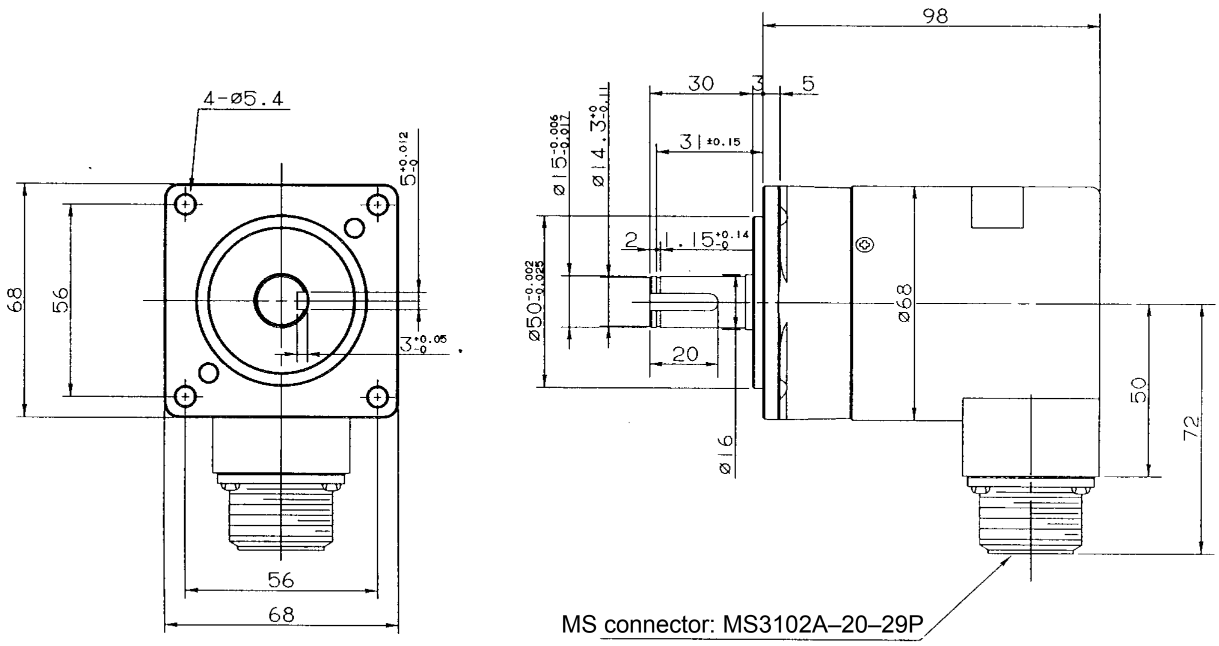
Name	Resolution	Accuracy (Max.)
α POSITIONCODER S	360,000 / revolution	40/1000° (Note)

> **NOTE**
> The accuracy listed in the above table does not include the error due to resolution (360/360000 = 1/1000°). It does not also include the error caused by the pulley or timing belt when the POSITIONCODER is connected to the spindle with a belt.

11.2.2.2 Signal phase relationships (timing chart)

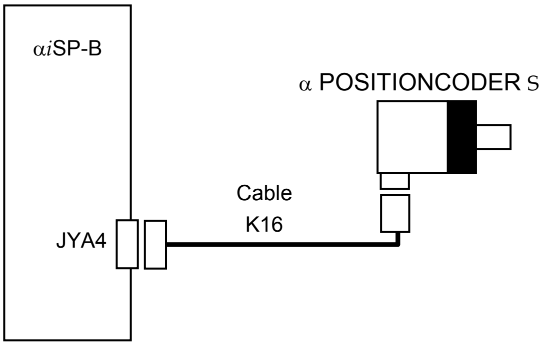


11.2.2.3 Dimensions



11.2.2.4 Connection

Connection diagram (overview)

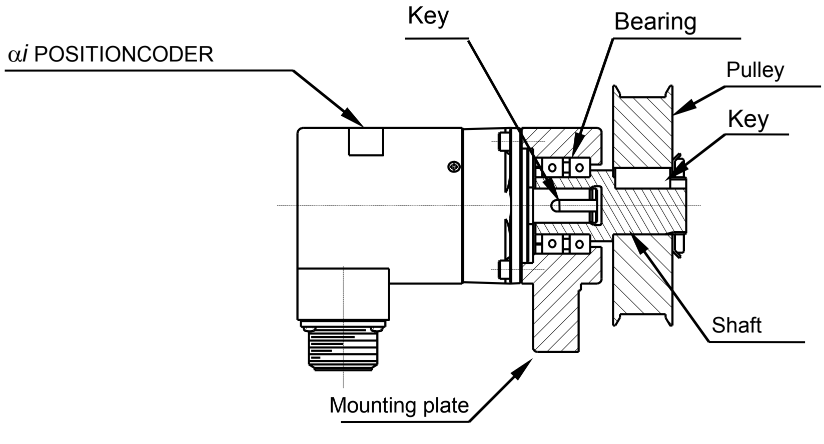


11.2.2.5 Installation conditions and notes

Two methods of connecting the α*i* POSITIONCODER or α POSITIONCODER S to the spindle are available as described below.

(1) With one method, the POSITIONCODER is connected to the rear part of the spindle by using a flexible joint
In this case, the rotation of the spindle is transported accurately to the POSITIONCODER, resulting in a higher accuracy in POSITIONCODER positioning. However, the POSITIONCODER installation location is limited, so that the mechanical section may need to be modified.

(2) Connection with a timing belt
With the other method, a shaft for holding a pulley is fitted into the shaft of the POSITIONCODER and is held by two bearings as shown below. In this case, a timing belt is used to connect the pulley of the POSITIONCODER to the pulley attached to the spindle.



This commonly used method requires attention to the following points.

<1> If there is a clearance between the shaft for holding the pulley and the shaft of the POSITIONCODER, the shaft of the POSITIONCODER can suffer from fretting or loosening of the key of the shaft, resulting in a degraded accuracy in POSITIONCODER positioning. So, specify tolerances for good fitting so that there is no clearance between the shaft of the POSITIONCODER and the shaft for holding the pulley and between the key and key groove.

<2> If the outer diameter center of the pulley of the POSITIONCODER is not aligned with the axis center of the shaft of the POSITIONCODER, or if the outer diameter center of the pulley fitted around the spindle is not aligned with the axis center of the spindle, the spindle positioning accuracy is degraded in proportion to the magnitude of eccentricity. For this reason, try to minimize these eccentricities.

Shock

The POSITIONCODER is a precision sensor. So, be careful not to apply a shock to the shaft.

Atmosphere

The protection of the POSITIONCODER satisfies class IP55. Note, however, that the waterproof performance indicated in IP is valid only for water and for a short period of time. The performance is not guaranteed. Continuous exposure of the POSITIONCODER to cutting fluid or the like and continuous damp condition may lead to a failure of the POSITIONCODER. Make sure to attach a cover or another protection of the machine so that as little cutting fluid as possible may drip on the POSITIONCODER.

11.2.3 α*i*BZ SENSOR (for Spindle)

α*i*BZ SENSOR can be used as a sensor for the spindle.

11.2.3.1 Specification

The following specifications are available depending on the difference in Detection rings and connectors. Select the right specification for your intended purpose.

Names and specification numbers

Name	Specification number (A860-)		Remarks				
	Waterproof connector type	Non-waterproof connector type	Number of teeth	Maximum rotation speed (min^{-1})	Detection ring: Inner diameter (mm)	Detection ring: Outer diameter (mm)	Mounting method
α*i*BZ SENSOR 96	2150-T111	2155-T111	96	80,000	ϕ30	ϕ39.2	Heat shrink fitting
α*i*BZ SENSOR 128	2150-T201	2155-T201	128	20,000	ϕ40	ϕ52	
α*i*BZ SENSOR 128H	2150-T211	2155-T211		70,000			
α*i*BZ SENSOR 192	2150-T301	2155-T301	192	20,000	ϕ60	ϕ77.6	
α*i*BZ SENSOR 192H	2150-T311	2155-T311		40,000			
α*i*BZ SENSOR 256	2150-T401	2155-T401	256	15,000	ϕ82	ϕ103.2	
α*i*BZ SENSOR 256S	2150-T404	2155-T404			ϕ88		
α*i*BZ SENSOR 256H	2150-T411	2155-T411		30,000	ϕ82		
α*i*BZ SENSOR 384	2150-T511	2155-T511	384	15,000	ϕ125	ϕ154.4	Heat shrink fitting or screwing
α*i*BZ SENSOR 512	2150-T611	2155-T611	512	10,000	ϕ160	ϕ205.6	
α*i*BZ SENSOR 640	2150-T711	2155-T711	640	6,000	ϕ220	ϕ256.8	
α*i*BZ SENSOR 768	2150-T811	2155-T811	768	5,000	ϕ250	ϕ308	
α*i*BZ SENSOR 1024	2150-T911	2155-T911	1024	3,000	ϕ360	ϕ410.4	

Environmental conditions

Item	Specification
Operating temperature range	0 to +80°C
Humidity	95%RH or less

Electrical specifications

Item			Specification
Power supply voltage			$5V^{+5\%}_{-10\%}$
Current consumption			0.05A or less
Output signal	VA,VB	α*i*BZ SENSOR 96	96λ / revolution
		α*i*BZ SENSOR 128/128H	128λ / revolution
		α*i*BZ SENSOR 192/192H	192λ / revolution
		α*i*BZ SENSOR 256/256H/256S	256λ / revolution
		α*i*BZ SENSOR 384	384λ / revolution
		α*i*BZ SENSOR 512	512λ / revolution
		α*i*BZ SENSOR 640	640λ / revolution
		α*i*BZ SENSOR 768	768λ / revolution
		α*i*BZ SENSOR 1024	1024λ / revolution
	VZ	Common to all models	1λ / revolution

Resolution and accuracy

Name	Resolution in Cs contour control	Accuracy (typ.)
α*i*BZ SENSOR 96	360,000 / revolution	50/1000°
α*i*BZ SENSOR 128/128H		30/1000°
α*i*BZ SENSOR 192/192H		25/1000°
α*i*BZ SENSOR 256/256H/256S		20/1000°
α*i*BZ SENSOR 384		15/1000°
α*i*BZ SENSOR 512		10/1000°
α*i*BZ SENSOR 640		10/1000°
α*i*BZ SENSOR 768		8/1000°
α*i*BZ SENSOR 1024		6/1000°

NOTE

1. Accuracy indicated in the above table is not a guaranteed value but a typical value.
2. Accuracy indicated in the above table does not consider the effect of an error due to runout in Detection ring installation. The influence of runout in sensor ring installation on precision can be calculated as follows:

   Error (°) = A (mm) × 360/B (mm)

   A : Axis runout of the machine spindle or sleeve on the Detection ring mounting surface

   B : Perimeter of the Detection ring

   Example : If the axis runout on the mounting surface is 0.005 mm when a 256λ Detection ring (103.2 in diameter) is used, the error is:
   0.005 × 360/(103.2 × π) = 0.0055(°)

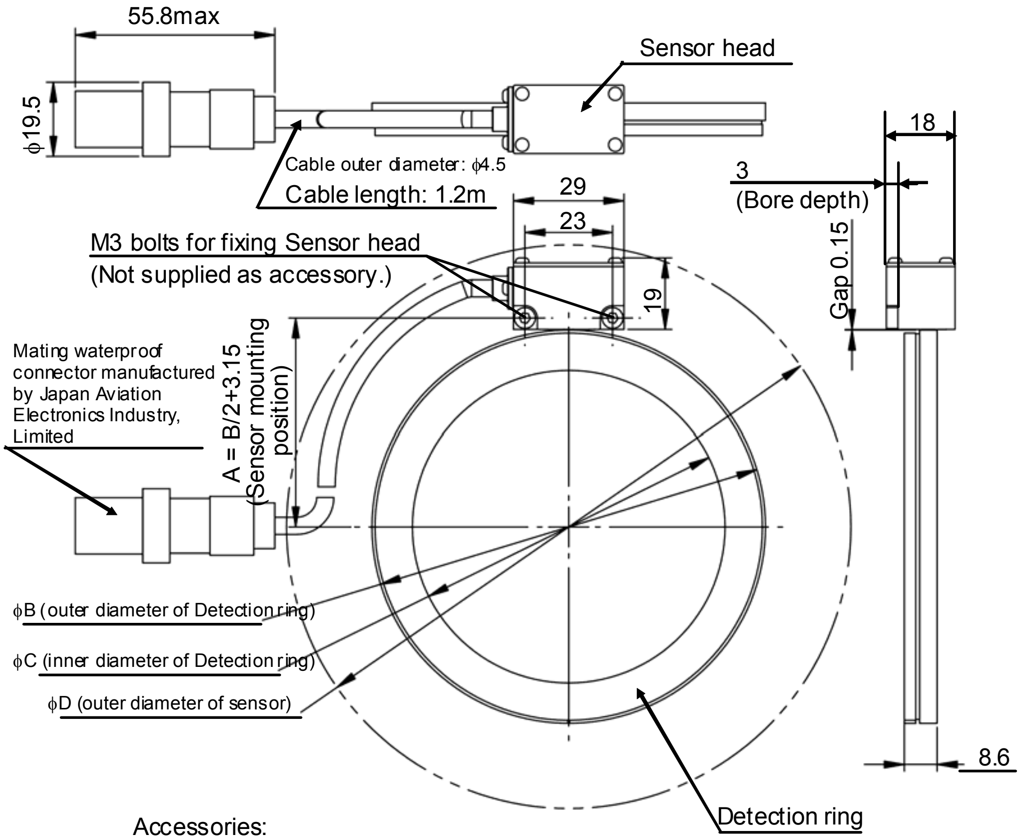
NOTE

1. Use the sensor under 80°C.
2. The sensor is a precision part. Use special care in handling. In particular, do not apply force to the Sensor head. Fasten the cable to the machine at an appropriate position so that no force is applied directly to the Sensor head.
3. Sensors with waterproof connectors satisfy class IP67 of waterproof performance when the connectors are properly mated. Note, however, that the waterproof performance indicated in IP is valid only for water and a short period of time. The performance is not guaranteed. Attach a cover or prepare another protection against dripping to protect the sensor from direct exposure to cutting fluid and the like.
4. Detection rings with 384 or more teeth can be mounted by screwing on the end face aside from heat shrink fitting. See "Installing the Detection ring" for details.
5. Make sure to satisfy specifications described later in "Installing the sensor" when mounting the sensor to a machine.
6. For easy maintenance, mount the sensor at a position where it can be replaced easily.
7. The Detection ring can be replaced with another ring with the same specification number.

11.2.3.2 Dimensions

Dimensions of waterproof connector type A860-2150-Txxx

Number of teeth: 96 to 256



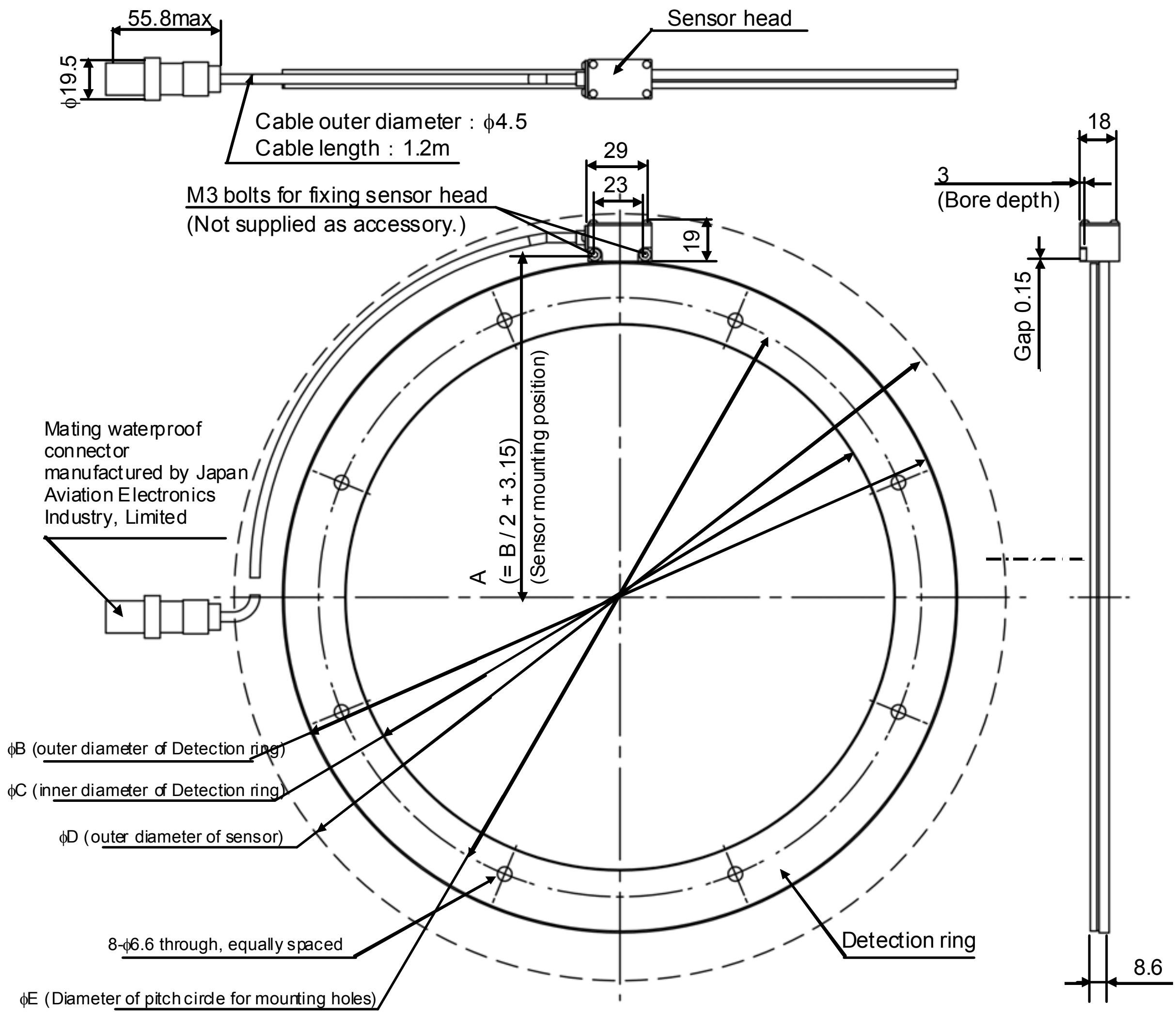
Accessories:

Parallel pin (JIS B 1354-1988, class A, normal diameter of ϕ3, normal length of 6) × 2,
Thickness gauge (t=0.15mm) × 1

Unit: mm

Sensor type number	Number of teeth	Dimensions			
		Sensor mounting position A	Outer diameter of Detection ring ϕB	Inner diameter of Detection ring ϕC	Outer diameter of sensor ϕD
A860-2150-T111	96	22.75	39.2+0/-0.02	30+0/-0.016	92
A860-2150-T201	128	29.15	52+0/-0.02	40+0.016/-0	98
A860-2150-T211					
A860-2150-T301	192	41.95	77.6+0/-0.02	60+0/-0.018	122
A860-2150-T311					
A860-2150-T401	256	54.75	103.2+0/-0.02	82+0/-0.018	148
A860-2150-T404				88+0/-0.018	
A860-2150-T411				82+0/-0.018	

Number of teeth: 384 to 1024



Accessories:
Parallel pin (JIS B 1354-1988, class A, normal diameter of φ3, normal length of 6) × 2,
Thickness gauge (t = 0.15 mm) × 1

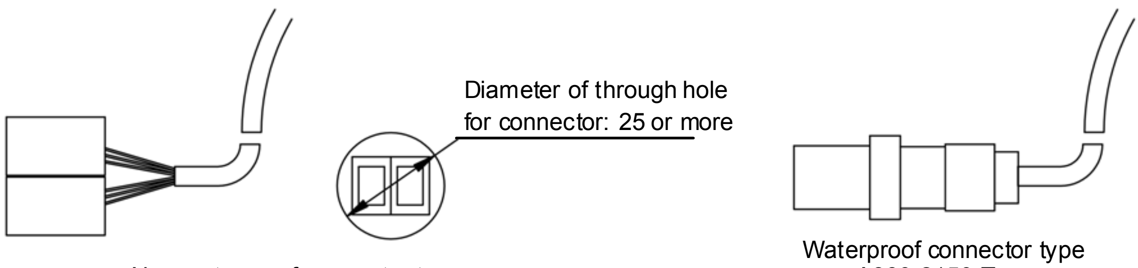
Unit: mm

Sensor type number	Number of teeth	Dimensions (mm)					
		Sensor head mounting position A	Outer diameter of Detection ring φB	Inner diameter of Detection ring φC	Outer diameter of sensor φD	Through hole for mounting Detection ring E
A860-2150-T511	384	80.35	154.4 +0/-0.02	125 +0.025/-0	198	8-φ4.5 through, equally spaced on φ134 circumference
A860-2150-T611	512	105.95	205.6 +0/-0.02	160 +0.020/-0.005	249	8-φ5.5 through, equally spaced on φ170 circumference

Sensor type number	Number of teeth	Dimensions (mm)				
		Sensor head mounting position A	Outer diameter of Detection ring φB	Inner diameter of Detection ring φC	Outer diameter of sensor φD	Through hole for mounting Detection ring E
A860-2150-T711	640	131.55	256.8 +0/-0.02	220 +0/-0.025	300	8-φ5.5 through, equally spaced on φ230 circumference
A860-2150-T811	768	157.15	308 +0/-0.02	250 +0/-0.025	352	8-φ6.6 through, equally spaced on φ275 circumference
A860-2150-T911	1024	208.35	410.4 +0/-0.02	360 +0/-0.025	454	8-φ6.6 through, equally spaced on φ380 circumference

Dimensions of non-waterproof connector type A860-2155-Txxx

Only the connector of the Sensor head is different between non-waterproof and waterproof connector specifications.



Non-waterproof connector type
A860-2155-Txxx
(Manufactured by Honda Tsushin Kogyo Co., LTD.)

Waterproof connector type
A860-2150-Txxx
(Manufactured by Japan Aviation Electronics Industry, Limited)

11.2.3.3 Interference of the Detection ring

The following table lists the interference for heat shrink fitting for the Detection ring (difference between the inner diameter of the Detection ring and the diameter of a shaft) at each maximum rotation speed. Determine the interference according to the type of Detection ring and the maximum rotation speed.

Unit: μm

Maximum rotation speed (min^{-1})	**96** **A860-2150 -T111**	**128** **A860-2150 -T201**	**128H** **A860-2150 -T211**	**192** **A860-2150 -T301**	**192H** **A860-2150 -T311**	**256** **A860-2150 -T401**	**256S** **A860-2150 -T404**	**256H** **A860-2150 -T411**
4,500	6 - 32	6 - 32	6 - 32	6 - 34	6 - 34	7 - 35	7 - 35	7 - 35
6,000	↑	↑	↑	7 - 35	7 - 35	9 - 37	9 - 37	9 - 37
8,000	↑	↑	↑	8 - 36	8 - 36	11 - 39	11 - 39	11 - 39
10,000	↑	↑	↑	9 - 37	9 - 37	14 - 42	15 - 43	14 - 42
12,000	↑	7 - 33	7 - 33	11 - 39	11 - 39	18 - 46	19 - 47	18 - 46
15,000	↑	8 - 34	8 - 34	13 - 41	13 - 41	26 - 54	28 - 56	26 - 54
20,000	7 - 33	10 - 36	10 - 36	19 - 47	19 - 47			41 - 69
25,000	8 - 34		12 - 38		27 - 55			62 - 90
30,000	10 - 36		15 - 41		37 - 65			87 - 115
40,000	13 - 39		23 - 49		61 - 89			
50,000	17 - 43		33 - 59					
60,000	22 - 48		43 - 69					
70,000	27 - 53		57 - 83					
80,000	34 - 60							

Unit: μm

Maximum rotation speed (min^{-1})	**384** **A860-2150 -T511**	**512** **A860-2150 -T611**	**640** **A860-2150 -T711**	**768** **A860-2150 -T811**	**1024** **A860-2150 -T911**
500	8 - 43	11 - 41	16 - 51	16 - 51	27 - 62
1,000	↑	↑	17 - 52	19 - 54	33 - 68
1,500	↑	↑	20 - 55	22 - 57	43 - 78
2,000	↑	↑	23 - 58	28 - 63	57 - 92
2,500	↑	↑	27 - 62	34 - 69	75 - 110
3,000	↑	↑	32 - 67	43 - 78	96 - 131
3,500	9 - 44	13 - 43	38 - 73	53 - 88	
4,000	↑	↑	45 - 80	64 - 99	
4,500	11 - 46	19 - 49	53 - 88	77 - 112	
5,000	↑	↑	62 - 97	91 - 126	
5,500	↑	↑	72 - 107		
6,000	15 - 50	29 - 59	83 - 118		
8,000	24 - 59	47 - 77			
10,000	35 - 70	71 - 101			
12,000	47 - 82				
15,000	71 - 106				

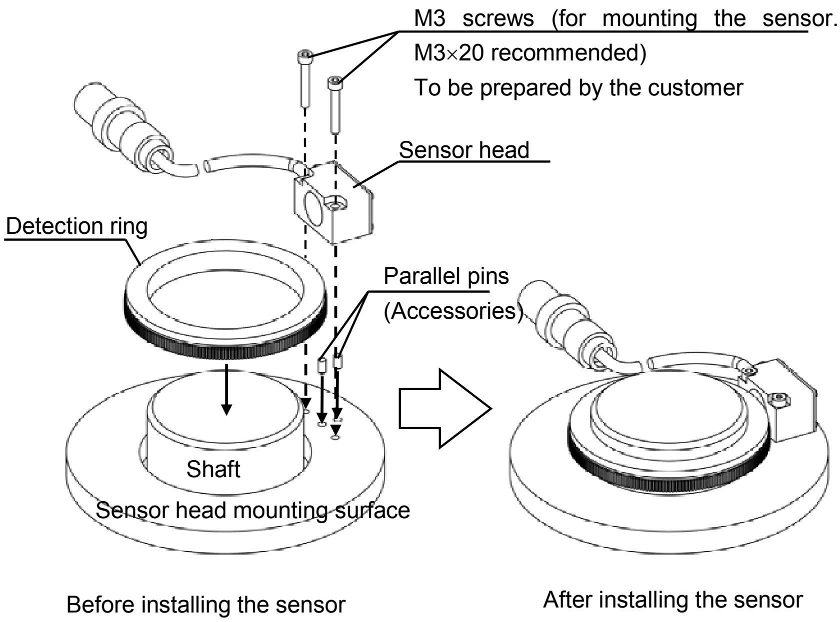
> **NOTE**
> 1 The Detection ring cannot be used with a speed higher than the maximum rotation speed listed in the table above. An interference not listed in the table above may damage the Detection ring or make it spin free.
> 2 Detection rings with 384 or more teeth can be mounted by screwing on the end face aside from heat shrink fitting. See "Installing the Detection ring" for details.

11.2.3.4 Installing the sensor

Installation procedure (overview)

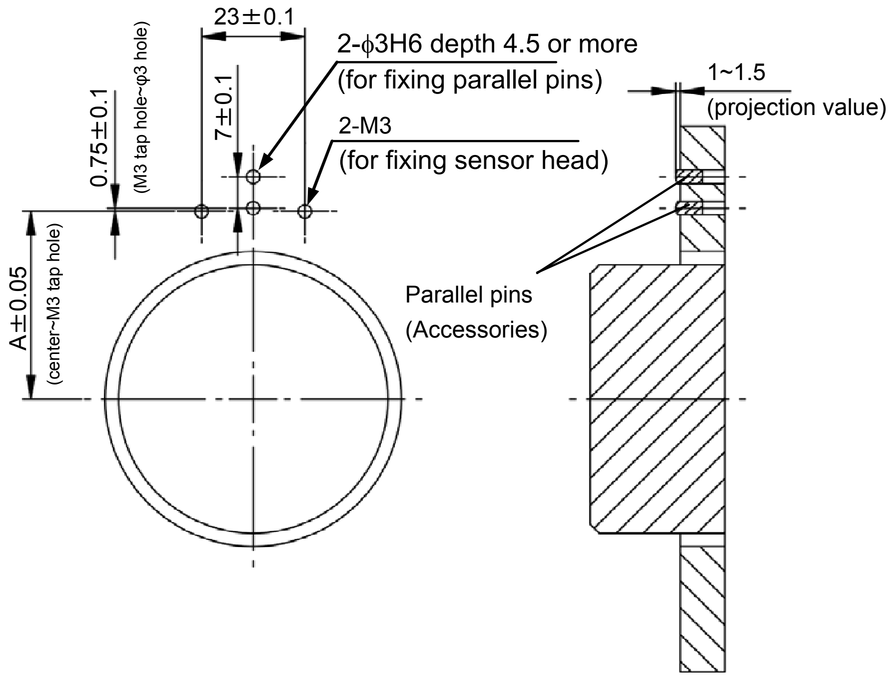
Install the sensor according to the following procedure. See the following sections for details in each step.

- Machine the sensor mounting surface as necessary then insert the parallel pins.
- Mount the Detection ring onto the shaft or sleeve of the machine, center, and fix with screws.
- Adjust the gap between the Sensor head and Detection ring, and then mount the sensor on the machine.



Machining the sensor mounting surface and inserting parallel pins

Machine the sensor mounting surface as shown in the figure below and insert the supplied parallel pins in the 2-ϕ3H6 holes. The parallel pins serve as a guide for gap adjustment of the Sensor head.



> **NOTE**
> See "Dimensions" above for dimension A.

Installing the Detection ring

Fit the Detection ring around the shaft or sleeve of the machine by heat shrink fitting.

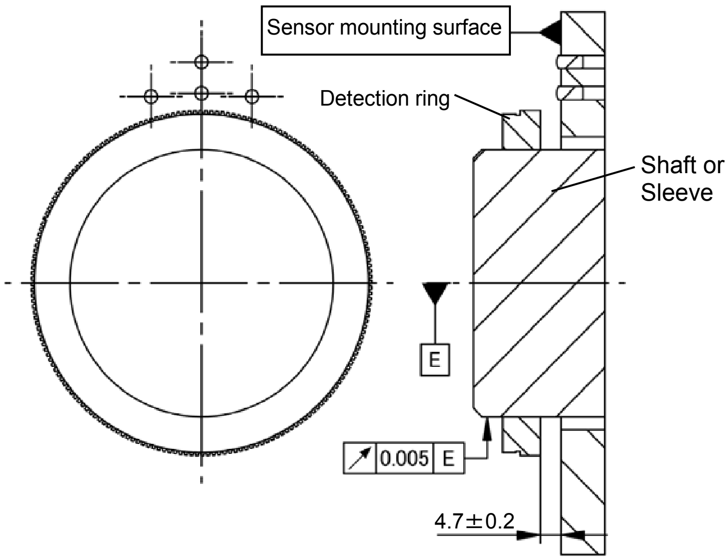
Detection rings with 384 or more teeth can be mounted by screwing on the end face aside from heat shrink fitting.

> **NOTE**
> Inadequately fastened Detection ring may cause the spindle to behave in an unexpected manner. Make sure to fasten the Detection ring to the shaft or sleeve.

Installing the Detection ring by heat shrink fitting

Fit the Detection ring around the shaft or sleeve by heat shrink fitting so that the bottom of the phase AB signal generation section (gear) is 4.7 ± 0.2 mm off the sensor mounting surface.

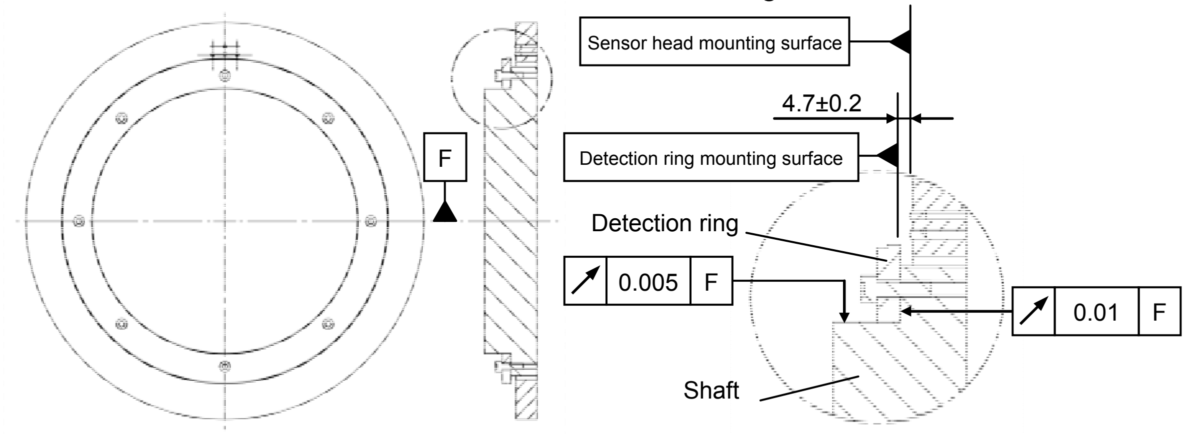
The variation of the shaft or sleeve part around which the Detection ring is fit by heat shrink fitting must be 0.005 mm or less.



> **NOTE**
> 1 The maximum temperature for heating the Detection ring is 200°C as a general rule. Unless there is a compelling reason, the heating below 180°C is recommended. Although the Detection ring may tarnish when heated at high temperature, the heating below 200°C will cause no performance problem.
> 2 See "Interference of the Detection ring" above for interference at each maximum speed.

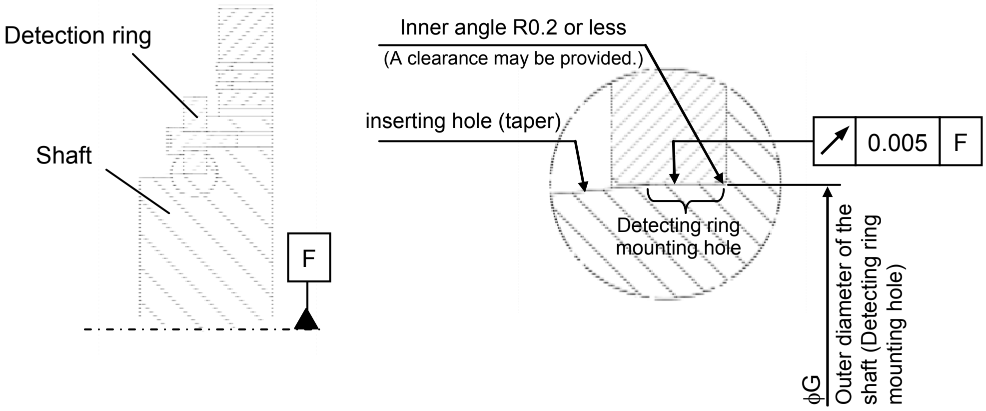
Installing the Detection ring by screwing the end face

Detection rings with 384 or more teeth can be mounted by screwing on the end face aside from heat shrink fitting. Make sure that the Detection ring mounting surface is 4.7 ± 0.2 mm off the sensor mounting surface.
Minimize the variation of the inner diameter of the Detection ring.



Sensor	Positions of Detection ring mounting holes	Mounting screw	Recommended tightening torque for screws
α*i*BZ SENSOR 384	8-φ4.5 through, equally spaced on φ134 circumference	Hexagon socket head cap screw (steel) M4	3.0N·m ± 5%
α*i*BZ SENSOR 512	8-φ5.5 through, equally spaced on φ170 circumference	Hexagon socket head cap screw (steel) M5	6.0N·m ± 5%
α*i*BZ SENSOR 640	8-φ5.5 through, equally spaced on φ230 circumference	Hexagon socket head cap screw (steel) M5	6.0N·m ± 5%
α*i*BZ SENSOR 768	8-φ6.6 through, equally spaced on φ275 circumference	Hexagon socket head cap screw (steel) M6	10.5N·m ± 5%
α*i*BZ SENSOR 1024	8-φ6.6 through, equally spaced on φ380 circumference	Hexagon socket head cap screw (steel) M6	10.5N·m ± 5%

The following shape is recommended for the shaft.
Adjust the shaft dimensions by applying a taper to the part the Detection ring is inserted to minimize the clearance between the shaft's outer diameter and the Detection ring's inner diameter where the Detection ring is mounted.



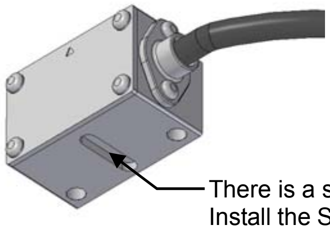
Sensor	Outer diameter of shaft in the spot the Detection ring is mounted (recommended) φG
α*i*BZ SENSOR 384	125 +0.025/-0

Sensor	Outer diameter of shaft in the spot the Detection ring is mounted (recommended) ϕG
αiBZ SENSOR 512	160 +0.020/-0.005
αiBZ SENSOR 640	220 +0/-0.025
αiBZ SENSOR 768	250 +0/-0.025
αiBZ SENSOR 1024	360 +0/-0.025

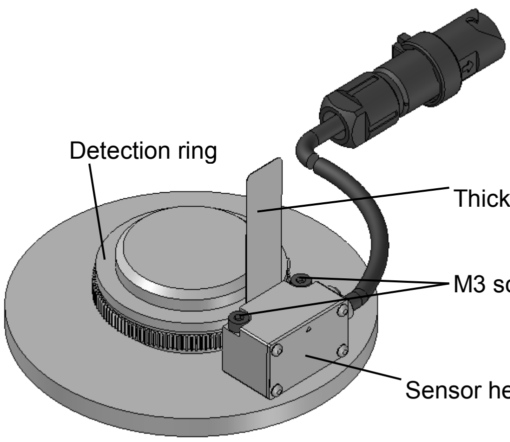
Installing the Sensor heads

Install the Sensor heads according to the procedure below.

- Place the Sensor head on the sensor mounting surface so that the parallel pins are positioned in the slot on the bottom of the Sensor head, and fasten the Sensor head temporarily. The magnet in the Sensor head and the Detection ring attract each other. When installing the Sensor head, be careful not to hit the Sensor head against the Detection ring. Impact can damage elements in the Sensor head.



- Insert the thickness gauge (supplied as an accessory, t = 0.15 mm) between the Detection ring and the Sensor head, and while lightly pressing the Sensor head against the thickness gauge, tighten the screws (recommended tightening torque: 1.3 Nm ± 10%). Apply a thread locker or the like to the sensor mounting screws to prevent them from becoming loose.



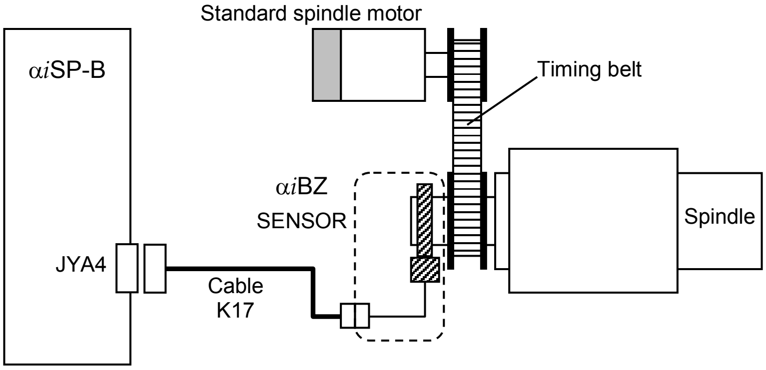
- Pull out the thickness gauge, and slowly turn the shaft to ensure that the Detection ring and the Sensor head do not touch each other. Make sure that the Detection ring and sensor are at least 0.1 mm apart from one another (optimal gap is 0.15 mm).

11.2.3.5 Connection

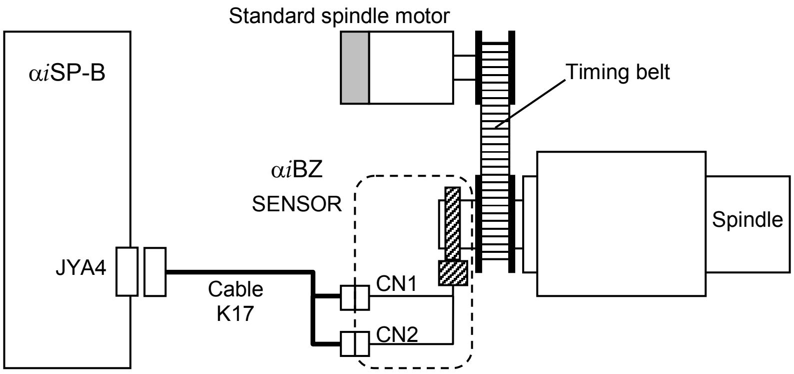
Connection diagram (overview)

Connect α*i*SP-B and α*i*BZ SENSOR as shown in the following figure.

Connection of A860-2150-Txxx equipped with waterproof connector



Connection of A860-2155-Txxx equipped with non-waterproof connector

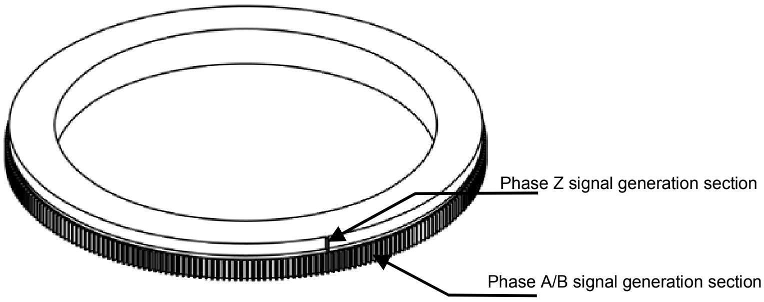


NOTE

1. Prepare cable K17 by yourself. The connector for cable K17 is not supplied as an accessory. Make your own arrangement for the connector. See Subsection 9.3.3.8, "Details of cable K17" for details on connection.
2. Cable K17 may be relayed in midway. For such relaying, it is recommended to use a connector of class IP54 or higher or a terminal box.

11.2.3.6 Notes on the Detection ring

The Detection ring consists of the phase Z signal generation section and the phase A/B signal generation section.
For the αiBZ SENSOR (A860-2150-Txxx and A860-2155-Txxx), the phase A/B signal generation section and the phase Z signal generation section are integrated into one piece and the phase Z signal generation section has a convex shape. When handling the sensor ring, be very careful not to deform or damage the teeth on the outer surface of the Detection ring.



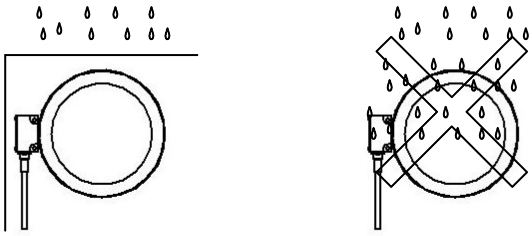
11.2.3.7 Usage with consideration of environmental resistance

Since the sensor is an electric part, if it is used in an environment in which it is exposed to the cutting fluid or lubricant, the cutting fluid or lubricant may enter the inside of the sensor, adversely affecting the sensor. In particular, if the cutting fluid adheres to the sensor, it can cause the deterioration of the resin or rubber sealing parts or cables and the degradation of sealing performance of the sensor, which may allow a large amount of cutting fluid to enter the inside of the sensor, resulting in damage to the sensor. When using the sensor, note the points described below.

Sensor installation conditions

If the sensor is used in an environment in which it is exposed to the cutting fluid or lubricant, the cutting fluid or lubricant may adversely affect the sensor sealing parts or cables and enter the inside of the sensor, resulting in damage to these sensor. When using the sensor, note the points described below.

Make sure that the sensor surface is never wet with the cutting fluid or lubricant, also make sure that no cutting fluid or lubricant builds up around the sensor. If there is a possibility of the surface being wet, a cover is required.

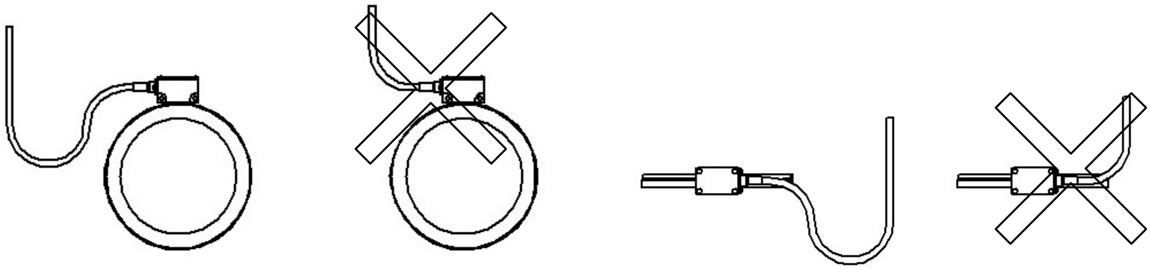


If the cutting fluid or lubricant is misted, it may form condensation in the inside of the cover and fall on the sensor. Make sure that no dew drops of the cutting fluid or lubricant fall on the sensor.
Completely separate the sensor area from the machining area.

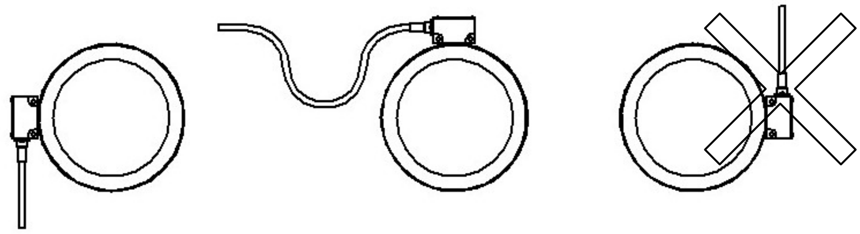
Cable layout

When using the sensor, note the points described below.

Make sure that no cutting fluid or lubricant is led to the sensor via any cable. When a horizontal cable outlet is used, a slack can be formed in the cable to prevent the cutting fluid or lubricant from being led to the sensor.



When an upward cable outlet is used, the cutting fluid or lubricant collects around the sensor connector. Use a horizontal or downward cable outlet whenever possible.



11.2.4 α*i*CZ SENSOR (for Spindle)

α*i*CZ SENSOR is used for high-precision Cs-axis contour control.

11.2.4.1 Specification

The following specifications are available depending on different Detection rings. Select the right specification for your intended purpose.

Names and specification numbers

Name	Specification number	Remarks	
		Number of teeth	Maximum rotation speed (min^{-1})
α*i*CZ SENSOR 512 IS	A860-2163-T411	512	15,000
α*i*CZ SENSOR 768 IS	A860-2163-T511	768	10,000
α*i*CZ SENSOR 1024 IS	A860-2163-T611	1024	8,000

Environmental conditions for use

Item	Specifications
Operating temperature range	0°C to +70°C
Humidity	95%RH or less

Mechanical and electrical specifications

Item	Specifications
Power supply voltage	$5V^{+5\%}_{-10\%}$
Current consumption	150mA
Water and dust proof class	Equivalent to IP67

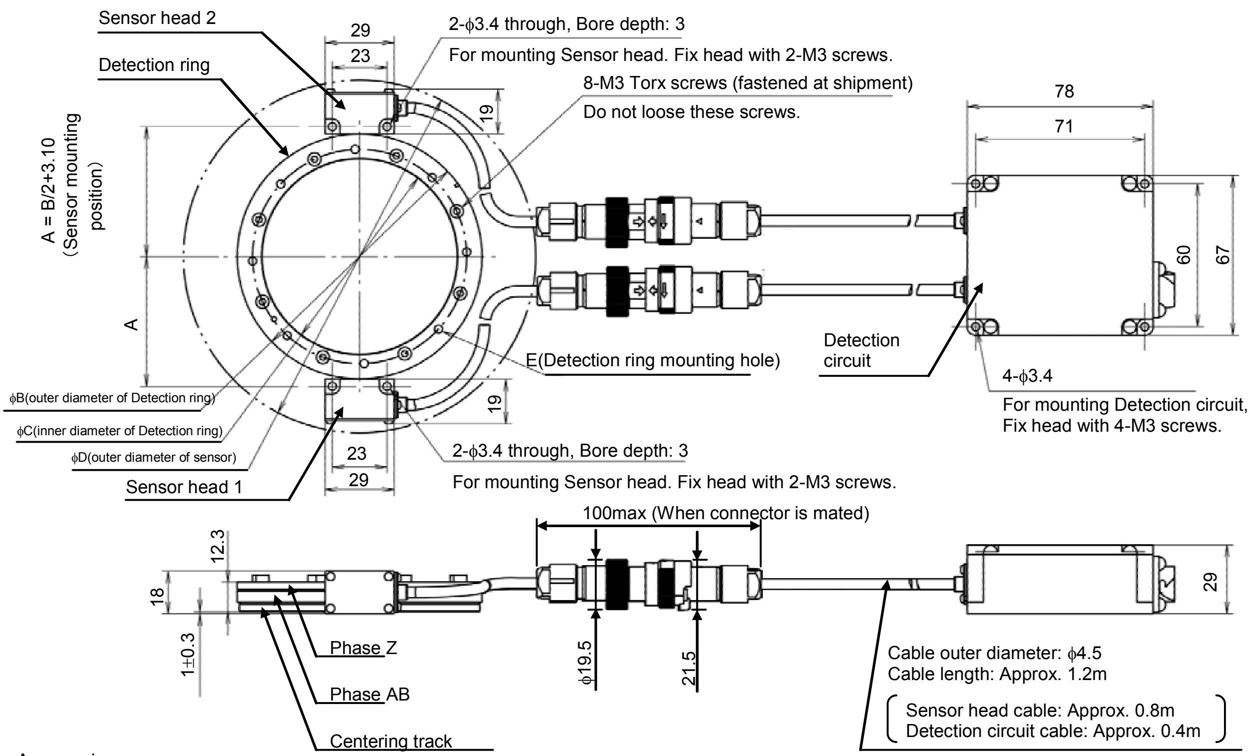
Resolution and accuracy

Name	Resolution when controlling Cs contour	Positioning accuracy		Repetition accuracy
		Typ.	Max.	Typ.
αiCZ SENSOR 512 IS	3,600,000 / revolution	±4”	±8”	±1”
αiCZ SENSOR 768 IS		±3”	±6”	
αiCZ SENSOR 1024 IS		±2”	±4”	

NOTE

The following functions are not available.
Spindle switch control, spindle differential spindle speed control, and POSITIONCODER signal output

11.2.4.2 Dimensions



Accessories:
Parallel pin (JIS B 1354-1988, class A, normal diameter of ϕ3, normal length of 6) × 4
Thickness gauge (t =0.1mm) × 1

Specification number	Number of teeth	Dimensions (mm)				
		Sensor mounting position A	Outer diameter of Detection ring ϕB	Inner diameter of Detection ring ϕC	Outer diameter of sensor ϕD	Detection ring mounting hole E
A860-2163-T411	512	54.5	102.8 +0/-0.02	82 +0.02/-0	148	8-ϕ3.4 through, equally spaced on ϕ90 circumference
A860-2163-T511	768	80.1	154 +0/-0.02	125 +0.02/-0	198	8-ϕ4.5 through, equally spaced on ϕ134 circumference
A860-2163-T611	1024	105.7	205.2 +0/-0.02	160 +0.02/-0	249	8-ϕ5.5 through, equally spaced on ϕ170 circumference

NOTE

1 The sensor is a precision part. Use special care in handling. In particular, do not apply force to the Sensor head.
2 Take necessary measures to protect the sensor from chips, dust, and other foreign matter.
3 The sensor satisfies class IP67 of waterproof performance when the connector is properly mated. Note, however, that the waterproof performance indicated in IP is valid only for water for and for a short period of time. The performance is not guaranteed. Continuous exposure of the sensor to cutting fluid or the like and continuously damp condition may lead to a failure of the sensor. Make sure to attach a cover or another protection of the machine so that as little cutting fluid as possible may drip on the sensor.
4 For easy maintenance, mount the sensor at a position where it can be replaced easily.
5 Ensure that no vibration greater than 1 G is applied to the Detection circuit.
6 Ground the Detection circuit. Grounding can be performed simply by screwing the Detection circuit as the bottom of the circuit is not coated.
7 Fasten the cables to the machine near the Sensor heads lest direct stress is applied to the Sensor heads.
8 All of the cables used for the sensor are flexible cables.

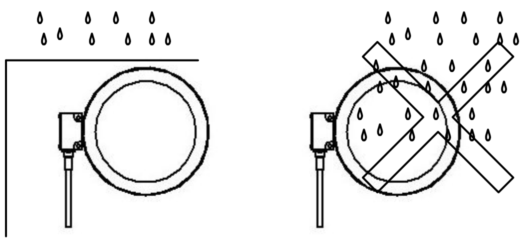
11.2.4.3 Usage with consideration of environmental resistance of α*i*CZ SENSOR

Sensors are electric components. They may be adversely affected by exposure to cutting fluid or lubricant. Cutting fluid on the sensor surface significantly increases the risk of the damage as the resin or rubber sealing parts are deteriorated, which in turn leads a large amount of cutting fluid entering into the sensor. When using the sensor, note the points described below.

Sensor installation conditions

If the sensor is used in an environment in which it is exposed to the cutting fluid or lubricant, the cutting fluid or lubricant may adversely affect the sensor sealing parts or cables and enter the inside of the sensor, resulting in damage to these sensor. When using the sensor, note the points described below.

- Make sure that the sensor surface is never wet with the cutting fluid or lubricant, and also make sure that no cutting fluid or lubricant builds up around the sensor. If there is a possibility of the surface being wet, a cover is required.

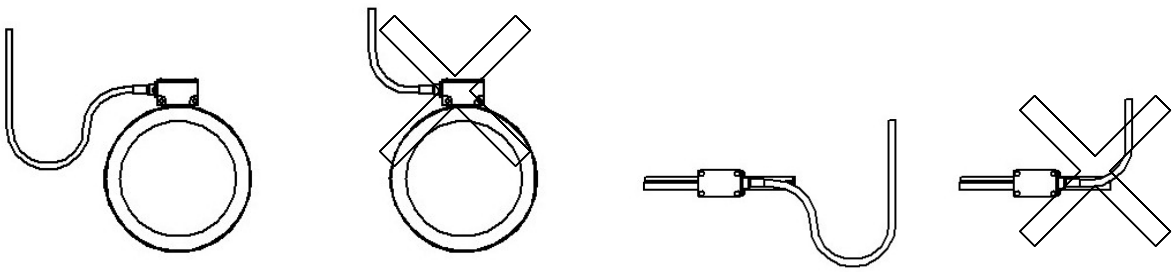


- If the cutting fluid or lubricant is misted, it may form condensation in the inside of the cover and fall on the sensor. Make sure that no dew drops of the cutting fluid or lubricant fall on the sensor.
- Completely separate the sensor area from the machining area.

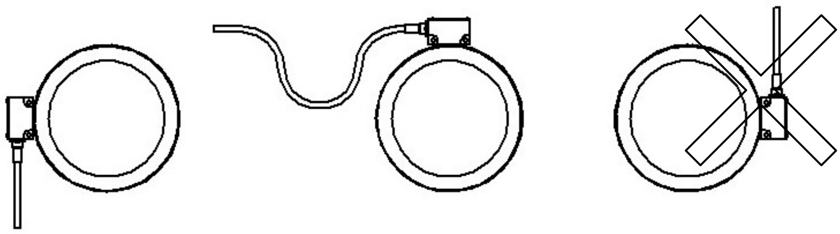
Cable layout

When using the sensor, note the points described below.

- Make sure that no cutting fluid or lubricant is led to the sensor via any cable. When a horizontal cable outlet is used, a slack can be formed in the cable to prevent the cutting fluid or lubricant from being led to the sensor.



- When an upward cable outlet is used, the cutting fluid or lubricant collects around the sensor connector. Use a horizontal or downward cable outlet whenever possible.

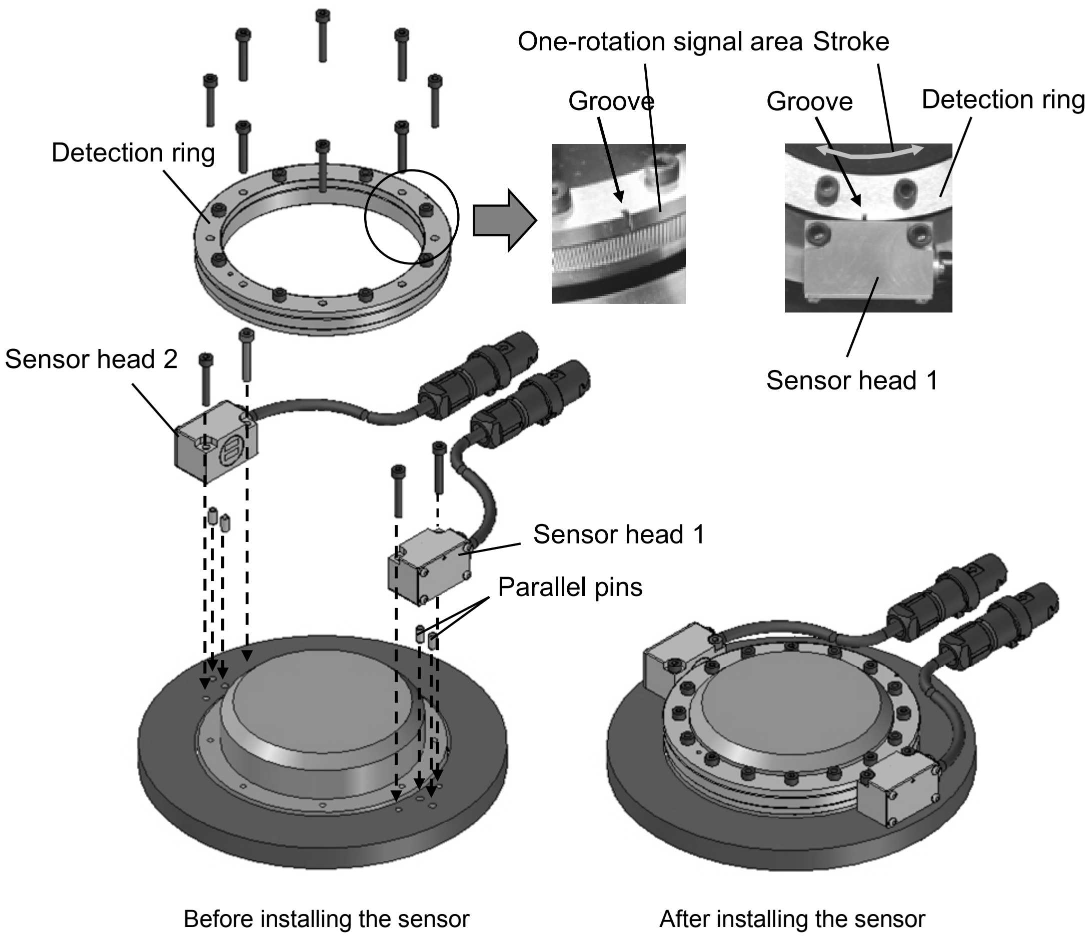


11.2.4.4 Installing the sensor

Installation procedure (overview)

Install the sensor according to the following procedure. See the following sections for details in each step.

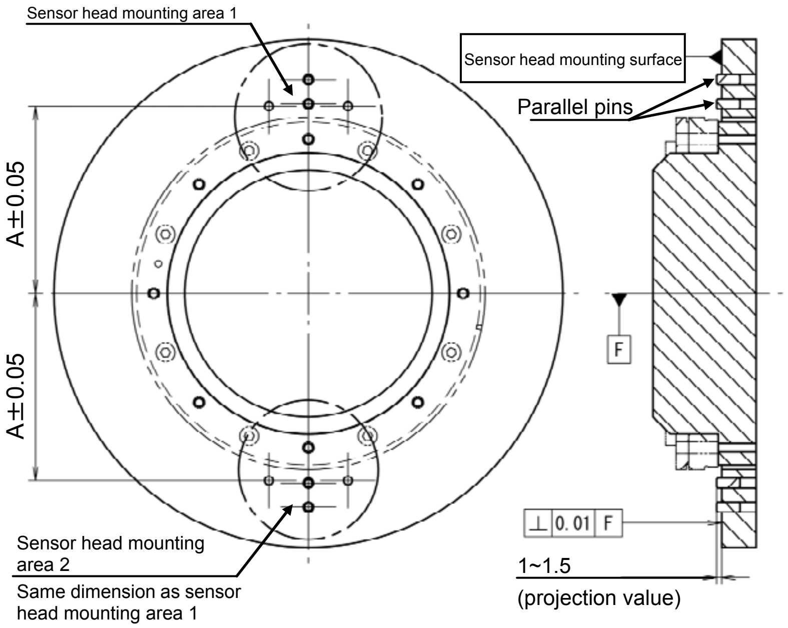
- Sensor head Machine the Sensor head mounting surface as necessary then insert the parallel pins.
- Mount the Detection ring onto the shaft or sleeve of the machine, center, and fix with screws.
- Adjust the gap between the Sensor head and Detection ring, and then mount the Sensor head on the machine.

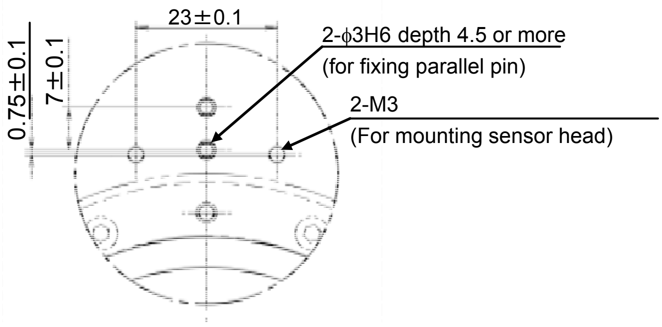


> **NOTE**
> Ensure that the groove of the one-rotation signal area of the Detection ring passes Sensor head 1 within the stroke.

Sensor head mounting surface

Machine the sensor mounting surface as shown in the figure below and insert the supplied parallel pins in the 2-ϕ3H6 holes. These pins are used as the guide for the gap adjustment of the Sensor head.



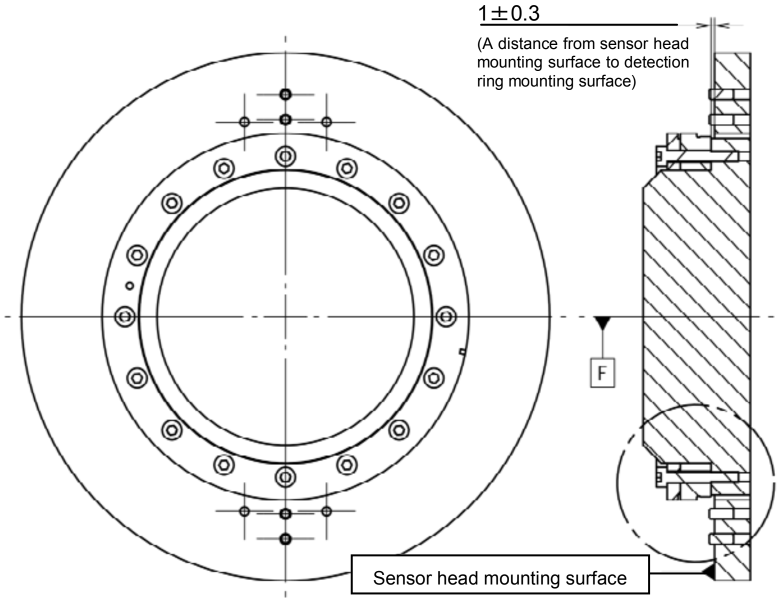


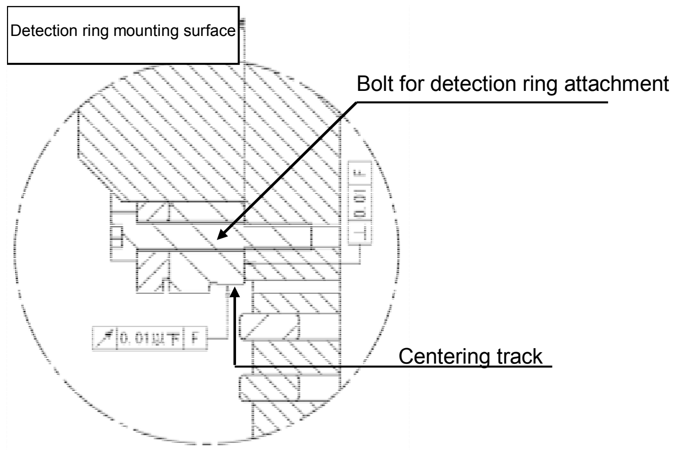
Detailed view of sensor head mounting surface 1

NOTE
1 See "Dimensions" above for dimension A.
2 The design should ensure that the required dimensions are satisfied by the positions of the threaded holes for mounting the Sensor heads after assembly rather than by the components with their mounting surface.

Installing the Detection ring

Center the Detection ring by using the centering track so that the runout to the rotation center is 0.01 mm or less, and install it. Moreover, design so that the Detection ring mounting surface is 1 ± 0.3 mm apart from the Sensor head mounting surface in the direction of the shaft. Ensure that the perpendicularity of the Detection ring mounting surface is within 0.01 mm from the rotation center. Apply a thread locker or the like to the sensor mounting screws to prevent them from becoming loose.





Specification number	Outer diameter of centering track (mm)	Positions of Detection ring mounting holes	Mounting screws	Recommended tightening torque for screws (N·m)
A860-2163-T411	ϕ101	8-ϕ3.4 through, equally spaced on ϕ90 circumference	M3	1.5±5%
A860-2163-T511	ϕ152.2	8-ϕ4.5 through, equally spaced on ϕ134 circumference	M4	3.0±5%
A860-2163-T611	ϕ203.4	8-ϕ5.5 through, equally spaced on ϕ170 circumference	M5	6.0±5%

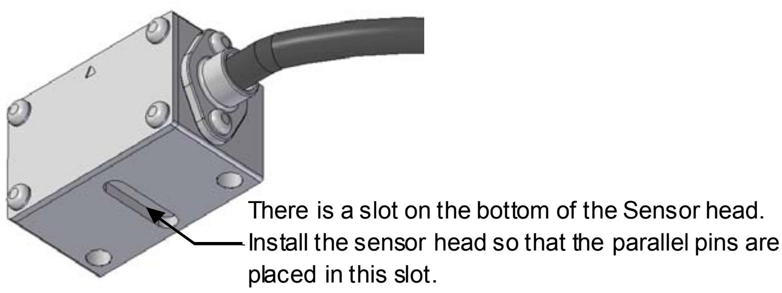
NOTE

1 For centering, the outer diameter of the shaft or sleeve must be designed to leave a gap of at least 0.1 mm from the inner diameter of the Detection ring on each side.
2 Screw the Detection ring on end face. Do not mount the ring by means of heat shrink fitting.
3 The Detection ring consists of the phase Z ring and phase AB ring. They are fastened together with screws before the shipment of the sensor. Never detach the screws. Spot facing is not provided to the screw portion of the Detection ring. So, at the time of machine design, make sure the machine does not interfere with the screw heads.
4 Centering must be performed on the centering track. The outer diameter of the phase Z ring and the teeth pitch circle are not coaxial. Use a tool such as a plastic hammer for centering in order not to damage the gear teeth.
5 Magnetic matter attached to gear teeth can lead to a detection error. When centering is completed, remove such foreign matter by air blowing.
6 If the Detection ring is tightened with excessive torque, the Detection ring may be deformed elastically, resulting in reduced detection accuracy. Apply the recommended tightening torque for mounting the Detection ring.
7 Inadequately fastened Detection ring may cause the spindle to behave in an unexpected manner. Make sure to fasten the Detection ring to the shaft and sleeve.

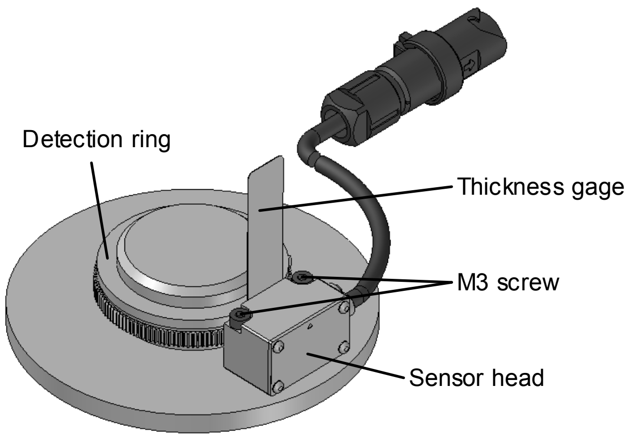
Installing the Sensor heads

Install the Sensor heads according to the procedure below. The same procedure applies to Sensor head 1 and Sensor head 2.

- Place the Sensor head on the sensor mounting surface so that the parallel pins are positioned in the slot on the bottom of the Sensor head, and fasten the Sensor head temporarily. The magnet in the Sensor head and the Detection ring attract each other. When installing the Sensor head, be careful not to hit the Sensor head against the Detection ring. Impact can damage elements in the Sensor head.



■ Insert the thickness gauge (supplied as an accessory, t = 0.1 mm) between the Detection ring and the Sensor head, and while lightly pressing the Sensor head against the thickness gauge, tighten the screws (recommended tightening torque: 1.3 N･m ±10%). Apply a thread locker or the like to the sensor mounting screws to prevent them from becoming loose.

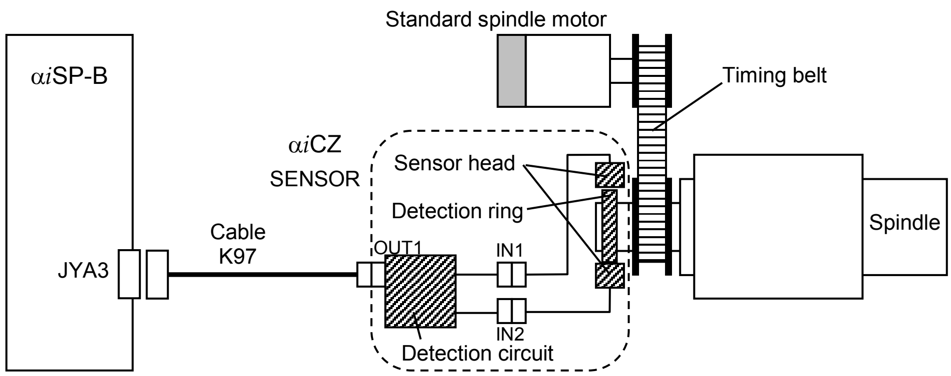


■ Pull out the thickness gauge, and slowly turn the Detection ring to ensure that the Detection ring and the Sensor head do not touch each other.

11.2.4.5 Connection

Connection diagram (overview)

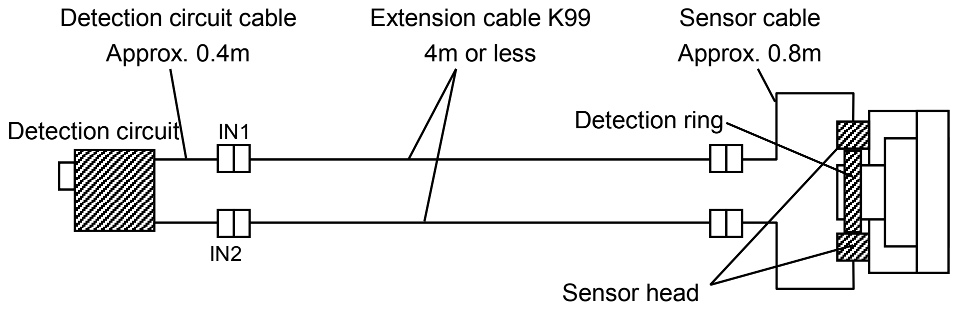
Connect α*i*SP-B and α*i*CZ SENSOR as shown in the following figure.



> **NOTE**
> Prepare cable K97 by yourself. No connectors for the cable are included with your product. Please order the connectors separately. See Subsection 9.3.3.16, "Details of cable K97" for details on connection.

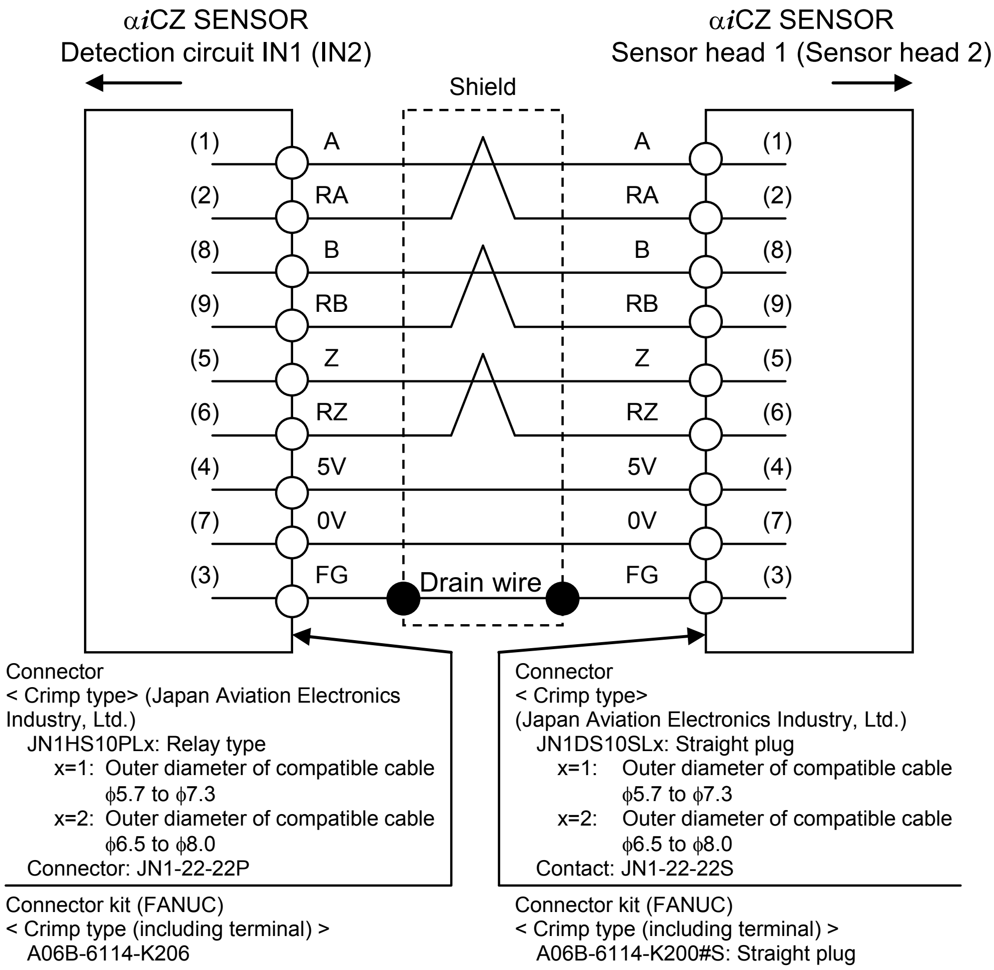
Method of extending the sensor cables

The sensor cables from the Sensor heads to the Detection circuit can be extended up to 4 m as shown in the figure below.



> **NOTE**
> Prepare the extension cable K99 by yourself. No connectors for the cable are included with your product. Please order the connectors separately. See "Details of cable K99" below for details on the connection.

Details of cable K99



Using cable conductor

Signal name	Configuration
5V, 0V	0.5 mm^2 or more × 2
A, RA, B, RB, Z, RZ	0.2 mm^2 or more, Twisted-pair cable
Drain wire	0.15 mm^2 or more

Recommended cable conductor

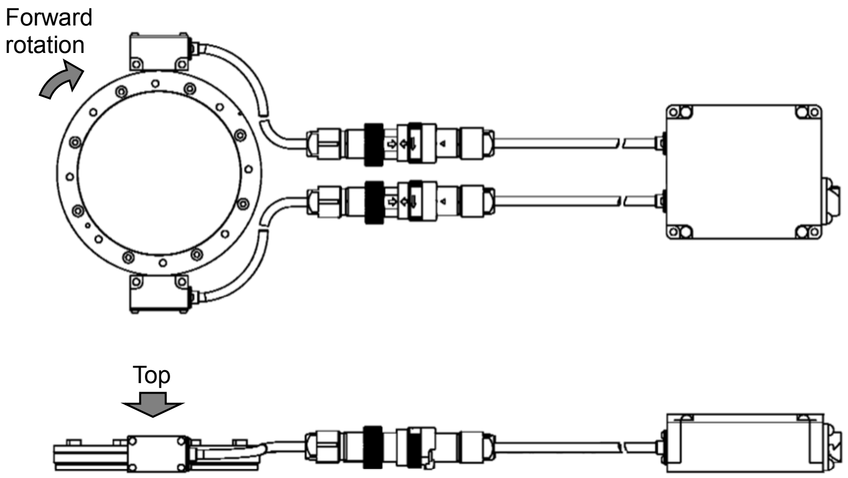
Cable specification	Cable length
A66L-0001-0482	4m or less

NOTE

1. Prepare the extension cable K99 by yourself. No connectors for the cable are included with your product. Please order the connectors separately.
2. The Sensor head 2 does not output Z and RZ signals. However, there is no problem to make a connection.
3. Make sure that the sum of the resistance values between 5 V and 0 V does not exceed 2 Ω.
4. Make sure that the power line and signal line do not run in parallel.
5. For details of the recommended cable, refer to APPENDIX B, "CABLES."
6. See "Details of cable K97" above for the crimping tool for the connector.

11.2.4.6 Rotation direction

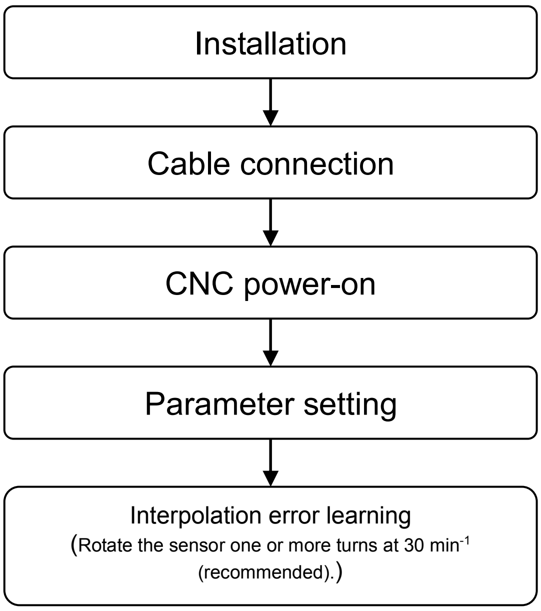
When the sensor is viewed from the top as shown in the following figure, clockwise rotation of the Detection ring is referred to as forward rotation:



11.2.4.7 Start-up procedure

Overview

Install the sensor according to the procedure below.



NOTE

If it is difficult to rotate the sensor at least one turn for interpolation error learning, repeat forward and reverse rotations under the above rotation conditions until the sum of angular displacements becomes one turn or more.

11.2.4.8 Interpolation error correction

The αiCZ SENSOR includes the circuit which detects the interpolation errors automatically. The detection conditions vary depending on the model. For any model, however, recommended value is 30 min^{-1} for all specifications.

Each time the sensor is turned on, rotate under the following conditions and make correction for interpolation errors.

Detection conditions for interpolation errors
- A860-2163-T411 : 25 to 105min^{-1}, constant speed, one or more turns
- A860-2163-T511 : 20 to 70min^{-1}, constant speed, one or more turns
- A860-2163-T611 : 15 to 50min^{-1}, constant speed, one or more turns

Recommended detection conditions
- Common to three models : 30min^{-1}, constant speed, one or more turns

NOTE

1. While power is supplied to the αiCZ SENSOR, interpolation error correction data is retained in the sensor. When the power is removed, the data is no longer retained. To ensure accuracy, rotate the sensor at a speed that satisfies detection conditions each time the power is turned on and perform correction for interpolation errors.
2. Incomplete learning may lead to reduced detection accuracy of the αiCZ SENSOR.
3. If it is difficult to rotate the sensor at least one turn, repeat forward and reverse rotations under the above rotation conditions until the sum of angular displacements reaches one turn or more.

11.2.4.9 Operating precautions

Sensor head

The Detection circuit memorizes the initial conduction state. So, do not move the Sensor head afterward. If the Sensor head is moved after the initial conduction state, the reference position may be displaced. Moreover, a pulse error alarm may be issued. Issue the battery zero alarm and perform reference position return operation according to "Procedure for initializing the Detection circuit."

Magnetic powder attached to the Detection ring

The αiCZ SENSOR detects an angular displacement according to a change in magnetic flux density between the Sensor heads and Detection ring. So, if magnetic powder is attached to a location of the Detection ring, the magnetic flux density at that location changes locally, deteriorating the accuracy of detection. This accuracy deterioration occurs each time the location to which magnetic powder is attached passes Sensor head 1 and Sensor head 2, that is, at every 180°. This deterioration leads to an increased positioning error, torque command variation, abnormal sound, vibration, and so forth.
After installing the sensor, be sure to blow the Detection ring by air. Moreover, to prevent magnetic powder and chips from being attached to the Detection ring and Sensor heads during operation, provide protection against dust and water on the machine side.
If nonmagnetic matter (such as aluminum, austenitic stainless steel, resin, and oil) is attached to the Detection ring or Sensor head, such accuracy deterioration as described above does not occur. However, foreign matter caught between the Detection ring and a Sensor head can mechanically damage the Sensor head. So, prevent foreign matter, even if nonmagnetic, from being attached to the Detection ring.

11.2.4.10 Displaying Sensor amplitude and offset data

Use the following procedure to check the amplitude of the output signal from α*i*CZ SENSOR and offset data on the diagnosis screen of the CNC unit. Once the sensor is assembled, check if the output signal is normal.

- Set "9" for parameter No.4532.

30*i*-B

4532	**Number of flexible data output function (for display on the diagnosis screen)**

- Check the values for No.720 and No.722 on the diagnosis screen.

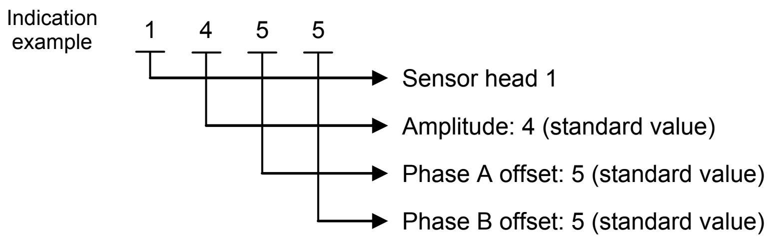
720	**Amplitude of the phase A/B of the Sensor head 1 and offset data**

Thousands place: Represents the Sensor head number. 1: Sensor head 1, 2: Sensor head 2
Hundreds place: Represents the amplitude in levels from 1 to 9. Reference values are 3 to 7.
Tens place: Represents the offset value of the phase A in levels from 1 to 9. Reference values are 3 to 7.
Ones place: Represents the offset value of the phase B in levels from 1 to 9. Reference values are 3 to 7.

722	**Amplitude of the phase A/B of the Sensor head 2 and offset data**

Thousands place: Represents the Sensor head number. 1: Sensor head 1, 2: Sensor head 2
Hundreds place: Represents the amplitude in levels from 1 to 9. Reference values are 3 to 7.
Tens place: Represents the offset value of the phase A in levels from 1 to 9. Reference values are 3 to 7.
Ones place: Represents the offset value of the phase B in levels from 1 to 9. Reference values are 3 to 7.

NOTE
1 Other data are displayed when No.4532 is other than 9.
2 Check the displayed values on the diagnosis screen while rotating the spindle.

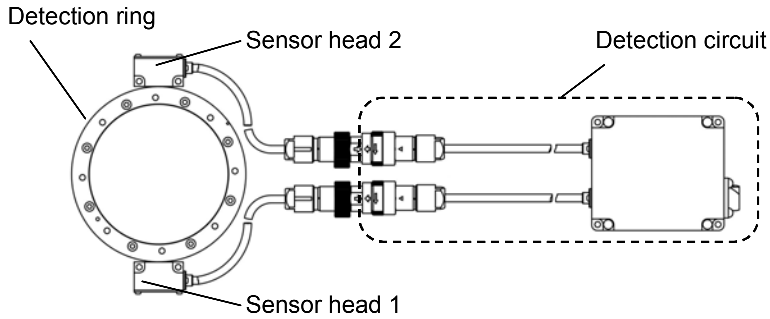


Diagnosis number

Spindle	Sensor head 1	Sensor head 2
Spindle 1	720 (Each spindle type)	722 (Each spindle type)
Spindle 2		
Spindle 3		
Spindle 4		

11.2.4.11 Maintenance parts

As shown below, the αiCZ SENSOR consists of four parts: Detection ring, Sensor head 1, Sensor head 2, and Detection circuit. Each part can be maintained separately. So, place an order on each part as needed according to the specification numbers indicated below.



Specifications of maintenance parts

Specification number / Part specification	αiCZ SENSOR 512 IS A860-2163-T411	αiCZ SENSOR 768 IS A860-2163-T511	αiCZ SENSOR 1024 IS A860-2163-T611
Detection ring	A860-2160-V901	A860-2160-V902	A860-2160-V903
Sensor head 1	A860-2162-V001 (common to all specifications)		
Sensor head 2	A860-2162-V012 (common to all specifications)		
Detection circuit	A860-2163-V201 (common to all specifications)		

11.2.4.12 Spindle alarms

Alarm No.	LED indication	Alarm name	Alarm description	Cause
30*i*	SP			
SP9132	d2	Serial data error	Communication between the sensor and spindle amplifier is not performed.	• The feedback cable is broken. • The connector is not connected normally.
SP9133	d3	Data transfer error	Serial data transmission/reception is not performed normally.	• The communication signal was disturbed due to noise.
SP9134	d4	Soft phase alarm	An abnormal acceleration rate was detected.	• The communication signal was disturbed due to noise. • The internal sensor signal was disturbed.
SP9139	d9	Pulse error alarm	An error occurred in the interpolation circuit.	• The gap between the Sensor head and the Detection ring is large (the A/B phase amplitude is small). • The Sensor head signal is disconnected (the A/B phase amplitude is small). • The runout of the shaft in which the sensor ring is mounted is large (the signal phase difference between Sensor heads 1 and 2 became at least 120°, compared with the signal phase difference at power on). • The interpolation circuit is faulty.
SP9140	E0	Count error alarm	The number of pulses between one phase Z and another is shifted by 4λ or more.	• The internal sensor signal was disturbed due to noise. • The number of teeth on the Detection ring is not a multiple of 128.

Alarm No. 30*i*	LED indication SP	Alarm name	Alarm description	Cause
SP9141	E1	Sensor one-rotation signal undetected	No absolute position is established within 5 turns immediately after communication between the spindle amplifier and sensor is started.	• The signal is disconnected (Z-phase signal error).

11.3 SPINDLE SENSORS BY OTHER MANUFACTURERS

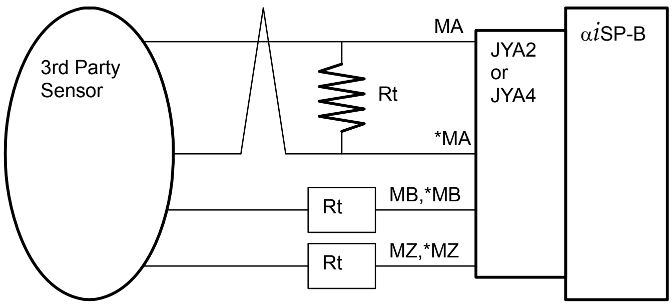
11.3.1 Overview

This section describes spindle sensors provided by other manufacturers that are supported by α*i*SP-B and α*i*SVP-B.
α*i*SP-B and α*i*SVP-B support the following spindle sensor signals.

- 1Vpp sine-wave signal (compatible connectors: JYA2 and JYA4)
- Square-wave signal (compatible connector: JYA3)
- Serial output signal (compatible connector: JYA3)

11.3.2 Notes

(1) The spindle amplifier does not have any built-in terminating resistor (120Ω).
Compatibility of specifications between the sensor output and spindle amplifier input needs to be considered by taking the terminating resistor into account. In case a terminating resistor is necessary for the input waveform to be compatible with the differential signal waveforms 1) through 3) of the maximum rating in Subsection 11.3.3.1, attach such a terminating resistor outside of the spindle amplifier.



Rt is defind in specification of 3rd party sensor.

The Level-up α*i*SP-B and Level-up α*i*SVP-B have built-in terminating resistors (120Ω). The following parameters can set whether to use these terminating resistors (120Ω) or not.

[JYA2]	No.4004#6=0: (Disables 120Ω terminating resistor), No.4004#6=1: (Enables 120Ω terminating resistor)
[JYA4]	No.4004#7=0: (Disables 120Ω terminating resistor), No.4004#7=1: (Enables 120Ω terminating resistor)

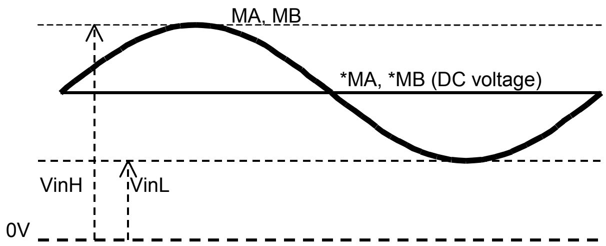
(2) Setting one-rotation signal
Set a driver type if the driver being used is not compatible with α*i*MZ SENSOR or α*i*BZ SENSOR.

11.3.3 Sensor Signal Specifications

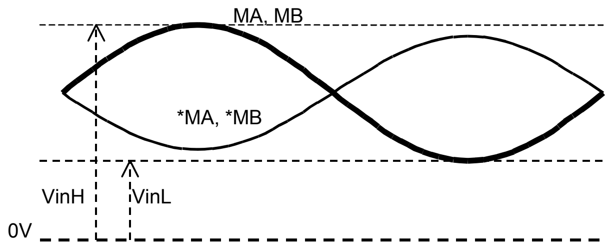
Applicable signal specifications are presented for sensors by other manufacturers.

11.3.3.1 Input signal for JYA2 or JYA4 (output signals of phases A, B, and Z)

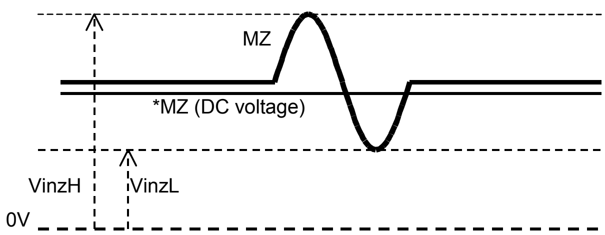
Waveform 1 (A and B signals)



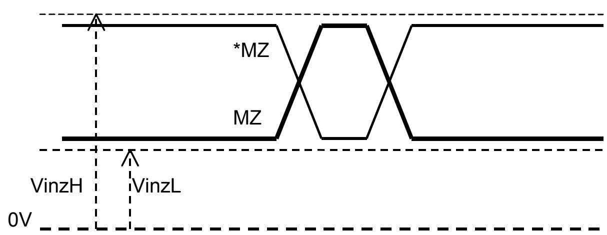
Waveform 2 (A and B signals)



Waveform 3 (Z signal)

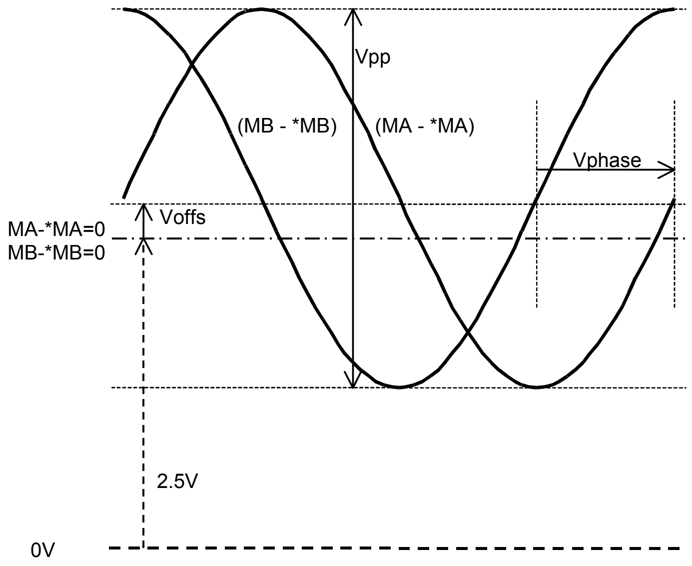


Waveform 4 (Z signal)



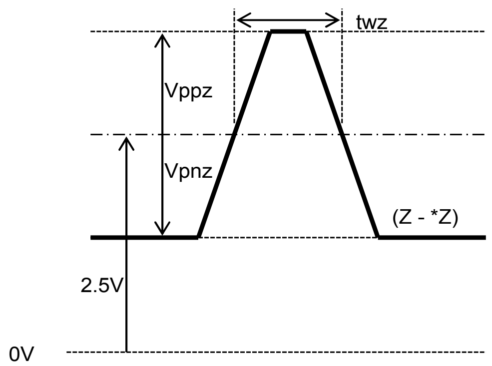
		Symbol	Check pin	Value
1	Input resistance	Rin		100kΩ
2	Power supply	Vcc (Vdd = 0V)	JYA2-pin9,18,20 JYA4-pin9,18,20	5Vdc±5%, 150mAMax
3	Phases A and B of input signal (MA,*MA, MB, *MB)	VinL VinH	MA JYA2-pin5, JYA4-pin5 *MA JYA2-pin6, JYA4-pin6 MB JYA2-pin7, JYA4-pin7 *MB JYA2-pin8, JYA4-pin8	VinH = 3.5V Max VinL = 1.5V Min
4	Phase Z of input signal (MZ, *MZ)	VinzL VinzH	MZ JYA2-pin1, JYA4-pin1 *MZ JYA2-pin2, JYA4-pin2	VinzH = Vcc Max VinzL = 0V Min
5	Sine-wave per one rotation			128 to 32767 sin/rev 32768 to 65534 sin/rev (even numbers only)
6	Maximum frequency	Fmax		400kHz

1) 1 Vpp phases A and B of sine-wave (differential signal waveform)



		Symbol	Check pin	Value
1	Signal amplitude (MA - *MA, MB - *MB)	Vpp	(from JYA4) PA2,PB2	0.60Vppmin, 1.2Vppmax (including acceptable error)
2	Signal offset (MA - *MA, MB - *MB)	Voffs		±100mVMax
3	Signal amplitude unbalance (MA - *MA) / (MB - *MB)	Vppdef		1.00±0.10Max
4	Phase offset (MA - *MA, MB - *MB)	Vphase		90±3deg

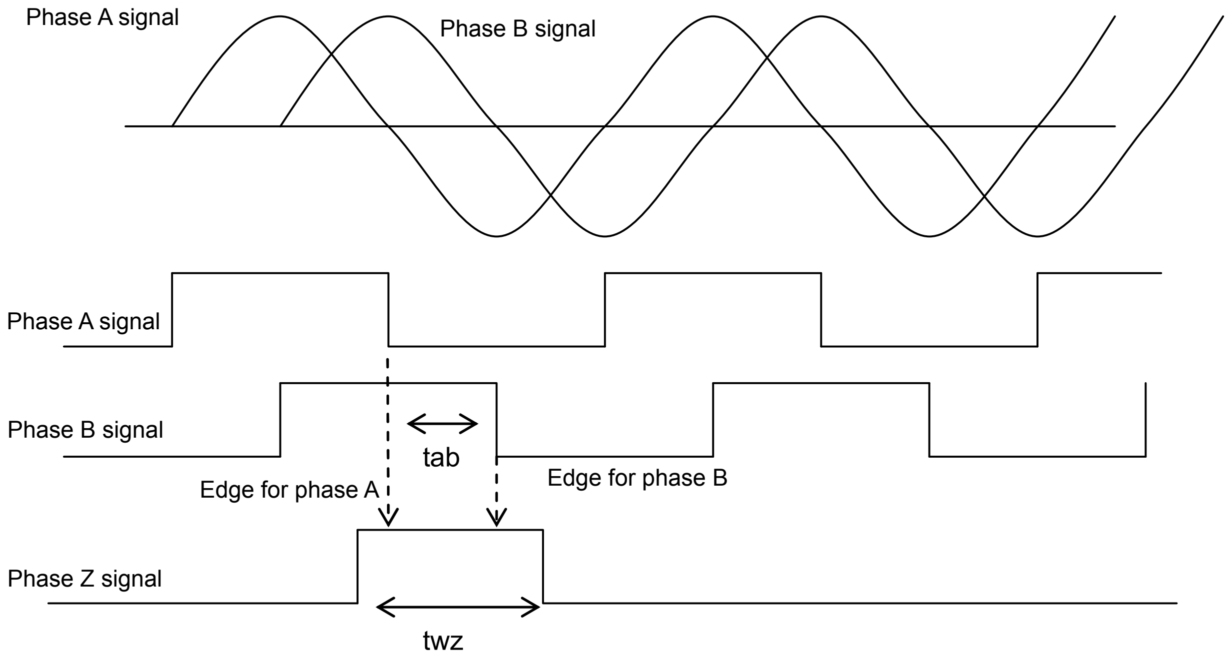
2) Driver type phase Z



		Symbol	Check terminal	Value
1	Pulse width (MZ - *MZ)	Twz	(from JYA2) PS1	2.5μsec min
2	Amplitude of phase Z signal (MZ - *MZ)	Vppz	(from JYA4) PS2	0.23Vmin
		Vpnz		0.23Vmin

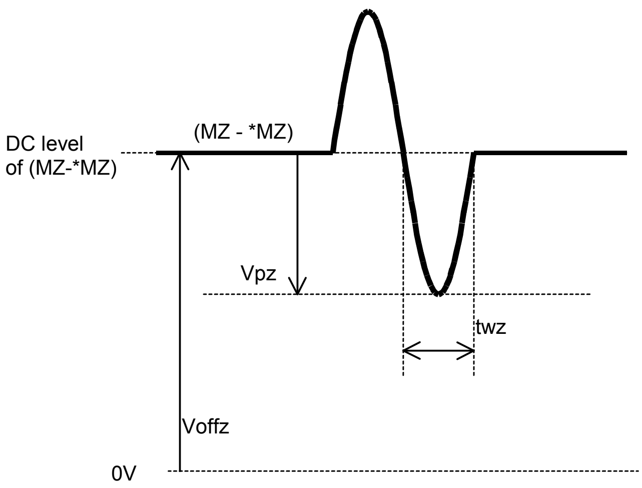
NOTE

- There must be at least one edge each for phase A and phase B between the width twz of phase Z signal.
- See PARAMETER MANUAL for the spindle motor (B-65280EN) for types which generate multiple phase Z signals in one turn.



twz > tab

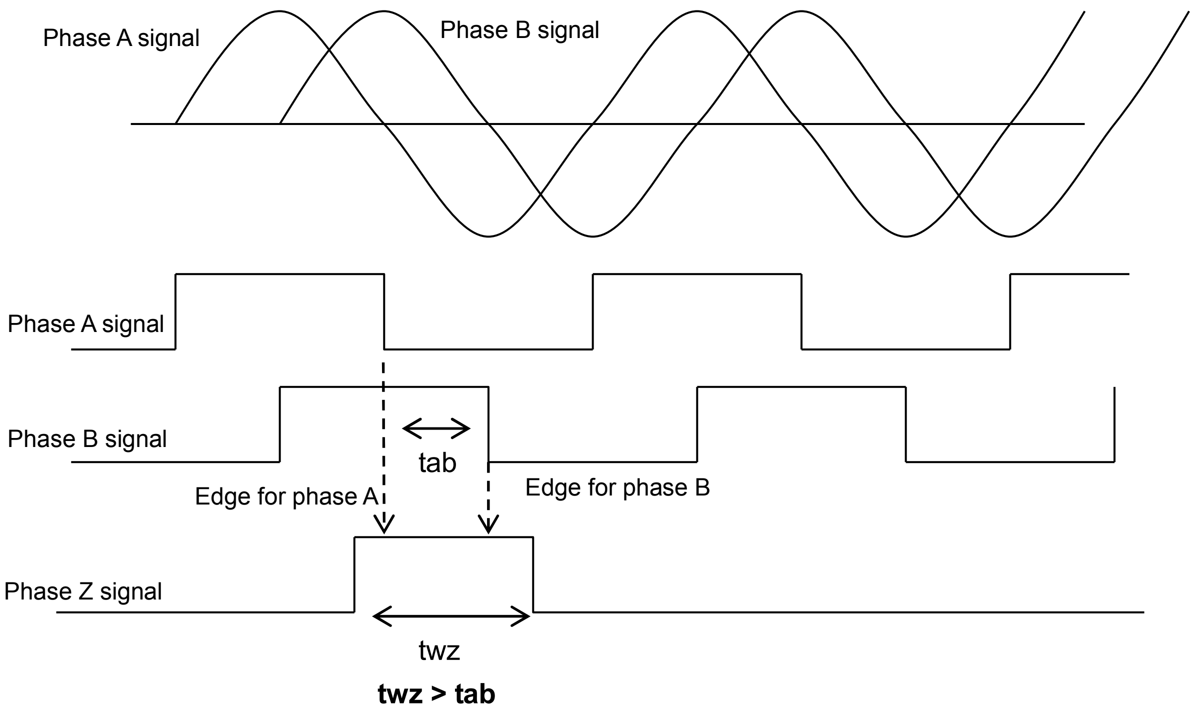
3) Sine-wave phase Z (compatible with phase Z of α*i*BZ SENSOR)



	MZ - *MZ	Symbol	Check terminal	Value
1	Pulse width	twz	(from JYA2) PS1 (from JYA4) PS2	2.5μsec min
2	Amplitude of phase Z signal	Vpz		0.23Vmin
3	DC signal offset	Voffz		3.5Vmax 2Vmin

NOTE

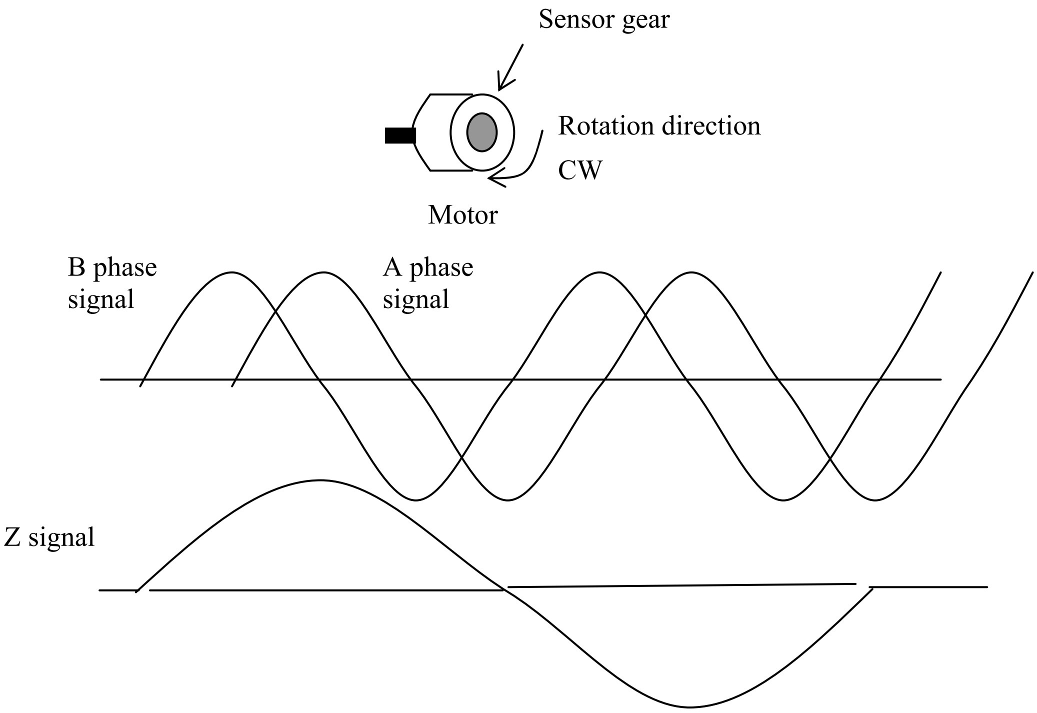
- There must be at least one edge each for phase A and phase B between the width twz of phase Z signal.
- See PARAMETER MANUAL for the spindle motor (B-65280EN) for types which generate multiple phase Z signals in one turn.



Phase sequence of phase A/B signal

The relationship between the rotation direction and phase A/B of the sensor in the FANUC circuit is shown below.

FANUC circuit will recognize a reverse rotation when the sensor with reverse phase sequence is used.

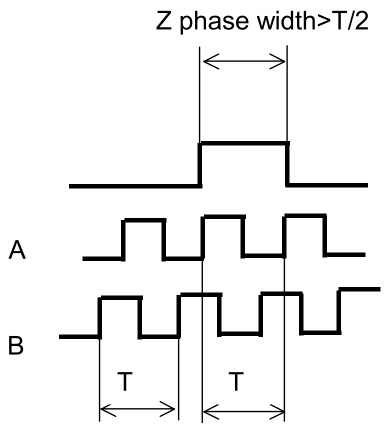


11.3.3.2 Input signal to JYA3 (phases A, B, and Z of output signal)

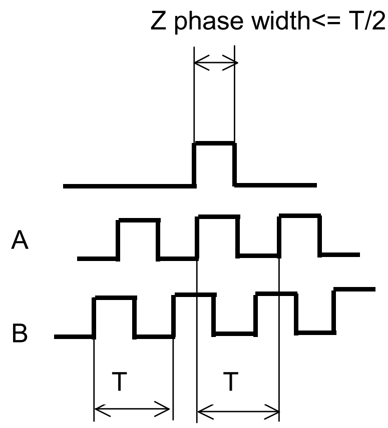
		Symbol	Check pin	Value
1	Input resistance	Rin		150Ω
2	Power supply	Vcc (Vdd = 0V)	JYA3-pin9,18,20	5Vdc±5%, 350mAMax
3	Phases A and B of input signal (PAC,*PAC,PBC, *PBC)	VinL VinH	PAC JYA3-pin5 *PAC JYA3-pin6 PBC JYA3-pin7 *PBC JYA3-pin8	VinH = 2.5V Min VinL = 0.5V Max (Conforms to RS422)
4	Phase offset with phases A and B of input signal (PAC,*PAC,PBC,*PBC)	Vphase		90±3deg
5	Phase Z of input signal (PSC, *PSC)	VinzL VinzH	PSC JYA3-pin1 *PSC JYA3-pin2	VinH = 2.5V Min VinL = 0.5V Max (Conforms to RS422)
6	Pulse width (PSC, *PSC)	Twz	PSC JYA3-pin1 *PSC JYA3-pin2	2.5μsec min
7	Square-wave per one rotation			128 to 32767 period/rev 32768 to 65534 period/rev (even numbers only)
8	Maximum frequency	Fmax		400kHz

1) Square-wave signal

Phase Z of square-wave with normal width



Phase Z of square-wave with narrow width

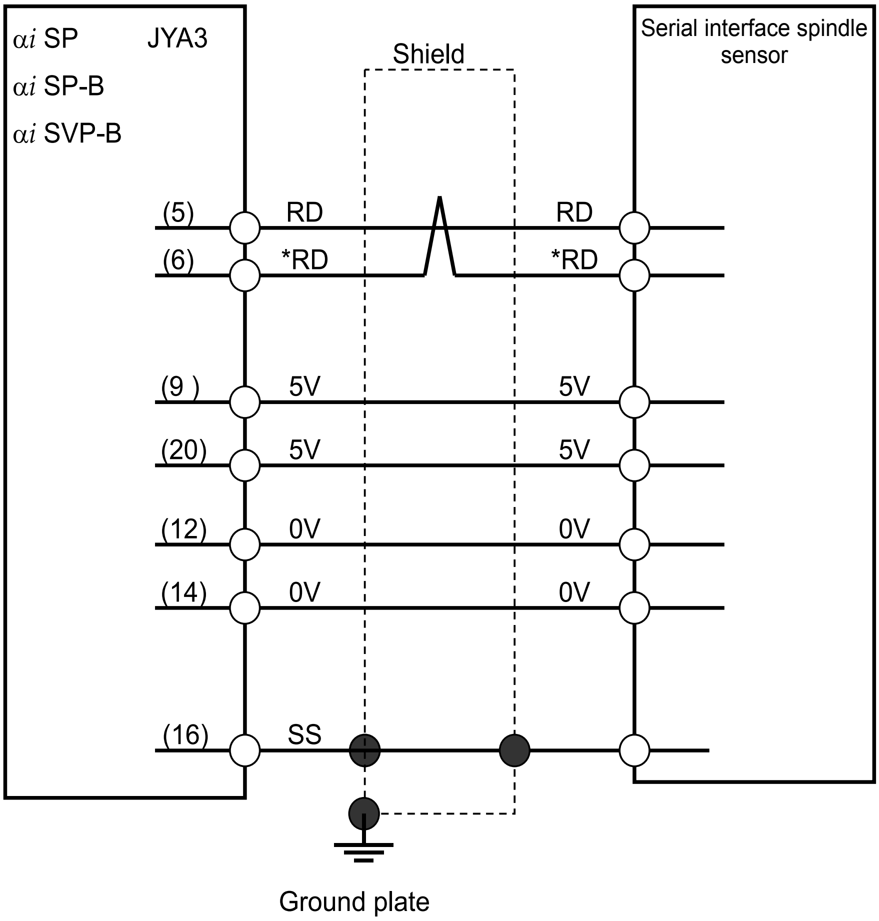


> **NOTE**
> Phase Z signal must be generated only once per rotation.

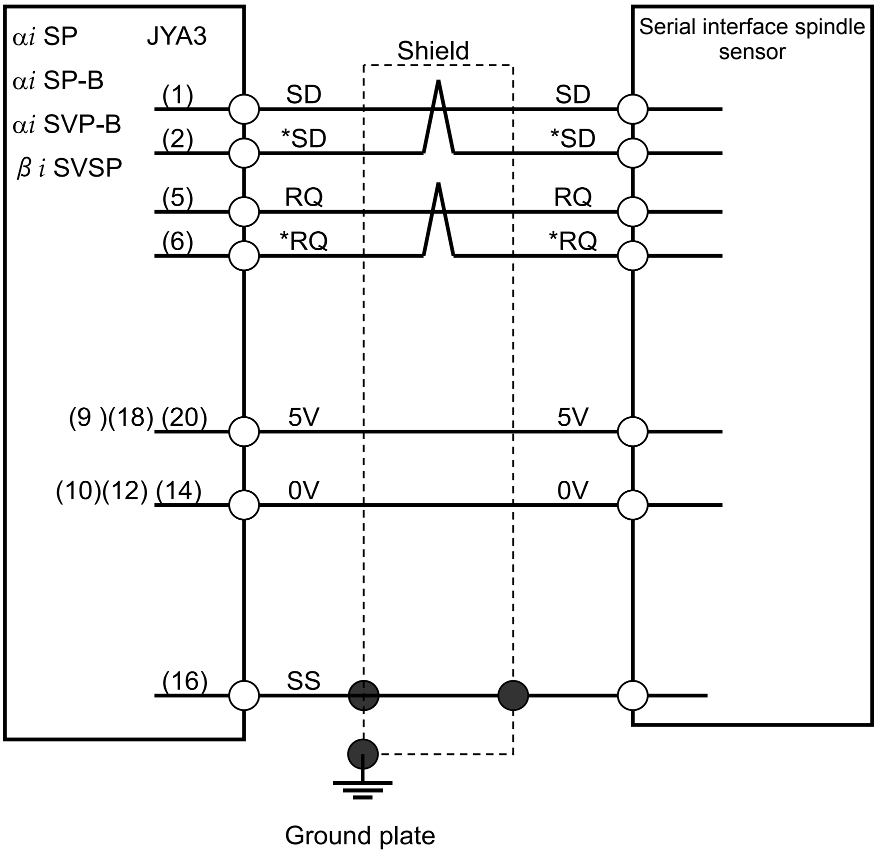
2) Spindle sensor of serial interface

Use α*i* interface or a sensor compatible with the α interface.

α*i* interface connection



α interface connection



11.3.4 Parameters

11.3.4.1 Overview

This subsection describes parameter settings for available spindle sensors.
Note) The following terms are used for the description.

Motor sensor:
: A sensor mounted at the edge of a motor to output signals for controlling motor speed and spindle position

Spindle sensor:
: A sensor mounted at the edge of a spindle to output signals for controlling spindle position

11.3.4.2 List of parameters for setting up a sensor

The following parameters are used to set up a sensor.

Parameter number	Description	Related item
No.4010#2,1,0	Type of motor sensors	11.3.4.3 (1)
No.4011#2,1,0	Number of teeth of motor sensor	11.3.4.3 (2)
No.4334	Flexible number of teeth of motor sensor	11.3.4.3 (2)
No.4397#4	Type of temperature sensors	11.3.4.3 (3)
No.4134	Motor overheat level	11.3.4.3 (3)
No.4002#3,2,1,0	Type of spindle sensors	11.3.4.4 (1)
No.4003#7,6,5,4	Number of teeth of spindle sensor	11.3.4.4 (2)
No.4361	Flexible number of teeth of spindle sensor	11.3.4.4 (2)
No.4394#2	Setting of one-rotation signal detection at or below $10min^{-1}$	11.3.4.3 (1) 11.3.4.4 (1)

NOTE

There are setting parameters other than the above when a sensor with an absolute address reference mark is used.
See B-65280EN for details.

11.3.4.3 Parameter settings for motor sensor

(1) Setting of the type of motor sensors

<table>
<tr><th rowspan="2"></th><th rowspan="2">Type of motor sensors</th><th rowspan="2">Connector</th><th colspan="3">Setting a type of motor sensors
No.4010</th><th rowspan="2">Remarks</th></tr>
<tr><th>#2</th><th>#1</th><th>#0</th></tr>
<tr><td>(a)</td><td>αiM SENSOR</td><td>JYA2</td><td>0</td><td>0</td><td>0</td><td></td></tr>
<tr><td>(b)</td><td>αiMZ SENSOR, αiBZ SENSOR, and αiCZ SENSOR (analog)</td><td></td><td>0</td><td>0</td><td>1</td><td>See (Note 1) for setting of one-rotation signal detection setting at or below 10 min^{-1}.</td></tr>
<tr><td>(c)</td><td>αiCZ SENSOR (serial)</td><td>JYA3</td><td>0</td><td>1</td><td>1</td><td></td></tr>
<tr><td>(d)</td><td>Sensors by other manufacturers (1)
1 Vpp phase A/B of sine-wave,
Phase Z of sine-wave (compatible with phase Z of αiBZ SENSOR)
(see Subsection 11.3.3.1)</td><td rowspan="2">JYA2</td><td>1</td><td>1</td><td>0</td><td>See (Note 1) for setting of one-rotation signal detection setting at or below 10 min^{-1}.</td></tr>
<tr><td>(e)</td><td>Sensors by other manufacturers (2)
1 Vpp phase A/B of sine-wave,
Driver type phase Z
(see Subsection 11.3.3.1)</td><td>1</td><td>1</td><td>1</td><td>See (Note 1) for setting of one-rotation signal detection setting at or below 10 min^{-1}.
Other setting parameters than the ones mentioned on the left-hand side are also necessary for a sensor with an absolute address reference mark.
See B-65280EN for details.</td></tr>
</table>

> **NOTE**
> 1 Normally, a target sensor cannot detect one-rotation signal at a speed of 10 min^{-1} or less. However, the detection is enabled by the following settings.

	#7	#6	#5	#4	#3	#2	#1	#0
4394						ZPHDTC		

ZPHDTC Detection of one-rotation signal at a speed of 10 min^{-1} or less is:
0: Disabled
1: Enabled

Pay attention to the following points when using this setting for the sensors (b) and (d) as mentioned above.

- No.4010#2, 1, 0 = 1, 1, 1 needs to be set.
- The detection position of one-rotation signal may vary depending on the offset variation associated with the change in the temperature of the sensor.

(2) Setting of the number of teeth of motor sensor

Number of teeth (λ/rev)	Word parameter Setting the number of teeth with No.4334	Setting the number of teeth with bit parameter No.4011		
		#2	#1	#0
64	=0	0	0	0
128		0	0	1
256		0	1	0
512		0	1	1
192		1	0	0
384		1	0	1
Flexible number of teeth	>0 Data unit: 1λ/rev Data range: 32 to 32767	*	*	*
	<0 Data unit: -2λ/rev Data range: -16 to -32767 Example: Set "-18000" for the number of teeth of 36000λ/rev.	*	*	*

(3) Setting of the temperature sensor for detecting motor overheat

Type of sensors	Selection of type of temperature sensors		Overheat level	Remarks
	No.4397#4	No.4587	No.4134	Parameters for MAIN spindle
	No.4470#4	No.4787	No.4310	Parameters for SUB spindle
Thermostat	0	0	0	
FANUC standard thermistor	0	0	≠0 (90 to 180°C)	
KTY84-130	1	0 (or 1)	≠0 (90 to 180°C)	
Pt1000	0	2	≠0 (1 to 180°C)	Spindle software: Series 9DAA edition 08 or later

11.3.4.4 Parameter settings for spindle sensor

(1) Setting of the type of spindle sensor

	Spindle sensor	Connector	Sensor type No.4002				Remarks
			#3	#2	#1	#0	
(a)	None (Position control is not performed)	—	0	0	0	0	
(b)	A motor sensor is used (A motor sensor is used for both speed and position control)	JYA2	0	0	0	1	See Section 2 for details on parameter settings of types of sensors and number of teeth.
(c)	αi POSITIONCODER	JYA3	0	0	1	0	The number of teeth is fixed at 1024, parameters No.4003#7, 6, 5, 4 and 4361 for setting the number of teeth are invalidated. See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.
(d)	αi BZ SENSOR αi CZ SENSOR (analog)	JYA4	0	0	1	1	Set parameters No.4003 #7, 6, 5, 4 or No.4361 for setting the number of teeth of the spindle sensor. See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.
(e)	αi CZ SENSOR (serial)	JYA3	0	1	1	0	
(f)	α POSITIONCODER S	JYA4	0	1	0	0	The number of teeth is fixed at 1024, parameters No.4003#7, 6, 5, 4 and 4361 for setting the number of teeth are invalidated. See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.
(g)	Sensors by other manufacturers (1) 1 Vpp phase A/B of sine-wave, Phase Z of sine-wave (compatible with phase Z of αi BZ SENSOR) (see Subsection 11.3.3.1)	JYA4	1	1	0	1	Set parameters No.4003 #7, 6, 5, 4 or No.4361 for setting the number of teeth of the spindle sensor. See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.
(h)	Sensors by other manufacturers (2) 1 Vpp phase A/B of sine-wave, Driver type phase Z (see Subsection 11.3.3.1)	JYA4	1	1	1	0	Set parameters No.4003 #7, 6, 5, 4 or No.4361 for setting the number of teeth of the spindle sensor. See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less. Other setting parameters than the ones mentioned on the left-hand side are also necessary for a sensor with an absolute address reference mark. See B-65280EN for details.
(i)	Sensors by other manufacturers (3) Phase A/B of square-wave Phase Z of square-wave with normal width (see Subsection 11.3.3.1)	<u>JYA3</u>	<u>1</u>	1	1	1	• Set parameters No.4003 #7, 6, 5, 4 or No.4361 for setting the number of teeth of the spindle sensor. • See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.
(j)	Sensors by other manufacturers (4) Phase A/B of square-wave Phase Z of square-wave with narrow width (see Subsection 11.3.3.1)	JYA3	1	1	0	0	• Set parameters No.4003 #7, 6, 5, 4 or No.4361 for setting the number of teeth of the spindle sensor. • See (Note 1) for detection settings for one-rotation signal at 10 min^{-1} or less.

	Spindle sensor	Connector	Sensor type No.4002 #3	#2	#1	#0	Remarks
(k)	Sensors by other manufacturers (5) α interface (2-pair communication)	JYA3	0	1	0	1	
(l)	Sensors by other manufacturers (6) α*i* interface (1-pair communication)	JYA3	0	1	1	0	

NOTE

1 Normally, a target sensor cannot detect one-rotation signal at a speed of 10 min^{-1} or less. However, the detection is enabled by the following settings.

	#7	#6	#5	#4	#3	#2	#1	#0
4394						ZPHDTC		

ZPHDTC Detection of one-rotation signal at a speed of 10 min^{-1} or less is:
0: Disabled
1: Enabled

Pay attention to the following points when using this setting for the sensors (d) and (g) as mentioned above.

- No.4002#3, 2, 1, 0=1, 1, 1.0 needs to be set.
- The detection position of one-rotation signal may vary depending on the offset variation associated with the change in the temperature of the sensor.

(2) Setting of the number of teeth of spindle sensor
(2-1) Spindle sensors (a) to (j)

Number of teeth (λ/rev)	Word parameter Setting the number of teeth with No.4361	Setting the number of teeth with bit parameter No.4003 #7	#6	#5	#4
256	=0	0	0	0	0
128		0	0	0	1
512		0	1	0	0
64		0	1	0	1
768		1	0	0	0
1024		1	0	0	1
384		1	1	0	0
Flexible number of teeth	>0 Data unit: 1λ/rev Data range: 64 to 32767	*	*	*	*
	<0 Data unit: -2λ/rev Data range: -32 to -32767 Example: Set "-18,000" when the number of teeth of a sensor is 36,000.	*	*	*	*

(2-2) Spindle sensor (k)

Resolution format	Setting of bit parameter No.4003			
	#7	#6	#5	#4
Standard resolution format	0	0	0	0
High resolution format A	0	0	0	1
High resolution format B	0	0	1	0

(2-3) Spindle sensor (l)

Format	Setting of word parameter No.4361
Types of number of binary scale	8192

12 LEAKAGE DETECTION FUNCTION

Chapter 12, "LEAKAGE DETECTION FUNCTION," consists of the following sections:

12.1 OVERVIEW

The αi-B amplifiers contain a leakage detection function which can detect any sign of insulation degradation of a motor or power line automatically with a high degree of accuracy.
This function enables the automatic measurement of the ground insulation resistance of the motor and power cable using the voltage charged in the DC link of a servo amplifier immediately after the servo amplifier enters the emergency stop state from the servo-on state.
If an insulation resistance of 10 MΩ or less is detected, this function issues a warning.

12.2 USAGE OF THE LEAKAGE DETECTION FUNCTION

(1) To use the leakage detection function, make the following parameter settings.

	Parameter No.	Leakage detection function enables parameter (for each axis)
Servo amplifier	No. 2429#0	0: SV Leakage detection function disabled (default)/ 1: Enabled
Spindle amplifier	No. 4549#0	0: SP Leakage detection function disabled (default)/ 1: Enabled

(2) To measure insulation resistance, the DC link voltage must be charged. So, release the emergency stop state for at least 5 seconds before measurement. When the machine operated normally, the above release of the emergency stop state is not required.

(3) After the DC link voltage is charged, the function measures insulation resistance when the emergency stop signal (*ESP) input to connector CX4 on the Power Supply is set to the emergency stop state.

> ⚠ **CAUTION**
>
> 1 The function does not measure insulation resistance when:
>   (1) The servo amplifier enters the emergency stop state again before the ready state.
>   (2) The emergency stop state is released while insulation degradation check operation is being performed.
>
> 2 If operation is continued for a long time even after insulation degradation is detected, further insulation degradation may be caused and the machine may stop due to operation of the ground fault interrupter, an alarm, or the like. If insulation degradation is detected, replace the relevant motor or power cable as soon as possible.

> ⚠ **CAUTION**
>
> 3 Insulation resistance cannot be measured precisely while the motor is rotating. So, this function does not measure insulation resistance while the motor is rotating even in the emergency stop state. (Such as when the spindle motor is coasting)

> ⚠ **WARNING**
>
> This function measures insulation resistance when the emergency stop signal (*ESP) input to connector CX4 on the Power Supply.
> The voltage charged in the DC link is applied to the motor while insulation resistance is measured.
> To prevent electric shock, do not touch the motor during measurement.
> Insulation resistance is measured during 6 seconds after the servo amplifier becomes the emergency stop state.

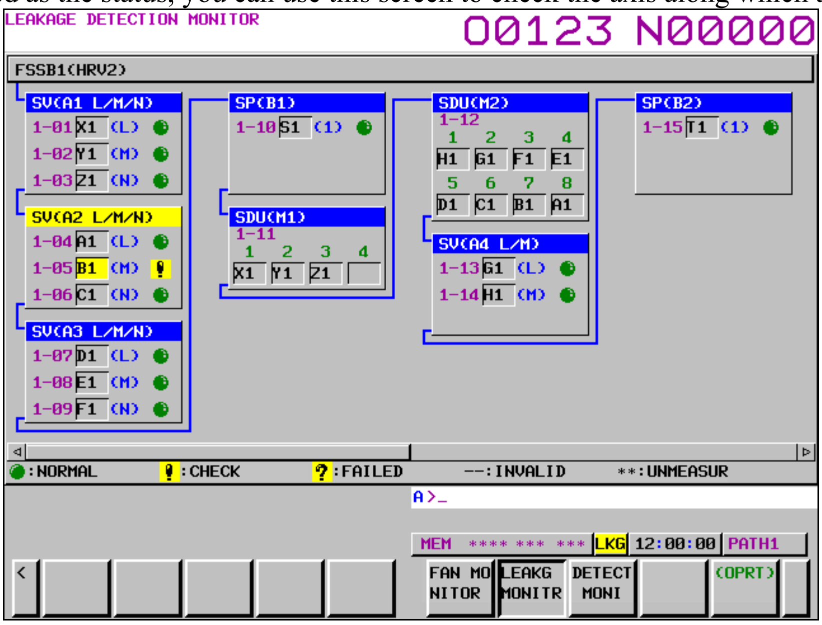
12.3 CHECKING INSULATION DEGRADATION

1 Press function key SYSTEM.

2 Press the continuous menu key ▷ until soft key [MAINTEMONITR] appears.

3 Press the soft key [MAINTEMONITR].

Press soft key [LEAKG MONITR] to display the LEAKAGE DETECTION MONITOR screen.
On this screen, you can check insulation degradation information for servo and spindle amplifiers. When "LKG" is displayed as the status, you can use this screen to check the axis along which an error occurred.



Insulation degradation status

●	: NORMAL	Insulation resistance is normal.
!	: CHECK	Insulation resistance is degraded. Inspect the servo or spindle amplifier.
?	: FAILED	The measurement of insulation resistance was failed. Inspect the servo or spindle amplifier.
--	: INVALID	The servo or spindle amplifier does not support the measurement of insulation resistance.
**	: UNMEASUR	Insulation resistance is not measured.

For details, refer to diagnostic data Nos. 1700, 1701 (servo), 1702, and 1703 (spindle).

NOTE
1. If the FSSB is not connected properly, this screen is not displayed normally.
2. This screen is not automatically updated when displayed. To update the information, first display another screen, then display this screen again.

12.4 ACTION

If insulation degradation is detected, separately measure insulation resistance of the motor and power cable with a mega-ohmmeter and determine whether insulation degradation occurred in the motor or power cable.
Then, replace the faulty motor or power cable.

12.5 CHANGING WARNING LEVELS

Warning levels of insulation resistance can be freely changed with the following editions of the software. (The warning model was fixed at 10 MΩ in previous editions.)

[Compatible editions of software]

Servo control software

30*i* /31*i* /32*i* /35*i*-B	• Series 90G0 edition 19.0 or later, Series 90G3 edition 05.0 or later • Series 90J0 edition 01.0 or later, Series 90J3 edition 01.0 or later • Series 90K0 edition 01.0 or later
Power Motion *i*-A	• Series 90GP edition 02.0 or later • Series 90JP edition 01.0 or later
0*i*-F	• Series 90M0 edition 02.0 or later, Series 90M8 edition 02.0 or later • Series 90L0 edition 01.0 or later, Series 90M8 edition 01.0 or later
0*i*-D	• Series 90C8 edition 04.0 or later, Series 90E8 edition 04.0 or later
0*i* Mate-D	• Series 90H0 edition 02.0 or later

Spindle control software
- Series 9DA0 edition 19(S) or later
- Series 9DB0 edition 01(A) or later

[Parameters]

Servo

2464	Insulation degradation detection function: Warning level

[Unit] 0.1 MΩ
[Data range] 6 to 1000
Value "0" is treated as 10.0 MΩ. A warning is issued when the measured insulation resistance is less than the specified level. An invalid parameter alarm is issued when a parameter out of the setting range is specified.

Spindle

4664	Insulation degradation detection function: Warning level

[Unit] 0.1 MΩ
[Data range] 6 to 1000
Value "0" is treated as 10.0 MΩ. A warning is issued when the measured insulation resistance is less than the specified level. An invalid parameter alarm is issued when a parameter out of the setting range is specified.

13 POWER FAILURE DETECTION FUNCTION

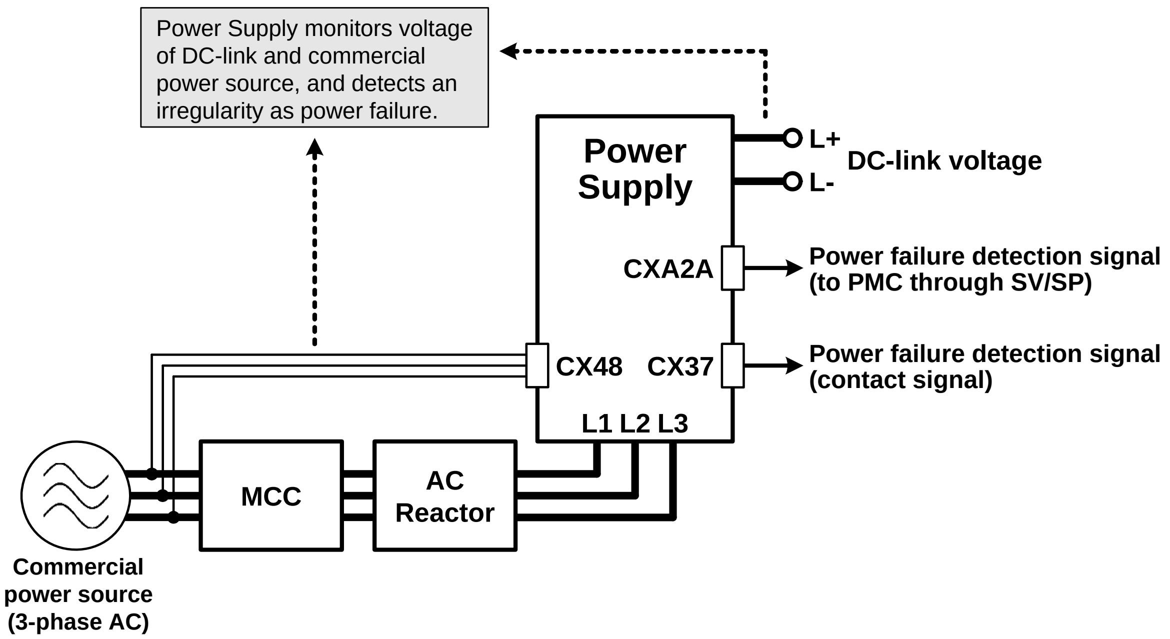
Chapter 13, "POWER FAILURE DETECTION FUNCTION," consists of the following sections:

13.1 OVERVIEW

The αiPS-B monitors the DC-link voltage and commercial power source voltage and detects an irregularity (voltage drop) as a power failure.

The power failure status detected by the αiPS-B is output to external devices via contact signal and PMC signals.

The feed axes can be stopped and be retracted according to these signals to prevent damage to the machine due to an irregularity of commercial power source.



> **NOTE**
> 1 For αiPS-B, additional hardware component (relay) is required to use the power failure detection function and MCC shutdown test of the Dual Check Safety function together. For αiPS-B, these functions can be used together without additional hardware component. For details, see Section 13.2, "POWER FAILURE DETECTION CONDITIONS."

> **NOTE**
>
> 2 When the Quick Stop Function or Retract Function at a power failure is used, the Power Failure Backup Module is used and a power failure is detected by that module. In this case, do not use the power failure detection signals detected by the αiPS-B main body. For details, see APPENDIX I, "POWER FAILURE BACKUP MODULE MODEL B."

13.2 POWER FAILURE DETECTION CONDITIONS

The Power Supply for the αiPS-B when any of the following conditions is satisfied:

(1) Voltage drop of DC-link.
(2) Voltage drop of commercial power source (3-phase AC).
(3) Open phase of commercial power source (3-phase AC)

Once the αiPS-B detects a power failure, it keeps the status for at least 20 msec.
Power Supply halts regeneration operation immediately when a power failure is detected during power source regeneration.

> **NOTE**
>
> 1 It's possible to change the detection levels for conditions (1) and (2) (Power Supply software edition 9G00/08.0 or later) by parameter settings.
> For details, see Chapter 15, "PARAMETERS FOR POWER SUPPLIES."
>
> 2 Open phase of commercial power source (three-phase AC) leads to a change in the behavior of αiPS-B according to the situations as below.
>
> (1) Emergency stop state
> Power failure detection operation is stopped.
>
> (2) αiPS-B pre-charge after emergency stop is released
> The alarm message screen of the CNC unit displays a message "SV0442 PS Pre-charge Error" or "SP9033 PS Pre-charge Error."
>
> (3) Light load of αiPS-B after emergency stop is released
> Normal operation is continued as much as possible and no alert of open phase is displayed on the CNC screen and LED of αiPS-B. "00" and "14" may be alternately displayed on the LED of αiPS-B during the acceleration and deceleration of the motor.
>
> (4) Heavy load of αiPS-B after emergency stop is released
> Power failure is detected and the alarm message screen of the CNC unit displays a message "SV0442 PS Pre-charge Error" or "SP9004 PS Pre-charge Error."

The αiPS-B disables power failure detection when any of the following conditions is satisfied:

(1) The machine becomes the emergency stop state.
⇒ *ESP:X8.4=0
(2) The servo axis is not in the ready state.
⇒ SA:Fn000#6=0
(3) The emergency stop signal for the spindle is set to "0".
⇒ *ESPA:Gn071#1=0, *ESPB:Gn075#1=0, *ESPC:Gn205#1=0, *ESPD:Gn267#1=0
(4) The MCC shutdown test of the dual check safety function is being conducted.
⇒ OPT:Gn191#2=1

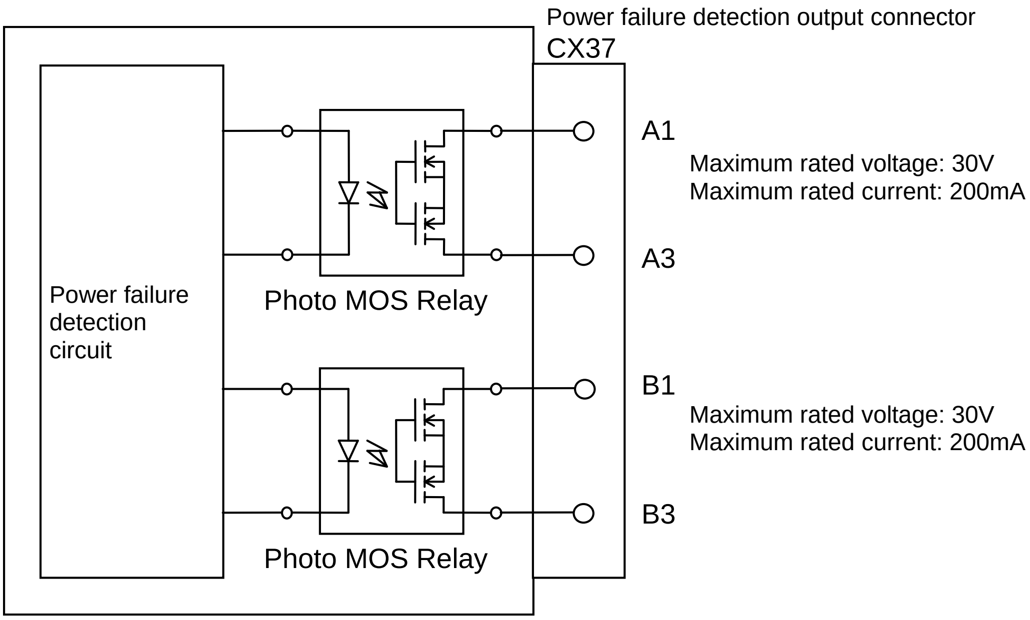
At this time, the power failure detection signals are in the "normal state" (contact signal output: Closed, PMC signal output: "1").

13.3 POWER FAILURE DETECTION SIGNALS

The power failure status detected by the α*i*PS-B is output to external devices via contact and PMC signals.

13.3.1 Contact Signal

The power failure status is output from connector CX37 as a contact signal. The contact output is:
Closed normally
Open when a power failure is detected



Connector specification: Connector manufactured by Tyco Electronics AMP
Housing: 1-1318119-3
Contact: 1318107-1

NOTE
1. The same contact signal is output from the two channels.
2. When the Power Failure Backup Module Model B is used, use the power failure signal output from that Backup Module Model B. Do not use this signal. For details, see APPENDIX I.

13.3.2 PMC Signal

- **Address of signal output via servo amplifier**

30*i*-B	#7	#6	#5	#4	#3	#2	#1	#0
Fn374	XPFL8	XPFL7	XPFL6	XPFL5	XPFL4	XPFL3	XPFL2	XPFL1

*** The number at the end of each signal indicates the number of the corresponding servo axis.**

- **Address of signal output via spindle amplifier**

	30*i*-B	#7	#6	#5	#4	#3	#2	#1	#0
1st spindle	Fn307							XPFLA	
2nd spindle	Fn309							XPFLB	
3rd spindle	Fn311							XPFLC	
4th spindle	Fn313							XPFLD	

XPFL1 to 8 Power failure detection signal (for servo axes)
XPFLA Power failure detection signal (for 1st spindle)
XPFLB Power failure detection signal (for 2nd spindle)
XPFLC Power failure detection signal (for 3rd spindle)
XPFLD Power failure detection signal (for 4th spindle)

0: Power failure status
1: Normal

The power failure status detected by the α*i*PS-B is output as a DO signal via the servo/spindle amplifier.

NOTE

1 There is a transfer lag of up to 12 msec until the power failure status is notified to PMC after the α*i*PS-B detects a power failure.
2 The output of this signal is undefined until the communication between the α*i*PS-B and PMC is established. Build a sequence so that this signal is ignored until the servo ready signal (SA: Fn000.6) is set to "1" for the first time after power on.
3 When the Power Failure Backup Module Model B is used, use the power failure signal output from that Backup Module Model B. Do not use this signal. For details, see APPENDIX I.

13.4 PROTECTION FUNCTIONS USING POWER FAILURE DETECTION SIGNALS

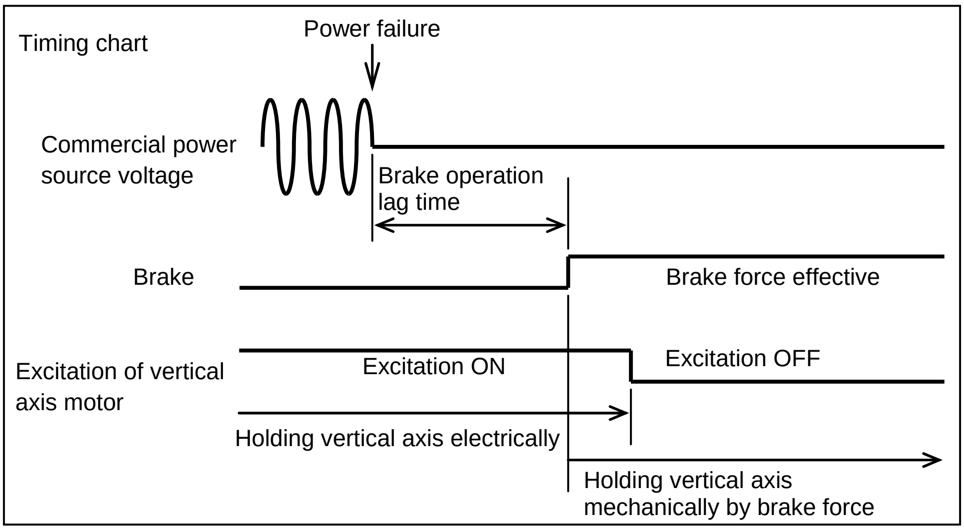
Protection functions using power failure detection signals are listed below:

(1) Function for Preventing Vertical Axes from Falling (Subsection 13.4.1)
(2) Quick Stop Function (Subsection 13.4.2)
(3) Retract Function (Subsection 13.4.3)

13.4.1 Function for Preventing Vertical Axes from Falling

This function uses power failure signals detected by the Power Supply for the α*i*PS-B to prevent vertical axes from falling at a power failure. The following operations must be performed for it.

(1) Apply the brake promptly after a power failure occurs.
(2) Keep vertical axis motors excited until the brake works after a power failure occurs.



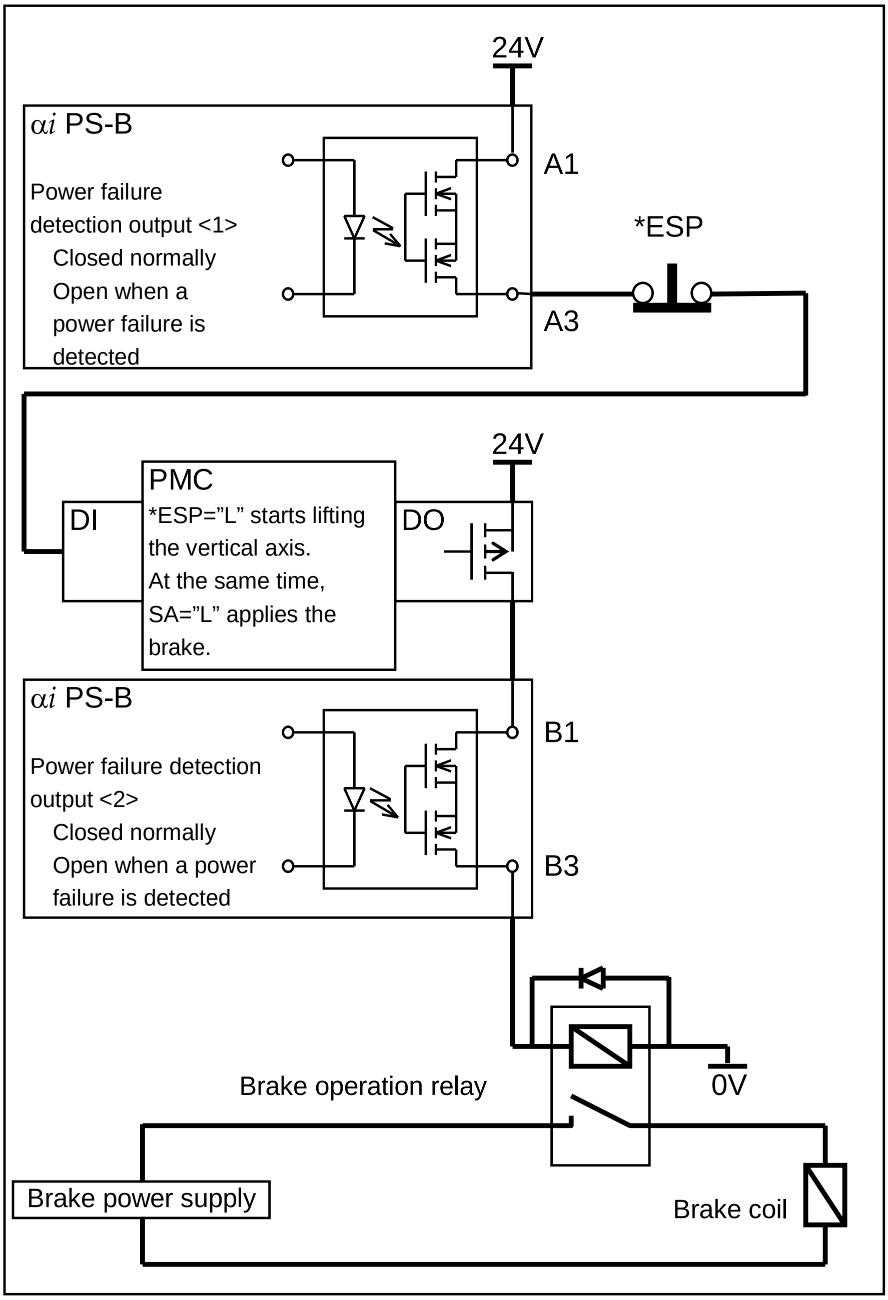
To keep the control power supply (24 VDC) for the CNC and Servo Amplifiers until the mechanical brake works after a power failure occurs, use an uninterruptible power supply unit (UPS).

13.4.1.1 Procedure

(1) Configure a brake circuit that operates promptly after a power failure occurs. (Subsection 13.4.1.2)
(2) Keep vertical axis motors excited until the brake works after a power failure occurs. (Subsection 13.4.1.3)
  - Check the control power supply maintaining time.
  - Set parameters.
(3) Confirm the effect of the function. (Subsection 13.4.1.5)

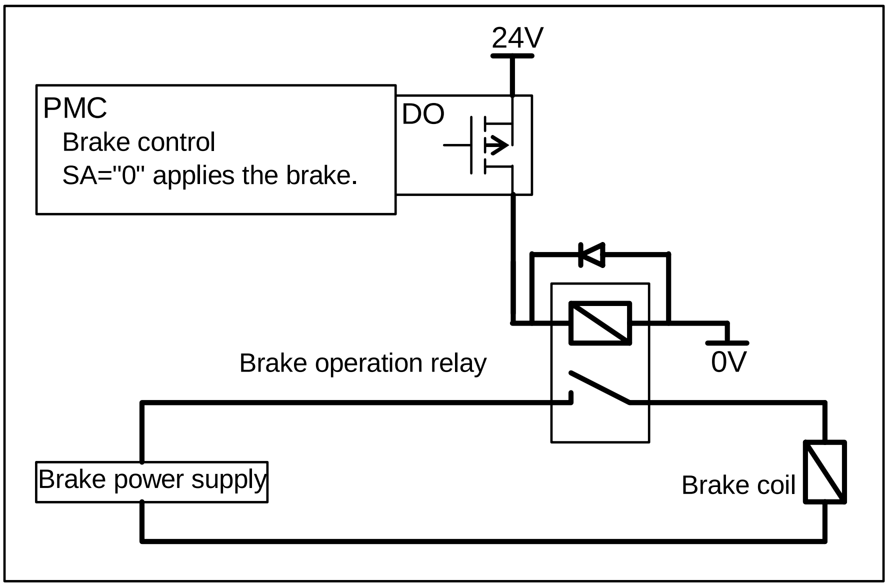
13.4.1.2 Brake circuit

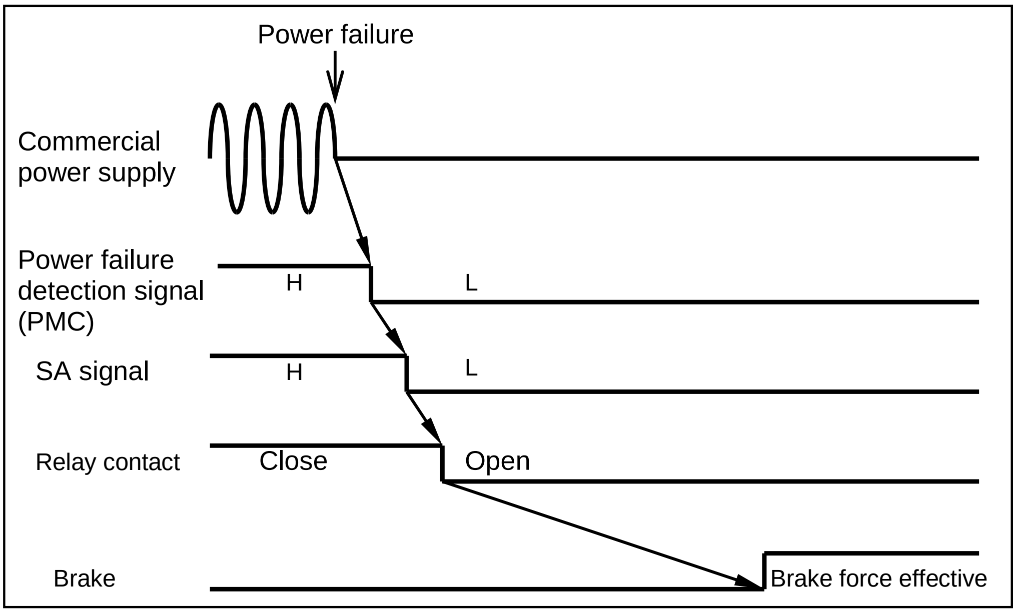
(1) When a contact signal is used as the power failure detection signal
The emergency stop signal (*ESP) and the brake operation relay must be operated together on a power failure detection output from the α*i*PS-B.
Configure a brake circuit as shown below.



For details of the specification of the brake operation relay contacts, refer to "FANUC AC SERVO MOTOR α*i*-B/α*i* series DESCRIPTIONS" (B-65262EN). Connect a surge suppression element such as a diode in parallel to the relay coil to suppress voltage surges that may occur when the relay is turned off.

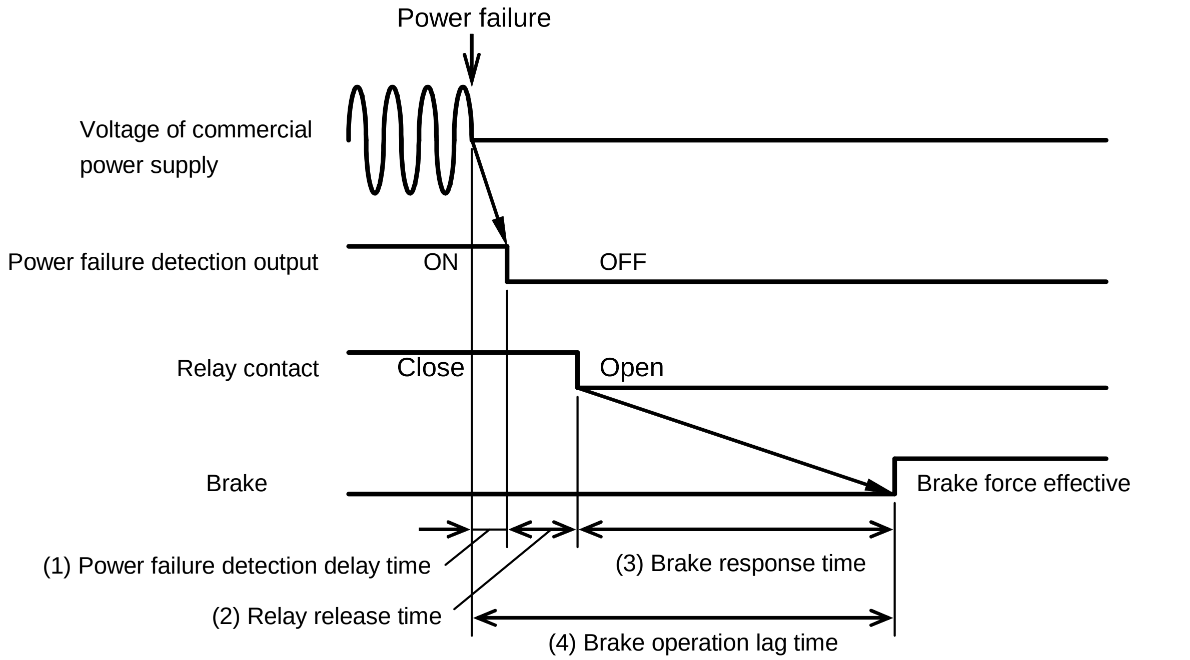
(2) When PMC signals are used as power failure detection signals
It is not necessary to modify the brake circuit hardware configuration.
Set SA="0" when a power failure detection signal is changed from 1 to 0.





Time from the occurrence of a power failure until the brake operates

The "brake operation lag time" from the occurrence of a power failure is the sum of the "power failure detection delay time," "relay release time," and "brake response time."



(1) Power failure detection delay time :
Time until a power failure detection signal is output and the relay coil voltage is turned off after a power failure occurs

(2) Relay release time :
Time from cutting off the rated voltage supplied to the relay coil until the relay contact is turned off ("a contact " becomes open)

(3) Brake response time :
Time from cutting off the rated voltage supplied to the brake coil until the brake force becomes effective

(4) Brake operation lag time : Time from a power failure until the brake force becomes effective

Relay release time

Select a relay with a short contact release time.
Example)
G2R by Omron (coil voltage of 24 VDC, with a built-in diode): Release time of 20 msec or less

Brake response time

Listed below are the specifications of the built-in brake of each motor model. Servo motors with "-B" and without "-B" have the same built-in brake.

Motor model	α*i*S 2-B, α*i*S 4-B α*i*S 8-B, α*i*S 12-B α*i*F 1-B, α*i*F 2-B α*i*F 4-B, α*i*F 8-B (including HV model)	α*i*S 22-B to α*i*S 40-B α*i*F 12-B, α*i*F 40-B (including HV model) * Standard brake	α*i*S 40-B to α*i*S 60-B α*i*S 50 FAN-B α*i*S 60 FAN-B α*i*F 40-B, α*i*F 40FAN-B (including HV model) * High-torque brake	α*i*S 100-B α*i*S 200-B (including HV model, with fans)
Response time (max)	20ms	30ms	50ms	60ms

Brake operation lag time

Given below is an example of calculating the time that elapses from the occurrence of a power failure until the brake operates.

Conditions

(1) Power failure detection delay time → 10msec
(2) Relay (G2R by Omron) release time → 20msec
(3) Brake (built-in brake for α*i* F8-B) response time → 20msec

Result 10msec + 20msec + 20msec = 50msec

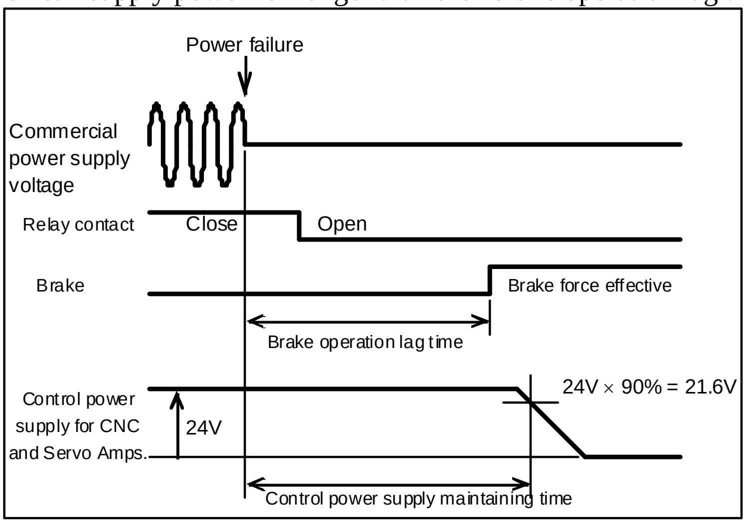
13.4.1.3 Method for keeping vertical axis motors excited

To keep vertical axis motors excited after a power failure occurs, the following conditions must be satisfied:

(1) The control power supply for the CNC and Servo Amplifiers is kept on.
(2) Parameters for enabling the brake control function are set.

Keeping the control power supply on

To keep vertical axis motors excited after a power failure occurs, the control power supply for the CNC and Servo Amplifiers must be kept on for longer than the "brake operation lag time."
To keep the control power supply (24 VDC) for the CNC and amplifier on until the mechanical brake works after a power failure occurs, use an uninterruptible power supply unit (UPS) or a power supply unit (24-VDC output) which can supply power for longer than the "brake operation lag time."



* For details of the brake operation lag time, see Subsection 13.4.1.2.

Parameter settings

Set parameters for the brake control function.

(1) Brake control function bit (BRKC): Set this bit to the brake control function enable state.

(2) Brake control timer: Set a value not less than the brake operation lag time (around 100msec).
(3) Emergency stop timer in the αi amplifier (ESPTM1, ESPTM0): Set a value longer than the brake control timer.

CNC	Parameter No.			
	BRCK	Brake control timer	ESPTM1	ESPTM0
FS15*i*	No.1883 #6	No.1976	No.1750 #6	No.1750 #5
FS16*i*, 18*i*, 21i, 30*i*, 31*i*, 32*i*, 0*i*	No.2005 #6	No.2083	No.2210 #6	No.2210 #5
Sample setting	1	100	0	1

For details, see FANUC AC SERVO MOTOR αi series PARAMETER MANUAL (B-65270EN).

NOTE
If a multi-axis amplifier (such as a 2- or 3-axis amplifier) is used for vertical axes, set the above parameters for all axes assigned to the multi-axis amplifier.

13.4.1.4 Cautions

(1) If a power failure occurs during heavy cutting, it might be impossible to prevent vertical axes from falling. This is because the load on the motor is high and a DC-link low voltage alarm is issued before the brake works. To prevent vertical axes from falling also in these situations, connect the Power Failure Backup Module Model B and a capacitor module. For more details, see APPENDIX I.

(2) Even if the function is used to prevent vertical axes from falling, a vertical axis falls through the distance corresponding to the backlash of the brake (up to 20 μm in case of using a ball screw pitch of 10 mm). If this distance cannot be ignored, the vertical axis lifting function at emergency stop can be used to lift it through that distance before a complete stop. For details of this function and parameter settings, refer to the parameter manual (B-65270EN).

13.4.1.5 Confirming effect

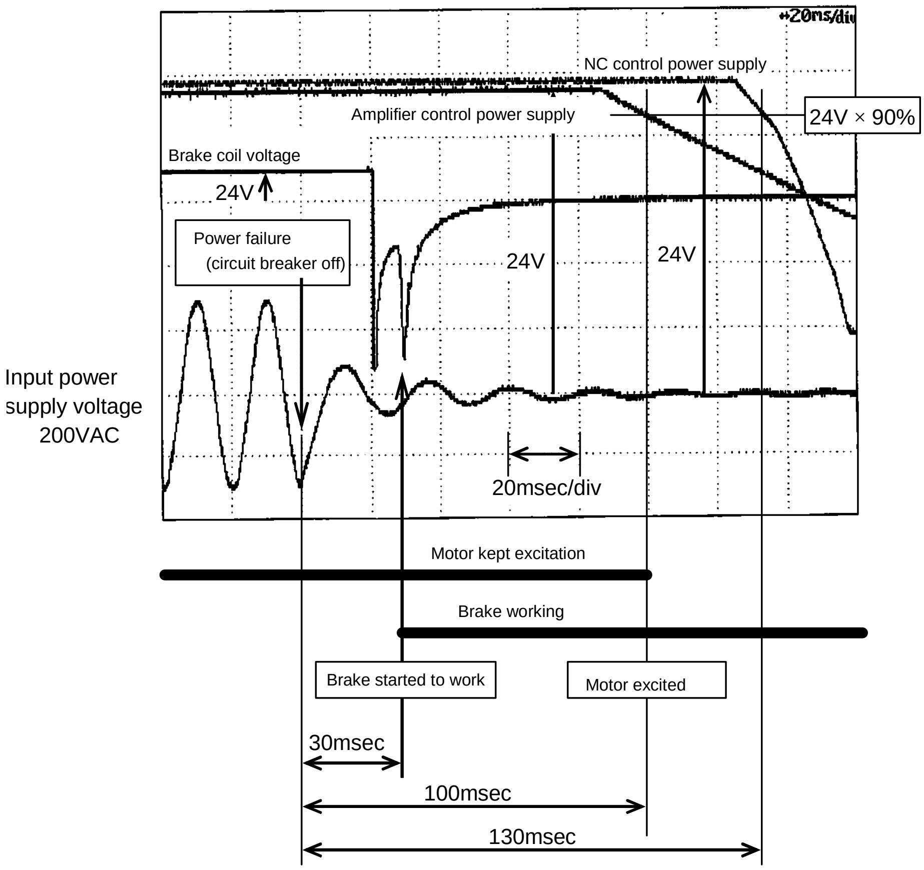
The following procedure can be used to check whether a measure taken to prevent vertical axes from falling is effective:
(1) Keep a vertical axis at a halt and record its absolute coordinates.
(2) Turn the machine main circuit breaker off to cause a power failure.
(3) Restart the machine, check the absolute coordinates of the vertical axis to see whether it has fallen or not.
* The vertical axis will fall through the distance corresponding to the backlash of the brake (up to 20 μm in case of using a ball screw pitch of 10 mm).

[Measure for a falling vertical axis when the circuit breaker is turned off]
If a vertical axis falls when the circuit breaker is turned off, observe the waveforms as described below to find causes:
(1) Brake coil voltage → Observe the voltage between both ends of the brake coil.
(2) Amplifier control power supply voltage → Observe the output voltage of the 24-V power supply to the amplifier.
(3) Control power supply voltage supplied to the NC → Observe the output voltage of the 24-V power supply for the NC.
(4) Input power supply voltage → Observe the AC input power voltage with using an insulated probe.

If the control power for the amplifier or NC drops before the brake works, take action listed below:

- Change the power failure detection relay for operating the brake coil (review the release time specification).
- Prolong the maintaining time by increasing the capacity of the control power supply (reducing the load ratio).

The following figure shows examples of waveforms observed when a measure taken to prevent vertical axes from falling works normally.



13.4.2 Quick Stop Function

The Quick Stop Function decelerates and stops the machine with a time constant not greater than that used for normal control to prevent damage to the machine due to overrun if a power failure occurs in the rapid traverse mode. The function can also decelerate and stop the spindle at a power failure.Power Failure Backup Module is required for this function. For details, see Appendix I.

NOTE
The Quick Stop Function uses PMC signals instead of the power failure signal (CX37 output) detected by αiPS-B.

13.4.3 Retract Function

The Retract Function retracts the workpiece and tool to the positions where they do not interfere with each other while keeping synchronization if a power failure occurs during synchronized operation. The Power Failure Backup Module Model B is required for this function. For more details, see APPENDIX I.

NOTE
PFB-B uses power failure signals detected by αiPS-B.

14 SAFE TORQUE OFF (STO) FUNCTION

Chapter 14, "SAFE TORQUE OFF FUNCTION (hereinafter called the STO function)," consists of the following sections:

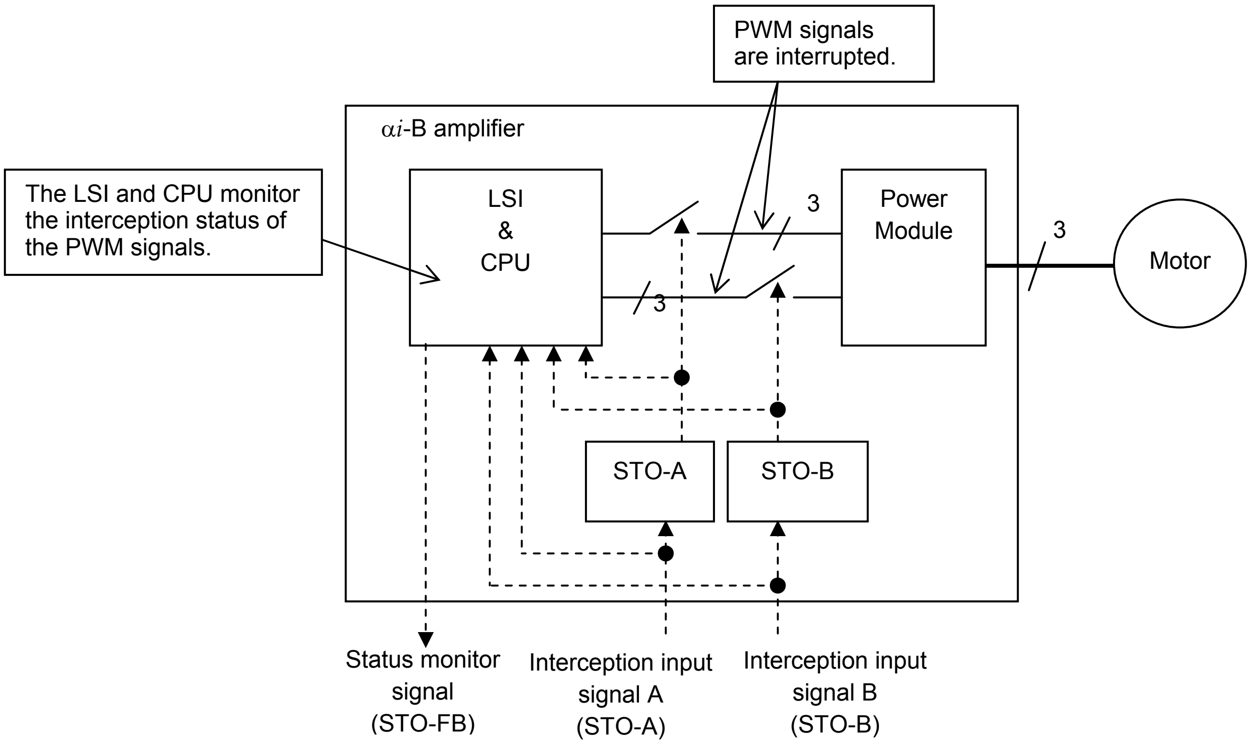
14.1 INTERCEPTION MODE

The interception modes provided by the servo amplifier with additional functions and the settings for switch SW1 are presented in the following table.
It is impossible to individually cut off the power of M-axis and N-axis because their interception input signals are interlocked.

Interception mode of STO	Number of axes to intercept	SW1 - 1, 2	SW1 - 3, 4	SW1 - 5, 6
Cut off L-axis only	1	OFF	ON	ON
Cut off M-axis only	1	ON	OFF	ON
Cut off N-axis only	1	ON	ON	OFF
Simultaneously cut off L-axis and M-axis	2	OFF	OFF	ON
Simultaneously cut off L-axis and N-axis	2	OFF	ON	OFF
Simultaneously cut off M-axis and N-axis	2	ON	OFF	OFF
Simultaneously cut off all axes (L, M, and N)	3	OFF	OFF	OFF
Individually cut off L-axis and M-axis	2	OFF	OFF	ON
Individually cut off L-axis and N-axis	2	OFF	ON	OFF
Individually cut off M-axis and N-axis	2	Impossible (M-axis and N-axis cannot be individually cut off)		
Individually cut off L-axis, and simultaneously cut off M-axis and N-axis	3	OFF	OFF	OFF
Individually cut off M-axis, and simultaneously cut off L-axis and N-axis	3	Impossible (individual interception of M-axis combined with simultaneous interception of L-axis and N-axis is impossible)		
Individually cut off N-axis, and simultaneously cut off L-axis and M-axis	3	Impossible (individual interception of N-axis combined with simultaneous interception of L-axis and M-axis is impossible)		
Individually cut off all three axes	3	Impossible (individual interception of all three axes is impossible)		

14.2 OVERVIEW

During setup of a machine tool, the operator may attach or remove the workpiece in the machining area while the protection door is open. To ensure the safety of this work, conventionally, it is necessary to place the machine tool in the emergency stop state to cut off the power to the feed axes or install a device such as a magnetic contactor between the servo amplifier and servo motor to cut off the power.
αi-B amplifier supports the STO function in compliance with IEC61800-5-2, making it possible to safely cut off power of servo axes.
By inputting two external interception signals (STO-A and STO-B) to the servo amplifier, the PWM signals are turned off in the servo amplifier. The off status of the PWM signals is monitored in the servo amplifier and the status monitor signal (STO-FB) is output. The power to the servo amplifier can be cut off safely by monitoring the STO-A, STO-B, and STO-FB signals.



(*) The safety of the system is to be checked finally by the machine tool builder.

⚠ WARNING

When the power output is cut off using the STO function, the dynamic brake module does not operate.
When there is external force or the servo motor is used for a vertical axis, the motor runs. In this case, an external mechanical brake is required when the related axis must be held.

14.3 SERVO AMPLIFIERS SUPPORTING THE STO FUNCTION

14.3.1 Servo Amplifier

The following table lists the servo amplifiers that support the STO function.

Servo amplifiers and their editions that support the STO function

Specification	Edition
A06B-6240-H101 to -H106	Edition B or later
A06B-6240-H109	Edition A or later
A06B-6240-H121 to -H129	Edition A or later
A06B-6240-H201 to -H211	Edition B or later
A06B-6240-H301 to -H308 (*)	Edition B or later
A06B-6240-H321 to -H328	Edition A or later
A06B-6290-H101 to -H105	Edition B or later
A06B-6290-H106 to -H110	Edition A or later
A06B-6290-H121 to -H130	Edition A or later
A06B-6290-H201 to -H209	Edition B or later
A06B-6290-H301 to -H305 (*)	Edition B or later
A06B-6290-H321 to -H325	Edition A or later

(*) The STO function is not available for the N-axis of a 3-axis amplifier.

14.3.2 Servo Software

The following series and editions of servo software are required to use the STO function:

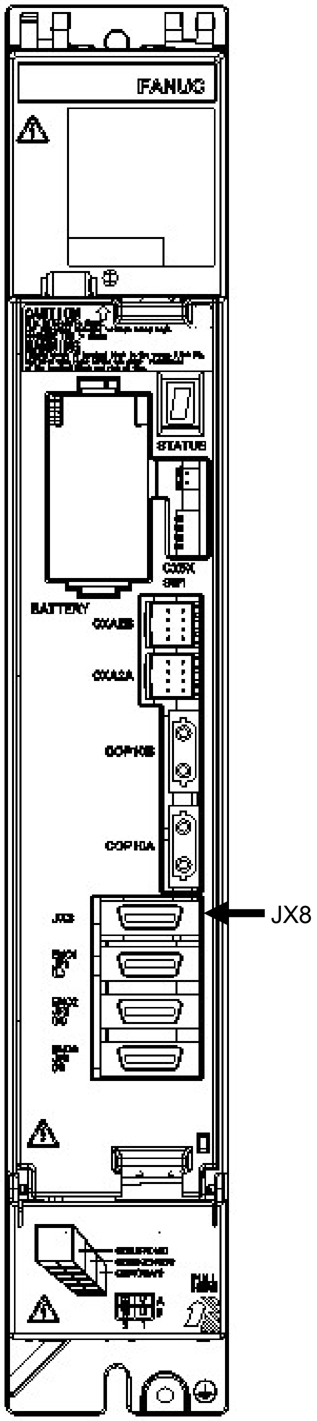
30*i* /31*i* /32*i* /35*i*-B	• Series 90G0 edition 03.0 or later, Series 90G3 edition 01.0 or later • Series 90J0 edition 01.0 or later, Series 90J3 edition 01.0 or later • Series 90K0 edition 01.0 or later
Power Motion *i*-A	• Series 90GP edition 02.0 or later • Series 90JP edition 01.0 or later
0*i*-F	• Series 90M0 edition 02.0 or later, Series 90M8 edition 02.0 or later • Series 90L0 edition 01.0 or later, Series 90M8 edition 01.0 or later

14.4 INPUT/OUTPUT SIGNALS

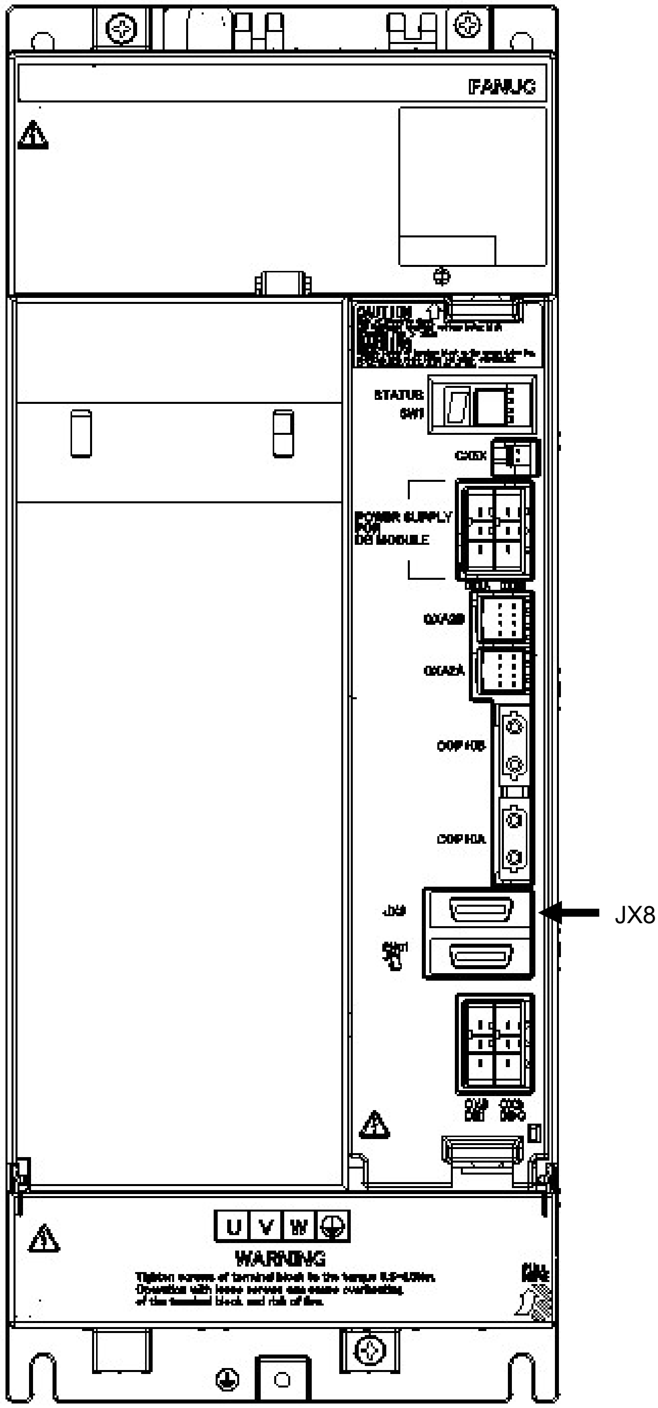
14.4.1 Connector Used for the STO Function

Location of the connector

Connector "JX8" is used for inputting and outputting the STO function signals.



60/90 mm-wide model



150 mm-wide model

14.4.2 Connector Specification

Crimp type

Ordering number		A06B-6078-K223
Manufacturer		Hirose Electric Co., Ltd.
Manufacturer part number	**Connector**	FI30-20S
	Housing	FI-20-CVS2 (plastic)

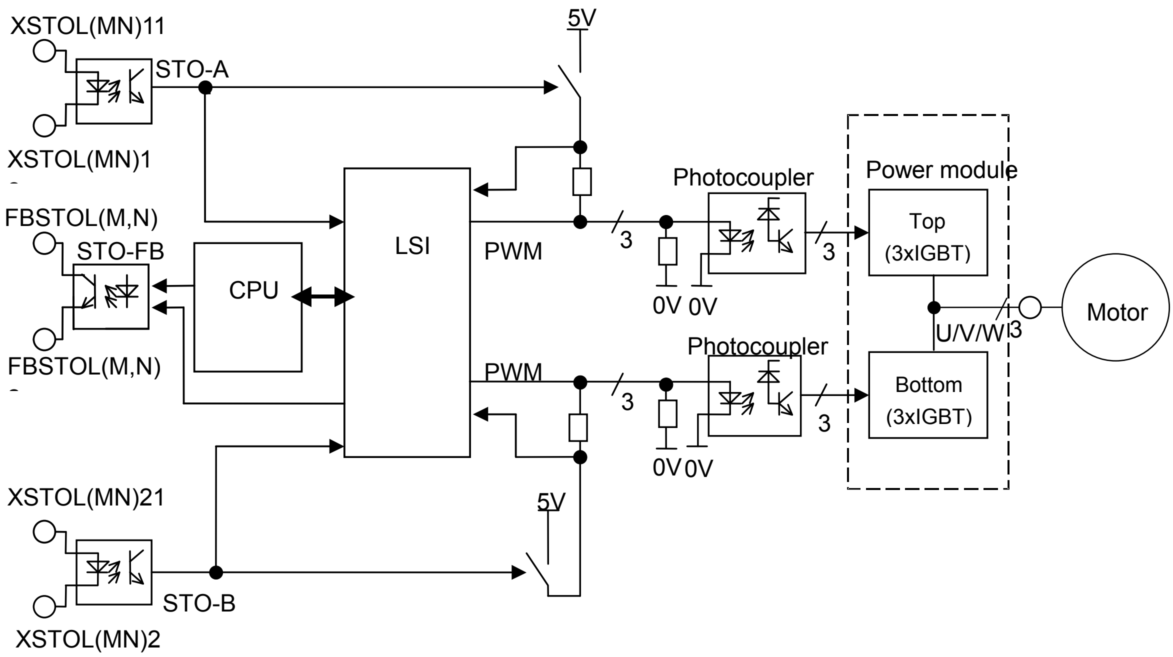
Soldering type

Ordering number		A06B-6078-K224
Manufacturer		Hirose Electric Co., Ltd.
Manufacturer part number	**Connector**	FI40B-20S
	Housing	FI-20-CVS2 (plastic)

14.4.3 Input/Output Specifications

Block diagram

A block diagram of the STO function is shown below. M-axis and N-axis share interception input signals.



Connector pin arrangement

The pin arrangement of connector "JX8" is shown below.

Pin number	01	02	03	04	05	06	07	08	09	10
Signal name	XSTOL 12	XSTOL 22	XSTOL 11	XSTOL 21	FBSTOM 2	-	FBSTOL 2	FBSTOM 1	-	FBSTOL 1
Pin number	11	12	13	14	15	16	17	18	19	20
Signal name	XSTOMN 12	-	XSTOMN 11	-	-	XSTOMN 22	XSTOMN 21	FBSTON 2-	FBFSTN 1-	-

Input specifications (interception input signals: STO-A, STO-B)

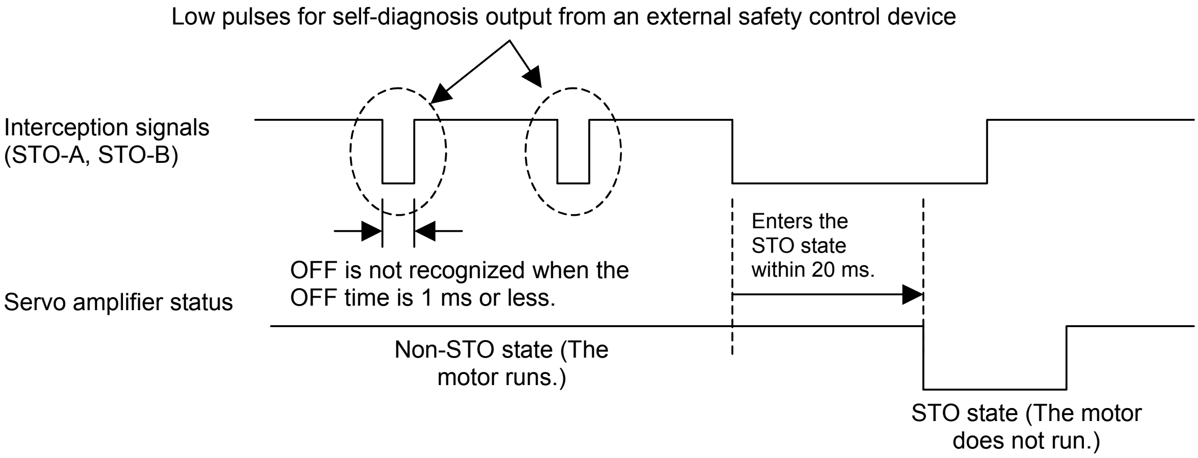
For operation of each input signal, see the table below.

Signal name		Operation
First axis STO-A Interception input	XSTOL11 XSTOL12	This input signal controls the STO function for the first axis. The driving power supply to the upper arm of the first axis power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
First axis STO-B Interception input	XSTOL21 XSTOL22	This input signal controls the STO function for the first axis. The driving power supply to the lower arm of the first axis power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
Second and third axes STO-A Interception input	XSTOMN11 XSTOMN12	This input signal controls the STO function for the second and third axes. The driving power supply to the upper arm of the second/third-axis power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
Second and third axes STO-B Interception input	XSTOMN21 XSTOMN22	This input signal controls the STO function for the second and third axes. The driving power supply to the lower arm of the second/third-axis power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.

For the electrical specifications of each input signal, see the table below.

Item	Characteristics	Note
Input current	3.5mA (Typ.)	Per channel
ON input voltage range	18 to 26V	
OFF input voltage range	0 to 4V	
Pulse width	At least 20 ms	A pulse width of 1 ms or less is not recognized.

When the STO function is used, the 24-V supply to STO-A and STO-B is turned on and off from a safe control device (such as a safety PLC) on the machine to cut off the power to the servo amplifier.
When an external safety control device such as a light curtain is connected, its safety output signals may contain a low pulse for self-diagnosis.
To prevent the STO function of the servo amplifier from malfunctioning due to the low pulse for self-diagnosis output from any external safety control device, the STO-A and STO-B input circuit on the servo amplifier has an internal filter for removing the low pulse for self-diagnosis so that the OFF state is not recognized if the OFF time is 1 ms or less.
To surely place the servo amplifier in the STO state, it is necessary to input the OFF state of STO-A and STO-B continuously for at least 20 ms. If the OFF time does not exceed 20 ms, it may not be recognized.
To cut off the power to the motor, be sure to turn the two signals, STO-A and STO-B, off.



Output specifications (status monitor signal: STO-FB)

αi-B amplifiers have an output for detecting and monitoring a failure (STO-FB) that is equivalent to STO-FB defined in APPENDIX B of IEC 61800-5-2. STO-FB is a status monitor output that allows an external safety control device to monitor the interception status of the servo amplifier and detect a failure in the STO function of the servo amplifier or any of the two interception input signals.

The relationships among the interception input signals (STO-A and STO-B) and status monitor signal (STO-FB) are shown in the table below. Only when both of the two interception input signals are OFF (the STO function operates), the interception state is determined to occur and the STO-FB signal is turned on. (See the table below.)

Relationships among two interception input signals and status monitor signal

	Interception input signal (STO-A)	Interception input signal (STO-B)	Status monitor signal (STO-FB)
Each input/output photocoupler	ON	ON	OFF
	ON	OFF	OFF
	OFF	ON	OFF
	OFF	OFF	ON

Interception input signal: ON = 24 V supplied, OFF = 24 V not supplied
Status monitor signal: ON = Output is ON (short), OFF = Output is OFF (open)
The maximum delay time from the input of the STO-A and STO-B signals to the output of the STO-FB signal is 20 ms.

The following table lists the output specifications of the status monitor signal.

Specification of the status monitor signal output

Item	Characteristics	Note
Maximum allowable voltage	45VDC (Max.)	Per channel
Maximum current	100mA (Max)	
Maximum voltage drop at ON	0.5V	Voltage between output pins at a current of 100 mA

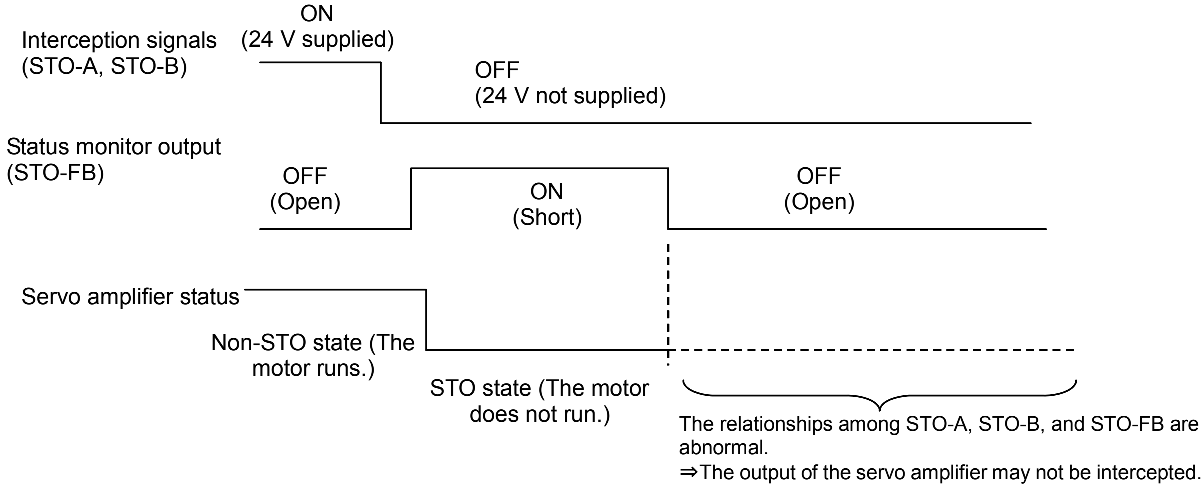
If any of the combinations of states listed in the table below occurs, an error may occur in the interception circuit of the servo amplifier. In this case, take action (shut down the input power supply or keep the safety door closed) so that the operators are not in danger.

Combinations of states of two interception input signals and status monitor signal that indicate abnormal status

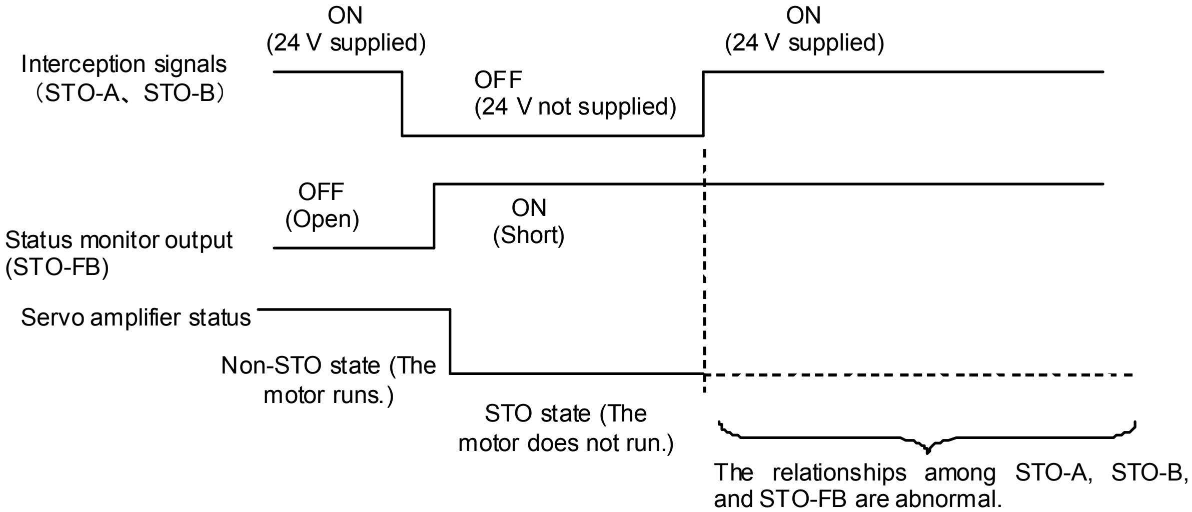
	Interception input signal (STO-A)	Interception input signal (STO-B)	Status monitor signal (STO-FB)
Each input/output photocoupler	ON	ON	ON
	ON	OFF	ON
	OFF	ON	ON
	OFF	OFF	OFF

For example, combinations of states (a) and (b) described below indicate a dangerous state. Shut down the input power supply, keep the safety door closed, and take other appropriate actions.

(a) Although both interception input signals STO-A and STO-B are off, status monitor signal STO-FB is not turned on.



(b) Although both or either of interception input signals STO-A and STO-B are on, status monitor signal STO-FB is turned on.



⚠ **WARNING**

When using the STO function, be sure to monitor the status of STO-A, STO-B, and STO-FB with an external safety control device. You can configure a safety system in which the relationships among interception input signals STO-A and STO-B and status monitor output STO-FB are monitored with an external safety control device to detect failures in the STO function including a disconnection between the safety control device and servo amplifier.
The status monitor output is used to monitor any failure in the STO function by the safety control device on the machine. Do not use this signal for any purposes other than failure monitoring. There is no problem when the status monitor output is used to monitor the STO function to see whether the function operates normally according to the two interception input signals by inputting it to the safety PLC again. In this case, if a failure occurs in the status monitor output, the power is surely cut off according to the status of the two interception signals. The failure in the status monitor output itself does not affect the safety function directly. However, if the status monitor output is used to output a safety signal and a device such as a safety relay is operated directly with the safety signal, a failure in the status monitor output can link with danger directly.
For example, assume that the safety guard is operated directly by using the status monitor output. If a failure occurs in the status monitor output, a dangerous state, such as that although the power is not shut off, the safety guard is opened, may occur.

14.5 USING THE STO FUNCTION

14.5.1 Setting the Parameter

To use the STO function, set the following parameter.

Parameter No.	Parameter setting
No.2436#1	0: Does not use the STO function. 1: Uses the STO function.

14.5.2 Setting a Switch on the Servo Amplifier

To use the STO function, set switch SW1 on the front panel of the servo amplifier to OFF as shown in the table below. (Factory setting: ON)

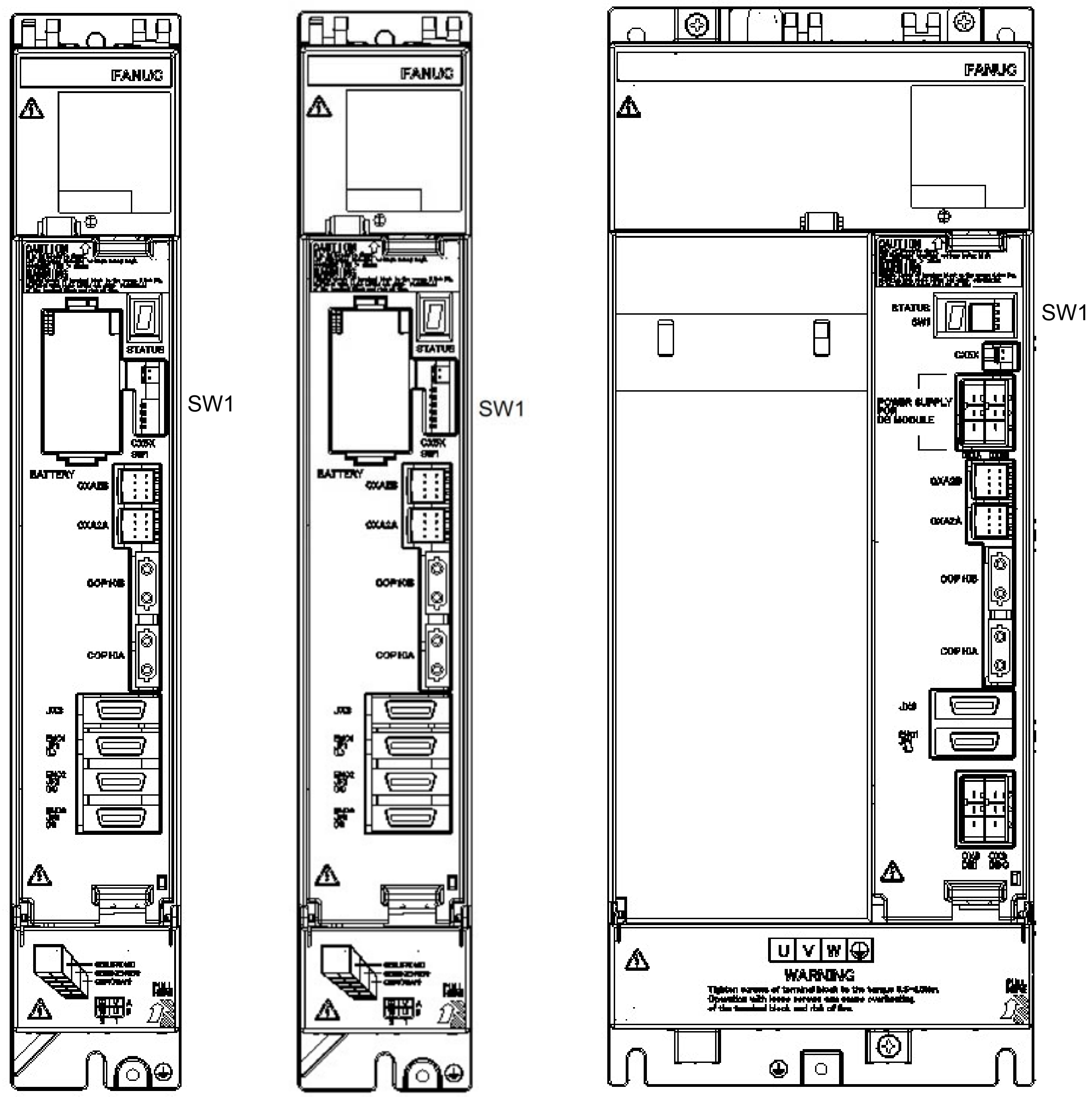
(1) To use the STO function for the L-axis, set SW1-1 and SW1-2 to OFF.
(2) To use the STO function for the M-axis, set SW1-3 and SW1-4 to OFF.
(3) To use the STO function for the N-axis, set SW1-5 and SW1-6 to OFF.
(4) The STO function can be used only with the N-axis of 3-axis amplifiers of Level-up α*i*SV-B.
(5) If the switch is not set correctly, an "SV drive off circuit failure" alarm is issued. For details of the switch setting, see the table below.

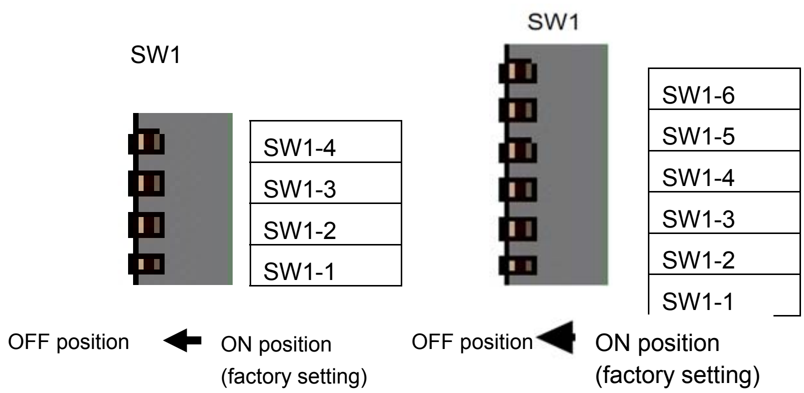
Setting axis	Switch number	STO setting
L-axis	SW1-1	ON: Disabled (factory setting) OFF: Enabled
	SW1-2	ON: Disabled (factory setting) OFF: Enabled
M-axis	SW1-3	ON: Disabled (factory setting) OFF: Enabled
	SW1-4	ON: Disabled (factory setting) OFF: Enabled
N-axis	SW1-5 (Available only with Level-up α*i*SV-B series)	ON: Disabled (factory setting) OFF: Enabled
	SW1-6 (Available only with Level-up α*i*SV-B series)	ON: Disabled (factory setting) OFF: Enabled

14.5.3 Switch SW1

For the location of switch SW1, see the figure below.

(60/90 mm-wide) Level-up α*i*SV-B (60/90 mm-wide) (150/30 mm-wide)





14.5.4 Interception Mode

The interception modes provided by the servo amplifier with additional functions and the settings for switch SW1 are presented in the following table.
It is impossible to individually cut off the power of M-axis and N-axis because their interception input signals are interlocked.

Interception mode of STO	Number of axes to intercept	SW1 - 1, 2	SW1 - 3, 4	SW1 - 5, 6
Cut off L-axis only	1	OFF	ON	ON
Cut off M-axis only	1	ON	OFF	ON
Cut off N-axis only	1	ON	ON	OFF
Simultaneously cut off L-axis and M-axis	2	OFF	OFF	ON
Simultaneously cut off L-axis and N-axis	2	OFF	ON	OFF
Simultaneously cut off M-axis and N-axis	2	ON	OFF	OFF
Simultaneously cut off all axes (L, M, and N)	3	OFF	OFF	OFF
Individually cut off L-axis and M-axis	2	OFF	OFF	ON
Individually cut off L-axis and N-axis	2	OFF	ON	OFF
Individually cut off M-axis and N-axis	2	Impossible (M-axis and N-axis cannot be individually cut off)		
Individually cut off L-axis, and simultaneously cut off M-axis and N-axis	3	OFF	OFF	OFF
Individually cut off M-axis, and simultaneously cut off L-axis and N-axis	3	Impossible (individual interception of M-axis combined with simultaneous interception of L-axis and N-axis is impossible)		
Individually cut off N-axis, and simultaneously cut off L-axis and M-axis	3	Impossible (individual interception of N-axis combined with simultaneous interception of L-axis and M-axis is impossible)		
Individually cut off all three axes	3	Impossible (individual interception of all three axes is impossible)		

14.6 SV DRIVE OFF CIRCUIT FAILURE ALARM

14.6.1 Condition of Alarm

The CPU in the servo amplifier always monitors the status of the two interception input signals and the two interception circuits in the servo amplifier. If an inconsistency occurs between these two interception input signals or between the status of these interception input signals and the status of these interception circuits in the servo amplifier, the CPU in the servo amplifier detects an SV drive off circuit failure alarm. If an inconsistency between the two interception input signals continues for at least 10 seconds, the CPU in the servo amplifier detects an alarm. The two interception input signals are inputted from the machine. The variation in the operation timing should be within 10 seconds.

Status of the two interception input signals and whether an alarm is detected according to the status

	Interception input signal (STO-A)	Interception input signal (STO-B)	Alarm
Each input/output photocoupler	ON	ON	Not detected
	ON	OFF	Detected
	OFF	ON	Detected
	OFF	OFF	Not detected

Interception input signal : ON = 24 V supplied (The photocoupler is turned on.)
: OFF = 24 V not supplied (The photocoupler is turned off.)

Status of the interception input signals, status of the interception circuit, and whether an alarm is detected according to the combination of the statuses

	Interception input signal (STO-A, STO-B)	Status of the interception circuit in the servo amplifier	Alarm
Each input/output photocoupler	ON	Off	Not detected
	ON	On	Detected
	OFF	Off	Detected
	OFF	On	Not detected

Interception input signal : ON = 24 V supplied (The photocoupler is turned on.)
: OFF = 24 V not supplied (The photocoupler is turned off.)

As described above, the CPU in the servo amplifier always monitors the operation of the STO function. The LSI connected to the CPU always monitors the operation of the CPU also. If an error occurs in CPU operation, the LSI detects a CPU watch dog alarm.

14.6.2 Troubleshooting an SV Drive OFF Circuit Failure Alarm

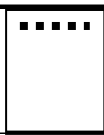
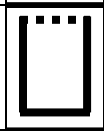
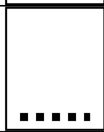
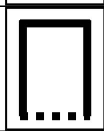
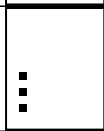
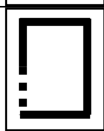
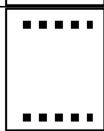
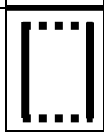
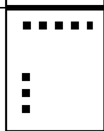
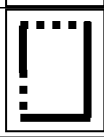
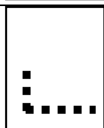
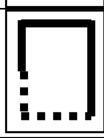
Check the following items if an SV drive off circuit failure alarm occur.

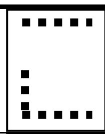
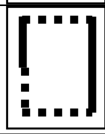
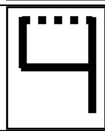
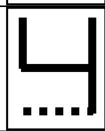
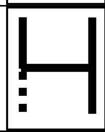
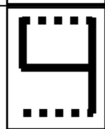
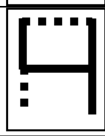
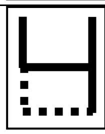
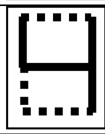
(1) Setting of setting switch SW1
  (a) Although the STO function is not used according to the setting (bit 1 of parameter No. 2436 is set to 0), setting switch SW1 of the servo amplifier is set to OFF (the STO function is used).
  (b) Although the STO function is used according to the setting (bit 1 of parameter No. 2436 is set to 1), setting switch SW1 of the servo amplifier is set to ON.
(2) Disconnection of the STO-A and STO-B input cables
(3) Input time difference between STO-A and STO-B (up to 10 s)
(4) Failure in the servo amplifier
(5) Failure in the safety PLC and other devices

14.7 LED DISPLAY OF THE SERVO AMPLIFIER

The following table lists the LED display of the servo amplifier when the STO function is used.

LED display of the servo amplifier when the STO function is used

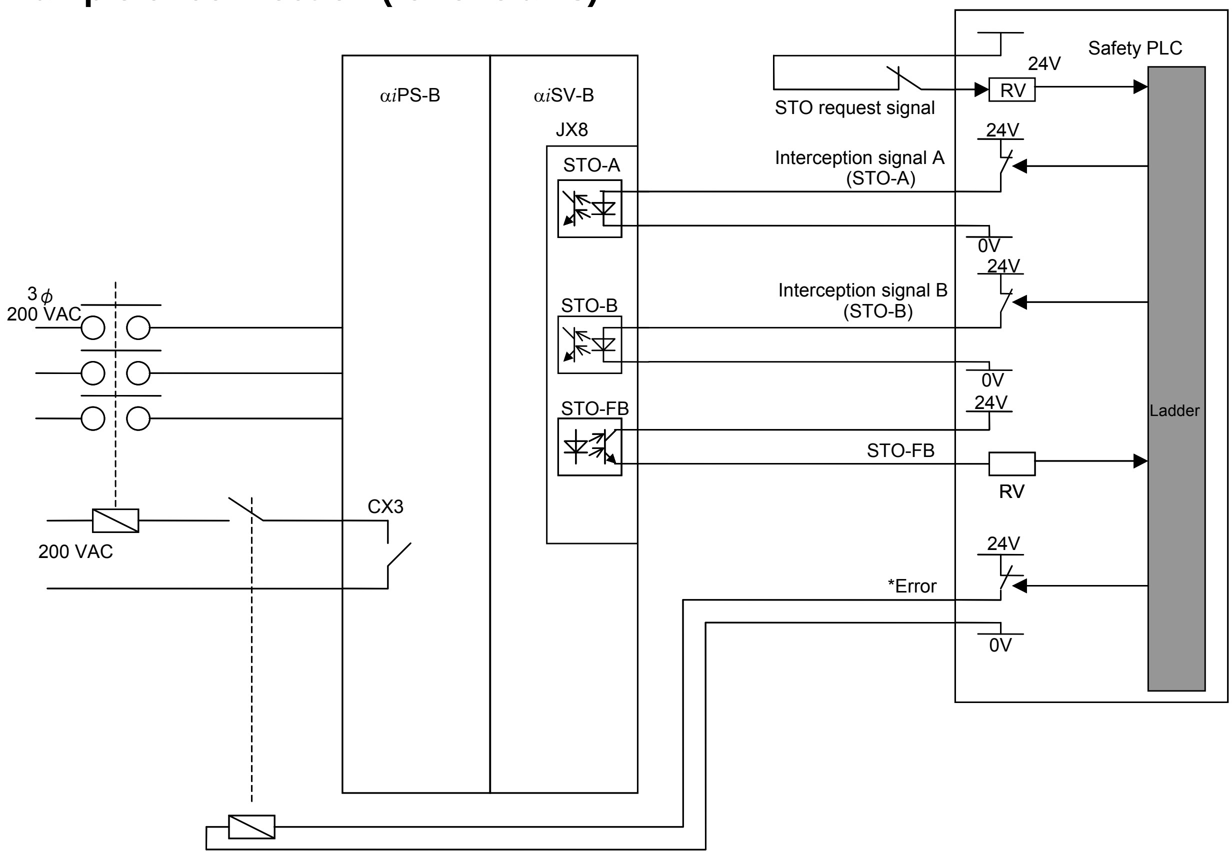
Servo amplifier status				LED display of the servo amplifier	
L-axis	**M-axis**	**N-axis**	**Servo amplifier status**		
STO	Not STO	Not STO	Not ready	The top crossbar blinks	
STO	Not STO	Not STO	Ready	"0" is displayed and the top crossbar blinks	
Not STO	STO	Not STO	Not ready	The bottom crossbar blinks	
Not STO	STO	Not STO	Ready	"0" is displayed and the bottom crossbar blinks	
Not STO	Not STO	STO	Not ready	The vertical bar in the bottom left corner blinks	
Not STO	Not STO	STO	Ready	"0" is displayed and the vertical bar in the bottom left corner blinks	
STO	STO	Not STO	Not ready	The top and bottom crossbars blink	
STO	STO	Not STO	Ready	"0" is displayed and the top and bottom crossbars blink	
STO	Not STO	STO	Not ready	The top crossbar and the vertical bar in the bottom left corner blink	
STO	Not STO	STO	Ready	"0" is displayed and the top crossbar and the vertical bar in the bottom left corner blink	
Not STO	STO	STO	Not ready	The bottom crossbar and the vertical bar in the bottom left corner blink	
Not STO	STO	STO	Ready	"0" is displayed and the bottom crossbar and the vertical bar in the bottom left corner blink	

Servo amplifier status				**LED display of the servo amplifier**	
L-axis	**M-axis**	**N-axis**	**Servo amplifier status**		
STO	STO	STO	Not ready	The top crossbar, the bottom crossbar and the vertical bar in the bottom left corner blink	
STO	STO	STO	Ready	"0" is displayed and the top crossbar, the bottom crossbar and the vertical bar in the bottom left corner blink	
Abnormal	Normal	Normal	Not ready	"4" is displayed and the top crossbar blinks	
Normal	Abnormal	Normal	Not ready	"4" is displayed and the bottom crossbar blinks	
Normal	Normal	Abnormal	Not ready	"4" is displayed and the vertical bar in the bottom left corner blinks	
Abnormal	Abnormal	Normal	Not ready	"4" is displayed and the top crossbar and the bottom crossbar blink	
Abnormal	Normal	Abnormal	Not ready	"4" is displayed and the top crossbar and the vertical bar in the bottom left corner blink	
Normal	Abnormal	Abnormal	Not ready	"4" is displayed and the bottom crossbar and the vertical bar in the bottom left corner blink	
Abnormal	Abnormal	Abnormal	Not ready	"4" is displayed and the top crossbar, the bottom crossbar and the vertical bar in the bottom left corner blink	

14.8 EXAMPLE OF CONNECTION

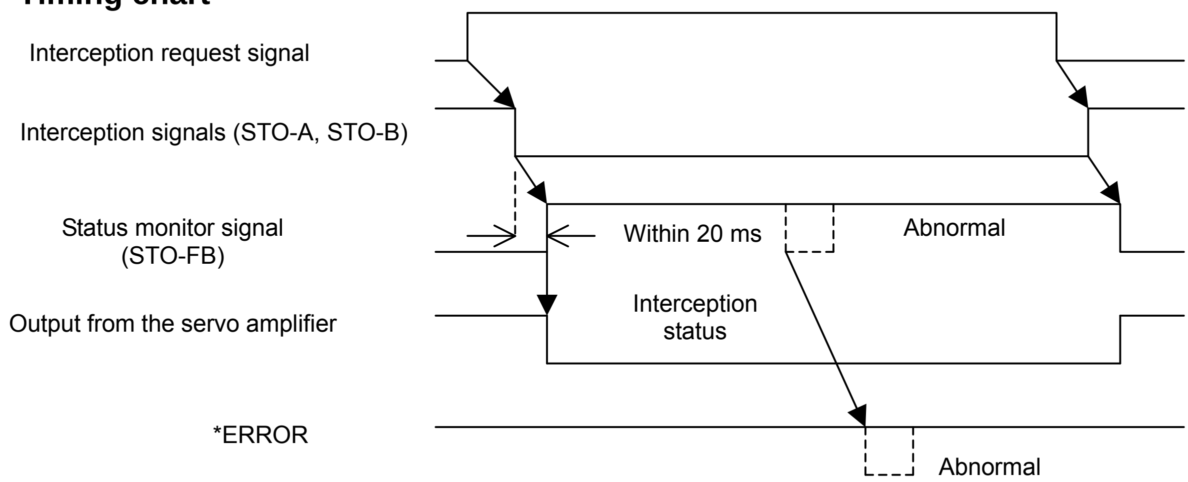
To use the STO function, it is necessary to connect the interception signals and status monitor signal to JX8 on the servo amplifier.
In the figure below, a safety PLC is connected. For details of connection with the safety PLC and create a ladder, refer to the manual of the safety PLC.

Example of connection (for one axis)



(1) STO-A and STO-B are turned on with the STO request signal and the power to the servo amplifier is cut off.
(2) The OFF status of the status monitor signal (STO-FB) is confirmed.
(3) The status of STO-A, STO-B, and STO-FB is monitored. If the status matches any of table of Subsection 14.4.3, "Combinations of states of two interception input signals and status monitor signal that indicate abnormal status," the input is intercepted with the ERROR signal.

- Timing chart



14.9 REMAINING RISKS

The following risks remain in the STO function.

(1) The STO function electrically cuts off the power to the servo motor, and does not shut down the input power supply for the servo amplifier or physically cut off the connection between the servo amplifier and servo motor. For this reason, danger of an electric shock cannot be removed with the STO function.
(2) If the power module of the servo amplifier is faulty, the motor may rotate by up to 22.5 degrees.
(3) Be sure to supply the STO input signals from one power supply. If different power supplies are used, the STO function may malfunction due to sneak current.
(4) The safety of the system is to be checked finally by the machine manufacturer.

14.10 OTHER NOTES

(1) After the motor stops, place the machine in the STO state.
(2) When the power to the motor is cut off using the STO function, the dynamic brake module does not operate.
(3) If an SV drive off circuit failure alarm is issued, the input magnetic contactor is cut off and the machine is stopped with the dynamic brake module in the same way as for a usual alarm.
(4) When there is external force or the servo motor is used for a vertical axis, the motor runs. In this case, an external mechanical brake is required when the related axis must be held.
(5) The status monitor signal is not a safety signal. Do not use this signal for purposes other than the failure monitoring function.

14.11 THE STO FUNCTION OF SPINDLE AMPLIFIERS

See Subsections 14.1 through 14.10 for basic usage of the STO function.

14.11.1 Spindle Amplifiers that Support the STO Function

Level-up α*i*SP-B supports the STO function. α*i*SP-B models that support the STO function are presented in the following table.

200 V input series

Ordering number	Name
A06B-6222-H002#H610	α*i*SP 2.2-B
A06B-6222-H006#H610	α*i*SP 5.5-B
A06B-6222-H011#H610	α*i*SP 11-B
A06B-6222-H015#H610	α*i*SP 15-B
A06B-6222-H022#H610	α*i*SP 22-B
A06B-6222-H026#H610	α*i*SP 26-B
A06B-6222-H030#H610	α*i*SP 30-B
A06B-6222-H037#H610	α*i*SP 37-B
A06B-6222-H045#H610	α*i*SP 45-B
A06B-6222-H055#H610	α*i*SP 55-B

400 V input series

Ordering number	Name
A06B-6272-H006#H610	α*i*SP 5.5HV-B
A06B-6272-H011#H610	α*i*SP 11HV-B
A06B-6272-H015#H610	α*i*SP 15HV-B
A06B-6272-H022#H610	α*i*SP 22HV-B
A06B-6272-H030#H610	α*i*SP 30HV-B
A06B-6272-H045#H610	α*i*SP 45HV-B
A06B-6272-H060#H610	α*i*SP 60HV-B
A06B-6272-H075#H610	α*i*SP 75HV-B
A06B-6272-H100#H610	α*i*SP 100HV-B
A06B-6272-H100#H610#S	α*i*SP 100HV(SiC)-B

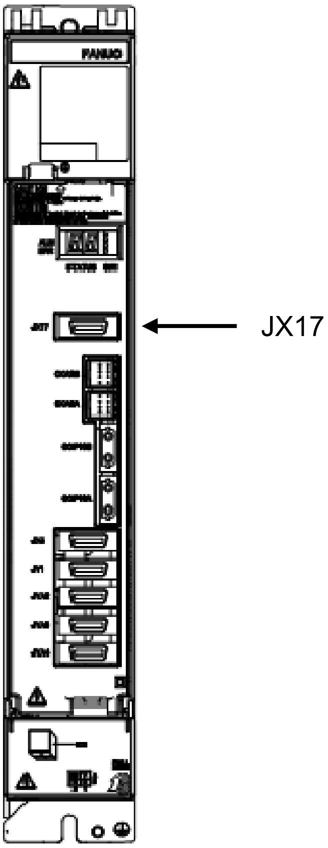
14.11.2 Differences and Commonalities with the STO Function of Servo Amplifiers

Beware of the following differences with servo amplifiers when using the STO function.
- Connector position for input/output signals for the STO function (See Subsection 14.11.3.)
- Connector pin arrangement for input/output signals for the STO function (See Subsection 14.11.4.)
- CNC parameter setting for enabling the STO function (See Subsection 14.11.5.)
- Switch setting for enabling the STO function (See Subsection 14.11.5.)
- SV drive off circuit failure alarm number displayed on the CNC unit (See Subsection 14.11.6.)
- LED display indicating the status of interception by STO (See Subsection 14.11.7.)

There are following commonalities with α*i*SV-B. See Subsection 14.4.2.
- Connector specifications for input/output signals for the STO function

14.11.3 Connector Position for Input/Output Signals for the STO Function

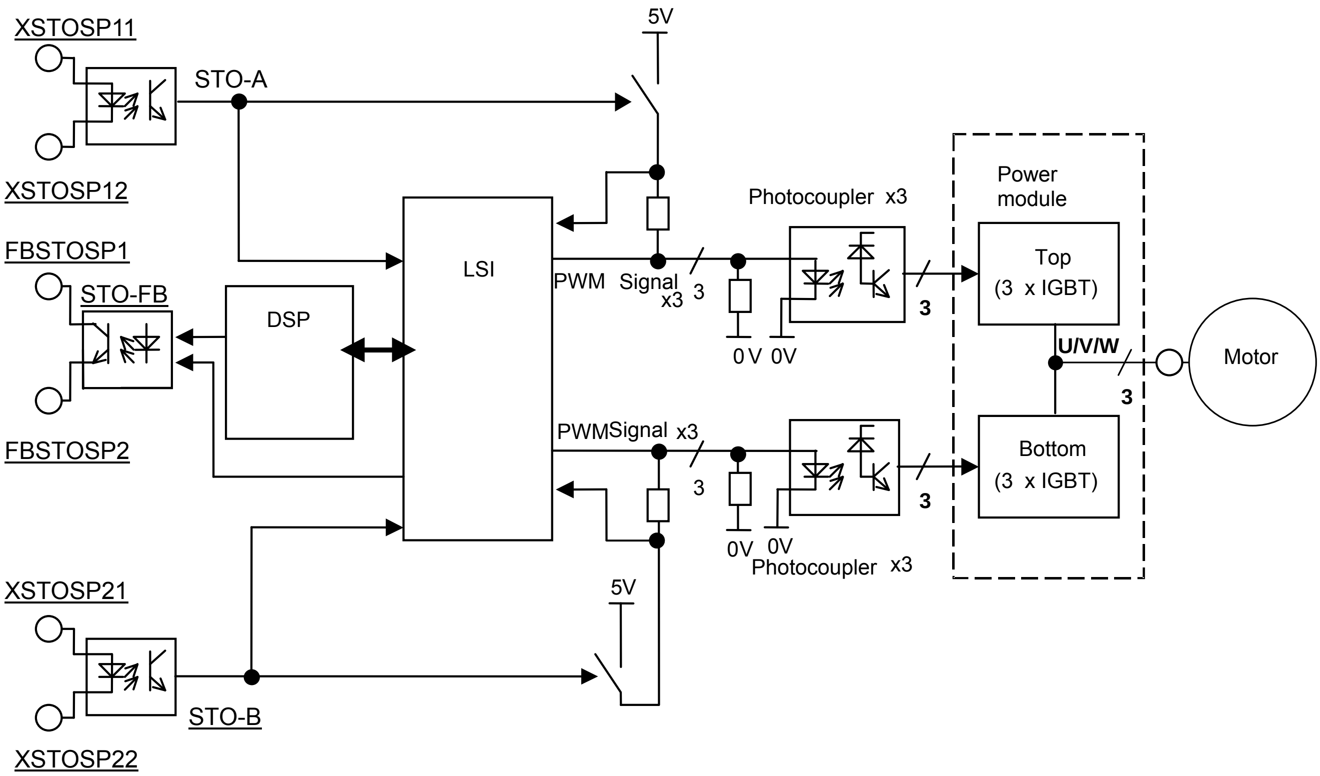
Use connector "JX17" for input and output of STO function signals.
See the following diagram for connector positions.



14.11.4 Input/Output Specifications

Block diagram

The block diagram for the STO function is presented below.



Connector pin arrangement

Pin arrangement of connector "JX17" is as follows.

Pin number	01	02	03	04	05	06	07	08	09	10
Signal name	XSTOSP12	XSTOSP22								
Pin number	11	12	13	14	15	16	17	18	19	20
Signal name	FBSTOSP1		FBSTOSP2					XSTOSP11		XSTOSP21

For operation of each input signal, see the table below.

Signal name		Operation
STO-A Interception input	XSTOSP11 XSTOSP12	This input signal controls the STO function. The driving power supply to the upper arm of the power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
STO-B Interception input	XSTOSP21 XSTOSP22	This input signal controls the STO function. The driving power supply to the lower arm of the power transistor is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.

The relationships among the interception input signals (STO-A and STO-B) and status monitor signal (STO-FB) are shown in the table below. Only when both of the two interception input signals are OFF (the STO function operates), the interception state is determined to occur and the STO-FB signal is turned on.

	Interception input signal (STO-A)	**Interception input signal (STO-B)**	**Status monitor signal (STO-FB)**
Each input/output photocoupler	ON	ON	OFF
	ON	OFF	OFF
	OFF	ON	OFF
	OFF	OFF	ON

Interception input signal: ON = 24 V supplied, OFF = 24 V not supplied
Status monitor signal: ON = Output is ON (short), OFF = Output is OFF (open)
The maximum delay time from the input of the STO-A and STO-B signals to the output of the STO-FB signal is 20 ms.

14.11.5 Using The STO Function

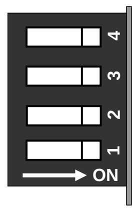
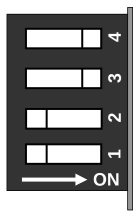
14.11.5.1 Setting of the parameter

To use the STO function, set the following parameter.

Parameter number	Parameter setting
No.4542#1	0: Does not use the STO function 1: Uses the STO function

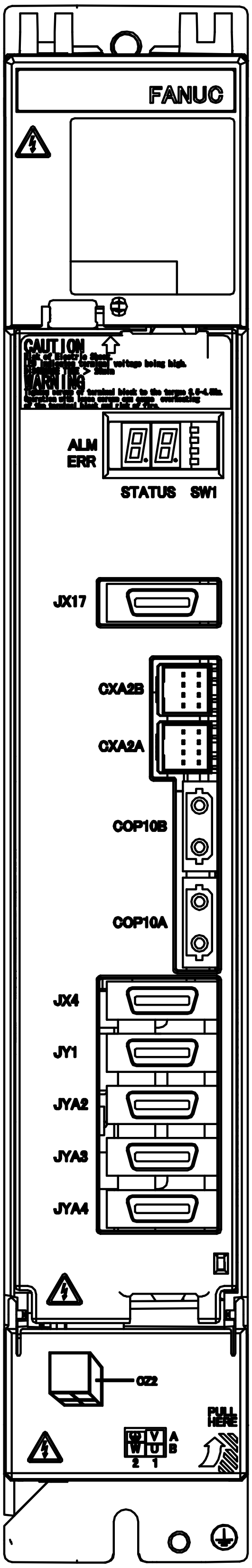
14.11.5.2 Setting of the switch

To use the STO function, set switch SW1 on the front panel of the spindle amplifier to OFF as shown in the table below. (Factory setting: ON)

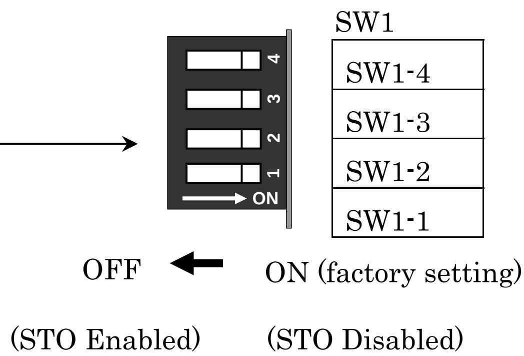
Usage of the function	**Switch number**	**STO setting**	**Switch setting**
Does not use the STO function	SW1-4 SW1-3 SW1-2 SW1-1	ON: Disabled (factory setting)	
Uses the STO function	SW1-4 SW1-3	ON: Disabled (factory setting)	
	SW1-2 SW1-1	OFF: Enabled	

14.11.5.3 Switch SW1

For the location of switch SW1, see the figure below.



Do not alter the factory setting of SW1-3 and SW1-4.



14.11.6 SV Drive Off Circuit Failure Alarm

14.11.6.1 Condition of alarm

The DSP in the spindle amplifier constantly monitors the status of the two interception inputs and the two interception circuits in the spindle amplifier. If any inconsistency occurs between these two interception input status or between the status spindle of these interception inputs and the status of these interception circuits in the amplifier, the DSP in the spindle amplifier detects an SV drive off circuit failure alarm (SP9169, "G9" in LED display).
If an inconsistency between the two interception input signals continues for at least 10 seconds, the DSP in the spindle amplifier detects an alarm. The two interception input signals are inputted from the machine. The variation in the operation timing should be within 10 seconds.

Status of the two interception input signals and whether an alarm is detected according to the status

	Interception input signal (STO-A)	Interception input signal (STO-B)	Alarm
Each input/output photocoupler	ON	ON	Not detected
	ON	OFF	Detected
	OFF	ON	Detected
	OFF	OFF	Not detected

Interception input : ON = 24 V supplied (The photocoupler is turned on.)
: OFF = 24 V not supplied (The photocoupler is turned off.)

Status of the interception input signals, status of the interception circuit, and whether an alarm is detected according to the combination of the statuses

	Interception input signal (STO-A, STO-B)	Status of interception circuit in the spindle amplifier	Alarm
Each input/output photocoupler	ON	Off	Not detected
	ON	On	Detected
	OFF	Off	Detected
	OFF	On	Not detected

Interception input : ON = 24 V supplied (The photocoupler is turned on.)
: OFF = 24 V not supplied (The photocoupler is turned off.)

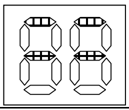
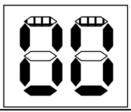
14.11.6.2 Troubleshooting for SV drive off circuit failure alarms

Check the following items in case any SV drive off circuit failure alarm is issued.

(1) Setting of setting switch SW1
(a) Although the STO function is not used according to the setting (bit 1 of parameter No.4542 is set to 0), setting switch SW1 of the spindle amplifier is set to OFF (the STO function is used).
(b) Although the STO function is used according to the setting (bit 1 of parameter No.4542 is set to 1), setting switch SW1 of the spindle amplifier is set to ON.
(2) Disconnection of the STO-A and STO-B input cables
(3) Input time difference between STO-A and STO-B (up to 10 s)
(4) Failure in the spindle amplifier
(5) Failure in the safety PLC and other devices

14.11.7 LED Display of the Spindle Amplifier

The following table lists the LED display of the spindle amplifier when the STO function is used.

Status of αiSP-B		LED display of the spindle amplifier	Setting of the parameter for enabling STO
Spindle axis	**Status of the spindle**		
STO state (intercepting)	Not ready (not excited)	crossbar blinks 	No.4542#1=1
STO state (intercepting)	Ready (excited)	"00" is displayed and blinks 	
STO state (intercepting)	-	"G9" is displayed to indicate that the SP9169 SV drive off circuit failure alarm is issued. See Subsection 14.10.6, "SV Drive Off Circuit Failure Alarm" for the alarm.	No.4542#1=0

(Note) The display of the spindle alarm number takes priority when spindle alarms other than the SP9169 SV drive off circuit failure alarm are issued. Therefore, the above LED display does not appear even when STO is enabled.

14.11.8 Precautions

When using the STO function, be sure to monitor the status of STO-A, STO-B, and STO-FB with an external safety control device. You can configure a safety system in which the relationships among interception input signals STO-A and STO-B and status monitor output STO-FB are monitored with an external safety control device to detect failures in the STO function including a disconnection between the safety control device and spindle amplifier.
The status monitor output signal is used to monitor any failure in the STO function by the safety control device on the machine. Do not use this signal for any purposes other than failure monitoring. There is no problem when the status monitor output signal is used to monitor the STO function to see whether the function operates normally according to the two interception input signals by inputting it to the safety PLC again. In this case, even if a failure occurs in the status monitor output signal, the power is reliably cut off according to the status of the two interception signals. The failure in the status monitor output itself does not affect the safety function directly. However, if the status monitor output signal is used to output a safety signal and a device such as a safety relay is operated directly with the safety signal, a failure in the status monitor output signal can link with danger directly.
For example, assume that the safety guard is operated directly by using the status monitor output signal. If a failure occurs in the status monitor output signal, a dangerous state, such as that although the power is not shut off, the safety guard is opened, may occur.
In order to cut off the driving power of the motor with the STO function, enable the STO after the motor stops.
If an SV drive off circuit failure alarm is issued, cut off the input magnetic contactor in the same way as with a usual alarm.

14.12 THE STO FUNCTION OF α*i*SVP-B

See Subsections 14.1 through 14.10 for the basic usage of the STO function.

14.12.1 α*i*SVP-B Compatible with the STO Function

Level-up α*i*SVP-B supports the STO function. α*i*SVP-B supporting the STO function are presented in the table below.

200 V input series

Ordering number	Name
A06B-6232-H001#H610	α*i*SVP 20/20/20-5.5-B
A06B-6232-H003#H610	α*i*SVP 20/20/20-2.2-B
A06B-6232-H004#H610	α*i*SVP 40/40/40-2.2-B

400 V input series

Ordering number	Name
A06B-6282-H001#H610	α*i*SVP 10/10/10-5.5HV-B

14.12.2 Differences and Commonalities with the STO Function of Servo Amplifiers/Spindle Amplifiers

Level-up α*i*SVP-B can individually cut off the servo axes and spindle axes.
When using the STO function, note the following differences with the STO function of α*i*SV-B and α*i*SP-B.

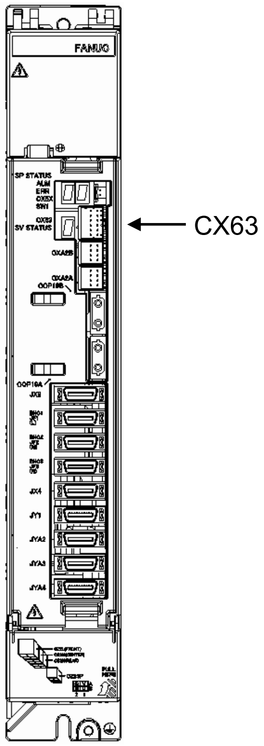
- Interception mode for servo axes: Batch interception of all axes
- Connector position for input/output signals for the STO function
- Connector pin arrangement for input/output signals for the STO function

There are following commonalities shared with α*i*SV-B and α*i*SP-B. See Subsections 14.1 through 14.10 for the commonalities with α*i*SV-B. See Subsection 14.11 for the commonalities with α*i*SP-B.

- CNC parameter setting for enabling the STO function
- Switch setting for enabling the STO function
- LED display indicating the status of interception of servo axes by STO
- LED display indicating the status of interception of spindle axes by STO
- SV drive off circuit failure alarm number displayed on the CNC unit

14.12.3 Connector Position for Input/Output Signals for the STO Function

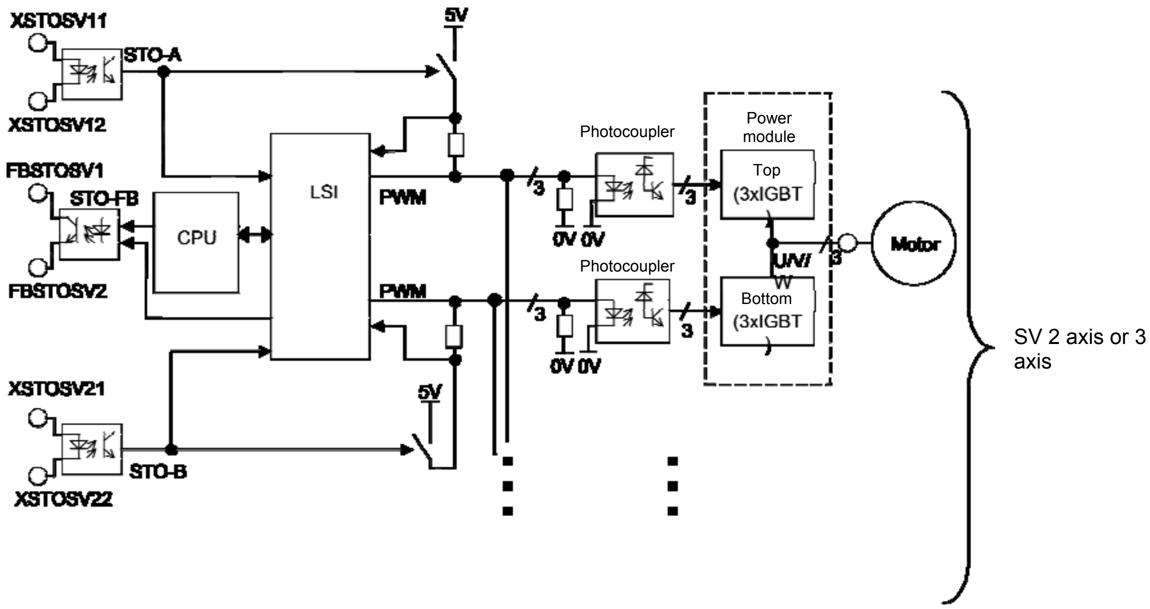
Use connector "CX63" for input and output of STO function signals.
See the following figure for the position of the connector.

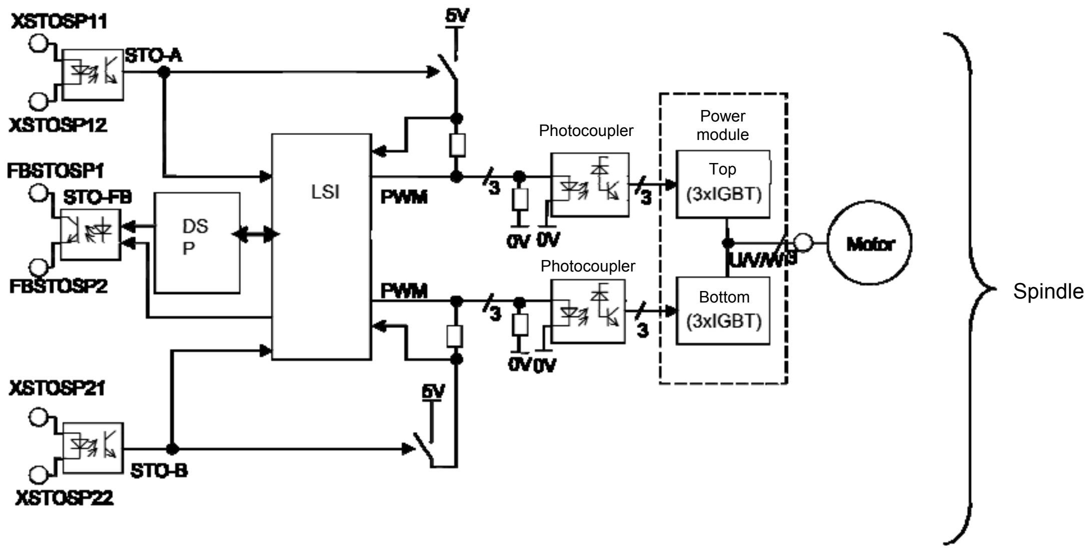


14.12.4 Input/Output Specifications

Block diagram

The block diagram for the STO function is presented below.





Connector pin arrangement

Pin arrangement of connector "CX63" is as follows.

Pin number	01	02	03	04	05	06	
A	XSTOSV11	XSTOSV21	FBSTOSV1	XSTOSP11	XSTOSP21	FBSTOSP1	Signal name
B	XSTOSV12	XSTOSV22	FBSTOSV2	XSTOSP12	XSTOSP22	FBSTOSP2	

Input specifications (interception input signal: STO-A and STO-B)

For operation of each input signal, see the table below.

Signal name		Operation
All servo axes STO-A interception input	XSTOSV11 XSTOSV12	This input signal controls the STO function for all servo axes. The driving power supply to the upper arm of the power transistor for all servo axes is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
All servo axes STO-B interception input	XSTOSV21 XSTOSV22	This input signal controls the STO function for all servo axes. The driving power supply to the lower arm of the power transistor for all servo axes is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
Spindle axis STO-A interception input	XSTOSP11 XSTOSP12	This input signal controls the STO function for spindle axes. The driving power supply to the upper arm of the power transistor for spindle axes is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.
Spindle axis STO-B interception input	XSTOSP21 XSTOSP22	This input signal controls the STO function for spindle axes. The driving power supply to the lower arm of the power transistor for spindle axes is cut off. When 24 V is input, the motor can operate. When 24 V is not input, the power to the motor is cut off.

For electrical specifications of each input signal, see the table below.

Item	Characteristics	Remarks
Input current	3.5mA (Typ.)	Per channel
ON input voltage range	18V to 26V	
OFF input voltage range	0V to 4V	
Pulse width	At least 20ms	A pulse width of 1ms or less is not recognized.

14.12.5 Usage

14.12.5.1 Setting of the parameter

To use the STO function, set the following parameter.

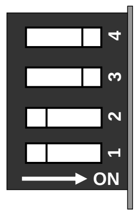
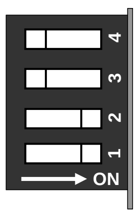
Axis	Parameter number	Parameter setting
All servo axes	No.2436#1	0: Does not use the STO function 1: Uses the STO function
Spindle axis	No.4542#1	0: Does not use the STO function 1: Uses the STO function

> **NOTE**
> Set parameters for all servo axes (X, Y, and Z) in order to set up the STO function for them.

14.12.5.2 Setting of the switch

To use the STO function, set switch SW1 on the front panel of the servo amplifier to OFF as shown in the table below. (Factory setting: ON)

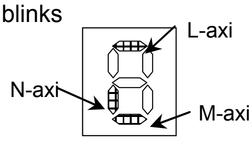
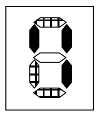
(1) To use the STO function with the spindle axes, set SW-1 and SW-2 to OFF.
(2) To use the STO function with all servo axes, set SW-3 and SW-4 to OFF.
(3) The STO function cannot be used with independent interception of each servo axis.
(4) Incorrect setting of the switches leads to issue an "SV drive off circuit failure alarm." For the switch setting, see the table below.

Setting axis	Switch number	STO setting	SW setting
Spindle axis	SW-1 SW-2	ON: Disabled (factory setting) OFF: Enabled	
All servo axes	SW-3 SW-4	ON: Disabled (factory setting) OFF: Enabled	

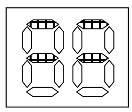
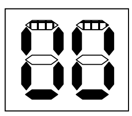
14.12.6 LED Display of α*i*SVP-B

The following table lists the LED display for the servo unit and spindle unit when the STO function is used.

(1) Display for the servo unit when the STO function is used

Status of α*i*SVP-B		LED display of the servo amplifier	Setting of the parameter for enabling STO
All servo axes	**Status of the servo unit**		
STO state	Not ready	crossbar blinks  α*i*SVP-B's indicators for all axes blink as all axes are intercepted simultaneously.	No.2436#1=1
STO state	Ready	"0" is displayed and blinks 	
STO state	-	"4" is displayed to indicate that an "SV drive off circuit failure alarm" was issued.	No.2436#1=0

(2) Display for the spindle unit when the STO function is used

Status of α*i*SVP-B		LED display of the servo amplifier	Setting of the parameter for enabling STO
Spindle axis	**Status of the spindle**		
STO state	Not ready	crossbar blinks 	No.4542#1=1
STO state	Ready	"0" is displayed and blinks 	
STO state	-	"G9" is displayed to indicate that an "SV drive off circuit failure alarm" was issued.	No.4542#1=0

15 PARAMETERS FOR POWER SUPPLIES

Operation of the Power Supplies for the α*i*PS-B can be changed by CNC parameters.
This chapter describes the procedure for setting parameters for Power Supplies.

Chapter 15, "PARAMETERS FOR POWER SUPPLIES," consists of the following sections:

15.1 PROCEDURE FOR SETTING PARAMETERS FOR POWER SUPPLIES

15.1.1 Parameters for Power Supplies

As a Power Supply doesn't communicate with CNC directly, parameters for Power Supply are transferred from the CNC to the Power Supply via the parameters assigned in the PS control axis*NOTE (servo or spindle axis).
For this reason, to set parameters for a Power Supply, set parameters in the PS control axis.

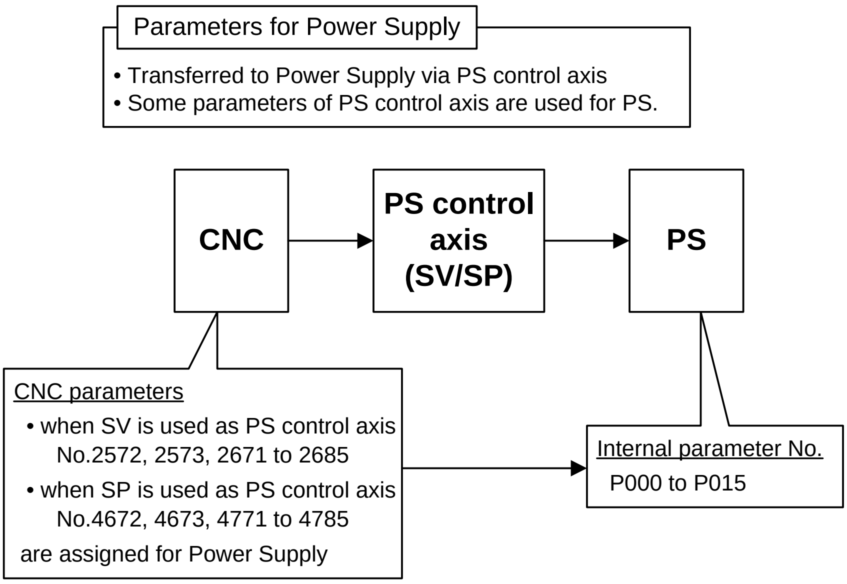


Fig. 15.1.1 (a) Transfer of parameters for a Power Supply

When multiple servo and spindle amplifiers are connected to one Power Supply, it is also necessary to set parameters via not Non-PS control axis but PS control axis.
For this reason, it is necessary to understand the connection among amplifiers*NOTE to use parameters for Power Supply.

NOTE
For details of how to check the PS control axis and amplifier connection, see Section 15.3, "CONNECTION AMONG SERVO AMPLIFIERS."

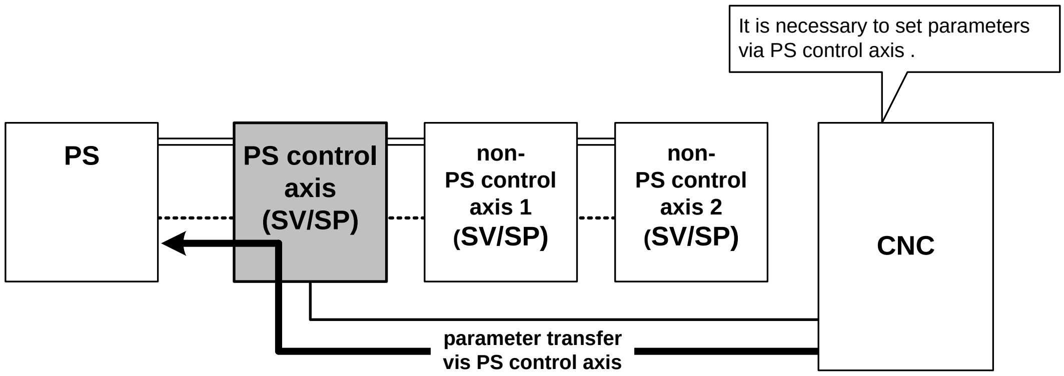


Fig. 15.1.1 (b) Transfer path of parameters for the Power Supply

For the procedure for setting parameters, see either of the following subsections according to the type of PS control axis:

When a servo axis is used as the PS control axis
→ Subsection 15.1.2, "Parameter Setting Procedure [PS Control Axis: SV]"
When a spindle is used as the PS control axis
→ Subsection 15.1.3, "Parameter Setting Procedure [PS Control Axis: SP]"

15.1.2 Parameter Setting Procedure [PS Control Axis: SV]

This subsection describes the procedure for setting parameters for a Power Supply (Nos. 2572, 2573, and from 2671 to 2685) when a servo axis is used as the PS control axis.

<1> Set a parameter for the Power Supply.

NOTE
Set "0" for unused parameters.

<2> On the CNC ALARM MESSAGE screen, "PW0000 POWER MUST BE OFF" will be displayed.
<3> When you want to change plural other parameters, set them successively.
After changing all parameters, turn the power to the CNC off, then on again.
<4> Parameter setting is now completed.

NOTE
1 After the CNC is restarted, if "SV0031 PS ILLEGAL PARAMETER" is displayed on the CNC ALARM MESSAGE screen, turn the power to the CNC off, then on again once more.
2 If "SV0031 PS ILLEGAL PARAMETER" is still displayed on the CNC ALARM MESSAGE screen even after the power to the CNC is turned off, then on again once more, perform operation described in Subsection 15.1.4, "Action to Be Taken When a Parameter Setting Error Occurs."

15.1.3 Parameter Setting Procedure [PS Control Axis: SP]

This subsection describes the procedure for setting parameters for a Power Supply (Nos. 4672, 4673, and from 4771 to 4785) when a spindle is used as the PS control axis.

<1> Set a parameter for the Power Supply.

> **NOTE**
> Set "0" for unused parameters.

<2> On the CNC ALARM MESSAGE screen, "PW0000 POWER MUST BE OFF" will be displayed.
<3> When you want to change plural other parameters, set them successively.
After changing all parameters, turn the power to the CNC off, then on again.
<4> Parameter setting is now completed.

> **NOTE**
> After the CNC is restarted, if "SP9211 PS ILLEGAL PARAMETER" is displayed on the CNC ALARM MESSAGE screen, perform operation described in Subsection 15.1.4, "Action to Be Taken When a Parameter Setting Error Occurs."

15.1.4 Action to Be Taken When a Parameter Setting Error Occurs

When an invalid value is set for a parameter for the Power Supply, on the CNC ALARM MESSAGE screen, "SV0031 PS ILLEGAL PARAMETER" or "SP9211 PS ILLEGAL PARAMETER" is displayed.
Follow the procedure below to identify the number of the parameter in which an invalid value is set and set a valid value.

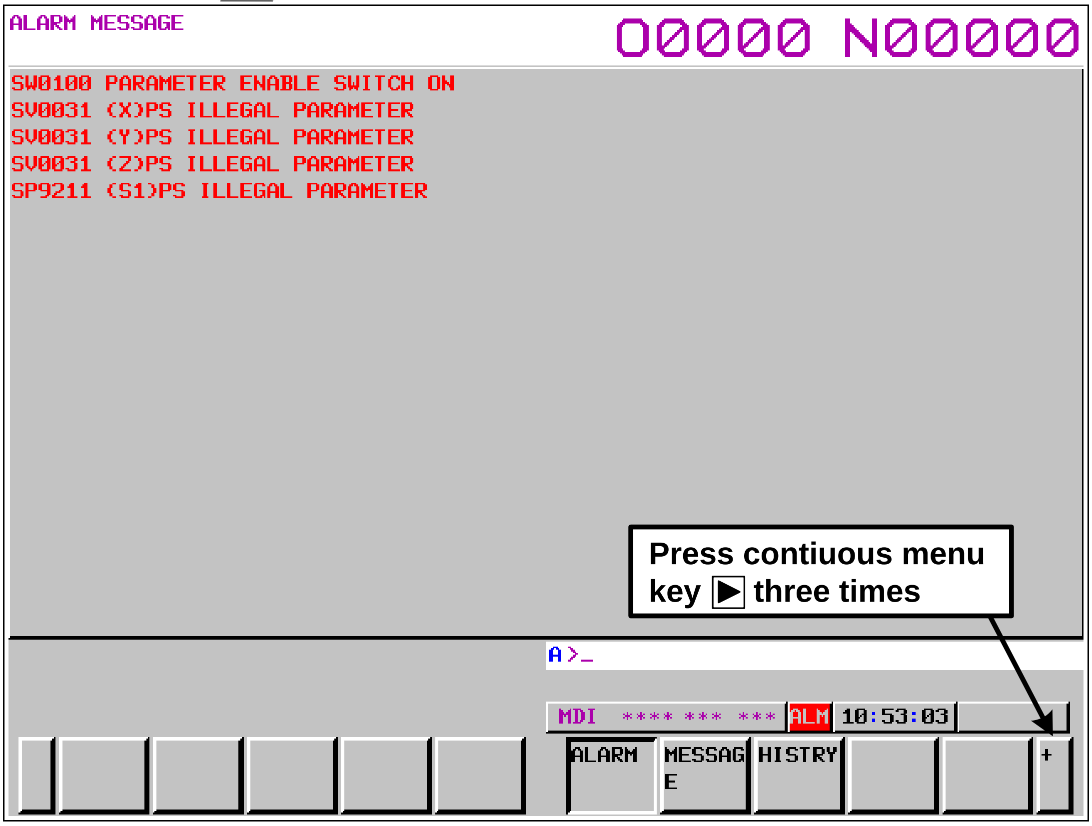
15.1.4.1 Displaying the TROUBLE DGN. MONITOR Screen (CURRENT)

To identify the number of the parameter in which an invalid value is set, use the TROUBLE DGN. MONITOR (CURRENT) screen.

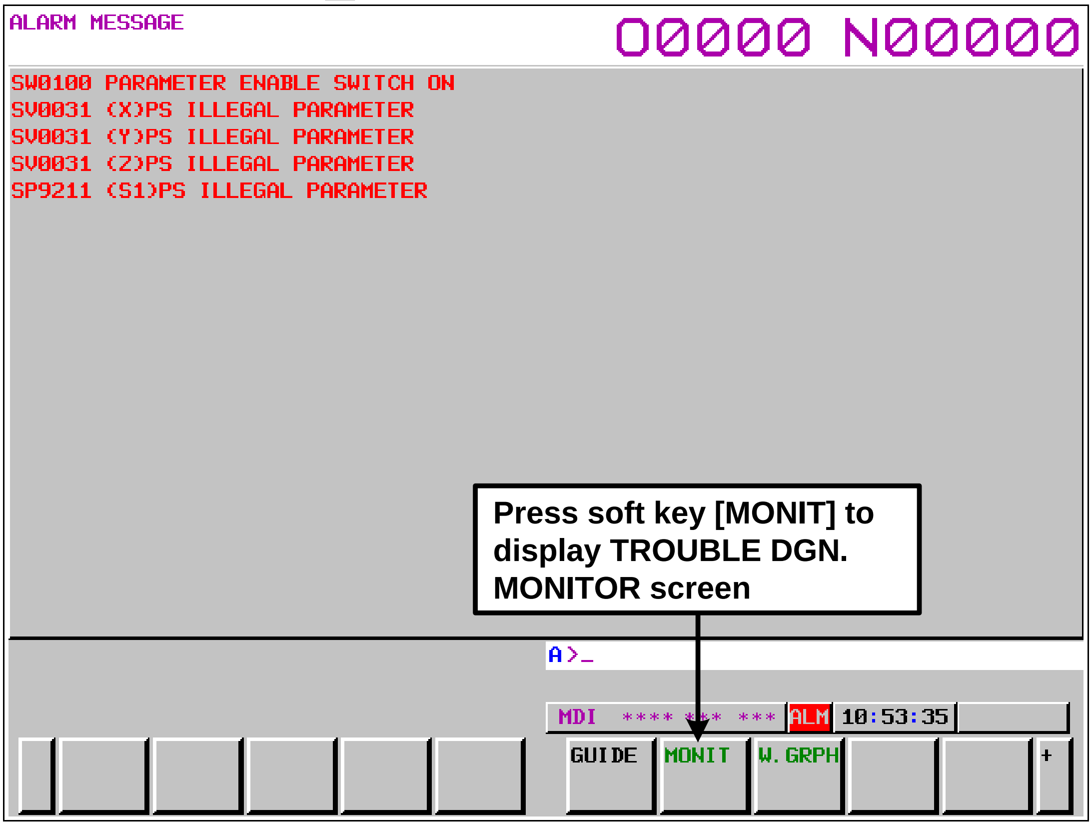
Follow the procedure below to display the TROUBLE DGN. MONITOR (CURRENT) screen.

[Displaying the TROUBLE DGN. MONITOR (CURRENT) screen]

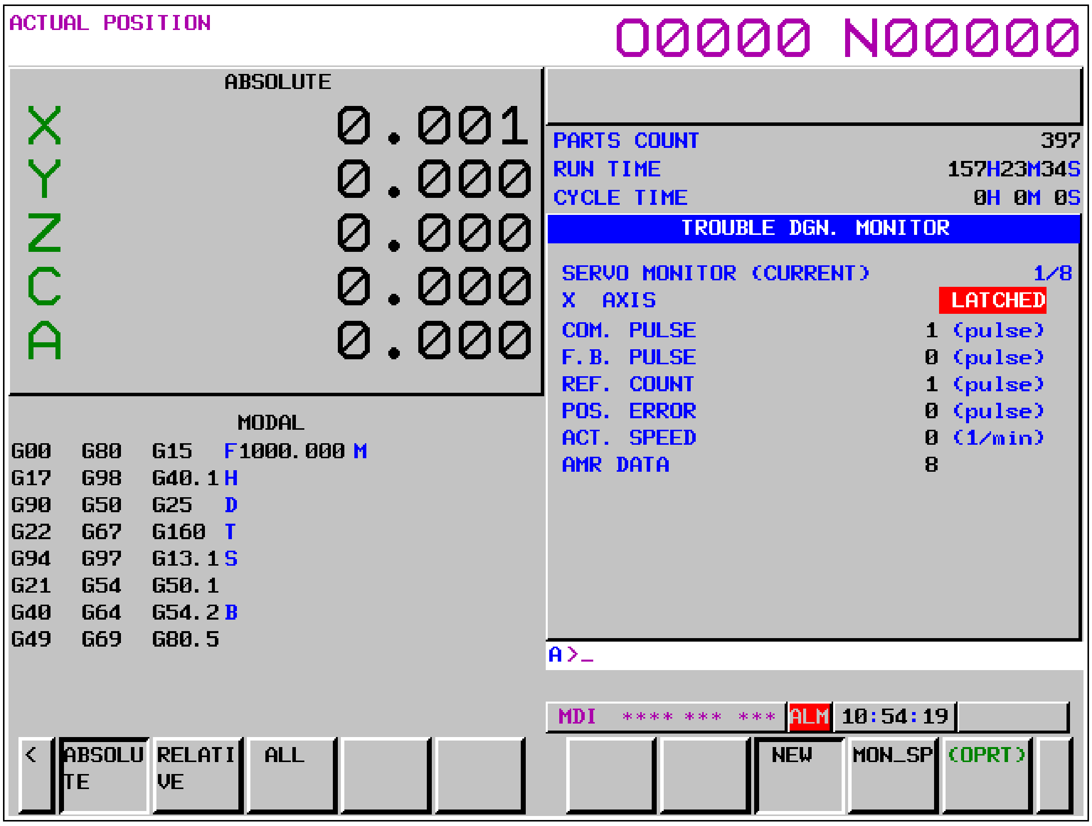
<1> Press function key [MESSAGE] to display the ALARM MESSAGE screen.



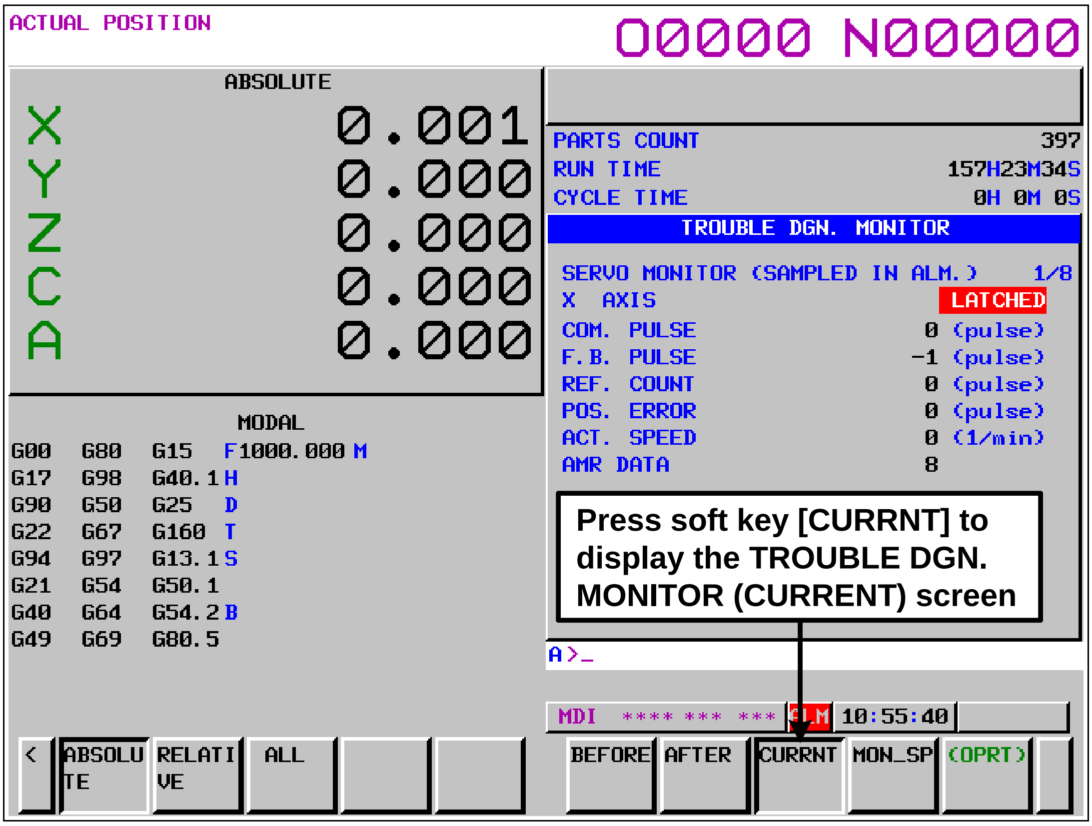
<2> Press continuous menu key ▷ three times to display the screen below.



<3> Press soft key [MONITOR] to display the "TROUBLE DGN. MONITOR (CURRENT) screen."



If the TROUBLE DGN. MONITOR (SAMPLED IN ALM.) screen is displayed, press soft key [CURRNT] to display the TROUBLE DGN. MONITOR (CURRENT) screen.



<4> Proceed to the steps described in Subsection 15.1.4.2, "Invalid setting parameter identification and resetting."

15.1.4.2 Invalid setting parameter identification and resetting

Follow the procedure below to identify the parameter in which an invalid value is set and set it again.

<1> Select the TROUBLE DGN. MONITOR (CURRENT) screen and display "PS DGN.INFO." for the PS control axis.

When a servo axis is used as the PS control axis

⇒Page "5/8" of the TROUBLE DGN. MONITOR (CURRENT) screen

When a spindle is used as the PS control axis

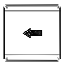
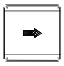
⇒Page "5/9" of the TROUBLE DGN. MONITOR (CURRENT) screen

[Displaying a desired page of the TROUBLE DGN. MONITOR (CURRENT) screen]

Displaying a page for a servo axis or spindle

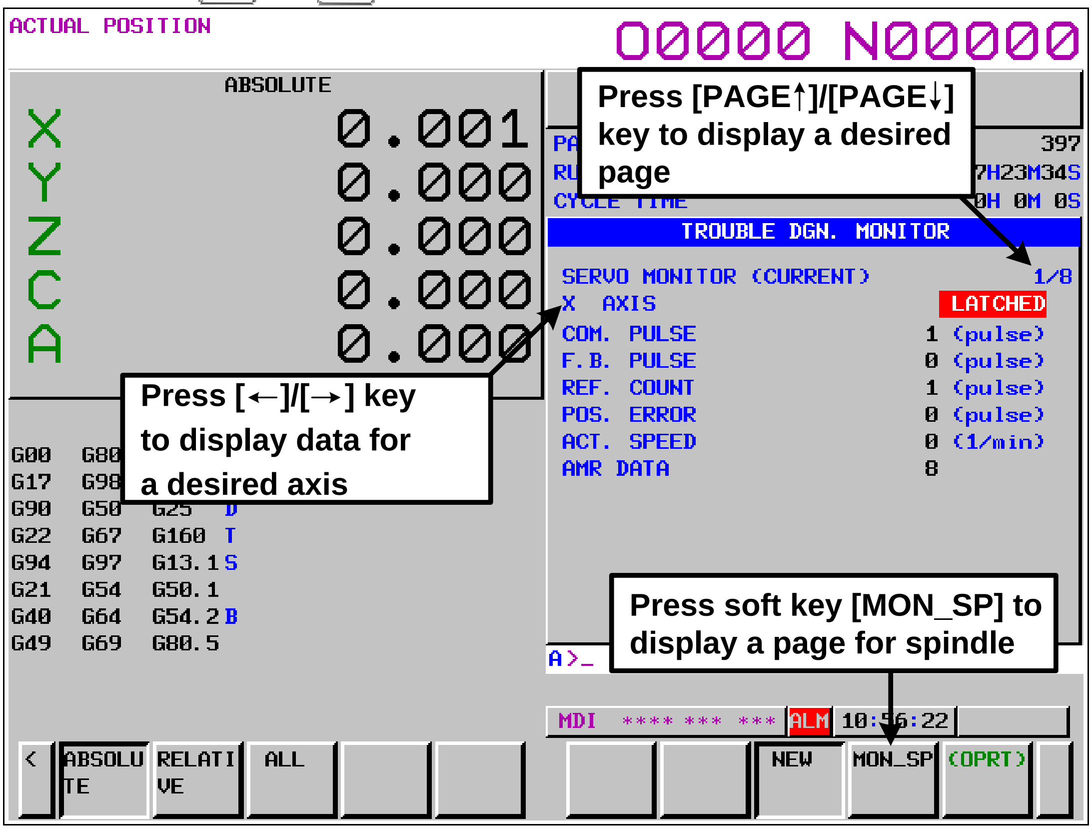
⇒Soft key [MON_SV] or [MON_SP]

Displaying data for a desired servo axis or spindle

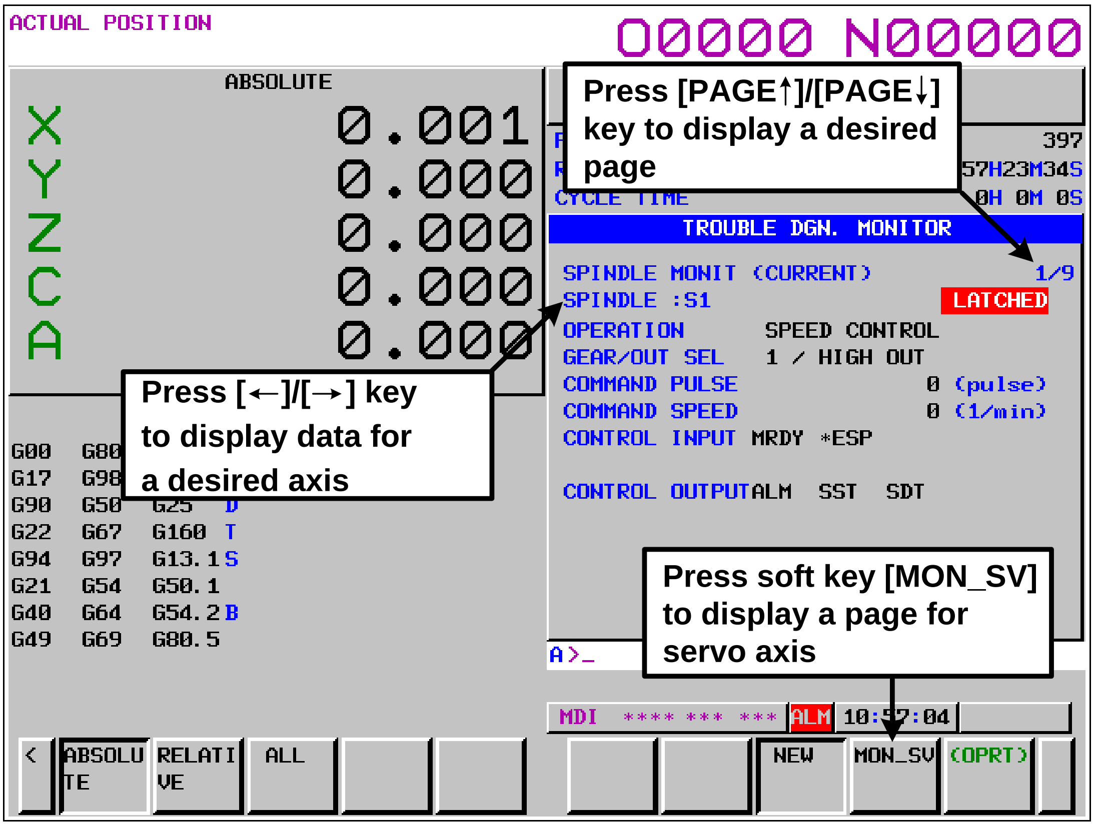
⇒Cursor key  or 

Displaying a desired page

⇒Page key  or 



Displaying a desired page [when the monitor screen displays servo axis data]



Displaying a desired page [when the monitor screen displays spindle data]

<2> Check the first digit of PS DGN.INFO. for the PS control axis (see the sample screen below). Perform either of the following operations according to the value:

When the first digit of PS DGN.INFO. is "1"

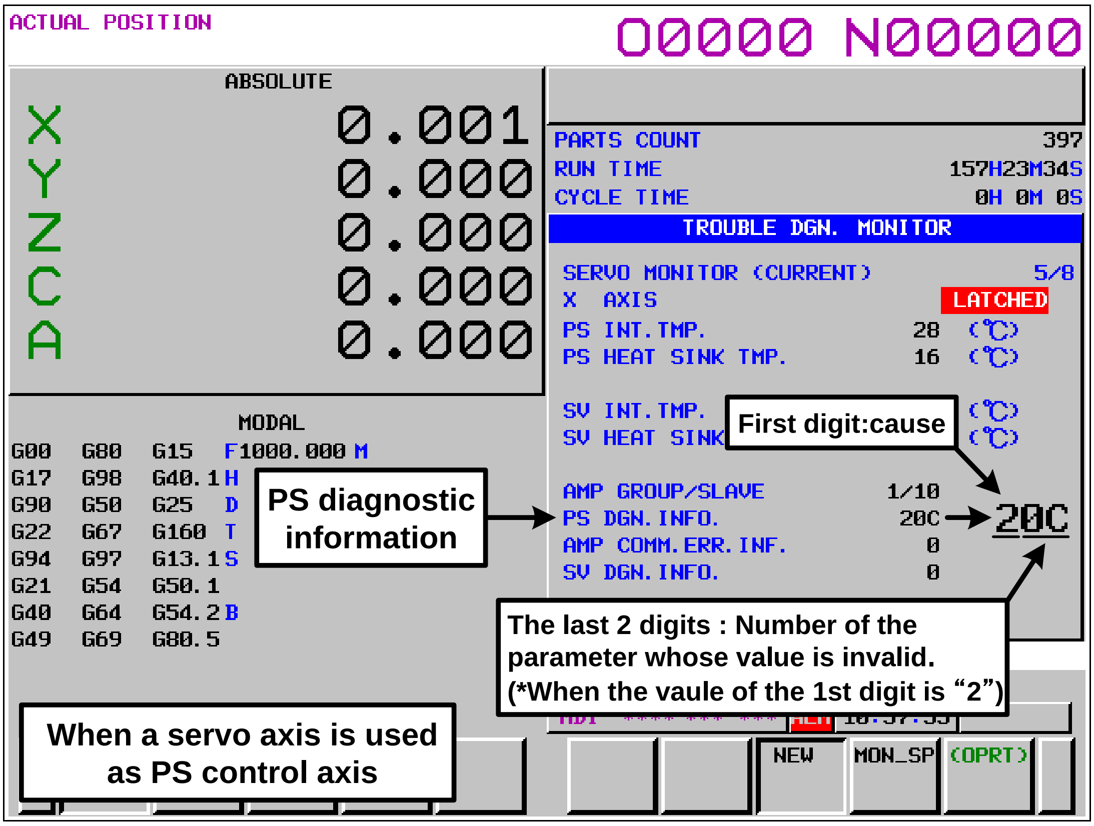
⇒Turn the power to the CNC off, then on again.

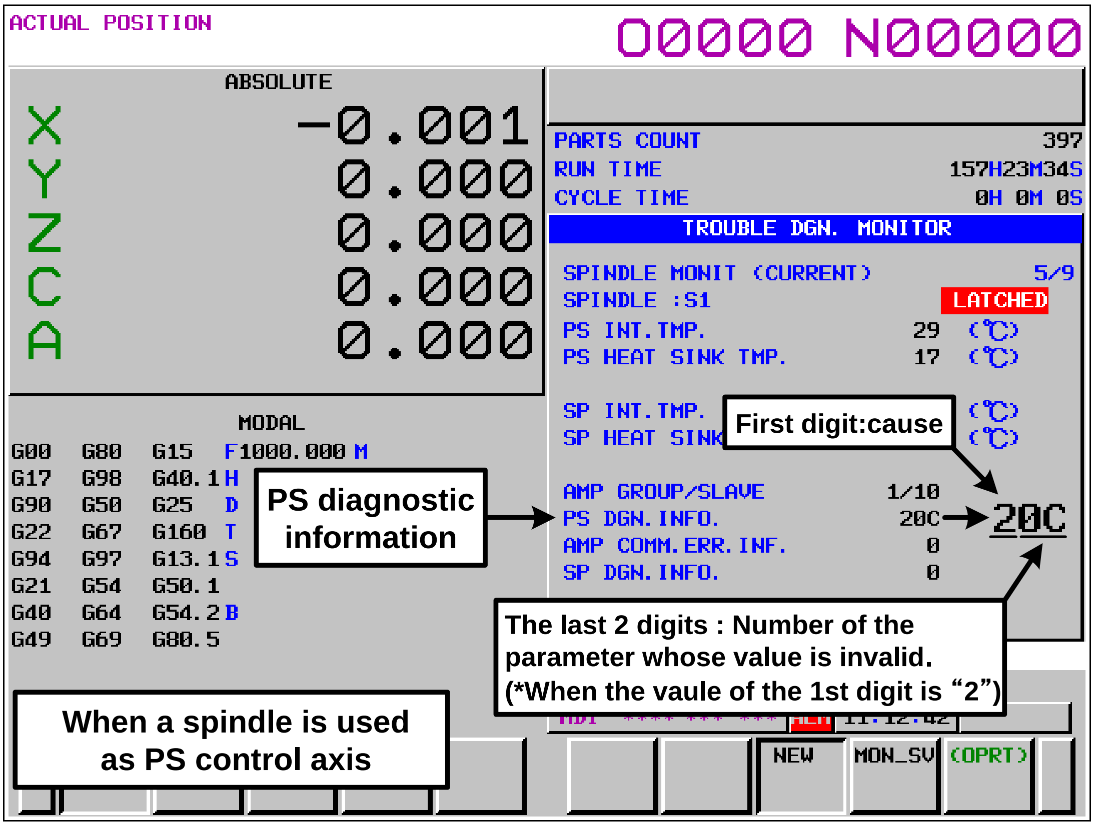
When the first digit of PS DGN.INFO. is "2"

⇒See the table below and check the parameter number corresponding to the value of the last two digits of PS DGN.INFO.

Values displayed on the TROUBLE DGN. MONITOR screen and their corresponding invalid setting parameters

Value of the last two digits of PS DGN.INFO.	CNC parameter number	
	PS control axis: SV	PS control axis: SP
00	No.2572/No.2573	No.4672/No.4673
01	No.2671	No.4771
02	No.2672	No.4772
03	No.2673	No.4773
04	No.2674	No.4774
05	No.2675	No.4775
06	No.2676	No.4776
07	No.2677	No.4777
08	No.2678	No.4778
09	No.2679	No.4779
0A	No.2680	No.4780
0B	No.2681	No.4781
0C	No.2682	No.4782
0D	No.2683	No.4783
0E	No.2684	No.4784
0F	No.2685	No.4785





<3> See Subsection 15.2.2, "Details of Parameters" and set a valid value.

NOTE
Set "0" for unused parameters.

<4> Turn the power to the CNC off, then on again.

15.1.5 Alarms

The following table shows alarms related to parameters for Power Supplies.

Alarms related to parameters for Power Supplies

Alarm No.	Alarm name	Description
SV0031	PS ILLEGAL PARAMETER (PS control axis)	• A parameter for Power Supplies was changed. • An invalid value was set in a parameter for Power Supplies.
SV0417	ILL DGTL SERVO PARAMETER (NOTE) (non-PS control axis)	• A value other than "0" is set in a parameter for Power Supplies for servo axes.
SP9211	PS ILLEGAL PARAMETER (PS control axis)	• A parameter for Power Supplies was changed. • An invalid value was set in a parameter for Power Supplies.
	PS ILLEGAL PARAMETER (non-PS control axis)	• A value other than "0" is set in a parameter for Power Supplies for Spindles.

NOTE
For details of invalid parameters, refer to the following parameter manuals: FANUC AC SERVO MOTOR αi series/βi series, LINEAR MOTOR L*i*S series FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR D*i*S series PARAMETER MANUAL (B-65270EN/08 or later)

15.2 PARAMETERS

15.2.1 Overview of Parameters

The following table shows parameters for Power Supplies and series and editions of applicable software.

Internal number*1	CNC parameter number PS control axis*2 SV	SP	bit	Description	Series and edition of applicable software*3
P000[H]	2572	4672	07 to 06	Not used*4	
			05	Setting of power failure detection at emergency stop	Series 9G00 edition 18.0 or later Series 9G10 edition 06.0 or later
			04	Not used*4	
			03	Setting of thermostat connection of external I/O devices	Series 9G10 edition 01.0 or later
			02	Setting of power failure detection specifications	Series 9G10 edition 01.0 or later
			01 to 00	Not used*4	
P000[L]	2573	4673	07 to 00	Not used*4	
P001 | P013	2671 | 2683	4771 | 4783	-	Not used*4	
P014	2684	4784	-	Power failure detection level 1 / Power failure detection time 1	Series 9G00 edition 08.0 or later Series 9G10 edition 01.0 or later
P015	2685	4785	-	Power failure detection level 2 / Power failure detection time 2	Series 9G00 edition 08.0 or later Series 9G10 edition 01.0 or later

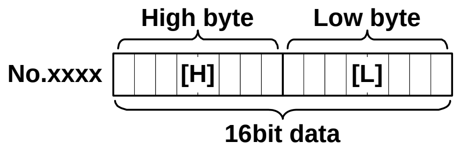
NOTE

*1 Internal parameter number used in Power Supply software
*2 For details of the PS control axis, see Subsection 15.3.1, "PS Control Axis."
*3 For details of how to check the series and edition of Power Supply software, see Section 15.4, "CHECKING THE SERIES AND EDITION OF POWER SUPPLY SOFTWARE."
*4 Set "0" for unused parameters.

15.2.2 Details of Parameters

NOTE

"[H]" and "[L]" at the end of the parameter number means the high byte and low byte of parameter No. xxxx, respectively (see the figure below).



Sample settings
No.4784[H]: Power failure detection level 1 = 70
No.4784[L]: Power failure detection time 1 = 10
When the above settings are made, the setting of parameter No.4784 is:
No.4784 = 70 × 256 + 10 = 17930

Internal number	Parameter No. PS control axis SV	SP	#7	#6	#5	#4	#3	#2	#1	#0
P000[H]	2572[H]	4672[H]			ESPREC		EXTTH	PFLPFB		

PFL PFB: Setting of power failure detection specifications
0: Does not conform to the power failure detection specifications when PFB-R/PFB-C is connected.
1: Conforms to the power failure detection specifications when PFB-R/PFB-C is connected.

Sets the power failure detection specifications. To enable the same power failure detection as if PFB-R/PFB-C were connected when PFB-R/PFB-C is not connected, specify "1."

NOTE

This parameter is valid in series 9G10 edition 01.0 or later.
This parameter is invalid in series 9G00.

EXTTH: Setting of thermostat connection of external I/O devices
0: Does not connect the thermostat of external I/O devices.
1: Connects the thermostat of external I/O devices.

To use external input devices' thermostat, specify "1."

NOTE

This parameter is valid in series 9G10 edition 01.0 or later.
This parameter is invalid in series 9G00.

ESPREC: Setting of power failure detection at emergency stop
0: Disables power failure detection at emergency stop
1: Enables power failure detection at emergency stop

To detect power failure and recovery at emergency stop, specify "1."

> **NOTE**
> This parameter is valid in series 9G00 edition 18.0 or later and series 9G10 edition 06.0 or later.

Internal number	Parameter No. PS control axis SV	SP	
P014[H]	**2684[H]**	**4784[H]**	**Power failure detection level 1**

[Unit of data] 1%
[Valid data range] 0, 25 to 80
[Standard setting] 0 (When "0" is set as a value, it means "70%.")
Set a power failure detection condition. For details, see the item, "P015[L]: Power failure detection time 2."

> **NOTE**
> This parameter is valid in series 9G00 edition 08.0 or later and series 9G10 edition 01.0 or later.

Internal number	Parameter No. PS control axis SV	SP	
P014[L]	**2684[L]**	**4784[L]**	**Power failure detection time 1**

[Unit of data] 1msec
[Valid data range] 0, 5 to 100
[Standard setting] 0 (When "0" is set as a value, it means "10msec.")
Set a power failure detection condition. For details, see the item, "P015[L]: Failure detection time 2."

> **NOTE**
> This parameter is valid in series 9G00 edition 08.0 or later and series 9G10 edition 01.0 or later.

Internal number	Parameter No. PS control axis SV	SP	
P015[H]	**2685[H]**	**4785[H]**	**Power failure detection level 2**

[Unit of data] 1%
[Valid data range] 0, 25 to 80
[Standard setting] 0 (When "0" is set as a value, it means "71%.")
Set a power failure detection condition. For details, see the item, "P015[L]: Failure detection time 2."

> **NOTE**
> This parameter is valid in series 9G00 edition 08.0 or later and series 9G10 edition 01.0 or later.

Internal number	Parameter No. PS control axis SV	SP	
P015[L]	**2685[L]**	**4785[L]**	**Power failure detection time 2**

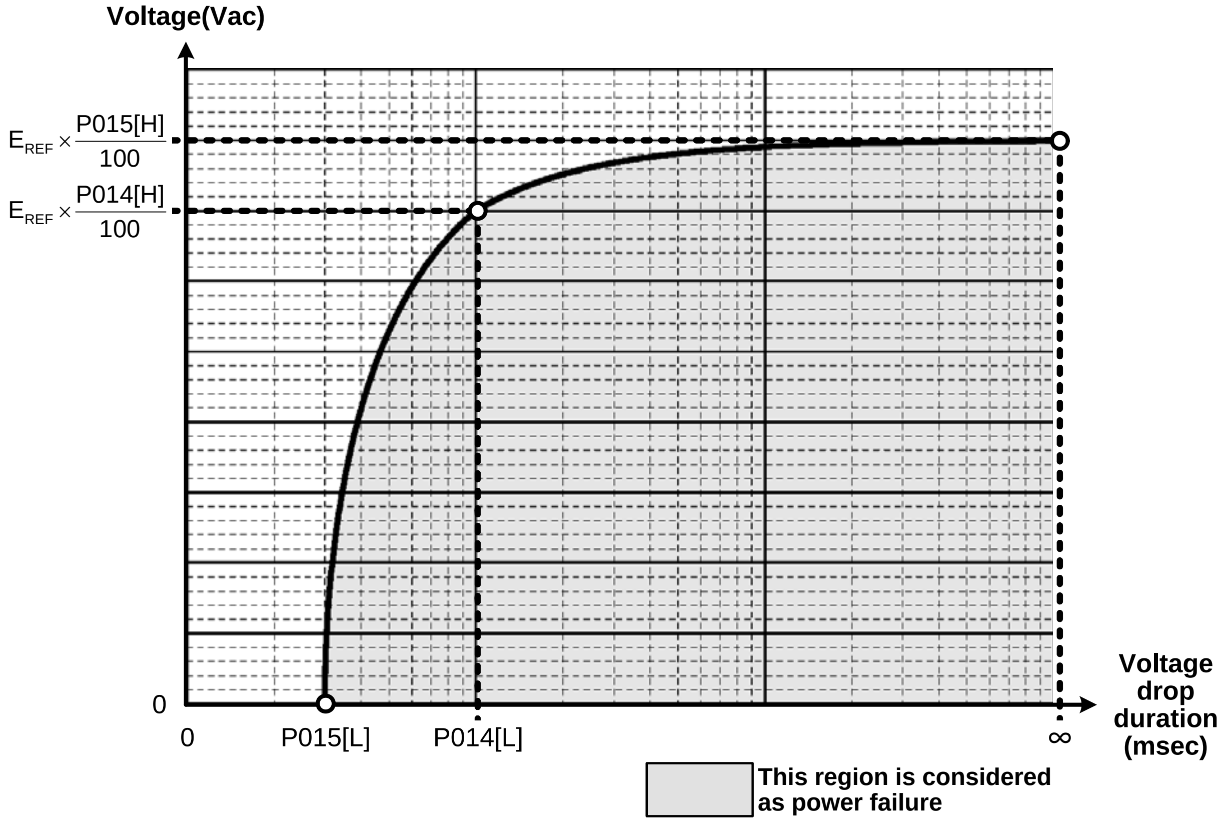
[Unit of data] 1msec
[Valid data range] 0 to 100
[Standard setting] 0 (When "0" is set as a value, it means "3msec.")
Set a power failure detection condition.

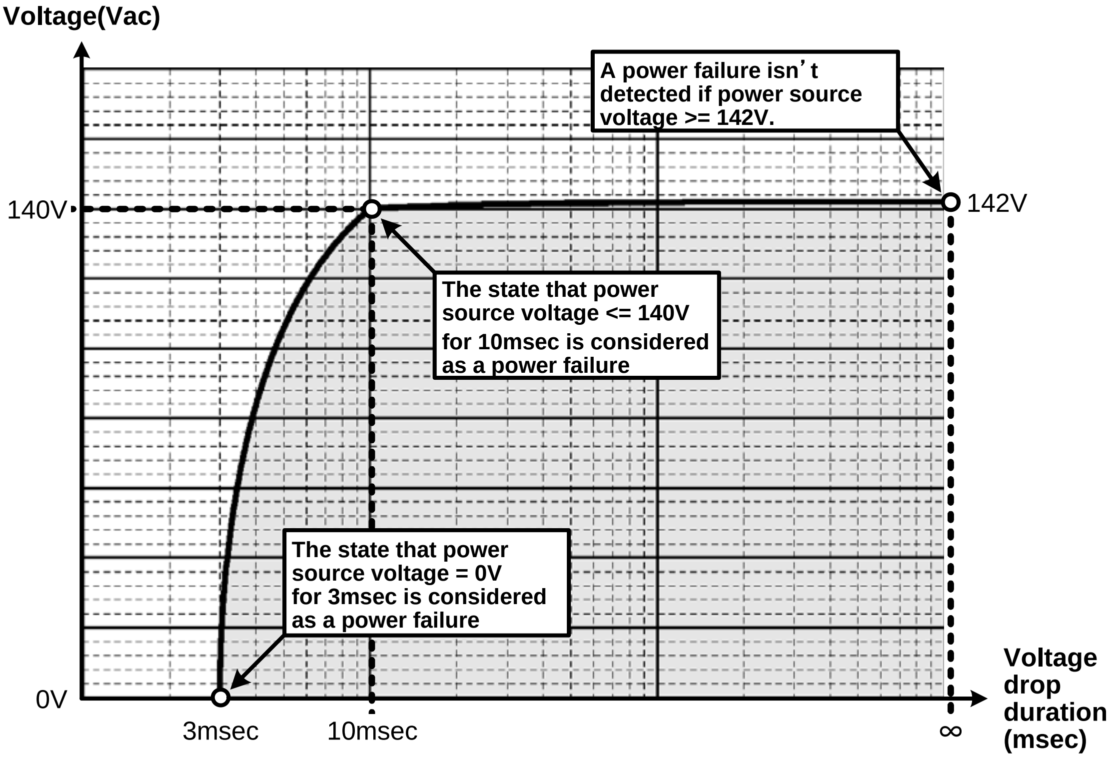
(1) Power failure detection condition according to the DC-link voltage
Voltage drop of DC-link which satisifies the condition below is considered as power failure.

$$\text{DC link voltage} \leq V_{REF} \times \frac{\text{P014[H]}}{100}$$

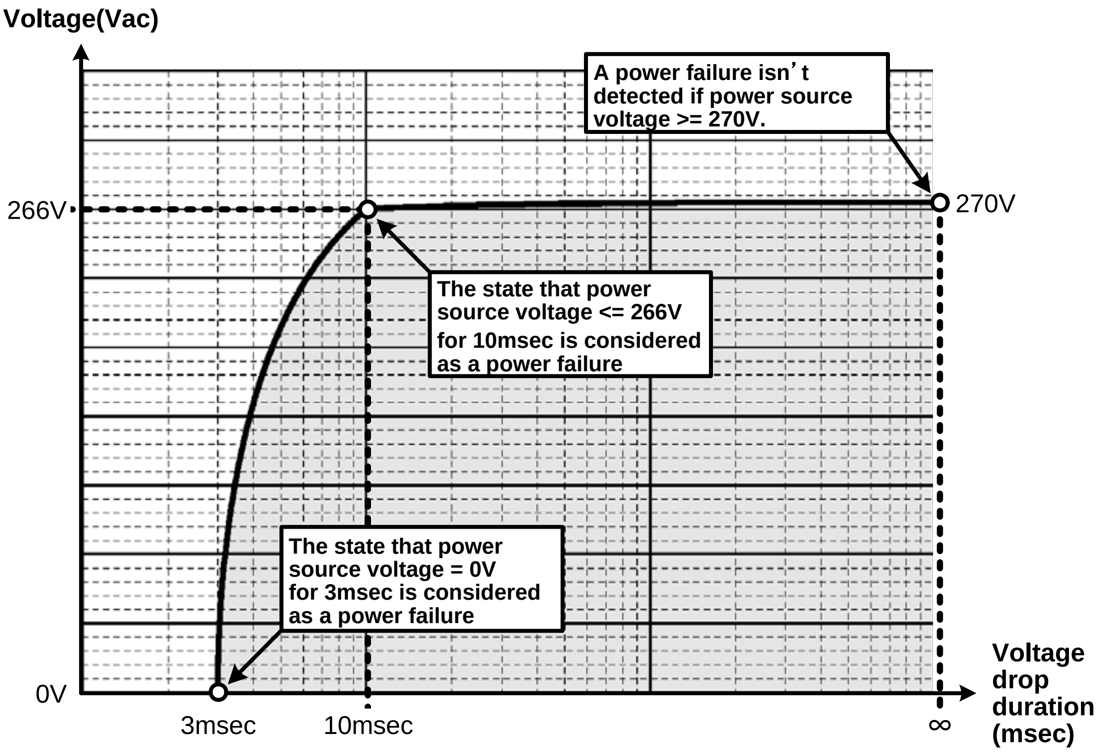
where, V_{REF} = 283Vdc (for a 200 V input series Power Supply)
= 537Vdc (for a 400 V input series Power Supply)

(2) Power failure detection condition according to the input power supply voltage
Voltage drop of commercial power source which satisfies the condition shown in the figure below is considered as a power failure.
where, E_{REF} =200Vac (for a 200 V input series Power Supply)
=380Vac (for a 400 V input series Power Supply)





Power failure detection characteristics when the default setting is made (all parameters are set to "0") [for 200 V input series Power Supplies]



Power failure detection characteristics when the default setting is made (all parameters are set to "0") [for 400 V input series Power Supplies]

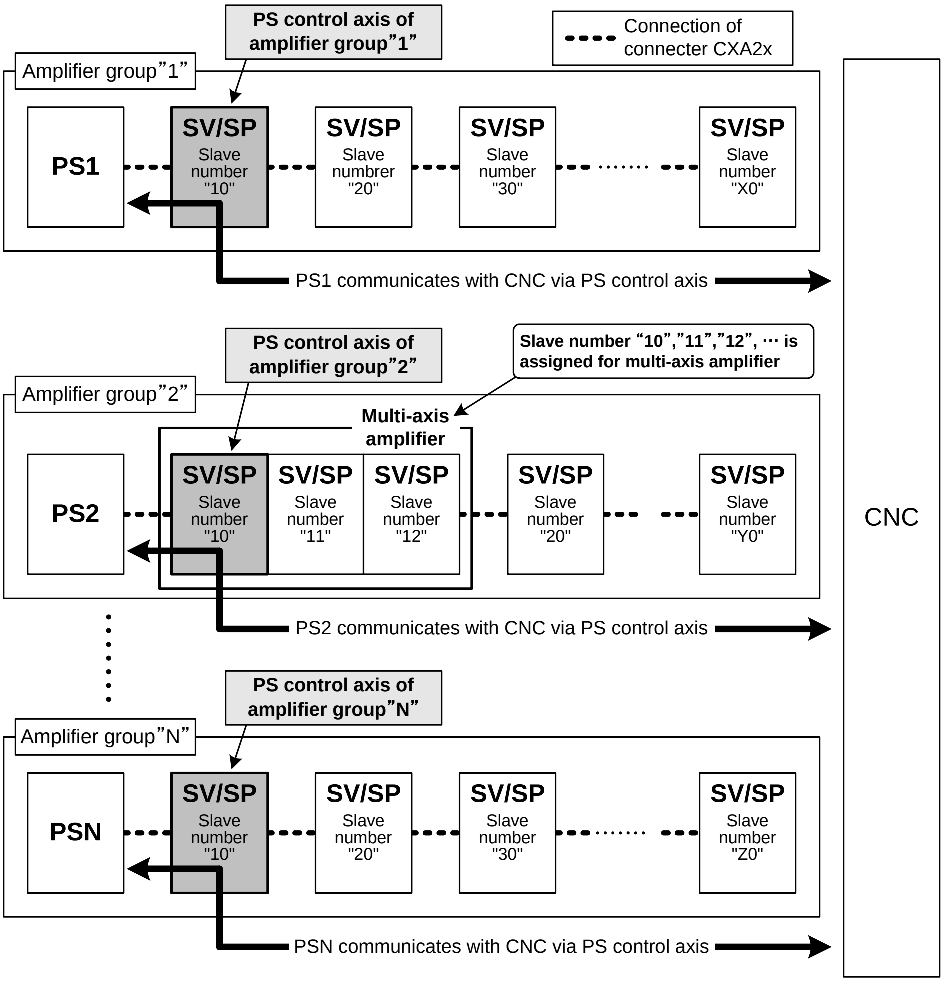
NOTE

This parameter is valid in series 9G00 edition 08.0 or later and series 9G10 edition 01.0 or later.

15.3 CONNECTION AMONG SERVO AMPLIFIERS

15.3.1 PS Control Axis

A set of one Power Supply and the Servo/Spindle Amplifiers connected to it is defined as one "amplifier group." In a system having more than one Power Supply, there are multiple amplifier groups.
In an amplifier group, a "slave number," 10, 20, 30, ..., or 150 is assigned to each of the Servo/Spindle Amplifiers connected to the Power Supply in order of connection[*NOTE]. The axis having the smallest slave number "10" in each amplifier group is defined as a "PS control axis."
Data communication between the Power Supply and CNC is performed via the PS control axis.



NOTE

This means the connection of inter-amplifier communication linked by connector CXA2x.
It does not mean the connection of FSSB.

15.3.2 Servo Amplifier Connection Check

The connection among Servo/Spindle Amplifiers and the Power Supply that supplies the main power to them is available on the TROUBLE DGN. MONITOR screen.

> **NOTE**
> Specifying PS control axis is required before using parameters for Power Supplies. If PS control axis has not specified yet, perform automatic determination by setting No.11549#0=1.
> For details, see "FANUC SERVO AMPLIFIER αi series for 30*i*-B series CNC MAINTENANCE MANUAL."

15.3.2.1 Displaying TROUBLE DGN. MONITOR (CURRENT)

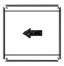
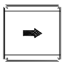
To check the connection among amplifiers, use the TROUBLE DGN. MONITOR (CURRENT) screen.

<1> Display the TROUBLE DGN. MONITOR (CURRENT) screen.
For details of how to display the screen, see Subsection 15.1.4.1, "Displaying the TROUBLE DGN. MONITOR (CURRENT) screen."

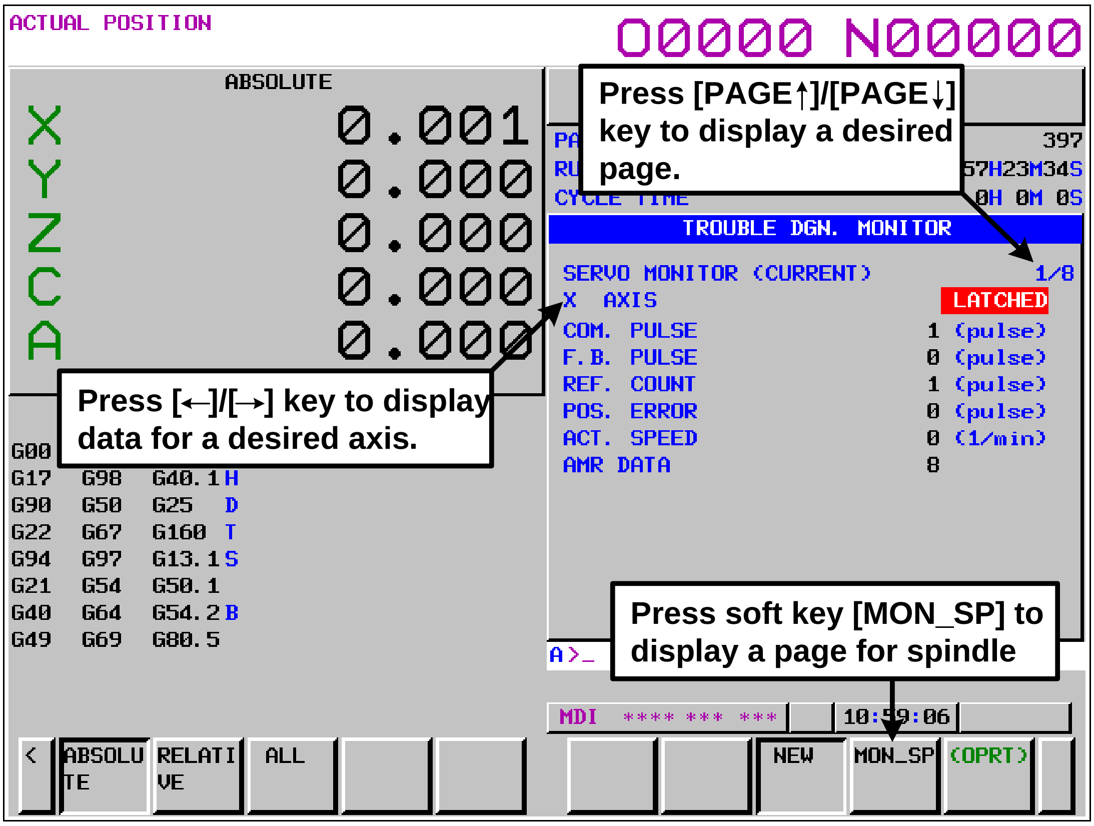
15.3.2.2 Checking the connection among amplifiers

Follow the procedure below to check the connection among amplifiers.

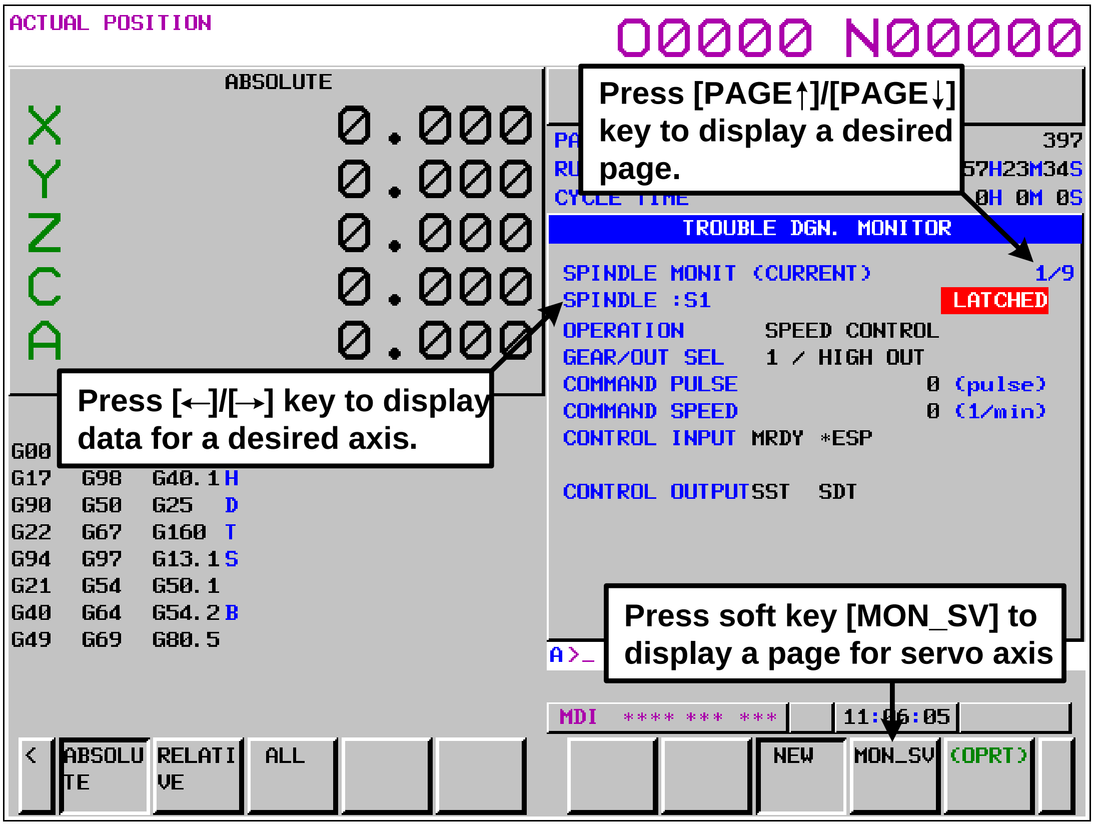
<1> Select the TROUBLE DGN. MONITOR (CURRENT) screen and display the "amplifier group number" of the target servo axis and spindle.
For servo axes
⇒Page "5/8" of the TROUBLE DGN. MONITOR (CURRENT) screen
For spindles
⇒Page "5/9" of the TROUBLE DGN. MONITOR (CURRENT) screen

[Displaying a desired page of the TROUBLE DGN. MONITOR (CURRENT) screen]
Displaying a page for a servo axis or spindle
⇒Soft key [MON_SV] or [MON_SP]
Displaying data for a desired servo axis or spindle
⇒Cursor key  or 
Displaying a desired page
⇒Page key 

or 

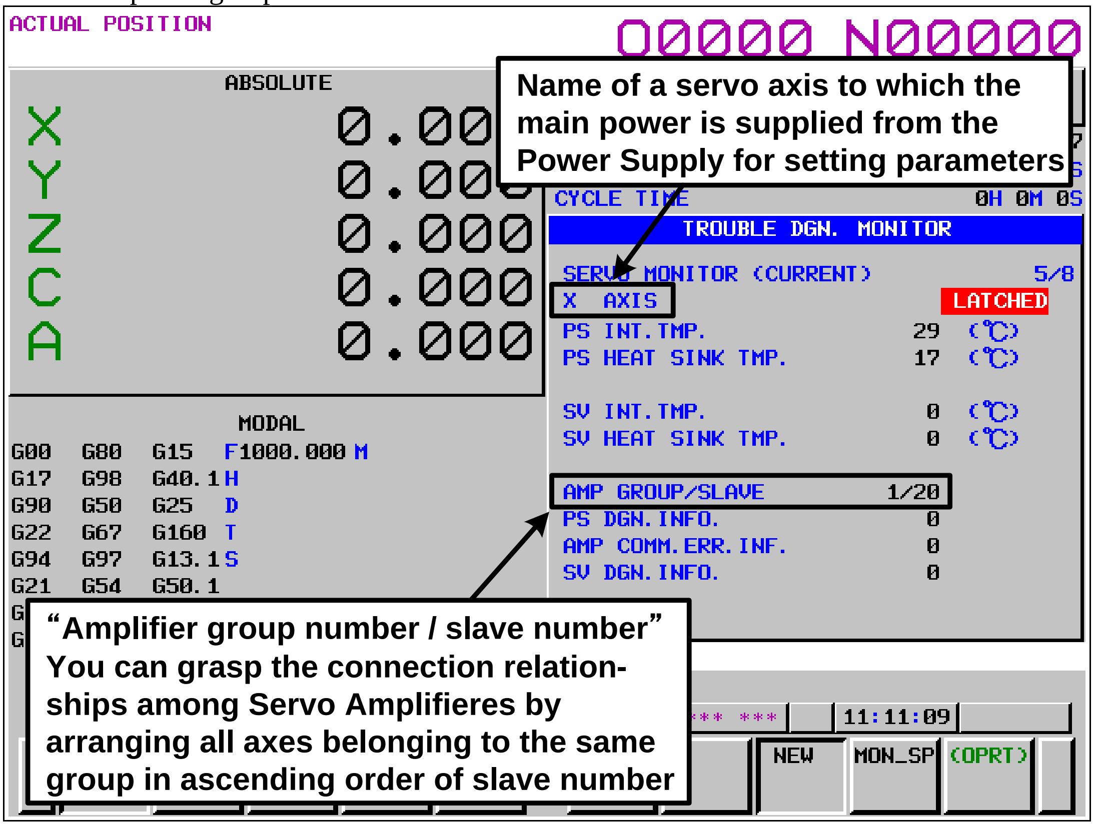


Displaying a desired page [when the monitor screen displays servo axis data]

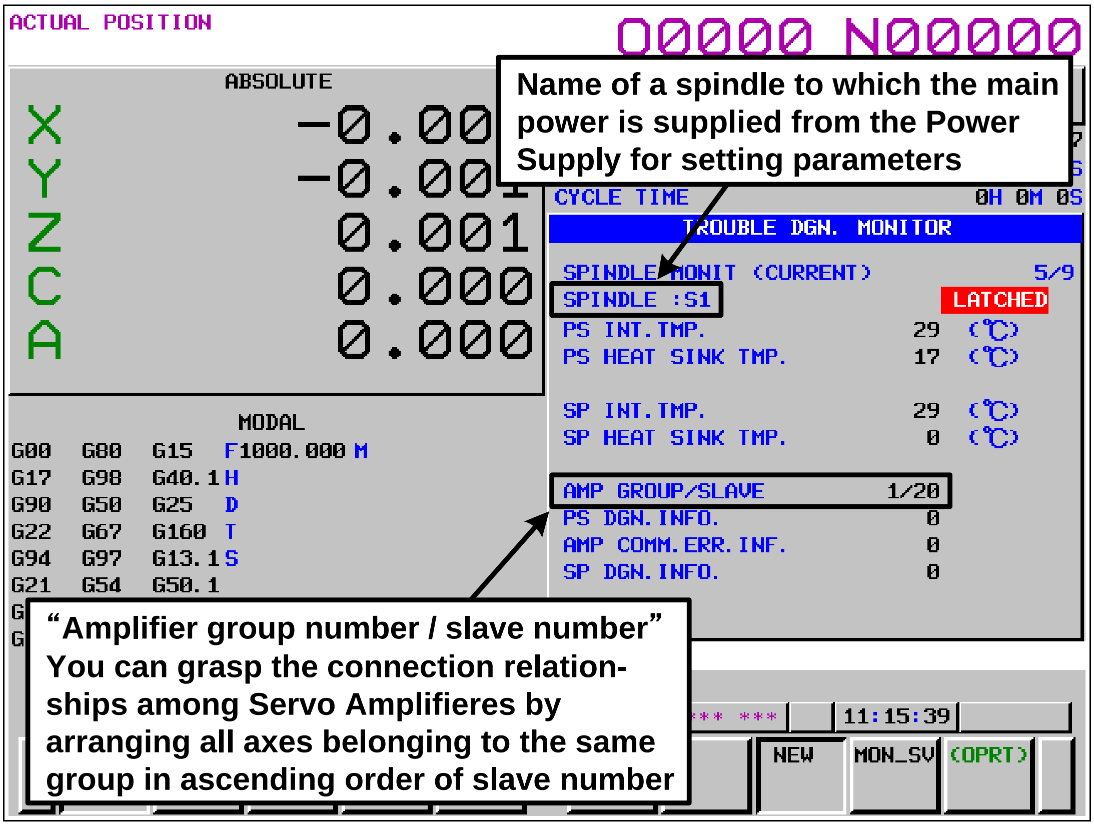


Displaying a desired page [when the monitor screen displays spindle data]

<2> On the TROUBLE DGN. MONITOR (CURRENT) screen, check the servo axes and spindle having the same amplifier group number.



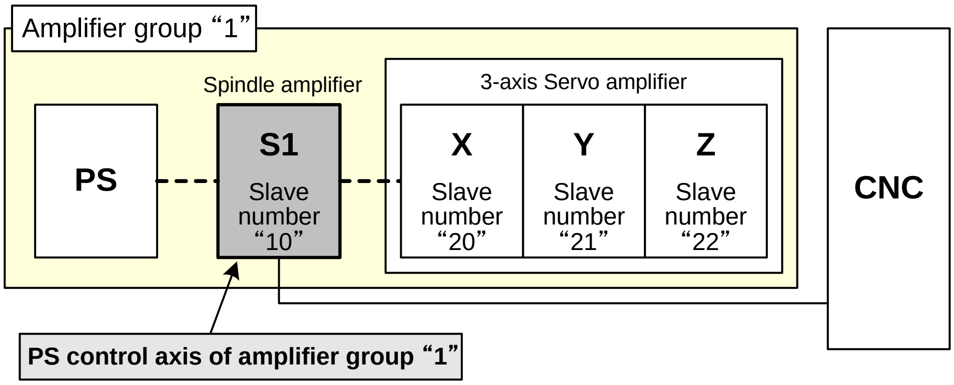
Checking the amplifier group number [when the monitor screen displays servo axis data]

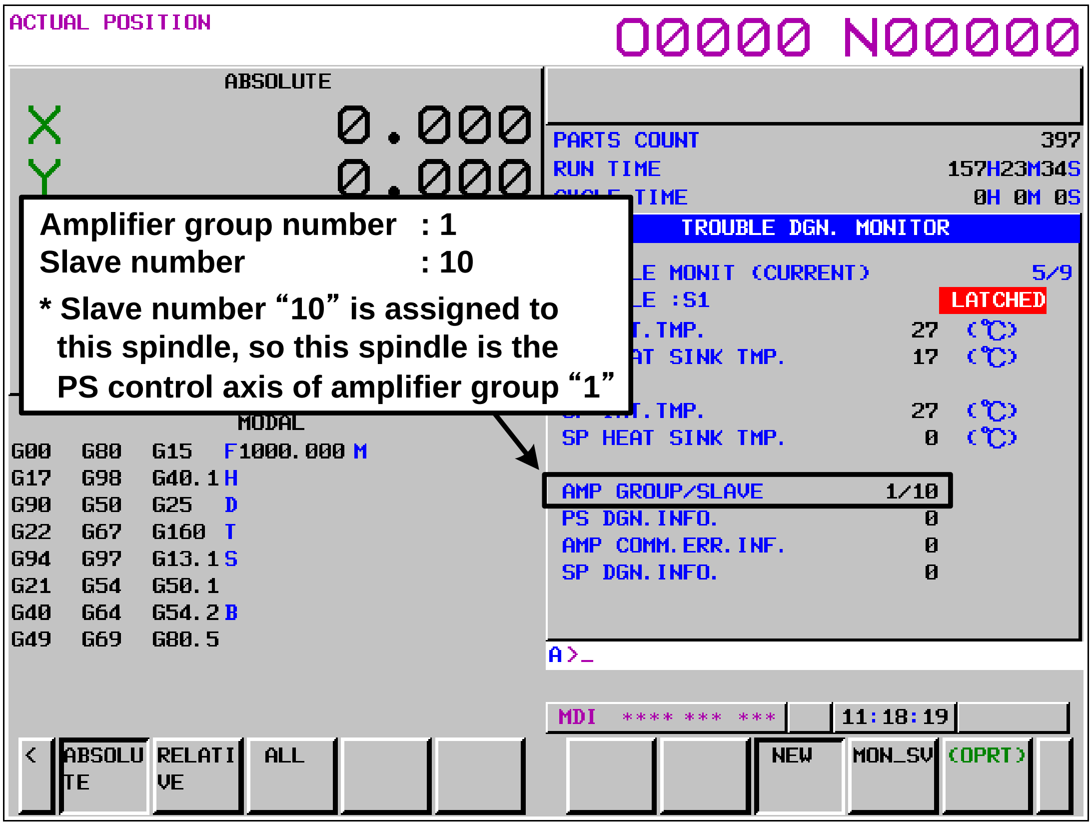


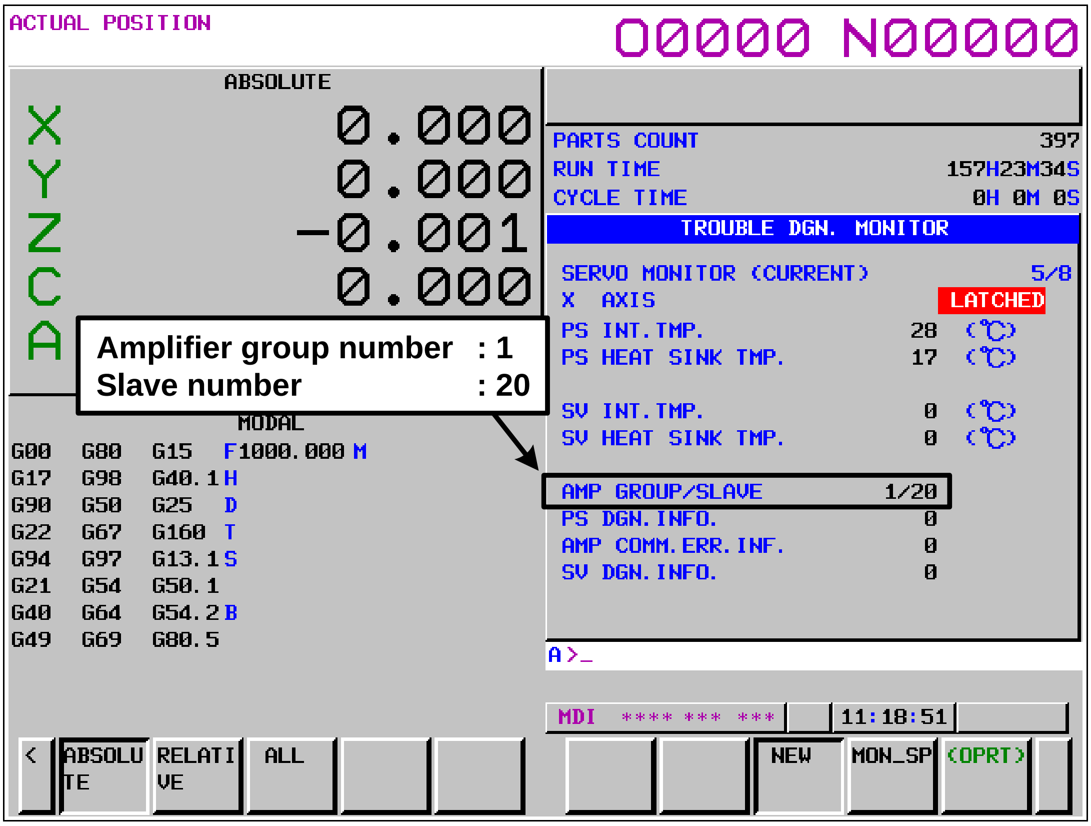
Checking the amplifier group number [when the monitor screen displays spindle data]

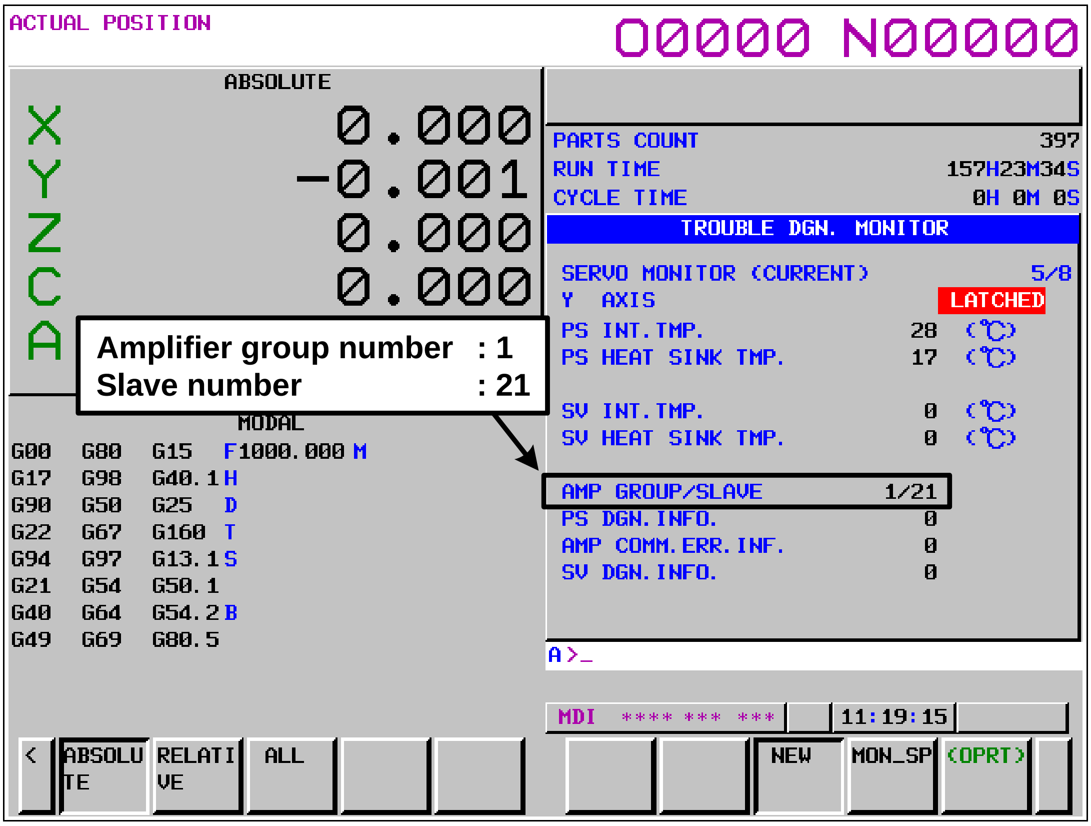
<3> Arrange the servo axes and spindle having the same amplifier group number in ascending order of slave number to check the connection among the Servo Amplifiers.

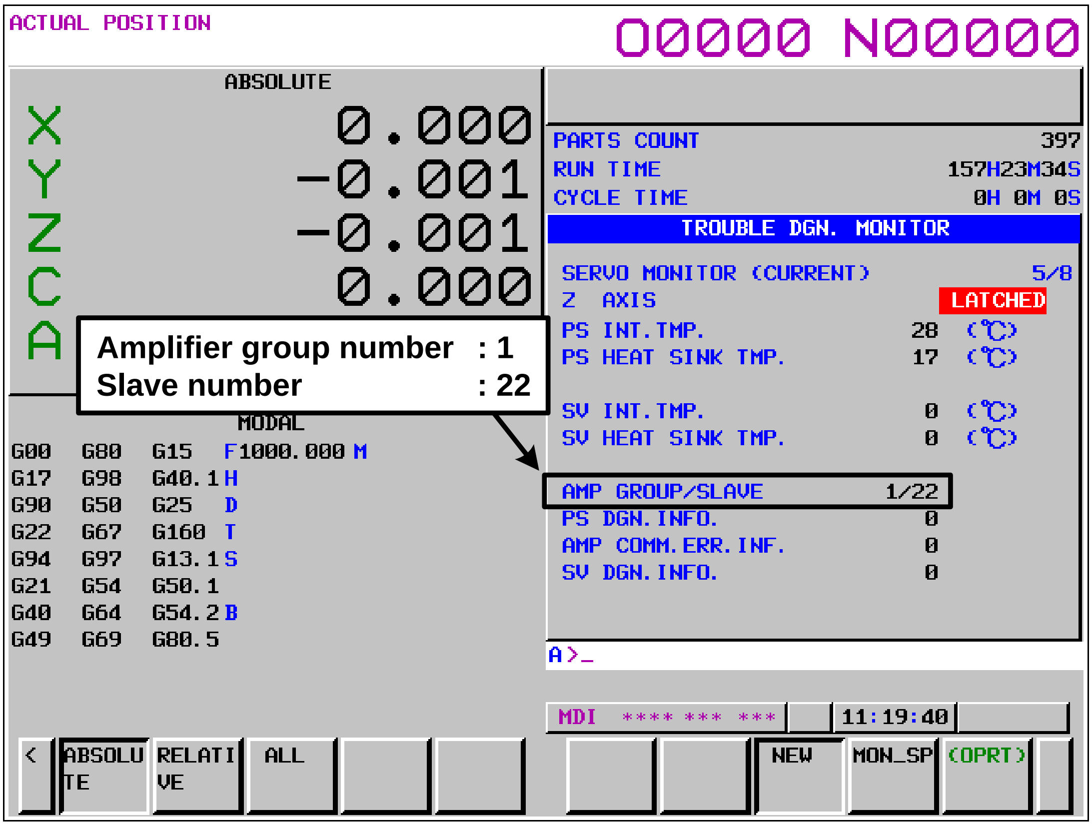
<4> When Servo Amplifiers are configured as follows, the TROUBLE DGN. MONITOR (CURRENT) screen displays data as shown in the figures below.





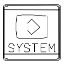

ACTUAL POSITION
O0000 N00000
ABSOLUTE
X 0.000
Y 0.000
Z -0.001
C 0.000
A
Amplifier group number : 1
Slave number : 20
MODAL
G00 G80 G15 F1000.000 M
G17 G98 G40.1 H
G90 G50 G25 D
G22 G67 G160 T
G94 G97 G13.1 S
G21 G54 G50.1
G40 G64 G54.2 B
G49 G69 G80.5
PARTS COUNT 397
RUN TIME 157H23M34S
CYCLE TIME 0H 0M 0S
TROUBLE DGN. MONITOR
SERVO MONITOR (CURRENT) 5/8
X AXIS
LATCHED
PS INT.TMP. 28 (℃)
PS HEAT SINK TMP. 17 (℃)
SV INT.TMP. 0 (℃)
SV HEAT SINK TMP. 0 (℃)
AMP GROUP/SLAVE 1/20
PS DGN.INFO. 0
AMP COMM.ERR.INF. 0
SV DGN.INFO. 0
A>_
MDI **** *** *** 11:18:51
ABSOLUTE
RELATIVE
ALL
NEW
MON_SP
(OPRT)


ACTUAL POSITION
O0000 N00000
ABSOLUTE
X 0.000
Y -0.001
Z 0.000
C 0.000
A
Amplifier group number : 1
Slave number : 21
MODAL
G00 G80 G15 F1000.000 M
G17 G98 G40.1 H
G90 G50 G25 D
G22 G67 G160 T
G94 G97 G13.1 S
G21 G54 G50.1
G40 G64 G54.2 B
G49 G69 G80.5
PARTS COUNT 397
RUN TIME 157H23M34S
CYCLE TIME 0H 0M 0S
TROUBLE DGN. MONITOR
SERVO MONITOR (CURRENT) 5/8
Y AXIS
LATCHED
PS INT.TMP. 28 (℃)
PS HEAT SINK TMP. 17 (℃)
SV INT.TMP. 0 (℃)
SV HEAT SINK TMP. 0 (℃)
AMP GROUP/SLAVE 1/21
PS DGN.INFO. 0
AMP COMM.ERR.INF. 0
SV DGN.INFO. 0
A>_
MDI **** *** *** 11:19:15
ABSOLUTE
RELATIVE
ALL
NEW
MON_SP
(OPRT)

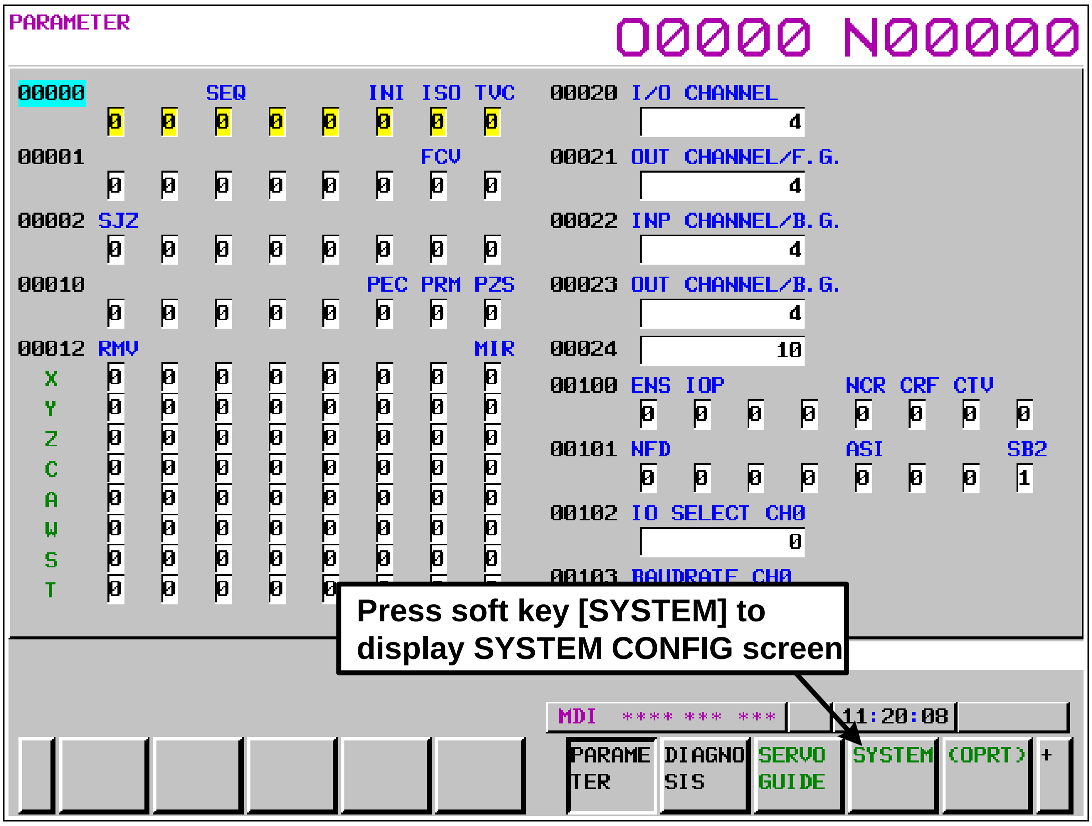

ACTUAL POSITION
O0000 N00000
ABSOLUTE
X 0.000
Y -0.001
Z -0.001
C 0.000
A
Amplifier group number : 1
Slave number : 22
MODAL
G00 G80 G15 F1000.000 M
G17 G98 G40.1 H
G90 G50 G25 D
G22 G67 G160 T
G94 G97 G13.1 S
G21 G54 G50.1
G40 G64 G54.2 B
G49 G69 G80.5
PARTS COUNT 397
RUN TIME 157H23M34S
CYCLE TIME 0H 0M 0S
TROUBLE DGN. MONITOR
SERVO MONITOR (CURRENT) 5/8
Z AXIS LATCHED
PS INT.TMP. 28 (℃)
PS HEAT SINK TMP. 17 (℃)
SV INT.TMP. 0 (℃)
SV HEAT SINK TMP. 0 (℃)
AMP GROUP/SLAVE 1/22
PS DGN.INFO. 0
AMP COMM.ERR.INF. 0
SV DGN.INFO. 0
A>_
MDI **** *** *** 11:19:40
< ABSOLUTE RELATIVE ALL NEW MON_SP (OPRT)

15.4 CHECKING THE SERIES AND EDITION OF POWER SUPPLY SOFTWARE

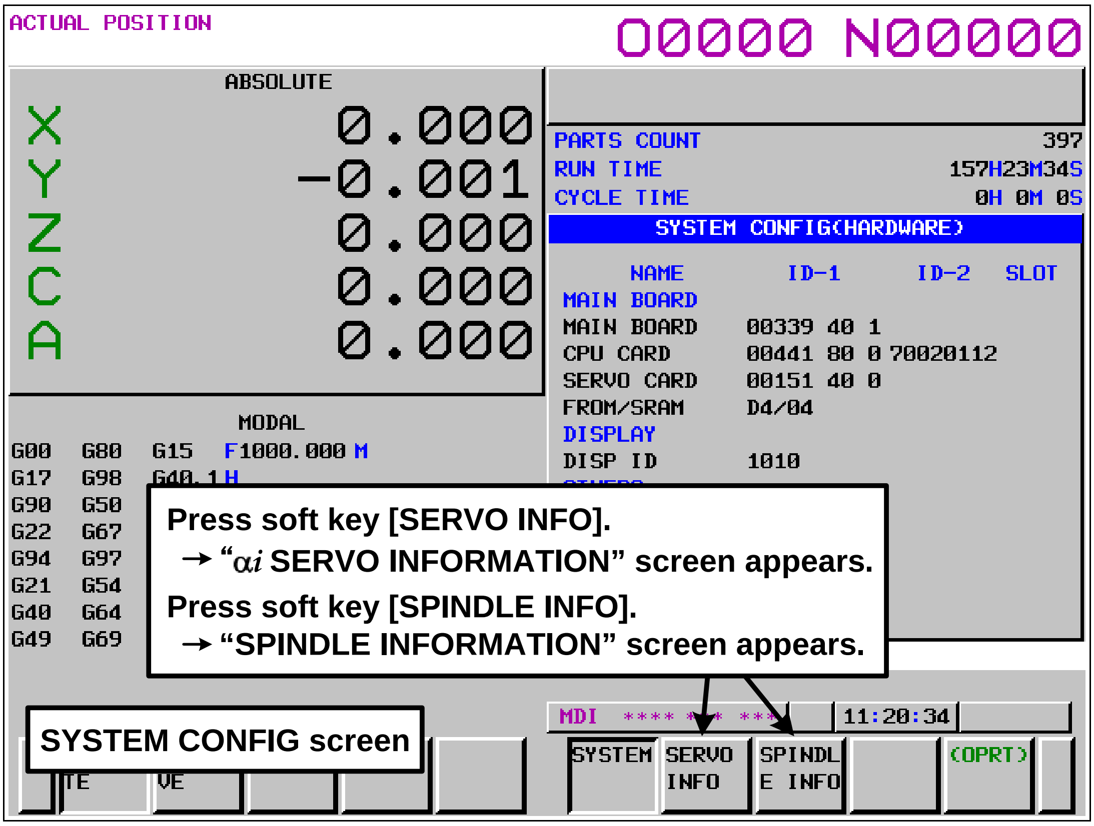
The series and edition of Power Supply software is available on the αi SERVO INFORMATION or SPINDLE INFORMATION screen. Follow the procedure below.

<1> Press function key 

to display the PARAMETER screen.



<2> Press the soft key [SYSTEM] to display the SYSTEM CONFIG screen.



<3> Display the information screen according to the type of axis connected to the Power Supply.

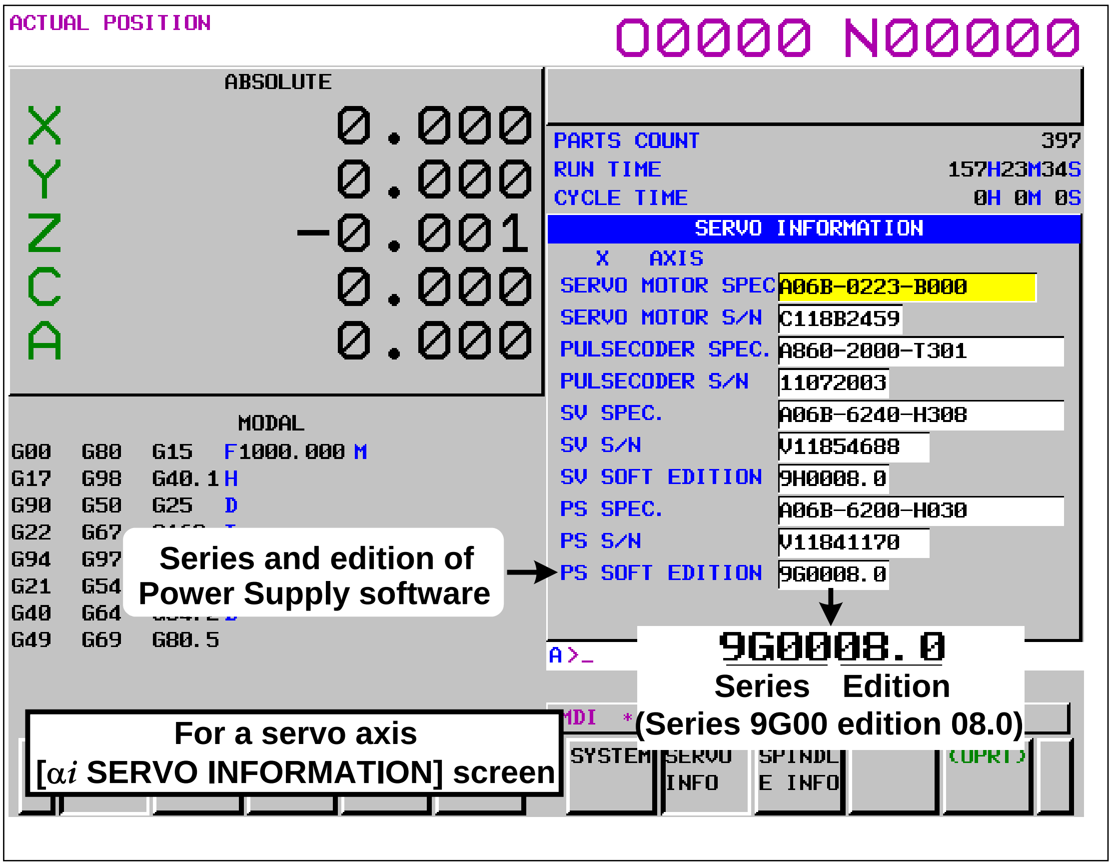
For servo axes

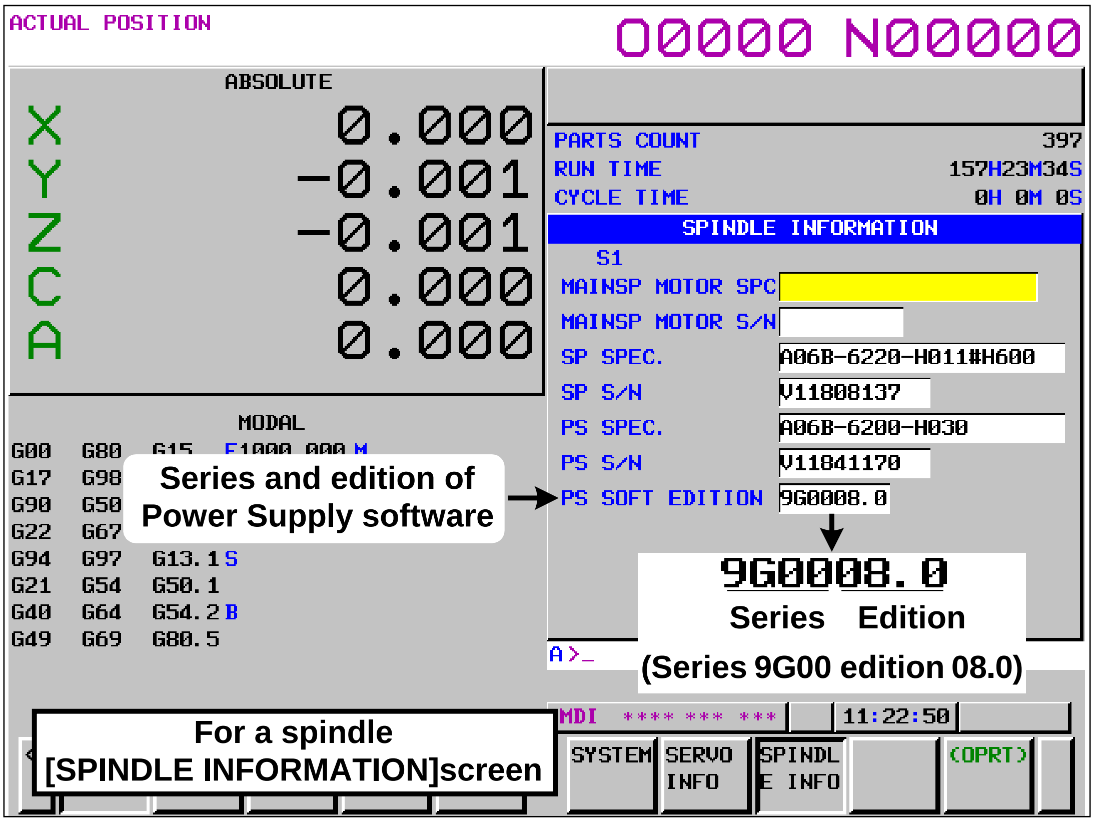
⇒Press the soft key [SERVO INFO] to display the α*i* SERVO INFORMATION screen.

For spindles

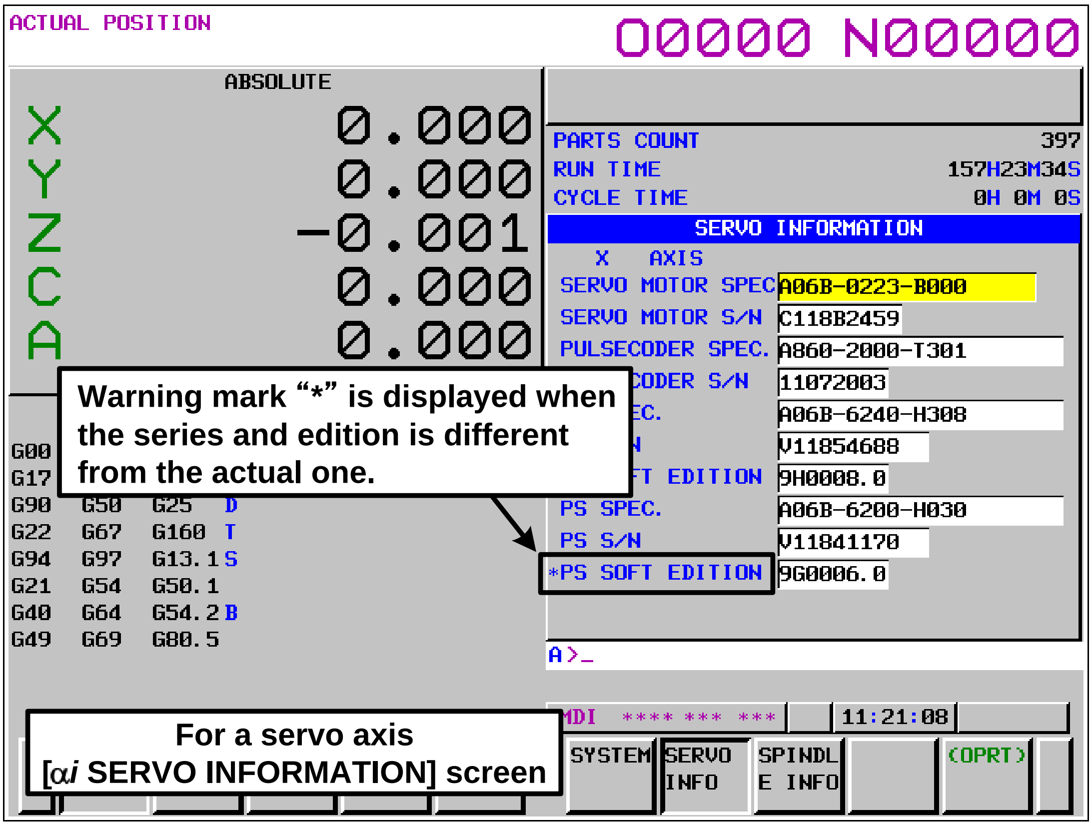
⇒Press the soft key [SPINDLE INFO] to display the SPINDLE INFORMATION screen.

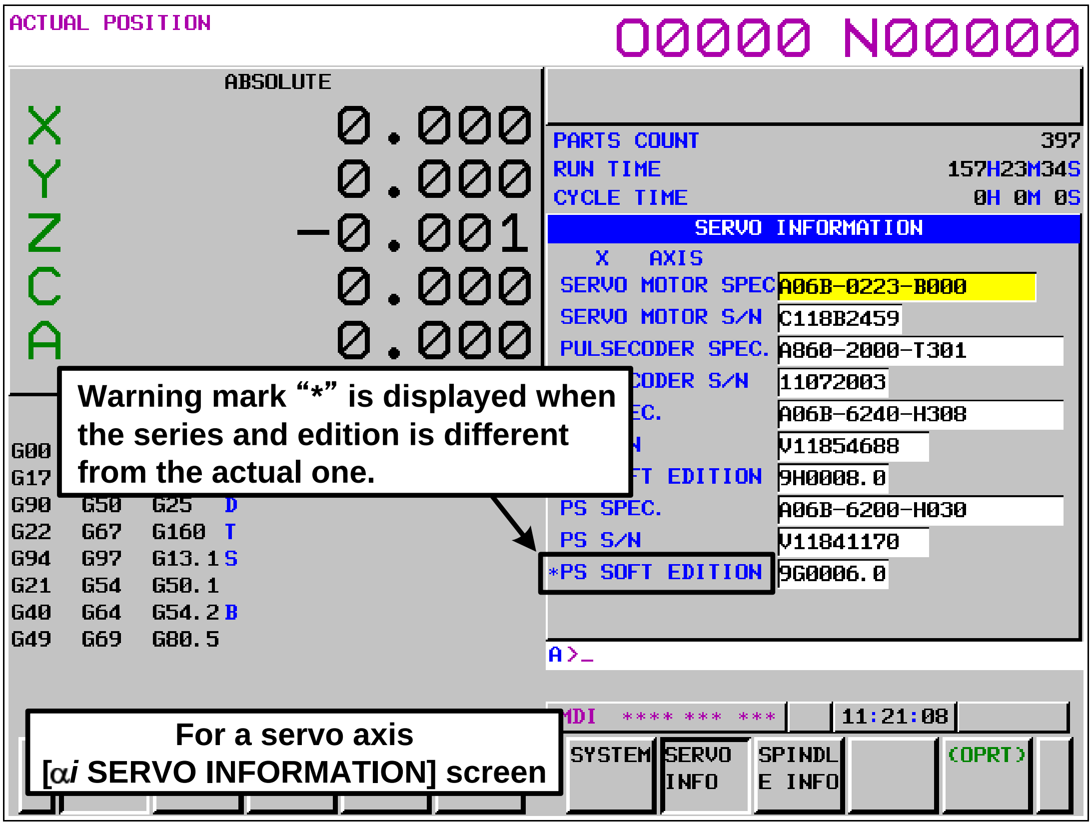
<4> From the value displayed for "PS SOFT EDITION," check the series and edition of Power Supply software.





If nothing is displayed for the series and edition of Power Supply software or the displayed value is not the actual series and edition of Power Supply software (warning mark "*" is displayed), update the series and edition information of Power Supply software as instructed in the Maintenance Manual (B-64485EN/02 or later) or Operation and Maintenance Handbook (B-64487EN/03 or later).





16 TROUBLE DIAGNOSIS FUNCTION

Chapter 16, "TROUBLE DIAGNOSIS FUNCTION," consists of the following sections:

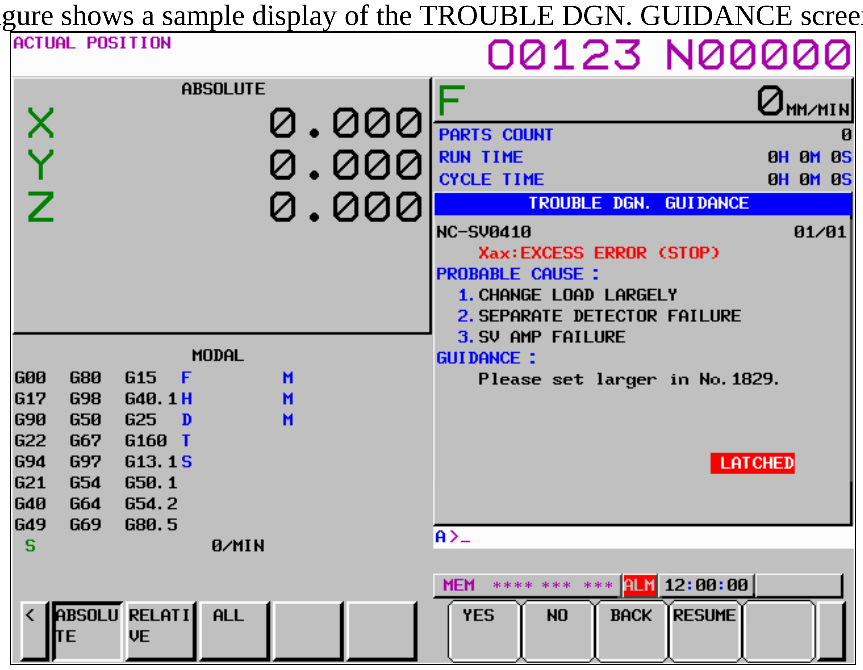
16.1 OVERVIEW

The 30*i*-B series CNC has a trouble diagnosis function, which allows you to check diagnostic information useful to know the status when a servo, spindle, or CNC alarm is issued, on the CNC screen.
The trouble diagnosis function has the following main features:

- "TROUBLE DGN. GUIDANCE screen": Allows you to determine the cause of an alarm according to the trouble diagnosis flow.
- "TROUBLE DGN. MONITOR screen": Allows you to latch data when an alarm is issued as well as monitor the status of servo and spindle amplifiers during normal operation.
- "TROUBLE DGN. GRAPHIC screen": Can display waveforms when a servo or spindle alarm is issued.

Among these features, the TROUBLE DGN. GUIDANCE screen can be used to determine the cause of an alarm and the action to be taken for it for a short time, which can be expected to reduce the down time of the machines.

The following figure shows a sample display of the TROUBLE DGN. GUIDANCE screen.



TROUBLE DGN. GUIDANCE screen

As the trouble diagnosis guidance, the trouble diagnosis function executes a diagnosis flow for determining the cause of an alarm. In most steps, the function automatically makes a decision based on information available in the NC, but it may ask a question on the GUIDANCE screen in some cases. Press soft key [YES] or [NO] in response to the question to proceed to the next step in the guidance flow.

NOTE

The most possible cause(s) and action to be taken based on obtained information are displayed as the cause(s) and guidance (action to be taken). Before replacing a device with a new one, however, be sure to check the device in another way (such as check of insulation resistance or check of conductivity).

16.2 TROUBLE DIAGNOSIS GUIDANCE

IMPORTANT

To use the trouble diagnosis guidance, the CNC must be set in the "SAMPLING" state. For details of operation for switchover to "SAMPLING" state, see Subsection 16.3.2.

Examples of determining the cause of an alarm using the trouble diagnosis guidance are shown below using diagnosis of SV0411, "EXCESS ERROR (MOVING)" and SV0449, "SV IPM ALARM."

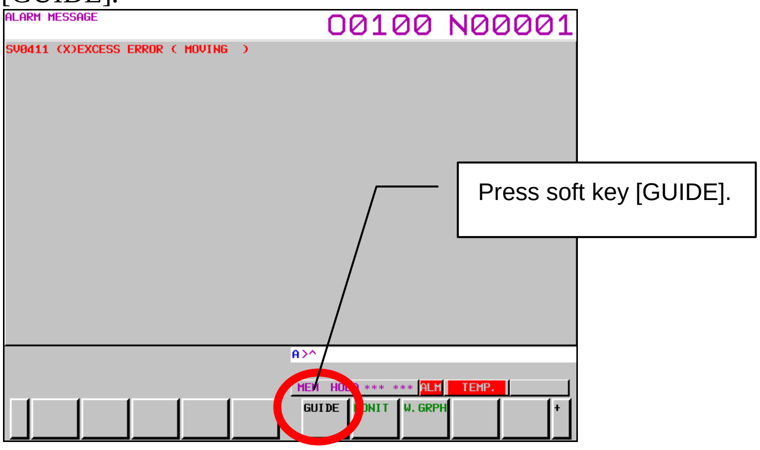
Example 1) When SV0411, "EXCESS ERROR (MOVING)" is issued

(1) When this alarm is issued, perform the following steps to display the TROUBLE DGN. GUIDANCE screen:

<1> When the ALARM MESSAGE screen is not displayed, press function key MESSAGE.

<2> Press the continuous menu key ▷ until soft key [GUIDE] appears.

<3> Press the soft key [GUIDE].

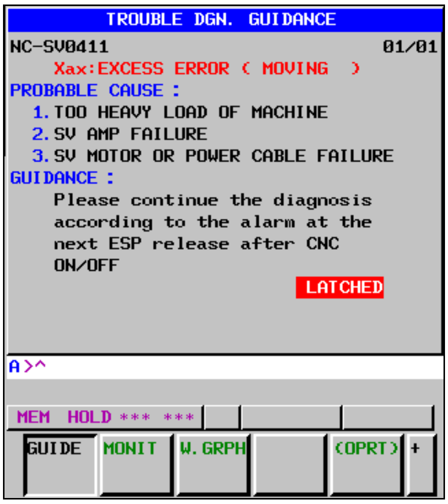


(2) Possible causes of the alarm, "EXCESS ERROR (MOVING)" are:

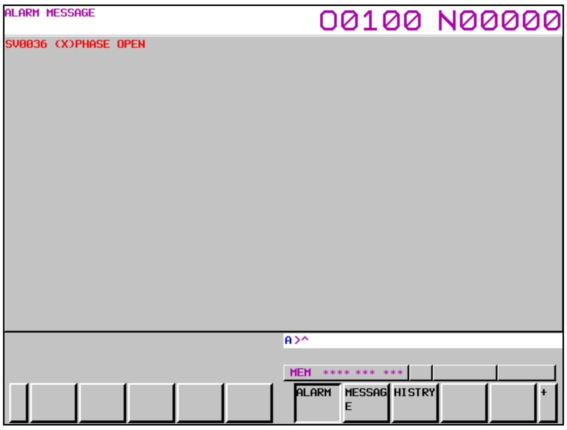
- Failure in the amplifier
- Short-circuit on the power cable or motor winding
- Disconnected power cable or motor winding
- Malfunction of the servo-off signal
- Large load change
- Failure in the brake
- Commanded speed exceeding the specification

As the trouble diagnosis guidance, the trouble diagnosis function executes a diagnosis flow for determining the cause of the alarm. In most steps, the function automatically makes a decision based on information available in the NC, but it may ask a question on the GUIDANCE screen in some cases. Press soft key [YES] or [NO] in response to the question to proceed to the next step in the guidance flow.

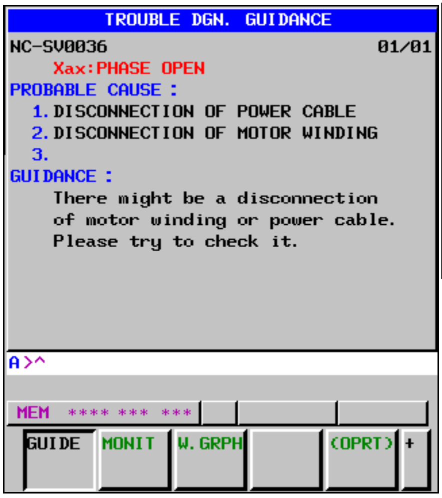
Example) When the disconnected power cable causes the alarm, "EXCESS ERROR (MOVING)" to be issued



When soft key [GUIDE] is pressed, the message shown at left is displayed. The guidance shows an instruction to "turn the power off." The function performs a self-diagnosis to check the servo amplifier for a failure when the power to the CNC is turned off, then on again.



The function performs a self-diagnosis immediately after power on of the CNC. Then, the PHASE OPEN alarm is issued. Press the soft key [GUIDE] again to display the TROUBLE DGN. GUIDANCE screen.



On the TROUBLE DGN. GUIDANCE screen, a message appears, which indicates that a possible cause is the disconnected power cable or motor winding.
Take action according to the instruction in the message.

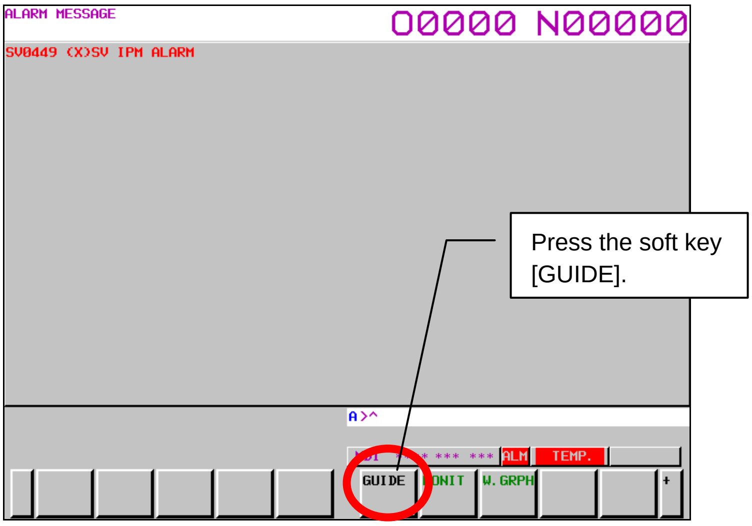
Example 2) When SV0449, "SV IPM ALARM" is issued

(1) When this alarm is issued, perform the following steps to display the TROUBLE DGN. GUIDANCE screen:

<1> When the ALARM MESSAGE screen is not displayed, press function key [MESSAGE].

<2> Press the continuous menu key ▷ until soft key [GUIDE] appears.

<3> Press the soft key [GUIDE].

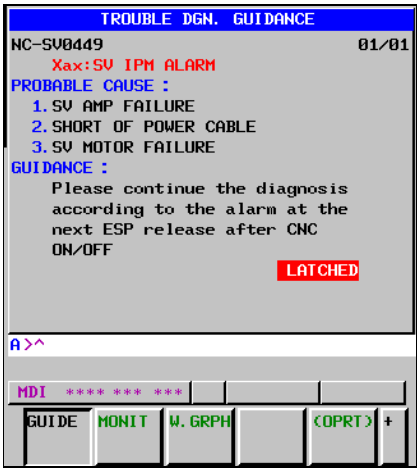


(2) Possible causes of the alarm, "SV IPM ALARM" are:

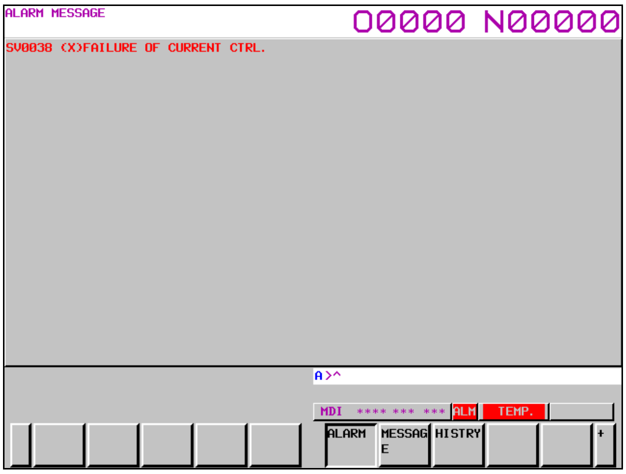
- Failure in the amplifier
- Short-circuit on the power cable or motor winding
- Disconnected power cable or motor winding
- Disturbance in current control

As the trouble diagnosis guidance, the trouble diagnosis function executes a diagnosis flow for determining the cause of the alarm. In most steps, the function automatically makes a decision based on information available in the NC, but it may ask a question on the GUIDANCE screen in some cases. Press soft key [YES] or [NO] in response to the question to proceed to the next step in the guidance flow.

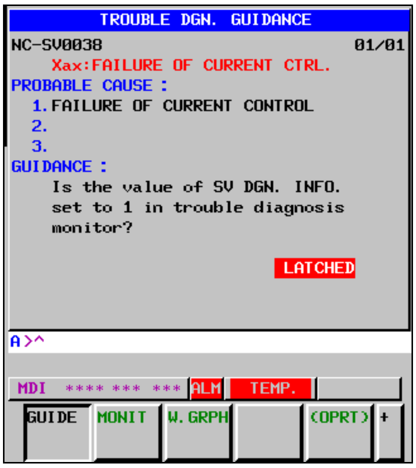
Example) When a short-circuit on the power cable causes the alarm, "SV IPM ALARM" to be issued



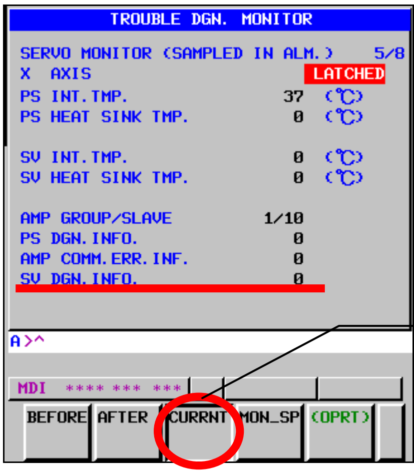
When [GUIDE] is pressed, the message shown at left is displayed. The guidance shows an instruction to "turn the power off." The function performs a self-diagnosis to check the servo amplifier for a failure when the power to the CNC is turned off, then on again.



The function performs a self-diagnosis immediately after power on of the CNC. Then, a FAILURE OF CURRENT CTRL. alarm is issued. Display the TROUBLE DGN. GUIDANCE screen again.

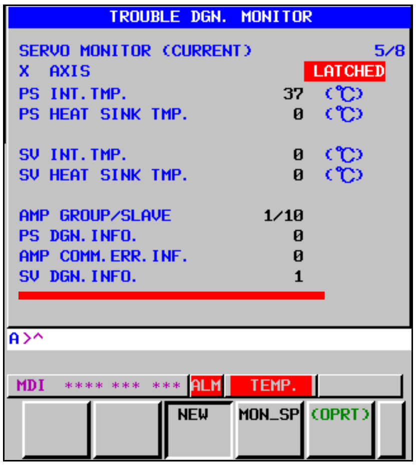


The guidance message, "Is the value of SV DGN. INFO. set to 1 in trouble diagnosis monitor," appears. Check the TROUBLE DGN. MONITOR screen.

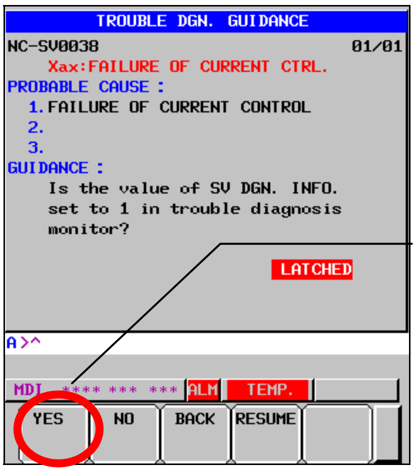


Display the TROUBLE DGN. MONITOR screen, move to the page containing SV DGN.INFO., and press soft key [CURRNT].

Press soft key [CURRNT].

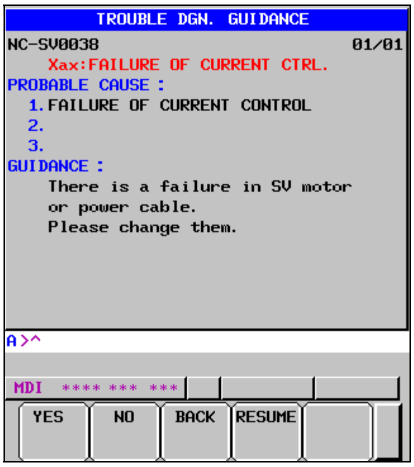


Check the value of SV DGN.INFO.. As the value of SV DGN.INFO., "0" or "1" is displayed.
When a short-circuit on the power cable or motor winding is detected during self-diagnosis of the servo amplifier, the value is "1."



Display the TROUBLE DGN. GUIDANCE screen and press soft key [YES].

Press soft key [YES].



A guidance message appears, which indicates that a possible cause is a short-circuit on the power cable or motor winding. Take action according to the instruction in the message.

16.3 TROUBLE DGN. MONITOR

IMPORTANT

The trouble diagnosis monitor can be in either of the following two states: "SAMPLING" and "LATCHED."
To monitor data when a new alarm will be issued, perform "CLEAR" operation. On the contrary, to save the status when alarms were issued in the past, do not perform "CLEAR" operation. For details of the operation, see Subsection 16.3.2.

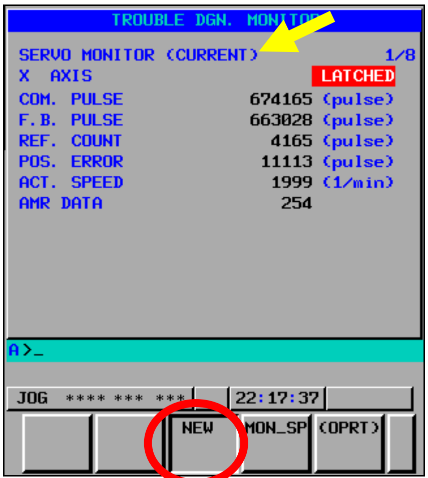
The trouble diagnosis monitor can display the information described below.
The procedures to display the TROUBLE DGN. MONITOR screen are below,

- Press function key [? MESSAGE] to display the ALARM MESSAGE screen.
- Press the continuous menu key [▷] until the soft key [MONITOR] appears.
- Press the soft key [MONITOR] to display the TROUBLE DGN. MONITOR screen.

16.3.1 How to Check the Data at an Alarm or Just Before an Alarm

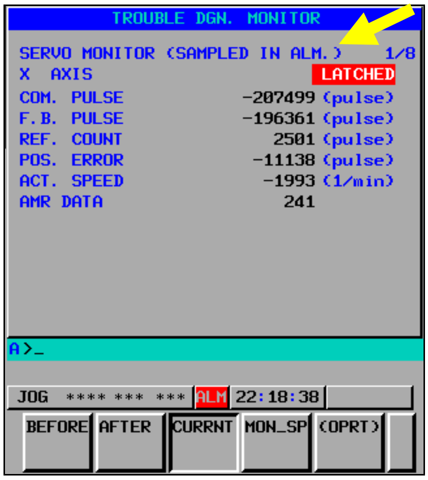
On the TROUBLE DGN. MONITOR screen, you can check the following data:

- Current data
- Data at an alarm
- Data just before an alarm during several sampling cycles

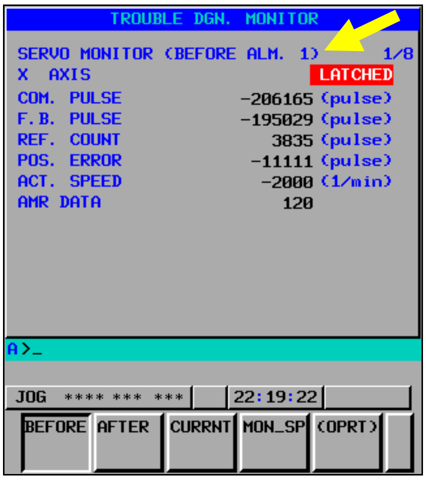


The current data are displayed.

When an alarm is issued and the soft key [NEW] is pressed



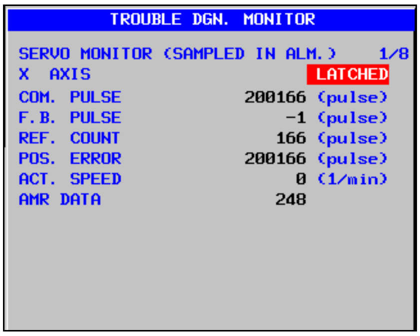
The data at the alarm are displayed.

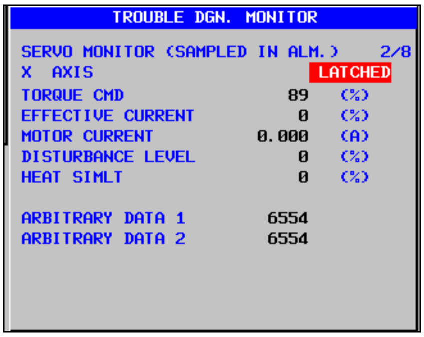


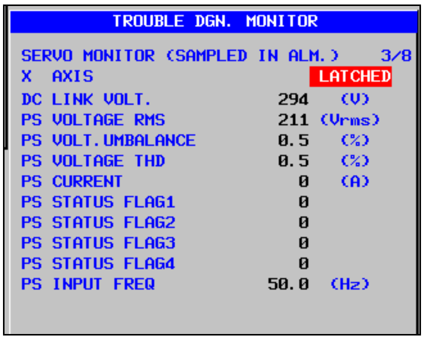
By pressing the soft key [BEFORE], the data up to five sampling cycles before the alarm can be displayed.

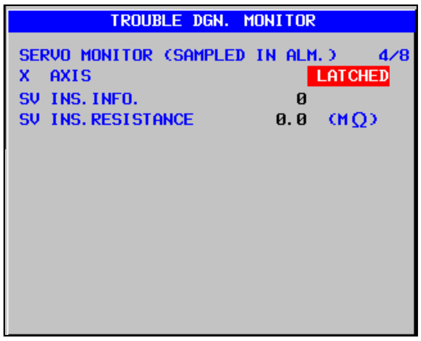
The data just one sampling cycle before are displayed.

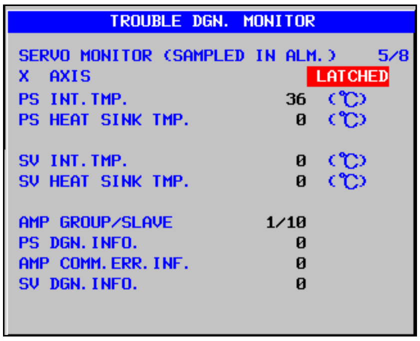
16.3.1.1 Details of monitor screens related to servo amplifiers

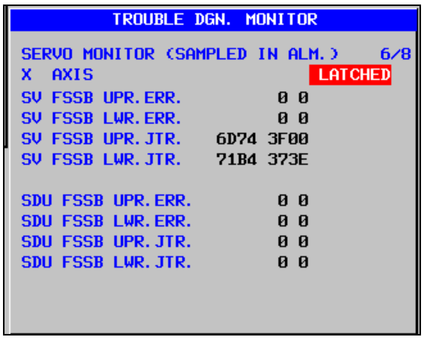


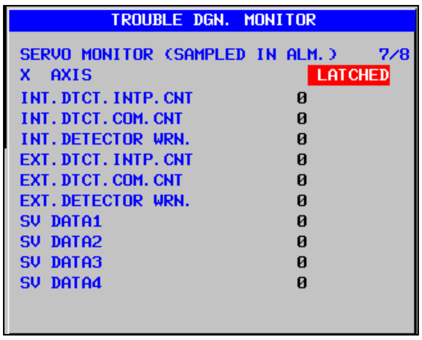


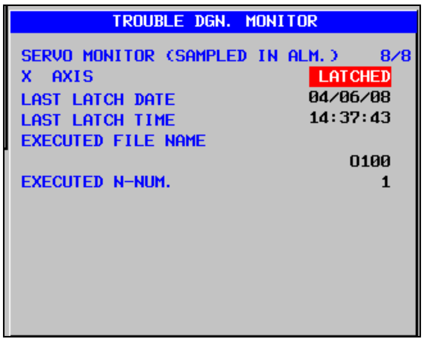












Data (unit)	Description	Displayed page number
COM. PULSE (pulse)	Position command pulse	1/8
F.B. PULSE (pulse)	Position feedback pulse (Note 3)	1/8
REF. COUNT (pulse)	Reference counter	1/8
POS. ERROR (pulse)	Position error	1/8
ACT. SPEED (1/min)	Actual speed	1/8
AMR DATA	Magnetic pole position data of the motor rotor (256/rotation in electrical angle)	1/8
TORQUE CMD (%)	Torque command (Maximum torque =100%)	2/8

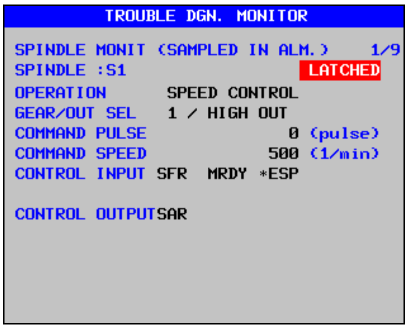
Data (unit)	Description	Displayed page number
EFFECTIVE CURRENT (%)	Maximum amplifier current =100%	2/8
MOTOR CURRENT (A)	Actual motor current	2/8
DISTURBANCE LEVEL (%)	Alarm level when unexpected torque detection is used =100%	2/8
HEAT SIMLT (%)	Result of heat simulation (OVC alarm level =100%)	2/8
ARBITRARY DATA 1	(Note 2)	2/8
ARBITRARY DATA 2	(Note 2)	2/82
DC LINK VOLT. (V)	Instantaneous DC link voltage value (Note 3)	3/8
PS VOLTAGE RMS (Vrms)	Average PS input voltage value during one power cycle (Note 3)	3/8
PS VOLT. UMBALANCE (%)	Average PS input voltage value during one power cycle (Note 3)	3/8
PS VOLTAGE THD (%)	Average PS input voltage THD (Total Harmonic Distortion) during one power cycle (Note 3)	3/8
PS CURRENT (A)	Average current amplitude during one power cycle (Note 3)	3/8
PS STATUS FLAG1	(Note 4)	3/8
PS STATUS FLAG2	(Note 4)	3/8
PS STATUS FLAG3	(Note 4)	3/8
PS STATUS FLAG4	(Note 4)	3/8
PS INPUT FREQ (Hz)	Average frequency value during one power cycle (Note 3)	3/8
SV INS. INFO.	Status flag of the Insulation deterioration detection function	4/8
SV INS.RESISTANCE (MΩ)	Motor insulation resistance when the Insulation deterioration detection function is enabled (Note 3)	4/8
PS INT. TMP. (°C)	PS internal temperature (Note 3)	4/8
PS HEAT SINK TMP. (°C)	PS heat sink temperature (Note 3)	5/8
SV INT.TMP. (°C)	SV internal temperature (Note 3)	5/8
SV HEAT SINK TMP. (°C)	SV heat sink temperature (Note 3)	5/8
AMP GROUP/SLAVE	Group number and slave number for each Power Supply (PS)	5/8
PS DGN. INFO.	Status flag of the Power Supply (PS)	5/8
AMP COMM. ERR. INF.	Error status flag of inter-amplifier communication	5/8
SV DGN. INFO.	Status flag of the servo amplifier (SV)	5/8
SV FSSB UPR. ERR.	FSSB error in SV (Note 5)	6/8
SV FSSB LWR. ERR.	FSSB error in SV (Note 5)	6/8
SV FSSB UPR. JTR.	FSSB jitter in SV (Note 5)	6/8
SV FSSB LWR. JTR.	FSSB jitter in SV (Note 5)	6/8
SDU FSSB UPR. ERR.	FSSB error in SDU (Note 5)	6/8
SDU FSSB LWR. ERR.	FSSB error in SDU (Note 5)	6/8
SDU FSSB UPR. JTR.	FSSB jitter in SDU (Note 5)	6/8
SDU FSSB LWR. JTR.	FSSB jitter in SDU (Note 5)	6/8
INT. DTCT. INTP. CNT	Built-in detector interpolation counter Number of times that built-in sensor data were distorted by noise (Number of times that data errors were detected)	7/8
INT. DTCT. COM. CNT	Built-in detector communication error counter Number of times that built-in sensor data were distorted by noise (number of communication errors were detected)	7/8
INT. DETECTOR WRN.	Built-in sensor warning information	7/8
EXT. DTCT. INTP. CNT	External detector interpolation counter Number of times that separate sensor data were distorted by noise (umber of times that data errors were detected)	7/8
EXT. DTCT. COM. CNT	External detector communication error counter Number of times that separate sensor data were distorted by noise (number of communication errors were detected)	7/8
EXT. DETECTOR WRN.	Separate sensor warning information	7/8
SV DATA1	(Note 2)	7/8
SV DATA2	(Note 2)	7/8
SV DATA3	(Note 2)	7/8
SV DATA4	(Note 2)	7/8

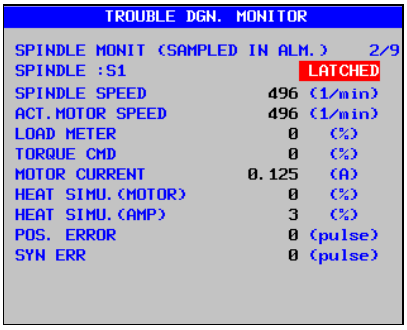
Data (unit)	Description	Displayed page number
LAST LATCH DATE	The latest date when data are latched	8/8
LAST LATCH TIME	The latest time when data are latched	8/8
EXECUTED FILE NAME	Executed program file name at the alarm	8/8
EXECUTED N-NUM.	Executed N-number at the alarm	8/8

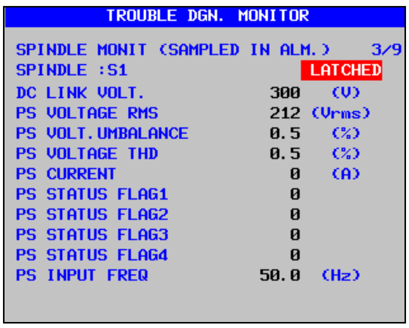
NOTE

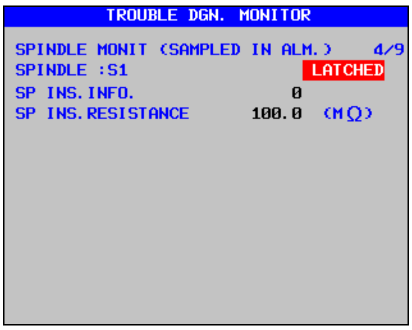
1 The specified range in this list is just the range within which the monitor function can display data, and does not indicate the performance or rating of the system.
2 ARBITRARY DATA 1 and ARBITRARY DATA 2, and SV DATA1 to SV DATA4 are used by FANUC for maintenance.
3 The displayed values related to voltage, current, frequency, and temperature are approximate and contain some errors. If you require a precise value, measure the target item using a specific measurement instrument.
4 PS STATUS FLAG1 to PS STATUS FLAG4 are used by FANUC for maintenance.
5 FSSB error and jitter data items indicate the FSSB communication status and are used by FANUC for maintenance.

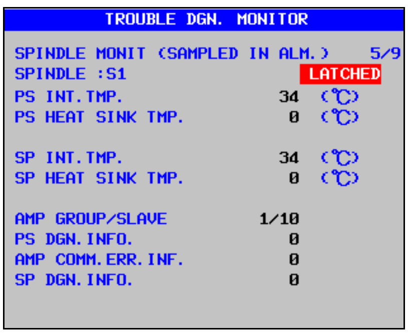
16.3.1.2 Details of monitor screens related to spindle amplifiers

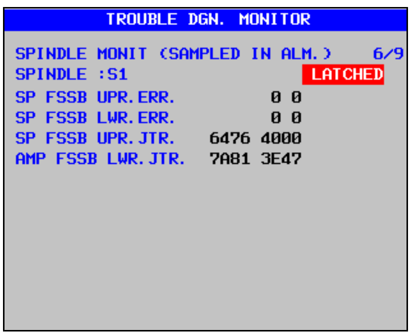


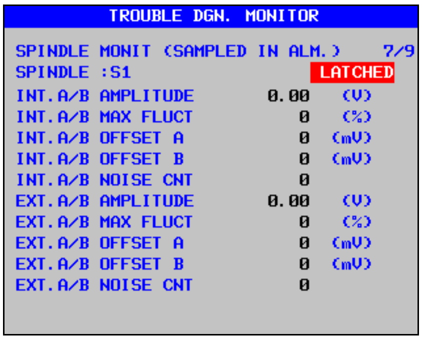


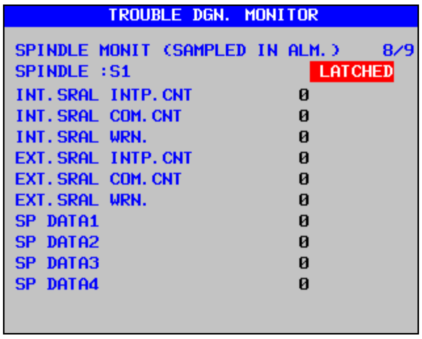


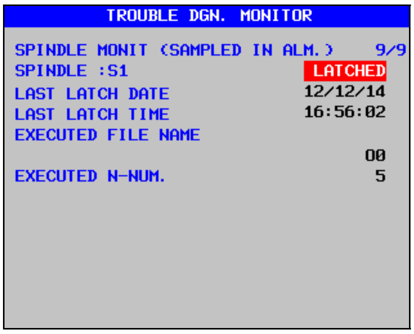












Data (unit)	Description	Displayed page number
OPERATION	Operation mode	1/9
GEAR/OUT SEL	Selected gear kind and selected output power	1/9
COMMAND PULSE (pulse)	Position command pulse	1/9
COMMAND SPEED (1/min)	Speed command (Note 2)	1/9
CONTROL INPUT	Input signals for spindle control	1/9
CONTROL OUTPUT	Output signals for spindle control	1/9
SPINDLE SPEED (1/min)	Actual spindle speed	2/9
ACT.MOTOR SPEED (1/min)	Actual spindle motor speed (Note 2)	2/9
LOAD METER (%)		2/9
TORQUE COM (%)	Torque command (Maximum torque = 100%)	2/9
MOTOR CURRENT (A)	Actual motor current	2/9
HEAT SIMU.(MOTOR) (%)	Result of heat simulation for motor (OVC alarm level = 100%)	2/9
HEAT SIMU.(AMP) (%)	Result of heat simulation for amplifier (OVC alarm level = 100%)	2/9
POS. ERROR (pulse)	Position error	2/9
SYN ERR (pulse)	Synchronous error for rigid tapping	2/9
DC LINK VOLT. (V)	Instantaneous DC link voltage value (Note 3)	3/9
PS VOLTAGE RMS (Vrms)	Average PS input voltage value during one power cycle (Note 3)	3/9
PS VOLT.UMBALANCE (%)	Average PS input voltage value during one power cycle (Note 3)	3/9
PS VOLTAGE THD (%)	Average PS input voltage THD (Total Harmonic Distortion) during one power cycle (Note 3)	3/9
PS CURRENT(A)	Average current amplitude during one power cycle (Note 3)	3/9
PS STATUS FLAG1	(Note 5)	3/9
PS STATUS FLAG2	(Note 5)	3/9
PS STATUS FLAG3	(Note 5)	3/9
PS STATUS FLAG4	(Note 5)	3/9
PS INPUT FREQ (Hz)	Average frequency value during one power cycle (Note 3)	3/9
SP INS.INFO.	Status flag of the insulation deterioration detection function	4/9
SP INS.RESISTANCE (MΩ)	Motor insulation resistance when the insulation deterioration detection function is enabled (Note 3)	4/9
PS INT.TMP. (°C)	PS internal temperature (Note 3)	5/9
PS HEAT SINK TMP. (°C)	PS heat sink temperature (Note 3)	5/9
SP INT.TMP. (°C)	SP internal temperature (Note 3)	5/9

Data (unit)	Description	Displayed page number
SP HEAT SINK TMP. (°C)	SP internal temperature (Note 3)	5/9
AMP GROUP/SLAVE	Group number and slave number for each Power Supply (PS)	5/9
PS DGN.INFO.	Status flag of the Power Supply (PS)	5/9
AMP COMM.ERR.INF.	Error status flag of inter-amplifier communication	5/9
SP DGN.INFO.	Status flag of the spindle amplifier (SP)	5/9
SP FSSB UPR.ERR.	FSSB error in SV (Note 6)	6/9
SP FSSB LWR.ERR.	FSSB error in SV (Note 6)	6/9
SP FSSB UPR.JTR.	FSSB jitter in SV (Note 6)	6/9
AMP FSSB LWR.JTR.	FSSB jitter in SV (Note 6)	6/9
INT.A/B AMPLITUDE (V)	Built-in analog sensor A/B phase signal amplitude	7/9
INT.A/B MAX FLUCT (%)	Maximum fluctuation rate of the built-in analog sensor A/B phase signal	7/9
INT.A/B OFFSET A (mV)	Phase A offset of the built-in analog sensor	7/9
INT.A/B OFFSET B(mV)	Phase B offset of the built-in analog sensor	7/9
INT.A/B NOISE CNT	Number of times that built-in analog sensor data were distorted by noise (number of times that data errors were detected)	7/9
EXT.A/B AMPLITUDE (V)	Separated analog sensor A/B phase signal amplitude	7/9
EXT.A/B MAX FLUCT (%)	Maximum fluctuation rate of the separated analog sensor A/B phase signal	7/9
EXT.A/B OFFSET A(mV)	Phase A offset of the separated analog sensor	7/9
EXT.A/B OFFSET B(mV)	Phase B offset of the separated analog sensor	7/9
EXT.A/B NOISE CNT	Number of times that separated analog sensor data were distorted by noise (number of times that data error were detected)	7/9
INT.SRAL INTP.CNT	Built-in serial sensor interpolation counter Number of times that built-in serial sensor data were distorted by noise (number of times that a data errors were detected)	8/9
INT.SRAL COM.CNT	Built-in serial sensor communication error counter Number of times that built-in serial sensor data were distorted by noise (number of communication errors were detected.)	8/9
INT.SRAL WRN.	Built-in serial sensor warning information	8/9
EXT.SRAL INTP.CNT	External serial sensor interpolation counter Number of times that separated serial sensor data were distorted by noise (number of times that data errors were detected)	8/9
EXT.SRAL COM.CNT	External serial sensor communication error counter Number of times that separated serial sensor data were distorted by noise (number of communication errors were detected.)	8/9
EXT.SRAL WRN.	Separated serial sensor warning information	8/9
SP DATA1	(Note 4)	8/9
SP DATA2	(Note 4)	8/9
SP DATA3	(Note 4)	8/9
SP DATA4	(Note 4)	8/9
LAST LATCH DATE	The latest date when data are latched	9/9
LAST LATCH TIME	The latest time when data are latched	9/9
EXECUTED FILE NAME	Executed program file name at the alarm	9/9
EXECUTED N-NUM.	Executed N-number at the alarm	9/9

NOTE

1. The specified range in this list is just the range within which the monitor function can display data, and does not indicate the performance or rating of the system.
2. To display COMMAND SPEED and ACT.MOTOR SPEED, set the parameters related to the maximum motor speed:
   - No.4020: Maximum motor speed of the main spindle
   - No.4196: Maximum motor speed of the sub-spindle (when the spindle switch function is used)
3. The displayed values related to voltage, current, frequency, and temperature are approximate and contain some errors. If you require a precise value, measure the target item using a specific measurement instrument.
4. SP DATA1 to SP DATA4 are used by FANUC for maintenance.
5. PS STATUS FLAG1 to PS STATUS FLAG4 are used by FANUC for maintenance.
6. FSSB error and jitter data items indicate the FSSB communication status and are used by FANUC for maintenance.

16.3.2 How to Switch the Trouble Diagnosis Guidance and Trouble Diagnosis Monitor to the "SAMPLING" State

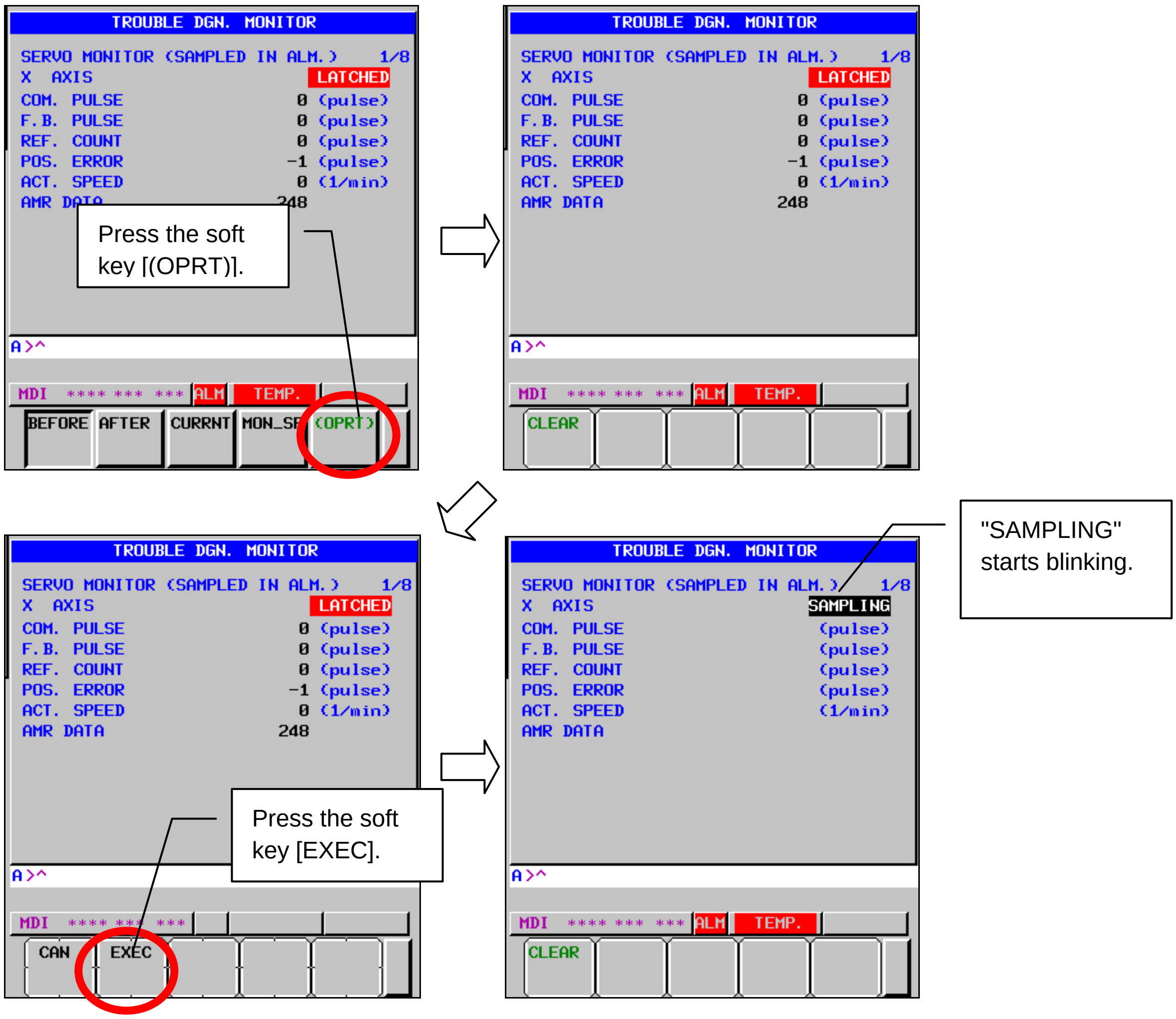
The trouble diagnosis monitor can be in either of the following two states: "SAMPLING" and "LATCHED."

When an alarm is issued, it enters into the "LATCHED" state.
When "CLEAR" operation is performed at the "LATCHED" state, the saved data when the alarm was issued are erased and the CNC returns to the "SAMPLING" state.

So,

- To monitor data when a new alarm will be issued, perform "CLEAR" operation.
- On the contrary, to save the status when an alarm was issued in the past, do not perform "CLEAR" operation.

To perform "CLEAR" operation to switch back to the "SAMPLING" state, follow the procedure below:


TROUBLE DGN. MONITOR
SERVO MONITOR (SAMPLED IN ALM.) 1/8
X AXIS
LATCHED
COM. PULSE 0 (pulse)
F.B. PULSE 0 (pulse)
REF. COUNT 0 (pulse)
POS. ERROR -1 (pulse)
ACT. SPEED 0 (1/min)
AMR DATA 248
Press the soft key [(OPRT)].
A>^
MDI **** *** *** ALM TEMP.
BEFORE AFTER CURRNT MON_SE (OPRT)
TROUBLE DGN. MONITOR
SERVO MONITOR (SAMPLED IN ALM.) 1/8
X AXIS
LATCHED
COM. PULSE 0 (pulse)
F.B. PULSE 0 (pulse)
REF. COUNT 0 (pulse)
POS. ERROR -1 (pulse)
ACT. SPEED 0 (1/min)
AMR DATA 248
A>^
MDI **** *** *** ALM TEMP.
CLEAR
TROUBLE DGN. MONITOR
SERVO MONITOR (SAMPLED IN ALM.) 1/8
X AXIS
LATCHED
COM. PULSE 0 (pulse)
F.B. PULSE 0 (pulse)
REF. COUNT 0 (pulse)
POS. ERROR -1 (pulse)
ACT. SPEED 0 (1/min)
AMR DATA 248
Press the soft key [EXEC].
A>^
MDI **** *** ***
CAN EXEC
TROUBLE DGN. MONITOR
SERVO MONITOR (SAMPLED IN ALM.) 1/8
X AXIS
SAMPLING
COM. PULSE (pulse)
F.B. PULSE (pulse)
REF. COUNT (pulse)
POS. ERROR (pulse)
ACT. SPEED (1/min)
AMR DATA
A>^
MDI **** *** *** ALM TEMP.
CLEAR
"SAMPLING" starts blinking.

APPENDIX

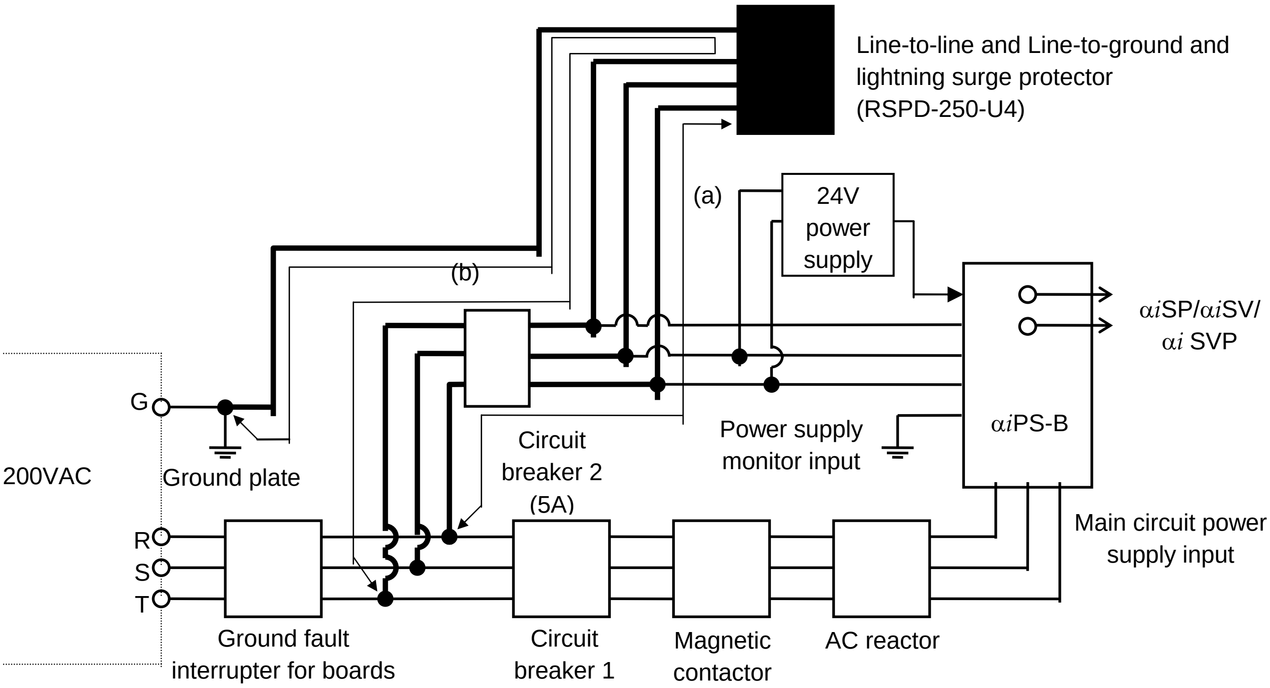
A FITTING A LIGHTNING SURGE PROTECTION DEVICE

This appendix describes how to install a lightning surge protector and provides notes on installation.

Appendix A, "FITTING A LIGHTNING SURGE PROTECTION DEVICE," consists of the following sections:

A.1 200 V INPUT SERIES POWER SUPPLY

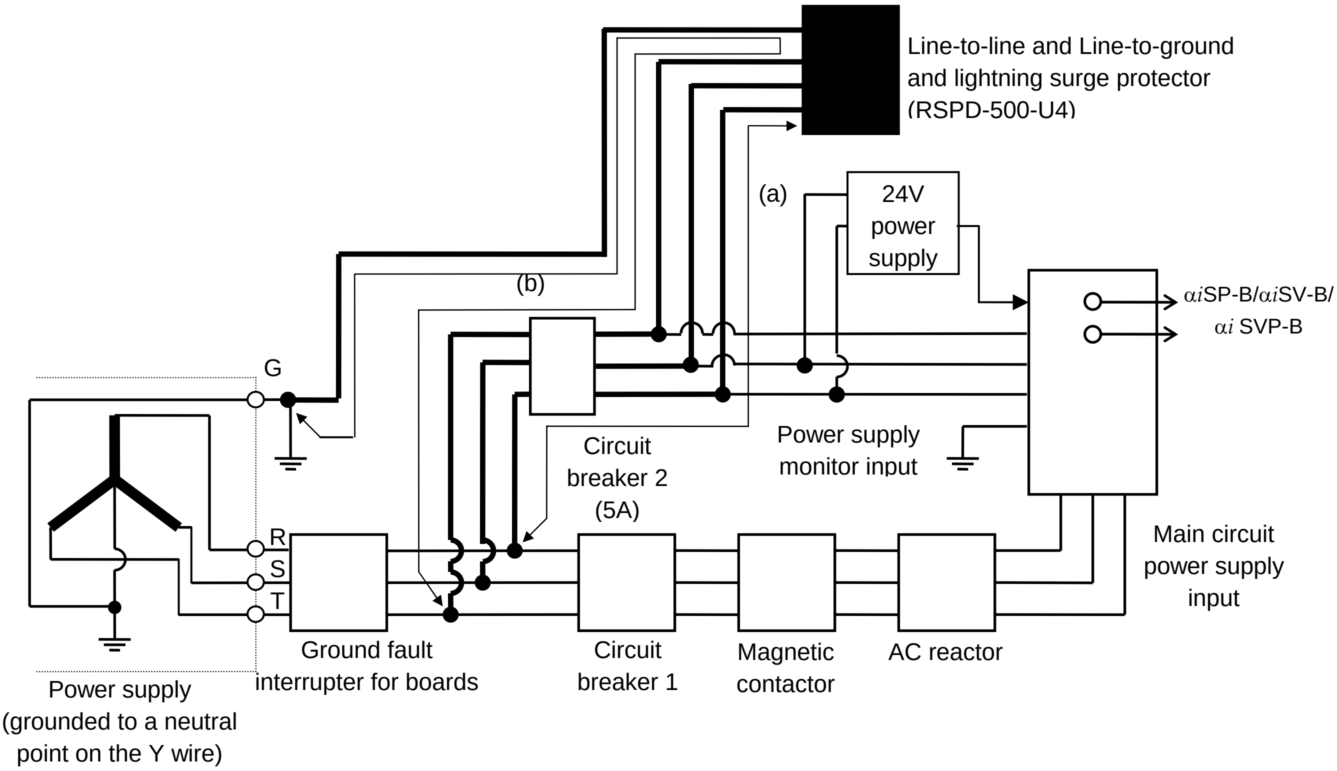
When a line-to-line and line-to-ground lightning surge protector is used



> ⚠ **CAUTION**
> If a voltage of 200 V is supplied from a 400 V power supply (with a neutral point used), a lightning surge protector should be used for 400 V; no lightning surge protector is needed for 200 V.

A.2 400 V INPUT SERIES POWER SUPPLY

When a line-to-line and line-to-ground lightning surge protector is used



> ⚠ **CAUTION**
> If a voltage of 200 V is supplied from a 400 V power supply (with a neutral point used), a lightning surge protector should be used for 400 V; no lightning surge protector is needed for 200 V.

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) Circuit breaker 2 (5 A) is necessary to protect the line when a surge voltage higher than the rating is applied to the lightning surge protector and a failure occurs in the protector due to a short-circuit.

(4) Because current does not flow through lightning surge protector in a normal state, the circuit breaker 2 (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	Product No.	Manufacturer	Manufacturer specification
10-pair cable	For general use		0.09mm^2 10 pairs	A66L-0001-0284 #10P	Hitachi Cable, 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 For αiCZ SENSOR (serial output, for spindle)	28m or less Flexible	0.3mm^2 5 cables 0.20mm^2 1 pairs	A66L-0001-0460	Hitachi Cable, 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 Cable, 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 Cable, 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 Cable, Ltd.	UL20276-SB(0) 5×20AWG+1P×25AWG
Composite 9-core cable	For PULSECODER For αiCZ SENSOR (serial output, for separate detector use)	28m or less Flexible	0.3mm^2 5 cables 0.20mm^2 2 pairs	A66L-0001-0479	Hitachi Cable, Ltd.	UL20276-SB(FLEX) 5×23AWG+2P×25AWG
		50m or less Flexible	0.5mm^2 5 cables 0.20mm^2 2 pairs	A66L-0001-0488	Hitachi Cable, Ltd.	UL20276-SB(FLEX) 5×23AWG+2P×25AWG
Composite 10-core cable	For αiM SENSOR (for αiI 0.5) For αiMZ SENSOR (for αiI 0.5) For αiBZ SENSOR (small-sized type, waterproof connector type)		0.3mm^2 2 cables 0.2mm^2 4 pairs	A66L-0001-0482	Hitachi Cable, Ltd.	UL20276-SB(FLEX) 2×23AWG+4P×25AWG
Composite 12-core cable	For αi POSITIONCODER For α POSITIONCODER S		0.5mm^2 6 cables 0.18mm^2 3 pairs	A66L-0001-0286	Hitachi Cable, Ltd.	F-CO-VV(0)-SB 6×0.5SQ+3P×O.18SQ
					Oki Electric Cable Co., Ltd.	MIX12C(7/0.18, 20/0.18) HRS-SV
10-pair cable	For αiBZ SENSOR (small-sized type, non-waterproof connector type)		0.18mm^2 10 pairs	A66L-0001-0367	Shinko Electric Industries Co., Ltd.	FNC-019
Composite 16-core cable	For αiM SENSOR For αiMZ SENSOR		0.5mm^2 6 cables 0.18mm^2 5 pairs	A66L-0001-0368	Shinko Electric Industries Co., Ltd.	FNC-021

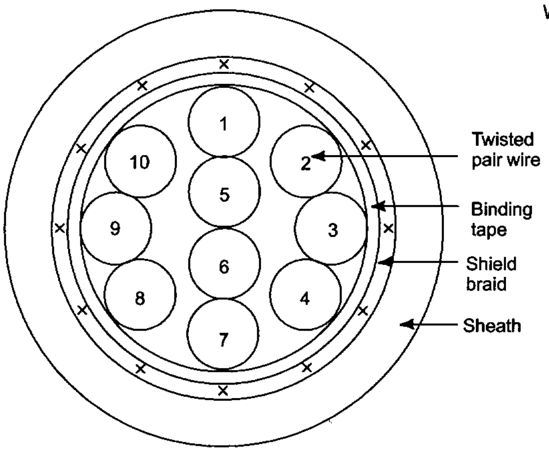
B.1 10-PAIR CABLE

B.1.1 A66L-0001-0284#10P

(a) 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.

(b) Cable structure

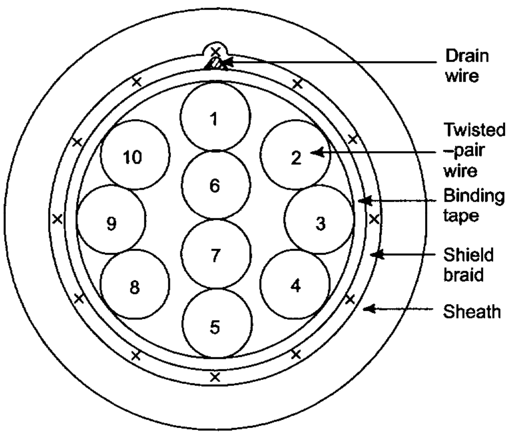


Wire identification table (Hitachi)

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.

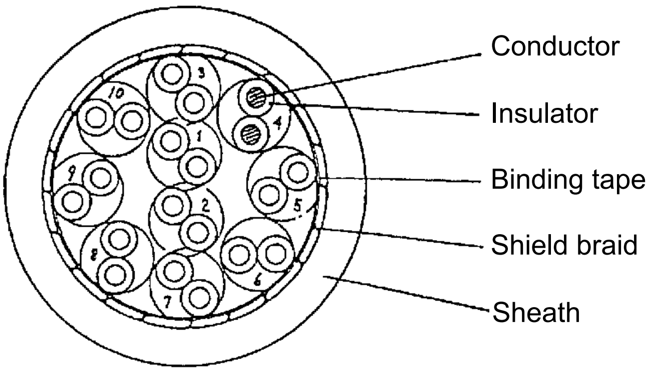
Fig.B.2(b) Cable made by Oki Electric Cable

B.1.2 A66L-0001-0367 (FNC-019)

(a) 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 polyvinyl chloride
	Shield braid		Tinned annealed copper wire
	Sheath		Heat-resistant, oil-resistance, flame retardant polyvinyl chloride (S-3)
Number of wires		Cores	20 (10 pairs)
Conductor	Nominal cross-sectional area	mm^2	0.18
	Structure	Conductors / mm	7/0.18
	Outside diameter	mm	Approx. 0.54
Insulator	Thickness	mm	0.25 (Average thickness: 90% or more)
	Outside diameter	mm	Approx. 1.04
Twisted pair	Outside diameter	mm	Approx. 2.08 (Pitch: 25 mm or less)
Lay	Outside diameter	mm	Approx. 6.5
Tape-wound wire	Outside diameter	mm	Approx. 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
Electric characteristics	Conductor resistance	Ω/km	110 or less (20°C JIS C 3005 6)
	Dielectric strength	V/min	AC500 (JIS C 3005 8 (2))
	Insulation resistance	MΩ-km	15 or more (20°C JIS C 3005 9.1)

(b) Cable structure



Pair No.	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

B.2 COMPOSITE 7-CORE CABLE

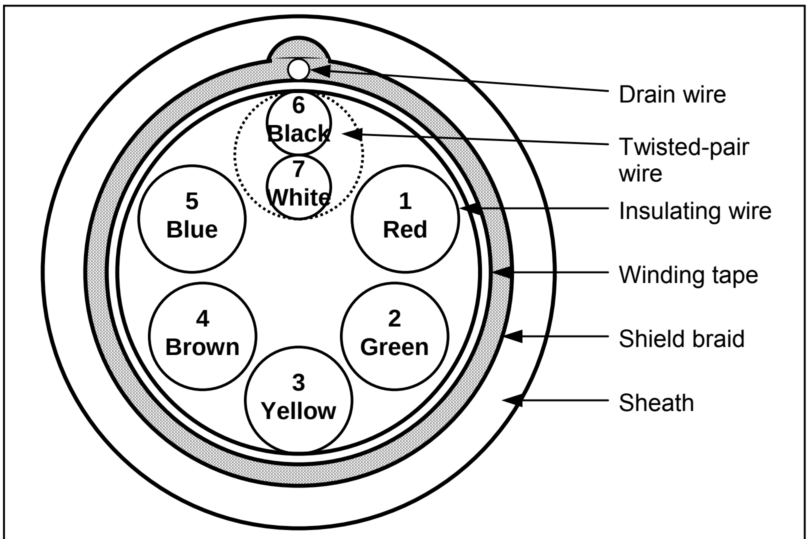
(a) Specifications of A66L-0001-0460

Item		Unit	Specifications	
Product No.		–	A66L-0001-0460	
Manufacturer		–	Hitachi Cable, 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	–	Heat-resistant oilproof 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
	Outside diameter	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	Conductors / 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	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 (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.

(b) Cable structure of A66L-0001-0460



The colors in the figure indicate the colors of insulators.

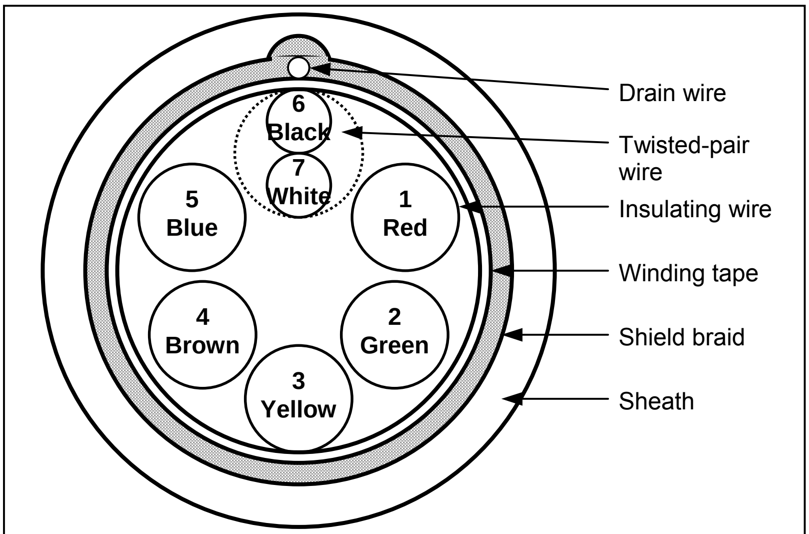
(c) Specifications of A66L-0001-0462

Item		Unit	Specifications	
Product No.		–	A66L-0001-0462	
Manufacturer		–	Hitachi Cable, 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	–	Heat-resistant oilproof 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
	Outside diameter	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	Conductors / 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	

Item		Unit	Specifications	
Electrical performance	Resistance of conductor (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.

(d) Cable structure of A66L-0001-0462



The colors in the figure indicate the colors of insulators.

(e) Specifications of A66L-0001-0481

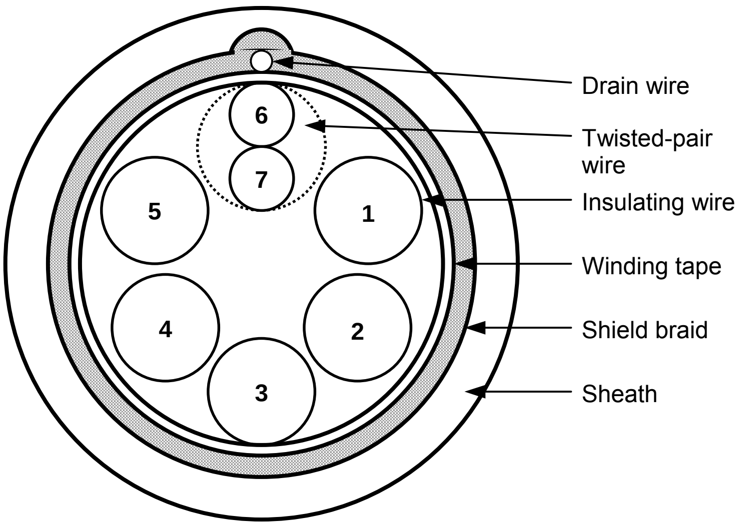
Item		Unit	Specifications	
Product No.		–	A66L-0001-0481	
Manufacturer		–	Hitachi Cable, Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant vinyl	
	Sheath	–	Heat-resistant oilproof vinyl	
Number 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
	Outside diameter	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	Conductors / mm	7/0.18	
	Outside diameter	mm	0.54	

Item		Unit	Specifications	
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 (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.

(f) Cable structure of A66L-0001-0481



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

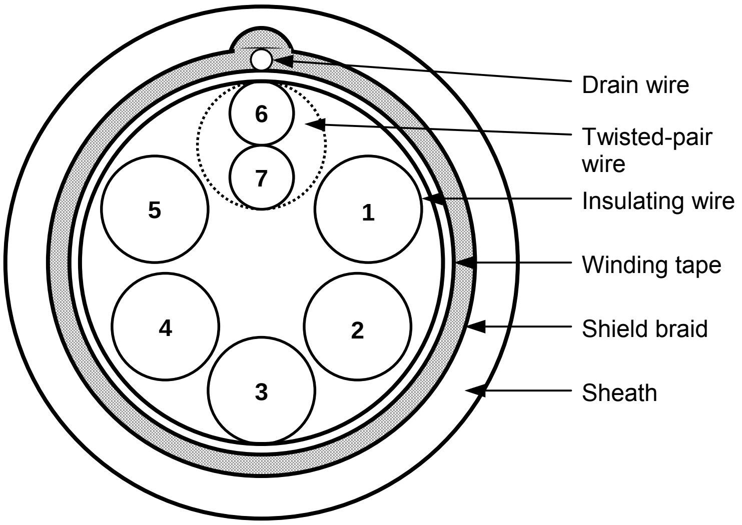
(g) Specifications of A66L-0001-0491

Item		Unit	Specifications	
Product No.		–	A66L-0001-0491	
Manufacturer		–	Hitachi Cable, 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	–	Heat-resistant oilproof 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
	Outside diameter	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	Conductors / 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 (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.

(h) Cable structure of A66L-0001-0491



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 9-CORE CABLE

(a) Specifications of A66L-0001-0479

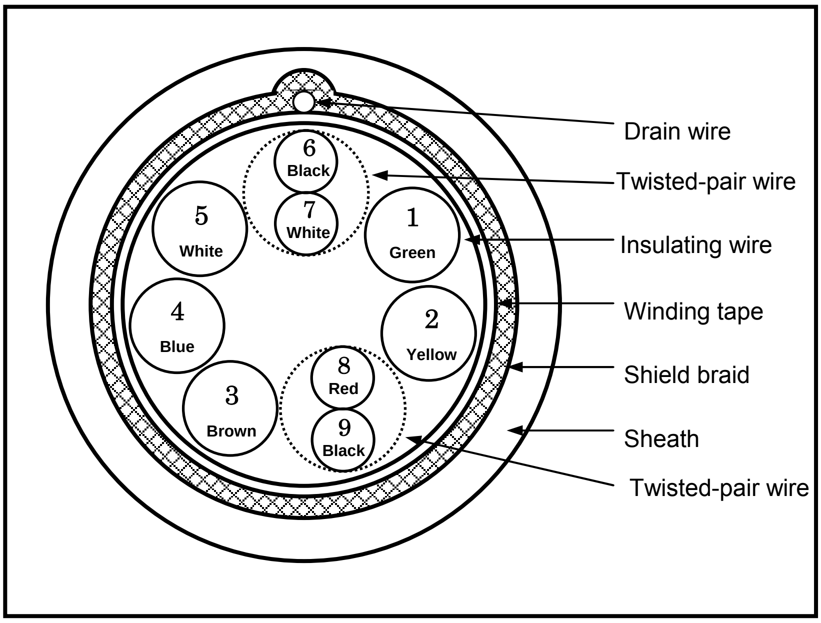
Item		Unit	Specifications	
Product No.		–	A66L-0001-0479	
Manufacturer		–	Hitachi Cable, Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Fluorine plastics (ETFE)	
	Sheath	–	Heat-resistant oilproof vinyl	
Number of wires (wire nos.)		Cores	5(1 to 5)	4(two pairs)(6 to 9)
Conductor	Size	mm^2	0.3	0.20
	Structure	Conductors / mm	60/0.08	40/0.08
	Outside diameter	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	4.0	
Drain wire	Size	mm^2	0.15	
	Structure	Conductors / mm	30/0.08	
	Outside diameter	mm	0.51	

Item		Unit	Specifications	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	85 or more	
	Outside diameter (approx.)	mm	4.8	
Sheath	Color	–	Black	
	Standard thickness	mm	1.1	
	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 (20°C)(wire nos.)	Ω/km	69.5 or less (1 to 5)	109 or less (6 to 9)
	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.

(b) Cable structure of A66L-0001-0479



(c) Specifications of A66L-0001-0488

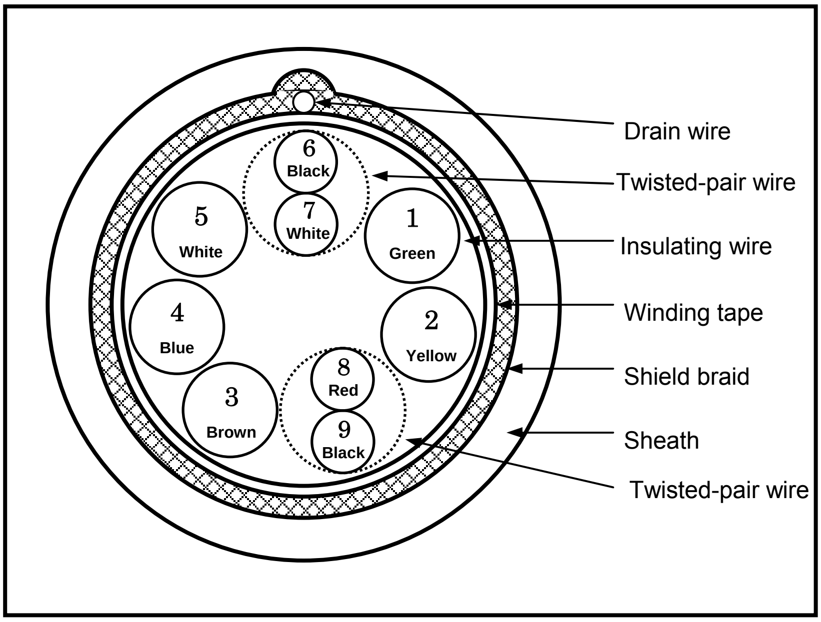
Item		Unit	Specifications	
Product No.		–	A66L-0001-0488	
Manufacturer		–	Hitachi Cable, Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Fluorine plastics (ETFE)	
	Sheath	–	Heat-resistant oilproof vinyl	
Number of wires (wire nos.)		Cores	5(1 to 5)	4(two pairs)(6 to 9)
Conductor	Size	mm^2	0.5	0.20
	Structure	Conductors / mm	104/0.08	40/0.08
	Outside diameter	mm	0.94	0.58

Item		Unit	Specifications	
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	4.7	
Drain wire	Size	mm^2	0.15	
	Structure	Conductors / 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	7.5	
	Outside diameter allowance	mm	6.5 to 8.0 (Note)	
Standard length		m	200	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (20°C)(wire nos.)	Ω/km	40.1 or less (1 to 5)	109 or less (6 to 9)
	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.

(d) Cable structure of A66L-0001-0488



B.4 COMPOSITE 10-CORE CABLE

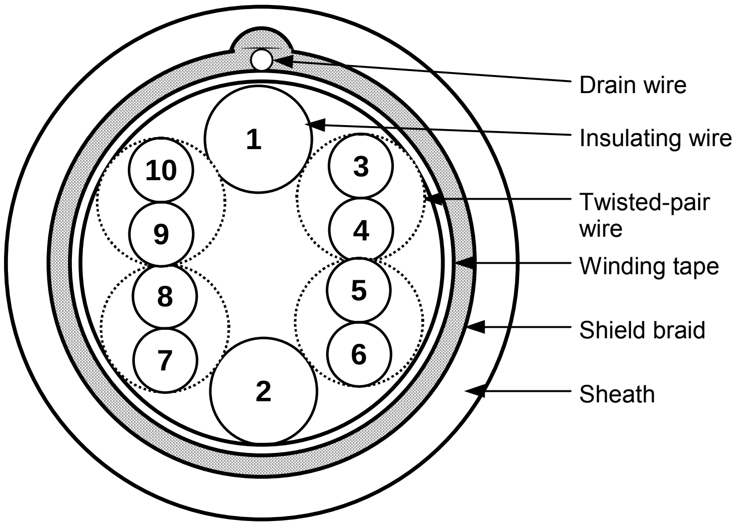
(a) Specifications of A66L-0001-0482

Item		Unit	Specifications	
Product No.		–	A66L-0001-0482	
Manufacturer		–	Hitachi Cable, 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	–	Heat-resistant oilproof 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
	Outside diameter	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 (approx.)		mm	5.0	
Drain wire	Size	mm^2	0.15	
	Structure	Conductors / 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 (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.

(b) Cable structure of A66L-0001-0482



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.5 COMPOSITE 12-CORE CABLE

(a) Specifications

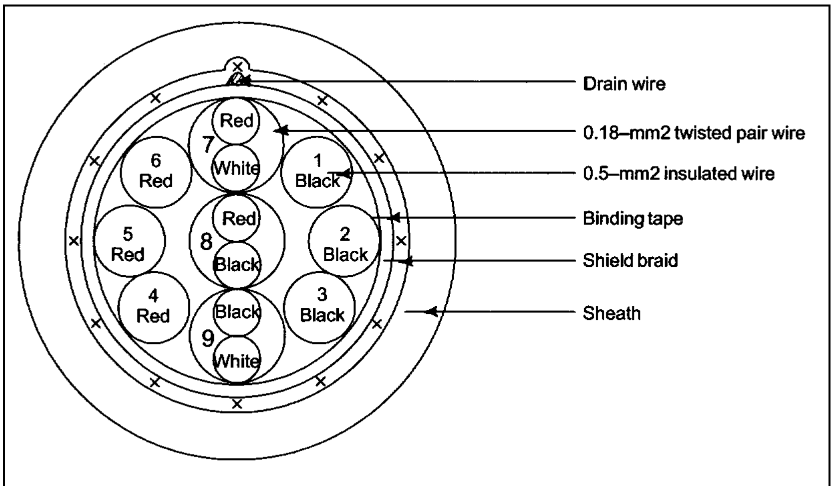
Item		Unit	Specifications	
Product No.		–	A66L-0001-0286	
Manufacturer		–	Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor, braid-shielded wire, drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat-resistant flame-retardant vinyl	
	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
	Outside diameter	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

Item		Unit	Specifications	
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 (approx.)		mm	5.7	
Drain wire	Size	mm^2	0.3	
	Structure	Conductors / 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	
Sheath	Outside diameter	mm	8.5Max.9.0(1)	
Standard length		m	100	
Packing method		–	Bundle	
Electrical performance	Resistance of conductor (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.

(b) Markings on cable
  (i) Name or symbol of the manufacturer
  (ii) Manufacturing year

(c) Cable structure
The cable structure is shown below.



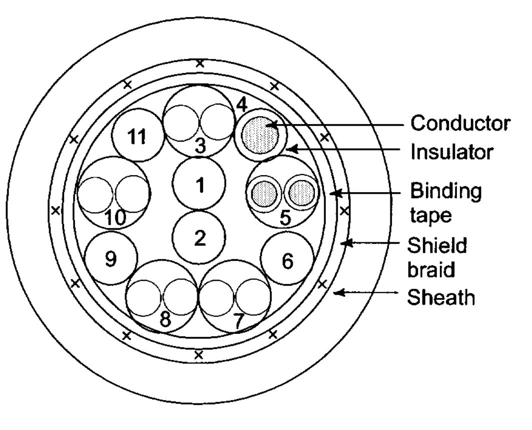
The colors in the figure indicate the colors of insulators.

B.6 COMPOSITE 16-CORE CABLE

(a) 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 wires		Cores	6	10(five pairs)
Conductor	Nominal cross-sectional area	mm^2	0.5	0.18
	Structure	Conductors / mm	20/0.18	7/0.18
	Outside diameter	mm	Approx. 0.9	Approx. 0.54
Insulator	Thickness	mm	0.25 (Average thickness : 90% or more)	0.2 (Average thickness : 90% or more)
	Outside diameter	mm	Approx. 1.5	Approx. 0.94
Twisted pair	Outside diameter	mm	–	Approx. 1.88 (pitch : 20 mm or less)
Lay	Outside diameter	mm	Approx. 6.5	
Tape-wound wire	Outside diameter	mm	Approx. 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)	
	Electric resistance 0.5mm^2	Ω/km	39.4 or less (20°C JIS C 3005 6)	
	Dielectric strength	V/min	AC500 (JIS C 3005 8 (2))	
	Insulation resistance	MΩ-km	15 or more (20°C JIS C 3005 9.1)	

(b) 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

C EXTERNAL DIMENSIONS OF EACH CONNECTOR

Manufacture: Tyco Electronics Japan G.K.
Type: 1-178128-3

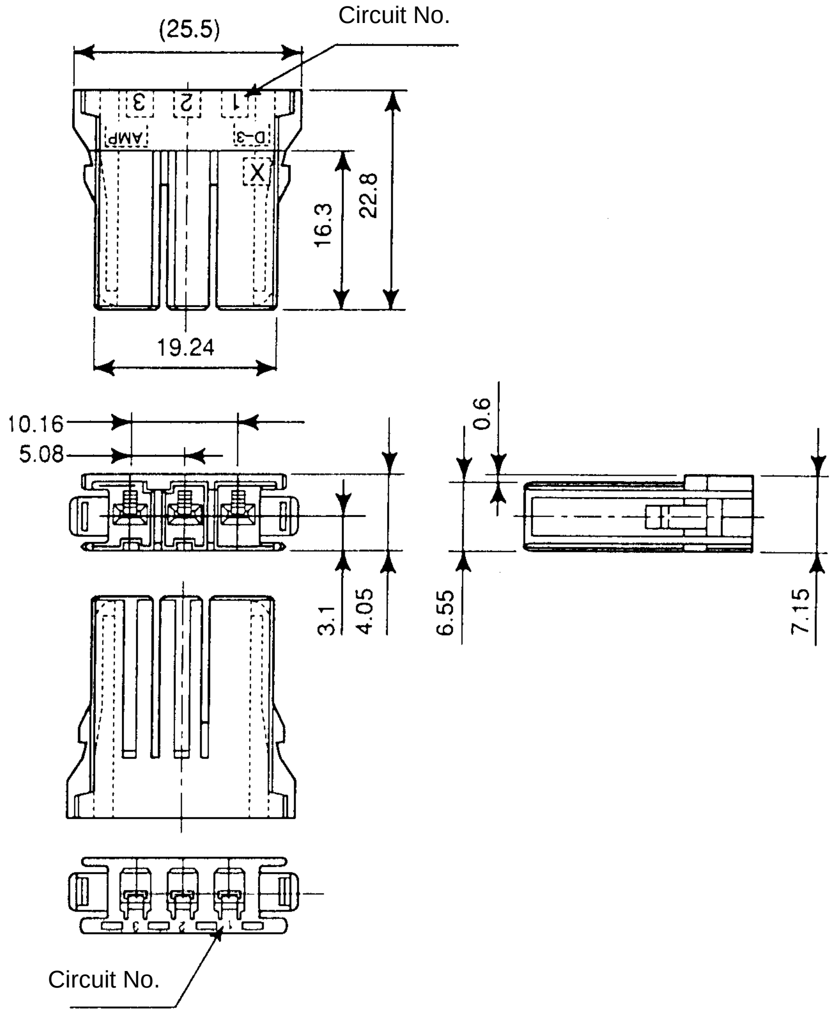


Fig. C(a) Tyco Electronics Japan connector (1)

Manufacture: Tyco Electronics Japan G.K.
Type: 2-178128-3

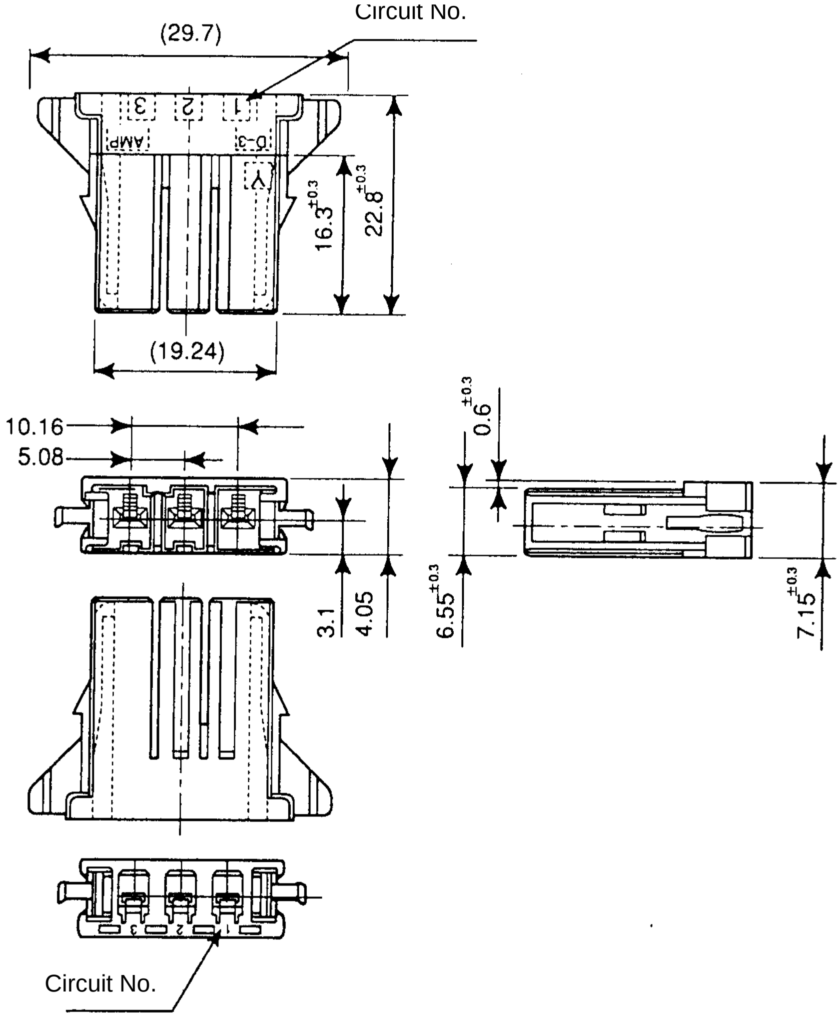


Fig. C(b) Tyco Electronics Japan connector (2)

Manufacture: Tyco Electronics Japan G.K.
Type: 1-175218-2
Cable: AWG16, 18, 20

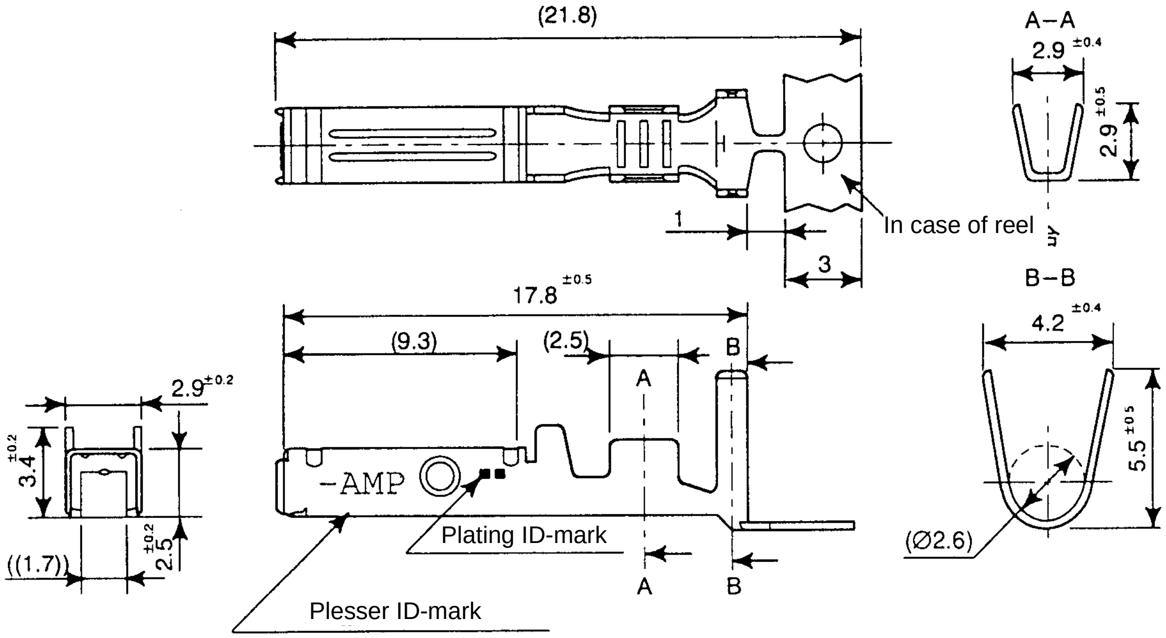


Fig. C(c) Contact for Tyco Electronics Japan connector

Manufacture: Tyco Electronics Japan G.K.
Type: 1-1318119-4

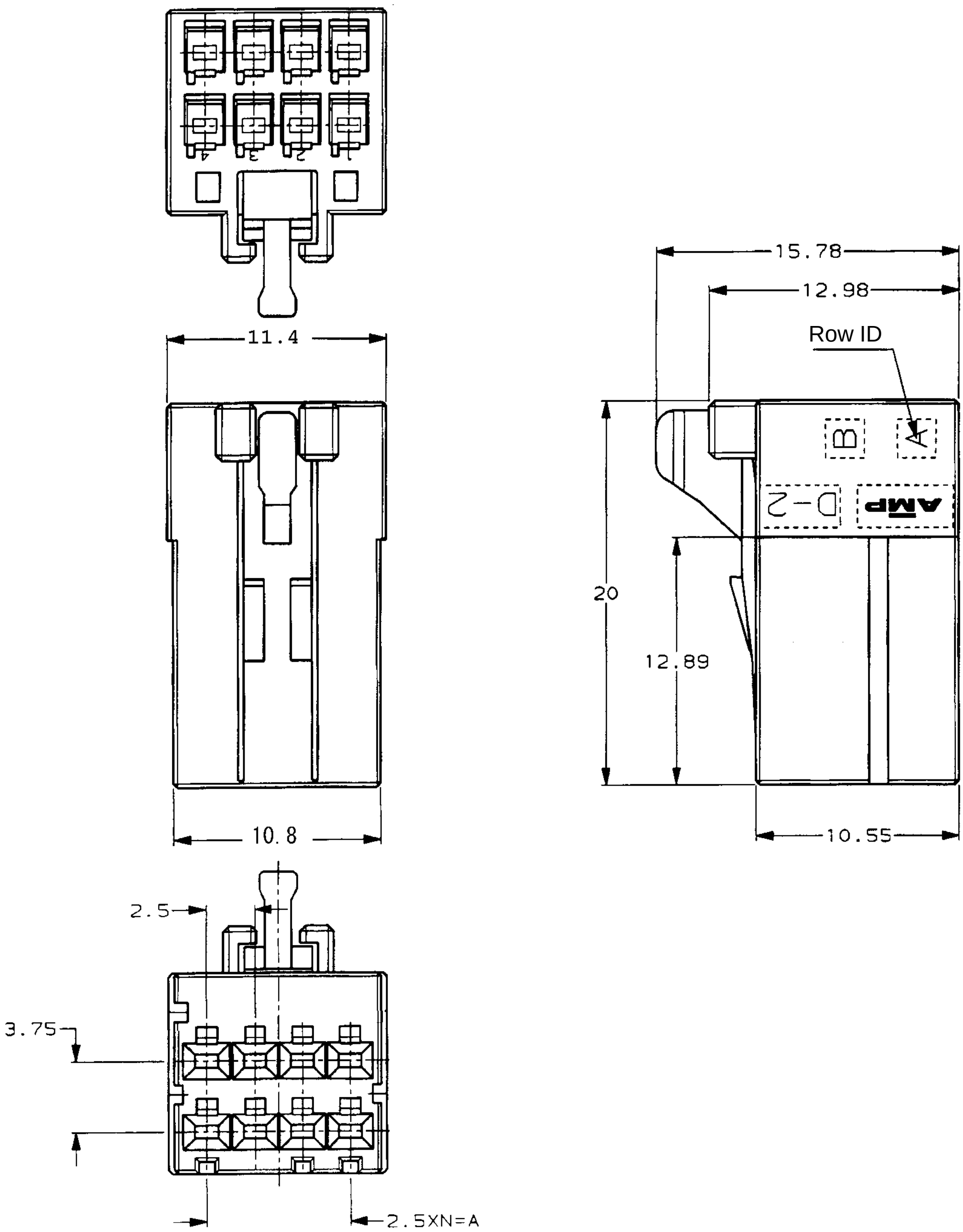


Fig. C(d) Contact for Tyco Electronics Japan connector

Manufacture: HIROSE ELECTRIC CO., LTD.
Type: FI30-20S (crimp type)
Housing: FI-20-CVS2 (plastic)

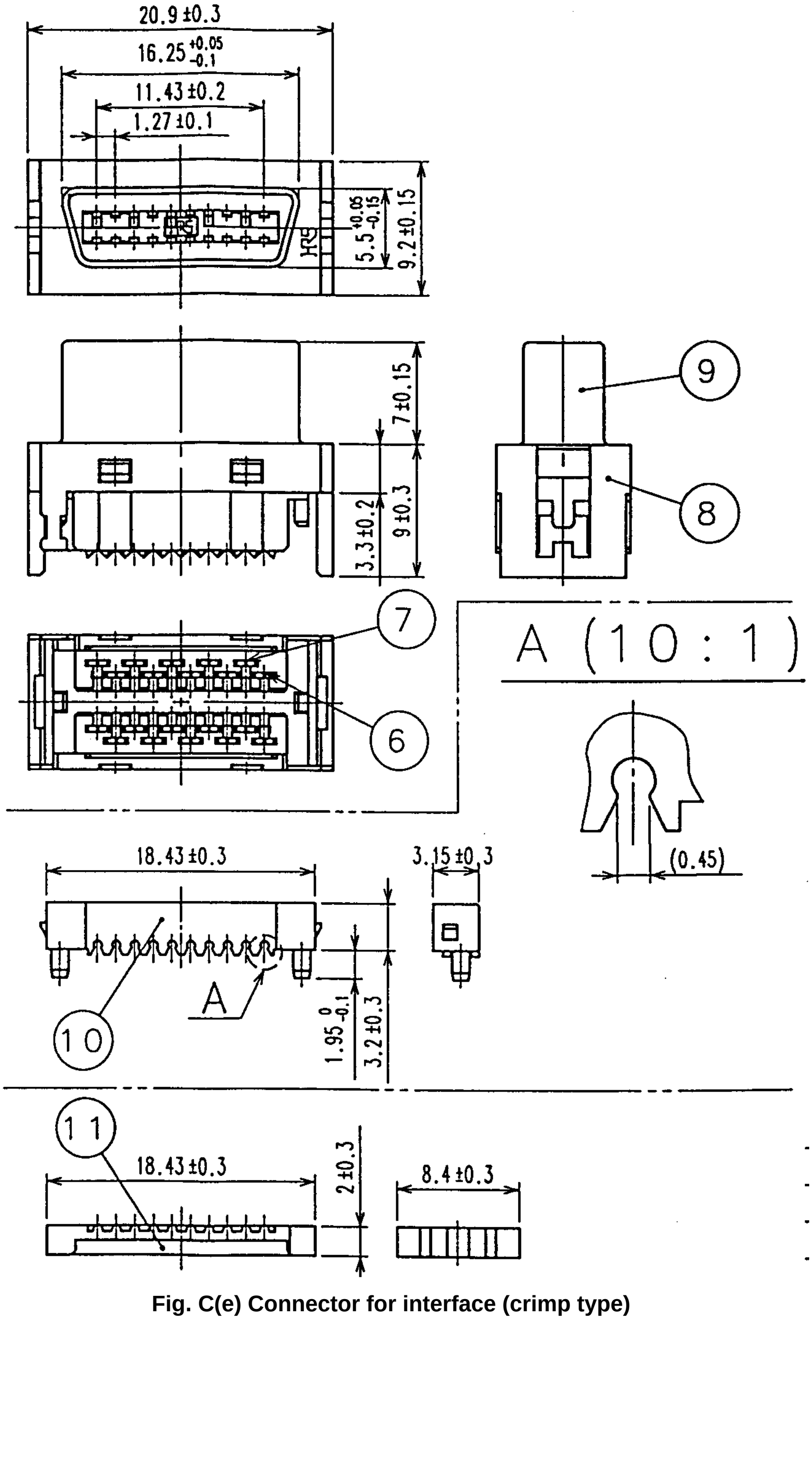


Fig. C(e) Connector for interface (crimp type)

Manufacture: HIROSE ELECTRIC CO., LTD.
Type: FI40B-20S (solder type)
Housing: FI-20-CVS5 (plastic)

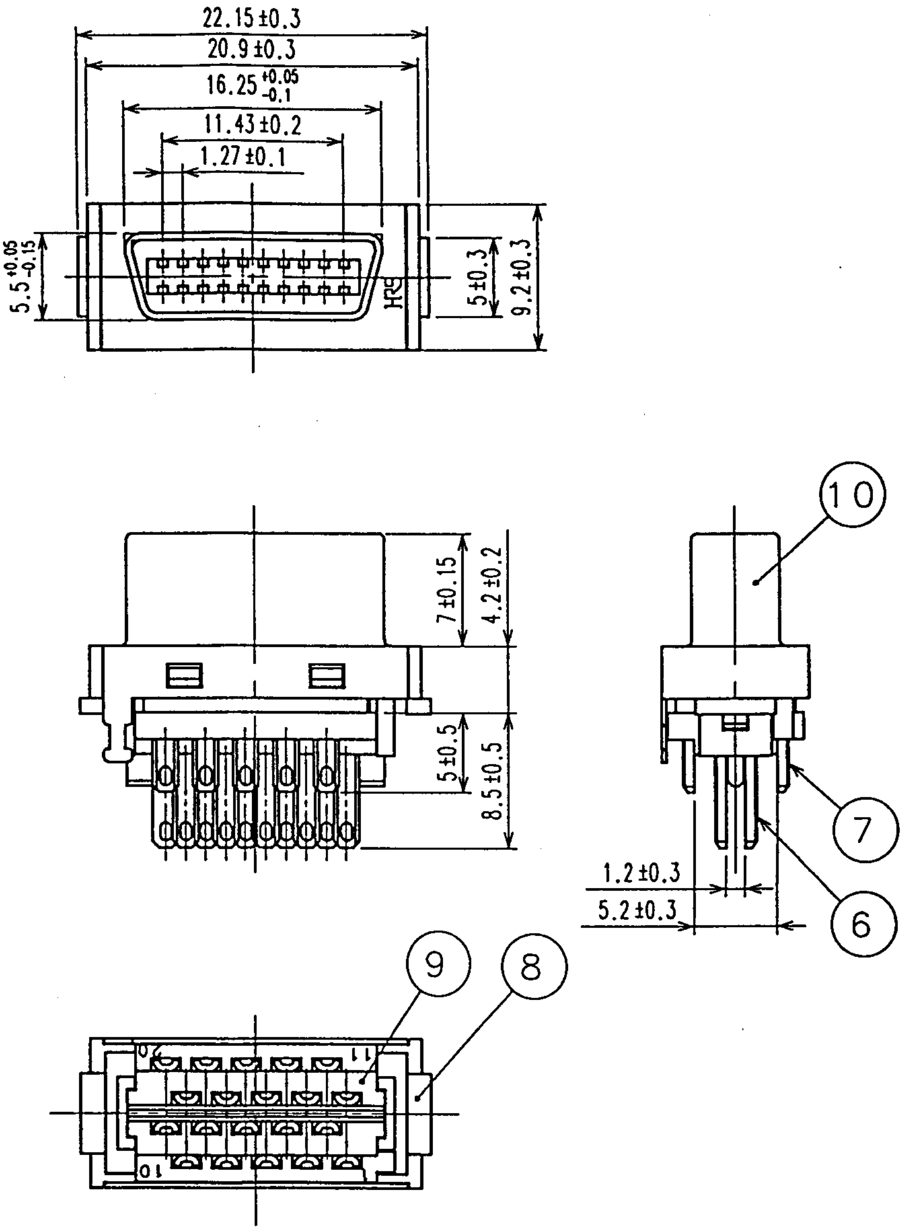


Fig. C(f) Connector for interface (solder type)

Manufacture: HIROSE ELECTRIC CO., LTD.
Type: FI40B-2015S (solder type)
Housing: FI-2015-CVS (plastic)

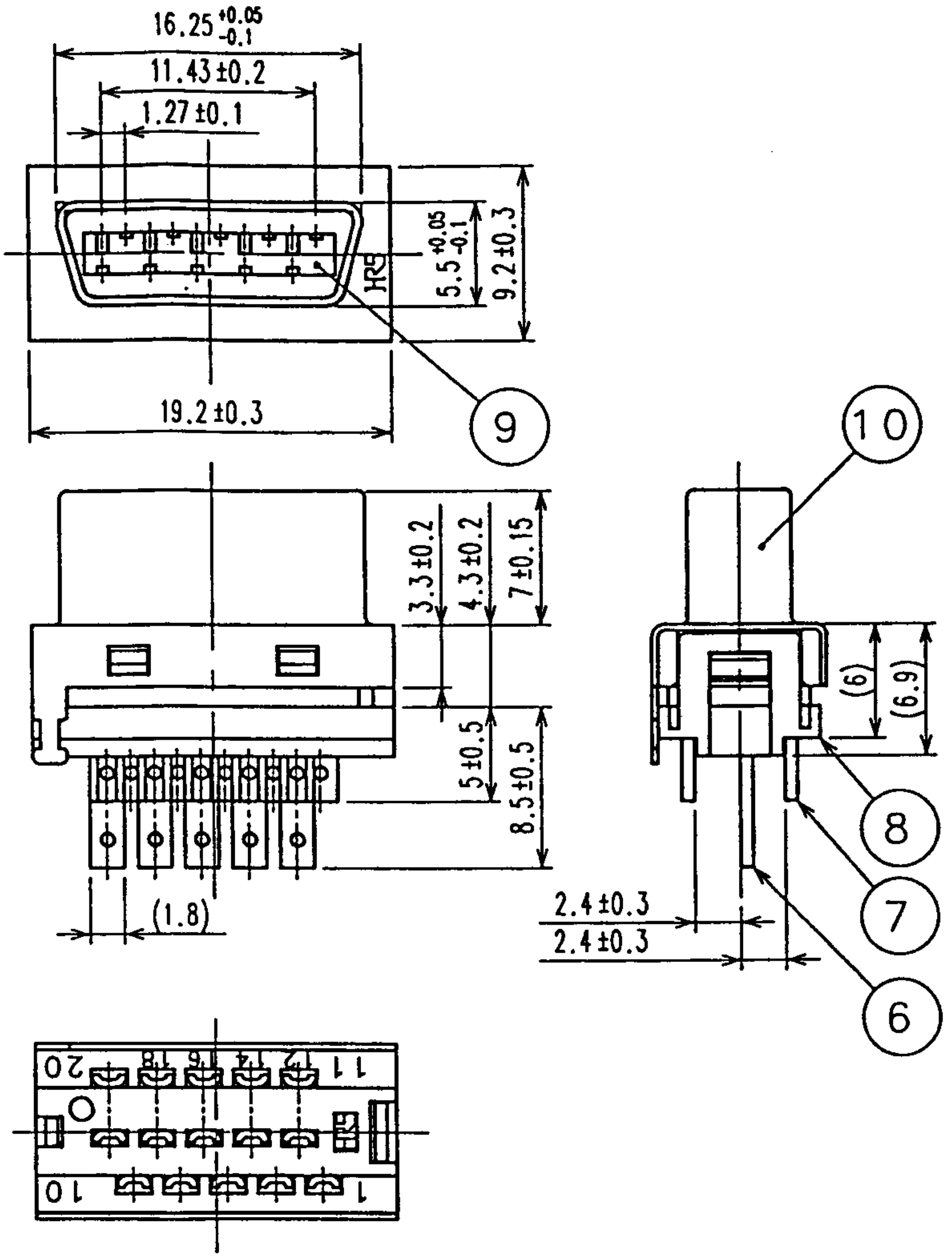


Fig. C(g) Connector for interface (solder type)

> **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

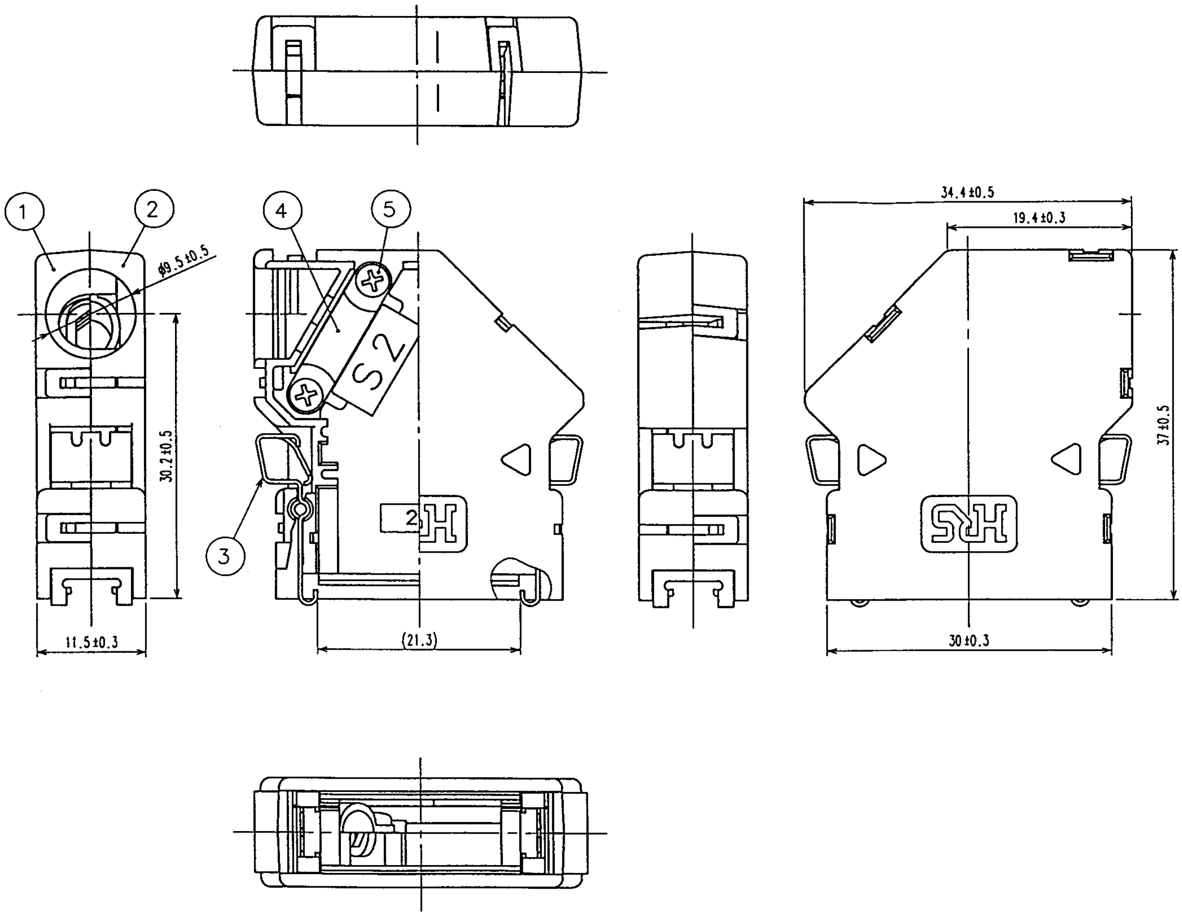


Fig. C(h) Connector housing (side cable type)

Manufacture: HIROSE ELECTRIC CO., LTD.
Type: FI-20-CVS5
Connector: FI40B-20S

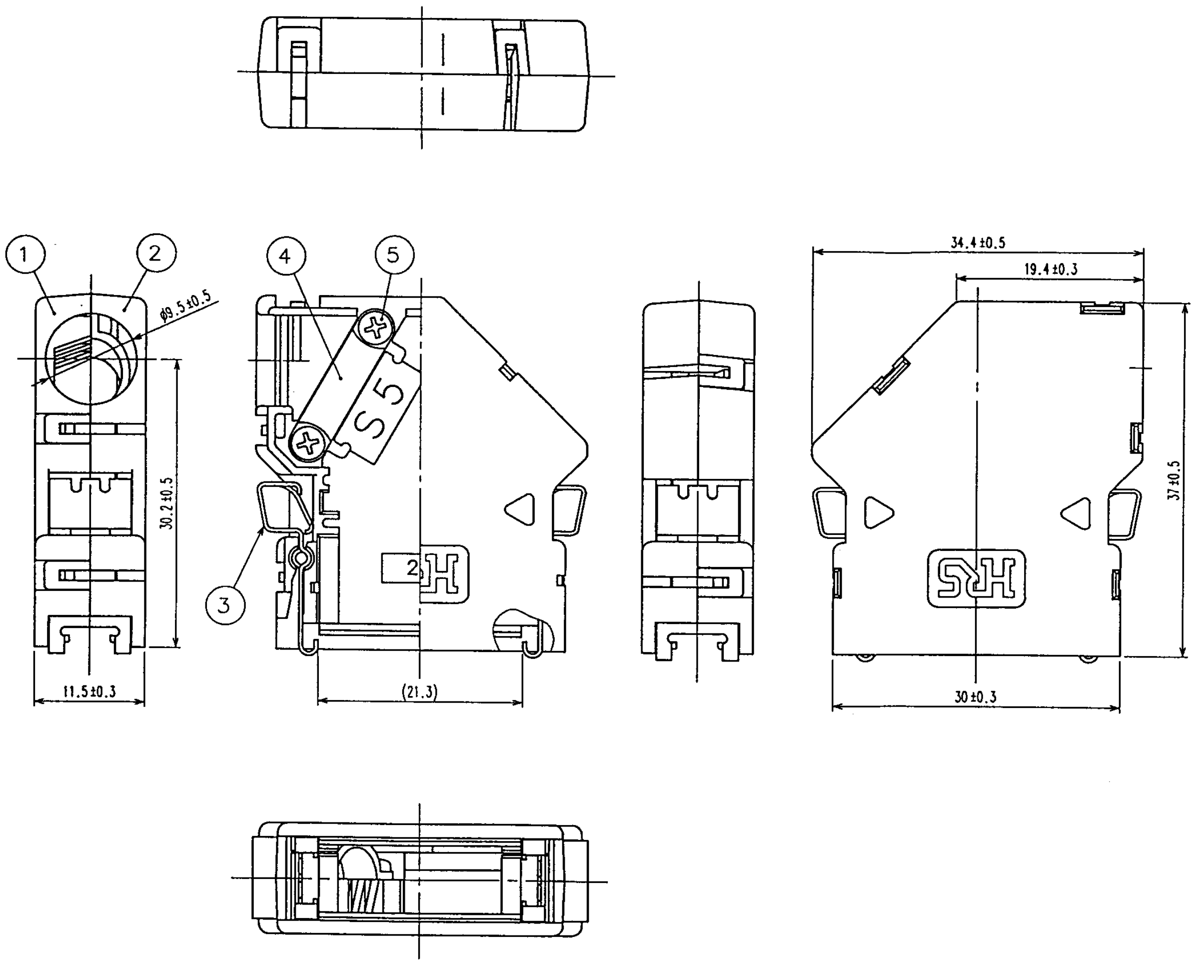


Fig. C(i) Connector housing (side cable type)

Manufacture: HIROSE ELECTRIC CO., LTD.
Type: FI-2015-CVS
Connector: FI40B-2015S

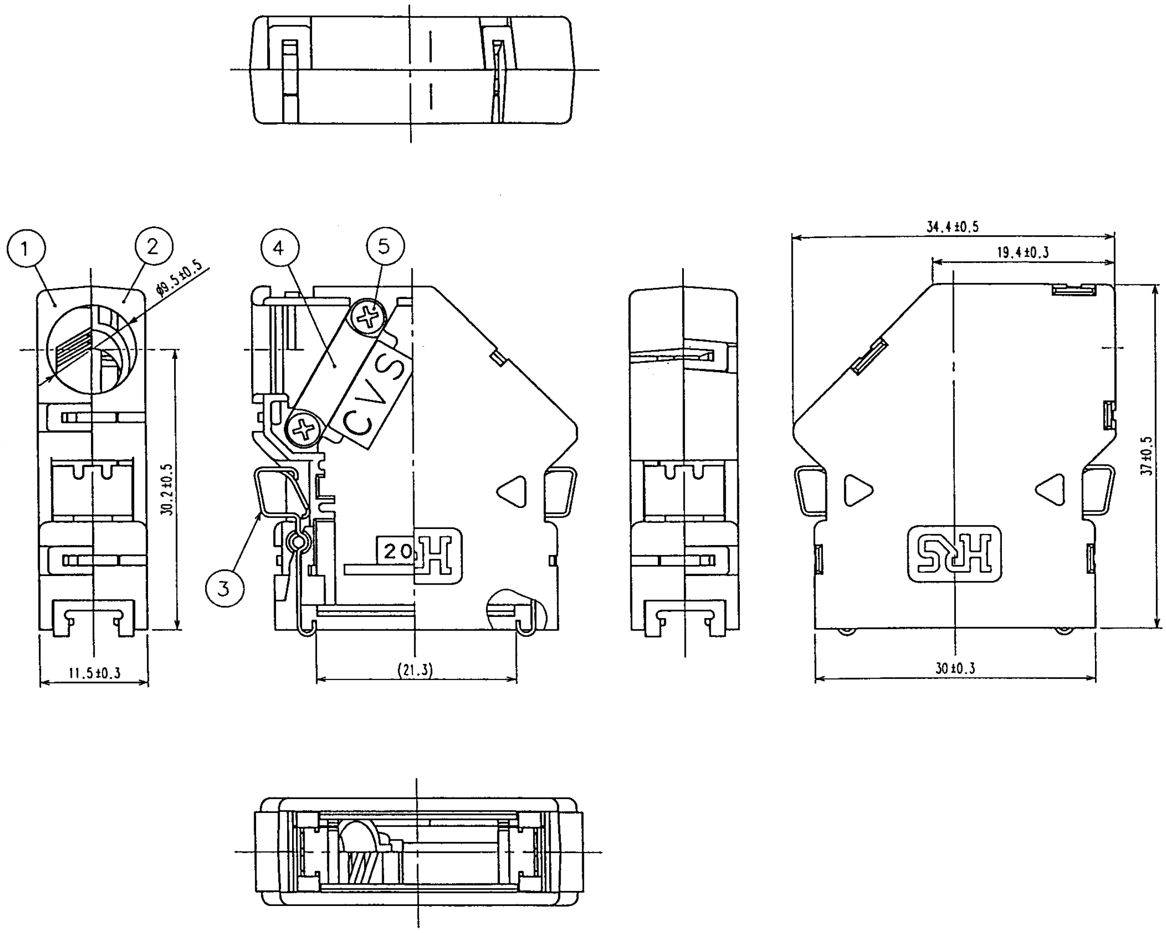


Fig. C(j) Connector housing (side cable type)

D FEEDBACK CABLE LENGTH

Appendix D, "FEEDBACK CABLE LENGTH," consists of the following sections:

D.1 SPINDLE SENSOR CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)
D.2 PULSECODER CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)

D.1 SPINDLE SENSOR CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)

Sensor	Recommended cable	Cable structure	Maximum cable length
α*i*M SENSOR	A66L-0001-0368	0.5 mm^2, 2 of 6 conductors used (for power supply) 0.18mm^2, 5 pairs (for signals)	72m (Note)
α*i*MZ SENSOR	A66L-0001-0368	0.5 mm^2, 2 of 6 conductors used (for power supply) 0.18mm^2, 5 pairs (for signals)	50m (Note)
α*i*M SENSOR (for α*i*I 0.5)	A66L-0001-0482	0.3 mm^2, 2 conductors (for power supply) 0.2mm^2, 3 pairs (for signals)	41m
α*i*MZ SENSOR (for α*i*I 0.5) α*i*BZ SENSOR (small-sized type)	A66L-0001-0482	0.3 mm^2, 2 conductors (for power supply) 0.2mm^2, 4 pairs (for signals)	28m
α*i*CZ SENSOR (serial output)	A66L-0001-0460 A66L-0001-0481	0.3mm^2, 5 conductors (for power supply) 0.2mm^2, 1 pair (for signals)	28m
	A66L-0001-0462 A66L-0001-0491	0.5mm^2, 5 conductors (for power supply) 0.2mm^2, 1 pair (for signals)	50m
α*i* POSITIONCODER	A66L-0001-0286	0.5 mm^2, 6 conductors (for power supply) 0.18mm^2, 3 pairs (for signals)	50m
α POSITIONCODER S	A66L-0001-0286	0.5 mm^2 , 6 conductors (for power supply) 0.18mm^2, 3 pairs (for signals)	50m

If a cable which is not recommended is used, the total resistance of +5V and 0V must not exceed the resistance listed in the table below.

Sensor	Total resistance of 5V and 0V
α*i*M SENSOR	5Ω
α*i*MZ SENSOR, α*i* BZ SENSOR	4Ω
α*i*CZ SENSOR (serial output)	2Ω
α*i* POSITIONCODER	2Ω
α POSITIONCODER S	2Ω

> **NOTE**
> A cable longer than the maximum cable length listed in the table can be used as long as the length is up to 100m and the maximum allowable speed according to the number of sensor teeth listed in the table below is not exceeded. If the maximum speed of the target model exceeds the maximum allowable speed, it must be limited.

Number of sensor teeth	Maximum allowable speed when the maximum cable length is exceeded (up to 100m)	Examples of motor models
128λ	12000 min^{-1}	α*i* I 1, α*i* I 1.5, α*i* I2, α*i* I 3
256λ	6000 min^{-1}	α*i* I 6, α*i* I 8, αi I 12, α*i* I 15, α*i* I 18, α*i* I 22, α*i* I 30, α*i* I 40, α*i* I 50, α*i* I 6HV, α*i* I 8HV, α*i* I 12HV, α*i* I 15HV, α*i* I 22HV α*i* I 40HV, α*i* I 50HV, α*i* I 60HV

D.2 PULSECODER CABLE LENGTH (WHEN RECOMMENDED CABLES ARE USED)

Recommended cable	Cable structure	Maximum cable length
A66L-0001-0460	0.3 mm^2, 5 conductors (for power supply) 0.20mm^2, 1 pair (for signals)	28m
A66L-0001-0462	0.5 mm^2, 5 conductors (for power supply) 0.20mm^2, 1 pair (for signals)	50m
A66L-0001-0481	0.3 mm^2, 5 conductors (for power supply) 0.18mm^2, 1 pair (for signals)	28m
A66L-0001-0491	0.5 mm^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

Appendix E, "POWER LINE FOR SERVO MOTOR AND AMPLIFIER," consists of the following sections:

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

Cable diameter [mm^2]	Environment temperature 30°C 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
14	Up to 56	Crimp terminal only

[Selection example 2]

- Heavy-duty power cable specification : Maximum allowable conductor temperature 80°C

Cable diameter [mm^2]	Environment temperature 55°C 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.: 3 wire bundles
  Maximum allowable conductor temperature 105°C

Cable diameter [mm^2]	Environment temperature 30°C Allowable current value [Arms]	Environment temperature 55°C Allowable current value [Arms]
0.75	Up to 12	Up to 10
1.25	Up to 16	Up to 13
2	Up to 21	Up to 17
3.5	Up to 32	Up to 26
5.5	Up to 43	Up to 35
8	Up to 55	Up to 44
14	Up to 79	Up to 64
22	Up to 113	Up to 92
30	Up to 137	Up to 112
38	Up to 160	Up to 131
50	Up to 190	Up to 155
60	Up to 220	Up to 180
80	Up to 269	Up to 219

Wire diameter versus AWG number table (reference)

Cable diameter [mm^2]	AWG number
0.8226	AWG18
1.307	AWG16
2.082	AWG14
3.309	AWG12
5.262	AWG10
8.368	AWG8
13.30	AWG6
21.15	AWG4
33.62	AWG2
42.41	AWG1
53.49	AWG1/0
67.42	AWG2/0
85.03	AWG3/0
107.2	AWG4/0

Selection example of servo motor power line (reference)

Example 1)

A heavy-duty power cable is used for the αi F22/3000 when the ambient temperature is 55°C.

- Check the continuous current rating of the servo motor with the applicable servo motor specification.
  (See descriptions about the stall current of the servo motor.)
  In this example, it is 18.4 Arms.
- Select a cable wire diameter from [Selection example 2] in this section.
  In this example, it is 3.5 mm^2.

Selection example of spindle motor power line (reference)

Example 1)

A polyflex wire is used for the αi I 8/8000 when the ambient temperature is 55°C.

- Check the continuous current rating of the spindle motor with the applicable spindle motor specification.
  (See descriptions about the stall current of the servo motor.)
  In this example, it is 43 Arms.
- Select a cable wire diameter from [Selection example 3] in this section.
  In this example, it is 8 mm^2.

F DC LINK TERMINAL BLOCK COVER

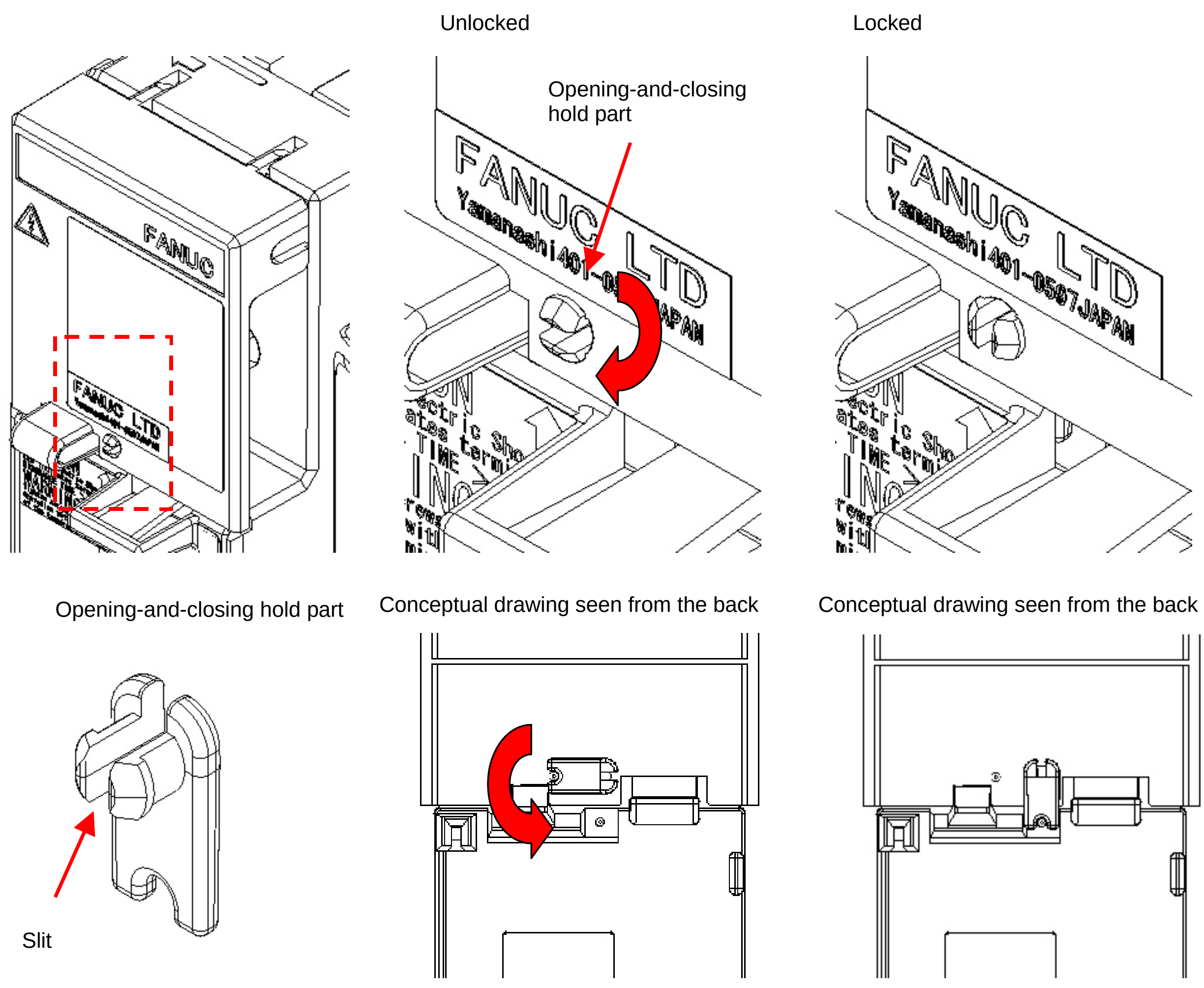
Appendix F, "DC LINK TERMINAL BLOCK COVER," consists of the following sections:

F.1 OPENING-AND-CLOSING LOCK OF THE DC LINK TERMINAL BLOCK COVER

(1) To keep the DC link terminal block cover from opening easily, lock the DC link terminal block cover. After the wiring of the DC link, insert a flat-blade screwdriver into the slit on the opening-and-closing hold part mounted on the DC link terminal block cover and rotate the part clockwise, as shown in the figure below.

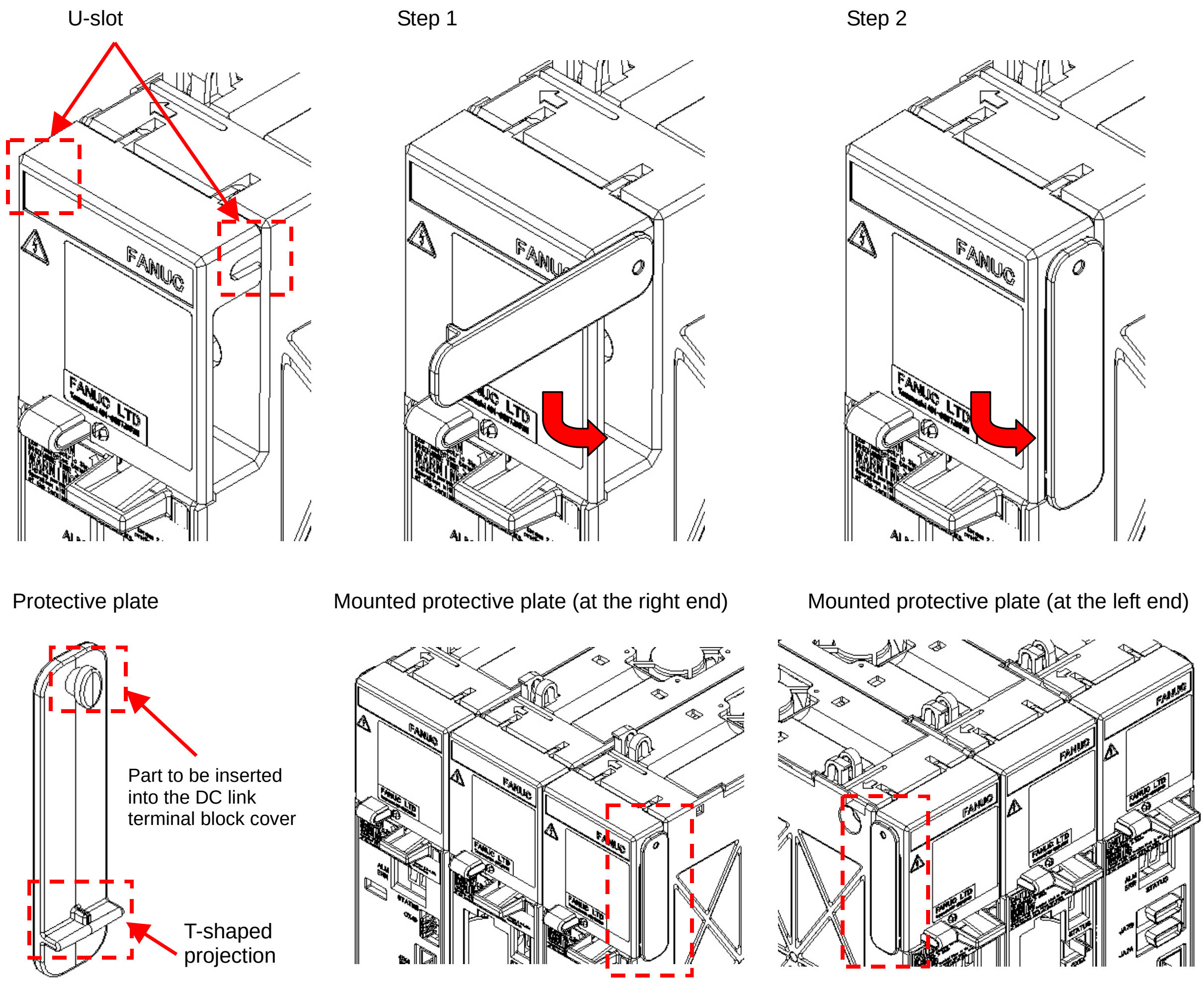
(2) When the slit is placed vertically as shown in the figure, the DC link terminal block cover is locked. The opening-and-closing hold part gets hung up on another part to keep the cover from opening, as shown in the conceptual drawing seen from the back.

(3) To open the DC link terminal block cover, rotate the slit on the opening-and-closing hold part to place it horizontally.



F.2 PREVENTING CONTACT WITH THE CONDUCTIVE PART OF THE DC LINK TERMINAL BLOCK

(1) To prevent contact with a side of the DC link terminal block, mount a protective plate on the DC link terminal block cover on each end of amplifiers arranged in a line.
(2) Two protective plates are supplied with a Power Supply.
(3) As shown in step 1, mount a protective plate on the U-slot of the DC link terminal block cover.
(4) After mounting the protective plate, rotate it in the direction shown in step 2 and fix it on the DC link terminal block cover. (To avoid the T-shaped projection, rotate the protective plate while bending it.)



G EXAMPLES OF RECOMMENDED POWER MAGNETICS CABINETS FOR SERVO AMPLIFIER INSTALLATION

Appendix G, "EXAMPLES OF RECOMMENDED POWER MAGNETICS CABINETS FOR SERVO AMPLIFIER INSTALLATION," consists of:

G.1 OVERVIEW

In order to prevent the reliability of servo amplifiers from lowering because of their environments, it is important to seal up the power magnetics cabinet for the servo amplifiers and to give consideration to the environment of the inside of the cabinet.
This document presents cautions to be observed when designing power magnetics cabinets. They should be useful to those who are going to design power magnetics cabinets.

Subsection No.	Subsection heading	Summary
G.2.1	Power Magnetics Cabinet Seal-up	Explains how to seal up power magnetics cabinets. Protecting electronics circuits in servo amplifiers requires installing them in a sealed power magnetics cabinet.
G.2.2	Environments for Amplifier Heat Sink Sections	Explains how to reduce extraneous materials, such as cutting fluid, oil mist, and cutting chips, that may get on heat sink sections. Those extraneous materials can lower the cooling efficiency of the servo amplifiers (leading to a lowered amplifier performance) and reduce the operating life of electronics components (power semiconductor devices, fan motors, etc).
G.2.3	Environments for Amplifier Installation	Describes cautions regarding environments in which amplifiers are installed. An environment impeding heat generation can lower the performance of the amplifiers and shorten the operating life of electronics components (power semiconductor devices, fan motors, etc).

G.2 DESCRIPTIONS

G.2.1 Power Magnetics Cabinet Seal-up

This subsection explains how to seal up power magnetics cabinets.
In order to protect servo amplifier electronics circuits, it is necessary to house the servo amplifier in a sealed power magnetics cabinet.

<1> Keep the power magnetics cabinet free of any hole or gap through which external air can enter the cabinet (Fig. G.2.1 (a)). Do not make any hole in a cabinet wall panel; fitting air filters in holes cannot necessarily seal up the cabinet.
<2> Do not make any hole in the cabinet wall panel to install a fan motor in the hole (Fig. G.2.1 (a)). In order to release heat from the cabinet to the outside, use a device (such as a heat exchanger or cooler) having a structure that will not hamper seal-up of the cabinet.

<3> Keep all joining areas of cabinet wall panels free of gaps. If cabinet wall panels are partly bonded (for example, spot-welded), fill any gaps between bonded areas with sealant, for example, in order to seal up the cabinet.

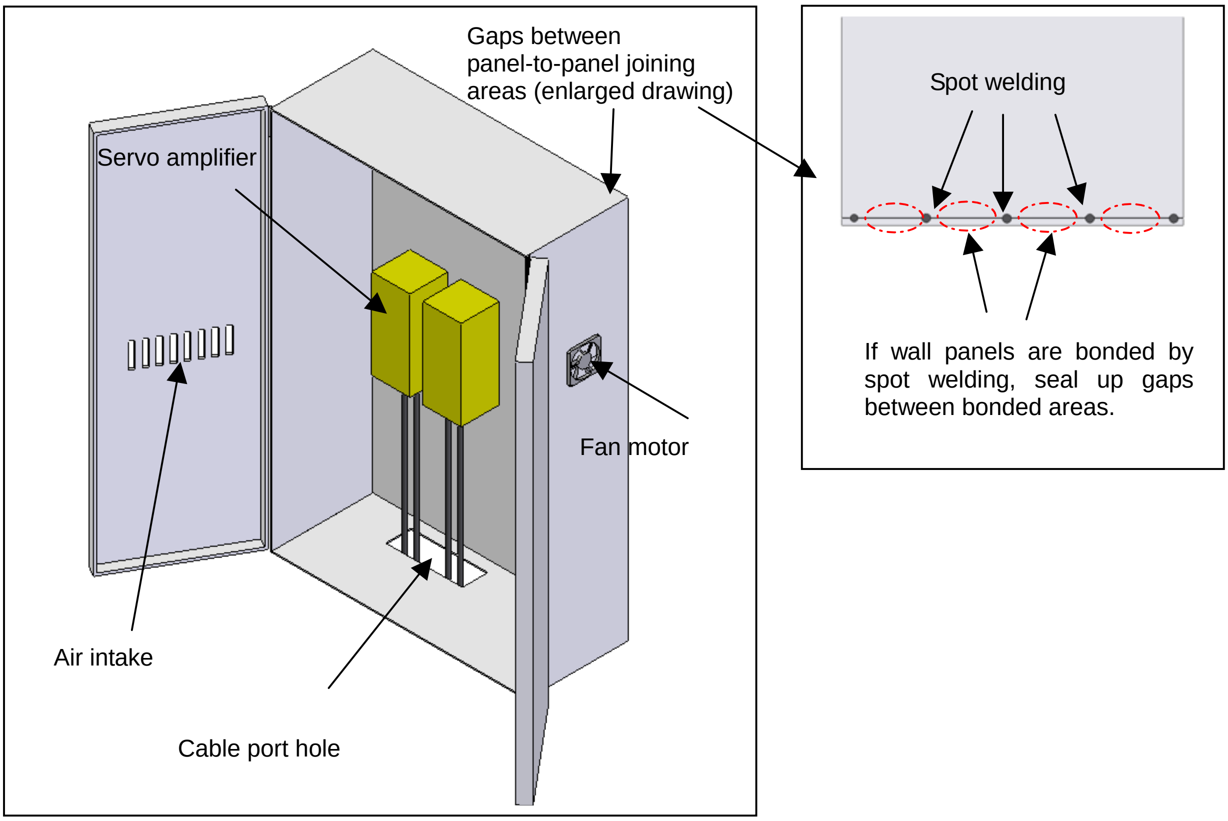


Fig. G.2.1 (a) Example of power magnetics cabinet not sealed well (example of poor work)

<4> Keep the cable port free of gaps (Fig. G.2.1 (a)).
(Concrete method)
1) Fit a conduit in the cable port hole (Fig. G.2.1 (b)).
2) If it is impossible to fit a conduit by any means, at least keep the cable port free of gaps. Shown below is an example of sealing by fitting sponge around cables (Fig. G.2.1 (c)). Do not allow cables to overlap with one on another; otherwise, gaps will occur around the cables. If there are many cables, separate them into several places.
3) If a cable duct is used as a cable port, be sure to seal up the duct. When leading cables into the duct, observe items 1) and 2).

Fig. G.2.1 (b) Fitting a conduit

Fig. G.2.1 (c) Sealing with sponge

<5> In order to prevent external air from entering through screw holes, observe the following:

1) Avoid making holes in cabinet wall panels as far as possible; for example, weld male screws (studs) to cabinet wall panels and use nuts with them (Fig. G.2.1 (d)). Using cap nuts and applying sealant around them is also effective (Fig. G.2.1 (e)). When using cap nuts, give consideration to the length of screws used with the cap nuts.
2) For the top panel in particular, be sure to observe item 1), because extraneous materials, such as cutting fluid, can easily get on the panel.
3) If a screw hole is left unused (open) because of no screw being inserted (for example, a grounding terminal screw hole left unused), be sure to block it up.

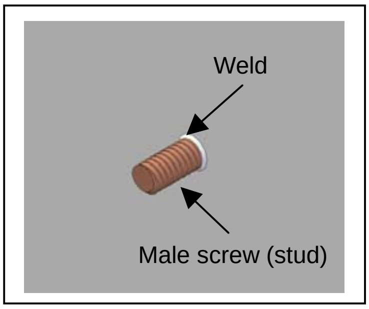


Fig. G.2.1 (d) Welding male screw

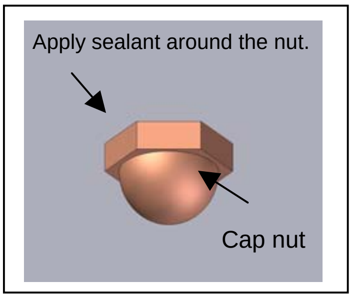


Fig. G.2.1 (e) Using cap nut

<6> Avoid allowing gaps in the portions where the door meets the door frame.

1) Seal the door, for example, by attaching gaskets to the inside edges of the door (Fig. G.2.1 (f)).
2) When attaching gaskets, do not leave gaps between the gaskets, especially those at the corner of the door (Fig. G.2.1 (f)).
3) If the cabinet has a double-door structure, use a gasket between the doors (Fig. G.2.1 (g)).
4) If a hole is made in a door panel to fit a component in it, seal the hole with a gasket to secure seal-up.
5) To seal up the cabinet, be sure to lock the door.

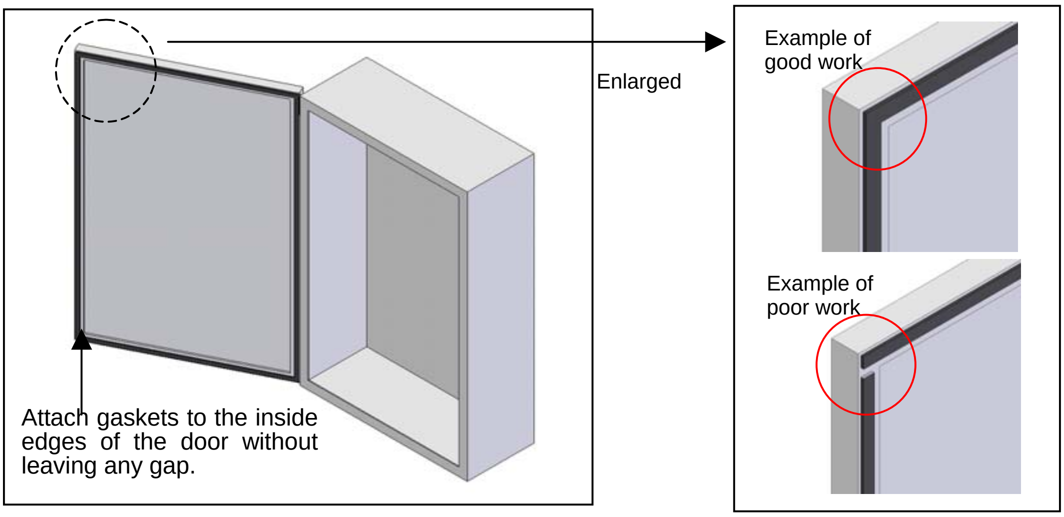


Fig. G.2.1 (f) Sealing doors

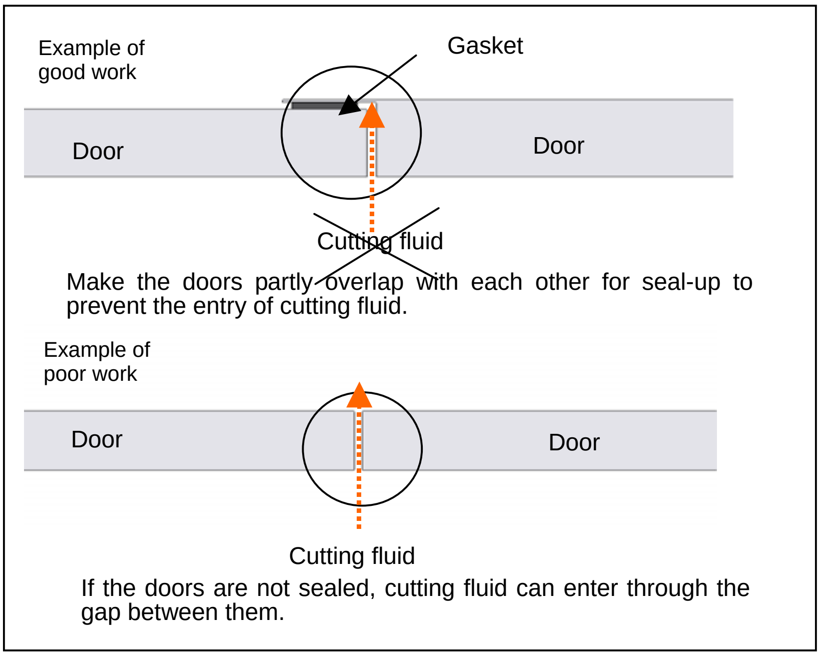


Fig. G.2.1 (g) Double-door structure seal-up (cross-section view of portion where the doors meet)

<7> Provide an underthroating at the portion where the power magnetics cabinet frame meets the door (Fig. G.2.1 (h)) to prevent the entry of cutting fluid.

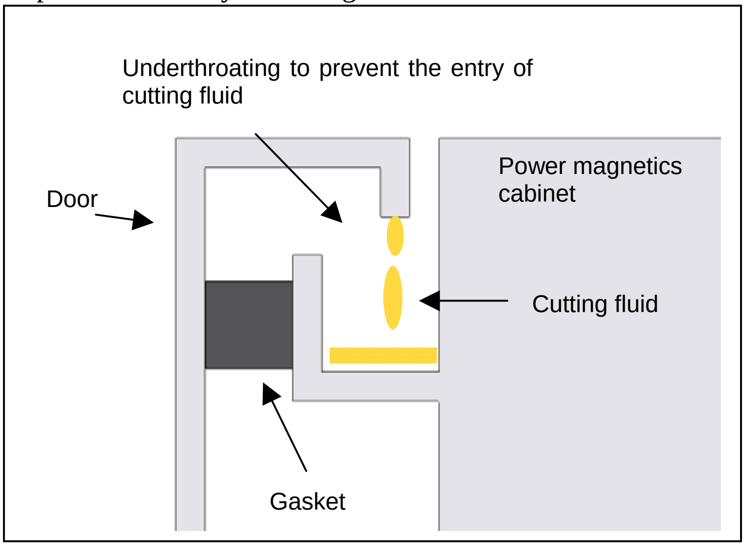


Fig. G.2.1 (h) Explanation of underthroating

<8> Lead cables into the power magnetics cabinet from below the cable port. This is intended to try to prevent cutting fluid entering the cabinet along cables (Fig. G.2.1 (i)).

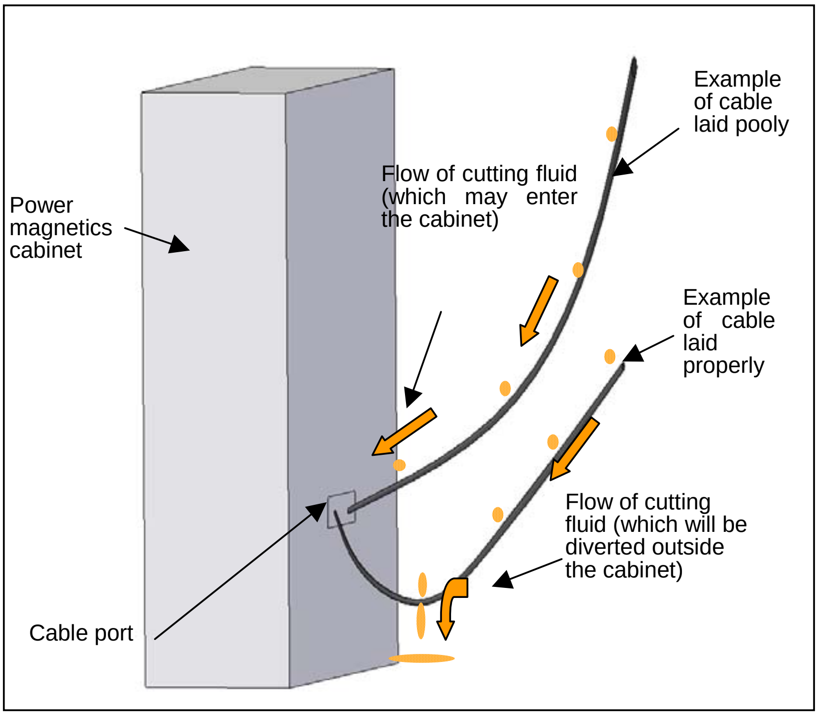


Fig. G.2.1 (i) How to lead in cables

<9> If holes are made in a power magnetics cabinet wall panel to install an amplifier, attach the supplied gaskets to the holes to seal up the cabinet. At each corner of the amplifier, make gaskets overlap with each other. If not (for example, gaskets are cut short), a gap may occur, leading to leakage (Fig. G.2.1 (j)).

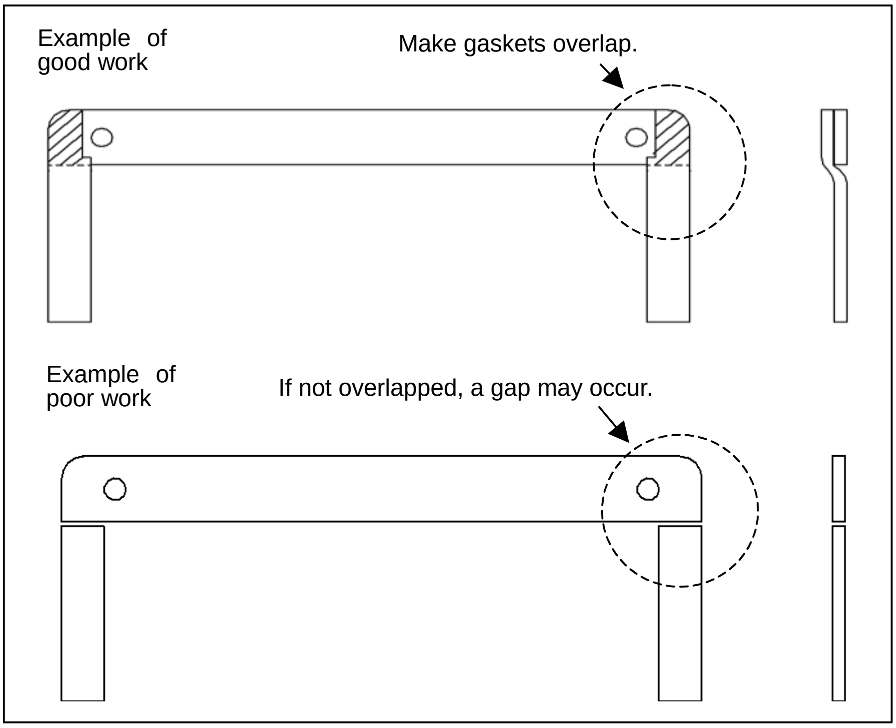


Fig. G.2.1 (j) How to attach gaskets

G.2.2 Environments for Amplifier Heat Sink Sections

This subsection explains how to prevent extraneous materials, such as cutting fluid, oil mist, and cutting chips, from getting on amplifier heat sink sections.
If extraneous materials, such as cutting fluid, oil mist, and cutting chips, get on servo amplifier heat sink sections or fan motors, they can lower the cooling efficiency (performance) of the servo amplifiers and shorten the operating life of electronics components (such as power semiconductor devices and fan motors).

<1> If a structure that takes in fresh air to cool a heat sink section is employed, be sure to enclose the heat sink section in a box having vent holes and cover the vent holes (both intake and discharge holes) with air filters to prevent the entry of cutting fluid mist (Fig. G.2.2 (a)). Select vent holes and air filters designed to release heat properly by giving consideration to the heat release property of the structure. Replace air filters at regular intervals; dirty air filters can lower the cooling efficiency.
Do not provide vent holes in the top panel; cutting fluid would accumulate in the air filter of any vent hole in the top panel and later drop into the box.

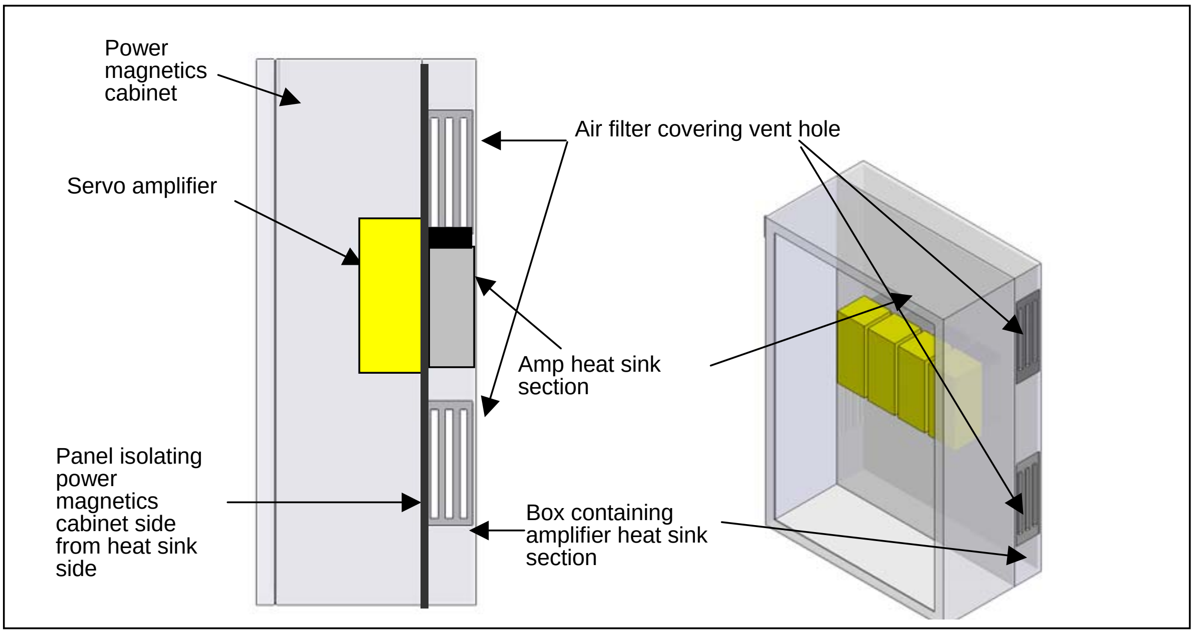


Fig. G.2.2 (a) Air filter locations

<2> Be sure to isolate the machining area from the amplifier heat sink section (Fig. G.2.2 (b)); if cutting fluid or cutting chips get in direct contact with an amplifier heat sink section, its heat release property gets lowered (Fig. G.2.2 (c)).

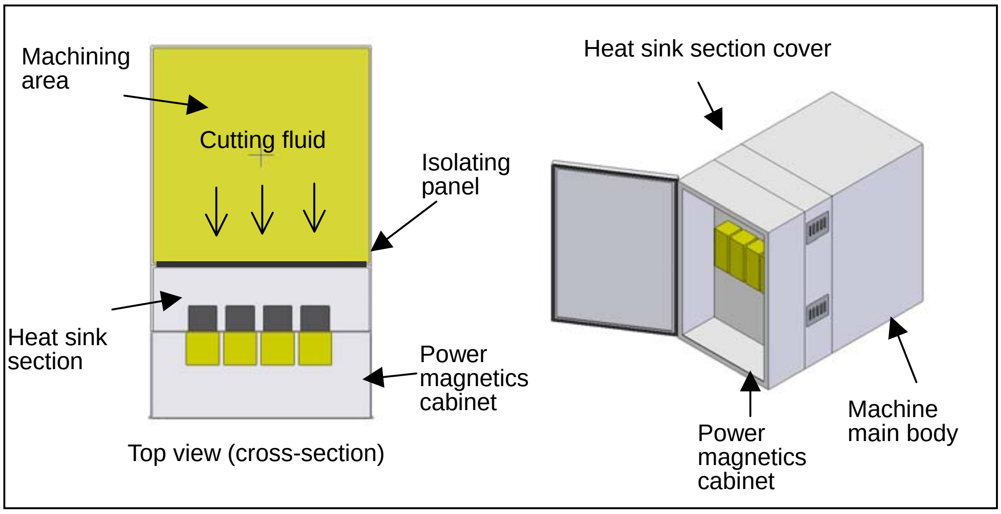


Fig. G.2.2 (b) Machining area isolated from amp heat sink section (example of good work)

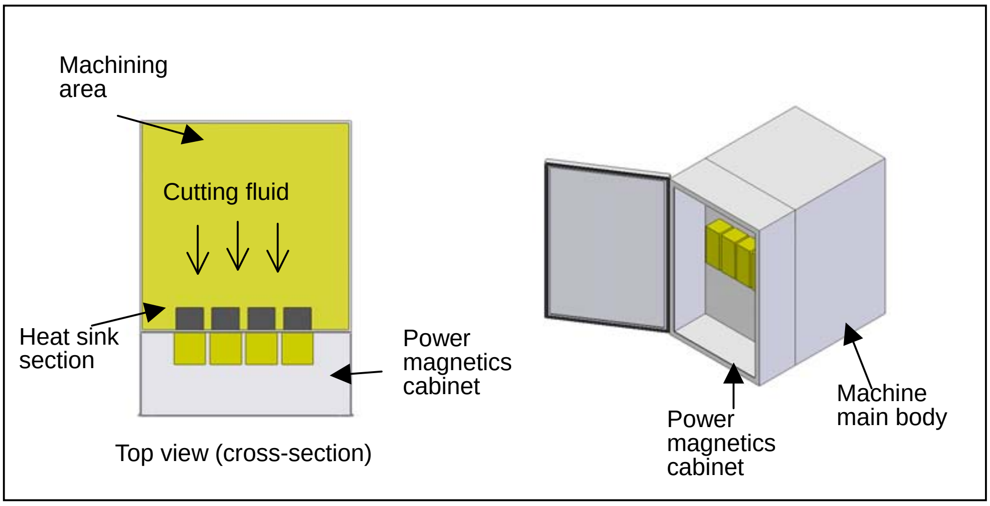


Fig. G.2.2 (c) Machining area and amp heat sink section sharing the same place (example of poor work)

G.2.3 Environments for Amplifier Installation

This subsection describes cautions to be observed with regard to environments for amplifier installation.
If the heat release property of the heat sink section of a servo amplifier gets lowered because of the servo amplifier installation environment being improper, it is likely that the amplifier performance may be lowered and the operating life of electronics components (such as power semiconductor devices and fan motors) may be shortened.

<1> Mounting heat exchangers
If the temperature inside the power magnetics cabinet is at least 10°C higher than the ambient temperature, use heat exchangers to cool the inside of the cabinet.
*1: When attaching a heat exchanger, fit gaskets around it to seal up the cabinet.
*2: Prevent air from heat exchangers from flowing directly onto amplifiers or electronics products; otherwise, it is likely that any dust and dirt in the cabinet may be blown to them.

<2> Installing a cooling fan for agitating air inside

Installing a cooling fan inside the power magnetics cabinet can homogenize the temperature and increase the heat release efficiency of the power magnetics cabinet (Fig. G.2.3 (a)).

*1: Do not place any cable that may hamper air agitation near the cooling fan air outlet.

*2: Prevent air blowing from a cooling fan directly onto amplifiers or electronics products; otherwise, it is likely that dust and dirt in the cabinet may be blown to them.

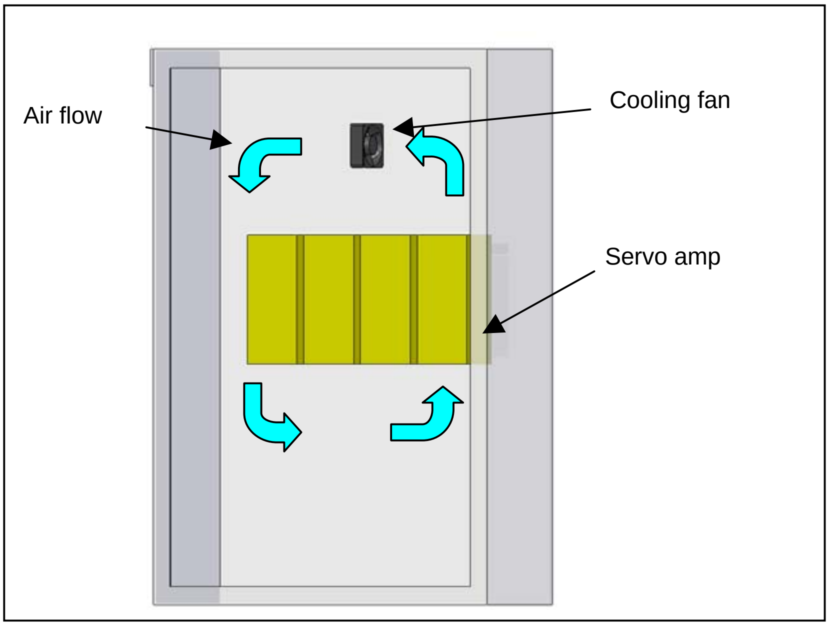


Fig. G.2.3 (a) Example of installing motor-driven fan for agitating air inside

<3> Using dehumidifying agent inside the power magnetics cabinet

Placing dehumidifying agent, such as dehumidifying sheets, in the power magnetics cabinet can prevent the reliability of servo amplifiers from lowering.

<4> How to install servo amplifiers

It is assumed that, when servo amplifiers are installed, they will be arranged in a raw. If you cannot help but arrange them in a column, observe the following (Fig. G.2.3 (b)):

*1: Keep cooling air for the lower amplifier from flowing directly onto the upper amplifier. If radiation performance degrades, the specified output may not be obtained.

*2: Keep the upper amplifier from blocking up the cooling air flow for the lower amplifier.

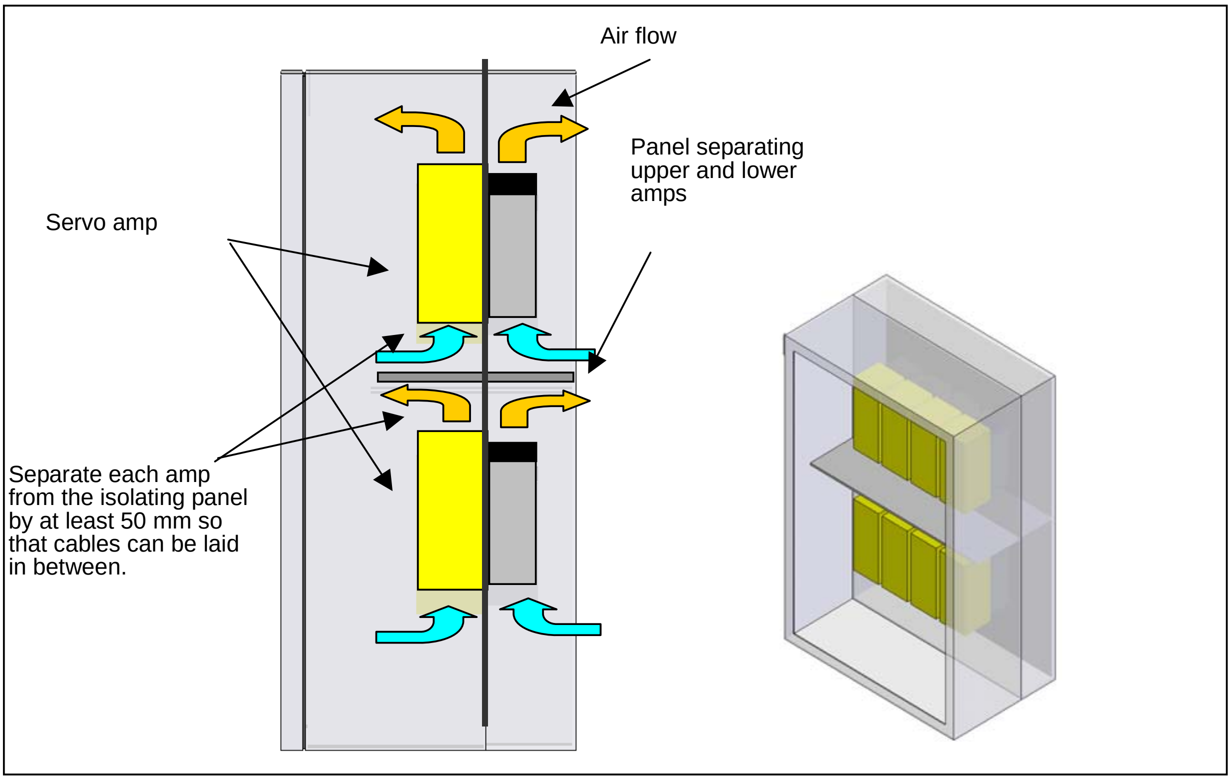


Fig. G.2.3 (b) Example of arranging amps in a column

H HARMONIC LEAKAGE CURRENT

Method of filling the harmonic leakage current calculation sheet according to the harmonics suppression measure guideline

This appendix provides the method of filling "Calculation sheet of harmonic leakage current from harmonic emission devices (No. 1)" by the user in connection with "Harmonics suppression measure guideline for users who receive power at high or specially high voltages" issued from Agency for JAPAN Natural Resources and Energy of the Ministry of Economy, Trade, and Industry.
Servo amplifier data needed for filling the calculation sheet is provided below.

Servo amplifier data
Device name: Servo amplifier for velocity control
Manufacturer: FANUC COPRPORATION
Model: Enter the drawing number of the servo amplifier.
Rated capacity: Refer to the descriptions of each servo amplifier.

- For rated capacity calculation, see "How to calculate the power equipment capacity" in Subsection 2.3.1.
  For "Minor circuit classification No." and "Conversion coefficient Ki," use the values on the table provided below.

- This appendix describes the method of filling the calculation sheet when no device for harmonic leakage current suppression is installed.
  If a device for harmonic leakage current suppression is already installed, "Calculation sheet of harmonic leakage current from harmonic emission devices (No. 2)" needs to be submitted.

- The circuit classification of a servo amplifier is 1 or 3. So, "Application of harmonic emission device manufacturers," which is required for circuit classification 10, need not be prepared.

- For details of the guideline, calculation method, and so forth, the user is requested to contact its electric power company.

Name	Target amplifier drawing number	Minor circuit classification No.	Conversion coefficient Ki	Remarks
Power Supply (αiPS-B)	A06B-6200-Hxxx	32	1.8	Note
Power Supply (Level-up αiPS-B)	A06B-6202-Hxxx			
Power Supply (αiPS HV-B)	A06B-6250-Hxxx			
Power Supply (Level-up αiPS HV-B)	A06B-6252-Hxxx			

NOTE
When the αi-B amplifier is used, no separate calculation is needed for each of the servo amplifier (αiSV-B) and spindle amplifier (αiSP-B). A calculation may be made for the αiPS-B.

I POWER FAILURE BACKUP MODULE MODEL B

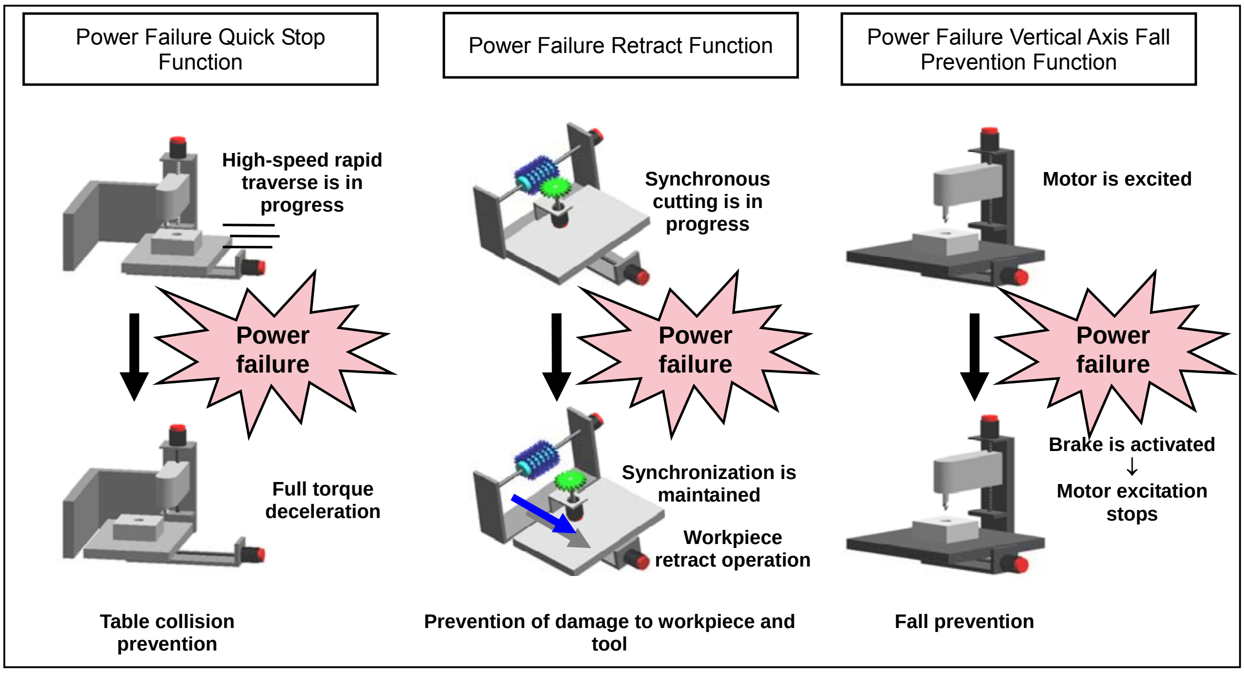
I.1 OVERVIEW

The Power Failure Backup Module Model B consists of the following modules:

Abbreviation	Remark 1	Remark 2
PFB-24	200 V input model	• Outputs 24 VDC. • At power failure, outputs 24 VDC for a certain period of time.
PFB-24 HV	400 V input model	
PFB-R	200 V input model	• At power failure, discharges the regenerative energy stored when the motor decelerates through a resistor.
PFB-R HV	400 V input model	
PFB-C	200 V input model	• At power failure, supplies energy needed for motor control. • Be sure to connect capacitor modules.
PFB-C HV	400 V input model	
Capacitor Module 25000	200 V input model	• At power failure, stores energy needed for motor control. • Connected to PFB-C and PFB-C HV.
Capacitor Module 4500 HV	400 V input model	

The Power Failure Backup Module Model B is used to protect the machine at power failure.
The power failure machine protection is classified into the following functions.

Power failure machine protection	Remarks
Power Failure Quick Stop Function	• This function decelerates and stops the motor without coasting after power failure. • This prevents damages to the machine by coasting of a motor.
Power Failure Retract Function	• This function retracts workpiece and tool to a position where they do not interfere with each other. • This prevents damages to workpiece or tool by coasting of a motor.
Power Failure Vertical Axis Fall Prevention Function	• This function prevents the fall of vertical axis at power failure. • This prevents damages to workpiece or tool by fall of the vertical axis.



I.1.1 Applications

The following shows typical applications of the Power Failure Backup Module Model B.

Machine	Purpose	Machine protection function to use at power failure	PFB-24 Note 2	PFB-R	PFB-C + Capacitor module
M/C, lathe	To avoid collision due to coasting of the feed axis	Power Failure Quick Stop Function Note 1	○	○	—
	To avoid collision due to coasting of linear motor or synchronous built-in motor		○	—	○
M/C, lathe Gear cutting machine, grinding machine	To avoid damage to workpiece or tool due to coasting	Power Failure Retract Function	○	—	○
M/C, lathe	To avoid damage to workpiece or tool due to fall of the vertical axis	Power Failure Vertical Axis Fall Prevention Function	—	—	—

○: Needed —: Not needed

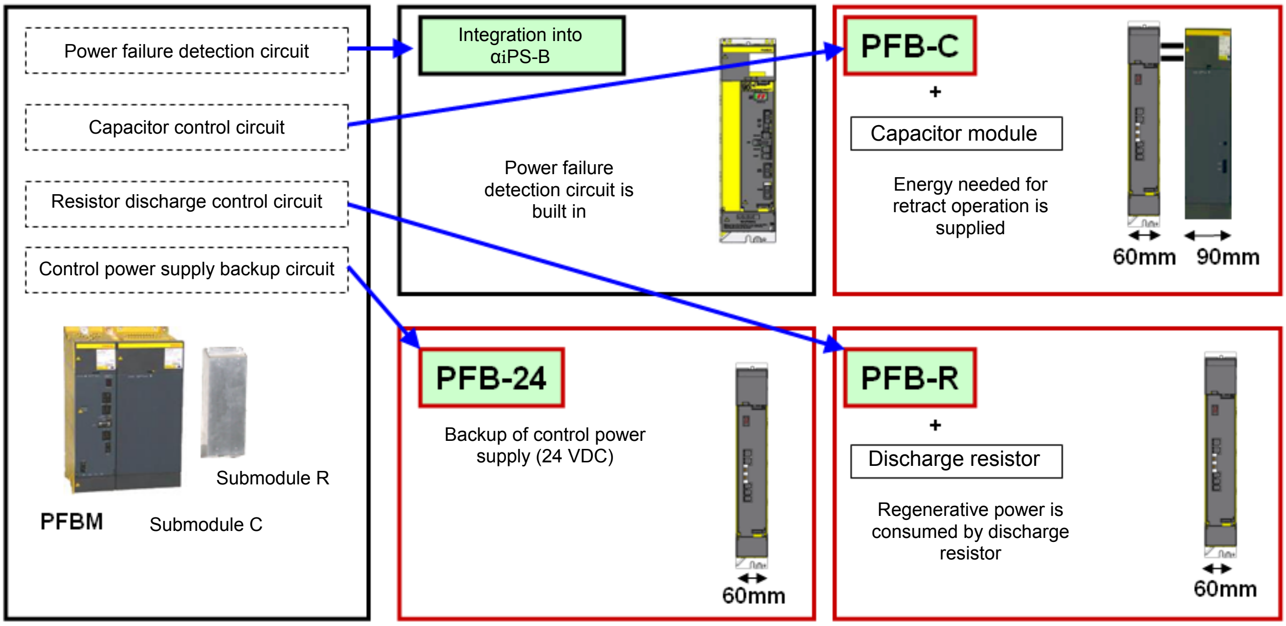
NOTE

1 When the stop distance reduction at power failure is applied, use PFB-24, and PFB-C and capacitor modules to decelerate and stop a linear motor, synchronous built-in motor, or any other motor used with a large inertial force and low rotational speed at power failure.

2 A commercially available uninterruptible power supply system (UPS) may be used to back up the 24-V control power supply instead of using PFB-24.

I.1.2 Differences from Previous Models

- Divide modules by functions
- Flexibly support each type of power failure machine protection



Current power failure backup module

Power Failure Backup Module Model B

Cost reduction and space saving
- Modules are selected according to necessary types of power failure machine protection, enabling cost reduction and space saving.
- The width of the capacitor module has been reduced to 90 mm.

Wire saving
- α*i*PS-B detects a power failure and transmits power failure detection signal to each module.

Enhanced capability
- The discharge power of PFB-R has been increased to 100 kW.
- With PFB-C, the charging energy of the capacitor module is kept constant independent of the power supply voltage.

I.1.3 Compatible Amplifiers

Series	Ordering number	PFB-24	PFB-R	PFB-C
α*i*PS-B	A06B-6200-Hxxx A06B-6250-Hxxx	○	×	×
α*i*PS-B	A06B-6202-Hxxx A06B-6252-Hxxx	○	○	○

○: Compatible ×: Incompatible

NOTE
This section describes the case where PFB-R and PFB-C are connected to αiPS-B (A06B-6202-Hxxx or A06B-6252-Hxxx).
If PFB-R or PFB-C is connected to αiPS-B (A06B-6200-Hxxx or A06B-6250-Hxxx), alarm 24 "PS hardware malfunction" (SV0034, SP9212) occurs in αiPS-B, or alarm C occurs in PFB-R or PFB-C.

I.1.4 Compatible CNCs

The Power Failure Backup Module Model B can be used with the following CNCs:

- FANUC Series 3x*i*-MODEL B
- FANUC Series 0*i*-MODEL F
- FANUC Series 0*i*-MODEL D

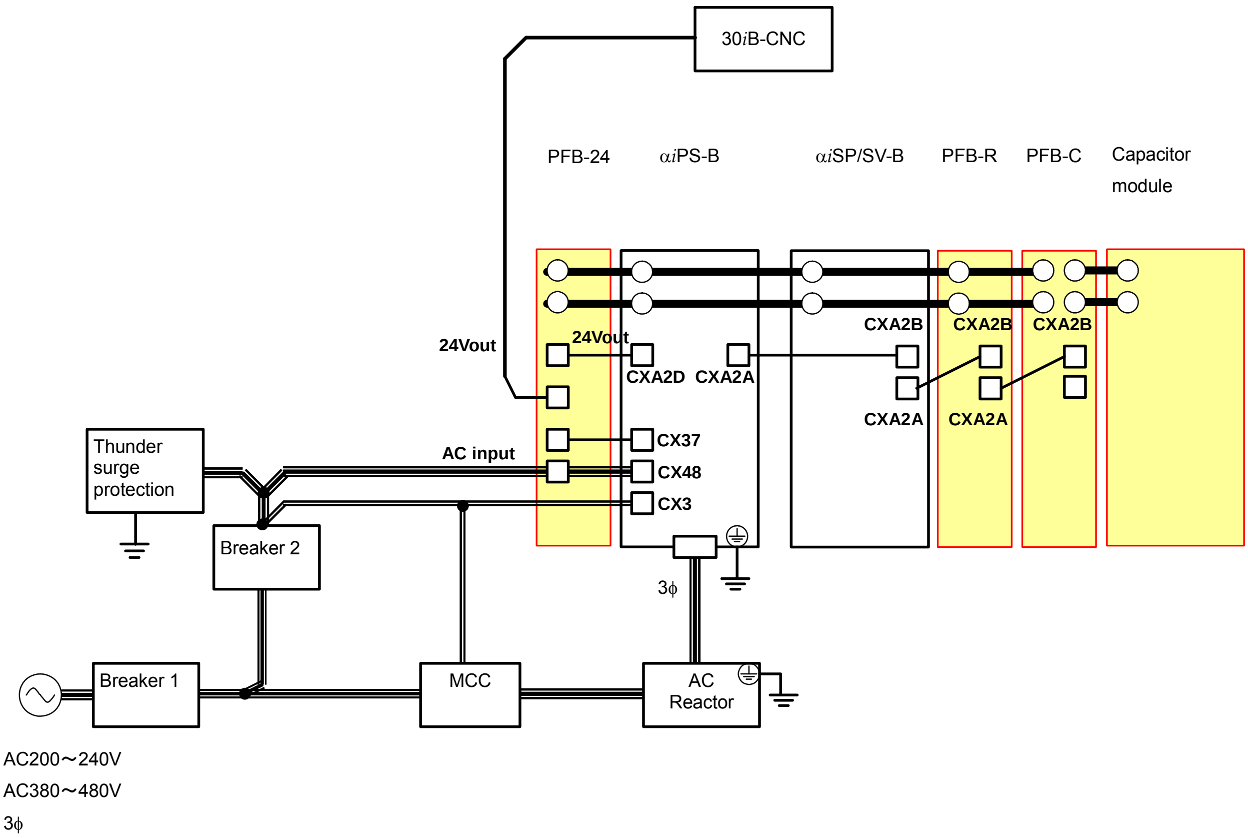
The wiring method and signal processing partially differ between Series 3x*i*-B or 0*i*-F and Series 0*i*-D. Sections I.2 to I.10 describe the wiring method and signal processing for Series 3x*i*-B or 0*i*-F and Section I.11 describes those for Series 0*i*-D.

I.2 CONFIGURATION AND ORDERING NUMBER

I.2.1 Configuration

(1) PFB-24
PFB-24 HV
(2) PFB-R
PFB-R HV
(3) PFB-C
PFB-C HV
(4) Capacitor Module 25000
Capacitor Module 4500 HV

Basic configuration (example)



NOTE

1 When two or more αiPS-Bs are used, one Power Failure Backup Module Model B is needed per αiPS-B.
2 Use the 24V-input type dynamic brake module and supply 24 V from PFB-24.
3 To retract the vertical axis at power failure, supply the brake power from PFB-24 so that the brake is not activated by the power failure.
4 In the power inlet of power magnetic cabinet, install lightning surge protection devices between lines, as well as between each line and the grounding to protect the device from lightning surge voltage. See APPENDIX A for details.

I.2.2 Ordering Number

PFB-24

Category	Name	Ordering number	Remarks
Standard	PFB-24	A06B-6209-H010	200 V input model
Standard	PFB-24 HV	A06B-6259-H010	400 V input model

PFB-R

Category	Name	Ordering number	Remarks
Standard	PFB-R	A06B-6209-H020	200 V input model
Standard	PFB-R HV	A06B-6259-H020	400 V input model

PFB-C

Category	Name	Ordering number	Remarks
Standard	PFB-C	A06B-6209-H030	200 V input model
Standard	PFB-C HV	A06B-6259-H030	400 V input model

Capacitor module

Category	Name	Ordering number	Remarks
Standard	Capacitor Module 25000	A06B-6209-H050	200 V input model
Standard	Capacitor Module 4500 HV	A06B-6259-H050	400 V input model

Fuses

Category	Name	Ordering number	Remarks
Standard	Fuses	A06B-6073-K250	F1(3.2A)

Cables

Category	Name	Ordering number	Distance between compatible terminals
Optional	DC link short bar	A06B-6209-K001	38mm
		A06B-6209-K002	60mm
		A06B-6078-K801	90mm
		A06B-6209-K003	150mm
		A06B-6209-K004	300mm

Connectors

(1) For PFB-24

Category	Use	Ordering number	Description	Use
Optional	Connector	A06B-6209-K500	Housing: 1 pcs. Contact: 4 pcs.	K133
		A06B-6209-K501	Housing: 5 pcs. Contact: 21 pcs.	K134, K135, K136, K137

(2) For PFB-R

Category	Use	Ordering number	Description	Use
Optional	Connector	A06B-6110-K210	Housing: 1 pcs. Contact: 8 pcs.	K69
		A06B-6110-K506	Housing: 1 pcs. Contact: 3 pcs.	K138
		A06B-6110-K508	Housing: 1 pcs. Contact: 13 pcs.	K139

(3) For PFB-C

Category	Use	Ordering number	Description	Use
Optional	Connector	A06B-6110-K210	Housing: 1 pcs. Contact: 8 pcs.	K69
		A06B-6110-K508	Housing: 1 pcs. Contact: 13 pcs.	K140

Configuration of A06B-6209-K500

Connector name	Manufacturer	Part number	Quantity	Use	Contact crimping tool
CXA2E1 CXA2E2 CXA2E3 CXA2E4	AMP	1-1318119-4 (Housing)	1	For 24 V output	A06B-6110-K220 #D2M
		1318107-1 (Contact)	4		

Configuration of A06B-6209-K501

Connector name	Manufacturer	Part number	Quantity	Use	Contact crimping tool
CX56	AMP	1-178128-3 (Housing)	1	For output shutdown	A06B-6110-K220 #D3L
		1-175218-2 (Contact)	3		
CX37	AMP	1-1318119-3 (Housing)	1	For αiPS interface	A06B-6110-K220 #D2M
		1318107-1 (Contact)	6		
CX57	AMP	1-1318119-3 (Housing)	1		
		1318107-1 (Contact)	6		
CX48A	AMP	3-178128-3 (Housing)	1	For power supply	A06B-6110-K220 #D3L
		1-175218-2 (Contact)	3		
CX48B	AMP	3-178128-3 (Housing)	1		
		1-175218-2 (Contact)	3		

Configuration of A06B-6110-K210

Connector name	Manufacturer	Part number	Quantity	Use	Contact crimping tool
CXA2A CXA2B	AMP	1-1318119-4 (Housing)	1	For αiPS interface	A06B-6110-K220 #D2M
		1318107-1 (Contact)	8		

Configuration of A06B-6110-K506

Connector name	Manufacturer	Part number	Quantity	Use	Contact crimping tool
CX55A CX55B	AMP	1-1318120-3 (Housing)	1	For PFB-R parallel drive	A06B-6110-K220 #D2M
		1318107-1 (Contact)	3		

Configuration of A06B-6110-K508

Connector name	Manufacturer	Part number	Quantity	Use	Contact crimping tool
CX53 CX60	AMP	1-1318118-9 (Housing)	1	For DI/DO	A06B-6110-K220 #D2M
		1318107-1 (Contact)	13		

I.3 SPECIFICATIONS

I.3.1 PFB-24

PFB-24 usually outputs 24 VDC with energy supplied from the AC power and, while at power failure, outputs 24 VDC with energy supplied from the DC link of the servo amplifier. This allows PFB-24 to output 24 VDC even after a power failure, as long as the DC link of the servo amplifier maintains its voltage.

[Specifications]
PFB-24

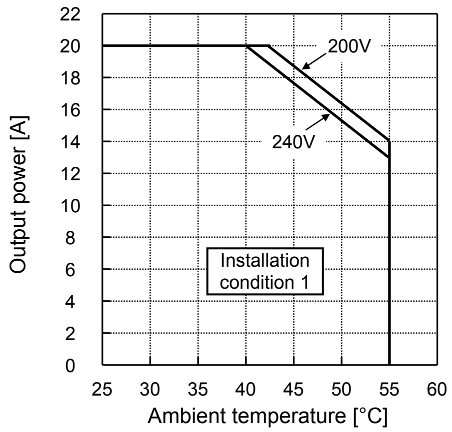
Item	Specifications
Input power supply (AC)	200VAC -15% to 240VAC +10%
Input power supply (AC) Input current	3.0Arms (200 VAC input, 20A output)
Input power supply (AC) Inrush current	45Ap (at power-on, 200VAC input, 20A output)
24 VDC output voltage	24V±5%
24 VDC output current	20A (at 40°C, 200VAC input, installation condition-1) Note) Derating of output is needed depending on the input voltage and installation conditions. See next item.
External dimensions	60mm x 380mm x 172mm (W x H x D)
Weight	2.5kg
Amount of heat dissipation	75W (200VAC input, 20A output)

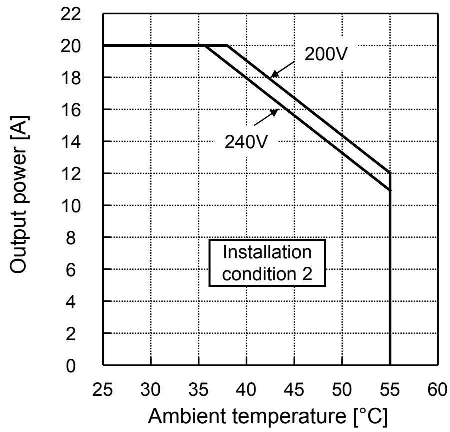
PFB-24 HV

Item	Specifications
Input power supply (AC)	380VAC -10% to 480VAC +10%
Input power supply (AC) Input current	1.5Arms (400VAC input, 20A output)
Input power supply (AC) Inrush current	25Ap (at power-on, 400VAC input, 20A output)
24 VDC output voltage	24V±5%
24 VDC output current	20A (at 40°C, 400VAC input, installation condition-1) Note) Derating of output is needed depending on the input voltage and installation conditions. See next item.
External dimensions	60mm x 380mm x 172mm (W x H x D)
Weight	2.7kg
Amount of heat dissipation	85W (400VAC input, 20A output)

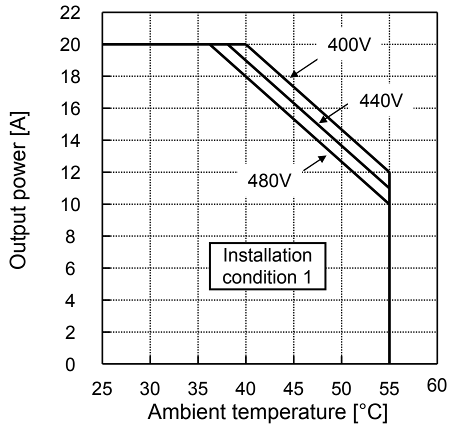
[Output derating]

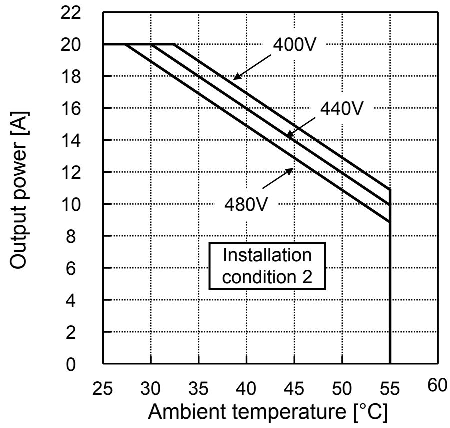
PFB-24





PFB-24 HV

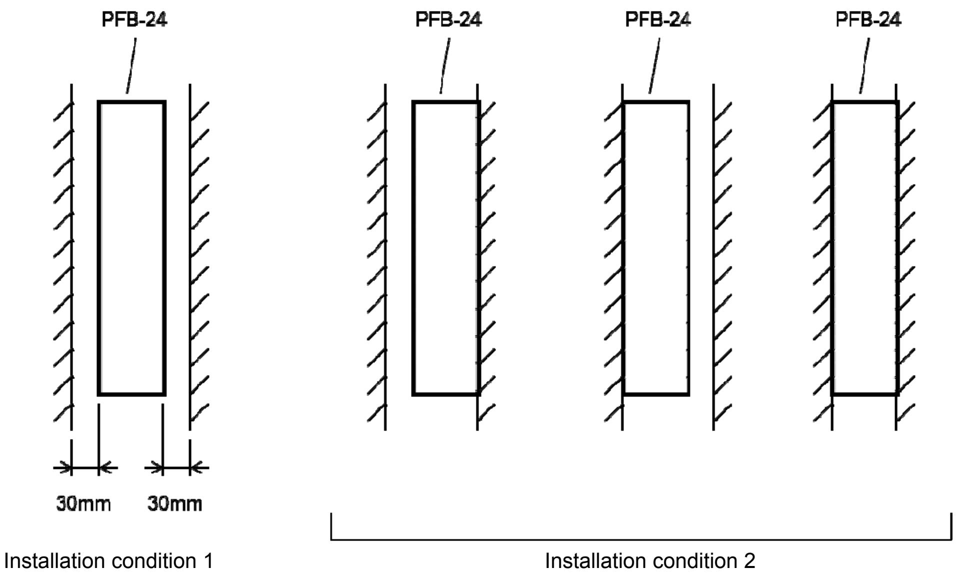




[Installation conditions]

Installation condition-1: When clearance of at least 30 mm is ensured on both sides of PFB-24.

Installation condition-2: When the above clearance is not ensured.



⚠ CAUTION

Continued usage of PFB-24 outside of the above output derating range may activate overheat protection and stop the 24 VDC output. In this case, the power failure backup function does not work. Be sure to observe the output derating.

⚠ CAUTION

If any capacitive load is connected via a switch or the like after the 24 VDC output has been activated, the charging current in the capacitive load may initiate the overcurrent protection function of this machine, thereby stopping the output of 24 VDC. In this case, the power failure backup function may not work properly. Do not connect any capacitive load after this equipment has been activated.

⚠ CAUTION

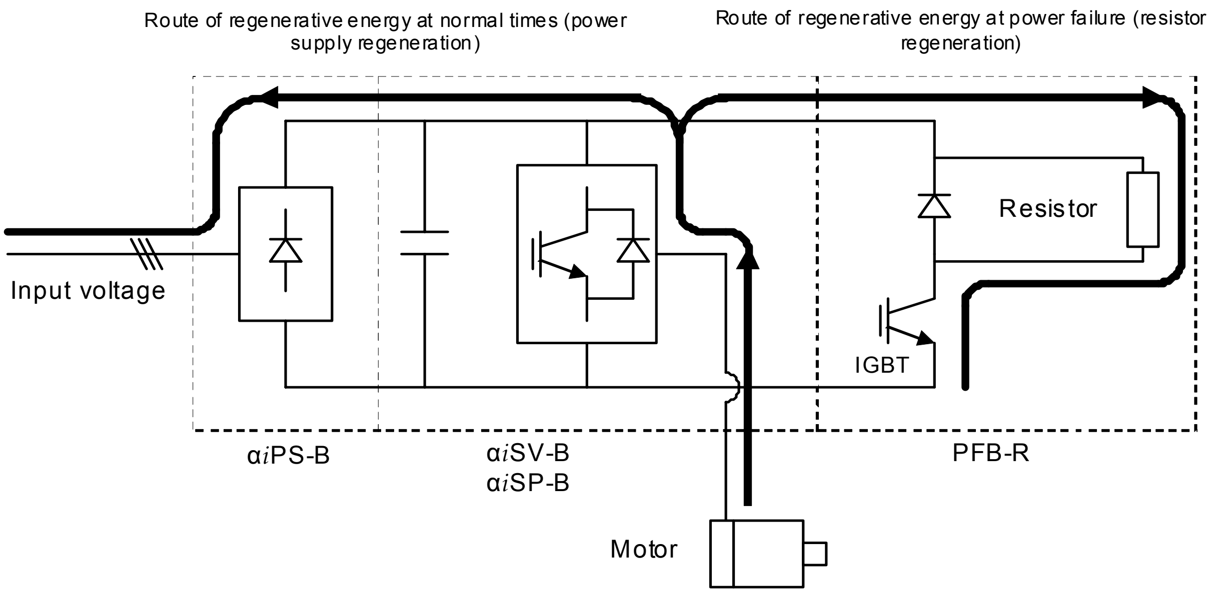
If two or more PFB-24s are used, never connect their 24 VDC outputs in series or in parallel.

NOTE

Some noise may be heard from PFB-24 when 24 V load is light, but this is normal.

I.3.2 PFB-R

At power failure, PFB-R discharges the regenerative energy generated when the motor decelerates via internal resistor. PFB-R is mainly used for the Power Failure Quick Stop Function.



NOTE

1 PFB-R enters ready to run state if the temperature of the discharge resistor is 70°C or lower after the emergency stop has been released. PFB-R can discharge the regenerative energy once it is ready to run. Start the machine operation after confirming that PFB-R entered ready to run state.
2 When a power failure occurs and just after PFB-R discharges, the discharge resistor becomes hot. PFB-R may not enter ready to run state even after restarting the machine and releasing the emergency stop.
3 PFB-R starts discharging when it is ready to run and the DC link voltage exceeds the threshold value. In power supplied state, the energy generated when the motor decelerates is returned to the power supply by αiPS-B; therefore, PFB-R does not discharge the energy. The discharge resistor does not generate heat. However, if αiPS-B's power supply regeneration function does not work properly due to high power supply impedance or for other reasons, the DC link voltage rises and PFB-R may start discharging. In this case, PFB-R may stop with an overheat alarm.
4 PFB-R enters not ready state if it is in the emergency stop or alarm state.

[Specifications]

PFB-R

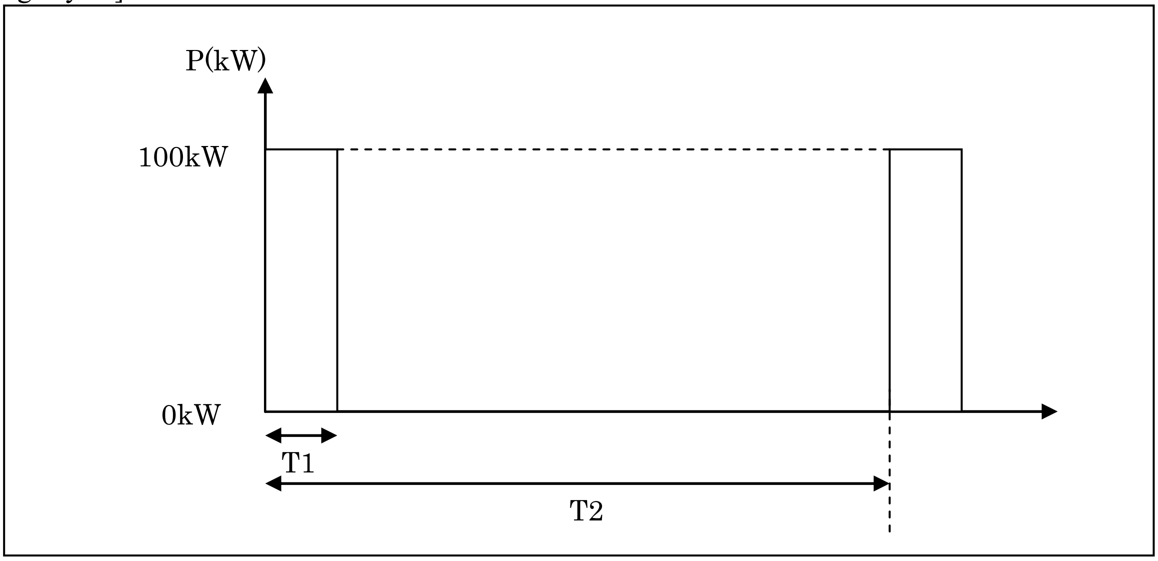
Item	Specifications
Main circuit input voltage	283VDC to 339VDC
Main circuit input current	245Ap
Control power supply voltage input	24VDC ± 5%
Control power supply current consumption	0.7A
Maximum output	100kW
Maximum discharge energy	50kJ
Discharge resistance	1.7Ω
ON threshold	415VDC
Parallel connection	Up to 8 units
External dimensions	60mm x 380mm x 272mm (W x H x D)
Weight	3.5kg
Amount of heat dissipation	20W

PFB-R HV

Item	Specifications
Main circuit input voltage	537VDC to 679VDC
Main circuit input current	125Ap
Control power supply voltage input	24VDC ± 5%
Control power supply current consumption	0.7A
Output specifications	100kW
Maximum discharge energy	50kJ
Discharge resistance	6.8Ω
ON threshold	DC830V
Parallel connection	Up to 8 units
External dimensions	60mm x 380mm x 272mm (W x H x D)
Weight	3.5kg
Amount of heat dissipation	20W

> ⚠ **CAUTION**
> Please take care not to get burned by touching the hot discharge resistor of PFB-R.

[Discharge cycle]



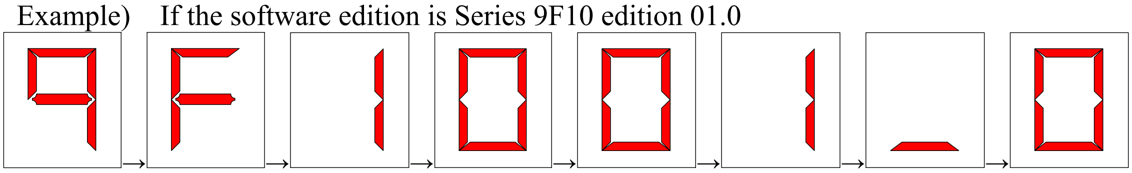
Discharge cycle	T1	T2
Short cycle	0.25s	600s
Long cycle	0.5s	1200s

> **NOTE**
> An alarm may occur if PFB-R repeats the above cycle in discharge operation.

[Software edition]

After turning the power on, the software edition is displayed on the 7-segment LED of PFB-R.

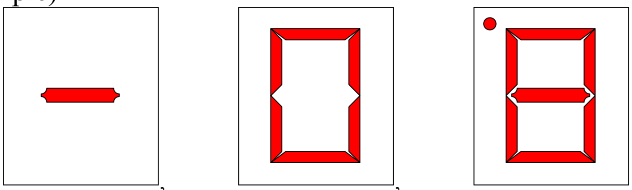
Example) If the software edition is Series 9F10 edition 01.0



[LED display]

After turning the power on, the software edition is displayed at first and then the state of PFB-R is displayed on the 7-segment LED.

Example)



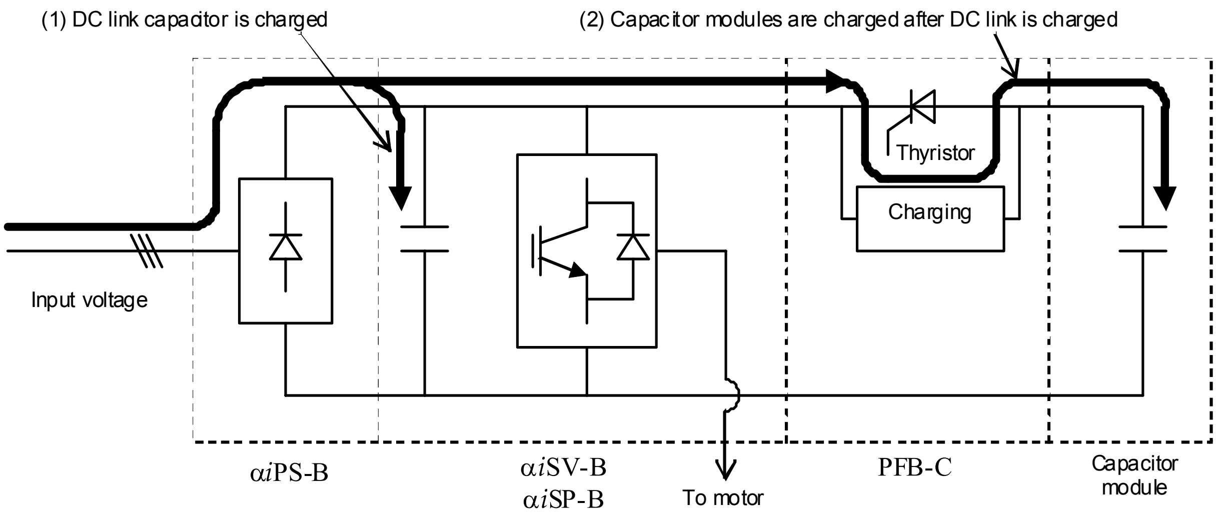
, etc.

LED display	Name	Specifications
―	Not ready	Indicates that PFB-R is not ready to run.
0	Ready	Indicates that PFB-R is ready to run.
1	IGBT malfunction alarm	Discharge IGBT failed.
2	Discharge IGBT overheat alarm	The temperature of discharge IGBT is abnormal.
3	Hardware malfunction alarm	Hardware failed.
4	Low DC link voltage alarm	DC link voltage dropped.
5	Discharge resistor overheat alarm	The temperature of discharge resistor is abnormal.
6	Alarm for voltage drop in control power supply	Control power supply voltage (24 V) dropped.
7	Discharge resistor OVC alarm	Regenerative energy is too large.
8	Discharge IGBT OVC alarm	Regenerative energy is too large.
9	Discharge resistor thermistor disconnection alarm	The temperature detection element of the discharge resistor disconnected.
A	Discharge IGBT thermistor disconnection alarm	The temperature detection element of the discharge IGBT disconnected.
b	Software error alarm	PFBM-R has not completed software processing within the specified time.
C	αiPS-B software incompatibility alarm	αiPS-B's software is incompatible with PFB-R.
P	Inter-amplifier communication error alarm	Inter-amplifier communication failed.
・#	Slave mode	Operates in slave mode. Discharge according to the instructions from the master unit.

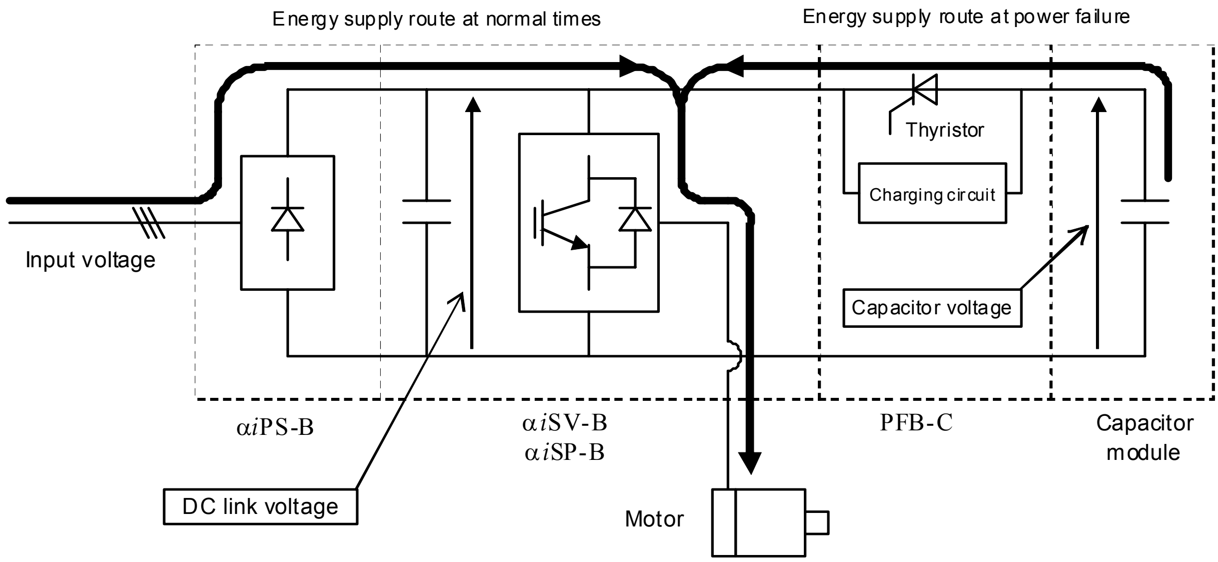
I.3.3 PFB-C

PFB-C charges energy to the capacitor modules in power supplied state and backs up energy needed for retract operation in power failure state. Mainly used for retract operation in power failure state.

(1) After the magnetic contactor (MCC) has been turned on and α*i*PS-B enters ready to run state (*CRDY = 0), PFB-C starts charging of the capacitor modules.
(2) The charge time depends on the number of connected capacitor modules and takes approx. 1.5 seconds per capacitor module.
(3) When charging of capacitor modules is completed, PFB-C transitions to ready to run state and the power failure backup operation becomes possible. Start the machine operation after confirming that PFB-C has entered ready to run state.
(4) Noise may be heard from PFB-C while the capacitor module is charged, but this is normal.



(5) After charging, the voltage of capacitor module drops due to self-discharge, thus PFB-C periodically charges the capacitor module. Noise may be heard from PFB-C while the capacitor module is recharged, but this is normal.
(6) The charging energy of the capacitor module is controlled constant irrespective of the power supply voltage. For charging energy, see the specifications of capacitor modules.
(7) When α*i*PS-B detects a power failure, it turns on the thyristor in PFB-C and releases the energy stored in the capacitor modules to the DC link. The energy is used to drive the servo motor.



[Specifications]

PFB-C

Item	Specifications
Control power supply input	24VDC ±5%
Control power supply current consumption	0.7A
Input voltage	283VDC to 339VDC +10% -15% (200VAC to 240VAC +10% -15% at the α*i*PS main circuit input)
Input current	5.5A
Output voltage	375VDC
Output current	5.5A
Maximum charging capacity	0.2F (Capacitor Module 25000 x 8 units)
Charging time	1.5 seconds per capacitor module
Parallel connection	Up to 2 units
External dimensions	60mm x 380mm x 172mm (W x H x D)
Weight	2.5kg
Amount of heat dissipation	20W

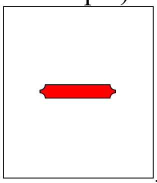
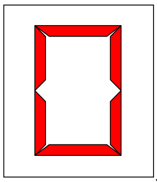
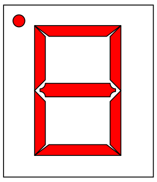
PFB-C HV

Item	Specifications
Control power supply input	24VDC ±5%
Control power supply current consumption	0.7A
Input voltage	537VDC to 679VDC +10% -10% (380VAC to 480VAC +10% -10% at the α*i*PS main circuit input)
Input current	5.5A
Output voltage	750VDC
Output current	5.5A
Maximum charging capacity	0.036F (Capacitor Module 4500 HV x 8 units)
Charging time	1.5 seconds per capacitor module
Parallel connection	Up to 2 units
External dimensions	60mm x 380mm x 172mm (W x H x D)
Weight	2.5kg
Amount of heat dissipation	20W

[LED display]

The status of PFB-C is displayed on the 7-segment LED.

Example)

, ,  , etc.

LED display	Name	Specifications
–	Not ready	Indicates that PFB-C is not ready to run.
0 (blink)	Charging in progress	PFB-C is charging the capacitor module.
0	Ready	Indicates that charging of the capacitor modules has completed and PFB-C is ready to run.
1	Overcurrent alarm	Charging current to the capacitor modules is too high.
2	Low capacitor voltage alarm	Capacitor module voltage dropped.
3	Hardware malfunction alarm	Hardware failed.
4	Low DC link voltage alarm	DC link voltage dropped.
5	Pre-charge error alarm	Pre-charge did not complete.
6	Alarm for voltage drop in control power supply	The control power supply voltage (24 V) dropped.
7	Power circuit overload alarm	The temperature of charging circuit is abnormal.
8	Capacitor overvoltage alarm	The voltage of capacitor module rose abnormally.
C	α*i*PS software incompatibility alarm	α*i*PS-B software is incompatible with PFB-C.
P	Inter-amplifier communication error	Inter-amplifier communication failed.

I.3.4 Capacitor Module

Energy needed for retract operation during power failure is charged in capacitor modules. Up to eight capacitor modules can be connected to one PFB-C.

[Specifications]

Capacitor Module 25000

Item	Specifications
Capacity	25000μF
Charging energy	1195J
Maximum input voltage	400V
External dimensions	90mm x 380mm x 192mm (W x H x D)
Weight	5.0kg
Amount of heat dissipation	5W

Capacitor Module 4500 HV

Item	Specifications
Capacity	4500μF
Charging energy	850J
Maximum input voltage	900V
External dimensions	90mm x 380mm x 192mm (W x H x D)
Weight	5.0kg
Amount of heat dissipation	4W

NOTE

If capacitor module malfunctions due to overheat or overvoltage, the explosion-proof valve is actuated to spray electrolyte from the top of capacitor module. Electrolyte is electrically conductive. Please determine its installation position very carefully.

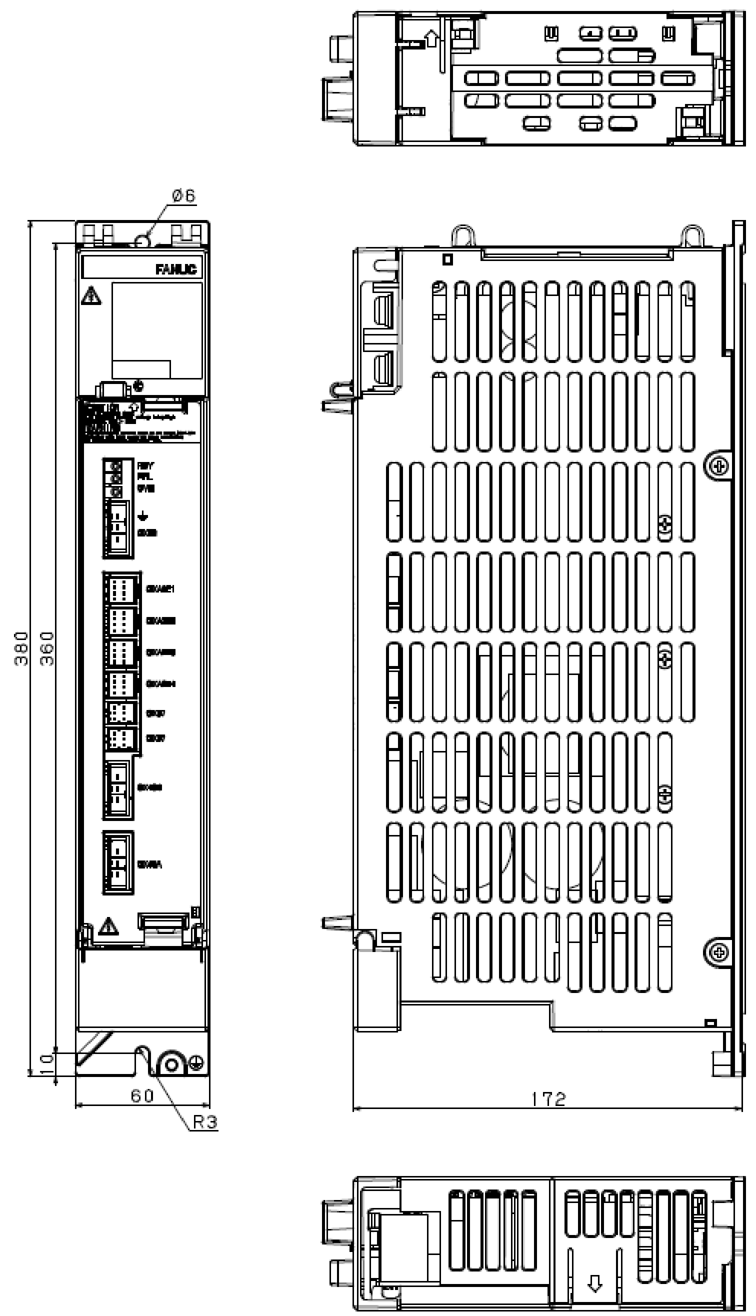
I.3.5 Environmental Conditions

See Section 2.2 for the environmental conditions for Power Failure Backup Module Model B.

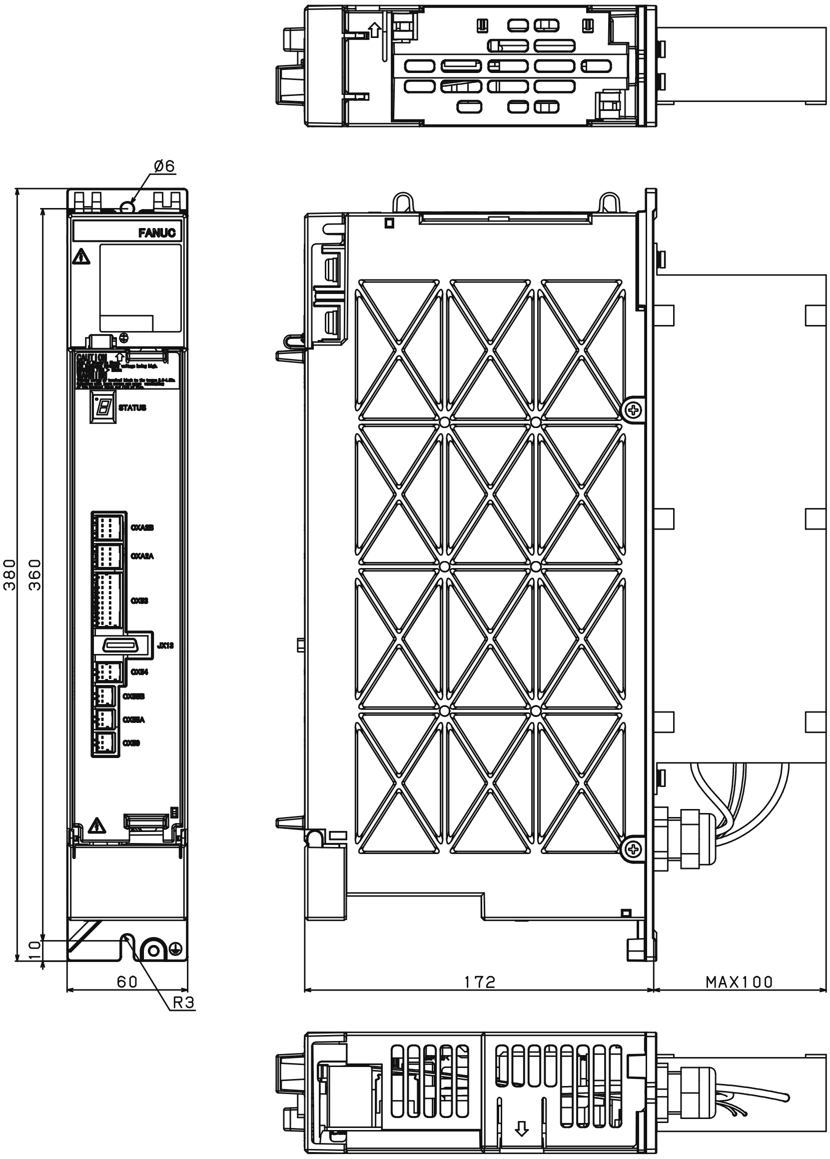
I.4 OUTLINE DRAWINGS AND PANEL CUT-OUT

I.4.1 Outline Drawings

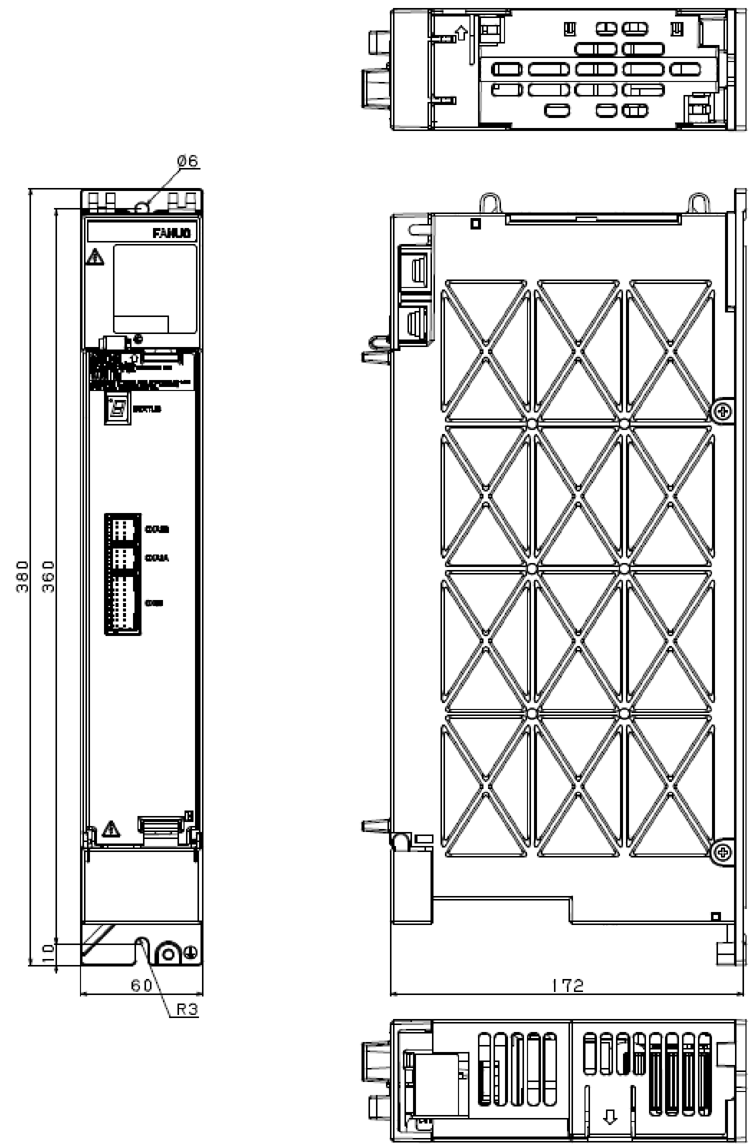
I.4.1.1 PFB-24, PFB-24 HV



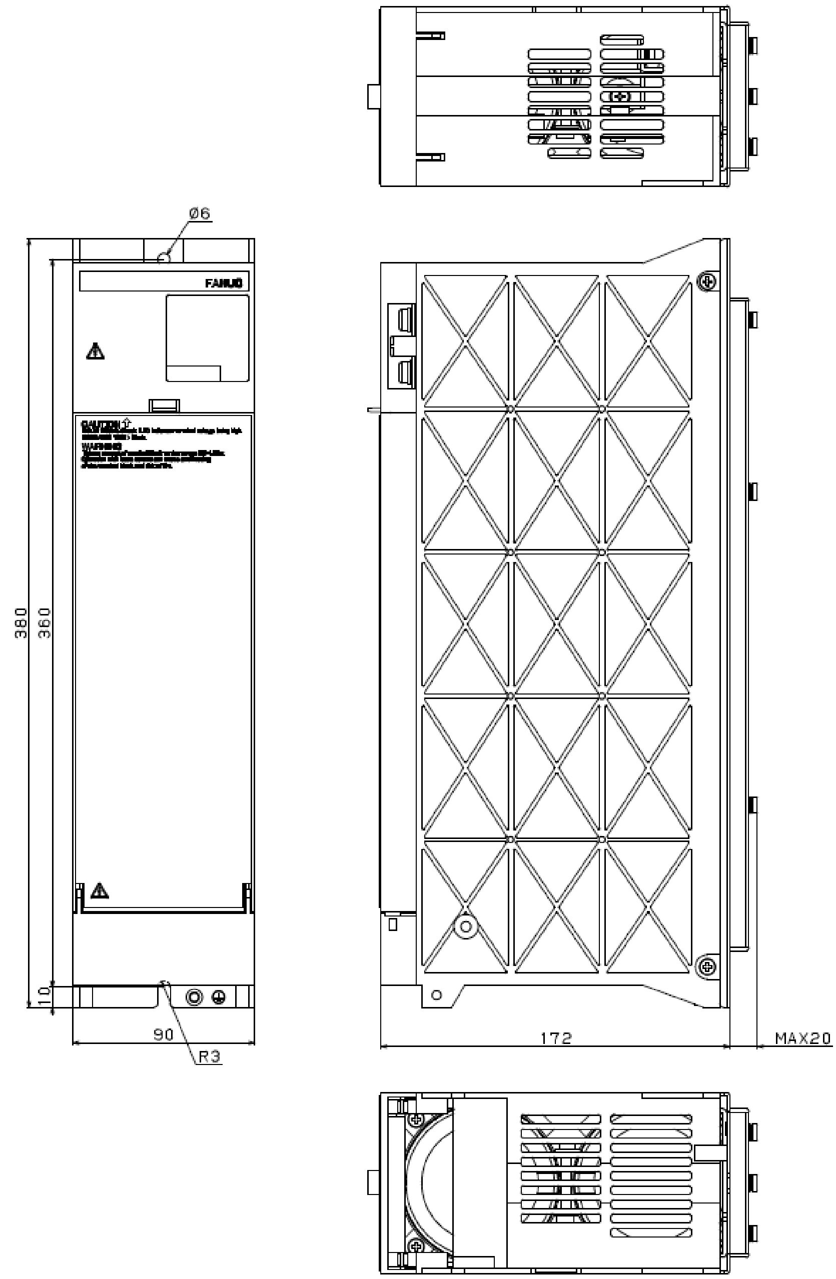
I.4.1.2 PFB-R, PFB-R HV



I.4.1.3 PFB-C, PFB-C HV

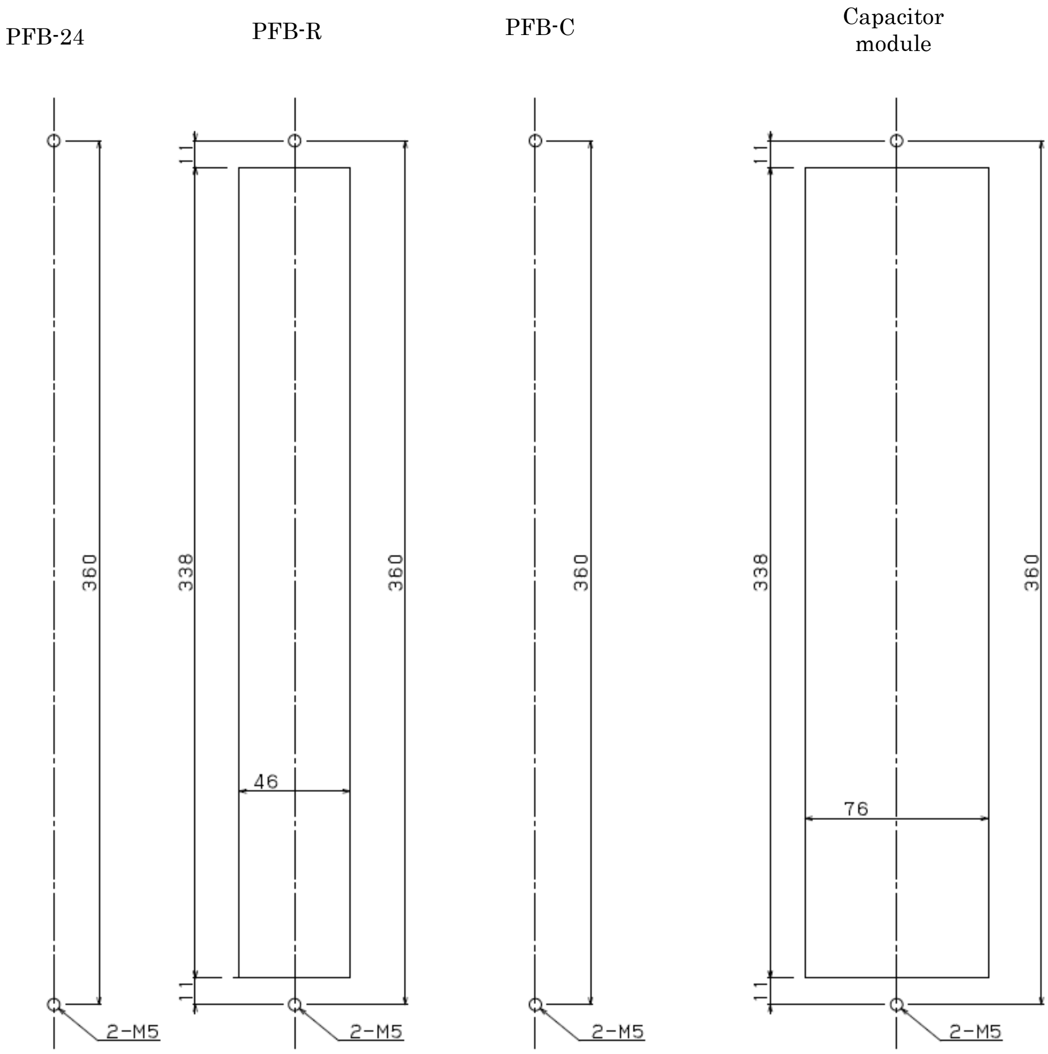


I.4.1.4 Capacitor Module

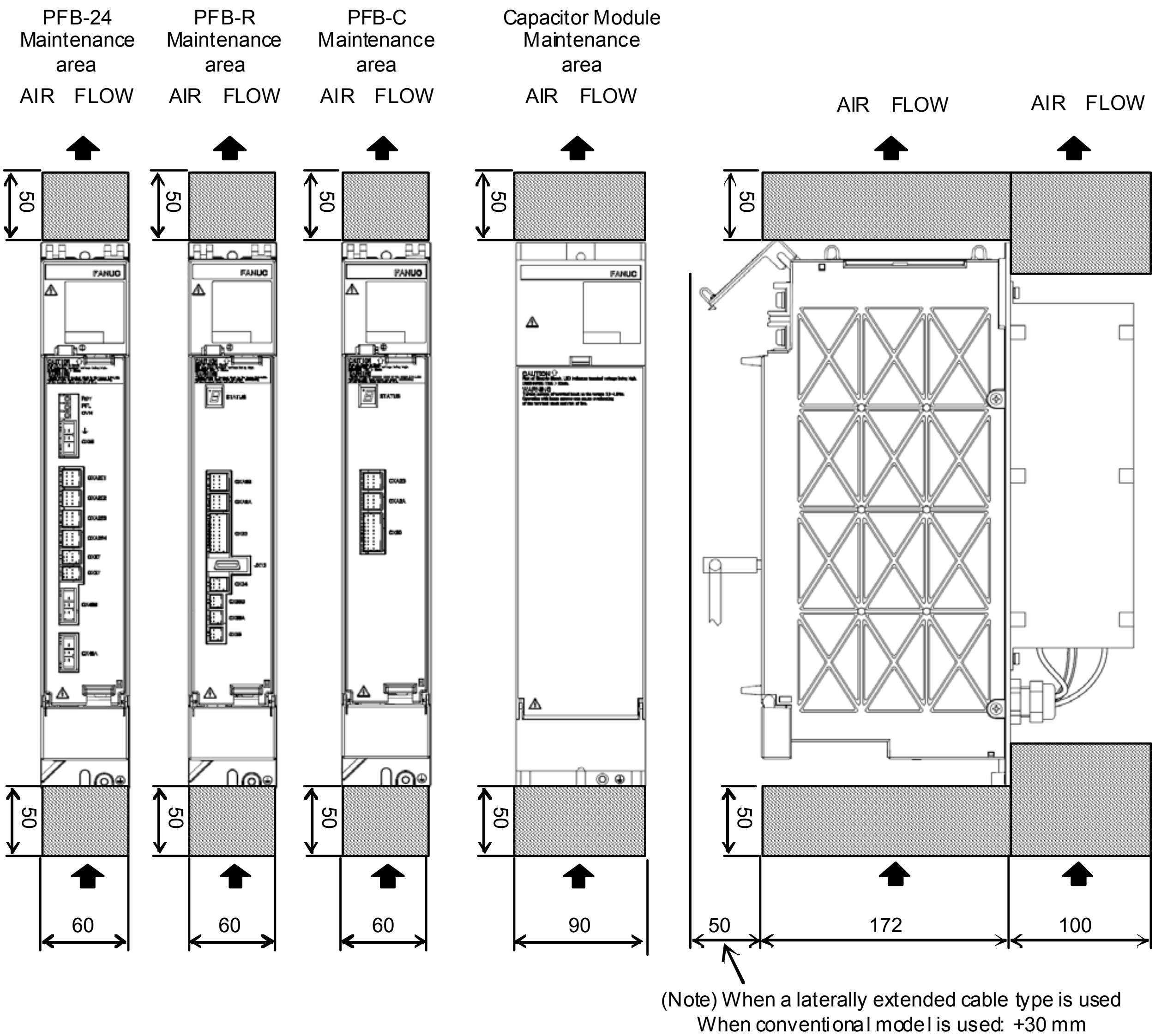


I.4.2 Panel Cut-out Diagram

The panel cut-outs of PFB-24, PFB-R, PFB-C, and capacitor module are shown from left to right.
To prevent intrusion of oil or dust, reinforce the right and left sides of the holes in the panel cut-out of power magnetics cabinet with L-angles or similar and apply the provided gasket (acrylonitrile-butadiene rubber, NBR [soft type]) so that the power magnetics cabinet closely contacts with the module side.



I.4.3 Maintenance Area

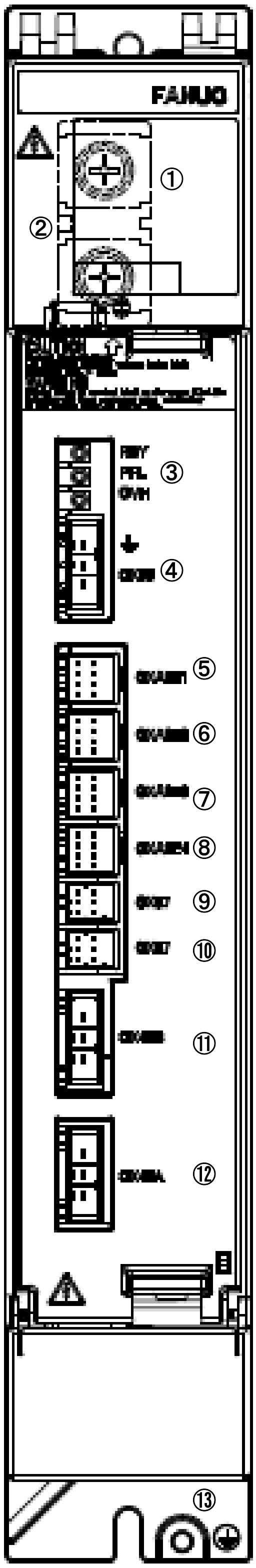


> ⚠ **CAUTION**
> Please keep in mind where maintenance areas are.
> Note that the devices shown above cannot be stacked vertically when using two or more.

I.5 CONNECTION

I.5.1 Connector Locations

(1) PFB-24, PFB-24 HV

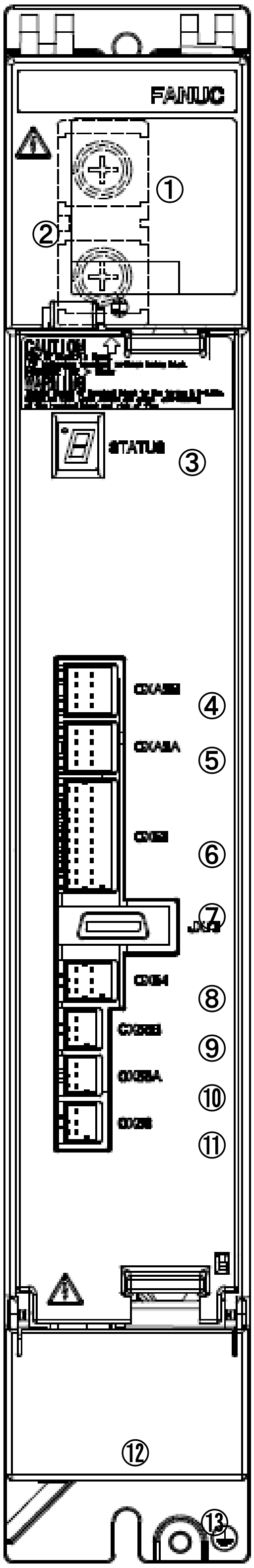


No.	Name	Display	Remarks
1	DC link terminal block		Displayed as TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Output shutdown signal connector Grounding wire connector	CX56	D-3200 3P-X
5	24 VDC output connector (for CNC connection)	CXA2E1	D-2100 8P-X
6	24 VDC output connector	CXA2E2	D-2100 8P-X
7	24 VDC output connector	CXA2E3	D-2100 8P-X
8	24 VDC output connector	CXA2E4	D-2100 8P-X
9	Interface connector	CX57	D-2100 6P-X
10	Interface connector	CX37	D-2100 6P-X
11	Power supply connector (power supply side)	CX48B	D-3200 3P-Z
12	Power supply connector (Power Supply side)	CX48A	D-3200 3P-Z See the following warning.
13	Tapped hole for grounding the flange	⏚	

NOTE
Connect CNC to CXA2E1 to prevent sneaking noise from other devices.

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.
Do not touch the pins in CX48A as they output the power supply voltage connected to CX48B.

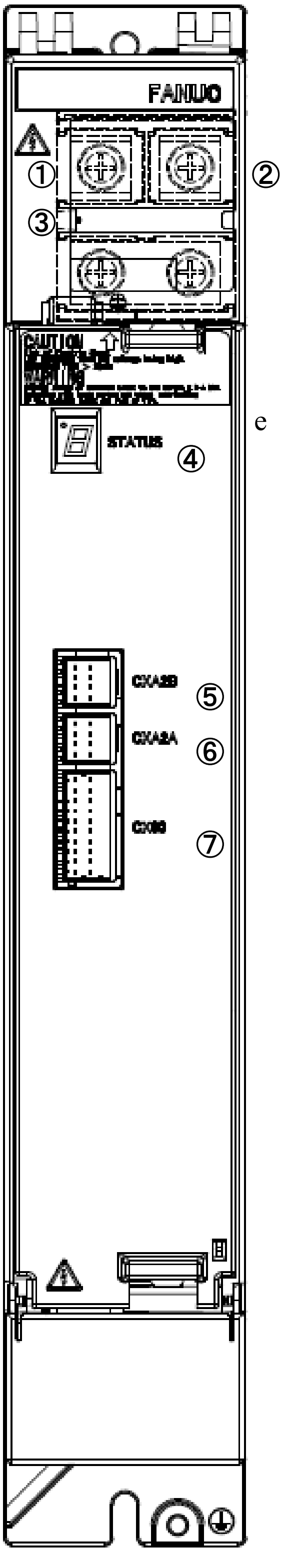
(2) PFB-R, PFB-R HV



No.	Name	Display	Remarks
1	DC link terminal block		Displayed as TB1.
2	DC link charge LED		See the following warning.
3	Status LED	STATUS	
4	Input connector for αiPS interface	CXA2B	D2100 8P-X
5	Input connector for αiPS interface	CXA2A	D2100 8P-X
6	DI/DO connector	CX53	D2100 20-pin
7	Maintenance connector	JX13	Unconnected
8	Unused	CX54	D2100 6P-X
9	PFB-R parallel drive connector	CX55B	D2100 3P-X
10	PFB-R parallel drive connector	CX55A	D2100 3P-X
11	Unused	CX59	D2100 3P-Y
13	Tapped hole for grounding the flange	⏚	D2100 8P-X

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(3) PFB-C, PFB-C HV

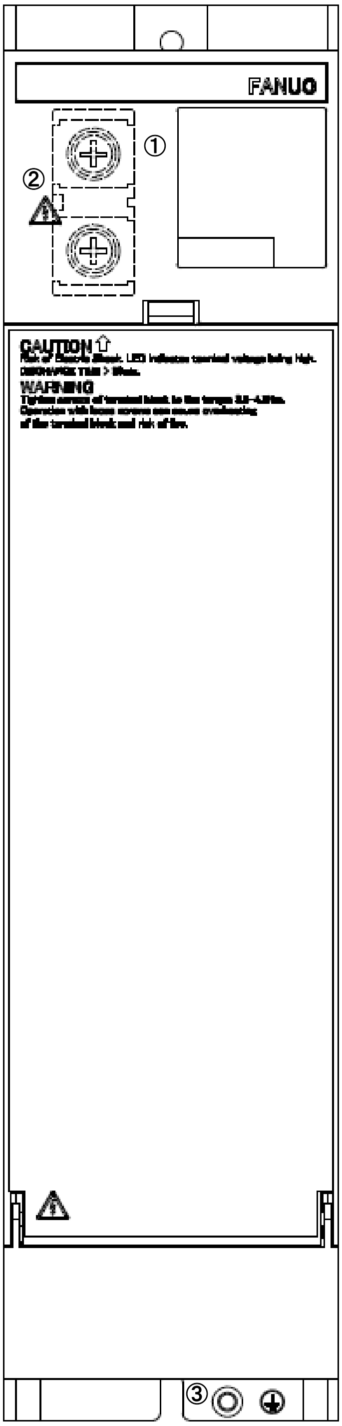


No.	Name	Display	Remarks
1	DC link terminal block		Displayed as TB1.
2	Capacitor module connection terminal block		Displayed as TB2.
3	DC link charge LED		See the following warning.
4	Status LED	STATUS	
5	Input connector for αiPS interface	CXA2B	
6	Input connector for αiPS interface	CXA2A	
7	DI/DO connector	CX60	D2100 20P-X
8	Tapped hole for grounding the flange	⏚	

⚠ WARNING

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

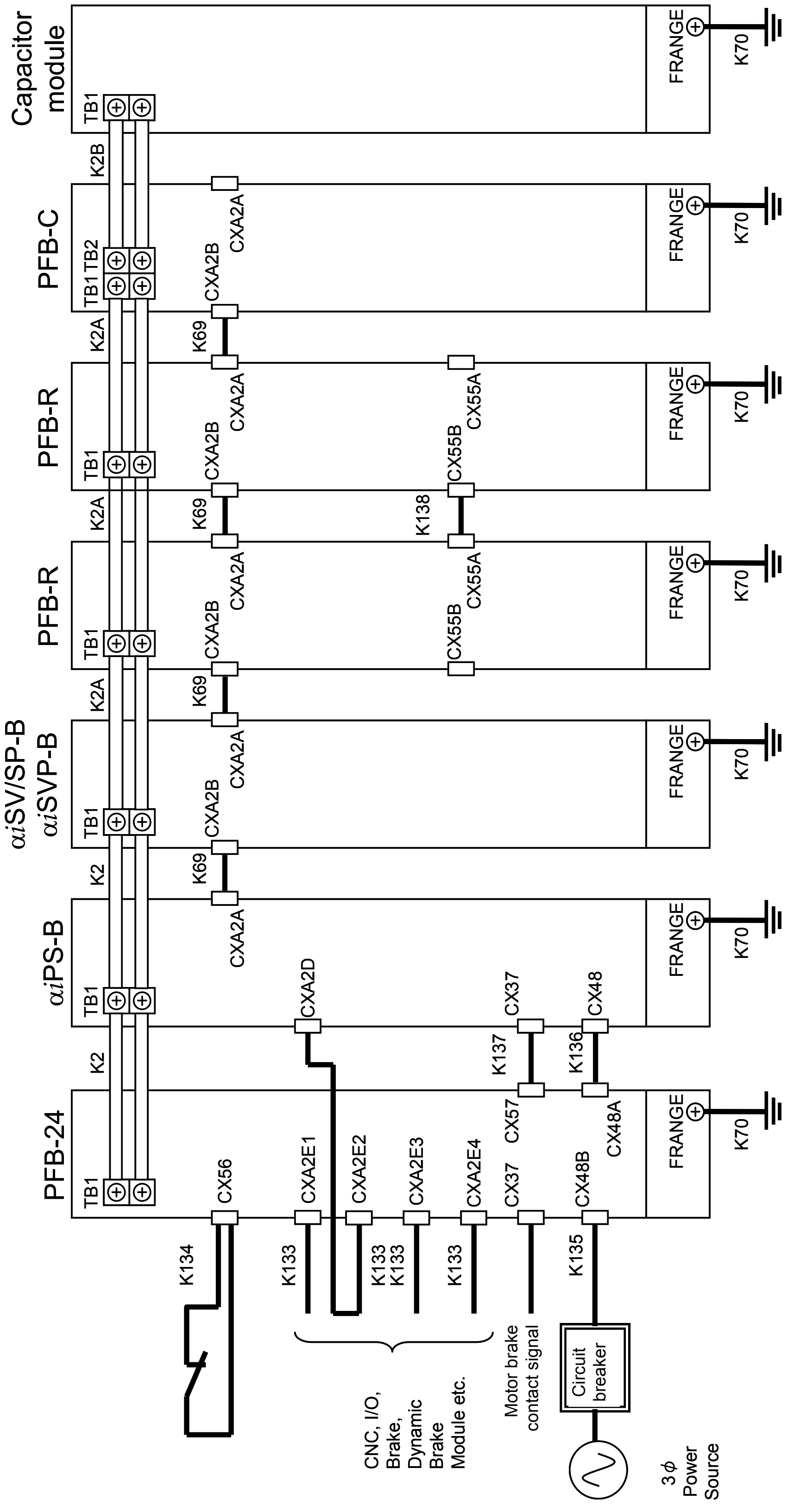
(4) Capacitor module



No.	Name	Display	Remarks
1	DC link terminal block		Displayed as TB1.
2	DC link charge LED		See the following warning.
3	Tapped hole for grounding the flange	⏚	

> ⚠ **WARNING**
> When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

I.5.2 Total Connection Diagram

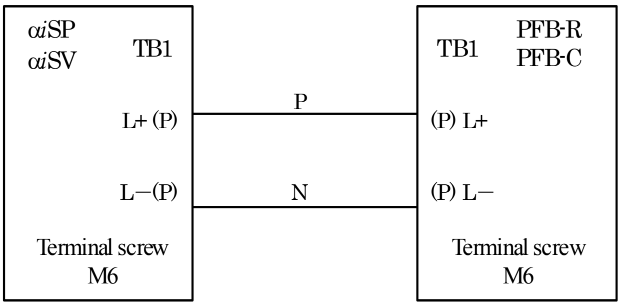


NOTE
1. When two or more αiPS-Bs are used, one Power Failure Backup Module Model B is needed per αiPS-B.
2. Use the 24V-input type dynamic brake module and supply 24 V from PFB-24.
3. To retract the vertical axis at power failure, supply the brake power from PFB-24 so that the brake is not activated by the power failure.
4. The same power failure detection signal is output to CX37 of PFB-24 as to CX37 of αiPS-B. If wiring is needed for CX37 of αiPS-B, use CX37 of PFB-24 instead. For details on CX37 of αiPS-B, see Chapter 13, "POWER FAILURE DETECTION FUNCTION."

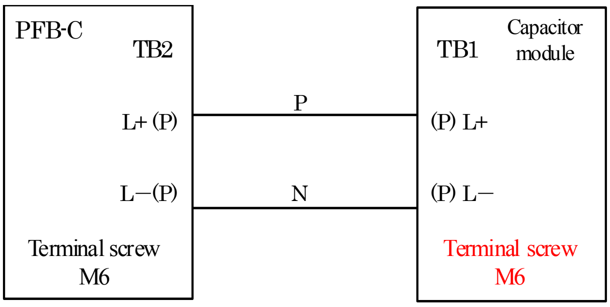
I.5.2.1 Details on connection of short bars K2, K2A, K2B, and K2C

[Short bar K2]
See Subsection 9.3.1.2, "Details of short bar K2."

[Short bar K2A]
Short bar K2A is a short bar to connect αiSP-B, αiSV-B, PFB-R, and PFB-C. To connect each module with close contact, design the short bar by referring to "Specifications of short bars to closely connect each module." Optional short bars are available from FANUC. See Subsection I.2.2, "Cables - DC link short bars."
To connect modules with rough contact, calculate the length of short bar by referring to "Location of module terminal block TB1."



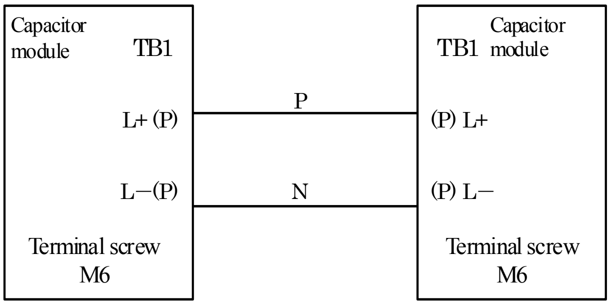
[Short bar K2B]
Short bar K2B is a short bar to connect PFB-C and a capacitor module. To connect modules with close contact, design the short bar by referring to "Specifications of short bars to closely connect each module." Optional short bars are available from FANUC. See Subsection I.2.2, "Cables - DC link short bars."
To connect modules with rough contact, calculate the length of short bar by referring to "Locations of module terminal blocks TB1 and TB2."



[Short bar K2C]

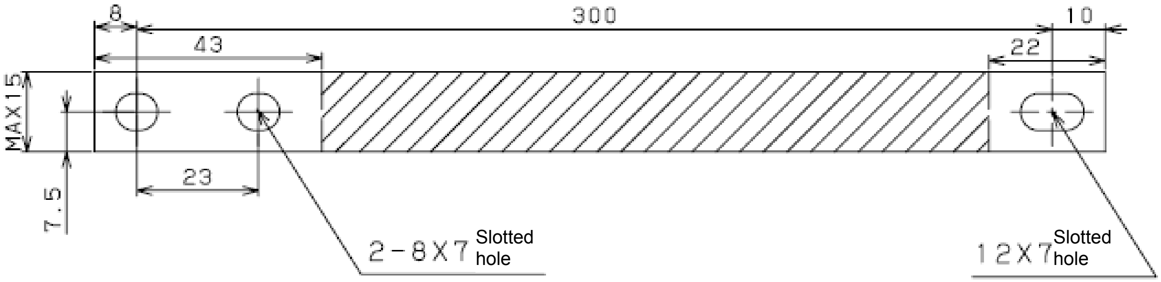
Short bar K2C is a short bar to connect capacitor modules. To connect modules with close contact, design the short bar by referring to "Specifications of short bars to closely connect each module." Optional short bars are available from FANUC. See Subsection I.2.2, "Cables."

To connect modules with rough contact, calculate the length of short bar by referring to "Locations of module terminal blocks TB1 and TB2."

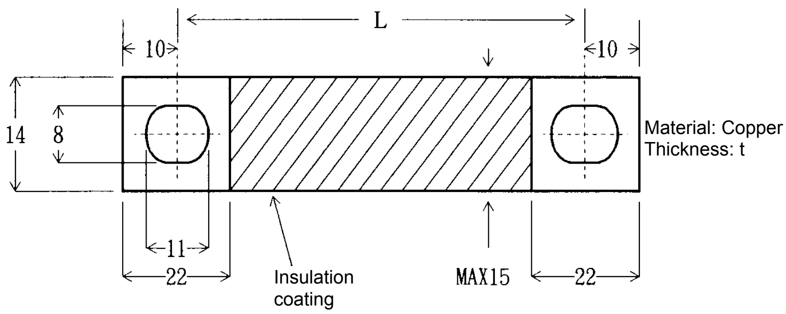


[Specifications of short bars to closely contact each module]

300 mm-wide short bar



150 mm-wide, 90 mm-wide, 60 mm-wide and 38 mm-wide short bars



Specifications of short bar K2A

Inter-module distance	Short bar length L	Short bar thickness t	Cross-sectional area (Note)
300 mm-wide	300mm	3.0mm	$50mm^2$
150 mm-wide	150mm	1.5mm	$21mm^2$
90 mm-wide	90mm	1.5mm	$21\ mm^2$
60 mm-wide	60mm	1.5mm	$21\ mm^2$

Specifications of short bar K2B

Inter-module distance	Short bar length L	Short bar thickness t	Cross-sectional area (Note)
38 mm-wide	38mm	1.5mm	21mm^2

Specifications of short bar K2C

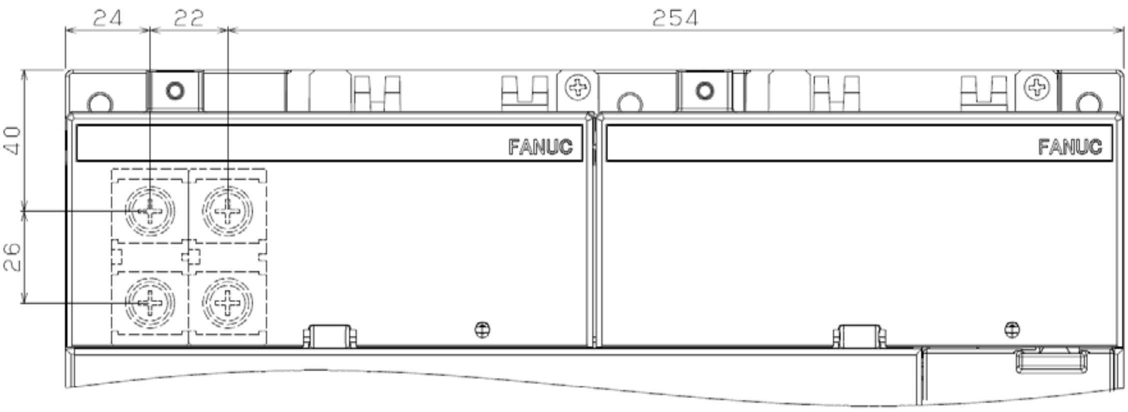
Inter-module distance	Short bar length L	Short bar thickness t	Cross-sectional area (Note)
90 mm-wide	90mm	1.5mm	21 mm^2

NOTE

1. Short bars (copper plate) may not be used to connect modules. When short bars are not used, modules cannot be arranged in close contact with each other and may have to separately locate modules.
2. If modules are connected with a cable, use a heat-resistant vinyl cable having wider cross-sectional area than shown here.

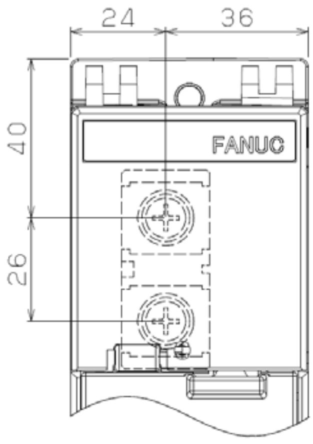
[Locations of module terminal blocks TB1 and TB2]

Figures (a), (b), and (c) show the locations of module terminal blocks TB1 and TB2. To mount modules at an interval other than specified, design short bars by referring to these dimensions.

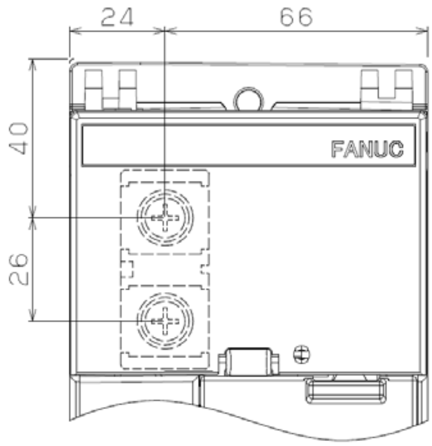


300 mm-wide unit

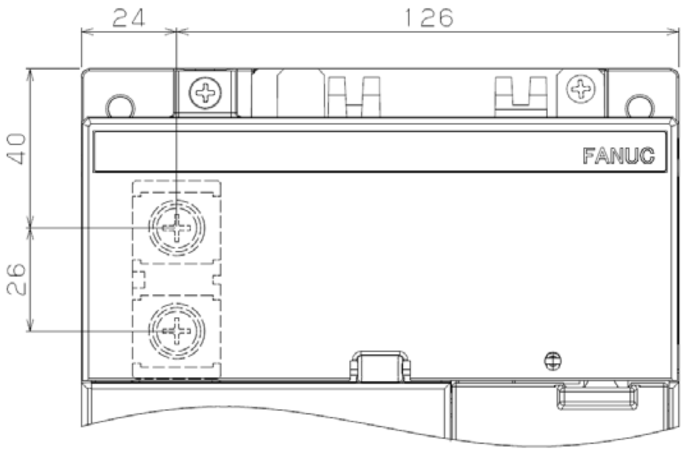
(a) Location of the terminal block TB1 for 300 mm-wide amplifiers



60 mm-wide unit

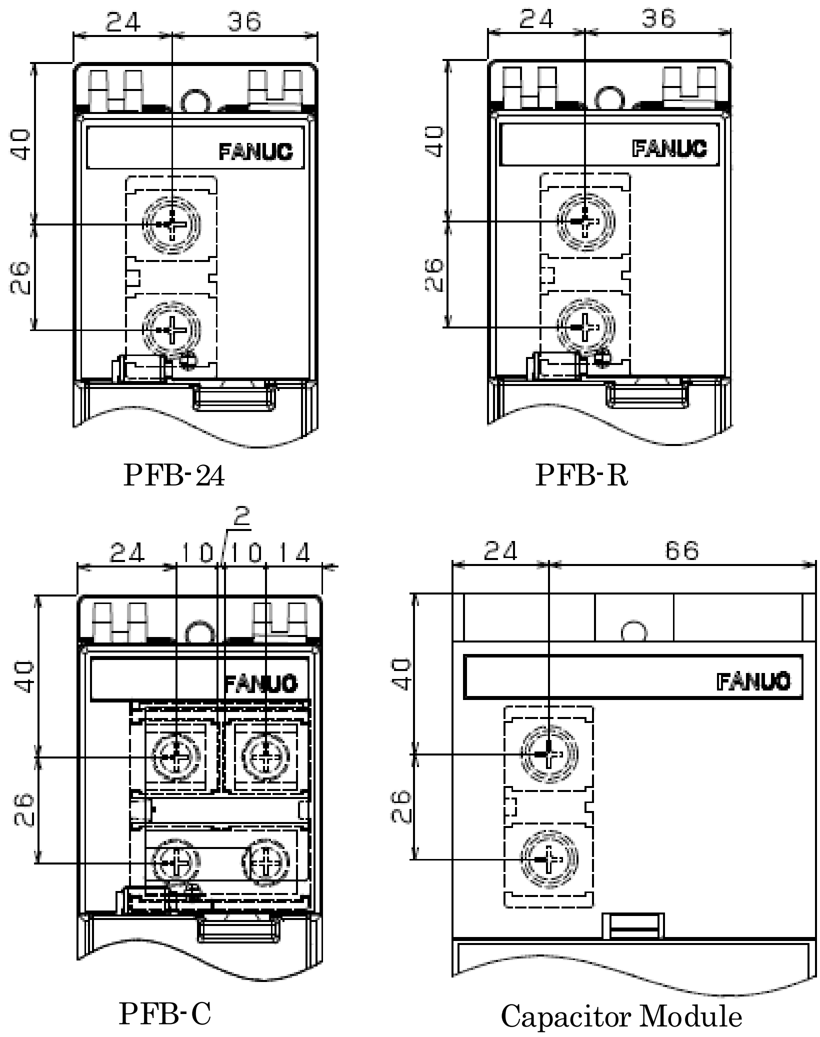


90 mm-wide unit



150 mm-wide unit

(b) Location of the terminal block TB1 for 60, 90, and 150 mm-wide amplifiers

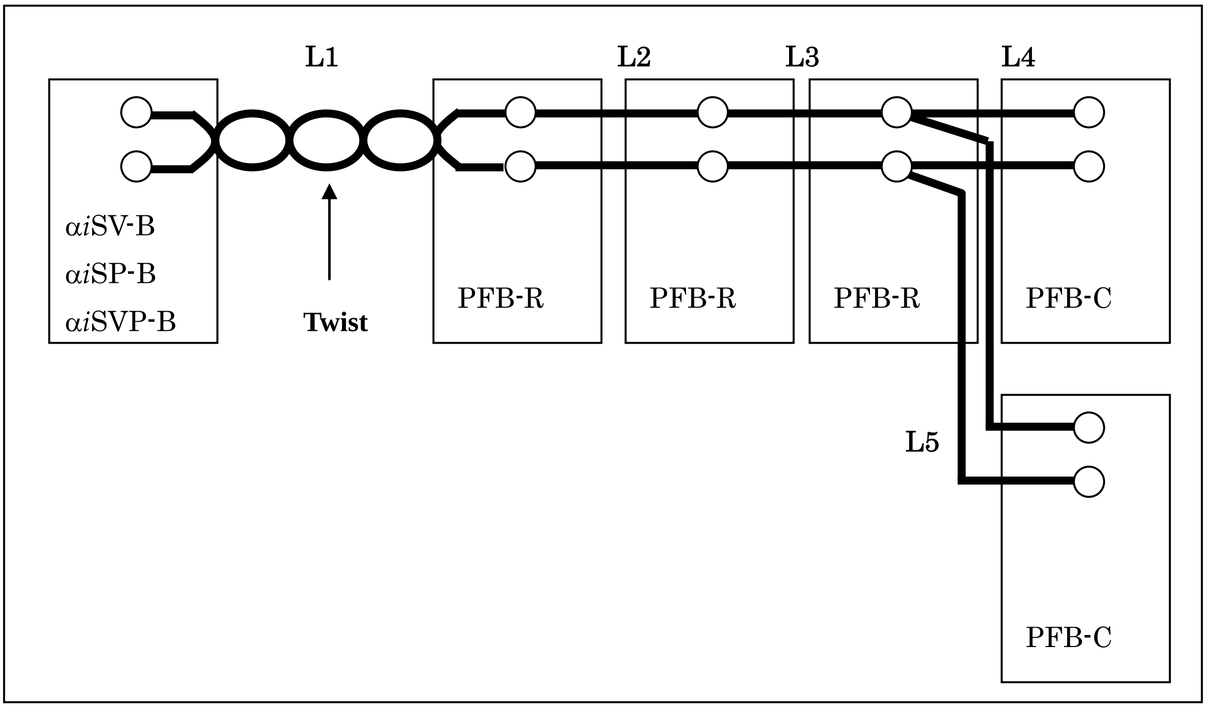


(c) Locations of terminal blocks TB1 and TB2 for PFB

[Length of cable K2A]

Ensure that the total length of cables between α*i*SV-B and α*i*SV-B and iSP-B and between PFB-R and PFB-C is 5 m or less.

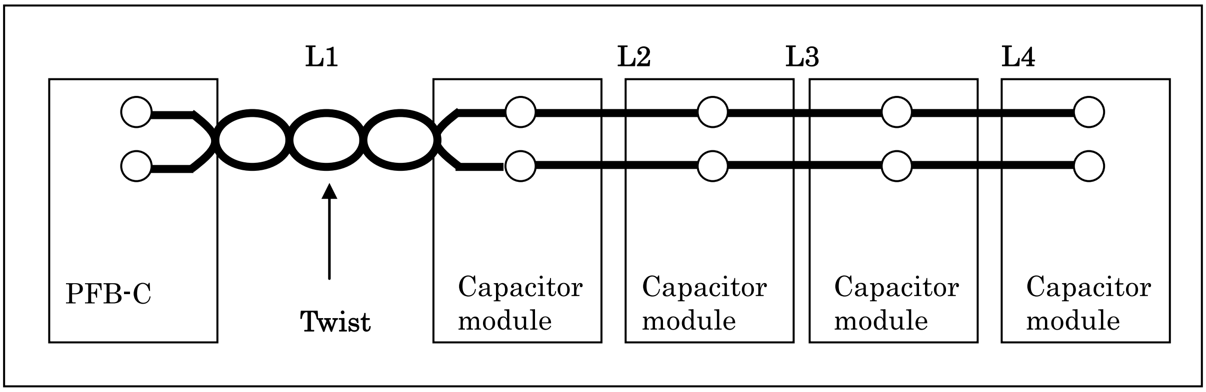
L1 + L2 + L3 +............+ Ln ≤ 5m



[Length of cables K2B and K2C]

Ensure that the total length of cables between PFB-C and capacitor modules is 5 m or less.

L1 + L2 + L3 +............+ Ln ≤ 5m

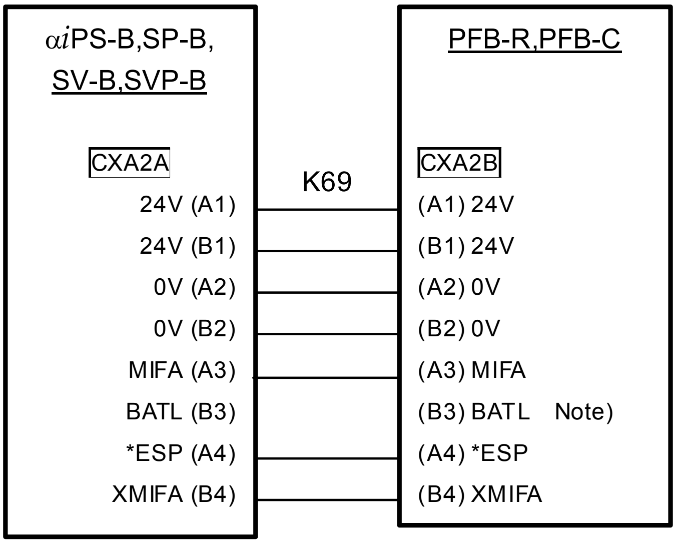


NOTE

When connecting between K2, K2A, K2B, and K2C with cables, twist the cable and connect to reduce the loop between cables.

I.5.2.2 Details of cable K69

Cable K69 is a cable to connect between α*i*PS-B, α*i*SP-B, α*i*SV-B, α*i*SVP-B, PFB-R, and PFB-C.



Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing 1-1318119-4 (1 piece) Contact 1318107-1 (8 pieces) [Ordering number: A06B-6110-K210 Connector only]
Conductor size	0.5mm^2, AWG20
Insulation sheath outer dimension	1.11-1.87

NOTE

(B3)BATL is the interface for connecting absolute Pulsecoder batteries. See Subsection 9.3.2.9, "Connecting the battery" for details.

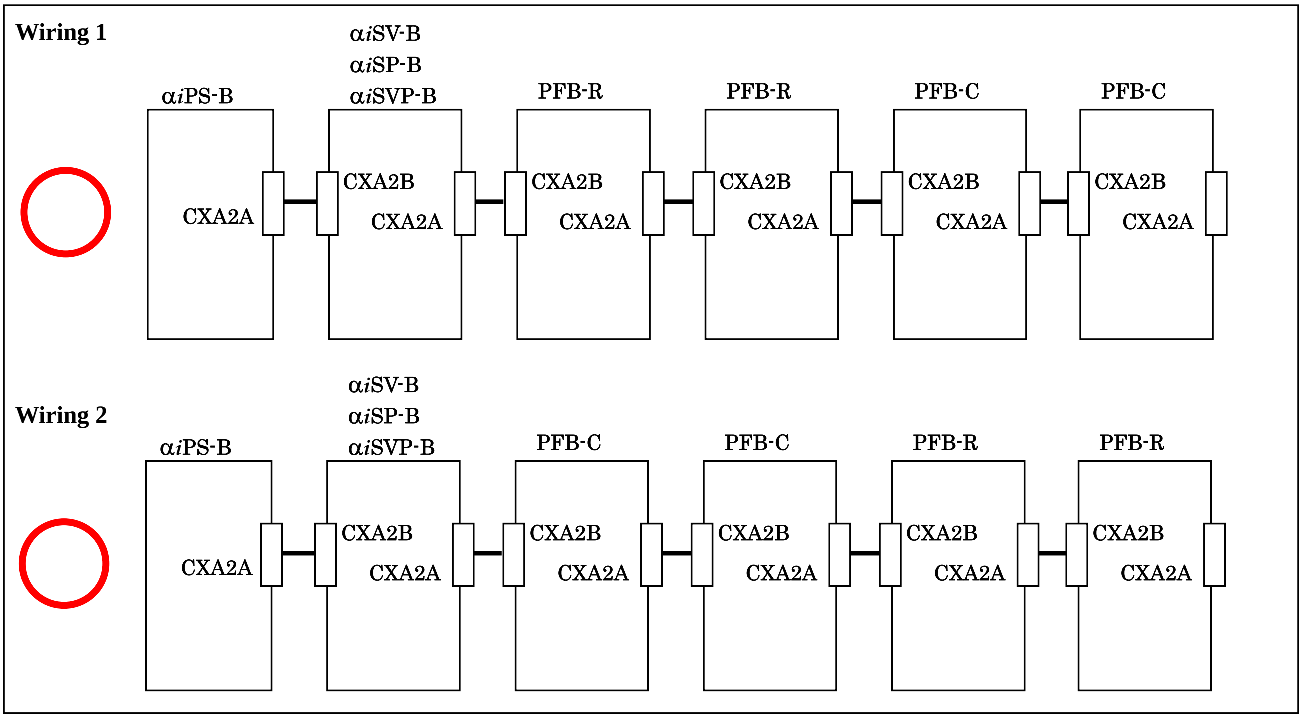
⚠ **WARNING**

1 When built-in battery (A06B-6114-K504) is used, never connect BATL(B3) of connector CXA2A or CXA2B.
It will be dangerous because output voltages of different α*i*SV-B batteries short-circuit and they may get hot.

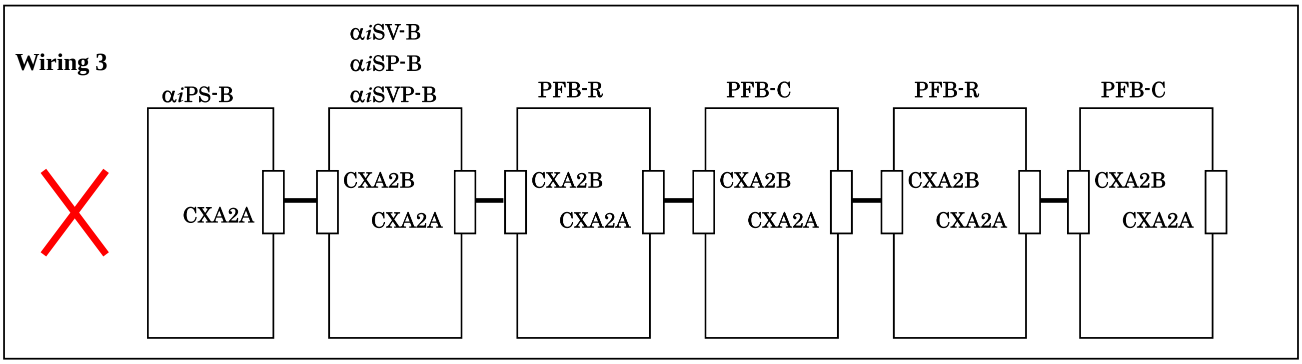
2 Do not connect two or more batteries to the same BATL(B3) line. Output voltages of different batteries short-circuit and batteries may get hot.

[Connection order (order of inter-amplifier communication) of cable K69]

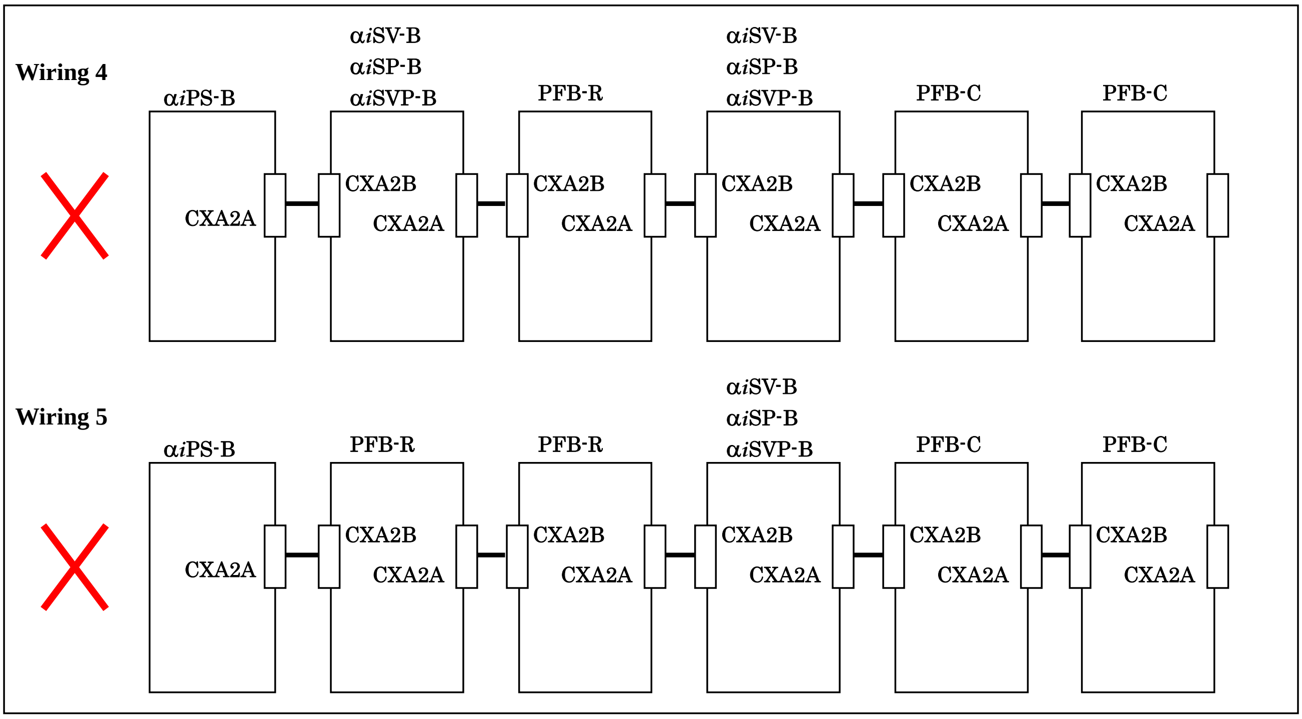
(1) PFB-R and PFB-C communicate with the α*i*-B amplifier. Cable K69 is connected for this purpose. Connect cable K69 in the order shown in Wiring 1 and Wiring 2.



(2) When connecting two or more PFB-Rs or PFB-Cs, locate them close to one another. In Wiring 3, α*i*PS-B alarm 28 (submodule error (SV0043, SP9216 alarm)) occurs.



(3) Connect PFB-R and PFB-C in downstream of α*i*SV-B, α*i*SP-B, and α*i*SVP-B.
In Wiring 4, α*i*PS-B alarm 28 (submodule error (SV0043, SP9216 alarm)) occurs.
In Wiring 5, α*i*PS-B alarm 28 (submodule error (SV0043, SP9216 alarm)) occurs.



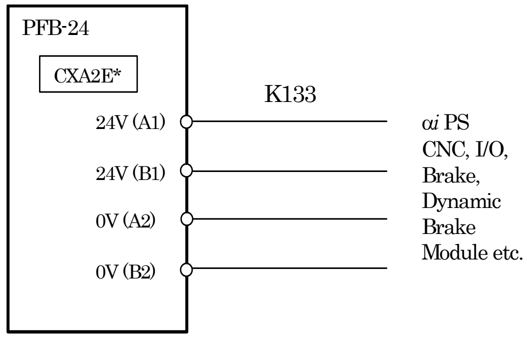
I.5.2.3 Details of cable K70

See Subsection 9.3.3.4, "Details of cable K70."

I.5.3 Connection of PFB-24

I.5.3.1 Details of cable K133

Cable K133 is used to supply control power (24 V) from PFB-24.



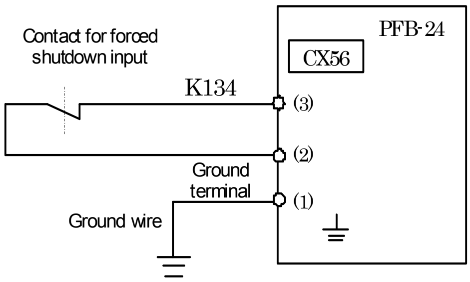
Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing 1-1318119-4 (1 piece) Contact 1318107-1 (4 pieces)
Conductor size	0.5mm2, AWG20
Insulation sheath outer dimension	1.11-1.87mm

NOTE
The maximum current that can be supplied per connector is 9 A.
Ensure that the total output from CXA2E1 to CXA2E4 does not exceed the total output current of PFB-24.

I.5.3.2 Details of cable K134

Cable K134 is used to input signals to forcibly shut down 24 VDC output to PFB-24.



Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-3200 series Housing (X key) 1-178128-3 (1 piece) Contact (L size) 1-175218-2 (3 pieces)
Cable specification	Conductor 1.25mm^2 (50/0.18)

(1) When the contact is ON (close), 24 VDC output is enabled. When the contact is OFF (open), 24 VDC output is forcibly shut down.

(2) The specifications of the contact input signal are as follows.
The minimum external contact capacity is 30 VDC and 100 mA.
Significant levels (voltage between input terminals) when non-contact input is used:
LOW level "logical 0" .... 2 V or less
HIGH level "logical 1" .... 20 V or more

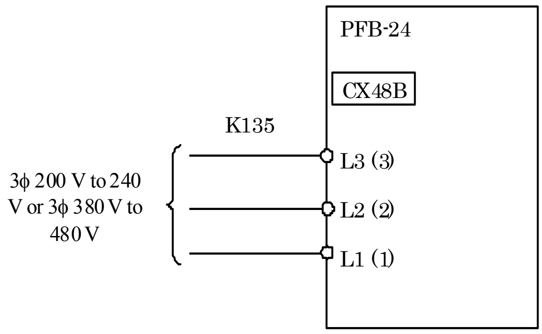
(3) No ground terminal is needed if the following conditions are met.

[Conditions to eliminate CX56 ground terminal wiring]

- If 0V of the load connected to cable K133 is grounded
- If the load of cable K133 is connected to α*i*PS-B (to ground 0V of connector CX4 of α*i*PS-B)
- If 0 V of cable K133 is directly grounded

I.5.3.3 Details of cable K135

Cable K135 is used to supply power to PFB-24. Cable K135 must be connected so that the order of phases connected to α*i*PS-B main circuit (L1, L2, and L3) is as shown in the figure. Connect cable K135 to CX48 B via a circuit breaker or fuse for short circuit protection.



Connector and cable specifications

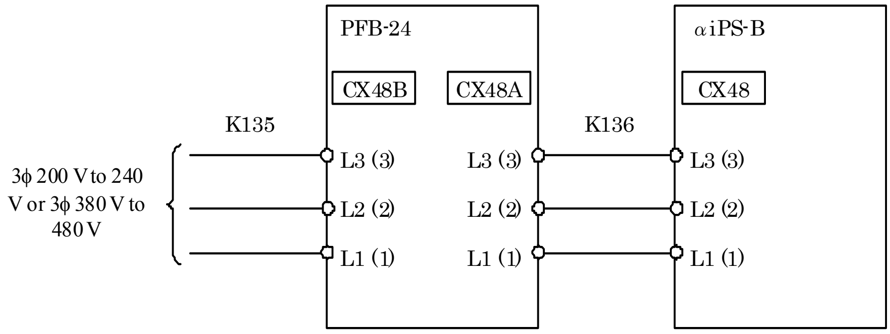
Manufacturer	Tyco Electronics AMP
Connector specification	D-3200 series Housing (Z key) 3-178128-3 (1 piece) Contact (L size) 1-175218-2 (3 pieces)
Cable specification	Conductor 1.25mm^2 (50/0.18) Withstand voltage: 600V

The overcurrent protection devices needed to protect 1.25 mm^2 cable are as follows:

Fuse: max. 15 A
Circuit breaker: max. 15 A

I.5.3.4 Details of cable K136

Cable K136 is used to monitor the input voltage of α*i*PS-B. Cable K136 must be connected so that the order of phases connected to α*i*PS-B main circuit (L1, L2, and L3) is as shown in the figure.

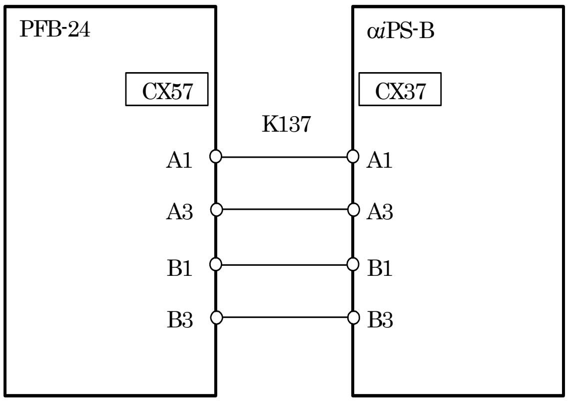


Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-3200 series Housing (Z key) 3-178128-3 (2 pieces) Contact (L size) 1-175218-2 (6 pieces)
Cable specification	Conductor 1.25mm^2 (50/0.18) Withstand voltage: 600V

I.5.3.5 Details of cable K137

Cable K137 is used to input α*i*PS-B power failure detection signals to PFB-24.

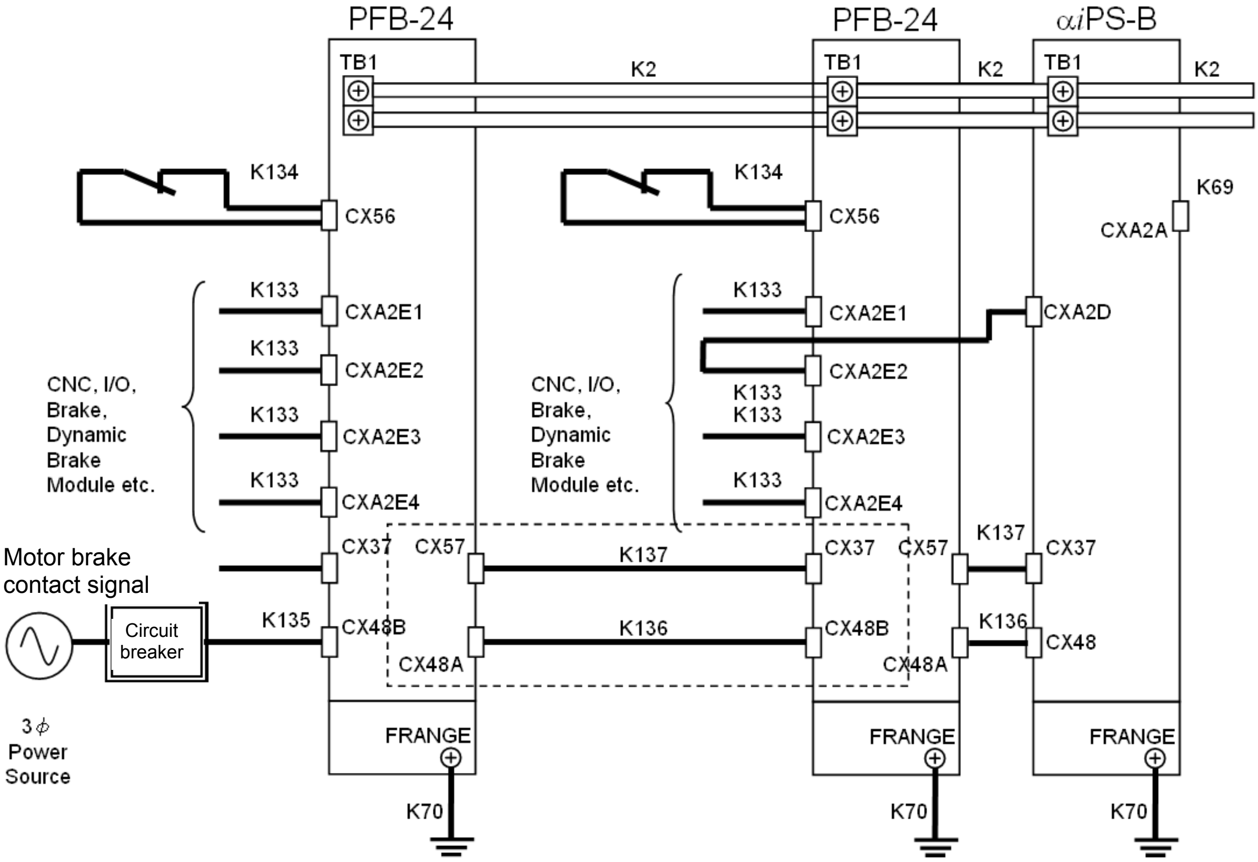


Connector and cable specifications

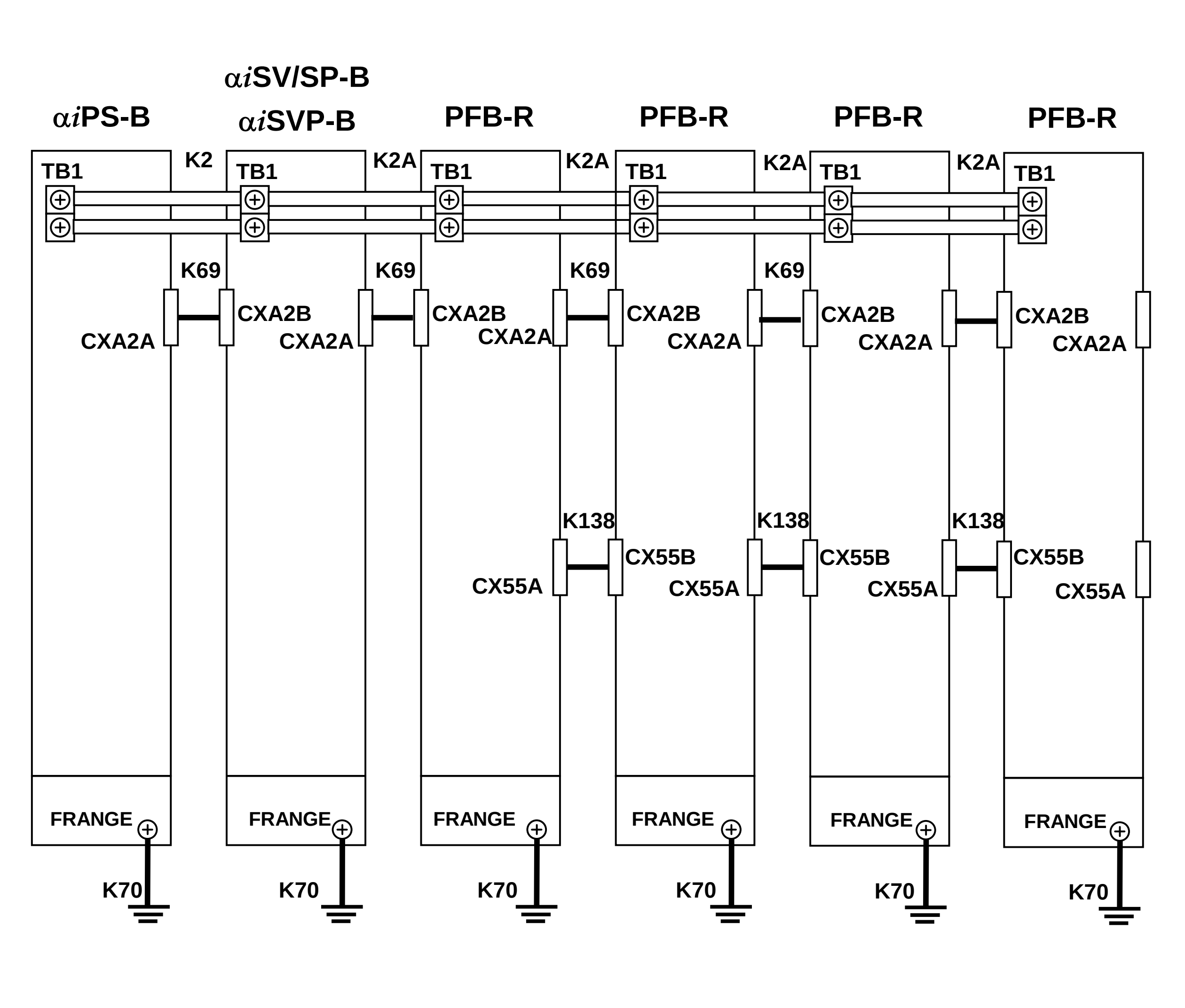
Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing: 1-1318119-3 Contact: 1318107-1
Conductor size	0.5mm^2, AWG20
Insulation sheath outer dimension	1.11-1.87

I.5.3.6 Connecting two or more PFB-24s

Two PFB-24s are connected to one α*i*PS-B as shown in the figure below.
Two or more PFB-24s can also be connected to one αiPS-B.



I.5.4 Connection of PFB-R



NOTE

1. Connect the DC link leading to αiPS-B to the TB1 terminal of PFB-R.
2. The control power (24 V) of PFB-R is supplied via cable K69.
3. PFB-R uses cable K69 for inter-amplifier communication. Ready signals and alarm signals are sent through inter-amplifier communication.
4. When two or more PFB-Rs are used, connect cable K138 between PFB-Rs.

I.5.4.1 Connecting two or more PFB-Rs

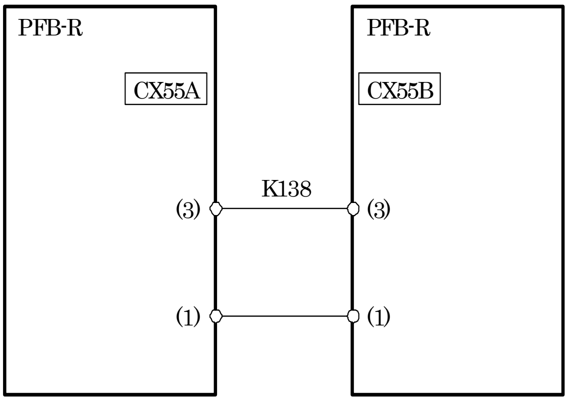
When only one PFB-R is used and discharge output and discharge energy are insufficient, up to eight PFB-Rs can be connected in parallel. The discharge specifications when PFB-Rs are connected in parallel are as follows.

Output when PFB-Rs are connected in parallel

Number of units connected	Discharge output	Discharge energy
1	100kW	50kJ
2	200kW	100kJ
3	300kW	150kJ
4	400kW	200kJ
5	500kW	250kJ
6	600kW	300kJ
7	700kW	350kJ
8	800kW	400kJ

I.5.4.2 Details of cable K138

Cable K138 is used to synchronize discharge operation of each PFB-R when two or more PFB-Rs are connected. The master and slave units are determined. The slave units follow the discharge operation of the master unit.



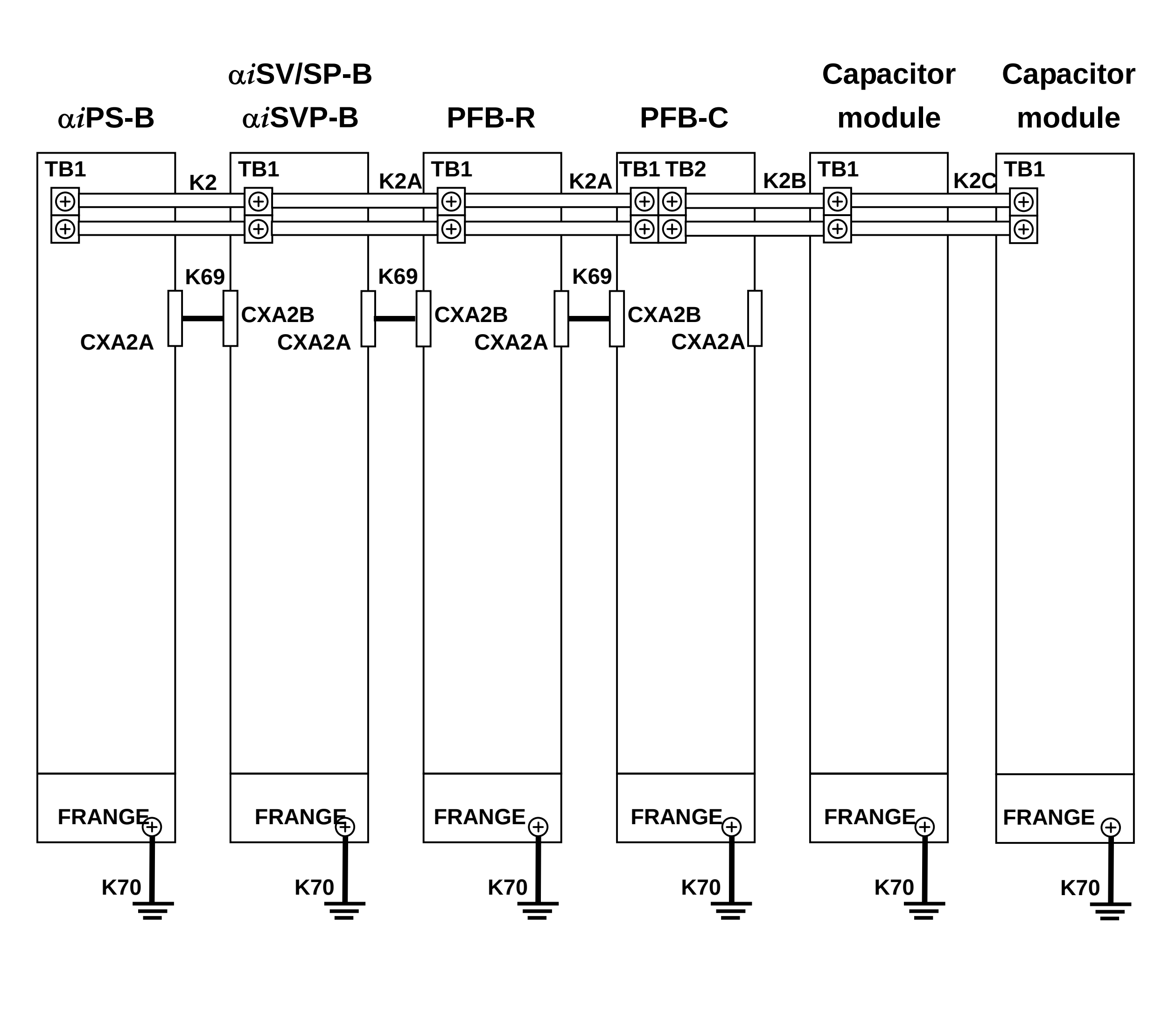
Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing: 1-1318120-3 (2 pieces) Contact: 1318107-1 (4 pieces)
Conductor size	0.5mm^2, AWG20
Insulation sheath outer dimension	1.08-2.83mm

NOTE

1 When two or more PFB-Rs are connected but no cable K138 is connected, alarm 28 occurs in αiPS-B.
2 If disconnection or contact failure happens to cable K138 in operation, alarm 3 occurs in PFB-R.
3 If nine or more PFB-Rs are connected, alarm 28 (submodule error (SV0043, SP9216 alarm)) occurs in αiPS-B.

I.5.5 Connection of PFB-C

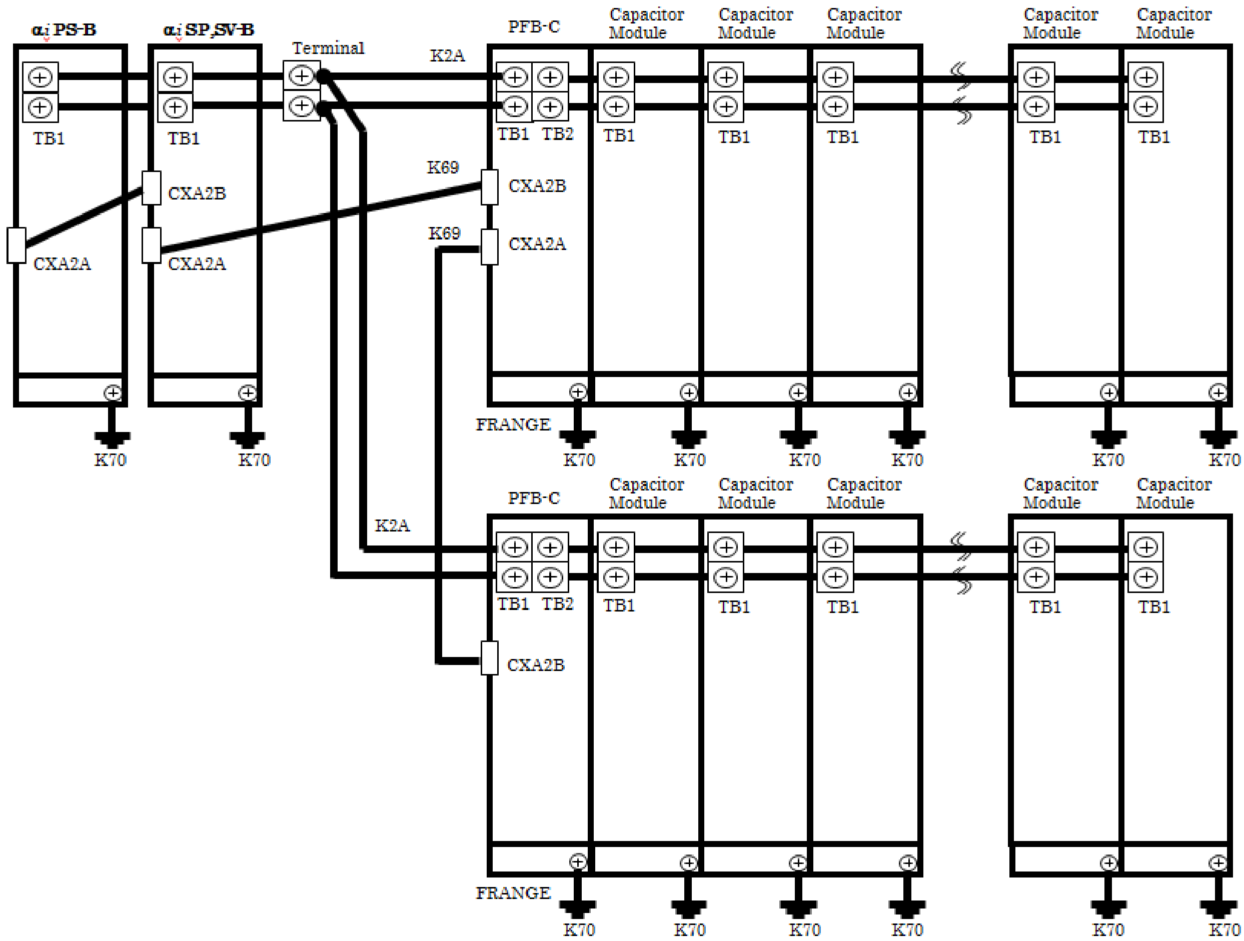


NOTE

1. Connect the DC link leading to αiPS-B to the TB1 terminal of PFB-C.
2. Do not connect any device other than capacitor modules to the TB2 terminal of PFB-C.
3. Up to eight capacitor modules can be connected to one PFB-C.
4. The control power (24 V) of PFB-C is supplied via cable K69.
5. PFB-C uses cable K69 for inter-amplifier communication. Ready signals and alarm signals are sent through inter-amplifier communication.

I.5.5.1 Connecting two or more PFB-Cs

Up to eight capacitor modules can be connected to one PFB-C. When only one PFB-C is used and the energy needed for retract is insufficient, up to two PFB-Cs can be connected in parallel. To connect two PFB-Cs, branch cable K2A at the terminal block.



NOTE
If three PFB-Cs are connected, alarm 28 (submodule error (SV0043, SP9216 alarm)) occurs in αiPS-B.

I.6 POWER FAILURE DETECTION SPECIFICATIONS

I.6.1 Power Failure Detection Signal

αiPS-B detects a power failure and outputs the following PMC signals via the servo amplifier and the spindle amplifier. Based on this signal, perform power failure machine protection operations (retract operation, feed axis stop operation, etc.).

• Address of the signal output via the servo amplifier

	#7	#6	#5	#4	#3	#2	#1	#0
Fn374	XPFL8	XPFL7	XPFL6	XPFL5	XPFL4	XPFL3	XPFL2	XPFL1

• Address of the signal output via the spindle amplifier

		#7	#6	#5	#4	#3	#2	#1	#0
1st spindle axis	Fn307							XPFLA	
2nd spindle axis	Fn309							XPFLB	
3rd spindle axis	Fn311							XPFLC	
3rd spindle axis	Fn313							XPFLD	

XPFL1 to 8 : Power failure detection signal (servo axis)
XPFLA : Power failure detection signal (1st spindle axis)
XPFLB : Power failure detection signal (2nd spindle axis)
XPFLC : Power failure detection signal (3rd spindle axis)
XPFLD : Power failure detection signal (4th spindle axis)
0: Power failure state
1: Power supplied state

NOTE
1 Use the bit corresponding to the PS control axis.
2 See Subsection 15.3.1, "PS Control Axis" for PS control axes.

I.6.2 Power Failure Detection Conditions

αiPS-B determines a power failure when any of the following conditions is met and changes the power failure detection signal (XPFL) from 1 to 0.

(1) Voltage drop in DC link is detected.
The detection level can be varied by changing the parameter. See Chapter 13 "POWER FAILURE DETECTION FUNCTION" and Chapter 15 "PARAMETERS FOR POWER SUPPLIES" for details.

(2) Voltage drop in input power supply (three-phase AC) is detected.
The detection level can be varied by changing the parameter. See Chapter 13 "POWER FAILURE DETECTION FUNCTION" and Chapter 15 "PARAMETERS FOR POWER SUPPLIES" for details.

(3) Constant unbalance in input power supply (three-phase AC) is detected.
Continuous unbalance rate of input power supply (three-phase AC) at or above 25% for eight frequency periods results in a power failure.

(4) An instantaneous open phase (half frequency period) is detected in the input power supply (three-phase AC).
The detection level is the same as that specified in "(2) Voltage drop in input power supply (three-phase AC) is detected."
This signal is valid when any of the following conditions is met:
   (a) When PFB-R or PFB-C is connected
   (b) When the Power Supply parameter P000H#02 = 1

(5) A power failure is detected with an external power failure detection signal (PMC signal).
This signal is the signal to notify α*i*PS-B of power failure state detected by an external device when a power failure is detected by an external device other than α*i*PS-B. It is used to notify α*i*PS-B of the power failure state if a power failure is detected by an external device earlier than α*i*PS-B.

This signal is valid when any of the following conditions is met:
   (a) When PFB-R or PFB-C is connected
   (b) When the Power Supply parameter P000H#02 = 1

The power failure signals detected by external devices are sent to α*i*PS-B using the following PMC signals and via the PS control axis.

• Signal address when the PS control axis is the servo axis

	#7	#6	#5	#4	#3	#2	#1	#0
Gn680	EXPF8	EXPF7	EXPF6	EXPF5	EXPF4	EXPF3	EXPF2	EXPF1

• Signal address when the PS control axis is the spindle axis

		#7	#6	#5	#4	#3	#2	#1	#0
1st spindle axis	G307				EXPFA				
2nd spindle axis	G311				EXPFB				
3rd spindle axis	G315				EXPFC				
3rd spindle axis	G319				EXPFD				

EXPF1 to 8 : External power failure detection notification signal
(when the PS control axis is the servo axis)
EXPFA : External power failure detection notification signal
(when the PS control axis is the 1st spindle axis)
EXPFB : External power failure detection notification signal
(when the PS control axis is the 2nd spindle axis)
EXPFC : External power failure detection notification signal
(when the PS control axis is the 3rd spindle axis)
EXPFD : External power failure detection notification signal
(when the PS control axis is the 4th spindle axis)
0: Power supplied state
1: Power failure state

NOTE

1 αiPS-B cannot detect a power failure that occurs in a line not connected to connector CX48 (e.g., power failure caused by malfunction of the magnetic contactor (MCC) connected to the αiPS-B main circuit input or disconnection of a cable connected to MCC).

2 If backup operation is needed for a power failure that occurs in a line not connected to connector CX48, install a power failure detector to the line and manipulate this external power failure signal by using the power failure signal output from it.

NOTE

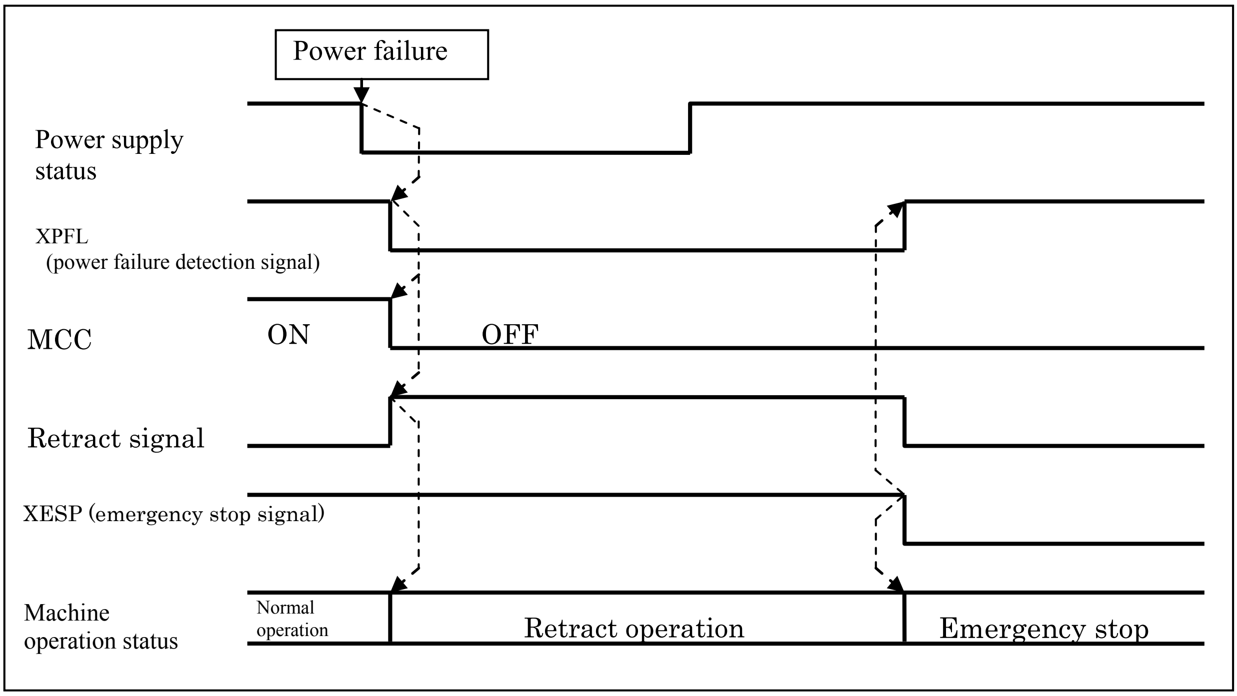
1 Use the bit corresponding to the PS control axis.

2 See Subsection 15.3.1, "PS Control Axis" for PS control axes.

I.6.3 Behavior after Power Failure Detection and Reset Conditions

(a) When PFB-R or PFB-C is connected
When the Power Supply parameter P000H#02 = 1

α*i*PS-B turns off the magnetic contactor after detecting a power failure (XPFL = 1 → 0). α*i*PS-B maintains the power failure detection state (XPFL = 0) even after the power supply is restored from the power failure state. α*i*PS-B cannot continue to operate after power failure detection (XPFL = 0), so immediately activate power failure machine protection (retract operation, feed axis stop operation, etc.) to stop the machine in a safe position. Once the emergency stop signal (*ESP:X8.4 = 0) is input and the α*i*-B amplifier stops operation, α*i*PS-B returns to a non-power failure detection state (XPFL = 1).

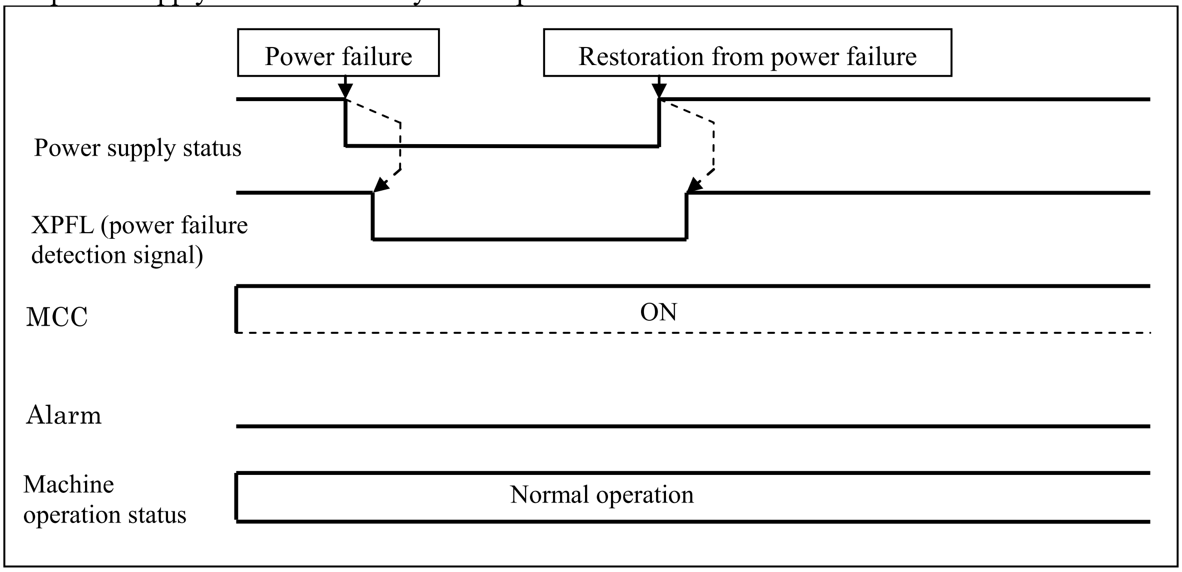


NOTE

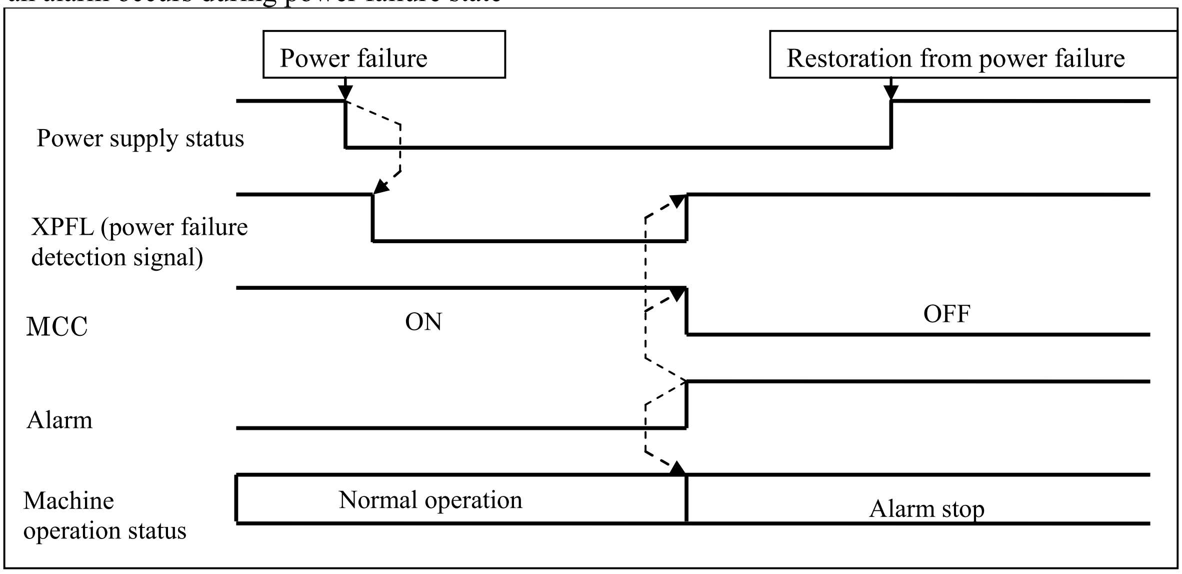
PFB-R and PFB-C are connected to stop the machine in safe condition immediately after a power failure.

(b) When only PFB-24 is connected (PFB-R or PFB-C is not connected)
α*i*PS-B returns to XPFL = 1 if the power supply is restored from power failure state after detection of a power failure (XPFL = 1 → 0). In power failure state, if the power supply is restored from power failure before any alarm due to power supply error is issued, α*i*PS-B can continue to operate.

If the power supply is restored shortly after a power failure



If an alarm occurs during power failure state



I.6.4 Settings of Power Supply Parameters

The power failure detection specifications of α*i*PS-B when PFB-R or PFB-C is connected are as follows:

A As PFB-R and PFB-C are connected to protect the machine at power failure, more reliable power failure detection requires α*i*PS-B to detect a power failure caused by an instantaneous open phase (half frequency period) as well.

B PFB-R and PFB-C are connected to stop the machine by returning it to a safe state rather than to operate it as long as possible during the power failure. α*i*PS-B turns off the magnetic contactor after detecting a power failure (XPFL = 1 → 0) and maintains the power failure detection state (XPFL = 0) even after the power supply is restored from the power failure state.

Even if PFB-R or PFB-C is not connected, setting the following CNC parameters of α*i*PS-B validates the same power failure detection specifications as when PFB-R and PFB-C are connected.
These CNC parameters are set when the vertical axis fall prevention function is used without connecting PFB-R or PFB-C.

Internal number	Parameter No. PS control axis SV	SP	#7	#6	#5	#4	#3	#2	#1	#0
P000[H]	2572	4672						PFL PFB		

PFL PFB : Power failure detection specification signal
- 0: Complies with the power failure detection specifications when PFB-R and PFB-C are not connected
- 1: Complies with the power failure detection specifications when PFB-R and PFB-C are connected

> **NOTE**
> See Chapter 15, "PARAMETERS FOR POWER SUPPLIES" for details on the Power Supply parameters.

I.6.5 Power Failure Detection Specifications Summary

	When FPB-R and PFB-C are connected	When only PFB-24 is connected (PFB-R and PFB-C are not connected)	When Power Supply parameters are set P000H #2=1
Voltage drop in DC link	○	○	○
Voltage drop in input power supply (three-phase AC)	○	○	○
Constant unbalance in input power supply (three-phase AC)	○	○	○
Instantaneous open phase (half frequency period) in input power supply (three-phase AC)	○	—	○
External power failure detection signal (PMC signal)	○	—	○
Operation after power failure detection	XPFL=1→0 Magnetic contactor turns OFF	XPFL=1→0 Magnetic contactor remains ON Power supply regeneration function is masked	XPFL=1→0 Magnetic contactor turns OFF
Power failure detection signal reset conditions	Even if the power supply is restored from power failure, XPFL = 0 and magnetic contactor remains OFF When the αi-B amplifier stops operation after emergency stop, XPFL = 0 → 1.	If the power supply is restored from power failure, XPFL = 0 → 1 and the power supply regeneration function is also restored.	Even if the power supply is restored from power failure, XPFL = 0 and magnetic contactor remains OFF When the αi-B amplifier stops operation after emergency stop, XPFL = 0 → 1.

○: Enabled; -: Disabled

I.7 SETTINGS FOR POWER FAILURE MACHINE PROTECTION

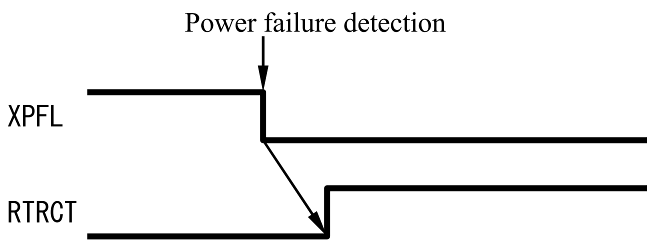
The power failure machine protection functions control machine protection operations as necessary in CNC. This section describes the outline of signal processing and parameter setting for machine protection operations. For details on parameter setting, see connection manual (functions) and parameter manual of each CNC.

I.7.1 Power Failure Retract Operation

The power failure retract function conducts retract operations by manipulating the CNC retract signals based on the power failure detection signal (XPFL) output from α*i*PS-B. To minimize the energy consumption during the period from occurrence of a power failure to the start of retract operations, make sure that PMC processing is performed on the first level (at 8-msec intervals).

I.7.1.1 When using the electronic gear box function or the flexible synchronous control function

Retract operation is conducted using the retract signal (RTRCT). When the power failure detection signal (XPFL) changes from "1" to "0," change the retract signal (RTRCT) from "0" to "1."



XPFL: Power failure detection signal
    The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

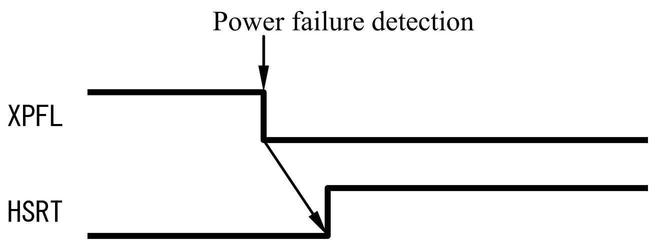
RTRCT: Retract signal
    When a rise from "0" to "1" is detected, the axis preset with a parameter is retracted. The amount and speed of retract are the values preset with parameters.

CNC	Signal address	Parameter No.	
	RTRCT	Retract speed	Retract amount
Series 30*i*-B/31*i*-B/32*i*-B Series 0*i*-F Series 0*i*-D	Gn066.4	No.7740	No.7741

For details, see the connection manual (functions) and parameter manual of the CNC.

I.7.1.2 When using the high-speed cycle machining retract function

The option for the high-speed cycle machining retract function is needed.
Retract operation is conducted using the high-speed cycle machining retract signal (HSRT).
When the power failure detection signal (XPFL) changes from "1" to "0," change the high-speed cycle machining retract signal (HSRT) from "0" to "1."



XPFL: Power failure detection signal
The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

HSRT: High-speed cycle machining retract signal
If high-speed cycle machining is in progress and the cycle in progress is set to retract operation enabled (retract operation selection flag RT in the seventh bit of the "data type specification variable" in the header is "1"), high-speed cycle machining retract operation starts when HSRT is "1." The retract speed, direction, and amount of travel for each axis are the values preset in parameters. After the retract operation is completed, the machine transitions to automatic operation suspension or retract cycle.

CNC	Signal address	Parameter No.	
	HSRT	Retract speed and direction	Retract amount (Note)
Series 30*i*-B/31*i*-B/32*i*-B	Gn065.3	No.7514	No.7515

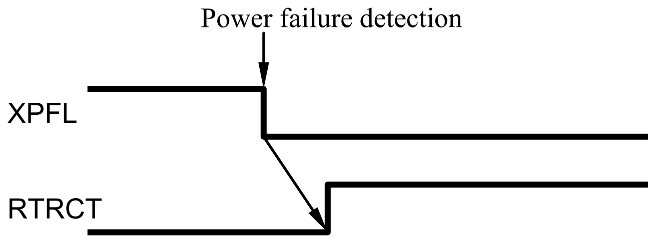
For details, see the connection manual (functions) and parameter manual of the CNC.

> **NOTE**
> Specify the retract operation distribution count for high-speed cycle machining retract operation.
> If the cycle in progress ends before distributing as many times as specified in this parameter, the retract operation ends at that point of time. The parameter value of zero is regarded as retract operation distribution count = infinite and the retract operation continues until the current cycle completes.

I.7.1.3 Power failure retract in machining and lathes

The general-purpose retract function is used. The general-purpose retract function is standard for Series 0*i*-F/0*i*-D, but optional for Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B.

Retract operation is conducted using the retract signal (RTRCT) same as the electronic gear box function. When the power failure detection signal (XPFL) changes from "1" to "0," change the retract signal (RTRCT) from "0" to "1."



XPFL: Power failure detection signal
The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

RTRCT: Retract signal
When a rise from "0" to "1" is detected, the axis preset with a parameter is retracted. The amount and speed of retract are the values preset with parameters.

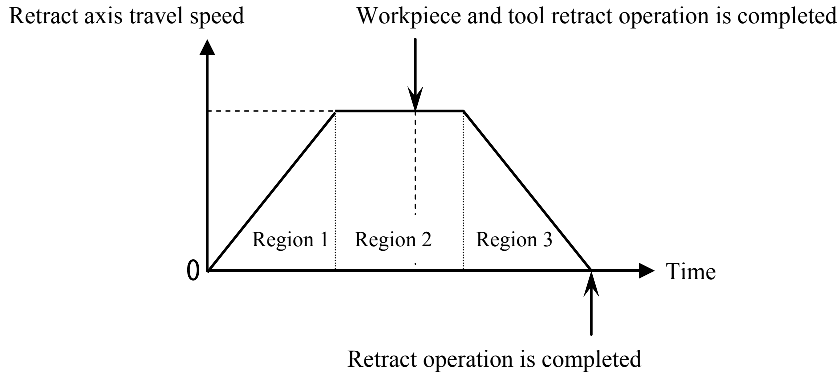
CNC	Signal address	Parameter No.	
	RTRCT	Retract speed	Retract amount
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	Gn066.4	No.7740	No.7741

For details, see the connection manual (functions) and parameter manual of the CNC.

NOTE
Set the retract amount parameter to a value more than twice of the travel distance needed to prevent an interference between the workpiece and tool.

[Supplementary information]
The change in the retract axis travel speed from the start to the end of retract operation is divided into three regions shown in the figure below:

Region 1 Region from the start of retract to the point at which the retract speed is reached
Region 2 Region in which the axis travels at retract speed (constant rotation)
Region 3 Region in which the retract axis decelerates



In regions 1 and 2, energy is supplied from the capacitor modules to move the retract axis. In region 3, the energy generated by decelerating retract axis returns to amplifier as electric energy. In normal operation, the energy generated by decelerating motor is regenerated to the power supply. However, during a power failure, there is no route to regenerate energy to the power supply, the DC link voltage rises and a DC link overvoltage alarm may be issued. If the alarm occurs, the synchronization cannot be maintained, possibly causing damage to the workpiece or tool. Therefore, the workpiece and tool need to be retracted to a position where they do not interfere before entering region 3.

If PFB-R is connected, the energy generated by decelerating retract axis is discharged via the discharge resistor of PFB-R and no DC link overvoltage alarm occurs in region 3. Therefore, if PFB-R is connected, the retract amount parameter may be set to the same value as the travel distance needed to prevent interference between the workpiece and tool.

I.7.2 Power Failure Quick Stop Function

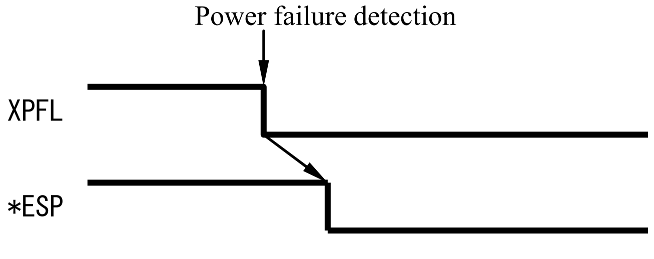
I.7.2.1 Feed axis deceleration and stop

When the power failure detection signal (XPFL) changes from "1" to 0," perform feed hold stop by using the emergency stop (*ESP) or automatic operation suspension signal (*SP) of the CNC.

(1) When stopping the axis by using the emergency stop signal

The axis is decelerated and stopped with the maximum motor torque. The stop distance is minimum but the trajectory is not maintained during deceleration.

When the power failure detection signal (XPFL) changes from "1" to "0," set the emergency stop (*ESP) of the CNC to "0."
When the emergency stop signal is used to stop the axis, the after-mentioned parameter setting is needed.



Power failure detection signal (XPFL):
The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

Emergency stop signal (*ESP) of the CNC

CNC	Signal address (*ESP)
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	X008.4 (for the 1st machining group) X008.4 (for the 2nd machining group) X008.1 (for the 3rd machining group)

CNC	Signal address (*ESP)
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	Gn008.4

When the power failure detection signal (XPFL) changes from "1" to "0," manipulate X008.4, 0, 1 or Gn008.4.

Setting of the parameter

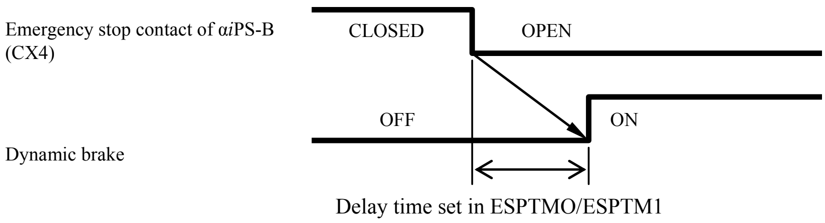
- DBST: Use the Quick Stop Function → Set to Use ("1").
- BRKC: Use the brake control function → Set to Use ("1").
- Brake control timer → Set a value greater than the rapid traverse time constant. (Unit: msec.)

CNC	Parameter No.		
	DBST	BRKC	Brake control timer
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	No.2017 #0	No.2005 #6	No.2083
Setting example	1	1	500

- Setting of the emergency stop timer built in the α*i* amplifier
  After a power failure, if the emergency stop is activated for α*i*PS-B (CX4) during motor deceleration, the brake switches from regenerative brake to dynamic brake and the stop distance increases. To prevent this, the emergency stop for the amplifier must be delayed until the feed axis stops. Setting the following parameters can delay the time from the opening of the emergency stop contact of α*i*PS-B (α*i*PS-B: CX4) to the actual activation of emergency stop by up to 400 msec. If 400 msec or more is needed for the motor to decelerate and stop, make the external circuit keep the emergency stop contact of α*i*PS-B (CX4) closed until the feed axis stops.

CNC	Parameter No.	
	ESPTM1	ESPTM0
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	No.2210 #6	No.2210 #5
Setting example	1	1

ESPTM1	ESPTM0	Delay time
0	0	50msec
0	1	100msec
1	0	200msec
1	1	400msec

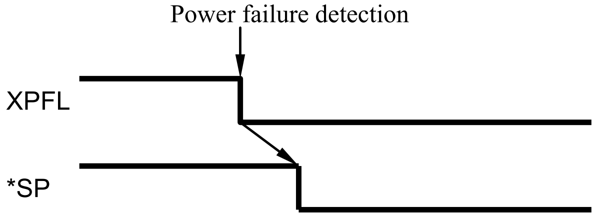


The above-mentioned parameter must be set to all axes which use the Power Failure Quick Stop Function. For details, see PARAMETER MANUAL for FANUC AC SERVO MOTOR α*i*-B/α*i* /β*i*-B/β*i* series.

> **NOTE**
> When PFB-R is used to stop the feed axis or spindle axis at the time of power failure, close the αiPS-B connector CX4 contact until the axis stops. If the connector CX4 contact is open, PFB-R stops discharge of the energy generated by motor deceleration, possibly causing a DC link overvoltage alarm.

(2) When stopping the feed hold

The axis is controlled and stopped with the acceleration/deceleration time constant set in a parameter. When the power failure detection signal (XPFL) changes from "1" to "0," change the automatic operation suspension signal (*SP) to "0."



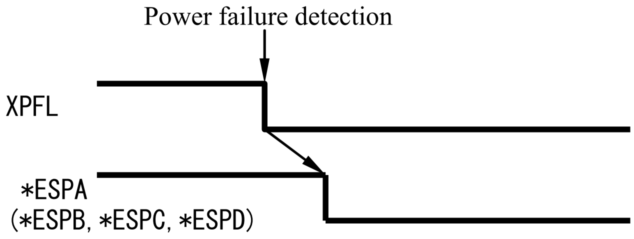
Power failure detection signal (XPFL):
The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

Automatic operation suspension signal (*SP)

CNC	Signal address (*SP)
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	Gn008.5

I.7.2.2 Spindle axis deceleration and stop

When the power failure detection signal (XPFL) changes from "1" to "0," set the spindle axis control input signal *ESPA (*ESPB, *ESPC, or *ESPD) to "0."



XPFL: Power failure detection signal
The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

*ESPA: 1st spindle axis emergency stop signal (spindle axis control input signal)
*ESPB: 2nd spindle axis emergency stop signal (spindle axis control input signal)
*ESPC: 3rd spindle axis emergency stop signal (spindle axis control input signal)
*ESPD: 4th spindle axis emergency stop signal (spindle axis control input signal)

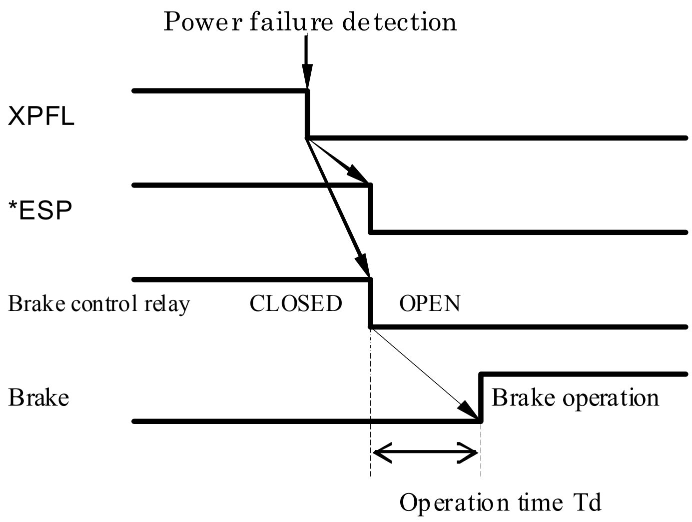
CNC	Signal address (Note)			
	*ESPA	*ESPB	*ESPC	*ESPD
Series 30*i*-B/31*i*-B/32*i*-B/35*i*-B Series 0*i*-F Series 0*i*-D	Gn071 .1	Gn075 .1	Gn205 .1	Gn267 .1

Note: For details, see PARAMETER MANUAL for FANUC AC SPINDLE MOTOR α*i*/β*i* series.

I.7.3 Power Failure Vertical Axis Fall Prevention Function

The Power Failure Vertical Axis Fall Prevention Function is available without the Power Failure Backup Module Model B.
However, if a power failure occurs during heavy cutting, a low DC link voltage alarm may occur before the brake is activated and the vertical axis may not be prevented to fall. If protection is needed for such a case, connect PFB-24, PFB-C, and capacitor modules.
The following describes the signal processing in such a case.

When the power failure detection signal (XPFL) changes from "1" to "0," activate the brake and at the same time change the emergency stop (*ESP) of the CNC to "0." See Chapter 13, "POWER FAILURE DETECTION FUNCTIONS" for details on parameter setting and precautions.



Power failure detection signal (XPFL):

The power failure detection signal of α*i*PS-B is output to the PMC signal via servo amplifier.

I.8 CONTROL SEQUENCE

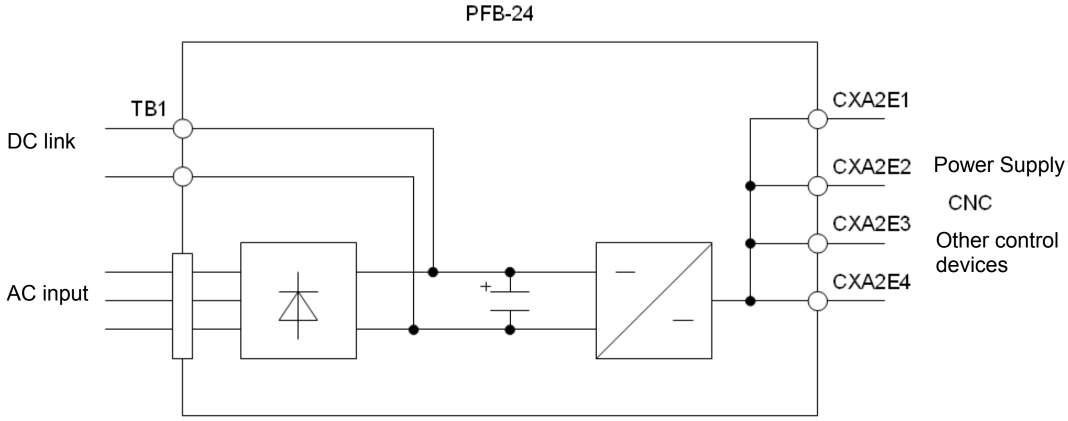
I.8.1 Sequence of PFB-24

[When the power supply is turned on]

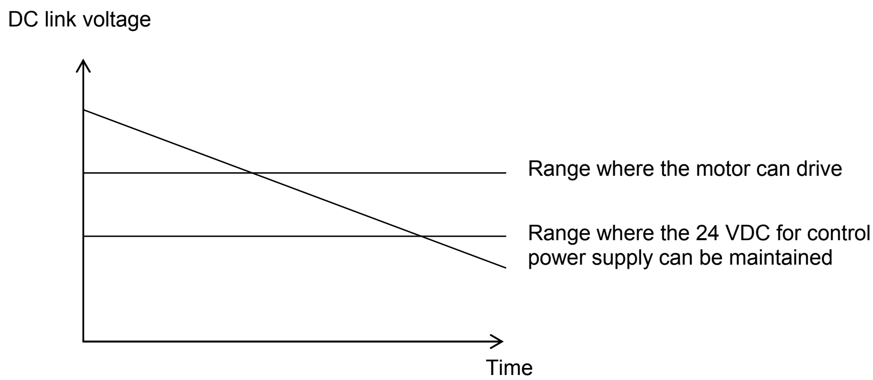
The rise time of 24 VDC power supply varies depending on the load. Please check with an actual machine.

[When a power failure occurs]

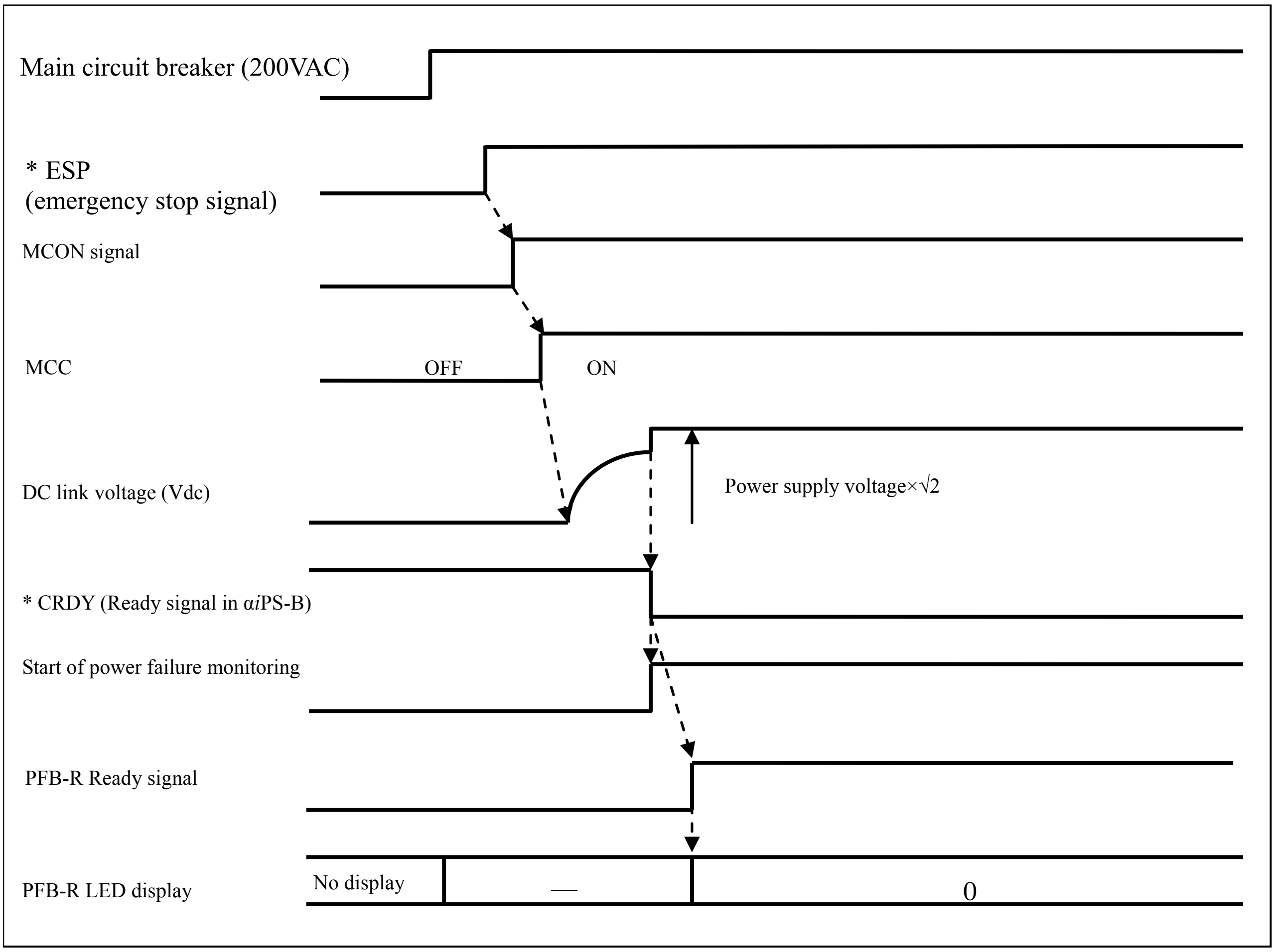
At normal times, the 24 VDC power is supplied from the AC input.
When a power failure is detected, the power source changes from the AC input to the DC link.
After the power supply is restored from power failure, the power source is changed to the AC input.



When PFB-24 is applied, after a power failure occurs, the 24 VDC for control power supply is maintained as long as the DC link voltage is within the range where the motor can be driven.
If the DC link voltage drops below the range where the motor can be driven, a low DC link voltage alarm occurs and the motor cannot be driven.



I.8.2 Sequence of PFB-R Ready



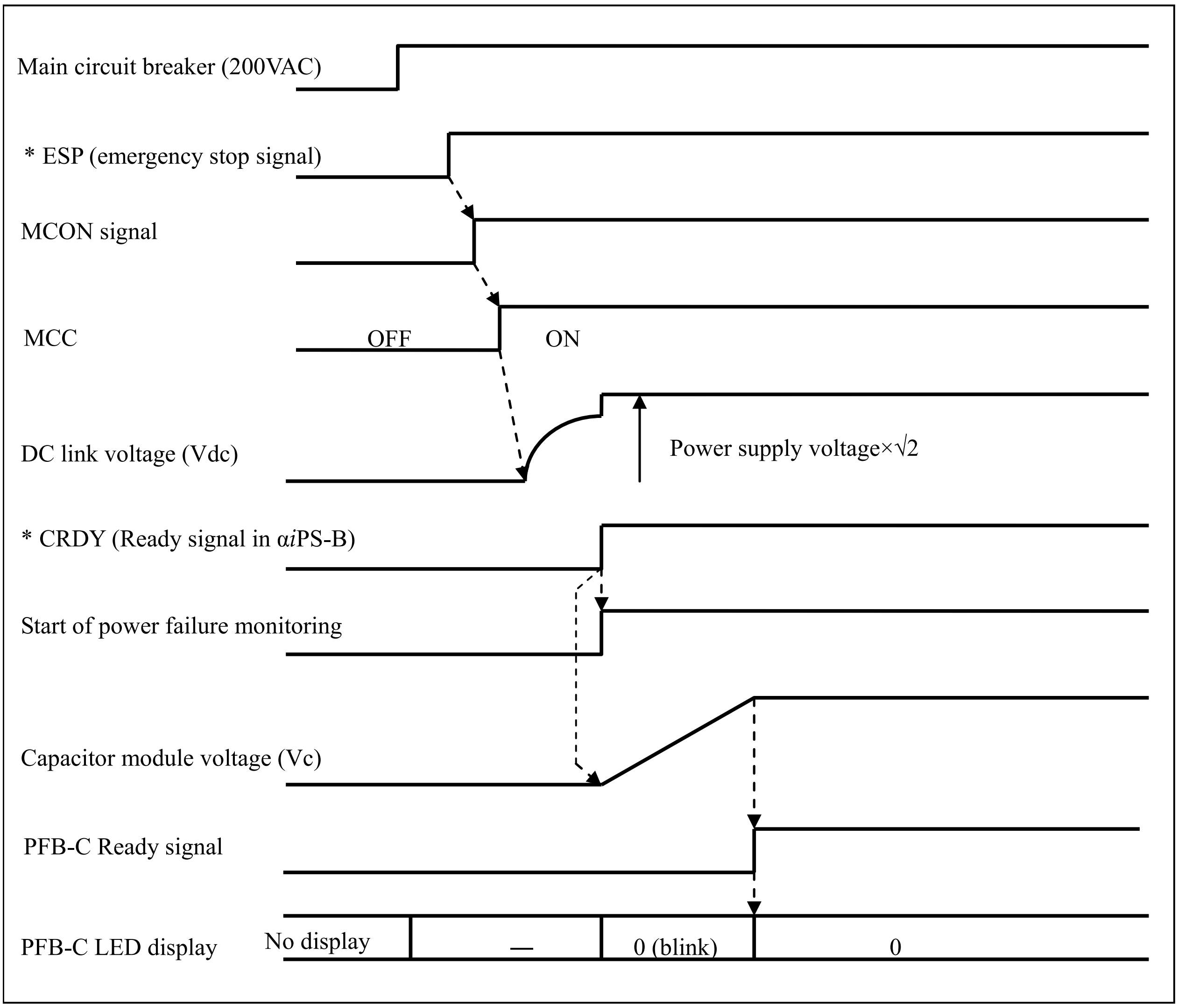
(1) Power failure detection of α*i*PS-B is enabled after α*i*PS-B changes to *CRDY = 0. When an external power failure detection signal is used, make sure that EXPFL becomes 0 until α*i*PS-B changes to *CRDY = 0.

(2) PFB-R enters ready to run state if α*i*PS-B is *CRDY = 0 and the temperature of discharge resistor is 70°C or less. In discharge operation during power failure, it may take a while to transition to ready to run state immediately after the discharge resistor gets hot.

(3) PFB-R becomes to be able to discharge when it is in ready to run state. If the machine is operated before PFB-R enters ready to run state and a power failure occurs, discharge operation will not start. Operate the machine after PFB-R enters ready to run state.

(4) For details on how to check the PFB-R ready signal, see Subsection I.8.4.

I.8.3 Sequence of PFB-C Ready



(1) Power failure detection of α*i*PS-B is enabled when α*i*PS-B becomes *CRDY = 0. When an external power failure detection signal is used, make sure that EXPFL becomes 0 until α*i*PS-B becomes *CRDY = 0.
(2) PFB-C starts charging the capacitor modules after α*i*PS-B becomes *CRDY = 0 and enters ready to run state when charging of the capacitor modules completes.
(3) PFB-C becomes to be able to back up the power failure when it is in ready to run state. If the machine is operated before PFB-C enters ready to run state and a power failure occurs, power failure backup operation will not start. Operate the machine after PFB-C enters ready to run state.
(4) For details on how to check the PFB-C ready signal, see Subsection I.8.4.

I.8.4 Sequence of Machine Start Operation

The ready signals of PFB-R and PFB-C are output via the PS control axis to the following PMC signals. Start the machine operation after confirming that the ready signal (PFBRDY) is 1.

• Address of the signal output via the servo amplifier

	#7	#6	#5	#4	#3	#2	#1	#0
Fn680	PFBRDY8	PFBRDY7	PBRDY6	PFBRDY5	PFBRDY4	PFBRDY3	PFBRDY2	PFBRDY1

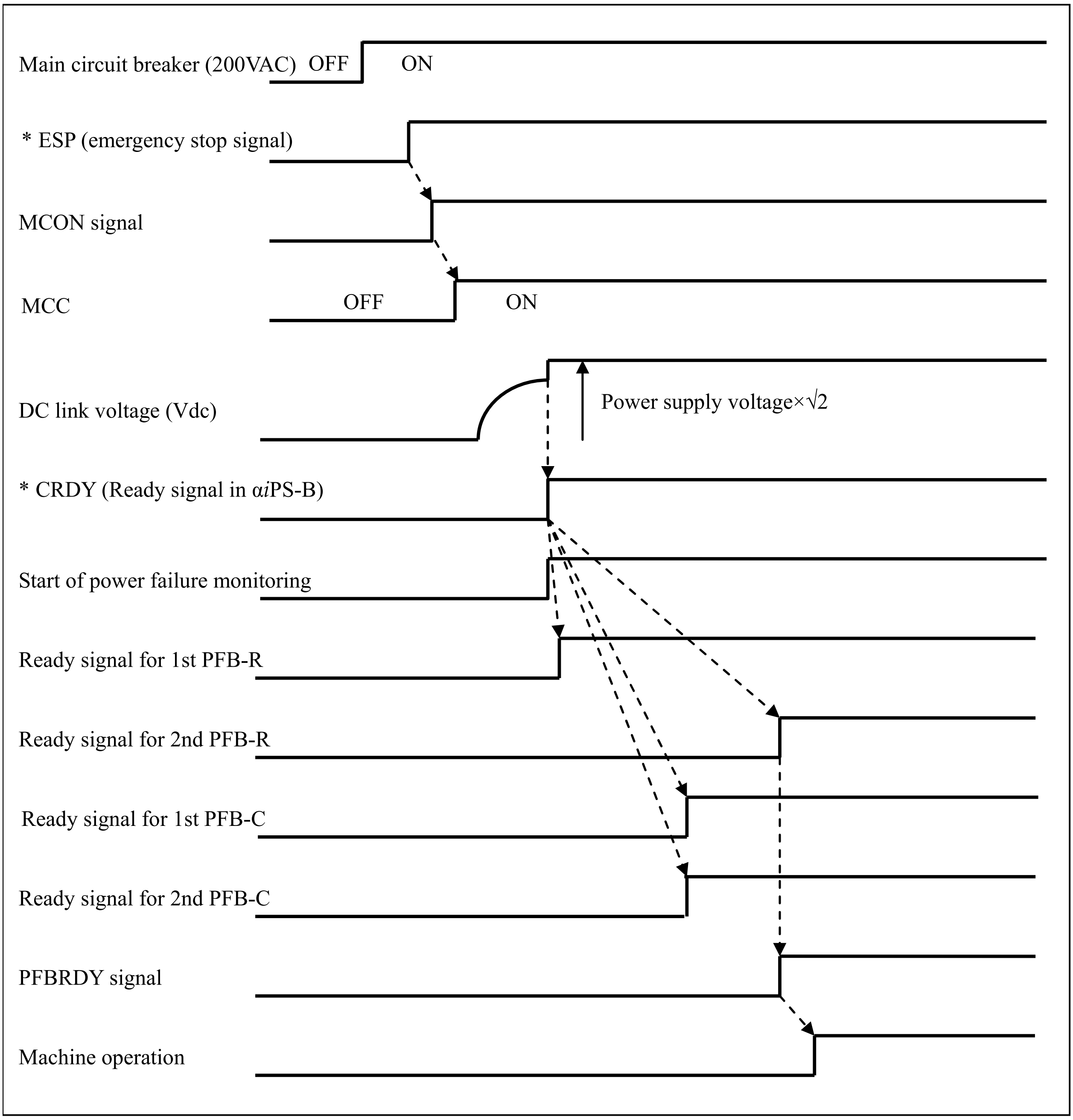
• Address of the signal output via the spindle amplifier

		#7	#6	#5	#4	#3	#2	#1	#0
1st spindle axis	Fn307				PFBRDYA				
2nd spindle axis	Fn309				PFBRDY B				
3rd spindle axis	Fn311				PFBRDY C				
3rd spindle axis	Fn313				PFBRDY D				

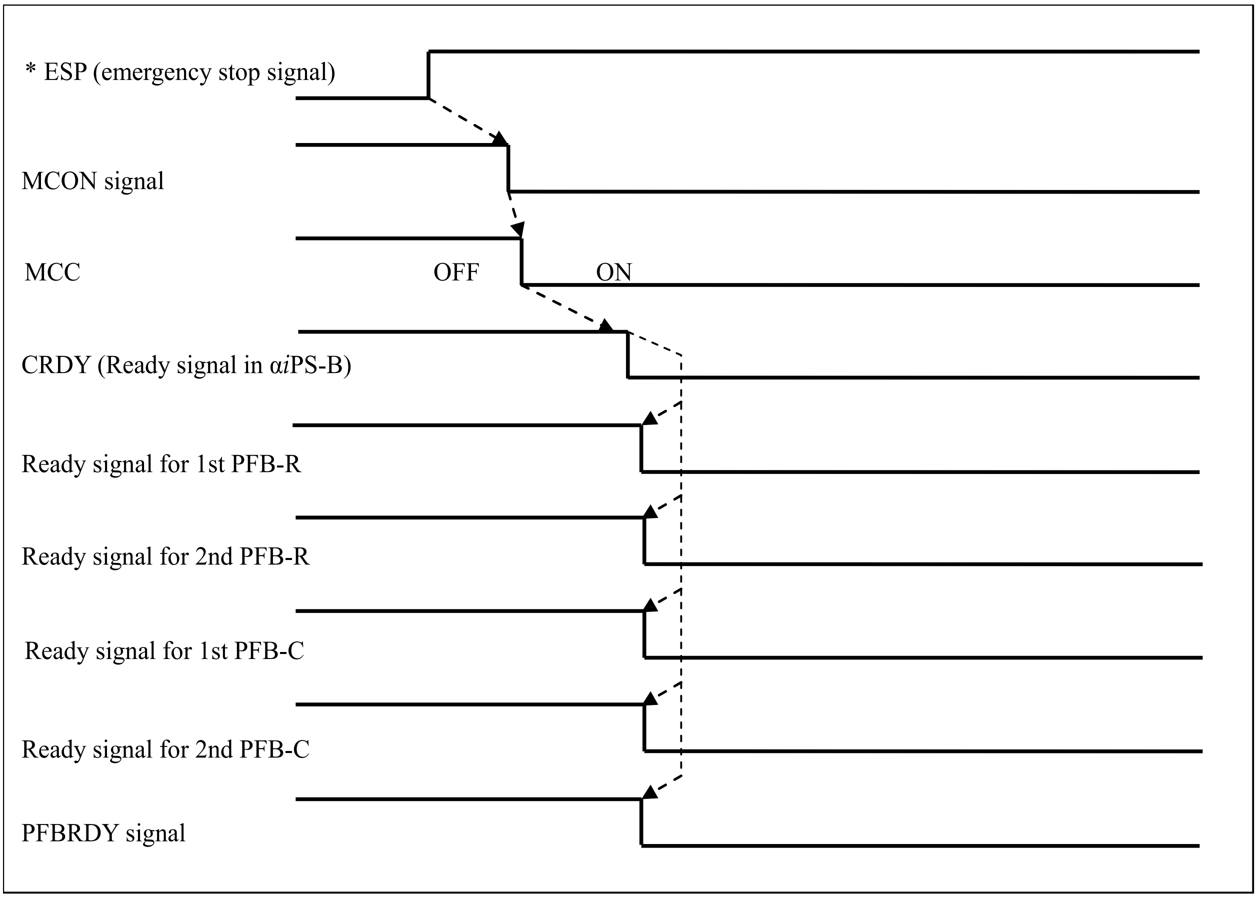
PFBRDY 1 to 8 : Ready signal (when the PS control axis is the servo axis)
PFBRDY A : Ready signal (when the PS control axis is the 1st spindle axis)
PFBRDY B : Ready signal (when the PS control axis is the 2nd spindle axis)
PFBRDY C : Ready signal (when the PS control axis is the 3rd spindle axis)
PFBRDY D : Ready signal (when the PS control axis is the 4th spindle axis)
0 : Not ready
1 : Ready

NOTE
1 Use the bit corresponding to the PS control axis.
2 See Subsection 15.3.1, "PS Control Axis" for details on PS control axes.

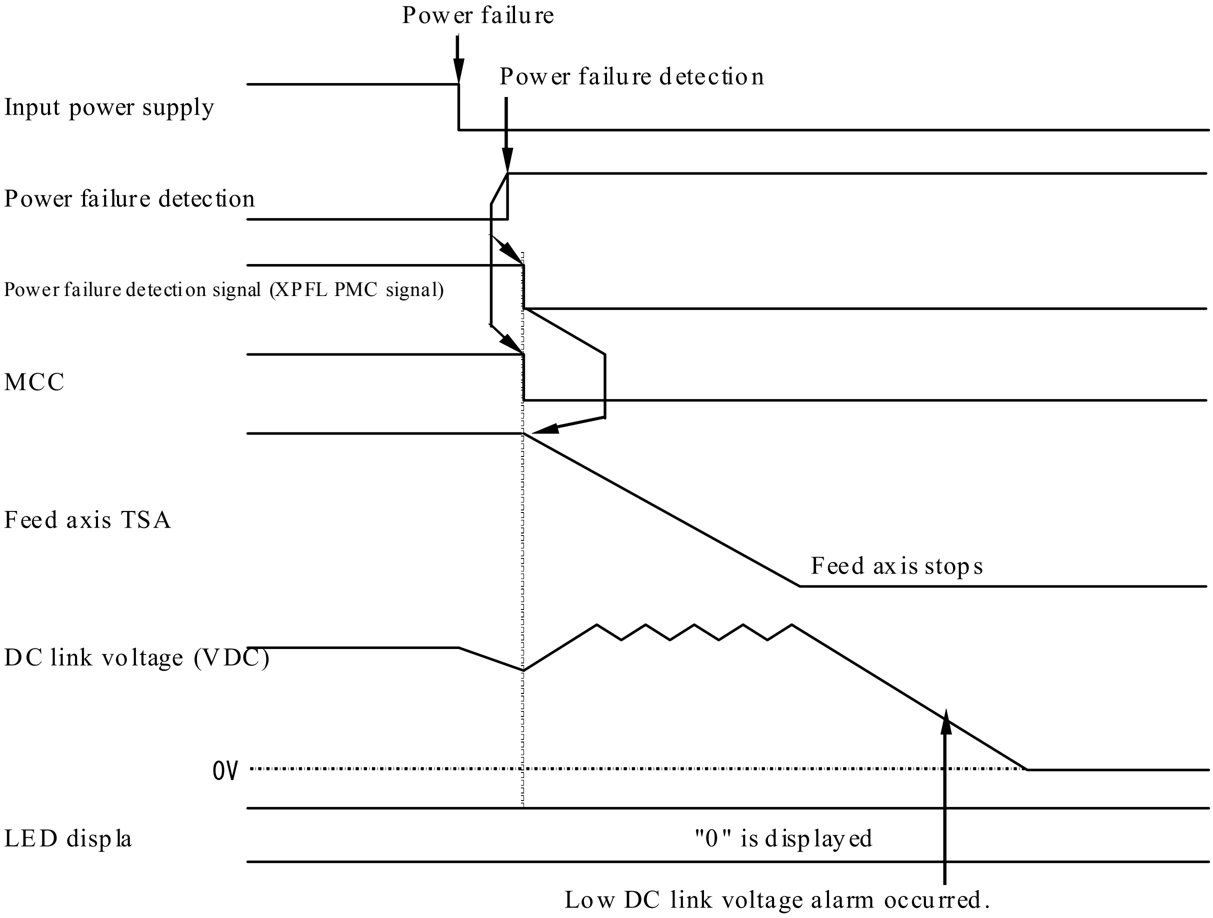
(1) Conditions under which PFBRDY changes from 0 to 1
- When two or more PFB-Rs or PFB-Cs are connected, the ready signal (PFBRDY) becomes 1 after all the PFB-Rs or PFB-Cs enter ready to run state.
- PFB-C enters ready to run state when charging of all capacitor modules completes.
- PFB-R enters ready to run state when the discharge resistor temperature is 70°C or less.
- Operate the machine after confirming that the ready signals (PFBRDY) of PFB-R and PFB-C are 1.



(2) Conditions under which PFBRDY changes from 1 to 0
- PFBRDY becomes 0 when an alarm occurs in PFB-R or PFB-C.
- PFBRDY becomes 0 when the magnetic contactor (MCC) is cut off.

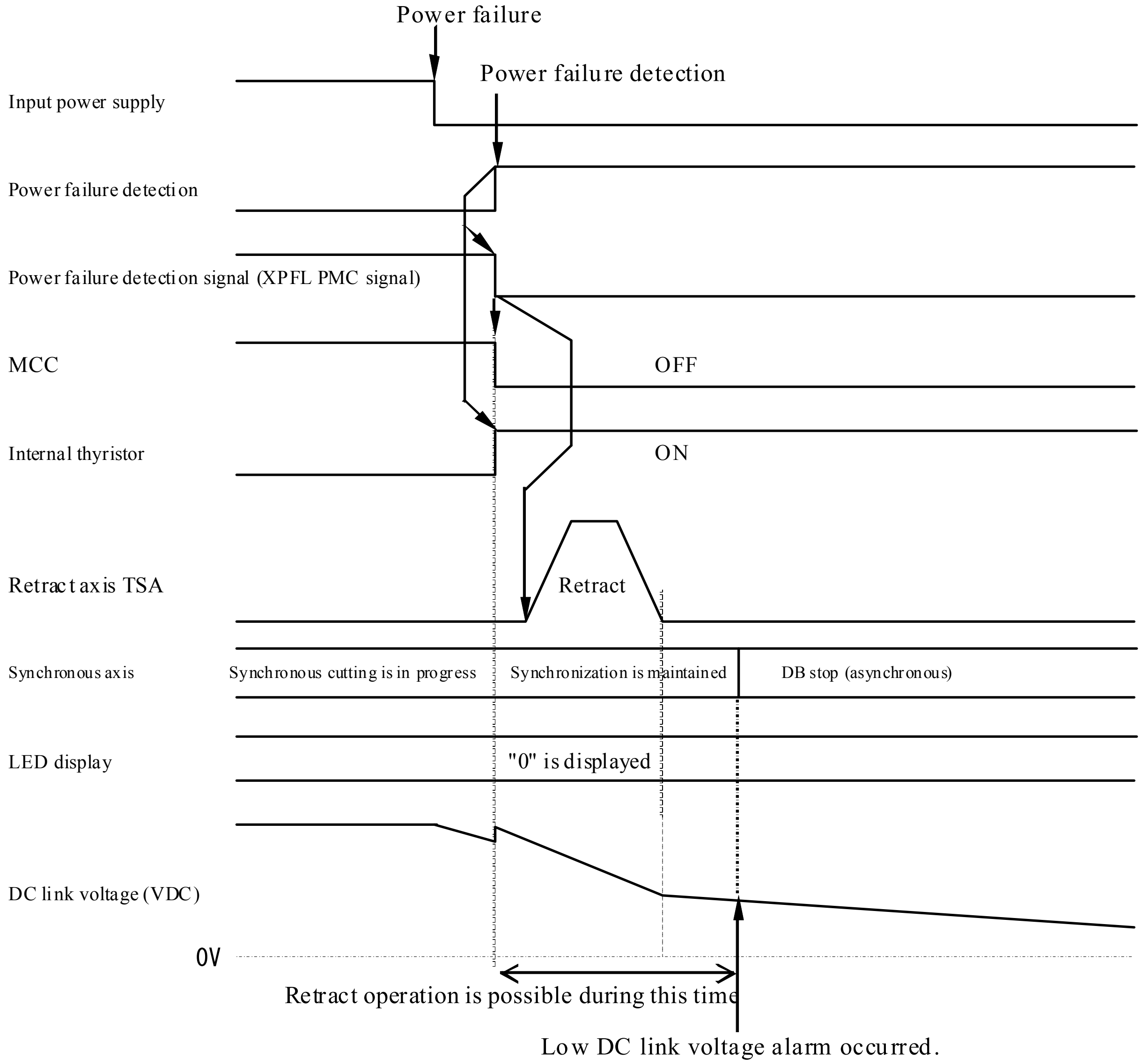


I.8.5 Power Failure Sequence (Discharge Operation of PFB-R)



> **NOTE**
> 1 When a power failure is detected, the power failure detection signal (XPFL = 0) is output. When this signal is received, perform ladder processing to give a stop command (emergency stop signal, automatic operation suspension signal, etc.) to the feed axis. When the automatic operation suspension signal is used to stop the axis and the acceleration/deceleration time constant is set relatively long, the stop distance may increase because energy (regenerative energy generated by deceleration) enough to control after power failure cannot be obtained.
> 2 To stop the spindle axis, give the emergency stop signal (spindle axis control signal ESPA, ESPB, ESPC, or ESPD).
> 3 Parameter setting to reduce the stop distance is needed.
> 4 The energy generated by motor deceleration is discharged via the discharge resistor of PFB-R.
> 5 After the feed axis and the spindle axis are stopped, a low DC link voltage alarm occurs due to DC link voltage drop.
> 6 Close the connector CX4 contact of α*i*PS-B until the feed axis and the spindle axis stop. If the connector CX4 contact is open, PFB-R stops discharge of the energy generated by motor deceleration, possibly causing a DC link overvoltage alarm.

I.8.6 Power Failure Sequence (PFB-C Energy Supply Control)



NOTE

1. When a power failure is detected, the power failure detection signal (XPFL = 0) is output. When this signal is received, immediately perform ladder processing to start retract operation.
2. After a power failure, motor is driven with the energy from the capacitor modules and DC link voltage drops gradually with consumption of energy, eventually resulting in a low DC link voltage alarm. This causes the servo motor to DB stop and the spindle motor to coast, making it impossible to maintain synchronization. It is therefore necessary to select the number of capacitor modules so that retract operation completes before these alarms occur.

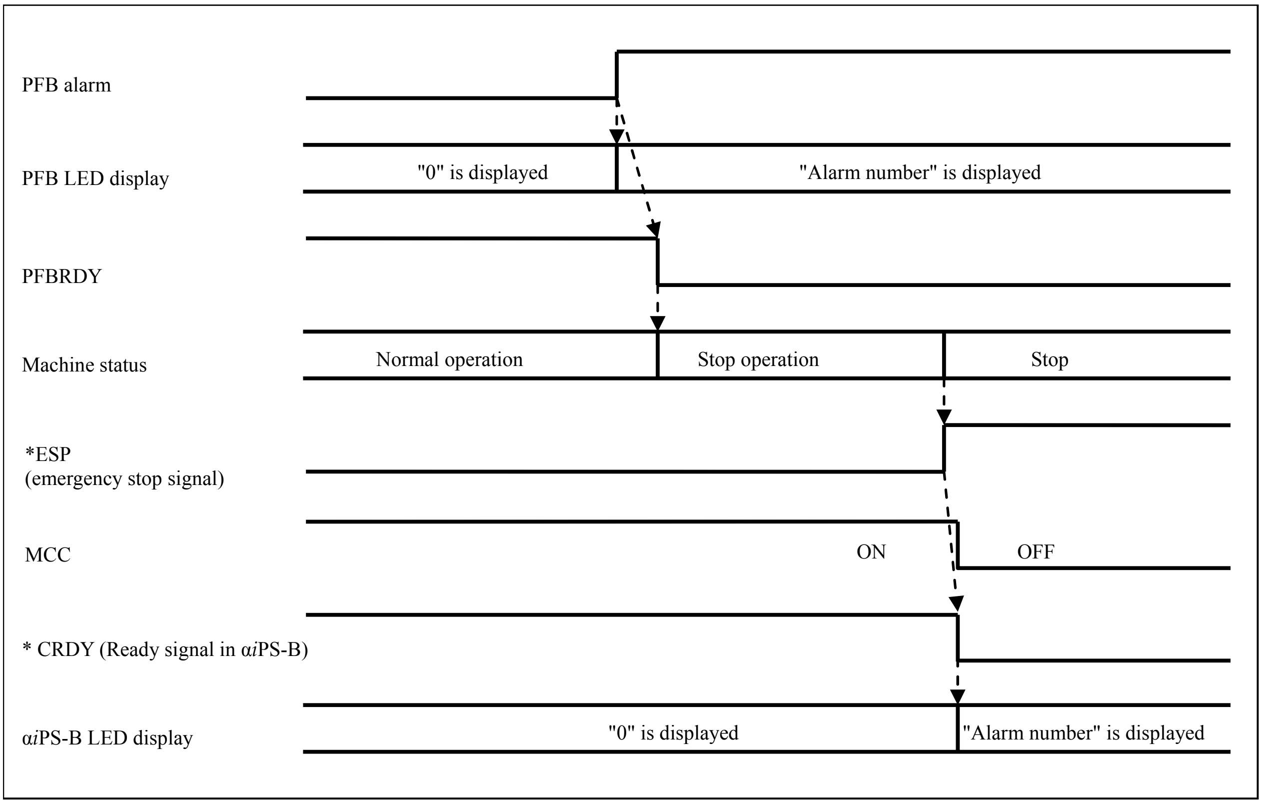
I.8.7 Sequence When Alarm Occurred in PFB-R and PFB-C

[If an alarm occurs in power supplied state]

When an error occurs in PFB-R or PFB-C, the alarm number corresponding to the error is displayed on the LED and PFBRDY becomes 0.

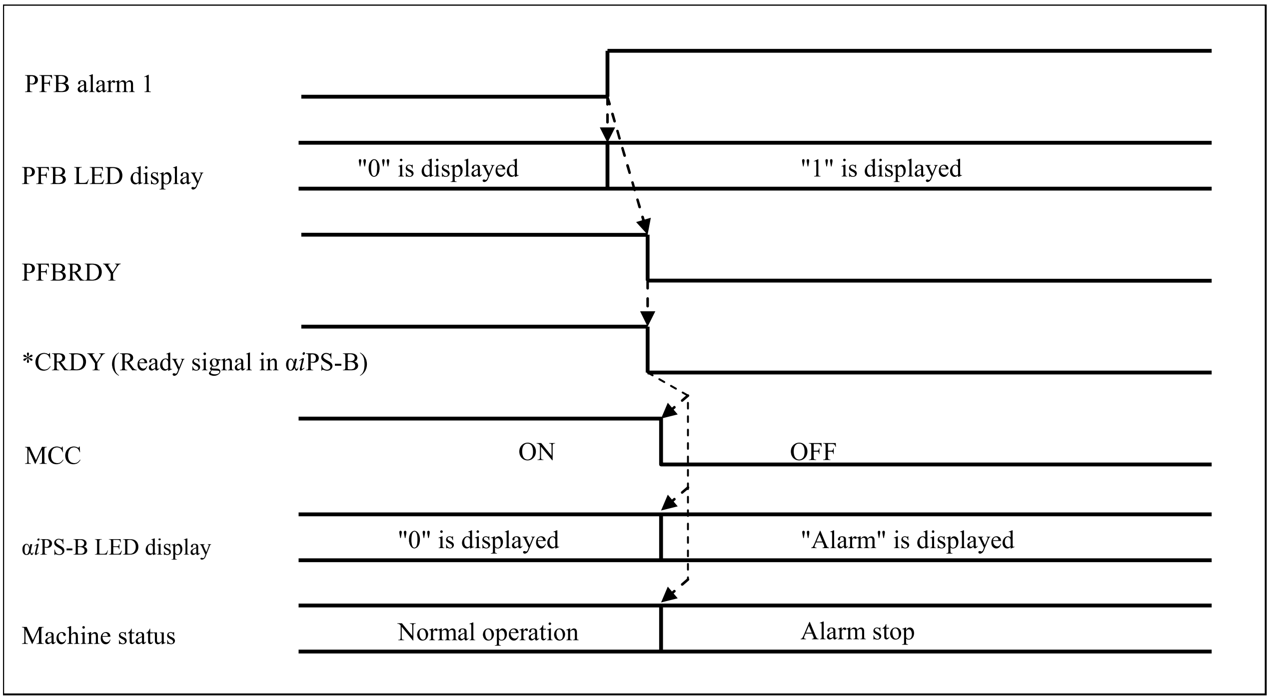
Even if an alarm occurs in PFB-R or PFB-C in power supplied state, α*i*PS-B does not forcibly cut off the power and the machine continues normal operation. However, if an alarm occurs in PFB-R or PFB-C, power failure backup operation will not be performed when a power failure occurs. If PFB-R or PFB-C becomes not-ready (PFBRDY = 0) in power supplied state, immediately take actions to safely stop the machine. To protect PFB-R and PFB-C, immediately after the machine stops, input the emergency stop signal to cut off the magnetic contactor (MCC) of the α*i*PS-B input part.

When the magnetic contactor is cut off, α*i*PS-B issues a power failure backup module error alarm. Check the content of the alarm on the diagnosis screen or on the LED display of PFB-R or PFB-C. See Section I.10 for details on alarms and their causes.



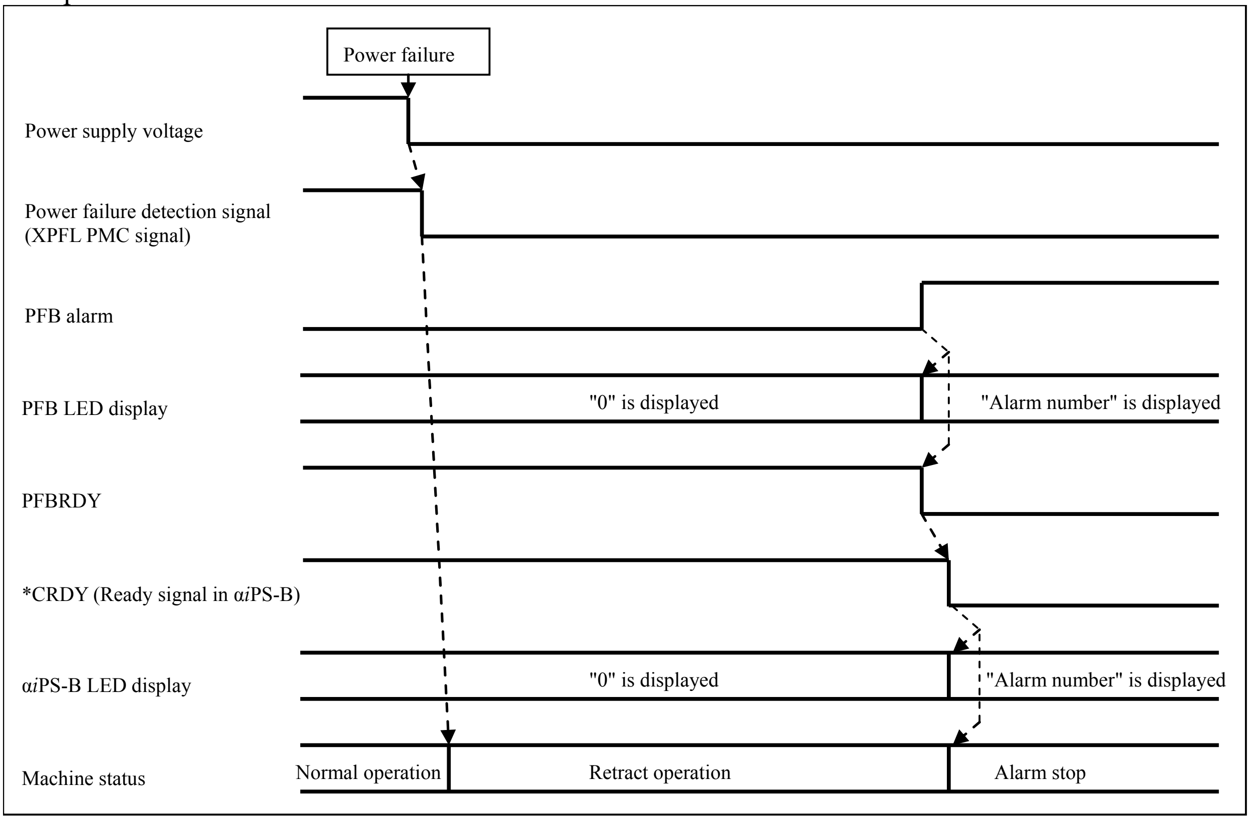
[If alarm 1 occurs in power supplied state]

When alarm 1 occurs in PFB-R or PFB-C, the machine may not operate properly. To protect other devices, α*i*PS-B immediately stops its operation (alarm stop) and cuts off the magnetic contactor. See Section I.10 for details on alarm 1 and its causes.



[If an alarm occurs during power failure backup operation]

If an alarm occurs in PFB-R or PFB-C during power failure backup operation, power failure backup operation cannot be continued. Therefore, α*i*PS-B immediately stops its operation (alarm stop) to protect other devices. See Section I.10 for details on alarms and their causes.



I.8.8 Operation Check

(1) Sequence check at start of machine operation

Be sure to start operation of the machine after the ready signals (PFBRDY) of PFB-R and PFB-C become 1.

(2) Sequence check at alarm occurrence

While the machine is running idle, perform a simulation that changes the ready signals (PFBRDY) of PFB-R and PFB-C to 0. Check that the machine stops and enters the emergency stop state.

I.9 SELECTION OF POWER FAILURE BACKUP MODULE MODEL B

I.9.1 Selection of PFB-24

Ensure that the sum of 24 VDC output of CXA2E1 to CXA2E4 does not exceed the output of PFB-24. See Section I.3 for the output of PFB-24. For the current consumption of each connected device (24 V), see the specifications of each device.

If the sum of 24 VDC output of CXA2E1 to CXA2E4 exceeds the output of PFB-24, two or more PFB-24s may be used. See Subsection I.5.3.6 for how to connect two or more PFB-24s.

I.9.2 Selection of PFB-R

When the Power Failure Quick Stop Function is used, PFB-R is needed to decelerate and stop the motor after a power failure. As the motor output and deceleration energy vary depending on the machine configuration, connect the number of PFB-Rs corresponding to the machine configuration.

To determine the number of PFB-Rs to connect, the following data are needed for each motor.

P [kW]: Maximum output of the motor Jm [kg・m^2]: Rotor inertia of the motor JL [kg・m^2]: Motor axis-converted inertia of load Vm [min^{-1}]: Speed of the motor at rapid traverse

Determine the number of PFB-Rs to connect based on the following two conditions:
Condition 1: Sum of the maximum output of the motors to be decelerated simultaneously at power failure (Note)
Condition 2: Sum of deceleration energy of the motors to be decelerated at power failure

Calculate the deceleration energy per motor as follows.

(a) In SI unit system

$$W = 5.48 \times 10^{-3} \cdot (Jm + JL) \cdot Vm^2$$

W: Deceleration energy [J]
Jm: Rotor inertia of the motor [kg・m^2]
JL: Motor axis-converted inertia of load [kg・m^2]
Vm: Speed of the motor at rapid traverse [min^{-1}]

(b) In CGS unit system

$$W = 5.37 \times 10^{-4} \cdot (Jm + JL) \cdot Vm^2$$

W: Deceleration energy [J]
Jm: Rotor inertia of the motor [kgf・cm・sec^2]
JL: Motor axis-converted inertia of load [kgf・cm・sec^2]
Vm: Speed of the motor at rapid traverse [min^{-1}]

From the following table, select the number of PFB-Rs to connect that meets conditions 1 and 2.

Number of units connected	Condition 1	Condition 2
1	100kW or less	50kJ or less
2	200kW or less	100kJ or less
3	300kW or less	150kJ or less
4	400kW or less	200kJ or less

NOTE
The "sum of the maximum output of motors" refers to the sum of the maximum output of the motors to be decelerated simultaneously. When both the servo motor and the spindle motor are decelerated and stopped at power failure, the "sum of the maximum output of motors" can be reduced by decelerating the spindle motor after decelerating and stopping the servo motor.

Selection example
Selection of PFB-Rs when simultaneously decelerating and stopping the motors shown below at power failure

Axis	Motor model	Maximum output	Deceleration energy	
X axis	α8/3000*i*	5.7kW	1.14kJ	
Y axis	α8/3000*i*	5.7kW	1.14kJ	
Z axis	α12/3000*i*	7.6kW	1.54kJ	
Spindle axis	α8/8000*i*	13.2kW	19.8kJ	
	Condition 1 →	32.2kW total	Condition 2 →	23.62kJ total

Because the above-mentioned motors are driven by 200 VAC, PFB-R (A06B-6209-H020) is used.
→ The sum of the maximum output of the motors to be decelerated simultaneously at power failure is 32.2 kW (condition 1).
→ The sum of deceleration energy of the motors to be decelerated at power failure is 23.62 kJ (condition 2).

Result of the selection
One PFB- R (A06B-6209-H020) is used.

I.9.3 Selection of PFB-C and Capacitor Modules

When the power failure retract function is used, PFB-C and capacitor modules are needed as an energy source for driving the motor after a power failure. As the amount of energy needed for retract operation varies depending on the machine configuration, connect the number of capacitor modules corresponding to the machine configuration.
The following describes how to calculate the number of capacitor modules to connect for a gear cutting machine.

To determine the number of capacitor modules to connect, the following data are needed.

P2 [kW]:	Maximum cutting output before power failure
Jm [kg・m^2]:	Rotor inertia of the motor
JL [kg・m^2]:	Motor axis-converted inertia of load
Vm [min^{-1}]:	Motor speed during retract operation
TL[N・m]:	Friction torque of the machine in the case of horizontal axis (motor-converted value) Torque required during rapid traverse rising in the case of vertical axis (motor-converted value)
d [mm]:	Travel distance to a position where the workpiece and tool do not interfere with each other (required retraction amount)
L [mm/rev]:	Travel distance per motor rotation
Is [A]:	Supply current of PFB-24
T [s]:	Time to completion of retract

Calculate the number of capacitor modules to connect by expression (1).

$$\text{Number of capacitor modules connected} \geqq \frac{\text{Energy needed for power failure retract operation and control power supply backup operation}}{\text{Amount of energy that can be supplied by one capacitor module} \times 0.7} \qquad \text{Expression (1)}$$

→ The amount of energy that can be supplied by one capacitor module W1 [J] is as follows.

	A06B-6209-H050 (for 200 V)	**A06B-6259-H050 (for 400 V)**
Amount of energy that can be supplied by one capacitor module	1195J	850J

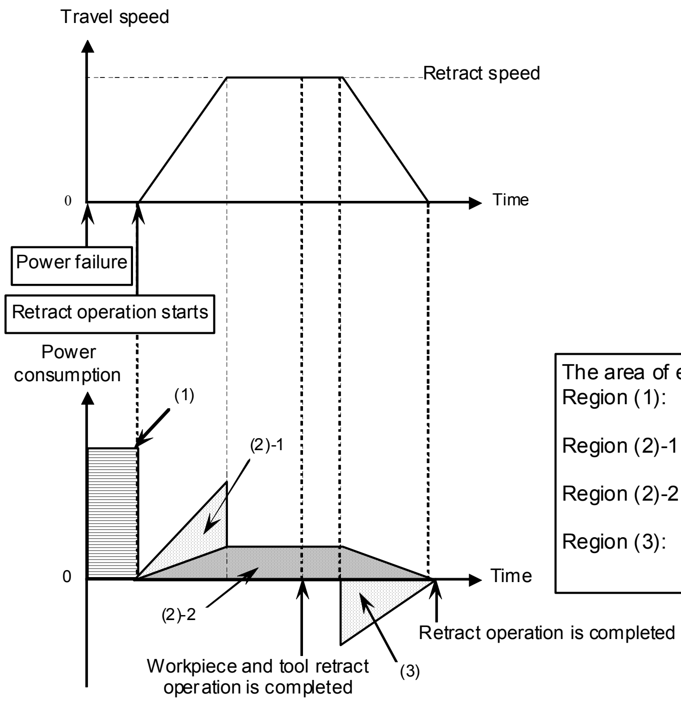
→ Calculate the amount of energy needed for power failure retract operation by expressions (2) and (3).
→ Calculate the amount of energy needed to back up the control power supply (24 V) (PFB-24) by expression (4).

[Calculation of the amount of energy needed for power failure retract operation]

The amount of energy needed after a power failure is the sum of (A) and (B) below.

(A) Amount of energy needed for cutting until retract operation starts after a power failure (expression (2))

(B) Amount of energy needed to move the retract axis (expression (3))



The area of each region represents the amount of energy.

Region (1): Amount of energy needed until retract operation starts after power failure detection

Region (2)-1: Amount of energy needed to accelerate to the retract speed

Region (2)-2: Amount of energy needed to oppose friction on the retract axis

Region (3): Amount of energy that returns to the amplifier when the retract axis decelerates

NOTE

In region (3), the deceleration energy of the motor returns to the amplifier. Under some conditions, a DC link overvoltage alarm may occur by the energy generated in region (3). Therefore, retract of the workpiece and tool needs to be completed before the retract axis starts decelerating. See Subsection I.7.1.3.

(A) Calculation of the amount of energy needed for cutting between power failure and the start of retract operation W2 [J]
Assuming the maximum cutting output before power failure is P2 [kW], the amount of energy needed for cutting until retraction operation starts (W2 [J]) can be calculated by expression (2).

$$\mathrm{W2} = 32 \times \mathrm{P2} \quad \text{... Expression (2)}$$

The maximum cutting output P2 [kW] in expression (2) can be calculated from the motor-converted axis torque Tm [Nm] at the maximum cutting output and the motor speed n [min^{-1}] by the expression below.

$$\mathrm{P2} = 1.047 \times 10^{-4} \times n \times Tm$$

(B) Calculation of the amount of energy needed to move the retract axis W3 [J]
The amount of energy needed to move the retract axis is the sum of the amount of energy needed for the retract axis to accelerate to the retract speed (region (2)-1) and the amount of energy needed against friction (region (2)-2).

(a) In SI unit system

$$\mathrm{W3} = 5.48 \times 10^{-3} \cdot (\mathrm{J}m + \mathrm{JL}) \cdot \mathrm{V}m^2 + 6.28 \cdot \mathrm{TL} \cdot \frac{d}{\mathrm{L}} \quad \text{....... Expression (3)}$$

W3: Amount of energy needed to move the retract axis [J]
Jm: Rotor inertia of the motor [kg・m^2]
JL: Motor axis-converted inertia of load [kg・m^2]
Vm: Motor speed during retract operation [min^{-1}]
TL: Friction torque of the machine in the case of horizontal axis (motor-converted value) [N・m]
Torque required during rapid traverse rising in the case of vertical axis (motor-converted value) [N・m]
d: Travel distance to a position where the workpiece and tool do not interfere with each other [mm]
L: Travel distance per motor rotation [mm/rev]

(b) In CGS unit system

$$\mathrm{W3} = 5.37 \times 10^{-4} \cdot (\mathrm{J}m + \mathrm{JL}) \cdot \mathrm{V}m^2 + 6.16 \times 10^{-1} \cdot \mathrm{TL} \cdot \frac{d}{\mathrm{L}} \quad \text{....... Expression (3)'}$$

W3: Amount of energy needed to move the retract axis [J]
Jm: Rotor inertia of the motor [kgf・cm・sec^2]
JL: Motor axis-converted inertia of load [kgf・cm・sec^2]
Vm: Motor speed during retract operation [min^{-1}]
TL: Friction torque of the machine in the case of horizontal axis (motor-converted value) [kg・cm]
Torque required during rapid traverse rising in the case of vertical axis (motor-converted value) [kg・cm]
d: Travel distance to a position where the workpiece and tool do not interfere with each other [mm]
L: Travel distance per motor rotation [mm/rev]

[Amount of energy needed to back up the control power supply (24 V) (PFB-24)]

$$\mathrm{W4} = \mathrm{I}s \times 24\mathrm{V} \times 1.2 \times \mathrm{T} \quad \text{....... Expression (4)}$$

W4: Amount of energy needed to back up the control power supply (24 V) [J]
Is: Supply current of PFB-24 [A]
T: Time to completion of retract [s]

[Example of selection of capacitor modules]
Selection example: When the gear cutting machine operates power failure retract operation

■ Conditions
Capacitor Modules 25000 (A06B-6209-H050) are used.
Maximum cutting output of synchronous axis: P2 = 10 [kW] (Spindle axis: 7 [kW], Servo axis: 3 [kW])

■ Retract axis
Rotor inertia of the motor Jm = 0.0062 [kg・m2]
Motor axis-converted inertia of load JL = 0.012 [kg・m2]
Motor speed during retract operation Vm = 1000 [min^{-1}]
Friction torque of the machine (motor-converted value) TL = 1.6 [N・m]
Travel distance to a position where the workpiece and tool do not interfere with each other d = 20 [mm]
Travel distance per motor rotation L = 2.5 [mm/rev]
Supply current of PFB-24 Is = 20 [A]
Time to completion of retract T = 0.5 [s]

■ Selection
1. Calculate the amount of energy needed for cutting between power failure and the start of retract operation W2 [J]. From expression (2),
   W2 = 32 × 10 = 320[J]
2. Calculate the amount of energy needed to move the retract axis W3 [J]. From expression (3),
   W3 = 5.48 × 10 - 3 × (0.0062 + 0.012) × 1000^2 + 6.28 × 1. 6× 20 ÷ 2.5 = 180[J]
3. The amount of energy needed for power failure retract operation is as follows:
   W2 + W3 = 320[J] + 180[J] = 500[J]
4. Calculate the amount of energy needed to back up the control power supply (24 V) (W4). From expression (4),
   W4 = 20[A] × 24[V] × 1.2 × 0.5ms = 288[J]
5. The amount of energy that can be supplied by one capacitor module W1 [J] is 1195 J.
6. Calculate the number of capacitor modules needed. From expression (1),
   (W2 + W3 + W4) / (W1 × 0.7) = 788 / (1195 × 0.7) = 0.94 → 1 unit

I.9.4 Operation Check

I.9.4.1 Power Failure Retract Operation

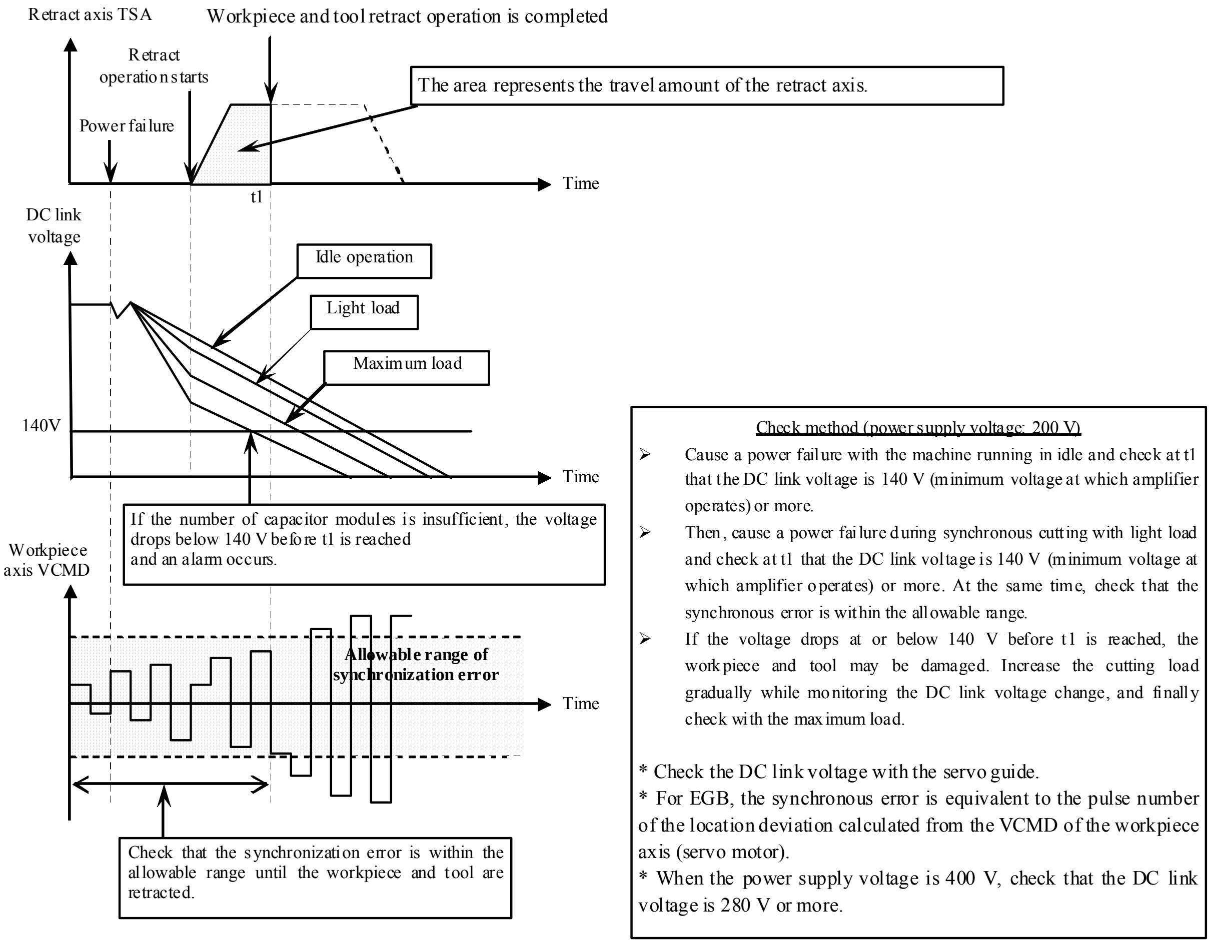
The following describes how to check the operation when power failure backup retract operation is performed for a gear cutting machine.

(1) Checking the backup operation of the control power supply
Check that the control power supply (24 V) is maintained by PFB-24 by using the following method. When the motor is stopped, turn off the main circuit breaker (power failure) and check that the following conditions are met.
- The NC screen remains on for several seconds.
- LED of α*i*PS-B continues to show "00" for several seconds.
- The PFL-LED of PFB-24 lights and stays on for several seconds.

(2) Checking the sequence
Check that retract operation is performed when the main circuit breaker on the power magnetics cabinet is turned off (power failure) while the machine is running idle.

(3) Checking retract operation during cutting
Check that synchronization enough to prevent the workpiece and tool from damage is kept during retract operation. Using the servo guide, monitor the following waveforms.
Waveforms to monitor: Retract axis position (POSF) and speed (SPEED)
Amount of error of the synchronous axis
DC link voltage

NOTE
When checking the retract operation, do not use the maximum cutting load from the beginning, but start with light load and increase the cutting load gradually so as to prevent the workpiece and tool from damage.

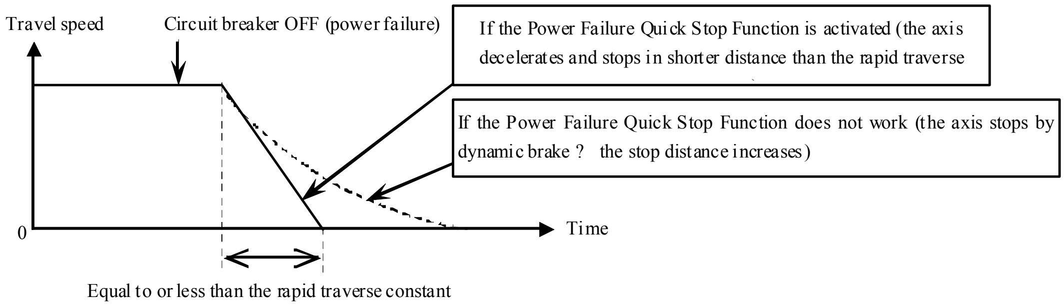


[Actions to take if retract operation is incomplete during a power failure]
One of possible reasons why power failure retract operation cannot be performed is an emergency stop before retract operation is completed. Check that no emergency stop line relays turn off before completion of the retract operation and no emergency stop is initiated with an alarm output from another device.

I.9.4.2 Power Failure Quick Stop Function

(1) Checking the backup operation of the control power supply
Check that the control power supply is maintained by PFB-24 by using the following method.
When the motor is stopped, turn off the main circuit breaker (power failure) and check that the following conditions are met.
- The NC screen remains on for several seconds.
- LED of α*i*PS-B continues to show "00" for several seconds.
- The PFL-LED of PFB-24 lights and stays on for several seconds.

(2) Checking the effectiveness of the Quick Stop Function
With the servo guide, monitor the speed change (SPEED) when the main circuit breaker is turned off (power failure) during rapid traverse to check if the deceleration time is less than the rapid traverse time constant.



Turn off the main circuit breaker (power failure) at a position where there is sufficient space to prevent the axis from colliding with the stroke end even if the power failure Quick Stop Function does not work and the axis is stopped by the dynamic brake.

(3) Checking that the spindle axis stops
Turn off the main circuit breaker (power failure) during constant spindle axis motor rotation and check that the spindle axis decelerates and stops. If the Power Failure Quick Stop Function does not work, the spindle axis coasts.

I.9.4.3 Power Failure Vertical Axis Fall Prevention Function

Check the function by using the following method:

(1) Stop the vertical axis and record its absolute coordinates.
(2) Turn off the main circuit breaker of the machine (power failure).
(3) Restart the machine and check the absolute coordinates of the vertical axis. Check that the vertical axis has not fallen more than the backlash of the machine and braking.

I.10 TRACING AND PROCESSING OF ALARMS

The following describes the method for tracing and processing of alarms issued in the Power Failure Backup Module Model B.

I.10.1 Alarms of α*i*PS-B

If an alarm occurs in PFB-R or PFB-C or improper connection exists, an alarm occurs in α*i*PS-B. The α*i*PS-B alarm code is displayed on the 7-segment LED of α*i*PS-B. Take actions corresponding to the alarm code.
To reset alarms, turn off and on the control power supply (24 V).

[Alarm 26: PFB-R error (SV0041, SP9214 alarm)]
(1) Description
An alarm occurred in PFB-R.
(2) Cause and tracing
See the alarm cause and tracing of PFB-R.

[Alarm 27: PFB-C error (SV0042, SP9215 alarm)]
(1) Description
An alarm occurred in PFB-C.
(2) Cause and tracing
See the alarm cause and tracing of PFB-C.

[Alarm 28: PS submodule error (SV0043, SP9216 alarm)]
(1) Description
Improper connection of the Power Failure Backup Module
(2) Cause and tracing
(a) Check that the number of PFB-Rs connected does not exceed 8.
(b) Check that the number of PFB-Cs connected does not exceed 2.
(c) Check that the number of slave units for inter-amplifier communication does not exceed 15.
(d) Check the connection sequence of PFB-R and PFB-C.
(e) Check that PFB-R or PFB-C of different power supply voltage system from α*i*PS-B is not connected.
(f) Inter-amplifier communication error in PFB-R or PFB-C. Check cable K69.
(g) If two or more PFB-Rs are connected, check cable K138 (CX55).

NOTE
If alarms occur in two or more PFB-Rs or PFB-Cs, the first alarm will be displayed.

I.10.2 TROUBLE DGN. MONITOR

Alarm codes of PFB-R and PFB-C can be checked on the TROUBLE DGN. MONITOR.

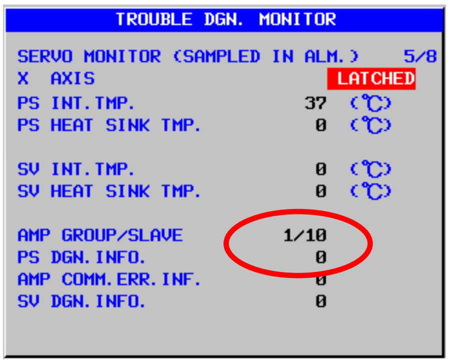
See Section 16.3, "TROUBLE DGN. MONITOR" for basic operation procedure for trouble diagnosis monitor.

[When checking on the servo amplifier monitor screen]
Displayed in the PS diagnosis information on page 5/8 of the servo amplifier monitor screen.

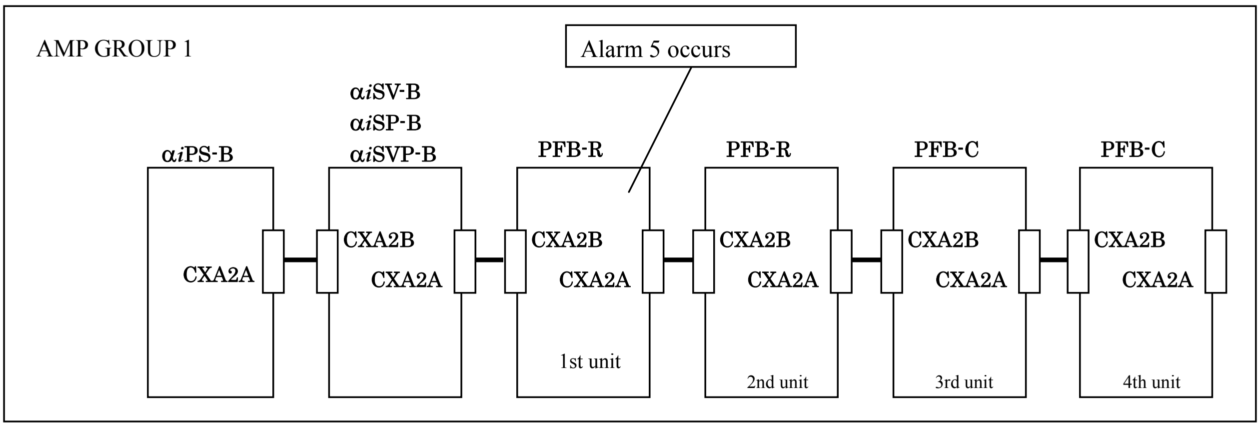
Description of the display:

AMP GROUP/SLAVE W/**
PS DGN. INFO. XYZ

W: αiPS-B AMP GROUP
X: Alarm occurred in Xth PFB-R or PFB-C
YZ: 01 to 09 = alarm code 1 to 9, 10 to 15 = alarm code A to F

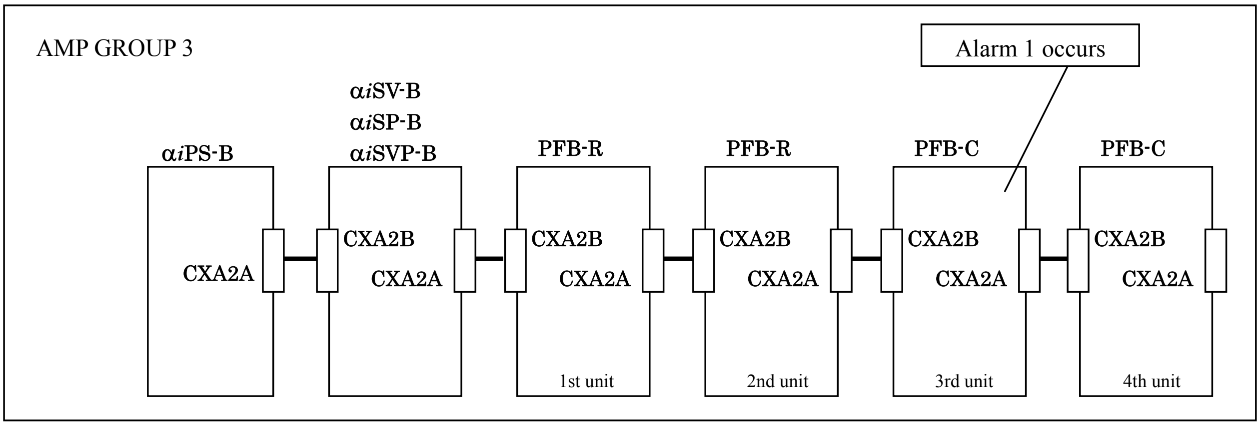


Example 1) If alarm code 5 occurred in the first PFB-R of AMP GROUP 2.
AMP GROUP/SLAVE 2/**
PS DGN. INFO. 105



NOTE
The PFB-R or PFBM-C connected with cable K69 and located closest to αiPS-B is defined as the first slave.

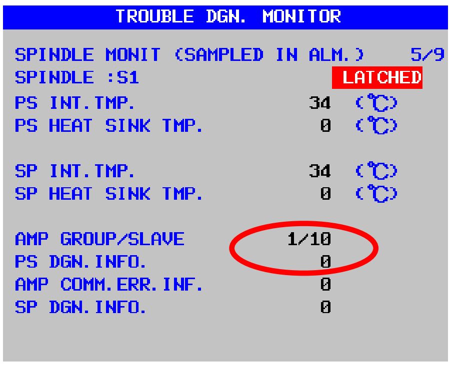
Example 2) If alarm code 1 occurred in the third PFB-C of AMP GROUP 3.
AMP GROUP/SLAVE 3/**
PS DGN. INFO. 301



[When checking on the spindle amplifier monitor screen]
Displayed in the PS diagnosis information on page 5/9 of the spindle amplifier monitor screen.

Description of the display:
AMP GROUP/SLAVE W/**
PS DGN. INFO. XYZ

W :α*i*PS-B AMP GROUP
X: Alarm occurred in Xth PFB-R or PFB-C
YZ: 01 to 09 = alarm code 1 to 9, 10 to 15 = alarm code A to F



NOTE
If alarms occur in two or more PFB-Rs or PFB-Cs, the first alarm will be displayed.

I.10.3 Alarms of PFB-24

If an alarm occurs in PFB-24, output from the control power supply (24 V) is stopped.
Only the overheat alarm occurs in PFB-24. In this case, the OVH LED lights.
If 24 V is not output from PFB-24, check the following.

[Overheat alarm (OVH LED is lit)]
(1) Description
The temperature of power element rose abnormally.
(2) Cause and tracing
(a) Check the supply current and temperature derating of PFB-24.
(b) Replace PFB-24.

[24 V is not output for other reasons]
(1) Description
24 V is not output.
(2) Cause and tracing
(a) Check the voltage of CX48B.
(b) Check the wiring.
(c) Replace PFB-24.

I.10.4 Alarms of PFB-R

When an alarm occurs, the alarm code is displayed on the 1-digit 7-segment LED.
Take actions corresponding to the alarm code.
To reset alarms, turn off and on the control power supply (24 V).

[Alarm 1: Discharge IGBT malfunction alarm]
(1) Description
The discharge IGBT failed.
The discharge resistor disconnected.
(2) Cause and tracing
Replace PFB-R.

[Alarm 2: Discharge IGBT overheat]
(1) Description
The temperature of the discharge IGBT rose abnormally.
(2) Cause and tracing
(a) If the alarm occurred in power failure state
Regenerative energy is too large. Check that the regenerative energy does not exceed the discharge capacity of PFB-R.
Turn off the control power supply and wait until the temperature of discharge IGBT falls.
(b) If the alarm occurred in power supplied state
Check that the power supply regeneration function of α*i*PS-B is working normally.

[Alarm 3: Hardware malfunction]
(1) Description
The hardware circuit malfunctioned.
(2) Cause and tracing
(a) If two or more PFB-Rs are connected, check cable K137's connection and pin assignment.
(b) Check that nothing is connected to connector JX13.
(c) Replace PFB-R.

[Alarm 4: Low DC link voltage]
(1) Description
DC link voltage dropped abnormally.
(2) Cause and tracing
(a) Check that short bar K2A is wired.
(b) Check for short circuit in the DC link parts of other amplifiers.
(c) The voltage detection circuit malfunctioned. Replace PFB-R.

[Alarm 5: Discharge resistor overheat]
(1) Description
The temperature of discharge resistor rose abnormally.
(2) Cause and tracing
(a) If the alarm occurred in power failure state
Regenerative energy is too large. Check that the regenerative energy does not exceed the discharge capacity of PFB-R.
Turn off the control power supply and wait until the temperature of discharge resistor falls.
(b) If the alarm occurred in power supplied state
Check that the power supply regeneration function of α*i*PS-B is working normally.

[Alarm 6: Voltage drop in control power supply]
(1) Description
The control power supply voltage (24 V) dropped.
(2) Cause and tracing
(a) Check the voltage of the control power supply (24 V).
(b) Check cable K64.
(c) Replace PFB-R.

[Alarm 7: Discharge resistor OVC]
(1) Description
Regenerative energy is too large.
(2) Cause and tracing
(a) If the alarm occurred in power failure state
Regenerative energy is too large. Check that the regenerative energy does not exceed the discharge capacity of PFB-R.
Turn off the control power supply and wait until the temperature of discharge resistor falls.
(b) If the alarm occurred in power supplied state
Check that the power supply regeneration function of α*i*PS-B is working normally.

[Alarm 8: Discharge IGBT OVC]
(1) Description
Regenerative energy is too large.
(2) Cause and tracing
(a) If the alarm occurred in power failure state
Regenerative energy is too large. Check that the regenerative energy does not exceed the discharge capacity of PFB-R.
Turn off the control power supply and wait until the temperature of discharge IGBT falls.
(b) If the alarm occurred in power supplied state
Check that the power supply regeneration function of α*i*PS-B is working normally.

[Alarm 9: Thermistor disconnection of discharge resistor]
(1) Description
The temperature detection element of the discharge resistor disconnected.
(2) Cause and tracing
Replace PFB-R.

[Alarm A: Thermistor disconnection of discharge IGBT]
(1) Description
The temperature detection element of the discharge IGBT disconnected.
(2) Cause and tracing
Replace PFB-R.

[Alarm b: Software error]
(1) Description
PFB-R has a software error.
(2) Cause and tracing
Replace PFB-R.

[Alarm C: PS software incompatibility]
(1) Description
α*i*PS-B's software is incompatible with PFB-R.
(2) Cause and tracing
Replace α*i*PS-B with A06B-6202-H***.

[Alarm P: Inter-amplifier communication error]
(1) Description
Inter-amplifier communication error
(2) Cause and tracing
(a) Check cable K69.
(b) Check that cable K69 is not running parallel to the DC link cable, power cable, or motor power cable.
(c) Replace PFB-R.

I.10.5 Alarms of PFB-C

When an alarm occurs, the alarm code is displayed on the 1-digit 7-segment LED.
Take actions corresponding to the alarm code.
To reset alarms, turn off and on the control power supply.

[Alarm 1: Charging current overcurrent alarm]
(1) Description
Excessive charging current flowed.
(2) Cause and tracing
Check for short circuit in the capacitor modules.
(a) Replace PFB-C.
(b) Replace the capacitor module.

[Alarm 2: Low capacitor voltage]
(1) Description
The capacitor module voltage dropped.
(2) Cause and tracing
(a) Check for wiring of short bars K2B and K2C.
(b) Replace PFB-C.
(c) Replace the capacitor module.

[Alarm 3: Hardware malfunction]
(1) Description
The hardware circuit malfunctioned.
(2) Cause and tracing
Replace PFB-C.

[Alarm 4: Low DC link voltage]
(1) Description
DC link voltage dropped abnormally.
(2) Cause and tracing
(a) Check for wiring of short bar K2A.
(b) Check for short circuit in the DC link parts of other amplifiers.
(c) Replace PFB-C.

[Alarm 5: Pre-charge error]
(1) Description
Charging of the capacitor module failed.
(2) Cause and tracing
(a) Check the wiring.
(b) Check that the capacitor modules are connected correctly.
(c) Check that the number of connected capacitor modules is 8 or less.
(d) Check that the input power supply voltage is within the specification range of α*i*PS-B.

[Alarm 6: Voltage drop in control power supply]
(1) Description
The control power supply voltage (24 V) dropped.
(2) Cause and tracing
(a) Check the voltage of the control power supply (24 V).
(b) Check cable K64.
(c) Replace PFB-C.

[Alarm 7: Power circuit overload]
(1) Description
The temperature of charging circuit rose abnormally.
(2) Cause and tracing
(a) Check the wiring.
(b) Check that the capacitor modules are connected correctly.
(c) Check that the number of connected capacitor modules is 8 or less.
(d) Check that the input power supply voltage is within the specification range of α*i*PS-B.

[Alarm 8: Capacitor overvoltage]
(1) Description
The voltage of capacitor module rose abnormally.
(2) Cause and tracing
(a) Check the wiring.
(b) Check that the capacitor modules are connected correctly.
(c) Replace PFB-C.

[Alarm C: PS software incompatibility]
(1) Description
αiPS-B software is incompatible with PFB-C.
(2) Cause and tracing
Replace α*i*PS-B with A06B-6202-H***.

[Alarm P: Inter-amplifier communication error]

(1) Description
Inter-amplifier communication error

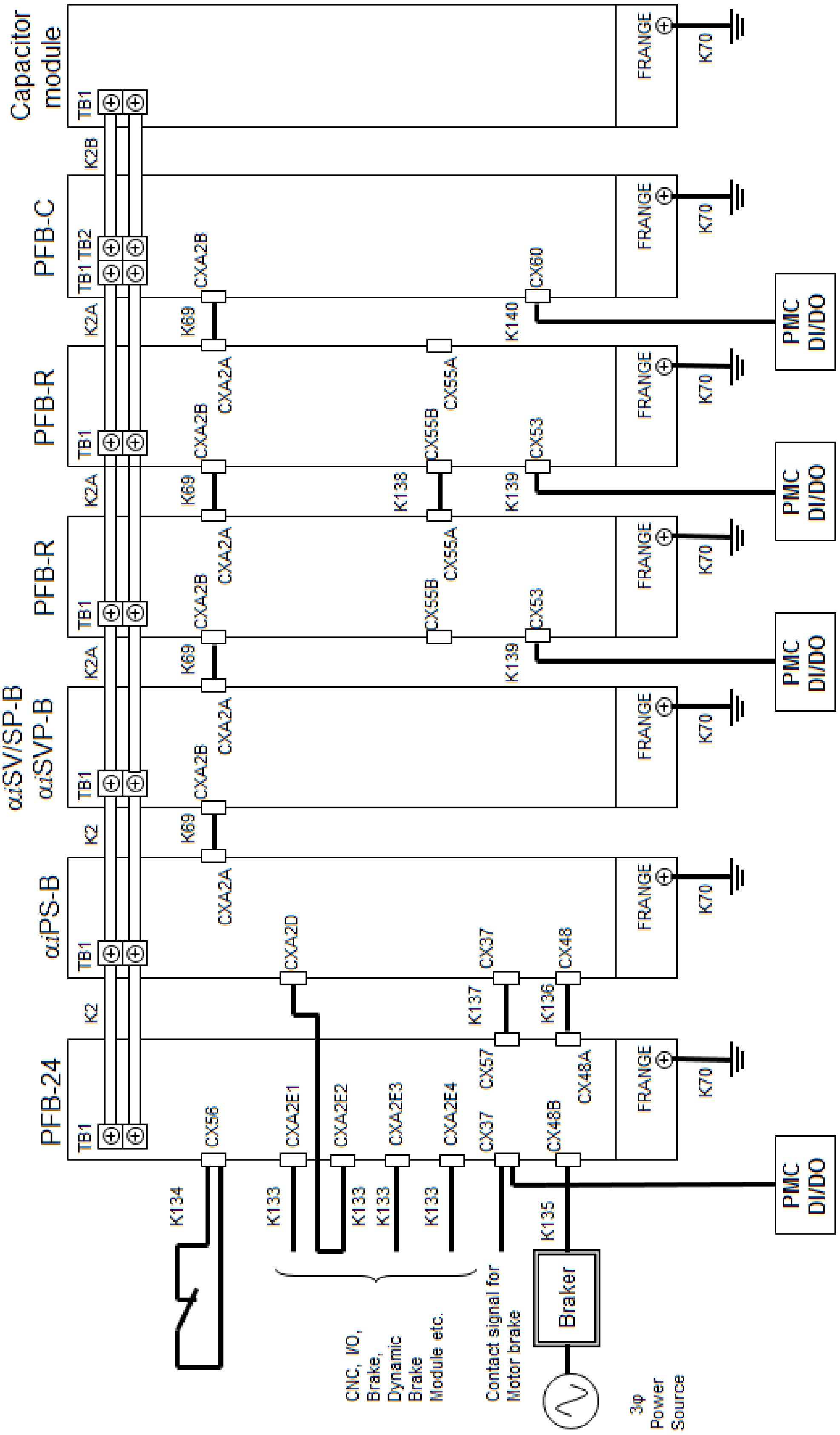
(2) Cause and tracing
- (a) Check cable K69.
- (b) Check that cable K69 is not running parallel to the DC link cable, power cable, or motor power cable.
- (c) Replace PFB-C.

I.11 WHEN FANUC SERIES 0*i*-D IS USED

This chapter describes how to use series 0i-D for the CNC of the α*i*-B amplifier to which PFB-R and PFB-C are connected. If the usage of series 30*i*-B/0*i*-F is different, such items are excerpted. For items not included in this chapter, the usage is same as that of series 30*i*-B/0*i*-F. See Sections I.1 to I.10.
The usage of series 0*i*-D differs from that of series 30*i*-B/0*i*-F in the following points.

Item	When series 30*i*-B/0*i*-F is used	When series 0*i*-D is used
Connection	See Section I.5.	See Subsection I.11.1.
	• Because the power failure detection signal of α*i*PS-B is sent to the CNC via the servo amplifier, it can be checked with the PMC signal.	• Wire the power failure detection signal of α*i*PS-B so that it can be checked with the contact signal of CX37.
	• Because the ready and alarm signals of PFB-R and PFB-C are sent to the CNC via the servo amplifier, they can be checked with the PMC signal.	• Wire the ready and alarm signals of PFB-R and PFB-C so that they can be checked with the contact signals of connectors CX53 and CX60.
Power failure detection specifications	See Section I.6.	See Subsection I.11.2.
	• Activate the power failure machine protection function with the PMC signal for power failure detection.	• Activate the power failure machine protection function with the CX37 contact signal.
	• The power failure detection level can be changed with a parameter. • Parameters for power failure detection specification setting are available.	Parameters in the left column are unavailable.
Control sequence	See Section I.8.	See Subsection I.11.3.
	• Determine whether to start or stop the machine operation with the PFB-R and PFB-C ready PMC signals.	• Check the ready signals of PFB-R and PFB-C with connector CX53 and CX60 contact signals to determine whether to start or stop the machine operation.
Tracing and processing of alarms	See Section I.10.	See Subsection I.11.4.
	• Trouble diagnosis monitor: Yes	• Trouble diagnosis monitor: No • Check for PFB-R and PFB-C alarm codes with connector CX53 and CX60 contact signals.

I.11.1 CONNECTION



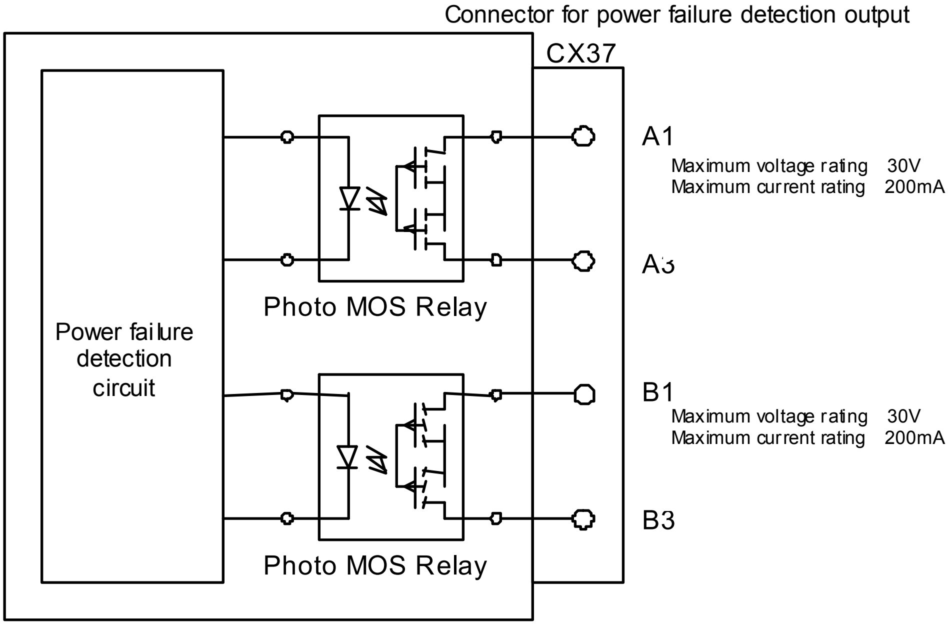
NOTE

1 Wire the power failure detection signal of α*i*PS-B so that it can be checked with the connector CX37 contact signal of α*i*PS-B or PFB-24.
2 Wire the ready and alarm signals of PFB-R and PFB-C so that they can be checked with the connector CX53 and CX60 contact signals.

[Cable K137]

The power failure state detected by α*i*PS-B is output from connector CX37 of α*i*PS-B or PFB-24 as a contact signal.

Contact output:
In power supplied state: CLOSE
In power failure state: OPEN



Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing: 1-1318119-3 Contact: 1318107-1
Conductor size	$0.5mm^2$, AWG20
Insulation sheath outer dimension	1.11-1.87

NOTE

The same contact signal is output from two channels.

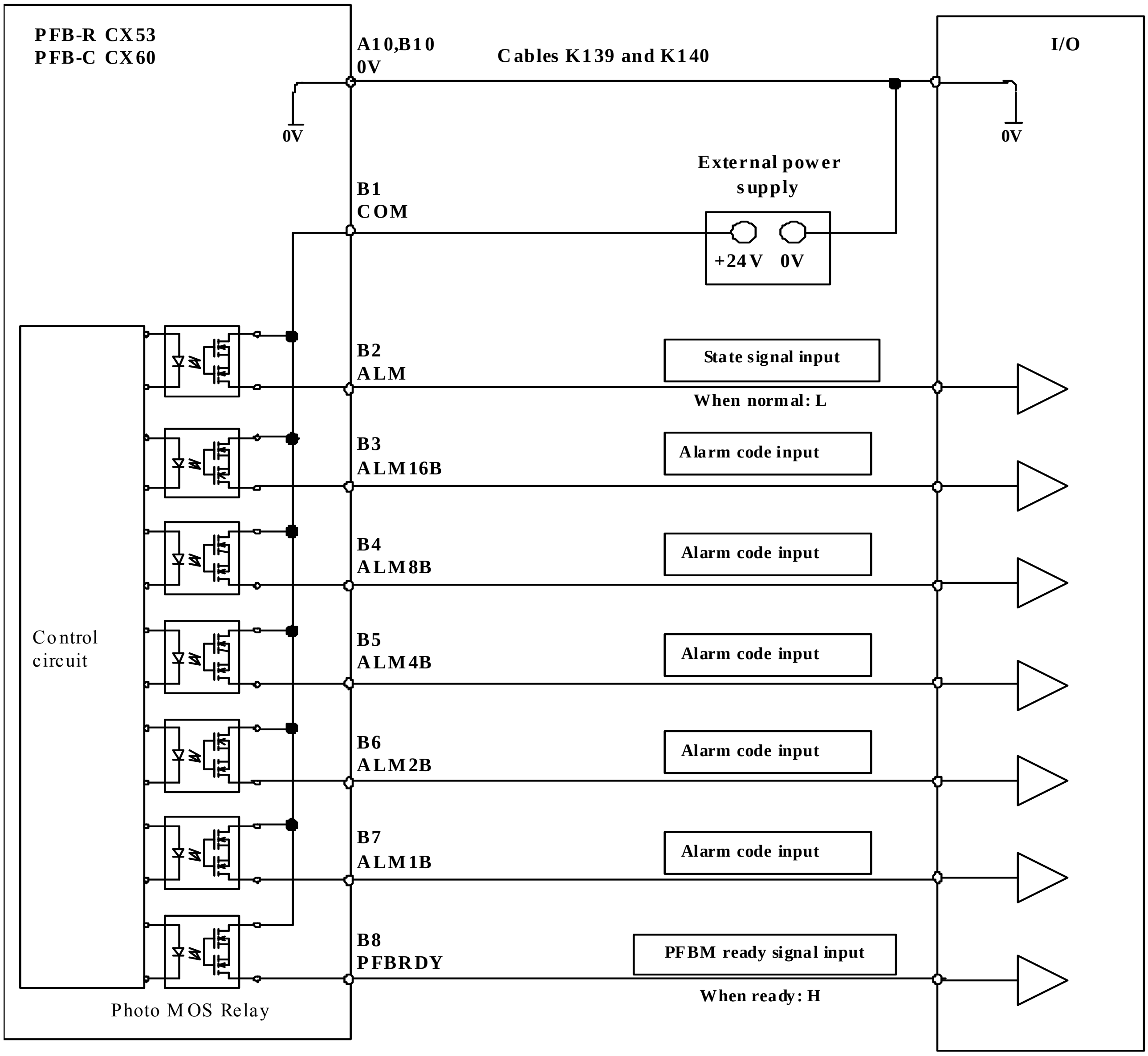
[Cables K138 and K140]

The ready and alarm signals of PFB-R and PFB-C are output from connectors CX53 and CX60 as contact signals.

Contact output:

H: CLOSE

L: OPEN



[Output signal specifications (ST*B, ALM*B, and PFBRDY)]

Maximum current	200mA or less
Maximum voltage	24V + 20% or less
Saturation voltage when ON	1V or less (at load current of 200mA)
Leak current when OFF	20µA or less

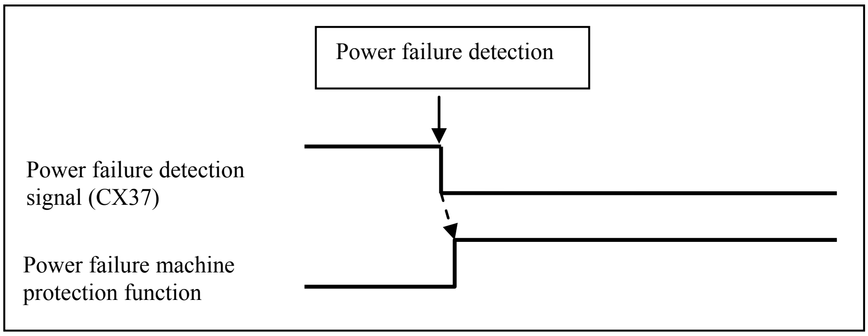
Connector and cable specifications

Manufacturer	Tyco Electronics AMP
Connector specification	D-2100 series Housing: 1-1318118-9 (Note 1) Contact: 1318107-1 Crimping tool: 91595-1
Conductor size	0.5mm^2, AWG20
Insulation sheath outer dimension	1.11-1.87mm

NOTE
1 Do not bind cables K139 and K140 with the power cable.
2 If cable K139 or K140 is long, it is recommended to use insulated FANUC I/O Unit-Model A to prevent signal malfunction due to noise.

I.11.2 Settings for Power Failure Detection and Power Failure Machine Protection

When Series 30*i*-B or 0*i*-F is used, the power failure detection signal of α*i*PS-B is sent to the CNC via the servo amplifier, so it can be checked with the PMC signal. However, the PMC signal cannot be utilized when Series 0*i*-D is used. Activate the desired power failure machine protection function by using the contact signal (power failure detection signal) output from connector CX37 of α*i*PS-B. See Section I.7, "SETTINGS FOR POWER FAILURE MACHINE PROTECTION" for details.



I.11.3 Sequence of Machine Operation

When Series 30*i*-B or 0*i*-F is used, the ready signals of PFB-R and PFB-C are sent to the CNC via the servo amplifier, so they can be checked with the PMC signal. However, the PMC signal cannot be utilized when Series 0*i*-D is used. Determine whether to start or stop the machine operation by using the contact signals (PFBRDY) of PFB-R and PFB-C. The conditions under which the contact signal (PFBRDY) changes from L to H or from H to L are same for the PMC signal using Series 30*i*-B or 0*i*-F.

[Start of machine operation]

Start the machine operation after confirming that the contact signal (PFBRDY) of PFB-R and PFB-C has become H.

When two or more PFB-Rs or PFB-Cs are used, start the machine operation after confirming that the contact signal (PFBRDY) of all PFB-Rs and PFB-Cs has become H.

[At emergency stop and when the magnetic contactor (MCC) is cut off]

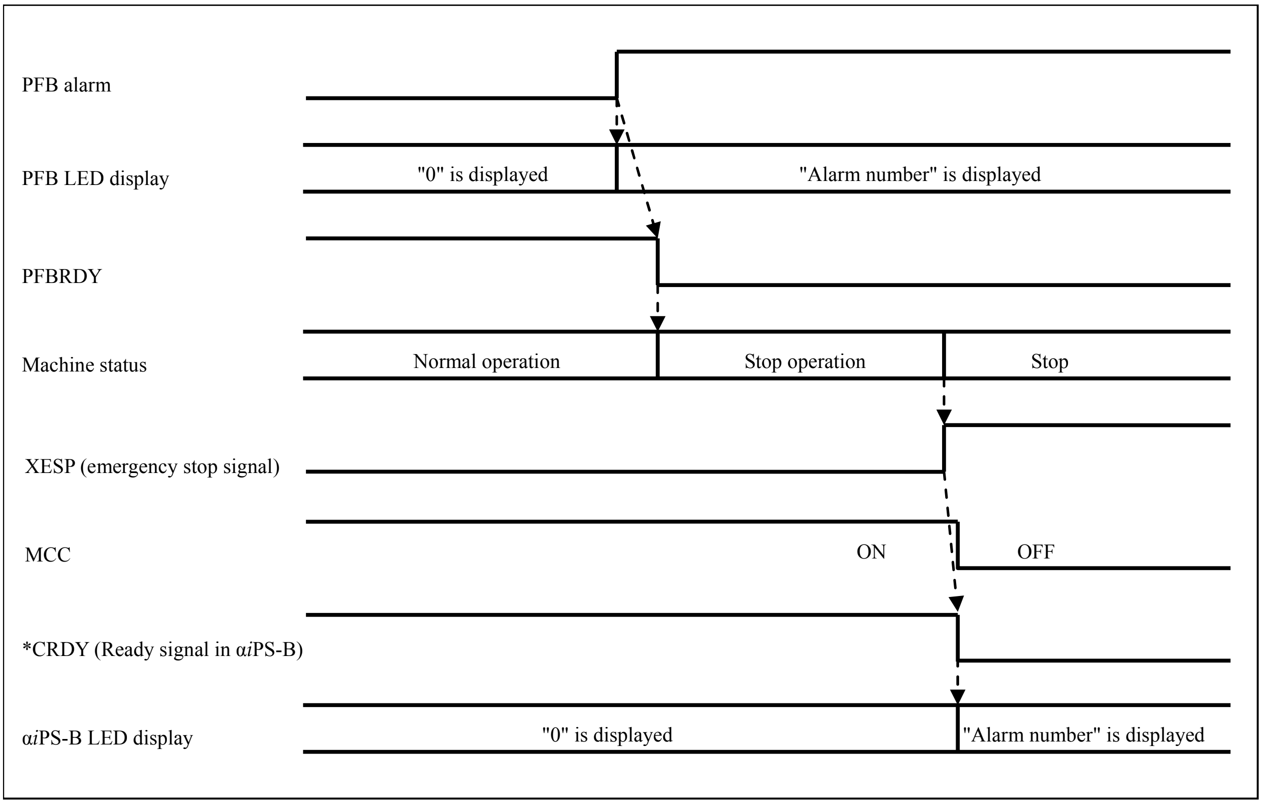
When MCC is cut off, the contact signal (PFBRDY) of PFB-R and PFB-C becomes L. At the same time, the LED display of PFB-R and PFB-C changes from "0" to "-."

[If an alarm occurs in power supplied state]

When an error occurs in PFB-R or PFB-C, the alarm number corresponding to the error is displayed on the LED and the contact signal (PFBRDY) becomes L.

Even if an alarm occurs in PFB-R or PFB-C in power supplied state, the power is not forcibly cut off and the machine continues normal operation. However, if an alarm occurs in the power failure backup module, power failure backup operation will not be performed when a power failure occurs. Therefore, if the contact signal of the power failure backup module (PFBRDY) becomes L in power supplied state, immediately take actions to safely stop the machine. To protect the power failure backup module, immediately after the machine stops, input the emergency stop signal to cut off the magnetic contactor (MCC) of the Power Supply input part.

When the magnetic contactor is cut off, α*i*PS-B issues a power failure backup module error alarm. Check the content of the alarm with the LED of PFB-R and PFB-C or the alarm contact signal of connectors CX53 and CX60. See Section I.10 for details on alarms and their causes.



> **NOTE**
> When two or more PFB-Rs or PFB-Cs are used, perform the above procedure if any of their PFBRDY signal becomes L.

I.11.4 Tracing and Processing of Alarms

When Series 30*i*-B or 0*i*-F is used, the failure diagnosis monitor can be used to check the alarm code of PFB-R and PFB-C. However, when Series 0*i*-D is used, the failure diagnosis monitor cannot be used. If an alarm occurs, check the display of 1-digit 7-segment LED or the alarm contact signal of connectors CX53 and CX60.

[Output of contact signals when an alarm occurs in PFB-R]

When an alarm occurs, the alarm code is displayed on the 1-digit 7-segment LED and a contact signal is output to connector CX53. See Section I.10 for actions corresponding to each alarm code.
To reset alarms, turn off and on the control power supply (24 V).

Alarm code	Description	PFB RDY	ALM	ALM 16B	ALM 8B	ALM 4B	ALM 2B	ALM 1B
1	Discharge IGBT malfunction alarm	L	H	L	L	L	L	H
2	Discharge IGBT overheat alarm	L	H	L	L	L	H	L
3	Hardware malfunction alarm	L	H	L	L	L	H	H
4	Low DC link voltage alarm	L	H	L	L	H	L	L
5	Discharge resistor overheat alarm	L	H	L	L	H	L	H
6	Alarm for voltage drop in control power supply	L	H	L	L	H	H	L
7	Discharge resistor OVC alarm	L	H	L	L	H	H	H
8	Discharge IGBT OVC alarm	L	H	L	H	L	L	L
9	Discharge resistor thermistor disconnection alarm	L	H	L	H	L	L	H
A	Discharge IGBT thermistor disconnection alarm	L	H	L	H	L	H	L
b	Software error alarm	L	H	L	H	L	H	H
C	αiPS-B software incompatibility alarm	L	H	L	H	H	L	L
P	Inter-amplifier communication error alarm	L	H	H	H	H	H	H

[Output of contact signals when an alarm occurs in PFB-C]

When an alarm occurs, the alarm code is displayed on the 1-digit 7-segment LED and a contact signal is output to connector CX60. See Section I.10 for actions corresponding to each alarm code.

To reset alarms, turn off and on the control power supply (24 V).

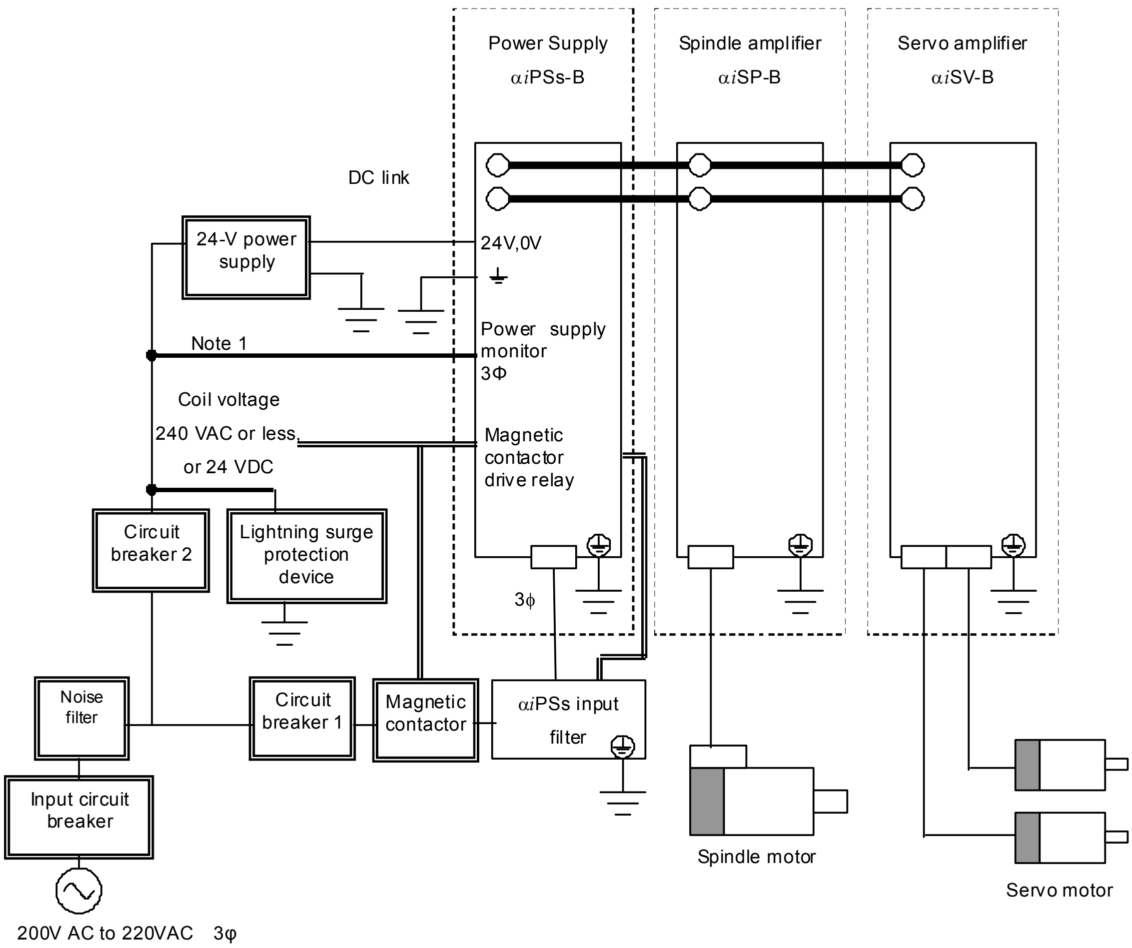
Alarm code	Description	PFB RDY	ALM	ALM 16B	ALM 8B	ALM 4B	ALM 2B	ALM 1B
1	Overcurrent alarm	L	H	L	L	L	L	H
2	Low capacitor voltage alarm	L	H	L	L	L	H	L
3	Hardware malfunction alarm	L	H	L	L	L	H	H
4	Low DC link voltage alarm	L	H	L	L	H	L	L
5	Pre-charge error alarm	L	H	L	L	H	L	H
6	Alarm for voltage drop in control power supply	L	H	L	L	H	H	L
7	Power circuit overload alarm	L	H	L	L	H	H	H
8	Capacitor overvoltage alarm	L	H	L	H	L	L	L
C	αiPS software incompatibility alarm	L	H	L	H	H	L	L
P	Inter-amplifier communication error	L	H	H	H	H	H	H

J PWM CONVERTER αiPSs-B SERIES

Add αiPSs-B, a Power Supply with PWM rectification system, to αi-B amplifier.
The PWM rectification system helps reduce harmonic current of the power supply.

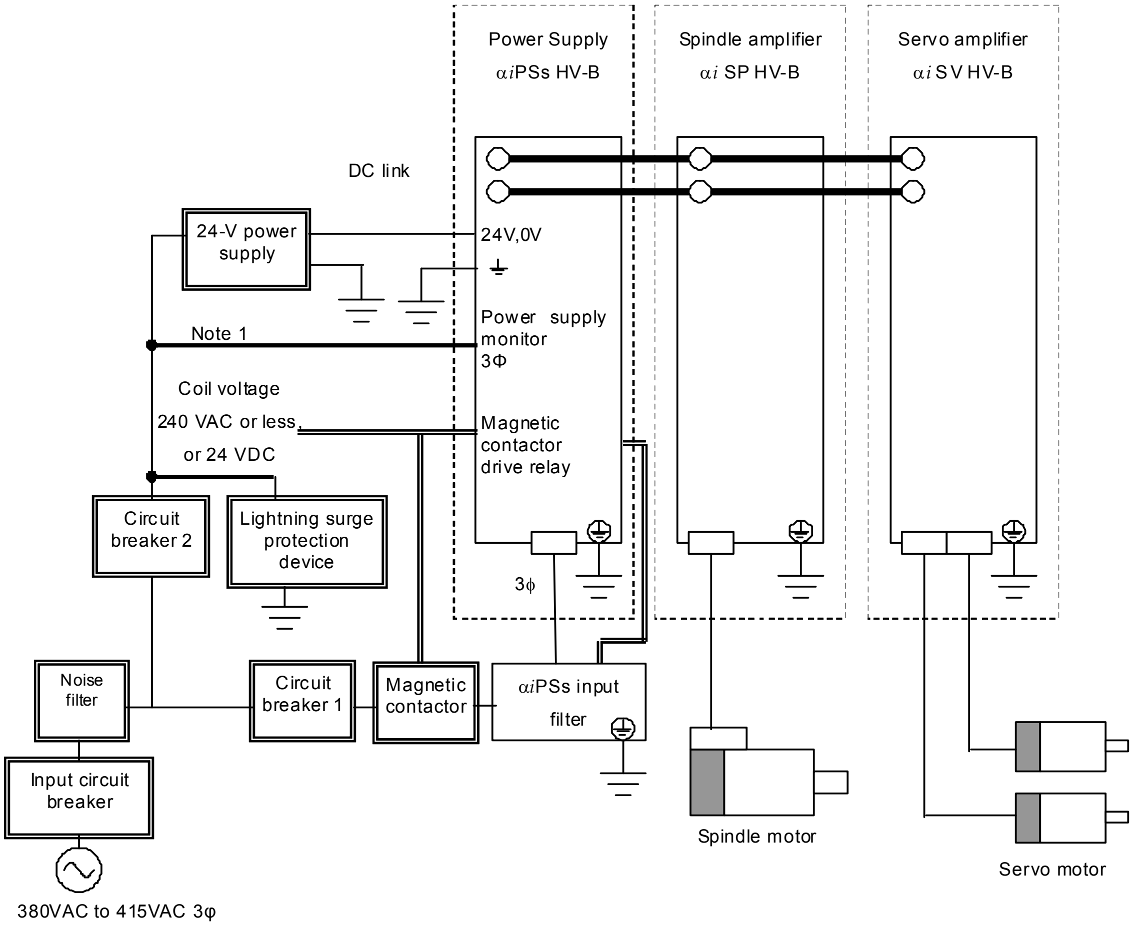
J.1 CONFIGURATION

Basic configuration (200 V input)



> **NOTE**
> 1 Connect the wiring for the power supply monitor after connecting circuit breaker 2 (may be substituted with a fuse) in order to protect the wiring.
> 2 Make sure to install circuit breaker 1, circuit breaker 2, a magnetic contactor, and αiPSs input filter.
> 3 In the power inlet of power magnetics cabinet, install lightning surge protection devices between lines, as well as between each line and the grounding to protect the device from lightning surge voltage. See APPENDIX A for details.

Basic configuration (400 V input)



NOTE

1. Connect the wiring for the power supply monitor after connecting circuit breaker 2 (may be substituted with a fuse) in order to protect the wiring.
2. Make sure to install circuit breaker 1, circuit breaker 2, a magnetic contactor, and αiPSs input filter.
3. In the power inlet of power magnetics cabinet, install lightning surge protection devices between lines, as well as between each line and the grounding to protect the device from lightning surge voltage. See APPENDIX A for details.

J.2 SPECIFICATIONS

J.2.1 Input Power and Grounding Connection

200 V input

No.	Item	Specifications	Remarks
1	Input power supply voltage range	200 VAC to 240 VAC, -15% +10% Allowable voltage range in the PWM rectification mode Maximum input voltage: 242 VAC (220 VAC + 10%) Minimum input voltage: 170 VAC (200 VAC - 15%) Nominal input voltage: 200 VAC to 220 VAC	Including the voltage fluctuation of power supply during normal acceleration and deceleration.
2	Input power supply frequency	47 Hz to 63 Hz	
3	Power supply unbalance	±2% or less	
4	Instantaneous power failure guarantee time	Power supply voltage 0% Time 3 ms	
5	Power supply system	TN-power system (star connection): Directly connectable TN-power system (delta connection): Connectable only to a 200 V system TT-power system, IT-power system: Connectable via an isolating-transformer	
6	Applicable CNC	• FANUC Series 30*i* /31 *i*/32*i* /35*i*-MODEL B • FANUC Series 0*i*-MODEL F • FANUC Power Motion *i*-MODEL A	

NOTE

1 Ground 1 phase or the neutral point of the 3-phrase power supply.

2 It is recommended not to install any power factor condenser as it may impair regeneration of power supply.

3 A noise filter needs to be installed to the input of Power Supply in order to comply with the EMC Directive in force in the EU.

4 [In case the nominal voltage of power supply is below 200 VAC]
Use a transformer or the like to bring the voltage of the power supply within the above-mentioned range for input power supply voltage. Please contact FANUC if it is difficult to install any transformer.

5 [In case the nominal voltage of power supply is above 220 VAC]
Use a transformer or the like to bring the voltage of the power supply within the above-mentioned range for input power supply voltage. Please contact FANUC if it is difficult to install any transformer.
Make sure to verify the conformity with the safety standards before use.

400 V input

No.	Item	Specifications	Remarks
1	input power supply voltage range	380 VAC to 480 VAC, -10%, +10% Allowable voltage range in the PWM rectification mode Maximum input voltage: 440 VAC (400 VAC + 10%, 415 VAC + 6%) Minimum input voltage: 340 VAC (380 VAC - 10%) Nominal input voltage: 380 VAC to 415 VAC	Including the voltage fluctuation of power supply during normal acceleration and deceleration.
2	Input power supply frequency	47 Hz to 63 Hz	
3	Power supply unbalance	±2% or less	
4	Instantaneous power failure guarantee time	Power supply voltage 0% Time 3 ms	
5	Power supply system	TN-power system (star connection): Directly connectable TN-power system (delta connection) TT-power system, IT-power system: Connectable via an isolating-transformer	
6	Applicable CNC	• FANUC Series 30*i* /31 *i*/32*i* /35*i*-MODEL B • FANUC Series 0*i*-MODEL F • FANUC Power Motion *i*-MODEL A	

NOTE

1 Ground the neutral point of the 3-phrase power supply.
2 It is recommended not to install any power factor condenser as it may impair regeneration of power supply.
3 A noise filter needs to be installed to the input of Power Supply in order to comply with the EMC Directive in force in the EU.
4 Servo amplifiers from αi series with input of 400V is designed in accordance with the safety standard EN61800-5. The pattern of the printed circuit board and isolation of the components are designed by assuming the voltage between the phase voltage and the ground connected to the neutral point of the star connection is 300 VACrms or less.
For this reason, insulation failure may be experienced with the pattern of the printed circuit board or other components when the power supply specifications do not satisfy the above conditions. As a result, servo amplifier may not function properly or high voltage may appear on exposed parts, both of which may lead to dangerous situation.
5 [In case the nominal voltage of power supply is below 380 VAC]
Use a transformer or the like to bring the voltage of the power supply within the above-mentioned range for input power supply voltage. Please contact FANUC if it is difficult to install any transformer.
6 [In case the nominal voltage of power supply is above 415 VAC]
Use a transformer or the like to bring the voltage of the power supply within the above-mentioned range for input power supply voltage. Please contact FANUC if it is difficult to install any transformer.
Make sure to verify the conformity with the safety standards before use.

Specific example of the connection of power supply with the main circuit

No.	Power supply system	Power supply specification	Power supply of servo amplifier
1	TN-power system	• Star connection • Neutral grounding on the power supply side • PE is on the power supply line • Power supply voltage specifications 380 VAC to 480 VAC (-10%, +10%) (Note 2)	• Direct connection can be made with power supply (transformer is not necessary)
2	TN-power system	• Star connection • Neutral grounding on the power supply side • PE is on the power supply line • Power supply voltage specifications When not in the range of 380 VAC to 480 VAC (-10%, +10%)¥ (Note 3)	[In case the power supply voltage is lower than the specifications] Boost the voltage of the power supply with an auto-transformer [In case the power supply voltage is higher than the specifications] Step down the voltage of the power supply with an auto-transformer Make sure to verify the conformity with the safety standards before use.
3	TN-power system	• Delta connection • 1-phase grounding on the power supply side • PE is on the power supply line	• Use an isolating-transformer • Make a star connection on the secondary side of the isolating-transformer and ground the neutral point
4	TT-power system	• Star connection • Neutral grounding on the power supply side • No PE on the power supply line	
5	TT-power system	• Delta connection • 1-phase grounding on the power supply side • No PE on the power supply line	
6	IT-power system	• Star connection • Direct grounding is not made on the power supply side • No PE on the power supply line	
7	IT-power system	• Delta connection • Direct grounding is not made on the power supply side • No PE on the power supply line	• Use an isolating-transformer • Make a star connection on the secondary side of the isolating-transformer and ground the neutral point

NOTE

1 TN-power system, TT-power system, and IT-power system must follow the standard IEC60364 for the distribution system of AC power supply.

2 When the PWM rectification mode is used, the power supply voltage specifications will be
"380 VAC to 400 VAC (-10%, +10%) or 380 VAC to 415 VAC (-10%, +6%)."

3 When the PWM rectification mode is used, the power supply voltage specifications will be
"not in the range of 380 VAC to 400 VAC (-10%, +10%) or 380 VAC to 415 VAC (-10%, +6%)."

J.2.2 Specifications

200 V input

Model	α*i*PSs 15-B	α*i*PSs 37-B
Continuous rated output	15kW	37kW
30-minute rated output	18.5kW	45kW
Peak maximum output	54kW	118kW
Power supply capacity	22kVA	54kVA
Width	90mm	150mm
Outline drawings, panel cut-out (See Chapter 8 EXTERNAL DIMENSIONS AND MAINTENANCE AREA.)	Outline drawing 3, panel cut-out 3	Outline drawing 4, panel cut-out 4
Weight	5.5kg	9.0kg

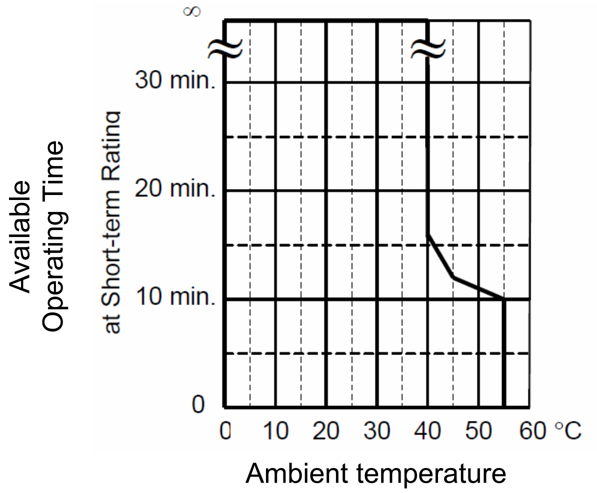
Model	α*i*PSs input filter (For α*i*PSs 15-B)	α*i*PSs input filter (For α*i*PSs 37-B)
Width	180mm	250mm
Weight	20kg	35kg

400 V input

Model	α*i*PSs 18HV-B	α*i*PSs 45HV-B	α*i*PSs 75HV-B	α*i*PSs 100HV-B
Continuous rated output	18kW	45kW	75kW	100kW
30-minute rated output	22kW	55kW	100kW	120kW
Peak maximum output	65kW	144kW	193kW	220kW
Power supply capacity	26kVA	65kVA	108kVA	144kVA
Width	90mm	150mm	300mm	300mm
Outline drawings, panel cut-out See Chapter 8 EXTERNAL DIMENSIONS AND MAINTENANCE AREA)	Outline drawing 3, panel cut-out 3	Outline drawing 4, panel cut-out 4	Outline drawing 5, panel cut-out 5	Outline drawing 5, panel cut-out 5
Weight	5.5kg	9.0kg	18.0kg	18.0kg

Model	α*i*PSs input filter (For α*i*PSs 18HV-B)	α*i*PSs input filter (For α*i*PSs 45HV-B)	α*i*PSs input filter (For α*i*PSs 75HV-B)	α*i*PSs input filter (For α*i*PSs 100HV-B)
Width	180mm	250mm	250mm	250mm
Weight	20kg	35kg	47kg	50kg

Derating
Consider the following derating in accordance with the ambient temperature.



J.3 ORDERING NUMBER

J.3.1 200 V Input Series

- Power Supply

Classification	Ordering number	Name	Remarks
Standard	A06B-6212-H015	α*i*PSs 15-B	
	A06B-6212-H037	α*i*PSs 37-B	

- α*i*PSs input filter

Category	Ordering number	Name	Remarks
Standard	A06B-6212-H215	α*i*PSs input filter	For α*i*PSs 15-B
	A06B-6212-H237	α*i*PSs input filter	For α*i*PSs 37-B

J.3.2 400 V Input Series

- Power Supply

Category	Ordering number	Name	Remarks
Standard	A06B-6262-H018	αiPSs 18HV-B	
	A06B-6262-H045	α*i*PSs 45HV-B	
	A06B-6262-H075	α*i*PSs 75HV-B	
	A06B-6262-H100	α*i*PSs 100HV-B	

- α*i*PSs input filter

Category	Ordering number	Name	Remarks
Standard	A06B-6262-H218	α*i*PSs input filter	For α*i*PSs 18HV-B
	A06B-6262-H245	α*i*PSs input filter	For α*i*PSs 45HV-B
	A06B-6262-H275	α*i*PSs input filter	For α*i*PSs 75HV-B
	A06B-6262-H300	α*i*PSs input filter	For α*i*PSs 100HV-B

J.3.3 Others

Connectors

For α***i***PS-B and α*i*PSs-B

Category	Ordering number	Description	Use	Connection tool
Standard	A06B-6200-K200	Housing: 4 pcs. Contact: 12 pcs.	K6, K7, K73, K124	Contact crimping tool A06B-6110-K220#D3L A06B-6110-K220#D2M
	A06B-6200-K201	Housing: 2 pcs. Contact: 16 pcs.	K127	Contact crimping tool A06B-6110-K220#D2M

Connector configuration

Configuration of A06B-6200-K200

Connector name	Manufacturer	Part number	Quantity	Use
CX48	Tyco Electronics AMP	3-178128-3 (housing)	1	For power supply voltage monitor Main power supply input
		1-175218-2 (contact)	3	
CX4	Tyco Electronics AMP	1-178128-3 (housing)	1	For emergency stop signal
		1-175218-2 (contact)	3	
CX3	Tyco Electronics AMP	2-178128-3 (housing)	1	For on-off control of external MCC
		1-175218-2 (contact)	2	
CXA2D	Tyco Electronics AMP	1-1318119-4 (housing)	1	Input of 24 VDC for control
		1318107-1 (contact)	4	

Configuration of A06B-6200-K201

Connector name	Manufacturer	Part number	Quantity	Use
CX62	Tyco Electronics AMP	2-1318119-4 (housing)	2	For α*i*PSs input filter
		1318107-1 (contact)	16	

Circuit breakers and magnetic contactors

α*i*PSs-B

Model	Circuit breaker 1	Circuit breaker 2	Magnetic contactor	Remarks
α*i*PSs 15-B	70A to 100A	15A or less (Note 3)	70A	
α*i*PSs 37-B	175A to 225A		175A	
α*i*PSs 18HV-B	45A		45A	
α*i*PSs 45HV-B	125A		125A	
α*i*PSs 75HV-B	200A		200A	
α*i*PSs 100HV-B	250A		250A	

NOTE

1. See Chapter J.1, "CONFIGURATION" for circuit breakers and magnetic contactors.
2. Select the rated voltage of circuit breaker 1 according to the voltage of the power supply.
3. The current should be 5 A or less when circuit breaker 2 is also used to protect from short-circuit of lightning surge protection device.
4. Use the operating coil of the magnetic contactor within the range of rated current and voltage for the internal contact [CX3 (MCC)] of αiPSs-B .See Subsection 9.3.1.5, "Details of cable K6" for details. If any circuit breaker trips, the contact point of magnetic contactor may have been welded. Make sure that no contact point is welded before turning ON the circuit breaker again.

Ordering drawing numbers of circuit breakers

Category	Applicable model	Ordering number	Outline drawing	Rated current of circuit breaker
Option	αiPSs 15-B	A06B-6077-K104	(Note 1)	75A
	αiPSs 37-B	A06B-6077-K110		175A
	αiPSs 18HV-B	A06B-6077-K102		50A
	αiPSs 45HV-B	A06B-6077-K108		125A
	αiPSs 75HV-B	A06B-6077-K109		200A
	αiPSs 100HV-B	A06B-6077-K111		250A
	For surge absorber	A06B-6077-K106		5A
	For voltage monitor	A06B-6077-K106		5A

Ordering drawing numbers of magnetic contactors

Category	Applicable model	Ordering number	Outline drawing
Option	αiPSs 15-B	A06B-6077-K124	(Note 2)
	αiPSs 37-B αiPSs 75HV-B	A06B-6077-K128	
	αiPSs 100HV-B	A06B-6077-K127	
	αiPSs 18HV-B	A06B-6077-K122	
	αiPSs 45HV-B	A06B-6077-K125	

NOTE

1. See Subsection 8.1.4, "Circuit Breaker" and Subsection 8.1.5, "Magnetic Contactors" for outline drawings of circuit breakers and magnetic contactors.
2. The coil voltage of magnetic contactors is designed for 200 VAC.

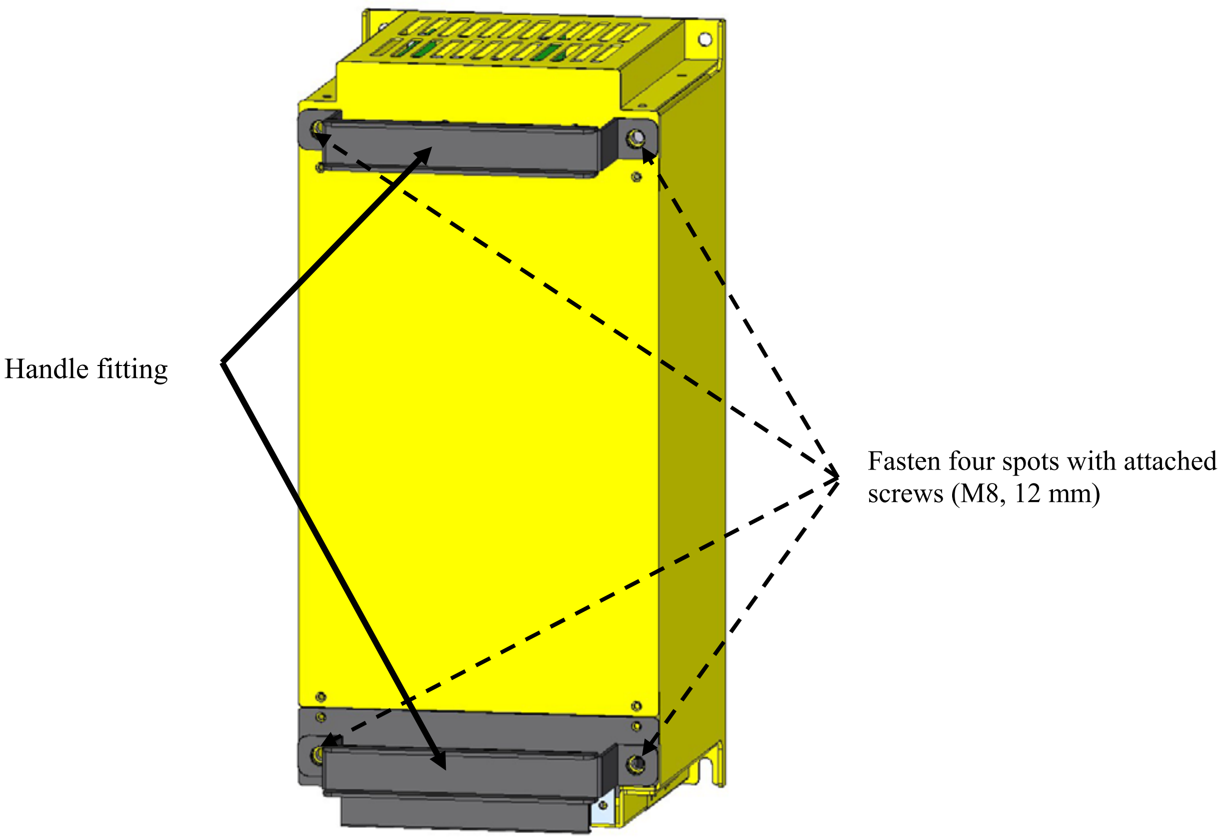
Options for αiPSs input filters

Ordering drawing numbers of options for αiPSs input filters

Category	Applicable model	Ordering number	Description	Remarks
Option	αiPSs input filters (for αi PSs 15-B and αi PSs 18HV-B)	A06B-6200-K506	Handle fitting: 2 pieces Screw (M8 x 12): 4 pieces	(Note)
	αiPSs input filters (for αi PSs 37-B, αi PSs 45HV-B, αi PSs 75HV-B, and αi PSs 100HV-B)	A06B-6200-K507	Handle fitting: 2 pieces Screw (M8 x 12): 4 pieces	

> **NOTE**
> The handle used to attach or transport the αiPSs input filter.

Example of use



J.4 SELECTION METHOD

J.4.1 Selecting αiPSs-B

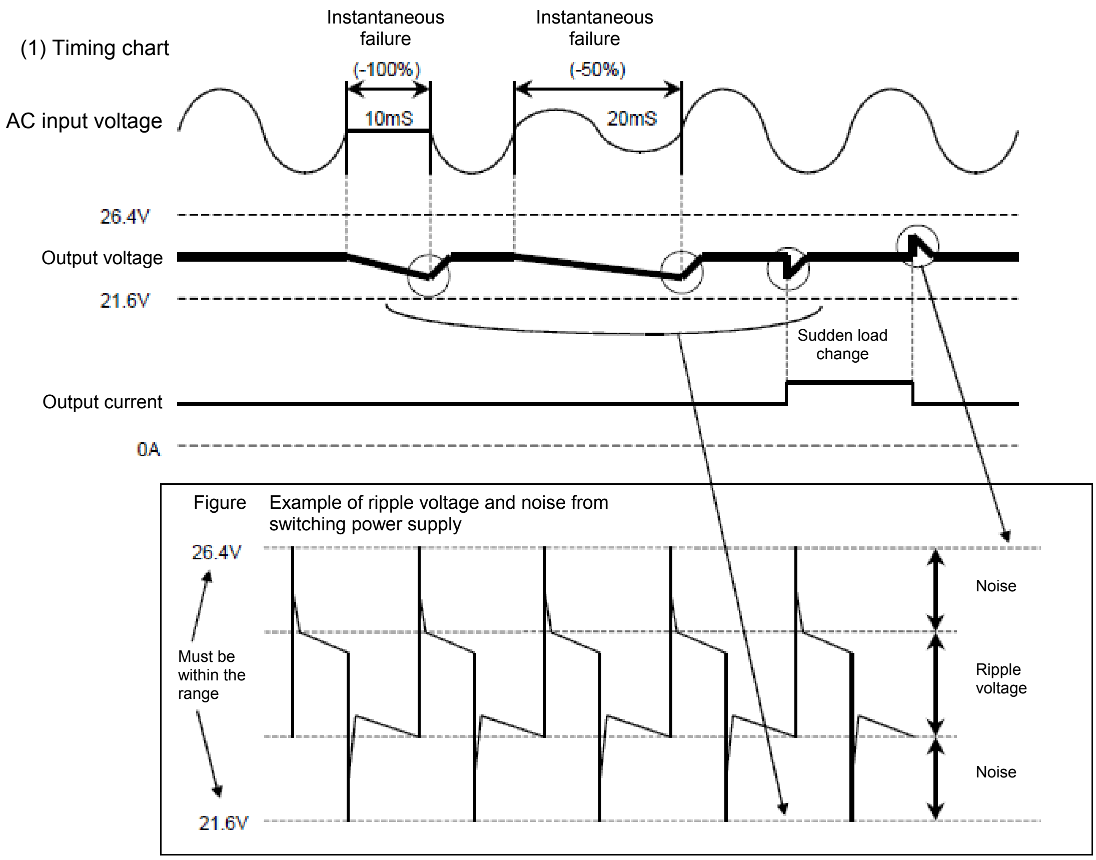
See Sections 4.4 and 4.5 for selection of the αiPSs-B amplifier.

J.4.2 Selecting a Control Power Supply

Requirement specifications for 24 VDC power supply

No.	Item	Specifications	Remarks
1	Power supply voltage	+24V±10%	Including ripple voltage and noise
2	Input current	Depends on amplifiers. See Table J.4.1(a).	
3	24-V retention time at instantaneous AC input interruption	10 ms (For -100%) 20 ms (For -50%)	
4	Startup time	Within 500 ms after CNC power is turned on	If the power is turned off within 500 ms before the power to the CNC is turned off, alarm information may be recorded in the CNC.

(1) Timing chart



> **NOTE**
> The maximum number of SV and SP models that can be connected to one Power Supply is 15.

Table J.4.1(a) Current supplied from each 24 VDC power supply to each amplifier (for selecting a 24-V power supply)

Type	Model	Current supplied from 24-V power supply	Remarks
Power Supply	αiPSs 15-B	1.0A	Including consumption current (0.5 A) of αiPSs input filter
	αiPSs 37-B	1.5A	
	αiPSs 18HV-B	1.0A	
	αiPSs 45HV-B	1.5A	
	αiPSs 75HV-B	2.2A	
	αiPSs 100HV-B	2.2A	

See Section 4.12 for other αi-B amplifiers.

Table J.4.1(b) Power supply units

Ordering number	Remarks
A06B-6200-K502	Specify this model when the total of currents supplied from 24-V power supply is 4.6 A or less.
A06B-6200-K503	Specify this model when the total of currents supplied from 24-V power supply is 11.2 A or less.

J.5 HEAT DISSIPATION

The amount of heat dissipation from α*i*PSs-B depends on the model of α*i*PSs-B and motor output (continuous rated output capacity).

J.5.1 200 V Input Series

(1) Total amount of heat dissipation
The total amount of heat dissipation by the α*i*PSs-B is calculated according to the following expression:
Total amount of heat dissipation = a + Ka × b
a: Amount of heat dissipation determined by the α*i*PSs-B model [W]
Ka: Coefficient determined by α*i*PSs-B [W/kW]
b: Continuous rated output capacity obtained for selecting α*i*PSs-B [kW]

Name	a [w]	Ka [W/kW]
α*i*PSs 15-B	16	22
α*i*PSs 37-B	21	25

(2) Residual amount of heat in the cabinet
By placing the heat sink section of the α*i*PSs-B outside the cabinet, the residual amount of heat in the cabinet can be calculated according to the expression below.
Total amount of heat dissipation = a + Kb × b
a: Amount of heat dissipation determined by the α*i*PSs-B model [W]
Kb: Coefficient determined by α*i*PSs-B [W/kW]
b: Continuous rated output capacity obtained for selecting α*i*PSs-B [kW]

Name	a [w]	Kb [W/kW]
α*i*PSs 15-B	16	2.0
α*i*PSs 37-B	21	1.3

(3) Total amount of heat dissipation and residual amount of heat in the cabinet at rated output (calculation results of (1) and (2))

Name	Rated output	Total amount of heat dissipation	Residual amount of heat in the cabinet
α*i*PSs 15-B	15kW	340W	49W
α*i*PSs 37-B	37kW	961W	69W

(4) Total amount of heat dissipation by the α*i*PSs input filter

Applicable model	Ordering number	Total amount of heat dissipation
α*i*PSs 15-B	A06B-6212-H215	340W
α*i*PSs 37-B	A06B-6212-H237	670W

J.5.2 400 V Input Series

(1) Total amount of heat dissipation

The total amount of heat dissipation by the α*i*PSs HV-B is calculated according to the following expression:

Total amount of heat dissipation = a + Ka × b

a: Amount of heat dissipation determined by the α*i*PSs HV-B model [W]

Ka: Coefficient determined by α*i*PSs HV-B [W/kW]

b: Continuous rated output capacity obtained for selecting α*i*PSs HV-B [kW]

Name	a [w]	Ka [W/kW]
α*i*PSs 18HV-B	18	24
α*i*PSs 45HV-B	22	22
α*i*PSs 75HV-B	37	23
α*i*PSs 100HV-B	37	17

(2) Residual heat in the cabinet

Residual heat in the cabinet is calculated by bringing the heat sink of α*i*PSs HV-B out of the cabinet.

Total amount of heat dissipation = a + Kb × b

a: Amount of heat dissipation determined by the α*i*PSs HV-B model [W]

Kb: Coefficient determined by α*i*PSs HV-B [W/kW]

b: Continuous rated output capacity obtained for selecting α*i*PSs HV-B [kW]

Name	a [w]	Kb [W/kW]
α*i*PSs 18HV-B	18	2.5
α*i*PSs 45HV-B	22	1.1
α*i*PSs 75HV-B	37	1.2
α*i*PSs 100HV-B	37	0.9

(3) Total amount of heat dissipation and residual amount of heat in the cabinet at rated output (calculation results of (1) and (2))

Name	Rated output	Total amount of heat dissipation	Residual amount of heat in the cabinet
α*i*PSs 18HV-B	18kW	454W	63W
α*i*PSs 45HV-B	45kW	992W	72W
α*i*PSs 75HV-B	75kW	1762W	127W
α*i*PSs 100HV-B	100kW	1728W	127W

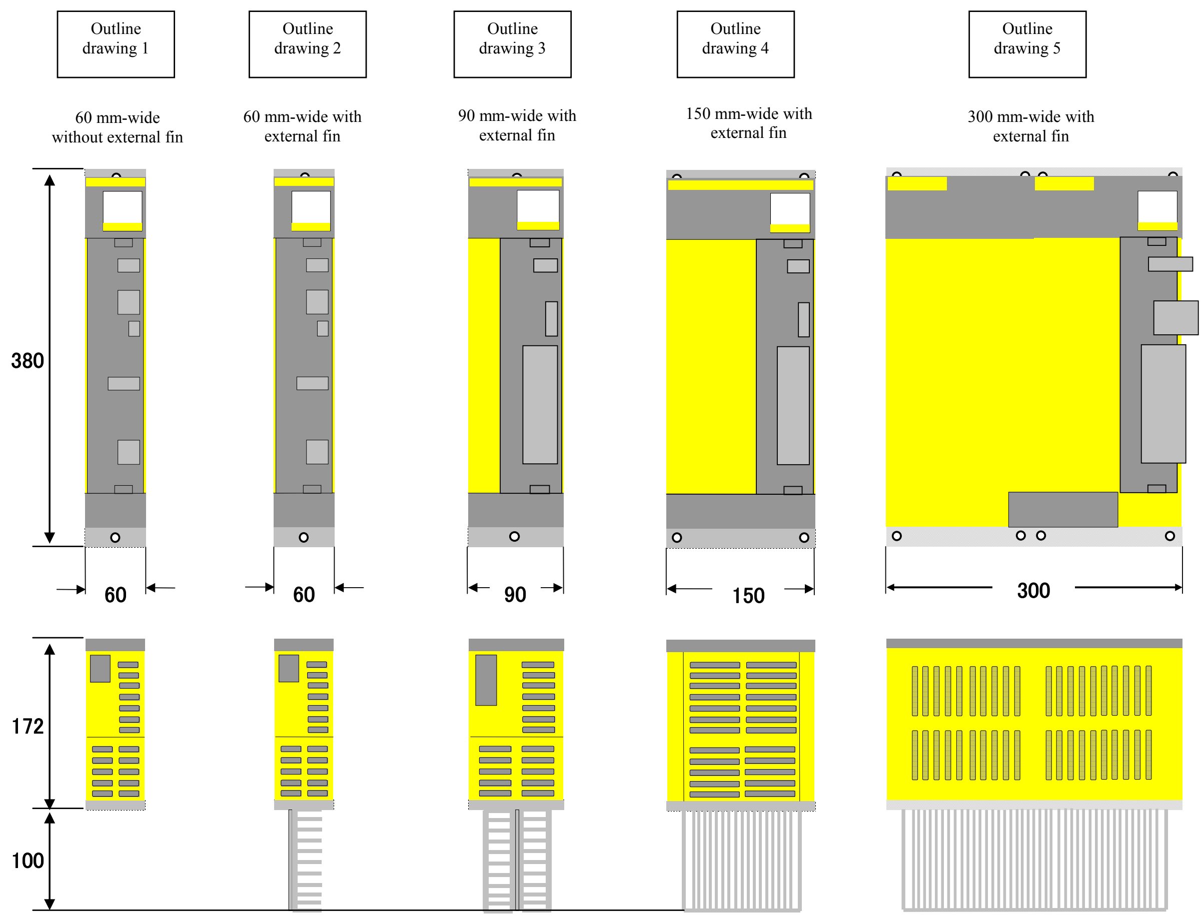
(4) Total amount of heat dissipation by the α*i*PSs input filter

Applicable model	Ordering number	Total amount of heat dissipation
α*i*PSs 18HV-B	A06B-6262-H218	300W
α*i*PSs 45HV-B	A06B-6262-H245	580W
α*i*PSs 75HV-B	A06B-6262-H275	750W
α*i*PSs 100HV-B	A06B-6262-H300	880W

J.6 EXTERNAL DIMENSIONS AND MAINTENANCE AREA

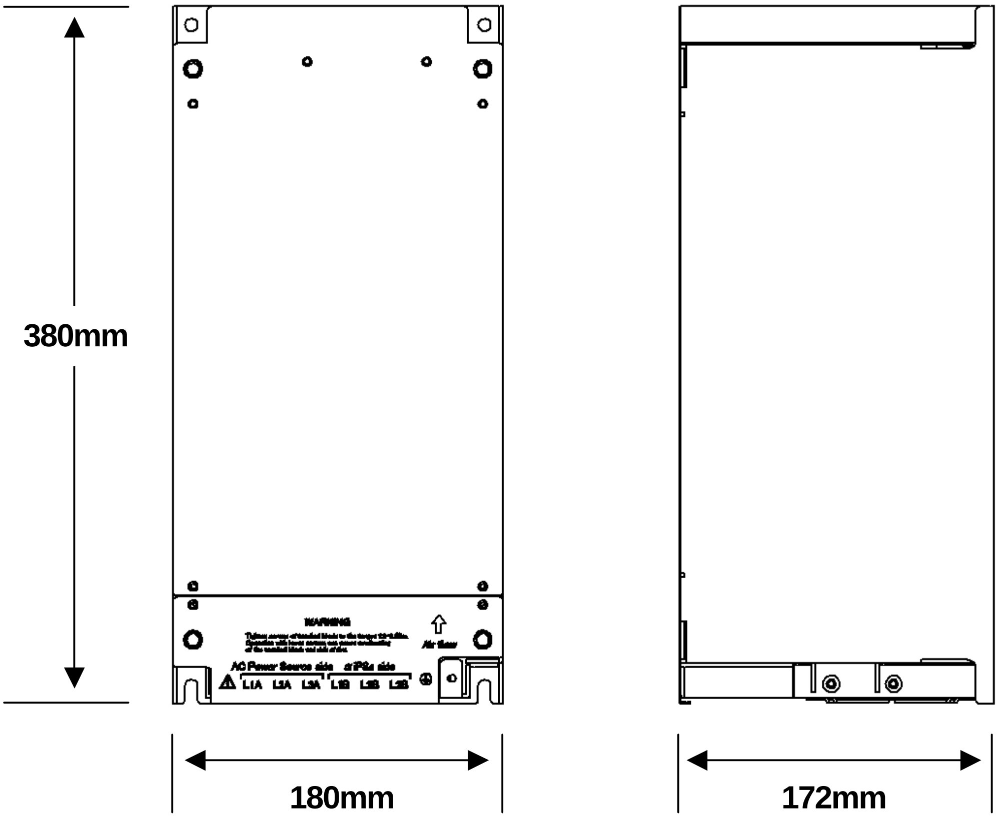
J.6.1 Outline Drawing of α*i*PSs-B

Type	Model	Outline drawing
Power Supply	α*i*PSs 15-B	Outline drawing 3
	α*i*PSs 37-B	Outline drawing 4
	α*i*PSs 18HV-B	Outline drawing 3
	α*i*PSs 45HV-B	Outline drawing 4
	α*i*PSs 75HV-B	Outline drawing 5
	α*i*PSs 100HV-B	

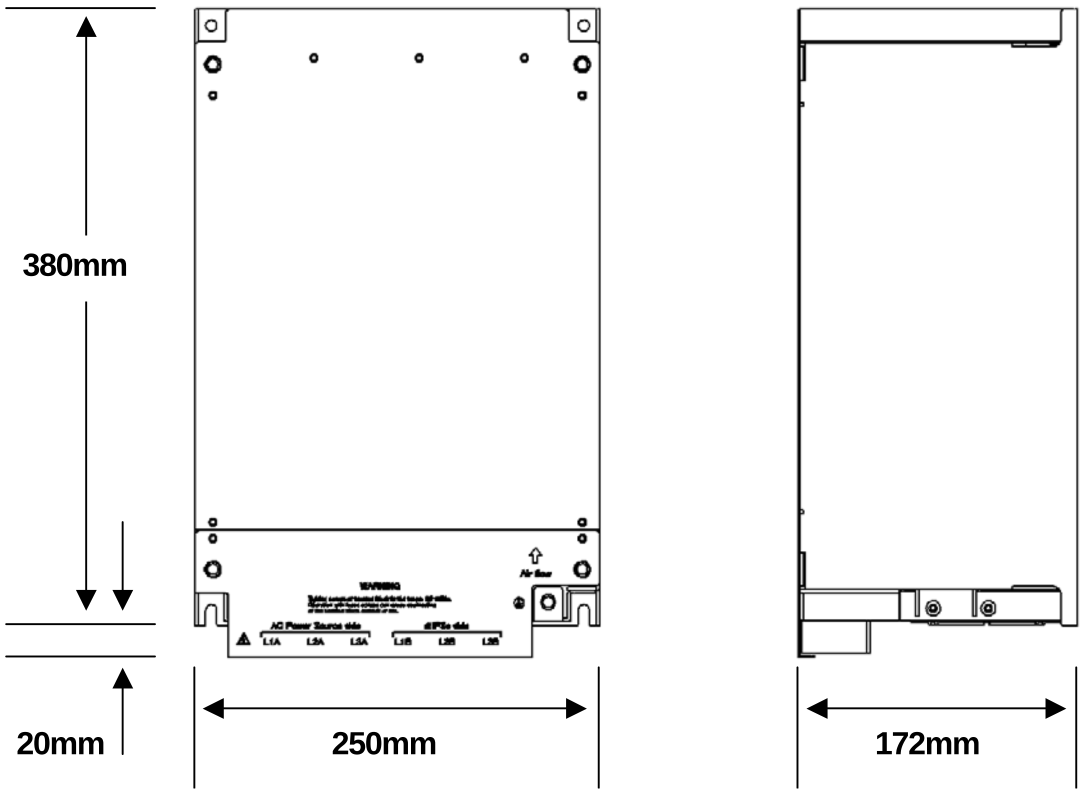


J.6.2 Outline Drawing of αiPSs Input Filter

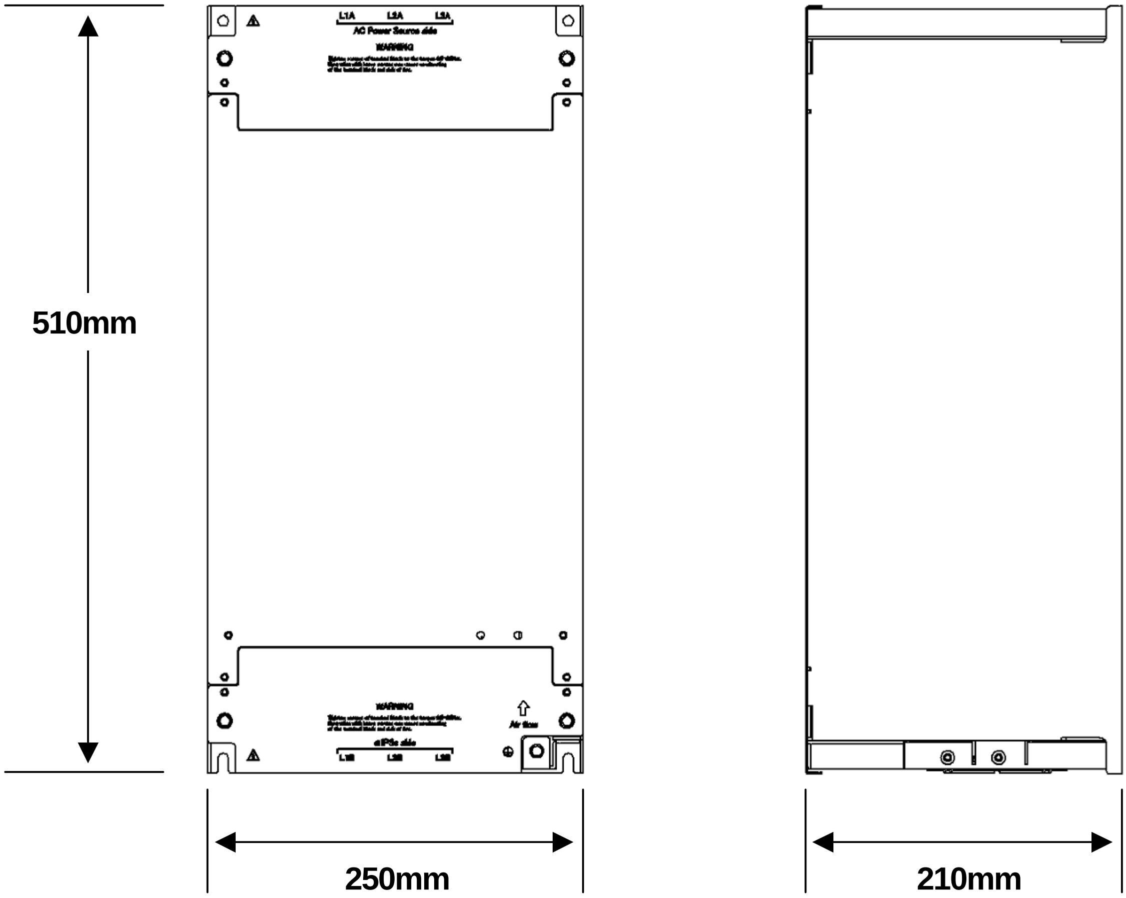
(1) A06B-6212-H215, A06B-6262-H218



(2) A06B-6212-H237, A06B-6262-H245

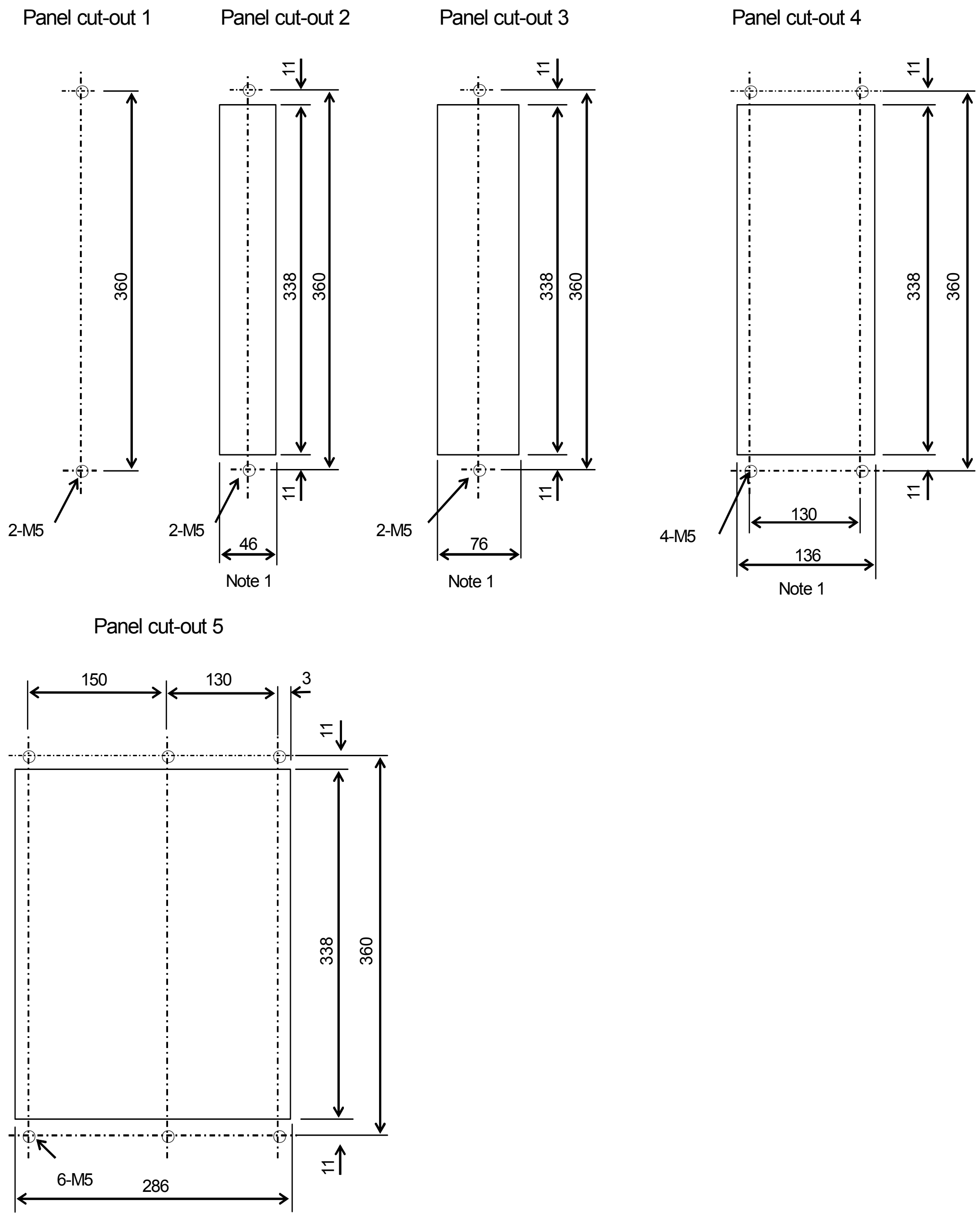


(3) A06B-6262-H275, A06B-6262-H300



J.6.3 Panel Cut-out of αiPSs-B

Model	Panel cut-out
αiPSs 15-B, αiPSs 18HV-B	Panel cut-out3
αiPSs 37-B, αiPSs 45HV-B	Panel cut-out4
αiPSs 75HV-B, αiPSs 100HV-B	Panel cut-out5



NOTE

1 The dimensional tolerance of each panel cut-out in the amplifier width direction is as follows:
- Panel cut-out 2: 46 (-0, +0.5) mm
- Panel cut-out 3: 76 (-0, +0.5) mm
- Panel cut-out 4: 136 (-0, +0.5) mm
- Panel cut-out 5: 286 (-0, +0.5) mm

2 Depending on the variation in dimensions of amplifier, mounting and dismounting work of amplifier may be difficult if the dimensions in cross direction of the amplifier for the panel-cut is smaller than the ones in the specifications (for example, 46 mm for panel cut-out 2).

3 Attach packing (acrylonitrile-butadiene rubber, NBR [soft type]) to the panel cut-outs 2, 3, 4, and 5 to protect from oil and rust.

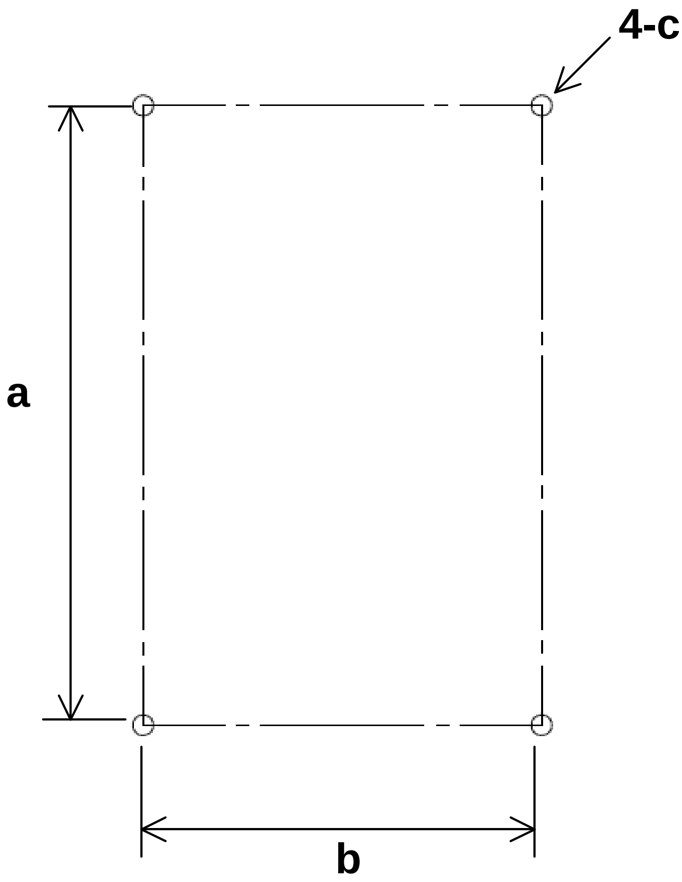
4 Reinforce right and left sides of the panel cut-out hole of the power magnetic cabinet with L-angles or the like to keep the plate of the cabinet firmly attached with the flange of the amplifier.

J.6.4 Panel Cut-out of αiPSs Input Filter

Ordering number	Size	a	b	c
A06B-6212-H215 A06B-6262-H218	Small	360mm	160mm	M6
A06B-6212-H237 A06B-6262-H245	Medium (Note)	360mm	230mm	M6
A06B-6262-H275 A06B-6262-H300	Large (Note)	490mm	230mm	M6

NOTE

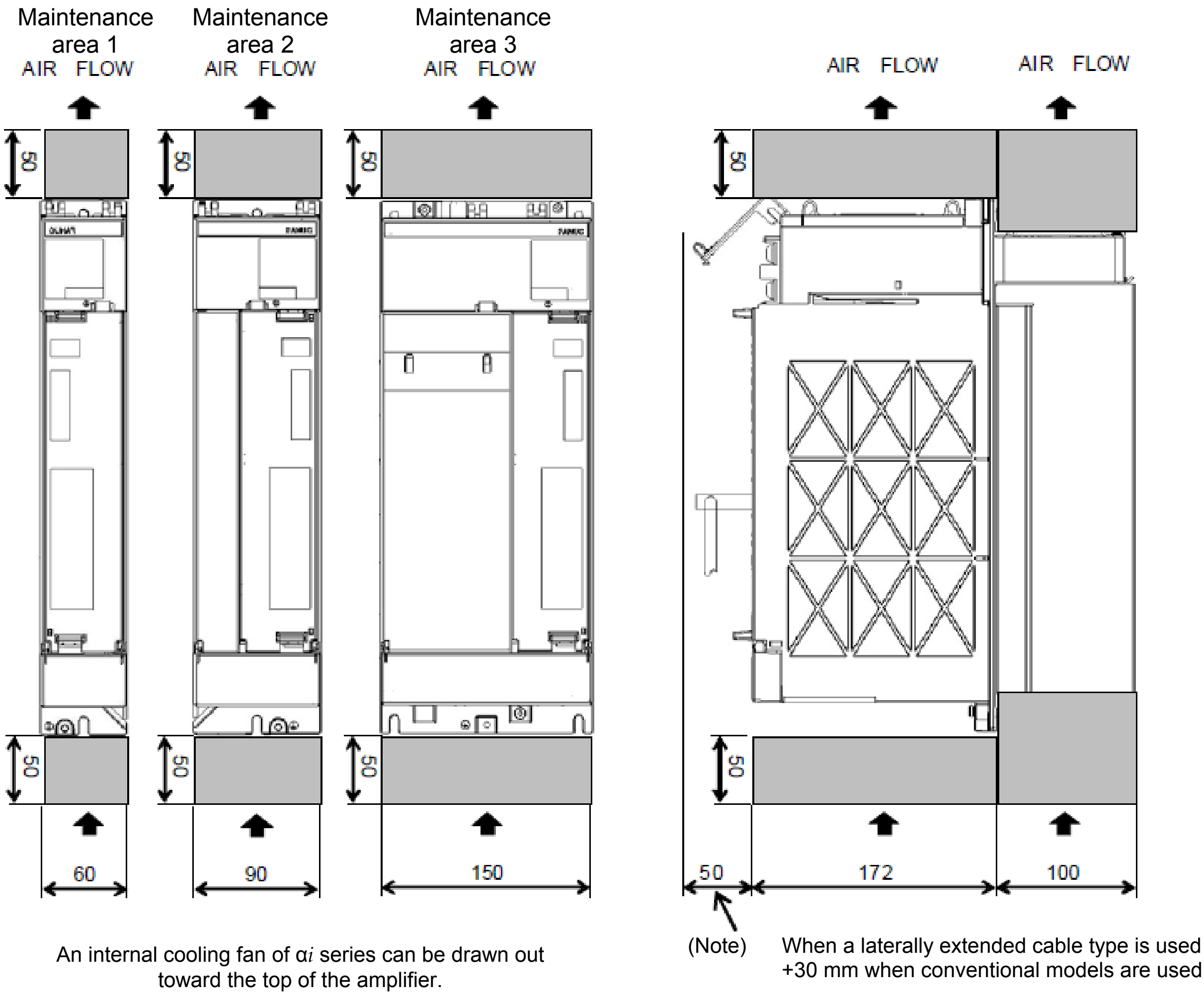
We recommend you to place medium- or large-sized αiPSs input filters horizontally (on the floor) because of their heavy weight. Before mounting any filter to a wall surface, check the strength of the wall.


4-c
a
b

J.6.5 Maintenance Area of αiPSs-B

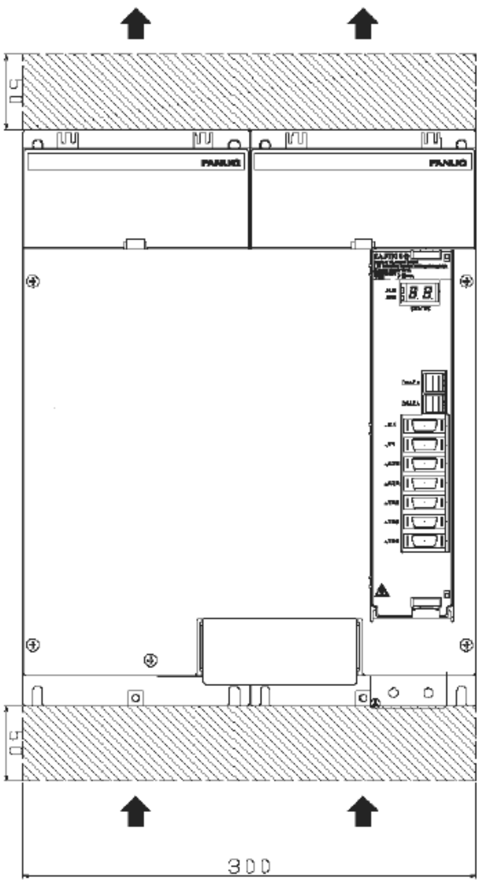
Type	Model	Maintenance area
Power Supply	αiPSs 15-B	Maintenance area 2
	αiPSs 37-B	Maintenance area 3
	αiPSs 18HV-B	Maintenance area 2
	αiPSs 45HV-B	Maintenance area 3
	αiPSs 75HV-B αiPSs 100HV-B	Maintenance area 4

An amplifier contains an internal cooling fan motor. To allow air to flow and make it easy to replace a fan unit, be sure to allocate the shaded areas shown in the figure below.
Allocate at least 50 mm of the maintenance area above the amplifier as shown in the figure. To improve the workability to maintain a fan motor, it is desirable to allocate an area of at least 80 mm.

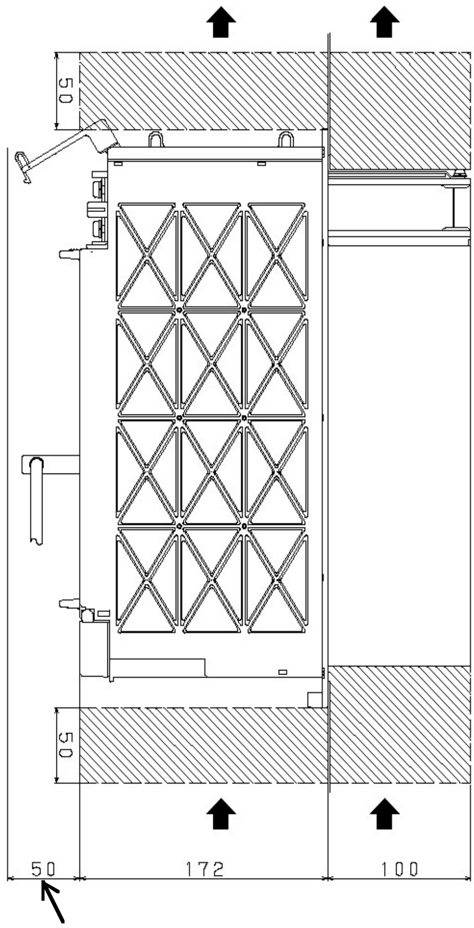


An internal cooling fan of αi series can be drawn out toward the top of the amplifier.

Maintenance area 4



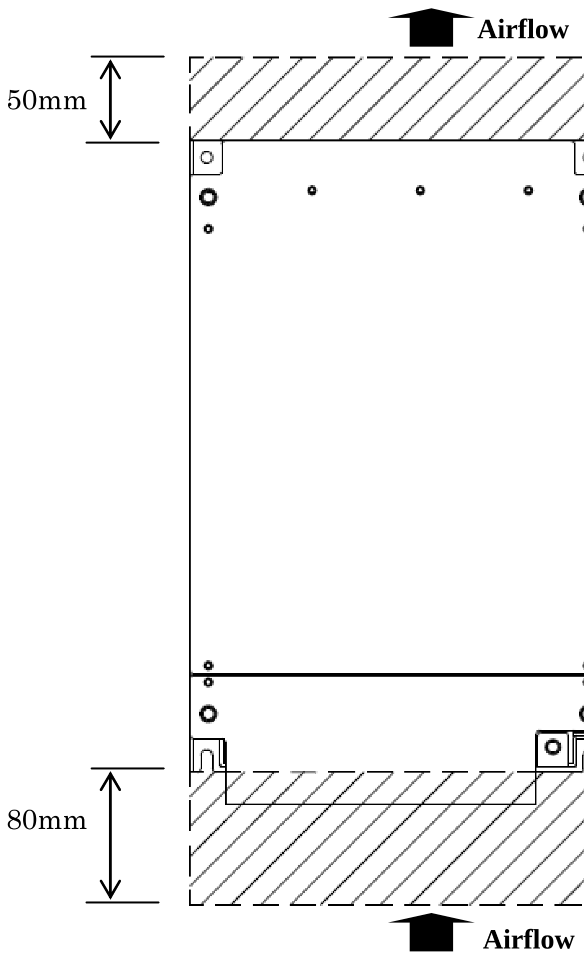
An internal cooling fan of αi series can be drawn out toward the top of the amplifier.



(Note) When a laterally extended cable type is used +30 mm when conventional models are used

J.6.6 Maintenance Area of αiPSs Input Filter

αiPSs input filter contains an internal cooling fan motor in bottom of the unit.
To allow air to flow and make it easy to replace a fan unit, be sure to allocate the shaded areas shown in the figure below.



J.7 CONNECTION

J.7.1 αiPSs-B Connector Location

(1) αiPSs 15-B,α iPSs 18HV-B

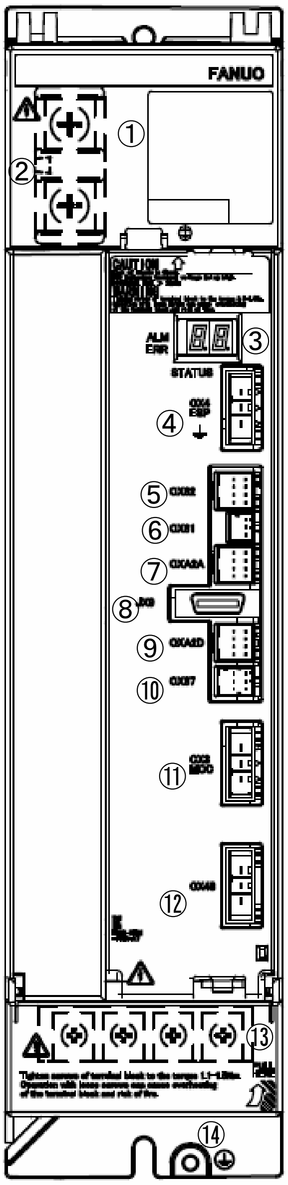


Table J.7.1(a) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal		Displayed as TB1.
2	DC link charge LED		Warning
3	Status LED	STATUS	
4	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
5	Connector for αiPSs input filter (Note)	CX62	D2100 8P-Y
6	Unused	CX61	
7	Output connector for αiPS-B interface	CXA2A	D2100 8P-X
8	Unused	JX9	
9	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
10	Connector for power failure detection output	CX37	D2100 6P-X
11	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
12	Connector for input power supply monitor	CX48	200 V/400 V 3φ D3200 3P-Z
13	Terminal block for connecting main power supply	TB2	
14	Tapped hole for grounding the flange	⏚	

NOTE
The connector used for connecting the interface cable between αiPSs-B and αiPSs input filter. An alarm is issued when this cable is not connected.

⚠ **WARNING**
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(2) α*i*PSs 37-B, αiPSs 45HV-B

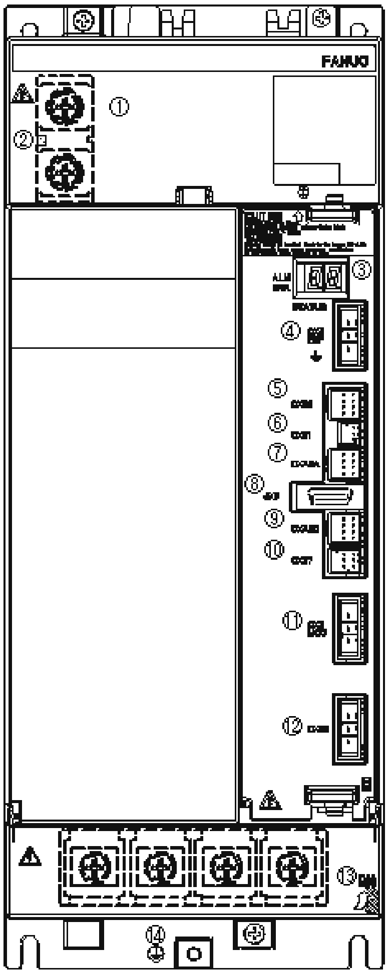


Table J.7.1(b) Names of connectors and terminal blocks

No.	Name	Display	Remarks
1	DC link terminal		Displayed as TB1.
2	DC link charge LED		Warning
3	Status LED	STATUS	
4	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
5	Connector for α*i*PSs input filter (Note)	CX62	D2100 8P-Y
6	Unused	CX61	
7	Output connector for α*i*PS-B interface	CXA2A	D2100 8P-X
8	Unused	JX9	
9	24 VDC power supply input connector	CXA2D	24 VDC power supply D2100 8P-X
10	Connector for power failure detection output	CX37	D2100 6P-X
11	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
12	Connector for input power supply monitor	CX48	200 V/400 V 3φ D3200 3P-Z
13	Terminal block for connecting main power supply	TB2	
14	Tapped hole for grounding the flange	⏚	

NOTE

The connector used for connecting the interface cable between αiPSs-B and αiPSs input filter.
An alarm is issued when this cable is not connected.

⚠**WARNING**

When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.

(3) α*i*PSs 75HV-B, αiPSs 100HV-B

Table J.7.1(c) Names of connectors and terminal blocks

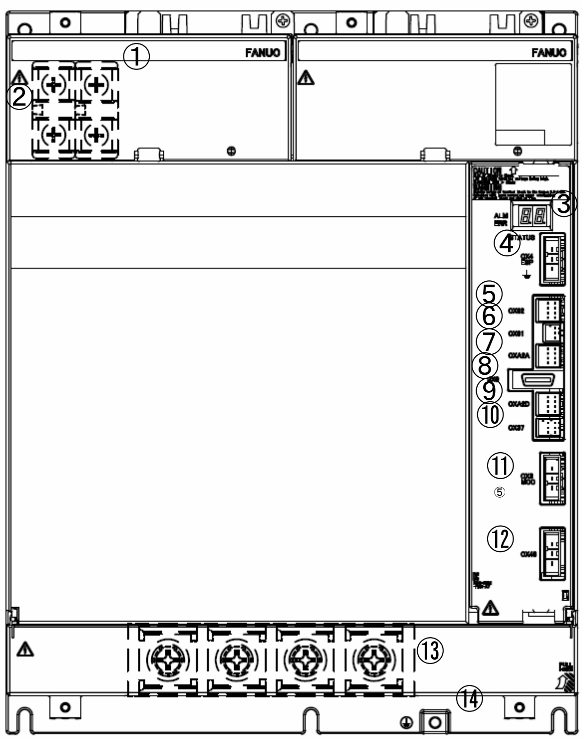
No.	Name	Display	Remarks
1	DC link terminal		Displayed as TB1.
2	DC link charge LED		Warning
3	Status LED	STATUS	
4	Connector for connecting ESP signal and ground wire	CX4	D3200 3P-X
5	Connector for α*i*PSs input filter (Note)	CX62	D2100 8P-Y
6	Unused	CX61	
7	Output connector for α*i*PS-B interface	CXA2A	D2100 8P-X
8	Unused	JX9	
9	24 VDC power supply input connector	CXA2D	24 VDC power supply, D2100 8P-X
10	Connector for power failure detection output	CX37	D2100 6P-X
11	Connector for controlling main power supply magnetic contactor	CX3	D3200 3P-Y
12	Connector for input power supply monitor	CX48	200 V/400 V 3φ, D3200 3P-Z
13	Terminal block for connecting main power supply	TB2	
14	Tapped hole for grounding the flange	⏚	

NOTE

The connector used for connecting the interface cable between α*i*PSs-B and α*i*PSs input filter.
An alarm is issued when this cable is not connected.

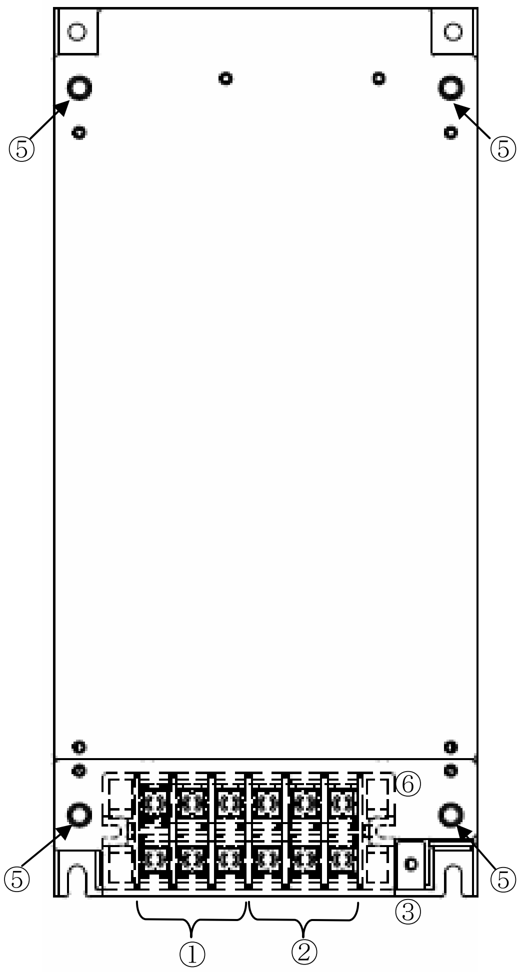
⚠ **WARNING**

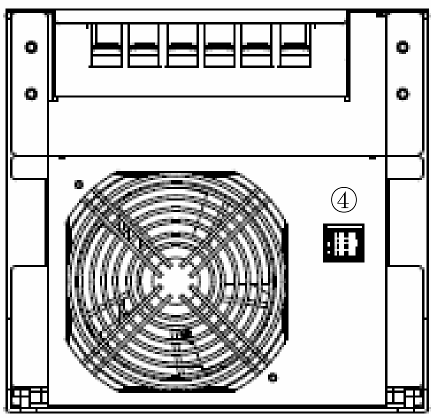
When the DC link charge LED is lit, touching parts in the amplifier or cables connected is hazardous; never touch them.



J.7.2 α*i*PSs Input Filter Connector Location

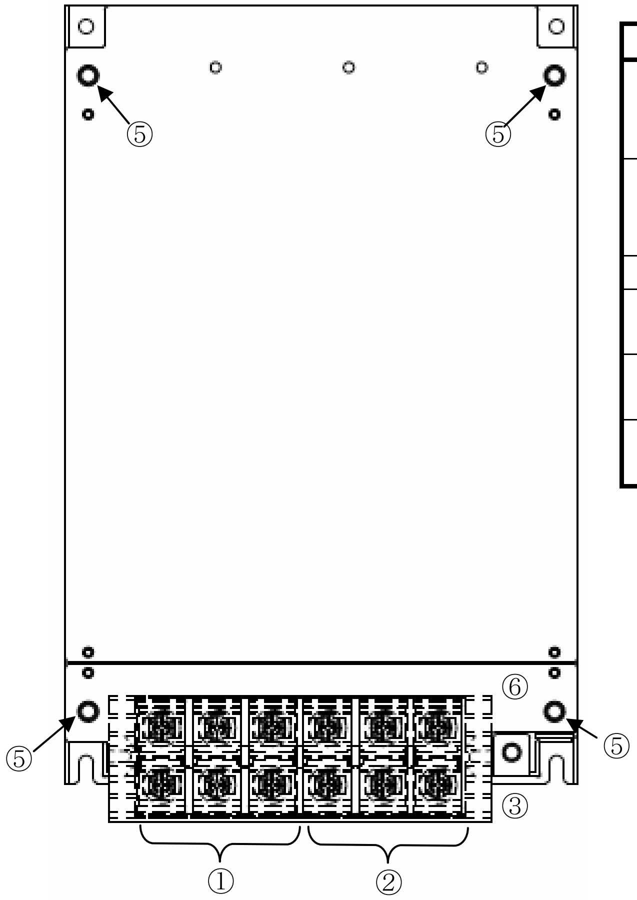
(1) A06B-6212-H215, A06B-6262-H218

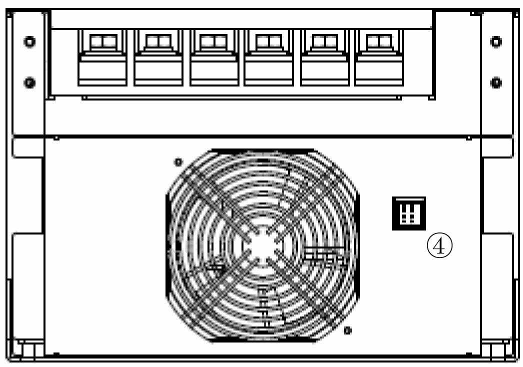




No.	Name	Display	Remarks
1	Terminals on the power input side	L1A L2A L3A	Screw size M5
2	Terminals on the side of α*i*PSs-B	L1B L2B L3B	Screw size M5
3	Grounding terminal		Screw size M5
4	Connector for α*i*PSs interface	CX62	D2100 8pin Key Y
5	Threaded hole for an eye bolt		4 spots in the front, M8
6	Terminal cover		Fasten with screws

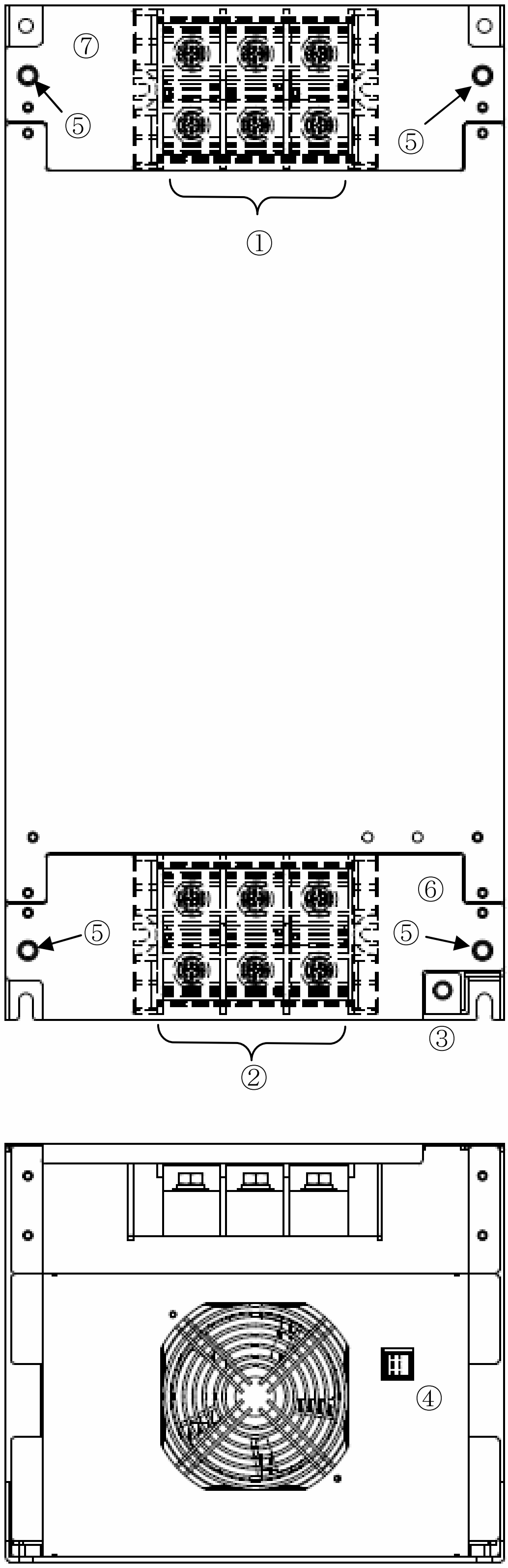
(2) A06B-6212-H237, A06B-6262-H245





No.	Name	Display	Remarks
1	Terminals on the power input side	L1A L2A L3A	Screw size M8
2	Terminals on the side of αiPSs-B	L1B L2B L3B	Screw size M8
3	Grounding terminal		Screw size M8
4	Connector for αiPSs interface	CX62	D2100 8pin Key Y
5	Threaded hole for an eye bolt		4 spots in the front, M8
6	Terminal cover		Fasten with screws

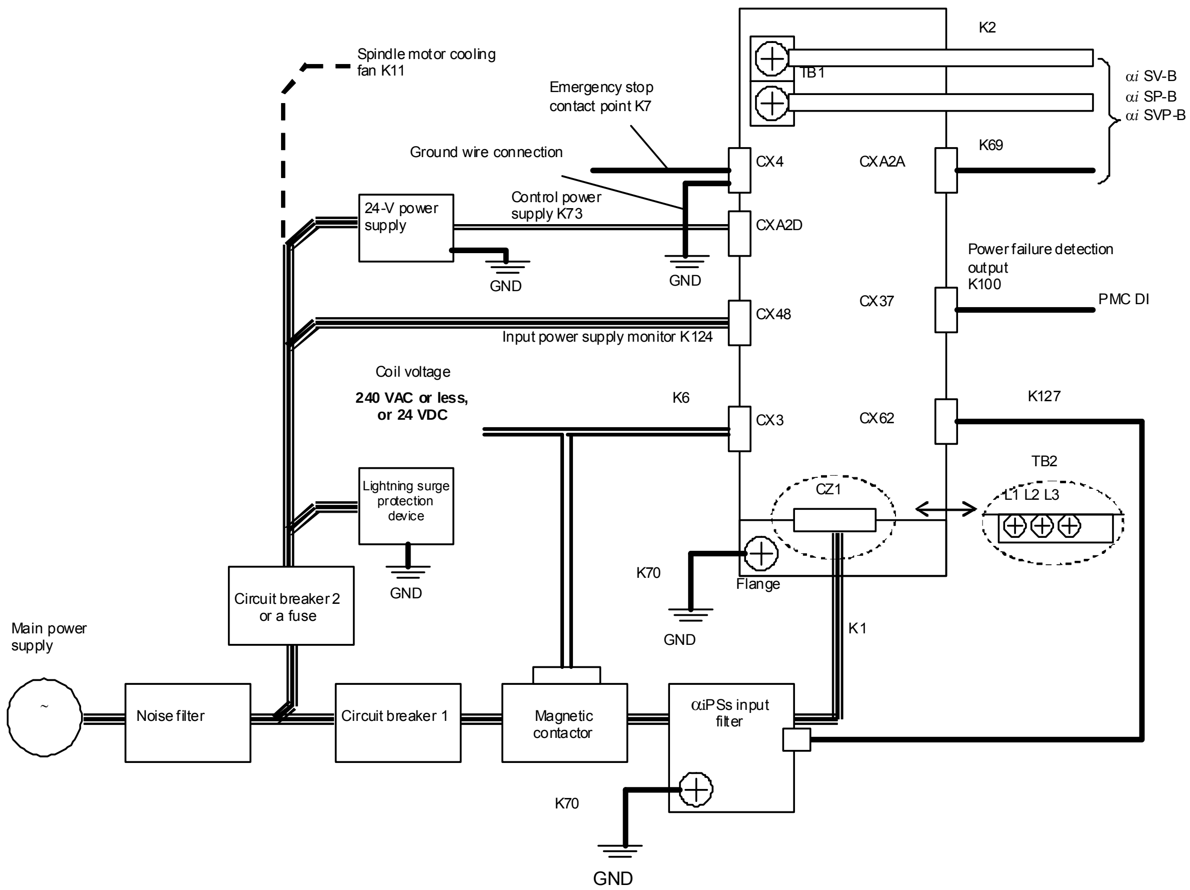
(3) A06B-6262-H275, A06B-6262-H300



No.	Name	Display	Remarks
1	Terminals on the power input side	L1A L2A L3A	Screw size M8
2	Terminal on αiPSs-B side	L1B L2B L3B	Screw size M8
3	Grounding terminal		Screw size M8
4	Connector for αiPSs interface	CX62	D2100 8pin Key Y
5	Threaded hole for an eye bolt		4 spots in the front, M8
6	Terminal cover		Fasten with screws
7			

J.7.3 Cable Connection

See Chapter 9 "CONNECTION" for details on connecting other than α*i*PSs input filters.



> ⚠ **CAUTION**
> 1 Make sure to install circuit breakers, a magnetic contactor, and the α*i*PSs input filter.
> 2 Connect a noise filter closer to the power supply than the magnetic contactor for α*i*PSs-B.
> 3 Connect a 5 A or less circuit breaker or a fuse to the input of the lightning surge protection device to protect burning caused by a short-circuit by applying surge voltage exceeding the tolerance of the protection device. For details, see APPENDIX A "FITTING A LIGHTNING SURGE PROTECTION DEVICE."

NOTE

1. Connect the cable of the input power supply monitor (CX48) following circuit breaker 2 or fuse for cable protection.
2. The phase order of the cable of the input power supply monitor (CX48) must be consistent with the phase order of CZ1 or TB1. See Subsection 9.3.1.7, "Details of cable K124" for details.
3. Be sure to connect ground wiring from the ground terminal for safe system operation. See Subsection 9.3.1.6, "Details of cable K7" for details.
4. In the power inlet of power magnetics cabinet, install lightning surge protection devices between lines, as well as between each line and the grounding to protect the device from lightning surge voltage. See APPENDIX A for details.
5. If the circuit breaker at the input section of the lightning surge protector trips, the lightning surge protector is disabled. It is necessary to detect the trip and issue a warning.

Details of cable K1

(1) α*i*PSs-B

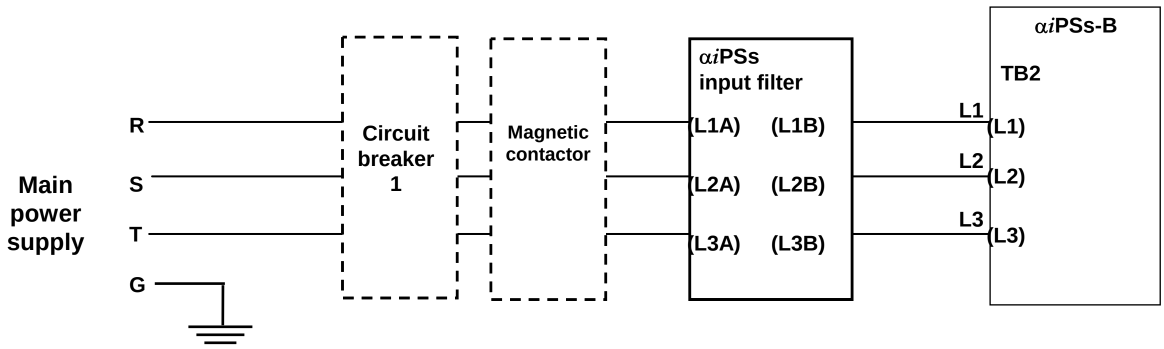


Table J.7.3(a) Cable K1 specifications, screw tightening torque (α*i*PSs-B)

Amplifier model	Applicable cable		α*i*PSs-B side		α*i*PSs input filter side		Cable length
	Heat-resistant cable (Note 1)	Cable conforming to UL Standard	Terminal screw	Tightening torque	Terminal screw	Tightening torque	
α*i*PSs 15-B	14 mm2 or more	AWG4 or more	M4	1.1 to 1.5Nm	M5	2.0 to 2.5Nm	(Note 4)
α*i*PSs 37-B	38 mm2 or more	AWG1 or more	M6 (Note 2)	3.5 to 4.5Nm	M8	8.5 to 9.5Nm	

> **NOTE**
> 1 Fire-retardant polyflex wire (heatproof temperature 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.
> 2 Applied crimp terminal 38-6S for αiPSs 37-B
> 3 The cross-sectional area of cable is selected according to the following conditions.
> (1) Rated output of αiPSs-B
> (2) Ambient temperature of cable: 30°C
> (3) Tie of 3 cables (normally, the grounding cable does not carry current)
> Choose the necessary cross-sectional area of a cable according to the environments and conditions of use.
> 4 Keep the cable length no longer than 1 m between the αiPSs input filters (L1B, L2B, and L3B) and αiPSs-B.

> ⚠ **WARNING**
> Reverse connection of the power cable between L1A (L2A, L3A) and L1B (L2B, L3B) may result in overheating and damage of the αiPSs input filter.
> Make sure the cable is properly connected before turning on the power supply.

(2) αiPSs HV-B

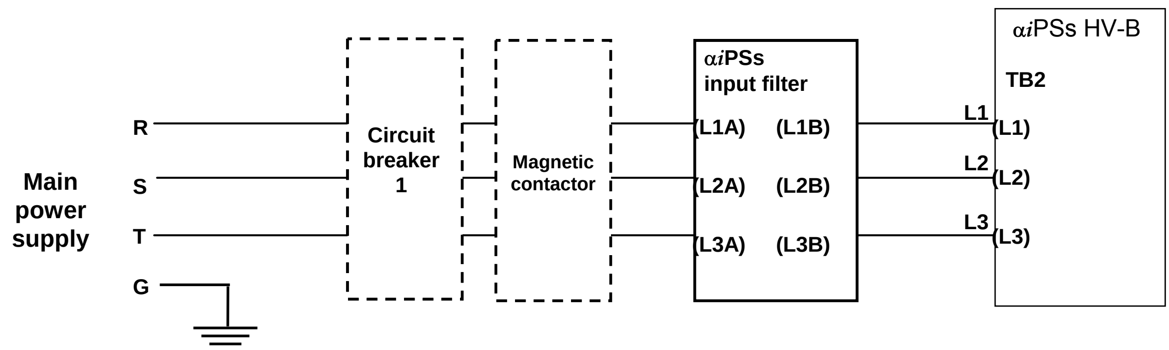


Table J.7.3(b) Cable K1 specifications, screw tightening torque

Amplifier model	Applicable cable		αiPSs-B side		αiPSs input filter side		Cable length
	Heat-resistant cable (Note 1)	Cable conforming to UL Standard	Terminal screw	Tightening torque	Terminal screw	Tightening torque	
αiPSs 18HV-B	8 mm2 or more	AWG8 or more	M4	1.1 to 1.5Nm	M5	2.0 to 2.5Nm	(Note 3)
αiPSs 45HV-B	22mm2 or more	AWG2 or more	M6	3.5 to 4.5Nm	M8	8.5 to 9.5Nm	
αiPSs 75HV-B	G: 22mm2 or more	AWG2 or more	M6	3.5 to 4.5Nm	M8	8.5 to 9.5Nm	
	R, S, T: 38mm2 or more	AWG1 or more	M10	15 to 16Nm			
αiPSs 100HV-B	G: 40mm2 or more	AWG1 or more	M6	3.5 to 4.5Nm	M8	8.5 to 9.5Nm	
	R, S, T: 80 mm2 or more	AWG3/0 or more	M10	15 to 16Nm			

NOTE

1 Fire-retardant polyflex wire (heatproof temperature 105°C) or equivalent to LMFC manufactured by The Furukawa Electric Co., Ltd.

2 The cross-sectional area of a cable is selected according to the following conditions.
   (1) Rated output of αiPSs-B
   (2) Ambient temperature of cable: 30°C
   (3) Tie of 3 cables (normally, the grounding cable does not carry current)
   Choose the necessary cross-sectional area of a cable according to the environments and conditions of use.

3 Keep the cable length no longer than 1 m between the αiPSs input filters (L1B, L2B, and L3B) and αiPSs-B.

⚠ **WARNING**

Reverse connection of the power cable between L1A (L2A, L3A) and L1B (L2B, L3B) may result in overheating and damage of the αiPSs input filter. Make sure the cable is properly connected before turning on the power supply.

Details of cable K2 (Short bar)

K2 cable connects DC links of an amplifier.
See Subsection 9.3.1.2, "Details of short bar K2" for details.

Details of cable K73

Cable K73 is used to supply control power to the servo amplifier.
Supply the power from an external 24 VDC power supply.
See Subsection 9.3.1.3, "Details of cable K73" for details.

Details of cable K69

Cable K69 connects amplifiers.
See Subsection 9.3.1.4, "Details of cable K69" for details.

Details of cable K6

Cable K6 is used to control an external magnetic contactor.
See Subsection 9.3.1.5, "Details of cable K6" for details.

Details of cable K7

Cable K7 is used to input an emergency stop signal and ground cable to the power supply.
See Subsection 9.3.1.6, "Details of cable K7" for details.

Details of cable K124

The signal line used to detect the condition of voltage of the Power Supply.
See Subsection 9.3.1.7, "Details of cable K124" for details.

Details of cable K70

See Table J.7.3 to determine a cable to connect the frame grounding of the power magnetic cabinet from αi-B amplifiers and metal frames of αiPSs input filters.

Table J.7.3 Diameter of grounding cable

Power cable cross-section S (mm^2)	Grounding cable cross-section (mm^2)
S ≤ 5.5	5.5 or more
5.5 < S ≤ 16	S or more
16 < S ≤ 35	16 or more
35 < S	S/2 or more

> **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 mm^2 to 22.66 mm^2

Wire cable K70 with terminal screw size and tightening torque in accordance with the following table.

(1) α*i*PSs-B

Amplifier model	Terminal screw	Tightening torque
α*i*PSs15-B, α*i*PSs37-B, α*i*PSs18HV-B, α*i*PSs45HV-B	M5	2.0 to 2.5Nm
α*i*PSs75HV-B α*i*PSs100HV-B,	M6	3.5 to 4.5Nm

(2) α*i*PSs input filter

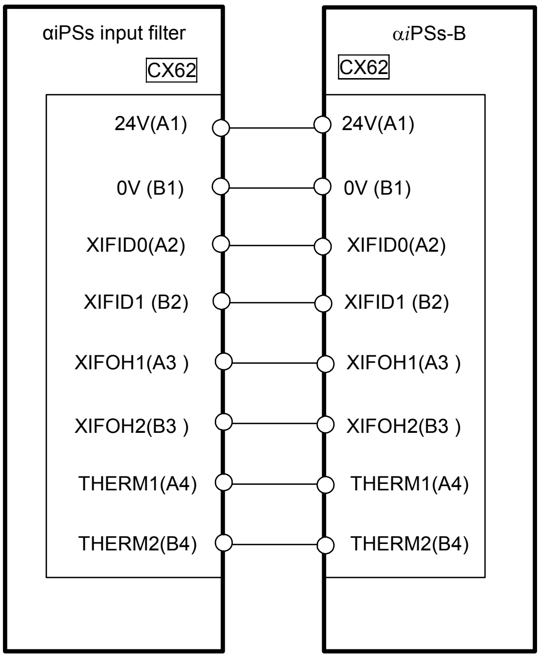
Compatible amplifier	Ordering number	Terminal screw	Tightening torque
α*i*PSs15-B,	A06B-6212-H215	M5	2.0 to 2.5Nm
α*i*PSs37-B,	A06B-6212-H237	M8	8.5 to 9.5Nm
α*i*PSs18HV-B,	A06B-6262-H218	M5	2.0 to 2.5Nm
α*i*PSs45HV-B,	A06B-6262-H245	M8	8.5 to 9.5Nm
α*i*PSs75HV-B	A06B-6262-H275	M8	8.5 to 9.5Nm
α*i*PSs100HV-B	A06B-6262-H300	M8	8.5 to 9.5Nm

Details of cable K100

Cable K100 is used to connect power failure output signals.
See Chapter 13 "POWER FAILURE DETECTION FUNCTION" for details.

Details of cable K127

Cable K127 connects α*i*PSs-B and α*i*PSs input filter.



Specifications of connector and cable

Connector	Tyco Electronics AMP D-2100 Series Housing (Y key) 2-1318119-4 (2 pieces) Contact (M size) 1318107-1 (16 pieces)
Cable	Wire size: 0.5 mm2, AWG20 Insulation sheath: 1.11 to 1.87 mm Cable length: up to 1.0 m

J.8 SETTING

J.8.1 Parameters

List of parameters

Parameters for Power Supply of αiPSs-B are presented in the following table.
See Section 15.2, "PARAMETERS" for details of parameters except for the internal number P001.

Internal number (Note 2)	CNC parameter number PS control axis (Note 1)		Description	Applicable software series/edition (Note 5)
	SV	SP		
–	2557	4657	Amplifier group number	Series 9G10 edition 03.0 or later
P000	2572	4672	Unused (Note 3)	
P001	2671	4771	Control method	Series 9G10 edition 03.0 or later
P002 to P013	2672 to 2683	4772 to 4783	Unused (Note 3)	
P014	2684	4784	Power failure detection level 1 / Power failure detection time 1 (Note 4)	Series 9G10 edition 03.0 or later
P015	2685	4785	Power failure detection level 2 / Power failure detection time 2 (Note 4)	Series 9G10 edition 03.0 or later

NOTE

1. See Subsection 15.3.1, "PS Control Axis" for details of PS control axis.
2. Parameter number in Power Supply software
3. Set "0" to unused parameters.
4. See Subsection 15.2.2, "Details of Parameters" for details of power failure detection levels 1 and 2 / power failure detection times 1 and 2.
5. See Section 15.4, "CHECKING THE SERIES AND EDITION OF POWER SUPPLY SOFTWARE" for how to check the series and edition of Power Supply software.

Parameters in detail

The following parameters were added to αiPSs-B.

Internal number	Parameter number PS control axis SV	SP	
P001	**2671**	**4771**	**Control mode of Power Supply**

[Data unit] -
[Range of effective data] 0
[Standard settings]

0	The settings differ by the type of Power Supply. αiPSs-B: PWM rectification mode: Standard function αiPS-B: Diode rectification mode

> **NOTE**
> See Chapter 15 "PARAMETERS FOR POWER SUPPLIES" for details of other parameters and how to set them.

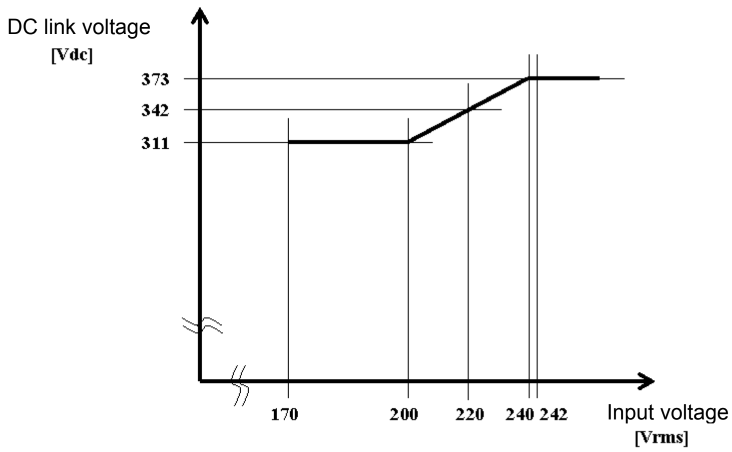
J.8.2 DC Link Voltage

PWM rectification mode: Standard function

PWM rectification mode: DC link voltage for standard function is set automatically according to the input voltage as indicated in the following figure. Make sure that the nominal voltage of the power supply does not deviate from the range of nominal input voltage as described below.

(1) 200 V input

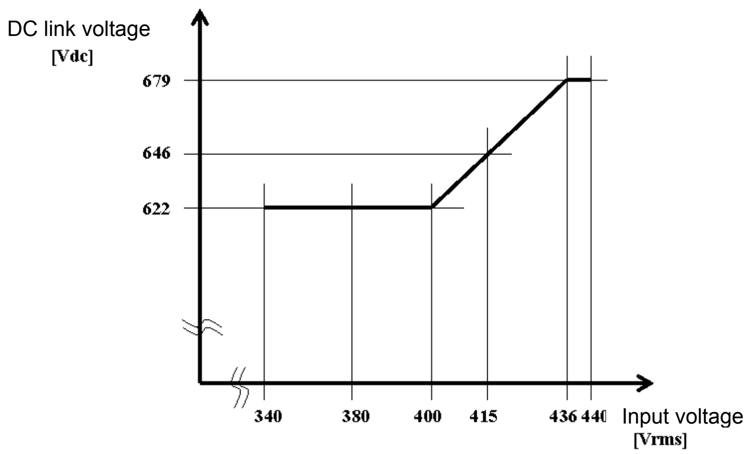
Maximum input voltage:	242 VAC (220 VAC +10%)
Minimum input voltage:	170 VAC (200 VAC -15%)
Nominal input voltage:	200 VAC to 220 VAC



DC link voltage and input voltage

(2) 400 V input

Maximum input voltage:	440 VAC (400 VAC +10%, 415 VAC + 6%)
Minimum input voltage:	340 VAC (380 VAC -10%)
Nominal input voltage:	380 VAC to 415 VAC



DC link voltage and input voltage

J.9 ALARM

The following alarms were added to α*i*PSs-B.
See Section 2.3, "Alarm number" of "α*i*series SERVO AMPLIFIER for 30i-B Start-up and Maintenance manual: B-65285EN/03-02/04," for details of alarm other than below.

(1) If PS control axis is α*i*SV-B

Alarm No.	LED display		Alarm description
	SV	PS	
SV0040	-	25	Abnormality in PS external input device or PS submodule 1 Cause: Wrong wiring between α*i*PSs-B (*i*PS-B) and α*i*PSs input filter, disconnection of cable K127, or abnormal heat dissipation in α*i*PSs input filter

(2) If PS control axis is α*i*SP-B

Alarm No.	LED display		Alarm description
	SV	PS	
SP9213	-	25	Abnormality in PS external input device or PS submodule 1 Cause: Wrong wiring between α*i*PSs-B (*i*PS-B) and α*i*PSs input filter, disconnection of cable K127, or abnormal heat dissipation in α*i*PSs input filter

K PULSECODER INTERFACE UNIT

Add a pulsecoder interface unit to α*i*-B amplifier.
The pulsecoder interface unit converts electric signals from a pulsecoder into optical signals for FSSB communication.

K.1 ORDERING INFORMATION

(1) Pulsecoder interface unit

Category	Name	Ordering number	Remarks
Standard	Pulsecoder interface unit	A06B-6061-H019	0.3kg

(2) Connectors

Category	Ordering number	Manufacturer			Quantity	Remarks
Standard	A06B-6078-K225	Hirose Electric Co., Ltd.	FI40B-2015S	Connector	1	For connection with the pulsecoder
			FI-20-CVS2	Case	1	
Option	A06B-6093-K303	Japan Aviation Electronics Industry, Ltd.	IL-L2S-S3L-B(N)	Housing	1	For connection with a battery
			IL-C2-1-00001	Contact	2	

(3) Fuses

Category	Ordering number	Remarks
Standard	A06B-6073-K250	Manufacturer: Daito Communication Apparatus Co., Ltd. Manufacturer part number: LM32C Specification: 3.2 A / 48 V Application: Short circuit protection for 24 VDC control power supply

(4) Battery for absolute pulsecoder

Category	Product name	Ordering number	Remarks
Option	Built-in battery	A06B-6135-K001	
Option	Built-in battery holder	A06B-6135-K002	
Option	Battery	A06B-6050-K061	Separate placement
Option	Battery case	A06B-6050-K060	Separate placement

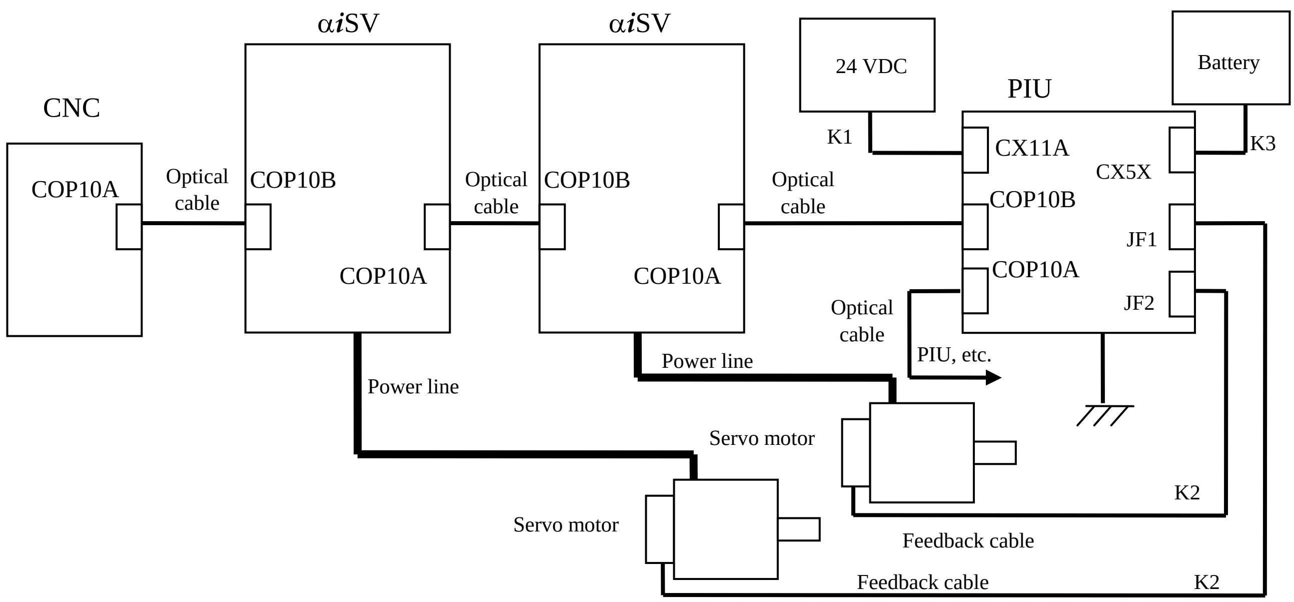
K.2 SPECIFICATION

Item	Specification
Power supply voltage	24 VDC ± 10%
Current consumption	Max 0.4 A
Number of supported axes	1-axis / 2-axis
Ambient temperature	0 to 55°C
Amount of heat dissipation	10 W
Compatible CNC	Series 30*i*/31*i*/32*i*-MODEL B Power Motion *i* -MODEL A
Series and edition of servo software	Series 90G0 edition 20.0 or later Series 90J0 edition 01.0 or later Series 90K0 edition 01.0 or later Series 90JP edition 01.0 or later

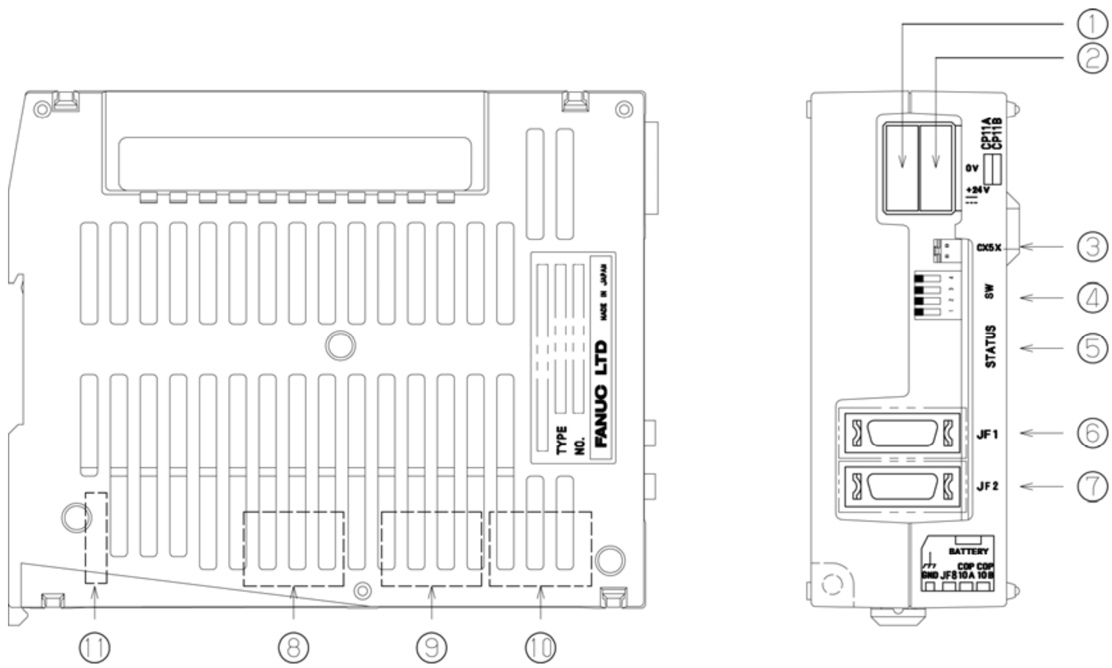
K.3 CONNECTION

K.3.1 Connection Diagram

The figure below shows an example of pulsecoder interface connection. (2 axes are used in this example.)



K.3.2 Connector Location



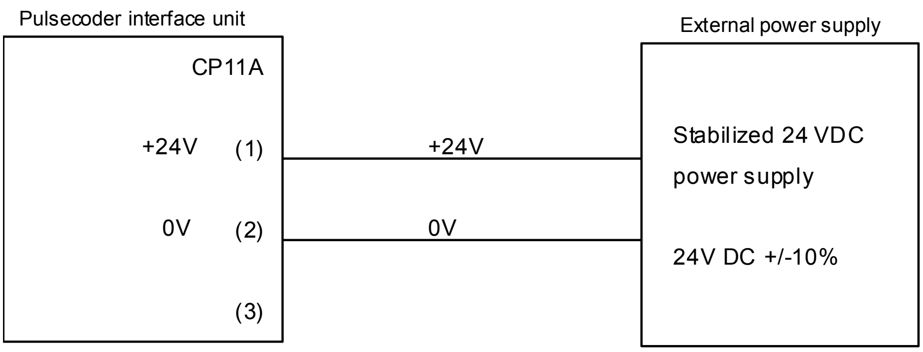
Connector name

No.	Name	Display	Remarks
1	24 V power input connector	CP11A	
2	24 V power output connector	CP11B	
3	Battery connector for absolute Pulsecoder	CX5X	
4	Switch for setting the number of axes	SW	
5	Status LED	STATUS	
6	Connector for pulsecoder (first axis)	JF1	
7	Connector for pulsecoder (second axis)	JF2	
8	Signal check connector	JX8	Not used.
9	FSSB optical output connector	COP10A	
10	FSSB optical input connector	COP10B	
11	Signal grounding terminal	GND	

K.3.3 Details of Connection

K.3.3.1 Details of cable K1

Supply external 24 VDC power to the pulsecoder interface unit.



Example of material 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
Receptacle housing: 1-178288-3
Receptacle contact: 1-175218-5

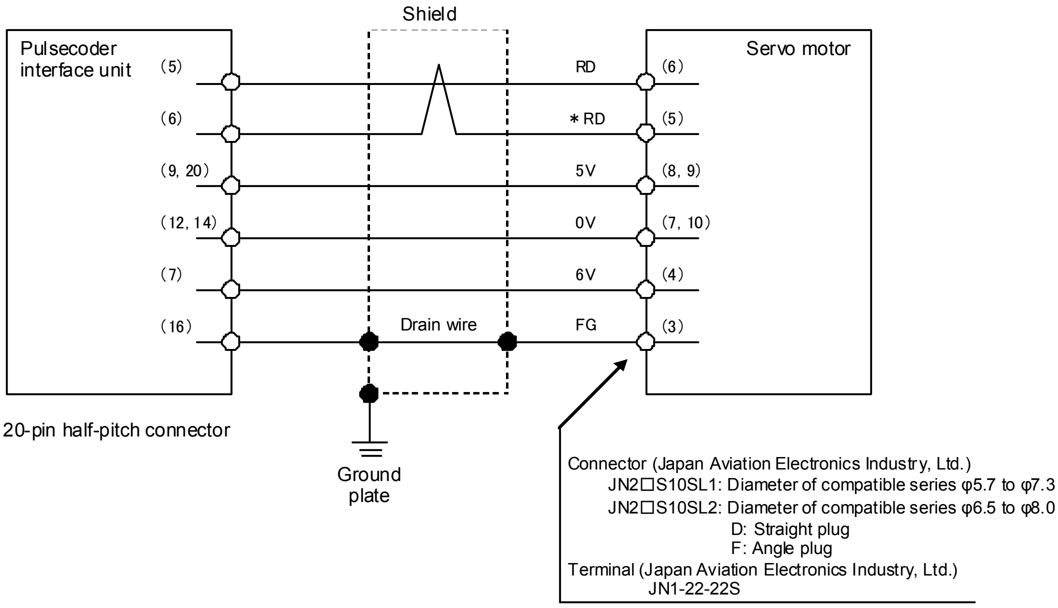
Recommended cable specification: A02B-0124-K830 (5 m)
(External power supply comes with M3 crimp terminals.)

NOTE

24 VDC power input to CP11A can be taken out from CP11B for branching. CP11B is connected in the same manner as CP11A. In this case, the power supply to CP11A should be a total of power capacity used by the pulsecoder interface unit and the capacity used by CP11B.

K.3.3.2 Details of cable K2

For connection of the pulsecoder interface unit and a pulsecoder.



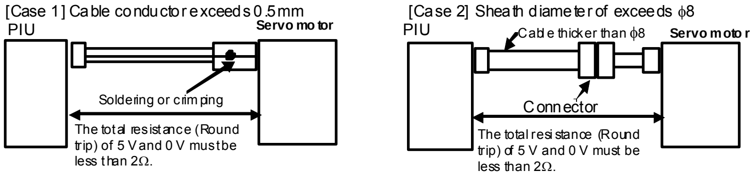
Using cable conductor

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

See Subsection 9.4.1 for PIU connectors compatible with the recommended cable.
See APPENDIX B "CABLES" in this manual for details on cables.

NOTE

1 Arrange the ground plate to be connected to the shield as close as possible to the pulsecoder interface unit.
2 If you intend to prepare a cable, make sure that the sum of resistances for 5 V and 0 V wires is 2 Ω or less.
3 The maximum diameter of compatible wire for motor connector is 0.5 mm^2 (strand configuration: 20/0.18 or 104/0.08, insulation outer diameter: φ1.5 or less), and sheath diameter is φ5.7 to φ8.0. When using a wire or cable thicker than the above size is used, take measures as shown below.



4 No 6 V connection is necessary with incremental pulsecoder.

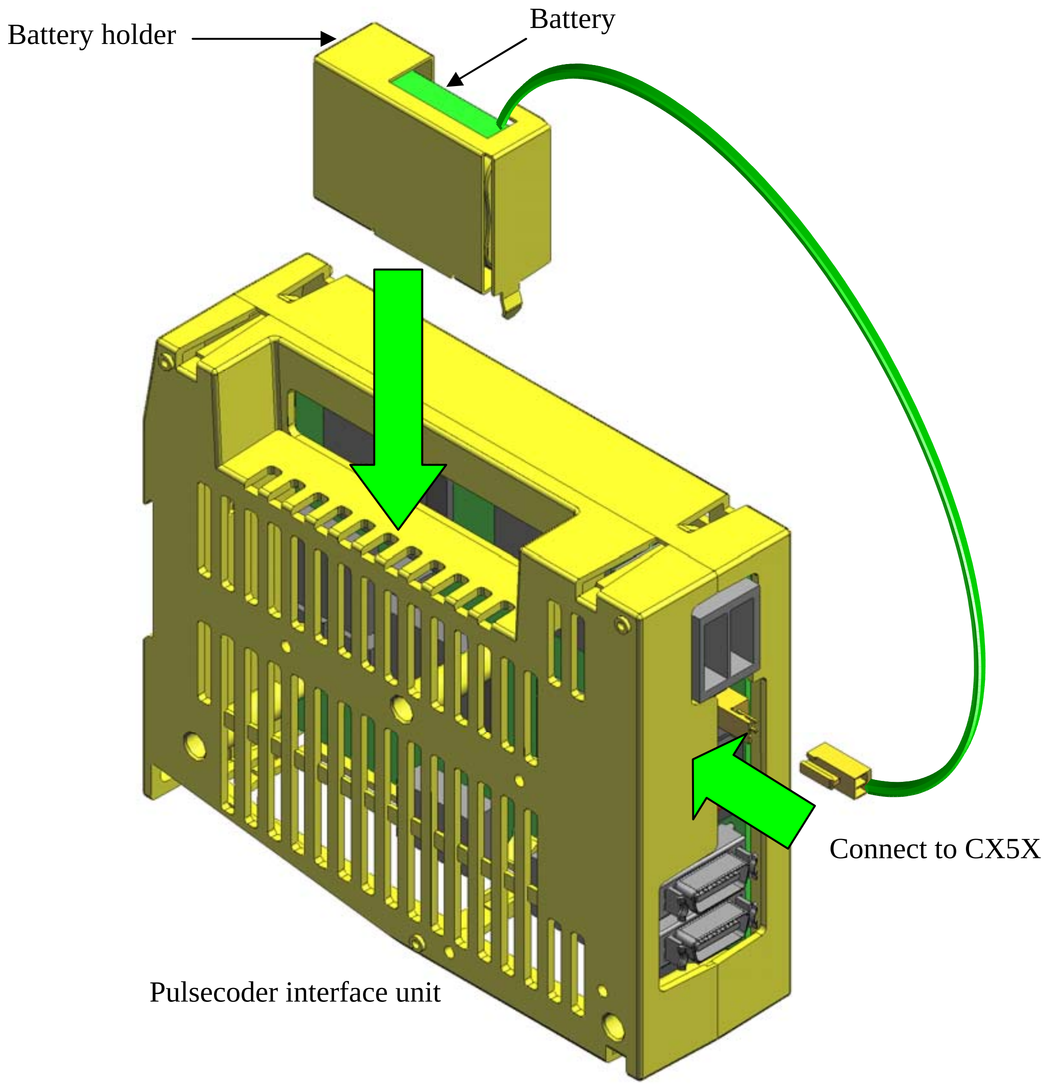
- Crimp tool specification
  A06B-6114-K201/JN1S: For 0.3 mm^2
  A06B-6114-K201/JN1L: For 0.18 mm^2 and 0.5 mm^2

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

K.3.3.3 Details of cable K3

[Connection method 1]
Method for installing a built-in battery into the pulsecoder interface unit

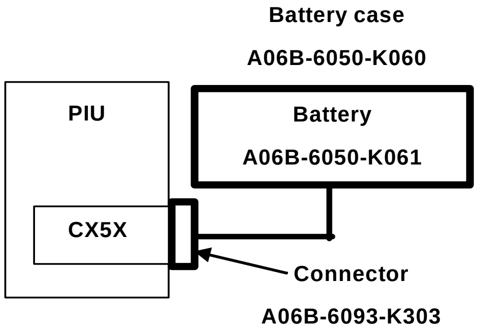


NOTE

1 The dedicated battery holder (A06B-6135-K002) is necessary for using the built-in battery (A06B-6135-K001).
2 The built-in battery needs to be bought directly from FANUC as it is not sold on the market. Because the battery requires periodic maintenance, we recommend you to prepare a spare battery.
3 The service life of the built-in battery is about two years when it is used for the αi series servo motor.

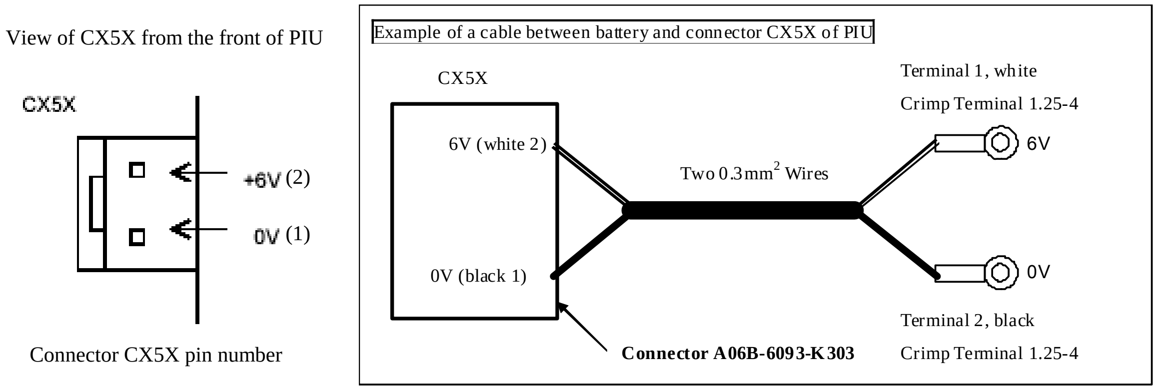
[Connection method 2]

Method for supplying battery power from separately placed battery case to the pulsecoder interface unit



An option is available to use the battery case (A06B-6050-K060), four D-cell alkaline batteries (A06B-6050-K061). Marketed D-cell alkaline batteries may also be used.

[Connection between the battery case and pulsecoder]



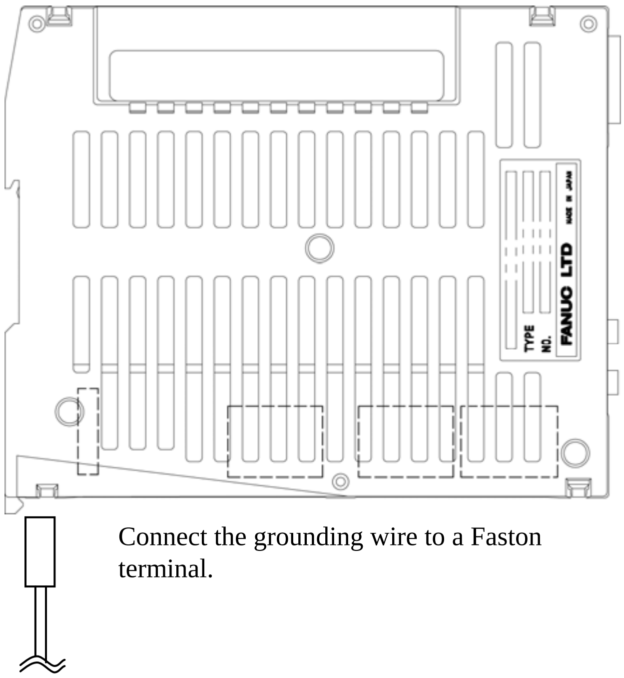
Connector with locking mechanism (A06B-6093-K303) is available as an option.

Ordering number	Manufacturer	Manufacturer part number	Product name	Quantity
A06B-6093-K303	Japan Aviation Electronics Industry, Ltd.	IL-L2S-S3L-B(N)	Housing	1
		IL-C2-1-00001	Contact	2

Connection of the contact with cable requires a special crimp tool. Please contact the manufacturer (Japan Aviation Electronics Industry).

K.3.3.4 Grounding connection

Connect a grounding wire to the signal grounding terminal.



Faston terminal specification for pulsecoder interface unit

Manufacturer	Tyco Electronics AMP	J.S.T. Mfg Co., Ltd.
Faston terminal specification	170604-1	FVDDF2-250

Cable specification

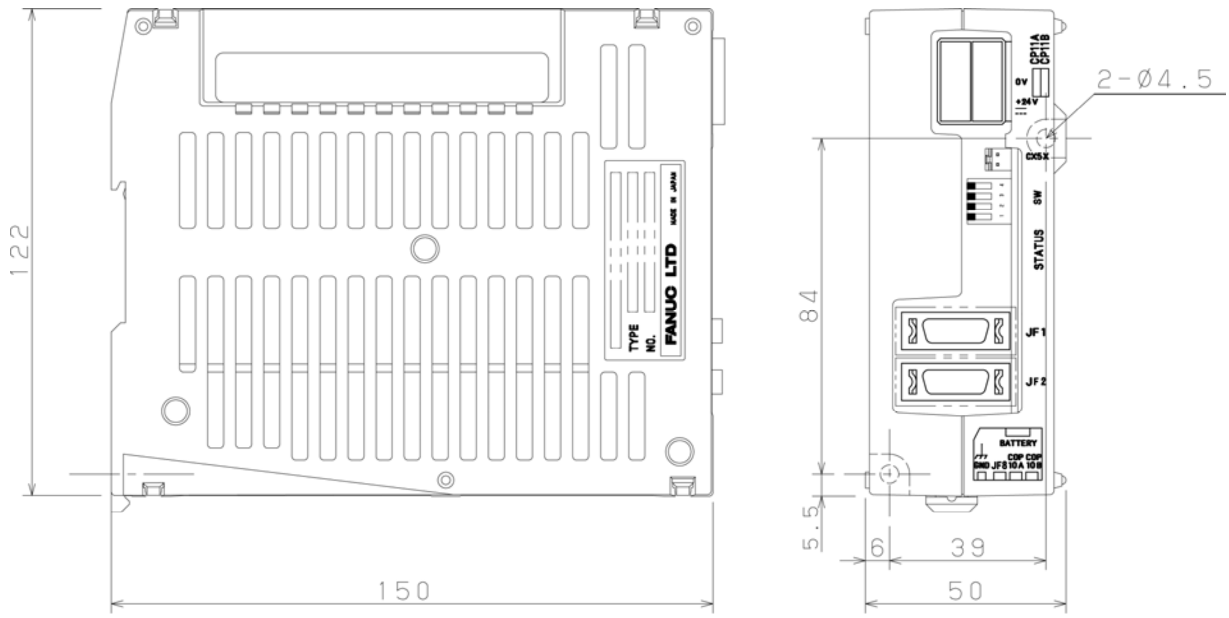
Conductor size	1.25 to 2.27 mm^2
Insulation sheath outer dimension	Max. 4.06 mm

K.4 MOUNTING

K.4.1 Mounting Instruction

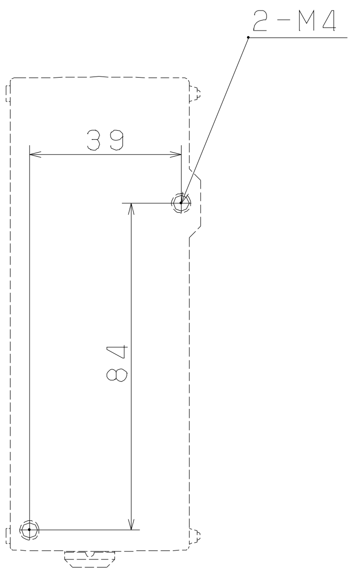
(1) Use this module in a completely sealed power magnetic cabinet.
(2) Mount this module on a vertical surface while leaving at least 100 mm of margin both on the top and bottom of the module. Do not place any device that generates intense heat below this module.

K.4.2 External Dimensions

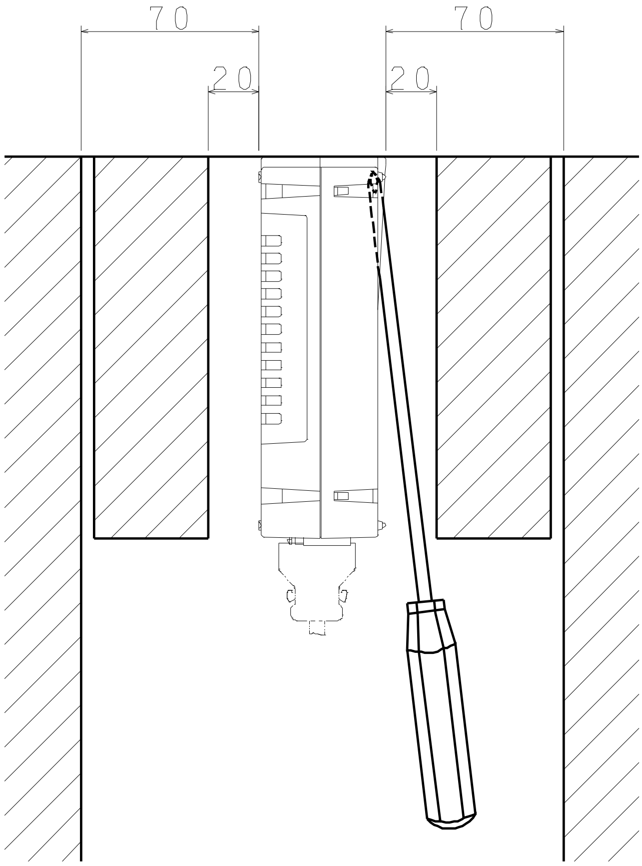


K.4.3 Details of Mounting Holes

Machining drawing of mounting holes (when DIN rail is not used)



K.4.4 Maintenance Area

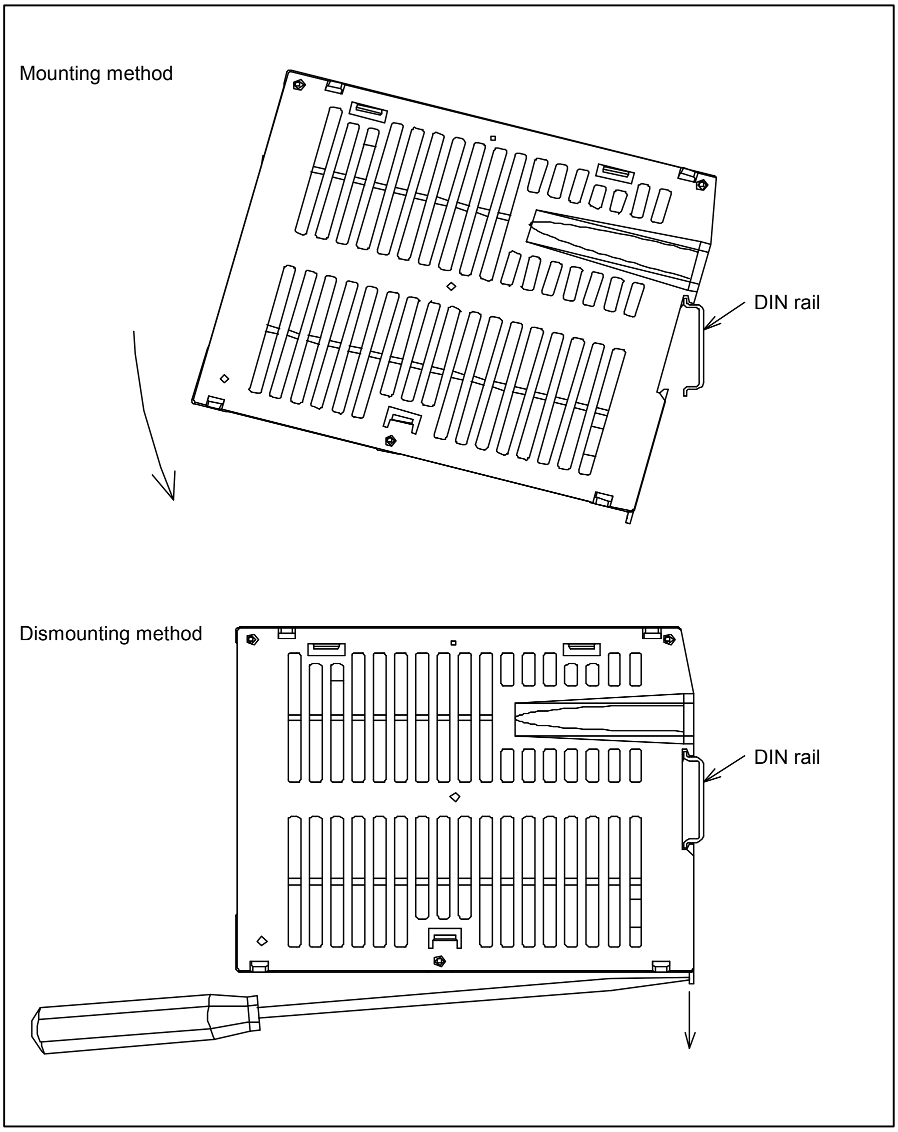


NOTE

Sufficient maintenance space is necessary on both sides of this unit in order to insert a screwdriver at an angle to mount or dismount this unit. As a guideline, if the front side of any neighboring unit is flush or behind this unit, leave about 20 mm of space from the neighboring module. If the front side of any neighboring unit is front of this unit, leave about 70 mm of space from the neighboring module.

When this unit is mounted close to the side of the power magnetic cabinet, leave about 70 mm of space between the unit and the side of the power magnetic cabinet.

K.4.5 Mounting to DIN Rail



Mounting method

1. Hang the hook of the unit to the top edge of the DIN rail.
2. Press the unit until it clicks.

Dismounting method

1. Pull down the locked part with a slotted screwdriver or the like.
2. Remove the unit by pulling the bottom part to the front.

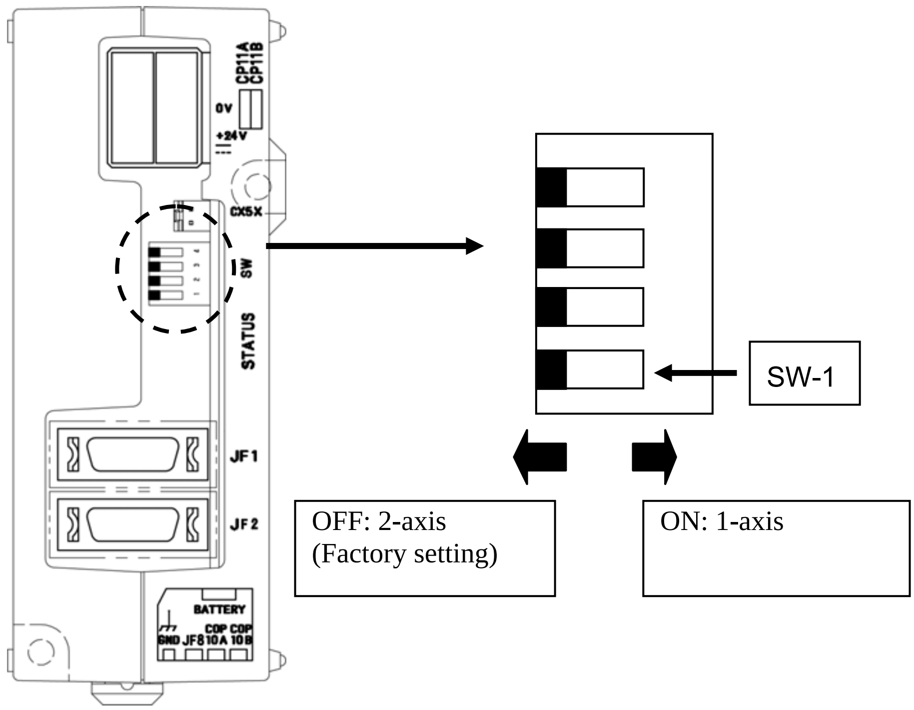
NOTE

Be careful not to damage the locked part with excessive force while removing the unit.
When mounting or dismounting the unit, hold its top and bottom portions to avoid excessive force to the (slit) sides of the unit.

K.5 SETTING

K.5.1 Switch Settings

Select 1-axis or 2-axis by using the front switch (SW).
Use only SW-1.



K.5.2 Parameter Settings

The following parameter settings are necessary for using the pulsecoder interface unit.

Set 1 to the following bits for all driven axes when obtaining feedback from the pulsecoder interface unit.

	#7	#6	#5	#4	#3	#2	#1	#0
2437			FBCPEX					

FBCPEX(#7) Motor feedback data (power interruption parameter) is
- 0: obtained from the driven amplifier.
- 1: copied from the axis of the pulsecoder interface unit.

NOTE

1. Set 1 to all axes that drive winding.
2. The pulsecoder interface unit is recognized by the CNC as a servo amplifier.
3. The axes of the pulsecoder interface unit occupies one control axis. The necessary number of control axes is 3 for driving each 2-winding motor. The necessary number of control axes is 5 for driving each 4-winding motor.
4. The value from the following table needs to be set to servo axis No.1023 for the axes of the pulsecoder interface unit and motor drive axes.

	Setting for No.1023	
	Motor drive axis	**Axes of pulsecoder interface unit**
When using a 2-winding motor	8n+1, 8n+2	8n+5
	8n+3, 8n+4	8n+6
When using a 4-winding motor	8n+1 to 8n+4	8n+5

(n=0,1,2,3,…)

5. The setting of No.2437#5 is not necessary for the axes of the pulsecoder interface unit.

The following bits need to be set to the axes of the pulsecoder interface unit.

	#7	#6	#5	#4	#3	#2	#1	#0
2009								DMY

DMY(#0) Set 1 (Enabled) to serial feedback dummy function.

The following bits need to be set to all the driven axes and the axes of the pulsecoder interface unit.

	#7	#6	#5	#4	#3	#2	#1	#0
2017					COMSRC			

COMSRC(#3) Set 1 to "fix the semi-close detector to α*i*/β*i* pulsecoder."

(Related parameters)

	#7	#6	#5	#4	#3	#2	#1	#0
2211	PLW4	PLW2						

PLW4(#7) 4-winding motor drive is
[set to all winding axes]
0: Disabled
1: Enabled

PLW2(#6) 2-winding motor drive is
[set to all winding axes]
0: Disabled
1: Enabled
Set 1 to all axes for windings of No.2211#7 or #6.

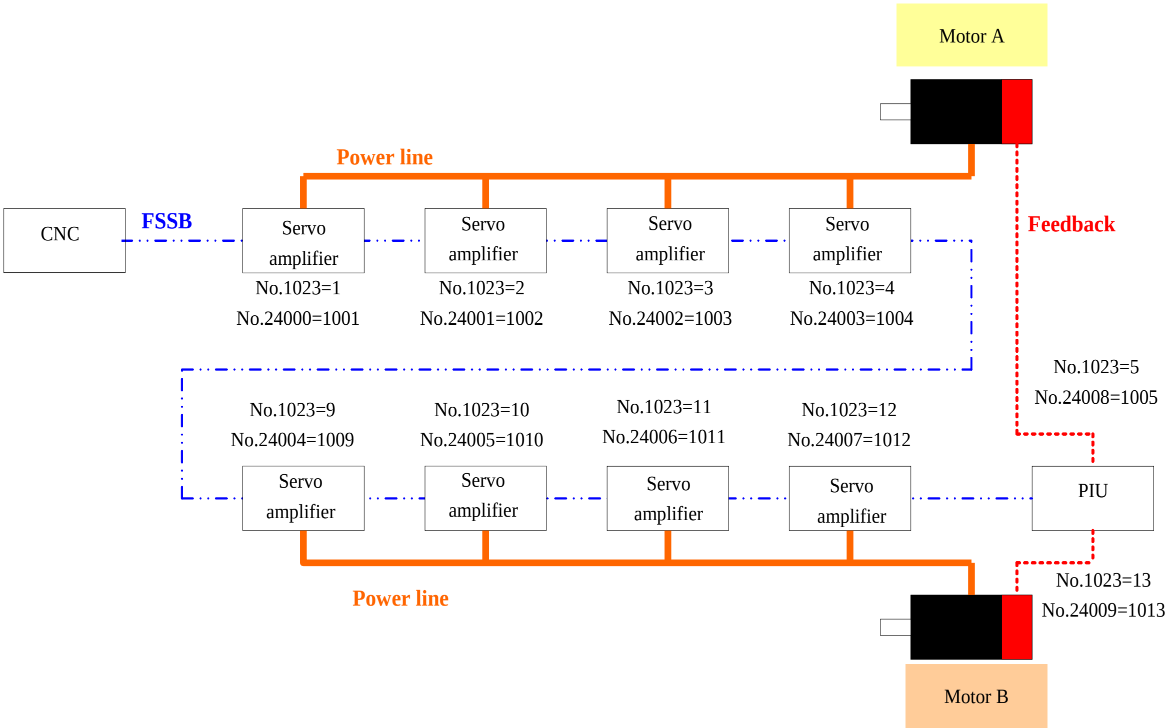
Set the servo of assigned axes in the pulsecoder interface unit to OFF.

	#7	#6	#5	#4	#3	#2	#1	#0
G126	SVF8	SVF7	SVF6	SVF5	SVF4	SVF3	SVF2	SVF1

SVFn Set servo off
[to FB acquisition axis]
0: No
1: Yes

(Setting example)

The following setting is applied for driving two 4-winding motors and receiving feedback with the PIU.



Connect a detector for driving motor A to the X5 axis and for driving motor B to the Y5 axis.

Motor A **Motor B**

	X1	X2	X3	X4	Y1	Y2	Y3	Y4	X5	Y5
No.1023	1	2	3	4	9	10	11	12	5	13
No.2211#6	0	0	0	0	0	0	0	0	0	0
No.2211#7	1	1	1	1	1	1	1	1	0	0
No.2437#5	1	1	1	1	1	1	1	1	0	0
No.2009#0	0	0	0	0	0	0	0	0	1	1

Axis for driving motor A (X1–X4) Axis for driving motor B (Y1–Y4) Pulsecoder interface unit (X5, Y5)

Set the setting value for No.1023 plus 1000 to FSSB No.24000 and beyond.

Parameter number	Setting value
No.24000	1001
No.24001	1002
No.24002	1003
No.24003	1004
No.24004	1009
No.24005	1010
No.24006	1011
No.24007	1012
No.24008	1005
No.24009	1013

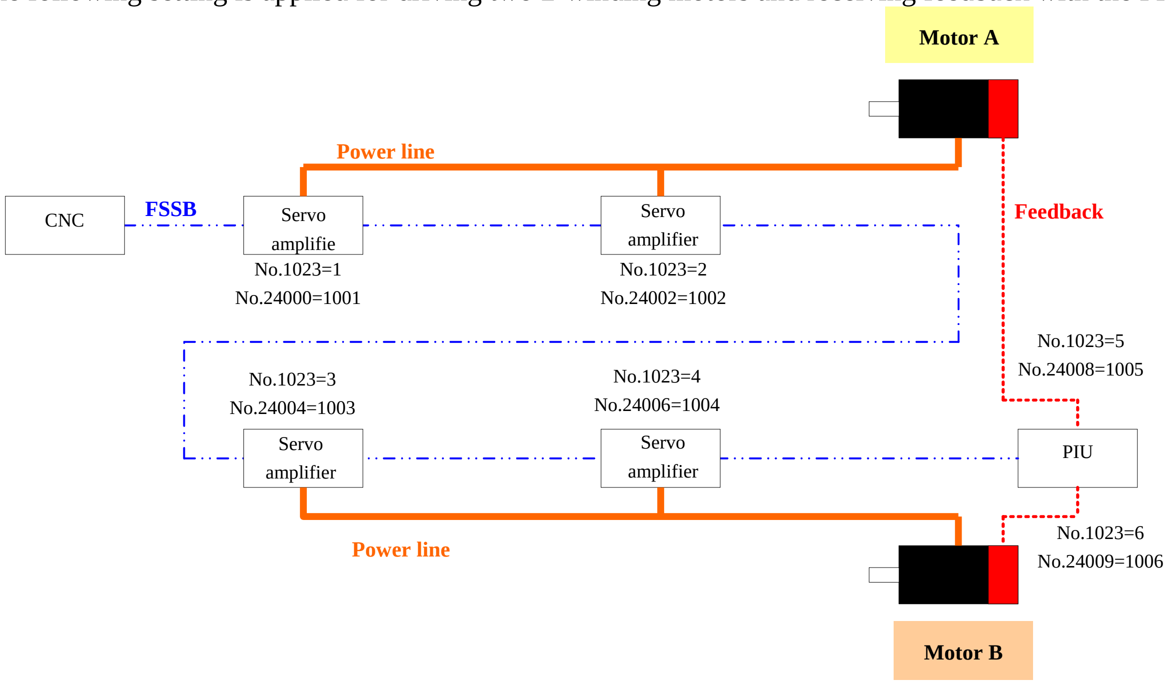
Motor A — No.24000 to No.24003: Axis for driving motor A

Motor B — No.24004 to No.24007: Axis for driving motor B

No.24008, No.24009: Pulsecoder interface unit

(Setting example)

The following setting is applied for driving two 2-winding motors and receiving feedback with the PIU.



Connect a detector for driving motor A to the X5 axis and for driving motor B to the Y5 axis.

Motor A Motor B

	X1	X2	Y1	Y2	X5	Y5
No.1023	1	2	3	4	5	6
No.2211#6	1	1	1	1	0	0
No.2211#7	0	0	0	0	0	0
No.2437#5	1	1	1	1	0	0
No.2009#0	0	0	0	0	1	1

Axis for driving motor A
Axis for driving motor B
Pulsecoder interface unit

Set the setting value for No.1023 plus 1000 to FSSB No.24000 and beyond.

Motor A
Motor B

Parameter number	Setting value
No.24000	1001
No.24001	1002
No.24002	1003
No.24003	1004
No.24004	1005
No.24005	1006
No.24006	1000
No.24007	1000
No.24008	1000
No.24009	1000

Axis for driving motor A
Axis for driving motor B
Pulsecoder interface unit

K.6 ALARM

When the pulsecoder interface unit detects any of the following alarms, the STATUS LED lights in red.

Alarm	Description	Troubleshooting
Low voltage of power supply for inverter control	Voltage of 24 VDC power lowered.	(1) PIU input voltage is low (21.6 VDC or less). (2) Power input cable disconnected or short-circuited. (3) PIU malfunction
Abnormal internal ROM data	ROM data in the PIU is abnormal.	(1) PIU malfunction
Internal communication error	Serial communication inside the PIU is abnormal.	(1) PIU malfunction
FSSB disconnection alarm	FSSB communication error	Disconnection of optical cable Voltage of 24 VDC power lowered. PIU malfunction Feedback cable malfunction

A flash of red LED lamp during the CNC startup does not represent any abnormality.

L EXTENDED COMBINATION OF CNC, AMPLIFIER, AND MOTOR

Free (seamless) combination of a CNC, an amplifier, and a motor is available in order to optimize the mechanical configuration considering technical and cost performance.

L.1 CNCS, AMPLIFIERS, AND MOTORS TO BE COMBINED SEAMLESSLY

The following CNCs, amplifiers, and motors can be combined seamlessly.

- CNC
  Series 0*i*-F, Series 30*i*-B / 31*i*-B / 32*i* -B / 35*i*-B

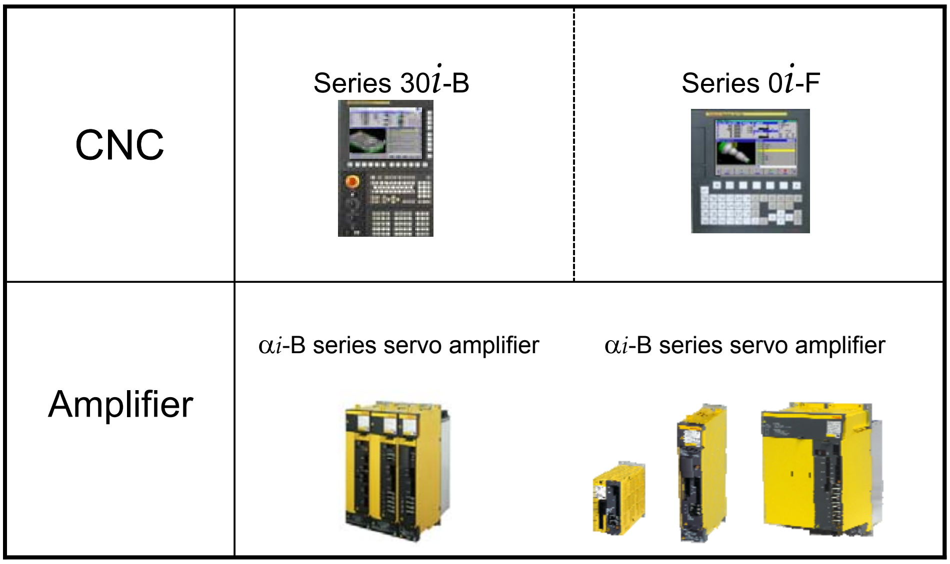
- Amplifier
  SERVO AMPLIFIER α*i*-B series [α*i*PS-B / α*i*SV-B / α*i*SP-B / α*i*SVP-B series]
  SERVO AMPLIFIER β*i*-B series [β*i* SV-B / β*i*SVSP-B series]

- Motor
  AC SERVO MOTOR α*i*-B / β*i*-B series [α*i*S-B / α*i*F-B / β*i*S-B / β*i*F-B series]
  AC SERVO MOTOR α*i* / β*i* series [α*i*S / α*i*F / β*i*S / β*i*F series]
  SYNCHRONOUS BUILT-IN SERVO MOTOR D*i*S series [D*i*S series]
  LINEAR MOTOR L*i*S series [L*i*S series]
  AC SPINDLE MOTOR α*i* / β*i* series [α*i*I / β*i*I series]
  BUILT-IN SPINDLE MOTOR B*i* series [B*i*I / B*i*S series]

NOTE
There are precautions and restrictions for some combinations. For details, see Subsection L.3.1 and thereafter.

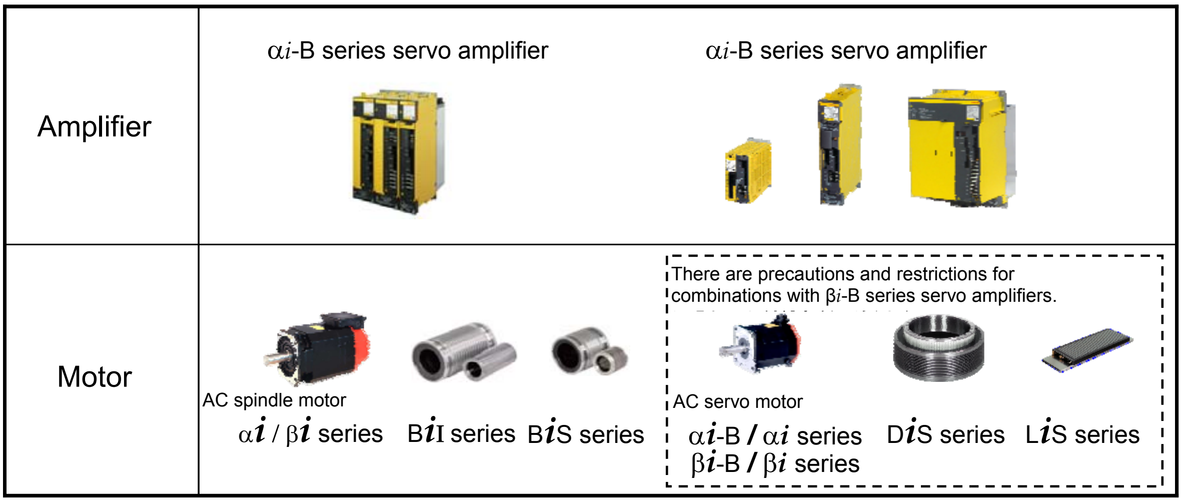
L.2 SEAMLESS COMBINATIONS OF CNCS AND AMPLIFIERS

Formerly, there were some restrictions in combining CNCs and amplifiers, but seamless combinations allow free combinations of CNCs and amplifiers.



L.3 SEAMLESS COMBINATIONS OF AMPLIFIERS AND MOTORS

Seamless combinations allow free combinations of any amplifier and any motor. Note, however, that there are precautions and restrictions for some combinations within the dashed line. For details, see Subsection L.3.1 and thereafter.



L.3.1 Precautions

β*i*SVSP-B amplifier and 2-axis β*i*SV-B amplifier may have different motor stop distance (dynamic brake stop distance) in emergency stop and alarm occurrence from α*i*SV-B, α*i*SVP-B, and 1-axis β*i*SV-B amplifier. Ensure that motor stop distance (dynamic brake stop distance) in emergency stop and alarm conditions is equal to or less than the desired distance by referring to "coefficients for calculating the dynamic brake stop distance" described in DESCRIPTIONS below.

"FANUC AC SERVO MOTOR α*i*-B / α*i* series DESCRIPTIONS (B-65262EN)"

"FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS (B-65422EN)"

> **NOTE**
> Contact us for details on the stop distance of D*i*S series synchronous built-in servo motors and L*i*S series linear motors.

☐ Application of the stop distance reduction function

The stop distance reduction function is recommended for all motors to shorten the stop distance in the event of emergency stop or power failure. For details, see "PARAMETER MANUAL (B-65270EN)."

In order to ensure the stop distance reduction function in the event of power failure, sustain the control power supply (24 VDC) to the CNC and amplifier by using PFB-24 (power failure backup module model B), a UPS (uninterrupted power supply), etc.

Occurrence of any alarm disables the stop distance reduction function and the stop distance is not shortened.

When applying the stop distance reduction function, confirm with the actual equipment that the stop distance is shortened in the event of emergency stop or power failure.

Reference example) Stop distance when the stop distance reduction function is applied

Model name	Status		Dynamic brake stop distance			
	Number of revolutions at the moment of braking	Inertia ratio	α*i*SV-B series	β*i*SVSP-B series		
			DB stop (*1)	DB stop (*1)	At power failure Q.S(*2)	At power failure Q.S + PFB-R(*3)
α*i*F 4/5000-B α*i*F 4/5000	5,000 rpm	x 3	31.1 rev	110.2 rev	80.6 rev	7.88 rev
α*i*F 8/3000-B α*i*F 8/3000	3,000 rpm	x 3	9.04 rev	22.6 rev	14.6 rev	2.79 rev
α*i*S 8/4000-B α*i*S 8/4000	4,000 rpm	x 3	6.66 rev	17.9 rev	9.65 rev	2.05 rev
α*i*S 8/6000-B α*i*S 8/6000	6,000 rpm	x 3	16.2 rev	43.7 rev	35.0 rev	6.70 rev
α*i*S 12/4000-B α*i*S 12/4000	4,000 rpm	x 3	6.41 rev	18.1 rev	14.0 rev	2.78 rev
α*i*F 8/4000-B α*i*F 8/4000	4,000 rpm	x 3	16.8 rev	50.0 rev	38.9 rev	4.36 rev
α*i*F 12/4000-B α*i*F 12/4000	4,000 rpm	x 3	45.8 rev	224.5 rev	202.3 rev	9.92 rev
α*i*F 22/3000-B α*i*F 22/3000	3,000 rpm	x 3	21.5 rev	100.9 rev	92.1 rev	5.91 rev

*1 DB stop: Dynamic brake stop distance

*2 Q.S: Dynamic brake stop distance using the stop distance reduction function

*3 Q.S + PFB-R: Dynamic brake stop distance using the stop distance reduction function and the power failure backup module

* The above example is a reference when the inertia ratio is 3. As the actual stop distance using the stop distance reduction function varies with the operating condition, always confirm with the actual equipment when applying the stop distance reduction function.

L.3.2 Combinations with Different Stop Distance at Emergency Stop or Alarm Occurrence

β*i* SVSP-B amplifier and 2-axis β*i*SV-B amplifier may have different motor stop distance (dynamic brake stop distance) in emergency stop and alarm occurrence from α*i*SV-B, α*i*SVP-B, and 1-axis βiSV-B amplifier. Combinations with different stop distance are listed below:
β*i*SVSP-B amplifiers and 2-axis β*i*SV-B amplifiers have no lineups supporting 400 V power input.

○: Combinations with the same dynamic brake stop distance
*: Combinations with different dynamic brake stop distance
-: No compatible amplifiers

☐ α*i*S-B / α*i*F-B / α*i*S / α*i*F series

200 V series		Amplifiers	
Model name	**Compatible amplifiers[Ap]**	**2-axis β*i*SV-B**	**β*i*SVSP-B**
α*i*S 2/5000-B α*i*S 2/5000	20	○	○
α*i*S 2/6000-B α*i*S 2/6000	20	○	○
α*i*S 4/5000-B α*i*S 4/5000	20	○	○
α*i*S 4/6000-B α*i*S 4/6000	20	○	○
α*i*S 8/4000-B α*i*S 8/4000	80	-	*
α*i*S 8/6000-B α*i*S 8/6000	80	-	*
α*i*S 12/4000-B α*i*S 12/4000	80	-	*
α*i*F 1/5000-B α*i*F 1/5000	20	○	○
α*i*F 2/5000-B α*i*F 2/5000	20	○	○
α*i*F 4/5000-B α*i*F 4/5000	40	*	*
α*i*F 8/3000-B α*i*F 8/3000	40	*	*
α*i*F 8/4000-B α*i*F 8/4000	80	-	*
α*i*F 12/4000-B α*i*F 12/4000	80	-	*
α*i*F 22/3000-B α*i*F 22/3000	80	-	*

☐ β*i*S-B / β*i*F-B / β*i*S / β*i*F series (*1): Servo motor for peripheral axes

200 V series		Amplifiers	
Model name	**Compatible amplifiers [Ap]**	**2-axis β*i*SV-B**	**β*i*SVSP-B**
β*i*S 0.2/5000 (*1)	4	-	-
β*i*S 0.3/5000 (*1)	4	-	-
β*i*S 0.4/5000-B (*1) β*i*S 0.4/5000 (*1)	20	○	○
β*i*S 0.5/6000-B (*1) β*i*S 0.5/6000 (*1)	20	○	○
β*i*S 1/6000-B (*1) β*i*S 1/6000 (*1)	20	○	○
β*i*S 2/4000-B β*i*S 2/4000	20	○	○
β*i*Sc 2/4000-B β*i*Sc 2/4000	20	○	○
β*i*S 4/4000-B β*i*S 4/4000	20	○	○
β*i*Sc 4/4000-B β*i*Sc 4/4000	20	○	○
β*i*S 8/3000-B β*i*S 8/3000	20	○	○
β*i*Sc 8/3000-B β*i*Sc 8/3000	20	○	○
β*i*S 12/2000-B β*i*S 12/2000	20	○	○
β*i*Sc 12/2000-B β*i*Sc 12/2000	20	○	○
β*i*S 12/3000-B β*i*S 12/3000	40	*	*
β*i*Sc 12/3000-B β*i*Sc 12/3000	40	*	*
β*i*S 22/2000-B β*i*S 22/2000	40	*	*
β*i*Sc 22/2000-B β*i*Sc 22/2000	40	*	*
β*i*S 22/3000-B β*i*S 22/3000	80	-	*
β*i*S 30/2000-B β*i*S 30/2000	80	-	*
β*i*S 40/2000-B β*i*S 40/2000	80	-	*
β*i*F 4/3000-B β*i*F 4/3000	20	○	○
β*i*F 8/2000-B β*i*F 8/2000	20	○	○
β*i*F 12/2000-B β*i*F 12/2000	20	○	○
β*i*F 22/2000-B β*i*F 22/2000	40	*	*
β*i*F 30/1500-B β*i*F 30/1500	80	-	*

☐ D*i*S series

200 V series		Amplifiers	
Model name	**Compatible amplifiers [Ap]**	**2-axis β*i*SV-B**	**β*i*SVSP-B**
D*i*S 15/1000	20	○	○
D*i*S 60/400	40	*	*
D*i*S 70/300	40	*	*
D*i*S 150/300	80	-	*
D*i*S 200/300	80	-	*
D*i*S 250/300	80	-	*
D*i*S 60/2000	80	-	*
D*i*S 70/1500	80	-	*

Contact us for details on the stop distance of D*i*S series.

☐ L*i*S series

200 V series		Amplifiers	
Model name	**Compatible amplifiers [Ap]**	**2-axis β*i*SV-B**	**β*i*SVSP-B**
L*i*S 300A1/4	20	○	○
L*i*S 600A1/4	40	*	*
L*i*S 900A1/4	40	*	*
L*i*S 1500B1/4	40	*	*
L*i*S 3000B2/2	40	*	*
L*i*S 3000B2/4	80	-	*
L*i*S 4500B2/2	80	-	*
L*i*S 6000B2/2	80	-	*
L*i*S 3300C1/2	80	-	*
L*i*S 3000D1/2	80	-	*

Contact us for details on the stop distance of L*i*S series.

NOTE

Models compatible with amplifiers of 160 A or more (200 V series) and 80 A or more (400 V series) are lined up in α*i*-B amplifiers only.

L.3.3 Restrictions

β*i*-B amplifiers have restricted output due to the integrated structure with power supply. β*i*-B amplifiers needs to restrict output when driving DiS series synchronous built-in servo motors and LiS series linear motors.
Contact us for details when driving D*i*S / L*i*S series with β*i*-B amplifiers.

NOTE

There is no restrictions in motor output when driving α*i*-B / β*i*-B /α*i* / β*i* series servo motors with β*i* -B amplifiers.

L.3.4 Combinations Requiring Restrictions in Motor Output

Restrictions in motor output is necessary when driving D*i*S / L*i*S series with β*i*-B amplifiers. Combinations that require restrictions in motor output are listed below.

○ : Combinations that can achieve specifications described in D*i*S / L*i*S series DESCRIPTIONS.
** : Combinations that require restrictions in output of D*i*S / L*i*S series
- : No compatible amplifiers

□ D*i*S series

200 V series		Amplifiers				
Model name	Compatible amplifiers [Ap]	α*i*SV-B	α*i*SVP-B	1-axis β*i*SV-B	2-axis β*i*SV-B	β*i*SVSP-B
D*i*S 15/1000	20	○	○	**	**	**
D*i*S 60/400	40	○	-	○	**	○
D*i*S 70/300	40	○	-	○	**	○
D*i*S 150/300	80	○	-	**	-	**
D*i*S 200/300	80	○	-	**	-	**
D*i*S 250/300	80	○	-	**	-	**
D*i*S 60/2000	80	○	-	**	-	**
D*i*S 70/1500	80	○	-	**	-	**

400 V series		Amplifiers				
Model name	Compatible amplifiers [Ap]	α*i*SV-B	α*i*SVP-B	1-axis β*i*SV-B	2-axis β*i*SV-B	β*i*SVSP-B
D*i*S 15/1000	20	○	-	○	-	-
D*i*S 60/400	40	○	-	○	-	-
D*i*S 70/300	40	○	-	○	-	-

□ L*i*S series

200 V series		Amplifiers				
Model name	Compatible amplifiers [Ap]	α*i*SV-B	α*i*SVP-B	1-axis β*i*SV-B	2-axis β*i*SV-B	β*i*SVSP-B
L*i*S 300A1/4	20	○	○	○	○	○
L*i*S 600A1/4	40	○	-	○	○	○
L*i*S 900A1/4	40	○	-	○	○	○
L*i*S 1500B1/4	40	○	-	**	**	**
L*i*S 3000B2/2	40	○	-	**	**	**
L*i*S 3000B2/4	80	○	-	**	-	**
L*i*S 4500B2/2	80	○	-	**	-	**
L*i*S 6000B2/2	80	○	-	**	-	**
L*i*S 3300C1/2	80	○	-	○	-	○
L*i*S 3000D1/2	80	○	-	○	-	○

400 V series		Amplifiers				
Model name	Compatible amplifiers [Ap]	α*i*SV-B	α*i*SVP-B	1-axis β*i*SV-B	2-axis β*i*SV-B	β*i*SVSP-B
L*i*S 1500B1/4	40	○	-	**	-	-
L*i*S 3000B2/2	40	○	-	**	-	-
L*i*S 4500B2/2 HV	40	○	-	**	-	-
L*i*S 3000D1/2 HV	40	○	-	○	-	-
L*i*S 4500D1/2 HV	40	○	-	**	-	-
L*i*S 6000D1/2 HV	40	○	-	**	-	-

L.3.5 Seamless Combinations with Spindle Motors

Seamless combinations enable any spindle motor to combine with any amplifier.
Amplifiers that can drive a 22kW or more spindle motors are α*i*-B amplifiers only.
For details, see "PARAMETER MANUAL (B-65280EN)."

○ : Combinations that can achieve specifications described in α*i*I / β*i*I series DESCRIPTIONS.
- : No compatible amplifiers

☐ α*i*I series

200 V series		Amplifiers		
Model name	Smallest compatible amplifier [kW]	α*i*SP-B	α*i*SVP-B	β*i*SVSP-B
α*i*I 0.5/10000	2.2	○	○	○
α*i*I 1/10000	2.2	○	○	○
α*i*I 1.5/10000	5.5	○	○	○
α*i*I 2/10000	5.5	○	○	○
α*i*I 3/10000	5.5	○	○	○
α*i*I 6/10000	11	○	-	○
α*i*I 8/8000	11	○	-	○
α*i*I 12/7000	15	○	-	○
α*i*I 15/7000	18	○	-	○
α*i*I 1/15000	5.5	○	○	○
α*i*I 1.5/20000	15	○	-	○
α*i*I 2/20000	18	○	-	○
α*i*I 3/12000	11	○	-	○
α*i*I 6/12000	11	○	-	○
α*i*I 8/10000	11	○	-	○
α*i*I 8/12000	15	○	-	○
α*i*I 12/10000	15	○	-	○
α*i*I 12/12000	15	○	-	○
α*i*I 15/10000	18	○	-	○
α*i*I 15/12000	18	○	-	○
α*i*IP 12/6000	11	○	-	○
α*i*IP 12/8000	11	○	-	○
α*i*IP 15/6000	15	○	-	○
α*i*IP 15/8000	15	○	-	○
α*i*IP 18/6000	15	○	-	○
α*i*IP 18/8000	15	○	-	○
α*i*IP 1.5/20000	15	○	-	○
α*i*IT 2/20000	18	○	-	○
α*i*IT 3/12000	11	○	-	○
α*i*IT 6/12000	15	○	-	○
α*i*IT 8/12000	15	○	-	○

☐ αiI series

400 V series		Amplifiers	
Model name	Smallest compatible amplifier [kW]	α*i*SP-B	α*i*SVP-B
α*i*I 0.5/10000 HV	5.5	○	○
α*i*I 1/10000 HV	5.5	○	○
α*i*I 1.5/10000 HV	5.5	○	○
α*i*I 2/10000 HV	5.5	○	○
α*i*I 3/10000 HV	5.5	○	○
α*i*I 6/10000 HV	11	○	-
α*i*I 8/8000 HV	11	○	-
α*i*I 12/7000 HV	15	○	-
α*i*IP 15/6000 HV	15	○	-
α*i*IT 3/12000 HV	11	○	-
α*i*IT 6/12000 HV	15	○	-
α*i*IT 8/12000 HV	15	○	-

☐ αiI series (Power up model)

200 V series		Amplifiers		
Model name	Smallest compatible amplifier [kW]	α*i*SP-B	α*i*SVP-B	β*i*SVSP-B
α*i*I 0.5/10000	2.2	○	○	○
α*i*I 0.5/15000	2.2	○	○	○
α*i*I 1/10000	2.2	○	○	○
α*i*I 1.5/10000	5.5	○	○	○
α*i*I 2/10000	7.5	○	-	○
α*i*I 3/10000	7.5	○	-	○
α*i*I 6/10000	11	○	-	○
α*i*I 8/8000	15	○	-	○
α*i*I 12/7000	15	○	-	○(*1)
α*i*I 6/12000	11	○	-	○
α*i*I 8/10000	15	○	-	○
α*i*I 8/12000	15	○	-	○
α*i*I 12/12000	15	○	-	○(*1)
α*i*IP 12/6000	11	○	-	○
α*i*IP 15/6000	15	○	-	○
α*i*IP 18/6000	15	○	-	○
α*i*IT 6/12000	11	○	-	○
α*i*I 8/12000	15	○	-	○

☐ αiI series (Power up model)

400 V series		Amplifiers	
Model name	Smallest compatible amplifier [kW]	α*i*SP-B	α*i*SVP-B
α*i*I 6/10000 HV	11	○	-
α*i*I 8/8000 HV	15	○	-
α*i*I 12/7000 HV	15	○	-
α*i*I 15/7000 HV	22	○	-
α*i*I 22/7000 HV	30	○	-

☐ β*i*I series

200 V series		Amplifiers		
Model name	Smallest compatible amplifier [kW]	α*i*SP-B	α*i*SVP-B	β*i*SVSP-B
β*i*I 3/10000	5.5	○	○	○
β*i*I 6/10000	11	○	-	○
β*i*I 8/10000	11	○	-	○
β*i*I 12/8000	15	○	-	○
β*i*I 15/7000	18	○	-	○
β*i*IP 12/6000	7.5	○	○	○
β*i*IP 15/6000	11	○	-	○
β*i*IP 18/6000	11	○	-	○
β*i*IP 22/6000	15	○	-	○
β*i*IP 30/6000	18	○	-	○
β*i*IP 40/6000	18	○	-	○
β*i*IT 12/10000	15	○	-	○
β*i*IT 15/8000	18	○	-	○

(*1) β*i*SVSP*-18-B is required. Cannot derive in β*i*SVSP*-15-B.

☐ B*i*I / B*i*S series

Contact us for details on seamless combinations of built-in spindle motor B*i*I series and B*i*S series.

L.4 COMBINATIONS OF AMPLIFIERS AND MOTORS WITH DIFFERENT CURRENT CAPACITY

β*i*SVSP-B amplifiers has enabled combinations with β*i*-B / β*i* series servo motors whose class is one level lower than compatible amplifiers. Seamless combinations of amplifiers and motors enable a compatible amplifier to drive a servo motor whose class is one level lower than compatible amplifiers when driving α*i*-B / β*i*-B / α*i* / β*i* series servo motors with α*i*-B amplifier or β*i*-B amplifier.
Motor IDs are listed below. For details, see "PARAMETER MANUAL (B-65270EN)."

☐ α*i*S-B / α*i*F-B / α*i*S / α*i*F series

Model name	Compatible amplifiers [Ap]	Motor ID		Compatible amplifiers [Ap]	Motor ID
α*i*S 2/5000-B α*i*S 2/5000	20	262	→	40	502
α*i*S 2/6000-B α*i*S 2/6000	20	284	→	40	503
α*i*S 4/5000-B α*i*S 4/5000	20	265	→	40	504
α*i*S 4/6000-B α*i*S 4/6000	20	466	→	40	505
α*i*F 1/5000-B α*i*F 1/5000	20	252	→	40	500
α*i*F 2/5000-B α*i*F 2/5000	20	255	→	40	501
α*i*F 4/5000-B α*i*F 4/5000	40	273	→	80	498
α*i*F 8/3000-B α*i*F 8/3000	40	277	→	80	499

☐ β*i*S-B / β*i*F-B / β*i*S / β*i*F series

Model name	Compatible amplifiers [Ap]	Motor ID		Compatible amplifiers [Ap]	Motor ID
β*i*S 0.4/5000-B β*i*S 0.4/5000	20	280	→	40	506
β*i*S 0.5/6000-B β*i*S 0.5/6000	20	281	→	40	507
β*i*S 1/6000-B β*i*S 1/6000	20	282	→	40	508
β*i*S 2/4000-B β*i*S 2/4000	20	253	→	40	254
β*i*S 4/4000-B β*i*S 4/4000	20	256	→	40	257
β*i*S 8/3000-B β*i*S 8/3000	20	258	→	40	259
β*i*S 12/2000-B β*i*S 12/2000	20	269	→	40	268
β*i*S 12/3000-B β*i*S 12/3000	40	272	→	80	477
β*i*S 22/2000-B β*i*S 22/2000	40	274	→	80	478
β*i*Sc 2/4000-B β*i*Sc 2/4000	20	306	→	40	310
β*i*Sc 4/4000-B β*i*Sc 4/4000	20	311	→	40	312
β*i*Sc 8/3000-B β*i*Sc 8/3000	20	283	→	40	294
β*i*Sc 12/2000-B β*i*Sc 12/2000	20	298	→	40	300
β*i*Sc 12/3000-B β*i*Sc 12/3000	40	496	→	80	497
β*i*Sc 22/2000-B β*i*Sc 22/2000	40	481	→	80	482
β*i*F 4/3000-B β*i*F 4/3000	20	483	→	40	484
β*i*F 8/2000-B β*i*F 8/2000	20	485	→	40	486
β*i*F 12/2000-B β*i*F 12/2000	20	487	→	40	488
β*i*F 22/2000-B β*i*F 22/2000	40	489	→	80	490

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REVISION RECORD

Edition	Date	Contents
02	Sep. 2016	- Added Level-up αi-B series. - Partially modified Chapter 6 HEAT DISSIPATION. - Reflected the appendices to edition 01 in the main body of this document.
01	Sep. 2012	

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