GE Fanuc Automation

Computer Numerical Control Products

Alpha Series AC Servo Motor

Maintenance Manual

GFZ-65165E/02 *June 2000*

Warnings, Cautions, and Notes as Used in this Publication

Warning

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

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

Caution

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

Note

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

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

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FANUC

GE Fanuc Automation

Computer Numerical Control Products

α *Series Control Motor*

Maintenance Manual

GFZ-65165E/01 *April 1994*

SAFETY PRECAUTIONS

This "Safety Precautions" section describes the precautions which must be observed to ensure safety when using FANUC servo motors (including spindle motors) and servo amplifiers (including spindle amplifiers). Users of any servo motor or amplifier model are requested to read the "Safety Precautions" carefully before using the servo motor or amplifier.
The users are also requested to read an applicable specification manual carefully and understand each function of the motor or amplifier for correct use.
The users are basically forbidden to do any behavior or action not mentioned in the "Safety Precautions." They are invited to ask FANUC previously about what behavior or action is prohibited.

Contents

1 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 damage 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.

2 FANUC SERVO MOTOR series

2.1 WARNING

- **Be safely dressed when handling a motor.**
  Wear safety shoes or gloves when handling a motor as you may get hurt on any edge or protrusion on it or electric shocks.

- **Use a crane or lift to move a motor from one place to another.**
  Motors are heavy. When moving them, use a crane or lift as required. (For the weight of motors, refer to their respective specification manuals.)
  When moving a motor using a crane or lift, use a hanging bolt if the motor has a corresponding tapped hole, or textile rope if it has no tapped hole.
  If a motor is attached with a machine or any other heavy stuff, do not use a hanging bolt to move the motor as the hanging bolt and/or motor may get broken.
  When moving a motor, be careful not to apply excessive force to its windings as the windings may break and/or their insulation may deteriorate.

- **Do not touch a motor with a wet hand.**
  A failure to observe this caution is vary dangerous because you may get electric shocks.

- **Before starting to connect a motor to electric wires, make sure they are isolated from an electric power source.**
  A failure to observe this caution is vary dangerous because you may get electric shocks.

- **Do not bring any dangerous stuff near a motor.**
  Motors are connected to a power line, and may get hot. If a flammable is placed near a motor, it may be ignited, catch fire, or explode.

- **Be sure to ground a motor frame.**
  To avoid electric shocks, be sure to connect the grounding terminal in the terminal box to the grounding terminal of the machine.

- **Do not ground a motor power wire terminal or short-circuit it to another power wire terminal.**
  A failure to observe this caution may cause electric shocks or a burned wiring.
  (*) Some motors require a special connection such as a winding changeover. Refer to their respective motor specification manuals for details.

- **Connect power wires securely so that they will not get loose.**
  A failure to observe this caution may cause a wire to be disconnected, resulting in a ground fault, short circuit, or electric shock.

- **Do not supply the power to the motor while any terminal is exposed.**
  A failure to observe this caution is very dangerous because you may get electric shocks if your body or any conductive stuff touches an exposed terminal.

- **Do not get close to a rotary section of a motor when it is rotating.**
  A rotating part may catch your cloths or fingers. Before starting a motor, ensure that there is no stuff that can fly away (such as a key) on the motor.

- **Before touching a motor, shut off the power to it.**
  Even if a motor is not rotating, there may be a voltage across the terminals of the motor.
  Especially before touching a power supply connection, take sufficient precautions.
  Otherwise you may get electric shocks.

- **Do not touch any terminal of a motor for a while (at least 5 minutes) after the power to the motor is shut off.**
  High voltage remains across power line terminals of a motor for a while after the power to the motor is shut off. So, do not touch any terminal or connect it to any other equipment. Otherwise, you may get electric shocks or the motor and/or equipment may get damaged.

- **To drive a motor, use a specified amplifier and parameters.**
  An incorrect combination of a motor, amplifier, and parameters may cause the motor to behave unexpectedly. This is dangerous, and the motor may get damaged.

- **Do not touch a motor when it is running or immediately after it stops.**
  A motor may get hot when it is running. Do not touch the motor before it gets cool enough. Otherwise, you may get burned.

- **Ensure that motors and related components are mounted securely.**
  If a motor or its component slips out of place or comes off when the motor is running, it is very dangerous.

- **Be careful not get your hair or cloths caught in a fan.**
  Be careful especially for a fan used to generate an inward air flow.
  Be careful also for a fan even when the motor is stopped, because it continues to rotate while the amplifier is turned on.

2.2 CAUTION

- **FANUC motors are designed for use with machines. Do not use them for any other purpose.**
  If a FANUC motor is used for an unintended purpose, it may cause an unexpected symptom or trouble. If you want to use a motor for an unintended purpose, previously consult with FANUC.

- **Ensure that a base or frame on which a motor is mounted is strong enough.**
  Motors are heavy. If a base or frame on which a motor is mounted is not strong enough, it is impossible to achieve the required precision.

- **Be sure to connect motor cables correctly.**
  An incorrect connection of a cable cause abnormal heat generation, equipment malfunction, or failure. Always use a cable with an appropriate current carrying capacity (or thickness). For how to connect cables to motors, refer to their respective specification manuals.

- **Ensure that motors are cooled if they are those that require forcible cooling.**
  If a motor that requires forcible cooling is not cooled normally, it may cause a failure or trouble. For a fan-cooled motor, ensure that it is not clogged or blocked with dust and dirt. For a liquid-cooled motor, ensure that the amount of the liquid is appropriate and that the liquid piping is not clogged.
  For both types, perform regular cleaning and inspection.

- **When attaching a component having inertia, such as a pulley, to a motor, ensure that any imbalance between the motor and component is minimized.**
  If there is a large imbalance, the motor may vibrates abnormally, resulting in the motor being broken.

- **Be sure to attach a key to a motor with a keyed shaft.**
  If a motor with a keyed shaft runs with no key attached, it may impair torque transmission or cause imbalance, resulting in the motor being broken.

2.3 NOTE

- **Do not step or sit on a motor.**
  If you step or sit on a motor, it may get deformed or broken. Do not put a motor on another unless they are in packages.

- **When storing a motor, put it in a dry (non-condensing) place at room temperature (0 to 40 5C).**
  If a motor is stored in a humid or hot place, its components may get damaged or deteriorated. In addition, keep a motor in such a position that its shaft is held horizontal and its terminal box is at the top.

- **Do not remove a nameplate from a motor.**
  If a nameplate comes off, be careful not to lose it. If the nameplate is lost, the motor becomes unidentifiable, resulting in maintenance becoming impossible.
  For a nameplate for a built-in spindle motor, keep the nameplate with the spindle.

- **Do not apply shocks to a motor or cause scratches to it.**
  If a motor is subjected to shocks or is scratched, its components may be adversely affected, resulting in normal operation being impaired. Be very careful when handling plastic portions, sensors, and windings, because they are very liable to break. Especially, avoid lifting a motor by pulling its plastic portion, winding, or power cable.

- **Do not conduct dielectric strength or insulation test for a detector.**
  Such a test can damage elements in the detector.

- **When testing the winding or insulation resistance of a motor, satisfy the conditions stipulated in IEC34.**
  Testing a motor under a condition severer than those specified in IEC34 may damage the motor.

- **Do not disassemble a motor.**
  Disassembling a motor may cause a failure or trouble in it.
  If disassembly is in need because of maintenance or repair, please contact a service representative of FANUC.

- **Do not modify a motor.**
  Do not modify a motor unless directed by FANUC. Modifying a motor may cause a failure or trouble in it.

- **Use a motor under an appropriate environmental condition.**
  Using a motor in an adverse environment may cause a failure or trouble in it.
  Refer to their respective specification manuals for details of the operating and environmental conditions for motors.

- **Do not apply a commercial power source voltage directly to a motor.**
  Applying a commercial power source voltage directly to a motor may result in its windings being burned. Be sure to use a specified amplifier for supplying voltage to the motor.

- **For a motor with a terminal box, make a conduit hole for the terminal box in a specified position.**
  When making a conduit hole, be careful not to break or damage unspecified portions.
  Refer to an applicable specification manual.

- **Before using a motor, measure its winding and insulation resistances, and make sure they are normal.**
  Especially for a motor that has been stored for a prolonged period of time, conduct these checks. A motor may deteriorate depending on the condition under which it is stored or the time during which it is stored. For the winding resistances of motors, refer to their respective specification manuals, or ask FANUC. For insulation resistances, see the following table.

- **To use a motor as long as possible, perform periodic maintenance and inspection for it, and check its winding and insulation resistances.**
  Note that extremely severe inspections (such as dielectric strength tests) of a motor may damage its windings. For the winding resistances of motors, refer to their respective specification manuals, or ask FANUC. For insulation resistances, see the following table.

MOTOR INSULATION RESISTANCE MEASUREMENT

Measure an insulation resistance between each winding and motor frame using an insulation resistance meter (500 VDC). Judge the measurements according to the following table.

Insulation resistance	Judgment
100MΩ or higher	Acceptable
10 to 100 MΩ	The winding has begun deteriorating. There is no problem with the performance at present. Be sure to perform periodic inspection.
1 to 10 MΩ	The winding has considerably deteriorated. Special care is in need. Be sure to perform periodic inspection.
Lower than 1 MΩ	Unacceptable. Replace the motor.

3 FANUC SERVO AMPLIFIER series

3.1 WARNINGS AND CAUTIONS RELATING TO MOUNTING

3.1.1 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.**
  Control motor amplifiers and AC reactors are heavy. When transporting them or mounting them in the cabinet, therefore, be careful not to injured yourself or damage the equipment. Be particularly carefull not to jam your fingers between the cabinet and amplifier.

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

- **Ensure that the power supply lines, power lines, and signal lines are securely connected.**
  A loose screw, loose connection, or the like will cause a motor malfunction or overheating, or a ground fault.

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

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

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

- **Do not disassemble the amplifier.**

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

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

3.1.2 CAUTION

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

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

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

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

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

- **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.

- **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.

3.1.3 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.

3.2 WARNINGS AND CAUTIONS RELATING TO A PILOT RUN

3.2.1 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.

- **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.**

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

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

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

3.3 WARNINGS AND CAUTIONS RELATING TO MAINTENANCE

3.3.1 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 pulse coder**
  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 series servo amplifier modules have batteries in their servo amplifiers. To replace the battery of any of those models, observe the following procedure: Open the door of the power magnetics cabinet; Leave the control power of the power supply module on; Place the machine in the emergency stop state so that the power being input to the amplifier is shut off; Then, replace the battery. Replacement work should be done only by a person who is trained in the related maintenance and safety requirements. The power 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 number of any alarm.**
  If the machine stops upon an alarm being issued, check the alarm number. Some alarms indicate that a component must be replaced. If the power is reconnected without first replacing the failed component, another component may be damaged, making it difficult to locate the original cause of the alarm.

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

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

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

3.3.2 CAUTION

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

- **Tighten all screws firmly.**

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

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

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

3.3.3 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.

PREFACE

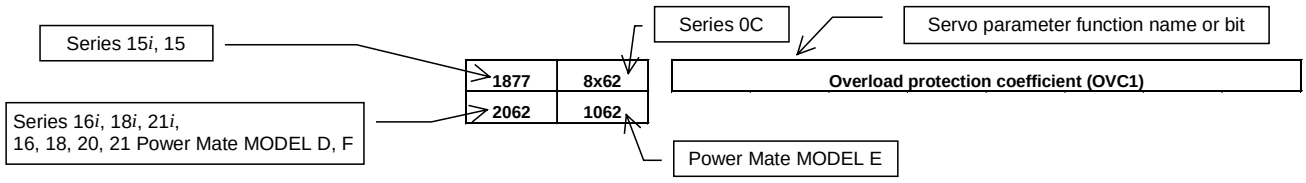
Organization of Parts I and II

This manual describes information necessary to maintain FANUC servo amplifier α series products, such as a power supply module, servo amplifier module, and spindle amplifier module.
Part I explains the start-up procedure, and part II focuses on troubleshooting.

The abbreviations listed below are used in this manual.

Product name	Abbreviations
FANUC Series 0-TC	FS0-TC
FANUC Series 0-MC	FS0-MC
FANUC Series 15*i*, 15	FS15*i*, FS15
FANUC Series 16*i*, 16	FS16*i*, FS16
FANUC Series 18*i*, 18	FS18*i*, FS18
FANUC Series 20	FS20
FANUC Series 21*i*, 21	FS21*i*, FS21
FANUC Power Mate-MODEL E	PM-E
FANUC Power Mate-MODEL D	PM-D
FANUC Power Mate-MODEL F	PM-F
Power Supply Module	PSM
Servo Amplifier Module	SVM
Spindle Amplifier Module	SPM

* In this manual, the parameter numbers of servo parameters are sometimes indicated without CNC product names as follows:



* The manuals shown below provide information related to this manual. This manual may refer you to these manuals.

1) FANUC SERVO AMPLIFIER α series Descriptions
B-65162E
2) FANUC AC SERVO MOTOR α series Parameter Manual
B-65150E
3) FANUC AC SPINDLE MOTOR α series Parameter Manual
B-65160E

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II. TROUBLESHOOTING

III. MOTOR MAINTENANCE

I. START-UP PROCEDURE

1 OVERVIEW

This part describes the units and components of the FANUC servo amplifier α series. It also explains the following information necessary to start up the control motor amplifier:

- Connecting the power
- Setting the printed-circuit board
- Initializing the parameter
- Confirmation of the operation

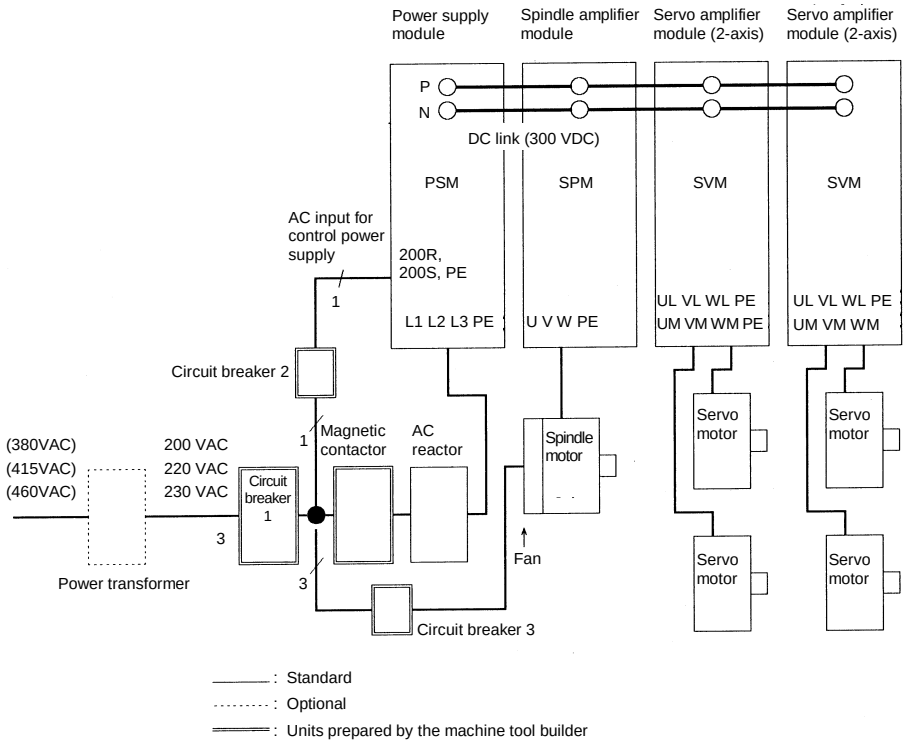
2 CONFIGURATIONS

2.1 CONFIGURATIONS

The FANUC servo amplifier α series consists of the units and components listed below:

(1) Power supply module (PSM) (basic)
(2) Servo amplifier module (SVM) (basic)
(3) Spindle amplifier module (SPM) (basic)
(4) AC reactor (basic)
(5) Connectors (for connecting cables) (basic)
(6) Fuses (basic)
(7) Power transformer (option)
(8) Fan adaptor (option)

The diagram below shows an example of a basic configuration of the FANUC servo amplifier α series system. The basic configuration consists of two two-axis servo amplifier modules and one spindle amplifier module.



NOTE
1 Refer to the Servo Amplifier α series Descriptions (B-65162E) for combinations of the power supply module, servo amplifier module, and spindle amplifier module.
2 Always use the circuit breakers, magnetic contactor, and AC reactor.
3 Install a surge suppressor between the power lines and between each power line and a ground at the input of the power magnetics cabinet to protect the system from lightning surge.

2.2 MAJOR COMPONENTS

2.2.1 Power Supply Modules

2.2.1.1 α series power supply modules

(1) Power supply modules (PSM) (200 VAC input, power regeneration type), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	Driver board specification	Connector board specification
PSM-5.5	A06B-6077-H106 (Revision B or later)	A06B-6077-C106 (Revision B or later)	A16B-2202-0661	A16B-2202-0420 (Revision 05D or later)		
	A06B-6077-H106#BM			A16B-2202-0423		
PSM-11	A06B-6077-H111 (Revision B or later)	A06B-6077-C111 (Revision B or later)		A16B-2202-0420 (Revision 05D or later)		
	A06B-6077-H111#BM			A16B-2202-0423		
PSM-15	A06B-6087-H115 (Revision B or later)	A06B-6087-C115 (Revision B or later)	A20B-1006-0470	A16B-2202-0421 (Revision 05D or later)	A20B-2902-0390	
	A06B-6087-H115#BM			A16B-2202-0424		
PSM-26	A06B-6087-H126 (Revision B or later)	A06B-6087-C126 (Revision B or later)	A20B-1006-0471	A16B-2202-0421 (Revision 05D or later)		
	A06B-6087-H126#BM			A16B-2202-0424		
PSM-30	A06B-6087-H130 (Revision B or later)	A06B-6087-C130 (Revision B or later)	A20B-1006-0472	A16B-2202-0421 (Revision 05D or later)		
	A06B-6087-H130#BM			A16B-2202-0424		
PSM-37	A06B-6087-H137	A06B-6087-C137		A16B-2202-0421		
	A06B-6087-H137#BM			A16B-2202-0424		
PSM-45	A06B-6087-H145	A06B-6087-C145	A20B-1006-0680	A16B-2202-0421	A20B-2002-0080	
			A20B-1007-0650			
	A06B-6087-H145#BM		A20B-1006-0680	A16B-2202-0424		
			A20B-1007-0650			
PSM-55	A06B-6087-H155	A06B-6087-C155	A20B-1007-0650	A16B-2202-0421		
	A06B-6087-H155#BM			A16B-2202-0424		

* The PSM-45 has been replaced by the PSM-55 (as of August 1999).

(2) Power supply modules (PSMR) (200 VAC input, resistance discharge type), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
PSMR-3	A06B-6081-H103 (Revision C or later)	A06B-6081-C103	A16B-2202-0542 (Revision 06B or later)	A16B-2001-0890
PSMR-5.5	A06B-6081-H106 (Revision C or later)	A06B-6081-C106	A16B-2202-0541 (Revision 06B or later)	A16B-2001-0890

(3) Power supply modules (PSM) (200 VAC input, power regeneration type), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	Driver board specification	Connector board specification
PSM-5.5	A06B-6077-H106 (Revision A)	A06B-6077-C106 (Revision A)	A16B-2202-0460	A16B-2202-0420 (Revision 04C or earlier)		
			A16B-2202-0461			
PSM-11	A06B-6077-H111 (Revision A)	A06B-6077-C111 (Revision A)	A16B-2202-0461			
PSM-15	A06B-6077-H115	A06B-6071-C112	A20B-1005-0591	A16B-2202-0080	A20B-2001-0011	A20B-2001-0130
	A06B-6087-H115 (Revision A)	A06B-6087-C115 (Revision A)	A20B-1006-0160	A16B-2202-0421 (Revision 04C or earlier)	A20B-2902-0280	
PSM-26	A06B-6077-H126	A06B-6071-C122	A20B-1005-0590	A16B-2202-0080	A20B-2001-0011	A20B-2001-0130
	A06B-6087-H126 (Revision B or earlier)	A06B-6087-C126 (Revision B or earlier)	A20B-1006-0161	A16B-2202-0421 (Revision 04C or earlier)	A20B-2902-0280	
PSM-30	A06B-6077-H130	A06B-6071-C126	A20B-1005-0592	A16B-2202-0080	A20B-2001-0011	A20B-2001-0130
	A06B-6087-H130 (Revision B or earlier)	A06B-6087-C130 (Revision B or earlier)	A20B-1006-0162	A16B-2202-0421 (Revision 04C or earlier)	A20B-2902-0280	

(4) Power supply modules (PSMR) (200 VAC input, resistance discharge type), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
PSMR-3	A06B-6081-H103 (Revision B or earlier)	A06B-6081-C103 (Revision B or earlier)	A16B-2202-0542 (Revision 05A or earlier)	A16B-2300-0100
PSMR-5.5	A06B-6081-H106 (Revision B or earlier)	A06B-6081-C106 (Revision B or earlier)	A16B-2202-0541 (Revision 05A or earlier)	A16B-2300-0100

2.2.1.2 α (HV) series power supply modules

(1) Power supply modules (PSM-HV) (400 VAC input, power regeneration type)

Model	Order specification	Unit specification	Wiring board specification	Driver board specification	Printed circuit board specification
PSM-18HV	A06B-6091-H118	A06B-6091-C118	A20B-1006-0611	A20B-2002-0080	A16B-2202-0422
PSM-30HV	A06B-6091-H130	A06B-6091-C130	A20B-1006-0610		
PSM-45HV	A06B-6091-H145	A06B-6091-C145	A20B-1006-0612		
PSM-75HV	A06B-6091-H175	A06B-6091-C175	A20B-1006-0681		
			A20B-1007-0651		

(2) Capacitor modules (PSMC-HV) (for the PSM-HV series)

Model	Order specification	Unit specification	Capacitor specification	
PSMC-18HV	A06B-6083-H218	A06B-6083-C218	A42L-0001-0340	(× 2)
PSMC-30HV	A06B-6083-H230	A06B-6083-C230	A42L-0001-0314	(× 2)
PSMC-45HV	A06B-6083-H245	A06B-6083-C245	A42L-0001-0322	(× 2)

(3) Power supply module (PSMV-HV) (400 VAC input, 300 VDC output, power regeneration type)

Model	Order specification	Unit specification	Wiring board specification	Driver board specification	Printed circuit board specification
PSMV-11HV	A06B-6098-H111	A06B-6098-C111	A20B-1007-0200	A20B-2002-0530	A16B-2203-0220

(4) AC reactor unit (PSMV-HV)

Order specification	Unit specification	AC reactor	Fuse
A06B-6098-H001	A06B-6098-C001	A81L-0001-0144	A60L-0001-0362#100U

2.2.2 Servo Amplifier Modules

2.2.2.1 200-V input series

(1) Single-axis servo amplifier modules (interface: Type A/B)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM1-2	A06B-6079-H121	A16B-2202-0742	A20B-2001-0930	
SVM1-4	A06B-6079-H122	A16B-2202-0743		
SVM1-12	A06B-6079-H101	A16B-2202-0740		
SVM1-20	A06B-6079-H102	A16B-2202-0741		
SVM1-40S	A06B-6079-H103	A16B-2203-0450 (A16B-2202-0760)		Enclosed in parentheses are the drawing numbers of the old specifications.
SVM1-40L	A06B-6079-H104	A16B-2203-0451 (A16B-2202-0761)		
SVM1-80	A06B-6079-H105	A16B-2203-0452 (A16B-2202-0762)		
SVM1-130	A06B-6079-H106	A16B-2203-0454 (A16B-2202-0790)	A20B-2001-0932	
SVM1-240	A06B-6079-H107	A20B-1006-0485	A16B-2202-0990	
SVM1-360	A06B-6079-H108	A20B-1006-0485	A16B-2202-0991	

(2) Two-axis servo amplifier modules (interface: Type A/B)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM2-3/3	A06B-6079-H291	A16B-2202-0753	A20B-2001-0931	
SVM2-12/12	A06B-6079-H201	A16B-2202-0750		
SVM2-12/20	A06B-6079-H202	A16B-2202-0751		
SVM2-20/20	A06B-6079-H203	A16B-2202-0752		
SVM2-12/40	A06B-6079-H204	A16B-2203-0590 (A16B-2202-0770)		Enclosed in parentheses are the drawing numbers of the old specifications.
SVM2-20/40	A06B-6079-H205	A16B-2203-0591 (A16B-2202-0771)		
SVM2-40/40	A06B-6079-H206	A16B-2203-0592 (A16B-2202-0772)		
SVM2-40/80	A06B-6079-H207	A16B-2203-0593 (A16B-2202-0773)	A20B-2001-0933	
SVM2-80/80	A06B-6079-H208	A16B-2203-0594 (A16B-2202-0774)		
SVM2-40L/40L	A06B-6079-H209	A16B-2203-0595 (A16B-2202-0775)		

(3) Three-axis servo amplifier modules (interface: Type A)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM3-12/12/12	A06B-6079-H301	A16B-2202-0780	A20B-2001-0940	
SVM3-12/12/20	A06B-6079-H302	A16B-2202-0781		
SVM3-12/20/20	A06B-6079-H303	A16B-2202-0782		
SVM3-20/20/20	A06B-6079-H304	A16B-2202-0783		
SVM3-12/12/40	A06B-6079-H305	A16B-2202-0784		
SVM3-12/20/40	A06B-6079-H306	A16B-2202-0785		
SVM3-20/20/40	A06B-6079-H307	A16B-2202-0786		

(4) Three-axis servo amplifier modules (interface: Type B)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM3-12/12/12	A06B-6080-H301	A16B-2202-0780	A20B-2001-0950	
SVM3-12/12/20	A06B-6080-H302	A16B-2202-0781		
SVM3-12/20/20	A06B-6080-H303	A16B-2202-0782		
SVM3-20/20/20	A06B-6080-H304	A16B-2202-0783		
SVM3-12/12/40	A06B-6080-H305	A16B-2202-0784		
SVM3-12/20/40	A06B-6080-H306	A16B-2202-0785		
SVM3-20/20/40	A06B-6080-H307	A16B-2202-0786		

(5) Single-axis servo amplifier module (interface: FSSB)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM1-2	A06B-6096-H121	A16B-2202-0742	A20B-2100-0540 (A20B-2100-0250)	When using HRV3, use the following boards together: Wiring board: A16B-2202-074X Printed circuit board: A20B-2100-054X
SVM1-4	A06B-6096-H122	A16B-2202-0743		
SVM1-12	A06B-6096-H101	A16B-2202-0740		
SVM1-20	A06B-6096-H102	A16B-2202-0741		
SVM1-40S	A06B-6096-H103	A16B-2203-0450 (A16B-2202-0760)	A20B-2100-0540 (A20B-2100-0250)	When using HRV3, use the following boards together: Wiring board: A16B-2203-045X Printed circuit board: A20B-2100-054X
SVM1-40L	A06B-6096-H104	A16B-2203-0451 (A16B-2202-0761)		
SVM1-80	A06B-6096-H105	A16B-2203-0452 (A16B-2202-0762)		
SVM1-130S	A06B-6096-H116	A16B-2203-0453		
SVM1-130	A06B-6096-H106	A16B-2203-0454 (A16B-2202-0790)	A20B-2100-0542 (A20B-2100-0252)	
SVM1-240	A06B-6096-H107	A20B-1006-0485	A16B-2203-0300	
SVM1-360	A06B-6096-H108	A20B-1006-0485	A16B-2203-0301	

(6) Two-axis servo amplifier modules (interface: FSSB)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM2-3/3	A06B-6096-H291	A16B-2202-0753	A20B-2100-0541 (A20B-2100-0251)	When using HRV3, use the following boards together: Wiring board: A16B-2202-075X Printed circuit board: A20B-2100-054X
SVM2-12/12	A06B-6096-H201	A16B-2202-0750		
SVM2-12/20	A06B-6096-H202	A16B-2202-0751		
SVM2-20/20	A06B-6096-H203	A16B-2202-0752		
SVM2-12/40	A06B-6096-H204	A16B-2203-0590 (A16B-2202-0770)	A20B-2100-0541 (A20B-2100-0251)	When using HRV3, use the following boards together: Wiring board: A16B-2203-059X Printed circuit board: A20B-2100-054X
SVM2-20/40	A06B-6096-H205	A16B-2203-0591 (A16B-2202-0771)		
SVM2-40/40	A06B-6096-H206	A16B-2203-0592 (A16B-2202-0772)		
SVM2-40/80	A06B-6096-H207	A16B-2203-0593 (A16B-2202-0773)	A20B-2100-0543 (A20B-2100-0253)	
SVM2-80/80	A06B-6096-H208	A16B-2203-0594 (A16B-2202-0774)		
SVM2-40L/40L	A06B-6096-H209	A16B-2203-0595 (A16B-2202-0775)		

(7) Three-axis servo amplifier modules (interface: FSSB)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM3-12/12/12	A06B-6096-H301	A16B-2202-0780	A20B-2100-0260	
SVM3-12/12/20	A06B-6096-H302	A16B-2202-0781		
SVM3-12/20/20	A06B-6096-H303	A16B-2202-0782		
SVM3-20/20/20	A06B-6096-H304	A16B-2202-0783		
SVM3-12/12/40	A06B-6096-H305	A16B-2202-0784		
SVM3-12/20/40	A06B-6096-H306	A16B-2202-0785		
SVM3-20/20/40	A06B-6096-H307	A16B-2202-0786		

2.2.2.2 400-V input series

(1) Single-axis servo amplifier modules (interface: Type A/B)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM1-20HV	A06B-6085-H102	A16B-2202-0800	A20B-2001-0932	
SVM1-40HV	A06B-6085-H103	A16B-2202-0801		
SVM1-60HV	A06B-6085-H104	A16B-2202-0802		

(2) Two-axis servo amplifier modules (interface: Type A/B)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM2-20/20HV	A06B-6085-H201	A16B-2203-0210	A20B-2001-0933	
SVM2-20/40HV	A06B-6085-H202	A16B-2203-0211		
SVM2-20/60HV	A06B-6085-H203	A16B-2203-0212		
SVM2-40/40HV	A06B-6085-H204	A16B-2203-0213		
SVM2-40/60HV	A06B-6085-H205	A16B-2203-0214		
SVM2-60/60HV	A06B-6085-H206	A16B-2203-0215		

(3) Single-axis servo amplifier modules (interface: FSSB)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM1-20HV	A06B-6097-H102	A16B-2202-0800	A20B-2100-0542 (A20B-2100-0252)	
SVM1-40HV	A06B-6097-H103	A16B-2202-0801		
SVM1-60HV	A06B-6097-H104	A16B-2202-0802		Enclosed in parentheses is the drawing number of the old specification.
SVM1-80HV	A06B-6097-H105	A16B-2202-0803		
SVM1-320HV	A06B-6097-H107	A20B-1007-0592	A16B-2203-0301	

(4) Two-axis servo amplifier modules (interface: FSSB)

Model	Order specification	Wiring board specification	Printed circuit board specification	Remarks
SVM2-20/20HV	A06B-6097-H201	A16B-2203-0210	A20B-2100-0543 (A20B-2100-0253)	
SVM2-20/40HV	A06B-6097-H202	A16B-2203-0211		
SVM2-20/60HV	A06B-6097-H203	A16B-2203-0212		
SVM2-40/40HV	A06B-6097-H204	A16B-2203-0213		Enclosed in parentheses is the drawing number of the old specification.
SVM2-40/60HV	A06B-6097-H205	A16B-2203-0214		
SVM2-60/60HV	A06B-6097-H206	A16B-2203-0215		

2.2.3 Spindle Amplifier Modules

2.2.3.1 α series spindle amplifier modules

The order specification varies according to the detector (function) used.

(1) α series spindle amplifier modules (SPM) type 1 (standard specification)

New specification (supporting spindle HRV control), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-2.2	A06B-6102-H202#H520	A06B-6102-H202	A16B-2202-0680	A16B-2203-0500	A06B-6102-H520 (9D20)
SPM-5.5	A06B-6102-H206#H520	A06B-6102-H206	A16B-2202-0681	A16B-2203-0501	
SPM-11	A06B-6102-H211#H520	A06B-6102-H211	A16B-2202-0682		
SPM-15	A06B-6102-H215#H520	A06B-6102-H215	A20B-1006-0486 A20B-2902-0390	A16B-2203-0502	
SPM-22	A06B-6102-H222#H520	A06B-6102-H222	A20B-1006-0487 A20B-2902-0390		
SPM-26	A06B-6102-H226#H520	A06B-6102-H226	A20B-1006-0488 A20B-2902-0390		
SPM-30	A06B-6102-H230#H520	A06B-6102-H230	A20B-1006-0489 A20B-2902-0390		
SPM-45	A06B-6102-H245#H520	A06B-6102-H245	A20B-1007-0591 A20B-2002-0080		
SPM-55	A06B-6102-H255#H520	A06B-6102-H255	A20B-1007-0590 A20B-2002-0081		

CE-marked products

Model	Order specification	Unit specification	Wiring board specification(*1)	Printed circuit board specification(*1)	ROM (series)
SPM-2.2	A06B-6078-H202#H500	A06B-6078-H202	A16B-2202-0680	A16B-2203-0330 (A16B-2202-0430)	A06B-6072-H500 (9D00, 9D0A)
SPM-5.5	A06B-6078-H206#H500	A06B-6078-H206	A16B-2202-0681	A16B-2203-0331 (A16B-2202-0431)	
SPM-11	A06B-6078-H211#H500	A06B-6078-H211	A16B-2202-0682		
SPM-15	A06B-6088-H215#H500	A06B-6088-H215	A20B-1006-0486 (A20B-1006-0480) A20B-2902-0390	A16B-2203-0332 (A16B-2202-0432)	
SPM-22	A06B-6088-H222#H500	A06B-6088-H222	A20B-1006-0487 (A20B-1006-0481) A20B-2902-0390		
SPM-26	A06B-6088-H226#H500	A06B-6088-H226	A20B-1006-0488 (A20B-1006-0482) A20B-2902-0390		
SPM-30	A06B-6088-H230#H500	A06B-6088-H230	A20B-1006-0489 (A20B-1006-0483) A20B-2902-0390		
SPM-45	A06B-6088-H245#H500	A06B-6088-H245	A20B-1007-0591 (A20B-1006-0690) A20B-2002-0080		

*1 Enclosed in parentheses are the drawing numbers of the old specifications.

Non-CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification(*1)	ROM (series)
SPM-2.2	A06B-6078-H202#H500	A06B-6078-H202	A16B-2202-0470	A16B-2203-0330 (A16B-2202-0430)	A06B-6072-H500 (9D00, 9D0A)
SPM-5.5	A06B-6078-H206#H500	A06B-6078-H206	A16B-2202-0471	A16B-2203-0331 (A16B-2202-0431)	
SPM-11	A06B-6078-H211#H500	A06B-6078-H211	A16B-2202-0472		
SPM-15	A06B-6088-H215#H500	A06B-6088-H215	A20B-1006-0170 A20B-2902-0280	A16B-2203-0332 (A16B-2202-0432)	
SPM-22	A06B-6088-H222#H500	A06B-6088-H222	A20B-1006-0171 A20B-2902-0280		
SPM-26	A06B-6088-H226#H500	A06B-6088-H226	A20B-1006-0172 A20B-2902-0280		

Non-CE-marked products (old specifications)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-15	A06B-6078-H215#H500	A06B-6078-H215	A20B-1005-0572 A20B-2001-0010	A16B-2202-0070 A20B-2001-0150 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-22	A06B-6078-H222#H500	A06B-6078-H222	A20B-1005-0571 A20B-2001-0010		
SPM-26	A06B-6078-H226#H500	A06B-6078-H226	A20B-1005-0570 A20B-2001-0010		
SPM-30	A06B-6078-H230#H500	A06B-6078-H230	A20B-1005-0575 A20B-2001-0010		

Applicable detectors

<1> M sensor (pulse generator), position coder, magnetic sensor

<2> MZ sensor (sensor built into a motor)

*1 Enclosed in parentheses are the drawing numbers of the old specifications.

(2) α series spindle amplifier modules (SPM), type 2 (Cs contour control/BZ sensor (separate built-in sensor) specification)

CE-marked products

Model	Order specification	Unit specification	Wiring board specification(*1)	Printed circuit board specification	ROM (series)
SPM-2.2	A06B-6078-H302#H500	A06B-6078-H302	A16B-2202-0680	A16B-2202-0433 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-5.5	A06B-6078-H306#H500	A06B-6078-H306	A16B-2202-0681	A16B-2202-0434 A20B-2901-0851	
SPM-11	A06B-6078-H311#H500	A06B-6078-H311	A16B-2202-0682		
SPM-15	A06B-6088-H315#H500	A06B-6088-H315	A20B-1006-0486 (A20B-1006-0480) A20B-2902-0390	A16B-2202-0435 A20B-2901-0851	
SPM-22	A06B-6088-H322#H500	A06B-6088-H322	A20B-1006-0487 (A20B-1006-0481) A20B-2902-0390		
SPM-26	A06B-6088-H326#H500	A06B-6088-H326	A20B-1006-0488 (A20B-1006-0482) A20B-2902-0390		
SPM-30	A06B-6088-H330#H500	A06B-6088-H330	A20B-1006-0489 (A20B-1006-0483) A20B-2902-0390		
SPM-45	A06B-6088-H345#H500	A06B-6088-H345	A20B-1007-0591 (A20B-1006-0690) A20B-2002-0080		

Non-CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-2.2	A06B-6078-H302#H500	A06B-6078-H302	A16B-2202-0470	A16B-2202-0433 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-5.5	A06B-6078-H306#H500	A06B-6078-H306	A16B-2202-0471	A16B-2202-0434	
SPM-11	A06B-6078-H311#H500	A06B-6078-H311	A16B-2202-0472	A20B-2901-0851	
SPM-15	A06B-6088-H315#H500	A06B-6088-H315	A20B-1006-0170 A20B-2902-0280	A16B-2202-0435 A20B-2901-0851	
SPM-22	A06B-6088-H322#H500	A06B-6088-H322	A20B-1006-0171 A20B-2902-0280		
SPM-26	A06B-6088-H326#H500	A06B-6088-H326	A20B-1006-0172 A20B-2902-0280		

*1 Enclosed in parentheses are the drawing numbers of the old specifications.

Non-CE-marked products (old specification)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-15	A06B-6078-H315#H500	A06B-6078-H315	A20B-1005-0572 A20B-2001-0010	A16B-2202-0160 A20B-2001-0140 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-22	A06B-6078-H322#H500	A06B-6078-H322	A20B-1005-0571 A20B-2001-0010		
SPM-26	A06B-6078-H326#H500	A06B-6078-H326	A20B-1005-0570 A20B-2001-0010		
SPM-30	A06B-6078-H230#H500	A06B-6078-H330	A20B-1005-0575 A20B-2001-0010		

Applicable detectors

<1> M sensor (pulse generator) + BZ sensor (separate built-in sensor) (use of position coder signals only)

<2> High-resolution magnetic pulse coder (for motor only)

<3> High-resolution magnetic pulse coder (for motor and spindle)

<4> High-resolution position coder + high-resolution magnetic pulse coder (for motor only)

(3) α series spindle amplifier modules (SPM), type 3 (spindle switching control/differential speed control specification)

CE-marked products

Model	Order specification	Unit specification	Wiring board specification(*1)	Printed circuit board specification	ROM (series)
SPM-11	A06B-6088-H411#H500	A06B-6088-H411	A20B-1006-0484 A20B-2902-0390	A16B-2202-0440 A20B-2001-0700 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-15	A06B-6088-H415#H500	A06B-6088-H415	A20B-1006-0486 (A20B-1006-0480) A20B-2902-0390		
SPM-22	A06B-6088-H422#H500	A06B-6088-H422	A20B-1006-0487 (A20B-1006-0481) A20B-2902-0390		
SPM-26	A06B-6088-H426#H500	A06B-6088-H426	A20B-1006-0488 (A20B-1006-0482) A20B-2902-0390		
SPM-30	A06B-6088-H430#H500	A06B-6088-H430	A20B-1006-0489 (A20B-1006-0483) A20B-2902-0390		
SPM-45	A06B-6088-H445#H500	A06B-6088-H445	A20B-1007-0591 (A20B-1006-0690) A20B-2002-0080		

Non-CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-11	A06B-6078-H411#H500	A06B-6078-H411	A20B-1005-0574 A20B-2001-0010	A16B-2202-0160 A20B-2001-0140 A20B-2901-0851	A06B-6072-H500 (9D00, 9D0A)
SPM-15	A06B-6078-H415#H500	A06B-6078-H415	A20B-1005-0572 A20B-2001-0010		
SPM-22	A06B-6078-H422#H500	A06B-6078-H422	A20B-1005-0571 A20B-2001-0010		
SPM-26	A06B-6078-H426#H500	A06B-6078-H426	A20B-1005-0570 A20B-2001-0010		
SPM-30	A06B-6078-H430#H500	A06B-6078-H430	A20B-1005-0575 A20B-2001-0010		

Applicable functions

<1> Spindle switching control (switching of speed only or switching of speed and position)

<2> Spindle switching control (switching of MZ sensor (built-in sensor))

<3> Differential speed control (position coder signal input circuit)

*1 Enclosed in parentheses are the drawing numbers of the old specifications.

(4) α series spindle amplifier modules (SPM), type 4 (α sensor Cs contour control)

New specification (supporting spindle HRV control), CE-marked products

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification	ROM (series)
SPM-2.2	A06B-6102-H102#H520	A06B-6102-H102	A16B-2202-0680	A16B-2203-0503 A20B-2902-0620	A06B-6102-H520 (9D20)
SPM-5.5	A06B-6102-H106#H520	A06B-6102-H106	A16B-2202-0681	A16B-2203-0504 A20B-2902-0620	
SPM-11	A06B-6102-H111#H520	A06B-6102-H111	A16B-2202-0682		
SPM-15	A06B-6102-H115#H520	A06B-6102-H115	A20B-1006-0486 A20B-2902-0390	A16B-2203-0505 A20B-2902-0620	
SPM-22	A06B-6102-H122#H520	A06B-6102-H122	A20B-1006-0487 A20B-2902-0390		
SPM-26	A06B-6102-H126#H520	A06B-6102-H126	A20B-1006-0488 A20B-2902-0390		
SPM-30	A06B-6102-H130#H520	A06B-6102-H130	A20B-1006-0489 A20B-2902-0390		
SPM-45	A06B-6102-H145#H520	A06B-6102-H145	A20B-1007-0591 A20B-2002-0080		
SPM-55	A06B-6102-H155#H520	A06B-6102-H155	A20B-1007-0590 A20B-2002-0081		

CE-marked products

Model	Order specification	Unit specification	Wiring board specification(*1)	Printed circuit board specification(*1)	ROM (series)
SPM-2.2	A06B-6078-H102#H500	A06B-6078-H102	A16B-2202-0680	A16B-2202-0433 Overall revision 16E or later A20B-2902-0620 (A20B-2902-0610)	A06B-6072-H500 (9D00, 9D0A)
SPM-5.5	A06B-6078-H106#H500	A06B-6078-H106	A16B-2202-0681	A16B-2202-0434 Overall revision 16E or later A20B-2902-0620 (A20B-2902-0610)	
SPM-11	A06B-6078-H111#H500	A06B-6078-H111	A16B-2202-0682		
SPM-15	A06B-6088-H115#H500	A06B-6088-H115	A20B-1006-0486 (A20B-1006-0480) A20B-2902-0390	A16B-2202-0435 Overall revision 13C or later A20B-2902-0620 (A20B-2902-0610)	
SPM-22	A06B-6088-H122#H500	A06B-6088-H122	A20B-1006-0487 (A20B-1006-0481) A20B-2902-0390		
SPM-26	A06B-6088-H126#H500	A06B-6088-H126	A20B-1006-0488 (A20B-1006-0482) A20B-2902-0390		
SPM-30	A06B-6088-H130#H500	A06B-6088-H130	A20B-1006-0489 (A20B-1006-0483) A20B-2902-0390		
SPM-45	A06B-6088-H145#H500	A06B-6088-H145	A20B-1007-0591 (A20B-1006-0690) A20B-2002-0080		

Applicable detectors

<1> MZ sensor (sensor built into a motor)

<2> MZ sensor (sensor built into a motor) + BZ sensor (separate built-in sensor)

*1 Enclosed in parentheses are the drawing numbers of the old specifications.

2.2.4 Power-Failure Backup Modules

(1) Power-failure backup modules

Order specification	Wiring board specification	Printed circuit board specification	Remarks
A06B-6077-H001	A16B-2203-0360	A20B-2002-0790	Without the control power supply backup function
A06B-6077-H002	A16B-2203-0510	A20B-2003-0020	With the control power supply backup function

(2) Sub-module C (auxiliary capacitor unit)

Order specification	Unit specification	Capacitor specification
A06B-6077-H010	A06B-6077-C010	A42L-0001-0375 (× 2)

3 START-UP PROCEDURE

3.1 START-UP PROCEDURE (OVERVIEW)

Make sure that the specifications of the CNC, servo motors, servo amplifiers, and other units you received are exactly what you ordered, and these units are connected correctly. Then, turn on the power.

(1) Before turning on the circuit breaker, check the power supply voltage connected.
→ See Section 3.2.

(2) Some types of PSM, SVM, and SPM require settings before the system can be used. So check whether you must make settings.
→ See Section 3.3.

(3) Turn on the power, and set initial parameters on the CNC.

For the initialization of servo parameters, refer to the following manual:
FANUC AC SERVO MOTOR α series Parameter Manual (B-65150E)

For the initialization of spindle parameters, refer to the following manual:
FANUC AD SPINDLE MOTOR α series Parameter Manual (B-65160E)

(4) For start-up adjustment and troubleshooting, see Chapter 4.
- Method of using optional wiring boards for adjustment of the PSM, SVM, and SPM
- Spindle sensor adjustment values

3.2 CONNECTING THE POWER

3.2.1 Checking The Voltage And Capacity Of The Power

Before connecting the power, you should measure the AC power voltage.

Table 3.2.1(1) Action for the AC power (200-V input type)

AC power voltage	Nominal voltage	Action
170 to 220 V 210 to 253 V	200 V 230 V	These power lines can be connected directly to the system. Note) If the voltage is below the rated value, the rated output may not be obtained.
254 V or more	380 to 550 V	This power line must be connected through an insulation transformer to step down the voltage to 200 V.

Table 3.2.1(2) Action for the AC power (400-V input type)

AC power voltage	Nominal voltage	Action
340 to 440 V 391 to 506 V	400 V 460 V	These power lines can be connected directly to the system. Note) If the voltage is below the rated value, the rated output may not be obtained.
507 V or more	480 to 550 V	This power line must be connected through an insulation transformer to step down the voltage to 400 V.

Table 3.2.1 (3) to (5) list the input power specification for the power supply module. Use a power source with sufficient capacity so that the system will not malfunction due to a voltage drop even at a time of peak load. Make sure that the AC power voltage value including voltage fluctuation at a time of peak load is within the range specified in the above table.

Table 3.2.1 (3) AC power voltage specifications

Model	PSMR -3	PSMR -5.5	PSM -5.5	PSM -11	PSM -15	PSM -26	PSM -30	PSM -37	PSM -45	PSM -55
Nominal voltage rating	200/220/230 VAC -15%, +10%									
Power source frequency	50/60 Hz ±1 Hz									
Power source capacity (for the main circuit) [kVA]	5	12	9	17	22	37	44	53	64	79
Power source capacity (for the control circuit) [kVA]	0.5		0.7							

Table 3.2.1 (4) AC power voltage specifications (for the main circuit)

Model	PSMV-11HV	PSM-18HV	PSM-30HV	PSM-45HV	PSM-75HV
Nominal voltage rating	400/460 VAC -15%, +10%				
Power source frequency	50/60 Hz ±1 Hz				
Power source capacity [kVA]	31	26	44	64	107

Table 3.2.1 (5) AC power voltage specifications (for the control circuit)

Model	PSMV-11HV	PSM-18HV	PSM-30HV	PSM-45HV	PSM-75HV
Nominal voltage rating	200/220/230 VAC -15%, +10%				
Power source frequency	50/60 Hz ±1 Hz				
Power source capacity [kVA]	0.7				

3.2.2 Connecting A Protective Ground

Refer to the items in Chapter 5, "Installation," in "FANUC SERVO AMPLIFIER α series Descriptions" B-65162E, and check that the protective ground line is connected correctly.

3.2.3 Selecting The Ground Fault Interrupter That Matches The Leakage Current

Refer to the items in Chapter 5, "Installation," in "FANUC SERVO AMPLIFIER α series Descriptions" B-65162E, and check that a correct ground fault interrupter is selected.

3.3 SETTING THE PRINTED-CIRCUIT BOARD

Before supplying power, set the printed-circuit board as listed below.

3.3.1 Power Supply Module

Checking the DIP switch setting

(1) CE-marked products

Model	DIP switch	Position	Description
PSM-5.5 to 11	S1	SHORT	Do not change the setting of the DIP switches because they were already set at the factory.
	S2	OPEN(*1)	
PSM-15 to 55	S1	SHORT	
	S2	OPEN	
PSM-18HV to 75HV	S1	SHORT	
	S2	OPEN	

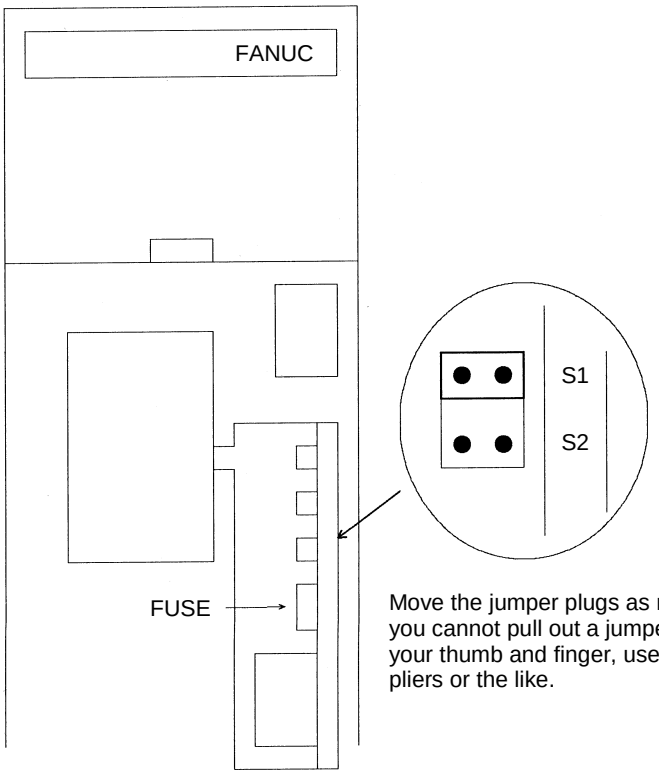
*1 This setting has been made in shipments after January, 2000. In earlier products, this switch was factory-set to SHORT.

(2) Non-CE-marked products

Model	DIP switch	Position	Description
PSM-5.5 to 11	S1	SHORT	Do not change the setting of the DIP switches because they were already set at the factory.
	S2	OPEN	
PSM-15 to 30	S1	SHORT	
	S2	OPEN	

3.3.2 Servo Amplifier Module

(1) Checking the jumper plug setting (for SVM1 and SVM2)
Set the servo amplifier module to either interface type A or B with the jumper plugs.



Jumper plug		Description
S1	S2	
SHORT	OPEN	With this setting, the servo amplifier module can operate with the CNC (such as FS0, FS15, FS16, FS18, or PM-D) designed for operation with interface type A. In this case the JV*B connector is used.
OPEN	SHORT	With this setting, the servo amplifier module can operate with the CNC (such as FS20 or FS21-G) designed for operation with interface type B. In this case the JS*B and JF* connectors are used.

NOTE
There is no jumper plug or DIP switch on the three-axis servo amplifier module. The specification of the servo amplifier module determines the type (A or B) of the interface with which it can operate.

(2) Mounting the batteries for the ABS pulse coder

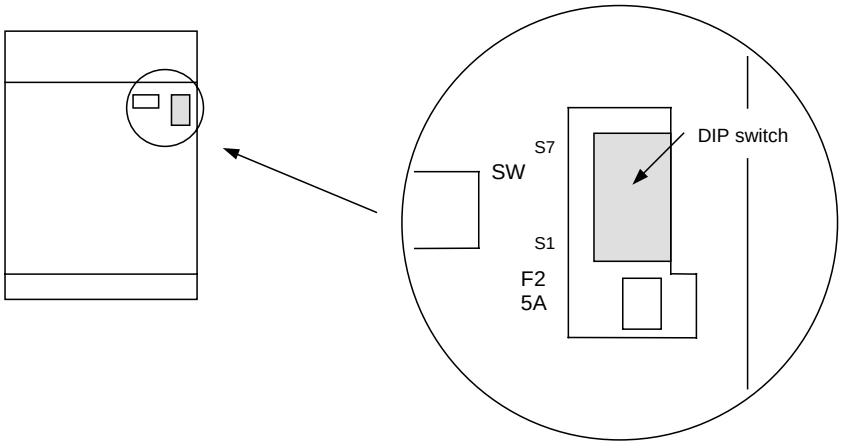
See Sec. I.5.1.

3.3.3 Spindle Amplifier Module

3.3.3.1 α series spindle amplifier module (SPM)

This type of modules do not have a DIP switch except the modules of which specification drawing numbers are A06B-6072-H***#00xx (D series spindle amplifier modules) and A06B-6078-H***#H5xx (non-CE-marked α series spindle amplifier modules).

Location of the DIP switch



DIP switch	Switch setting (factory-set to the underlined position)	Description	
S1	ON	If two SPMs are connected to one serial interface cable, S1 is set to ON in one SPM, and to OFF in the other.	
	OFF		
S2	ON	If an analog filter is used at the load meter output, S2 is set to ON. If not, it is set to OFF.	
	OFF		
S3	ON	If an analog filter is used at the speedometer output, S3 is set to ON. If not, it is set to OFF.	
	OFF		
S4 S5	S4:ON, S5:OFF	Reference switch of NPN type (pull up)	Reference switch (external reference signal receive function) setting for the main spindle
	S4:OFF, S5:OFF	Reference switch of PNP type (pull down)	
	S4:OFF, S5:OFF	The external reference signal receive function.	
S6 S7	S6:ON, S7:OFF	Reference switch of NPN type (pull up)	Reference switch (external reference signal receive function) setting for the sub-spindle
	S6:OFF, S7:OFF	Reference switch of PNP type (pull down)	
	S6:OFF, S7:OFF	The external reference signal receive function is not used.	

3.3.3.2 α (HV) series spindle amplifier module (SPM-HV)

This module does not have a DIP switch.

3.3.3.3 αC series spindle amplifier module (SPMC)

This module does not have a DIP switch.

3.4 INITIALIZING SERVO PARAMETERS

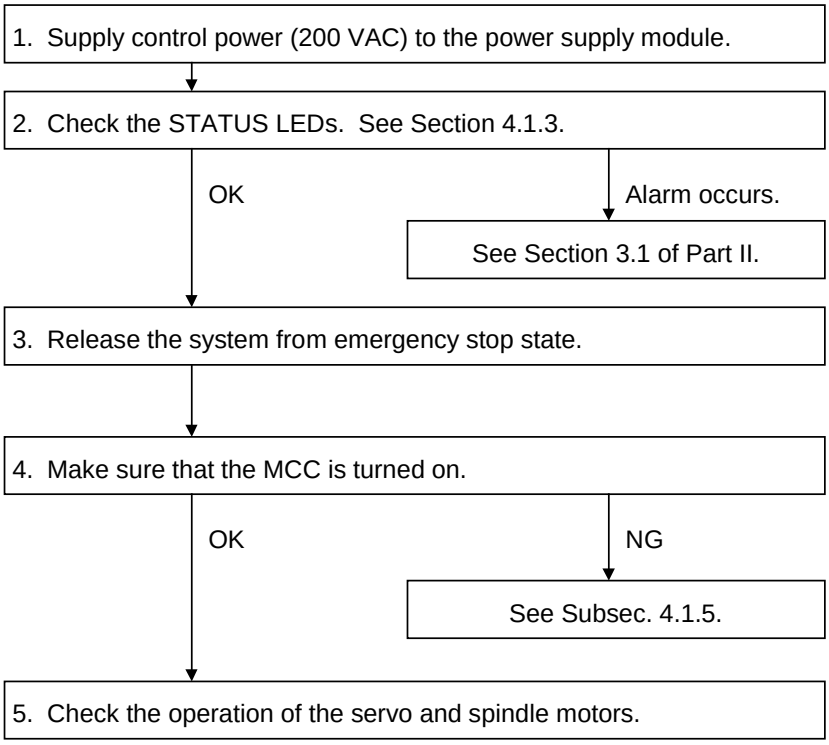
(1) Servo amplifier module
For the initialization of servo parameters, refer to the following manual:
FANUC AC SERVO MOTOR α series Parameter Manual (B-65150E)

(2) Spindle amplifier module
For the initialization of spindle parameters, refer to the following manual:
FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)

4 CONFIRMATION OF THE OPERATION

4.1 POWER SUPPLY MODULE

Check each item according to the procedure described below.



4.1.1 Check Terminal On The Printed-circuit Board

4.1.1.1 PSM, PSM-HV

Location of the check terminal

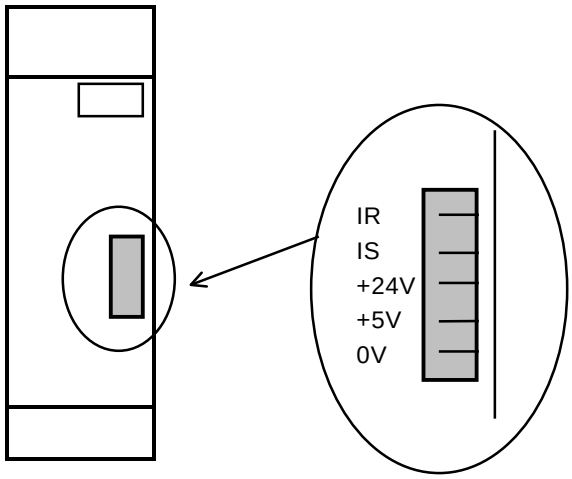


Table 4.1.1.1 Check terminal

Check terminal	Description	
IR	Phase L1 (phase R) current	The current is positive when it is input to the amplifier.
IS	Phase L2 (phase S) current	
+24V **+5V** **0V**	Control power	

Model	Amount of current
PSM-5.5	37.5A/1V
PSM-11	37.5A/1V
PSM-15	50A/1V
PSM-26	75A/1V
PSM-30	100A/1V
PSM-37	100A/1V
PSM-45	150A/1V
PSM-55	150A/1V
PSM-18HV	37.5A/1V
PSM-30HV	50A/1V
PSM-45HV	75A/1V
PSM-75HV	100A/1V

4.1.1.2 PSMV-HV

Location of check terminals

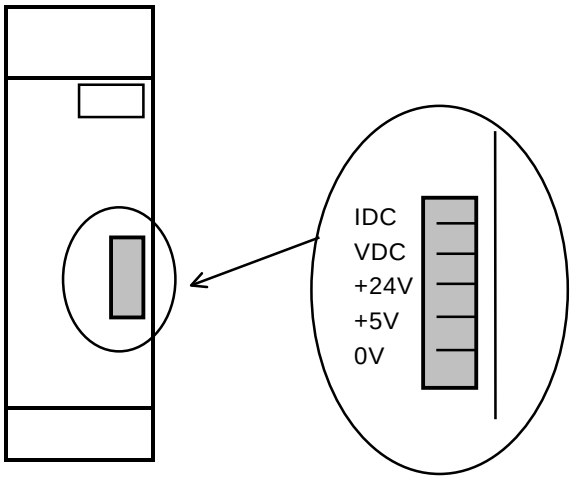


Table 4.1.1.2 Check terminals

Check terminal	Description	
IDC	DC link current	**Model** / **Amount of current**: PSMV-11HV / 50 A/1 V
VDC	DC link voltage	**Model** / **Amount of voltage**: PSMV-11HV / 100 V/1 V
+24V +5V 0V	Control power	

4.1.2 Checking The Power Supply Voltages

Table 4.1.2 Checking the power supply voltages

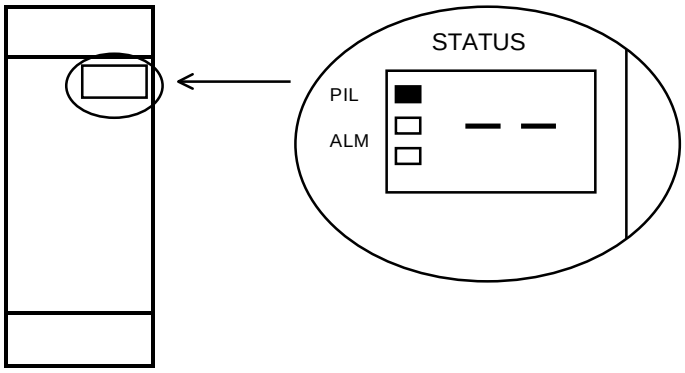
Measurement item	Check method
AC power line voltage	Check on L1, L2, and L3 at terminal board TB2. See Section 3.2.1.
Control power voltage	Check on the check terminals.

Check terminal	Rating
+24V - 0V	24 V ±5%
+5V - 0V	5 V ±5%

4.1.3 Checking The Status Leds

4.1.3.1 PSM, PSM-HV, and PSMV-HV

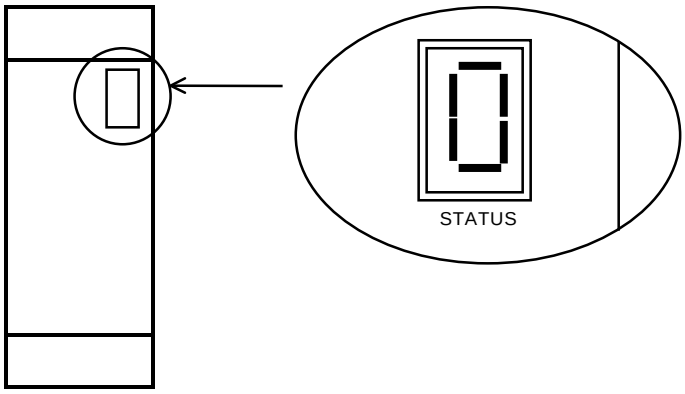
Position of the STATUS LEDs

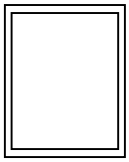
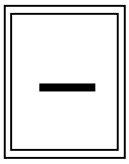
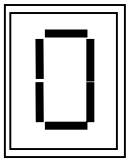
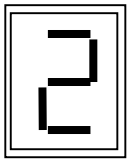


No.	STATUS LEDs On Off **The LED that is on is indicated in black.**	Description
1	PIL ALM	The PIL LED (power ON indicator) is off. Control power has not been supplied. The control power circuit is defective. See Section 4.1.2.
2	PIL ALM — —	PSM not ready The main circuit is not supplied with power (MCC OFF). Emergency stop state
3	PIL ALM 0 0	PSM ready The main circuit is supplied with power (MCC ON). The PSM is operable.
4	PIL ALM 0 1 Alarm code 01 or above is indicated.	Alarm state The PSM is not operable. See Section 3.1 of Part II.

4.1.3.2 PSMR

Position of the STATUS LEDs



No.	STATUS LEDs	Description
1		The STATUS display LED is off. Control power has not been supplied. The control power circuit is defective. See Section 4.1.2.
2		PSMR not ready The main circuit is not supplied with power (MCC OFF). Emergency stop state
3		PSMR ready The main circuit is supplied with power (MCC ON). The PSMR is operable.
4	 Alarm code 02 or above is indicated.	Alarm state The PSMR is not operable. See Section 3.1.3 of Part II.

4.1.4 The PIL LED (power ON indicator) Is Off.

Table 4.1.4 Check method and action

No.	Cause of trouble	Check method	Action
1	AC power for the control circuit not supplied	Check that power is connected to connector CX1A.	
2	Blown fuse in the control circuit	Check whether F1 or F2 has blown. (PSM, PSM-HV) Check whether FU1 or FU2 has blown. (PSMV-HV) For details on how to replace fuses, see Chapter 4 of Part II.	(1) If the AC power input for control is connected to connector CX1B by mistake, F2 (FU2) may blow. Connect the AC power input to CX1A. (2) Replace the fuse. If the fuse blows again after the replacement, replace the printed circuit board.
3	Incorrect wiring	Check whether the 24-V power output is short-circuited and whether a load exceeding the rating is connected.	
4	Faulty power supply circuit on the printed circuit board	The power-on LED indicator PIL operates on the +5-V power supply. See Subsection 4.1.2 to check the control power voltage.	(1) Replace the PSM. (2) Replace the printed circuit board, driver board, or power distribution board.

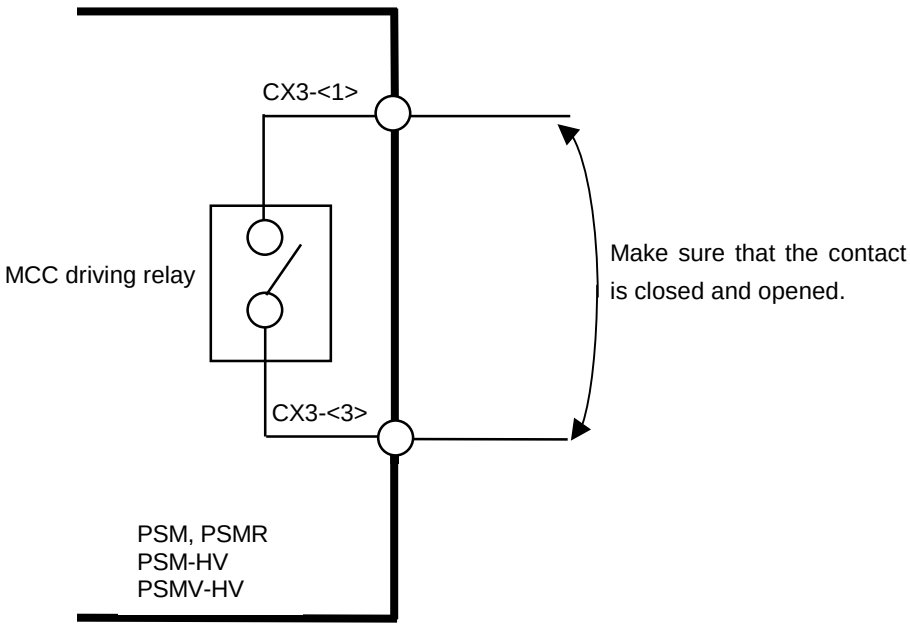
4.1.5 Checking For What Keeps The Mcc From Being Switched On

(1) The system is still in an emergency stop status.
→ Check the connection to make sure that the emergency stop signal connected to the PSM connector CX4 and the emergency stop signal (such as *ESP) input to the CNC are both released.

(2) There is a connector problem.
(a) No terminating connector is attached.
→ Check whether a terminating connector is attached to JX1B of the SVM or SPM at the end of the connection chain.
(b) The interface cable between JX1B of the power supply module and JX1A of the SVM or SPM is defective.
→ Check whether the interface cable is faulty.

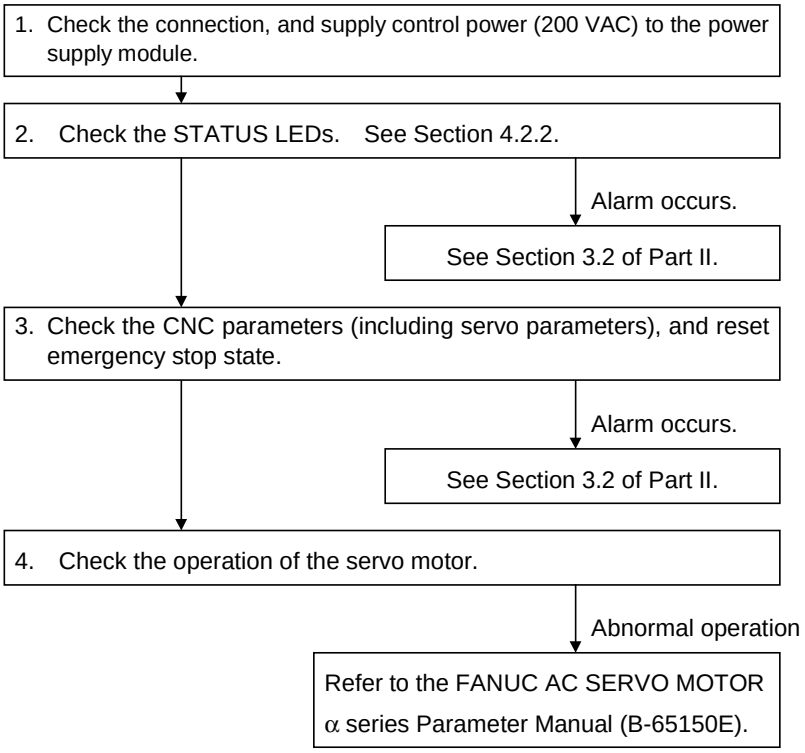
(3) The power for driving the magnetic contactor is not supplied.
→ Check the voltage across the both ends of the coil of the magnetic contactor.

(4) The relay for driving the magnetic contactor is defective.
→ Check that a circuit between pins <1> and <3> of connector CX3 is closed and opened.



4.2 SERVO AMPLIFIER MODULE

Check each item according to the procedure described below.



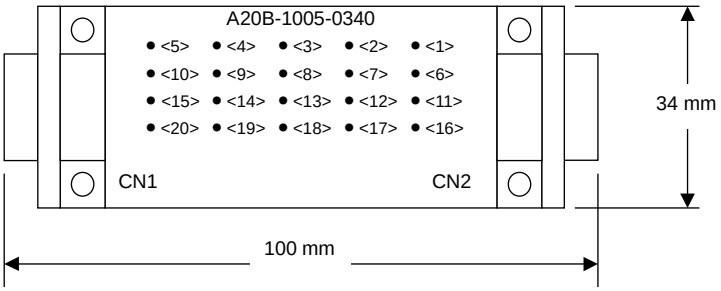
4.2.1 Check Pin Board

Use of the check pin board allows you to observe the signals inside the servo amplifier.

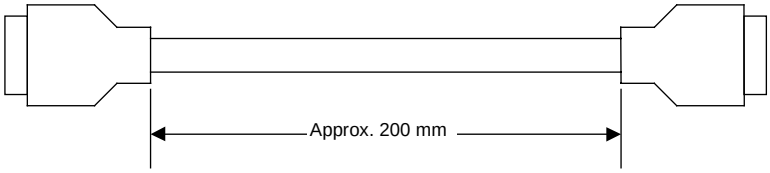
(1) Specifications

Order specification	Component	Remarks
A06B-6071-K290	Printed circuit board: A20B-1005-0340	Printed circuit board with check pins
	Cable : A660-2042-T031#L200R0	20-conductor cable with a one-to-one correspondence. Length: 200 mm

Printed circuit board: A20B-1005-0340



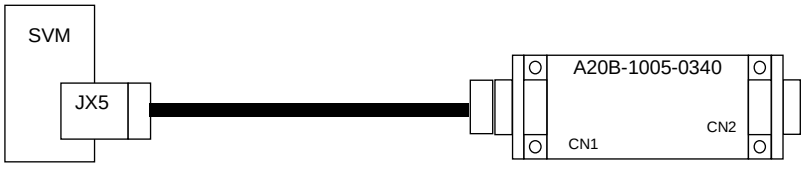
Cable: A660-2042-T031#L200R0



CN1 and CN2 are wired with a one-to-one correspondence.
The connector pin numbers correspond to the check pin numbers.

(2) Connection

Attach the cable to connector JX5 that is located on the front of the SVM.



(3) Signal output

SVM designed for operation with the FSSB interface

Pin No.	Signal name			Remarks
	SVM1	SVM2	SVM3	
<1>	CLR	CLR	CLR	Clear signal of the control circuit(Note)
<2>	+3.3V	+3.3V	+3.3V	+3.3-V power (Variations in voltage level within ±5% are regarded as normal.)
<3>	IRL	IRL	IRL	Phase R motor current for the L axis
<4>	ISL	ISL	ISL	Phase S motor current for the L axis
<5>		IRM	IRM	Phase R motor current for the M axis
<6>		ISM	ISM	Phase S motor current for the M axis
<7>	0V	0V		Reference voltage
			IRN	Phase R motor current for the N axis
<8>	0V	0V		Reference voltage
			ISN	Phase S motor current for the N axis
<9>	0V	0V	0V	Reference voltage
<10>				
<11>	+24V	+24V	+24V	+24-V power
<12>	+15V	+15V	+15V	+15-V power
<13>	-15V	-15V	-15V	-15-V power
<14>	+5V	+5V	+5V	+5-V power
<15>	ITL	ITL	ITL	Phase T motor current for the L axis
<16>				
<17>		ITM	ITM	Phase T motor current for the M axis
<18>				
<19>	0V	0V		Reference voltage
			ITN	Phase T motor current for the N axis
<20>				

NOTE
Do not touch the clear signal of the control circuit; otherwise, the servo amplifier may malfunction.

SVM designed for operation with the type A/B interface

Pin No.	Signal name			Remarks
	SVM1	SVM2	SVM3	
<1>	CLR	CLR	CLR	Clear signal of the control circuit(Note 1)
<2>	0V	0V	0V	Reference voltage
<3>	IRL	IRL	IRL	Phase R motor current for the L axis
<4>	ISL	ISL	ISL	Phase S motor current for the L axis
<5>		IRM	IRM	Phase R motor current for the M axis
<6>		ISM	ISM	Phase S motor current for the M axis
<7>	0V	0V		Reference voltage
			IRN	Phase R motor current for the N axis
<8>	0V	0V		Reference voltage
			ISN	Phase S motor current for the N axis
<9>	0V	0V	0V	Reference voltage
<10>	0V	0V	0V	Reference voltage
<11>	+24V	+24V	+24V	+24-V power
<12>	+15V	+15V	+15V	+15-V power
<13>	-15V	-15V	-15V	-15-V power
<14>	+5V	+5V	+5V	+5-V power
<15>	ITL	ITL	ITL	Phase T motor current for the L axis
<16>				
<17>		ITM	ITM	Phase T motor current for the M axis
<18>				
<19>	0V	0V		Reference voltage
			ITN	Phase T motor current for the N axis
<20>				

NOTE
1 Do not touch the clear signal of the control circuit; otherwise, the servo amplifier may malfunction.
2 Part of the signal may not be output depending on the revision of the printed circuit board.

(4) Observing the motor current

You can observe an instantaneous motor current value by observing the voltage across a reference voltage (0 V) check pin and a motor current check pin with an oscilloscope. Note that you cannot use a device such as a multimeter to observe correct values.

(Instantaneous motor current value) = (voltage at motor current check pin) × (factor for calculating motor current)

Calculation example:

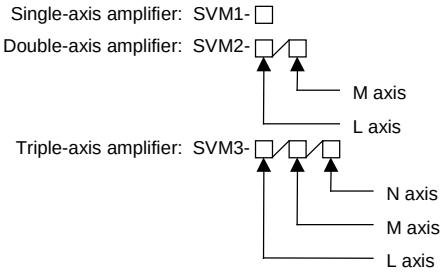
When the voltage at a motor current check pin is 3.2 V, and the factor for calculation is 3 A/V:

Actual motor current (A) = 3.2 V × 3 A/V = 9.6 A

Limit of instantaneous motor current value [A](Note 1)	Factor for calculating motor current [A/V](Note 2)
2	0.5
4	1
12	3
20	5
40	10
60	15
80	20
130	32.5
240	60
320	80
360	90

NOTE

1 Limit of instantaneous motor current value
Values in □ in servo amplifier names indicate the limits of instantaneous motor current values.



2 The factor for calculating the motor current of an SVM not listed in the above table can be obtained from the model name of the servo amplifier as follows:
Factor for calculating the motor current = (limit of instantaneous motor current value) ÷ 4 V

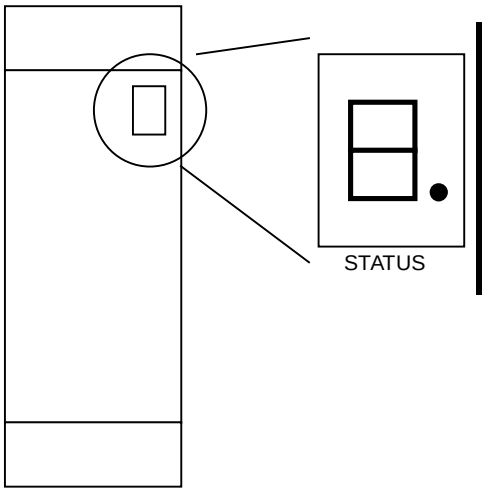
(4) Checking the power supply voltage

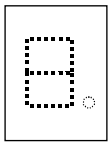
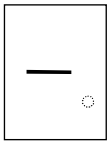
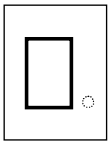
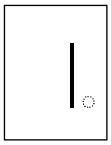
You can measure the voltage across a reference voltage (0V) check pin and a power check pin with a multimeter, oscilloscope, or the like to observe the power supply voltage for the control circuit inside the servo amplifier. If the measured voltage is within ±5% relative to the nominal voltage, the measured voltage can be considered to be acceptable.

Check pin	Nominal voltage
+3.3V	+3.3-V power
+24V	+24-V power
+15V	+15-V power
-15V	-15-V power
+5V	+5-V power

4.2.2 Checking The STATUS Display

The STATUS display (a 7-segment LED) on the front of the SVM indicates the operation status.



STATUS display	Description
	• The STATUS display LED is not on. <1> Power is not turned on. <2> Poor cable connection Check the cable. <3> The servo amplifier is defective. Replace the fuse (F1) or servo amplifier.
	• The control power supply is waiting for a ready signal.
	• The servo amplifier is ready to operate. The servo motor is supplied with power.
	• Alarm state If an alarm is issued in the servo amplifier, a value other than "0" and "-" is indicated on the STATUS display LED. See Section 3.2 of Part II.

4.2.3 VRDY-OFF Alarm Indicated on the CNC Screen

When the VRDY-OFF alarm is indicated on the CNC, check the items listed below. In addition to these causes, there are other possible causes of VRDY-OFF. If the problem still exists after the following items are checked, contact your FANUC service representative.

(1) Interface between modules
  (a) Is a terminating dummy connector for the interface between modules (JX1A, JX1B) attached to JX1B of the module (an SVM or SPM) at the end of the connection chain?

(2) Emergency stop signal (ESP)
  (a) Has the emergency stop signal (connector: CX4) applied to the PSM been released? Alternatively, is the signal connected correctly?
  (b) Is the emergency stop signal line (pin 3 of connectors CX2A and CX2B) between the PSM and SVM or SPM connected correctly?

(3) MCON signal
  (a) Has the ready command signal MCON been sent from the CNC to SVM?
    - Check for poor contact in the command cable between the CNC and SVM.
    - Use the servo check pin board to check the signal level.
  (b) For the multi-axis amplifier, is the MCON signal sent to all axes?

(4) External MCC
  (a) Is the external MCC connected correctly and is there any problem in the external MCC itself?

(5) Timing of turning on the power to the CNC (200 VAC, single phase) and the PSM control power (200 VAC, single phase)
  (a) Was the power to the CNC turned on at the same time when, or after, the power for PSM control was turned on?

(6) Is there an unused axis in a multi-axis amplifier?
  (a) Is a dummy connector inserted in the amplifier?
  (b) Are CNC parameters set correctly?

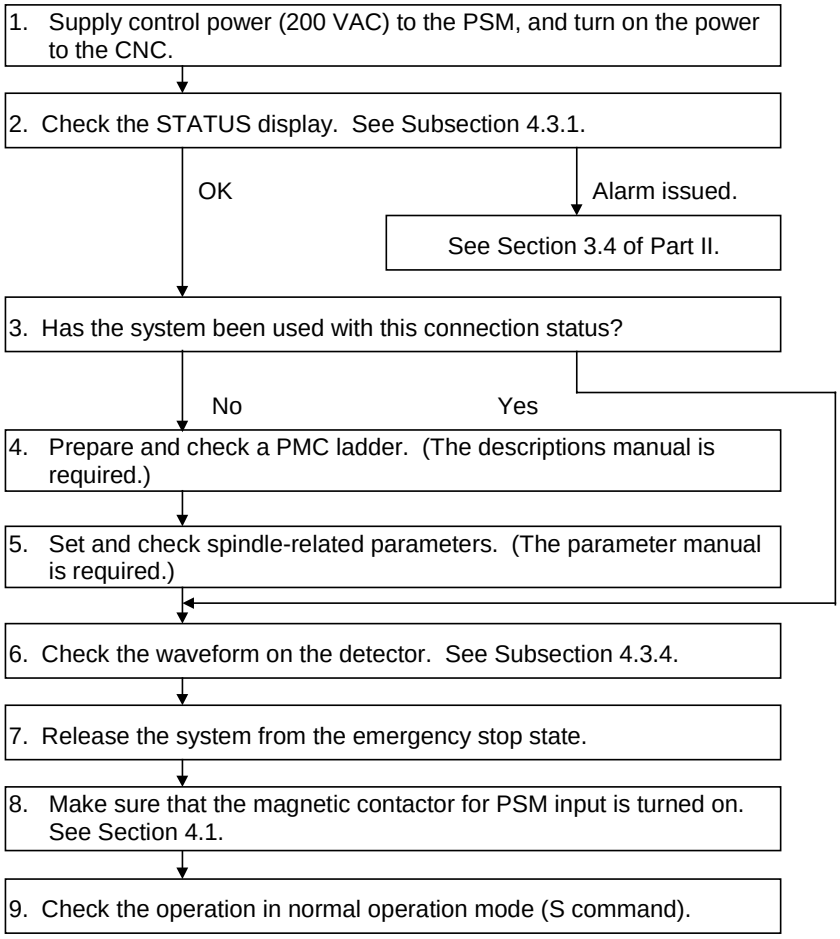
4.2.4 Servo Check Board

The servo check board receives the digital value used for control inside the digital servo as numerical data and converts it to an analog form.

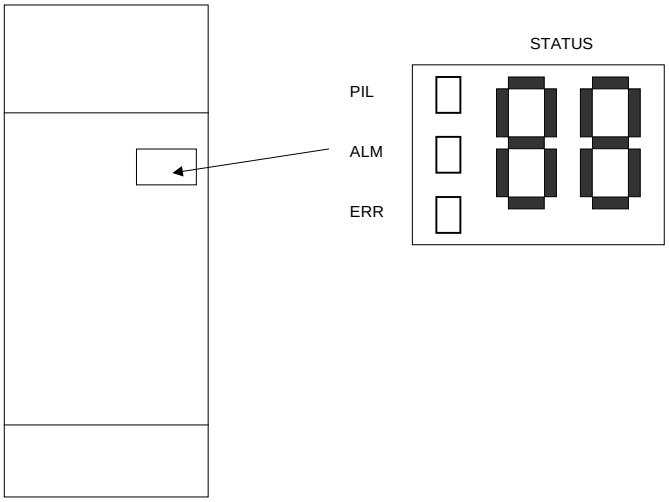
For details on how to connect and use the servo check board, refer to the following:
FANUC AC SERVO MOTOR α series Parameter Manual B-65150E/04 or later editions

4.3 SPINDLE AMPLIFIER MODULE

Check each item according to the procedure described below.



4.3.1 STATUS Display



No.	ALM	ERR	STATUS	Description
1.			No indication	The PIL LED (power ON indicator) is off. The control power supply has not been switched on. The power supply circuit is defective. See Section 3.1.2.
2.			20 ↓	For about 1.0 s after the control power supply is switched on, the lower two digits of the ROM series No. are indicated. Example) 20: ROM series No. 9D20
3.			04	The ROM edition number is displayed for about 1.0 s. 01, 02, 03, and so on correspond to A, B, C, and so on, respectively. Example) 04: ROM edition D
4.			-- Blinking	The CNC has not been switched on. The machine is waiting for serial communication and parameter loading to end.
5.			-- Lighting	Parameter loading has ended. The motor is not supplied with power.
6.			00	The motor is supplied with power.
7.	Lighting		01 or above is displayed.	Alarm state The SPM is not operable. See Section 3.4 of Part II.
8.		Lighting	01 or above is displayed.	Error state Incorrect parameter setting or improper sequence. See Section 4.3.3 of Part II.

The PIL lamp is always on while the control power is being supplied.

4.3.2 Troubleshooting at Startup

4.3.2.1 The PIL LED (power-on indicator) is off.

(1) When the PIL LED on the spindle amplifier module does not come on after the main circuit breaker is turned on

No.	Cause of trouble	Check method	Action
1	The 200-V control power is not supplied.	The PSM PIL lamp is off.	Check the cable attached to CX1A of PSM.
2	The cable attached to connector CX2A/B is defective.	The PSM PIL lamp is on.	Check the cabling.
3	The power is externally connected to 0 V, GND, or the like.	When all connectors except connector CX2A/B are detached, the PIL lamp is on.	Replace or repair the cable.
4	There is a blown fuse on the printed circuit board. (A06B-6102-Hxxx, 6104-Hxxx)	Even when all cables except the cable attached to connector CX2A/B are detached, the PIL lamp does not come on.	If the fuse blows, the printed circuit board may be faulty. Replace the SPM.
5	The printed circuit board is defective.		Replace the SPM.

4.3.2.2 The STATUS display is blinking with "--."

(1) When no spindle communication alarm message is indicated on the CNC
Check whether the CNC software option setting or bit setting is correct.

(2) When a communication alarm message is indicated on the CNC

No.	Cause of trouble	Check method	Action
1	The SPM switch setting is incorrect. For A06B-6072-Hxxx, A06B-6078-H215 to H230, and A06B-6078-H315 to H330 only	When a second SPM is connected, switch S1 is set to ON. When no other SPM is connected, switch S1 is set to OFF.	Correct the switch setting.
2	The cable is incorrect.	Note that the cable used for connecting an electric/optical adapter and the cable connected directly to the CNC differ in specifications.	Replace the cable with a correct cable.
3	The cable is defective.	Check whether the cable is broken. Check for short-circuit in the connector.	Repair or replace the cable.
4	The printed circuit board is defective.		Replace the SPM.

4.3.2.3 The motor does not turn.

(1) When "--" is indicated on the STATUS display of the SPM
Check whether spindle control signals are input. (An example for the first spindle is given below.)

FS0	FS15	FS16	#7	#6	#5	#4	#3	#2	#1	#0
G229	G227	G070	MRDYA		SFRA	SRVA				
G230	G226	G071							*ESPA	

(2) When "00" is indicated on the STATUS display of the SPM
No spindle speed command is input.
Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual," and check related parameters.

(3) When an alarm number is indicated on the SPM
See the description of the alarm number in Section 3.4 of Part II.

4.3.2.4 A specified speed cannot be obtained.

(1) When the speed always differs from a specified speed
Check parameters.
Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual," and check related parameters.

(2) When an alarm number is indicated on the SPM
See the description of the alarm number in Section 3.4 of Part II.

4.3.2.5 When cutting is not performed, the spindle vibrates, making noise.

(1) The spindle vibrates only when the spindle speed has reached or is at a particular speed level.

Check whether the spindle also vibrates when the motor is turning by inertia. If noise is unchanged, investigate the source of mechanical vibration. There are several methods to turn the spindle by inertia as explained below. Because these methods involve machine sequences, consult with the machine tool builder.

A. Setting spindle control signal MPOF (FS16 for the first spindle: G73#2, FS15 for the first spindle: G228#2) to 1 immediately causes the spindle to turn by inertia.

B. Set ALSP (FS16: bit 2 of parameter No. 4009, FS15 for the first spindle: bit 2 of parameter No. 3009) to 1. Then, when the power to the CNC is turned off during spindle rotation, the spindle turns by inertia. (On the spindle amplifier module, alarm 24 is indicated.)

(2) When noise is generated at the time the motor is stopped or at any time

A. See Subsection 4.3.4 of this part, and check and adjust the waveform of the spindle sensor.

B. Check that the motor part number matches its parameters. For details, refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual."

C. Adjust the velocity loop gain and so forth.
For details, refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual."

4.3.2.6 An overshoot or hunting occurs.

Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual," and adjust parameters.

4.3.2.7 Cutting power weakens or acceleration/deceleration slows down.

(1) When the load meter does not indicate the maximum output

A. A mechanical element such as a belt slip may occur.

(2) When the load meter indicates the maximum output

A. Check whether the torque limit signal is input incorrectly. (An example for the first spindle is given below.)

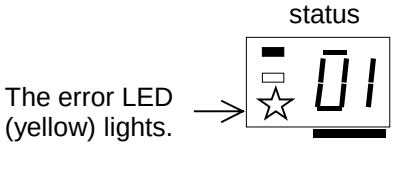
FS0	FS15	FS16	#7	#6	#5	#4	#3	#2	#1	#0
G229	G227	G070							TLMHA	TLMLA

B. Check that the motor part number matches its parameters. For details, refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual."

C. Check whether the output limit pattern is set incorrectly. For details, refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual."

4.3.3 Status Error Indication Function

When there is a sequence or parameter error, the error LED (yellow) in the display section of the spindle amplifier module (SPM) goes on with an error code displayed. This can ease troubleshooting at the time of machine startup.



When the spindle amplifier module does not operate for a certain function, check whether the status error is indicated. The status error number does not appear on the CNC screen.

No.	Description	Action
01	Although neither *ESP (emergency stop signal) (there are two types of signals, a PMC signal and PSM contact signal) nor MRDY (machine ready signal) has been input, SFR (forward rotation signal), SRV (reverse rotation signal), or ORCM (orientation command) is input.	Check the *ESP and MRDY sequences. (For MRDY, pay attention to the parameter that specifies whether to use the MRDY signal (FS16*i*: bit 0 of parameter No. 4001).)
02	When the spindle motor is equipped with a high-resolution magnetic pulse coder (Cs sensor) (FS16*i*: bits 6 and 5 of parameter No.4001 = 0, 1), 128 λ/rev must be set for the speed detector (FS16*i*: bits 2, 1, and 0 of parameter No. 4011 = 0, 0, 1). However, other than 128 λ/rev is set. In this case, the motor is not activated.	Check the speed detector parameter of the spindle motor (FS16*i*: bits 2, 1, and 0 of parameter No. 4011).
03	Although the use of a high-resolution magnetic pulse coder (FS16*i*: bit 5 of parameter No. 4001 = 1) or the use of the Cs contour control function by the α sensor (FS16*i*: bit 4 of parameter No. 4018 = 1) is not specified, a Cs control command is input. In this case, the motor is not activated.	Check the parameters of the detector for Cs contour control (FS16*i*: bit 5 of parameter No. 4001 and bit 4 of parameter No. 4018).
04	Although the parameter for using the position coder signal (FS16*i*: bit 2 of parameter No. 4001 = 1) is not set, a command for servo mode (rigid tapping or spindle positioning) or spindle synchronization is input. In this case, the motor is not activated.	Check the parameter of the position coder signal (FS16*i*: bit 2 of parameter No. 4001).
05	Although no orientation option is set, an orientation command (ORCM) is input.	Check the software option for orientation.

(Continued)

No.	Description	Action
06	Although no output switching option is set, low-speed winding is selected (RCH = 1).	Check the software option for spindle output switching and the power line status signal (RCH).
07	Although Cs contour control mode is specified, neither SFR nor SRV is input.	Check the sequence (CON, SFR, and SRV).
08	Although servo mode (rigid tapping or spindle positioning) is specified, neither SFR nor SRV is input.	Check the sequence (SFR and SRV).
09	Although spindle synchronization mode is specified, neither SFR nor SRV is input.	Check the sequence (SPSYC, SFR, and SRV).
10	In Cs contour control mode, another operation mode (servo mode, spindle synchronization, or orientation) is specified.	Do not specify another operation mode during execution of the Cs contour control command. Before entering another mode, cancel the Cs contour control command.
11	In servo mode (rigid tapping or spindle positioning), another operation mode (Cs contour control, spindle synchronization, or orientation) is specified.	Do not specify another operation mode during execution of the servo mode command. Before entering another mode, cancel servo mode.
12	During spindle synchronization, another operation mode (Cs contour control, servo mode, or orientation) is specified.	Do not specify another operation mode during execution of the spindle synchronization command. Before entering another mode, cancel the spindle synchronization command.
13	When an orientation specification is specified, another operation mode (Cs contour control, servo mode, or synchronization control) is specified.	Do not specify another operation mode during execution of the orientation command. Before entering another mode, cancel the orientation command.
14	The SFR signal and SRV signal are input at the same time.	Input one of the SFR and SRV signals.
15	Although the parameter to use the differential mode function (FS16*i*: bit 5 of parameter No. 4000 = 1) is set, Cs axis contour control is specified.	Check the setting of the parameter (FS16*i*: bit 5 of parameter No. 4000) and the PMC signal (CON).
16	Although the parameter not to use the differential mode function (FS16*i*: bit 5 of parameter No. 4000 = 0) is set, a differential speed mode command (DEFMD) is input.	Check the setting of the parameter (FS16*i*: bit 5 of parameter No. 4000) and the PMC signal (DEFMD).
17	The parameter settings for the speed detector (FS16*i*: bits 2, 1, and 0 of parameter No. 4011) are invalid. (There is no speed detector that matches the settings.)	Check the parameter settings (FS16*i*: bits 2, 1, and 0 of parameter No. 4011).

(Continued)

No.	Description	Action
18	Although the parameter not to use the position coder signal (FS16*i*: bit 2 of parameter No. 4001 = 0) is set, a position coder orientation command (ORCMA) is input.	Check the parameter setting (FS16*i*: bit 2 of parameter No. 4001) and the PMC signal (ORCM).
19	During magnetic sensor orientation, another operation mode is specified.	Do not specify another operation mode during execution of the orientation command. Before entering another mode, cancel the orientation command.
20	When the use of the slave operation mode function (FS16*i*: bit 5 of parameter No. 4014 = 1) is set, the use of a high-resolution magnetic pulse coder (FS16*i*: bit 5 of parameter No. 4001 = 1) or the use of the Cs contour control function by the α sensor (FS16*i*: bit 4 of parameter No. 4018 = 1) is set. These settings cannot be made at the same time.	Check the parameter settings (FS16*i*: bit 5 of parameter No. 4001, bit 5 of parameter No. 4014, and bit 4 of parameter No. 4018).
21	During position control (such as servo mode and orientation), a slave operation mode command (SLV) is input.	Input the slave operation mode command (SLV) in normal operation mode.
22	In slave operation mode (SLVS = 1), a position control command (such as servo mode and orientation) is input.	Input the position control command in normal operation mode.
23	Although the parameter not to use the slave operation mode function (FS16*i*: bit 5 of parameter No. 4014 = 0) is set, the slave operation mode command (SLV) is input.	Check the parameter setting (FS16*i*: bit 5 of parameter No. 4014) and the PMC signal (SLV).
24	After orientation is performed in incremental mode (INCMD = 1) first, an absolute position command (INCMD = 0) is input next.	Check the PMC signal (INCMD). Perform an absolute position command orientation first.
25	Although the spindle amplifier is not SPM type 4, the use of the Cs contour control function by the α sensor (FS16*i*: bit 4 of parameter No. 4018 = 1) is set.	Check the spindle amplifier specification and parameter setting (FS16*i*: bit 4 of parameter No. 4018).

4.3.4 Checking The Feedback Signal Waveform

First, refer to Subsection 9.2.3 of "FANUC SERVO AMPLIFIER α series Descriptions" (B-65162E), and make sure that the spindle sensors and other detectors are connected at the correct points. Next, see the table given below to find the corresponding check terminal names on the check board from the sensor connector connection points. Do not observe feedback signals before the parameters for the detectors that are set. Phase A, B, and Z signals may not be output correctly until the parameters are loaded from the CNC.

Signals input to the SPM and corresponding check terminals on the check board

(1) SPM type 1, type 2, and type 4

SPM input connector	Connector pin signal	Check terminal name	Main sensors	Remarks
JY2	Phase A: pin 5, 6 Phase B: pin 7, 8	**PA1** **PB1**	M, MZ, and BZ sensors Low resolution side of the high-resolution magnetic pulse coder (128 to 384 λ)	
	Phase A: pin 3, 4 Phase B: pin 17, 19	**PA4** **PB4**	High resolution side of the high-resolution magnetic pulse coder (1000 to 3000 λ)	For type 2 only
	Phase Z: pin 1, 2	**PS1**	MZ and BZ sensors (one-rotation signal)	
JY3	pin 18	**EXTSC1**	Proximity switch (external one-rotation signal)	
	pin 1, 3	**LSA1**	Magnetic sensor (LSA signal)	
	pin 5, 14	**MSA1**	Magnetic sensor (MSA signal)	*1
JY4	Phase A: pin 5, 6 Phase B: pin 7, 8	**PAD** **PBD**	α position coder (1024 p) Low resolution side of the high-resolution position coder (1024 p)	Parameter setting
	Phase A: pin 3, 4 Phase B: pin 17, 19	**PA3** **PB3**	High resolution side of the high-resolution position coder (3000 λ)	For type 2 only
	Phase Z: pin 1, 2	**PSD**	α position coder (one-rotation signal) High-resolution position coder (one-rotation signal)	Parameter setting
JY5	Phase A: pin 5, 6 Phase B: pin 7, 8	**PA2** **PB2**	M, MZ, and BZ sensors Low resolution side of a high-resolution magnetic pulse coder (128 to 384 λ) α position coder S (1024 λ)	For types 2 and 4 only
	Phase A: pin 3, 4 Phase B: pin 17, 19	**PA3** **PB3**	High resolution side of a high-resolution magnetic pulse coder (1000 to 3000 λ)	For type 2 only
	Phase Z: pin 1, 2	**PS2**	MZ and BZ sensors (one-rotation signal)	For type 4 only
	Phase Z: pin 1, 2	**PSD**	α position coder S (one-rotation signal) High-resolution magnetic pulse coder (one-rotation signal)	Parameter setting

*1 This check terminal is provided for A20B-1005-0740 only. With A20B-2001-0830, MSA is observed on CH1 or CH2.

Only for SMPs of which the specification is A06B-6078-H315 to 330

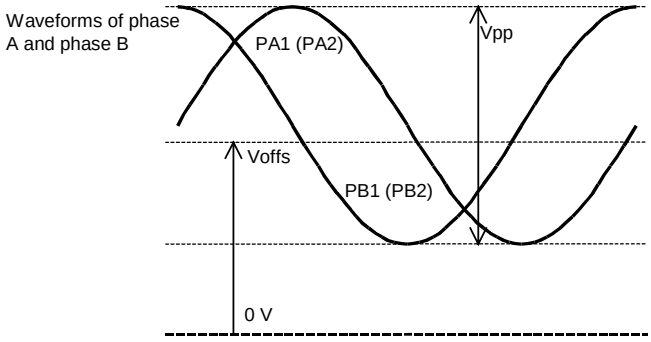
JY6	Phase A: pin 5, 6 Phase B: pin 7, 8	**PA2** **PB2**	M, MZ, and BZ sensors	For type 2 only

(2) SPM type 3

SPM input connector	Connector pin signal	Check terminal name	Main sensors	Remarks
JY2	Phase A: pin 5, 6 Phase B: pin 7, 8	**PA1** **PB1**	M, MZ, and BZ sensors	Main side
	Phase Z: pin 1, 2	**PS1**	MZ and BZ sensors (one-rotation signal)	Main side
JY6	Phase A: pin 5, 6 Phase B: pin 7, 8	**PA2** **PB2**	M, MZ, and BZ sensors	Sub side
	Phase Z: pin 1, 2	**PS2**	MZ and BZ sensors (one-rotation signal)	Sub side
JY4 or JY8	Phase A: pin 5, 6 Phase B: pin 7, 8 and Phase A: pin 5, 6 Phase B: pin 7, 8	**PAD** **PBD**	α position coder (1024 p)	When the main side is selected by spindle switching control, signals are output on JY4. When the sub side is selected, signals are output on JY8. Parameters must be set correctly.
	Phase Z: pin 1, 2 and Phase Z: pin 1, 2	**PSD**	α position coder (one-rotation signal)	When the main side is selected by spindle switching control, signals are output on JY4. When the sub side is selected, signals are output on JY8. Parameters must be set correctly.
JY3	pin 18	**EXTSC1**	Proximity switch (external one-rotation signal)	Main side
	pin 1, 3	**LSA1**	Magnetic sensor (LSA signal)	Main side
	pin 5, 14	**MSA1**	Magnetic sensor (MSA signal)	Main side(*1) For A20B-1005-0740 only
JY7	pin 18	**EXTSC2**	Proximity switch (external one-rotation signal)	Sub side
	pin 1, 3	**LSA2**	Magnetic sensor (LSA signal)	Sub side
	pin 5, 14	**MSA2**	Magnetic sensor (MSA signal)	Sub side(*1) For A20B-1005-0740 only

*1 With A20B-2001-0830, MSA is observed on CH1 or CH2.

4.3.4.1 M sensor

Measurement location	Measurement condition	Sample waveform
Input on JY2 side PA1, PB1 For sub side selected by spindle switching: Input on JY6 side PA2, PB2	The speed must be 1500 min^{-1} or less.	

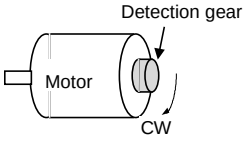
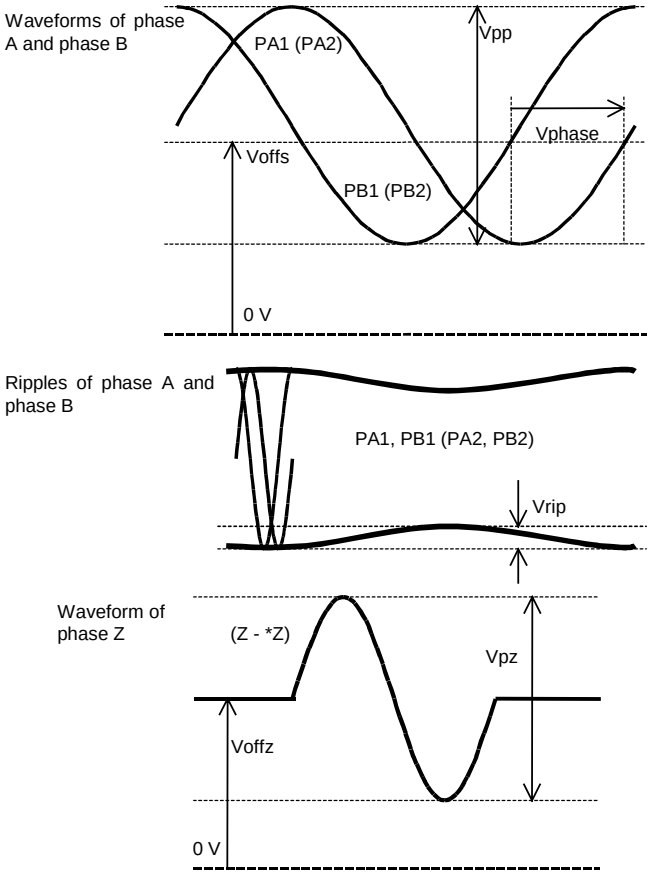
For the SPM type 4 or SPM of which the specification is A06B-6102-Hxxx#H520 or A06B-6104-Hxxx#H520

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.36 to 0.50 Vp-p		Adjustment is normally unnecessary.
Voffs	2.5 V ±100 mV	Use the DC range of a digital voltmeter.	Level check is possible, but adjustment is not possible.

For SPMs other than the above

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.64 to 0.90 Vp-p		Adjustment is normally unnecessary.
Voffs	2.5 V ±90 mV	Use the DC range of a digital voltmeter.	Level check is possible, but adjustment is not possible.

4.3.4.2 MZ and BZ sensors

Measurement location	Measurement condition	Sample waveform
Input on JY2 side PA1, PB1 For SPM type 4: Input on JY5 side PA2, PB2 For sub side selected by spindle switching: Input on JY6 side PA2, PB2	The speed must be 1500 min^{-1} or less. Rotation direction: CW  	

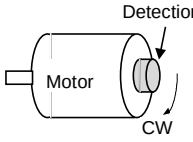
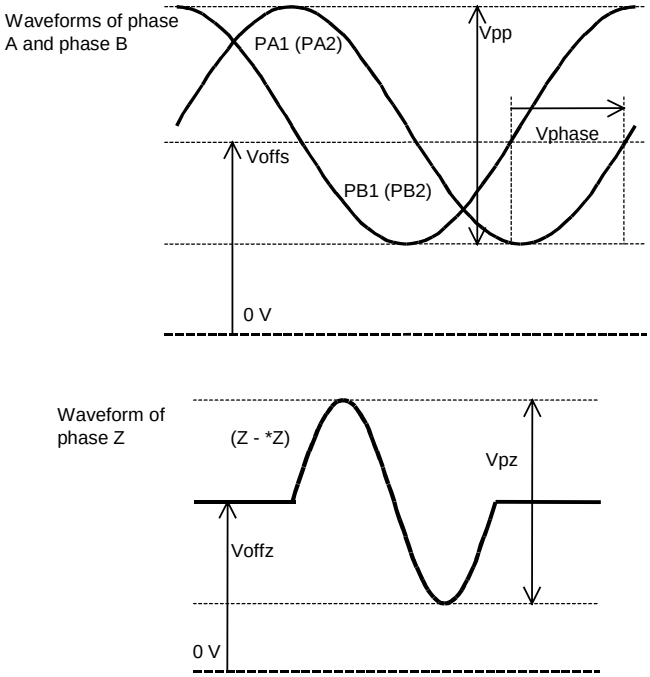
For the SPM type 4 or SPM of which the specification is A06B-6102-Hxxx#H520 or A06B-6104-Hxxx#H520

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.5 to 1.2 Vp-p		Normally, the MZ sensor need not be adjusted. For Voffs and Voffz, only level check is possible, but adjustment is not possible.
Voffs, Voffz	2.5 V ±100 mV	Use the DC range of a digital voltmeter.	
Vphase	90 ±3°		
Vrip	< 70 mV		
Vpz	> 1.0 V		

For SPMs other than the above

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.66 to 0.93 Vp-p		Normally, the MZ sensor need not be adjusted. For Voffs and Voffz, only level check is possible, but adjustment is not possible.
Voffs, Voffz	2.5 V ±272 mV	Use the DC range of a digital voltmeter.	
Vphase	90 ±3°		
Vrip	< 70 mV		
Vpz	> 1.0 V		

4.3.4.3 MZ sensor for α 0.5 (A06B-0866-B390) (old specification)

Measurement location	Measurement condition	Sample waveform
Input on JY2 side PA1, PB1 For sub side selected by spindle switching: Input on JY6 side PA2, PB2	The speed must be 1500 min^{-1} or less. Rotation direction: CW  	

For the SPM type 4 or SPM of which the specification is A06B-6102-Hxxx#H520 or A06B-6104-Hxxx#H520

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.5 to 1.2 Vp-p		Normally, the MZ sensor need not be adjusted. For Voffs and Voffz, only level check is possible, but adjustment is not possible.
Voffs,Voffz	2.5 V ±100 mV	Use the DC range of a digital voltmeter.	
Vphase	90 ±3°		
Vpz	> 1.0 V		

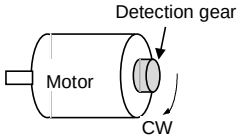
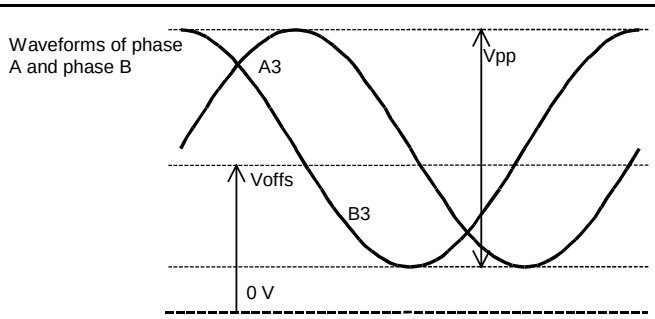
For SPMs other than the above

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.50 to 1.45 Vp-p		Normally, the MZ sensor need not be adjusted. For Voffs and Voffz, only level check is possible, but adjustment is not possible.
Voffs	2.5 V ±295 mV	Use the DC range of a digital voltmeter.	
Voffz	2.5 V ±500 mV	Use the DC range of a digital voltmeter.	
Vphase	90 ±3°		
Vpz	> 2.0 V		

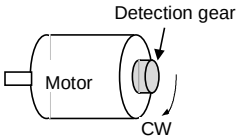
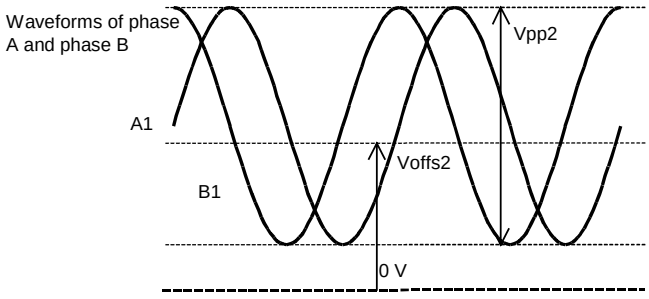
4.3.4.4 High-resolution magnetic pulse coder

After mounting a high-resolution magnetic pulse coder on the machine, check waveforms. If a measurement value exceeds the specified range, adjustment is required.
After mounting the sensor, you should check waveforms before installing components such as a pulley, drawbar, and brake to make adjustment easier.

(1) Adjusting check pins on the preamplifier
Signal on the low-resolution side 128 to 384 λ

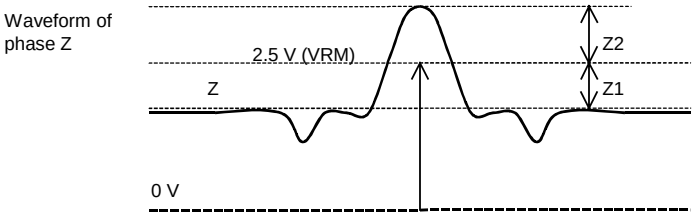
Measurement location	Measurement condition	Sample waveform
Check pins A3 and B3 on the preamplifier	The speed must be 500 min^{-1} or less. Rotation direction: CW 	

Signal on the high-resolution side 1000 to 3000 λ

Measurement location	Measurement condition	Sample waveform
Check pins A1 and B1 on the preamplifier	The speed must be 500 min^{-1} or less. Rotation direction: CW 	

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.36 to 0.50 Vp-p		Adjust potentiometers A3G and B3G on the preamplifier.
Vpp2	0.80 to 1.0 Vp-p		Adjust potentiometers A1G and B1G on the preamplifier.
Voffs	2.5 V ±50 mV	Use the DC range of a digital voltmeter.	Adjust potentiometers A3O and B3O on the preamplifier.
Voffs2	2.5 V ±10 mV	Use the DC range of a digital voltmeter.	Adjust potentiometers A1O and B1O on the preamplifier.

One-rotation signal

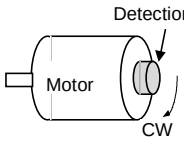
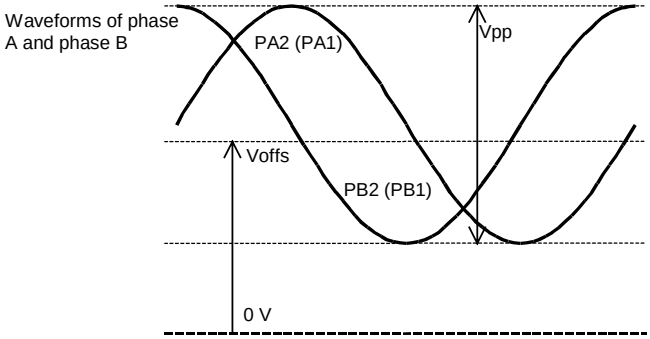
Measurement location	Measurement condition	Sample waveform
Check pin Z on the preamplifier	The speed must be 500 min^{-1} or less.	

Measurement item	Specification	Measurement method	Adjustment method
Z1, Z2	Z1 > 60 mV Z2 > 60 mV		Adjust potentiometer ZO on the preamplifier so that the value of Z1 and that of Z2 are almost the same.

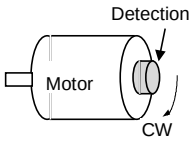
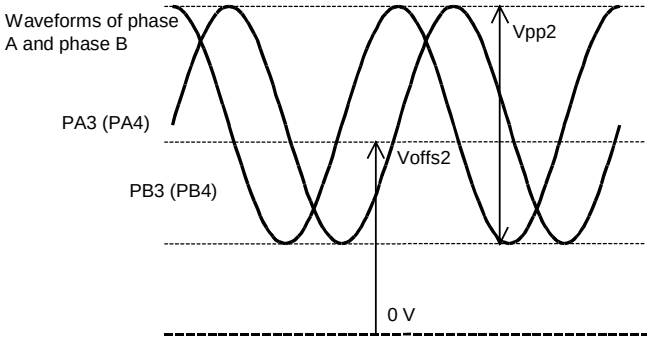
(2) Adjusting check pins on the check board

For the high-resolution magnetic pulse coder built into the motor, waveforms are factory-adjusted. If a waveform exceeds a specified value, however, adjust potentiometers on the preamplifier.

Signal on the low-resolution side 128 to 384 λ

Measurement location	Measurement condition	Sample waveform
Input on JY2 side PA1, PB1 Input on JY5 side PA2, PB2	The speed must be 500 min^{-1} or less. Rotation direction: CW 	

Signal on the high-resolution side 1000 to 3000 λ

Measurement location	Measurement condition	Sample waveform
Input on JY2 side PA4, PB4 Input on JY5 side PA3, PB3	The speed must be 500 min^{-1} or less. Rotation direction: CW 	

For the SPM type 4 or SPM of which the specification is A06B-6102-Hxxx#H520 or 6104-Hxxx#H520

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.36 to 0.50 Vp-p		Adjust potentiometers A3G and B3G on the preamplifier.
Vpp2	0.80 to 1.0 Vp-p		Adjust potentiometers A1G and B1G on the preamplifier.

For the SPM type 2

Measurement item	Specification	Measurement method	Adjustment method
Vpp	0.86 to 1.20 Vp-p		Adjust potentiometers A3G and B3G on the preamplifier.
Vpp2	1.20 to 1.51 Vp-p		Adjust potentiometers A1G and B1G on the preamplifier.
Voffs	2.5 V ±24 mV	Use the DC range of a digital voltmeter.	Adjust potentiometers A3O and B3O on the preamplifier.
Voffs2	2.5 V ±15 mV	Use the DC range of a digital voltmeter.	Adjust potentiometers A1O and B1O on the preamplifier.

NOTE
Adjust the one-rotation signal while checking the waveform on the preamplifier.

4.3.5 Spindle Check Board

When connecting the check board, you can:

<1> Observe signal waveforms.

<2> Observe internal data.

4.3.5.1 Spindle check board specifications

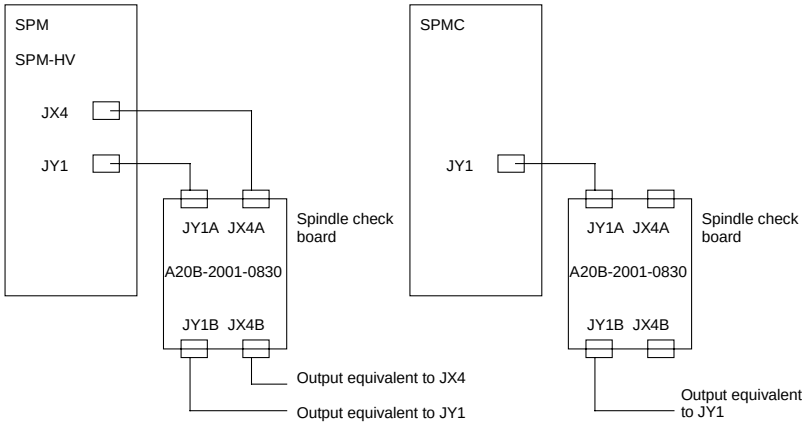
There are two types of spindle check boards: Check boards for the α series and for the D series. These types of check boards are not compatible. Select a spindle check board according to the drawing number of the SPM used.
Items that vary depending on the type of check board are described separately by indicating the printed circuit board drawing numbers of check boards.

Table 4.3.5.1 Spindle check board specifications

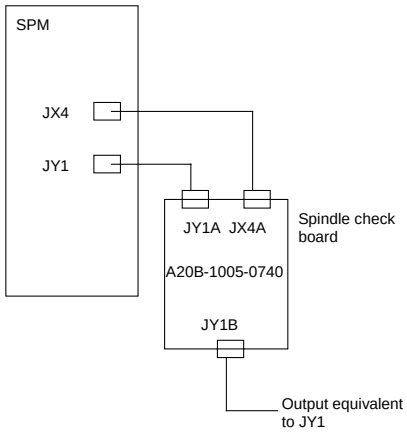
Specification	Drawing No. of printed circuit board	Applicable SPM
A06B-6078-H001	A20B-2001-0830	α series (all series after CE-marked products, and part of series before CE-marked products) TYPE1, TYPE4 A06B-6078-H102#H500, -H106#H500, -H111#H500 A06B-6078-H202#H500, -H206#H500, -H211#H500 A06B-6088-H2**#H500, H1**#H500 A06B-6092-H2**#H500, H1**#H500 A06B-6102-H2**#H520, H1**#H520 A06B-6104-H2**#H520, H1**#H520 TYPE2 A06B-6078-H302#H500, -H306#H500, -H311#H500 A06B-6088-H3**#H500 A06B-6092-H3**#H500 TYPE3 A06B-6088-H4**#H500
		αC series A06B-6082-Hxxx#H510, 511, 512
A06B-6072-H051	A20B-1005-0740	α series (part of series before CE-marked products) TYPE1 A06B-6078-H215#H500, -H222#H500, -H226#H500, -H230#H500 TYPE2 A06B-6078-H315#H500, -H322#H500, -H326#H500, -H330#H500 TYPE3 A06B-6078-H411#H500, -H415#H500, -H422#H500, -H426#H500, -H430#H500
		D series (all series)

4.3.5.2 Check board connection

(1) A06B-6078-H001 (A20B-2001-0830)



(2) A06B-6072-H051 (A20B-1005-0740)

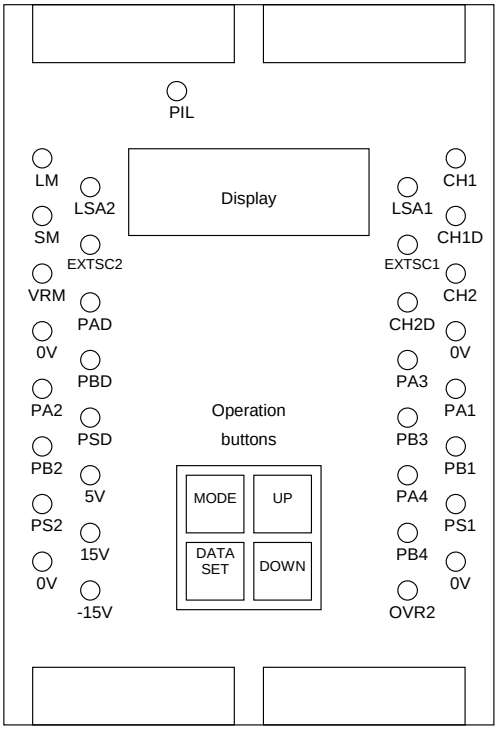


4.3.5.3 Check terminal output signals

(1) A06B-6078-H001 (A20B-2001-0830) check terminal output signals

Check terminal	Signal name	Check terminal	Signal name
LM	Load meter signal	PA1	Phase A sine wave signal 1
SM	Speed meter signal	PB1	Phase B sine wave signal 1
CH1	Analog output for internal data observation (Phase U current: IU. See 4.3.6.8 (3).)	PS1	Phase Z sine wave signal 1
CH2	Analog output for internal data observation (Motor speed TSA: 1638 min^{-1}/V)	PA2	Phase A sine wave signal 2
CH1D	Output for internal data bit observation	PB2	Phase B sine wave signal 2
CH2D	Output for internal data bit observation	PS2	Phase Z sine wave signal 2
VRM	Sensor reference voltage	PA3	Phase A sine wave signal 3
LSA1	Magnetic sensor output LSA signal (main)	PB3	Phase B sine wave signal 3
EXTSC1	External one-rotation signal (main)	PA4	Phase A sine wave signal 4
LSA2	Magnetic sensor output LSA signal (sub)	PB4	Phase B sine wave signal 4
EXTSC2	External one-rotation signal (sub)	OVR2	Analog override command
PAD	Phase A of position coder signal output	15V	+15 VDC power check
PBD	Phase B of position coder signal output	5V	+5 VDC power check
PSD	Phase Z of position coder signal output	-15V	-15 VDC power check
		GND	0 V

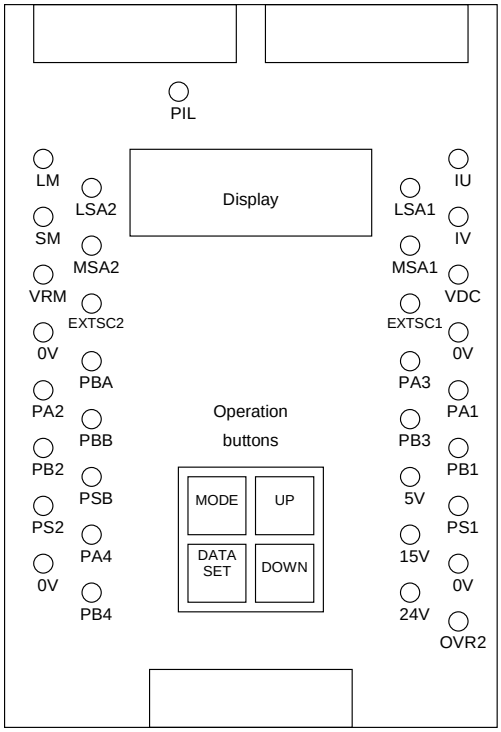
Check terminal arrangement



(2) A06B-6072-H051 (A20B-1005-0740) check terminal output signals

Check terminal	Signal name	Check terminal	Signal name
LM	Load meter signal	PA1	Phase A sine wave signal 1
SM	Speed meter signal	PB1	Phase B sine wave signal 1
IU	Phase U current(*1)	PS1	Phase Z sine wave signal 1
IV	Phase V current(*1)	PA2	Phase A sine wave signal 2
VDC	DC link voltage	PB2	Phase B sine wave signal 2
VRM	Sensor reference voltage	PS2	Phase Z sine wave signal 2
MSA1	Magnetic sensor output MSA signal (main)	PA3	Phase A sine wave signal 3
LSA1	Magnetic sensor output LSA signal (main)	PB3	Phase B sine wave signal 3
EXTSC1	External one-rotation signal (main)	PA4	Phase A sine wave signal 4
MSA2	Magnetic sensor output MSA signal (sub)	PB4	Phase B sine wave signal 4
LSA2	Magnetic sensor output LSA signal (sub)	OVR2	Analog override command
EXTSC2	External one-rotation signal (sub)	24V	+24 VDC power check
PAD	Phase A of position coder signal output	15V	+15 VDC power check
PBD	Phase B of position coder signal output	5V	5 VDC power check
PSD	Phase Z of position coder signal output	GND	0 V

Check terminal arrangement



*1 The value measured on the IU pin corresponds to the actual current as follows:

Model	Conversion value (A/V)
SPM-15	50
SPM-22	66.7
SPM-26	100
SPM-30	133

4.3.6 Observing Data Using the Spindle Check Board

4.3.6.1 Overview

By using the check board, you can convert digital signals used for control in the spindle amplifier module to analog voltage, and observe the conversion result with an oscilloscope. The internal data can be indicated also with the five-digit display.

- A20B-2001-0830
  This model has two analog output channels (CH1 and CH2) at which the internal data (with output of -5 V to +5 V) can be observed. It also has CH1D and CH2D at which specific bits such as data bits can be observed.
- A20B-1005-0740
  This model outputs internal data (output of 0 to 11 V) at terminals LM and SM using the analog output circuit for the load meter (LM) and speedometer (SM).

4.3.6.2 Major characteristics

Item	A20B-2001-0830		A20B-1005-0740
Measurement point	CH1, CH2	CH1D, CH2D	LM, SM
Output voltage range	-5 to +5 V	H: 2 Vmin L: 0.8 Vmax	0 to 11 V
Resolution	About 39 mV (10 V/256)	-	About 43 mV(11 V/256)
Output impedance	10 kΩmax	10 kΩmax	10 kΩmax

4.3.6.3 Observation method

By setting data using four DIP switches on the check board, you can output internal data to the five-digit display, analog voltage output circuit, channels 1 and 2 (LM and SM or CH1 and CH2).
Data on channels 1 and 2 is the one from an 8-bit D/A convertor.
The correspondence between channel 1/2 and the check terminal is listed below.

Measurement point	Check terminal	
	A20B-2001-0830	A20B-1005-0740
Channel 1	CH1 CH1D, data bit 0	LM
Channel 2	CH2 CH2D, data bit 0	SM

NOTE
When using printed-circuit board A20B-1005-0740, set DIP switches S2 and S3 on the spindle amplifier module front panel to OFF. After observation, set them to ON.
This operation is not necessary when you use printed-circuit board A20B-2001-0830.

DIP switch	ON position	OFF position
S2, S3	Output voltage is filtered out.	Output voltage is not filtered out.

4.3.6.4 Specifying data to be monitored

<1> Press the four setting switches at the same time for at least a second ."FFFFF" will be displayed on the indicator.

<2> Turn off the switches and press the "MODE" switch. "d-00" will be displayed on the indicator and the system will enter the mode for monitoring internal data.
In this mode, the motor can be operated normally.

<3> Press the "UP" or "DOWN" switch while holding down the "MODE" switch. The indicator display will change in the range of "d-00" to "d-12".

<4> The following shows the correspondence between the destinations of the internal data of the serial spindle and addresses d-01 to d-12.
- d-01 to d-04: Specifies the amount of data to be output to the indicator, data shift, and output format (decimal or hexadecimal).
- d-05 to d-08: Specifies the amount of data to be output to the LM terminal, data shift, and whether an offset is provided.
- d-09 to d-12: Specifies the amount of data to be output to the SM terminal, data shift, and whether an offset is provided.

<5> Select address d-xx in the procedure for setting data described in <3>.

<6> Turn off the "MODE" switch. "d-xx" will disappear 0.5 second later, and the data will be displayed for a second.
Change the set data using the "UP" or "DOWN" switch within the second the data is displayed.

<7> When more than a second elapses without pressing the "UP" or "DOWN" switch, data cannot be changed.
If the "MODE" switch is turned on or off, however, setting can be started from the beginning of the step in item <6>.

4.3.6.5 Address descriptions and initial values (SPM)

[Output to the indicator]

Address	Description	Initial value
d-01	Specifies a data number.	0
d-02	Shift at data output (0 to 31 bits)	0
d-03	Data shift direction 0 : Data is shifted right. 1 : Data is shifted left.	0
d-04	Display format 0 : Decimal notation 1 : Hexadecimal notation(0 to F)	0

[Output to the channel 1]

Address	Description	Initial value	
		A20B-2001-0830 (CH1)	A20B-1005-0740 (LM)
d-05	Specifies a data number	218 (U-phase current)	132
d-06	Shift at data output (0 to 31 bits)	8	0
d-07	Data shift direction 0: Data is shifted right 1: Data is shifted left	0	0
d-08	Offset 0: Not provided 1: Provided	1	0

[Output to the channel 2]

Address	Description	Initial value	
		A20B-2001-0830 (CH1)	A20B-1005-0740 (SM)
d-09	Specifies a data number	19 (Motor velocity)	131
d-10	Shift at data output (0 to 31 bits)	18	0
d-11	Data shift direction 0: Data is shifted right 1: Data is shifted left	0	0
d-12	Offset 0: Not provided 1: Provided	1	0

4.3.6.6 Address descriptions and initial values (SPMC)

[Output to the indicator]

Address	Description	Initial value
d-01	Specifies a data number.	0
d-02	Shift at data output (0 to 31 bits)	0
d-03	Data shift direction 0 : Data is shifted right. 1 : Data is shifted left.	0
d-04	Display format 0 : Decimal notation 1 : Hexadecimal notation(0 to F)	0

[Output to the channel 1]

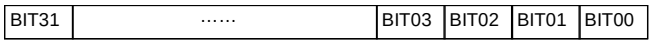
Address	Description	Initial value
		A20B-2001-0830 (CH1)
d-05	Specifies a data number	54 (Spindle load level)
d-06	Shift at data output (0 to 31 bits)	6
d-07	Data shift direction 0: Data is shifted right 1: Data is shifted left	0
d-08	Offset 0: Not provided 1: Provided	0

[Output to the channel 2]

Address	Description	Initial value
		A20B-2001-0830 (CH1)
d-09	Specifies a data number	34 (U-phase current)
d-10	Shift at data output (0 to 31 bits)	8
d-11	Data shift direction 0: Data is shifted right 1: Data is shifted left	0
d-12	Offset 0: Not provided 1: Provided	1

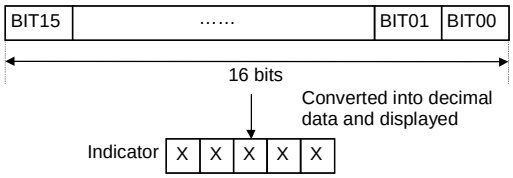
4.3.6.7 Principles in outputting the internal data of the serial spindle

The length of data is 32 bits (BIT31 TO BIT00) unless it is described as 16 bits.

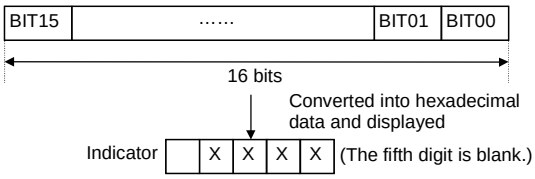


<1> Example of output to the indicator

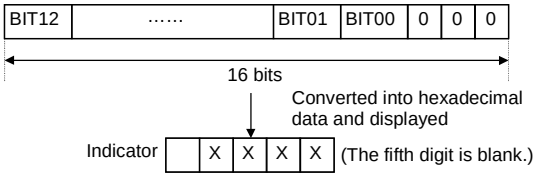
Example1 Displaying data in decimal
When the number of digits to shift data (d-02)=0 and display format (d-04)=0 (decimal notation): The last 16 bits of data (BIT15 to BIT00) are converted into decimal (0 to 65535 max.) and displayed.



Example2 Displaying data in hexadecimal
When the number of digits to shift data (d-02)=0 and display format (d-04)=1 (hexadecimal notation): The last 16 bits of data (BIT15 to BIT00) are converted into hexadecimal (0 to FFFFF max.) and displayed.

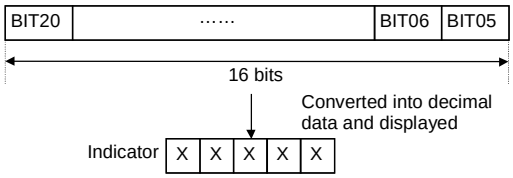


Example3 Shifting data left
When the number of digits to shift data (d-02)=3, the shift direction is left (d-03=1), and display format (d-04)=1 (hexadecimal notation): Data in BIT12 to BIT00 and the last three bits of data (=0) are converted into hexadecimal (0 to FFFFF max.) and displayed.



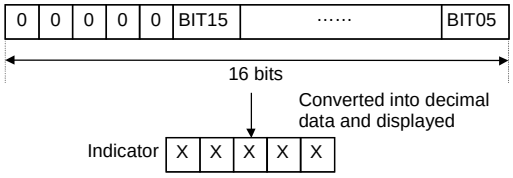
Example4 Shifting data right

When the number of digits to shift data (d-02)=5, shift direction is right (d-03=0), and display format (d-04)=0 (decimal notation): Data in BIT20 to BIT05 is converted into decimal (0 to 65535 max.) and displayed.



Example5 Shifting data right when the data length is 16 bits

When the data length is 16 bits, data shift (d-02)=5, shift direction is right (d-03=0), and display format is decimal notation (d-04=0): The first five bits of data and data in BIT15 to BIT05 are converted into decimal and displayed.



<2> Example of output to the channel 1

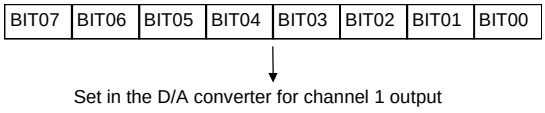
Internal data is output to channel 1 by setting it in an 8-bit D/A convertor.

The output range of the D/A convertor varies from one printed-circuit board to another. The output ranges from -5 V to +5 V (printed-circuit board A20B-2001-0830) or from 0 V to +11 V (printed-circuit board A20B-1005-0740) according to the internal data that is set. See the table below.

Internal data in binary (decimal)	Setting d-08 (whether there is offset)	Output on channel 1	
		A20B-2001-0830	A20B-1005-0740
00000000(0)	0	-5V	0V
11111111(255)	0	+4.96V	+11V
10000000(-128)	1	-5V	0V
00000000(0)	1	0V	+5.5V
01111111(127)	1	+4.96V	+11V

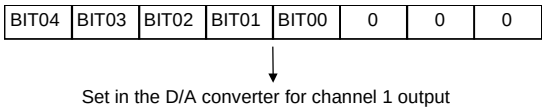
Example1 Data set

When the number of digits to shift data (d-06)=0 and when no offset is provided (d-08=0): The last eight bits of data (BIT07 to BIT00) is set in the D/A converter of the LM terminal.



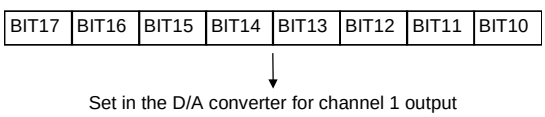
Example2 Shifting data left

When the number of digits to shift data (d-06)=3, shift direction is right (d-07=1), and no offset is provided (d-08=0): Data in BIT14 to BIT00 and the last three bits of data (=0) are set in the D/A converter.

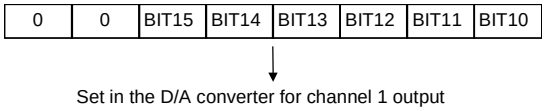


Example3 Shifting data right

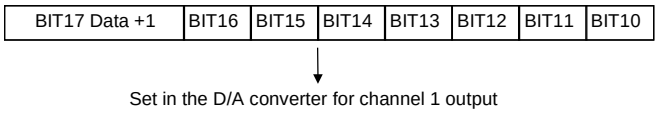
When the number of digits to shift data (d-06)=10, shift direction is right (d-07=1), and no offset is provided (d-08=0): Data in BIT17 to BIT10 is set in the D/A converter.



Example4 Shifting data right when the data length is 16 bits
When the data length is 16 bits, data shift (d-06)=10, shift direction is right (d-07=0), and no offset is provided (d-08=0): The first two bits of data (=0) and data in BIT15 to BIT10 are set in the D/A converter.



Example5 If an offset is provided
When the number of digits to shift data (d-06)=10, shift direction is right (d-07=0), and an offset is provided (d-08=1): Data in most significant bit BIT17 (to which 1 is added) and data in BIT16 to BIT10 are set in the D/A converter.



Example6 Data bit observation
(for printed-circuit board A20B-2001-0830 only)
For data shift (d-06) = 0 with no offset (d-08 = 0), the lowest data bit (BIT00) can be observed as a high/low level at check terminal CH1D.

<3> Example of output to the channel 2
Output to the channel 2 is the same as that to the channel 1. However, the addresses for setting data (d-09 to d-12) are different from those for output to the channel 1.
Setting velocity information in the channel 1 and the number of errors in the channel 2 enables simultaneous monitoring of the change in each data item using the two channels.

4.3.6.8 Data numbers

(1) SPM

Data No.	Description	Data length	Remarks
Main data			
16	Motor speed command	32	The 12th bit (BIT12) indicates a units in rpm.
19	Motor speed	32	The 12th bit (BIT12) indicates a units in rpm.
25	Motor speed deviation	32	(Speed command - motor speed) The 12th bit (BIT12) indicates a units in rpm.
4	Move command	32	Number of command pulses for ITP (usually 8 ms)
9	Positioning error	32	Number of erroneous pulses (Spindle synchronous control Cs contour control Rigid mode)
90	Torque command	16	0 to ±16384
131	Speedometer data	16	SM terminal
132	Load meter data	16	LM terminal
136	Position error	32	Number of erroneous pulses (Position coder orientation)
Data between the spindle and CNC			
5	Speed command data	16	±16384 for the maximum speed command
6	Spindle control signal 1	16	See the command signal from the PMC to spindle in (4).
10	Load meter data	16	±16384 for maximum output
11	Motor speed data	16	±16384 for maximum speed
12	Spindle status signal 1	16	See the status signal from the spindle to PMC in (4).
66	Spindle control signal 2	16	See the command signal from the PMC to spindle in (4).
182	Spindle status signal 2	16	See the status signal from the spindle to PMC in (4).
Other data			
218	Phase U current (A/D conversion data)	16	10 V/FS by shifting 8 bits left(Note)
219	Phase V current (A/D conversion data)	16	
121	Magnetic sensor signal (MS signal on the main side)	16	15.4 V/FS by shifting 8 bits left(Note)
125	Magnetic sensor signal (MS signal on the sub side)	16	
162	DC link voltage	16	1000 V/FS by shifting 8 bits left(Note)

NOTE

Printed-circuit board A20B-2001-0830 has no check pin for IU, IV, VDC, MSA1 or MSA2. To observe signals such as phase U current, output the corresponding internal data to channels 1 and 2. Shift the data to be observed by 8 bits left with an offset. The table (3) lists the internal data conversion.

(2) SPMC

Data No.	Description	Data length	Remarks
Main data			
19	Motor speed command	32	The 12th bit (bit 12) indicates the unit of min^{-1}.
8	Motor speed	32	The 12th bit (bit 12) indicates the unit of min^{-1} (only when a position coder is used)
13	Estimated motor speed	32	The 12th bit (bit 12) indicates the unit of min^{-1}.
18	Spindle speed	32	The 12th bit (bit 12) indicates the unit of min^{-1} (only when a position coder is used)
7	Motor speed deviation	32	(Speed command - motor speed). The 12th bit (bit 12) indicates the unit of min^{-1}.
4	Move command	32	Number of command pulses for ITP (usually 8 ms)
9	Position error	32	Number of erroneous pulses (spindle synchronization, Cs contour control, rigid mode)
90	Torque command	16	0 to ±16384
131	Load meter data	16	LM pin
117	Position error	32	Number of erroneous pulses (position coder orientation)
Data between the spindle and CNC			
74	Speed command data	16	±16384 for the maximum speed command
77	Spindle control signal 1	16	See the command signal from the PMC to spindle in (4).
54	Load meter data	16	±16384 for maximum output
55	Motor speed data	16	±16384 for maximum speed
61	Spindle status signal 1	16	See the status signal from the spindle to PMC in (4).
78	Spindle control signal 2	16	See the command signal from the PMC to spindle in (4).
62	Spindle status signal 2	16	See the status signal from the spindle to PMC in (4).
Other data			
34	Phase U current (A/D conversion data)	16	10 V/FS by shifting 8 bits left(Note)
35	Phase V current (A/D conversion data)	16	
39	DC link voltage	16	1000 V/FS by shifting 8 bits left(Note)

NOTE
Internal data conversion is performed as shown in the Table in (3).

(3) Internal data conversion (A20B-2001-0830)

<table>
<tr><th>Data No.</th><th>Signal name</th><th>Description (All are voltage values on check pins when the shift amount is 8.)</th></tr>
<tr><td>218</td><td>IU</td><td>Phase U current</td><td rowspan="2">The current is positive when it is input to the amplifier.
<table><tr><th>Model</th><th>Conversion result</th></tr><tr><td>SPM-2.2, 5.5
SPM-11HV</td><td>16.7 A/1 V</td></tr><tr><td>SPM-11, 15HV</td><td>33.3 A/1 V</td></tr><tr><td>SPM-15, 25HV</td><td>50.0 A/1 V</td></tr><tr><td>SPM-22, 45HV</td><td>66.7 A/1 V</td></tr><tr><td>SPM-26</td><td>100 A/1 V</td></tr><tr><td>SPM-30, 75HV</td><td>133 A/1 V</td></tr><tr><td>SPM-45</td><td>200 A/1 V</td></tr><tr><td>SPM-55</td><td>233 A/1 V</td></tr></table></td></tr>
<tr><td>219</td><td>IV</td><td>Phase V current</td></tr>
<tr><td>162</td><td>VDC</td><td colspan="2">DC link voltage signal 100 V/1 V (200 V/1 V for SPM-HV)</td></tr>
<tr><td>121</td><td>MSA1</td><td colspan="2">Magnetic sensor output MSA signal 1 1.54 V/1 V
(Adjustment value on check board: Single amplitude 2.0 V min, offset ±300 mV max)</td></tr>
<tr><td>125</td><td>MSA2</td><td colspan="2">Magnetic sensor output MSA signal 2 1.54 V/1 V</td></tr>
</table>

(4) Spindle control signals (PMC signals)

<table>
<tr><th>Data No.</th><th>Description</th></tr>
<tr><td>6</td><td>Spindle control signal 1 (command signal from the PMC to spindle)
<table>
<tr><td>BIT15</td><td>BIT14</td><td>BIT13</td><td>BIT12</td><td>BIT11</td><td>BIT10</td><td>BIT09</td><td>BIT08</td></tr>
<tr><td>RCH</td><td>RSL</td><td>INTG</td><td>SOCN</td><td>MCFN</td><td>SPSL</td><td>*ESP</td><td>ARST</td></tr>
<tr><td>BIT07</td><td>BIT06</td><td>BIT05</td><td>BIT04</td><td>BIT03</td><td>BIT02</td><td>BIT01</td><td>BIT00</td></tr>
<tr><td>MRDY</td><td>ORCM</td><td>SFR</td><td>SRV</td><td>CTH1</td><td>CTH2</td><td>TLMH</td><td>TLML</td></tr>
</table></td></tr>
<tr><td>66</td><td>Spindle control signal 2 (control signal from the PMC to spindle)
<table>
<tr><td>BIT15</td><td>BIT14</td><td>BIT13</td><td>BIT12</td><td>BIT11</td><td>BIT10</td><td>BIT09</td><td>BIT08</td></tr>
<tr><td></td><td></td><td>*DOPN</td><td>DSCN</td><td>SORSL</td><td>MPOF</td><td>SLV</td><td>MORCM</td></tr>
<tr><td>BIT07</td><td>BIT06</td><td>BIT05</td><td>BIT04</td><td>BIT03</td><td>BIT02</td><td>BIT01</td><td>BIT00</td></tr>
<tr><td>RCHHG</td><td>MFNHG</td><td>INCMD</td><td>OVR</td><td>DEFMD</td><td>NRRO</td><td>ROTA</td><td>INDX</td></tr>
</table></td></tr>
<tr><td>12</td><td>Spindle status signal 1 (status signal from the spindle to PMC)
<table>
<tr><td>BIT15</td><td>BIT14</td><td>BIT13</td><td>BIT12</td><td>BIT11</td><td>BIT10</td><td>BIT09</td><td>BIT08</td></tr>
<tr><td>MOAR2</td><td>MOAR1</td><td>POAR2</td><td>SLVS</td><td>RCFN</td><td>RCHP</td><td>CFIN</td><td>CHP</td></tr>
<tr><td>BIT07</td><td>BIT06</td><td>BIT05</td><td>BIT04</td><td>BIT03</td><td>BIT02</td><td>BIT01</td><td>BIT00</td></tr>
<tr><td>ORAR</td><td>TLM</td><td>LDT2</td><td>LDT1</td><td>SAR</td><td>SDT</td><td>SST</td><td>ALM</td></tr>
</table></td></tr>
<tr><td>182</td><td>Spindle status signal 2 (status signal from the spindle to PMC)
<table>
<tr><td>BIT15</td><td>BIT14</td><td>BIT13</td><td>BIT12</td><td>BIT11</td><td>BIT10</td><td>BIT09</td><td>BIT08</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>BIT07</td><td>BIT06</td><td>BIT05</td><td>BIT04</td><td>BIT03</td><td>BIT02</td><td>BIT01</td><td>BIT00</td></tr>
<tr><td></td><td></td><td></td><td>EXOF</td><td>SOREN</td><td>MSOVR</td><td>INCST</td><td>PC1DT</td></tr>
</table></td></tr>
</table>

4.3.6.9 Example of monitoring data

<1> Example of monitoring a positioning error using the channel 1

Address	Description	Set Data			
d-05	Data number	9	9	9	9
d-06	Data shift	0	1	1	2
d-07	Data shift direction	0	0	1	1
d-08	Offset	1	1	1	1
Data unit (NOTE)		256p/FS	512p/FS	128p/FS	64p/FS

NOTE
Printed-circuit board A20B-2001-0830:
FS=10V (-5V to 5V)
Printed-circuit board A20B-1005-0740:
FS=11V (0V to 11V)

<2> Example of monitoring a motor speed using the channel 2

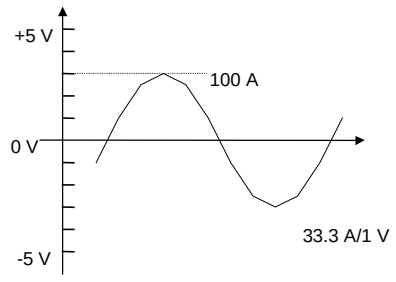
Address	Description	Set Data		
d-09	Data number	19	19	19
d-10	Data shift	12	13	11
d-11	Data shift direction	0	0	0
d-12	Offset	0	0	0
Data unit (NOTE)		$256min^{-1}$/FS	$512min^{-1}$/FS	128p/FS

NOTE
Printed-circuit board A20B-2001-0830:
FS=10V (-5V to 5V)
Printed-circuit board A20B-1005-0740:
FS=11V (0V to 11V)

<3> Observation of phase U current in the SPM-11

Setting of observation data

Data No.	218
Shift amount	8
Shift direction	0 (shifted left)
Offset	1 (provided)



5 PERIODIC MAINTENANCE OF SERVO AMPLIFIER

5.1 BATTERY FOR THE ABSOLUTE PULSE CODER

When the interface with the CNC is type B or FSSB, the battery for the absolute pulse coder is required for absolute-position detection.
The battery for the absolute pulse coder is installed in the following two methods:

Method 1: Installing a special lithium battery in the SVM
- Use A06B-6073-K001.

Method 2: Using a battery case (A06B-6050-K060)
- Use A06B-6050-K061 or a commercially available size-D battery.
- A connection cable (A06B-6093-K810) is required.

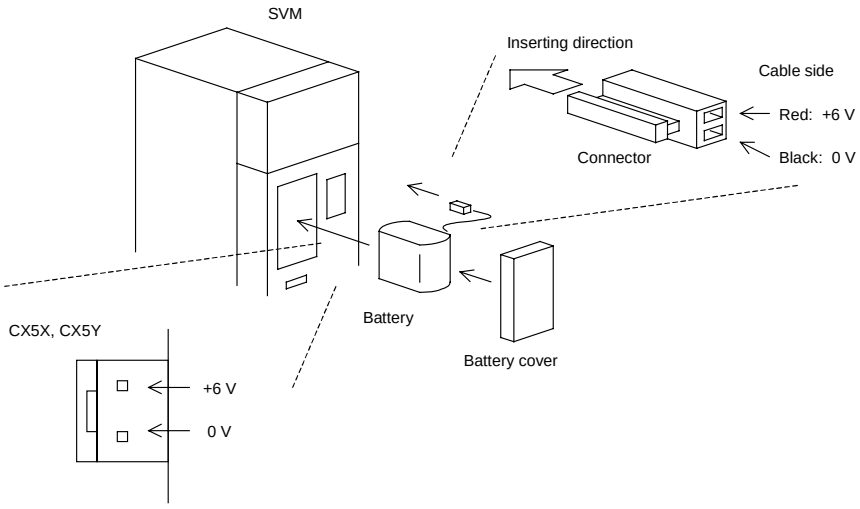
Use	Name	Order specification drawing No.	Classification
Method 1	Battery	A06B-6073-K001	Option
Method 2	Battery	A06B-6050-K061	
	Battery case	A06B-6050-K060	
	Cable for battery connection	A06B-6093-K810	
	Connector for battery connection	A06B-6093-K303	

5.1.1 Installing a Special Lithium Battery in the SVM (Method 1)

A special lithium battery (A06B-6073-K001) can be installed in the SVM (see the figure below).

[Installation procedure]

(1) Remove the battery cover from the SVM.
(2) Install the battery in the SVM as shown in the figure below.
(3) Install the battery cover.
(4) Attach the battery connector to CX5X or CX5Y of the SVM.



WARNING

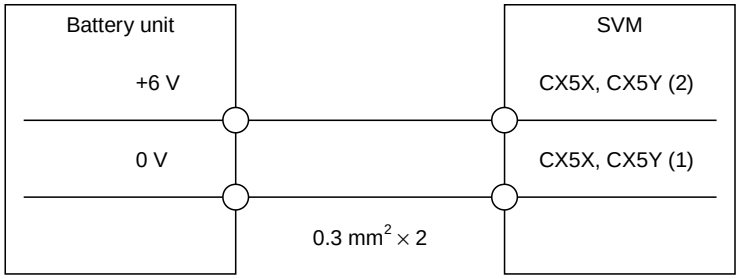
1 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.
2 When installing the battery with its connector attached to connector CX5X or CX5Y, attach the factory-installed protection socket to the unused connector. When the +6-V and 0-V pins of CX5X or CX5Y are short-circuited, the battery may overheat, blow out, or catch fire.

CAUTION

1 You may attach the battery connector to either CX5X or CX5Y.
2 When the battery is installed in the SVM from the side from which the cable is drawn, the cable may be stretched tight, which can lead to a poor contact condition. Therefore, install the battery so that the cable is not extended tightly.

5.1.2 Using a Battery Case (A06B-6050-K060) (Method 2)

Details of connection of the battery unit to the SVM



Screw terminal: M3
Crimp terminal: 1.25-4

Housing : 1L-L2S-S3L-B(N)
Contact : 1L-C2-1-00001
Manufacturer: Japan Aviation Electronics Industry, Ltd.

Note) A special crimping tool is required to attach the contacts to a cable. Contact the following:
Japan Aviation Electronics Industry, Ltd.

WARNING
1 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.
2 When installing the battery with its connector attached to connector CX5X or CX5Y, attach the factory-installed protection socket to the unused connector. When the +6-V and 0-V pins of CX5X or CX5Y are short-circuited, the battery may overheat, blow out, or catch fire.

CAUTION
1 You may attach the battery connector to either CX5X or CX5Y.
2 To an unused connector, attach the supplied protection socket.

5.1.3 Connecting a Battery to Multiple SVMs

There are two methods for connecting a battery to more than one SVM.

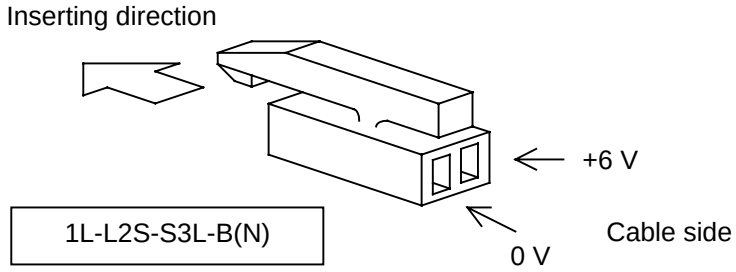
(1) Connecting a battery installed in one SVM to other SVMs

(2) Connecting a separate battery unit to SVMs

The following connector kit is provided for preparing cables:

Drawing No.	Manufacturer	Part number of manufacturer	Product	Quantity
A06B-6093-K303	Japan Aviation Electronics Industry, Ltd.	1L-L2S-S3L-B(N)	Housing	2
		1L-C2-1-00001	Contact	4

Note) A special crimping tool is required to attach contacts to a cable. Contact the following:
Japan Aviation Electronics Industry, Ltd.



WARNING

1 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.

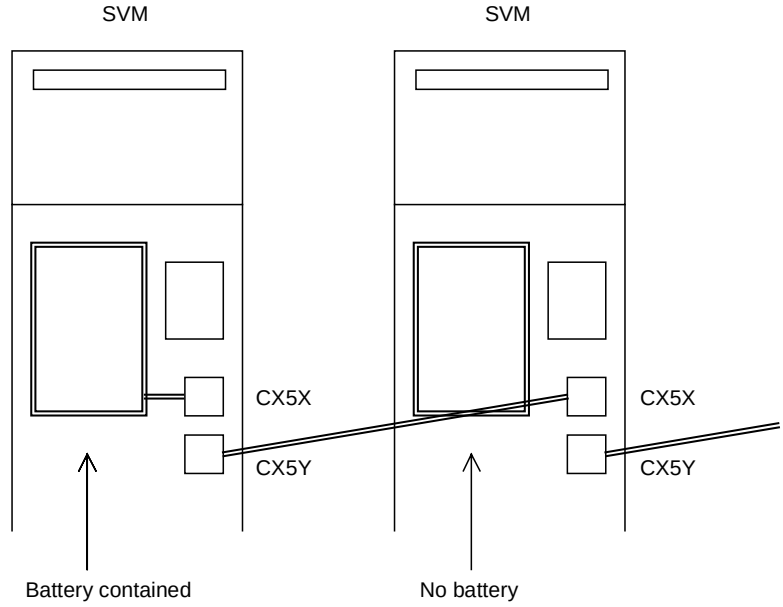
2 When installing the battery with its connector attached to connector CX5X or CX5Y, attach the factory-installed protection socket to the unused connector. When the +6-V and 0-V pins of CX5X or CX5Y are short-circuited, the battery may overheat, blow out, or catch fire.

CAUTION

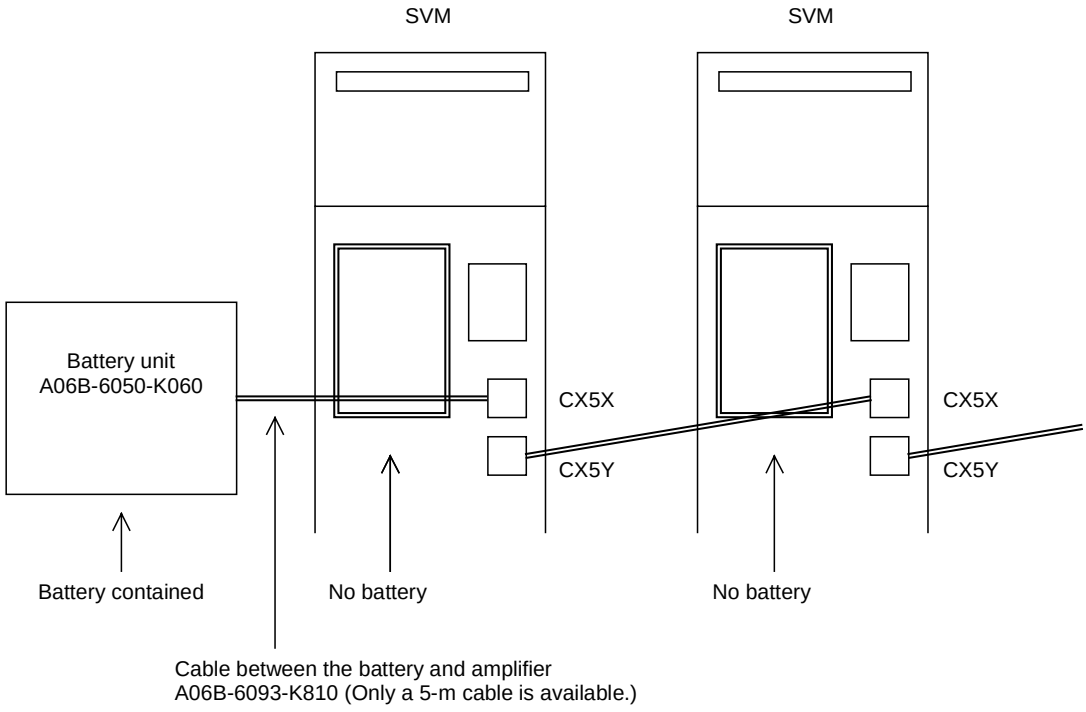
Note that when a battery is shared among more than one servo amplifier module (SVM), the battery life will shorten. The following table shows general life times of batteries.

Battery type	General life time
Lithium battery	One year for three axes
Alkaline size D battery	One year for six axes

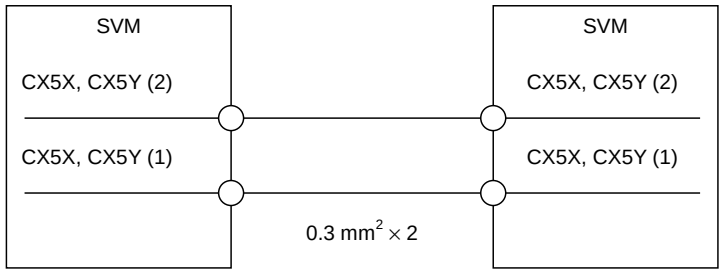
(1) Connecting a battery installed in one SVM to other SVMs



(2) Connecting a separate battery unit to SVMs



Details of connection between SVMs



Housing	:	1L-L2S-S3L-B(N)	Housing	:	1L-L2S-S3L-B(N)
Contact	:	1L-C2-1-00001	Contact	:	1L-C2-1-00001
Manufacturer	:	Japan Aviation Electronics Industry, Ltd.	Manufacturer	:	Japan Aviation Electronics Industry, Ltd.

5.1.4 Replacing the Battery

To prevent absolute-position information of the absolute pulse coder from being lost, replace the battery while the power for control is on. Follow the procedure explained below.

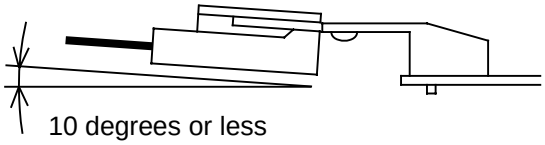
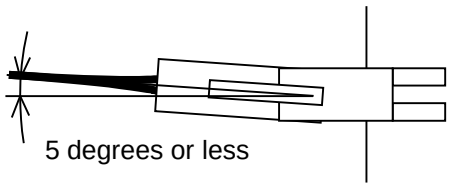
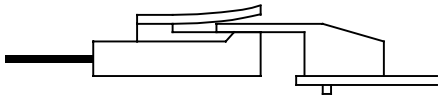
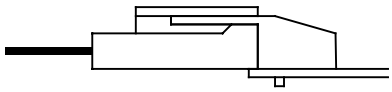
1. Make sure that the power to the SVM is on (the 7-segment LED on the front of the SVM is on).
2. Make sure that the emergency stop button of the system has been pressed.
3. Make sure that the motor is not activated.
4. Make sure that the DC link charge LED of the SVM is off.
5. Remove the old battery, and install a new battery.
6. This completes the replacement. You can turn off the power to the system.

WARNING

1 When replacing the battery, be careful not to touch bare metal parts in the panel. In particular, be careful not to touch any high-voltage circuits due to the electric shock hazard.
2 Before replacing the battery, check that the DC link charge confirmation LED on the front of the servo amplifier is off. Neglecting this check creates an electric shock hazard.
3 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.
4 When installing the battery with its connector attached to connector CX5X or CX5Y, attach the factory-installed protection socket to the unused connector. When the +6-V and 0-V pins of CX5X or CX5Y are short-circuited, the battery may overheat, blow out, or catch fire.

5.1.5 Attaching and Detaching Connectors

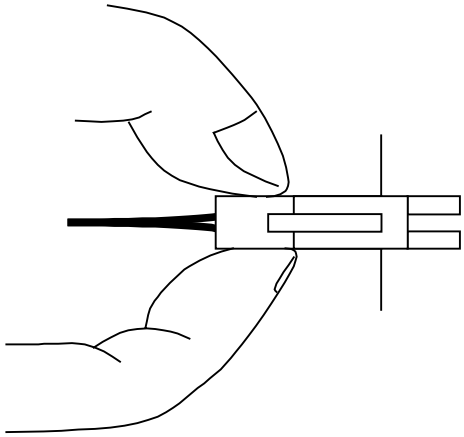
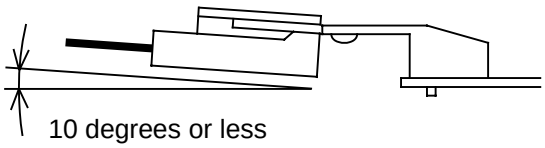
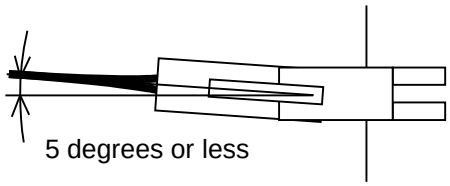
(1) Attaching connectors

<1>		Check the attachment position.
<2>		Plug the cable connector while raising it slightly.
<5>		Here, the angle of the cable connector to the horizontal must be 5 degrees or less.
<3>		After passing the lock pin, insert the connector straight.
<4>		The attachment of the connector is completed.

CAUTION

When attaching or detaching the battery connector, be careful not to apply excessive torsion to the connector. When the connector is attached or detached, applying excessive stress to the connector can lead to a poor contact condition or other problems.

(2) Detaching the connector

<1>		Hold both the sides of the cable insulator and the cable, and pull them horizontally.
<2>		Pull out the cable side while raising it slightly.
<3>		Here, the angle of the cable to the horizontal must be 5 degrees or less.

II. TROUBLESHOOTING

1 OVERVIEW

This part describes the troubleshooting procedure for each module. Read the section related to your current trouble to locate it and take an appropriate action.
First, check the alarm number and STATUS display indicated on your module with each list (alarm numbers in the list are those for the CNC) in Chapter 2 to find the corresponding detailed information in Chapter 3. Then take an appropriate action according to the detailed information.

2 ALARM NUMBERS AND BRIEF DESCRIPTIONS

2.1 FOR SERIES 16*i*, 18*i*, 20*i*, 21*i*, AND Power Mate *i*

Servo alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
360				Pulse coder checksum error (built-in)	3.3.7 (1)
361				Pulse coder phase error (built-in)	3.3.7 (1)
363				Clock error (built-in)	3.3.7 (1)
364				Soft phase alarm (built-in)	3.3.7 (1)
365				LED error (built-in)	3.3.7 (1)
366				Pulse error (built-in)	3.3.7 (1)
367				Count error (built-in)	3.3.7 (1)
368				Serial data error (built-in)	3.3.7 (3)
369				Data transfer error (built-in)	3.3.7 (3)
380				LED error (separate)	3.3.7 (2)
381				Pulse coder phase error (separate)	3.3.7 (2)
382				Count error (separate)	3.3.7 (2)
383				Pulse error (separate)	3.3.7 (2)
384				Soft phase alarm (separate)	3.3.7 (2)
385				Serial data error (separate)	3.3.7 (3)
386				Data transfer error (separate)	3.3.7 (3)
417				Invalid parameter	3.3.6
421				Excessive semi-full error	3.3.8
430				Servomotor overheat	3.3.5
431			03	Converter: main circuit overload	3.1
432			06	Converter: control undervoltage/open phase	3.1
433			04	Converter: DC link undervoltage	3.1
434	2			Inverter: control power supply undervoltage	3.2
435	5			Inverter: DC link undervoltage	3.2
436				Soft thermal (OVC)	3.3.3
437			01	Converter: input circuit overcurrent	3.1
438	8 9 A b C d E			Inverter: current alarm (L axis) (M axis) (N axis) (L and M axes) (M and N axes) (L and N axes) (L, M, and N axes)	3.2
439			07	Converter: DC link overvoltage	3.1
440			08	Converter excessive deceleration power	3.1

Alarm No.	SVM	SPM	PSM	Description	Remarks
441				Current offset error	3.3.8
442			05	Converter: DC link charging/inverter DB	3.1
443			02	Converter: cooling fan stopped	3.1
444	1			Inverter: internal cooling fan stopped	3.2
445				Soft disconnection alarm	3.3.4
446				Hard disconnection alarm	Not issued
447				Hard disconnection alarm (separate)	3.3.4
448				Feedback mismatch alarm	3.3.8
449	8. 9. A. b. C. d. E.			Inverter: IPM alarm (L axis) (M axis) (N axis) (L and M axes) (M and N axes) (L and N axes) (L, M, and N axes)	3.2
453				Soft disconnection alarm (α pulse coder)	3.3.4

Spindle alarm (n represents a spindle number. Example: n = 1 for the first spindle)

Alarm No.	SVM	SPM	PSM	Description	Remarks
749		A		Program ROM error	3.4
749		A0		Program ROM error	3.4
749		A1		Program RAM error	3.4
749		A2		Program RAM error	3.4
749		A3		SPM control circuit clock error	3.4
749		A4		SRAM parity error	3.4
7n01		01		Motor overheat	3.4
7n02		02		Excessive speed deviation	3.4
7n03		03		DC link fuse blown	3.4
7n04		04	06	Input power supply open phase and power supply failure	3.4
7n07		07		Excessive speed	3.4
7n09		09		Main circuit overload	3.4
7n11		11	07	DC link overvoltage	3.4
7n12		12		DC link overcurrent/IPM alarm	3.4
750		13		CPU internal data memory error	3.4
7n15		15		Output switching/spindle switching alarm	3.4
750		16		RAM error	3.4
750		19		Excessive offset of the phase U current detection circuit	3.4
750		20		Excessive offset of the phase V current detection circuit	3.4

(n represents a spindle number. Example: n = 1 for the first spindle)

Alarm No.	SVM	SPM	PSM	Description	Remarks
749		24		Serial transfer data error	3.4
749		25		Setting data transfer stopped	3.4
7n26		26		Cs contour control speed detection signal disconnected	3.4
7n27		27		Position coder signal disconnected	3.4
7n28		28		Cs contour control position detection signal disconnected	3.4
7n29		29		Short-period overload	3.4
7n30		30	01	PSM main circuit overcurrent	3.4
7n31		31		Speed detection signal disconnected and motor lock alarm	3.4
750		32		Serial communication LSI internal RAM error	3.4
7n33		33	05	DC link precharge failure	3.4
7n34		34		Parameter data out of the specifiable range	3.4
7n35		35		Too large of a gear ratio is specified.	3.4
7n36		36		Error counter overflow	3.4
7n37		37		Speed detector parameter error	3.4
7n39		39		Cs contour control one-rotation signal detection error	3.4
7n40		40		Cs contour control one-rotation signal not detected	3.4
7n41		41		Position coder one-rotation signal detection error	3.4
7n42		42		Position coder one-rotation signal not detected	3.4
7n43		43		Differential speed mode position coder signal disconnected	3.4
7n44		44		A/D conversion error	3.4
7n46		46		Position coder one-rotation signal detection error during thread cutting	3.4
7n47		47		Position coder signal error	3.4
7n48		49		Excessive differential speed conversion result	3.4
7n50		50		Excessive speed command calculation value during spindle synchronization	3.4
7n51		51	04	DC link undervoltage	3.4
7n52		52		ITP signal error I	3.4
7n53		53		ITP signal error II	3.4
7n54		54		Current overload alarm	3.4
7n55		55		Power line state error at spindle switching/output switching	3.4
7n56		56		Control circuit cooling fan stopped	3.4
7n56		57	08	Excessive regenerated power	3.4
7n58		58	03	PSM main circuit overload	3.4
7n59		59	02	PSM cooling fan stopped	3.4

2.2 FOR SERIES 15*i*

Servo alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
SV0027				Invalid digital servo parameter setting	3.3.6
SV0360				Pulse coder checksum error (built-in)	3.3.7 (1)
SV0361				Pulse coder phase error (built-in)	3.3.7 (1)
SV0363				Clock error (built-in)	3.3.7 (1)
SV0364				Soft phase alarm (built-in)	3.3.7 (1)
SV0365				LED error (built-in)	3.3.7 (1)
SV0366				Pulse error (built-in)	3.3.7 (1)
SV0367				Count error (built-in)	3.3.7 (1)
SV0368				Serial data error (built-in)	3.3.7 (3)
SV0369				Data transfer error (built-in)	3.3.7 (3)
SV0380				LED error (separate)	3.3.7 (2)
SV0381				Pulse coder phase error (separate)	3.3.7 (2)
SV0382				Count error (separate)	3.3.7 (2)
SV0383				Pulse error (separate)	3.3.7 (2)
SV0384				Soft phase alarm (separate)	3.3.7 (2)
SV0385				Serial data error (separate)	3.3.7 (3)
SV0386				Data transfer error (separate)	3.3.7 (3)
SV0421				Excessive semi-full error	3.3.8
SV0430				Servomotor overheat	3.3.5
SV0431			03	Converter: main circuit overload	3.1
SV0432			06	Converter: control undervoltage/open phase	3.1
SV0433			04	Converter: DC link undervoltage	3.1
SV0434	2			Inverter: control power supply undervoltage	3.2
SV0435	5			Inverter: DC link undervoltage	3.2
SV0436				Soft thermal (OVC)	3.3.3
SV0437			01	Converter: input circuit overcurrent	3.1
SV0438	8 9 A b C d E			Inverter: current alarm (L axis) (M axis) (N axis) (L and M axes) (M and N axes) (L and N axes) (L, M, and N axes)	3.2
SV0439			07	Converter: DC link overvoltage	3.1
SV0440			08	Converter excessive deceleration power	3.1
SV0441				Current offset error	3.3.8

Alarm No.	SVM	SPM	PSM	Description	Remarks
SV0442			05	Converter: DC link charging/inverter DB	3.1
SV0443			02	Converter: cooling fan stopped	3.1
SV0444	1			Inverter: internal cooling fan stopped	3.2
SV0445				Soft disconnection alarm	3.3.4
SV0446				Hard disconnection alarm	Not issued
SV0447				Hard disconnection alarm (separate)	3.3.4
SV0448				Feedback mismatch alarm	3.3.8
SV0449	8. 9. A. b. C. d. E.			Inverter: IPM alarm (L axis) (M axis) (N axis) (L and M axes) (M and N axes) (L and N axes) (L, M, and N axes)	3.2

Spindle alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
SP097x		A		Program ROM error	3.4
SP097x		A0		Program ROM error	3.4
SP097x		A1		Program RAM error	3.4
SP097x		A2		Program RAM error	3.4
SP097x		A3		SPM control circuit clock error	3.4
SP097x		A4		SRAM parity error	3.4
SP0001		01		Motor overheat	3.4
SP0002		02		Excessive speed deviation	3.4
SP0003		03		DC link fuse blown	3.4
SP0004		04	06	Power supply failure	3.4
SP0007		07		Excessive speed	3.4
SP0009		09		Main circuit overload	3.4
SP0011		11	07	DC link overvoltage	3.4
SP0012		12		DC link overcurrent/IPM alarm	3.4
SP098x		13		CPU internal data memory error	3.4
SP0015		15		Output switching/spindle switching alarm	3.4
SP098x		16		RAM error	3.4
SP098x		19		Excessive offset of the phase U current detection circuit	3.4
SP098x		20		Excessive offset of the phase V current detection circuit	3.4
SP022x		24		Serial transfer data error	3.4
SP022x		25		Serial data transfer stopped	3.4

Alarm No.	SVM	SPM	PSM	Description	Remarks
SP0026		26		Cs contour control speed detection signal error	3.4
SP0027		27		Position coder signal error	3.4
SP0028		28		Cs contour control position detection signal error	3.4
SP0029		29		Short-period overload	3.4
SP0030		30	01	PSM main circuit overcurrent	‘
SP0031		31		Speed detection signal disconnected and motor lock alarm	3.4
SP098x		32		Serial communication LSI internal RAM error	3.4
SP0033		33	05	DC link precharge failure	3.4
SP0034		34		Parameter data out of the specifiable range	3.4
SP0035		35		Too large of a gear ratio is specified.	3.4
SP0036		36		Error counter overflow	3.4
SP0037		37		Speed detector parameter error	3.4
SP0039		39		Cs contour control one-rotation signal detection error	3.4
SP0040		40		Cs contour control one-rotation signal not detected	3.4
SP0041		41		Position coder one-rotation signal detection error	3.4
SP0042		42		Position coder one-rotation signal not detected	3.4
SP0043		43		Differential speed mode position coder signal error	3.4
SP0044		44		A/D conversion error	3.4
SP0046		46		Position coder one-rotation signal detection error during thread cutting	3.4
SP0047		47		Position coder signal error	3.4
SP0049		49		Excessive differential speed conversion result	3.4
SP0050		50		Excessive speed command calculation value during spindle synchronization	3.4
SP0051		51	04	DC link undervoltage	3.4
SP0052		52		ITP signal error I	3.4
SP0053		53		ITP signal error II	3.4
SP0054		54		Current overload alarm	3.4
SP0055		55		Power line state error at spindle switching/output switching	3.4
SP0056		56		Control circuit cooling fan stopped	3.4
SP0056		57	08	Excessive regenerated power	3.4
SP0058		58	03	PSM main circuit overload	3.4
SP0059		59	02	PSM cooling fan stopped	3.4

2.3 FOR SERIES 16, 18, 20, 21

Servo alarm

Alarm No.	Diagnosis screen	SVM	SPM	PSM	Description	Remarks
350	Alarm 3				α pulse coder error alarm	3.3.7
351	Alarm 4				Pulse coder communication error alarm	3.3.7
400	OVL	1			Fan stopped alarm (SVM)	3.2
				2	Fan stopped alarm (PSM)	3.1
				3	Overheat alarm (PSM)	
					Overheat alarm (motor)	3.3.5
414	HVA			7	DC link overvoltage alarm	3.1
	HCA	8			Abnormal current alarm (L axis)	3.2
		9			(M axis)	
		A			(N axis)	
		b			(L, M axis)	
		C			(M, N axis)	
		d			(L, N axis)	
		E			(L, M, N axis)	
				1	(PSM overcurrent + IPM alarm)	3.1
		8.			IPM alarm (L axis)	3.2
		9.			(M axis)	
		A.			(N axis)	
		b.			(L, M axis)	
		C.			(M, N axis)	
		d.			(L, N axis)	
		E.			(L, M, N axis)	
	OVC				Soft thermal (OVC)	3.3.3
	LVA	2			Control power supply undervoltage alarm	3.2
		5			DC link undervoltage alarm (SVM)	
				4	DC link undervoltage alarm (PSM)	3.1
				6	Power supply state alarm	
	FAN	1			Fan stopped alarm (Series 20 only)	3.2
				2	Fan stopped alarm (Series 20 only)	3.1
	MCC			5	MCC fused, precharge alarm	3.1
	OFS				Current conversion error alarm	3.3.8
416	FBA				Feedback disconnected alarm	3.3.4
417	PRM				Invalid servo parameter setting alarm	3.3.6

For the correspondence between the diagnosis screen numbers and names, see the table below.

	DGN No.	#7	#6	#5	#4	#3	#2	#1	#0
Alarm 1	200	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
Alarm 2	201	ALD			EXP				
Alarm 3	202		CSA	BLA	PHA	RCA	BZA	CKA	SPH
Alarm 4	203	DTE	CRC	STB	PRM				
Alarm 5	204		OFS	MCC	LDM	PMS	FAN	DAL	ABF

Spindle alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
749		A		Program ROM error	3.4
749		A0		Program ROM error	3.4
749		A1		Program RAM error	3.4
749		A2		Program RAM error	3.4
749		A3		SPM control circuit clock error	3.4
749		A4		SRAM parity error	3.4
751 (AL-01)		01		Motor overheat	3.4
751 (AL-02)		02		Excessive velocity error	3.4
751 (AL-03)		03		DC link fuse blown	3.4
751 (AL-04)		04	06	Input power supply open phase and power supply failure	3.4
751 (AL-07)		07		Overspeed	3.4
751 (AL-09)		09		Main circuit overload	3.4
751 (AL-11)		11	07	DC link overvoltage	3.4
751 (AL-12)		12		DC link overcurrent/IPM alarm	3.4
750		13		CPU internal data memory failure	3.4
751 (AL-15)		15		Speed range switching and spindle switching alarm	3.4
750		16		RAM error	3.4
750		19		Phase U current detector circuit excessive offset	3.4
750		20		Phase V current detector circuit excessive offset	3.4
749		24		Serial transfer data error	3.4
749		25		Serial data transfer stopped	3.4
751 (AL-26)		26		Cs contouring control velocity detection signal disconnected	3.4
751 (AL-27)		27		Position coder signal disconnected	3.4
751 (AL-28)		28		Cs contouring control position detection signal disconnected	3.4
751 (AL-29)		29		Short-period overload	3.4
751 (AL-30)		30	01	PSM main circuit overcurrent	3.4
751 (AL-31)		31		Speed detection signal disconnected and motor lock alarm	3.4
750		32		Serial communication LSI internal RAM error	3.4

Alarm No.	SVM	SPM	PSM	Description	Remarks
751 (AL-33)		33	05	DC link precharge failure	3.4
751 (AL-34)		34		Parameter data out of specification	3.4
751 (AL-35)		35		Too large gear ratio specified	3.4
751 (AL-36)		36		Error counter overflow	3.4
751 (AL-37)		37		Speed detector parameter error	3.4
751 (AL-39)		39		Cs contouring control one-rotation signal detection error	3.4
751 (AL-40)		40		Cs contouring control one-rotation signal not detected	3.4
751 (AL-41)		41		Position coder one-rotation signal detection error	3.4
751 (AL-42)		42		Position coder one-rotation signal not detected	3.4
751 (AL-43)		43		Differential speed mode position coder signal disconnected	3.4
751 (AL-44)		44		A/D conversion error	3.4
751 (AL-46)		46		Position coder one-rotation signal detection error during thread cutting	3.4
751 (AL-47)		47		Position coder signal error	3.4
751 (AL-49)		49		Excessive differential speed conversion result	3.4
751 (AL-50)		50		Excessive speed command computed value during the synchronization control of the spindle	3.4
751 (AL-51)		51	04	DC link undervoltage	3.4
751 (AL-52)		52		ITP signal error I	3.4
751 (AL-53)		53		ITP signal error II	3.4
751 (AL-54)		54		Overload current alarm	3.4
751 (AL-55)		55		Power line state error at spindle or speed range switching	3.4
751 (AL-56)		56		Control circuit cooling fan stopped	3.4
751 (AL-57)		57	08	Excessive regenerated power	3.4
751 (AL-58)		58	03	PSM main circuit overload	3.4
751 (AL-59)		59	02	PSM cooling fan stopped	3.4

2.4 FOR SERIES 15

Servo alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
SV001				Soft thermal (OVC)	3.3.3
SV003	8			Abnormal current alarm (L axis)	3.2
	9			(M axis)	
	A			(N axis)	
	b			(L, M axis)	
	C			(M, N axis)	
	d			(L, N axis)	
	E			(L, M, N axis)	
			1	(PSM overcurrent + IPM alarm)	3.1
	8.			IPM alarm (L axis)	3.2
	9.			(M axis)	
	A.			(N axis)	
	b.			(L, M axis)	
	C.			(M, N axis)	
	d.			(L, N axis)	
	E.			(L, M, N axis)	
SV004			7	DC link overvoltage	3.1
SV005			5	Precharge alarm (Series 15-A) (simultaneously with SV006)	3.1
SV006	2			Control power supply undervoltage alarm	3.1
	5			DC link undervoltage alarm (SVM)	
			4	DC link undervoltage alarm (PSM)	
			6	Power supply state alarm	
			5	Precharge alarm (Series 15-A) (simultaneously with SV005)	3.1
SV015				Feedback disconnected alarm	3.3.4
SV023	1			Fan stop alarm (SVM)	3.2
			2	Fan stop alarm (PSM)	3.1
			3	Overheat alarm (PSM)	
				Overheat alarm (motor)	3.3.5
SV027				Invalid servo parameter setting alarm	3.3.6
SV110				α pulse coder error alarm	3.3.7
SV114				Rotation speed data error alarm	3.3.7
SV115				Pulse coder communication error alarm	3.3.7
SV116				Precharge alarm (Series 15-B)	
SV117				Current conversion error alarm	3.3.8
SV124				Excessive semi-full error alarm	3.3.8
SV129				Feedback mismatch alarm	3.3.8

Alarm No.	SVM	SPM	PSM	Description	Remarks
SV323				Soft disconnection alarm	3.3.7
SV324				Hard disconnection alarm	3.3.7
SV325				Pulse coder error alarm (built-in)	3.3.7(1)
SV326				Pulse coder error alarm (built-in)	3.3.7(1)
SV327				Speed error (built-in)	3.3.7(1)
SV330				Serial communication error (built-in)	3.3.7(1)
SV331				Pulse coder error alarm (built-in)	3.3.7(2)
SV333				Pulse coder error alarm (separate linear)	3.3.7(2)
SV334				Pulse coder error alarm (separate rotary)	3.3.7(2)
SV335				Speed error (separate rotary)	3.3.7(2)
SV338				Separate detector alarm	3.3.7(2)
SV339				Serial communication error (separate)	3.3.7(3)
SV340				Hard disconnection alarm (separate)	3.3.4
SV351				Soft disconnection alarm (α pulse coder)	3.3.4

Spindle alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
OT300		A		Program ROM error	3.4
OT300		A0		Program ROM error	3.4
OT300		A1		Program RAM error	3.4
OT300		A2		Program RAM error	3.4
OT300		A3		SPM control circuit clock error	3.4
OT300		A4		SRAM parity error	3.4
OT301		01		Motor overheat	3.4
OT302		02		Excessive velocity error	3.4
OT399		03		DC link fuse blown	3.4
OT399		04	06	Power supply failure	3.4
OT307		07		Overspeed	3.4
OT309		09		Main circuit overload	3.4
OT311		11	07	DC link overvoltage	3.4
OT312		12		DC link overcurrent/IPM alarm	3.4
OT300		13		CPU internal data memory failure	3.4
OT399		15		Speed range switching and spindle switching alarm	3.4
OT300		16		RAM error	3.4
OT300		19		Phase U current detector circuit excessive offset	3.4
OT300		20		Phase V current detector circuit excessive offset	3.4
OT300		24		Serial transfer data error	3.4
OT300		25		Serial data transfer stopped	3.4
OT326		26		Cs contouring control velocity detection signal disconnected	3.4
OT327		27		Position coder signal disconnected	3.4
OT328		28		Cs contouring control position detection signal disconnected	3.4
OT329		29		Short-period overload	3.4
OT330		30	01	PSM main circuit overcurrent	3.4
OT331		31		Speed detection signal disconnected and motor lock alarm	3.4
OT300		32		Serial communication LSI internal RAM error	3.4
OT333		33	05	DC link precharge failure	3.4
OT334		34		Parameter data out of specification	3.4
OT335		35		Too large gear ratio specified	3.4
OT336		36		Error counter overflow	3.4
OT399		37		Speed detector parameter error	3.4
OT399		39		Cs contouring control one-rotation signal detection error	3.4

Alarm No.	SVM	SPM	PSM	Description	Remarks
OT399		40		Cs contour controling one-rotation signal not detected	3.4
OT399		41		Position coder one-rotation signal detection error	3.4
OT399		42		Position coder one-rotation signal not detected	3.4
OT399		43		Differential speed mode position coder signal disconnected	3.4
OT399		44		A/D conversion error	3.4
OT399		46		Position coder one-rotation signal detection error during thread cutting	3.4
OT399		47		Position coder signal error	3.4
OT399		49		Excessive differential speed conversion result	3.4
OT399		50		Excessive speed command computed value during the synchronization control of the spindle	3.4
OT399		51	04	DC link undervoltage	3.4
OT399		52		ITP signal error I	3.4
OT399		53		ITP signal error II	3.4
OT399		54		Overload current alarm	3.4
OT399		55		Power line state error at spindle or speed range switching	3.4
OT399		56		Control circuit cooling fan stopped	3.4
OT399		57	08	Excessive regenerated power	3.4
OT399		58	03	PSM main circuit overload	3.4
OT399		59	02	PSM cooling fan stopped	3.4

2.5 FOR SERIES 0-C

Servo alarm

Alarm No.	Diagnosis screen	SVM	SPM	PSM	Description	Remarks
309	Alarm 3				α pulse coder error alarm	3.3.7
	Alarm 4				Pulse coder communication error alarm	
400	OVL	1			Fan stopped alarm (SVM)	3.2
				2	Fan stopped alarm (PSM)	3.1
				3	Overheat alarm (PSM)	
					Overheat alarm (motor)	3.3.5
414	HVA			7	DC link overvoltage alarm	3.2
	DCA & LVA			5	Precharge alarm	3.2
	HCA	8			Abnormal current alarm (L axis)	3.2
		9			(M axis)	
		A			(N axis)	
		b			(L, M axis)	
		C			(M, N axis)	
		d			(L, N axis)	
		E			(L, M, N axis)	
				1	(PSM overcurrent + IPM alarm)	
		8.			IPM alarm (L axis)	3.2
		9.			(M axis)	
		A.			(N axis)	
		b.			(L, M axis)	
		C.			(M, N axis)	
		d.			(L, N axis)	
		E.			(L, M, N axis)	
	OVC				Soft thermal (OVC)	3.3.3
	LVA	2			Control power supply undervoltage alarm	3.1
		5			DC link undervoltage alarm (SVM)	
				4	DC link undervoltage alarm (PSM)	3.2
				6	Power supply state alarm	
416	FBA				Feedback disconnected alarm	3.3.4
417	PRM				Invalid servo parameter setting alarm	3.3.6

For the correspondence between the diagnosis screen numbers and names, see the table below.

	DGN No.	#7	#6	#5	#4	#3	#2	#1	#0
Alarm 1	720 to 723	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
Alarm 2	730 to 733	ALD			EXP				
Alarm 3	760 to 763		CSA	BLA	PHA	RCA	BZA	CKA	SPH
Alarm 4	770 to 773	DTE	CRC	STB	PRM				

Spindle alarm

Alarm No.	SVM	SPM	PSM	Description	Remarks
945		A		Program ROM error	3.4
945		A0		Program ROM error	3.4
945		A1		Program RAM error	3.4
945		A2		Program RAM error	3.4
945		A3		SPM control circuit clock error	3.4
945		A4		SRAM parity error	3.4
409		01		Motor overheat	3.4
409		02		Excessive velocity error	3.4
409		03		DC link fuse blown	3.4
409		04	06	Input power supply open phase and power supply failure	3.4
409		07		Overspeed	3.4
409		09		Main circuit overload	3.4
409		11	07	DC link overvoltage	3.4
409		12		DC link overcurrent/IPM alarm	3.4
408		13		CPU internal data memory failure	3.4
409		15		Speed range switching and spindle switching alarm	3.4
408		16		RAM error	3.4
408		19		Phase U current detector circuit excessive offset	3.4
408		20		Phase V current detector circuit excessive offset	3.4
945		24		Serial transfer data error	3.4
945		25		Serial data transfer stopped	3.4
409		26		Cs contouring control velocity detection signal disconnected	3.4
409		27		Position coder signal disconnected	3.4
409		28		Cs contouring control position detection signal disconnected	3.4
409		29		Short-period overload	3.4
409		30	01	PSM main circuit overcurrent	3.4
409		31		Speed detection signal disconnected and motor lock alarm	3.4
408		32		Serial communication LSI internal RAM error	3.4
409		33	05	DC link precharge failure	3.4
409		34		Parameter data out of specification	3.4
409		35		Too large gear ratio specified	3.4
409		36		Error counter overflow	3.4
409		37		Speed detector parameter error	3.4
409		39		Cs contouring control one-rotation signal detection error	3.4

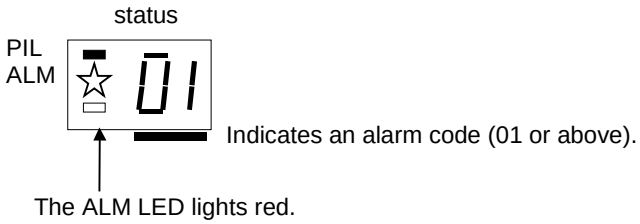
Alarm No.	SVM	SPM	PSM	Description	Remarks
409		40		Cs contouring control one-rotation signal not detected	3.4
409		41		Position coder one-rotation signal detection error	3.4
409		42		Position coder one-rotation signal not detected	3.4
409		43		Differential speed mode position coder signal disconnected	3.4
409		44		A/D conversion error	3.4
409		46		Position coder one-rotation signal detection error during thread cutting	3.4
409		47		Position coder signal error	3.4
409		49		Excessive differential speed conversion result	3.4
409		50		Excessive speed command computed value during the synchronization control of the spindle	3.4
409		51	04	DC link undervoltage	3.4
409		52		ITP signal error I	3.4
409		53		ITP signal error II	3.4
409		54		Overload current alarm	3.4
409		55		Power line state error at spindle or speed range switching	3.4
409		56		Control circuit cooling fan stopped	3.4
409		57	08	Excessive regenerated power	3.4
409		58	03	PSM main circuit overload	3.4
409		59	02	PSM cooling fan stopped	3.4

3 TROUBLESHOOTING AND ACTION

3.1 POWER SUPPLY MODULE

3.1.1 Power Supply Module (PSM, PSM-HV)

If an alarm occurs, in the STATUS display, the ALM LED lights red, and the two-digit 7-segment display indicates an alarm code.



3.1.1.1 Alarm code 01

For the PSM-5.5 to PSM-11

(1) Meaning
The main circuit power module (IPM) has detected an overload, overcurrent, or control supply voltage decrease.

(2) Cause and troubleshooting
(a) Cooling fan failure
Check whether the cooling fan rotates normally.
→ Replace the cooling fan.
(b) Dust buildup
→ Clean the cooling system with a vacuum cleaner or compressed air.
(c) Overload
→ Examine the operating conditions.
(d) Input supply voltage imbalance
→ Check the input power supply specification.
(e) The specification of the AC reactor does not match the PSM in use.
→ Check the PSM and the specification of the AC reactor.
(f) IPM failure, or control supply voltage decrease of the power module (IPM)
→ Replace the unit or IPM.

For PSM-15 to PSM-55, PSM-18HV to PSM-75HV

(1) Meaning
Overcurrent flowed into the input of the main circuit.

(2) Cause and troubleshooting
(a) Input supply voltage imbalance
→ Check the input power supply specification.
(b) The specification of the AC reactor does not match the PSM in use.
→ Check the PSM and the specification of the AC reactor.
(c) IGBT defective
→ Replace IGBT.

3.1.1.2 Alarm code 02

(1) Meaning
(a) A cooling fan for the control circuit has stopped.
(b) The control supply voltage has dropped.

(2) Cause and troubleshooting
(a) Cooling fan broken
Check whether the cooling fan rotates normally.
→ Replace it.
(b) Input voltage decrease
→ Check the power supply.

3.1.1.3 Alarm code 03

(1) Meaning
The temperature of the main circuit heat sink has risen abnormally.

(2) Cause and troubleshooting
(a) Cooling fan for the main circuit broken
Check whether the cooling fan for the main circuit rotates normally.
→ Replace it.
(b) Dust accumulation
→ Clean the cooling system with a vacuum cleaner or the factory air blower.
(c) Overload
→ Examine the operating conditions.

3.1.1.4 Alarm code 04

(1) Meaning
In the main circuit, the DC voltage (DC link) has dropped.

(2) Cause and troubleshooting
(a) A small power dip has occurred.
→ Check the power supply.
(b) Low input power supply voltage
→ Check the power supply specification.
(c) The main circuit power supply may have been switched off with an emergency stop state released.
→ Check the sequence.

3.1.1.5 Alarm code 05

(1) Meaning
(a) The input power supply is abnormal (open phase).
(b) The main circuit capacitor was not recharged within the specified time.

(2) Cause and troubleshooting
(a) The input power supply has an open phase.
→ Check the connection.
(b) Too many SVM and/or SPM units are connected.
→ Check the specification of the PSM.
(c) The DC link is short-circuited.
→ Check the connection.
(d) The recharge current limiting resistor is defective.
→ Replace the unit.

3.1.1.6 Alarm code 06

(1) Meaning
The input power supply is abnormal (open phase).

(2) Cause and troubleshooting
(a) The input power supply has an open phase.
→ Check the connection.

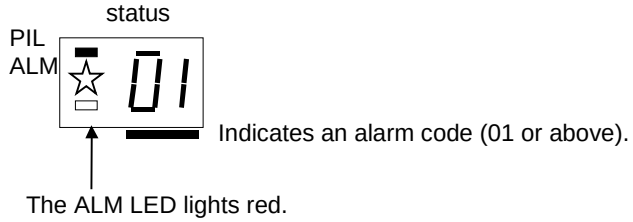
3.1.1.7 Alarm code 07

(1) Meaning
In the main circuit, the DC voltage at the DC link is abnormally high.

(2) Cause and troubleshooting
(a) Excessive regenerated power
Regeneration is impossible. The PSM does not have a sufficient capacity.
→ Check the specification of the PSM.
(b) The output impedance of the AC power source is too high.
→ Check the power source output impedance.
(Normal if the voltage variation at maximum output time is within 7%)
(c) Regeneration circuit failure
→ Replace the unit.
(d) The main circuit power supply may have been switched off with an emergency stop state released.
→ Check the sequence.

3.1.2 Power Supply Module (PSMV)

If an alarm occurs, in the STATUS display, the ALM LED lights red, and the two-digit 7-segment display indicates an alarm code.



3.1.2.1 Alarm code 01

(1) Meaning
Overcurrent flowed into the DC link of the main circuit.

(2) Cause and troubleshooting
(a) Thyristor or IGBT failure
→ Replace the thyristor or IGBT.
(b) DC link short-circuit
→ Check the connection.
(c) The specification of the AC reactor does not match the PSMV in use.
→ Check the PSMV and the specification of the AC reactor.

3.1.2.2 Alarm code 02

(1) Meaning
A cooling fan for the control circuit has stopped.

(2) Cause and troubleshooting
(a) Cooling fan for the control circuit broken
Check whether the cooling fan for the control circuit rotates normally.
→ Replace it.

3.1.2.3 Alarm code 03

(1) Meaning
The temperature of the main circuit heat sink has risen abnormally.

(2) Cause and troubleshooting
(a) Cooling fan for the main circuit broken
Check whether the cooling fan for the main circuit rotates normally.
→ Replace it.
(b) Dust accumulation
→ Clean the cooling system with a vacuum cleaner or the factory air blower.
(c) Overload
→ Examine the operating conditions.

3.1.2.4 Alarm code 04

(1) Meaning
In the main circuit, the DC voltage (DC link) has dropped.

(2) Cause and troubleshooting
(a) Low input power supply voltage
→ Check the power supply.

3.1.2.5 Alarm code 05

(1) Meaning
The main circuit capacitor was not recharged within the specified time.

(2) Cause and troubleshooting
(a) Too many SVM and/or SPM units are connected.
→ Check the specification of the PSMV.

3.1.2.6 Alarm code 06

(1) Meaning
(a) The main circuit supply voltage is not fed.
(b) Two or more input fuses of the AC reactor unit have blown.
Note) This alarm is also output when a momentary power failure occurs.

(2) Cause and troubleshooting
(a) The input supply voltage is not fed to the main circuit.
→ Check the connection.
(b) Two or more input fuses of the AC reactor unit have blown.
→ Replace the fuses.

3.1.2.7 Alarm code 16

(1) Meaning
(a) The main circuit power supply has an open phase.
(b) One input fuse of the AC reactor unit has blown.

(2) Cause and troubleshooting
(a) The main circuit power supply has an open phase.
→ Check the connection.
(b) One input fuse of the AC reactor unit has blown.
→ Replace the fuse.

3.1.2.8 Alarm code 26

(1) Meaning
The frequency of the main circuit input power supply is abnormal.

(2) Cause and troubleshooting
(a) Input power supply frequency error
→ Check the input power supply specification (50/60 Hz ±1 Hz).

3.1.2.9 Alarm code 36

(1) Meaning
The input power supply of the main circuit has an imbalance.

(2) Cause and troubleshooting
(a) The input supply voltage has an imbalance of 5% or more.
→ Check the input power supply specification.

3.1.2.10 Alarm code 46

(1) Meaning
When the magnetic contactor is turned on, the phase sequence of the power supply cannot be determined.

(2) Cause and troubleshooting
(a) Input power supply error
→ Check the input power supply specification.

3.1.2.11 Alarm code 07

(1) Meaning
In the main circuit, the DC voltage at the DC link is abnormally high.

(2) Cause and troubleshooting
(a) Excessive regenerated power
The PSMV does not have a sufficient capacity.
→ Check the specification of the PSMV.
(b) The output impedance of the AC power source is too high.
→ Check the power source output impedance.
(Normal if the voltage variation at maximum output time is within 7%)
(c) Regeneration circuit failure
→ Replace the unit.

3.1.2.12 Alarm code 17

(1) Meaning
In the main circuit, the voltage at the DC link is abnormally high. A fuse of the AC reactor unit may have blown.

(2) Cause and troubleshooting
(a) An input fuse of the AC reactor unit has blown.
→ Replace the fuse.
(b) Regeneration circuit failure
→ Replace the unit.

3.1.2.13 Alarm code 08

(1) Meaning
The offset of the current detection circuit of the main circuit DC link is excessive.

(2) Cause and troubleshooting
(a) The current detection circuit of the main circuit DC link malfunctions.
→ Replace the power printed wiring board.
(b) The control printed circuit board or A/D converter is faulty.
→ Replace the control printed circuit board.

3.1.2.14 Alarm code 18

(1) Meaning
An error occurred in internal parameter data transfer processing.

(2) Cause and troubleshooting
(a) The control printed circuit board is faulty.
→ Replace the control printed circuit board.

3.1.2.15 Alarm code A0

(1) Meaning
  (a) No ROM is installed.
  (b) The ROM is faulty.

(2) Cause and troubleshooting
  (a) The ROM is not installed correctly, or no ROM is installed.
  Check if the ROM is removed from the socket or if a bent lead has caused a bad contact.
  → Install the ROM correctly.
  (b) ROM specification error
  Check the software version stamped on the ROM.
  → Install a specified ROM correctly.
  (c) Control printed circuit board failure
  → Replace the control printed circuit board.

3.1.2.16 Alarm code A1

(1) Meaning
  The RAM is faulty.

(2) Cause and troubleshooting
  (a) The control printed circuit board is faulty.
  → Replace the control printed circuit board.

3.1.2.17 Alarm code A2

(1) Meaning
  A program is not operating normally.

(2) Cause and troubleshooting
  (a) The control printed circuit board is faulty.
  → Replace the control printed circuit board.

3.1.3 Power Supply Module (PSMR)

When an alarm is issued, the one-digit 7-segment LED indicates an alarm code.


Indicates an alarm code (02 or above).

3.1.3.1 Alarm code 2

(1) Meaning
A cooling fan for the control circuit has stopped.

(2) Cause and troubleshooting
(a) Cooling fan for the control circuit broken
Check whether the cooling fan for the control circuit rotates normally.
→ Replace it.

3.1.3.2 Alarm code 4

(1) Meaning
In the main circuit, the DC voltage (DC link) has dropped.

(2) Cause and troubleshooting
(a) A small power dip has occurred.
→ Check the power supply.
(b) Low input power supply voltage
→ Check the power supply specification.
(c) The main circuit power supply may have been switched off with an emergency stop state released.
→ Check the sequence.

3.1.3.3 Alarm code 5

(1) Meaning
  (a) The input power supply is abnormal (open phase).
  (b) The main circuit capacitor was not recharged within the specified time.

(2) Cause and troubleshooting
  (a) The input power supply has an open phase.
    → Check the connection.
  (b) Too many SVM and/or SPM units are connected.
    → Check the specification of the PSM.
  (c) The DC link is short-circuited.
    → Check the connection.
  (d) The recharge current limiting resistor is defective.
    → Replace the unit.

3.1.3.4 Alarm code 6

(1) Meaning
The control supply voltage has dropped.

(2) Cause and troubleshooting
  (a) Input voltage decrease
    → Check the power supply.

3.1.3.5 Alarm code 7

(1) Meaning
In the main circuit, the DC voltage at the DC link is abnormally high.

(2) Cause and troubleshooting
  (a) Excessive regenerated power
    The PSMR does not have a sufficient capacity.
    → Check the specification of the PSMR.
  (b) Regeneration circuit failure
    → Replace the unit.

3.1.3.6 Alarm code 8

(1) Meaning
  (a) The regenerative discharge unit is heated.
  (b) Regenerated power is excessive.

(2) Cause and troubleshooting
  (a) The regenerative resistance capacity is insufficient.
    → Check the specification of the regenerative resistance.
  (b) Excessive regenerated power
    → Decrease the frequency of acceleration/deceleration during operation.
  (c) The cooling fan of the regenerative discharge unit is faulty.
    → Check the rotation state of the cooling fan.

3.2 SERVO AMPLIFIER MODULE

3.2.1 Abnormal Current Alarms (8, 9, A, b, C, d, and E in the LED display)

(1) Make sure that the following parameters are set to the standard values. If they are not, abnormal current control is performed.

No. 1809	
No. 2004	No. 8X04

No. 1884	
No. 2006	No. 8X06

No. 1954(15-A),1955(15-B)	
No. 2011	No. 8X10

No. 1852	
No. 2040	No. 8X40

No. 1853	
No. 2041	No. 8X41

No. 1967	
No. 2074	No. 8X74

No. 1991	
No. 2098	No. 8X98

(2) Remove the power line wires from the amplifier terminals, and release an emergency stop state.
→ If an abnormal current alarm is issued, the servo amplifier module needs to be replaced.
→ If not, go to (3).

(3) Check for insulation between PE and each of the removed power wires U, V, and W. If insulation is perfect, go to (4). If not, disconnect the power wires from the motor connector. Then check for insulation between PE and each of the U, V, and W terminals on the motor.
→ If there is a short-circuit between PE and U, V, or W of the motor, replace the motor.
→ If insulation is perfect, replace the power wires.

(4) Connect the power wires. Attach the check board (A06B-6071-K290) to connector JX5 to measure the waveform of the actual current (IR and IS) in the servo amplifier module. Accelerate or decelerate the motor, and measure the actual current (IR and IS) of the amplifier.
→ If an abnormal current alarm occurs right after an emergency stop state is released, go to (5).

Release an emergency stop state, and start the motor.
Check whether the waveform of the actual current (IR and IS) is a normal sine wave.
→ If normal, go to (5).
→ If not, replace the amplifier.

(5) Check whether there is noise on the actual current (IR and IS) waveform.
→ If there is no noise, replace the amplifier.
→ If there is noise, use a shielding wire, and ground the shielding, or take other countermeasures as required.

(6) If still there is noise, a probable cause is a defective command cable or a hardware failure in the CNC.

3.2.2 IPM Alarms (8., 9., A., b., C., d., and E in the LED display; note these codes are displayed simultaneously with a period.)

(1) Wait for about 10 minutes. Then release the emergency stop state. If an IPM alarm still occurs, go to (2).
If the cause is IPM overheat, the IPM alarm will not recur. IPM overheat can occur if the ambient temperature is high or the motor is overloaded. Check the operating condition.

(2) Remove the power wires from the amplifier terminals, and release an emergency stop state.
If the IPM alarm does not recur, go to (3).

If the IPM alarm recurs, the probable cause is the operation of the IPM protective function (for overcurrent or power failure). Replace the amplifier and see.
→ If the IPM does not recur, go to (3).

(3) Check for insulation between PE and each of the removed power wires U, V, and W. If insulation is perfect, go to (4). If not, disconnect the power wires from the motor connector. Then check for insulation between PE and each of the U, V, and W terminals on the motor.
→ If there is a short-circuit between PE and U, V, or W of the motor, replace the motor.
→ If insulation is perfect, replace the power wires.

(4) Connect the power wires. Attach the check board (A06B-6071-K290) to connector JX5 to measure the waveform of the actual current (IR and IS) in the servo amplifier module. Accelerate or decelerate the motor, and measure the actual current (IR and IS) of the amplifier.
If an overcurrent alarm occurs right after an emergency stop state is released, go to (5).
Release an emergency stop state, and start the motor.
Check whether the waveform of the actual current (IR and IS) is a normal sine wave.
→ If normal, go to (5).
→ If not, replace the amplifier.

(5) Check whether there is noise on the actual current (IR and IS) waveform.
→ If there is no noise, replace the amplifier.
→ If there is noise, use a shielding wire, and ground the shielding, or take other countermeasures as required.

(6) If still there is noise, a probable cause is a defective command cable or a hardware failure in the CNC.

3.2.3 Control Power Supply Undervoltage Alarm (2 in the LED display)

(1) Check the three-phase input voltage to the amplifier.
→ If the voltage is below 0.85 times the rating, adjust it to the rated value.

(2) Replace the servo amplifier.

3.2.4 DC Link Undervoltage Alarm (5 in the LED display)

(1) Check the three-phase input voltage to the power supply module.
→ If the voltage is below 0.85 times the rating, adjust it to the rated value.

(2) Replace the servo amplifier module.

3.2.5 Fan Stopped Alarm (1 in the LED display)

(1) Make sure that the fan is not clogged up.

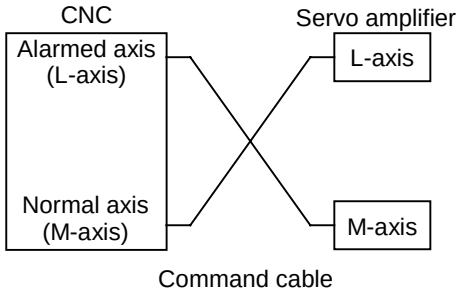
(2) Replace the servo amplifier module. Alternatively, replace the cooling fan inside the servo amplifier module according to Chapter 4.

3.2.6 Current Conversion Error Alarm

(1) Exchange the command cable with the cable for the axis on which no alarm has occurred.
→ If the alarm occurs on the same axis, go to (3).
→ If the alarm occurs on the new axis, go to (2).

(2) The command cable is defective. Replace it.

(3) Exchange the command cables according to the diagram here. When switching the CNC on, do so in an emergency stop state.
→ If the alarm recurs on the same axis, go to (5).
→ If the alarm occurs on the other axis, go to (4).



(4) The servo amplifier is defective.

(5) The module for current conversion in the CNC is defective.

3.3 SERVO SOFTWARE

If a servo alarm is issued, an alarm message is output, and details of the alarm are also displayed on the servo adjustment screen or the diagnosis screen. Using the alarm identification table given in this section, determine the alarm, and take a proper action. With a CNC of the *i* series, detailed alarm messages are displayed. So, from the information in the alarm identification table, select a proper action.

3.3.1 Servo Adjustment Screen

- **Series 0-C**

Press the PARAM key several times to display the servo setting screen.

Pressing the PAGE ↑ PAGE ↓ keys displays the servo screen.

If the servo setting screen does not appear, specify the following parameter, then switch the CNC off and on again:

	#7	#6	#5	#4	#3	#2	#1	#0
0389								SVS

SVS (#0)=0 (to display the servo setting screen)

- **Series 15-A/B, 15*i***

Press the SERVICE key several times to cause the servo setting screen to appear. Then press the ↓ key, and the servo adjustment screen will appear.

- **Series 16, 18, 20, 21**

SYSTEM → [SYSTEM] → [▷] → [SV-PRM] → [SV-TUN]

If the servo setting screen does not appear, specify the following parameter, then switch the CNC off and on again.

	#7	#6	#5	#4	#3	#2	#1	#0
3111								SVS

SVS (#0)=1 (to display the servo setting screen)

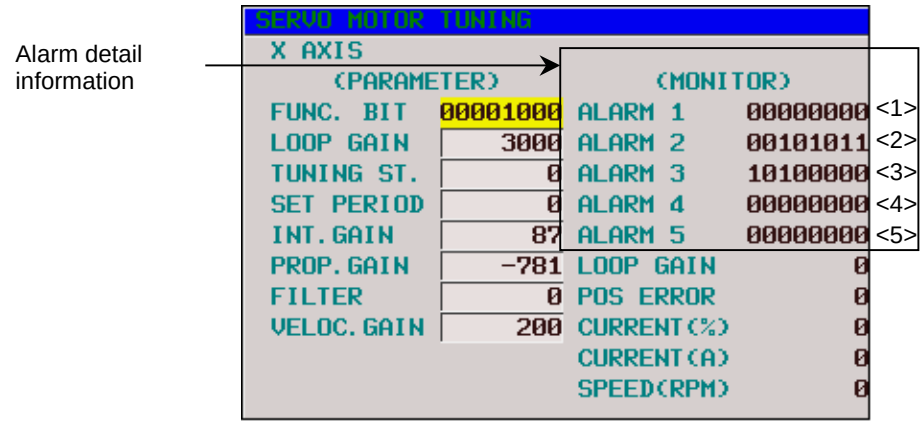


Fig. 3.3.1(a) Servo adjustment screen

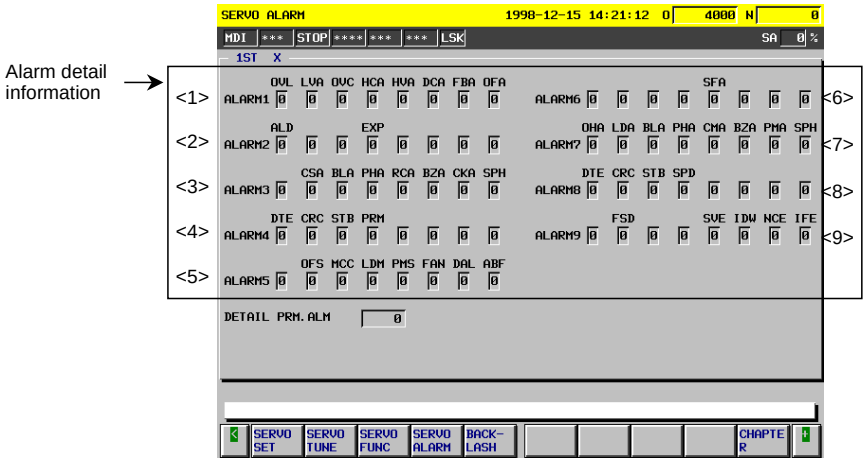


Fig. 3.3.1(b) Series 15*i* servo alarm screen

The table below indicates the names of the alarm bits.

Table 3.3.1 List of alarm bit names

	#7	#6	#5	#4	#3	#2	#1	#0
<1> Alarm 1	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
<2> Alarm 2	ALD			EXP				
<3> Alarm 3		CSA	BLA	PHA	RCA	BZA	CKA	SPH
<4> Alarm 4	DTE	CRC	STB	PRM				
<5> Alarm 5		OFS	MCC	LDM	PMS	FAN	DAL	ABF
<6> Alarm 6					SFA			
<7> Alarm 7	OHA	LDA	BLA	PHA	CMA	BZA	PMA	SPH
<8> Alarm 8	DTE	CRC	STB	SPD				
<9> Alarm 9		FSD			SVE	IDW	NCE	IFE

NOTE
The empty fields do not represent alarm codes.

3.3.2 Diagnosis Screen

The alarm items of the servo adjustment screen correspond to the diagnosis screen numbers indicated in the table below.

Table 3.3.2 Correspondence between the servo adjustment screen and diagnosis screen

Alarm No.	Series 0-C	Series 15-A, B, 15*i*	Series 16, 18, 20, 21	PowerMate-E
<1> Alarm 1	No 720 to 723	No 3014 + 20(X-1)	No 200	No 2711
<2> Alarm 2	730 to 733	3015 + 20(X-1)	201	2710
<3> Alarm 3	760 to 763	3016 + 20(X-1)	202	2713
<4> Alarm 4	770 to 773	3017 + 20(X-1)	203	2712
<5> Alarm 5	————	————	204	2714
<6> Alarm 6	————	————	———	———
<7> Alarm 7	————	————	205	———
<8> Alarm 8	————	————	206	———
<9> Alarm 9	————	————	———	———

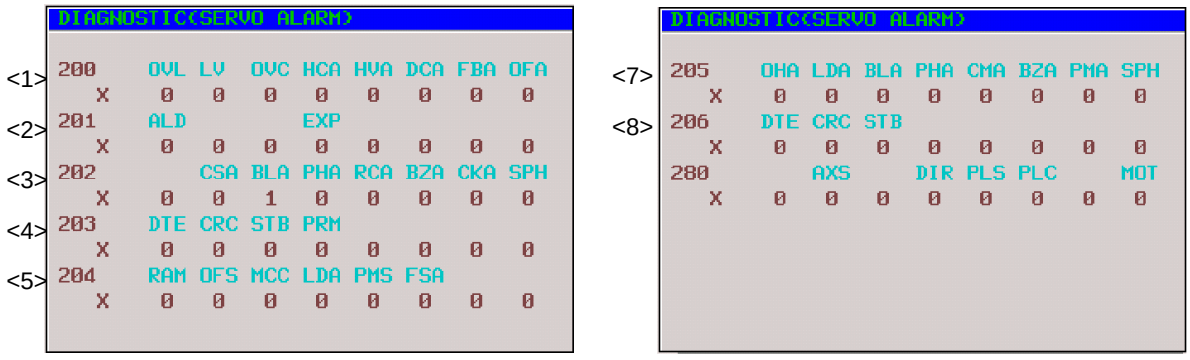


Fig. 3.3.2 Series 16*i* diagnosis screen

3.3.3 Overload Alarm (Soft Thermal, OVC)

(Alarm identification method)

	#7	#6	#5	#4	#3	#2	#1	#0
<1> Alarm 1	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA

(Action)

(1) Make sure that the motor is not vibrating.
⇒ If a motor vibrates, the current flowing in it becomes more than necessary, resulting in an alarm.

(2) Make sure that the power line to the motor is connected correctly.
⇒ If the connection is incorrect, an abnormal current flows in the motor, resulting in an alarm.

(3) Make sure that the following parameters are set correctly.
⇒ An overload alarm is issued based on the result of calculation of these parameters. Be sure to set them to the standard values. For details of the standard values, refer to the parameter manual (B-65150E).

1877	8x62	Overload protection coefficient (OVC1)
2062	1062	

1878	8x63	Overload protection coefficient (OVC2)
2063	1063	

1893	8x65	Overload protection coefficient (OVCLMT)
2065	1065	

(4) Attach the check board (A06B-6071-K290) to connector JX5 to measure the waveform of the actual current (IR and IS) of the servo amplifier module. Start the motor and measure the actual current (IR and IS).
⇒ If the actual current exceeds 1.4 times the rated current, the constant for the acceleration/deceleration duration is too small, or the load on the machine is too heavy for the capacity of the motor.
⇒ If the actual current exceeds 1.4 times the rated current during normal operation, the load on the machine is too heavy for the capacity of the motor.

3.3.4 Feedback Disconnected Alarm

(Alarm identification method)

	#7	#6	#5	#4	#3	#2	#1	#0
<1> Alarm 1	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
<2> Alarm 2	ALD			EXP				
<6> Alarm 6					SFA			

FBA	ALD	EXP	SFA	Alarm description	Action
1	1	1	0	Hard disconnection (separate phase A/B)	1
1	0	0	0	Soft disconnection (closed loop)	2
1	0	0	1	Soft disconnection (α pulse coder)	3

(Action)

Action 1: This alarm is issued when a separate phase A/B scale is used. Check if the phase A/B detector is connected correctly.

Action 2: This alarm is issued when the position feedback pulse variation is small relative to the velocity feedback pulse variation. This means that this alarm is not issued when a semi-full is used. Check if the separate detector outputs position feedback pulses correctly. If position feedback pulses are output correctly, it is considered that the motor alone is rotating in the reverse direction at the start of machine operation because of a large backlash between the motor position and scale position.

		#7	#6	#5	#4	#3	#2	#1	#0
1808	8X03							TGAL	
2003	1003								

TGAL (#1) 1: Uses the parameter for the soft disconnection alarm detection level.

		Soft disconnection alarm level
1892	8X64	
2064	1064	

Standard setting 4: Alarm issued for a 1/8 rotation of the motor. Increase this value.

Action 3: This alarm is issued when synchronization between the absolute position data sent from the built-in pulse coder and phase data is lost. Turn off the power to the CNC, then detach the pulse coder cable then attach it again. If this alarm is still issued, replace the pulse coder.

3.3.5 Overheat Alarm

(Alarm identification method)

	#7	#6	#5	#4	#3	#2	#1	#0
<1> Alarm 1	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
<2> Alarm 2	ALD			EXP				

OVL	ALD	EXP	Alarm description	Action
1	1	0	Motor overheat	1
1	0	0	Amplifier overheat	1

(Action)

Action 1: If this alarm is issued after a long-time of continuous operation, it is considered that the motor and amplifier are overheated. Stop operation for a while, then make a check. If this alarm is still issued after the power is off for about 10 minutes then is turned on again, the thermostat is considered to be faulty. If this alarm is issued intermittently, increase the time constant or increase stop time in the program to suppress the rise in temperature.

3.3.6 Invalid Servo Parameter Setting Alarm

The invalid servo parameter setting alarm is issued when a setting out of the specifiable range is specified, or an overflow has occurred in an internal calculation. When an invalid parameter is detected on the servo side, alarm 4 #4 (PRM) = 1 results.
(Alarm identification method)

	#7	#6	#5	#4	#3	#2	#1	#0
<4> Alarm 4	DTE	CRC	STB	PRM				

For details and action required when the invalid servo parameter setting alarm is issued on the servo side, refer to the parameter manual (B-65150E) edition 4 and up.

(Reference information)

Method of checking details of an invalid parameter detected on the servo side

(For Series 15*i*)

A number is indicated in the item "Details of invalid parameter" on the servo alarm screen (Fig. 3.3.1(b)).

(For Series 16*i*, 18*i*, 21*i*, and Power Mate *i*)

A number is indicated in No. 352 of the diagnosis screen.

3.3.7 Alarms Related to Pulse Coder and Separate Serial Detector

(Bits for alarm identification)

	#7	#6	#5	#4	#3	#2	#1	#0
<1> Alarm 1	OVL	LVA	OVC	HCA	HVA	DCA	FBA	OFA
<2> Alarm 2	ALD			EXP				
<3> Alarm 3		CSA	BLA	PHA	RCA	BZA	CKA	SPH
<4> Alarm 4	DTE	CRC	STB	PRM				
<5> Alarm 5		OFS	MCC	LDM	PMS	FAN	DAL	ABF
<6> Alarm 6					SFA			
<7> Alarm 7	OHA	LDA	BLA	PHA	CMA	BZA	PMA	SPH
<8> Alarm 8	DTE	CRC	STB	SPD				
<9> Alarm 9		FSD			SVE	IDW	NCE	IFE

(1) For a built-in pulse coder
An alarm is determined from the bits of alarms 1, 2, 3, and 5. The table below indicates the meaning of each bit.

Alarm 3							Alarm 5		1	Alarm 2		Alarm description	Action
CSA	BLA	PHA	RCA	BZA	CKA	SPH	LDM	PMA	FBA	ALD	EXP		
						1						Soft phase alarm	2
					1							Clock alarm (serial A)	
				1								Zero battery voltage	1
			1						0	0	0	Speed error (serial A)	
			1						1	1	0	Count error alarm (α pulse coder)	2
		1										Phase alarm (serial A)	2
	1											Battery voltage decrease (warning)	1
1												Checksum alarm (serial A)	
								1				Pulse error alarm (α pulse coder)	
							1					LED error alarm (α pulse coder)	

NOTE
An alarm for which no action number is given is considered to be caused by a pulse coder failure. Replace the pulse coder.

(2) For a separate serial detector
An alarm is determined from the bits of alarm 7. The table below indicates the meaning of each bit.

Alarm 7								Alarm description	Action
OHA	LDA	BLA	PHA	CMA	BZA	PMA	SPH		
							1	Soft phase alarm	2
						1		Pulse error alarm	
					1			Zero battery voltage	1
				1				Count error alarm	2
			1					Phase alarm	2
		1						Battery voltage decrease (warning)	1
	1							LED error alarm	
1								Separate detector alarm	

NOTE
An alarm for which no action number is given is considered to be caused by a detector failure. Replace the detector.

(Action)

Action 1: Battery-related alarms
Check if a battery is connected. When the power is turned on for the first time after a battery is connected, the zero battery voltage alarm is issued. In such a case, turn off the power, then turn on the power again. If the alarm is still issued, check the battery voltage. If the battery voltage decrease alarm is issued, check the voltage, and replace the battery as required.

Action 2: Alarms that may be issued for noise
If an alarm is issued intermittently or after emergency stop cancellation, noise is probably the cause. So, provide noise protection. If the same alarm is still issued after noise protection is provided, replace the detector.

(3) Alarms related to serial communication
An alarm is determined from the bits of alarms 4 and 8.

Alarm 4			Alarm 8			Alarm description
DTE	CRC	STB	DTE	CRC	STB	
1						Serial pulse coder communication alarm
	1					
		1				
			1			Separate serial pulse coder communication alarm
				1		
					1	

Action: Serial communication is not performed correctly. Check if the cable is connected correctly and is not broken. If CRC or STB is issued, noise may be the cause. So, provide noise protection. If CRC or STB is always issued after the power is turned on, the pulse coder or amplifier control board (*i* series) or the pulse module (*i* series) may be faulty.

3.3.8 Other Alarms

(Alarm identification method)

	#7	#6	#5	#4	#3	#2	#1	#0
<5> Alarm 5		OFS	MCC	LDM	PMS	FAN	DAL	ABF

OFS	DAL	ABF	Alarm description	Action
		1	Feedback mismatch alarm	1
	1		Excessive semi-full error alarm	2
1			Current offset error alarm	3

(Action)

Action 1: This alarm is issued when the move direction of the position detector is opposite to the move direction of the speed detector. Check the rotation direction of the separate detector. If the rotation direction of the separate detector is opposite to the rotation direction of the motor, take the following action:

For a phase A/B detector: Reverse the connections of A and $\overline{A}$.

For a serial detector: Reverse the setting of the signal direction of the separate detector.

		#7	#6	#5	#4	#3	#2	#1	#0
1960	-								RVRSE
2018	-								

RVRSE (#0) Reverses the signal direction of the separate detector.

0: Does not reverse the signal direction of the separate detector.

1: Reverses the signal direction of the separate detector.

If a large distortion exists between the motor and separate detector, this alarm may be issued in the case of abrupt acceleration/ deceleration. In such a case, modify the detection level.

		#7	#6	#5	#4	#3	#2	#1	#0
1741	-							RNLV	
2201	-								

RNLV (#1) Modifies the feedback mismatch alarm detection level.

1: Detected with 1000 min^{-1} or more

0: Detected with 600 min^{-1} or more

Action 2: This alarm is issued when the difference between the motor position and separate detector position exceeds the excessive semi-full error level. Check if the conversion efficient for dual position feedback is set correctly. If the conversion efficient is set correctly, increase the alarm level. If this alarm is still issued after the level is modified, check the connection direction of the scale.

1971	**-**	**Dual position feedback conversion coefficient (numerator)**
2078	**-**	

1972	**-**	**Dual position feedback conversion coefficient (denominator)**
2079	**-**	

$$\text{Conversion coefficient} = \frac{\left(\begin{array}{l}\text{Number of feedback pulses per motor}\\ \text{revolution (detection unit)}\end{array}\right)}{1{,}000{,}000}$$

1729	**-**	**Dual position feedback semi-full error level**
2118	**-**	

[Setting] Detection unit. When 0 is set, no detection is made.

Action 3: The current offset value of the current detector (equivalent to the current value in the emergency stop state) is abnormally high. If this alarm is still issued after the power is turned off then back on, the current detector is faulty. For the *i* series, replace the control board of the amplifier. For series other than the *i* series, replace the servo-related modules on the CNC.

3.4 SPINDLE AMPLIFIER MODULE

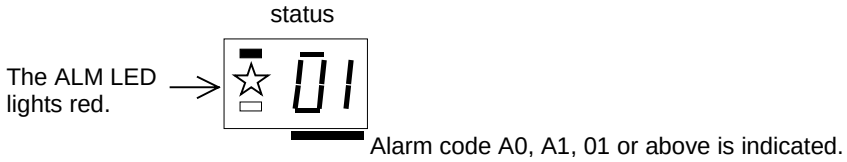
This section uses the following format for describing parameter numbers:

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6582	3082	4082	Setting of acceleration/deceleration time

The items of FS15*i* cover FS15. For a parameter number of FS15 different from FS15*i*, the item is described separately.
FS18*i*, 20*i*, 21*i*, PM*i*-D, 18, 20, and 21 are covered by the items of FS16*i*/16.

3.4.1 α Series and α (HV) Series Spindle Amplifier Module

If an alarm occurs in the spindle amplifier module, the ALM LED lights red in the STATUS display, and the two-digit 7-segment LEDs indicate the alarm code.



3.4.1.1 Alarm codes A, A0 to A4, and other Ax (x for representing an arbitrary number)

A, A0 : The SPM control program is not operating.
A1, A2, Ax : An error was detected in SPM control program processing.
A3 : An error was detected in the clock of the SPM control printed circuit board.
A4 : A parity error was detected in the SRAM on the SPM control printed circuit board.

(1) If an alarm is issued when the power to the PSM is turned on
  (a) The ROM is not installed correctly, no ROM is installed, or the ROM specification is incorrect
  If the ROM on the SPM control printed circuit board is once replaced, check the following:
  <1> Installation direction
  <2> Occurrence of a bent lead and so forth
  <3> Matching of the ROM series with the unit. Check Subsection 2.2.3 of Part I.
  (b) Printed circuit board failure
  Replace the SPM or SPM control printed circuit board.

(2) If an alarm is issued during motor activation
  (a) Influence of noise
  Referring to Chapter 5, "Installation," of "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the GND-related wiring. If the signal cable of the spindle sensor is bundled with the power line of the servo motor, separate them from each other.

3.4.1.2 Alarm code 01

The inside temperature of the motor is higher than the specified temperature.

(1) If this alarm is issued during cutting (the motor temperature is high)
  (a) Check the cooling state of the motor.
    <1> If the cooling fan of the spindle motor is stopped, check the power supply of the cooling fan. If the cooling fan is still inoperative, replace it with a new one.
    <2> When a liquid-cooled motor is used, check the cooling system.
    <3> When the ambient temperature of the spindle motor is higher than the specified temperature, lower the ambient temperature to satisfy the specification.
  (b) If this alarm is issued even when the load meter fluctuates in a limited range, check the short-period rating. If the specified value is exceeded, reduce the load.

(2) If this alarm is issued under a light load (the motor temperature is high)
  (a) When the frequency of acceleration/deceleration is too high
  Set such a use condition that the average including output at acceleration/deceleration does not exceed the continuous rating.
  (b) The parameters specific to the motor are not set correctly.
  Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."

(3) If this alarm is issued when the motor temperature is low
  (a) The spindle sensor feedback cable is faulty.
  Replace the cable.
  (b) The SPM control printed circuit board is faulty.
  Replace the SPM control printed circuit board or SPM.
  (c) The motor (internal thermostat) is faulty.
  Replace the motor.

3.4.1.3 Alarm code 02

The actual motor speed is largely deviated from the commanded speed.

(1) If this alarm is issued during motor acceleration
   (a) The parameter setting of acceleration/deceleration time is incorrect.
   In the following parameter, set the value equivalent to the spindle inertia plus some margin:

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6582	3082	4082	Setting of acceleration/deceleration time

   (b) The parameter for the speed detector is not set correctly.
   Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," set a correct value.

(2) If this alarm is issued during cutting
   (a) The cutting load has exceeded the motor output power.
   Check the load meter indication, and review the use condition.
   (b) The parameters for output restriction are not set correctly.
   Check that the settings of the following parameters satisfy the machine and motor specifications:

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6528	3028	4028	Output restriction pattern setting
6529	3029	4029	Output restriction value

   (c) The parameters specific to the motor are not correctly.
   Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."

3.4.1.4 Alarm code 03

The fuse of the DC link has blown. (The voltage at the DC link is insufficient.) This alarm is checked when emergency stop is cancelled.

(1) If this alarm is issued during spindle operation (rotation)
The fuse of the DC link inside the SPM has probably blown. So, replace the SPM. This alarm may be caused by the following:
<1> Power line short-circuited to ground
<2> Motor winding short-circuited to ground
<3> IGBT or IPM module failure

(2) If the PSM input magnetic contactor is once turned on and is turned off with this alarm when emergency stop is cancelled or the CNC is started (When two spindles are connected, the magnetic contactor may not be turned off.)
(a) The DC link wire is not connected.
Check the DC link (TB1) wiring for errors.
(b) A cable is faulty.
Pin 9 of the interface cable (JX1B-JX1A) between the PSM and SPM may be short-circuited to 0V. Replace the cable.
(c) The fuse of the DC link inside the SPM has blown.
Replace the SPM.

3.4.1.5 Alarm code 04

It is detected that the 3-phase input to the main circuit of the PSM has an open phase.

(1) If the PSM indicates alarm code 6
Troubleshoot according to the description of alarm code 6 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
(a) A cable is faulty.
The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
(b) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.1.6 Alarm code 07

The motor rotates at a speed exceeding 115% (standard setting) of the maximum allowable speed.

(1) If this alarm is issued during spindle synchronization
If the activation (SFR, SRV) of the motor on one side is turned off then back on in the spindle synchronization mode, the spindle motor is accelerated to correct a position error built up during the period, thus causing this alarm. Modify the ladder so that SFR and SRV are not turned off in the spindle synchronization mode.

(2) If this alarm is issued while the motor is stopped
(a) The connection cable of the spindle sensor is faulty.
Check if the cable of the spindle sensor built into the motor (BZ sensor when a built-in motor is used) is disconnected, and replace the cable as required.
(b) The spindle sensor built into the motor is not adjusted correctly.
Adjust the sensor according to Subsection 4.3.4 of Part I.

3.4.1.7 Alarm code 09

The temperature of the heat sink of the SPM main circuit has risen to the set value. This alarm is issued for SPM-15 and up or SPM-15HV and later. With SPM-2.2 to SPM-11 and SPM-11HV, however, alarm code 12 is issued for the same cause.

(1) If this alarm is issued during cutting (the heat sink temperature is high)
(a) If this alarm is issued when the load meter reads a value below the continuous rating of the amplifier, check the cooling state of the heat sink.
<1> If the cooling fan is stopped, check the power supply (connector CX1A/B). If the cooling fan is still inoperative, replace the SPM with a new one.
<2> When the ambient temperature is higher than the specified temperature, lower the ambient temperature to satisfy the specification.
(b) When this alarm is issued because the load meter reads a value above the continuous rating of the amplifier, improve the use method.

(c) When the heat sink on the back of the amplifier is too dirty, clean the heat sink, for example, by blowing air. Consider the use of a structure that prevents the heat sink from being directly exposed to coolant.

(2) If this alarm is issued under a light load (the heat sink temperature is high)
   (a) When the frequency of acceleration/deceleration is too high
   Set such a use condition that the average including output at acceleration/deceleration does not exceed the continuous rating.
   (b) The parameters specific to the motor are not set correctly.
   Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."

(3) If this alarm is issued when the heat sink temperature is low
   Replace the SPM.

3.4.1.8 Alarm code 11

The PSM detected that the DC link voltage was excessively high.

(1) If the PSM indicates alarm code 7
   Troubleshoot according to the description of alarm code 7 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
   (a) A cable is faulty.
   The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
   (b) The SPM is faulty.
   Replace the SPM or SPM control printed circuit board.

3.4.1.9 Alarm code 12

An excessively large current flowed into the DC link of the main circuit.

With SPM-2.2 to SPM-11 and SPM-11HV, this alarm indicates that the power module (IPM) of the main circuit detected an error such as an excessive load, overcurrent, or low control supply voltage.

(1) If this alarm is issued on SPM-2.2 to SPM-11 and SPM-11HV
Check alarm code 09 as well.

(2) If this alarm is issued immediately after a spindle rotation command is specified
   (a) The motor power line is faulty.
   Check for a short circuit between motor power lines and short-circuit to ground, and replace the power line as required.
   (b) The motor winding has an insulation failure.
   If the motor is short-circuited to ground, replace the motor.
   (c) The parameters specific to the motor are not set correctly.
   Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."
   (d) The SPM is faulty.
   A power element (IGBT, IPM) may be destroyed. Replace the SPM.

(3) If this alarm is issued during spindle rotation
   (a) A power element is destroyed.
   A power element (IGBT, IPM) may be destroyed. Replace the SPM.
   If the amplifier setting condition is not satisfied, or cooling is insufficient because the heat sink is dirty, the power elements may be destroyed.
   When the heat sink on the back of the amplifier is too dirty, clean the heat sink, for example, by blowing air. Consider the use of a structure that prevents the heat sink from being directly exposed to coolant.
   For the setting condition, refer to "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)."
   (b) The parameters specific to the motor are not set correctly.
   Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameters specific to the motor.
   (c) Speed sensor signal error
   Check the spindle sensor signal waveform according to Subsection 4.3.4 of Part I. If an error is found, make an adjustment or replace the detector as required.

3.4.1.10 Alarm code 13

The memory inside the CPU is faulty. A check is made when the power is turned on.

If this alarm is issued, replace the SPM or SPM control printed circuit board.

3.4.1.11 Alarm code 15

In output switching control or spindle switching control, the switching operation sequence was not executed correctly.
This alarm is issued if one second or more elapses from the transition of a switch request signal (SPSL or RSL) until a power line state check signal (MCFN, MFNHG, RCH, or RCHHG) makes a transition.

Troubleshooting when this alarm is issued

(a) The magnetic contactor (switch unit) for power line switching is faulty.
If the contact is inoperative, check the power supply of the magnetic contactor. If the magnetic contactor is still inoperative, replace the magnetic contactor.

(b) The I/O unit or wiring for checking the contact of the magnetic contactor is faulty.
If a defect is found in the I/O unit or wiring, replace the I/O unit or wiring.

(c) The sequence (ladder) is incorrect.
Modify the sequence so that switching is completed within 1 second. For details of the signals, refer to Chapter 10, "Interface Signals," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)."

3.4.1.12 Alarm code 16

The memory (RAM) is faulty. A check is made when the power is turned on.

If this alarm is issued, replace the SPM or SPM control printed circuit board.

3.4.1.13 Alarm codes 19 and 20

The offset voltage of the phase U (alarm code 19) or phase V (alarm code 20) current detection circuit is excessively high. A check is made when the power is turned on.

If this alarm is issued, replace the SPM. If this alarm is issued immediately after the SPM control printed circuit board is replaced, check the plugging of the connectors (CN1, CN3, and CN4) between the power unit and SPM control printed circuit board.

3.4.1.14 Alarm code 24

The power to the CNC is turned off. (This symptom does not represent an error.) Serial communication data transferred between the CNC and spindle amplifier module contains an error.

Troubleshooting when this alarm is issued

(a) Noise occurring between the CNC and spindle amplifier module (connected via an electric cable) caused an error in communication data.
Check the condition for maximum wiring length.
Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the condition of electric cable connection.

(b) Noise exercises an influence because a communication cable is bundled with the power line.
If a communication cable is bundled with the power line for the motor, separate them from each other.

(c) A cable is faulty.
Replace the cable.
If an optical I/O link adapter is used, the optical link adapter or optical cable may be faulty.

(d) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

(e) The CNC is faulty.
Replace the board or module related to the serial spindle.

3.4.1.15 Alarm code 25

Serial communication between the CNC and spindle amplifier module stopped.

Troubleshoot as in the case of alarm code 24.

3.4.1.16 Alarm code 26

The sensor signal (for speed control) for Cs contour control has an error.

<1> When a high-resolution magnetic pulse coder is used with SPM TYPE2 (using both of the JY2 and JY5 connectors), the amplitude of the sensor signal on the high-resolution side (1000 λ) of the high-resolution magnetic pulse coder built into the motor on the JY2 side is excessively small.

<2> When a built-in motor is used with SPM TYPE2 (using only the JY5 connector), the amplitude of the sensor signal on the high-resolution side (1000 to 3000 λ) of the high-resolution magnetic pulse coder is excessively small.

<3> When SPM TYPE4 is used, the amplitude of the spindle sensor (MZ sensor) built into the motor connected to JY2 is excessively small.

(1) If this alarm is issued when the motor is deactivated

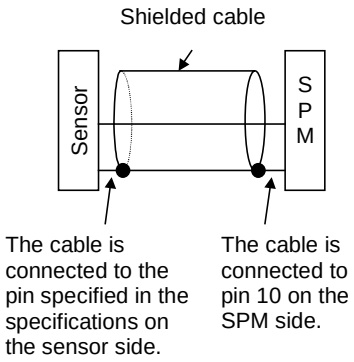
(a) The setting of a parameter is incorrect.
Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.

(b) The sensor is not adjusted correctly, or the cable is disconnected.
Adjust the sensor signal according to Subsection 4.3.4 of Part I of this manual. If the signal is not observed, replace the cable and sensor.

(c) The printed circuit board is faulty.
Replace the SPM or SPM control printed circuit board.

(2) If this alarm is issued when the cable is moved (as in the case where the spindle moves)

(a) The connector has a bad contact, or the cable is disconnected.
The conductor may be broken. Replace the cable. If coolant has penetrated into the connector, clean the connector.



(3) If this alarm is issued when the motor rotates

(a) The shielding of the cable between the preamplifier or MZ sensor (for TYPE4) and the SPM is faulty.
Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the shielding of the cable.

(b) The signal cable is bundled with the servo motor power line.
If the cable between the preamplifier or MZ sensor (for TYPE4) and the SPM is bundled with the servo motor power line, separate them from each other.

(c) Improve the cable routing between the motor and preamplifier.
If the cables (including those within a terminal box) extending from the motor to the preamplifier are close to the power line, separate the cables from the power line.

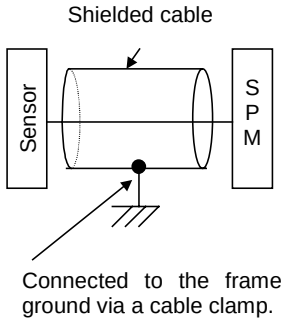
3.4.1.17 Alarm code 27

The sensor signal (position coder signal) for position control is abnormal.

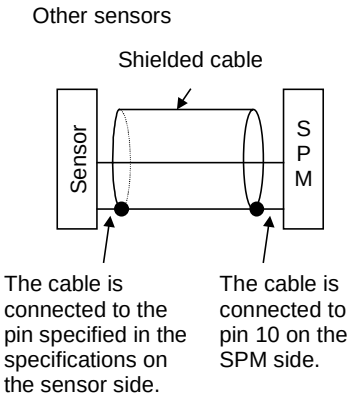
<1> The signal of the α position coder is disconnected (for all types).
<2> When an MZ or BZ sensor is used with SPM TYPE1 (using the JY2 connector), the amplitude of the sensor signal is excessively small.
<3> When a separate built-in sensor is used with SPM TYPE2 (using the JY2 and JY5 connectors), the amplitude of the spindle sensor signal on the JY2 side is excessively small.
<4> When a high-resolution magnetic pulse coder is used with SPM TYPE2 (using the JY2 and JY5 connectors), the amplitude of the sensor signal on the low-resolution side (128 to 384 λ) on the JY5 side is excessively small.
<5> When SPM TYPE4 is used, the amplitude of the spindle sensor signal connected to JY5 is excessively small.

(1) If this alarm is issued when the motor is deactivated
  (a) The setting of a parameter is incorrect.
  Referring to Chapter 2 of "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
  (b) The cable connected to JY4 is disconnected. (α position coder)
  When the α position coder is used, adjustment is impossible. Replace the cable.
  (c) The sensor is not adjusted correctly.
  Adjust the sensor signal according to Subsection 4.3.4 of Part I of this manual. If the sensor signal cannot be adjusted correctly, or the sensor signal is not observed, replace the connection cable and sensor.
  (d) The SPM is faulty.
  Replace the SPM or SPM control printed circuit board.

α position coder



(2) If this alarm is issued when the cable is moved (as in the case where the spindle moves)
  (a) The connector has a bad contact, or the cable is disconnected.
  The conductor may be broken. Replace the cable. If coolant has penetrated into the connector, clean the connector.



(3) If this alarm is issued when the motor rotates
   (a) The shielding of the cable between the sensor and the SPM is faulty.
   Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the shielding of the cable.
   (b) The signal cable is bundled with the servo motor power line. If the cable between the sensor and the SPM is bundled with the servo motor power line, separate them from each other.

3.4.1.18 Alarm code 28

The sensor signal (for position control) for Cs contour control is abnormal.

<1> When a high-resolution magnetic pulse coder is used with SPM TYPE2 (using both of the JY2 and JY5 connectors), the amplitude of the sensor signal on the high-resolution side (1000 to 3000 λ) of the high-resolution magnetic pulse coder on the JY5 side is excessively small.

<2> When SPM TYPE4 is used, the amplitude of the spindle sensor (MZ sensor) built into the motor connected to JY5 is excessively small.

Troubleshoot as in the case of alarm code 26.

3.4.1.19 Alarm code 29

An excessive load (standard setting: load meter reading of 9 V) has been applied continuously for a certain period (standard setting: 30 seconds).

(1) If this alarm is issued during cutting
Check the load meter, and review the cutting condition.

(2) If this alarm is issued during a stop
(a) The spindle is locked.
Check the sequence to see if the spindle is locked when a command for very slow movement is specified or orientation is specified for the spindle.

(3) If the spindle does not rotate as specified (the spindle rotates at a very low speed) and this alarm is issued
(a) The setting of a parameter is incorrect.
Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
(b) The phase sequence of the motor power line is incorrect.
(c) The feedback cable of the motor has a problem.
Check if the phase A/B signals are connected correctly.
(d) The feedback cable of the motor is faulty.
Rotate the motor manually to see if a speed is indicated in the item of motor speed on the CNC diagnosis screen or on the spindle check board. If no speed indication is provided, replace the cable or spindle sensor (or motor).

(4) If the spindle does not rotate as specified (the spindle does not rotate at all) and this alarm is issued
(a) The power line is abnormal.
Check if the motor power line is connected normally. If spindle switching or output switching is performed, check if the magnetic contactor is on.
(b) The SPM is faulty.
Replace the SPM.

3.4.1.20 Alarm code 30

An excessively large current is detected at the input of the 3-phase main circuit of the PSM.

(1) If the PSM indicates alarm code 1
Troubleshoot according to the description of alarm code 1 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
(a) A cable is faulty.
The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
(b) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.1.21 Alarm code 31

The motor failed to rotate as specified, and has stopped or is rotating at a very low speed.

(1) If the motor rotates at a very low speed and this alarm is issued
(a) The setting of a parameter is incorrect.
Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
(b) The motor phase sequence is incorrect.
Check if the motor phase sequence is correct.
(c) The feedback cable of the motor has a problem.
Check if the phase A/B signals are connected correctly.
(d) The feedback cable of the motor is faulty.
Rotate the motor manually to see if a speed is indicated in the item of motor speed on the CNC diagnosis screen or on the spindle check board. If no speed indication is provided, replace the cable or spindle sensor (or motor).

(2) If the motor does not rotate at all and this alarm is issued
(a) The sequence for locking the spindle is incorrect.
Check the sequence to see if the spindle is locked.
(b) The power line is faulty.
Check if the power line is connected to the motor correctly. If spindle switching or winding switching is performed, check if the magnetic contactor is on.
(c) The SPM is faulty.
Replace the SPM.

3.4.1.22 Alarm code 32

LSI memory for serial communication is abnormal. A check is made when the power is turned on.

If this alarm is issued, replace the SPM or SPM control printed circuit board.

3.4.1.23 Alarm code 33

The PSM could not be charged within a specified time.
PSM input has an open phase.

(1) If the PSM indicates alarm code 5
Troubleshoot according to the description of alarm code 5 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
(a) A cable is faulty.
The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
(b) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.1.24 Alarm code 34

Parameter data outside the specifiable range was set.

Troubleshooting when this alarm is issued
Connect the spindle check board.
The spindle check board displays "AL-34" and "F-xxx" alternately. "F-xxx" indicates a parameter number outside the specifiable range. For the correspondence between the CNC parameter numbers and "F-xxx," refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."

3.4.1.25 Alarm code 35

The gear ratio set in a parameter exceeds the value range allowable for internal processing. This alarm is issued with a parameter related to orientation of magnetic sensor type.

Troubleshooting when this alarm is issued

(a) The gear ratio set in a parameter is incorrect.
Check if an excessively large gear ratio is set.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6556 to 6559	3056 to 3059	4056 to 4059	Gear ratio between the spindle and motor
6560 to 6563	3060 to 3063	4060 to 4063	Position gain at orientation

3.4.1.26 Alarm code 36

The error counter overflowed.

(1) The setting of a parameter is incorrect.
(a) The gear ratio set in a parameter is incorrect.
Check if an excessively large gear ratio is set.
(b) The setting of a position gain is incorrect.
If the gear ratio data is correct, increase the position gain.
(c) The setting of a position detector mounting direction or the setting of spindle and motor rotation directions is incorrect.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6556 to 6559	3056 to 3059	4056 to 4059	Gear ratio between the spindle and motor
6565 to 6568	3065 to 3068	4065 to 4068	Position gain in the servo mode/spindle synchronization
6569 to 6572	3069 to 3072	4069 to 4072	Position gain in Cs contour control

(2) Sequence error
(a) Check if the motor is deactivated (by turning off SFR/SRV) in a position control mode (rigid tapping, Cs contour control, or spindle synchronization).

3.4.1.27 Alarm code 37

After emergency stop signal input, the motor is accelerated without being decelerated. This alarm is issued also when the motor is not deactivated (the motor is not decelerated completely) when the acceleration/deceleration time (initial parameter setting: 10 seconds) has elapsed after emergency stop signal input.

Troubleshooting when this alarm is issued

(a) The parameter setting of the speed detector is incorrect.
Referring to Chapter 1 in "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," set a correct time.

(b) The parameter setting of an acceleration/deceleration time is not proper.
Check the parameter-set value and actual acceleration/ deceleration time, then set an actual acceleration/ deceleration time plus some margin.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6582	3082	4082	Acceleration/deceleration time setting

3.4.2 Alarm Code 39

The position where the one-rotation signal for Cs contour control is generated is incorrect. This alarm is not issued when the parameter indicated below is not set.

<1> When SPM TYPE2 is used, phase A/B/Z on the high-resolution (1000 to 3000 λ) side of the high-resolution magnetic pulse coder on the spindle side has a problem.

<2> When SPM TYPE4 is used, the spindle sensor connected to JY5 is faulty.
Troubleshoot as in the case of alarm code 41.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6516#5	3016#5	4016#5	Whether the function for detecting the one-rotation signal of the detector for Cs contour control is provided 1: The function is provided.

Troubleshooting when this alarm is issued (at the time of reference position return on the Cs axis)

(a) The setting of a parameter is incorrect.
Referring to Chapter 2 in "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.

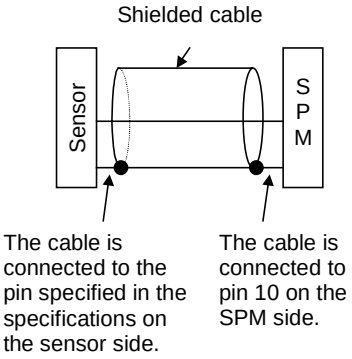
(b) The sensor is not adjusted correctly.
Adjust the sensor according to Subsection 4.3.4 of Part I of this manual. If the signal is not observed, replace the sensor.

(c) The shielding of the cable between the preamplifier and SPM is faulty.
Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the shielding of the cable.

(d) The signal cable is bundled with the servo motor power line.
If the cable between the preamplifier and SPM is bundled with the servo motor power line, separate them from each other.

(e) Improve the cable routing between the motor and preamplifier.
If the cables (including those within a terminal box) extending from the motor to the preamplifier are close to the power line, separate the cables from the power line.

(f) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.



3.4.2.1 Alarm code 40

The one-rotation signal for Cs contour control is not generated.

<1> When SPM TYPE2 is used, phase A/B/Z on the high-resolution (1000 to 3000 λ) side of the high-resolution magnetic pulse coder on the spindle side has a problem.

<2> When SPM TYPE4 is used, the spindle sensor connected to JY5 is faulty.
Troubleshoot as in the case of alarm code 42.

Troubleshooting when this alarm is issued (at the time of reference position return on the Cs axis)

(a) The setting of a parameter is incorrect.
Referring to Chapter 2 in "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.

(b) The sensor is not adjusted correctly.
Adjust the sensor according to Subsection 4.3.4 of Part I of this manual. If the signal is not observed, replace the sensor.

(c) The cable is disconnected.
Check the check pin PSD on the check board. If the signal is not observed per sensor rotation, replace the cable.

(d) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

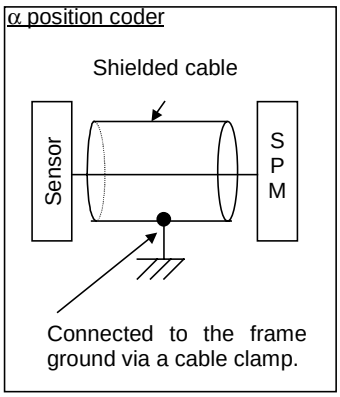
3.4.2.2 Alarm code 41

<1> The position where the one-rotation signal of the α position coder is generated is incorrect.
<2> The position where the one-rotation signal of the MZ sensor or BZ sensor is generated is incorrect.
<3> The position where the one-rotation signal of α position coder S is generated is incorrect.

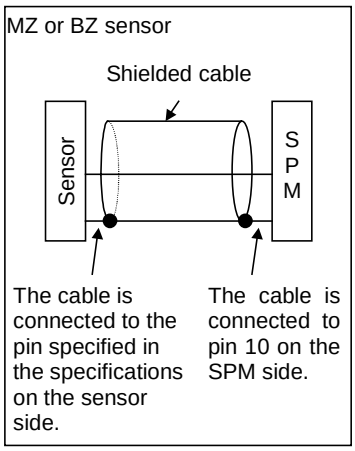
(1) If orientation based on the external one-rotation method is used
  (a) The settings of parameters are incorrect.
  Check that the gear ratio data matches the specification of the machine.

FS0	FS15	FS15*i*	FS16*i*/16, PM-D/F	Description
6935 6937	3315 3317	3171 3173	4171 4173	Number of teeth on the spindle side
6936 6938	3316 3318	3172 3174	4172 4174	Number of teeth on the position detector side

  (b) Slippage between the spindle and motor
  Check that there is no slippage between the spindle and motor. Orientation based on the external one-rotation method is not applicable to V-belt connection.



(2) Troubleshooting in other cases
  (a) The setting of a parameter is incorrect.
  Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
  (b) A sensor (MZ sensor or BZ sensor) is not adjusted correctly.
  Adjust the sensor according to Subsection 4.3.4 of Part I of this manual. If the signal is not observed, replace the sensor.
  (c) The α position coder is faulty.
  Check the check pin PSD on the spindle check board. If the signal is not generated per rotation, replace the position coder.
  (d) The shielding of the cable between the sensor and SPM is faulty.
  Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the shielding of the cable.
  (e) The signal cable is bundled with the servo motor power line.
  If the cable between the sensor and SPM is bundled with the servo motor power line, separate them from each other.
  (f) The SPM is faulty.
  Replace the SPM or SPM control printed circuit board.



3.4.2.3 Alarm code 42

<1> The one-rotation signal of the α position coder is not generated.
<2> The one-rotation signal of the MZ sensor or BZ sensor is not generated.
<3> The one-rotation signal of α position coder S is not generated.

Troubleshooting when this alarm is issued

(a) The setting of a parameter is incorrect.
Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
(b) The MZ sensor or BZ sensor is not adjusted correctly.
Adjust the sensor according to Subsection 4.3.4 of Part I of this manual. If the sensor cannot be adjusted or the signal is not observed, replace the connection cable and sensor.
(c) The α position coder is faulty.
Check the check pin PSD on the spindle check board. If the signal is not generated per rotation, replace the connection cable and position coder.
(d) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.2.4 Alarm code 43

The position coder signal of the spindle on the mater side used in the differential speed mode is disconnected.

Troubleshoot as in the case of alarm code 27.

3.4.2.5 Alarm code 44

An error occurred in the A/D converter.

When this alarm is issued, replace the SPM or SPM control printed circuit board.

3.4.2.6 Alarm code 46

The one-rotation signal of the position coder cannot be detected normally during thread cutting.

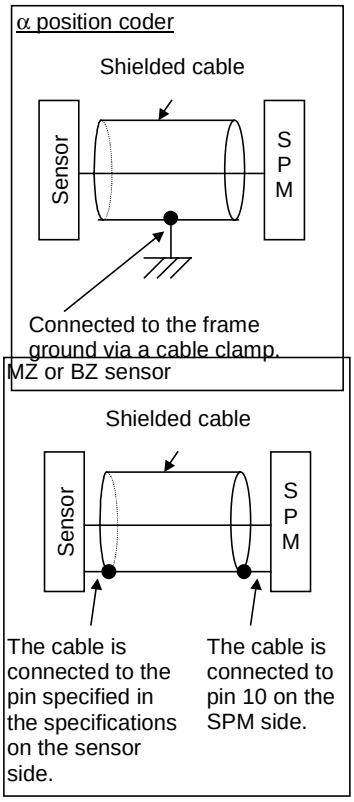
Troubleshoot as in the case of alarm code 41.

3.4.2.7 Alarm code 47

<1> The count value of α position coder signal pulses is abnormal.
<2> The pulse count value of the MZ sensor or BZ sensor is abnormal.

Phases A and B for the position coder have a feedback pulse count of 4096 p/rev per spindle rotation. The SPM checks the pulse counts of phases A and B equivalent to the position coder each time a one-rotation signal is generated. The alarm is issued when a pulse count beyond the specified range is detected.

(1) If this alarm is issued when the cable is moved (as in the case where the spindle moves)
   (a) The connector has a bad contact, or the cable is disconnected.
   The conductor may be broken. Replace the cable. If coolant has penetrated into the connector, clean the connector.



(2) Troubleshooting in other cases
   (a) The setting of a parameter is incorrect.
   Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameter for sensor setting.
   (b) A sensor (MZ sensor or BZ sensor) is not adjusted correctly.
   Adjust the sensor according to Subsection 4.3.4 of Part I of this manual.
   (c) The shielding of the cable between the sensor and SPM is faulty.
   Referring to Chapter 9, "Connection," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)," check the shielding of the cable.
   (d) The signal cable is bundled with the servo motor power line.
   If the cable between the sensor and SPM is bundled with the servo motor power line, separate them from each other.
   (e) The SPM is faulty.
   Replace the SPM or SPM control printed circuit board.

3.4.2.8 Alarm code 49

In the differential speed mode, the spindle speed on the master side (remote) converted to a motor speed on the slave side (local) exceeded the maximum allowable speed of the motor.

Troubleshooting when this alarm is issued

A differential speed is calculated by multiplying the speed on the target speed by a gear ratio.
Ensure that the maximum allowable speed of the motor is not exceeded.

3.4.2.9 Alarm code 50

A value obtained by internal calculation in spindle synchronization exceeded the allowable range.

Troubleshooting when this alarm is issued

(a) The setting of parameters for gear ratio setting is incorrect.
Check if an excessively large gear ratio is set.

(b) Position gain setting limit
If correct gear ratio data is set, increase the position gain value in spindle synchronization.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6556 to 6559	3056 to 3059	4056 to 4059	Gear ratio between the spindle and motor
6565 to 6568	3065 to 3068	4065 to 4068	Position gain in the servo mode/spindle synchronization

3.4.2.10 Alarm code 51

The PSM detected that the DC link voltage was excessively low.

(1) If the PSM indicates alarm code 4
Troubleshoot according to the description of alarm code 4 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm

(a) A cable is faulty.
The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.

(b) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.2.11 Alarm codes 52 and 53

The synchronization signal (ITP) in communication data transferred to and from the CNC stopped.

Troubleshooting when this alarm is issued

(a) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.
(b) The CNC is faulty.
Replace the board or module related to the serial spindle.

3.4.2.12 Alarm code 54

A large current flowing in the motor for a long time was detected.

Troubleshoot as in the case of alarm code 29.

3.4.2.13 Alarm code 55

In spindle switching control or output switching control, a mismatch between the switching request signal (SPSL or RSL) and the power line state check signal (MCFN, MFNHG, RCH, or RCHHG) continues during motor activation.

Troubleshooting when this alarm is issued

(a) The magnetic contactor (switch unit) for power line switching is faulty.
If the contact is inoperative, check the power supply of the magnetic contactor. If the magnetic contactor is still inoperative, replace the magnetic contactor.
(b) The I/O unit or wiring for checking the contact of the magnetic contactor is faulty.
If a defect is found in the I/O unit or wiring, replace the I/O unit or wiring.
(c) The sequence (ladder) is incorrect.
Modify the sequence so that switching is not performed during activation. For details of the signals, refer to Chapter 10, "Interface Signals," in "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)."

3.4.2.14 Alarm code 56

The cooling fan of the control circuit stopped.

When this alarm is issued, replace the SPM or the internal cooling fan of the SPM. When replacing the internal cooling fan, see Chapter 4.

3.4.2.15 Alarm code 57

The temperature of the regenerative resistance of the PSM (resistance regenerative type) is excessively high. The PSM is faulty.

(1) If the PSM indicates alarm code 8 or above
Troubleshoot according to the description of alarm code 8 (or the pertinent code) provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
   (a) A cable is faulty.
   The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
   (b) The SPM is faulty.
   Replace the SPM or SPM control printed circuit board.

3.4.2.16 Alarm code 58

The temperature of the main circuit-cooling fan of the PSM is abnormally high.

(1) If the PSM indicates alarm code 3
Troubleshoot according to the description of alarm code 3 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
   (a) A cable is faulty.
   The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
   (b) The SPM is faulty.
   Replace the SPM or SPM control printed circuit board.

3.4.2.17 Alarm code 59

The internal cooling fan of the PSM stopped.

(1) If the PSM indicates alarm code 2
Troubleshoot according to the description of alarm code 2 provided in Section 3.1 of Part II.

(2) If the PSM indicates no alarm
(a) A cable is faulty.
The connection cable between the PSM (JX1B) and SPM (JX1A) is faulty. Replace the cable.
(b) The SPM is faulty.
Replace the SPM or SPM control printed circuit board.

3.4.3 αC Series Spindle Amplifier Module

For the αC series, only those alarm codes that have the same number as for the α series and require troubleshooting different from the α series are described.
For an alarm code not covered by this subsection, see the description of the alarm code for the α series spindle amplifier module.

3.4.3.1 Alarm code 12

An excessively high motor current was detected.
An excessively high current flowed into the DC link of the main circuit.

For SPMC-2.2 to SPMC-11
The power module (IPM) of the main circuit detected an excessive load, excessively high current, or decrease in control supply voltage.

(1) If an SPMC from SPMC-2.2 to SPMC-11 indicates this alarm
Check alarm code 09 as well.

(2) If this alarm is issued immediately after a spindle move command is specified
  (a) The motor power line is faulty.
  Check for a short circuit between motor power lines and short-circuit to ground, and replace the power line as required.
  (b) The motor winding has an insulation failure.
  If the motor is short-circuited to ground, replace the motor.
  (c) The parameters specific to the motor are not set correctly.
  Refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."
  (d) The SPMC is faulty.
  A power element (IGBT, IPM) may be destroyed. Replace the SPMC.

(3) If this alarm is issued during spindle rotation
  (a) Belt slippage
  The belt between the spindle and motor may be slipping. Clean the pulley and run the belt again.
  (b) The parameters specific to the motor are not set correctly.
  Referring to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)," check the parameters specific to the motor.

(c) A power element is destroyed.
A power element (IGBT, IPM) may be destroyed. Replace the SPM.
If the amplifier setting condition is not satisfied, or cooling is insufficient because the heat sink is dirty, the power elements may be destroyed.
When the heat sink on the back of the amplifier is too dirty, clean the heat sink, for example, by blowing air. Consider the use of a structure that prevents the heat sink from being directly exposed to coolant.
For the setting condition, refer to "FANUC SERVO AMPLIFIER α series Descriptions (B-65162E)."

3.4.3.2 Alarm code 35

The motor speed calculated from the position coder much differs from the motor speed estimated in the SPMC.

(1) If this alarm is issued when a rotation command is specified
(a) The setting of parameters for position coder setting is incorrect.
Set the bits related to the rotation directions of the position coder and spindle and the rotation directions of the spindle and motor. For details, refer to "FANUC AC SPINDLE MOTOR α series Parameter Manual (B-65160E)."
(b) The setting of parameters for gear ratio setting is incorrect.
Check if incorrect gear ratio data is set. The gear ratio data is used for conversion from the position coder to a motor speed. So, be sure to set correct values.

FS0	FS15*i*	FS16*i*/16, PM-D/F	Description
6556 to 6559	3056 to 3059	4056 to 4059	Gear ratio between the spindle and motor

(c) Slippage between the spindle and motor
Make an adjustment to prevent the belt from slipping.

(2) If this alarm is issued during cutting
The motor speed is decreased because of an overload. Review the cutting condition.

3.5 POWER-FAILURE BACKUP MODULE

When an alarm is issued, the one-digit 7-segment LED indicates an alarm code.


Indicates an alarm code (01 or above).

3.5.1 Alarm Code 1

(1) Meaning
Sub-module C cannot be charged.

(2) Cause and troubleshooting
(a) Sub-module C connection error
→ Check the connection.
(b) Charging circuit failure
→ Replace the power-failure backup module.

3.5.2 Alarm Code 2

(1) Meaning
After sub-module C was charged, the voltage decreased for a cause.

(2) Cause and troubleshooting
(a) Charging circuit failure
→ Replace the power-failure backup module.

3.5.3 Alarm Code 3

(1) Meaning
An abnormal current flowed in sub-module R.

(2) Cause and troubleshooting
(a) Excessive regenerated power
→ If the sum of maximum servo motor outputs exceeds 20 kW, use two sub-module R units.
(b) Regenerative circuit failure
→ Replace the power-failure backup module.

3.5.4 Alarm Code 4

(1) Meaning
The regenerative resistance in sub-module R is overheated.

(2) Cause and troubleshooting
(a) Sub-module R is placed in conductive state at all times because of a regenerative circuit failure.
→ Replace the power-failure backup module.

3.5.5 Alarm Code 5

(1) Meaning
The supply voltage for driving the thyristor decreased.

(2) Cause and troubleshooting
(a) The power supply circuit for driving the thyristor is abnormal.
→ Replace the power-failure backup module.

4 HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS

WARNING
Before replacing fuses or printed-circuit boards, make sure that the recharge-under-way LED (red) is off.

Before replacing fuses or printed circuit boards, see the table given below to find which section or subsection in this manual provides information about the related replacement procedure.

(1) Power supply module

Model	Drawing No.	Case disassembly	Fuse replacement
PSM-5.5 to 11	A06B-6077-H106 to 111	4.1.1	4.2.1(1)
PSM-15 to 37	A06B-6087-H115 to 137	4.1.2	4.2.1(1), (3)
	A06B-6077-H115 to 130	4.1.2	4.2.1(2), (3)
	A06B-6071-H115 to 130	4.1.3	4.2.1(2), (3)
PSM-45, 55	A06B-6087-H145 to 155	4.1.4	4.2.1(1)
PSM-15HV to 45HV	A06B-6091-H115 to 145	4.1.2	4.2.1(1), (3)
PSM-75HV	A06B-6087-H175	4.1.4	4.2.1(1)
PSMR-3, 5.5	A06B-6081-H103, H106	4.1.1	4.2.1(4), (5)
PSMV-11HV	A06B-6098-H111	4.1.2	4.2.1(1), (6)

(2) Servo amplifier module

Model	Drawing No.	Case disassembly	Fuse replacement
SVM1-12 to 130	A06B-6079-H101 to H106 A06B-6096-H101 to H106	4.1.1	4.2.2(1)
SVM1-240, 360	A06B-6079-H107, H108 A06B-6096-H107, H108	4.1.2	4.2.2(1), 4.2.3(2)
SVM2-12/12 to 80/80	A06B-6079-H201 to H209 A06B-6096-H201 to H209	4.1.1	4.2.2(1)
SVM3-12/12/12 to SVM3-20/20/40	A06B-6079-H301 to H307 A06B-6080-H301 to H307 A06B-6096-H301 to H307	4.1.1	4.2.2(1)
SVM1-20HV to 60HV	A06B-6085-H102 to H104 A06B-6097-H102 to H104	4.1.1	4.2.2(1)
SVM2-20/20HV to SVM2-60/60HV	A06B-6085-H201 to H206 A06B-6097-H201 to H206	4.1.1	4.2.2(1)

(3) Spindle amplifier module (In drawing numbers, # and the subsequent part is omitted.)

Model	Drawing No.	Case disassembly	Fuse replacement	Replacement of the program ROM and the spindle sensor module
SPM-2.2 to 11 TYPE1 TYPE4	A06B-6102-H202 to H211 A06B-6102-H102 to H111	4.1.1	4.2.3(1)	4.3.1(1)
SPM-15 to 30 TYPE1 TYPE4	A06B-6102-H215 to H230 A06B-6102-H115 to H130	4.1.2	4.2.3(1), (2)	4.3.1(1)
SPM-45 to 55 TYPE1 TYPE4	A06B-6102-H245, H255 A06B-6102-H145, H155	4.1.4	4.2.3(1)	4.3.1(1)
SPM-2.2 to 11 TYPE1 TYPE2 TYPE4	A06B-6078-H102 to H211 A06B-6078-H302 to H311	4.1.1		4.3.1(2)
SPM-15 to 30 TYPE1 TYPE2 TYPE4	A06B-6088-H115 to H230 A06B-6088-H315 to H330	4.1.2	4.2.3(2)	4.3.1(2)
SPM-11 to 30 TYPE3	A06B-6088-H411 to H430	4.1.3	4.2.3(2)	4.3.1(3)
SPM-45 to 55 TYPE1 TYPE2 TYPE4	A06B-6088-H245, H255 A06B-6088-H345, H355 A06B-6088-H145, H155	4.1.4	4.2.3(2)	4.3.1(2)
SPM-45 TYPE3	A06B-6088-H445	4.1.5		4.3.1(3)
Old SPM15 to 30	A06B-6078-H215 to H330	4.1.3	4.2.3(2), (3)	4.3.1(6), (7)
Old SPM11	A06B-6078-H411	4.1.3	4.2.3(2), (3)	4.3.1(7)
SPMC2.2 to 11	A06B-6082-H202 to H211	4.1.1		4.3.1(4)
SPMC15 to 26	A06B-6082-H215 to H226	4.1.2	4.2.3(2)	4.3.1(5)
SPM11HV TYPE1 TYPE4	A06B-6104-H211 A06B-6104-H111	4.1.1	4.2.3(1)	4.3.1(1)
SPM15HV to 45HV TYPE1 TYPE4	A06B-6104-H215 to H245 A06B-6104-H115 to H145	4.1.2	4.2.3(1), (2)	4.3.1(1)
SPM75HV TYPE1 TYPE4	A06B-6104-H275 A06B-6104-H175	4.1.4	4.2.3(1)	4.3.1(1)
SPM11HV TYPE1 TYPE2 TYPE4	A06B-6092-H211 A06B-6092-H311 A06B-6092-H111	4.1.1		4.3.1(2)
SPM15HV to 45HV TYPE1 TYPE2 TYPE4	A06B-6092-H215 to H245 A06B-6092-H315 to H345 A06B-6092-H115 to H145	4.1.2	4.2.3(2)	4.3.1(2)
SPM75HV TYPE1 TYPE2 TYPE4	A06B-6092-H275 A06B-6092-H375 A06B-6092-H175	4.1.4		4.3.1(2)
SPM15HV to 45HV TYPE3	A06B-6092-H415 to H445	4.1.4	4.2.3(2)	4.3.1(3)
SPM75HV TYPE3	A06B-6092-H475	4.1.5		4.3.1(3)

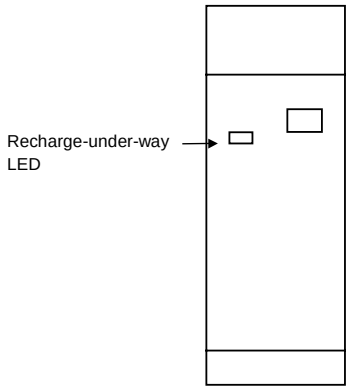
(4) Power-failure backup module

Drawing No.	Case disassembly	Fuse replacement
A06B-6077-H001	4.1.1	4.2.4(1)
A06B-6077-H002	4.1.1	4.2.4(1)

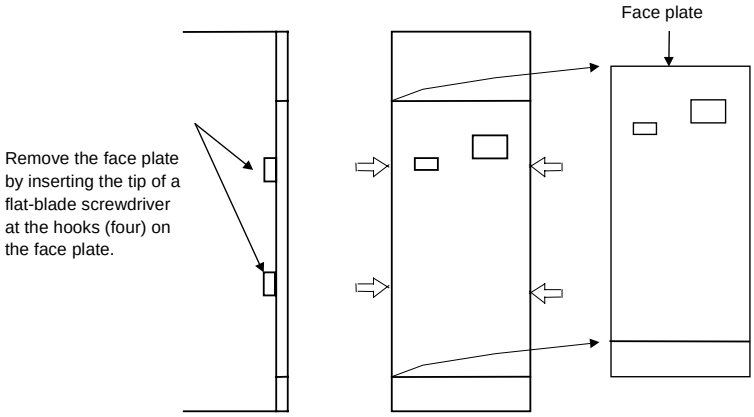
4.1 CASE DISASSEMBLY

4.1.1 60/90 mm Width Modules

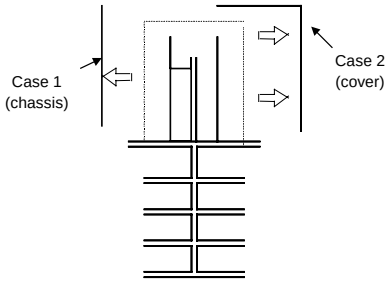
Make sure that the recharge-under-way LED (red) is off.



Remove the face plate.

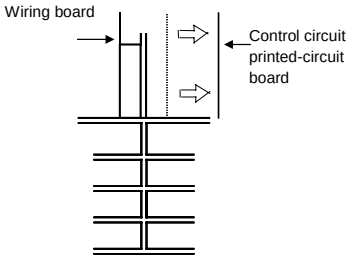


Remove the cases.

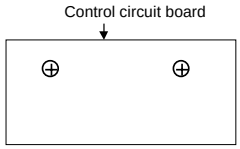


Remove the screws fastening the case and the screws (5 × M4) holding down the terminal board.

Remove the printed-circuit board.

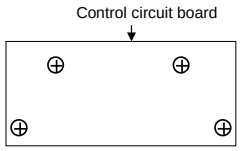


- Cases for the SVM



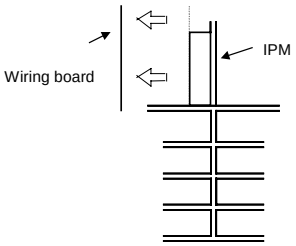
Remove the screws (2 × M3) fastening the printed-circuit board.

- Cases for the PSM and SPM



Remove the screws (4 × M3) fastening the printed-circuit board.

Remove the IPM.



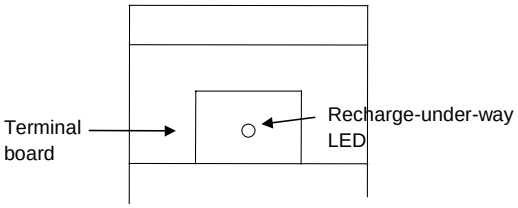
<1> Remove the screws (5 × M5) fastening the IPM. Then remove the wiring board.

<2> Remove the IPM.

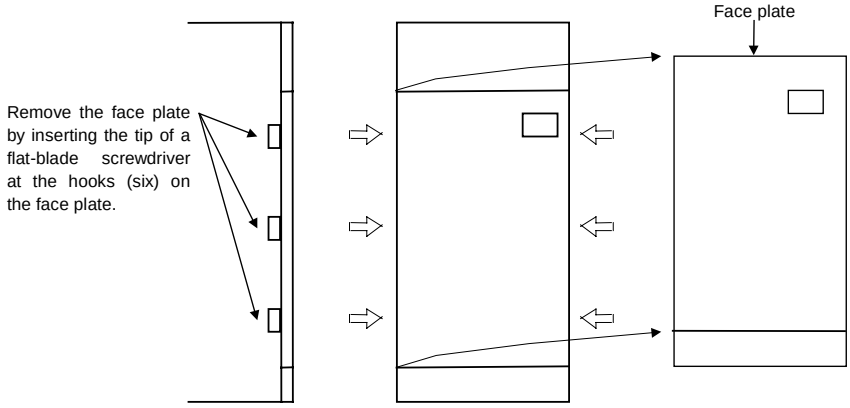
Note) There is a snubber capacitor between the IPM and wiring board. When re-assembling, do not forget to mount it.

4.1.2 150 mm Width Module (without the Connector Module)

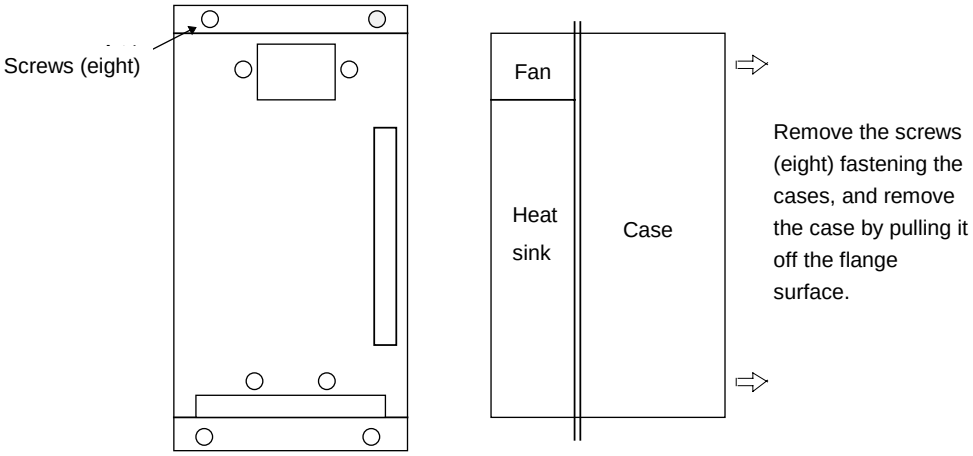
Make sure that the recharge-under-way LED (red) is off.
The recharge-under-way LED (red) is at the center of terminal board TB1. Open the cover at the top of the module, and check the LED.



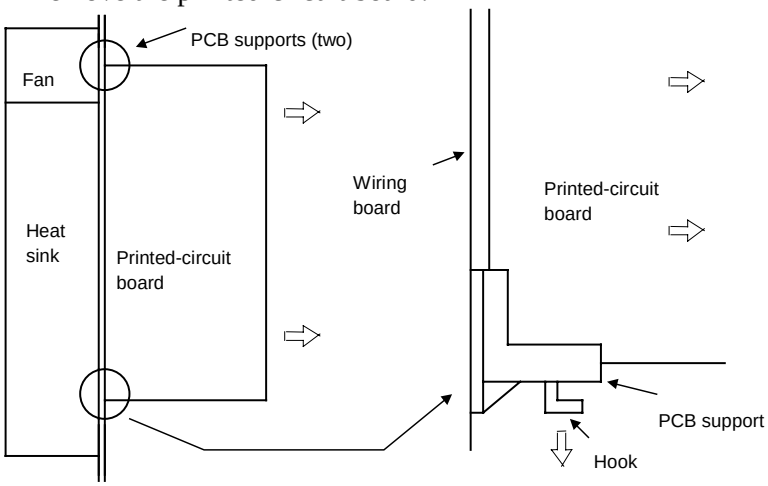
Remove the face plate.



Remove the case.

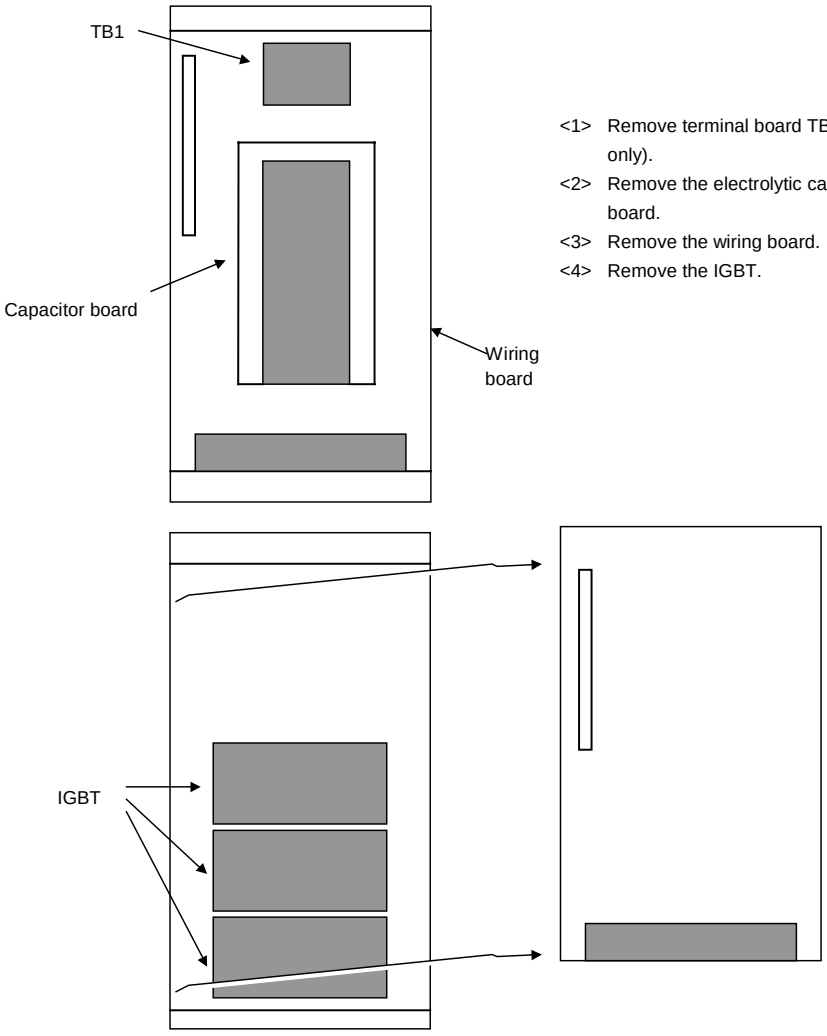


Remove the printed-circuit board.



While spreading the PCB support hooks, pull the printed-circuit board off the flange surface to remove it.

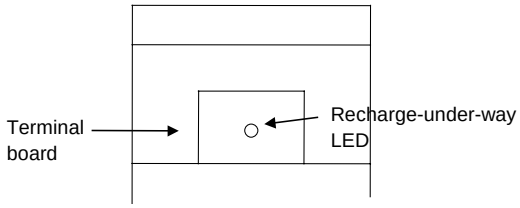
Remove the IGBT.



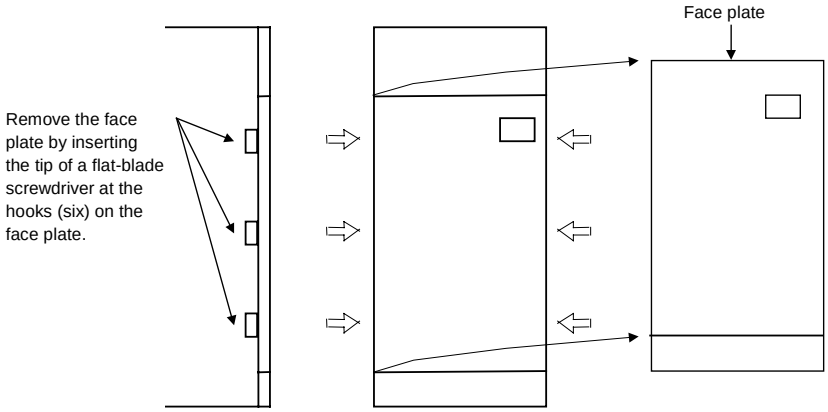
<1> Remove terminal board TB1 (for SPM only).
<2> Remove the electrolytic capacitor board.
<3> Remove the wiring board.
<4> Remove the IGBT.

4.1.3 150 mm Width Module (with the Connector Module)

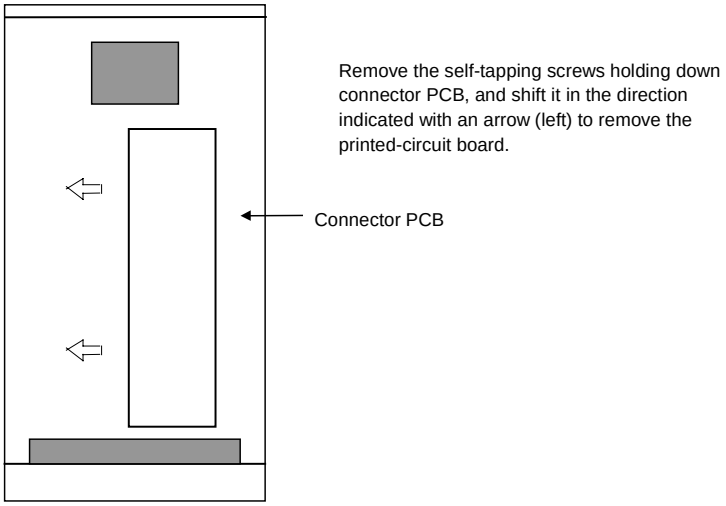
Make sure that the recharge-under-way LED (red) is off.
The recharge-under-way LED (red) is at the center of terminal board TB1. Open the cover at the top of the module, and check the LED.



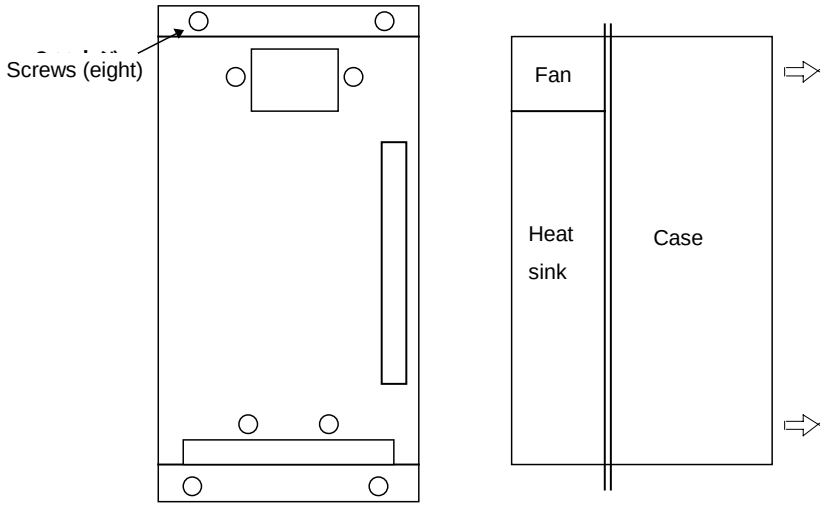
Remove the face plate.



Remove connector PCB.

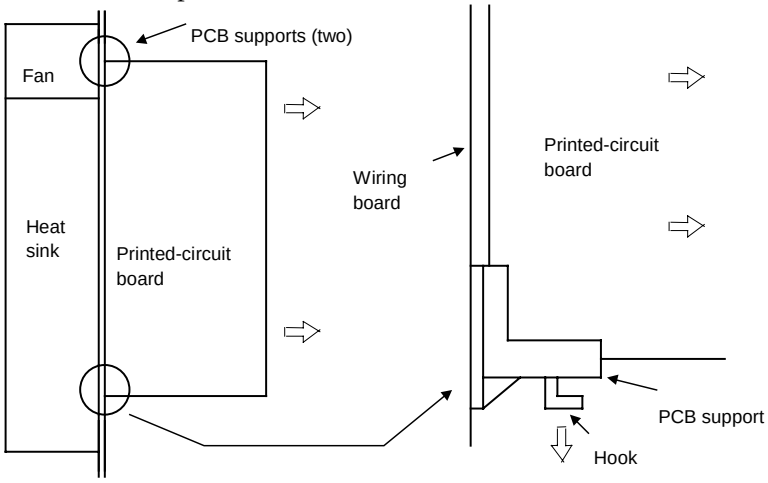


Remove the case.



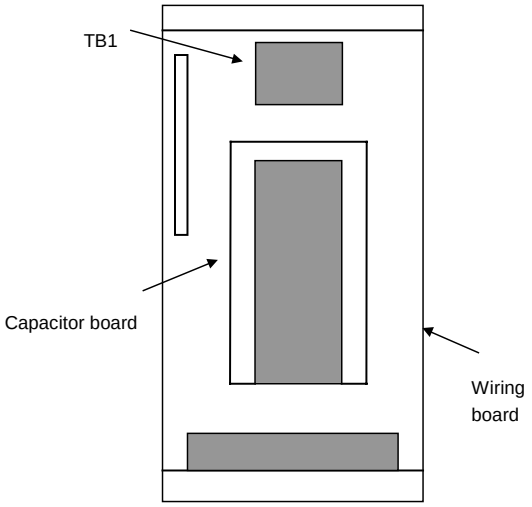
Remove the screws (eight) fastening the cases, and remove the case by pulling it off the flange surface.

Remove the printed-circuit board.

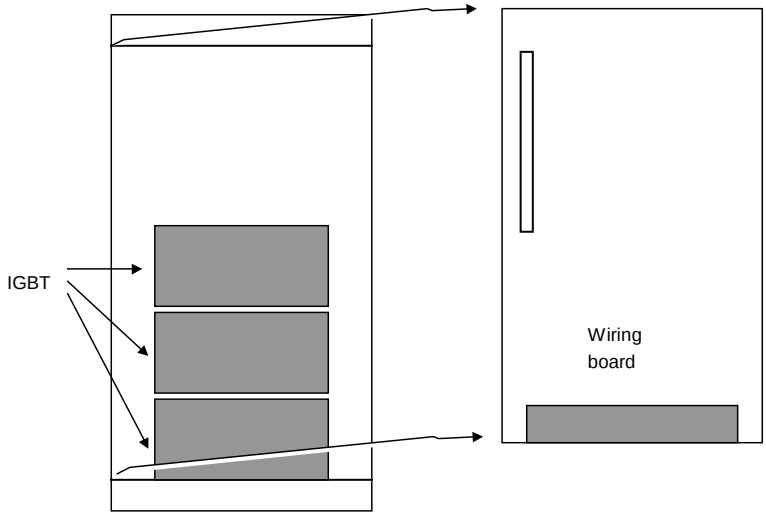


While spreading the PCB support hooks, pull the printed-circuit board off the flange surface to remove it.

Remove the IGBT.

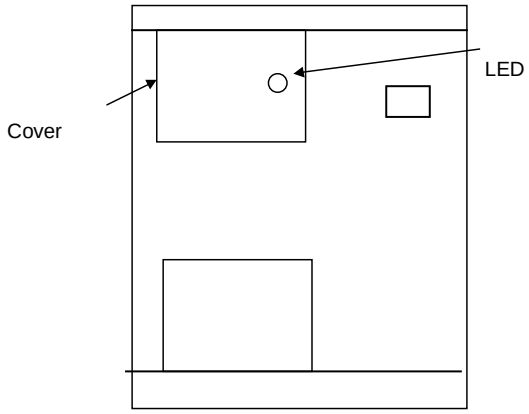


<1> Remove terminal board TB1 (for SPM only).
<2> Remove the electrolytic capacitor board.
<3> Remove the wiring board.
<4> Remove the IGBT.

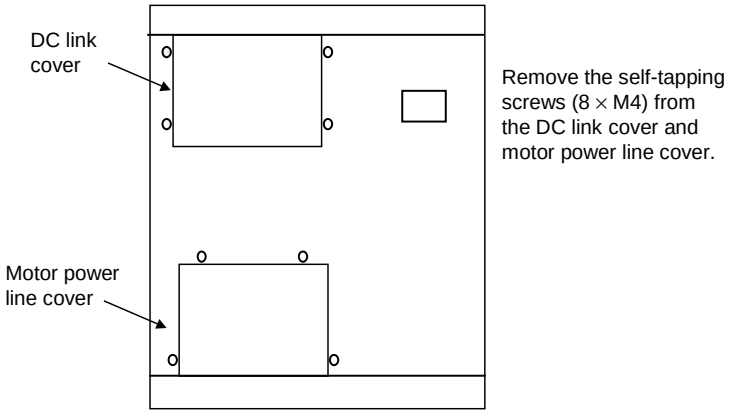


4.1.4 300-mm Wide Module (without the Connector Module)

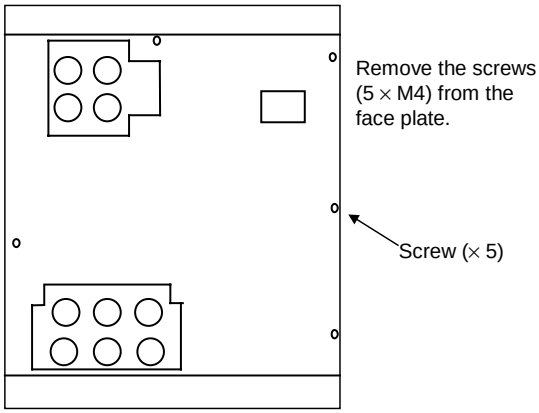
Make sure that the recharge-under-way LED (red) is off. View the recharge-under-way LED (red) from the upper part of the DC link cover.



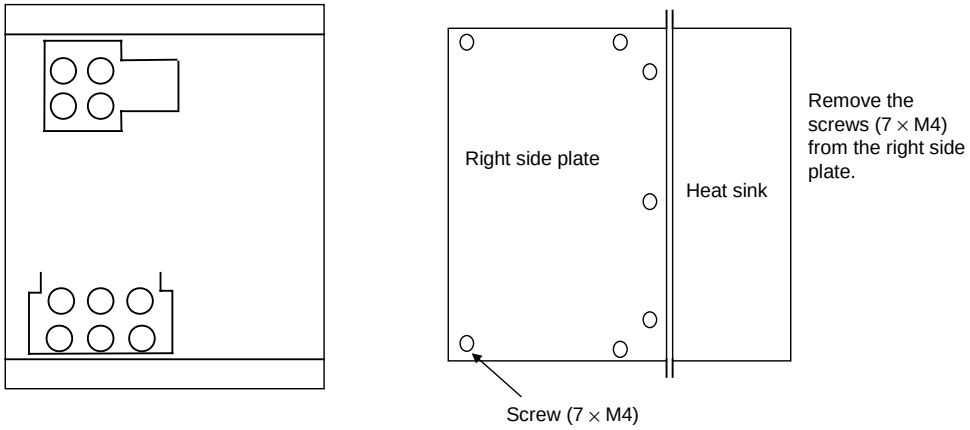
Remove the DC link cover and motor power line cover.



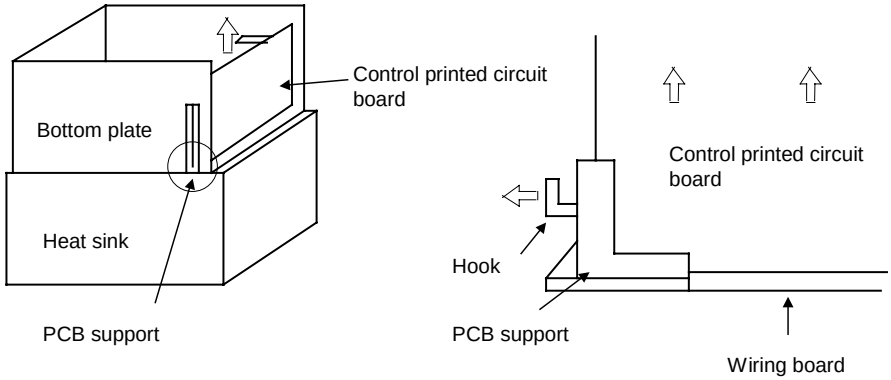
Remove the face plate.



Remove the right side plate.

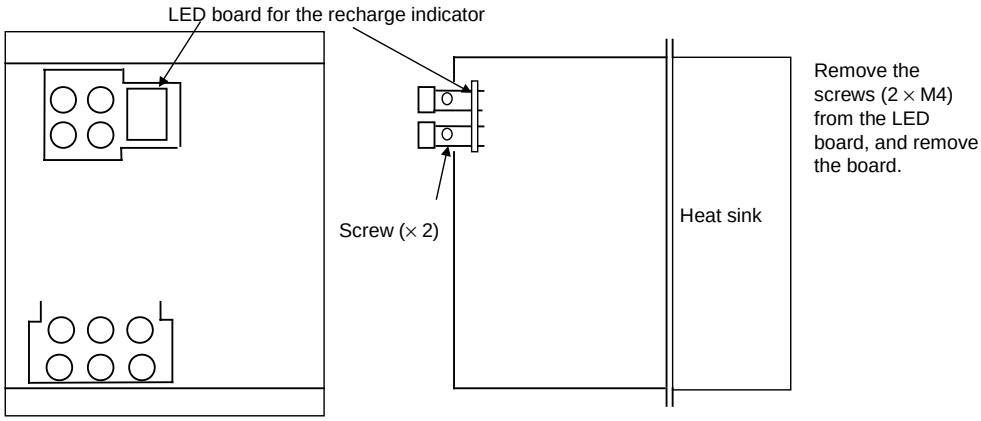


Remove the control printed circuit board.

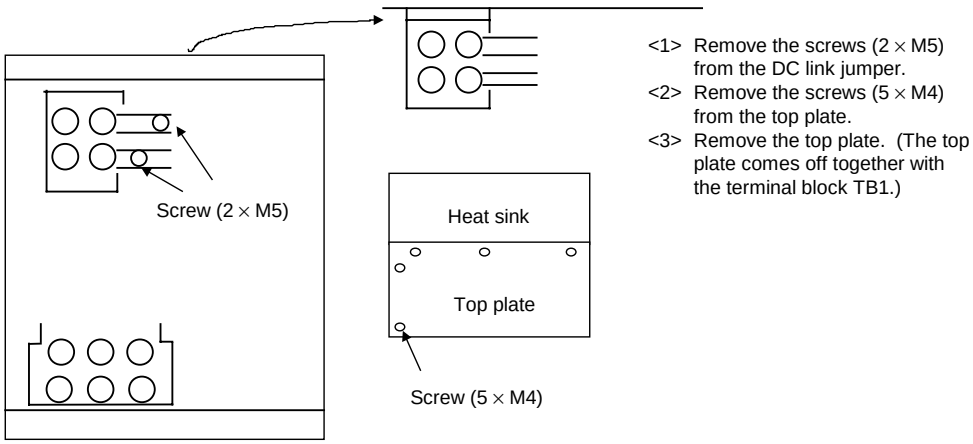


Insert the tip of a screwdriver into the opening on the bottom plate, and while spreading the hook of the PCB support, pull the printed circuit board off the flange surface toward you.

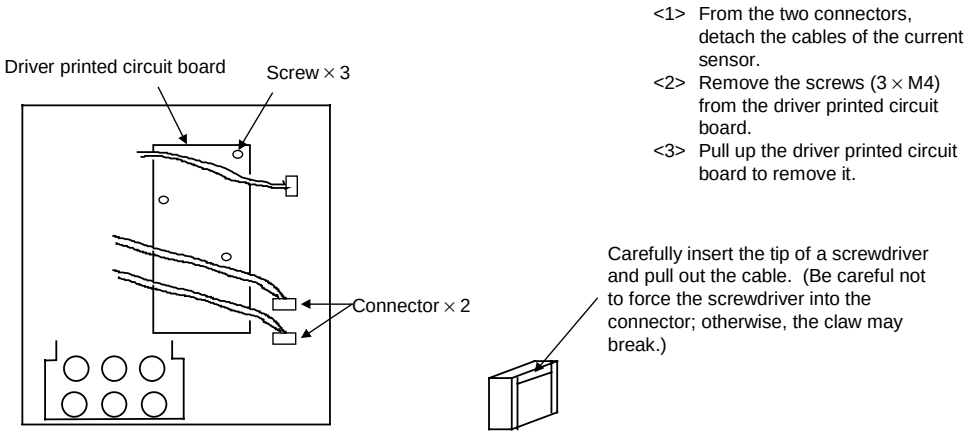
Remove the LED board for the recharge indicator.



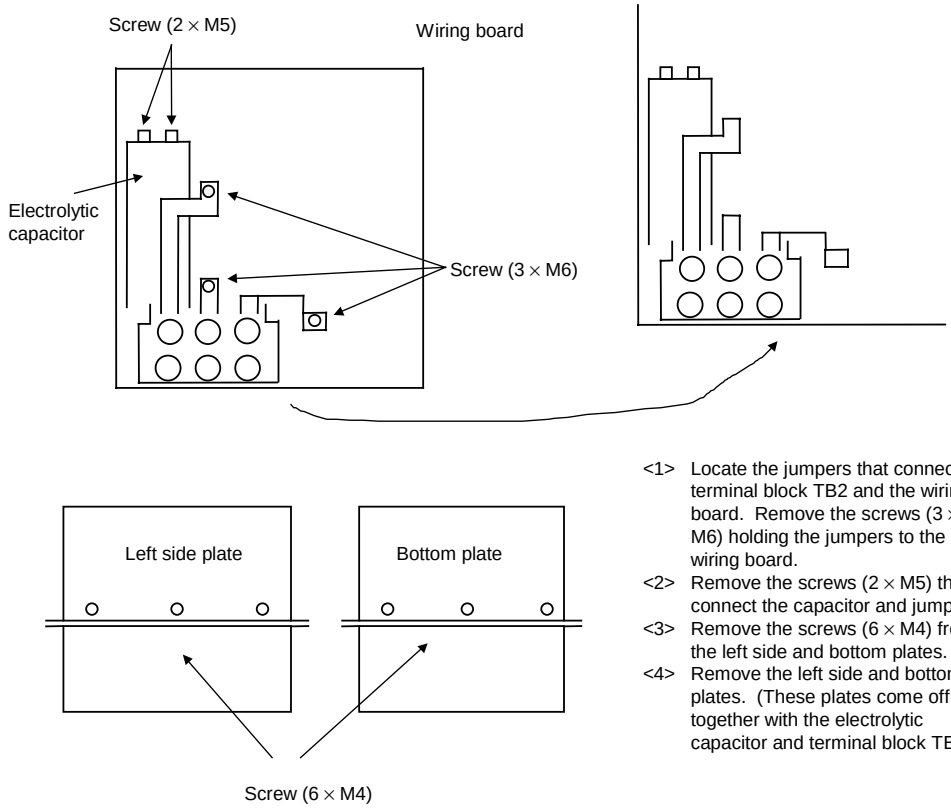
Remove the top plate.



Remove the driver printed circuit board.



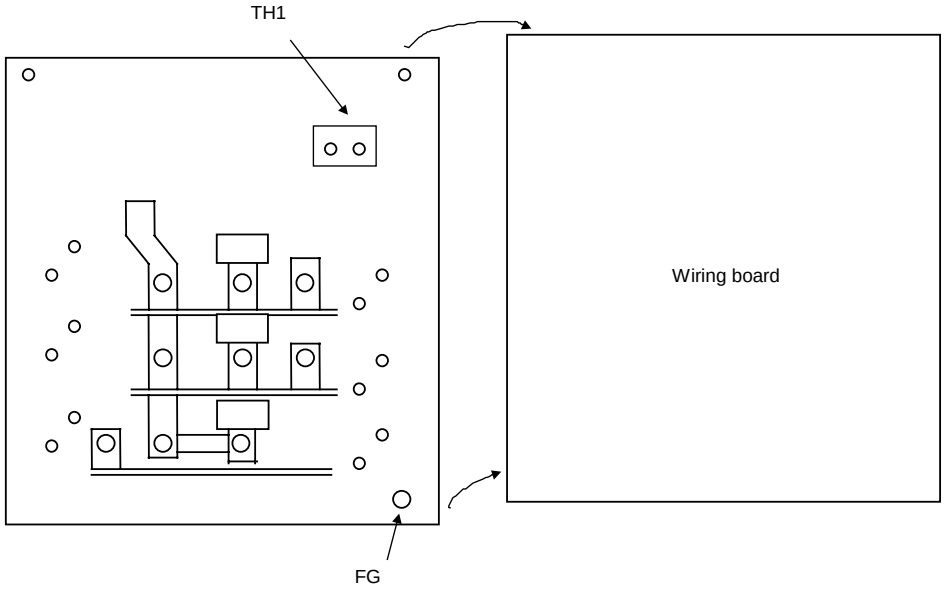
Remove the left side and bottom plates.



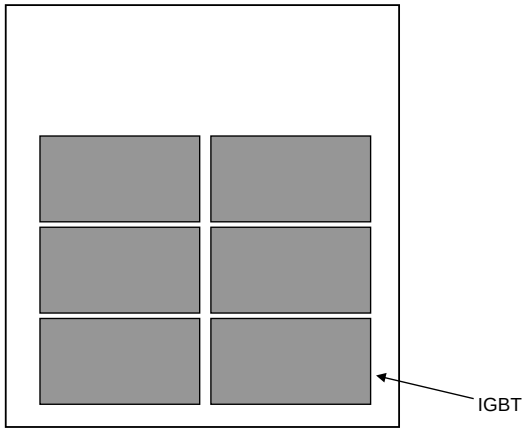
<1> Locate the jumpers that connect the terminal block TB2 and the wiring board. Remove the screws (3 × M6) holding the jumpers to the wiring board.
<2> Remove the screws (2 × M5) that connect the capacitor and jumpers.
<3> Remove the screws (6 × M4) from the left side and bottom plates.
<4> Remove the left side and bottom plates. (These plates come off together with the electrolytic capacitor and terminal block TB2.)

Remove the power printed circuit board.

<1> Remove the screws that connect the IGBT and wiring board (9 × M6, 12 × M4).
<2> Remove the screws of the thermostat TH1 (2 × M4).
<3> Remove the screws that connect the wiring board and heat sink (2 × M4, 1 × M5).
<4> Remove the wiring board.

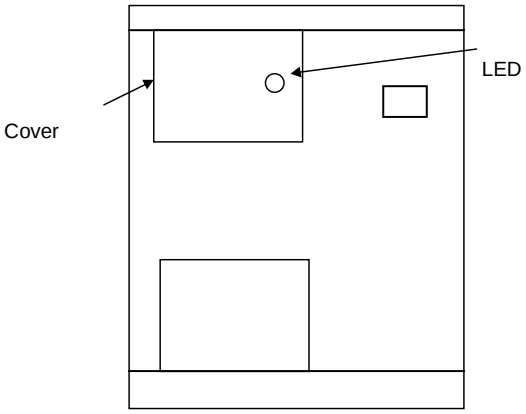


Remove the IGBT.

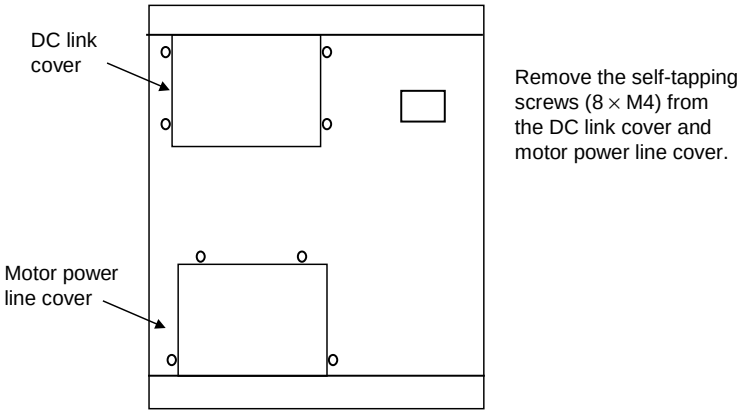


4.1.5 300-mm Wide Module (with the Connector Module)

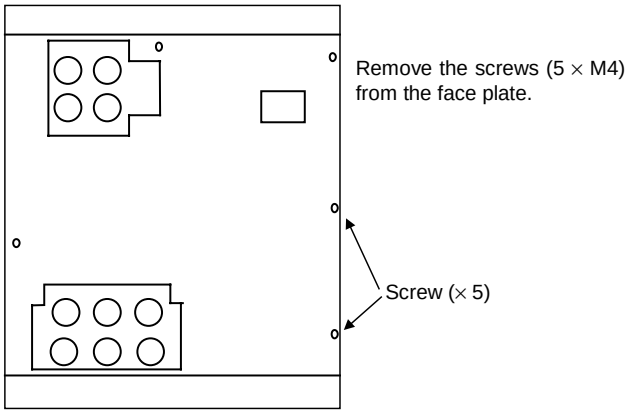
Make sure that the recharge-under-way LED (red) is off. View the recharge-under-way LED (red) from the upper part of the DC link cover.



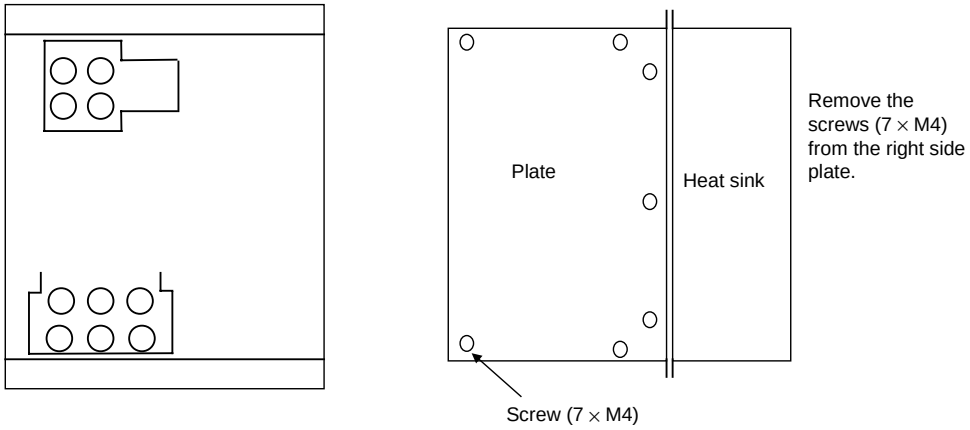
Remove the DC link cover and motor power line cover.



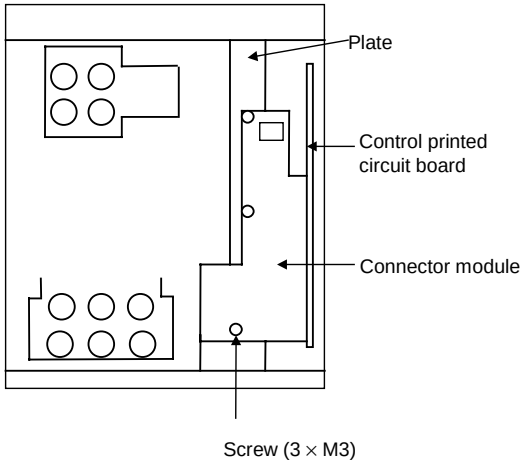
Remove the face plate.



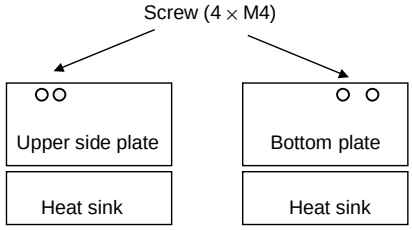
Remove the right side plate.



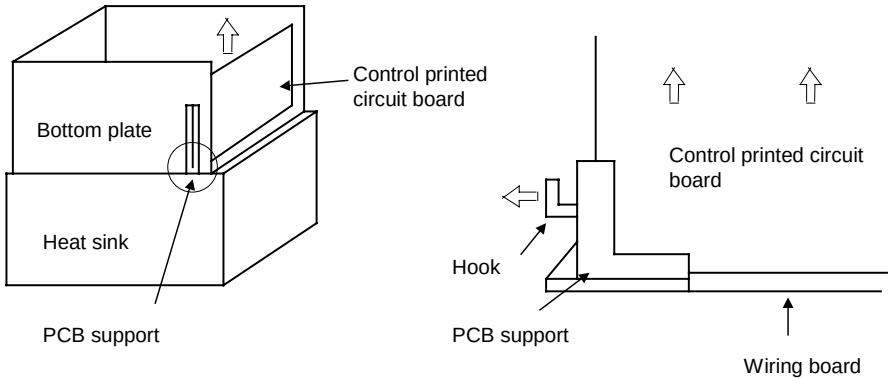
Remove the connector module and plate.



<1> Remove the screws (3 × M3) from the connector module.
<2> Pull the connector module out of the control printed circuit board.
<3> Remove the screws (4 × M4) from the plate, and remove the plate.

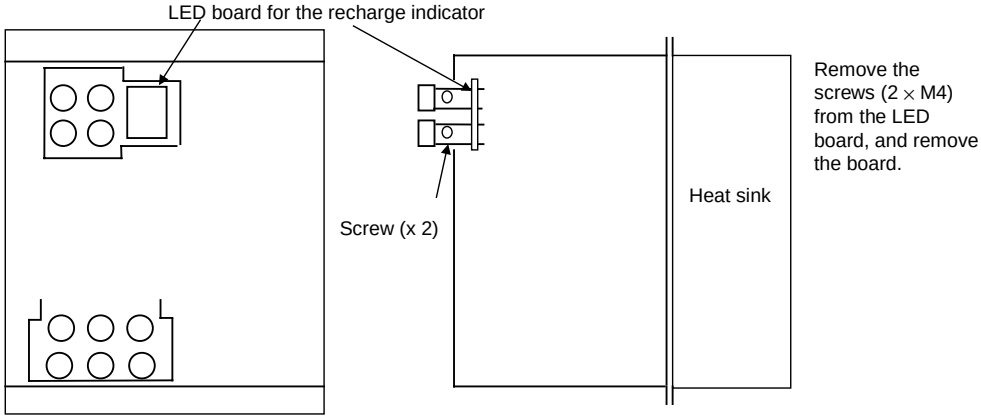


Remove the control printed circuit board.

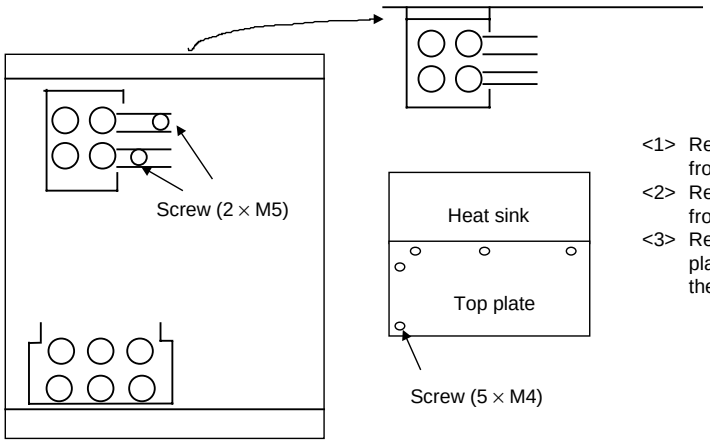


Insert the tip of a screwdriver into the opening on the bottom plate, and while spreading the hook of the PCB support, pull the printed circuit board off the flange surface toward you.

Remove the LED board for the recharge indicator.

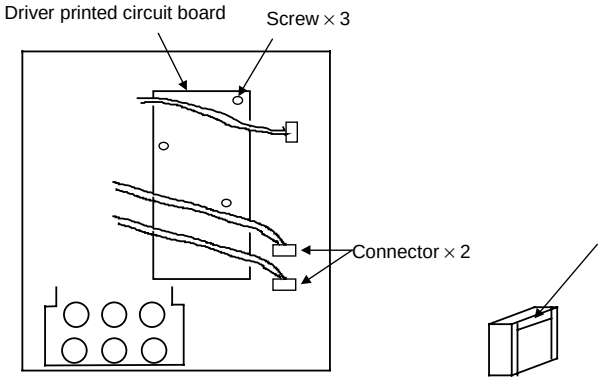


Remove the top plate.



<1> Remove the screws (2 × M5) from the DC link jumper.
<2> Remove the screws (5 × M4) from the top plate.
<3> Remove the top plate. (The top plate comes off together with the terminal block TB1.)

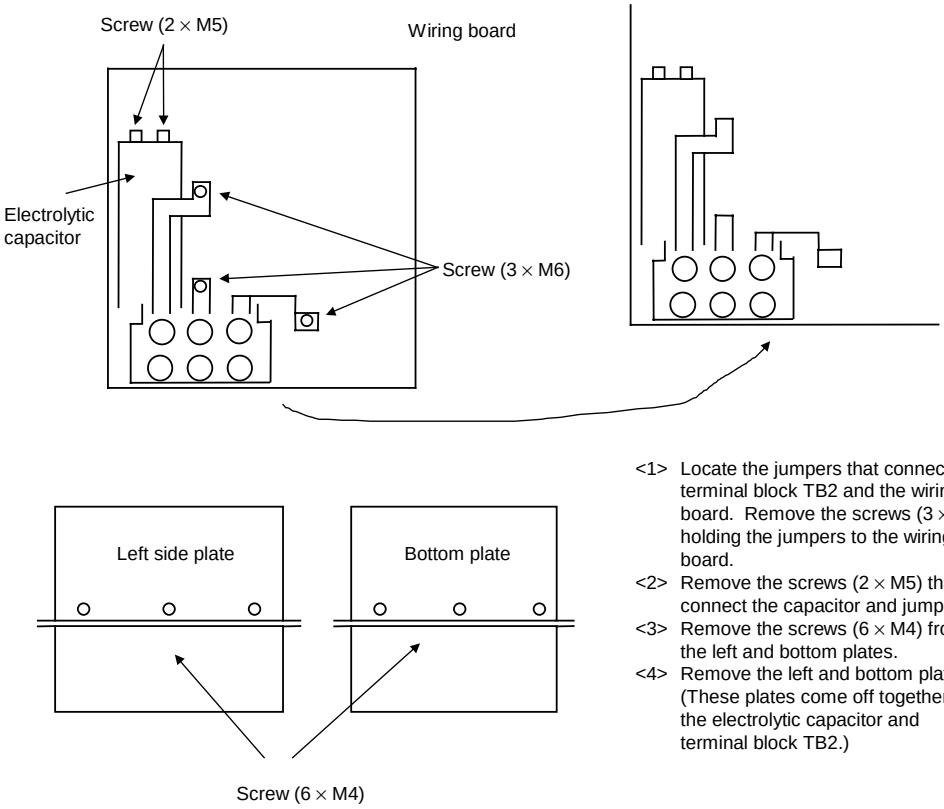
Remove the driver printed circuit board.



<1> From the two connectors, detach the cables of the current sensor.
<2> Remove the screws (3 × M4) from the driver printed circuit board.
<3> Pull up the driver printed circuit board to remove it.

Carefully insert the tip of a screwdriver and pull out the cable. (Be careful not to force the screwdriver into the connector; otherwise, the claw may break.)

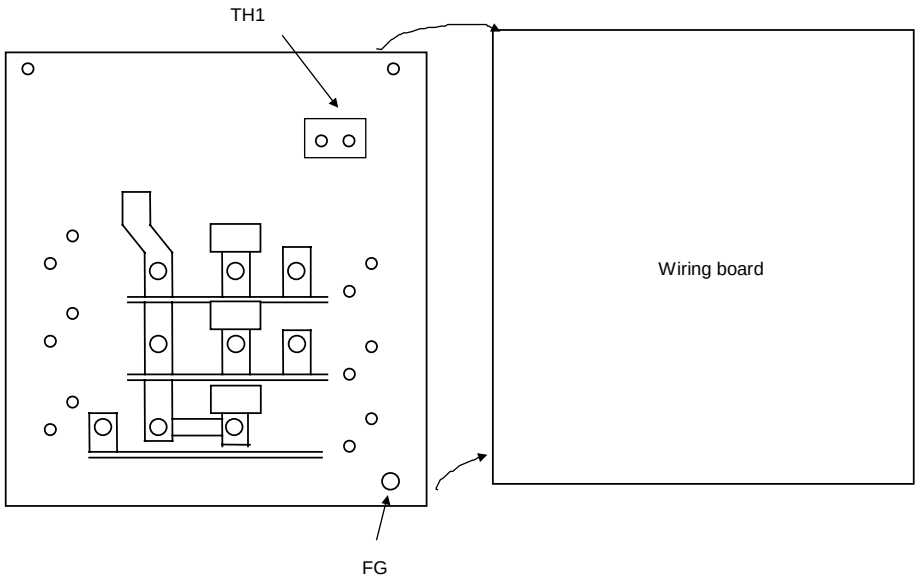
Remove the left side and bottom plates.



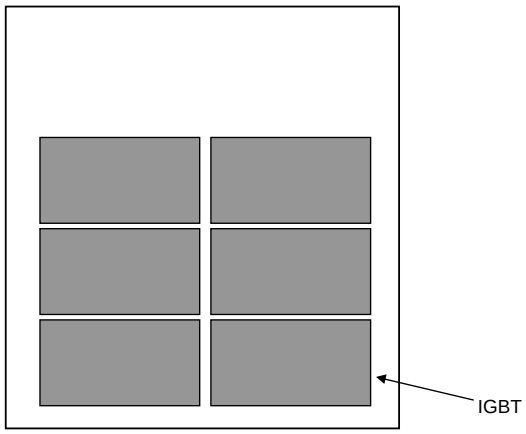
<1> Locate the jumpers that connect the terminal block TB2 and the wiring board. Remove the screws (3 × M6) holding the jumpers to the wiring board.
<2> Remove the screws (2 × M5) that connect the capacitor and jumpers.
<3> Remove the screws (6 × M4) from the left and bottom plates.
<4> Remove the left and bottom plates. (These plates come off together with the electrolytic capacitor and terminal block TB2.)

Remove the power printed circuit board.

<1> Remove the screws that connect the IGBT and wiring board (9 × M6, 12 × M4).
<2> Remove the screws of the thermostat TH1 (2 × M4).
<3> Remove the screws that connect the wiring board and heat sink (2 × M4, 1 × M5).
<4> Remove the wiring board.



Remove the IGBT.

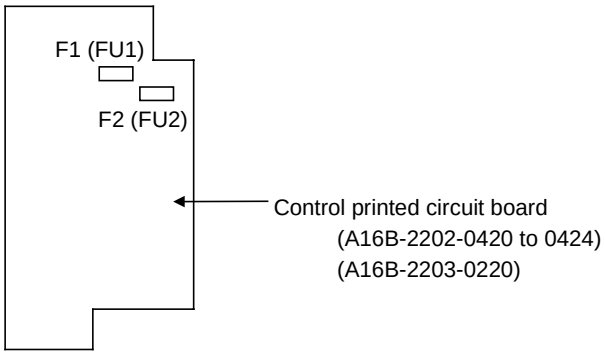


4.2 REPLACING FUSES

4.2.1 Power Supply Module

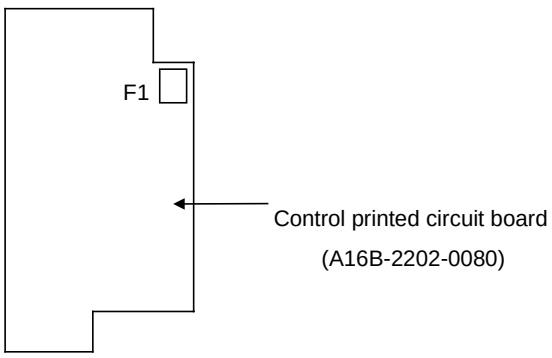
(1) Replacing fuses on the control printed circuit board
   a) F1 for 200 V for the control power
   b) F2 for 200 V for CX1B external cooling fan
      For A16B-2202-0423 to 0424 only.

Fuse	Specification drawing No.	Remarks
F1 (FU1)	A60L-0001-0359	250V F5.0A DAITO HM50
F2 (FU2)	A60L-0001-0175#2.0A	250V F2.0A DAITO HM20



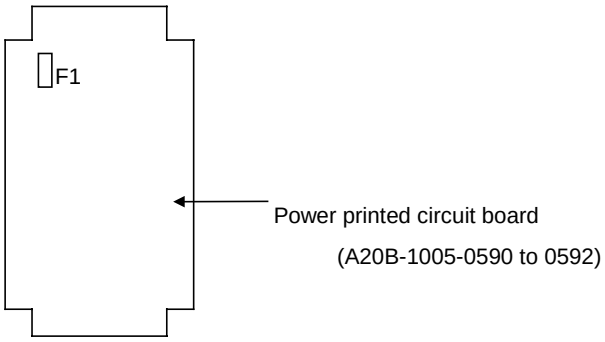
(2) Replacing a fuse on the control printed circuit board
   a) F1 for 200 V for the control power

Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0245#GP75	250V F7.5A DAITO GP75



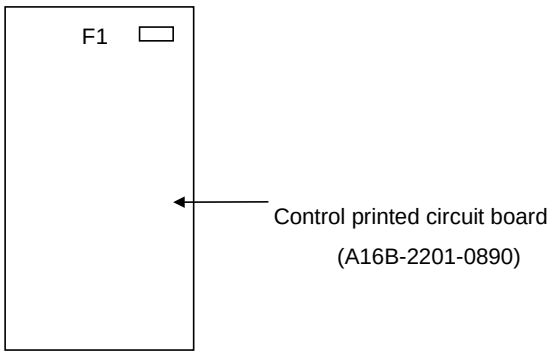
(3) Replacing a fuse on the power printed circuit board
a) F1 for the external cooling fan

Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0175#0.5A	250V F0.5A DAITO HM05



(4) Replacing a fuse on the control printed circuit board
a) F1 for 200 V for the control power

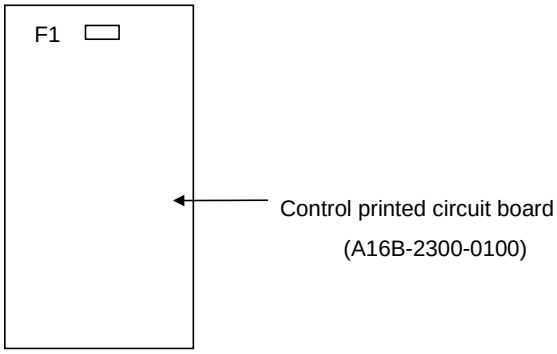
Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0175#5.0A	250V F5.0A DAITO HM50



(5) Replacing a fuse on the power printed circuit board

a) F1 for 200 V for the external cooling fan

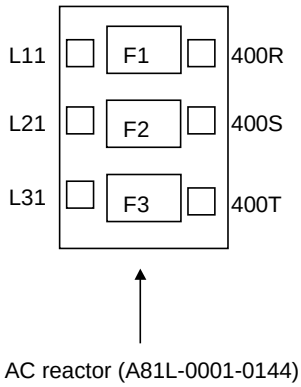
Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0359	250V F5.0A DAITO HM50



(6) Replacing fuses on the AC reactor

a) F1 to F3 for main circuit protection

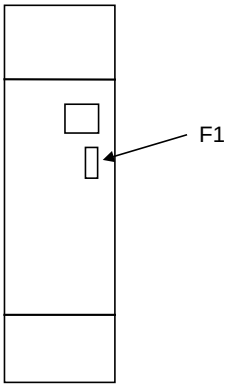
Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0362#100U	CR6L-100/UL
F2		
F3		



4.2.2 Servo Amplifier Module

(1) Replacing a fuse on the unit (control printed circuit board)
a) F1 for the 24-V control power

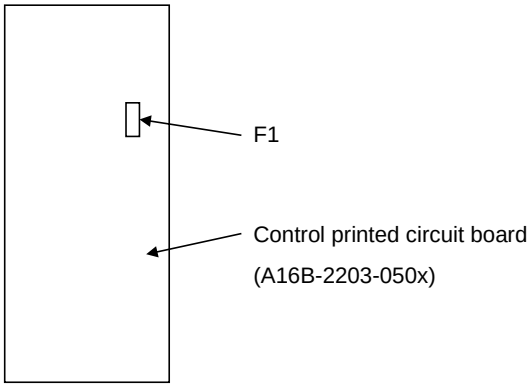
Fuse	Specification drawing No.	Remarks
F1	A60L-0001-0290#LM32C	48V F3.2A DAITO LM32C



4.2.3 Spindle Amplifier Module

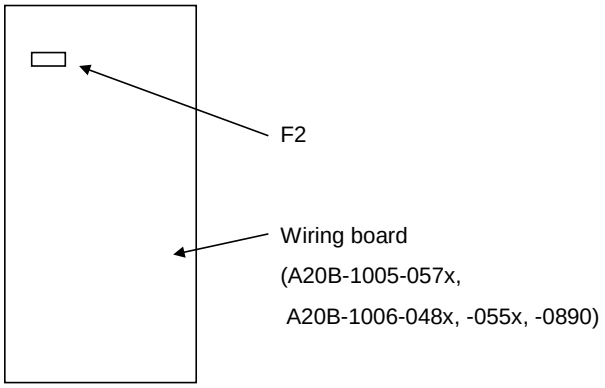
(1) Replacing a fuse on the control printed circuit board
a) F1 for the 24-V control power

Fuse	Specification drawing No.	Remarks
F2	A60L-0001-0290#LM32C	48V F3.2A DAITO LM32C



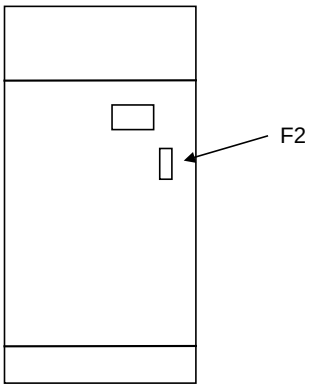
(2) Replacing a fuse on the power printed circuit board
a) F2 for 200 V for the external cooling fan

Fuse	Specification drawing No.	Remarks
F2	A60L-0001-0175#0.5A	250V F5.0A DAITO HM50



(3) Replacing a fuse on the unit (control printed circuit board)
a) F2 for the 24-V control power

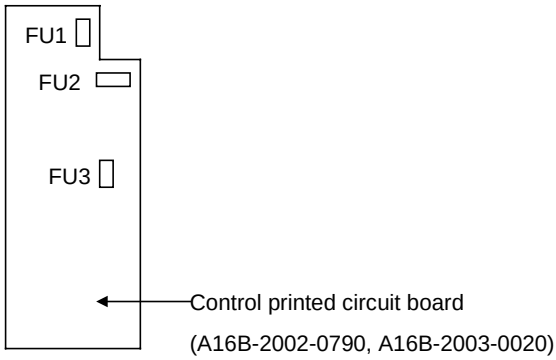
Fuse	Specification drawing No.	Remarks
F2	A60L-0001-0290#LM50C	50V F5.0A DAITO LM50C



4.2.4 Power-Failure Backup Module

(1) Replacing fuses on the unit (control printed circuit board)
   a) FU1 for 200 V for the control power
   b) FU2 for 200 V for the control power
      Fuses a) and b) above are provided for A16B-2203-0020 only.
   c) FU3 for the 24-V control power

Fuse	Specification drawing No.	Remarks
FU1	A60L-0001-0396#10A	216-010 (ECX)
FU2		
FU3	A60L-0001-0290#LM32C	48V F3.2A DAITO LM32

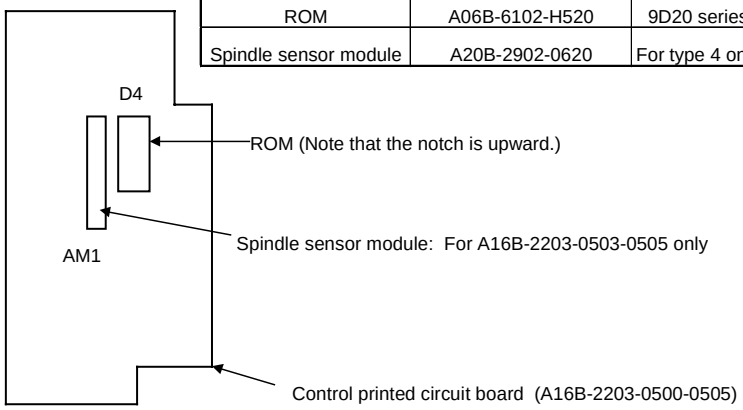


4.3 OTHER COMPONENTS

4.3.1 Replacing the SPM Program ROM and Spindle Sensor Module

(1) SPM type 1 and type 4

Name	Specification drawing No.	Remarks
ROM	A06B-6102-H520	9D20 series
Spindle sensor module	A20B-2902-0620	For type 4 only



(2) SPM types 1 to 4

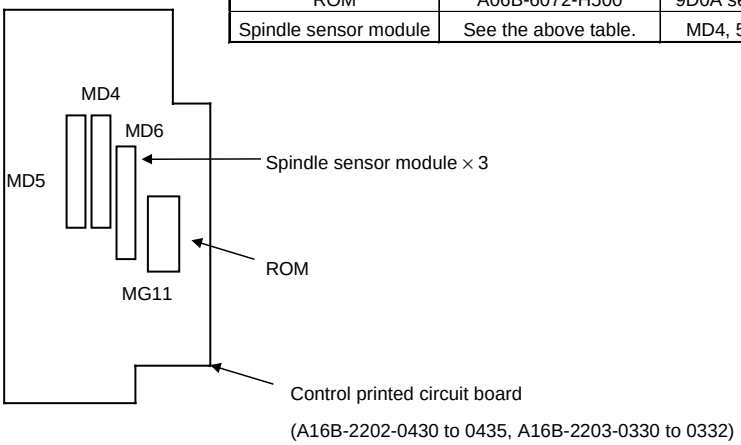
The drawing number of the spindle sensor module differs depending on the SPM type as follows:

SPM type 2: A20B-2901-0851
Mounting location = MD4, MD5, MD6

SPM type 4: A20B-2902-0620 (old specification A20B-2902-0610 also allowed)
Mounting location = MD4, MD6

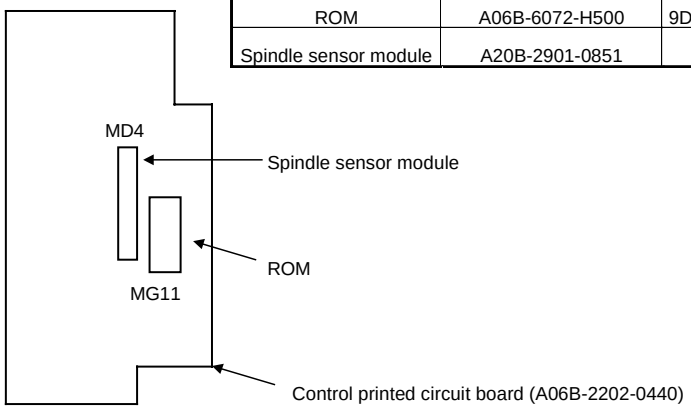
NOTE
For SPM type 4, the revision of the control printed circuit board must be the following:
A16B-2202-0433, 0434: 16E or later
A16B-2202-0435: 13C or later

Name	Specification drawing No.	Remarks
ROM	A06B-6072-H500	9D0A series
Spindle sensor module	See the above table.	MD4, 5, 6



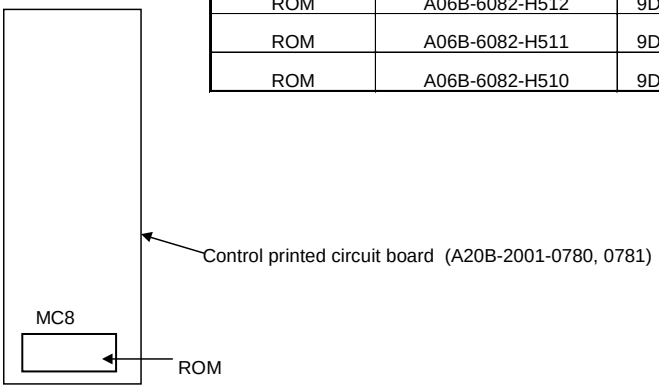
(3) SPM type 3

Name	Specification drawing No.	Remarks
ROM	A06B-6072-H500	9D0A series
Spindle sensor module	A20B-2901-0851	



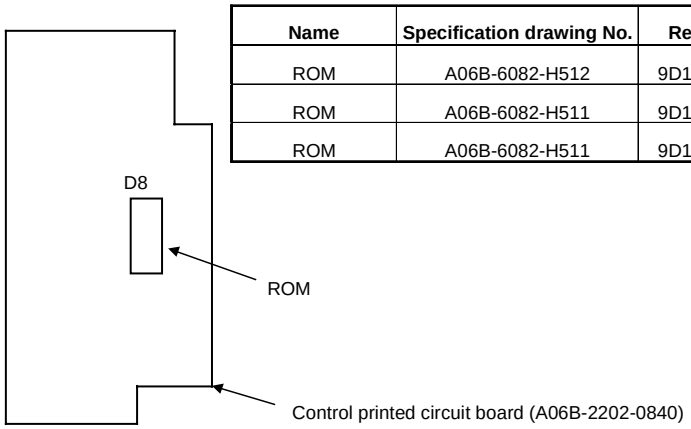
(4) SPMC-2.2 to 11

Name	Specification drawing No.	Remarks
ROM	A06B-6082-H512	9D12 series
ROM	A06B-6082-H511	9D11 series
ROM	A06B-6082-H510	9D10 series



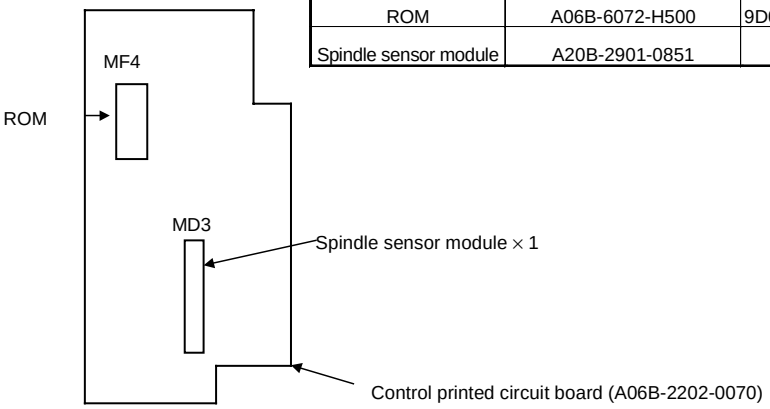
(5) SPMC-15 to 26

Name	Specification drawing No.	Remarks
ROM	A06B-6082-H512	9D12 series
ROM	A06B-6082-H511	9D11 series
ROM	A06B-6082-H511	9D10 series



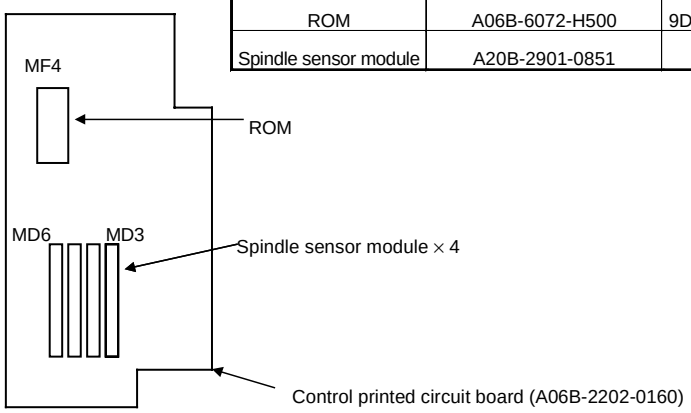
(6) SPM type 1 of old specification

Name	Specification drawing No.	Remarks
ROM	A06B-6072-H500	9D0A series
Spindle sensor module	A20B-2901-0851	



(7) SPM types 2 and 3 of old specification

Name	Specification drawing No.	Remarks
ROM	A06B-6072-H500	9D0A series
Spindle sensor module	A20B-2901-0851	



III. MOTOR MAINTENANCE

1 AC SERVO MOTOR MAINTENANCE

Generally, AC servo motors have no parts that wear off or that must be replaced periodically, unlike DC servo motors, which have brushes that must be replaced periodically.
However, you should perform periodic maintenance for servo motors so as to keep their initial performance as long as possible and to prevent breakdowns. AC servo motors have precision detectors. Their incorrect use or damage caused during transportation or assembling can result in breakdowns or accidents. We recommend that you inspect the servo motors periodically according to the descriptions given below.

1.1 RECEIVING AND KEEPING AC SERVO MOTORS

When you receive an AC servo motor, make sure that:

- The motor is exactly the one you ordered, in terms of model, shaft, and detector specifications.
- No damage has been caused on the motor.

Because FANUC inspects servo motors strictly before shipment, you do not, in principle, have to inspect them when you receive them. However, you should check the specifications (wiring, current, and voltage) of the motor and detector carefully, as required.
The servo motors should be kept indoors as a rule. The storage temperature range is -20 to +60°C. Do not place or install AC servo motors in the place where:

- It is extremely humid and dew is prone to form,
- There is a steep change in temperature,
- There is constant vibration, which may cause damage to the shaft bearings, or
- There is lots of dust and trash.

1.2 DAILY INSPECTION OF AC SERVO MOTORS

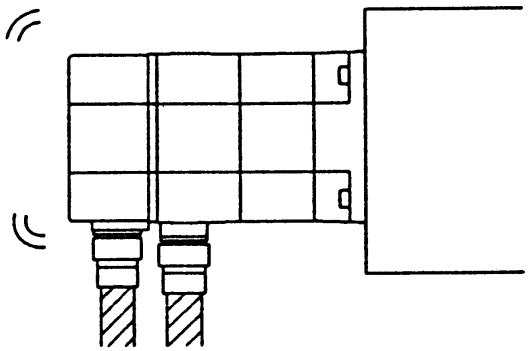
Before starting operation, or periodically (once a week or month), you should inspect the AC servo motors in terms of the following:

(1) Vibration and noise

Check the motor for abnormal vibration (by the hand) and noise (by the ear) when the motor is:

- Not rotating
- Rotating at low speed
- Accelerating or decelerating

If you find anything unusual, contact your FANUC service staff.

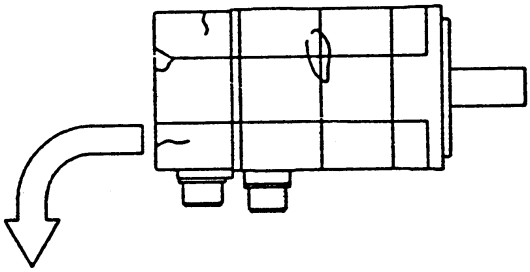


(2) Damage on the outside

Check the motor cover (red plastic) for crevices and the motor surface (black coating) for scratches and cracks.

If you find a crevice in the motor cover, you should replace it as quickly as possible. For how to replace, see the description about the pulse coder in Section 1.4. If you are not sure about replacement, contact you FANUC service staff.

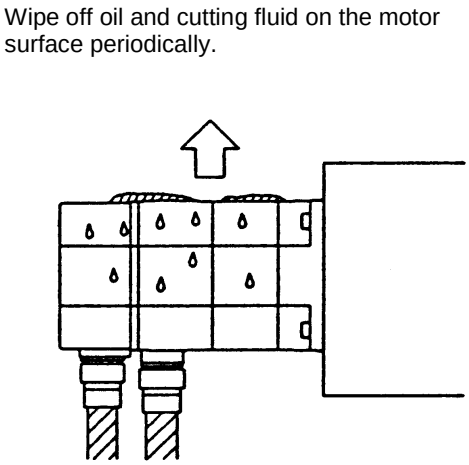
If there is a scratch or crack on the motor surface, the user should repair it by himself as required. If coating has come off, dry the portion of interest (or the entire surface) and coat it with paint for machines such as urethane paint.



Replace a motor cover with a crevice or crack as quickly as possible.

(3) Stains and smudges

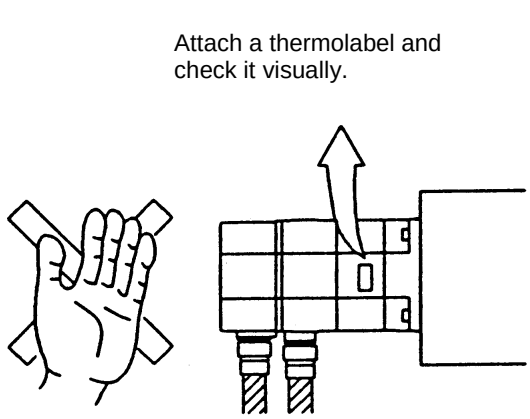
Check the motor surface and bolt holes for oil or cutting fluid.
Wipe off oil and cutting fluid on the motor surface periodically.
Oil or cutting fluid can damage the coating by chemical reaction, possibly leading to a failure.
Also check how such a liquid leaks onto the motor, and repair if needed.



(4) Overheating

Check to see if the motor is too hot during normal operation.
Attach a thermolabel on the motor surface and check it visually to see if the motor becomes too hot during normal operation.

Note) Temperature on the motor surface can exceed 80°C under some conditions. Never touch it by the hand.



1.3 PERIODIC INSPECTION OF AC SERVO MOTORS

We recommend that you inspect the AC servo motors for the following items at least once a year.

(1) Observation of torque command (TCMD) and speed command (VCMD) waveforms

Observe normal voltage waveforms with an oscilloscope, and keep notes of them. During periodic inspection, check the current waveforms with the records.

The waveforms vary according to the operating conditions such as load and cutting speed. Note that you should make comparisons under the same condition (for example, during fast traverse to the reference position or low-speed cutting).

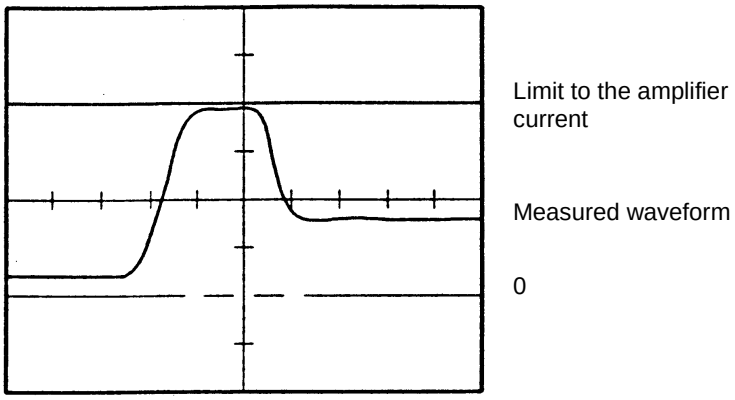
See descriptions on the check boards in I-4.2.5 for detailed inspection procedures.

(2) Diagnosis by waveforms

Check the measured waveforms to see whether:

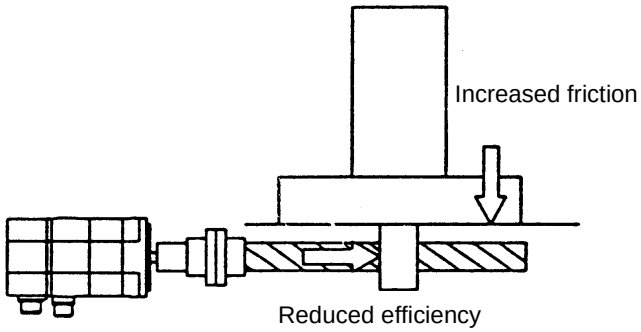
<1> The peak current is within the limit to the current in the amplifier.

The limit to the amplifier current is listed below.



⇒ The motor used to accelerate/decelerate with the amplifier current within the limit (the acceleration/deceleration torque used to be sufficient), but something is wrong now. If this is the case, the probable causes are:

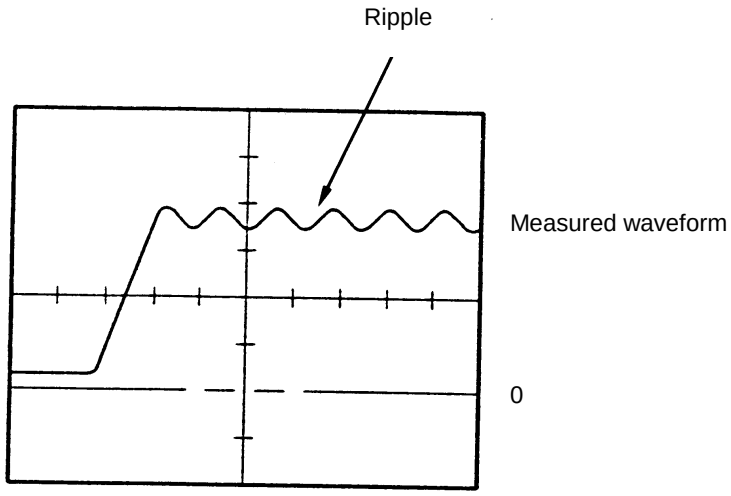
- The load conditions in the machine have changed because of changed friction or reduced machine efficiency after long period of use.
- Motor failure



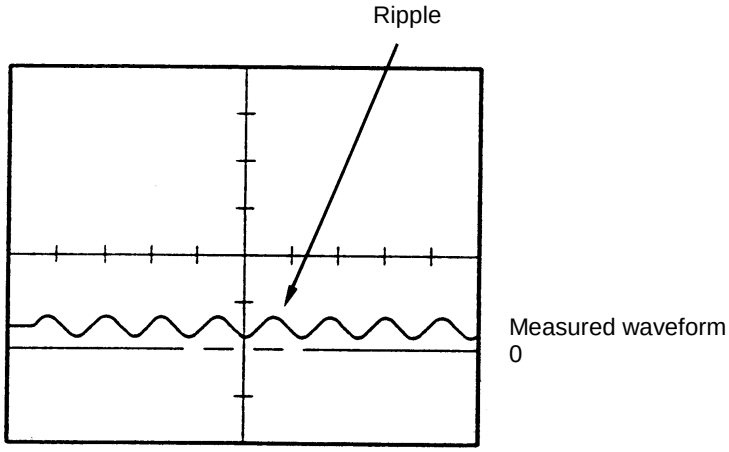
[Table 1]

Models	Current value
α1/3000, α2/2000, α2/3000	12Ap
αM2/3000, αM2.5/3000, αC3/2000, αC6/2000, αC12/2000, α3/3000HV, α6/3000HV	20Ap
α3/3000, α6/2000, α12/2000, α22/1500, αC22/1500, α12/3000HV, αM6/3000HV, αM9/3000HV	40Ap
α22/3000HV, α30/3000HV, αM22/3000HV, αM30/3000HV	60Ap
α6/3000, α12/3000, α22/2000, α30/1200, αM6/3000, αM9/3000, αL6/3000, αL9/3000	80Ap
α22/3000, α30/2000, α30/3000, α40/2000, α40/2000 (with fan), αM22/3000, αM30/3000, αM40/3000, αL25/3000, αL50/2000	130Ap
α65/2000	240Ap
αM40/3000 (with fan), α100/2000, α150/2000	360Ap
α300/2000, α400/2000	360Ap × 2

<2> The waveform has ripple during constant-speed feeding.



<3> The current waveform has ripple or jumps when the motor is not rotating.



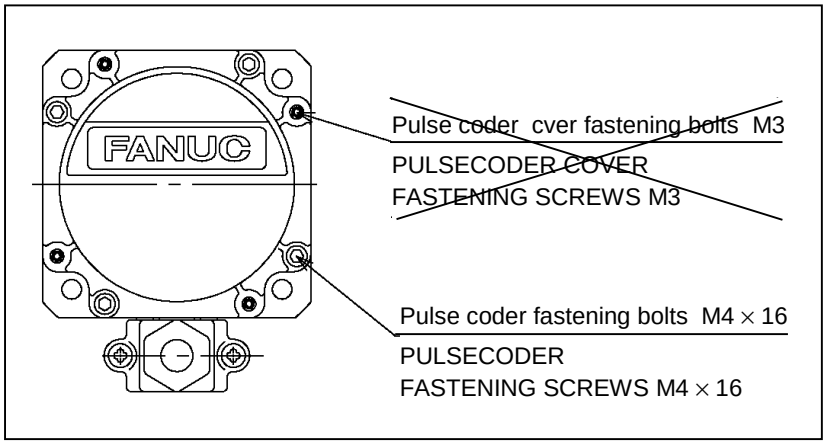
If you find anything unusual in relation to the above items, contact your FANUC service staff.

1.4 REPLACING THE PULSE CODER

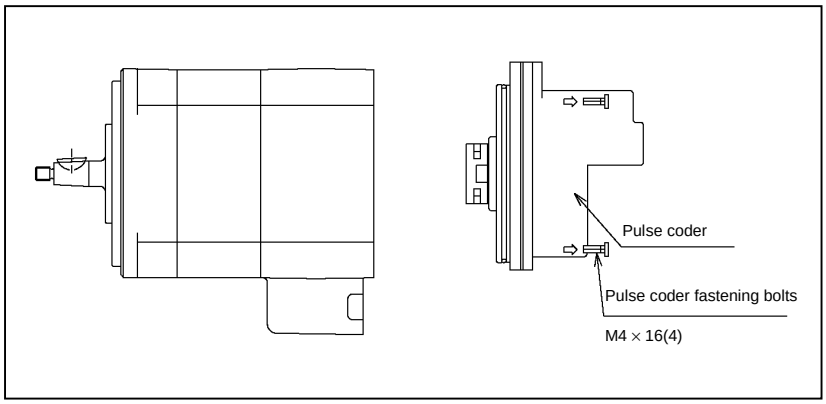
This section explains how to replace the pulse coder and motor cover, assuming that the pulse coder has broken down and is in need of immediate replacement.
When replacing the pulse coder and motor cover, be careful not to give a shock to the pulse coder or motor, because they are precision devices prone to a breakdown. Also keep them from dust and cutting chips.

(1) Models α1, α2, αM2, αM2.5

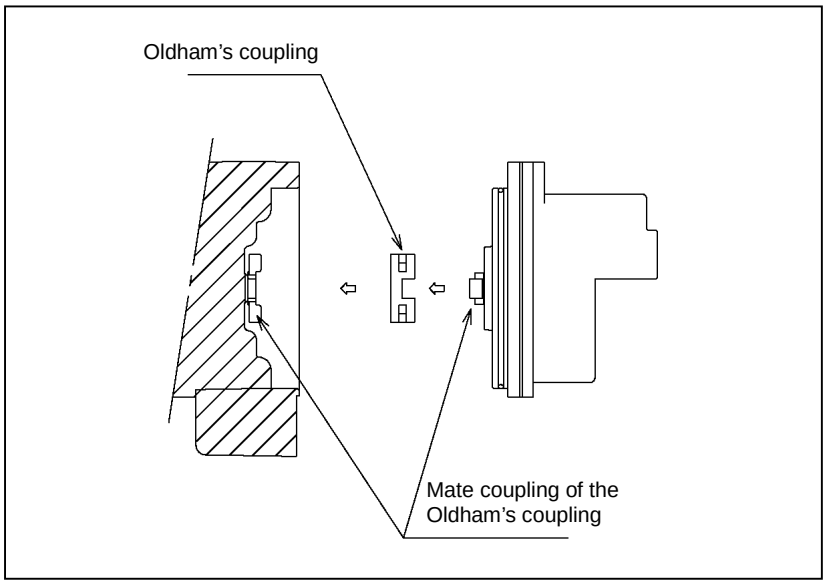
<1> Remove the four M4 hexagonal socket head bolts that fasten the pulse coder. Do not loosen the M3 bolts near each M4 bolt. (Removing the M3 bolts will impair airtightness.)



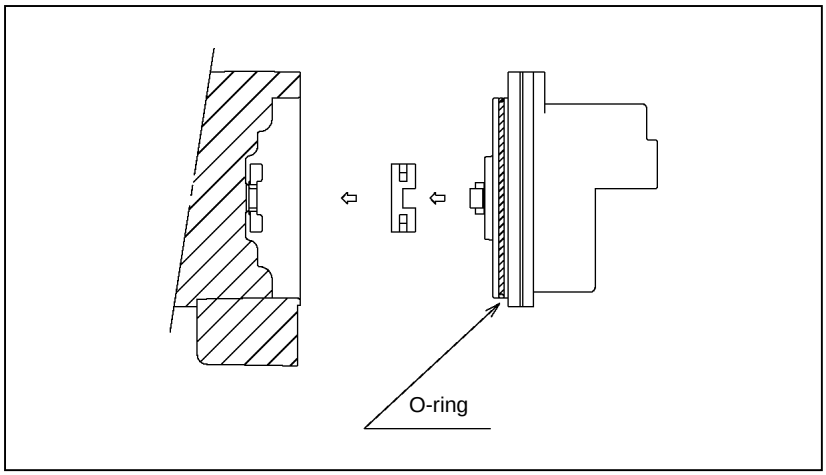
<2> Remove the pulse coder and Oldham's coupling.



<3> Set a new pulse coder and a new Oldham's coupling in the motor. Place the Oldham's coupling with the correct orientation, and engage the teeth.

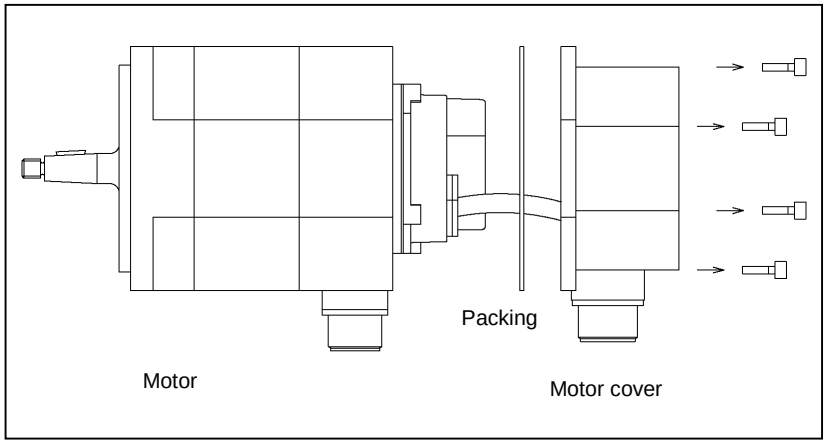


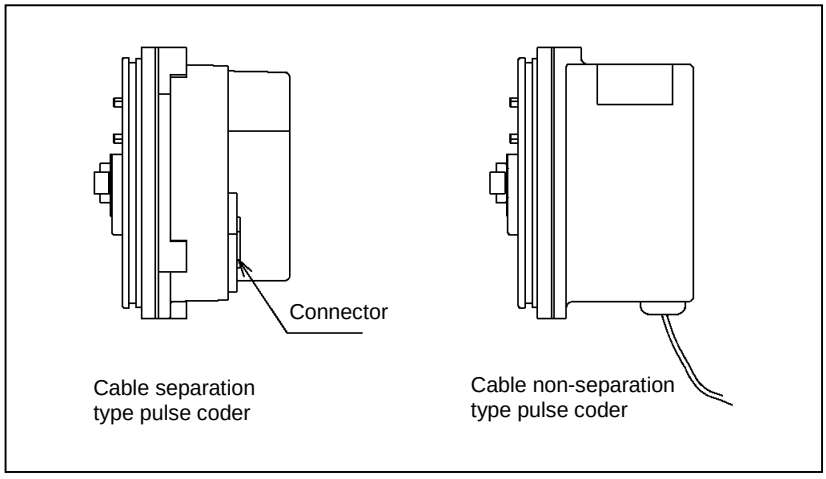
<4> Fasten the pulse coder with the four M4 hexagonal socket head bolts. When tightening the bolts, be careful not to catch the O-ring mounted on the pulse coder.



(2) Models α3 to α40, αM6 to αM40, αL, αC, α3HV to α30HV, αM6HV to αM30HV

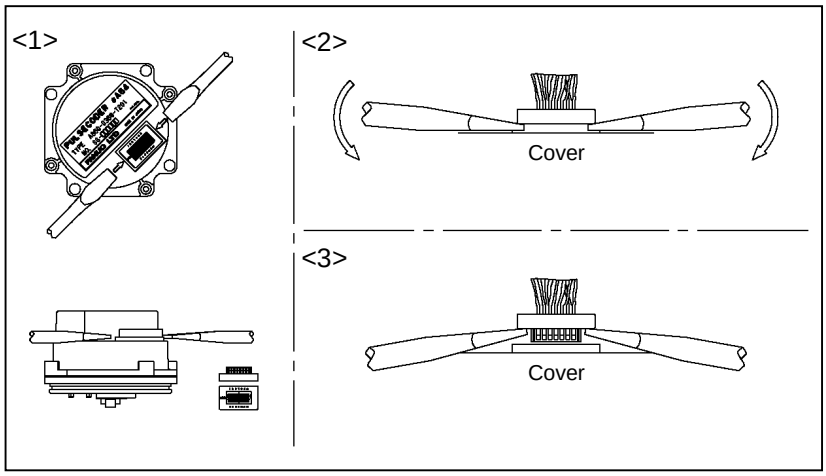
<1> Loosen the bolts that retain the red motor cover to remove the cover. Check whether the pulse coder is of the cable separation type (the pulse coder cable can be detached from the red cover of the pulse coder) or of the cable non-separation type (the cable cannot be detached from the cover). For the replacement of a cable separation type pulse coder, see Item <2>-1. For the replacement of a cable non-separation type pulse coder, see Item <2>-2.



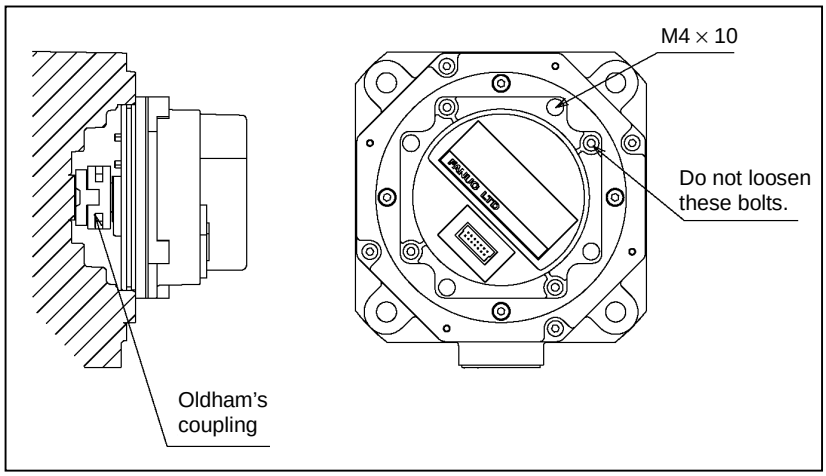


<2>-1 (Cable separation type)

(a) Remove the cable of the pulse coder by using a screwdriver.



(b) Remove the four M4 hexagonal socket head bolts that retain the pulse coder. Do not loosen the M3 bolts that retain the pulse coder cover.



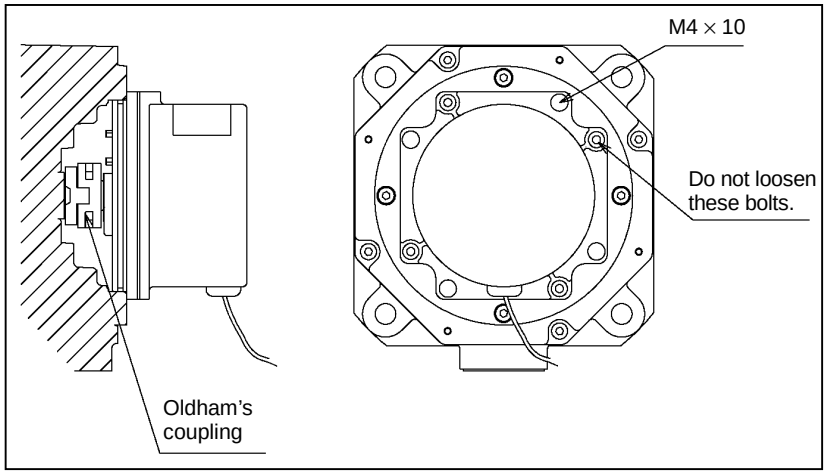
(c) Remove the pulse coder and Oldham's coupling.

(d) Set a new pulse coder and new Oldham's coupling in the motor. Although the mounting orientation is not specified in particular, it is recommended that the pulse coder be set with the same orientation as before the replacement. This is because of the convenience of cabling. Place the Oldham's coupling with the correct orientation, and engage the teeth.

(e) Fasten the pulse coder with the four M4 hexagonal socket head bolts.

(f) Replace the packing on the motor cover mounting surface. Reusing old packing cannot provide sufficient sealing performance. Whenever taking off the motor cover, be sure to replace the packing.
(g) Connect the cable of the pulse coder.
(h) Install the motor cover. Be careful not to catch the lead wires of the pulse coder. After installing the motor cover, fasten the cover using the M4 hexagonal socket head bolts.

<2>-2 (Cable non-separation type)
(a) Detach the cannon connector of the pulse coder from the red motor cover.
  (a)-1 Remove the M3 screw that retains the connector.
  (a)-2 Shift the rubber packing, and remove the C-ring that retains the insulator on the rear side (connection side) of the connector to separate the connector housing from the terminal section. Replace the rubber packing with a new one.
  (a)-3 Remove the connector terminal section from the motor cover.
  (a)-4 Set the housing in the removed pulse coder (the pulse coder to be replaced with a new one) in place, and hold the housing with the C-ring.
(b) Cut the lead wires of the thermal switch. The wires should be cut at the root of the crimp terminals where possible.
(c) Remove the four M4 hexagonal socket head bolts that retain the pulse coder. Do not loosen the M3 bolts that retain the pulse coder cover.



(d) Remove the pulse coder and Oldham's coupling.

(e) Set a new pulse coder and new Oldham's coupling in the motor. Although the mounting orientation is not specified in particular, it is recommended that the pulse coder be set with the same orientation as before the replacement. This is because of the convenience of cabling. Place the Oldham's coupling with the correct orientation, and engage the teeth.

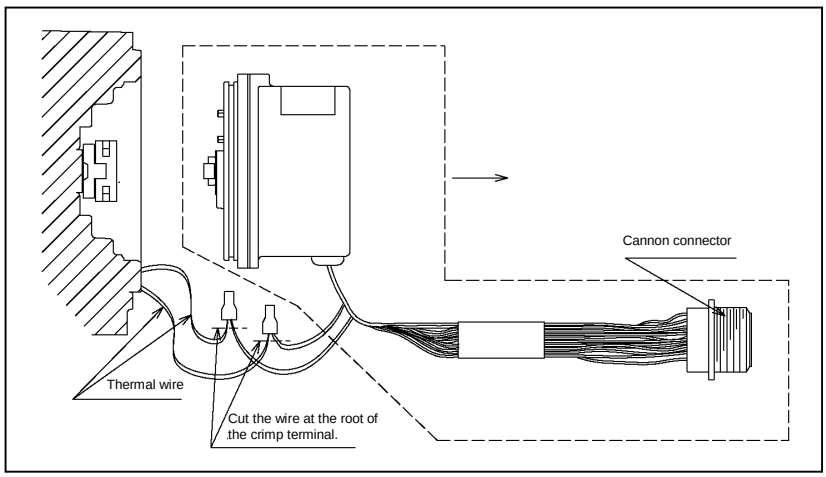
(f) Fasten the pulse coder with the four M4 hexagonal socket head bolts.

(g) Replace the packing on the motor cover mounting surface. Reusing old packing cannot provide sufficient sealing performance. Whenever taking off the motor cover, be sure to replace the packing.

(h) Install the connector in the cover in the reverse order of step (a). Keying is provided for the connector insulator (the insulating material around the terminals). So, perform keying (phase) alignment when installing the connector.

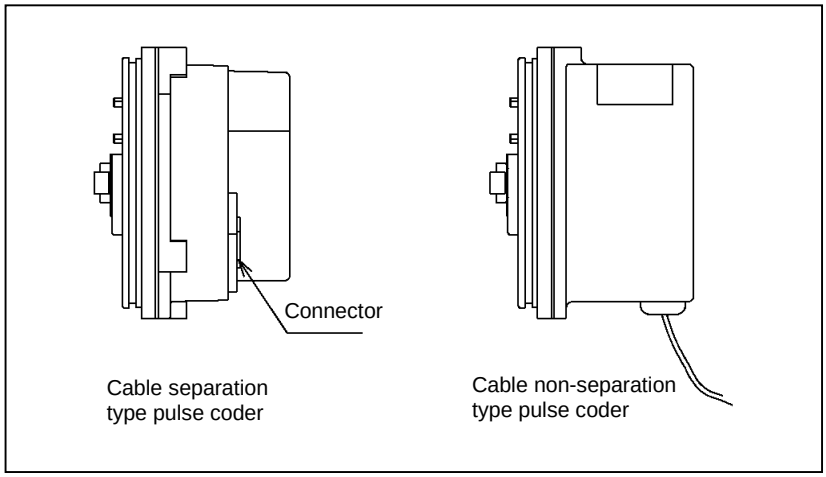
(i) Connect the lead wires of the thermal switch. Peel off about 1 cm of the jacket from the cut end of each motor lead wire, and tie the wire to the terminal of the pulse coder. Use of a crimp terminal is recommended for connection. (In case of an emergency, insulate both connection portions with insulating tape.)

(j) Install the motor cover. Be careful not to catch the lead wires of the pulse coder. After installing the motor cover, bolt the cover.



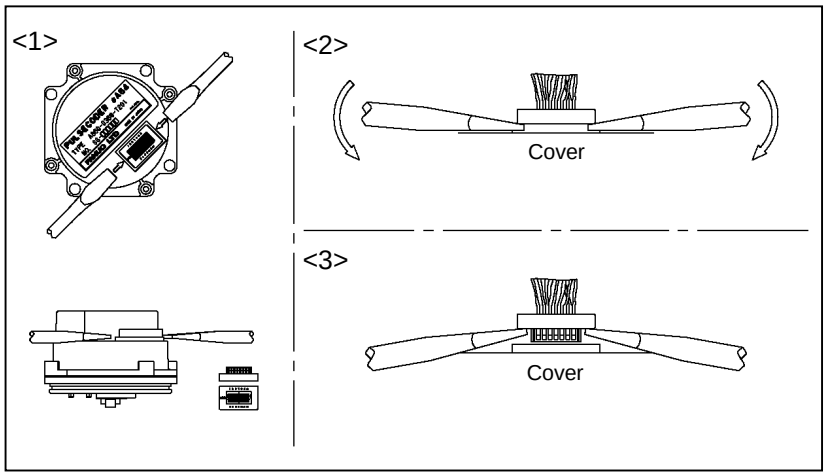
(3) Models α65 to α150

<1> Loosen the bolts that retain the red motor cover to remove the cover. Check whether the pulse coder is of the cable separation type (the pulse coder cable can be detached from the red cover of the pulse coder) or of the cable non-separation type (the cable cannot be detached from the cover). For the replacement of a cable separation type pulse coder, see Item <2>-1. For the replacement of a cable non-separation type pulse coder, see Item <2>-2.



<2>-1 (Cable separation type)

(a) Remove the cable of the pulse coder by using a screwdriver.



(b) Remove the four M4 hexagonal socket head bolts that retain the pulse coder. Do not loosen the M3 bolts that retain the pulse coder cover.

(c) Remove the pulse coder and Oldham's coupling.

(d) Set a new pulse coder and new Oldham's coupling in the motor. Although the mounting orientation is not specified in particular, it is recommended that the pulse coder be set with the same orientation as before the replacement. This is because of the convenience of cabling. Place the Oldham's coupling with the correct orientation, and engage the teeth.
(e) Fasten the pulse coder with the four M4 hexagonal socket head bolts.
(f) Replace the packing on the motor cover mounting surface. Reusing old packing cannot provide sufficient sealing performance. Whenever taking off the motor cover, be sure to replace the packing.
(g) Connect the cable of the pulse coder.
(h) Install the motor cover. Be careful not to catch the lead wires of the pulse coder. After installing the motor cover, bolt the cover.

<2>-2 (Cable non-separation type)

(a) Remove the cannon connector of the pulse coder from the motor terminal box.
  (a)-1 Remove the M3 screw that retains the connector.
  (a)-2 Shift the rubber packing, and remove the C-ring that retains the insulator on the rear side (connection side) of the connector to separate the connector housing from the terminal section. Replace the rubber packing with a new one.
  (a)-3 Pull out the connector terminal section from the terminal box toward the pulse coder.
  (a)-4 Set the housing in the removed pulse coder (the pulse coder to be replaced with a new one) in place, and hold the housing with the C-ring.
(b) Cut the lead wires of the thermal switch. The wires should be cut at the root of the crimp terminals where possible.
(c) Remove the four M4 hexagonal socket head bolts that retain the pulse coder. Do not loosen the M3 bolts that retain the pulse coder cover.
(d) Remove the pulse coder and Oldham's coupling.
(e) Set a new pulse coder and new Oldham's coupling in the motor. Although the mounting orientation is not specified in particular, it is recommended that the pulse coder be set with the same orientation as before the replacement. This is because of the convenience of cabling. Place the Oldham's coupling with the correct orientation, and engage the teeth.
(f) Fasten the pulse coder with the four M4 hexagonal socket head bolts.

(g) Replace the packing on the motor cover mounting surface. Reusing old packing cannot provide sufficient sealing performance. Whenever taking off the motor cover, be sure to replace the packing.

(h) Install the connector in the cover in the reverse order of step (a). Keying is provided for the connector insulator (the insulating material around the terminals). So, perform keying (phase) alignment when installing the connector.

(i) Connect the lead wires of the thermal switch. Peel off about 1 cm of the jacket from the cut end of each motor lead wire, and tie the wire to the terminal of the pulse coder. Use of a crimp terminal is recommended for connection. (In case of an emergency, insulate both connection portions with insulating tape.)

(j) Install the motor cover. Be careful to keep the lead wires of the pulse coder clear of the motor cover. After installing the motor cover, bolt the cover.

1.5 SPECIFICATION NUMBERS OF REPLACEMENT PARTS

The following lists the ordering specification numbers for maintenance:

(1) Ordering specifications of pulse coders

<1> Ordering specifications of pulse coders with no motor cover

- Models α1 to α2, αM2 to αM2.5
  A290-0371-T575 : αA64 (with Oldham's coupling)
  A290-0371-T577 : αI64 (with Oldham's coupling)
  A290-0371-T588 : αA1000 (with Oldham's coupling)
- Models α3 to α400, αM6 to αM40, αL, αC, α3HV to α30HV, and αM6HV to αM30HV
  - Cable separation type
    A860-0360-V501: αA64
    A860-0365-V501: αI64
    A860-0370-V502: αA1000
    A860-0360-V906: Cable assembly (common to αA64, αI64, and αA1000)
    A290-0501-V535: Oldham's coupling (to be replaced together with the pulse coder at a time)
  - Cable non-separation type (reference)
    A860-0360-T201 : αA64
    A860-0365-T101 : αI64
    A860-0370-T201 : αA1000
    A290-0501-V535: Oldham's coupling (to be replaced together with the pulse coder at a time)

<2> Ordering specifications of pulse coders with a motor cover

- Models α3 to α6, αM6 to αM9, αL6 to αL9, αC3 to αC6, α3HV to α6HV, and αM6HV to αM9HV
  A290-0121-T575 : αA64
  A290-0121-T577 : αI64
  A290-0121-T588 : αA1000
- Models α12 to α40, αM22 to αM40, αL25 to αL50, αC12 to αC22, α12HV to α30HV, and αM22HV to αM30HV
  A290-0141-T575 : αA64
  A290-0141-T577 : αI64
  A290-0141-T588 : αA1000

(2) Ordering specifications of motor covers

A290-0121-X035: α3 to α6, αM6 to αM9, αL6 to αL9, αC3 to αC6, α3HV to α6HV, αM6HV to αM9HV

A290-0141-X035: α12 to α40, αM22 to αM40, αL25 to αL50, αC12 to αC22, α12HV to α30HV, αM22HV to αM30HV

(3) Oldham's coupling

A290-0501-V535

(4) Packing

A290-0511-X043: α3 to α6, αM6 to αM9, αL6 to αL9, αC3 to αC6, α3HV to α6HV, αM6HV to αM9HV

A290-0501-X043: α12 to α40, αM22 to αM40, αL25 to αL50, αC12 to αC22, α12HV to α30HV, αM22HV to αM30HV

A290-0301-X008: α65 to α150

(5) Rubber packing and nylon band

A290-0651-X034: Rubber packing

A6-NYB-T1 : Nylon band

2 SPINDLE MOTOR MAINTENANCE

2.1 PREVENTIVE MAINTENANCE

To maintain the original performance and reliability of the spindle motor for a long time, it is necessary to inspect them as described below.

(1) Visual inspection

WARNING
Be careful not to be struck by electric shocks or caught in gears or other mechanisms during inspection. When taking corrective actions, keep the entire machine switched off.

Inspection item	Symptom	Action	
Noise or abnormal vibration	There is unusual noise or vibration. The vibration acceleration of the motor exceeds 0.5 G at the maximum speed.	Check the following and take necessary actions: • Base and installation • Centering accuracy of directly coupled section • Abnormal sound from motor shaft bearings (See "Motor shaft bearing" below.) • Vibration of or noise from the reducer or belts • Amplifier failure • Fan motor failure (See "Fan motor" below.)	
Cooling air path	The cooling air path is clogged with dust.	Clean the stator vents and fan motor on a regular basis.	
Motor surface	Cutting fluid on the motor surface.	• Clean the motor surface. • If the motor is splashed excessively with coolant, place a cover or take a similar action.	
Fan motor	Not rotating.	If the fan motor can be rotated by the hand,	Replace the fan motor.
		If the fan motor cannot be rotated by the hand,	Remove foreign materials, if any. Adjust its mounting position by loosening the bolts and tightening them again. If unusual noise still remains, replace the fan motor.
	Unusual sound	Remove foreign materials, if any. Adjust its mounting position by loosening the bolts and tightening them again. If unusual noise still remains, replace the fan motor.	
Motor shaft bearing	Unusual sound from the motor shaft bearing	Replace the shaft bearing, and check the shaft for centering accuracy. Also check on the radial load. Before replacing the shaft bearing, contact your FANUC service staff.	
Internal condition of the terminal box	Cutting fluid in the terminal box	Check the terminal box lid and conduit packing. If there is lot of fluid on the terminal box surface, protect the terminal box by installing a shelter over it.	
	Loosen screw in the terminal block	• Tighten the screw. • Check whether there is abnormal vibration during motor rotation.	

(2) Checking the insulation between the winding and frame
Use a megohmmeter to measure the insulation resistance on 500 VDC. From the measurement result, determine whether the insulation is acceptable or not according to the following criteria:

- More than 100 MΩ: Acceptable
- 10 to 100 MΩ: Deterioration has started. Although there is no performance problem, periodic check is required.
- 1 to 10 MΩ: Deterioration is in an advanced state. Special care must be taken. Periodic check is required.
- Less than 1 MΩ: Unacceptable. Replace the motor.

CAUTION

1 Before measuring insulation resistance, disconnect the connection to the spindle amplifier module. If insulation resistance is measured with the spindle amplifier module connected, the spindle amplifier module may be damaged.
2 During the measurement of insulation resistance, applying voltage to the motor for a long time may further deteriorate the insulation of the motor. Therefore, the measurement of insulation resistance should be performed in a minimum amount of time where possible.

(3) Check items for the coolant through spindle motor αT series and αL series

<1> Check whether coolant is always leaking out from the drains or notch of the rotary joint support housing. (See Fig. 2.)

<2> Check whether the vibration acceleration of the motor turning at the maximum speed exceeds 0.5 G. (See Fig. 3.)

<3> Check whether coolant leaks out from the coolant joint of the coupling. (See Fig. 4.)

<4> Check for backlash in the coupling.

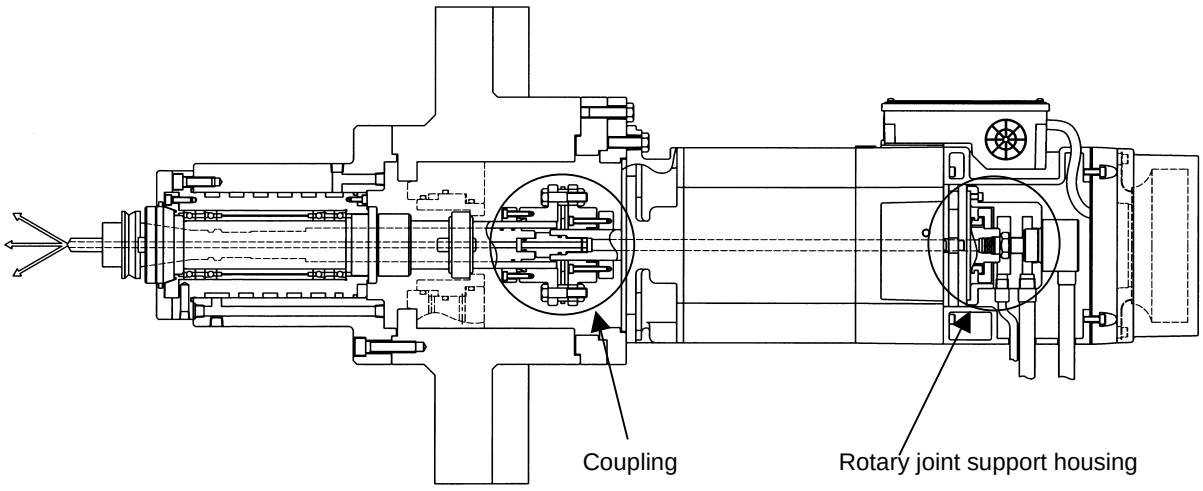


Fig. 1 Example of using the coolant through spindle motor

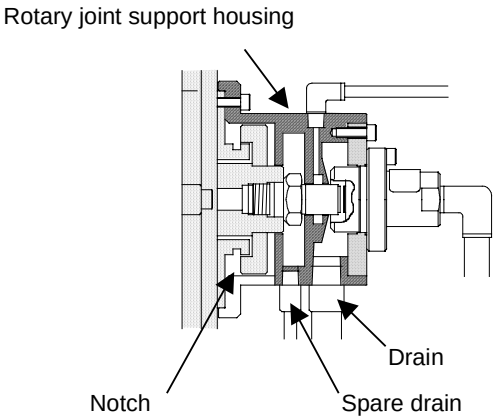


Fig. 2 Rotary joint support housing

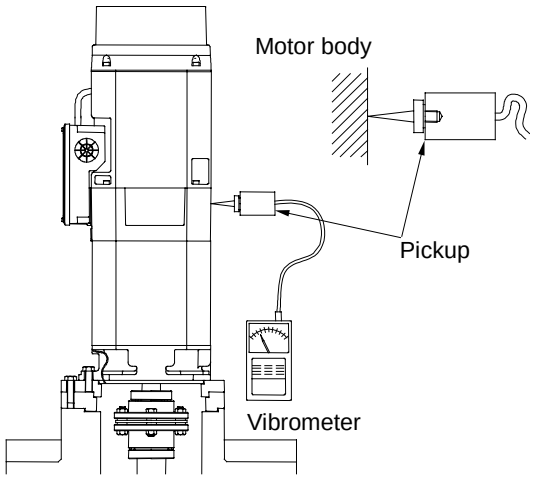


Fig. 3 Measuring vibration acceleration

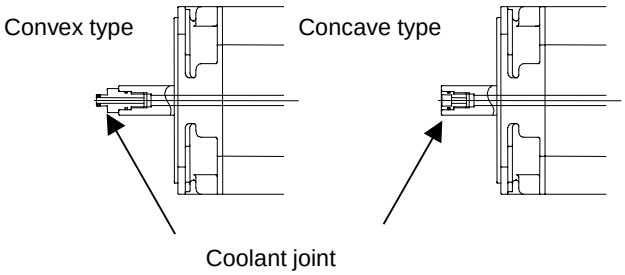


Fig. 4 Example of a coolant joint

2.2 MAINTENANCE PARTS

(1) Parts of the terminal box (α, αP, αC, and αHV series)

Model	Terminal box assembly		Lid of terminal box
	When the motor drawing No. ends with B□0□ or B□9□ (Note 1)	When the motor drawing No. ends with B□3□ (Note 1)	
α1, α1.5, αC1, αC1.5	A290-0850-T400	————————	A290-0853-V410
α2, α3, αC2, αC3	A290-0853-T400	A290-0853-T401	A290-0853-V410
α6 to α15 αP8 to αP22 α6HV to α15HV αC6 to αC15	A290-0854-T400	A290-0854-T401	A290-0854-V410
α18, α22 α18HV, α22HV αC18, αC22	A290-0731-T420	A290-0731-T421	A290-0731-V410
α30, α40 α30HV, α40HV	A290-0860-T400	A290-0860-T401	A290-1040-X402
αP30 to αP50	A290-0731-T455	A290-0731-T456	A290-0731-V410
αP60	A290-0833-T400	A290-0833-T401	A290-1040-X402
α60HV	A290-0860-T403	A290-0860-T404	A290-1040-X402

NOTE
1 For example, drawing number A06B-0856-B100 ends with B□0□, and A06B-0856-B130 ends with B□3□.
2 The above table may not apply to motors of which motor drawing number ends with B9□□. Contact your FANUC service representative.
3 The above table may not apply to maintenance parts of high-speed models.

(2) Terminal box drawing numbers (αT series)

Model name	Motor drawing No.(Note 4)	Terminal box assembly	Lid of terminal box
αT1.5/15000	A06B-0871-B927	A290-0853-T408	A290-0853-V410
αT2/15000	A06B-0869-B927		
αT3/12000	A06B-0853-B927		
αT6/12000	A06B-0854-B927	A290-0854-T408	A290-0854-V410
αT8/12000	A06B-0855-B927		
αT15/10000	A06B-0857-B927, B928		
αT22/10000	A06B-0859-B927, B928	A290-0731-T457	A290-0731-V410

NOTE
4 The above table may not apply to the motors other than the drawing numbers listed in the above table. Contact your FANUC service representative.

(3) Fan motor parts (α, αP, αC, and αHV series)

Model	Fan cover	Fan motor	Air flow direction
α1, α1.5 αC1, αC1.5	A290-0850-T500(Note 5)	A90L-0001-0491/R	Backward
	A290-0850-T501(Note 5)	A90L-0001-0491/F	Forward
α2, α3 αC2, αC3	A290-0853-X501	A90L-0001-0442/R	Backward
		A90L-0001-0442/F	Forward
α6, α8, αP8 αC6, αC8	A290-0854-X501	A90L-0001-0443/R	Backward
		A90L-0001-0443/F	Forward
α12, α15, αP12, αP15 αC12, αC15, αP18, αP22	A290-0856-X501	A90L-0001-0444/RS	Backward
		A90L-0001-0444/FS	Forward
α18, α22 αC18, αC22	A290-0856-X501	A90L-0001-0444/R	Backward
		A90L-0001-0444/F	Forward
α30, α40 αP30, αP40	A290-0731-T510(Note 5)	A90L-0001-0318/R	Backward
	A290-0731-T511(Note 5)	A90L-0001-0318/F	Forward
αP50, αP60	A290-0832-T500(Note 5)	A90L-0001-0319/R	Backward
	A290-0832-T501(Note 5)	A90L-0001-0319/F	Forward
α6HV, α8HV	A290-0854-X501	A90L-0001-0457/R	Backward
		A90L-0001-0457/F	Forward
α12HV, α15HV	A290-0856-X501	A90L-0001-0458/RS	Backward
		A90L-0001-0458/FS	Forward
α18HV, α22HV	A290-0856-X501	A90L-0001-0458/R	Backward
		A90L-0001-0458/F	Forward
α30HV, α40HV	A290-0780-T510(Note 4)	A90L-0001-0399/R	Backward
	A290-0780-T511(Note 4)	A90L-0001-0399/F	Forward
α60HV	A290-0883-T500(Note 4)	A90L-0001-0400/R	Backward
	A290-0883-T501(Note 4)	A90L-0001-0400/F	Forward

NOTE
5 These drawing numbers include fan motors.
6 The above table may not apply to motors of which motor drawing number ends with B9□□. Contact your FANUC service representative.
7 The above table may not apply to maintenance parts of high-speed models.

(4) Fan motor parts (αT series)

Model name	Motor drawing No.(Note 9)	Fan cover	Fan motor	Fan base
αT1.5/15000	A06B-0871-B927	A290-0850-T504(Note 8)	A90L-0001-0491/RL	————————
αT2/15000	A06B-0869-B927	A290-0853-X501	A90L-0001-0442/RL	A290-0853-X507
αT3/12000	A06B-0853-B927			
αT6/12000	A06B-0854-B927	A290-0854-X501	A90L-0001-0443/RL	A290-0854-X507
αT8/12000	A06B-0855-B927			
αT15/10000	A06B-0857-B927, B928	A290-0856-X501	A90L-0001-0444/RL	A290-0856-X504
αT22/10000	A06B-0859-B927, B928			

NOTE
8 These drawing numbers include fan motors.
9 The above table may not apply to the motors other than the drawing numbers listed in the above table. Contact your FANUC service representative.

2.3 PERMISSIBLE RADIAL LOAD

Use motor output axes under the permissible radial load listed below or less:

Model	Permissible radial load	
	Output axis end	Center of output axis
⟨0.5	294 N (30 kgf)	323 N (33 kgf)
α1, αC1	392 N (40 kgf)	441 N (45 kgf)
α1.5, αC1.5	882 N (90 kgf)	980 N (100 kgf)
α2, αC2	882 N (90 kgf)	999 N (102 kgf)
α3, αC3	1470 N (150 kgf)	1607 N (164 kgf)
α6, α6HV, αC6	1960 N (200 kgf)	2205 N (225 kgf)
α8, αP8, α8HV, αC8	2940 N (300 kgf)	3371 N (344 kgf)
α12, α15, αP12, αP15 α12HV, α15HV, αC12, αC15	2940 N (300 kgf)	3410 N (348 kgf)
α18, α22, αP18, αP22 α18HV, α22HV, αC18, αC22	4410 N (450 kgf)	4988 N (509 kgf)
α30, α40, αP30, αP40 α30HV, α40HV	5390 N (550 kgf)	6134 N (626 kgf)
αP50	10780 N (1100 kgf)	12299 N (1255 kgf)
αP60, α60HV		19600 N (2000 kgf)
α1/15000	392 N (40 kgf)	441 N (45 kgf)
α2/15000	490 N (50 kgf)	558 N (57 kgf)
α3/12000	980 N (100 kgf)	1068 N (109 kgf)
α6/12000	1470 N (150 kgf)	1656 N (169 kgf)
α8/8000, αP8/8000	1960 N (200 kgf)	2244 N (229 kgf)
α12/8000, α15/8000 αP12/8000, αP15/8000	2450 N (250 kgf)	2842 N (290 kgf)
α18/8000, α22/8000 αP18/8000, αP22/8000	2940 N (300 kgf)	3332 N (340 kgf)
α30/8000, αP30/8000, αP40/8000	5390 N (550 kgf)	6134 N (626 kgf)

NOTE
1 When using a belt, adjust the tension of the belt so that the permissible value listed above is not exceeded.
2 When the belt tension center is positioned beyond the end of an output axis, the permissible load becomes smaller than that at the end of the output axis.

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