FANUC SERVO AMPLIFIER βi-B series

I/O Link Option

MAINTENANCE MANUAL

B-65435EN/01

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

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For re-export these products, please contact FANUC for advice.

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

- If operation is abnormal, for example, when an alarm is issued or a hardware failure occurs, the operation described in this manual is not guaranteed unless otherwise specifically noted. If operation is abnormal, take action according to the instructions specifically described in this manual if any or contact FANUC when the instructions are not described.
- Generally, a "safety function" means a function that protects the operators from danger posed by the machine.
  The signals and functions described in this manual cannot be used separately for any "safety function" unless otherwise described as being [usable for the safety function]. Their specifications are not assumed to be used as the [safety function] in this case, unexpected danger may be caused. If you have any questions, contact FANUC.
- A device connection error or setting error can lead to unpredictable operation. When starting to operate the machine for the first time after assembling the machine, replacing parts, or changing parameter settings, exercise extreme care.

SAFETY PRECAUTIONS

The "Safety Precautions" section describes the safety precautions relating to the use of FANUC servo motors and servo amplifiers (β*i*SV-B).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

DEFINITION OF WARNING, CAUTION, AND NOTE s-2
FANUC AC SERVO MOTOR β*i* series s-3
Warning s-3
Caution s-4
Note s-6
FANUC SERVO AMPLIFIER β*i*-B series s-8
Warnings and Cautions Relating to Mounting s-8
Warning s-8
Caution s-9
Note s-10
Warnings and Cautions Relating to a Pilot Run s-11
Warning s-11
Caution s-11
Warnings and Cautions Relating to Maintenance s-12
Warning s-12
Caution s-13
Note s-14

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.

If a precaution described even as "CAUTION" is not followed, a serious result may be caused depending on the status. Be sure to follow the precautions described as "WARNING" and "CAUTION" since they give important information.

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

FANUC AC SERVO MOTOR βi series

Warning

⚠ WARNING

- **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.

- **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 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.

- **When connecting a cord such as a power line to the terminal block, use specified tightening torque to firmly connect the cord.**

If operation is performed with a loose terminal, the terminal block can overheat, resulting in a fire. Moreover, a terminal can be detached, resulting in a ground fault, short circuit, or electric shock.

- **Do not apply current when a terminal of the terminal block or the crimp terminal of a power line is exposed.**

If the hand or a conductive object touches a terminal of the terminal block or the crimp terminal of a power line, you may get electric shocks. Attach an insulation cover (accessory) onto the terminal block. Moreover, cover the crimp terminal at the tip of a power line with an insulation tube.

- **Assemble and install a power connector securely.**

If a power line is detached due to a failure in crimping or soldering, or a conductive area is exposed due to a failure in shell assembly, you may get electric shocks.

- **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 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 20 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.

- **On the machine, install a stop device for securing safety.**

The brake built into the servo motor is not a stop device for securing safety. The machine may not be held if a failure occurs.

⚠ WARNING

- **Do not enter the area under the vertical axis without securing safety.**

If a vertical axis drop occurs unexpectedly, you may be injured.

- **Fasten a motor firmly before driving the motor.**

If a motor is driven when the motor is not fastened firmly or is fastened insufficiently, the motor can tumble or loose, resulting in a danger. If the motor mounting section is not sufficiently strong, the machine may be damaged or the user may be injured.

- **Do not get close to a rotary section of a motor when it is rotating.**

When a motor is rotating, clothes or fingers can be caught, resulting in an injury.

- **Do not drive a motor with an object such as a key exposed.**

An object such as a key can be thrown away, resulting in an injury. Before rotating a motor, check that there is no object that is thrown away by motor rotation.

- **Do not apply a radial load exceeding the "allowable radial load".**

The shaft can break, and components can be thrown away. When the vertical axis is involved, a vertical axis drop can occur.

- **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 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 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.**

A motor is heavy, so that if you lift a motor by hand, you may be exposed to various risks. For example, your waist can be damaged, and the motor can drop to injure you. Use equipment such as a crane as needed. (For the weight of a motor, see Descriptions.)

Caution

⚠ CAUTION

- **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.

- **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.

- **Install the components around a motor securely.**

It is dangerous to move or loose the components during motor rotation.

⚠ CAUTION

- **Use the eyebolt of a motor to move the motor only.**

When a motor is installed on a machine, do not move the machine by using the eyebolt of the motor. Otherwise, the eyebolt and motor can be damaged.

- **Do not disassemble a motor.**

Disassembling a motor may cause a failure or trouble .
If disassembly is in need because of maintenance or repair, please contact a service representative of FANUC.
For Pulsecoder replacement, refer to the Subsection, “Maintenance of a Detector”.

- **Do not machine and modify a motor.**

Do not machine and modify a motor in any case except when motor machining or modification is specified by FANUC. Modifying a motor may cause a failure or trouble.

- **Do not conduct dielectric strength or insulation test for a sensor.**

Such a test can damage elements in the sensor.

- **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). Refer to the Specification manual of each motor for details of the connection method etc.

- **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. Plastic components and sensors can be damaged easily. So, handle those components very carefully. In particular, do not lift a motor by hooking a plastic component, connector, terminal block, and so forth.

- **Do not step or sit on a motor, and do not put a heavy object 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 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.

- **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 Descriptions 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.

⚠ CAUTION

- **Do not use the brake built into a motor for braking.**

The brake built into a servo motor is designed for holding. If the brake is used for braking, a failure can occur.

- **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 storing a motor, put it in a dry (non-condensing) place at room temperature (0 to 40 °C).**

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.

- **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.

Note

NOTE

- **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.

- **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.

- **When testing the winding or insulation resistance of a motor, satisfy the conditions stipulated in IEC60034.**

Testing a motor under a condition severer than those specified in IEC60034 may damage 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 the Descriptions.

- **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 the Descriptions, or ask FANUC. For insulation resistances, see the following table.

NOTE

- **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 the Descriptions, 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. Make an insulation resistance measurement on a single motor unit after detaching cords such as a power line.

Insulation resistance	Judgment
100 MΩ 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.

FANUC SERVO AMPLIFIER βi-B series

Warnings and Cautions Relating to Mounting

Warning

⚠ WARNING

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

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

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

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

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

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

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

- **Never touch the regenerative discharge resistor or radiator directly.**
  The surface of the radiator and regenerative discharge 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.

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

- **Prevent conductive, flammable, or corrosive foreign matters, mists, or water droplets from entering the unit.**
  If conductive or flammable foreign matters enter the unit, explosion or corruption may be caused.
  If corrosive or conductive mists or water droplets are attached to an electric circuit, unexpected

operation may be caused in the circuit.
The electronic circuit portion must be installed in an environment of pollution level 2 specified by IEC60664-1. To achieve pollution level 2 in a severe machine tool environment, it is generally necessary to install the portion in a cabinet that satisfies IP54.

Caution

⚠ CAUTION

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

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

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

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

- **Take appropriate measures to prevent coolant, oil mist, or chips from being adhered to the radiator and fan motors that are exposed to the outside of the power magnetic cabinet.**
  A deposit of coolant, oil mist, or chips on the air inlet will result in a reduction in the cooling efficiency. In some cases, the required efficiency cannot be achieved. The deposit may also lead to a reduction in the useful life of the fan motors and semiconductors. Especially, when outside air is drawn in, mount filters on both the air inlet and outlet. These filters must be replaced regularly.
  So, an easy-to-replace type of filter should be used.

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

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

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

- **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.

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

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

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

- **Ensure that the amplifier and peripheral equipment are securely connected.**

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

⚠ CAUTION

- **Check that the amplifier is securely mounted in the power 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.

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

Note

NOTE

- **Keep the nameplate clearly visible.**

- **Keep the legend on the nameplate clearly visible.**

- **After unpacking the amplifier, carefully check for any damage.**

- **Mount the amplifier in a location where it can be easily accessed periodic inspection and daily maintenance.**

- **Leave sufficient space around the machine to enable maintenance to be performed easily.**
  Do not place any heavy objects such that they would interfere with the opening of the doors.

- **Keep the parameter table and spare parts at hand.**
  Also, keep the specifications at hand. These items must be stored in a location where they can be retrieved immediately.

- **Provide adequate shielding.**
  A cable to be shielded must be securely connected to the ground plate, using a cable clamp or the like.

- **Note regarding Korean KC mark**
  This equipment is industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home.
  이 기기는 업무용(A 급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Warnings and Cautions Relating to a Pilot Run

Warning

⚠ WARNING

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

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

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

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

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

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

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

Caution

⚠ CAUTION

- **Check that alarms relative to the amplifier are not displayed during turning on or 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.

⚠ CAUTION

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

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

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

Warnings and Cautions Relating to Maintenance

Warning

⚠ WARNING

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

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

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

⚠ WARNING

- **Notes on replacing the battery of the absolute Pulsecoder**
  Replace the battery only while the power is on. If the battery is replaced while the power is turned off, the stored absolute positioning data will be lost. If the battery is installed in the β*i*-B series servo amplifier, open the door of the power magnetics cabinet and enter the emergency stop state without turning off the control power, interrupt the input of the power system of the amplifier and 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 alarm number.**
  If the machine stops upon an alarm being issued, check the alarm number. Some alarms indicate that a component must be replaced. If the power is reconnected without first replacing the failed component, another component may be damaged, making it difficult to locate the original cause of the alarm.

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

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

Caution

⚠ CAUTION

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

- **Tighten all screws firmly.**

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

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

- **Notes on cleaning the heat sink and fan**
  1) A dirty heat sink or fan results in reduced semiconductor cooling efficiency, which degrades reliability. Periodic cleaning is necessary.
  2) Using compressed air for cleaning scatters the dust. A deposit of conductive dust on the amplifier or peripheral equipment will result in a failure.
  3) To clean the heat sink, do so only after turning the power off and ensuring that the heat sink has cooled to room temperature. The heat sink becomes extremely hot, such that touching it during operation or immediately after power-off is likely to cause a burn. Be extremely careful when touching the heat sink.
- **Notes on removing the amplifier**
  Before removing the amplifier, first ensure that the power is shut off. Be careful not to jam your fingers between the power magnetics cabinet and amplifier.

⚠ CAUTION

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

Note

NOTE

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

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

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

PREFACE

Organization of this manual

This manual describes information necessary to maintain FANUC SERVO AMPLIFIER β*i*SV-B series (I/O Link option) products, such as FANUC SERVO MOTOR α*i* series, FANUC SERVO MOTOR β*i* series products.
Parts I, II, III and IV explain the start-up procedure, operation, troubleshooting, and maintenance for the β*i*SV–B series.
Part V and VI explain the maintenance.

The abbreviations listed below are used in this manual.

Product name	Abbreviations
FANUC Series 0*i*-F	0*i*-F
FANUC Series 30*i*-B	30*i*-B
FANUC Series 31*i*-B	31*i*-B
FANUC Series 32*i*-B	32*i*-B
FANUC Series 35*i*-B	35*i*-B
FANUC Power Motion *i*-A	PM*i*-A
FANUC SERVO Amplifier β*i*SV-B series	β*i*SV-B

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

1) FANUC SERVO AMPLFIER β*i*-B series DESCRIPTIONS B-65422EN
2) FANUC AC SERVO MOTOR β*i*-B/β*i*s series DESCRIPTIONS B-65302EN
3) FANUC AC SERVO MOTOR α*i*-B/α*i* series/ β*i*-B/β*i* series/ LINEAR MOTOR LiS series/SYNCHRONOUS BUILT-IN SERVO MOTOR DiS series PARAMETER MANUAL B-65270EN

⚠ **WARNING**
When maintaining and inspecting the servo amplifier module, keep the power turned off and make sure that the LED (red) on the front panel of the servo amplifier module that indicates whether electric charge is in progress is off. (See Appendix A.)

TABLE OF CONTENTS

SAFETY PRECAUTIONS s-1
DEFINITION OF WARNING, CAUTION, AND NOTE s-2
FANUC AC SERVO MOTOR βi series s-3
Warning s-3
Caution s-4
Note s-6
FANUC SERVO AMPLIFIER βi-B series s-8
Warnings and Cautions Relating to Mounting s-8
Warning s-8
Caution s-9
Note s-10
Warnings and Cautions Relating to a Pilot Run s-11
Warning s-11
Caution s-11
Warnings and Cautions Relating to Maintenance s-12
Warning s-12
Caution s-13
Note s-14
PREFACE p-1
I. START-UP PROCEDURE
1 OVERVIEW 3
2 CONFIGURATIONS 4
2.1 CONFIGURATIONS 4
2.2 MAJOR COMPONENTS 5
2.2.1 Servo Amplifier 5
3 START-UP PROCEDURE 6
3.1 START-UP PROCEDURE (OVERVIEW) 6
3.2 CONNECTING THE POWER 7
3.2.1 Checking the Voltage and Capacity of the Power 7
3.2.2 Connecting a Protective Ground 8
3.2.3 Selecting the Ground Fault Interrupter That Matches the Leakage Current 8
3.3 INITIALIZING PARAMETERS (SWITCHES AND DUMMY CONNECTORS) 8
3.4 PARAMETER INITIALIZATION 9
4 CONFIRMATION OF THE OPERATION 14

4.1 LED 14
4.2 Check Procedure 15

II. HANDLING

1 OVERVIEW 19
1.1 SERVO AMPLIFIER INTERFACE 19
1.2 FANUC I/O Link *i* and I/O Link INTERFACE AREA 19
1.3 INTERFACE 19
1.3.1 Peripheral Equipment Control Interface 20
1.3.2 Direct Command Interface 20
1.3.3 Interface Switching 20
1.4 CAUTIONS ON USING THE POWER MATE CNC MANAGER 20

2 SIGNAL DESCRIPTIONS 21
2.1 DO/DO SIGNALS 21
2.1.1 Peripheral Equipment Control Interface 21
2.1.2 Direct Command Interface 23
2.2 SIGNALS (LISTED IN GROUPS) 24
2.3 SIGNAL DETAILS 26
2.3.1 Preparation Completion 26
2.3.2 Reset and Emergency Stop 26
2.3.3 Alarm 27
2.3.4 Mode Selection 28
2.3.5 Jog Feed 28
2.3.6 Status Signals 29
2.3.7 Feedrate 33
2.3.8 Interlock 34
2.3.9 Reference Position Return 34
2.3.10 Automatic Operation 35
2.3.11 Clamp and Unclamp (for the Peripheral Equipment Control Interface Only) 36
2.3.12 Servo-off 37
2.3.13 Peripheral Equipment Control Function Code and Related Information 37
2.3.14 Direct Command Function Code and Related Information 40
2.3.15 Direct Input Signals 45

3 PERIPHERAL EQUIPMENT CONTROL 47
3.1 COMMAND FORMAT FOR PERIPHERAL EQUIPMENT CONTROL 47
3.2 PERIPHERAL EQUIPMENT CONTROL PROCEDURE 47

3.2.1 Specifying Operation Using a Function Code....47
3.2.2 Receiving Response Data....48
3.3 FUNCTION CODES....48
3.3.1 Function Codes....48
3.4 DETAILS OF FUNCTION CODES....51
3.4.1 ATC/Turret Control....51
3.4.2 Point Positioning Control....52
3.4.3 Reference Position Return....54
3.4.4 Reference Position Setting (when the Reference Position External Setting Function is Used)....55
3.4.5 Positioning Control (Absolute/Incremental Specification, for Skip Function)....56
3.4.6 Speed Control....57
3.4.6.1 Overview....57
3.4.6.2 System configuration....58
3.4.6.3 Peripheral equipment control command format....58
3.4.6.4 Command timing chart....60
3.4.6.5 Parameter....62
3.4.6.6 Signal....64
3.4.6.7 Alarm....64
3.4.6.8 Others....64
3.4.7 Coordinate System Setting....65
3.4.8 Rewriting of Parameters....66
3.4.8.1 Overview....66
3.4.8.2 System configuration....66
3.4.8.3 Peripheral equipment control command format....66
3.4.8.4 Command timing chart....67
3.4.8.5 Alarm....67
3.4.8.6 Parameter....68
3.4.9 Control of the Point Data External Setting Function....68
3.4.10 Teaching-based Data Setting Control....69
3.5 REFERENCE POSITION RETURN FUNCTION WITH DOGS....70
3.5.1 Explanation of Function....70
3.5.1.1 Reference position return operation (grid method)....70
3.5.1.2 Deceleration limit switch installation condition....71
3.5.1.3 Tip....71
3.5.2 Parameter....72
3.6 UPGRADING OF THE ROTATION AXIS CONTROL FUNCTION....73
3.6.1 Function for Specifying the Direction of Rotation Axis High-speed Reference Position Return....73
3.6.1.1 Explanation of function....73

3.6.1.2 Parameter 73
3.6.2 Rotation Axis Rotation Direction Sign Specification Function 73
3.6.2.1 Explanation of function 73
3.6.2.2 Example of program 73
3.6.2.3 Parameter 74
3.7 UPGRADING OF THE CLAMP/UNCLAMP CONTROL FUNCTION 74
3.7.1 Start of the Timer Counting Until Servo-off in Clamp Processing 74
3.7.1.1 Explanation of function 74
3.7.1.2 Parameter 74
3.7.2 Disabling of Clamp Processing When Jog Operation is Stopped 75
3.7.2.1 Explanation of function 75
3.7.2.2 Parameter 75
3.8 UPGRADING OF THE RESPONSE DATA READ FUNCTION 75
3.8.1 Overview 75
3.8.2 Details of Function 75
3.8.3 DI/DO Signals 76
3.8.4 Parameter 77
3.8.5 Notes 78
3.9 IMPROVEMENT OF TURRET/MAGAZINE NUMBER OUTPUT 79
3.9.1 Overview 79
3.9.2 Details of Function 79
3.9.3 Signal 82
3.9.4 Parameter 83
3.9.4.1 Related parameters 84
3.10 MANUAL HANDLE INTERFACE 86
3.10.1 Overview 86
3.10.2 Details of Function 86
3.10.3 Signal 87
3.10.3.1 Signal on the servo amplifier 87
3.10.3.2 Signal on the CNC (host) 88
3.10.4 Parameter 89
3.10.4.1 Parameter on the servo amplifier 89
3.10.4.2 Parameter on the CNC (host) 89
4 DIRECT COMMANDS 90
4.1 DIRECT COMMAND FORMAT 90
4.2 DIRECT COMMAND CONTROL PROCEDURE 91
4.2.1 Direct Command Control Procedure 91
4.2.2 Instruction Command Control (EBUF, EBSY, and ECNT) 91
4.2.3 Response Command Control (EOREND, EOSTB, EOPC, USR1, and ECONT) 92

4.2.4 Command Completion Notification (ECF) 92
4.2.5 Alarm (DAL) 92
4.2.6 Direct Command Execution Result 92
4.3 LIST OF DIRECT COMMANDS 93
4.4 DETAILS OF DIRECT COMMAND FUNCTIONS 94
4.4.1 Signal Operation Commands 94
4.4.2 Parameter 94
4.4.3 Status Read 96
4.4.4 Axis Movement Commands 106
4.5 THIRTY-TWO-BLOCK BUFFERING OPERATION 117
4.5.1 Overview 117
4.5.2 Memory Registration Procedure 117
4.5.3 Operation Procedure 117
5 EXTERNAL PULSE INPUT FUNCTION 118
5.1 OVERVIEW 118
5.2 DETAILED DESCRIPTION 118
6 UNEXPECTED DISTURBANCE TORQUE DETECTION FUNCTION Optional function 119
6.1 OVERVIEW 119
6.2 SERIES AND EDITIONS OF APPLICABLE SERVO SOFTWARE 119
6.3 SETUP METHOD 120
6.3.1 Overview 120
6.3.2 Details of the Setup Method 121
6.4 Signal 124
6.5 Parameter 124
6.6 ALARM 126
6.7 DIAGNOSIS 126
7 QUICK STOP FUNCTION 127
7.1 OVERVIEW 127
7.2 SERIES AND EDITIONS OF APPLICABLE SERVO SOFTWARE 127
7.3 SETTING METHOD 127
7.4 PARAMETER 127

III. TROUBLESHOOTING

1 OVERVIEW 131
2 ALARM NUMBERS AND BRIEF DESCRIPTIONS 132

3 ACTION AGAINST NOISE 140
3.1 NOTES ON CONNECTING THE GROUND SYSTEMS 141
3.2 NOTES ON SELECTING THE SPARK KILLER 143

IV. REPLACING SERVO AMPLIFIER COMPONENTS

1 HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS 147
1.1 HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS 147
1.1.1 Ordering Number of Printed Circuit Board 148
1.1.2 Fuse Locations 149
1.2 HOW TO REPLACE THE FAN MOTOR 150
1.2.1 For Fan Motors for Internal Agitation for βiSV4-B and βiSV20-B 150
1.2.2 For Fan Motors for Internal Agitation for βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, and βiSV40HV-B 151
1.2.3 Removing the Fan Units for Cooling the Radiators for βiSV80-B and βiSV40HV-B 152
1.2.4 Removing the Fan Motor from the Fan Unit（βiSV4-B, βiSV20-B） 153
1.2.5 Removing the Fan Motor from the Fan Unit（βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B） 154
1.2.6 Specifications of Fan Units for Maintenance 154
1.3 REPLACING BATTERY FOR ABSOLUTE PULSECODERS 155
1.3.1 Overview 155
1.3.2 Replacing Batteries 155
1.3.3 Replacing the Batteries in a Separate Battery Case 156
1.3.4 Replacing the Battery Built into the Servo Amplifier 156
1.3.5 Notes on Replacing a Battery (Supplementary Explanation) 158
1.3.5.1 Battery connection modes 158
1.3.5.2 Replacing βiS 0.2 to βiS 0.3 batteries 160
1.3.5.3 Notes on attaching connectors 160

V. MOTOR/DETECTOR/AMPLIFIER PREVENTIVE MAINTENANCE

1 MOTOR/DETECTOR/AMPLIFIER PREVENTIVE MAINTENANCE ... 165
1.1 LIST OF MANUALS RELATED TO MOTORS AND AMPLIFIERS 166
1.2 PREVENTIVE MAINTENANCE OF MOTORS AND DETECTORS 167
1.2.1 Warnings, Cautions, and Notes on Preventive Maintenance of Motors and Detectors 167
1.2.2 Preventive Maintenance of a Motor (Common to All Models) 169
1.2.2.1 Main inspection items 169

1.2.2.2 Periodic cleaning of a motor 171
1.2.2.3 Notes on motor cleaning 172
1.2.2.4 Notes on the cutting fluid (informational) 172
1.2.3 Maintenance of a Detector 172
1.2.3.1 Alarms for built-in detectors (αi and βi Pulsecoders) and troubleshooting actions 173
1.2.3.2 Detailed troubleshooting methods 173
1.2.3.3 Maintenance of βiS servo motor (□40 and □60) Pulsecoders 175
1.3 PREVENTIVE MAINTENANCE OF SERVO AMPLIFIERS 176
1.3.1 Warnings, Cautions, and Notes on Operation of Servo Amplifiers 176
1.3.2 Preventive Maintenance of a Servo Amplifier 179
1.3.3 Maintenance of a Servo Amplifier 180
1.3.3.1 Display of the servo amplifier operation status 180
1.3.3.2 Replacement of a fan motor 180
1.4 REPLACING BATTERY FOR ABSOLUTE PULSECODERS 180

VI. MOTOR MAINTENANCE

1 SERVO MOTOR MAINTENANCE 183
1.1 SERVO MOTOR MAINTENANCE PARTS 183
1.1.1 Pulsecoder 183

APPENDIX

A SERVO AMPLIFIER FRONT VIEW 187
B PARAMETER LIST 189
B.1 CONTROLLED-AXIS PARAMETERS 194
B.2 COORDINATE SYSTEM AND STROKE LIMIT PARAMETERS 195
B.3 FEEDRATE PARAMETERS 198
B.4 ACCELERATION/DECELERATION CONTROL PARAMETERS 200
B.5 INPUT/OUTPUT SIGNALS PARAMETERS 203
B.6 SERVO PARAMETERS 211
B.7 DIGITAL SERVO STANDARD PARAMETER TABLE 230
C DIAGNOSIS LISTS 234
C.1 SIGNALS SENT FROM CNC (HOST) TO SERVO AMPLIFIER 234
C.1.1 Peripheral Equipment Control Interface (DRC = 0) 234
C.1.2 Direct Command Interface (DRC = 1) 234
C.2 SIGNALS SENT FROM SERVO AMPLIFIER TO CNC (HOST) 235
C.2.1 Peripheral Equipment Control Interface (DRC = 0) 235
C.2.2 Direct Command Interface (DRC = 1) 235

C.3 SERVO POSITIONAL DEVIATION AMOUNT (SERVO AMPLIFIER) 235
C.4 ACCELERATION/DECELERATION DELAY AMOUNT (SERVO AMPLIFIER) 236
C.5 FUNCTION BIT (SERVO AMPLIFIER) 236
C.6 DIRECT INPUT SIGNAL STATUSES (SERVO AMPLIFIER) 236
C.7 MOTOR CURRENT VALUES (SERVO AMPLIFIER) 236
C.8 SERVO POSITIONAL DEVIATION AMOUNTS (SERVO AMPLIFIER) 237

D POWER MATE CNC MANAGER FUNCTIONS 238

D.1 POWER MATE CNC MANAGER FUNCTION (30*i*-B, 31*i*-B, 32*i*-B, 35*i*-B, PM*i*-A, 0*i*-F) 238
D.1.1 Screen Display 238
D.1.2 Inputting and Outputting Parameters 242
D.1.3 Parameters 244
D.1.4 Note 245

E SERVO TUNING TOOL SERVO GUIDE 246

ADDITIONAL INFORMATION

I. START-UP PROCEDURE

1 OVERVIEW

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

- Configurations
- Start-up procedure
- Confirmation of the operation

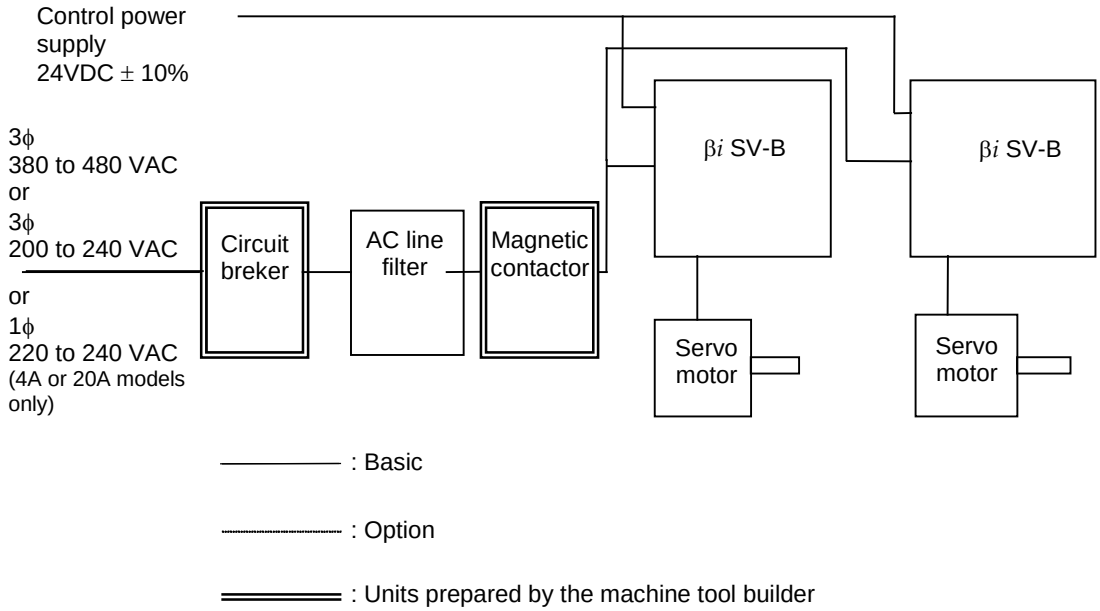
2 CONFIGURATIONS

2.1 CONFIGURATIONS

A system using servo amplifier βi SV-B series consists of the following units and parts:

(1)	Servo amplifier (βi SV-B)	(basic)
(2)	AC line filter	(basic)
(3)	Connectors (for connecting cables)	(basic)
(4)	Fuses	(option)
(5)	Power transformer	(option)

Constituent (example)



⚠ WARNING

Take great care to prevent incorrect operation of the motor or a ground fault caused by looseness of a screw, incorrect insertion of a connector, etc.
Take great care to prevent fire caused by looseness of a screw (or incorrect contact with a connector or incorrect connection between a connector terminal and a cable) in a power line or motor power line through which large current flows.

NOTE

1 Be sure to use a stabilized power supply as the 24VDC amplifier power supply. Do not use the 24VDC motor brake power supply as the 24VDC amplifier power supply.
2 A circuit breakers , magnetic contactor, and AC line filter are always required.

NOTE

3 To protect the unit from surge voltage caused by lightning, connect lightning surge protector between lines, and between the lines and ground, at the power inlet of the power magnetics cabinet.

4 If a surge voltage higher than or equal to the permissible voltage of the lighting surge protector is applied, a short-circuit fault occurs, causing a burnout accident. To prevent such an accident, be sure to connect a breaker or fuse of 5 A or less at the input part of each lighting surge protector. For details, see Appendix A, " FITTING A LIGHTING SURGE PROTECTION DEVICE." in the SERVO AMPLIFIER βi –B series DESCRIPTIONS (B-65422EN).

5 The AC line filter is different from an AC reactor, which has a different use. The AC line filter cannot be used in place of or with the AC reactor.

2.2 MAJOR COMPONENTS

2.2.1 Servo Amplifier

Table 2.2.1(a) (200-Vtype)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
βiSV4-B	A06B-6162-H001	A06B-6162-C001	A20B-2101-0090	A20B-8101-0840
βiSV20-B	A06B-6162-H002	A06B-6162-C002	A20B-2101-0091	
βiSV40-B	A06B-6162-H003	A06B-6162-C003	A16B-3200-0512	
βiSV80-B	A06B-6162-H004	A06B-6162-C004	A16B-3200-0513	

Table 2.2.1(b) (4400-V type)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
βiSV10HV-B	A06B-6163-H001	A06B-6163-C001	A16B-3200-0515	A20B-8101-0840
βiSV20HV-B	A06B-6163-H002	A06B-6163-C002	A16B-3200-0516	
βiSV40HV-B	A06B-6163-H003	A06B-6163-C003	A16B-3200-0517	

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.

The items to be checked are described below.

No.	Description	Check method
Checking the installation of the servo amplifier		
1	Specification of the servo amplifier and servo motor	Check the combination of the servo amplifier and the servo motor is correct. Refer to the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
2	Packing of the flange	Check the supplied packing is attached properly and that there is no gap between the control panel and the amplifier flange.
3	Keeping maintenance areas	Keep maintenance areas above and below the amplifier. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
4	Prevention of contact with conductive section	Check a protective plate is attached to the DC link terminal board. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN) (βiSV-B (I/O Link Option) does not have the DC link terminal board).
5	Measure against entry of coolant	Take a measure to prevent electroconductive, flammable, and corrosive material as well as mist and water drop from getting in the unit. For keeping of the effective closeness of the control panel, refer to Appendix G "EXAMPLES OF RECOMMENDED POWER MAGNETICS CABINETS FOR SERVO AMPLIFIER INSTALLATION" in the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
Checking the wiring for the servo amplifier		
6	Connecting protective ground	Use a proper cable for grounding in order to prevent electrical shocks at a ground fault. For details, refer to Subsection 9.3.1.7 of the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
7	Installing the lightning serge protector	In order to prevent damage due to a surge voltage applied to the input power supply, install a lightning surge protector. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions" (B-65422EN).
8	Measure against noise	Check that ground wires, including feedback cable shielding clamps, are connected to proper places to maintain a stable operation of the machine. For details, refer to the Servo Amplifier βi-B series Descriptions" (B-65422EN).
9	Phase order of motor power lines	If the phase order of motor power lines is incorrect, the motor may operate unexpectedly. Make sure that the motor power lines are connected correctly.
10	Confirming that the motor feedback wireand power wire are connected correctly	If the axis to which the motor feedback wire and power wire are connected is incorrect, the motor may operate unexpectedly. So, make sure that the connection is correct.
11	Connection of batteries	Do not connect the built-in batteries in parallel. Please make sure, if the built-in batteries are used with an amp-to-amp battery connection cable (CXA19A/B or BATL (B3)) attached, they may be connected in parallel. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions" (B-65422EN).
Check during startup of operation		
12	Checking the power supply voltage	Before turning on the power, check that the power supply voltage is in its proper range. For details of the power supply voltage specification, refer to the FANUC Servo Amplifier βi-B series Descriptions" (B-65422EN).

No.	Description	Check method
13	Checking the ground potential	The 400 V servo amplifier supports only neutral grounding. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions" (B-65422EN).
14	Setting the ground fault breaker	Use a ground fault interrupter that supports inverters. For information about leakage current, refer to the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
15	Checking the control power	Check that the voltage of the 24 V power supply for amplifiers is in its proper range and the selected current capacity is proper. For details, refer to the FANUC Servo Amplifier βi-B series Descriptions (B-65422EN).
16	Checking the settings	Some units require settings (such as switches and dummy connectors) to be made before use. Check the settings. See Section 3.3.
17	Setting parameters	Set initial parameters with reference to Section 3.4.
18	Handling early failures	To solve start-up problems, such as being impossible to turn on the power, motor failing to rotate, and occurrence of an alarm, see Section 4.2 of this document.

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(a) Action for the AC power (200-V input type)

Permissible voltage fluctuation width	Nominal voltage	Action
-15% +10%	3-phase 200 to 240VAC	βiSV4-B, βiSV20-B βiSV40-B, βiSV80-B Permitted. Note) If the voltage is below the rated value, the rated output may not be obtained.
-15% +10%	1-phase 220 to 240VAC	βiSV4-B, βiSV20-B Single-phase input is permitted when the power supply is 380 to 415 VAC to neutral grounding.
Other than the above		βiSV4-B, βiSV20-B βiSV40-B, βiSV80-B Not permitted. Use an insulating transformer to adjust the input voltage.

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

Permissible voltage fluctuation width	Nominal voltage	Action
-10% +10%	3-phase 380 to 480VAC	βiSV10HV-B, βiSV20HV-B, βiSV40HV-B Permitted. Note) If the voltage is below the rated value, the rated output may not be obtained.
Other than the above		βiSV10HV-B, βiSV20HV-B, βiSV40HV-B Not permitted. Use an insulating transformer to adjust the input voltage.

Table 3.2.1 (c) and (d) list the input power specification. 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.

Table 3.2.1 (c) AC power voltage specifications (200-V input type)

Model	βiSV4-B	βiSV20-B	βiSV40-B	βiSV80-B
Nominal voltage rating	200 to 240VAC -15%, +10%			
Power source frequency	50/60Hz ±1Hz			
Power source capacity (for the main circuit) [kVA]	0.2	2.8	4.7	6.5
Power source capacity (for the control circuit) [kVA]	22			

Table 3.2.1 (d) AC power voltage specifications (400-V input type)

Model	βiSV10HV-B	βiSV20HV-B	βiSV40HV-B
Nominal voltage rating	AC380V~480V -10%,+10% (AC400V~480V -15%,+10%)		
Power source frequency	50/60Hz ±1Hz		
Power source capacity (for the main circuit) [kVA]	1.9	3.9	6.2
Power source capacity (for the control circuit) [kVA]	22		

3.2.2 Connecting a Protective Ground

Check that a protective ground is connected correctly with reference to individual items in Chapter 6 "INSTALLATION" in the FANUC SERVO AMPLIFIER βi-B series Descriptions (B-65422EN).

3.2.3 Selecting the Ground Fault Interrupter That Matches the Leakage Current

Check that a ground fault breaker is selected correctly with reference to individual items in Chapter 6 "INSTALLATION" in the FANUC SERVO AMPLIFIER βi-B series Descriptions (B-65422EN).

3.3 INITIALIZING PARAMETERS (SWITCHES AND DUMMY CONNECTORS)

βiSV4-B, βiSV20-B

- When no regenerative resistor is used
  Connect connector CXA20 by using a dummy connector.
  See FANUC SERVO AMPLIFIER βi-B series DESCRIPTIONS (B-65422EN).

βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B

- Switch (SW) setting
  The regenerative resistor alarm level is set. The setting condition varies depending on the regenerative resistor used (the built-in regenerative resistor or separate regenerative resistor). Perform the setting properly.

> ⚠ **WARNING**
> Incorrect setting can damage the regenerative resistor.

See FANUC SERVO AMPLIFIER β*i*–B series DESCRIPTIONS (B-65422EN).

- When the built-in regenerative resistor is used
  Connect connector CXA20 by using a dummy connector.
  Connect connector CZ6 by using a dummy connector.
  See the FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS (B-65422EN).

3.4 PARAMETER INITIALIZATION

(1) Preparation prior to servo parameter initialization
Before servo parameter initialization, check the following:
<1> Servo motor model (Example: β*i*S8/3000)
<2> Amount of travel per motor rotation (Example: 10 mm/motor revolution)

At first, decide "detection unit", for example detection unit = 1μm.
Next, calculate number of pulses per motor revolution with "detection unit" and "amount of travel per motor revolution".

(Number of pulses per motor revolution)
= (Amount of travel per motor revolution) / (Detection unit)

Example)
In case detection unit = 1μm, amount of travel per motor revolution =10mm
10mm/1μm=10000
Then, number of pulses per motor revolution = 10000 pulses/revolution

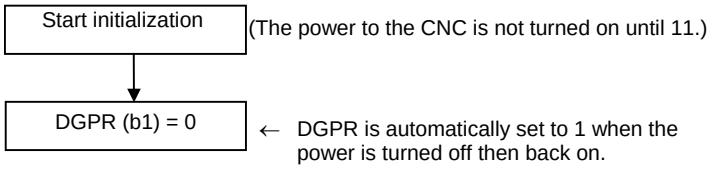
(2) Procedure for servo parameter initialization
<1> Turn on the power to the servo amplifier.
<2> Turn on the power to the host controller in the emergency stop state.
<3> Perform parameter initialization from the CNC.
Set values for the parameters listed below. (See <5> to <9>.)

	Example	Parameter number
Motor type number	258	No.125
CMR	2	No.32
Numerator for the number of pulses per revolution	10000	No.105
Denominator for the number of pulses per revolution	1	No.106
Direction of travel	111	No.31
Reference counter capacity	10000	No.180

<4> Set initialization bit DGPR to 0.

	b7	b6	b5	b4	b3	b2	b1	b0
No.12							**DGPR**	

When this bit is set to 0, a power disconnection request alarm (alarm No. 0) is issued. However, <5> to < 9> below can be set.



<5> Set a motor type number.
In parameter No. 125, set the motor type number of the servo motor to be used.

βiSV 4-B

Motor model	βiS0.2/5000	βiS0.3/5000
Motor specification	0111	0112
Motor type number	260	261
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later

βiSV 20-B

Motor model	αiF1/5000	βiS2/4000	αiF2/5000	βiS4/4000	βiS8/3000
Motor specification	0202	0061	0205	0063	0075
Motor type number	252	253	255	256	258
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/5000	αiS4/5000	βiS12/2000	αiC4/3000	αiC8/2000
Motor specification	0212	0215	0077	0221	0226
Motor type number	262	265	269	271	276
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS0.4/5000	βiS0.5/6000	βiS1/6000	αiS2/6000	αiC12/2000
Motor specification	0114	0115	0116	0218	0241
Motor type number	280	281	282	284	291
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS4/6000				
Motor specification	0210				
Motor type number	466				
Edition corresponding to the 88A7 series	Edition 01 or later				

βiSV 40-B

Motor model	βiS12/3000	αiF4/4000	βiS22/2000	αiF8/3000	αiC22/2000
Motor specification	0078	0223	0085	0227	0246
Motor type number	272	273	274	277	296
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later

βiSV 80-B

Motor model	αiS8/4000	αiS12/4000	αiS8/6000	αiF12/3000	αiF22/3000
Motor specification	0235	0238	0232	0243	0247
Motor type number	285	288	290	293	297
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiC30/1500	βiS22/3000	βiS30/2000	βiS40/2000	
Motor specification	0251	0082	0087	0089	
Motor type number	301	313	472	474	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	

βiSV 10 HV-B

Motor model	βiS2/4000HV	αiS2/5000HV	βiS4/4000HV	αiS4/5000HV	βiS8/3000HV
Motor specification	0062	0213	0064	0216	0076
Motor type number	251	263	264	266	267
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/6000HV	αiS4/6000HV			
Motor specification	0219	0214			
Motor type number	287	467			
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later			

βiSV 20 HV-B

Motor model	βiS12/3000HV	αiF4/4000HV	βiS22/2000HV	αiF8/3000HV	
Motor specification	0079	0225	0086	0229	
Motor type number	270	275	278	279	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	

βiSV 40 HV-B

Motor model	αiS8/4000HV	αiS12/4000HV	αiS8/6000HV	αiF12/3000HV	αiF22/3000HV
Motor specification	0236	0239	0233	0245	0249
Motor type number	286	289	292	295	299
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS22/3000HV	βiS30/2000HV	βiS40/2000HV		
Motor specification	0083	0088	0090		
Motor type number	314	473	475		
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later		

<6> Set CMR.
In parameter No. 32, set a factor by which the amount of travel specified in the CNC is multiplied for the servo system.

CMR = Command unit/detection unit

When CMR is 1 to 48	Setting = CMR x 2

When CMR is 1/2 to 1/27	Setting = 1/CMR + 100

Usually, CMR = 1. So, set 2.

<7> Set the number of pulses per revolution
The number of pulses per revolution is calculated with reduction ratios or leads of the ball screws and detection unit.

(Number of pulses per motor revolution)
= (amount of travel per motor revolution) / (detection unit)

$$\frac{\text{Numerator for the number of pulses per rotation}}{\text{Denominator for the number of pulses per rotation}} = \frac{\text{(Parameter No. 105) (}\leq 32767\text{)}}{\text{(Parameter No. 106) (}\leq 32767\text{)}}$$

$$= \frac{\text{(Parameter No. 179) (}>32767\text{)}}{\text{(Parameter No. 106) (}\leq 32767\text{)}}$$

Example of setting)

10um detection in semi-closed loop

Ball screw lead	Number of pulses per rotation Numerator/denominator
10 (mm/rev) 20 (mm/rev) 30 (mm/rev)	10mm/10μm=1000/1 20mm/10μm=2000/1 30mm/10μm=3000/1

Example of setting)

1/100 degree detection with a deceleration ratio of 10:1 for a rotation axis

Every time the motor makes one rotation, the table rotates through 360/10 degrees. The number of pulses per motor rotation is 360/10 ÷ (1/100) = 3600 pulses, so set the following: Numerator = 3600, Denominator = 1

<8> Set the direction of motor travel in parameter No. 31.

111	Clockwise as viewed from the pulse coder
-111	Counterclockwise as viewed from the pulse coder

<9> Set the reference counter capacity. (Parameter No. 180)

Set the reference counter capacity when performing a reference position return operation based on the grid method. Set the number of position pulses per motor rotation, or set that number divided by an integer.

Example of setting)

αi, βi pulse coders, semi-closed loop (1μm detection)

Ball screw lead	Number of pulses per motor revolution	Reference counter	Grid width
10mm/revolution 20 30	10000/1 20000/1 30000/1	10000 20000 30000	10mm 20mm 30mm

<10>Turn off/on both CNC and servo amplifier and servo parameter initialization is finished.

<11>If you use αi or βi pulse coder as an absolute pulse coder, some procedures described below are needed.

1 Set "1" in APCX of parameter, then turn off / on the host CNC and servo amplifier .

	b7	b6	b5	b4	b3	b2	b1	b0
No.11	**APCX**							**ABSX**

APCX (#7) Absolute position detector is
0 : not used
1 : used

ABSX (#0) Position of machine and position of absolute pulse coder is
0 : not matched
1 : matched

2 Make sure that a battery is connected to the absolute pulse coder, and turn the power to the host CNC and servo amplifier off and on again.

3 A reference position return request is indicated.

4 Rotate the servo motor through one or more rotations by jogging and so on.

5 Turn the power to the host CNC and servo amplifier off, then back on again.

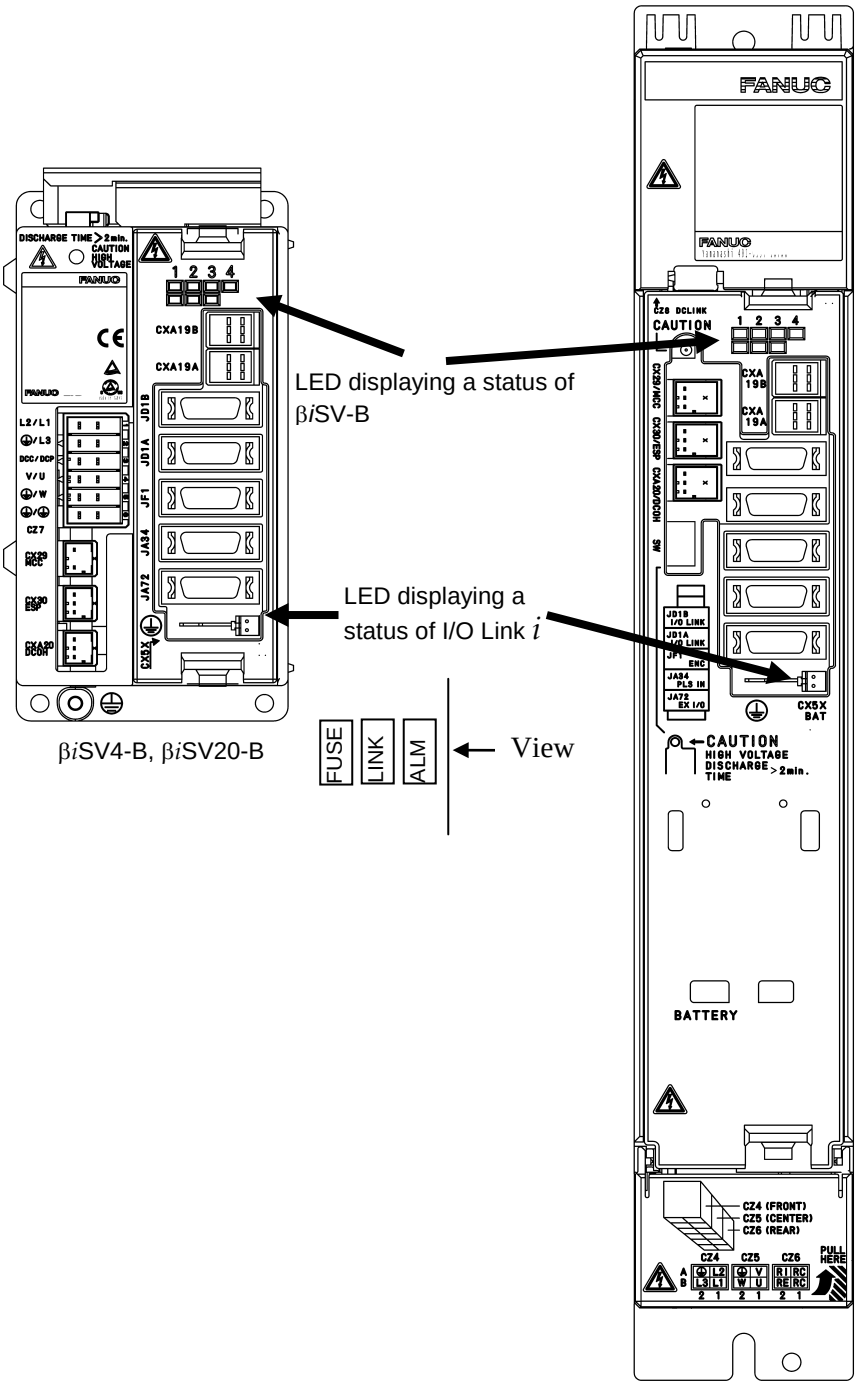
6 CNC requires the reference position return again.

7 Perform reference position return. The ABSX is set to 1 after finishing the reference position return.

4 CONFIRMATION OF THE OPERATION

4.1 LED

The FANUC Servo Amplifier β*i*SV-B Series (I/O Link Option) has an LED displaying a status of β*i*SV-B and an LED displaying a status of I/O Link *i*.



β*i*SV4-B, β*i*SV20-B

β*i*SV40-B, β*i*SV80-B,
β*i*SV10HV-B, β*i*SV20HV-B, β*i*SV40HV-B

NOTE

For details of the LED displaying a status of βiSV-B, see Table 4.1 in Section 4.2 or Chapter 2 in Part III. For details of the LED displaying a status of I/O Link *i*, refer to the maintenance manual of the host controller.

4.2 Check Procedure

1. Supply the power.

↓ ↓ When the LED display is not □□□■ □□□ or ■■■■ □□□

↓ See Part III, "TROUBLESHOOTING."

↓

2. The LED display is □□□■ □□□.

↓

3. Release the emergency stop state.

↓ ↓ The LED display does not become ■■■■ □□□.

↓ Check the *ESP input of the servo amplifier.

↓ Check the *ESP input signal via I/O Link.

↓

4. The LED display is ■■■■ □□□.

↓

5. Issue an instruction from the host controller.

↓

6. Check the operation of the servo motor.

↓ ↓ ↓ An alarm occurs.

↓ ↓ See Part III, "TROUBLESHOOTING."

↓ ↓ The motor does not run.

↓ Check the details of the command.

↓ Check the details of the parameters.

↓ Check the *RILK input of the servo amplifier.

↓ The motor operation is unusual.

Check whether parameter standard settings are made correctly. Check the values of No. 100 (load inertial ratio) and No. 107 (position loop gain).

Table 4.1 LED display and description

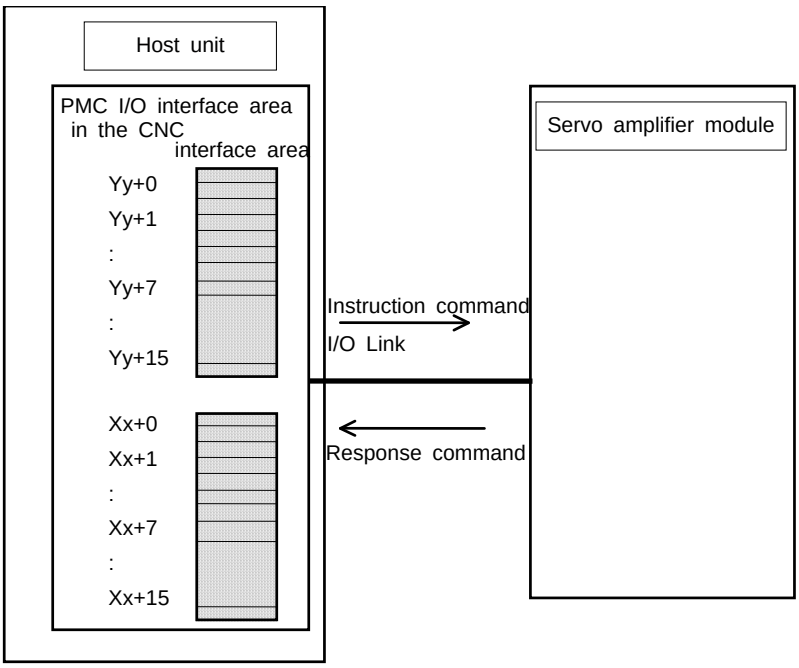
LED display	Status	Description
□□□■ □□□	Servo amplifier NOT READY	Indicates that the control power (+24 VDC) is supplied. There is no alarm, but the motor is not yet in a ready status.
■■■■ □□□	Servo amplifier READY	Indicates that the motor is in a ready status and is prepared to accept a command.
■■■■ □□□ blinking	Command being executed	Indicates that a command has been accepted and is being executed.
□□■□ □□□ blinking	Parameters being loaded	Indicates that parameters are being loaded from the Power Mate CNC manager at a time.
Display other than above	Alarm	An alarm has occurred. For details of the alarm, see Part III, "TROUBLESHOOTING."

II. HANDLING

1 OVERVIEW

1.1 SERVO AMPLIFIER INTERFACE

The servo amplifier is connected to a host unit such as a CNC via 128 DI and 128 DO points of the FANUC I/O Link *i* and FANUC I/O Link. The ladder program on the host unit sends move commands to the servo amplifier and monitors its status, via this interface.



1.2 FANUC I/O Link *i* and I/O Link INTERFACE AREA

The interface area used to transfer data via the FANUC I/O Link *i* and FANUC I/O Link is divided into two sections: A signal area for handling reset and alarm signals, and a command code area for handling move commands and status monitor command code.

The host unit can directly read- and write-access the signal area. It can be used to select the interface mode, start/stop operations, and monitor for alarm conditions.

The command code area can be used to issue commands to servo amplifier by combining function code and command data. For example, it is possible to send absolute/incremental move command and reference position return move command blocks, and receive the current position data.

1.3 INTERFACE

Interfaces are used to transfer data to and from the servo amplifier.
Essentially, there are two operation modes: Peripheral equipment control interface and direct command interface. The mode to be used is selected by the DRC signal in the signal area.

1.3.1 Peripheral Equipment Control Interface

This interface offers a high degree of compatibility with the peripheral equipment control functions of the Power Mate-E. It is provided with commands that can be used to control the peripheral equipment of machine tools. It enables the implementation of a series of positioning operations, such as axis clamp/unclamp, with a single command. This interface is useful if a ladder program, created based on this interface, is already available.

1.3.2 Direct Command Interface

This interface is used to implement a positioning operation with a single command, unlike peripheral equipment control, in which a single command can perform multiple operations. Besides a positioning command, this interface offers commands such as wait, parameter read/write, and diagnosis data read commands, enabling a wide range of operations can be implemented.

The two interface modes can be switched during operation. Interface switching causes the meaning of signals to be changed, requiring complicated ladder program logic. So, it is recommended that the interface mode not be changed during a servo amplifier module control sequence.

1.3.3 Interface Switching

Either peripheral equipment control or direct command interface mode is available depending on the situation. Usually, interface switching is not performed while the power is on. When necessary, however, the host can switch the interface by issuing a DRC signal.

When the DRC signal is 0, the peripheral equipment control interface is selected. When it is 1, the direct command interface is selected.

When the DRCO signal is 0, response data received from the servo amplifier unit indicates the peripheral equipment control interface. When it is 1, the response data indicates the direct command interface.

DRC signal switching must be performed during a reset state. Signal switching causes the meaning of a signal in use to be changed. Be careful when a command is being issued or axis movement is occurring, a signal switching may result in unexpected behavior.

Once the DRC signal is switched, defer issuing a command until one scan after the DRCO signal is switched. If the DRC signal is inverted again before the DRCO signal is switched, it may become impossible to exchange data with the servo amplifier normally. Before inverting the DRC signal again, wait for at least one scan after the DRCO signal is switched.

1.4 CAUTIONS ON USING THE POWER MATE CNC MANAGER

When the direct command interface is selected, using a Power Mate CNC manager function at the same time causes the area for response commands (Xx+4 to Xx+15) to be shared by the PMC and the manager. For this reason, it is necessary to distinguish between the response commands for their respective instruction commands and receive only those response commands for the PMC of the host. "USR1" in a response command is used to determine whether it is for the PMC or the manager.
If "USR1" is "0", the response command is for the PMC of the host and the PMC can receive it; if "USR1" is "1", it is for the Power Mate CNC manager and the PMC must ignore it.

2 SIGNAL DESCRIPTIONS

2.1 DO/DO SIGNALS

A host unit such as a CNC is connected to the servo amplifier via 128 DI and 128 DO points of the FANUC I/O Link.

> ⚠ **CAUTION**
> I/O link interface signal assignment differs between the peripheral equipment control and direct command interfaces.

2.1.1 Peripheral Equipment Control Interface

Locations Yy+0, Yy+1, and Yy+7 are allocated as the DO signal area, while locations Xx+0, Xx+1, Xx+2, and Xx+7 are allocated as the DI signal area. To control the servo amplifier, it is necessary to turn on or off directly those signals that are assigned to these areas or read them.
For the command code area, the function code and command data 1 are assigned to location Yy+2, and command data 2 is assigned to locations Yy+3 to Yy+6. Command issue to the servo amplifier must be done using these locations. Also, response commands are assigned to locations Xx+3 to Xx6; receive the response data for instruction commands.

CNC (host) → Servo amplifier (DRC=0)

	7	6	5	4	3	2	1	0
Yy+0	ST	UCPS2	-X	+X	DSAL	MD4	MD2	MD1
Yy+1			DRC	ABSRD	*ILK	SVFX	*ESP	ERS
Yy+2	Function code				Command data 1			
Yy+3 Yy+4 Yy+5 Yy+6	Command data 2							
Yy+7	RT	DRN	ROV2/MP2	ROV1/MP1	*OV8	*OV4	*OV2	*OV1
Yy+8 Yy+9 Yy+10 Yy+11 Yy+12 Yy+13 Yy+14 Yy+15	Unusable (System reserved area)							

Servo amplifier → CNC (host) (DRC=0)

	7	6	5	4	3	2	1	0
Xx+0	OPC4	OPC3	OPC2	OPC1	INPX	SUPX	IPLX	DEN2
Xx+1	OP	SA	STL	UCPC2	OPTENB	ZRFX	DRCO	ABSWT
Xx+2	MA	AL	DSP2	DSP1	DSALO	TRQM	RST	ZPX
Xx+3 Xx+4 Xx+5 Xx+6	Response data							
Xx+7		SVERX		PSG2	PSG1	MVX	APBAL	MVDX
Xx+8 Xx+9 Xx+10 Xx+11 Xx+12 Xx+13 Xx+14 Xx+15	Unusable (Power mate CNC manager response area)							

See Section 2.3 for details of the signals. Section 3.3 explains the function code, command data, and response data.

⚠ CAUTION

In the past, the "V READY OFF alarm ignore signal (IGNVRY<Yy+1#6>)" existed. When the servo amplifier is normal, however, V READY OFF alarm (No. 401) is not issued. This signal is, therefore, deleted. If this signal was used in the ladder program, delete it.

NOTE

#4 and #5 of Yy+7 are used by both the rapid traverse override signal (ROV1 and ROV2) and the incremental feed signal (MP1 and MP2). If bit 5 (MP) of parameter No. 5 is "1" and the system is in manual handle mode, they are for the incremental feed signal, and if MP is "0" or the system is not in manual handle mode, they are for the rapid traverse signal. If MP is "1", before switching from manual handle mode to another mode, the signal must be returned to such a setting that the bits are for the rapid traverse override signal.

2.1.2 Direct Command Interface

Locations Yy+0 to Yy+3 are allocated as the DO signal area, while locations Xx+0 to Xx+3 are allocated as the DI signal area. To control the servo amplifier unit, turn on or off directly those signals that are assigned to these areas or read them.
In the "instruction command area", direct commands (instruction commands) are assigned to locations Yy+4 to Yy+15, which are used to send commands to the servo amplifier. Also, direct commands (response commands) are assigned to locations Xx+4 to Xx+15; receive the response commands for instruction commands.

CNC (host) → Servo amplifier (DRC=1)

	7	6	5	4	3	2	1	0
Yy+0	ST		-X	+X		MD4	MD2	MD1
Yy+1			DRC	WFN	*ILK	SVFX	*ESP	ERS
Yy+2	RT	DRN	ROV2	ROV1	*OV8	*OV4	*OV2	*OV1
Yy+3	INPF							
Yy+4	EBUF	EOREND						ECNT
Yy+5	Direct command (function code)							
Yy+6	Direct command (command data 1)							
Yy+7	Direct command (command data 2)							
Yy+8	Direct command (command data 3)							
Yy+9	Direct command (command data 4)							
Yy+10	Direct command (command data 5)							
Yy+11	Direct command (command data 6)							
Yy+12	Direct command (command data 7)							
Yy+13	Direct command (command data 8)							
Yy+14	Direct command (command data 9)							
Yy+15	Direct command (command data 10)							

> ⚠ **CAUTION**
> In the past, the "V READY OFF alarm ignore signal (IGNVRY<Yy+1#6>)" existed. When the servo amplifier is normal, however, V READY OFF alarm (No. 401) is not issued. This signal is, therefore, deleted. If this signal was used in the ladder program, delete it.

Servo amplifier → CNC (host) (DRC=1)

	7	6	5	4	3	2	1	0
Xx+0					INPX	SUPX	IPLX	DEN2
Xx+1	OP	SA	STL		OPTENB	ZRFX	DRCO	WAT
Xx+2	MA	AL				TRQM	RST	ZPX
Xx+3	INPFO	SVERX		PSG2	PSG1	MVX	APBAL	MVDX
Xx+4	EBSY	EOSTB	ECF		USR1	EOPC	DAL	ECONT
Xx+5	Direct command (function code)							
Xx+6	Reserved				Execution result			
Xx+7	Direct command (response data 1)							
Xx+8	Direct command (response data 2)							
Xx+9	Direct command (response data 3)							
Xx+10	Direct command (response data 4)							
Xx+11	Direct command (response data 5)							
Xx+12	Direct command (response data 6)							
Xx+13	Direct command (response data 7)							
Xx+14	Direct command (response data 8)							
Xx+15	Direct command (response data 9)							

See Section 2.3 for details of the signals. Section 4.4 explains the function number, command data, and response data.

2.2 SIGNALS (LISTED IN GROUPS)

* The following list contains not only signals transferred via the I/O link interface but also direct input/output signals such as *ESP, *-OT, *+OT, *RILK, *DEC, and HDI.
* Each listed address is based on the I/O link assignment address of each slave of the host.

Function list

Group	Signal name	Symbol	Address		Reference item
			Peripheral equipment	Direct command	
1	Preparation completion signal	MA	Xx+2#7		2.3.1
	Servo preparation completion signal	SA	Xx+1#6		2.3.1
2	Emergency stop signal	*ESP	Yy+1#1		2.3.2
	External reset signal	ERS	Yy+1#0		2.3.2
	Reset in-progress signal	RST	Xx+2#1		2.3.2
3	Alarm signal	AL	Xx+2#6		2.3.3
	Absolute pulse coder battery alarm signal	APBAL	Xx+7#1	Xx+3#1	2.3.3
4	Mode selection signal	MD4,MD2,MD1	Yy+0#0 to Yy+0#2		2.3.4
5	Feed axis and direction selection signal	+X,-X	Yy+0#4,Yy+0#5		2.3.5
6	Remaining travel in-range signal	DEN2	Xx+0#0		2.3.6
	Distribution pulse signal	IPLX	Xx+0#1		2.3.6
	Acceleration/deceleration pulse signal	SUPX	Xx+0#2		2.3.6
	In-position signal	INPX	Xx+0#3		2.3.6
	Servo positional deviation monitor signal	SVERX	Xx+7#6	Xx+3#6	2.3.6
	Axis movement in-progress signal	MVX	Xx+7#2	Xx+3#2	2.3.6
	Movement direction signal	MVDX	Xx+7#0	Xx+3#0	2.3.6
	Area signal	PSG1,PSG2	Xx+7#3,Xx+7#4	Xx+3#3,Xx+3#4	2.3.6
	Speed control in-progress signal	TRQM	Xx+2#2		2.3.6
	Function enable signal	OPTENB	Xx+1#3		2.3.6
7	Feedrate override signal	*OV1 to *OV8	Yy+7#0 to Yy+7#3	Yy+2#0 to Yy+2#3	2.3.7
	Manual rapid traverse selection signal	RT	Yy+7#7	Yy+2#7	2.3.7
	Rapid traverse override signal	ROV1,ROV2	Yy+7#4,Yy+7#5	Yy+2#4,Yy+2#5	2.3.7
	Incremental feed signal	MP1, MP2	Yy+7#4,Yy+7#5	--	2.3.7
8	Interlock signal	*ILK	Yy+1#3		2.3.8
9	Reference position return completion signal	ZPX	Xx+2#0		2.3.9
	Reference position establishment signal	ZRFX	Xx+1#2		2.3.9
10	Automatic operation start signal	ST	Yy+0#7		2.3.10
	Automatic operation start in-progress signal	STL	Xx+1#5		2.3.10
	Automatic operation signal	OP	Xx+1#7		2.3.10
	Dry run signal	DRN	Yy+7#6	Yy+2#6	2.3.10
11	Unclamp command signal	UCPC2	Xx+1#4	--	2.3.11
	Clamp/unclamp state output signal	UCPS2	Yy+0#6	--	2.3.11
12	Servo-off signal	SVFX	Yy+1#2		2.3.12

Group	Signal name	Symbol	Address		Reference item
			Peripheral equipment	Direct command	
13	Operation completion signal	OPC1, OPC2, OPC3, OPC4	Xx+0#4 to Xx+0#7	--	2.3.13
	Function code	CMD CODEP	Yy+2#4 to Yy+2#7	--	2.3.13
	Command data 1	CMD DATA1	Yy+2#0 to Yy+2#3	--	2.2.13
	Command data 2	CMD DATA2	Yy+3 to Yy+6	--	2.3.13
	Response data	ANS DATAP	Xx+3 to Xx+6	--	2.3.13
	Response data check signal	DSP1,DSP2	Xx+2#4 to Xx+2#5	--	2.3.13
	Response data write completion signal	ABSWT	Xx+1#0	--	2.3.13
	Response data read completion signal	ABSRD	Yy+1#4	--	2.3.13
	Alarm output command signal	DSAL	Yy+0#3	--	2.3.13
	Alarm output state check signal	DSALO	Xx+2#3	--	2.3.13
14	Function code command strobe signal	EBUF	--	Yy+4#7	2.3.14
	Function code command read completion signal	EBSY	--	Xx+4#7	2.3.14
	Function code	CMD CODE	--	Yy+5	2.3.14
	Command data	CMD DATA	--	Yy+6 to Yy+15	2.3.14
	Response data	ANS DATA	--	Xx+7 to Xx+15	2.3.14
	Continuously output data signal	EOPC	--	Xx+4#2	2.3.14
	Response data readable signal	EOSTB	--	Xx+4#6	2.3.14
	Response data read completion signal	EOREND	--	Yy+4#6	2.3.14
	Command continuation notification signal	ECNT	--	Yy+4#0	2.3.14
	PMM data signal	USR1	--	Xx+4#3	2.3.14
	Response data continuation notification signal	ECONT	--	Xx+4#0	2.3.14
	Function code command completion notification signal	ECF	--	Xx+4#5	2.3.14
	Alarm signal	DAL	--	Xx+4#1	2.3.14
	Wait signal	WAT	--	Xx+1#0	2.3.14
	Wait completion signal	WFN	--	Yy+1#4	2.3.14
	Memory registration signal	INPF	--	Yy+3#7	2.3.14
	Memory registration in-progress signal	INPFO	--	Xx+3#7	2.3.14
	Interface switch signal	DRC	--	Yy+1#5	2.3.14
	Interface status notification signal	DRCO	--	Xx+1#1	2.3.14
15	Emergency stop signal	*ESP	Direct input		2.3.15
	Overtravel signal	*-OT,*+OT	Direct input		2.3.15
	High-speed interlock signal	*RILK	Direct input		2.3.15
	Deceleration signal for reference position return	*DEC	Direct input		2.3.15
	Skip signal	HDI	Direct input		2.3.15

2.3 SIGNAL DETAILS

2.3.1 Preparation Completion

(1) Preparation completion signal MA

[Classification] Input signal <Xx+2#7> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the servo amplifier is ready to operate.

[Input condition] The signal becomes 1 when:

1. Self-diagnosis in the servo amplifier completes normally when the power is switched on.

The signal becomes 0 when:

1. The power to the servo amplifier is switched off.
2. A control unit error such as a CPU or memory failure is detected.

(2) Servo preparation completion signal SA

[Classification] Input signal <Xx+1#6> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the servo amplifier is ready to operate. Conversely, if this signal is not issued, the servo amplifier is not operating.

[Input condition] The signal becomes 1 when:

1. Self-diagnosis in the servo system completes normally when the power to the control unit is switched on.
2. A servo alarm (if any has occurred) is reset.
3. An emergency stop condition (if any has occurred) is reset.

The signal becomes 0 when:

1. The power to the control unit is switched off.
2. A servo alarm condition is detected.
3. An emergency stop is effected.

NOTE

In the servo-off state, the SA signal remains at 1 unless a condition which resets it to 0 occurs.

2.3.2 Reset and Emergency Stop

(1) Emergency stop signal *ESP

[Classification] Output signal <Yy+1#1> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal brings the control unit to an emergency stop.

[Operation] When the signal becomes 0, the control unit operates as follows:

1. The control unit stops immediately during axis movement.
2. A reset is applied after the stop.
3. When the emergency stop signal is 0, the servo preparation completion signal SA is also 0, because the servo system is not operating. If axis movement occurs while the servo system is not operating, the amount of movement is reflected in the current position coordinates held in the control unit (follow-up).
4. While the emergency stop signal is 0, jog and function code commands cannot be issued.

(2) External reset signal ERS

[Classification] Output signal <Yy+1#0> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal resets the servo amplifier.

[Operation] When the signal becomes 1, the servo amplifier operates as follows:

1. The servo amplifier immediately decelerates axis movement to a stop.
2. After a stop, the servo amplifier is reset, then the following are canceled:
   - Function code commands are canceled regardless of whether they are under execution, buffered, or on input signals.
   - In an alarm state, those alarms that can be canceled are canceled.
3. While the external reset signal is 1, jog and function code commands cannot be issued.

(3) Reset in-progress signal RST

[Classification] Input signal <Xx+2#1> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the control unit is being reset.

[Input condition] The signal becomes 0 when:

1. A reset is completed.

The signal becomes 1 when:

1. A reset is in progress.

That is, the external reset signal ERS ((2) in Section 2.3.2) is 1, or the emergency stop signal *ESP ((1) in Section 2.3.2) is 0.

2.3.3 Alarm

(1) Alarm signal AL

[Classification] Input signal <Xx+2#6> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the servo amplifier is in an alarm state.

[Input condition] The signal becomes 1 when:

1. The servo amplifier enters an alarm state.
   The following alarms can occur in the servo amplifier.
   1) P/S alarm
   2) Pulse coder alarm
   3) Servo alarm
   4) Overtravel alarm

The signal becomes 0 when:

1. The servo amplifier is released from an alarm state by a reset.
   Some alarms occur again after they are reset, unless their cause is removed.
   So, the AL signal is issued again immediately. In this case, the AL signal may become 0 for a moment.

(2) Absolute pulse coder battery alarm signal APBAL

[Classification] Input signal <Xx+7#1> (peripheral equipment control interface)
<Xx+3#1> (direct command interface)

[Function] This signal indicates that the batteries of the absolute pulse coder require replacement.

[Input condition] The signal becomes 1 when:

1. The absolute pulse coder battery voltage is low.

The signal becomes 0 when:

1. The batteries are replaced, and the battery voltage becomes higher than or equal to the rating.
   This alarm will occur again after it is reset, unless the batteries are replaced.

So, the APBAL signal is immediately issued again. In this case, the APBAL signal may become 0 for a moment.

> ⚠ **CAUTION**
> Use this signal to display this battery alarm on the machine operator's panel. On the host controller, this battery alarm is not displayed if the power mate CNC manager screen is not displayed.

2.3.4 Mode Selection

(1) Mode selection signal MD1, MD2 and MD4

[Classification] Output signal <Yy+0#0 to #2> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal selects an operation mode.

[Operation] The signal is a code signal consisting of three bits: MD1, MD2, and MD4. The code signal selects one of three modes: automatic operation (AUTO), handle feed (HANDLE), or jog (JOG), according to the combination of these bits.

MD4	MD2	MD1	Description
0	0	1	Automatic operation (AUTO)
1	0	0	Handle feed (HANDLE)
1	0	1	Jog feed by +X and -X (JOG)

> ⚠ **CAUTION**
> Do not switch the operation mode during automatic operation. Stop automatic operation before switching the operation mode.

> **NOTE**
> See Section 3.10, "MANUAL HANDLE INTERFACE" or Chapter 5, "EXTERNAL PULSE INPUT FUNCTION" for details of handle feed.

2.3.5 Jog Feed

(1) Feed axis and direction selection signals +X and -X

[Classification] Output signal <Yy+0#4,#5>(common to both the peripheral equipment control and direct command interfaces)

[Function] These signals select the direction in which jog feed movement (rotation) is to be performed, and start the rotation in selected direction .

[Operation] The signals are valid when jog feed (JOG) mode is selected. They indicate the direction of feed. After JOG mode is selected, changing +X or -X, whichever is desired, from 0 to 1 causes and keeps movement in the corresponding direction at a feedrate specified by the override signals *OV1 to *OV8 ((1) of Subsection 2.3.7) or the manual rapid traverse selection signal RT ((2) of Subsection 2.3.7), provided the signal is 1.

NOTE
1 Simultaneously setting +X and -X to 1 results in neither direction being selected (equivalent to when both are 0).
2 If a feed axis selection signal becomes 1 before the jog feed signal (JOG) is selected, these signals are ignored. If the JOG signal is selected, it must be reset to 0 before the feed axis selection signal is set. The servo amplifier unit begins feeding when the JOG signal rises.

2.3.6 Status Signals

(1) Remaining travel in-range signal DEN2

[Classification] Input signal <Xx+0#0> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that, in the servo amplifier, the number of axis move command distribution pulses that have not been used for axis movement (residual movement amount) is smaller than a parameter-specified value.

[Input condition] The signal becomes 1 when:

1. The number of axis move command distribution pulses that have not been used for axis movement (residual movement amount) is smaller than a parameter-specified value.

The signal becomes 0 when:

1. The number of axis move command distribution pulses that have not been used for axis movement (residual movement amount) is larger than a parameter-specified value.
2. When the value of a parameter for the remaining travel in-range signal is 0.

NOTE
1 The DEN2 signal remains 0 during jog feed (JOG).
2 The DEN2 signal maintains its current state until another move command is issued.

(2) Distribution pulse signal IPLX

[Classification] Input signal <Xx+0#1> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the servo amplifier has axis move command distribution pulses that have not been used for axis movement (residual movement amount).

[Input condition] The signal becomes 1 when:

1. There are axis move command distribution pulses that have not been used for axis movement (residual movement amount).

The signal becomes 0 when:

1. There is no axis move command distribution pulse that has not been used for axis movement (residual movement amount).

NOTE
The IPLX signal is valid while jog feed (JOG) mode is set.

(3) Acceleration/deceleration pulse signal SUPX

[Classification] Input signal <Xx+0#2> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the servo amplifier has accumulated pulses in the acceleration/deceleration control section.

[Input condition] The signal becomes 1 when:

1. Axis movement distribution pulses are accumulated in the acceleration/deceleration control section.

The signal becomes 0 when:

1. No axis movement distribution pulses are accumulated in the acceleration/deceleration control section.

(4) In-position signal INPX

[Classification] Input signal <Xx+0#3> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that the controlled axis is in position (has reached the specified value).

[Input condition] The signal becomes 1 when:

1. There is no acceleration/deceleration delay (accumulated pulses) for the controlled axis, and the servo positional deviation is within a parameter-specified range.

The signal becomes 0 when:

1. There is an acceleration/deceleration delay (accumulated pulses) for the controlled axis, or
2. The servo positional deviation falls outside a parameter-specified range.

(5) Servo positional deviation monitor signal SVERX

[Classification] Input signal <Xx+7#6> (peripheral equipment control interface)
<Xx+3#6> (direct command interface)

[Function] This signal indicates that, in the servo amplifier, the amount of servo positional deviation has exceeded a parameter-specified value.

[Input condition] The signal becomes 1 when:

1. The servo positional deviation amount is larger than a parameter-specified value.

The signal becomes 0 when:

1. A parameter-specified value for the servo positional deviation amount is 0, or
2. The servo positional deviation amount is within a parameter-specified range.

(6) Axis movement in-progress signal MVX

[Classification] Input signal <Xx+7#2> (peripheral equipment control interface)
<Xx+3#2> (direct command interface)

[Function] The signal indicates that movement along the controlled axis is being performed.

[Input condition] The signal becomes 1 when:

1. Controlled axis movement begins.
2. Bit 7 (SVFP) of parameter No. 010 is set to 1 to perform follow-up in clamp processing or servo-off state, and the servo position deviation amount (DGN No. 032) is not zero.

The signal becomes 0 when:

1. Controlled axis movement ends, and the controlled axis enters the in-position state.
2. Bit 7 (SVFP) of parameter No. 010 is set to 1 to perform follow-up in clamp processing or servo-off state, and the servo position deviation amount (DGN No. 032) is zero.

NOTE

The MVX signal is valid while jog feed (JOG) mode is set.

(7) Movement direction signal MVDX

[Classification] Input signal <Xx+7#0> (peripheral equipment control interface)
<Xx+3#0> (direct command interface)

[Function] The servo amplifier indicates the movement direction of its controlled axis.

[Input condition] The signal becomes 1 when:

1. Controlled axis movement in the negative direction begins.

The signal becomes 0 when:

1. Controlled axis movement in the positive direction begins.

NOTE

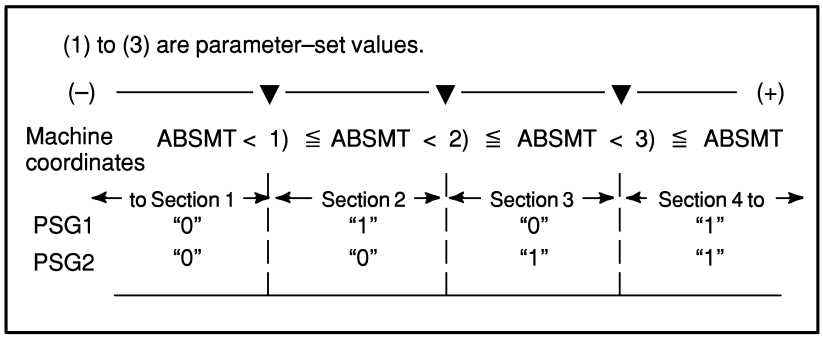
1 The MVDX signal is valid while jog feed (JOG) mode is set.
2 The MVDX signal maintains its current state during a stop. It does not become 0 even upon a stop after movement in the negative direction.
3 The servo amplifier outputs the MVDX signal even during follow-up, provided the necessary condition is satisfied.

(8) Area signals PSG1 and PSG2

[Classification] Input signal PSG1<Xx+7#3>, PSG2<Xx+7#4>
(peripheral equipment control interface)
PSG1<Xx+3#3>, PSG2<Xx+3#4>
(direct command interface)

[Function] The servo amplifier performs code input with two-point signals, indicating that the current machine coordinates are in the respective parameter-set sections.

[Input condition] If a parameter is set up as shown below, PSG1 and PSG2 are output in the respective sections, as shown below.



NOTE

1 The servo amplifier performs input in the above status even during follow-up.
2 When bit 1 (PSSV) of parameter No. 007 is "1", input is accomplished with the position (actual motor position) with consideration given to the acceleration/deceleration, servo positional deviation, etc.

(9) Speed control mode signal TRQM

[Classification] Input signal <Xx+2#2>

[Function] The servo amplifier notifies that the speed control mode is set.

[Input condition] The signal becomes 1 when:

1. When speed control is activated, and the speed control mode is set

The signal becomes 0 when:

1. When the speed control stop command is executed
2. Servo alarm, overtravel alarm, reset, emergency stop, servo-off

(10) Function enable signal OPTENB

[Classification] Input signal <Xx+1#3> (common to both the peripheral equipment control and direct command interfaces)

[Function] The servo amplifier notifies that the function is enabled (usable).

The function is as follows:

- Unexpected disturbance torque detection function (software option function)

[Input condition] The signal becomes 1 when:

1. The function becomes usable.

The signal becomes 0 when:

1. The function is under preparation, immediately after power on.
2. The function is not ordered.

> ⚠ **CAUTION**
> The Unexpected disturbance torque detection function is disabled until this signal becomes "1". Be sure to confirm that this signal is "1" before starting axis movement.

2.3.7 Feedrate

(1) Override signals *OV1 to *OV8

[Classification] Output signal<Yy+7#0 to #3> (peripheral equipment control interface)
<Yy+2#0 to #3> (direct command interface)

[Function] The host applies override to jog feed and cutting feedrates.

[Operation] Four binary code signals are provided. They correspond to the override values listed below.

*OV8	*OV4	*OV2	*OV1	Override value (%)
1	1	1	1	0
1	1	1	0	10
1	1	0	1	20
1	1	0	0	30
1	0	1	1	40
1	0	1	0	50
1	0	0	1	60
1	0	0	0	70
0	1	1	1	80
0	1	1	0	90
0	1	0	1	100
0	1	0	0	110
0	0	1	1	120
0	0	1	0	130
0	0	0	1	140
0	0	0	0	150

Actual jog feed and automatic cutting feedrates are obtained by multiplying the respective specified values by the override values.

(2) Manual rapid traverse selection signal RT

[Classification] Output signal <Yy+7#7> (peripheral equipment control interface)
<Yy+2#7> (direct command interface)

[Function] The host selects rapid traverse for jog feed.

[Operation] The RT signal is valid when jog feed mode (JOG) is selected. When the signal is 1, jog feed is performed at a rapid traverse rate. Under this condition, setting a feed axis and direction selection signal (+X or -X) to 1 starts rapid traverse in the specified direction. If jog feed is selected, a feed axis and direction selection signal (+X or -X) is 1, and an override signal is valid, setting the RT signal to 1 starts rapid traverse. Resetting the RT signal to 0 resumes normal feed.

(3) Rapid traverse override signals ROV1 and ROV2

[Classification] Output signal <Yy+7#4 to #5> (peripheral equipment control interface)
<Yy+2#4 to #5> (direct command interface)

[Function] The host specifies override for rapid traverse.

[Operation] The following table lists the override amounts.

ROV2	ROV1	Override value
0	0	100%
0	1	50%
1	0	25%
1	1	F0

NOTE
F0 is a value specified in parameter No. 061.

(4) Incremental feed signal MP1and MP2

[Classification] Output signal <Yy+7#4 to #5> (peripheral equipment control interface)
[Function] Used to select the manual handle feed magnification of the servo amplifier.
[Operation] In manual handle mode, the servo amplifier drives the motor for the pulses, which is obtained by multiplying values of input manual pulse generator by the magnification selected by this signal.

MP2	MP1	Amount of travel per graduation of the manual pulse generator
0	0	1 user unit
0	1	10 user units
1	0	100 user units
1	1	(M/N) user unit (M = Parameter No. 62, N = Parameter No. 63)

NOTE
1 This signal is effective if bit 5 (MP) of parameter No. 5 of the servo amplifier is 1.
2 This signal is effective in manual handle mode only.
3 This signal shares the same bits with the rapid traverse override signal. In manual handle mode, these bits are for the incremental feed signal; in modes other than manual handle mode, they are for the rapid traverse override signal. Before switching from manual handle mode to another mode, this signal must be returned to such a setting that the bits are for the rapid traverse override signal.

2.3.8 Interlock

(1) Interlock signal *ILK

[Classification] Output signal <Yy+1#3> (common to both the peripheral equipment control and direct command interfaces)
[Function] The host stops sending all movement commands.
[Input condition] When the *ILK signal is 0, the host resets all movement command signals to 0 to decelerate and stop controlled axis feed. Movement commands remain valid when the *ILK signal is 0. When it becomes 1, movement is resumed immediately.
No command other than a move command is affected.

NOTE
The interlock signal is valid in jog feed mode (JOG).

2.3.9 Reference Position Return

(1) Reference position return completion signal ZPX

[Classification] Input signal <Xx+2#0> (common to both the peripheral equipment control and direct command interfaces)
[Function] The servo amplifier indicates that it is at the reference position.
[Input condition] The signal becomes 1 when:
1. Manual reference position return is completed, and the servo amplifier enters the in-position state.
2. Function code command-based reference position return is completed, and the servo amplifier enters the in-position state.

The signal becomes 0 when:
1. The servo amplifier moves out of the reference position.

(2) Reference position establishment signal ZRFX

[Classification] Input signal <Xx+1#2> (common to both the peripheral equipment control and direct command interfaces)

[Function] The servo amplifier notifies the host of the reference position establishment state.

[Input condition] The signal becomes 1 when:
1. Reference position establishment is completed.

The signal becomes 0 when:
1. Reference position establishment is not completed.

NOTE
This signal is effective if bit 2 (ZRNO) of parameter No. 004 is "1".

2.3.10 Automatic Operation

(1) Automatic operation start signal ST

[Classification] Output signal <Yy+0#7> (common to both the peripheral equipment control and direct command interfaces)

[Function] The host starts function code commands, such as part of peripheral equipment control ATC operations and point positioning. Specifically, the host issues a direct command to start 32-block buffering.

[Operation] When the ST signal is set to 1 then reset to 0 again, the servo amplifier begins operating. Section 3.3.1 explains the function codes for which the ST signal is valid in peripheral equipment control.

NOTE
It is also possible to start operation at the rising edge (from off to on) of the ST signal as specified by the STON parameter (bit 7 of parameter No. 003).

(2) Automatic operation start in-progress signal STL

[Classification] Input signal <Xx+1#5> (common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that automatic operation has been started.

[Input condition] The signal becomes 1 when a command to start automatic operation is issued.
It becomes 0 when automatic operation stops.

(3) Automatic operation signal OP

[Classification] Input signal <Xx+1#7>(common to both the peripheral equipment control and direct command interfaces)

[Function] This signal indicates that a series of automatic operations is in progress.

[Input condition] The signal becomes 1 when a command to start automatic operation is issued. The signal remains set to 1 even after automatic operation stops. It becomes 0 upon the occurrence of a reset.

(4) Dry run signal DRN

[Classification] Output signal <Yy+7#6>(peripheral equipment control interface)

<Yy+2#6>(direct command interface)

[Function] Dry run is valid during automatic operation (AUTO mode). During dry run, a feedrate command issued during automatic operation is ignored, and a manual-feed feedrate determined by override signals *OV1 to *OV8 ((1) of Section 2.3.7) is used. Dry run is also valid for rapid traverse. When the RT signal ((2) of Section 2.3.7) is set to 1 during dry run, the "rapid traverse rate" and the "maximum manual-feed feedrate" are used for the rapid traverse and cutting feed blocks, respectively. When the RT signal is reset to 0, the "same rate as the manual-feed feedrate" is resumed.

[Operation] Setting the DRN signal to 1 causes the system to enter the dry run state. Resetting it to 0 resumes the feed rate specified during automatic operation.

2.3.11 Clamp and Unclamp (for the Peripheral Equipment Control Interface Only)

NOTE
When the signal described below is used, the speed control, the manual handle interface, and the external pulse input function cannot be used.

(1) Unclamp command signal UCPC2

[Classification] Input signal <Xx+1#4>

[Function] An actual machine clamp/unclamp operation is performed by the host. The servo amplifier outputs this signal when a function code command for peripheral equipment control is executed, thereby requesting a clamp/unclamp operation to the host.

[Input condition] The signal becomes 1 when:
The servo amplifier requests an unclmap operation to the host.
The signal becomes 0 when:
The servo amplifier requests a clamp operation to the host.
The servo amplifier sets UCPC2 to "1" when a move command with a function code starts. The servo amplifier sets it to "0" at the end of the move command. For details, see the timing chart of each function code for peripheral equipment control.

NOTE
The UCPC2 signal is valid when the NCLP parameter (bit 1 of parameter No. 003) is 0.

(2) Clamp/unclamp state output signal UCPS2

[Classification] Output signal <Yy+0#6>

[Function] When the servo amplifier requests clamping/unclamping of the machine, using the UCPC2 signal, the host actually clamps/unclamps the machine. Upon the completion of clamping/unclamping, it reports it to the servo amplifier unit, which then proceeds to the next processing.

[Operation] The signal is set to 1 when the machine is unclamped. When it is clamped, the signal is reset to 0. See the timing chart for the function codes for peripheral equipment control.

NOTE
The UCPS2 signal is valid when the NCLP parameter (bit 1 of parameter No. 003) is 0.

2.3.12 Servo-off

(1) Servo-off command signal SVFX

[Classification] Output signal <Yy+1#2> (common to both the peripheral equipment control and direct command interfaces)

[Function] The host turns off the servo circuit for a controlled axis, that is, shuts off the current to the servo motor of the controlled axis. This disables positioning control. Position detection continues, however. So, the current position will not be lost.

[Operation] The servo motor remains off while the signal is 1. If the machine is moved by the application of external force, its coordinates are shifted, because positioning control does not work during the servo-off state. How the shifted machine coordinates are handled can be selected by a parameter, as follows:

1. The machine coordinate shift is recorded in an error counter.
   When the servo-off signal becomes 0, the machine moves to cancel out the error recorded in the error counter.
2. Follow-up is performed.
   The machine coordinate shift is regarded as being the result of a command, and the control unit adjusts its current position data so that the error counter becomes 0. With this method, the machine remains in a shifted position even after the servo-off signal becomes 0. However, the machine moves to the correct position the next time an absolute command is issued, because the control unit has information about the correct position.

[Use] Generally, method 1 above is used to prevent excessive current flowing through the servo motor when it is clamped mechanically with a force stronger than the servo motor can generate. Usually, the host keeps the interlock signal at 0 while the servo-off signal is 1. Generally, method 2 is used to operate the machine by rotating the motor with a handle feed mechanism.

2.3.13 Peripheral Equipment Control Function Code and Related Information

(1) Operation completion signals OPC1, OPC2, OPC3, and OPC4

[Classification] Input signal <Xx+0#4 to #7>

[Function] The servo amplifier indicates information about the completion of each function code. The host executes its sequence according to this signal.

[Input condition] See the timing chart of each function code for the corresponding input timing.

OPC1 indicates, to the host, that the servo amplifier has received a command.
The servo amplifier issues an unclamp command signal (UCPC2 = 1) to request the host to unclamp the machine.
OPC2 indicates, to the host, that the servo amplifier has received an unclamp completed command signal (UCPS2 = 1). The servo amplifier starts axis operation.
OPC3 indicates, to the host, that an axis operation is completed and the in-position state is assumed, simultaneously as the clamp command (UCPC2 = 0).
OPC4 indicates, to the host, that the servo amplifier has received the clamp completion signal (UCPS2 = 0) and finished executing all commands.
The timing at which the signal is input is set in parameter No. 166.

⚠ CAUTION
If the unclamp command signal (UCPC2) and the clamp/unclamp state output signal (UCPS2) are not used (bit 1 (NCLP) of parameter No. 003 = 1), OPC4 is output to the host even if the instruction command is interrupted due to an external reset, emergency stop, alarm, etc.

NOTE
When the unclamp command signal (UCPC2) and clamp/unclamp state output signal (UCPS2) are not used (when bit 1 (NCLP) of parameter No. 003 = 1), OPC2 and OPC3 are not output to the host. In this case, OPC4 is output to the host when an axis operation is completed and the in-position state is assumed.

(2) Function code

[Classification] Output signal <Yy+2#4 to #7>
[Function] The host sets the peripheral equipment control function code.
[Output condition] See the timing chart of each function code for the corresponding output timing. See Sections 3.3 and 3.4 for details.

(3) Command data 1

[Classification] Output signal <Yy+2#0 to #3>
[Function] The host sets command data 1 to specify the feed rate for peripheral equipment control.
[Output condition] See the timing chart of each function code for the corresponding output timing. See Sections 3.3 and 3.4 for details.

(4) Command data 2

[Classification] Output signal <Yy+3 to Yy+6>
[Function] The host sets command data 2 to specify the amount of movement for peripheral equipment control.
[Output condition] See the timing chart of each function code for the corresponding output timing. See Sections 3.3 and 3.4 for details.

(5) Response data

[Classification] Input signal <Xx+3 to Xx+6>
[Function] (A) The servo amplifier outputs the current position number (point, turret, or magazine number) for point or ATC control. This response data is set up upon the completion of positioning. The servo amplifier continues to output the previous number until the new response data is set up.

(B) By setting parameter No. 020 appropriately, it is possible to output the following data items real-time:

- Machine coordinates
- Workpiece coordinates
- Motor current value
- Skip measurement data
- Actual feedrate
- Actual rotation speed
- Torque command

NOTE
Skip measurement data is output when the skip signal is input or when the end point is reached.

(C) When the DSAL signal [Subsection 2.3.13.(9)] is 1, the servo amplifier outputs the number of alarms and the first alarm number.

[Input condition] See the function code command list for details.

⚠ CAUTION

1 The purpose of this data, when used by the host, is limited to display on the host. This data consists of 32 bits of DI signals; the bits are not updated at a time, but are updated on a bit-by-bit basis. So, if this data is being updated when coordinates are read during movement on axes, the correct position may not be read normally. This data is prepared for position display on the host, so that this data cannot be used to make a machine area check. However, correct coordinates can be read even during movement on axes by establishing synchronization between the host and servo amplifier. For details, see Section 3.8. This is true of all data items output real-time.

2 The current position number (point, turret, and magazine number) is not output until the reference position is established. If bit 2 (NZRPO) of parameter No. 007 is "1", it is output even if the reference position is not established.

3 The current position number (point, turret, and magazine number) is 0 when the power is turned on, and is output upon the completion of positioning due to peripheral equipment control ATC operations, point positioning, or reference position return. If, then, a move command such as JOG operation is executed, the current position number no longer matches the current position on the axes. If, after the completion of ATC operations, point positioning, or reference position return, a move command such as jog operation is started, it is no longer possible to control the current position on the axes by looking at the current position number output on the host. Besides, if, after an index command of ATC operations is started, it is interrupted due to the occurrence of a reset, alarm, etc., the current position number no longer matches the current position on the axes. As for the turret/magazine number, however, the constraint described above is eliminated and the correct number can be constantly output because of improved specifications. For details, see Section 3.9, "Turret/Magazine Number Output Improvement".

(6) Response data check signals DSP1 and DSP2

[Classification] Input signal <Xx+2#4 to #5>

[Function] The servo amplifier indicates the contents of the response data.

[Input condition] The servo amplifier specifies the response data using a combination of signals, as listed below.

DSP2	DSP1	Response data
0	0	Not output
1	1	Coordinates, motor current value, skip measurement data, or torque command
1	0	Current position number (ATC, point number)
0	1	Actual feedrate or actual speed

NOTE
1 The setting of parameter No. 20 determines which of coordinates, motor current value, skip measurement data, and torque command the response data is.
2 The setting of parameter No. 20 determines which of actual feedrate and actual speed the response data is.

(7) Response data write completion signal ABSWT

[Classification] Input signal <Xx+1#0>

[Function] After writing response data (Xx+3 to Xx+6), the servo amplifier inverts this signal for notification to the host.

[Operation] The servo amplifier exclusive-ORs ABSWT with ABSRD. When the result of exclusive-OR is 0, response data (Xx+3 to Xx+6) is written, and this signal is inverted.

(8) Response data read completion signal ABSRD

[Classification] Output signal <Yy+1#4>

[Function] After reading response data (Xx+3 to Xx+6), the host inverts this signal for notification to the servo amplifier.

[Operation] The host exclusive-ORs ABSWT with ABSRD. When the result of exclusive-OR is 1, response data (Xx+3 to Xx+6) is read, and this signal is inverted.

(9) Alarm output command signal DSAL

[Classification] Output signal <Yy+0#3>

[Function] The host specifies that alarm information be output as response data. When DSAL is 1, the following information is output as response data.

Xx+3	Number of alarms (byte type)
Xx+4,Xx+5	Alarm number (word type)

[Operation] When the signal is 0, a turret, magazine, point number, coordinates, or motor current value are output as response data. When the signal is 1, the number of alarms and the first alarm number are output as response data.

(10) Alarm output state check signal DSALO

[Classification] Input signal <Xx+2#3>

[Function] The servo amplifier indicates the contents of the response data.

[Input condition] When the signal is 0, a turret, magazine, point number, coordinates, or motor current value are being output as response data. When the signal is 1, the number of alarms and the first alarm number are being output as response data.

2.3.14 Direct Command Function Code and Related Information

(1) Function code command strobe signal EBUF

[Classification] Output signal <Yy+4#7>

[Function] After setting the function code (Yy+5) and command data (Yy+6 to Yy+15), the host inverts the logical state of this signal to indicate to the servo amplifier that the function code is ready for transfer.

[Operation] The servo amplifier exclusive-ORs EBUF with EBSY. If the result of exclusive ORing is 1, the servo amplifier behaves as follows:

(A) When the function code command is to be buffered before execution.

1. If the function code command buffer of the servo amplifier is available, the servo amplifier receives the function code command at the function code command buffer.

2. If the function code command buffer of the servo amplifier is unavailable, the servo amplifier waits until it becomes available, that is, rejects reception of the current function code command.

(B) If the function code command is of a type to be executed immediately without being buffered

1. The servo amplifier receives the function code command at its execution buffer immediately and starts processing according to the function code command.

(2) Function code command read completion signal EBSY

[Classification] Input signal <Xx+4#7>

[Function] The servo amplifier indicates that it has accepted a function code command. Because the result of exclusive-ORing EBUF and EBSY becomes 0, it becomes possible to issue another function code.

[Input condition] The state of the signal is inverted when a function code command is received by the servo amplifier.

(3) Function code

[Classification] Output signal <Yy+5>

[Function] The host specifies the function code command to be executed.

[Operation] The servo amplifier behaves as directed by the function code command when receiving it. See "Direct command function details" for details.

(4) Command data

[Classification] Output signal <Yy+6 to Yy+15>

[Function] The host provides data for a function code command.

[Operation] The servo amplifier behaves as directed by the function code command when receiving it. See "Direct command function details" for details.

(5) Response data

[Classification] Input signal <Xx+7 to Xx+15>

[Function] (A) The servo amplifier returns the result of function code command execution.

(B) The servo amplifier returns the data requested by the function code.

(C) The servo amplifier outputs continuous-output data, such as the current position, requested by the continuous read command.

[Input condition] (A) The servo amplifier returns the result of function code command execution.
It is possible to defer the return of the result of each function code command and return their results at the same time, if they are of a type that can be buffered.

(B) The servo amplifier outputs data, such as alarm information, requested by the function code.

(C) When the host receives data, such as the current position, that is being monitored continuously, the servo amplifier continues to output the requested data in response to a single request.
After setting the above data or result, the servo amplifier inverts the state of EOSTB. They can be read when the result of exclusive-ORing EOREND with EOSTB is 1. EOPC indicates that the current data is of continuous output type. When EOPC is 0, it indicates data covered in (A) or (B). When it is 1, it indicates data covered in (C).

(6) Continuously output data signal EOPC

[Classification] Input signal <Xx+4#2>

[Function] The servo amplifier indicates that continuously output data requested using a function code command is being output as response data.

[Input condition] The signal becomes 1 when:

1. Continuously output data requested by a function code command is being output as response data.

The signal becomes 0 when:

1. Data other than continuously output data requested by a function code command is being output as response data.

(7) Response data readable signal EOSTB

[Classification] Input signal <Xx+4#6>

[Function] The servo amplifier indicates that data requested using a function code command has been output as response data and is now readable.

[Input condition] The state of the signal is inverted when:

1. The response data becomes readable.

(8) Response data read completion signal EOREND

[Classification] Output signal <Yy+4#6>

[Function] The host notifies the servo amplifier that it has read response data.

[Operation] When the state of the signal is inverted, the servo amplifier behaves as follows:

1. The result of function code command execution is output as response data.
2. If a function code command is a data output command, the command is executed, and the result is output as response data.

NOTE

If the result of exclusive-ORing EOSTB with EOREND is 1, it becomes impossible to output further command data. Before inverting the state of EOREND, apply appropriate countermeasures.

(9) Command continuation notification signal ECNT

[Classification] Output signal <Yy+4#0>

[Function] When the host has too much command data to be sent at one time, it sets the ECNT signal to 1 to inform the slave that remaining data exists.

[Operation] When the ECNT signal becomes 1, the servo amplifier behaves as follows:

1. After receiving command data from the buffer, the servo amplifier inverts the state of the EBSY signal so that it matches the state of the EBUF, thereby prompting the transfer of the next data.

The signal is reset to 0 at the last data of a series of commands.

(10) PMM data signal USR1

[Classification] Input signal <Xx+4#3>

[Function] Direct commands transfer data using the same area as the power mate CNC manager function. If USR1 is 0, it is necessary to perform special processing to read the data, because it is a response from the ladder program of the host. If USR1 is 1, the response command (Xx+4 and after) is for the power mate CNC manager and, therefore, the ladder program on the host ignores it.

[Input condition] The signal becomes 1 when:

1. The response data is power mate CNC data.

The signal becomes 0 when:

1. The response data is data from a ladder program.

(11) Response data continuation notification signal ECONT

[Classification] Input signal <Xx+4#0>

[Function] If there is too much response data to be sent at one time, the ECONT signal is set to 1. In this case, after reading the current data, the host waits for the next data. The host must continue to read data for as long as the ECONT signal is 1. The "next data" is input from Xx+5.

[Input condition] The signal becomes 1 when:

1. Remaining response data exists.

The signal becomes 0 when:

1. All response data has been read.

---

(12) Function code command completion notification signal ECF

[Classification] Input signal <Xx+4#5>

[Function] If function code command execution completion notification mode is entered with NMOD set to 1, the servo amplifier sets ECF to 1 to indicate that positioning directed by this command has been completed, and waits for the next command to be executed until the host responds. The host issues the SET FIN command to cause processing to move to the next command.

[Input condition] The signal becomes 1 when:

1. The system enters function code command execution completion notification mode with NMOD set to 1, and positioning directed by the function code is completed.

The signal becomes 0 when:

1. The SET FIN command is executed.

---

(13) Alarm signal DAL

[Classification] Input signal <Xx+4#1>

[Function] If an alarm condition occurs in the servo amplifier, the servo amplifier sets the DAL signal to 1. The host issues a READ ALARM STATUS command to read details of the alarm condition, as required.

[Input condition] The signal becomes 1 when:

1. When an alarm condition occurs in the slave.

The signal becomes 0 when:

1. When there is no alarm condition in the slave.

---

(14) Wait signal WAT

[Classification] Input signal <Xx+1#0>

[Function] The servo amplifier indicates, to the host, that it is in the wait state. After performing the necessary processing, the host returns a wait completion signal (WFN) to cause the servo amplifier to continue operating. This method is used by the servo amplifier to request the host to perform processing, when the servo amplifier is running continuously in memory operation mode.

[Input condition] The signal becomes 1 when:

1. The servo amplifier executes a wait command during memory operation.

The signal becomes 0 when:

1. The host sets the wait completion signal WFN to 1.

---

(15) Wait completion signal WFN

[Classification] Output signal <Yy+1#4>

[Function] If the servo amplifier issues wait signal WAT to cause it to enter the wait state, the host releases the servo amplifier from the wait state. Upon receiving the wait completion signal, the servo amplifier executes the next command.

[Operation] When the servo amplifier is in the wait state, it sets the wait signal WAT to 1. If the WFN signal is set to 1 under this condition, the servo amplifier unit and host behave as follows:

1. The servo amplifier resets the wait signal WAT to 0. Upon detecting that the WAT becomes 0, the host resets the WFN to 0. The servo amplifier exits from the wait state and executes the next command.

(16) Memory registration signal INPF

[Classification] Output signal <Yy+3#7>

[Function] The host can store function code commands into the memory of the servo amplifier unit and control memory operation according to the data in the memory. If buffering type function code, such as a position command, is issued with INPF set to 1, it is registered into memory instead of being executed. Up to 32 blocks can be registered. Once a series of registration operations has been completed, the INPF is reset to 0. This command is erased when the power is switched off. It is necessary to register it in memory before memory operation is used. If the INPF is set to 1 when function code is already registered in memory, the function code is cleared from memory, allowing new function code to be registered.

[Operation] If buffering type function code is issued with INPF set to 1, it is stored into memory instead of being executed.

(17) Memory registration in-progress signal INPFO

[Classification] Input signal <Xx+3#7>

[Function] The servo amplifier indicates, to the host, that it is in memory registration mode. When the INPFO signal is 1, a buffering type function code command, such as a positioning command, is stored into memory instead of being executed.

[Input condition] The signal becomes 1 when:

1. The host sets the INPF signal to 1 to specify memory registration mode, and the servo amplifier enters memory registration mode.

The signal becomes 0 when:

1. The host resets the INPF signal to 0 to release memory registration mode, and the servo amplifier exits from memory registration mode.

(18) Interface switch signal DRC

[Classification] Output signal <Yy+1#5>

[Function] The host informs the servo amplifier of the interface type (peripheral equipment control interface or direct command interface) to be used.

[Operation] When the DRC signal is 0, the slave runs using the peripheral equipment control interface. When it is 1, the slave runs using the direct command interface. The servo amplifier also sends the interface status notification signal DRCO ((19) of Section 2.3.14) to the host. After detecting the DRCO signal, the host issues commands.

After changing the DRC signal, the host should not issue a command within one scan after the DRCO signal changes. Once the state of the DRC signal is inverted, do not invert it again before the state of the DRCO signal changes accordingly, as data communication with the servo amplifier is hindered. Before inverting the state of the DRC signal again, wait for at least one scan after the state of the DRCO signal changes.

NOTE

Usually, the DRC signal should not be switched while the power is switched on. If necessary, it should be switched during a reset state, that is, while neither automatic nor JOG operation is in progress. Moreover, it should not be switched when the motor is not in the in-position state.

(19) Interface status notification signal DRCO

[Classification] Input signal <Xx+1#1>

[Function] The servo amplifier informs the host of the current interface mode (peripheral equipment control or direct command interface). After detecting the DRCO signal, the host issues commands.

[Input condition] The signal becomes 1 when:

1. The slave is in direct command interface mode.

The signal becomes 0 when:

1. The slave is in peripheral equipment control interface mode.

2.3.15 Direct Input Signals

NOTE
The following signals are not host-to-servo amplifier FANUC I/O Link interface signals.

(1) Emergency stop signal *ESP

[Classification] Servo amplifier direct input signal

[Function] The host stops the servo amplifier immediately.

[Operation] When the signal becomes 0, the servo amplifier behaves as follows:

1. Hosts stops servo amplifier immediately.
2. A reset is performed after a stop.
3. The servo system cannot operate for as long as the emergency stop signal is 0. So, the servo preparation completion signal SA is held at 0. If the machine is shifted while the SA is 0, the shift is reflected in the current coordinates in the servo amplifier; the current position will not be lost (follow-up).
4. Neither jog feed nor a function code command can be issued while the emergency stop signal is 0.

(2) Overtravel signals *-OT and *+OT

[Classification] Servo amplifier direct input signal

[Function] The host indicates that the controlled axis has reached the stroke limit described below.

*-OT: The stroke limit in the negative direction has been reached.

*+OT: The stroke limit in the positive direction has been reached.

[Operation] When the signal becomes 0, the servo amplifier behaves as follows:

1. The controlled axis is stopped immediately by zero-speed-based deceleration, and an OT alarm for the input direction is output. A movement in the opposite direction can be made by jog feed or handle feed. The execution of function code commands and the reading of commands are stopped.
2. The direction in which the signal becomes 0 is memorized. Even after the signal is returned to 1, the controlled axis is prevented from operating in that direction until the OT alarm is reset.

(3) High-speed interlock signal *RILK

[Classification] Servo amplifier direct input signal

[Function] The host stops all movement command-specified feed.

[Operation] While the signal is 0, the servo amplifier resets the all movement command-specified feed to 0 to stop controlled axis feed. Axis movement is decelerated to a stop.

A move command remains valid even when the signal is 0. Movement can be resumed immediately when the signal is set to 1 again. This does not affect non-move commands.

(4) Deceleration signal for reference position return *DEC

[Classification] Servo amplifier direct input signal

[Function] The host decelerates feed operation based on a reference position return command.

[Operation] The servo amplifier decelerates feed for reference position return when this signal switches from 1 to 0. After deceleration, the FL feedrate (set in parameter No. 054) is used for movement. If this signal switches from 0 to 1 during movement at the FL feedrate, the movement being made along an axis stops at the first encountered grid, and that position becomes a reference position. At this time, the reference position return completion signal (ZPX) is set to 1. For details, see Section 3.5.

NOTE
When the signal described above is used, the high-speed interlock signal (*RILK) cannot be used.

---

(5) Skip signal HDI

[Classification] Servo amplifier direct input signal

[Function] The workpiece coordinates at the point when this signal is input are recorded.

[Operation] If, during the execution of the peripheral equipment control command (function code 8) for positioning for the skip function, a rise ("0" to "1") or "1" to "0") of this signal is captured, axis movement is stopped immediately and command execution is terminated. Also, the workpiece coordinates (skip measurement data) at the point when this signal is input are recorded. The recorded data can be read as response data by setting parameter No. 020 to "5".

Also, while the direct command for positioning for the skip function is being executed independently (the SKIP bit of the absolute positioning command and the incremental positioning command is set), axis movement is stopped immediately and command execution is terminated. If thirty-two-block buffering operation is in progress, the system skips the currently executed block, moving to the next block. Skip measurement data is also recorded during the execution of the direct command. The recorded data can be read on the host by executing the direct command for "reading skip measurement data".

NOTE
1 To perform positioning for the skip function, bit 0 (HENB) of parameter No. 017 must be set to "1" (use the skip function).
2 It is possible to specify, using an appropriate parameter, whether to retain the previous skip measurement data or record the specified end point coordinates if, during the execution of positioning for the skip function (peripheral equipment control/direct command), the skip signal (HDI) is not input and the end point is reached. If bit 2 (SPCO) of parameter No. 17 is "0", the previous skip measurement data is recorded; if "1", the specified end point coordinates.
3 If reading skip measurement data with peripheral equipment control, confirm the completion of positioning for the skip function (OPC4 = 1) beforehand.
4 If, during the execution of positioning for the skip function (peripheral equipment control/direct command), the execution is interrupted due to an external reset, emergency stop, alarm, etc., no skip measurement data is updated.
5 An excess amount Qmax after HDI signal input is as follows.

$$Qmax = Fm \times 1/60 \times 1/1000 \times (17 + Tc + Ts)$$

Qmax: Excess amount [user-specified units]
Fm: Speed [user-specified units/min]
Tc: CNC-side time constant [msec]
Ts: Servo time constant [msec] (1/loop gain)

3 PERIPHERAL EQUIPMENT CONTROL

3.1 COMMAND FORMAT FOR PERIPHERAL EQUIPMENT CONTROL

The servo amplifier receives a command, issued in the specified format, from the host, then executes a sequence of operations for performing peripheral equipment control. When a command for reading the current position is specified, the servo amplifier returns the result of command execution to the host. The command and result are exchanged, in an interface area, in the formats shown below.

- General format of instruction commands (host → servo amplifier)

	7	6	5	4	3	2	1	0
Yy+2	Function code				Command data 1			
Yy+3								
Yy+4	Command data 2							
Yy+5								
Yy+6								

- General format of response commands (servo amplifier → host)

	7	6	5	4	3	2	1	0
Xx+3								
Xx+4	Response data							
Xx+5								
Xx+6								

- Data types

Byte type: (BYTE)

7	6	5	4	3	2	1	0	BIT

Word type: (WORD)

7	6	5	4	3	2	1	0	BIT
Lower byte								
Higher byte								

Data = (higher byte)*256 + (lower byte)

Double precision type (DWORD):

7	6	5	4	3	2	1	0	BIT
Lowest byte								
Second lowest byte								
Second highest byte								
Highest byte								

Data = (highest byte)*16777216
+ (second highest byte)* 65536
+ (second lowest byte)*256
+ (lowest byte)

3.2 PERIPHERAL EQUIPMENT CONTROL PROCEDURE

3.2.1 Specifying Operation Using a Function Code

In peripheral equipment control, the host sets a function code, command data 1, and command data 2, then turns the automatic operation start signal (ST) in the interface area on then off to start the instruction command. Some instruction commands use a feed axis and direction select signal (+X or -X).

The servo amplifier returns a operation completion signal (OPC1, OPC2, OPC3, OPC4) according to the status of command execution; the host performs the corresponding processing.

OPC1 : This signal notifies the host that a function code has been received. At the same time, the unclamp command is output.

OPC2 : This signal notifies the host that the unclamp state output signal has been received.

OPC3 :This signal notifies the host that a movement has been completed. At the same time, the clamp command is output.

OPC4 : This signal notifies the host that the clamp state output signal has been received, and that a function code has been executed. Response data, if any, is set at the same time.

Until OPC4 is received, the next instruction command must not be set.

NOTE

When the clamp/unclamp function is not used, OPC2 and OPC3 are not output from the servo amplifier.

3.2.2 Receiving Response Data

From the response data, the host can read the current position of the axis controlled by a servo amplifier as well as any alarm information.

To read alarm information, the host sets the alarm output command signal (DSAL) to 1. When the alarm output state check signal (DSALO) is 1, the number of alarms and alarm numbers are returned as response data.

When the alarm output command signal (DSAL) is set to 0, position information is set as response data. Position data can be selected using parameter No. 20 (PHOUT). The type of data can be checked using a response data check signal (DSP1, DSP2).

3.3 FUNCTION CODES

3.3.1 Function Codes

Function code	Command data 1 4 bits	Command data 2 4 bytes	Mode	Start signal	Remarks
0 : Jog operation	0	0	JOG	+X/-X	(Note 1)
2 : ATC operation/turret control	1: Automatic operation (shortcut rotation) 2: Automatic operation (positive direction) 3: Automatic operation (negative direction)	Turret/magazine number	AUTO	ST	Set an amount of travel per ATC rotation and the number of turrets/magazines in the parameters. (Note 3, Note 4, Note 8)
	4 : 1-pitch rotation 5 : Continuous indexing (Note 2)	0	JOG	+X/-X	
3 : Point positioning	Feedrate code 1 to 7 15: Rapid traverse	Point number 1 to 12	AUTO	ST	(Note 5, Note 6, Note 7, Note 8)
4 : Reference position return	Reference position number 1: First reference position 2: Second reference position 3: Third reference position	0	JOG	ST	
	15: Reference position setting (Note 9, Note 10)			+X/-X	
	15: Reference position external setting (Note 11)			ST	

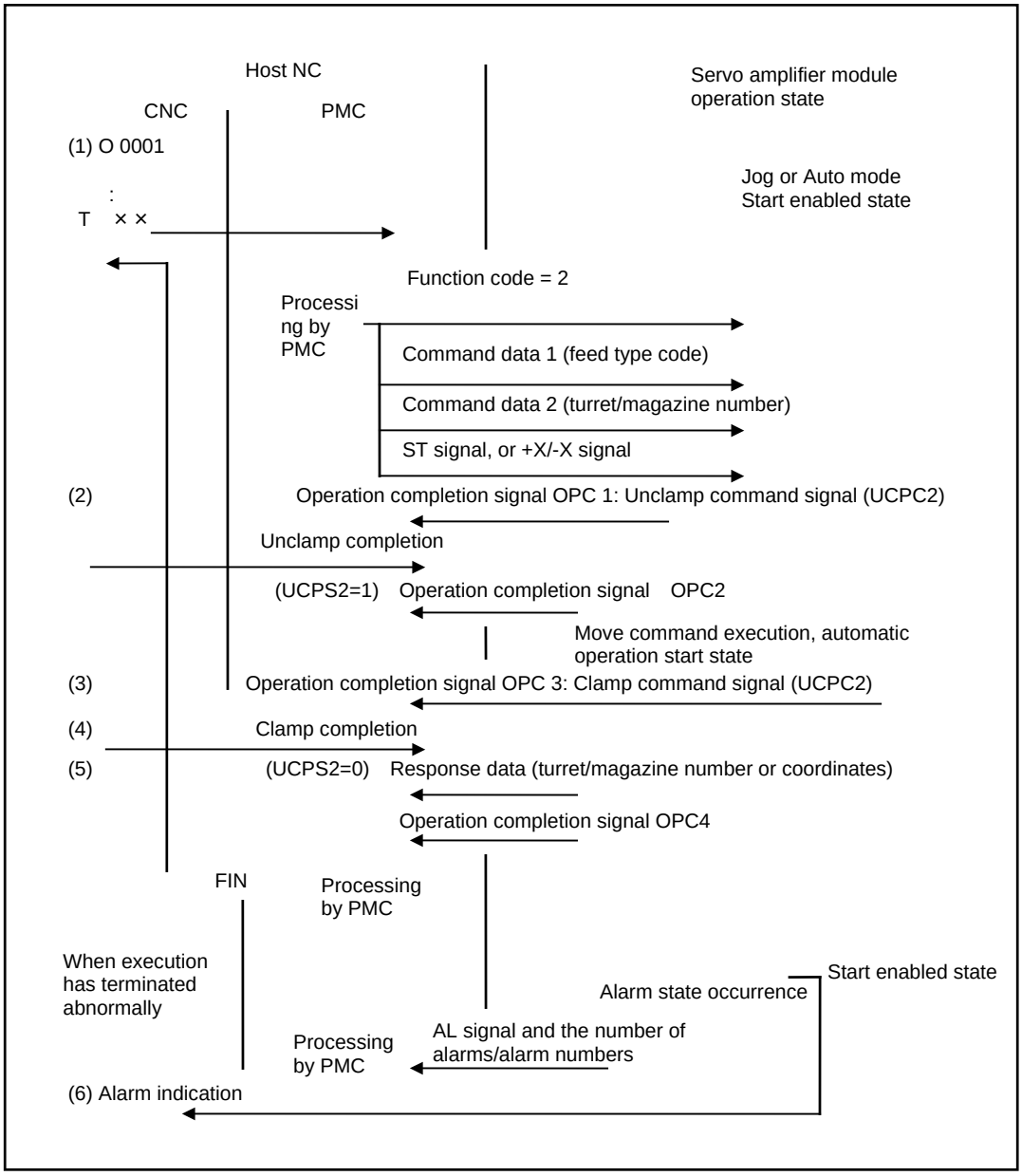
Function code	Command data 1 4 bits	Command data 2 4 bytes	Mode	Start signal	Remarks
5 : Positioning (absolute specification)	Feedrate code 1 to 7 15: Rapid traverse	Workpiece coordinates	AUTO	ST	(Note 6)
6 : Positioning (incremental specification)	Feedrate code 1 to 7 15: Rapid traverse	Travel distance	AUTO	ST	(Note 6)
7 : Speed control	0: Start-up or change-gear command 1: Stop command	Speed command value	AUTO	ST	(Note 12)
8 : Positioning (for skip function)	BIT3: 0(absolute specification) BIT0-2: Feedrate code 1 to 7	Workpiece coordinates	AUTO	ST	(Note 6, Note 13, Note 14)
	BIT3: 0(incremental specification) BIT0-2: Feedrate code 1 to 7	Travel distance			
10: Coordinate system setting	1: Coordinate system setting 2: Magazine number setting 3: Point number setting	Coordinates Magazine number Point number	AUTO	ST	The coordinates corresponding to a number represent the current position.
12 : Parameter rewriting	Parameter type 1: Byte 2: Word 3: Two-word (1st) 4: Two-word (2nd)	Parameter number and parameter value		ST	
14 : Point data external setting	Point number 1 to 12	Point data	JOG	ST	Data is entered into the parameter corresponding to a point number.
15 : Data setting by teaching		Point number 1 to 12	JOG	ST	A coordinate is entered into the parameter corresponding to a point number.

NOTE

1 Besides function code 0, jog operation can also be performed with 1, 10, and 15.
2 If the remaining distance to the next point is shorter than the required deceleration distance for stopping at that point when the feed axis and direction selection switch (+X, -X) is released, movement is made to the point immediately after the next point.
3 Set bit 1 (ROTX) of parameter No. 000 (for rotation axis setting) to 1, and set bit 7 (ROAX) of parameter No. 000 to 1 (for rollover).
4 In ATC automatic operation mode, rapid traverse (parameter No. 040) is assumed unconditionally. In jog operation mode, rapid traverse is assumed if the RT signal is ON (parameter No. 040) and jog speed is assumed if the RT signal is OFF (parameter No. 041).
5 As the position corresponding to each point number, workpiece coordinates are set in parameter Nos. 154 to 165.
6 The feedrates of feedrate codes 1 to 7 are set in parameter Nos. 044 to 050, and a rapid traverse rate is set in parameter No. 040.
7 In rollover setting, shortcut control is possible. In rollover setting, set a value within ±1 rotation for the absolute positioning command.
8 When a half rotation command is issued with ATC or point positioning, operation is in the + direction if end point > start point and in the - direction if end point < start point.
9 After the power is turned on, performing reference position setting causes 1 to be output as the turret/magazine number. If performing the reference position return function without dogs, be sure to use jog operation to move the tool at a certain speed or greater and for a certain distance or greater (speed and distance enough to accumulate 128 pulses or more of servo positional deviation) in the reference position return direction set in the parameter. After reference position return, by setting bit 1 (SZRN) of parameter No. 011 appropriately, the reference position can be shifted by one grid each time +X/-X is turned ON.
10 When bit 2 (DZRN) of parameter No. 011 is set to 1, the reference position return function with dogs is enabled. For details, see Section 3.5, "Reference Position Return Function with Dogs".
11 When the absolute pulse coder is used, the current position can be set as the reference position. After positioning to the reference position, perform the reference position external setting function.
12 Speed control cannot use clamping/unclamping.
13 To perform positioning for the skip function, bit 0 (HENB) of parameter No. 017 must be set to "1" (use the skip function).
14 With positioning for the skip function, the command can be interrupted (skipped) during positioning at the time when the skip signal (HDI) is input. Rapid traverse cannot be specified as the positioning speed.
15 Never change the current mode during operation. The mode can be changed only after operation has been stopped.
16 Axis movement commands other than JOG operation are not executed if the alarm signal (AL) is "1".

3.4 DETAILS OF FUNCTION CODES

3.4.1 ATC/Turret Control



(1) When the host NC program executes a T code command, the PMC on the host NC sets the function code, command data 1, and command data 2, then sends the ST signal or +X/-X signal to the servo amplifier. Upon receipt of the data, the servo amplifier returns the operation completion signal OPC 1 to the host NC, and also outputs the unclamp command signal.

(2) When unclamp completion notification is sent from the host NC, the servo amplifier unit returns the operation completion signal OPC 2 to the host NC, then starts movement to the position corresponding to a specified turret/magazine number.

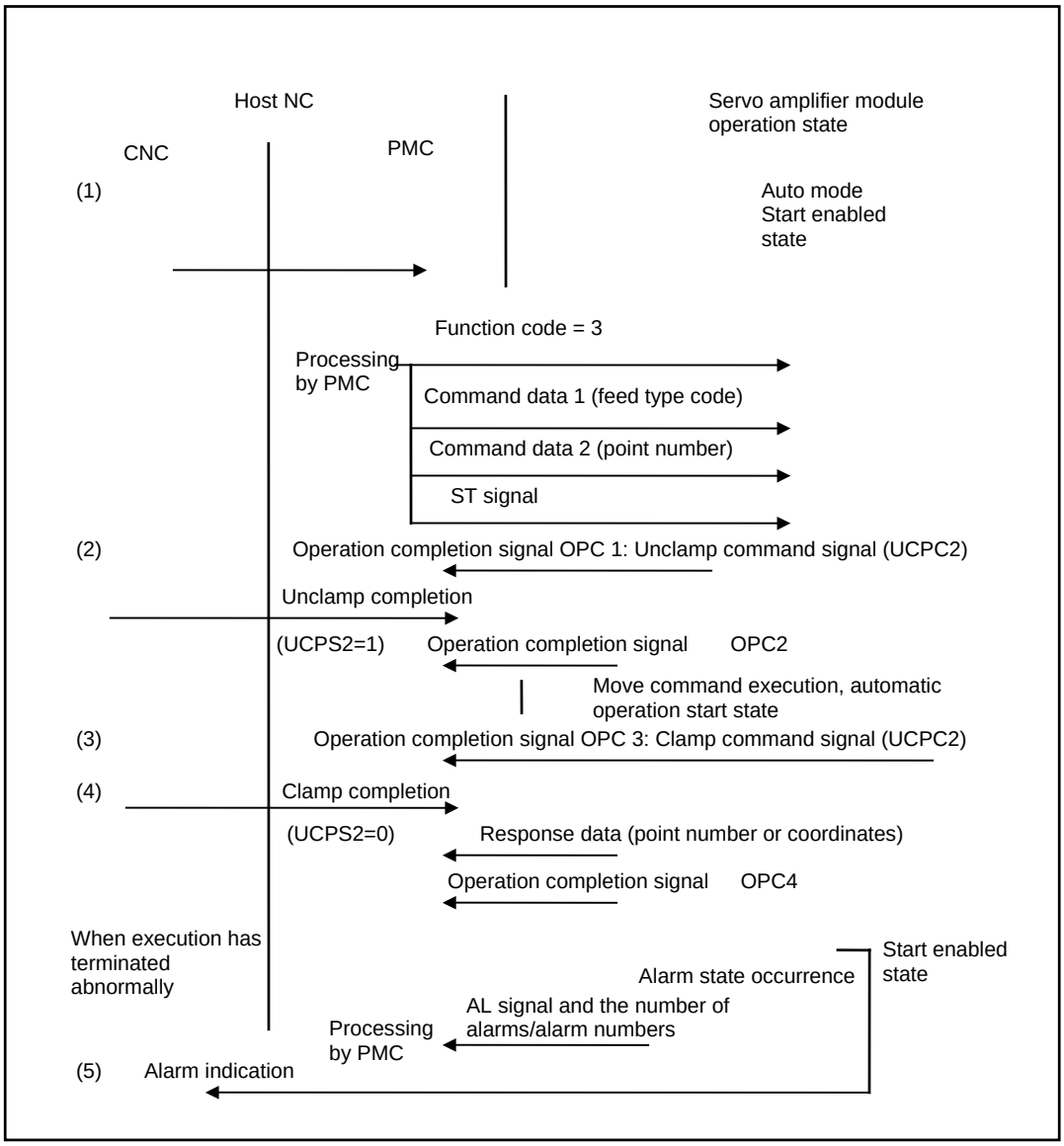
(3) Upon completion of the movement, the servo amplifier returns the operation completion signal OPC 3 to the host NC, and also outputs the clamp command signal.

(4) When clamp completion notification is sent from the host NC, the servo amplifier unit returns response data (turret/magazine number or coordinates) and the operation completion signal OPC 4, and is placed in the start enabled state.

(5) Upon receipt of the operation completion signal OPC 4, the PMC on the host NC returns the FIN signal.
(6) If an alarm is issued while the servo amplifier is executing an instruction, the AL signal is output. So, the PMC on the host NC is to perform processing such as alarm indication. In this case, the number of alarms and alarm numbers can be included in the response data by setting the DSAL signal [Subsection 2.3.13.(9)] to 1.

Supplementary information
1) The unclamp/clamp command signal and state signal are used for communication with the host.
2) Whether the unclamp/clamp state signal is to be checked is specified by setting bit 2 (IGCP) of parameter No. 003. When IGCP is set such that no check is to be made, the unclamp command signal UCPC2 is not output.
3) Use parameter No. 167 to set the period between the servo amplifier being turned on and the output of the unclamp command signal. Use parameter No. 168 to set the period between the clamp command signal being output and the servo amplifier unit being turned off.
4) The ST signal can be accepted in the start enabled state only.
5) The start enabled state is that state in which the STL signal is off.

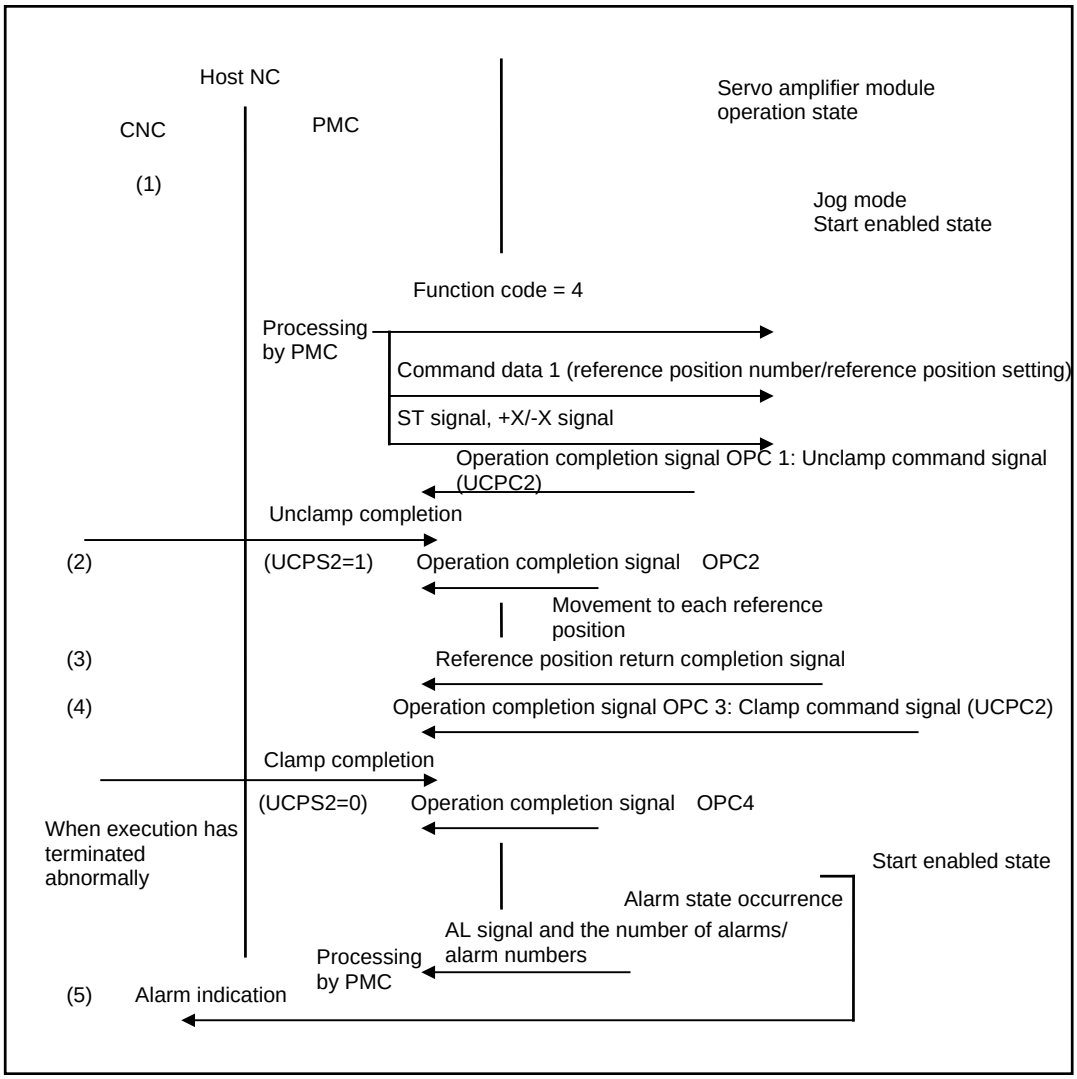
3.4.2 Point Positioning Control



(1) The PMC on the host NC sets the function code, command data 1, and command data 2, then sends the ST signal to the servo amplifier. Upon receipt of the data, the servo amplifier returns the operation completion signal OPC 1 to the host NC, and also outputs the unclamp command signal to the host NC.
(2) When unclamp completion notification is sent from the host NC, the servo amplifier returns the operation completion signal OPC 2 to the host NC, and starts movement to the position corresponding to a specified point number.
(3) Upon completion of the movement, the servo amplifier returns the operation completion signal OPC 3 to the host NC, and also outputs the clamp command signal to the host NC.
(4) When clamp completion notification is sent from the host NC, the servo amplifier returns response data (point number or coordinates) and the operation completion signal OPC 4, and is placed in the start enabled state.
(5) If an alarm is issued while the servo amplifier is executing an instruction, the AL signal is output. So, the PMC on the host NC is to perform processing such as alarm indication. In this case, the number of alarms and alarm numbers can be included in the response data by setting the DSAL signal [Subsection 2.3.13.(9)] to 1.

Supplementary information
1) The unclamp/clamp command signal and state signal are used for communication with the host NC.
2) Whether the unclamp/clamp state signal is to be checked is specified by setting bit 2 (IGCP) of parameter No. 003. When IGCP is set such that no check is performed, the unclamp command signal UCPC2 is not output.
3) Use parameter No. 167 to set the period between the servo amplifier being turned on and the unclamp command signal being output. Use parameter No. 168 to set the period between the clamp command signal being output and the servo amplifier unit being turned off.
4) The ST signal can be accepted in the start enabled state only.
5) The start enabled state is that state in which the STL signal is off.

3.4.3 Reference Position Return



(1) The PMC on the host NC sets the function code and command data 1, then sends the ST signal or +X/-X signal to the servo amplifier. Upon receipt of the data, the servo amplifier returns the operation completion signal OPC 1 to the host NC, and also outputs the unclamp command signal.

(2) When unclamp completion notification is sent from the host NC, the servo amplifier unit returns the operation completion signal OPC 2 to the host NC, and starts movement to a specified reference position.

(3) Upon completion of the movement, the servo amplifier returns the reference position return completion signal and operation completion signal OPC 3 to the host NC, and also outputs the clamp command signal.

(4) When clamp completion notification is sent from the host NC, the servo amplifier unit returns the operation completion signal OPC 4 to the host NC, enters the start enabled state, then ends the cycle.

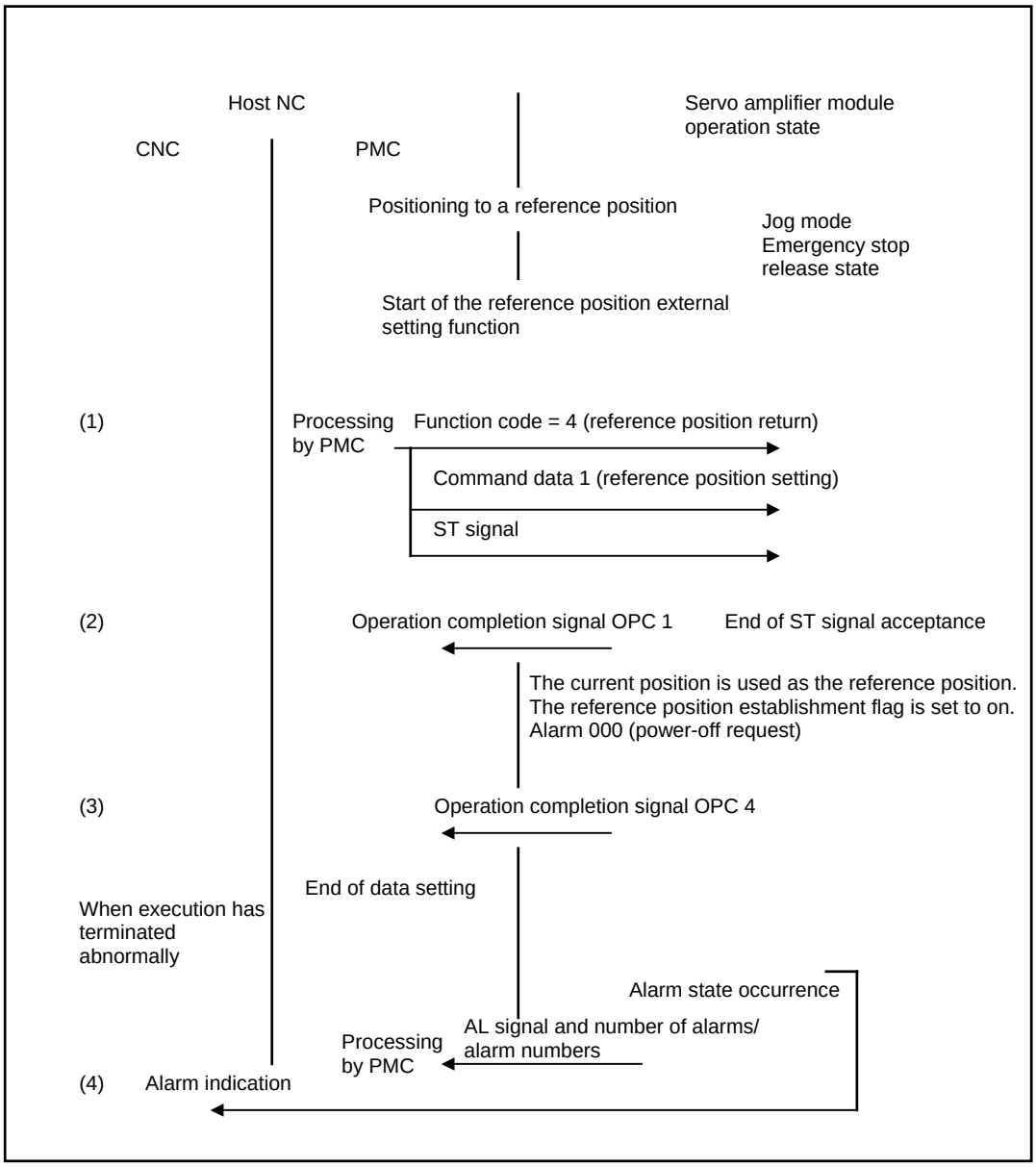
(5) If an alarm is issued while the servo amplifier is executing a reference position return operation, the AL signal is output. So, the PMC on the host NC is to perform processing such as alarm indication. In this case, the number of alarms and alarm numbers can be included in the response data by setting the DSAL signal [Subsection 2.3.13.(9)] to 1.

Supplementary information

1) The unclamp/clamp command signal and state signal are used for communication with the host NC.

2) Whether the unclamp/clamp state signal is to be checked specified by setting bit 2 (IGCP) of parameter No. 003. When IGCP is set such that no check is performed, the unclamp command signal UCPC2 is not output.
3) Use parameter No. 167 to set the period between the servo amplifier being turned on and the unclamp command signal being output. Use parameter No. 168 to set the period between the clamp command signal being output and the servo amplifier unit being turned off.
4) The ST signal can be accepted only in the start enabled state.
5) The start enabled state is that state in which the STL signal is off.

3.4.4 Reference Position Setting (when the Reference Position External Setting Function is Used)



(1) When the reference position external setting function is used, the PMC on the host NC sets the function code and command data 1, then sends the ST signal to the servo amplifier after positioning to the reference position.
(2) Upon receipt of the data, the servo amplifier returns the operation completion signal OPC 1 to the host NC.

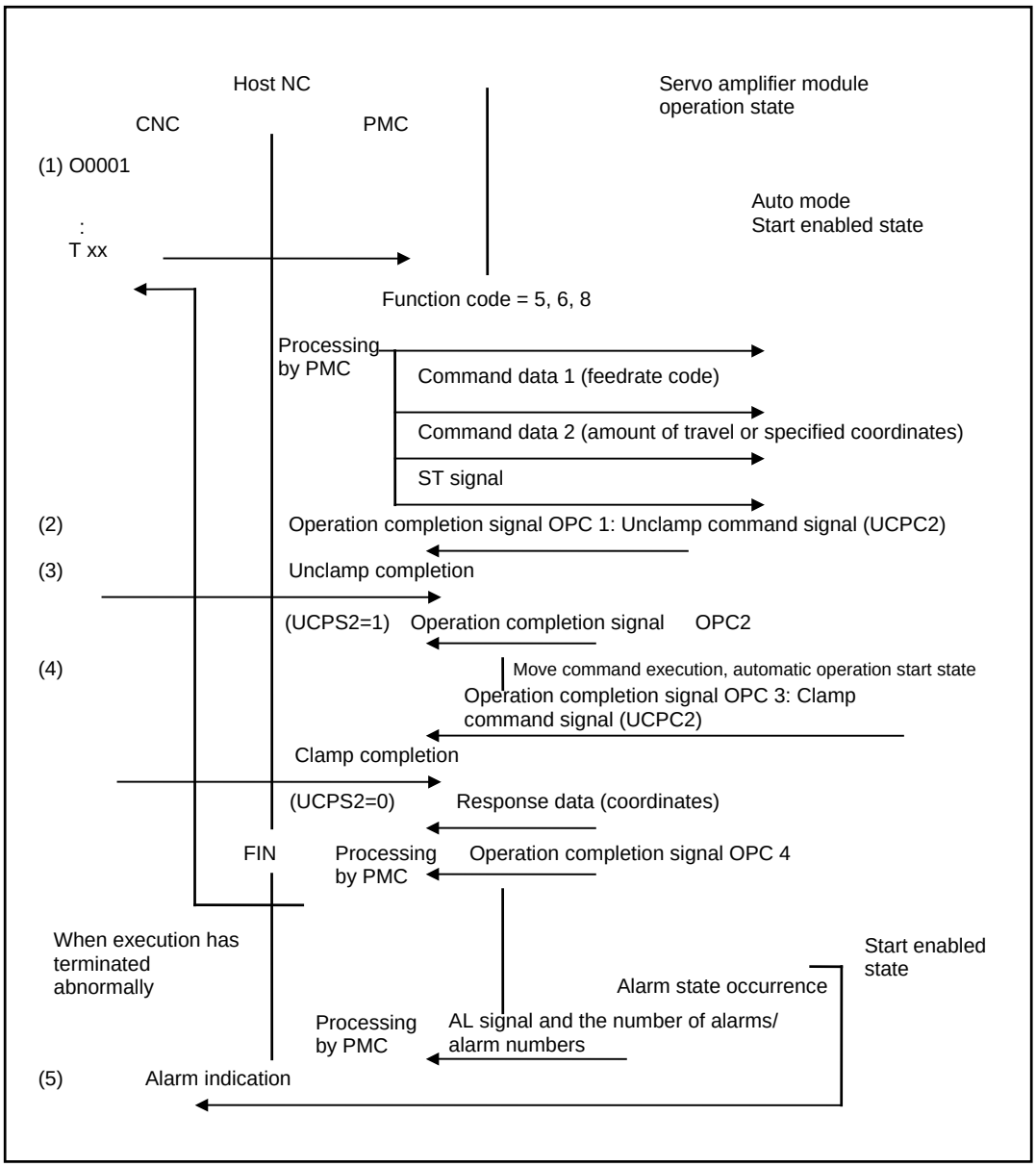
(3) The servo amplifier uses the current position as the reference position, sets the reference position establishment flag (bit 0 (ABSX) of parameter No. 011), outputs alarm 000 (power-off request), returns the operation completion signal OPC 4, then terminates.

(4) If an alarm is issued while the servo amplifier is executing reference position setting, the AL signal is output. So, the PMC on the host NC is to perform processing such as alarm indication. In this case, the number of alarms and alarm numbers can be included in the response data by setting the DSAL signal [Subsection 2.3.13.(9)] to 1.

Supplementary information

1) This function is enabled only when an absolute pulse coder is used.
2) The start enabled state is that state where the STL signal is off.

3.4.5 Positioning Control (Absolute/Incremental Specification, for Skip Function)



(1) The PMC on the host NC sets a function code, command data 1, and command data 2, then sends the ST signal to the servo amplifier. Upon receipt of the data, the servo amplifier returns the operation

completion signal OPC 1 to the host NC, and also outputs the unclamp command signal to the host NC.

(2) When unclamp completion notification is sent from the host NC, the servo amplifier unit returns the operation completion signal OPC 2 to the host NC, then starts movement.
If positioning for the skip function (function code 8) is issued, the skip function with the skip signal (HDI) is enabled. When HDI is input, axis movement is stopped immediately.

(3) After the end of movement (for the skip function, after the input of HDI), the servo amplifier returns the operation completion signal OPC3 to the host NC, and at the same time, outputs a clamp command signal to the host NC.

(4) When clamp completion notification is sent from the host NC, the servo amplifier unit returns response data (coordinates) and the operation completion signal OPC 4, and is placed in the start enabled state.

(5) If an alarm is issued while the servo amplifier is executing an instruction, the AL signal is output. So, the PMC on the host NC is to perform processing such as alarm indication. In this case, the number of alarms and alarm numbers can be included in the response data by setting the DSAL signal [Subsection 2.3.13.(9)] to 1.

Supplementary information

1) The unclamp/clamp command signal and state signal are used for communication with the host.
2) Whether the unclamp/clamp state signal is to be checked is specified by setting bit 2 (IGCP) of parameter No. 003. When IGCP is set such that no check is performed, the unclamp command signal UCPC2 is not output.
3) Use parameter No. 167 to set the period between the servo amplifier being turned on and the unclamp command signal being output. Use parameter No. 168 to set the period between the clamp command signal being output and the servo amplifier unit being turned off.
4) The ST signal can be accepted in the start enabled state only.
5) The start enabled state is that state in which the STL signal is off.
6) With the skip function, the workpiece coordinates at the point the skip signal (HDI) is input are internally recorded. The recorded skip measurement data (workpiece coordinates) can be read as response data by setting parameter No. 20 to "5".

NOTE

1 To perform the skip function, bit 0 (HENB) of parameter No. 017 must be set to "1" (use the skip function).
2 It is possible to specify, using an appropriate parameter, whether to retain the previous skip measurement data or record the specified end point coordinates if, during the execution of positioning for the skip function, the skip signal (HDI) is not input and the end point is reached. If bit 2 (SPCO) of parameter No. 17 is "0", the previous skip measurement data is recorded; if "1", the specified end point coordinates.
3 If reading skip measurement data, confirm the completion of positioning for the skip function (OPC4 = 1) beforehand.
4 If, during the execution of positioning for the skip function, the execution is interrupted due to an external reset, emergency stop, alarm, etc., no skip measurement data is updated.

3.4.6 Speed Control

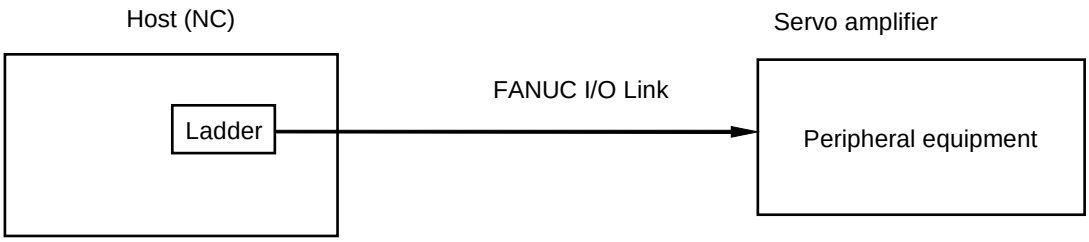
3.4.6.1 Overview

The speed control function executes speed control by specifying a speed value as command data. Moreover, acceleration/deceleration is applied using a time constant (parameter No. 135) dedicated to

speed control. Note, however, that acceleration/deceleration based on a time constant is not applied in an emergency stop operation. During speed control, follow-up is performed, thus updating the position. In addition, a change in speed can be specified during speed control. If control is switchable between speed control and position control, an override can be applied to a velocity loop gain for position control when speed control is selected (parameter No. 116).
Speed control is executed in the AUTO mode.
A speed command value can be specified in steps of 1 min^{-1} of the motor, so that the speed control function is useful in controlling the continuous feed of a tool such as a rotation tool.
If a speed deviation check finds that a parameter-set value (parameter No. 136) is exceeded in the speed control mode, an alarm can be issued.
Speed control is available in types A and B. The difference is that type B allows specification of the torque limit. During speed control, the torque limit specified in parameter No. 108 has no effect. To make the torque limit take effect, use type B.

3.4.6.2 System configuration

The system configuration is shown below.



In the configuration above, the host issues a ladder-based command to peripheral equipment control via the FANUC I/O Link to control the servo amplifier.
With the speed control function, the servo amplifier first receives the speed command value (and for type B, the torque limit, too) and then starts operation with the ST signal (automatic operation start signal).

3.4.6.3 Peripheral equipment control command format

A speed command value is specified using the following command:
Command (host → servo amplifier)

	7	6	5	4	3	2	1	0	BIT
Yy+2	Function code				Command data 1				
Yy+3									
Yy+4	Command data 2								
Yy+5									
Yy+6									

Mode : AUTO
Function code : 7
Command data 1 : Specifies speed control activation, a speed change, or stop.
0: Specifies activation or a speed change.
1 : Specifies a stop.
Command data 2 :
<1> Type A (Parameter No.007#4 (VCTLB) = 0)
Specifies a speed command value of word type in Yy+3 and Yy+4.
Unit : [min^{-1}]
Valid data range : ±0 to the maximum speed of the motor
Always set 0 in Yy+5 and Yy+6.

Example) For a speed command of 4000 min^{-1}.
Speed command value = 4000 (= 0FA0h)min^{-1}

Yy+3	A0
Yy+4	0F
Yy+5	00
Yy+6	00

<2> Type B (Parameter No.007#4 (VCTLB) = 1)
Specifies a speed command value of word type in Yy+3 and Yy+4.
Unit : [min^{-1}]
Valid data range : ±0 to the maximum speed of the motor
Specifies the torque limit of the motor of word type in Yy+5 and Yy+6.
Valid data range : 0 to 7282
Determine the setting with the following calculation:
Setting = Torque limit [%] x 7282/100
A setting of 0 is assumed to be 100% (7282).

Example) Speed command of 1500 min-1 with a torque limit of 50%
Speed command value = 1500 (= 05DCh)min^{-1}
Setting of the torque limit = 50% x (7282/100) = 3641 (= 0E39h)

Yy+3	DC
Yy+4	05
Yy+5	39
Yy+6	0E

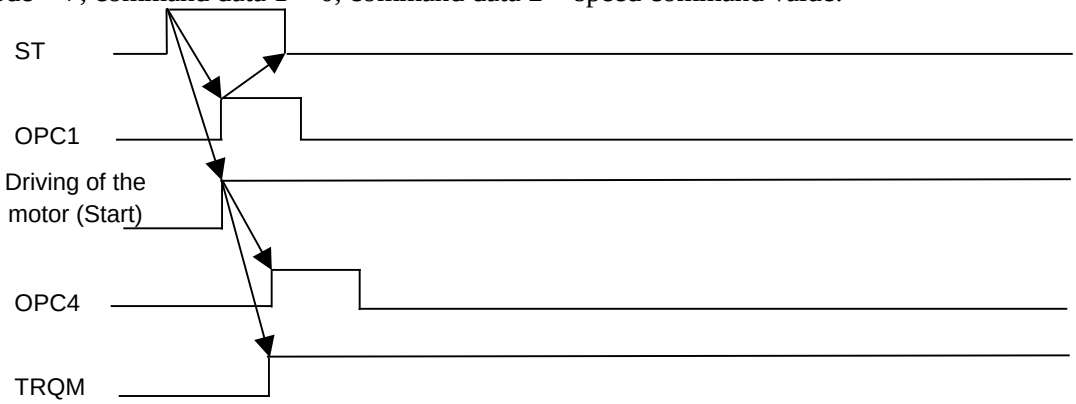
NOTE
1 The maximum speed of the motor depends on the motor used.
2 For type B, even if torque limit is not performed (torque limit of 100%), specify 0 or 7282 for the torque limit.
3 For type B, to change only the torque limit with the speed unchanged, use the variable speed command. At this time, specify the same speed as that specified the last time.
4 For type B, the torque limit cannot be specified with the stop command. After the stop command, torque limit value specified before the start of speed control (determined with parameter No. 108 and bit 2 of parameter No. 10)will be activated again.
5 For type B, the specified torque limit is clamped with the setting of parameter No. 080 (current limit).
6 Clamping/unclamping cannot be used.

3.4.6.4 Command timing chart

(1) Start of speed control

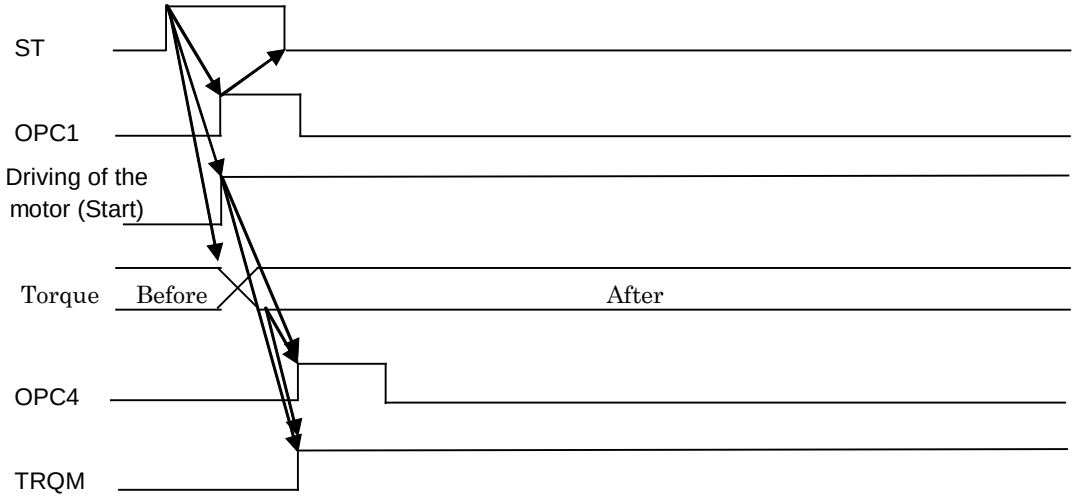
<1> Type A

Speed control is activated according to the timing chart shown below after the setting of function code = 7, command data 1 = 0, command data 2 = speed command value.



<2> Type B

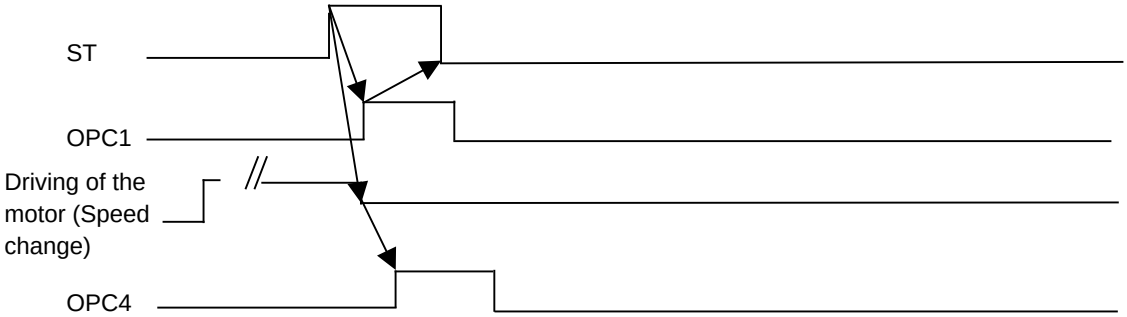
Speed control is activated according to the timing chart shown below after the setting of function code = 7, command data 1 = 0, command data 2 = speed command value.



(2) Speed change with speed control

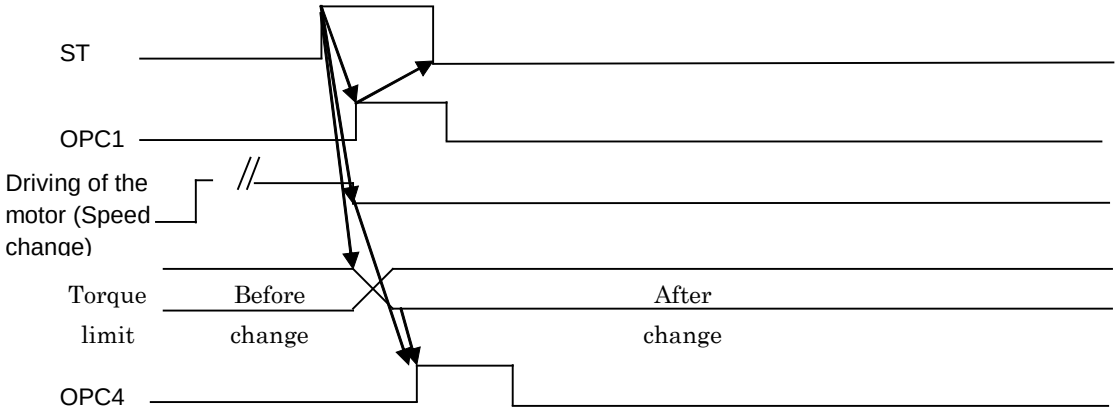
<1> Type A

A speed change based on speed control is activated according to the timing chart shown below after the setting of function code = 7, command data 1 = 0, command data 2 = new speed command value.



<2> Type B

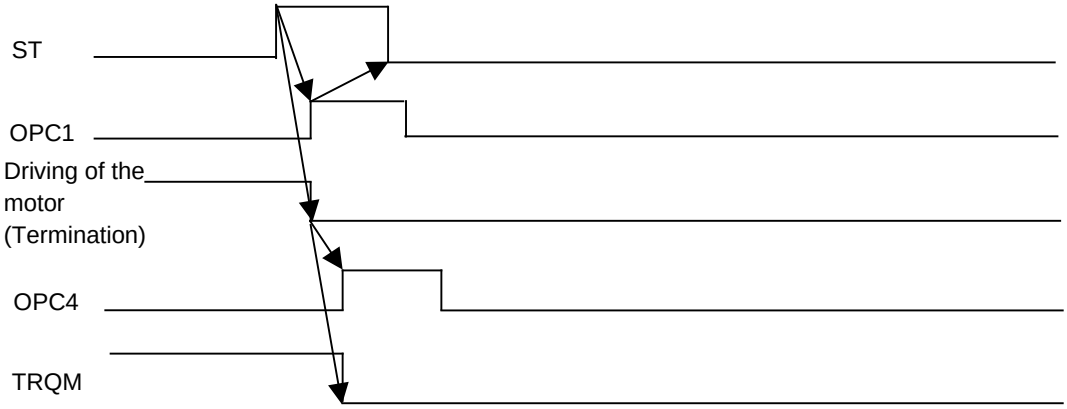
A speed change based on speed control is activated according to the timing chart shown below after the setting of function code = 7, command data 1 = 0, command data 2 = new speed command value. Use this command also to change the torque limit only.



(3) Termination of speed control

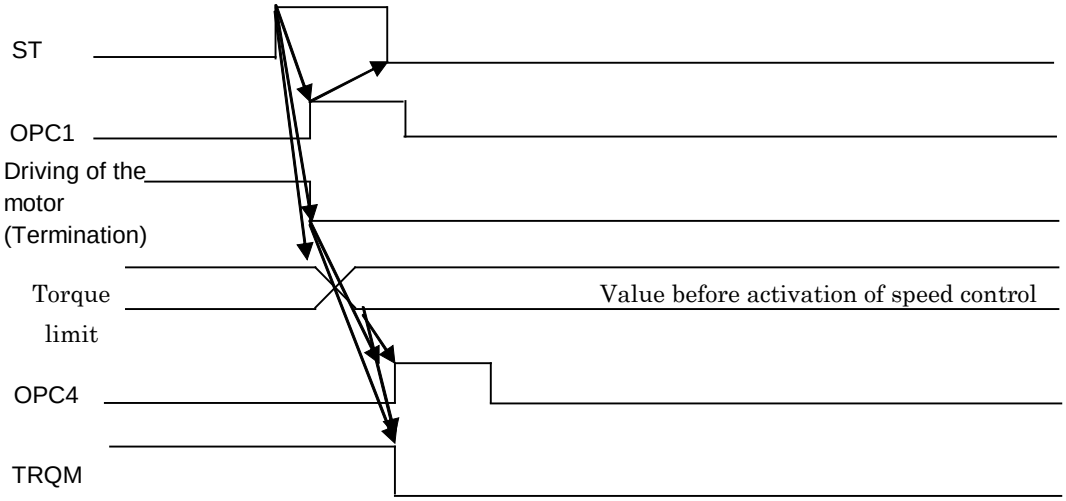
<1> Type A

Speed control is terminated according to the timing chart shown below after the setting of function code = 7 and command data 1 = 1.



<2> Type B

Speed control is terminated according to the timing chart shown below after the setting of function code = 7 and command data 1 = 1.



3.4.6.5 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
000	ROAX						ROTX	

[Size] 1 byte (bit type)
[Standard setting value] 0

ROTX Specifies whether the controlled axis is a linear or rotation axis, as follows:
0 : Linear axis
1 : Rotation axis
* To perform speed control, set this bit to "1".

ROAX Specifies whether the roll-over function of the rotation axis is valid, as follows:
0 : Invalid
1 : Valid
* To perform speed control, set this bit to "1".

No.	#7	#6	#5	#4	#3	#2	#1	#0
003							NCLP	

[Size] 1 byte (bit type)
[Standard setting value] 1 only for NCLP

NCLP Specifies whether to use clamping/unclamping, as follows:
0 : Clamping/unclamping is used.
1 : Clamping/unclamping is not used.
* To perform speed control, set this bit to "1".

No.	#7	#6	#5	#4	#3	#2	#1	#0
007				VCTLB				

[Size] 1 byte (bit type)
[Standard setting value] 0

VCTLB The speed control type of peripheral equipment control is:
0 : Type A (torque limit not specifiable)
1 : Type B (torque limit specifiable)

No.	
100	Load inertia ratio (LDINT)

[Size] 2-byte
[Standard setting value] 0 to 1024

Set the ratio of the machine load inertia to the motor inertia, using a value obtained from the formula below as a guideline.
Load inertia ratio = (machine load inertia/motor inertia) × 256
Note that If a value obtained by calculation exceeds 500, the value should be set to 500 .
When a value is set in this parameter, the velocity loop gain is set to PK1V, and PK2V is increased by a factor of (1 + LDINT)/256.
As a larger value is set in this parameter, the response to a velocity command improves, and servo rigidity increases. If an excessively large value is set, however, the servo system vibrates, and an unusual sound is generated during machine movement. Usually, set a value

not exceeding 500. If the machine vibrates at a high frequency, the use of the torque command filter of parameter No. 102 is effective.

No.	
116	Velocity loop gain override during speed control (%)

[Size] 2-byte
[Standard value] 0 (Override processing is not performed.)

Set this parameter when switching between position control and speed control. When the speed control mode is set, an override specified here is applied to the velocity loop gain and integration gain used for position control.

The relationships among a velocity loop proportional gain, integration gain, load inertia ratio, and velocity loop gain override in speed control are explained below using an example. Assume the following:

Integration gain = 100
Proportional gain = -500
Load inertia ratio = 128
Velocity loop gain override in speed control = 200%

[Gain in position control]

Integration gain = 100 × (1 + 128/256) = 150
Proportional gain = -500 × (1 + 128/256) = -750

[Gain in speed control]

Integration gain = 100 × (1 + 128/256) × 200/100 = 300
Proportional gain = -500 × (1 + 128/256) × 200/100 = -1500

Thus, when speed control is exercised, a gain override is applied to a gain that takes a load inertia ratio into consideration.

No.	
135	Linear acceleration/deceleration time constant for speed control

[Size] 2-byte
[Unit of data] ms
[Valid data range] 8 to 4000

Specify a time required until 4000 min^{-1} is reached.

Example)

When a speed command value of 2000 min^{-1} is specified, and the time required until 2000 min^{-1} is reached needs to be 1000 ms, the value to be set in this parameter is calculated as follows:

Setting = (4000/2000) × 1000 = 2000

No.	
136	**Speed deviation check limit value in speed control**

[Size] 2-byte
[Unit of data] min^{-1}
[Valid data range] 0 to 4000
[Standard setting value] 0 (No speed deviation check is made.)

Set a speed deviation check limit value in the speed control mode. If the difference between a command speed and actual speed exceeds the value set in this parameter in the speed control mode, alarm No. 447 is issued.

3.4.6.6 Signal

	7	6	5	4	3	2	1	0	BIT
Xx+2						TRQM			

Speed control mode signal TRQM
[Classification] Input signal <Xx+2#2>
[Function] The servo amplifier notifies that the speed control mode is set.
[Input condition] The signal becomes 1 when:
1. When speed control is activated, and the speed control mode is set

The signal becomes 0 when:
1. When the speed control stop command is executed
2. Servo alarm, overtravel alarm, reset, emergency stop, servo-off

3.4.6.7 Alarm

No.	LED indication	Description	Action
254	□ ■ ■ ■ ■ □ □	Function code or mode is invalid.	Check the value specified as the function code of a function code command. Check the mode.
255	■ □ □ □ ■ □ □	Operation cannot be activated because an invalid mode is specified or because block execution is in progress.	Check the mode. Check whether a block is being executed.
447	□ ■ ■ ■ ■ □ ■	Excessive speed deviation (speed control)	Check the actual speed. Check the setting of parameter No. 136.

3.4.6.8 Others

(1) To exercise speed control, the parameters below usually need to be modified.
Do not modify parameters other than the parameters below.
No.000 (bit 1) : Set this bit to 1 (rotation axis specification).
No.000 (bit 7) : Set this bit to 1 (to enable rotation axis roll-over).
No.003 (bit 1) : Set this bit to 1 (not use clamping/unclamping).
No.007 (bit 4) : 0 if type A and 1 if type B.
No.100 : Load inertia ration. Set an adjusted value.

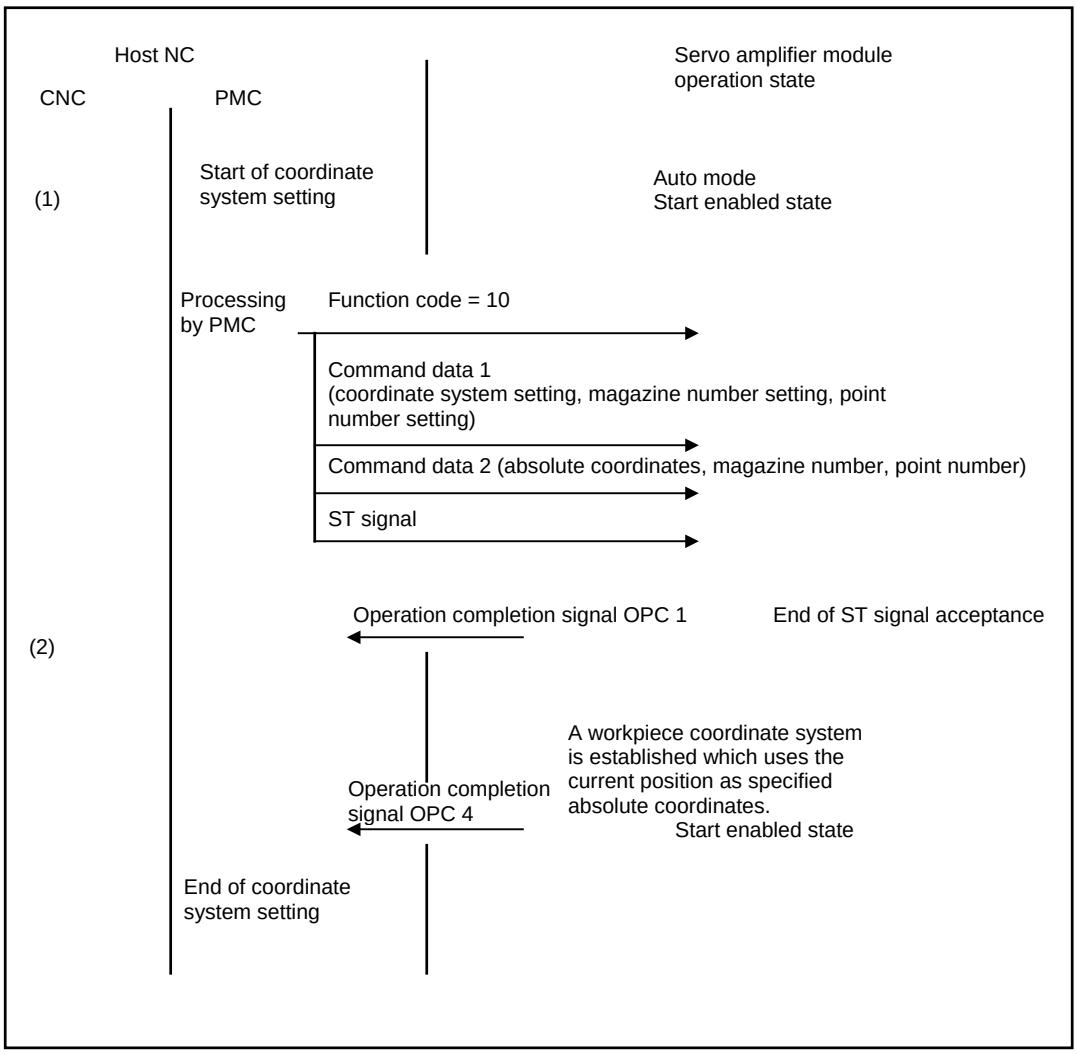
The parameters below are dedicated to speed control. So, once these parameters are set, they need not be modified each time control is switched to speed control.
No.116 : Velocity loop gain override in speed control. (Set this parameter when switching between position control and speed control.)
No.135 : Linear acceleration/deceleration time constant for speed control
No.136 : Speed deviation check limit value in speed control

(2) In the speed control mode, the processing described below is performed based on output signals.
When the overtravel alarm is issued, a gradual stop occurs, and the speed control mode is terminated.
When the external reset signal ERS (Yy+1#0) is set to 1, a gradual stop occurs, and the speed control mode is terminated. When the interlock signal *ILK (Yy+1#3) is set to 0, a gradual stop occurs. When the interlock signal is set to 1 again, acceleration is performed to restart a movement.
When the servo-off command signal SVFX (Yy+1#2) is set to 1, a gradual stop occurs, and the speed control mode is terminated.

(3) The states of input signals in the speed control mode are described below.
Follow-up is performed for position updating, so that the axis movement in-progress signal MVX (Xx+7#2) and the distribution pulse signal IPLX (Xx+0#1) are set to 1.

During movement in one direction, the movement direction signal MVDX (Xx+7#0) is set to 1. The automatic operation signal OP (Xx+1#7) and the automatic operation start in-progress signal STL (Xx+1#5) are set to 1. Clamp/unclamp control is disabled in the speed control mode, so that the unclamp command signal UCPC2 (Xx+1#4) is not set to 1.

3.4.7 Coordinate System Setting



(1) In coordinate system setting, the PMC on the host NC sets the function code, command data 1, and command data 2, then sends the ST signal to the servo amplifier. Upon receipt of the data, the servo amplifier returns the operation completion signal OPC 1 to the host NC.

(2) Upon completion of coordinate system setting, the servo amplifier returns the operation completion signal OPC 4, and is placed in the start enabled state.

Supplementary information

1) The start enabled state is that state in which the STL signal is off.

3.4.8 Rewriting of Parameters

3.4.8.1 Overview

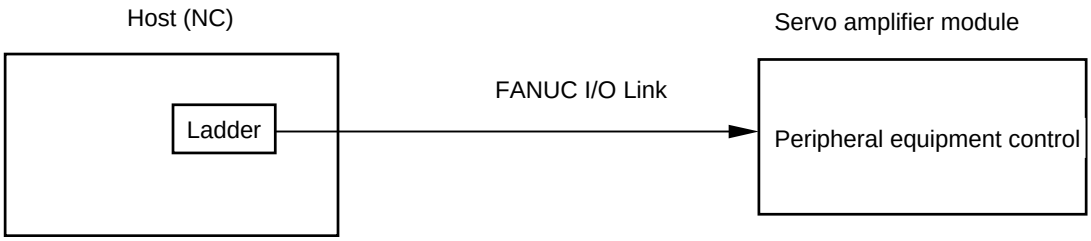
When using the peripheral equipment control parameter rewrite function, specify 12 as function code, a data size as command data 1, a parameter number and parameter value as command data 2, and start operation with the ST signal. For a double-word parameter, specify a parameter value twice. Parameter rewrite operation is performed in the emergency stop state. However, if operation is not being performed, the following parameter can be rewritten in a state other than the emergency stop state:

- Parameter No. 20

> ⚠ **CAUTION**
> The number of times the memory (EEPROM) for holding parameters can be rewritten to is limited (to several ten thousands times), so the memory does not allow frequent rewriting. For an application that rewrites parameters frequently, bit 3 (NEPRM) of parameter No. 0004 needs to be set to 1 to modify RAM data only without writing to the EEPROM.

3.4.8.2 System configuration

The system configuration is shown below.



In the configuration above, the host issues a ladder-based command to peripheral equipment control via the FANUC I/O Link to control the servo amplifier. With the parameter rewrite function, the servo amplifier receives command data for parameter rewrite operation, then executes parameter rewrite operation with the ST signal (automatic operation start signal).

3.4.8.3 Peripheral equipment control command format

A parameter to be rewritten is specified using the following command:
Command (host → servo amplifier)

	7	6	5	4	3	2	1	0
Yy+2	Function code				Command data 1			
Yy+3								
Yy+4	Command data 2							
Yy+5								
Yy+6								

Function code : 12
Command data 1 :
1 : Rewrites a byte parameter.
2 : Rewrites a word parameter.
3 : Rewrites a double-word parameter (first time).
B : Rewrites a double-word parameter (second time).
Command data 2 :

Sets the number of a parameter to be rewritten in Yy+3 and Yy+4.
Sets the value of a parameter to be rewritten in Yy+5 and Yy+6.

Data type

1) Byte type

Yy+5	

Example: Number 22, data 5
Yy+3=16 [hexadecimal], Yy+4=00
Yy+5=05 [hexadecimal], Yy+6=00

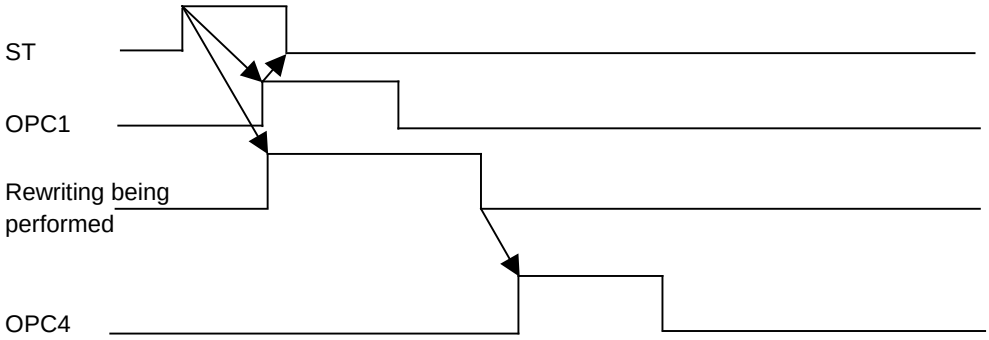
2) Word type

Yy+5	**Lower byte**
Yy+6	**Higher byte**

Data = higher byte × 256 + lower byte

- When rewriting a double-word parameter, divide the value of the parameter into two for two specifications.
  Example: Number 140, data 500000
  500000=0007A120 [hexadecimal]
  First time:
  Yy+3=8C [hexadecimal], Yy+4=00
  Yy+5=20 [hexadecimal], Yy+6=A1 [hexadecimal]
  Second time:
  Yy+3=8C [hexadecimal], Yy+4=00
  Yy+5=07 [hexadecimal], Yy+6=00

3.4.8.4 Command timing chart



3.4.8.5 Alarm

No.	LED indication	Description	Action
250	□ ■ ■ ■ ■ □ □	Command data 1 or the instruction command is invalid.	Check the specified value of command data 1 of a function code command.
251	□ ■ ■ ■ ■ □ □	Command data 2 is invalid.	Check the specified value of command data 2 of a function code command.
254	□ ■ ■ ■ ■ □ □	Function code or mode is invalid.	Check the specified value of function code of a function code command. Check the mode.

3.4.8.6 Parameter

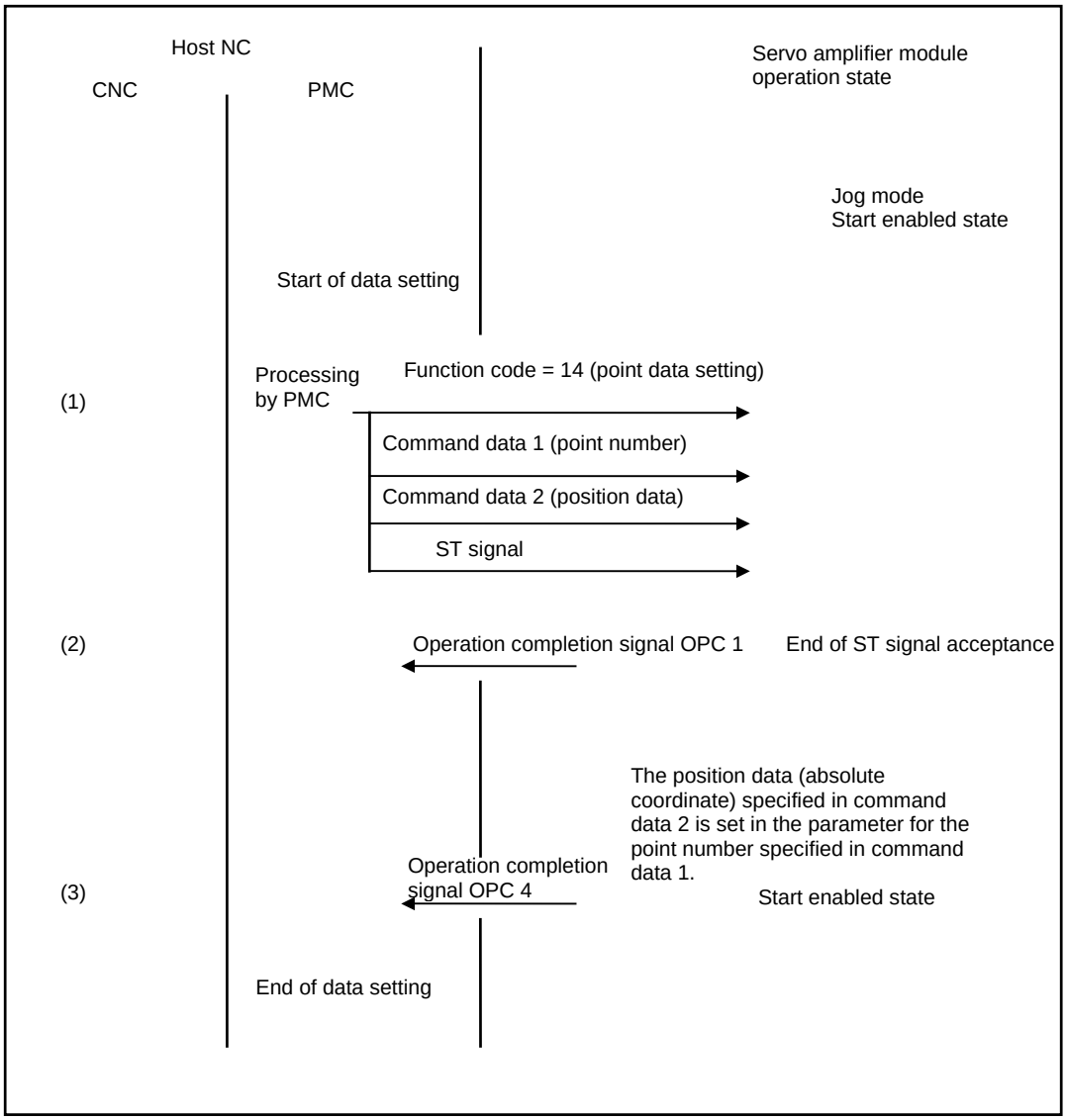
No.	#7	#6	#5	#4	#3	#2	#1	#0
004					NEPRM			

[Size] 1 byte (bit type)
[Standard value] 0

NEPRM When the peripheral equipment control parameter rewrite function is executed, writing to the EEPROM (memory for holding parameters) is:
0 : Performed.
1 : Not performed.

⚠ CAUTION
1 For an application that rewrites parameters frequently with the peripheral equipment control parameter rewrite function, set this parameter to 1.
2 The setting of this parameter is applicable to the rewriting of parameters using a direct command.

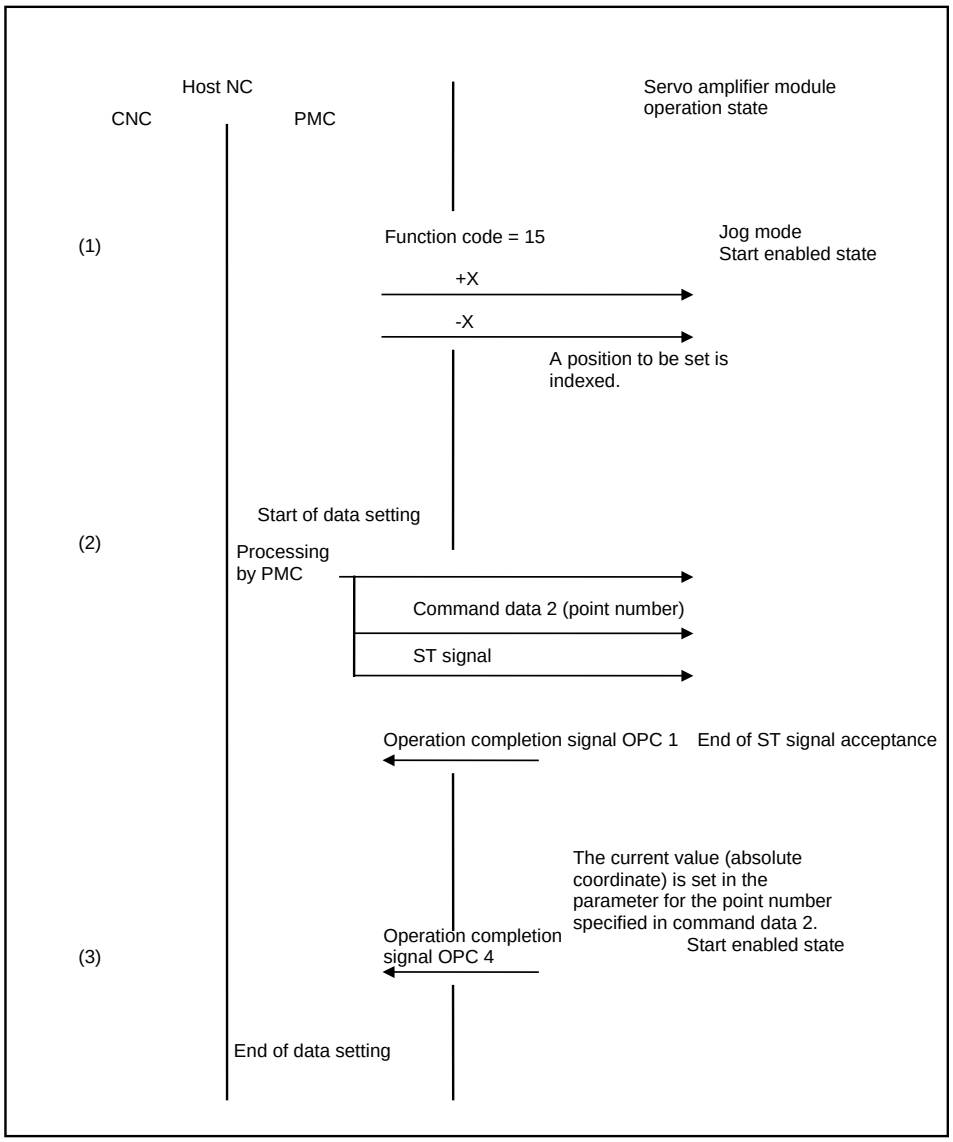
3.4.9 Control of the Point Data External Setting Function



(1) In data setting, the PMC on the host NC sets the function code, command data 1, and command data 2, then sends the ST signal to the servo amplifier.
(2) When the function code, command data 1, and command data 2 are received, the servo amplifier returns the operation completion signal OPC 1 to the host NC.
(3) Upon the completion of setting data in the parameter, the servo amplifier returns the operation completion signal OPC 4.

Supplementary information
1) The start enabled state is that state in which the STL signal is off.

3.4.10 Teaching-based Data Setting Control



(1) After function code setting, the host NC indexes a position according to the +X/-X signal.
(2) In data setting, the PMC on the host NC sets the function code and command data 2, then sends the ST signal to the servo amplifier. Upon receipt of command data 2, the servo amplifier returns the operation completion signal OPC 1 to the host NC.
(3) Upon the completion of setting the current value in a parameter, the servo amplifier returns the operation completion signal OPC 4, and is placed in the start enabled state.

Supplementary information
1) The coordinate for a point number is set in the parameter area.
2) Perform teaching-based data setting while no movement is being performed along the axes.
3) The start enabled state is that state in which the STL signal is off.

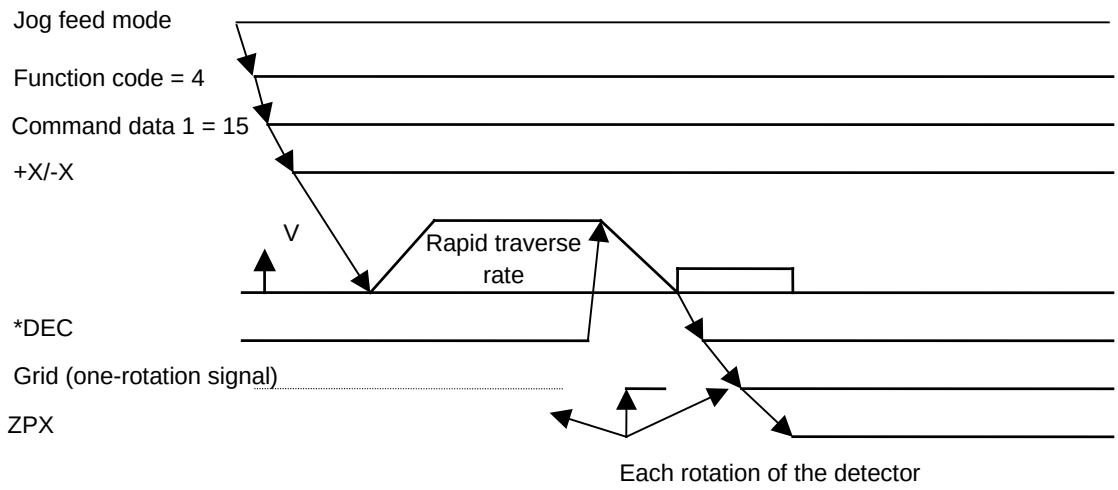
3.5 REFERENCE POSITION RETURN FUNCTION WITH DOGS

3.5.1 Explanation of Function

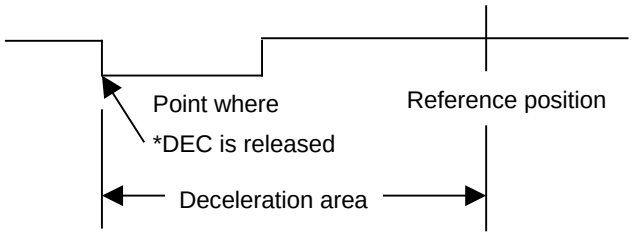
This function moves the machine movable part automatically or manually in a specified direction to return to a reference position. This method of reference position return is referred to as the grid method. With this method, a reference position is determined by an electronic grid position determined by the one-rotation signal of a position detector.
The deceleration signal for reference position return (*DEC) is placed in the same position as the high-speed interlock signal (*RILK) on the built-in DI. So, when the reference position return function with dogs is used, the high-speed interlock signal (*RILK) cannot be used.

3.5.1.1 Reference position return operation (grid method)

The machine movable part moves by rapid traverse when the jog feed mode is set, 4 is set as function code, 15 is set as command data 1, and feed toward a reference position is specified using the feed axis and direction select signal (+X or -X).
If the deceleration signal for reference position return (*DEC) is set to 0 because a deceleration limit switch is pressed, the feedrate is reduced, then movement continues at a low constant feedrate.
When an electronic grid position is reached after the deceleration limit switch is released and the deceleration signal for reference position return is set to 1 again, feed operation stops. At this time, the reference position return completion signal (ZPX) is set to 1.
A reference position return direction can be set in the parameter No.010#5(ZMIX).
The operation described above is shown in the timing chart below.



A gradual stop occurs if a mode other than the jog feed mode is selected or the feed axis direction command signal (+X or -X) is turned off during reference position return. Reference position return must start at a point sufficiently away from a deceleration area and must be performed in the direction toward the reference position. The deceleration area is as shown below.

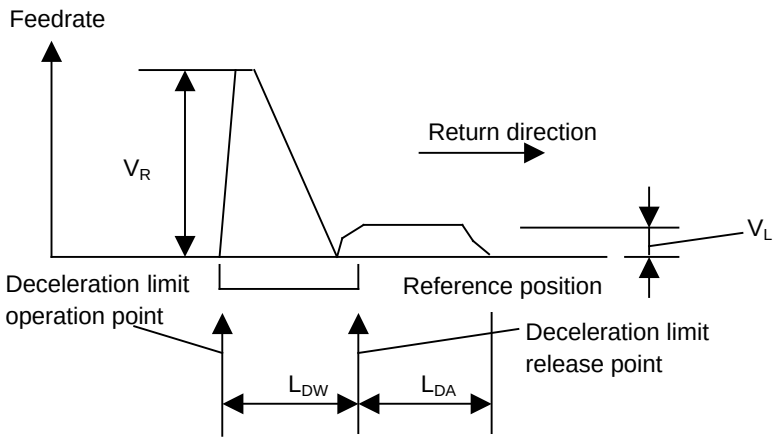


A low constant feedrate after deceleration is set using parameter No. 054.

NOTE
1 If the direct command interface is used, select the AUTO mode and input 60H as function code, then invert the EBUF signal. Then, the machine movable part moves by rapid traverse for reference position return operation.
2 If a reference position is already established, the machine is always positioned by rapid traverse at the reference position.

3.5.1.2 Deceleration limit switch installation condition

When a deceleration limit switch for reference position return is installed, the condition shown below must be satisfied.



(i) L_{DW}: Deceleration dog width (user unit)
$L_{DW} > (V_R((T_R/2)+11+T_S)+4V_L \times T_S)/60000$
V_R:Rapid traverse rate (user unit/min)
T_R:Rapid traverse time constant (msec)
T_S:Servo time constant (msec)
V_L:Feedrate after deceleration (user unit/min)

(ii) L_{DA}:Distance between the deceleration limit switch release point and reference position
L_{DA}:Travel distance equivalent to a half rotation of the motor
The condition above does not include limit switch operation variation. Consider such variation into consideration when installing a limit switch.

3.5.1.3 Tip

To perform reference position return according to the sequence mentioned here, the machine must be fed once in the reference position return direction at such a feedrate that the servo positional deviation exceeds 128, before the first reference position return operation. A servo positional deviation (E) is determined from a feedrate (F) and servo loop gain (G).

E=(F/G)×(1/U)
E:Servo positional deviation (user unit)
F:Feedrate (user unit/sec)
U:Detection unit (user unit)
G:Servo loop gain

In general, the detector unit is one user unit.
When the machine is fed at a rapid traverse rate of 6000000 user units/min, the servo positional deviation in the steady state is as follows if the position loop gain is 30:

E=((6000000/60)/30)×(1/1) =3333

On the contrary, such a feedrate that the servo positional deviation is 128 is as follows if the detection unit is one user unit, and the servo loop gain is 30:

F=128×30×60=230,400 (user unit/min)

This means that when the servo loop gain is 30, and the detection unit is one user unit, the machine needs to be fed in the reference position return direction at a feedrate of 230400 user units/min or more before reference position return. A servo positional deviation present when the machine is actually fed can be checked using DGN No. 032.

> ⚠ **CAUTION**
> When this function is used, the high-speed interlock signal is disabled.

3.5.2 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
010			ZMIX					

[Size] 1 byte (bit type)
[Standard value] 0

ZMIX The grid movement direction and backlash initial direction upon the reference position return is:
0 : Plus direction
1 : Minus direction

No.	#7	#6	#5	#4	#3	#2	#1	#0
011						DZRN		

[Size] 1 byte (bit type)
[Standard value] 0

DZRN The reference position return function with dogs is:
0 : Disabled. (The reference position return function without dogs is selected.)
1 : Enabled.

> ⚠ **CAUTION**
> When DZRN = 1, the high-speed interlock signal (*RILK) is disabled.

3.6 UPGRADING OF THE ROTATION AXIS CONTROL FUNCTION

3.6.1 Function for Specifying the Direction of Rotation Axis High-speed Reference Position Return

3.6.1.1 Explanation of function

The direction of high-speed reference position return of a rotation axis after reference position establishment depends on the setting of bit 5 (ZMIX) of parameter No. 0010.

3.6.1.2 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
005						REFDRC		

[Size] 1 byte (bit type)
[Standard value] 0

REFDRC The direction of high-speed reference position return of a rotation axis is determined by:
0 : Sign of the result of subtracting the current position from the reference position
1 : Setting of bit 5 (ZMIX) of parameter No. 0010

No.	#7	#6	#5	#4	#3	#2	#1	#0
010			ZMIX					

[Size] 1 byte (bit type)
[Standard value] 0

ZMIX When bit 2 (REFDRC) of parameter No. 0005 is set to 1, the direction of high-speed reference position return of a rotation axis is:
0 : Plus direction
1 : Minus direction

NOTE
1 This function is enabled only when a rotation axis is set (when bit 1 (ROTX) of parameter No. 0000 = 1).
2 When shortcut rotation is enabled (when both bit 6 (RABX) and bit 7 (ROAX) of parameter No. 0000 are set to 1), this function is disabled.

3.6.2 Rotation Axis Rotation Direction Sign Specification Function

3.6.2.1 Explanation of function

With an absolute command for a rotation axis, a rotation direction can be specified using a sign.

3.6.2.2 Example of program

When parameter No. 0141 for specifying the travel distance of one rotation of a rotation axis is set to 360000, and the current position is 100000, specify 300000 with an absolute command to move by rotation in the plus direction to the position of 300000. At this time, the travel distance is as follows:
Travel distance: 300000 - 100000 = +200000

To move by rotation in the minus direction to the position of 300000, specify -300000 with an absolute command. At this time, the travel distance is as follows:
Travel distance = (300000 - 100000) - 360000 = -160000

3.6.2.3 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
000						RAB2X		

[Size] 1 byte (bit type)
[Standard value] 0

RAB2X The specification of the rotation direction sign of a rotation axis with an absolute command is:
0 : Disabled.
1 : Enabled.

NOTE
1 This function is enabled only when roll-over is set (when both bit 1 (ROTX) and bit 7 (ROAX) of parameter No. 0000 are set to 1).
2 When shortcut rotation is enabled (when both bit 6 (RABX) and bit 7 (ROAX) of parameter No. 0000 are set to 1), this function is disabled.
3 When this function is used to specify an absolute value of 0 based on rotation in the minus direction, specify a travel distance of one rotation. For example, when the travel distance of one rotation is 360000, and an absolute value of 0 is to be specified based on rotation in the minus direction, specify -360000.

3.7 UPGRADING OF THE CLAMP/UNCLAMP CONTROL FUNCTION

3.7.1 Start of the Timer Counting Until Servo-off in Clamp Processing

3.7.1.1 Explanation of function

In clamp processing, the timer (parameter No. 0168) counting until servo-off can be started when the clamp/unclamp state output signal is turned off.

3.7.1.2 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
005							CLPSVF	

[Size] 1 byte (bit type)
[Standard value] 0

CLPSVF As a period of time from the start of clamp processing to servo-off (parameter No. 0168):
0 : Time after the unclamp command signal (UCPC2) is turned off is set.
1 : Time after the clamp/unclamp state output signal (UCPS2) is set.

3.7.2 Disabling of Clamp Processing When Jog Operation is Stopped

3.7.2.1 Explanation of function

When jog operation is stopped, clamp processing is not performed, but the unclamp state can be held .

3.7.2.2 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
005								JNCL

[Size] 1 byte (bit type)
[Standard value] 0

JNCL When jog operation is stopped, clamp processing is:
0 : Performed.
1 : Not performed. (The unclamp state is held.)

3.8 UPGRADING OF THE RESPONSE DATA READ FUNCTION

3.8.1 Overview

At present, response data cannot be read for a purpose other than display during operation such as movement on axes.
This function allows the host to read correct response data from a servo amplifier unit even during movement on axes by establishing synchronization between the host and servo amplifier with the response data read function of the host. Note, however, that the ATC and point numbers are not updated until the end of a command. The ATC number can be updated at all times as described in Section 3.9, "Improvement of Turret/Magazine Number Output".

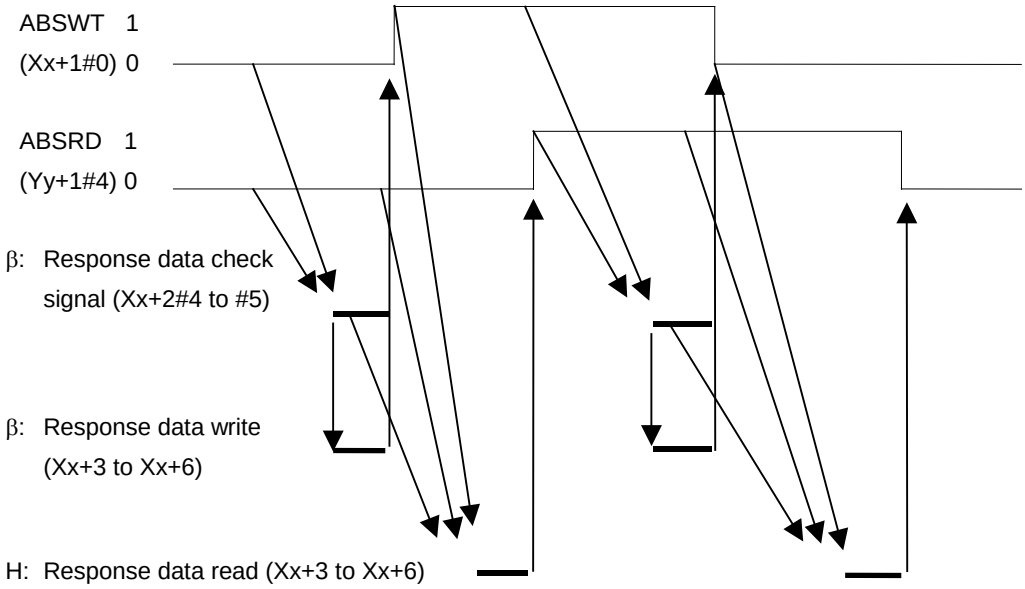
3.8.2 Details of Function

For synchronization establishment, the following two bits are added onto the I/O Link:
ABSWT (Xx+1#0): Response data write completion signal
ABSRD (Yy+1#4): Response data read completion signal

[Details of processing] When the logic levels of ABSWT and ABSRD are equal (ABSWT = ABSRD = 0 or ABSWT = ABSRD = 1), the servo amplifier writes response data to Xx+3 to Xx+6, and inverts the logic level of ABSWT.

When the logic levels of ABSWT and ABSRD are not equal (ABSWT = 0 and ABSRD = 1, or ABSWT = 1 and ABSRD = 0), the host takes in response data from Xx+3 to Xx+6, and inverts the logic level of ABSRD.

[Timing chart] H : Processing by the host
β : Processing by the servo amplifier



3.8.3 DI/DO Signals

The DI/DO signals are signals on the FANUC I/O Link.

	7	6	5	4	3	2	1	0
Yy+1				ABSRD				
	7	6	5	4	3	2	1	0
Xx+1								ABSWT
	7	6	5	4	3	2	1	0
Xx+2			DSP2	DSP1				

Response data write completion signal ABSWT

[Classification] Input signal <Xx+1#0> (peripheral equipment control only)

[Function] After writing response data (Xx+3 to Xx+6), the servo amplifier inverts this signal for notification to the host.

[Operation] The servo amplifier exclusive-ORs ABSWT with ABSRD. If the result of exclusive-OR is 0, the servo amplifier writes response data (Xx+3 to Xx+6), and inverts this signal.

Response data read completion signal ABSRD

[Classification] Output signal <Xx+1#4> (peripheral equipment control only)

[Function] After reading response data (Xx+3 to Xx+6), the host inverts this signal for notification to the servo amplifier.

[Operation] The host exclusive-ORs ABSWT with ABSRD. If the result of exclusive-OR is 1, the host reads response data (Xx+3 to Xx+6), and inverts this signal.

Response data check signals DSP1 and DSP2

[Classification] Input signal <Xx+2#4 to #5> (peripheral equipment control only)

[Function] The servo amplifier indicates the contents of response data.

[Input condition] The servo amplifier sets the contents of data being output in the response data by using a combination of signals as indicated in the table below.

DSP2	DSP1	Response data
0	0	Not output
1	1	Coordinates, motor current value, skip measurement data, or torque command
1	0	Current position number (ATC, point number)
0	1	Actual feedrate or actual rotation speed

NOTE
1 The setting of parameter No. 20 determines which of coordinates, motor current value, skip measurement data, and torque command the response data is.
2 The setting of parameter No. 20 determines which of actual feedrate and actual speed the response data is.

3.8.4 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
005	ABSPS	LDM						

[Size] 1 byte (bit type)
[Standard value] 0

ABSPS With the response data read function, the host and servo amplifier are:
0 : Not synchronized.
1 : Synchronized. (Even during movement on axes, the host can read correct position data.)
LDM Motor current value output in response data (Xx+3 to Xx+6) is:
0 : Disabled.
1 : Enabled.

No.	
020	Response data specification (PHOUT)

[Size] 1 byte
[Standard value] 3

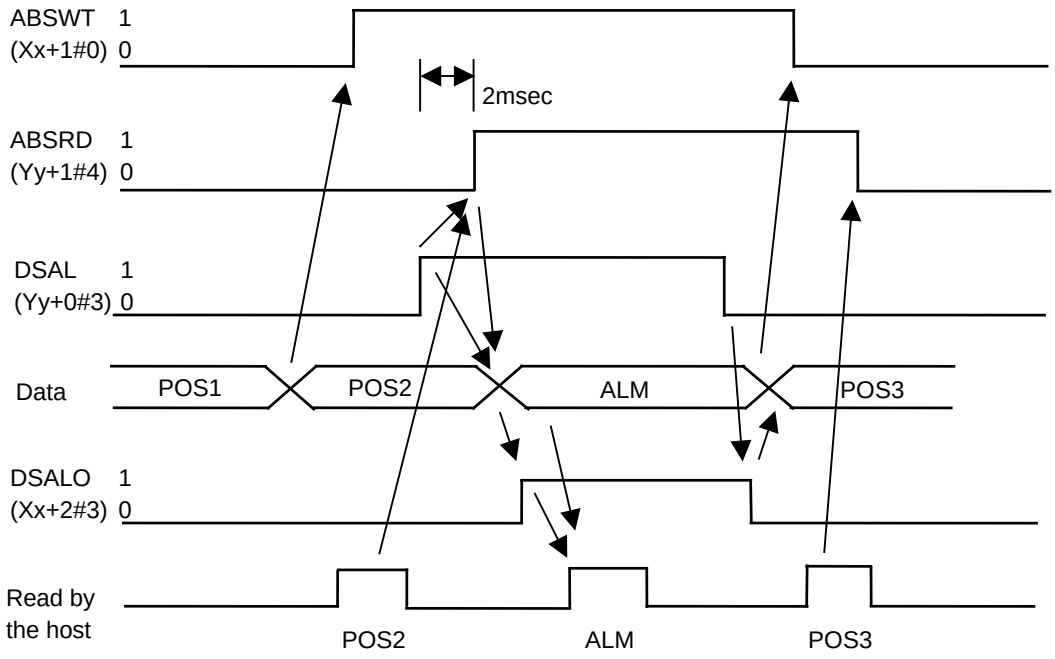
PHOUT As response data (Xx+3 to Xx+6):
0 : No data is output.
1 : ATC or point number data is output.
In the case of ATC cycle or point positioning:
2 : Machine coordinates are output in real time.
3 : Workpiece coordinates are output in real time.
4 : A motor current value is output. The motor current value 6554 represents the maximum current value of the servo amplifier.
5 : Measurement data (workpiece coordinates) obtained when a skip signal is input is output.
6 : An actual feedrate is output in real time.
[Unit of data] 10^NUser-specified unit/MIN (N:Parameter No. 021)
7 : An actual speed is output in real time.
[Unit of data] min^{-1}
8 : A torque command is output in real time. The maximum value of a torque command is 6554.
The least significant bit is a signal indicating whether the torque limit is reached.
Least significant bit =
0: The torque limit is not reached.
1: The torque limit is reached.

NOTE
1 For output of a motor current value as response data, set bit 6 (LDM) of parameter No. 0005 to 1, and set parameter No. 0020 to 4.
2 When bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data), set this parameter to 1.
3 The value of an actual speed is output with a sign. While the motor is being stopped, the motor current may drift, causing the sign to be unstable.

3.8.5 Notes

1 This function is enabled only when bit 7 (ABSPS) of parameter No. 0005 is set to 1.
2 This function can be used only with the peripheral equipment control interface. When this function is used, the direct command interface cannot be used.
3 When synchronous processing is being performed with this function, the setting of bit 7 (ABSPS) of parameter No. 0005 cannot be modified.
4 The ATC and point numbers are not updated until the end of a command. As for the ATC number, however, it is possible to read constantly updated response data as described in Section 3.9, "Improvement of Turret/Magazine Number Output".
5 Information is not updated real-time and, therefore, the function cannot be used for such purposes as the position switch, which must monitor the position constantly. (Response data based on the position at the time when the logic of ABSWT (Xx+1#0) is inverted is retained, and is not updated the next time the logic of ABSWT is inverted.)
6 When reading response data using ABSWT (Xx+1#0) and ABSRD (Yy+1#4), note that there are variations of up to about 40 ms in the transfer between the host and the servo amplifier. The variation maximum may be greater depending on how the ladder program is created.
7 If turning on the alarm output command signal DSAL (Yy+0#3) when using this function, turn it on at least 2 msec. before the response data read completion signal ABSRD is inverted. A timing chart is given below.

(Timing chart)



8 Refrain from conducting parameter rewriting frequently because there is a limit on the number of times data can be written to EEPROM (memory for retaining parameters) (several tens of thousands of times).

If it is necessary to conduct parameter rewriting frequently, set bit 3 (NEPRM) of parameter No. 004 to "1". In this case, rewritten parameters will not be retained after the power is turned off.

3.9 IMPROVEMENT OF TURRET/MAGAZINE NUMBER OUTPUT

3.9.1 Overview

ATC/turret control of peripheral equipment control allows output of the turret/magazine number in response data. In the past, however, the turret/magazine number based on the current position was not output until ATC/turret control was issued after the power was turned on or if the control was interrupted. Because of this improvement, the turret/magazine number based on the current position is constantly output including the above cases.

3.9.2 Details of Function

The turret/magazine number to be output in response data is improved as described below.

(1) The turret/magazine number based on the current position is constantly output.

- It is constantly output, even until ATC/turret control is issued after the power is turned on and if ATC/turret control is interrupted.
- The nearest turret/magazine number is output even if the current position is not a magazine position. For example, if one rotation about the rotation axis is by "360° " and the number of magazine/turret numbers (parameter No. 068) is "4", the turret/magazine number is output as shown in Fig. 3.9.2 (a)

.

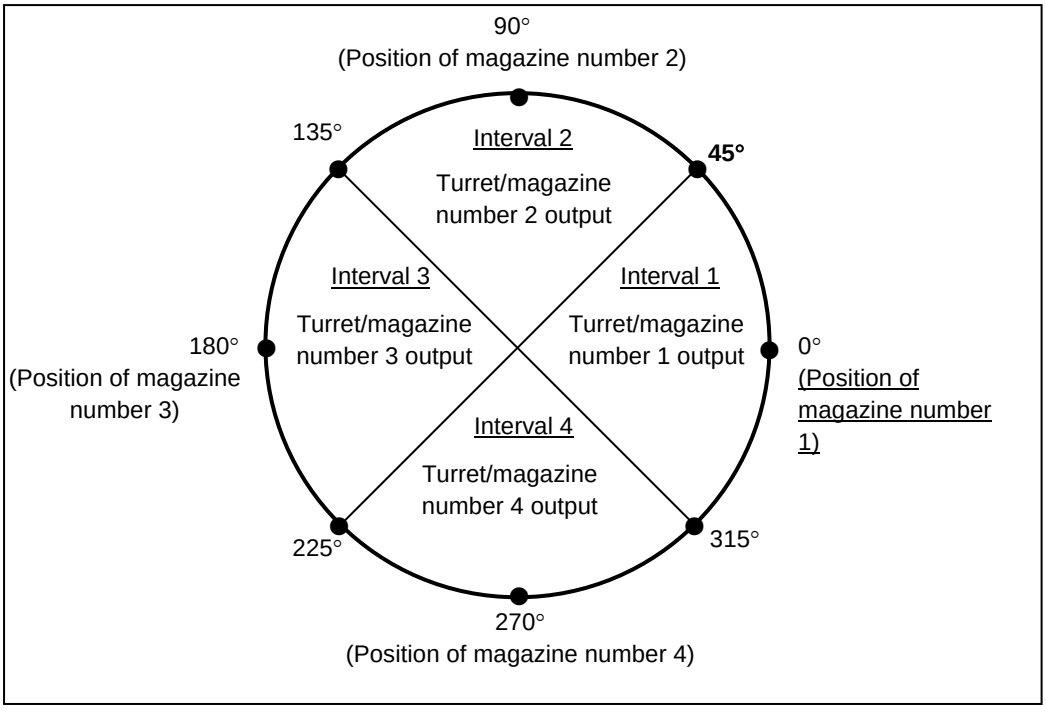


Fig. 3.9.2 (a) Turret/Magazine Number Output Example

Interval 1 (315° ≤ Current position < 45°) → Turret/magazine number 1
Interval 2 (45° ≤ Current position < 135°) → Turret/magazine number 2
Interval 3 (135° ≤ Current position < 225°) → Turret/magazine number 3
Interval 4 (225° ≤ Current position < 315°) → Turret/magazine number 4

- A magazine number boundary is regarded as the midpoint between two adjacent magazines. If the current position is on a boundary, the magazine number on the + side is output.
- That the number is constantly output does not mean that response data is automatically updated; response data needs to be read in synchronization with the host. Before reading response data, use ABSWT (X_{X+1}#0) and ABSRD (Y_{y+1}#4) to update the response data. For details of how to do this, see Section 3.8, "Upgrading of the Response Data Read Function".

(2) A signal reports on whether the current position is in the permissible magazine position range.

<1> If the current position is in the permissible magazine position range
→ MINP signal (X_{X+6}#7) output
<2> If the current position is not in the permissible magazine position range
→ If it out of the permissible range in the + direction → +MOR signal (X_{X+6}#6) output
→ If it is out of the permissible range in the direction → -MOR signal (X_{X+6}#5) output

- For example, if one rotation about the rotation axis is by "360°" and the number of magazine/turret numbers (parameter No. 068) is "4", each signal is output as shown in Fig. 2.

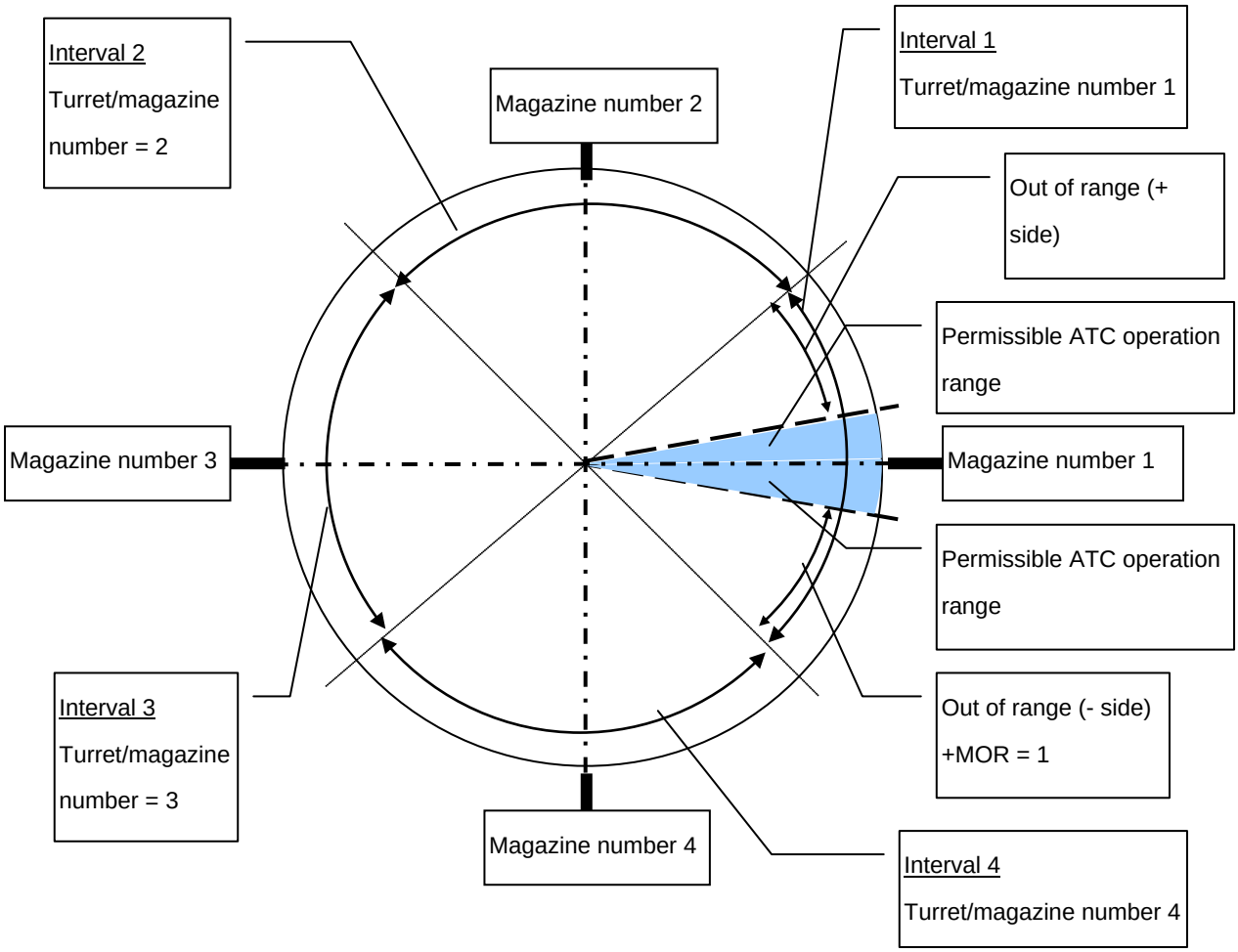


Fig. 3.9.2 (b) MINP, +MOR, and -MOR Signal Output Example

- The following explanation assumes that the current position is in interval 1.
  - When the current position is in the permissible range (the gray portion in Fig. 2) set in the permissible index point value (parameter No. 170) from the magazine position, the MINP signal (X_{X+6}#7) becomes "1" as well as the turret/magazine number.
  - When it is out of the permissible magazine range in the + direction, the +MOR signal (X_{X+6}#6) becomes "1" as well as the turret/magazine number. When it is out of the range in the - direction, the -MOR signal (X_{X+6}#5) becomes "1".
  - Even if the current position is in another interval, the MINP, +MOR, and -MOR signal output conditions are the same; only the turret/magazine number differs.
- For the MINP, +MOR, -MOR signals, response data must be updated using ABSWT (X_{X+1}#0) and ABSRD (Y_{y+1}#4) before reading the response data, as with the turret/magazine number.

⚠ CAUTION

This improvement is intended for ATC/turret control, and is not applied to point positioning with function code 3. Response data is also output if point positioning is performed, but it does not contain the point number but the turret/magazine number based on the current position. Also, the MINP, +MOR, and -MOR signals do not correspond to the point number but correspond to the turret/magazine number. Also note that the response data output if another function code is issued contains the turret/magazine number and the MINP, +MOR, and -MOR signals based on the current position.

NOTE

1 Information is not updated real-time and, therefore, the function cannot be used for such purposes as the position switch, which must monitor the position constantly. (Response data based on the position at the time when the logic of ABSWT (X_{x+1}#0) is inverted is retained, and is not updated the next time the logic of ABSWT is inverted.)

2 When reading response data using ABSWT (X_{X+1}#0) and ABSRD (Y_{y+1}#4), note that there are variations of up to 40 ms in the transfer between the host and the servo amplifier. If, therefore, response data is read during axis movement, the response data may not match the current turret/magazine number and the MINP, +MOR, and -MOR signals because of the variations. The variation maximum may be greater depending on how the ladder program is created.

3 Even if, after the power is turned on, response data is read using ABSWT (X_{X+1}#0) an ABSRD (Y_{y+1}#4) before performing ATC/turret control, the turret/magazine number and the MINP, +MOR, -MOR signals based on the current position are output.

4 If the current position is near a magazine number boundary, the turret/magazine number may fluctuate if the motor fluctuates.

5 For compatibility with conventional types, bit 5 (ATCR2) of parameter No. 007 must be set to "1" to use this improved type.

6 No response data is output until the reference position is established. If bit 2 (NZRPO) of parameter No. 007 is set to "1", however, response data is output even if the reference position is not established.

3.9.3 Signal

When the setting is such that the ATC and point numbers are output in response data (parameter No. 020 = 1), the following response data is output in this improved type:

	7	6	5	4	3	2	1	0
Xx+3	Turret/magazine number							
Xx+4								
Xx+5	Reserved							
Xx+6	MINP	+MOR	-MOR					

Response data (turret/magazine number)

[Classification] Input signal <Xx+3, Xx+4>

[Function] The nearest turret/magazine number is constantly output.

NOTE

1 Because response data must be read by accomplishing synchronization, response data based on the position at the time when the logic of ABSWT (X_{X+1}#0) is inverted is retained, and is not updated the next time the logic of ABSWT is inverted.

2 No response data is output until the reference position is established. If bit 2 (NZRPO) of parameter No. 007 is set to "1", however, response data is output even if the reference position is not established.

MINP

[Classification] Input signal <Xx+6#7>

[Function] This signal notifies that the current position is in the permissible magazine range.

[Input condition] The signal becomes 1 when:

1. The current position is in the permissible magazine range. The next ATC operation is possible.

The signal becomes 0 when:

1. The current position is out of the permissible magazine range. The next ATC operation is not possible.

+MOR

[Classification] Input signal <Xx+6#6>

[Function] This signal notifies that the current position is out of the permissible magazine range in the + direction.

[Input condition] The signal becomes 1 when:

1. The current position is out of the permissible magazine range in the + direction.

The signal becomes 0 when:

1. The current position is in the permissible magazine range. Or, it is out of the permissible range in the - direction.

-MOR

[Classification] Input signal <Xx+6#5>

[Function] This signal notifies that the current position is out of the permissible magazine range in the - direction.

[Input condition] The signal becomes 1 when:

1. The current position is out of the permissible magazine range in the - direction.

The signal becomes 0 when:

1. The current position is in the permissible magazine range. Or, it is out of the permissible range in the + direction.

3.9.4 Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
007			ATCR2					

[Size] 1 byte (bit type)

[Standard setting value] 0

ATCR2 Specifies when to output a turret/magazine number, as follows:

0 : A turret/magazine number is output when ATC/turret control is performed. (Conventional method)

1 : A turret/magazine number is always output. (New method)

⚠ **CAUTION**
In the new method, even if a function code for other than ATC/turret control (function code 2) is specified, the turret/magazine number and MINP, +MOR, and -MOR signals corresponding to the current position are always output to response data. Note that, for example, if point positioning is performed, a point number and the MINP, +MOR, and -MOR signals corresponding to the point number are not output to response data.

NOTE
1 To enable the new method, the following conditions must also be satisfied.
- Set parameters as described below to enable ATC/turret control (function code 2).
  Select a rotation axis (bit 1 of parameter No.000 is 1).
  Enable the roll-over function (bit 7 of parameter No.000 is 1).
  Set the number of magazines/turrets (parameter No. 068).
  Set an index point tolerance (parameter No. 170).
- Set parameter No.020 to 1 (an ATC and point number are output to response data).
- Set bit 7 of parameter No.005 to 1 (the host and a servo amplifier are synchronized with each other in the response data read function).

2 In the new method, response data must be read in a synchronous manner. The response data retained is thus based on a position when the logic of ABSWT (XX+1#0) is reversed, and the data is not updated until the next time the ABSWT logic is reversed.
3 No response data is output until the reference position is established. If bit 2 (NZRPO) of parameter No. 007 is set to "1", however, response data is output even if the reference position is not established.

3.9.4.1 Related parameters

No.	#7	#6	#5	#4	#3	#2	#1	#0
005	ABSPS							

[Size] 1 byte (bit type)
[Standard setting value] 0

ABSPS Specifies whether the host and a servo amplifier are to be synchronized with each other in the response data read function, as follows:
0 : Not synchronized.
1 : Synchronized. (This makes it possible for the host to read the correct position even during axis movement.)

NOTE
1 For details, see Part II, Section 3.8, "Upgrading the Response Data Read Function."
2 This parameter is also valid when bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data).

No.	#7	#6	#5	#4	#3	#2	#1	#0
007						NZRPO		

[Size] 1 byte (bit type)
[Standard setting value] 0

NZRPO Specifies whether to output a turret/magazine number or point number when ATC/turret control or point positioning control is performed, if a reference position is not established, as follows:
0 : Not output.
1 : Output.

⚠ CAUTION
When an incremental pulse coder is used with bit 2 (NZRPO) of parameter No. 007 set to 1, be sure to set a coordinate system to establish a relationship between the machine and absolute coordinates, before performing ATC operation or point positioning. If ATC operation or point positioning is performed before a coordinate system is set, positioning to correct machine positions may not occur. A turret/magazine number or point number that is then output may not be correct. This affects all types of positioning, not only ATC operation and point positioning.

NOTE
1 This parameter is valid when parameter No. 020 is set to 1.
2 This parameter is also valid when bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data).

No.	
020	Response data specification (PHOUT)

[Size] 1 byte
[Standard setting value] 3

PHOUT Specifies whether or what to output as response data (Xx+3 to Xx+6), as follows:
0 : Nothing is output.
1 : An ATC and point No. are output if an ATC cycle and point positioning are involved.
2 : Machine coordinates are output in real time.
3 : Workpiece coordinates are output in real time.
4 : The motor current value is output. The motor current value is 6554, which is the maximum current value for the amplifier.
5 : Measurement data (workpiece coordinates) obtained when a skip signal is input is output.
6 : An actual feedrate is output in real time.
[Unit of data] 10^NUser-specified unit/MIN (N:Parameter No. 021)
7 : An actual speed is output in real time.
[Unit of data] min^{-1}
8 : A torque command is output in real time. The maximum value of a torque command is 6554.
The least significant bit is a signal indicating whether the torque limit is reached.
Least significant bit =
0: The torque limit is not reached.
1: The torque limit is reached.

NOTE
1 If the motor current value is output as response data, set LDM (bit 6 of parameter No. 005) to "1" and set "4" for parameter No. 020.
2 This parameter is also valid when bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data).
3 The value of an actual speed is output with a sign. While the motor is being stopped, the motor current may drift, causing the sign to be unstable.

No.	
170	Index point tolerance

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] When the 1-pitch rotation of ATC/turret control is specified, the index point is preserved if the machine deviates from the index point during clamping/ unclamping, as long as the absolute value for the movement amount is equal to or less than this value. For example, when the machine is to move from index point 1 to 2, it can move to the position of point 2 even if it has deviated from the position of point 1 in the direction opposite from the direction of movement, as long as the movement amount is within the value specified in this parameter.

In ATC/turret control, this parameter is also used to specify a tolerable magazine range when a turret/magazine number is always output to response data.

NOTE
When bit 5 of parameter No.007 is 1 (a turret/magazine number is always output to response data), set a tolerable magazine range in this parameter.

3.10 MANUAL HANDLE INTERFACE

3.10.1 Overview

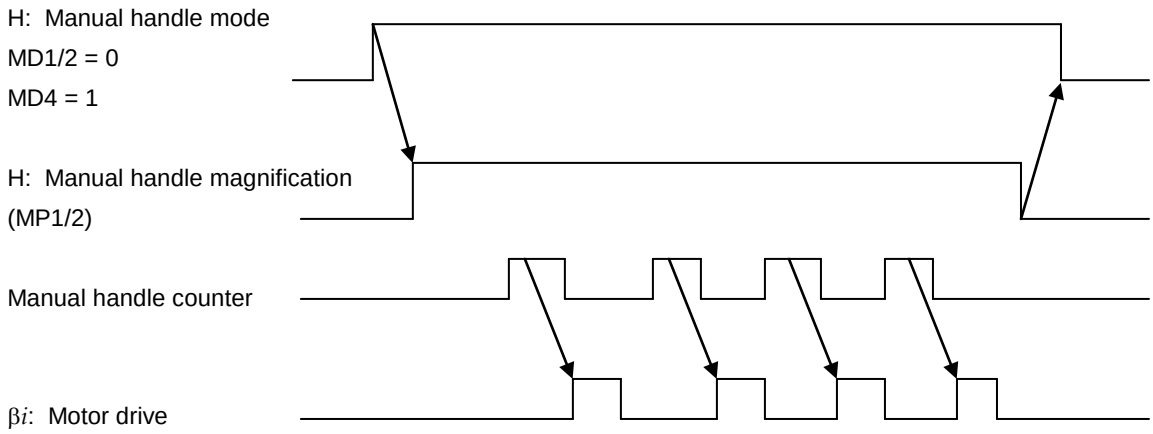
This function enables the manual handle feed of a servo amplifier using the manual pulse generator on the host. The pulses of the manual pulse generator are reported from the host to the servo amplifier via the I/O Link. Through appropriate parameter switching, it is possible to multiply the pulse output signal of the manual pulse generator. This function can be used in the peripheral equipment control interface only.
This function is an option function on the host.

3.10.2 Details of Function

The host, after selecting the manual handle mode of the servo amplifier (MD1(Yy+0#0)=0, MD2(Yy+0#1)=0, MD4(Yy+0#2)=1), reports the magnification for the manual pulse generator (MP1(Yy+7#4), MP2(Yy+7#5)) to the servo amplifier, to change the manual handle counter.
The servo amplifier drives the motor by reading only changes in the manual handle counter.

[Timing chart]

(H: Processing on the host βi: Processing on the servo amplifier)



NOTE

This function does not operate unless the motor has been activated. When this function is used, therefore, clamping/unclamping using the unclamp command signal (UCPC2) and the clamp/unclamp state output signal (UCPS2) (when bit 1 (NCLP) of parameter No. 003 is "0") cannot be used. Set "1" in bit 1 (NCLP) of parameter No. 003, and perform clamping/unclamping, using the servo off signal (SVFX).

3.10.3 Signal

3.10.3.1 Signal on the servo amplifier

	7	6	5	4	3	2	1	0
Yy+0						MD4	MD2	MD1
Yy+7			MP2	MP1				

Mode select signals MD1, MD2, and MD4

[Classification] Output signal <Yy+0#0 to #2>

[Function] These signals are used to select an operation mode.

[Operation] These signals are used to select the manual handle feed of the servo amplifier.

MD1	MD2	MD4	Remarks
0	0	1	Manual handle feed (HANDLE)

NOTE

1 Enter manual handle mode before rotating the manual pulse generator.

2 Do not switch modes during the manual handle operation of the servo amplifier.

Incremental feed signal MP1 and MP2

[Classification] Output signal <Yy+7#4,#5>

[Function] These signals are used to select a magnification for the manual handle feed of the servo amplifier.

[Operation] In manual handle mode, the servo amplifier drives the motor for the input pulses of the manual pulse generator times the magnification selected with these signals.

MP1	MP2	Amount of travel per graduation of the manual pulse generator
0	0	1 user unit
0	1	10 user units
1	0	100 user units
1	1	(M/N) user units (M = Parameter No. 62, N = Parameter No. 63)

NOTE
1 This signal is effective if bit 5 (MP) of parameter No. 5 of the servo amplifier is 1.
2 This signal is effective in manual handle mode only.
3 This signal shares the same bits with the rapid traverse override signal. In manual handle mode, these bits are for the incremental feed signal; in modes other than manual handle mode, they are for the rapid traverse override signal. Before switching from manual handle mode to another mode, this signal must be returned to such a setting that the bits are for the rapid traverse override signal.

3.10.3.2 Signal on the CNC (host)

No.	#7	#6	#5	#4	#3	#2	#1	#0
G199							IOLBH3	IOLBH2

Manual handle feed generator select signals IOLBH2 and IOLBH3

[Classification] Input signal <G199#0,#1>

[Function] These signals are used to select the manual pulse generator used to feed the servo amplifier.

[Operation] These signals are used to select the manual pulse generator used to feed the servo amplifier.

IOLBH3	IOLBH2	Manual pulse generator used to feed the servo amplifier
0	0	1st
0	1	2nd
1	0	3rd
1	1	Not for use

NOTE
Do not switch manual pulse generators in manual handle mode.

3.10.4 Parameter

3.10.4.1 Parameter on the servo amplifier

No.	#7	#6	#5	#4	#3	#2	#1	#0
005			MP	IOH				

[Size] 1 byte (bit type)
[Standard setting value] 0

IOH Specifies whether to enable manual handle feed over the I/O Link, as follows:
0 : Disabled.
1 : Enabled.

NOTE
When this parameter is set to 1, bit 6 (EXPLS) of parameter No. 003 must be set to 0.

MP Specifies whether to enable setting of a magnification in 4 steps with the MP1/MP2 signal for input manual handle pulses for manual handle feed, as follows:
0 : Disabled.
1 : Enabled.

3.10.4.2 Parameter on the CNC (host)

No.	#7	#6	#5	#4	#3	#2	#1	#0
7105		BHS	LBH					

[Size] 1 byte (bit type)

IOLBH The manual handle feed to β*i*SV-B , using the I/O Link manual pulse generator is:
0 : Disabled.
1 : Enabled.

BHS When β*i*SV-B is operated by the manual pulse generator on the host, automatic determination is:
0 : Not performed. (Set with parameters Nos. 12330 to 12337.)
1 : Performed.

NOTE
For details, refer to the CNC manual.

4 DIRECT COMMANDS

4.1 DIRECT COMMAND FORMAT

The servo amplifier receives a command issued in the specified format from the host, then executes the command. After command execution, the servo amplifier returns the result of command execution to the host. Such commands are called direct commands. These commands are set in an interface area in the formats shown below.

- General format of instruction commands (host → servo amplifier)

	7	6	5	4	3	2	1	0
Yy+4	Control flag 1							
Yy+5	Function code							
Yy+6	Command data 1							
Yy+7	Command data 2							
Yy+8	Command data 3							
:	:							
:	:							
Yy+15	Command data 10							

- General format of response commands (servo amplifier → host)

	7	6	5	4	3	2	1	0
Xx+4	Control flag 2							
Xx+5	Function code (same as that in the insurrection command)							
Xx+6	Reserved				Execution result			
Xx+7	Response data 1							
Xx+8	Response data 2							
Xx+9	Response data 3							
:	:							
:	:							
Xx+15	Response data 9							

- Data types

	7	6	5	4	3	2	1	0	BIT
Byte type:									
	(BYTE)								

	7	6	5	4	3	2	1	0	BIT
Word type: (WORD)	Lower byte								
	Higher byte								

Data = (higher byte)*256 + (lower byte)

	7	6	5	4	3	2	1	0	BIT
Double precision type (DWORD):	Lowest byte								
	Second lowest byte								
	Second highest byte								
	Highest byte								

Data = (highest byte)*16777216
+ (second highest byte)* 65536
+ (second lowest byte)*256
+ (lowest byte)

4.2 DIRECT COMMAND CONTROL PROCEDURE

4.2.1 Direct Command Control Procedure

Direct commands are classified into two types: instruction commands which are sent from the host to a servo amplifier, and response commands which are returned from a servo amplifier to the host. Such command transfer is controlled by using two flags, control flag 1 and control flag 2. Control flag 1 is sent from the host to a servo amplifier. Control flag 2 is returned from a servo amplifier to the host.

	7	6	5	4	3	2	1	0
Control flag 1	**EBUF**	**EOREND**						**ECNT**

	7	6	5	4	3	2	1	0
Control flag 2	**EBSY**	**EOSTB**	**ECF**		**USR1**	**EOPC**	**DAL**	**ECONT**

⚠ **CAUTION**
When the power mate CNC manager function is used, control flag 2 transfers data using the same area as that used by the power mate CNC manager function, simultaneously as the function. If the USR1 signal is 0, control flag 2 is for the ladder. If the USR1 signal is 1, control flag 2 is for the power mate CNC manager and, therefore, must be ignored.

NOTE
1 Clamping/unclamping of peripheral equipment control cannot be used. Be sure to set bit 1 (NCLP) of parameter No. 003 to "1".
2 To perform jog operation, select jog (JOG) mode and start it with a feed axis direction select signal (+X or -X). The override signals (*OV1 to *OV8) and the manual rapid traverse select signal (RT) can also be used.

4.2.2 Instruction Command Control (EBUF, EBSY, and ECNT)

Instruction commands sent from the host to a servo amplifier are controlled with EBUF and EBSY.
When the EBUF and EBSY states (values) match, the host can write a command into the interface area. After writing the command, the host inverts EBUF.
If the EBUF and EBSY states differ, the servo amplifier assumes that a new command has been specified. Therefore, control flag 1 must be written last after a function number and command data are written. After the servo amplifier reads the command, it inverts the EBSY state.
EBUF is initially set to 0.

Since the instruction command data area is limited, instruction command data sometimes cannot be sent if the amount of data is excessive. In such a case, more than one instruction command must be issued to send all the data. If there is an additional instruction command to be sent, ECNT is set to 1 to indicate that another command follows.

NOTE
When the power mate CNC manager function is used, the inverted EBSY state is posted to the host for 40 ms. This duration can be changed by parameter setting (parameter No. 022).

4.2.3 Response Command Control (EOREND, EOSTB, EOPC, USR1, and ECONT)

Response commands returned from the servo amplifier are controlled with EOREND, EOSTB, and EOPC. EOPC indicates that the response command is in continuous read mode.
The host reads response data according to the following control procedure:
When the EOREND state and EOSTB state do not match, the host can read response data. After reading the data, the host inverts EOREND such that the EOREND state matches the EOSTB state. As EOREND is inverted, the servo amplifier regards the data read operation as having been completed.

When the amount of data in a response command is too great to enable the sending of all the data at one time, ECONT indicates 1. In this case, after reading the current data, the host inverts EOREND such that it matches the EOSTB state, then waits for the next data. The host must read the data repeatedly until ECONT becomes 0. Note that the next data (continuous data) is output from Xx+5 (function code address).

> ⚠ **CAUTION**
> When the power mate CNC manager function is used, the area used by the power mate CNC manager function is also used simultaneously by the direct commands of the PMC ladder program to exchange the data. USR1 being set to 0 indicates that the data in the area is a response to the ladder program, so read processing must be performed. USR1 being set to 1 indicates that data in the area is a response to the power mate CNC manager and is to be ignored.

4.2.4 Command Completion Notification (ECF)

When NMOD is set to 1 for an instruction command, the command is executed in completion notification mode. This means that the servo amplifier notifies the host that execution of the instruction command has been completed, and the servo amplifier does not execute the next command until the servo amplifier unit receives a response from the host.

(1) Upon the completion of command execution, the servo amplifier sets ECF to 1.
(2) The host issues the FIN instruction command to notify the servo amplifier that the host has received completion notification.

> **NOTE**
> When the power mate CNC manager function is used, ECF being set to 1 is posted to the host for 40 ms. This duration can be changed by parameter setting (parameter No. 022).

4.2.5 Alarm (DAL)

If an alarm is issued in the servo amplifier, DAL is set to 1. When detailed information about the alarm is required, the host specifies the READ ALARM STATUS command.

4.2.6 Direct Command Execution Result

The servo amplifier returns the result of execution using the following code. Upon the reception of an execution result, the host performs appropriate processing such as error display and retry operation.

Completion code	Meaning	Description (action)
0	Normal termination	
1	Execution error	Execution was attempted with no program. Start of execution was attempted during execution.
2	Data length error	Direct command has an illegal command format.
3	Incorrect number of data items	Direct command has an illegal command format.
4	Data attribute error	Direct command has an illegal command format.
7	Write protect error	
8	Memory overflow	
9	Parameter error	An illegal parameter is set.
10	Buffer control error	
12	Mode select error	
14	Reset or halted	
15	Execution in progress	

4.3 LIST OF DIRECT COMMANDS

Function	Function code	Reference item
1. Signal operation commands		
(1) Setting and releasing the torque limit enable signal	0x0C	4.4.1 (1)
(2) Specifying the torque limit value	0x91	4.4.1 (2)
2. Parameters		
(1) Reading parameters	0x20	4.4.2 (1)
(2) Writing parameters	0x21	4.4.2 (2)
3. Status read		
(1) Reading the absolute position	0x30	4.4.3 (1)
(2) Reading the machine position	0x31	4.4.3 (2)
(3) Reading skip measurement data	0x32	4.4.3 (3)
(4) Reading the servo positional deviation	0x33	4.4.3 (4)
(5) Reading the acceleration/deceleration delay	0x34	4.4.3 (5)
(6) Reading the actual feedrate	0x36	4.4.3 (6)
(7) Reading the status	0x37	4.4.3 (7)
(8) Reading alarm information	0x38	4.4.3 (8)
(9) Reading the series and edition of system software	0x3F	4.4.3 (9)
(10) Reading data continuously	0x41	4.4.3 (10)
(11) Reading the motor current value	0x95	4.4.3 (11)
(12) Reading the torque command	0x96	4.4.3 (12)
(13) Reading the actual speed	0x97	4.4.3 (13)
4. Axis movement commands		
(1) Reference position return	0x60	4.4.4 (1)
(2) Absolute positioning	0x61	4.4.4 (2)
(3) Incremental positioning	0x62	4.4.4 (3)
(4) Dwell	0x63	4.4.4 (4)
(5) Coordinate system setting	0x64	4.4.4 (5)
(6) Acquiring the FIN state	0x66	4.4.4 (6)
(7) FIN command	0x67	4.4.4 (7)
(8) Speed control	0x6F	4.4.4 (8)
(9) Wait command	0x90	4.4.4 (9)

4.4 DETAILS OF DIRECT COMMAND FUNCTIONS

4.4.1 Signal Operation Commands

(1) Setting and releasing the torque limit enable signal
The host specifies the setting and release of the torque limit enable signal.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	0	0	1	1	0	0	(0x0C)
Yy+6	0	0	0	1	0	0	0	SET	

SET = 0 : Releases the torque limit enable signal.
SET = 1 : Sets the torque limit enable signal.

- Response command format
This command has no response data.
It only inverts EBSY.

(2) Specifying the torque limit value
The host specifies the torque limit value when the torque limit is enabled.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	1	0	0	1	0	0	0	1	(0x91)
Yy+6	0	0	0	1	0	0	0	0	
Yy+7 Yy+8	Torque limit value								

Torque limit value : 0 to 7282
Setting value = Torque limit value [%] × (7282/100)

- Response command format
This command has no response data.
It only inverts EBSY.

NOTE
1 Set bit 2 (IEBL) of parameter No. 010 to "1" to enable the torque limit function.
2 After the release command, the system returns to the torque limit value set in parameter No. 108.
3 A torque limit value of 0 means 100% (disabled).

4.4.2 Parameter

(1) Reading parameters
The host can read parameters for the servo amplifier.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	0	0	0	0	0	(0x20)
Yy+6 Yy+7	Parameter No. (Word type)								

- Response command format

Byte type

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	0	0	0	0	0	(0x20)
Xx+6	Reserved				Execution result				
Xx+7	Data length (Byte type) = 1								
Xx+8	Parameter (Byte type)								

Word type

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	0	0	0	0	0	(0x20)
Xx+6	Reserved				Execution result				
Xx+7	Data length (Byte type) = 2								
Xx+8 Xx+9	Parameter (Word type)								

DWORD type

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	0	0	0	0	0	(0x20)
Xx+6	Reserved				Execution result				
Xx+7	Data length (Byte type) = 4								
Xx+8 Xx+9 Xx+10 Xx+11	Parameter (DWORD type)								

(2) Writing parameters

The host can write parameters for the servo amplifier.

⚠ CAUTION

1 Writing parameters from the host is prohibited while the servo amplifier unit is operating.

2 There is a limit to the number of writes to the memory (EEPROM) in the β amplifier that is used to store parameter settings (tens of thousands of writes).
For this reason, the direct command, parameter rewrite instruction, cannot be used for applications that frequently change parameters. It is, however, possible to frequently change parameters if the parameter setting is such that only the data on the RAM is changed without writes to the EEPROM (NEPRM (bit 3 of parameter No. 004) = 1).
If the number of parameter rewrites exceed the limit, any subsequent writes to the memory are prohibited, possibly causing an alarm (LED display: "8").

- Instruction command format

Byte type

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	0	0	0	0	1	(0x21)
Yy+6 Yy+7	Parameter No. (Word type)								
Yy+8	0	0	0	0	0	0	0	1	
Yy+9	Data length (Byte type) = 1								
Yy+10	Parameter (Byte type)								

Word type

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	0	0	0	0	1	(0x21)
Yy+6 Yy+7	Parameter No. (Word type)								
Yy+8	0	0	0	0	0	0	0	1	
Yy+9	Data length (Byte type) = 2								
Yy+10 Yy+11	Parameter (Word type)								

DWORD type

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	0	0	0	0	1	(0x21)
Yy+6 Yy+7	Parameter No. (Word type)								
Yy+8	0	0	0	0	0	0	0	1	
Yy+9	Data length (Byte type) = 4								
Yy+10 Yy+11 Yy+12 Yy+13	Parameter (DWORD type)								

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	0	0	0	0	1	(0x21)
Xx+6	Reserved				Execution result				

4.4.3 Status Read

(1) Reading the absolute position
The host can read the absolute position of the servo amplifier.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	0	0	0	(0x30)
Yy+6	0	0	0	0	0	0	0	1	

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	0	0	0	(0x30)
Xx+6	Reserved				Execution result				
Xx+7	Absolute position data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(2) Reading the machine position
The host can read the machine position of the servo amplifier.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	0	0	1	(0x31)
Yy+6	0	0	0	0	0	0	0	1	

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	0	0	1	(0x31)
Xx+6	Reserved				Execution result				
Xx+7	Machine position data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(3) Reading skip measurement data
This function reads from the host the workpiece coordinates at the time of skip signal input. (This function can be used only when the skip function is enabled (bit 0 (HENB) of parameter No. 017 is 1).

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	0	1	0	(0x32)
Yy+6	0	0	0	0	0	0	0	1	

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	0	1	0	(0x32)
Xx+6	Reserved				Execution result				
Xx+7	Skip measurement data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(4) Reading the servo positional deviation
This function reads the servo positional deviation of the servo amplifier from the host.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	0	1	1	(0x33)
Yy+6	0	0	0	0	0	0	0	1	

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	0	1	1	(0x33)
Xx+6	Reserved				Execution result				
Xx+7	Servo positional deviation data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(5) Reading the acceleration/deceleration delay
The host can read the acceleration/deceleration delay in the servo amplifier.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	1	0	0	(0x34)
Yy+6	0	0	0	0	0	0	0	1	

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	1	0	0	(0x34)
Xx+6	Reserved				Execution result				
Xx+7	Acceleration/deceleration delay data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(6) Reading the actual feedrate
The host can read the actual feedrate of the servo amplifier.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	1	1	0	(0x36)

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	1	1	0	(0x36)
Xx+6	Reserved				Execution result				
Xx+7	Actual feedrate data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

(7) Reading the status
The host can read the execution status of the servo amplifier (such as the mode being selected and the alarm state).

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	0	1	1	1	(0x37)

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	0	1	1	1	(0x37)
Xx+6	Reserved				Execution result				
Xx+7	Operation state				Mode state				
Xx+8					Action state				
Xx+9	Alarm state				Emergency stop state				

Mode state: 1:AUTO, 4:HANDLE, 5:JOG

Operation state: 0:(reset), 1: STOP, 3:START

Action state: 0:***, 2: Dwelling, 1: Operating

Emergency stop state:
0:***, 2: Reset state, 1: Emergency stop state

Alarm satte: 0:***, 2: Battery alarm issued, 1: Alarm issued

(8) Reading alarm information
When an alarm is issued in the servo amplifier, the host can read the alarm number of the alarm. Among issued alarm numbers, up to three alarm numbers can be read in ascending order.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	1	0	0	0	(0x38)
Yy+6	Data size (*1)								

(*1) In "data size", specify the number of alarm numbers to be read x 3. Because up to three numbers can be read, the maximum for "data size" is 9.

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	1	0	0	0	(0x38)
Xx+6	Reserved				Execution result				
Xx+7	0	0	0	0	0	0	0	0	
Xx+8 Xx+9	Alarm number 1 (Word type)								
Xx+10	0	0	0	0	0	0	0	0	Not larger than the data size
Xx+11 Xx+12	Alarm number 2 (Word type)								
	.....								
	1	1	1	1	1	1	1	1	(*2)

(*2) As final data, 0xFF is output.

NOTE
1 The data length depends on the data size.
2 If ECONT is "1", this indicates that there is remaining response command(s). After the current response command is read, inverting EOREND causes the remaining command to be output from Xx+5. Repeat this operation until ECONT becomes "0".

(9) Reading the series and edition of system software
The host can read the series and edition of system software.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	0	1	1	1	1	1	1	(0x3F)

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	1	1	1	1	(0x3F)
Xx+6	Reserved				Execution result				
Xx+7									
Xx+8									
Xx+9									
Xx+10									
Xx+11	Series								
Xx+12									
Xx+13									
Xx+14									
Xx+15	Edition								
Xx+16									
Xx+17									
Xx+18									
Xx+19									
Xx+20									

The edition is output as ASCII codes. The high-order two bytes of the edition is always "0" (ASCII code 0x30). The low-order two bytes is the edition information. For example, if the edition is 08, the following is output:

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+15	0	0	1	1	0	0	0	0	(0x30)
Xx+16	0	0	1	1	0	0	0	0	(0x30)
Xx+17	0	0	1	1	0	0	0	0	(0x30)
Xx+18	0	0	1	1	1	0	0	0	(0x38)

Two separate response commands are output. The output data of the first response command and that of the second are as follows:

<First response command>

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	0	1	1	1	1	1	1	(0x3F)
Xx+6	Reserved				Execution result				
Xx+7									
Xx+8									
Xx+9									
Xx+10									
Xx+11	Series								
Xx+12									
Xx+13									
Xx+14									
Xx+15	Edition								

<Second response command>

	#7	#6	#5	#4	#3	#2	#1	#0
Xx+4	Control flag 2							
Xx+5	Edition							
Xx+6								
Xx+7								
Xx+8								
Xx+9								

Thus, the edition is output by a combination of Xx+15 of the first response command and Xx+5 to Xx+7 of the second response command.

(10) Reading data continuously

This function reads from the host the absolute position, machine position, servo positional deviation, etc. of the servo amplifier continuously.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	0	0	0	0	0	1	(0x41)
Yy+6	Number of data items to be read (*1)								
	Read data specification 1								
//									//
	Read data specification n								

(*1) Up to four data items can be specified for reading. When continuous read operation is canceled, the host sets 0 as the number of data items.

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	1	0	0	0	0	0	1	(0x41)
Xx+6	Reserved				Execution result				
	Continuously read data 1								
//									//
	Continuously read data n								

NOTE

1 The data length varies according to the specified data.
2 If a stop command (number of items: 0) is issued, "0x80" is output as a completion code to Xx+6. When this response command is read and EOREND is inverted, continuous data reading ends.
3 If ECONT is "1", this indicates that there is remaining response command(s). After the current response command is read, inverting EOREND causes the remaining command to be output from Xx+5. Repeat this operation until ECONT becomes "0".

The types of data to be read continuously are specified using the following codes. The read data format for each code is also shown below.

(a) Reading the absolute position 0x01
(b) Reading the machine position 0x02
(c) Reading the servo positional deviation 0x03
(d) Reading the acceleration/deceleration delay 0x04
(e) Reading the actual feedrate 0x05
(f) Reading the status 0x06
(g) Reading the motor current value 0x0D
(h) Reading the torque command 0x0E
(i) Reading the actual speed 0x0F

(a) Reading the absolute position 0x01

- Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	0	1	(0x01)
1	0	0	0	0	0	0	0	1	

- Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	0	1	(0x01)
1	Reserved				Execution result				
2	Absolute position data (DWORD type)								
3									
4									
5									

(b) Reading the machine position 0x02

- Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	1	0	(0x02)
1	0	0	0	0	0	0	0	1	

- Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	1	0	(0x02)
1	Reserved				Execution result				
2	Machine position data (DWORD type)								
3									
4									
5									

(c) Reading the servo positional deviation 0x03

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	1	1	(0x03)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	0	1	1	(0x03)
1	Reserved				Execution result				
2	Servo positional deviation data (DWORD type)								
3									
4									
5									

(d) Reading the acceleration/deceleration delay 0x04

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	0	0	(0x04)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	0	0	(0x04)
1	Reserved				Execution result				
2	Acceleration/deceleration delay data (DWORD type)								
3									
4									
5									

(e) Reading the actual feedrate 0x05

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	0	1	(0x05)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	0	1	(0x05)
1	Reserved				Execution result				
2	Actual feedrate data (DWORD type) Unit: 10^N user units/MIN(N: Parameter No. 021)								
3									
4									
5									

(f) Reading the status of a slave 0x06

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	1	0	(0x06)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	0	1	1	0	(0x06)
1	Reserved				Execution result				
2	Operation state				Mode state				
3					Action state				
4	Alarm state				Emergency stop state				

Mode state: 1 AUTO 4 HANDLE
5 JOG
Operation state: 0 (reset)
1 STOP 3 START
Action state: 0 *** 2 Dwelling
1 Operating
Emergency stop state: 0 *** 2 Reset state
1 Emergency stop state
Alarm state: 0 *** 2 Battery alarm issued
1 Alarm issued

(g) Reading the motor current value 0x0D

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	0	1	(0x0D)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	0	1	(0x0D)
1	Reserved				Execution result				
2	Motor current value data (DWORD type)								
3									
4									
5									

The motor current value means the maximum current value of the amplifier when it is 6554.

(h) Reading the torque command 0x0E

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	1	0	(0x0E)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	1	0	(0x0E)
1	Reserved				Execution result				
2	Torque command data (DWORD type)								
3									
4									
5									

The maximum value of the torque command is 6554. The least significant bit of the torque command means the torque limit arrival signal.

The least significant bit of the torque command =
0: The torque limit has not been reached.
1: The torque limit has been reached.

(i) Reading the actual speed 0x0F

● Data specification code for continuous read

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	1	1	(0x0F)
1	0	0	0	0	0	0	0	1	

● Continuous read data format

	#7	#6	#5	#4	#3	#2	#1	#0	
0	0	0	0	0	1	1	1	1	(0x0F)
1	Reserved				Execution result				
2	Actual speed data (DWORD type) Unit: min^{-1}								
3									
4									
5									

(11) Reading the motor current value
This function reads the motor current value from the host.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	1	0	0	1	0	1	0	1	(0x95)
Yy+6	0	0	0	0	0	0	0	1	

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	1	0	0	1	0	1	0	1	(0x95)
Xx+6	Reserved				Execution result				
Xx+7	Motor current value data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

The motor current value means the maximum current value of the amplifier when it is 6554.

(12) Reading the torque command
This function reads from the host the torque command of the servo amplifier.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	1	0	0	1	0	1	1	0	(0x96)
Yy+6	0	0	0	0	0	0	0	1	

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	1	0	0	1	0	1	1	0	(0x96)
Xx+6	Reserved				Execution result				
Xx+7	Torque command data (DWORD type)								
Xx+8									
Xx+9									
Xx+10									

The maximum value of the torque command is 6554. The least significant bit of the torque command means the torque limit arrival signal.
The least significant bit of the torque command =
0: The torque limit has not been reached.
1: The torque limit has been reached.

(13) Reading the actual speed
This function reads from the host the actual speed of the servo amplifier.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	1	0	0	1	0	1	1	1	(0x97)
Yy+6	0	0	0	0	0	0	0	1	

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	1	0	0	1	0	1	1	1	(0x97)
Xx+6	Reserved				Execution result				
Xx+7	Actual speed data (DWORD type) Unit of data : min^{-1}								
Xx+8									
Xx+9									
Xx+10									

4.4.4 Axis Movement Commands

Axis movement commands are executed in AUTO mode.

> ⚠ **CAUTION**
> Do not change the mode during operation. Change the mode only after operation stops.

NOTE
1 The command cannot be executed if the alarm signal (AL) is "1".
2 Clamping/unclamping of peripheral equipment control cannot be used. Be sure to set bit 1 (NCLP) of parameter No. 003 to "1".

(1) Reference position return

This command instructs the servo amplifier to perform reference position return.
For reference position return without dogs, when the reference position has not been established, movement is performed at low speed (parameter No. 054) in the reference position return direction (bit 5 (ZMIX) of parameter No. 010) to stop at the first grid position, which is regarded as the reference position. When the reference position has already been established, return to the reference position is performed at high speed (rapid traverse rate).
Setting bit 2 (DZRN) of parameter No.011 to "1" causes reference position return with dogs to be enabled. For details, see Section 3.5, "Reference Position Return Function with Dogs".

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	0	0	0	(0x60)
Yy+6	0	0	0	0	NMOD	0	0	0	
Yy+7	0	0	0	0	0	0	0	1	

NMOD = 1 : Execution completion notification mode
(For details, see Section 4.2.)

● Response command format
This command has no response data.
It only inverts EBSY.

NOTE
This command can be executed even if alarm 224 has been issued.

(2) Absolute positioning
This command instructs the servo amplifier to perform absolute positioning.
The motor moves through an amount equal to the difference between a specified absolute position and the current position.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	0	0	1	(0x61)
Yy+6	0	0	0	0	NMOD	0	0	1	
Yy+7	SKIP	RPD	SMZX	0	0	0	0	1	
Yy+8 Yy+9	Feedrate								
Yy+10 Yy+11 Yy+12 Yy+13	Absolute position								

Feedrate : 1 to 65535 [10^N user-specified unit/MIN]]
(N is set with parameter No. 021.)

Absolute position : -99999999 to 99999999 [user-specified unit]

NMOD = 1 : Execution completion notification mode
(For details, see Section 4.2.)

SMZX = 1 : Performs an in-position check during cutting feed.

<1> If RPD is "0" and SMZX is "1", an in-position check is performed with the in-position width set in parameter No. 137 (when bit 3 (CIPC) of parameter No. 002 = 1) at the end of the command. After the end of the command, confirm whether the motor is in position by checking if the following are true: Distribution pulse signal IPLX (Xx+0#1) = 0, acceleration/deceleration pulse signal SUPX (Xx+0#2) = 0, in-position signal INPX (Xx+0#3) = 1, axis movement signal MVX (Xx+3#2) = 0, and automatic operation start signal STL (Xx+1#5) = 0.

<2> If RPD is "1", an in-position check is performed with the in-position width set in parameter No. 111. After the end of the command, confirm whether the motor is in position by checking if the following are true: Distribution pulse signal IPLX (Xx+0#1) = 0, acceleration/deceleration pulse signal SUPX (Xx+0#2) = 0, in-position signal INPX (Xx+0#3) = 1, axis movement signal MVX (Xx+3#2) = 0, and automatic operation start signal STL (Xx+1#5) = 0.

RPD = 1 : Rapid traverse
SKIP = 1 : Skip function used

If the command is being executed independently when the skip signal (HDI) is input, axis movement is stopped immediately and command execution is ended. If during thirty-two-buffering operation, the currently executed block is skipped to proceed to the next block. In this case, the workpiece coordinates at the time of skip signal input are recorded. The recorded data can be read with the direct command for reading skip measurement data (function code 0x32).

- Response command format
  This command has no response data.
  It only inverts EBSY.

NOTE

1 To use SMZX, bit 7 (CSMZ) of parameter No. 002 must be set to "1".
2 "Cutting feed" means feed which is neither rapid traverse nor jog (JOG) feed.
3 When RPD = 0 and SMZX = 1, if bit 3 (CIPC) of parameter No. 002 is "0", an in-position check is performed at the end of the command with the in-position width set in parameter No. 111.
4 The in-position check during reference position return (function code: 0x60) is the same as that if RPD is "1" (equivalent to that described in SMZX<2>). In addition to the signals mentioned in SMZX<2>, check if the reference position return completion signal ZPX(Xx+2#0) is 1.
5 To use the skip function, bit 0 (HENB) of parameter No. 017 must be set to "1".
6 It is possible to specify, using an appropriate parameter, whether to retain the previous skip measurement data or record the specified end point coordinates if, during the execution of the skip function, the skip signal (HDI) is not input and the end point is reached. If bit 2 (SPCO) of parameter No. 17 is "0", the previous skip measurement data is recorded; if "1", the specified end point coordinates.
7 If, during the execution of the skip function, the execution is interrupted due to an external reset, emergency stop, alarm, etc., no skip measurement data is updated.

(3) Incremental positioning

This command instructs the servo amplifier to perform incremental positioning. The motor moves through a specified amount of travel.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	0	1	0	(0x62)
Yy+6	0	0	0	0	NMOD	0	0	1	
Yy+7	SKIP	RPD	SMZX	0	0	0	0	1	
Yy+8 Yy+9	Feedrate								
Yy+10 Yy+11 Yy+12 Yy+13	Incremental travel amount								

Feedrate : 1 to 65535 [10^N user-specified unit/MIN]]
(N is set with parameter No. 021.)

Incremental travel amount:
-99999999 to 99999999 [user-specified unit]

NMOD = 1 : Execution completion notification mode
(For details, see Section 4.2.)

SMZX = 1 : Performs an in-position check during cutting feed.

<1> If RPD is "0" and SMZX is "1", an in-position check is performed with the in-position width set in parameter No. 137 (when bit 3 (CIPC) of parameter No. 002 = 1) at the end of the command. After the end of the command, confirm whether the motor is in position by checking if the following are true: Distribution pulse signal IPLX (Xx+0#1) = 0, acceleration/deceleration pulse signal SUPX (Xx+0#2) = 0, in-position signal INPX

(Xx+0#3) = 1, axis movement signal MVX (Xx+3#2) = 0, and automatic operation start signal STL (Xx+1#5) = 0.

<2> If RPD is "1", an in-position check is performed with the in-position width set in parameter No. 111. After the end of the command, confirm whether the motor is in position by checking if the following are true: Distribution pulse signal IPLX (Xx+0#1) = 0, acceleration/deceleration pulse signal SUPX (Xx+0#2) = 0, in-position signal INPX (Xx+0#3) = 1, axis movement signal MVX (Xx+3#2) = 0, and automatic operation start signal STL (Xx+1#5) = 0.

RPD = 1 : Rapid traverse

SKIP = 1 : Skip function used

If the command is being executed independently when the skip signal (HDI) is input, axis movement is stopped immediately and command execution is ended. If during thirty-two-buffering operation, the currently executed block is skipped to proceed to the next block. In this case, the workpiece coordinates at the time of skip signal input are recorded. The recorded data can be read with the direct command for reading skip measurement data (function code 0x32).

- Response command format
  This command has no response data.
  It only inverts EBSY.

NOTE

1 To use SMZX, bit 7 (CSMZ) of parameter No. 002 must be set to "1".
2 "Cutting feed" means feed which is neither rapid traverse nor jog (JOG) feed.
3 When RPD = 0 and SMZX = 1, if bit 3 (CIPC) of parameter No. 002 is "0", an in-position check is performed at the end of the command with the in-position width set in parameter No. 111.
4 The in-position check during reference position return (function code: 0x60) is the same as that if RPD is "1" (equivalent to that described in SMZX<2>). In addition to the signals mentioned in SMZX<2>, check if the reference position return completion signal ZPX(Xx+2#0) is 1.
5 To use the skip function, bit 0 (HENB) of parameter No. 017 must be set to "1".
6 It is possible to specify, using an appropriate parameter, whether to retain the previous skip measurement data or record the specified end point coordinates if, during the execution of the skip function, the skip signal (HDI) is not input and the end point is reached. If bit 2 (SPCO) of parameter No. 17 is "0", the previous skip measurement data is recorded; if "1", the specified end point coordinates.
7 If, during the execution of the skip function, the execution is interrupted due to an external reset, emergency stop, alarm, etc., no skip measurement data is updated.

(4) Dwell
This command instructs the servo amplifier to perform dwell. The execution of the next block can be delayed by a specified amount of time.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	0	1	1	(0x63)
Yy+6	0	0	0	0	NMOD	0	0	1	
Yy+7	0	0	0	0	0	0	0	1	
Yy+8 Yy+9 Yy+10 Yy+11	Dwell time								

Dwell time: 1 to 99999999 [msec]

NMOD = 1 : Execution completion notification mode
(For details, see Section 4.2.)

- Response command format
  This command has no response data.
  It only inverts EBSY.

(5) Setting a coordinate system
The absolute position of the servo amplifier is preset at a specified coordinate value.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	1	0	0	(0x64)
Yy+6	0	0	0	0	NMOD	0	0	1	
Yy+7	0	0	0	0	0	0	0	1	
Yy+8 Yy+9 Yy+10 Yy+11	Coordinate system setting value								

Dwell time: -99999999 to 99999999 [user-specified unit]

NMOD = 1 : Execution completion notification mode
(For details, see Section 4.2.)

- Response command format
  This command has no response data.
  It only inverts EBSY.

(6) Acquiring the FIN state
The host issues this command to check whether the servo amplifier is waiting for FIN in command completion notification mode.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	1	1	0	(0x66)

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	1	1	0	0	1	1	0	(0x66)
Xx+6	Reserved				Execution result				
Xx+7								ECF0	

ECF0 = 1 : Command completed (waiting for the FIN command)

NOTE
This command is valid when command completion notification mode is set (NMOD = 1).

(7) FIN command
If the servo amplifier is waiting for FIN in command completion notification mode, the host issues this command to release the FIN wait state.

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	0	1	1	1	(0x67)
Yy+6								ECFIN0	

ECFIN0 : FIN specification
If the servo amplifier is waiting for FIN (ECF0 = 1) in command completion notification mode, the host responds with this command.

- Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	0	1	1	0	0	1	1	1	(0x67)
Xx+6	Reserved				Execution result				

(8) Velocity control
Speed control is issued to the servo amplifier. The motor moves at the specified speed command value (speed).

- Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	0	1	1	0	1	1	1	1	(0x6F)
Yy+6	0	0	0	0	0	0	0	1	
Yy+7	0	0	0	0	0	0	0	1	
Yy+8	Function selection								
Yy+9 Yy+10	Speed command value								
Yy+11 Yy+12	Torque limit value								

Function selection =
1 : Start or speed change command (torque limit disabled)
2 : Start of spec change command (torque limit enabled)
3 : Stop command

Speed command value : ±0 to maximum speed of the motor [min^{-1}]

Torque limit value : 0 to 7282
Determine the setting with the following formula:
Setting = Torque limit value [%] x
A setting of 0 is regarded as 100% (7282).

[Example]
To set the torque limit to 50% with a speed command of 1500 min^{-1}.
Speed command value = 1500 (= 05DCh) min^{-1}
Setting of the torque limit value = 50% x (7282/100) = 3641 (= 0E39h)

Yy+8	2
Yy+9	DC
Yy+10	05
Yy+11	39
Yy+12	0E

- Response command format
  This command has no response data.
  It only inverts EBSY.

NOTE
1. The maximum speed of the motor depends on the motor used.
2. If the function selection is "1", the torque limit value need not be specified. The torque limit is invalid and 100% is assumed.
3. If the function selection is "2", to change only the torque limit value with the speed unchanged, specify the same speed command value as the previous one.
4. If the function selection is "2", the specified torque limit value is clamped with the setting of parameter No. 080 (current limit value).
5. If the function selection is "3", the speed command value and the torque limit value need not be specified. After the stop command, the system returns to the torque limit value assumed before the start of speed control (determined with parameter No. 108 and bit 2 of parameter No. 10).

- Parameter

No.	#7	#6	#5	#4	#3	#2	#1	#0
000	ROAX						ROTX	

[Size] 1 byte (bit type)
[Standard value] 0

ROTX Specifies whether the controlled axis is a linear or rotation axis, as follows:
0 : Linear axis
1 : Rotation axis
* Set this bit to "1" to perform speed control.

ROAX Specifies whether the roll-over function of the rotation axis is valid, as follows:
0 : Invalid
1 : Valid
* Set this bit to "1" to perform speed control.

No.	
100	Load inertia ratio (LDINT)

[Size] 2-byte
[Valid data range] 0 to 1024

Set the ratio of the load inertia of the machine to the inertia of the motor, using the value calculated with the formula below as a rough guide:
Load insertia ratio = (load inertia of the machine/inertia of the motor) x 256
If the calculated value exceed 500, set 500.
By setting a value here, the velocity loop gain will be PK1V, and PK2V will be (1 + LDINT/256).
The larger this value, the higher the responsiveness to the speed command and the higher the servo rigidity. Too large a value, however, will cause the servo system to vibrate and abnormal sound during machine movement. Normally, regard about 500 as the upper limit.
If the machine vibrates at a high frequency, the torque command filter (parameter No. 102) is effective.

No.	
116	Velocity loop gain override during velocity control (%)

[Size] 2-byte
[Standard value] 0 (overriding not performed)

Set this parameter if the system is switched between position control and velocity control.
When the system enters velocity control mode, the velocity loop proportional gain and the integral gain that are used in position control are multiplied by the above override.
The relationships among the velocity loop proportional gain, integral gain, load inertia ratio, and the velocity loop gain override during velocity control are explained using the following example:
Assume the following:
Integral gain = 100
Proportional gain = -500
Load inertia ratio = 128
Velocity loop gain override during velocity control = 200%

[Gain during position control]
Integral gain = 100 × (1+128/256) = 150
Proportional gain = -500 × (1+128/256) = -750

[Gain during velocity control]
Integral gain = 100 × (1+128/256) 200/100 = 300
Proportional gain = -500 × (1+128/256) 200/100 = -1500

Thus, the gain with the load inertia ratio taken into consideration is multiplied by the gain override during velocity control.

No.	
135	Linear acceleration/deceleration time constant for velocity control

[Size] 2-byte
[Unit of data] ms
[Valid data range] 8 to 4000

Specify the time required to reach 4000 min^{-1}.

Example)
If the value specified for velocity is 2000 min^{-1}, and the time required to reach 2000 min^{-1} is to be 1000 msec, the value to be set is calculated as follows:
Value to be set = (4000/2000) × 1000 = 2000

No.	
136	Velocity deviation check limit during velocity control

[Size] 2-byte
[Unit of data] min^{-1}
[Valid data range] 0 to 4000
[Standard value] 0 (velocity deviation check not performed)

Set the limit on the velocity deviation check to be performed in velocity control mode.
In velocity control mode, alarm No. 447 is issued if the deviation of the actual velocity from the specified velocity exceeds the value set for this parameter.

● Signal

	#7	#6	#5	#4	#3	#2	#1	#0
Xx+2						TRQM		

Speed control mode signal TRQM

[Classification] Input signal <Xx+2#2>
[Function] The servo amplifier notifies that the system is in speed control mode.
[Input condition] The signal becomes 1 when:

1. Speed control is started and the system is in speed control mode.

The signal becomes 0 when:

1. A speed control stop command is executed.
2. A servo alarm, overtravel alarm, reset, emergency stop, or servo off

● Alarm

No.	LED indication	Description	Action
250	□ ■ ■ ■ ■ □ □	Command data 1 or instruction command is invalid.	Check the specified value of command data 1 of function code command.
254	□ ■ ■ ■ ■ □ □	The function code or mode is invalid.	Check the specified value of the function code of the function code command. Check the mode.
255	■ □ □ □ ■ □ □	Operation cannot be activated because an invalid mode is specified or because block execution is in progress.	Check the mode. Check whether a block is being executed.
447	□ ■ ■ ■ ■ □ ■	Excessive speed deviation (speed control)	Check the actual speed. Check the setting of parameter No. 136.

● Others

(i) The following parameters usually need to be changed to perform speed control.
Do not change any other parameters.
No.000 (bit 1): Set it to 1. (Rotation axis specification)
No.000 (bit 7): Set it to 1. (Rotation axis rollover enabled)
No.100: Load inertia ratio. Set an adjusted value.

The following parameters are for speed control only; once values are set, they usually need not be changed at each switching.
No. 116: Velocity loop gain override during speed control. (To be set to switch between position control and speed control)
No. 135: Linear acceleration/deceleration time constant for speed control.
No. 136: Speed deviation check limit value during speed control.

(ii) The actions with output signals during speed control are as follows:

If an overtravel alarm is issued, speed control mode ends after a deceleration stop. If the external reset signal ERS (Yy+1#0) becomes "1", speed control mode ends after a deceleration stop. If the interlock signal *ILK (Yy+1#3) becomes "0", a deceleration stop occurs. If it becomes "1" again, movement restarts with acceleration.
If the servo off command signal SVFX (Yy+1#2) becomes "1", speed control mode ends after deceleration stop.

(iii) The states of the input signals during speed control are as follows:
Because the position is updated by performing follow-up, the axis movement signal MVX (Xx+3#2) and the distribution pulse signal IPLX (Xx+0#1) become "1".
During movement in one direction, the movement direction signal MVDX (Xx+3#0) becomes "1".
The automatic operation signal OP (Xx+1#7) and the automatic operation start signal STL (Xx+1#5) become "1".

(9) Wait command
This command instructs the servo amplifier to wait. When this command is executed, the servo amplifier outputs the wait signal WAT [2.3.14(14)] to the host and enters the wait state. To cancel the wait state, the host sets the wait completion signal WFN [2.3.14(15)] to "1". This causes the servo amplifier to set the WAT signal to "0". Upon confirming that the WAT signal has become "1", the host sets the WFN signal to "0". With these actions, the wait state is canceled and the servo amplifier moves to the next block.

● Instruction command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Yy+4	Control flag 1								
Yy+5	1	0	0	1	0	0	0	0	(0x90)
Yy+6	0	0	0	0	0	0	0	0	
Yy+7	ID code (1 to 255)								

● Response command format

	#7	#6	#5	#4	#3	#2	#1	#0	
Xx+4	Control flag 2								
Xx+5	1	0	0	1	0	0	0	0	(0x90)
Xx+6	Reserved				Execution results				
Xx+7									
Xx+8									
Xx+9	ID code (same ID code as that of the instruction command)								

NOTE
1 The ID code of the instruction command is effective when bit 5 (WAT2) of parameter No. 003 is 1.
2 The response command is output when bit 5 (WAT2) of parameter No. 003 is 1. When the response command is output, the host returns an answer by reading the ID code and inverting the response data read completion signal EOREND [2.3.14(8)].
Then, the host checks the WAT signal and controls the WFN signal so that it changes from "0" to "1" and back to "0".

4.5 THIRTY-TWO-BLOCK BUFFERING OPERATION

4.5.1 Overview

The host can register and execute up to 32 blocks of direct commands in the internal memory of the servo amplifier.

NOTE
One block consists of one instruction command which is a direct command.

4.5.2 Memory Registration Procedure

The host registers up to 32 blocks of direct commands in the internal memory of the servo amplifier by means of the procedure explained below.

(1) The host sets memory registration signal INPF [2.3.14 (16)] to 1.
(2) After confirming that memory registration in-progress signal INPFO [2.3.14 (17)] has been set to 1, the host registers direct commands in the servo amplifier through EBUF/EBSY control.
(3) Upon the completion of registration, the host sets memory registration signal INPF to 0.

⚠ **CAUTION**
The registered blocks are all erased when the INPF signal state is changed from 0 to 1. Also, the registered blocks are all erased when the power is disconnected.

NOTE
An attempt to register more than 32 blocks results in the issue of alarm 70.

4.5.3 Operation Procedure

The host operates and executes registered direct commands by means of the procedure explained below.

(1) Select AUTO mode. (MD1 = 1, MD2 = 0, MD4 = 0 [2.3.4 (1)])
(2) Change the status of automatic operation start signal ST [2.3.10 (1)] from 1 to 0. When the level of the ST signal falls, buffering operation starts. (It is also possible to start operation when the ST signal level rises by parameter setting (bit 7 (STON) of parameter No. 3)).

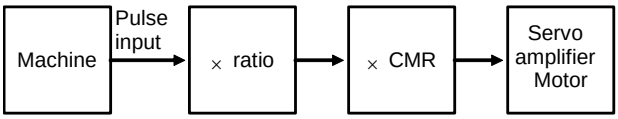
NOTE
1 After the last block has been executed, operation is halted. To perform operation again from the first block, cause a reset to locate the first block, then start operation by using the ST signal. A reset causes the top of the registered blocks to be located.
2 During buffering, switching the ST signal state from 0 to 1 causes a single-block stop. To restart operation, change the ST signal state from 1 to 0.
3 During the execution of buffering operation, switching the INPF signal from "0" to "1" causes a single-block stop, deleting all registered blocks.
4 If, in the halt state, an attempt is made to start operation with the ST signal with the INPF signal changed from "0" to "1", alarm 254 is issued.
5 If, during the execution of a skip command block, the skip signal (HDI) is input, the currently executed block is skipped to proceed to the next block.

5 EXTERNAL PULSE INPUT FUNCTION

5.1 OVERVIEW

This function enables movement in sync with external pulses generated from the machine.
Input external pulses to connector JA34.

5.2 DETAILED DESCRIPTION



(1) Input external pulses to connector JA34. The A-phase (PA, *PA) and B-phase (PB, *PB) signals are used for an input waveform as well as for a position coder output waveform. The C-phase signal is not required.
(2) The ratio of the amount of travel along an axis to an external pulse can be set with parameters. The ratio is expressed as M/N (where, M = parameter magnification 1 (parameter No. 0062), N = parameter magnification 2 (parameter No. 0063)).
(3) When the A-phase signal is 90° ahead of the B-phase signal, movement is performed in the positive direction.
When the A-phase signal lags 90° behind the B-phase signal, movement is performed in the negative direction.
(4) Parameter setting (bit 6 (EXPLS) of parameter No. 0003) determines whether to enable axis movement by external pulses.
(5) For axis movement by external pulses, interlock and overtravel detection are valid.
(6) The acceleration/deceleration type used for axis movement by external pulses is the same as that for jog feed. (Set bit 1 (JOGE) of parameter No. 0002.)
(7) Select manual handle mode. This mode is selected when signal output is performed from the host to a servo amplifier (MD1 = 0, MD2 = 0, MD4 = 1 [2.3.4 (1)].
(8) If the feedrate for axis movement by external pulses exceeds the upper limit for a specified feedrate, as set in parameter No. 43, a choice of the following responses can be made by parameter setting (bit 6 (EPEXA) and bit 7 (EPEXB) of parameter No. 0001):
    (a) The feedrate is clamped to the upper limit, and the excess pulses are accumulated.
    If the number of accumulated pulses exceeds 99999999, the excess pulses are discarded.
    (b) The feedrate is clamped to the upper limit, and the excess pulses are discarded.
    (c) Alarm 291 is issued, and movement is decelerated and stopped.

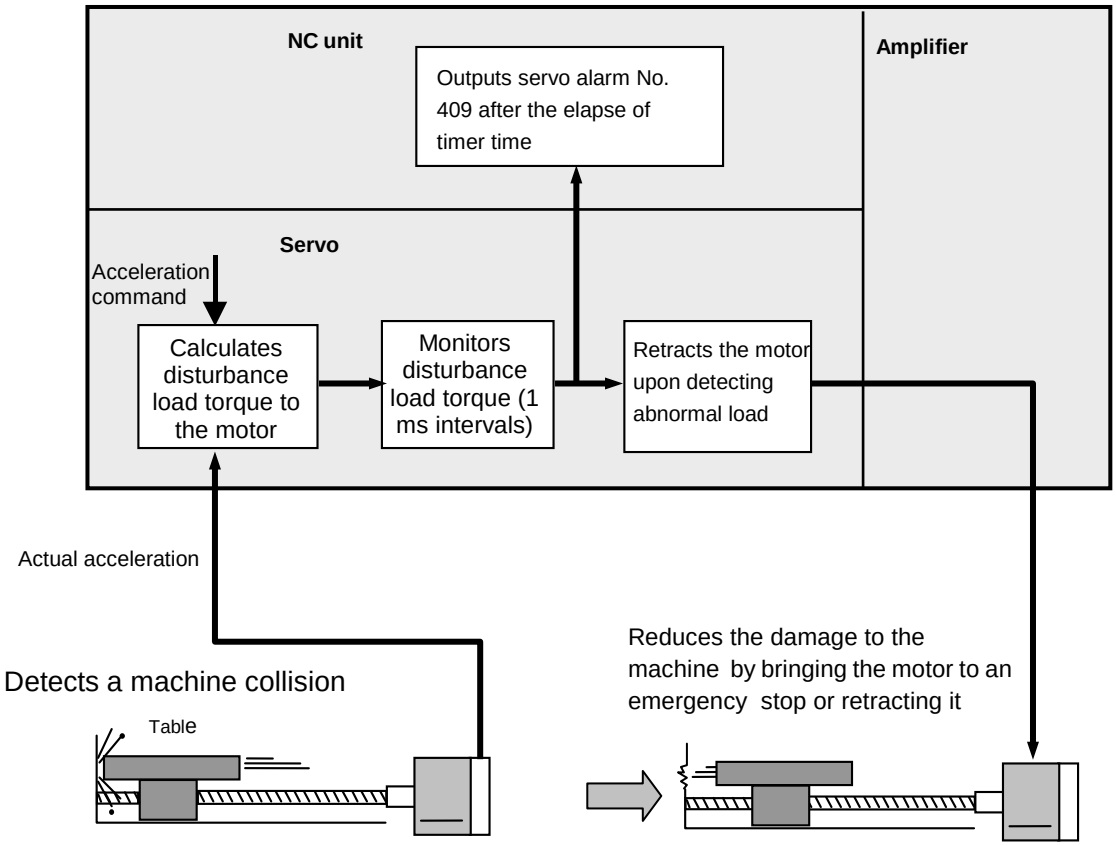
NOTE
This function does not operate unless the motor has been activated. When this function is used, therefore, clamping/unclamping using the unclamp command signal (UCPC2) and the clamp/unclamp state output signal (UCPS2) (when bit 1 (NCLP of parameter No. 003 is "0") cannot be used. Set "1" in bit 1 (NCLP) of parameter No. 003, and perform clamping/unclamping, using the servo off signal (SVFX).

6 UNEXPECTED DISTURBANCE TORQUE DETECTION FUNCTION

Optional function

6.1 OVERVIEW

In the event of a machine collision, for example, the servo motor receives higher load torque than in normal feed.
This function estimates the load torque to be received by this motor, and upon detecting an abnormal value, brings the servo motor to an emergency stop or retract the motor in the direction opposite to the advance direction, thereby reducing damage to the machine.



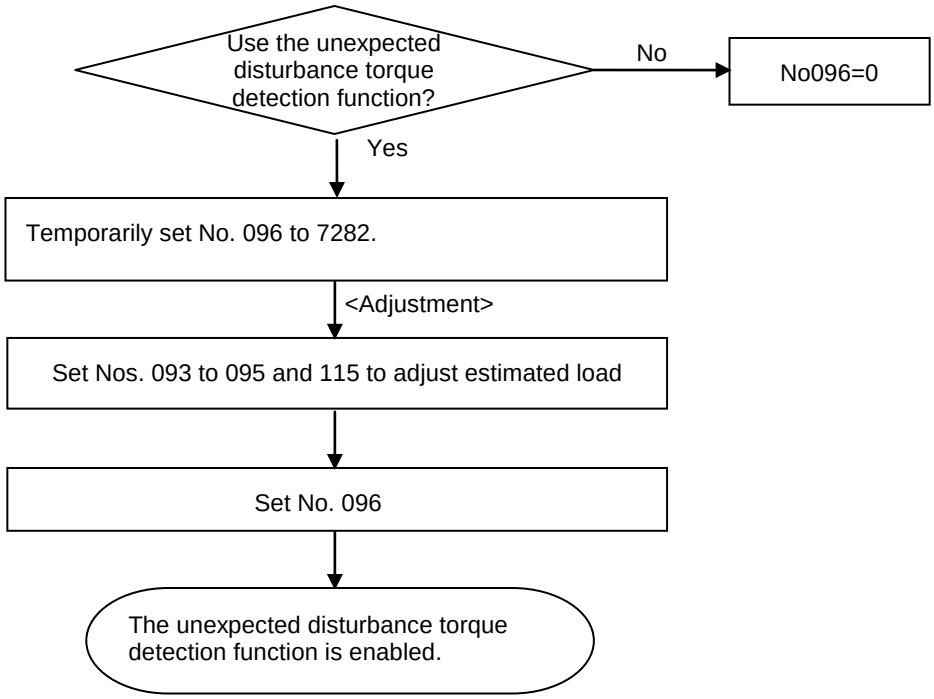
6.2 SERIES AND EDITIONS OF APPLICABLE SERVO SOFTWARE

Software programs of the following series and editions are required:
(β*i* SV-B control software)
Series 88A7/01(A) and subsequent editions
(CNC software)
All of 30*i* -B/31*i* –B/32*i* -B/35*i* –B/0*i* –F/Power Motion *i* –A are supported.

6.3 SETUP METHOD

6.3.1 Overview

To use the unexpected disturbance torque detection function, set appropriate parameters beforehand, using the procedure below.



6.3.2 Details of the Setup Method

<1> Confirm that the unexpected disturbance torque detection function is usable.
Confirm that the unexpected disturbance torque detection function is usable, using diagnosis (DGN) No. 034#1 (ABTDTC) and the signal Xx+1#3 (OPTENB).

<2> Temporarily set an alarm threshold
For adjustment, set parameter No. 096 to 7282 because no alarms will be detected and no estimated load torque will be calculated if the alarm threshold of abnormal load detection is 0.

<3> Adjust the value of the observer parameter POA1 (No. 115)
Turn the servo motor to perform linear back and forth operation at a speed equal to about 50% of the rapid traverse rate, and observe the motor speed (SPEED) and the estimated disturbance value (DTRQ) through “SERVO GUIDE”.

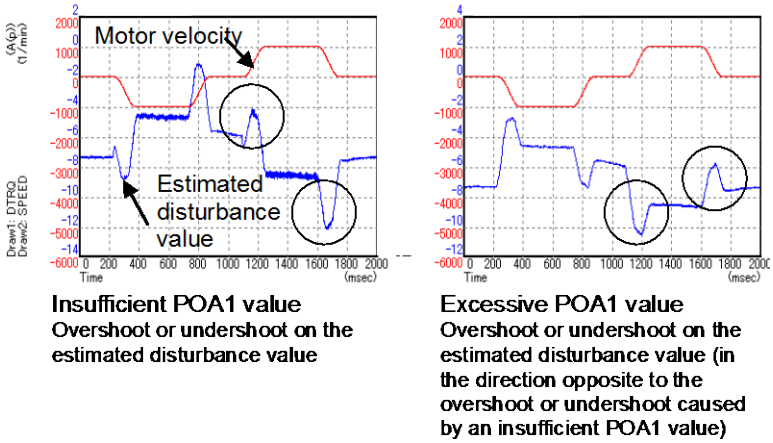


Fig. 6.3.2(a) Before model constant adjustment

Adjust the value of the observer parameter (POA1) so that neither an overshoot nor an undershoot will not be observed on the estimated disturbance value at acc./dec. After adjustment, the waveforms shown below should be obtained.
(A clear waveform as shown below may not be obtained in some machines. In such machines, find the POA1 parameter value that can minimize the overshoot and undershoot while watching the estimated disturbance waveform at acc./dec.)

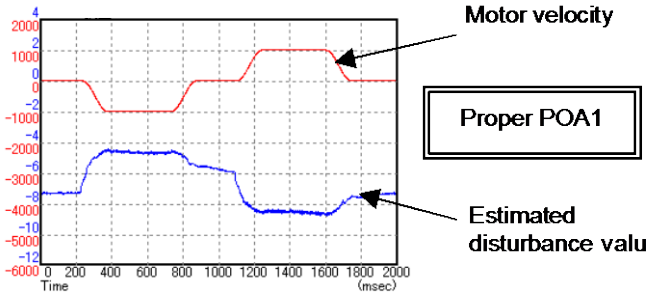


Fig. 6.3.2(b) After model constant adjustment

<4> Adjust the torque offset (parameter No. 93)
For axes to which a constant force is applied constantly, such as the vertical axis, set parameter No. 093, torque offset, to remove the effect.

Estimated disturbance values for constant-velocity movements in the + direction and - direction are read. In the figure below, minimum value A (signed) is read in a movement in the + direction, and maximum value B (signed) is read in a movement in the - direction. A torque offset parameter setting is given using the following expressions:

$$\text{Torque offset} = \frac{\text{A [Ap]} + \text{B [Ap]}}{\text{Maximum amplifier current value [Ap]}} \times 3641$$

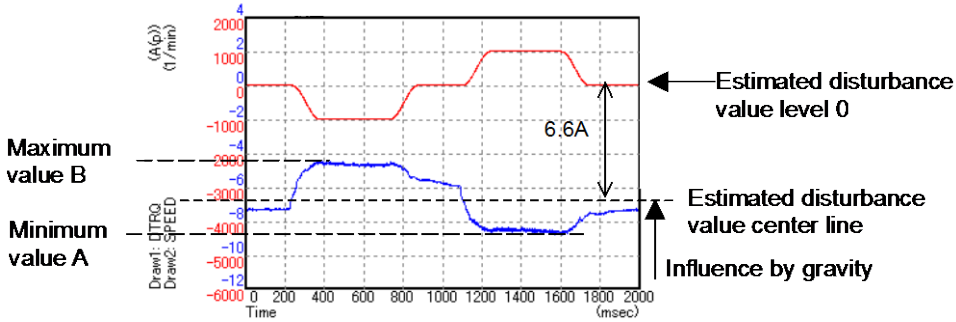


Fig. 6.3.2(c) Before offset adjustment

If you read the minimum value A and maximum value B as –8.6 [Ap] and –4.5 [Ap] in the above chart (the amplifier used is rated at 80 [Ap] maximum),
the torque offset parameter = -[(-8.6)+(-4.5)]/80×3641 = 596. The following chart applies when the parameter is set with 596.

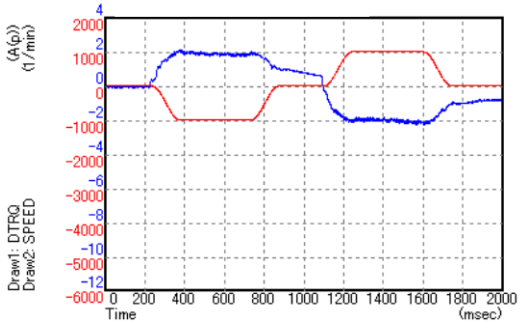
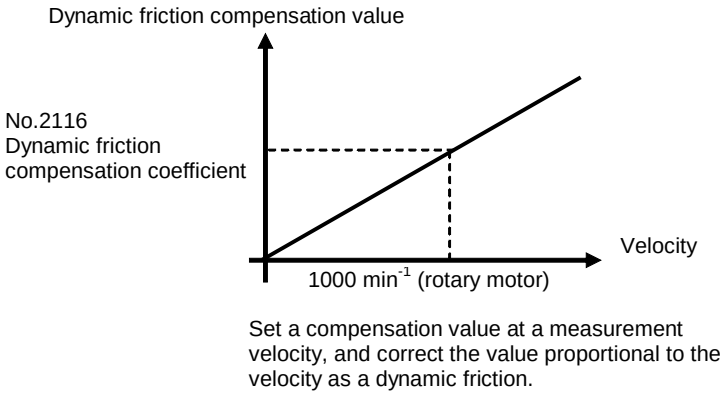


Fig. 6.3.2 (d) After Offset Adjustment

<5> Adjust dynamic friction compensation (parameter No. 94)
Measure an estimated disturbance value at a constant velocity. Then, by assuming this measured value as a dynamic friction, set the proportional coefficient for a velocity and dynamic friction compensation value (No. 94).

$$\text{Dynamic friction compensation coefficient} = \frac{\text{Estimated disturbance value [Ap]}}{\text{Maximum amplifier current value [Ap]}} \times 7282$$

NOTE
If the measurement velocity is too high, lower the measurement velocity, and measure the estimated disturbance value. By proportional calculation, obtain the estimated disturbance value at the above measurement velocity.



(Example of setting for a rotary motor)

- Suppose that the estimated disturbance value at 1000 min^{-1} is 1 [Ap] (the maximum amplifier current value is 40 [Ap]).
  Dynamic friction compensation coefficient = 1/40 × 7282 = 182

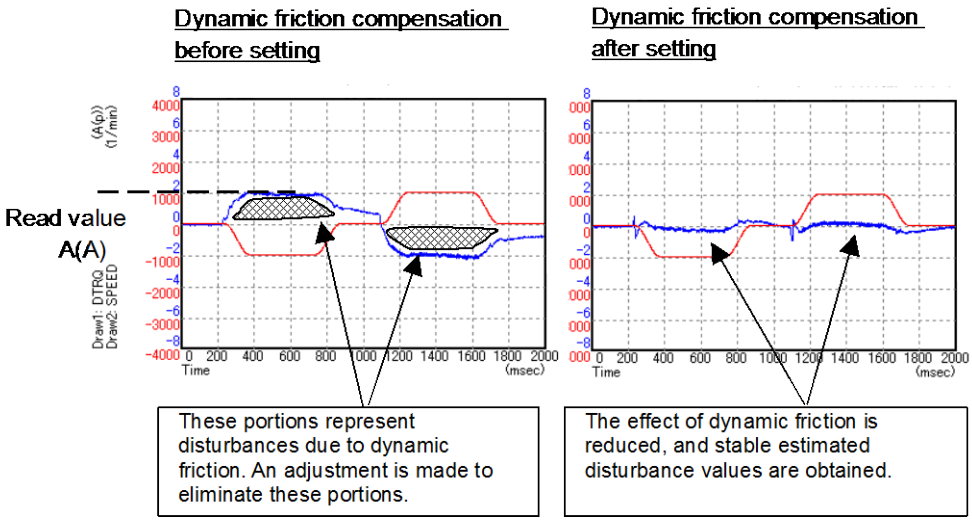
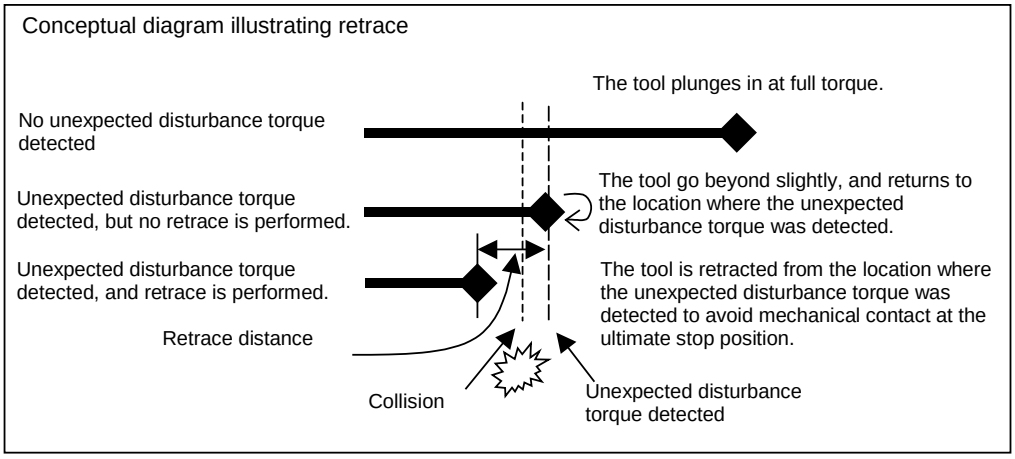


Fig. 6.3.2 (e) Adjustment of Dynamic Friction Compensation

<6> Adjust the alarm threshold value lever (parameter No. 96)
Alarm level conversion uses the following expression.

$$\text{Unexpected disturbance torque detection alarm level} = \frac{|\text{Estimated disturbance value [Ap]}|}{\text{Maximum amplifier current value [Ap]}} \times 7282 + 500 \text{ to } 1000 \text{ approximately}$$

<7> Adjust the retraced distance (parameter No.95)
If the retrace amount parameter is 0, the motor stops at the point where an unexpected disturbance torque was detected. To retract the tool from the location of collision quickly, set the retrace distance parameter.



6.4 Signal

No.	#7	#6	#5	#4	#3	#2	#1	#0
Xx+1					OPTENB			

Function enable signal OPTENB

[Classification] Input signal <Xx+1#3> (common to both the peripheral equipment control and direct command interfaces)

[Function] The servo amplifier module notifies that the function is enabled (usable).

The function is as follows:

- Unexpected disturbance torque detection function (software option function)

[Input condition] The signal becomes 1 when:

1. The function is usable.

The signal becomes 0 when:

1. The function is under preparation, immediately after the power is turned on.
2. The function is not ordered.

> ⚠ **CAUTION**
> The unexpected disturbance torque detection function is disabled until this signal becomes "1". Be sure to start axis movement after confirming hat this signal has become "1".

6.5 Parameter

No.	
130	Unexpected disturbance torque detection alarm timer

[Size] 2-byte

[Unit of data] msec

[Valid data range] 0 to 32767 (200 msec if 0 is set)

Set the time from when an unexpected disturbance torque is detected to when a servo alarm is issued. A fraction smaller than 8 msec is rounded up.

Example) Setting of 30: assumed to be 32 msec

No.	
115	Model constant（POA1）

[Size] 2-byte
[Valid data range] 0 to 32767
The model constant is a motor-specific value. Usually, it is fixed as a standard parameter. However, it should be tuned so as to obtain the estimated load torque correctly.

NOTE

Load torque estimation takes the load inertia ratio into consideration. Changing the load inertia ratio causes the optimum value for the model constant to change. Determine the load inertia ratio, as the first step of the servo adjustment procedure.
If changing the setting of the load inertia ratio after determining the model constant, set a new model constant, using the following formula:
(New model constant) = Parameter No. 115

$$\times \frac{\text{Load inertia ratio after adjustment}+256}{\text{Load inertia ratio before adjustment}+256}$$

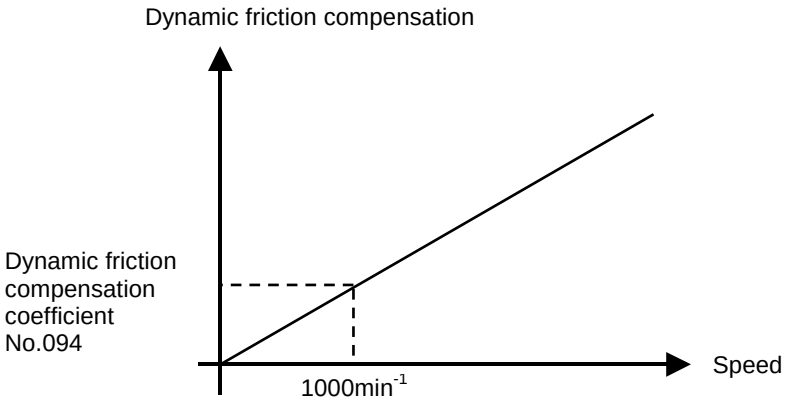
Load inertia ratio: Parameter No. 100

No.	
093	Estimated load torque: torque offset compensation

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] -7282 to 7282 (7282 is the maximum current value of the amplifier)
The setting is added to an estimated load torque, thereby eliminating an effect of stationary torque including gravity.

No.	
094	Estimated load torque: dynamic friction compensation coefficient

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] 0 to 7282 (7282 is the maximum current value of the amplifier)
[Setting value] An estimated load torque at 1000 min^{-1} is measured and set.
The compensation proportional to the speed is added to the estimated load torque, thereby eliminating an effect of dynamic friction.



Set the compensation at 1000min^{-1} in torque command units to compensate the value proportionate to the speed as dynamic friction.

No.	
095	Unexpected disturbance torque detection: retract distance

[Size] 2-byte
[Unit of data] Detection unit
[Valid data range] 0 to 65535
[Setting value] Set approximately 3 mm.

NOTE

Even if this parameter is set, if the movement is at a speed lower than the that described below, retraction is not performed but the tool stops at the position at which an abnormal load is detected.
Let the value of the retraction parameter to be A,
If the speed is equal to or less than A/8 x detection unit x 1000 [mm/min]: Stop at the detection point
If the speed is equal to or greater than A/8 x detection unit x 1000 [mm/min]: Stop after retraction

No.	
096	Unexpected disturbance torque detection: alarm threshold value

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] 0 to 7282 (7282 is the maximum current value of the amplifier)

Set a limit (threshold) value at which an unexpected disturbance torque detection alarm is issued. If the setting is 0, processing for unexpected disturbance torque detection is disabled, and alarm detection and calculation of an estimated load torque are not performed.
First set bit 1 (TDOU) of parameter No. 014 to 1 (bit 0 of parameter No.014 must be 0), and observe load torque. Then, set parameter No. 096 to a value greater than the maximum torque value.

6.6 ALARM

Number	LED indication	Description	Action
409	□ ■ ■ □ ■ □ ■	An abnormal load is detected.	Look for the mechanical cause of the abnormal load. If there is no mechanical cause, increase the check amount of the parameter (No. 096).

6.7 DIAGNOSIS

No.	#7	#6	#5	#4	#3	#2	#1	#0
034							ABTDTC	

ABTDTC Unexpected disturbance torque detection function is:
0 : Disabled.
1 : Enabled.

7 QUICK STOP FUNCTION

7.1 OVERVIEW

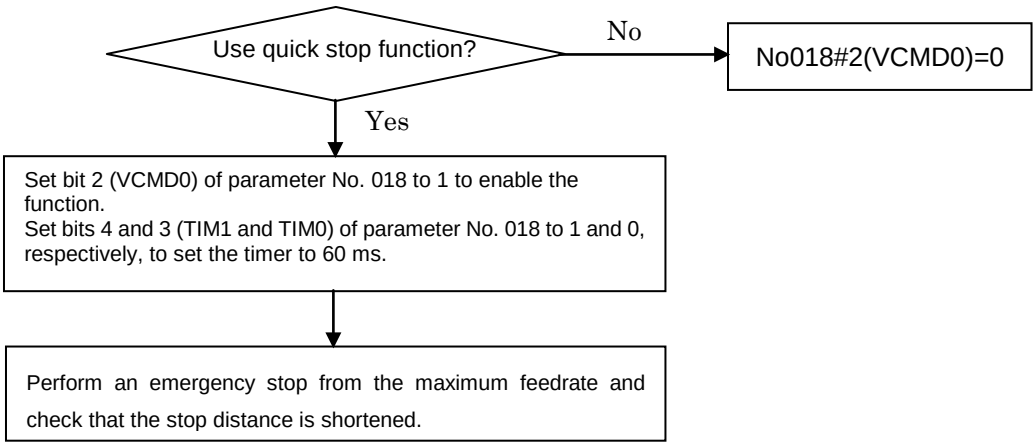
This function enables the motor to stop with a shorter distance than with a normal DB stop, by performing a stop operation in a controlled manner when a directly input emergency stop signal is input. To perform a stop operation in a controlled manner, it is necessary to set the delay time from the time the pressing of the emergency stop switch is recognized until the magnetic contactor of the amplifier is actually shut down. The β*i* SV-B allows setting of 60 and 100 ms through appropriate parameter setting.

7.2 SERIES AND EDITIONS OF APPLICABLE SERVO SOFTWARE

Software of the following series and edition is necessary:
(control software)
Series 88A7 /01(A) and subsequent editions

7.3 SETTING METHOD

To use the quick stop function, set appropriate parameters with the procedure given below.



7.4 PARAMETER

No.	#7	#6	#5	#4	#3	#2	#1	#0
018				TIM1	TIM0	VCMD0		

[Size] 1 byte/bit type
VCMD0(#2) Quick stop function is:
0 : Disabled.
1 : Enabled.

TIM1,0(#4,#3) Setting of the MCC off timer

The delay time from the time an emergency stop signal is input until MCC is turned off can be selected with a combination of TIM1 and TIM0. If VCMD0 is 0, the setting is invalid. Usually set it to 60 ms. If a sufficult effect cannot be obtained, set it to 100 ms.

Delay time	TIM1	TIM0
0ms	0	0
60ms	1	0
100ms	1	1

NOTE

1 It is not possible to set a delay time of 100 ms or greater by mounting an additional external timer as αi series servo amplifier.
2 Do not turn an emergency stop OFF/ON instantaneously.
3 The timer on the amplifier operates in conjunction with connector CX30 or with *ESP on CXA19B. It does not operate only with an emergency stop signal on the FANUC I/O Link between the host and a servo amplifier.

III. TROUBLESHOOTING

1 OVERVIEW

This part describes the troubleshooting procedure. Read the section related to your current trouble to locate it and take an appropriate action.
First, check the LEDs on the servo amplifier or the alarm number (displayed on the host controller), examine the cause, and take an appropriate action.

2 ALARM NUMBERS AND BRIEF DESCRIPTIONS

Number	Alarm type	LED type (Classification by Red LED)
000 to 299	Program or setting alarm	□□□□ □□□ or □□□□ □□■
300 to 399	Pulse coder alarm	□□□□ ■■□
400 to 499	Servo alarm	□□□□ ■□■ or □□□□ □■■
500 to 599	Overtravel alarm	□□□□ ■□□ (same as PS alarm)
-	System alarm or I/O Link alarm	□□□□ □■□ or □□□□ ■■■
-	No alarm (see Section 4.2, "CHECK PROCEDURE" in Part I, "START-UP PROCEDURE")	□□□□ □□□ (All of red LEDs are off)

Program or setting alarms (PS alarms)

No.	LED display	Description	Countermeasure
000	□□□■ ■□□	A parameter that requires power-down has been specified.	Turn the power off, then back on.
011	□□■□ ■□□	The specified feedrate is zero. (specified speed)	Check the feedrate parameter specified with a function code.
013	□□■□ ■□□	The specified feedrate (maximum feedrate) is zero.	Check the value of parameter No.043, which indicates the maximum feedrate that can be specified.
070	□□■■ ■□□	More than 32 blocks have been registered for a buffering operation.	Reduce the number of registered blocks to 32.
090	□■□■ ■□□	Reference position setting cannot be executed normally.	Move the tool in the direction of reference position return in jog mode at a speed that causes the servo position error to exceed 128. Then, specify another reference position setting.
093	□■■□ ■□□	(1) A first to third reference position return cannot be executed because the reference position has not yet been established. (2) The reference position external setting was executed without Absolute pulse coder.	(1) Set the reference position. (2) Absolute pulse coder must be used.
224	□■■□ ■□□	The reference position has not yet been established. This occurs only when the ZRTN bit of parameter No.001 is set to 0.	Set the reference position.
250	□■■■ ■□□	Command data 1 or the instruction command is invalid.	Check the specified value of command data 1 of a function code command.
251	□■■■ ■□□	Command data 2 is invalid.	Check the specified value of command data 2 of a function code command.
254	□■■■ ■□□	A function code or mode is invalid.	Check the command code, specified with a function code. Check the mode.
255	■□□□ ■□□	Operation cannot be activated because an invalid mode is specified or because block execution is in progress.	Check the mode. Check whether a block is being executed.
290	■□□■ ■□□	The interface switch signal (DRC) was switched during block execution.	Switch the signal after block execution stops.

No.	LED display	Description	Countermeasure
291	■□■□ ■□□	The speed of an axial movement specified by an external pulse has exceeded the upper limit. This occurs only when the EPEXA bit of parameter No.001 is set to 1.	Check the speed specified by the external pulse. Check the magnification of the external pulse (parameters No.062 and 063).
292	■□■■ ■□□	A checksum error for the nonvolatile memory was detected.	Parameters are cleared. Set the parameters again. If this alarm subsequently recurs, replace the unit.
293	■■□□ ■□□	Software version between FROM on CPU and EPROM is same.	Remove the EPROM.
294	■■□■ ■□□	CRC check alarm of EPROM was detected.	Remove the EPROM.

Pulse coder alarms

No.	LED display	Description	Countermeasure
300	□□□■ ■■□	A communication error (DTER) for the serial pulse coder was detected.	Check the continuity of the signal cable. If the cable is normal, the pulse coder or servo amplifier may be defective. This error can also be caused by external noise. See the chapter on noise reduction in "Descriptions."
301	□□□■ ■■□	A communication error (CRCER) for the serial pulse coder was detected.	Check the continuity of the signal cable. If the cable is normal, the pulse coder or servo amplifier may be defective. This error can also be caused by external noise. See the chapter on noise reduction in "Descriptions."
302	□□□■ ■■□	A communication error (STBER) for the serial pulse coder was detected.	Check the continuity of the signal cable. If the cable is normal, the pulse coder or servo amplifier may be defective. This error can also be caused by external noise. See the chapter on noise reduction in "Descriptions."
303	□□■□ ■■□	An LED disconnection (LDAL) was detected in the serial pulse coder.	Turn the power off. If this alarm recurs when the power is reapplied, replace the motor.
304	□□■□ ■■□	A pulse miss alarm (PMAL) for the serial pulse coder was detected.	Turn the power off. If this alarm recurs when the power is reapplied, replace the motor.
305	□□■□ ■■□	A count miss alarm (CMAL) for the serial pulse coder was detected.	Turn the power off. If the alarm recurs when the power is re-applied, replace the motor. Even if the alarm does not recur, restart the operation from reference position return.
306	□□■■ ■■□	The motor has overheated (OHAL).	This alarm is issued when the motor has overheated, causing the thermostat to trip. Possible causes include an excessively high ambient temperature and excessively strict operating conditions. Check the actual cause. If it occurs again when the motor is cooled, the motor or servo amplifier may have failed. Replace the faulty motor or servo amplifier.

No.	LED display	Description	Countermeasure
308	□□■□ ■■□	A soft phase alarm (SPHAL) was detected.	Turn the power off. This alarm may be caused by noise.

No.	LED display	Description	Countermeasure
319	□■□□ ■■□	When the absolute pulse coder is used, the motor has not yet rotated through more than one turn after the first power-up.	Cause the motor to rotate through more than one turn in jog feed mode, then turn the power off then back on.
350	□■□■ ■■□	The battery voltage of the absolute pulse coder is low.	Replace the battery. Restart the operation from reference position return.
351	□■■□ ■■□	The battery voltage of the absolute pulse coder is low. (warning)	Replace the battery.

Servo alarms

No.	LED display	Description	Countermeasure
400	□□□■ ■□■	The servo motor has overheated. (estimated value)	The motor operation condition may be too severe. Check the operation condition.
401	□□■□ ■□■	DRDY(Drive Ready signal) becomes 0. The servo amplifier is not ready.	
404	□■□□ ■□■	The regenerative discharge unit has overheated.	This alarm is issued when the average regenerative discharge energy is too high (when the acceleration/deceleration frequency is too high, for example).
		(1) When the separate regenerative discharge resistor is not used. For theβi SV4-B and βi SV20-B i, check whether the CXA20 connector is short-circuited by using a dummy connector. For the βi SV40-B and βi SV80-B, check whether the CXA20 and CZ6 connectors are short-circuited by using dummy connectors. (2) The average regenerative discharge energy may be too high. Decrease the acceleration/deceleration frequency. (3) The separate regenerative discharge unit may not be connected properly. Check the connection. (4) The thermostat of the separate regenerative discharge unit may be defective. Disconnect the separate regenerative discharge unit, then check the thermostat. If the thermostat is open even through the separate regenerative discharge unit is cool, replace the separate regenerative discharge unit. (5) The resistor of the separate regenerative discharge unit may be defective. Disconnect the separate regenerative discharge unit, then check the resistance. If it does not fall in the range of the predetermined resistance "20%, replace the separate regenerative discharge unit. (6) If from (1) to (5) are not the cause of the alarm, replace the servo amplifier.	
405	□■□■ ■□■	Reference position return could not be executed correctly.	Re-execute reference position return.
		If a value in the range of 4 to 96 is set for parameter No. 032 (CMR), an alarm may be issued. In this case, prevent an alarm from being issued by setting N405(bit4 of parameter No. 001) to "1".	
409	□■■□ ■□■	Unexpected disturbance torque has been detected.	Look for the mechanical cause of the abnormal load. If no mechanical cause is found, specify a larger value for the parameter.

No.	LED display	Description	Countermeasure
410	□■■■ ■□■	The servo position error in the stop state is larger than the value specified in parameter No.110.	Determine the mechanical cause of the large position error. If no mechanical cause is found, specify a larger value for the parameter.
411	□■■■ ■□■	The servo position error during movement is larger than the value specified in parameter No.182.	Determine the mechanical cause of the large position error. If no mechanical cause is found, apply any of the following countermeasures: • Specify a larger value for the parameter. • Specify a lower feed rate. • Increase the time constants.
412	■□□□ ■□■	Over Current Alarm has been issued.	This alarm is issued when an excessively large current flows in the main circuit.
		(1) Check whether the motor ID number is correctly set in parameter No.125. (2) Check whether the standard values (see Appendix B) are specified in the current control parameters for servo control. Correct current control is possible only when the standard values are specified for the following parameters: No.70, 71, 72, 78, 79, 84, 85, 86, 87, 88, 89, 90, 99, 118, 119 (3) Disconnect the power line from the servo amplifier connector. - Then, release the emergency stop state. If the over-current alarm continues to be issued, replace the servo amplifier. - If no over-current alarm is issued, go to (4). (4) Check the insulation between the ground and each of U, V, and W. - If the insulation is satisfactory, go to (5). If a short-circuit is detected, disconnect the power line from the motor connector. Then, check the insulation between the ground and each of U, V, and W of the motor. - If a short-circuit is found between the ground and U, V, or W of the motor, replace the motor. - If the insulation is satisfactory, replace the power line. (5) Connect the power line. Observe the waveform of the motor current (IR, IS) while the motor is accelerating or decelerating. See the description of the checking of the motor current in Appendix E, " SERVO TUNING TOOL SERVO GUIDE". - If the motor current (IR, IS) does not exhibit a normal sine wave, replace the servo amplifier. (6) Check if the motor current (IR, IS) waveforms include noise. - When noise is included, take an action such as making a connection to shield ground. - When noise is not included, replace the servo amplifier. If (1) to (6) above are not the cause of the alarm, the pulse coder, command cable or internal hardware of the CNC may be defective.	

No.	LED display	Description	Countermeasure
413	■□□□ ■□■	DC Link Over Voltage Alarm has been issued.	This alarm is issued when the DC voltage of the main circuit power is too high.
		(1) When βi SV4-B or βi SV20-B is used, and a separate regenerative discharge unit is not used, check the specification to see if regenerative energy per one time does not exceed the allowable regenerative energy of the servo amplifier. (2) For the βi SV40-B and the βi SV80-B , when the separate regenerative discharge resistor is not used, check whether the CZ6 connector is short-circuited with a dummy connector. (3) The supply voltage for dynamic power may exceed the rated value. Check the voltage. If the voltage is too high, reduce the voltage to an appropriate level. (4) The regenerative discharge unit may not be properly connected. Check the connection. (5) The resistance of the separate regenerative discharge unit may be abnormal. Disconnect the separate regenerative discharge unit, then check the resistance. If the resistance is not within ±20% of the predetermined resistance, replace the separate regenerative discharge unit. If from (1) to (5) are not the cause of the alarm, replace the servo amplifier unit.	
414	■□■□ ■□■	DC Link Low Voltage Alarm has been issued.	This alarm is issued when the DC voltage of the main circuit power is too low.
		(1) 190 ms or longer may pass from the time when both the *ESP of the built-in DI and the *ESP of the I/O link interface signal are canceled until the external magnetic contactor inserted into the input for motive power turns on(including the operating time of the magnetic contactor). The magnetic contactor must turn on within 100 ms. (2) The external circuit breaker may be turned off. Check the circuit breaker. (3) The supply voltage for dynamic power is lower than the rated value. Check the voltage. If the voltage is too low, increase it to an appropriate level. (4) The external magnetic contactor may not be connected properly. Check the connection. If from (1) to (4) are not the cause of the alarm, replace the servo amplifier unit.	
416	□□■■ □■■	Inverter IPM Alarm has been issued.	
		(1) Check whether the fan for cooling the external radiator fin is not stopped. (2) Check whether the motor is used within related current. (3) Check whether the temperature in locker is higher. Check the fin or filter in locker. (4) Check whether the temperature is higher around the servo amplifier. (5) Disconnect the power line from the servo amplifier connector. Then, release the emergency stop state. - If the IPM alarm continues to be issued, replace the servo amplifier. - If no IPM alarm is issued, go to (6). (6) Disconnect the power line from the servo amplifier connector. Then, check the insulation between the ground and each of U, V, and W. - If the insulation is satisfactory replace the servo amplifier. - If the insulation is not satisfactory, go to (7). (7) Disconnect the power line from the servo motor. Then check the insulation. - If the insulation of servo motor is not satisfactory, replace the servo motor - If the insulation of power line is not satisfactory, replace the servo amplifier.	

No.	LED display	Description	Countermeasure
417	■□■■ ■□■	A parameter has been specified incorrectly.	
		Check the following parameters: - When the both No.030 and No.125 are set for motor ID number, this alarm is issued.it is necessary to set motor ID number on No.125 and to set 0 on No.030. - No.031: the parameter for direction of rotate is not selected in “111” or “–111”. - No.106: Is the denominator of the number of pulses per single revolution of the motor 0? - No.107: Is this parameter too large? - No.179: Is this parameter out of range (8388607 lower or equal)? - Is No.107 (position gain)/No.105 or No.179 (number of pulses per single revolution of the motor) less than 0.488? - No.180: Is the specified reference counter capacity 0 or a negative value?	
423	■■□■ ■□■	The specified speed exceeds 32767000 detection units per second.	Re-examine the CMR and speed settings.
425	■■■□ ■□■	The fan motor for internal agitation for βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, or βiSV40HV-B has stopped.	This alarm is issued when the fan motor built into the servo amplifier has failed. The fan motor is consumable. For the explanation about its replacement procedure, see Part IV "REPLACING SERVO AMPLIFIER COMPONENTS"
		(1)Check that the fan is not clogged with foreign matter. (2)Check that the power connector of the fan is connected properly. (3)Replace the fan or servo amplifier.	
446	■■■■ ■□■	The external pulse input line is disconnected.	Connect the external pulse input signal correctly.
447	□■■■ ■□■	Excessive speed deviation (speed control)	Check the actual speed. Check the setting of parameter No. 136.
449	□□□■ □■■	No.080 is not corrected. (This parameter is out of range from 0 to 8010)	Set No.080 correctly (from 0 to 8010).
601	□□■□ □■■	∓ The fan motor for internal agitation for βiSV4-B or βiSV20-B has stopped.	This alarm is issued when the fan motor for inverter radiator has failed. The fan motor is consumable. For an explanation of the replacement procedure, see Part IV, "REPLACING SERVO AMPLIFIER COMPONENTS"
		(1)Check that the fan is not clogged with foreign matter. (2)Check that the power connector of the fan is connected properly. (3)Replace the fan or servo amplifier.	

Overtravel alarms

No.	LED display	Description	Countermeasure
500	■■■■ ■□□	The positive stroke limit has been exceeded.	Check whether *+OT and *-OT are connected correctly. Check whether a correct move command is specified. Move the tool in the opposite direction in jog mode, then perform a reset.
501	■■■■ ■□□	The negative stroke limit has been exceeded.	
510	■■■■ ■□□	The positive soft stroke limit has been exceeded.	Check whether appropriate values have been specified for parameters No.142 and 143. Check whether a valid move command is specified. Move the tool in the opposite direction in jog mode, then perform a reset.
511	■■■■ ■□□	The negative soft stroke limit has been exceeded.	

System alarms

No.	LED display	Description	Countermeasure
–	□□□■ □■□	An error was detected in the RAM write/read test at power-up. (External SRAM)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□□■□ □■□	A watchdog alarm 1 was issued.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□□■■ □■□	A watchdog alarm 2 was issued.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■□□ □■□	A watchdog alarm 3 was issued.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■□■ □■□	The logic supply was less than 5V.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■■□ □■□	The low voltage of the 24-VDC control supply was detected.	Check the 24-VDC control supply voltage. If the voltage is low, increase the voltage to an appropriate level.
–	□■■■ □■□	An error was detected in the data collation check for the nonvolatile memory.	Turn the power off then back on. Then, re-enter the parameters. If this alarm recurs, replace the servo amplifier.
–	■□□□ □■□	A data transfer alarm for the nonvolatile memory has been issued.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	■□□■ □■□	A CRC check alarm for the FROM that is built into the CPU is issued.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	■□■□ □■□	A alarm for the servo amplifier is issued. (Synchronous deviation alarm)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	■□■■ □■□	A alarm for the servo amplifier is issued. (Dead-band 0 alarm)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	■■□□ □■□	A alarm for the servo amplifier is issued. (Timer for skip position measurement)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	■■■□ □■□	Loading of a software on the FROM that is built into the CPU is incomplete. An error was detected in the RAM write/read test at power-up. (Internal RAM) An error was detected in the control circuit.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.

No.	LED display	Description	Countermeasure
–	□□□□ □■□	An error was detected in the control circuit.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□□□■ ■■■	A alarm for the servo amplifier is issued. (General illegal instruction)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□□■□ ■■■	A alarm for the servo amplifier is issued. (Slot illegal instruction)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□□■■ ■■■	A alarm for the servo amplifier is issued. (CPU address error)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■□□ ■■■	A alarm for the servo amplifier is issued. (DTC address error)	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■□■ ■■■	Stuck overflow occurred.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■■□ ■■■	Stuck underflow occurred.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.
–	□■■■ ■■■	The software on the FROM built into the CPU is not correct.	Replace the servo amplifier.
–	■□□■ ■■■	An abnormality has been detected in the I/O Link control circuit.	Turn the power off then back on. If this alarm recurs, replace the servo amplifier.

I/O link alarm

No.	LED display	Description	Countermeasure
–	■□□□ ■■■	An I/O Link error occurred. Some unit connected to the line was turned off.	Turn off the power to all units connected to the line. Then, turn on the slave devices, followed by the master device.
–	■□■□ ■■■	A stop of an I/O Link *i* signal has been detected.	Check the CNC power. Check the power to the unit between the CNC and servo amplifier. Check the cable between the CNC and servo amplifier for a break or poor contact.

No LED display

No.	LED display	Description	Countermeasure
–	No indicators lit	The control circuit is not operating normally.	(1) Check the 24-VDC control supply voltage. If the voltage is low, increase the voltage to an appropriate level. (2) Check whether a fuse in the servo amplifier has blown. If a blown fuse is found, replace it, following the procedure described in Part IV "REPLACING SERVO AMPLIFIER COMPONENTS" If (1) and (2) are not the cause, replace the servo amplifier.

3 ACTION AGAINST NOISE

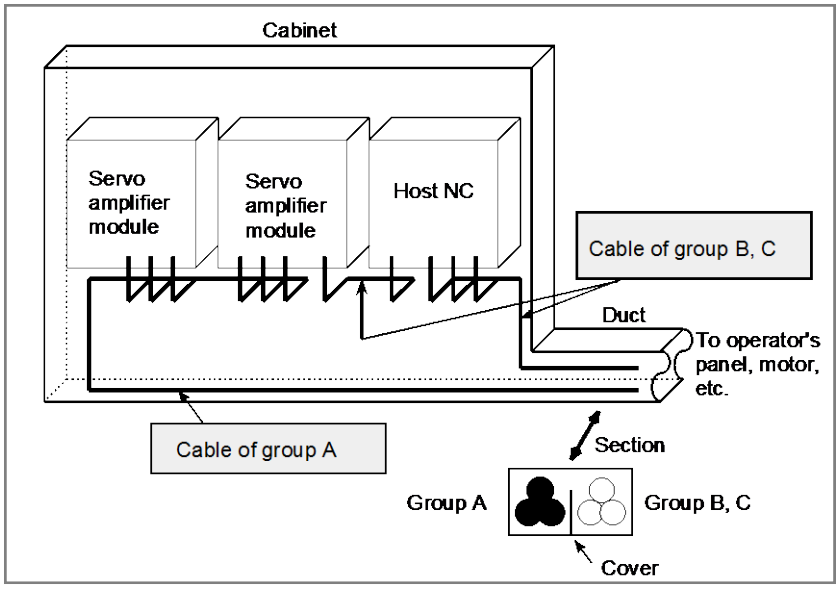
The servo amplifier module has been steadily reduced in size using surface-mount and custom LSI technologies for electronic components. The servo amplifier module also is designed to be protected from external noise. However, it is difficult to measure the level and frequency of noise quantitatively, and noise has many uncertain factors. It is important to prevent both noise from being generated and generated noise from being introduced into the servo amplifier module. This precaution improves the stability of the servo amplifier module machine tool system.
The servo amplifier module component units are often installed close to the parts generating noise in the power magnetics cabinet. Possible noise sources into the servo amplifier module are capacitive coupling, electromagnetic induction, and ground loops.
When designing the power magnetics cabinet, guard against noise in the machine as described in the following section.

- Separating signal lines

The cables used for the machine are classified as listed in the following table:
Process the cables in each group as described in the action column.

Group	Signal line	Action
A	Primary AC power line	Bind the cables in group A separately (Note 1) from groups B and C, or cover group A with an electromagnetic shield (Note 2). Connect spark killers or diodes with the solenoid and relay.
	Secondary AC power line	
	AC/DC power lines (containing the power lines for the servo motors)	
	AC/DC solenoid	
	AC/DC relay	
B	DC solenoid (24VDC)	Connect diodes with DC solenoid and relay. Bind the cables in group B separately from group A, or cover group B with an electromagnetic shield. Separate group B as far from Group C as possible. It is more desirable to cover group B with the shield.
	DC relay (24VDC)	
	DC power line	
C	Cable between the host and servo amplifier	Bind the cables in group C separately from group A, or cover group C with an electromagnetic shield. Separate group C as far from Group B as possible. Be sure to perform shield processing.
	Cable for position and velocity feedback	
	External pulse input	
	Other cables to be covered with the shield	

NOTE
1 The groups must be 100mm or more apart from one another when binding the cables in each group.
2 The electromagnetic shield refers to shielding between groups with grounded steel plates.



- **Ground**

The following 3 ground systems are provided for the CNC machine tool:

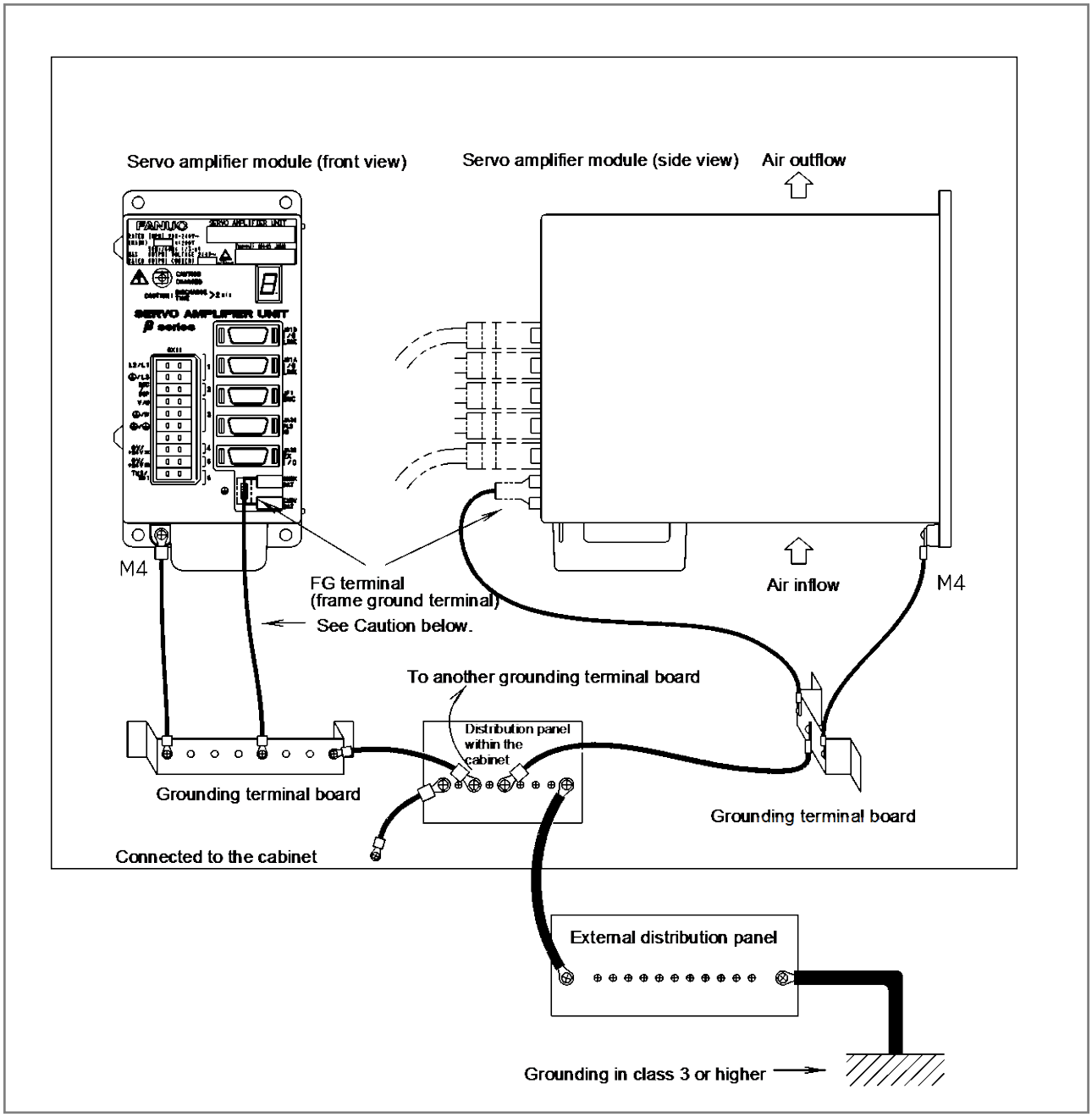
- The signal ground supplies the reference voltage (0V) of the electrical signal system.
- The frame ground system is used for safety, and suppressing external and internal noises. In the frame ground system, the frames, cases of the units, panels, and shields for the interface cables between the units are connected.
- The protective earth (PE) is designed so that the protective grounds provided between the units are connected to ground at one point from a system point of view.

3.1 NOTES ON CONNECTING THE GROUND SYSTEMS

- The grounding resistance of the protective earth shall be 100 ohms or less (class D grounding).
- The protective earth (PE) cable must have enough cross-sectional area to safety carry the accidental current flow into the protective earth (PE) when an accident such as a short circuit occurs. (Generally, it must have the cross-sectional area of the AC power cable or more.)
- Use the cable containing the AC power wire and the protective earth (PE) wire so that power is supplied with the ground wire connected.

- **Connecting the frame ground of the servo amplifier module**

Connect the 0 V line of the electronic circuit in the servo amplifier module with the ground plate of the cabinet via the frame ground (FG) terminal.
The SG terminal is located on the printed circuit board at the rear of the control unit.



⚠ CAUTION

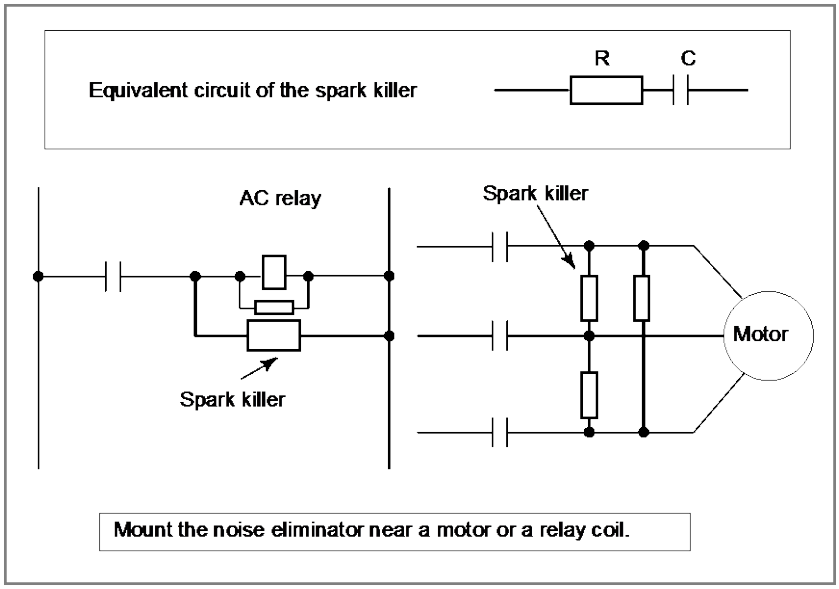
Use the Faston terminals (A02B-0166-K330) for connection using the frame ground. Also connect to the grounding terminal board using 100 to 300 mm stranded wire with a cross-section of 2 mm^2 or more. Otherwise, the servo amplifier unit will be susceptible to noise.

- Noise suppressor

The AC/DC solenoid and relay are used in the power magnetics cabinet.
A high pulse voltage is caused by coil inductance when these devices are turned on or off.
This pulse voltage induced through the cable causes the electronic circuits to be disturbed.

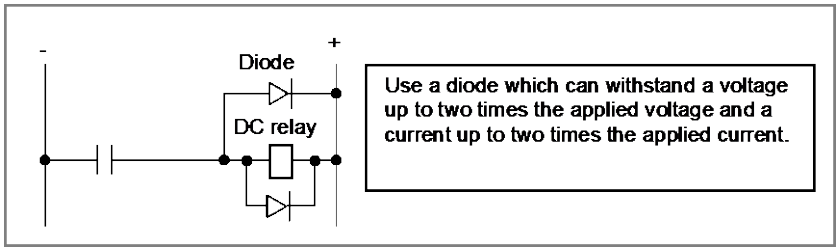
3.2 NOTES ON SELECTING THE SPARK KILLER

- Use a spark killer consisting of a resistor and capacitor in series. This type of spark killer is called a CR spark killer.(Use it under AC)
  (A varistor is useful in clamping the peak voltage of the pulse voltage, but cannot suppress the sudden rise of the pulse voltage. FANUC therefore recommends a CR spark killer.)
- The reference capacitance and resistance of the spark killer shall conform to the following based on the current (I (A)) and DC resistance of the stationary coil:
  - Resistance (R) : Equivalent DC resistance of the coil
  - Capacitance (C) : $\frac{I^2}{10}$ to $\frac{I^2}{20}$ (μF)
    where I : Current at stationary state of the coil



NOTE
Use a CR-type noise eliminator. Varistor-type noise eliminators clamp the peak pulse voltage but cannot suppress a sharp rising edge.

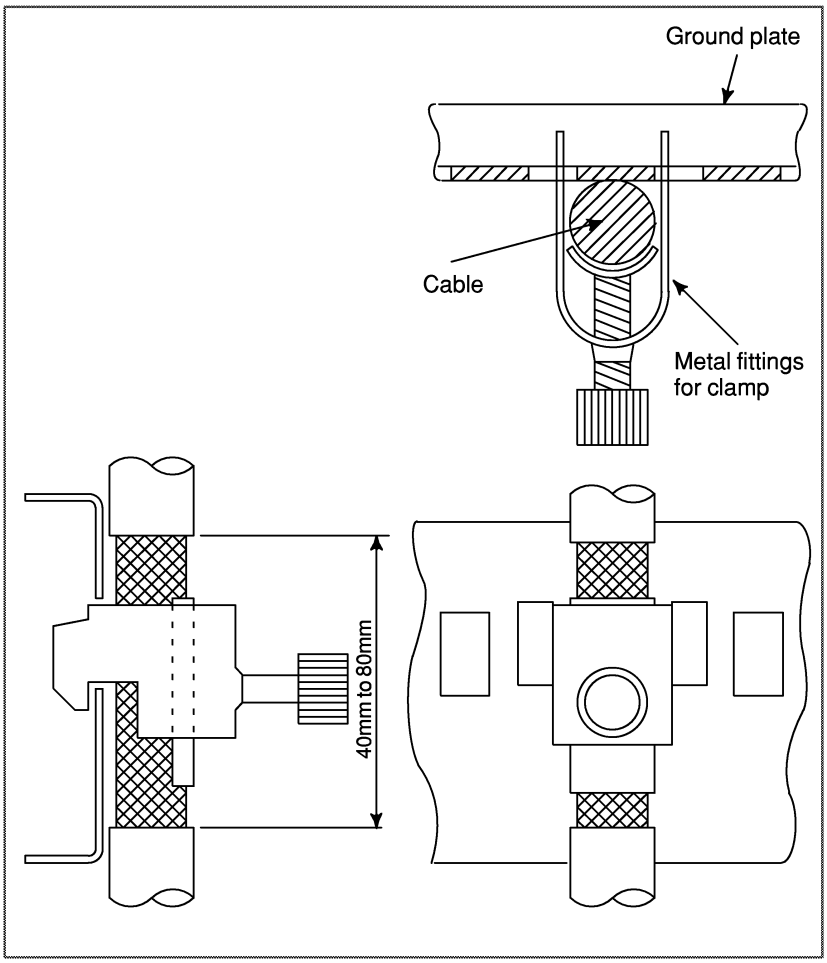
- Diode is used for direct-current circuits



- Cable clamp and shield processing

The servo amplifier module cables that require shielding should be clamped by the method shown below. This cable clamp treatment is for both cable support and proper grounding of the shield. To insure stable CNC system operation, follow this cable clamp method.

Partially peel out the sheath and expose the shield. Push and clamp by the plate metal fittings for clamp at the part. The ground plate must be made by the machine tool builder, and set as follows :



Cable clamp (1)

IV. REPLACING SERVO AMPLIFIER COMPONENTS

1 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.

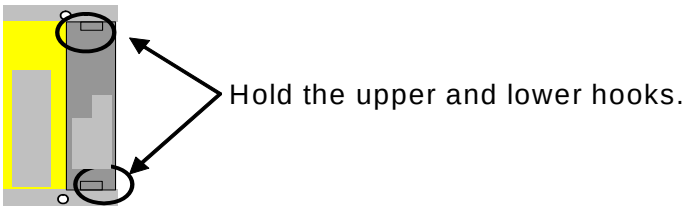
Before replacing a fuse, printed-circuit board, or the like of the servo amplifier, check the procedure sufficiently.

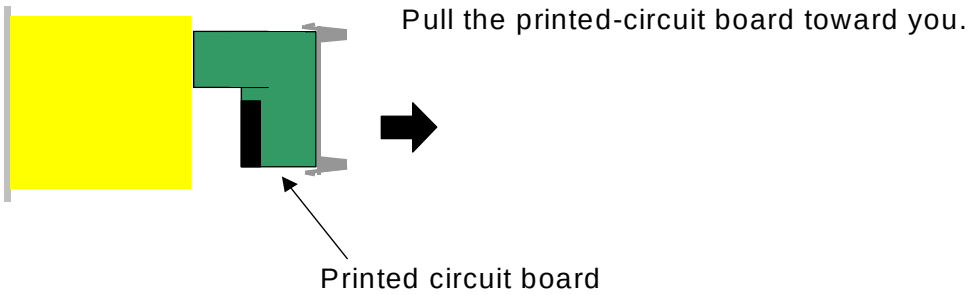
NOTE
1 If a fuse blows, it is likely that there is a short-circuit in the power supply for a device (such as a sensor) connected to the servo amplifier.
After checking that all devices connected to the servo amplifier are normal, replace the fuse.
If you do not remove the cause, it is very much likely that the fuse will blow again.
2 Do not use any fuse not supplied from FANUC.
3 Before replacing a fuse, check a marking on it with that on the printed-circuit board. Be careful not to mount a fuse with an incorrect rating.

1.1 HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS

A printed-circuit board can be removed and inserted from the front of the servo amplifier.

β*i*SV4-B, β*i*SV20-B

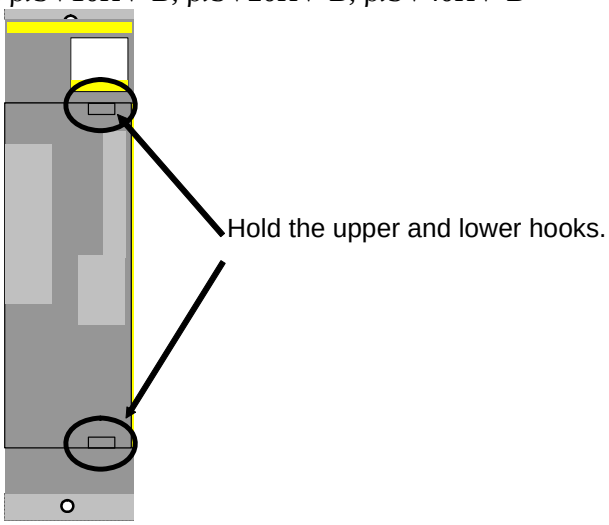


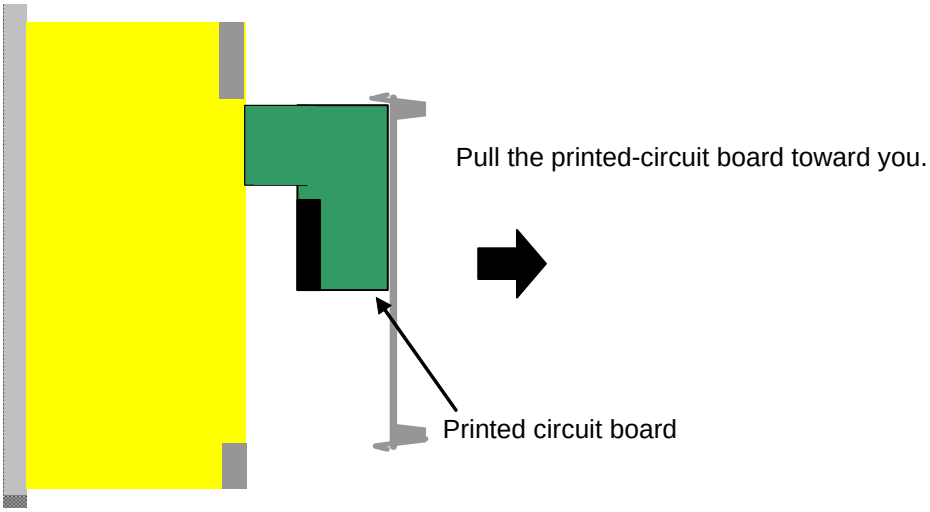


To insert the printed-circuit board, reverse the above procedure.

Ensure that the upper and lower hooks snap into the housing.
If the printed-circuit board is not inserted completely, the housing remains lifted. Pull out the printed-circuit board and insert it again.

βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B





To insert the printed-circuit board, reverse the above procedure.
Ensure that the upper and lower hooks snap into the housing.
If the printed-circuit board is not inserted completely, the housing remains lifted. Pull out the printed-circuit board and insert it again.

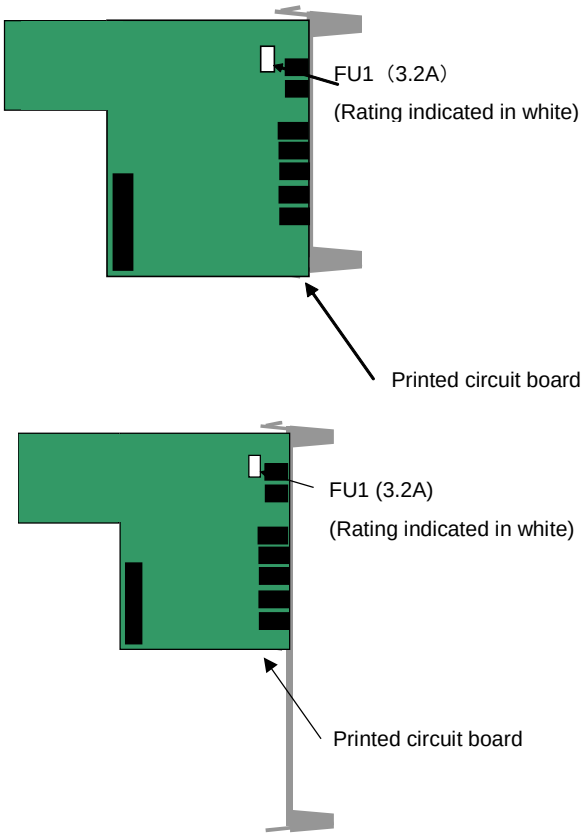
1.1.1 Ordering Number of Printed Circuit Board

Unit specification	Ordering number
A06B-6162-H001, -H002, -H003, -H004 A06B-6163-H001, -H002, -H003	A20B-8101-0840

1.1.2 Fuse Locations

There is one fuse on the βiSV-B printed-circuit board.

(1) A20B-8101-0840



Fuse specification

Symbol	Ordering number
FU1	A60L-0001-0290#LM32C

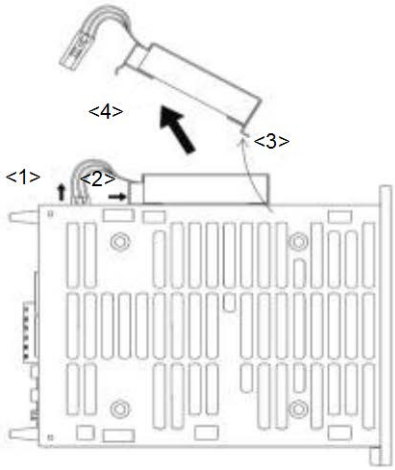
1.2 HOW TO REPLACE THE FAN MOTOR

⚠ WARNING
Because the Servo Amplifier uses a large-capacitance electrolytic capacitor internally, the Servo Amplifier remains charged for a while even after the power is turned off. Before touching the Servo Amplifier for maintenance or other purposes, ensure your safety by measuring the residual voltage in the DC link with a tester and confirming that the charge indication LED (red) is off.

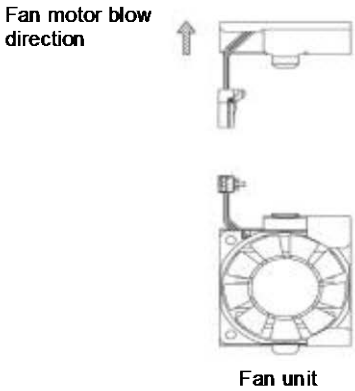
⚠ CAUTION
- Install the fan motors when the control power to βiSV-B is not turned on.

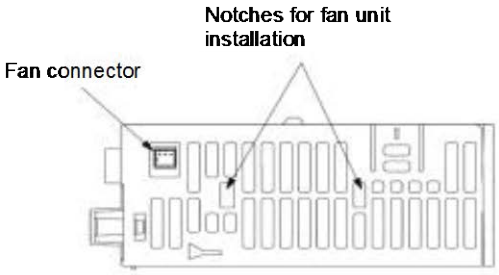
1.2.1 For Fan Motors for Internal Agitation for βiSV4-B and βiSV20-B

1 Pull out the fan connector upward.
2 Push the front of the fan unit to disengage the lug.
3 Disengage the rear of the fan unit.
4 Lift the fan unit in a slant direction.



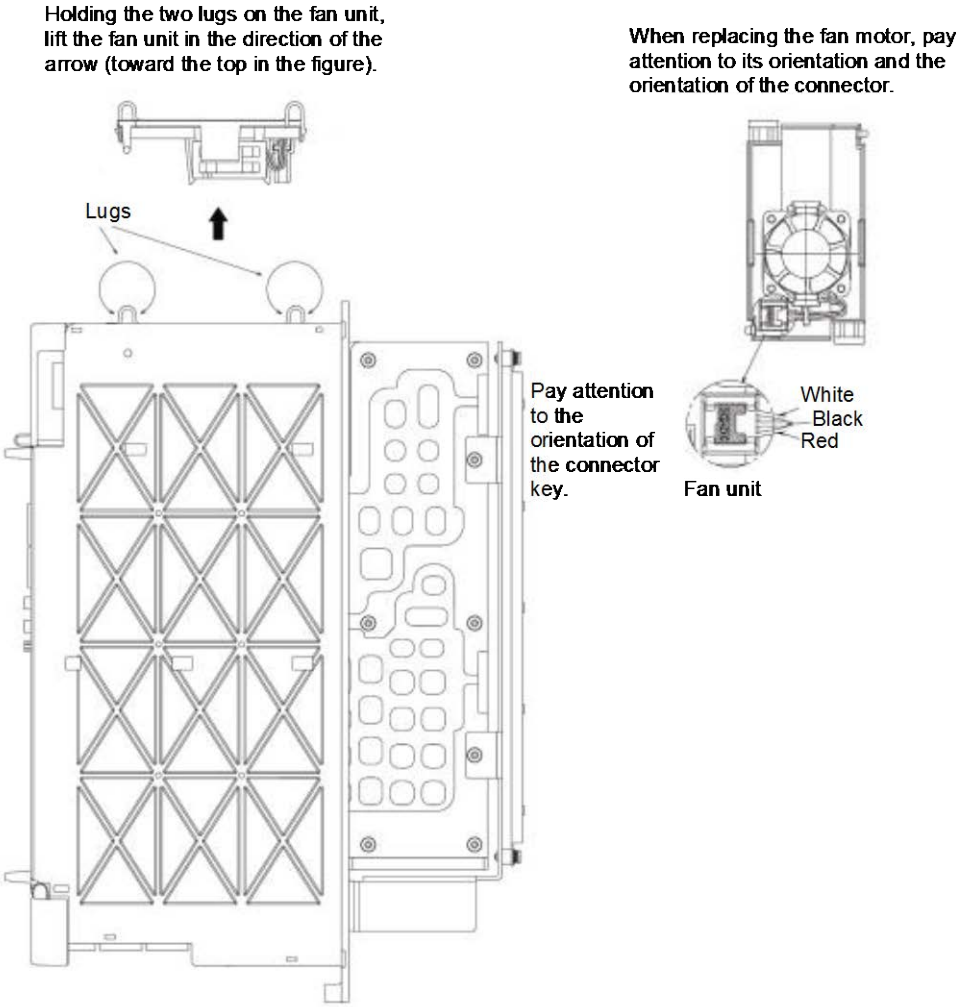
When replacing the fan motor, pay attention to its orientation and the cable drawing position.





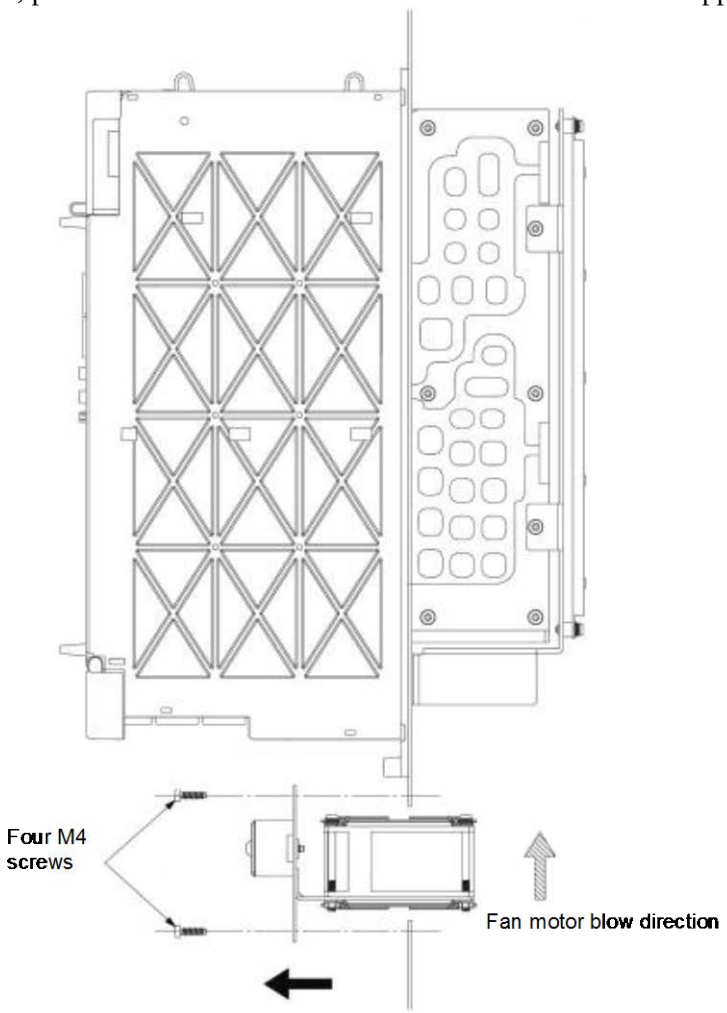
1.2.2 For Fan Motors for Internal Agitation for βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, and βiSV40HV-B

1) Remove the four sheet metal fixing screws and then pull out the fan unit.



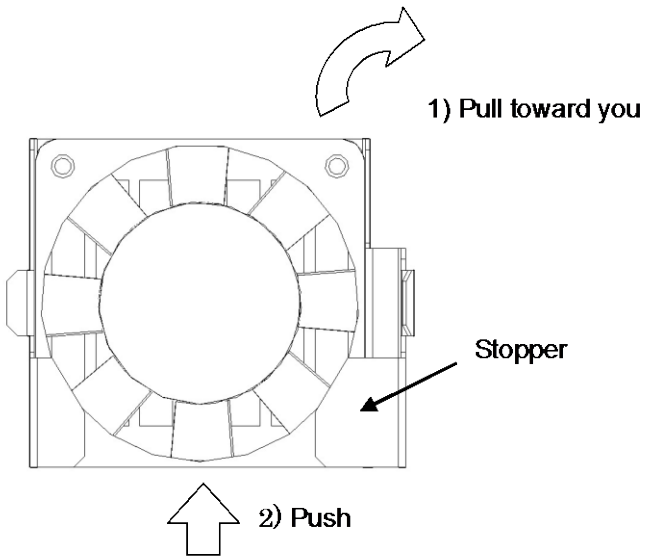
1.2.3 Removing the Fan Units for Cooling the Radiators for βiSV80-B and βiSV40HV-B

(1) Pull up the side of the fan motor (the side without the case stoppers) away from the case.While pulling up the fan motor, push it toward its center from the side where the case stoppers are located.



1.2.4 Removing the Fan Motor from the Fan Unit（βiSV4-B, βiSV20-B）

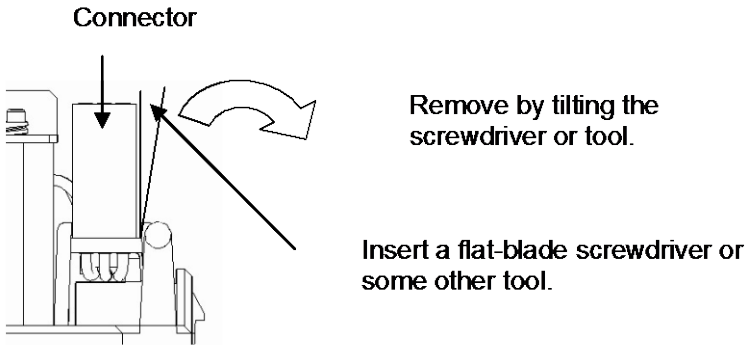
(1) Holding the two lugs on the fan unit, lift the fan unit in the direction of the arrow (upward in the figure).



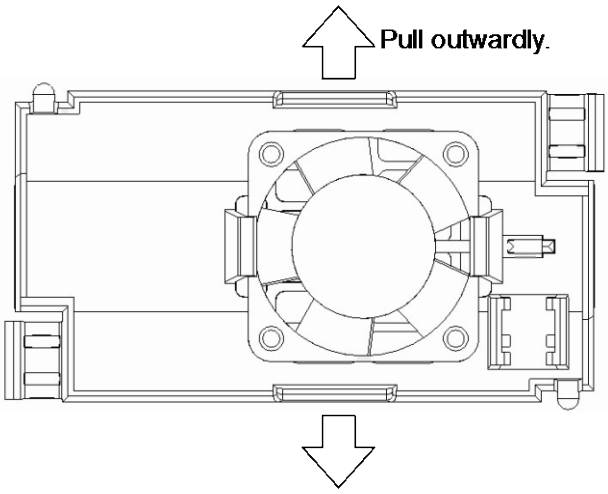
When replacing the fan motor, pay attention to its orientation (when the fan motor is mounted in an amplifier, its label is facing upward)

1.2.5 Removing the Fan Motor from the Fan Unit（βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B）

(1) Remove the connector from the case.
<1> Insert a flat-blade screwdriver or some other tool between the case and the connector.
<2> Tilt the inserted screwdriver or tool.



(2) Pull the lugs on the case outwardly, and remove the fan motor.



When replacing the fan motor, pay attention to its orientation (when the fan motor is mounted in an amplifier, its label is facing upward) as well as to the orientation of the connector.

1.2.6 Specifications of Fan Units for Maintenance

Model name	Internal cooling fan		Radiator cooling fan	
	Fan unit	Fan motor	Fan unit	Fan motor
βiSV 4-B βiSV 20-B	A06B-6134-K003	A90L-0001-0423#50	-	-
βiSV 40-B	A06B-6110-C605	A90L-0001-0510	-	-
βiSV 80-B	A06B-6110-C605	A90L-0001-0510	A06B-6134-K002	A90L-0001-0445#B
βiSV 10HV-B βiSV 20HV-B	A06B-6110-C605	A90L-0001-0510	-	-
βiSV 40HV-B	A06B-6110-C605	A90L-0001-0510	A06B-6134-K002	A90L-0001-0445#B

1.3 REPLACING BATTERY FOR ABSOLUTE PULSECODERS

1.3.1 Overview

- When the voltage of the batteries for absolute Pulsecoders becomes low, alarm 350 or 351 occurs.
- When alarm 351 (alarm indicating the voltage of the battery becomes low) occurs, replace the battery as soon as possible.
  In general, the battery should be replaced within one or two weeks, however, this depends on the number of Pulsecoders used.
- When alarm 350 (battery zero alarm) occurs, Pulsecoders are reset to the initial state, in which absolute positions are not held. Alarm 224 (reference position return request alarm) also occurs, indicating that reference position return is required.
- In general, replace the batteries periodically within the service life listed below.
  - A06B-6050-K061 or D-size alkaline dry cells (LR20) : Two years (for each six-axis configuration)
  - A06B-6093-K001 : Two years (for each one-axis configuration)
  - A06B-6114-K504 : One year (for each three-axis configuration)

NOTE
The above values indicate the estimated service life of batteries used with FANUC absolute Pulsecoders. The actual battery service life depends on the machine configuration based on, for example, detector types. For details, contact the machine tool builder.

1.3.2 Replacing Batteries

To prevent absolute position information in absolute Pulsecoders from being lost, turn on the machine power before replacing the battery. The replacement procedure is described below.
<1> Ensure that the power to the servo amplifier is turned on.
<2> Ensure that the machine is in the emergency stop state (the motor is inactive).
<3> Ensure that the DC link charge LED of the servo amplifier is off.
<4> Detach the old batteries and attach new ones.
The replacement of the batteries in a separate battery case and the replacement of the battery built into the servo amplifier are described below in detail.

⚠ **WARNING**
1 The absolute Pulsecoder of each of the αi series servo motors or βi series servo motors (βiS0.4 to βiS40, βiSc, and βiF) has a built-in backup capacitor. Therefore, even when the power to the servo amplifier is off and the batteries are replaced, reference position return is not required if the replacement completes within less than 10 minutes. Turn the power on and replace the batteries if the replacement will take 10 minutes or more.
2 To prevent electric shock, be careful not to touch metal parts in the power magnetics cabinet when replacing the batteries.

⚠ WARNING

3 Because the servo amplifier uses a large-capacitance electrolytic capacitor internally, the servo amplifier remains charged for a while even after the power is turned off. Before touching the servo amplifier for maintenance or other purposes, ensure your safety by measuring the residual voltage in the DC link with a tester and confirming that the charge indication LED (red) is off.

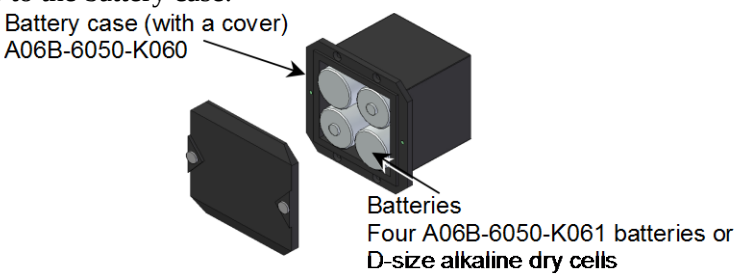
4 Be sure to replace the batteries with specified ones. Pay attention to the battery polarity. If a wrong type of battery is used or a battery is installed with incorrect polarity, the battery may overheat, blow out, or catch fire, or the absolute position information in the absolute Pulsecoders may be lost.

5 Ensure that the battery connector is inserted in the correct position.

1.3.3 Replacing the Batteries in a Separate Battery Case

Use the following procedure to replace the batteries in the battery case.

<1> Loosen the screws on the battery case and detach the cover.
<2> Replace the batteries in the case (pay attention to the polarity).
<3> Attach the cover to the battery case.



⚠ CAUTION

1 Four D-size alkaline dry cells (LR20) that are commercially available can be used as batteries. A set of four A06B-6050-K061 batteries is optionally available from FANUC.

2 Replace all the four batteries with new ones. If old and new batteries are mixed, the absolute position information in the absolute Pulsecoders may be lost.

1.3.4 Replacing the Battery Built into the Servo Amplifier

Use the following procedure to replace the special lithium battery.

<1> Detach the battery case.
<2> Replace the special lithium battery.
<3> Attach the battery case.

⚠ CAUTION

1 Purchase the battery from FANUC because it is not commercially available. It is therefore recommended that you have a backup battery.

2 When the built-in battery is used, do not connect BATL (B3) of connector CXA19B/CXA19A. Also, do not connect two or more batteries to the same BATL (B3) line. These connections are dangerous because battery output voltages may be short-circuited, causing the batteries to overheat.

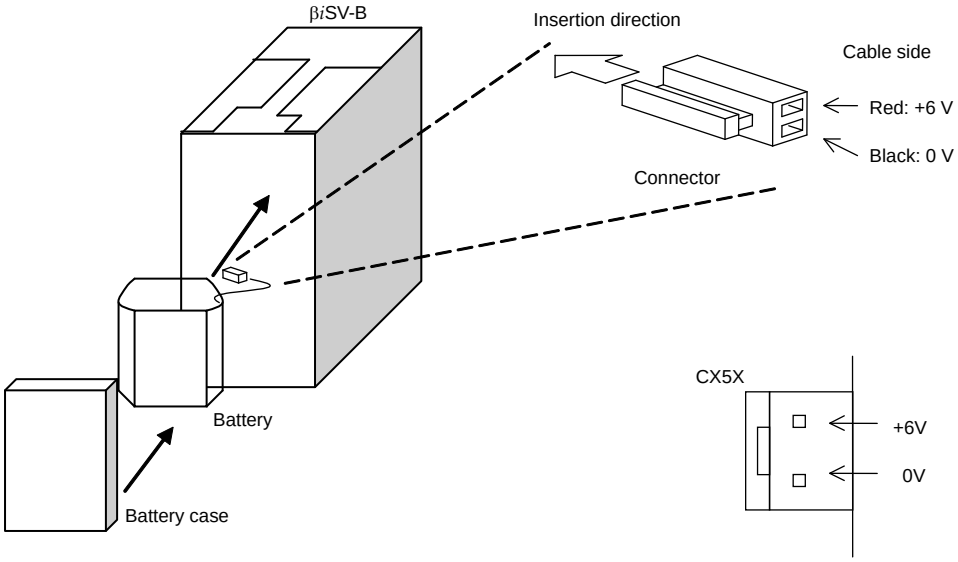
3 Install the battery in the servo amplifier in a direction that allows slack in the cable. If the battery cable is under tension, a bad connection may occur.

⚠ CAUTION

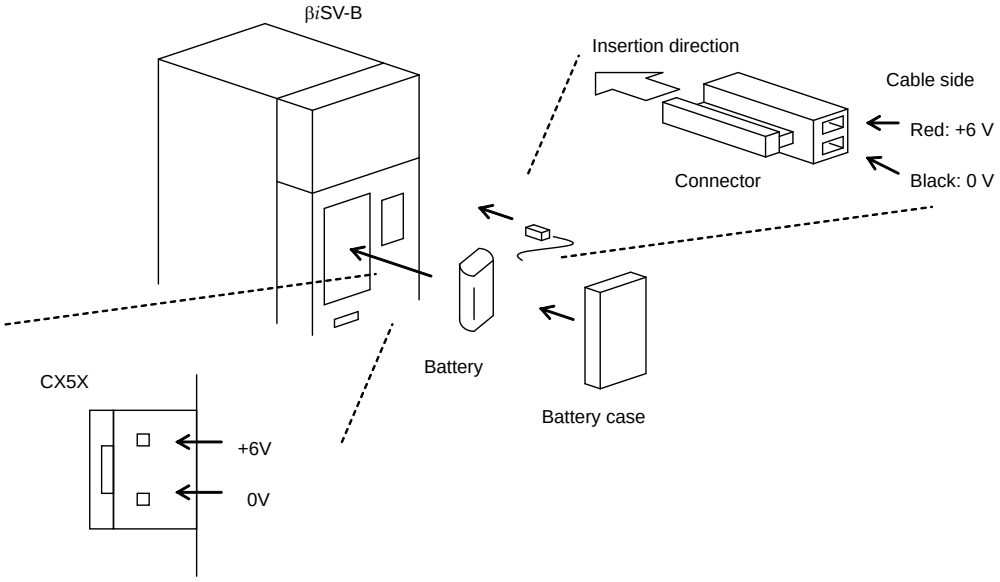
4 If the +6 V pin and 0 V pin of CX5X are short-circuited, the battery may overheat, blow out, or catch fire, or the absolute position information in the absolute Pulsecoders may be lost.

5 When inserting the connector, align it to the connector pins.

(1) For βiSV4-B and βiSV20-B



(2) For βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, and βiSV40HV-B



Used batteries

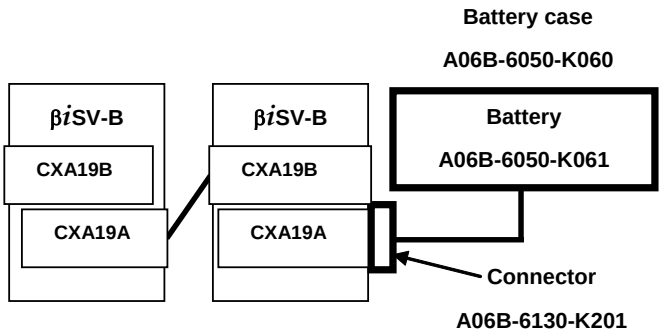
Old batteries should be disposed as "INDUSTRIAL WASTES" according to the regulations of the country or autonomy where your machine has been installed.

1.3.5 Notes on Replacing a Battery (Supplementary Explanation)

1.3.5.1 Battery connection modes

The battery for the absolute Pulsecoder can be connected using [Connection method 1] and [Connection method 2] explained below.
For details, refer to "Connecting the Battery" in the FANUC SERVO AMPLIFIER β*i*-B Series Descriptions (B-65422EN).

[Connection method 1] Method of supplying battery power from one battery to multiple β*i*SV-B amplifiers

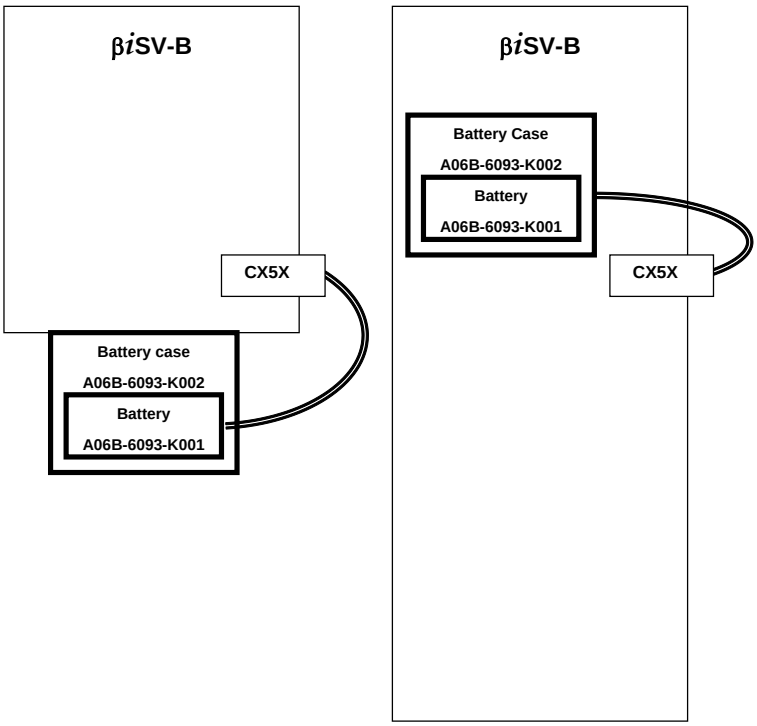


- If a low battery voltage or a battery voltage of 0 V is indicated by an APC (absolute Pulsecoder) alarm, replace the battery. If a battery voltage of 0 V is indicated, you need to make a zero point return.
- The absolute Pulsecoder of the α*i* series servo motor and the β*i* series servo motor (β*i*S 0.4 to β*i*S 40, β*i*Sc, β*i*F) is incorporated with a backup capacitor as standard. This backup capacitor enables an absolute position detection to be continued for about 10 minutes. Therefore, no zero point return need be performed if the time during which servo amplifier power is kept off for battery replacement is within 10 minutes.
  The Pulsecoder of some of the β*i*S series servo motors (β*i*S 0.2 to β*i*S0.3) does not include a backup capacitor. Be careful when replacing the battery for this Pulsecoder. For details, see section 1.3.5.2 “Replacing β*i*S 0.2 to β*i*S0.3 Batteries” .
- The battery service life is about two years for the α*i* series servo motor and the β*i* series servo motors (β*i*S 0.4~β*i*S 40, β*i*Sc, β*i*F) if servo motors for six axes are connected. For some of the β*i*S series servo motors (β*i*S 0.2 to β*i*S0.3), the battery service life is about one year.
  FANUC recommends that you replace the batteries periodically according to the battery service life.
- The battery unit consists of four LR20 alkaline batteries. Commercial batteries can be used in the battery unit. The optional battery offered by FANUC is A06B-6050-K061.

⚠ **WARNING**

1 Do not connect more than one battery to the same BAT (B3) line. If the output voltage is different between the batteries, they may be short-circuited, resulting in the batteries becoming very hot.
2 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.

[Connection method 2] Method of building a built-in battery into each βiSV-B



- If a low battery voltage or a battery voltage of 0 V is indicated by an APC (absolute Pulsecoder) alarm, replace the battery (A06B-6093-K001 or A06B-6114-K504). If a battery voltage of 0 V is indicated, you need to make a zero point return.
- The absolute Pulsecoder of the αi series servo motor and the βi series servo motor (βiS 0.4 to βiS 40, βiSc, and βiF) is incorporated with a backup capacitor as standard. This backup capacitor enables an absolute position detection to be continued for about 10 minutes. Therefore, no zero point return need be performed if the time during which servo amplifier power is kept off for battery replacement is within 10 minutes.
  The Pulsecoder of some of the βiS series servo motors (βiS 0.2 to βiS0.3) does not include a backup capacitor. Be careful when replacing the battery for this Pulsecoder. For details, see section 1.3.5.2. “Replacing βiS 0.2 to βiS0.3 Batteries”.
- The battery service life is about two years for the αi series servo motor and the βi series servo motors (βiS 0.4 to βiS 40, βiSc, and βiF). For some of the βiS series servo motors (βiS 0.2 to βiS0.3), the battery service life is about one year.
  FANUC recommends that you replace the batteries periodically according to the battery service life.
- The built-in batteries are not commercially available. They must be purchased from FANUC. So, FANUC recommends that you keep spares.

⚠ WARNING

1 When using the built-in batteries (A06B-6073-K001 or A06B-6114-K504), do not connect them to the BAT (B3) of connector CXA19B/CXA19A.
  The output voltages from different batteries may be short-circuited, resulting in the batteries becoming very hot.
2 Do not connect more than one battery to the same BAT (B3) line. If the output voltage is different between the batteries, they may be short-circuited, resulting in the batteries becoming very hot.
3 Install the battery with correct polarity. If the battery is installed with incorrect polarity, it may overheat, blow out, or catch fire.

1.3.5.2 Replacing βiS 0.2 to βiS 0.3 batteries

Some servo motors of the βi series (βiS 0.2 to βiS 0.3) do not have a backup capacitor in the Pulsecoder as a standard feature. Therefore, to avoid losing the absolute position data of the absolute Pulsecoder, you need to have the control power on when replacing the battery. The replacement procedure is described below.

[Replacement procedure]

1 Check that the power of βiSV-B is on (that the "POWER" LED on the front side of βiSV-B is on).
2 Check that the emergency stop button of the system has been pressed.
3 Check that the motor is not excited.
4 Check that the DC link charge LED of βiSV-B is off.
5 Remove the old battery, and attach the new one.
6 The replacement procedure is complete. You are ready to turn off the power of the system.

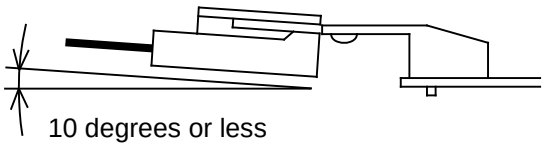
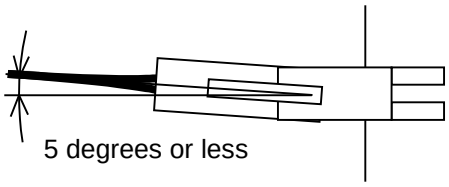
⚠ WARNING

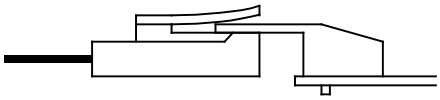
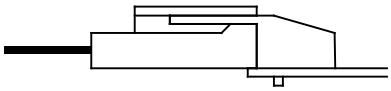
1 When replacing the battery, be careful not to touch bare metal parts in the power magnetics cabinet. Particularly, touching a high voltage part may cause electric shock.
2 Before replacing the battery, check that the DC link charge LED on the front side of the servo amplifier is off. Replacing the battery when this LED is on may cause electric shock.
3 When connecting the battery, pay attention to its polarity. If connected with the wrong polarity, the battery may overheat, burst, or catch fire.
4 Be careful not to short-circuit '+6V' and '0V' of the battery. If short-circuited, the battery may overheat, burst, or catch fire.

1.3.5.3 Notes on attaching connectors

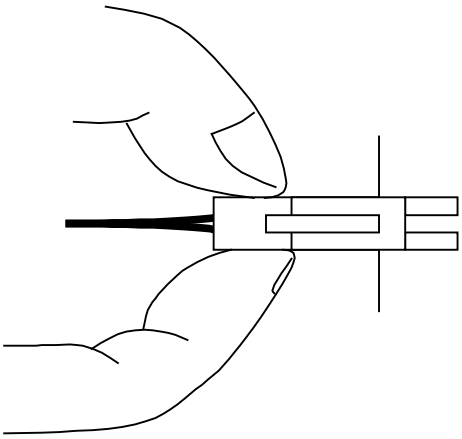
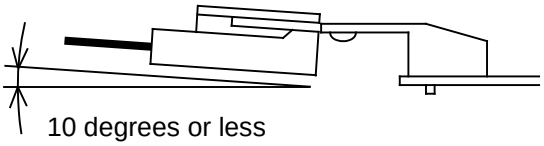
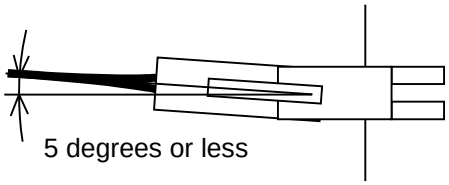
If an excessive strain is applied to a connector when it is inserted or removed, a poor contact may result. When inserting and removing the battery connector, therefore, be careful not to apply an excessive wrenching force to it; just follow the instructions given in the following table.

(1) Attaching connectors

<1>		Check the attachment position.
<2>		Plug the cable connector while raising it slightly.
<3>		Here, the angle of the cable connector to the horizontal must be 5 degrees or less.

<4>		After passing the lock pin, insert the connector straight.
<5>		The attachment of the connector is completed.

(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.

V. MOTOR/DETECTOR/AMPLIFIER PREVENTIVE MAINTENANCE

1 MOTOR/DETECTOR/AMPLIFIER PREVENTIVE MAINTENANCE

This chapter describes preventive maintenance of motors, detectors, and amplifiers that is to be performed by the customer the machine uses.

Contents

1.1 LIST OF MANUALS RELATED TO MOTORS AND AMPLIFIERS....166
1.2 PREVENTIVE MAINTENANCE OF MOTORS AND DETECTORS....167
1.2.1 Warnings, Cautions, and Notes on Preventive Maintenance of Motors and Detectors....167
1.2.2 Preventive Maintenance of a Motor (Common to All Models)....169
1.2.2.1 Main inspection items....169
1.2.2.2 Periodic cleaning of a motor....171
1.2.2.3 Notes on motor cleaning....172
1.2.2.4 Notes on the cutting fluid (informational)....172
1.2.3 Maintenance of a Detector....172
1.2.3.1 Alarms for built-in detectors (α*i* and β*i* Pulsecoders) and troubleshooting actions....173
1.2.3.2 Detailed troubleshooting methods....173
1.2.3.3 Maintenance of β*i*S servo motor (□40 and □60) Pulsecoders....175
1.3 PREVENTIVE MAINTENANCE OF SERVO AMPLIFIERS....176
1.3.1 Warnings, Cautions, and Notes on Operation of Servo Amplifiers....176
1.3.2 Preventive Maintenance of a Servo Amplifier....179
1.3.3 Maintenance of a Servo Amplifier....180
1.4 REPLACING BATTERY FOR ABSOLUTE PULSECODERS....180

1.1 LIST OF MANUALS RELATED TO MOTORS AND AMPLIFIERS

Details of individual motors and amplifiers are described in the manuals listed in the table below. Before performing periodic inspection or any other maintenance work, consult with the machine tool builder and, if necessary, obtain the latest version of the corresponding manual shown in the list. The information about the specifications of each device, such as the weight and winding resistance value, is given in the relevant "DESCRIPTIONS" manual.

Manual name	Type of manual	Specification number
FANUC AC SERVO MOTOR αi series	DESCRIPTIONS	B-65262
FANUC AC SERVO MOTOR βi series	DESCRIPTIONS	B-65302
FANUC SYNCHROUNOUS BUILT-IN SERVO MOTOR DiS series	DESCRIPTIONS	B-65332
FANUC SERVO AMPLIFIER αi series	DESCRIPTIONS	B-65282
FANUC SERVO AMPLIFIER βi series	DESCRIPTIONS	B-65322
FANUC SERVO AMPLIFIER βi-B series	DESCRIPTIONS	B-65422
FANUC AC SERVO MOTOR αi series FANUC AC SERVO MOTOR βi series FANUC LINEAR MOTOR LiS series FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR DiS series	PARAMETER MANUAL	B-65270
FANUC AC SERVO MOTOR αi series AC SPINDLE MOTOR αi series SERVO AMPLIFIER αi series	MAINTENANCE MANUAL	B-65285
FANUC AC SERVO MOTOR βi series AC SPINDLE MOTOR βi series SERVO AMPLIFIER βi series	MAINTENANCE MANUAL	B-65325
FANUC SERVO AMPLIFIER βi series	MAINTENANCE MANUAL	B-65395
FANUC SERVO GUIDE	OPERATOR'S MANUAL	B-65404
FANUC AC SERVO MOTOR αis/αi/βis series	SERVO TUNING PROCEDURE (BASIC)	B-65264

1.2 PREVENTIVE MAINTENANCE OF MOTORS AND DETECTORS

1.2.1 Warnings, Cautions, and Notes on Preventive Maintenance of Motors and Detectors

This subsection contains the safety precautions for motor and detector preventive maintenance, which are classified into "warnings", "cautions", and "notes" according to their bearing on safety. Make sure that you understand and comply with these precautions when carrying out the maintenance work.

⚠ WARNING

- **Make sure that you are safely dressed and have a safe working environment when performing preventive maintenance for a motor.**
  - Be dressed safely, e.g. by wearing gloves and safety shoes, to protect against injury due to an edge or protrusion and electric shock.
  - Have the work done by more than one person, where possible, so that immediate action can be taken if an accident occurs when handling a motor.
  - A motor is heavy. When moving it, use a crane or other appropriate equipment to protect against injury. For information about the weight of the motor, refer to its DESCRIPTIONS manual (shown earlier).
  - Clothes or fingers can be caught in a rotating motor or come into contact with a moving part of it. Standing in the direction of motor rotation (direction of motion) can pose a risk of injury. Before rotating a motor, check that there is no object that is thrown away by motor rotation.

- **Be careful about electric shock, fire, and other accidents.**
  - Do not handle a motor with a wet hand.
  - To prevent electric shock, make sure that no conductive object, such as a terminal, is exposed when the motor is powered on.
  - Before touching a motor or any surrounding part, check that the power is shut off and take appropriate safety precautions.
  - High voltage remains across power line terminals of a motor even after the power is shut off (for at least twenty minutes). Do not touch a motor in such a condition or connect it to other equipment.
  - A loose or disconnected terminal, short-circuited terminals, or a terminal connected to the ground can cause overheating, spark, fire, or damage to the motor. Take appropriate precautions to prevent these accidents.
  - When placed near any inflammable object or material, a motor can be ignited, catch fire, or explode. Avoid placing it near such object or material.

- **Do not disassemble or modify a motor.**
  Motors such as synchronous built-in spindle motors contain very strong magnets. If electronic medical apparatus comes near, these motors can cause the apparatus to malfunction, potentially putting the user's life in danger. Also, disassembling or modifying a motor can cause a failure, regardless of the type of motor. Do not disassemble or modify a motor in any way not specified by FANUC.

⚠ CAUTION

- **Ensure that the specified cooling conditions are met.**
  If the specified cooling conditions are not met (the motor is insufficiently or excessively cooled), the motor can fail. Problems that can cause a motor failure, such as liquid piping clog, leakage, and fan motor trouble, should be eliminated through periodic inspection. Do not drive the motor when the cooling system is in an abnormal condition.

- **Do not change the system configuration.**
  Do not change the configuration of the system when it is running normally. Doing so can cause an accident or failure. If you disconnect a cable for maintenance or some other purpose, take an appropriate measure, such as putting a mark on it, to ensure you can restore the original state.

- **Use the tapped holes of a motor only to move the motor.**
  Do not use the tapped holes of a motor to lift or move any other object along with the motor. Doing so can damage the motor. Depending on the type of motor, the place and direction in which the motor can be lifted may be predetermined. For details, refer to the DESCRIPTIONS manual of the motor (shown earlier).

- **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.

NOTE

- **Do not remove a nameplate from a motor.**
  The nameplate is used to identify the motor during maintenance work. If a nameplate comes off, be careful not to lose it.

- **Do not step or sit on a motor, and avoid applying shock to a motor.**
  Any of these acts can deform or break the motor or affect its component, crippling the normal motor operation. Do not put a motor on top of another motor.

- **Comply with the specified conditions when conducting an electric test (winding resistance test, insulation resistance test, etc.) for a motor or other device or supplying power.**
  - Conduct an electric test according to the specified method. Conducting such a test by any method that is not specified can damage the motor.
  - Do not conduct a dielectric strength test or insulation test for a Pulsecoder or other detector, or do not apply a commercial power source voltage. Doing so can destroy the internal elements.

- **Perform preventive maintenance (inspection of the external appearance, measurement of winding resistance, insulation resistance, etc.) and cleaning on a regular basis.**
  To use a motor safely throughout its entire service life, perform preventive maintenance and cleaning on a regular basis. Be careful, however, because excessively severe inspection (dielectric strength test, etc.) can damage its windings. For information about winding resistance values, refer to the DESCRIPTIONS manual of the motor (its specification number is shown in this manual). Information about insulation resistance is given later in this manual.

NOTE

- This manual is focused on the preventive maintenance work to be performed for a single FANUC motor or detector alone. The information contained herein may not apply depending on the type or configuration of the machine. When reading this manual, refer to the manual of the machine as well. If you have any questions or doubts, do not act on your own; please contact the machine tool builder or FANUC.
- For detailed information about a motor, see the manual list shown earlier and, if necessary, obtain the latest version of the corresponding manual.

1.2.2 Preventive Maintenance of a Motor (Common to All Models)

This subsection describes the common preventive maintenance items to be handled regardless of the model of the motor. For the items specific to a particular motor model, see one of the subsequent subsections that pertains to that particular motor model.

⚠ CAUTION

- The preventive maintenance method differs from machine to machine in many respects. Depending on the machine in use, it may be difficult for the user to perform periodic inspection or cleaning. If you are not sure about anything as to preventive maintenance, consult with the machine tool builder and ensure that you can perform periodic inspection and cleaning.
- The machine should be used within the scope of specification defined by the machine tool builder. Using the machine in any way that is outside the specified scope can reduce the motor's service life or cause a failure.

1.2.2.1 Main inspection items

The following table summarizes the main inspection items for a motor. If any of these items **is found to be abnormal, stop the use of the machine immediately and fix the abnormal part** by repairing or replacing it. At the same time, **identify and remove the cause and take a measure to prevent its recurrence**. If it is difficult to take a preventive measure or to prevent its recurrence, consult with the machine tool builder or FANUC.

Appearance of the motor	Crack or deformation	- Check the motor for any scar, crack, deformation, bulge, etc. - If the interior of the motor is visible or there is interference with a peripheral component, it is imperative to replace the motor or the peripheral component. - A light peel-off or scar of the surface may be repairable; consult with FANUC.
	Wet or dirty part	- If you find any wet or dirty part, clean it immediately. - A preventive measure is needed if the part in question remains wet continually due to cutting fluid or dew condensation.
Operating conditions	Temperature, humidity, etc.	- Comply with the operating conditions of the machine. For details of the operating conditions of a specific motor, refer to the corresponding DESCRIPTIONS manual. Generally, the ambient temperature should be 0°C to 40°C and dew condensation is not allowed. In a place subject to severe vibration, the components of the motor may be broken.

Connection state	Cable	- Check for any cable sheath damage, exposed conductor, damaged conduit or cable bearing, abnormal bending, loose terminal, etc. - If there is any trace of fluid flowing, the fluid may have entered the inside of the motor or connector. It is necessary to make a check and take a measure to prevent recurrence.
	Connector/terminal	- Check for any cracked, exposed, loose, or removed terminal or connector, etc. - Fluid causes a failure; be sure to remove fluid. - A scarred or damaged connector or terminal needs to be replaced. In the case of a resin molded motor, such as a linear motor, the motor needs to be replaced.
Operation of the motor	Noise/vibration	- Check for any abnormal noise or vibration not only when the motor is running (the spindle is rotating) but also when it is stopped. - Abnormal noise heard when the motor is rotating indicates an abnormality of the bearing or a failure inside the motor.
	Movement	- Check that the motor operates normally and smoothly. - If the circuit breaker trips at the same time the motor starts to operate, it indicates abnormal motor windings.
	Heat	Check whether the motor does not overheat during the normal operation cycle. Note: While the motor is running or immediately after it is stopped, the motor surface may become very hot. Instead of touching the motor directly by hand, use a thermo label, surface thermometer, etc.
Electric characteristics of the motor	Winding resistance	If the resistance value exceeds the specified range, the motor needs to be replaced. Note: When conducting winding resistance measurement, disconnect the motor from the amplifier and measure the resistance at the power line or connector closest to the motor.
	Insulation resistance	For the measuring method and judgment criteria, see the table that follows.
Cooling fan (for a model with a fan motor)	Noise/vibration	- Check that the fan blows air normally without causing abnormal noise or vibration. - If abnormal noise is heard even when the motor is stopped, it indicates a fan motor failure.
	Movement	- If the power is on and if the fan does not operate or the fan blades cannot be moved even manually, or if the fan blades are rotating but no cooling wind is blown out, the fan motor may have cutting chips or sludge accumulated in it and needs to be cleaned. - If the fan does not operate normally for any other reason, the fan motor needs to be replaced.
Forcible cooling unit (when using an external cooling unit such as liquid cooling unit)	Dew condensation (over-cooling)	- Check that forcible cooling does not cause dew condensation on the motor surface. Dew condensation is likely particularly when the cooling unit continues to run after the machine is stopped. In that case, be sure to make this check. - Dew condensation or water drop on the motor surface can reduce the motor's service life. It is necessary to wipe it dry and take a measure to prevent recurrence.
	Liquid leakage/clog	- Check the cooling pipe for leakage or clog. Do not drive the motor unless the leakage or clog is fixed. - If the motor gets wet due to liquid leakage or any other cause, it is necessary to clean and dry the motor and perform electric characteristic checks (winding resistance/insulation resistance).

Insulation resistance measurement

The following table shows the judgment criteria to be applied when measuring insulation resistance between winding and frame using a megohmmeter (500 VDC).

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

If insulation resistance drops sharply during a short period of time or if the circuit breaker trips, the cutting fluid or other foreign matter may have entered the inside of the motor or cable. In that case, contact the machine tool builder or FANUC for instructions.

⚠ CAUTION

- Let the motor dry and cool to room temperature before winding or insulation resistance is measured. Otherwise, not only an accurate measurement cannot be performed but also the motor may be damaged.
- The winding or insulation resistance measurement should be performed on the motor alone, with its power line disconnected.
  Measuring insulation resistance with the motor connected to the amplifier may damage the amplifier.
- During insulation resistance measurement, 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.
- When disconnecting the power line and other cables, take an appropriate measure, such as labeling, to ensure that they can be restored to their original state.

1.2.2.2 Periodic cleaning of a motor

Periodic cleaning is necessary to remove an accumulation of cutting chips or sludge that may eventually cause a failure. Also, leaving the cutting fluid or other chemical substance attached for a long time can reduce the motor's service life substantially. When forcible cooling is provided by a liquid or air cooling unit, check the unit for pipe clog, fan failure, etc. and perform cleaning periodically to ensure that the coolant flows smoothly and that the motor is cooled properly.

⚠ WARNING

Depending on the type of motor, the handling may involve a risk and require safety education in advance. Also, some machines are difficult for users to clean on their own. If you are to clean the motor, consult with the machine tool builder in advance with regard to the cleaning method, safety education, etc.

1.2.2.3 Notes on motor cleaning

A motor is an electric product, which is incompatible with most kinds of fluid. When removing cutting chips, sludge, cutting fluid, etc. during cleaning, note the following.

Note on cleaning	Measure
Do not sprinkle fluid. Do not wash by submerging.	Do not sprinkle or spray detergent or any other fluid over the motor (including its peripheral components), or do not wash the motor by submerging it in such fluid. When cleaning the motor, use a cloth moistened with a small amount of neutral detergent so that the fluid does not enter the inside the motor.
Do not use solvent.	Solvent may damage the motor; do not use one. If the dirt is difficult to remove with neutral detergent, use a cloth moistened with a small amount of industrial alcohol (e.g., IPA). Be careful, however, because rubbing with force or repeatedly may damage the coated or resin surface.
Do not leave the motor wet or moistened.	If the motor is wet or moistened after cleaning, dry it before supplying power and before performing electric tests. When drying the motor in an oven, make sure that the temperature is below 40°C and that hot air does not blow directly against the motor.

1.2.2.4 Notes on the cutting fluid (informational)

Depending on the type of cutting fluid used, the motor and amplifier may be affected greatly. Take due care because, even if you ensure that they do not come into direct contact with the fluid, a mist or atmosphere of the fluid can cause the problems described below.

Type of cutting fluid requiring care	Expected problem
Cutting fluid containing highly active sulfur	Some types of cutting fluid contain highly active sulfur. If such cutting fluid enters the inside of the motor or amplifier, it causes copper, silver, and other kinds of metal to corrode, leading to a component failure.
Synthetic cutting fluid with high permeability	Some types of cutting fluid containing such substance as polyalkylene glycol have very high permeability. Such cutting fluid permeates into the inside of the motor, causing insulation deterioration or component failure.
Highly alkaline, water-soluble cutting fluid	Some types of cutting fluid that enhance their alkaline property using such substance as alkanolamine remain highly alkaline - pH10 or higher - when diluted. If such cutting fluid is left attached for a long time, its chemical change will deteriorate the resin and other materials of the motor and amplifier.

Other types of cutting fluid not mentioned above may cause various unexpected problems. If any problem arises for which the cutting fluid is thought to be responsible, consult with the machine tool builder or FANUC.

1.2.3 Maintenance of a Detector

⚠ **CAUTION**

- Detectors such as Pulsecoders are precision equipment. When handling a detector, avoid applying shock to it. Also, exercise care to prevent cutting powder, dust, cutting fluid, or other foreign matter from attaching to it.
- Make sure that all connectors are connected properly and securely. A connection failure can cause an alarm or some other problem.
- If the detector and/or connectors are not installed securely, cutting fluid may enter the inside of the detector, making it necessary to replace the detector. In that case, contact the machine tool builder or FANUC.

NOTE
If you use a detector not manufactured by FANUC, contact the machine tool builder or detector manufacturer for detailed information on the detector.

1.2.3.1 Alarms for built-in detectors (αi and βi Pulsecoders) and troubleshooting actions

These alarms concern built-in detectors that are connected directly to the control unit (CNC/servo amplifier).
Based on the alarm number and description, take an appropriate action as described in the following subsection, "Detailed troubleshooting methods".

Alarm No.: Alarm	Description	Possible cause	Action	Detailed troubleshooting method
308: SOFT PHASE ALARM(INT)	Position data alarm	- Noise - Entry of cutting fluid	Check the effect of noise. Replace the Pulsecoder.	(1) (3)
303: BROKEN LED(INT)	LED disconnection	- Pulse coder failure	Replace the Pulsecoder.	(3)
304: PULSE MISS(INT)	Small internal signal amplitude	- Pulse coder failure - Noise	Replace the Pulsecoder.	(3) (4)
305: COUNT MISS(INT)	Position data count error	- Pulse coder failure - Noise	Replace the Pulsecoder.	(3) (4)
300,301.302: SERIAL DATA ERROR(INT)	Communication interruption Communication data alarm	- Cable disconnection - Pulse coder failure - Noise	Check the cable. Replace the Pulsecoder. Check the effect of noise.	(1) (2) (3) (4)

1.2.3.2 Detailed troubleshooting methods

(1) Checking the effect of noise

Check CNC diagnosis information No.356 (Built-in detector), No.357 (Separate detector).
Normally, 0 is displayed. However, if the position data from the Pulsecoder becomes unstable due to noise or some other factor, this value is incremented. The value is cleared when the CNC unit is powered off. Immediately after the power is turned on, 0 is displayed.

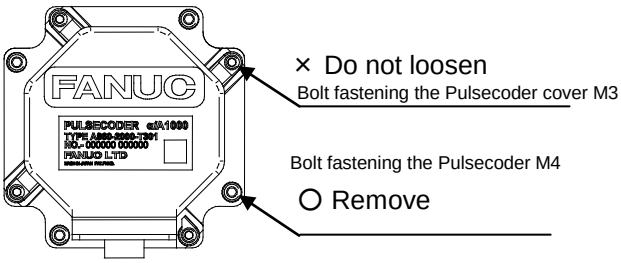
(2) Checking the cable

Check whether the feedback cable is not disconnected and whether the connector is properly plugged.

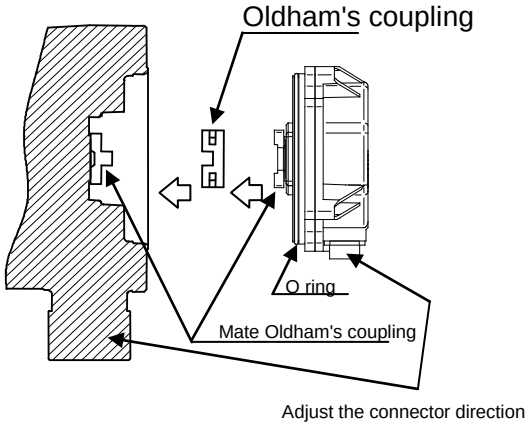
(3) Replacing the Pulsecoder

(3)-1 Pulsecoder replacement procedure

<1> Remove the four M4 hexagon socket head cap screws fastening the Pulsecoder. The M3 bolts fastening the Pulsecoder cover do not need to be loosed. (See the figure at right.)

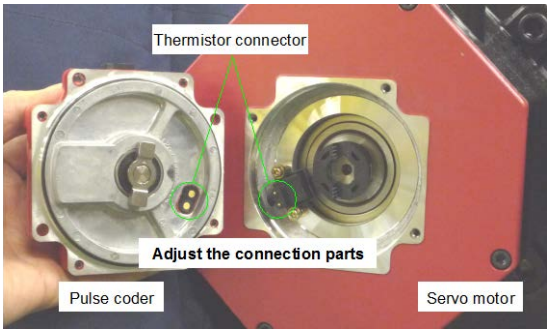


<2> Remove the Pulsecoder and Oldham's coupling (See the following figure).



<3> Set the new Pulsecoder and Oldham's coupling on the motor. Adjust the direction of the mate Oldham's coupling to that of the Oldham's coupling so that the teeth are engaged.

Push in the Pulsecoder until the O ring fits in the joint between the motor and Pulsecoder. Take care so that the O ring of the Pulsecoder is not bitten.

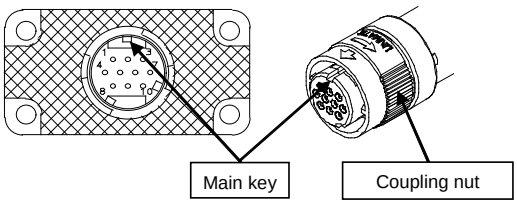


Attach the Pulsecoder in such a direction that the power connector of the servo motor and the feedback cable of the Pulsecoder face the same direction or that the thermistor connection parts of the servo motor and Pulsecoder match each other (see the figure at left).

<4> Fastening the Pulsecoder with the four M4 hexagon socket head cap screws. (Appropriate torque: 1.5 Nm)

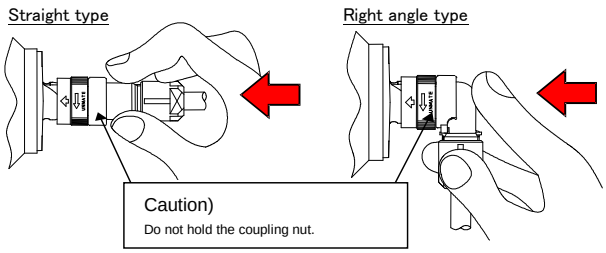
(3)-2 Feedback cable plugging procedure

Plug in the feedback cable connector, as instructed in the procedure below, and check that the connector is securely connected.



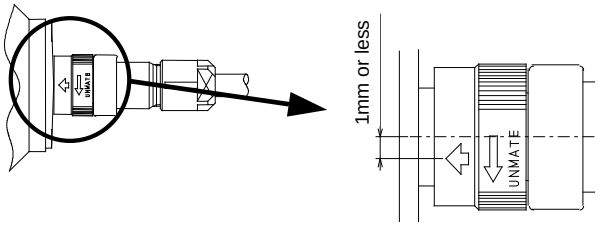
<1> Check the plugging side and key direction.
Check that the plugging side is free of foreign matter, such as dirt or oil.

<2> Plug in the feedback cable connector.
Hold the connector, as shown in the figure at right. Plug in the connector until you hear a click.



<3> Check the connection condition.

1. Check that the arrow mark of the connector is at the center, as shown in the figure at right. If the arrow mark is not at the center, turn the coupling nut manually until the mark comes to the appropriate position.



2. Hold the connector by the same part as in <2>, and pull it lightly to check that the connector does not come off. Do not pull the cable.

(4) If troubleshooting is difficult for the user

If the problem is difficult for the user to troubleshoot because it is due to a detector failure or noise, consult with the machine tool builder or FANUC.

1.2.3.3 Maintenance of βiS servo motor (□40 and □60) Pulsecoders

Problems concerning the Pulsecoders of the motors listed in the table below require the maintenance (replacement) of the entire motor (it is not possible to maintain the Pulsecoder alone).

Motor model	Motor specification	Remarks
βiS 0.2/5000	A06B-0111-Bcc3#dddd	Frame size □40
βiS 0.3/5000	A06B-0112-Bcc3#dddd	
βiS 0.4/5000	A06B-0114-Bcc3#dddd	Frame size □60
βiS 0.5/6000	A06B-0115-Bcc3#dddd	
βiS 1/6000	A06B-0116-Bcc3#dddd	

(cc, dddd : Any)

1.3 PREVENTIVE MAINTENANCE OF SERVO AMPLIFIERS

1.3.1 Warnings, Cautions, and Notes on Operation of Servo Amplifiers

This subsection contains the safety precautions on preventive maintenance of a servo amplifier (a generic term to refer to the β*i*SV-B and β*i*SVSP-B). These precautions are classified into "warnings", "cautions", and "notes" according to their bearing on safety. Make sure that you understand and comply with these precautions when carrying out the maintenance work.

⚠ WARNING

- **Make sure that you are safely dressed and have a safe working environment when performing preventive maintenance for a servo amplifier.**
  - Be dressed safely, e.g. by wearing gloves and safety shoes, to protect against injury due to an edge or protrusion and electric shock.
  - Have the work done by more than one person, where possible, so that immediate action can be taken if an accident occurs when handling a motor.
  - A servo amplifier and AC reactor contain heavy components. Be careful when transporting them or mounting them on the power magnetic cabinet. Also be careful not to get your fingers caught between the power magnetics cabinet and servo amplifier.

- **Before turning on the power, check that the door of the power magnetics cabinet and all other doors.**
  - Ensure that the door of the power magnetics cabinet containing the servo amplifier, as well as all other doors, are closed and locked except during maintenance work.

- **When the need arises to open the door of the power magnetics cabinet, only a person trained in the maintenance of the corresponding machine or equipment should do the task 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.**

- **Be careful about electric shock, fire, and other accidents.**
  - If the machine must be operated with the door open for adjustment or 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.
  - Ensure that the door of the power magnetics cabinet is locked so that the door cannot be opened by anyone, except service personnel or a qualified person trained in maintenance to prevent electric shock, when the servo amplifier is powered on.
  - When the need arises for an operator to open the door of the power magnetics cabinet and perform an operation, ensure that the operator is sufficiently educated in safety or that a protective cover is added to prevent the operator from touching any dangerous part.
  - The servo amplifier contains a large-capacity electrolytic capacitor in it and remains charged for a while after the power is shut off. Before touching the servo amplifier for maintenance or some other purpose, measure the residual voltage of the DC link connection using a tester and check that the red LED for indicating charging is in progress is not lit, in order to ensure safety.
  - After wiring, be sure to close the servo amplifier cover.

⚠ WARNING

- A loose screw or poor connector contact can cause a motor malfunction or overheating, connection to ground, or short-circuit. Be extremely careful with power supply lines, motor power lines, and DC link connections through which a large electric current flows, because a loose screw or poor connector contact may lead to a fire. Tighten screws and connectors using the specified screw tightening torque.
- The surfaces of the regenerative discharge unit and heat radiator may become very hot. Do not touch them directly by hand.

- **When operating the machine for the first time after preventive maintenance, check that the machine operates as instructed.**
  - To check whether the machine operates as instructed, first specify a small value for the motor and then increase the value gradually. If the motor operates abnormally, perform an emergency stop immediately.
  - When pressing the emergency stop button, check that the motor stops immediately and that the power being supplied to the amplifier is shut off by the magnetic contactor.

- **Notes on alarms**
  - If the machine stops due to an alarm, check the alarm number. Depending on the alarm issued, if the power is supplied without replacing the failed component, another component may be damaged, making it difficult to identify the original cause of the alarm.
  - Before resetting an alarm, ensure that the original cause of the alarm has been removed.

- **If the motor causes any abnormal noise or vibration while operating, stop it immediately.**
  - Using the motor in spite of the abnormal noise or vibration may damage the servo amplifier.

- **Do not disassemble or modify a servo amplifier.**
  Do not disassemble or modify a servo amplifier in any way not specified by FANUC; doing so can lead to a failure.

⚠ CAUTION

- **Notes on servo amplifier replacement and wiring**
  - The work of servo amplifier replacement and wiring should be carried out by a person trained in the maintenance of the machine and equipment concerned.
  - When replacing a servo amplifier, check that the combination of the amplifier and the motor is appropriate.
  - Check that the servo amplifier is securely mounted on the power magnetics cabinet. If there is any clearance between the power magnetics cabinet and the surface on which the amplifier is mounted, dust entering the gap may hinder the normal operation of the servo amplifier.
  - Ensure that the power supply lines, motor power lines, and signal lines are each connected to the correct terminal or connector.
  - Unless otherwise instructed, do not unplug a connector and plug it back with the power on; doing so may cause the servo amplifier to fail.
  - When mounting or unmounting the servo amplifier, exercise care not to get your fingers caught between the servo amplifier and power magnetics cabinet.
  - Take care not to lose track of removed screws. Turning on the power with any lost screw left in the unit may damage the machine.
  - Exercise care to prevent the power supply lines and motor power lines from being connected to the ground or being short-circuited.
  - Protect the lines from any stress such as bending. Handle the line ends appropriately.

⚠ CAUTION

- **Be careful about the handling of a servo amplifier.**
  - Do not disassemble a servo amplifier. Doing so poses the risk of electric shock, because the capacitor may remain charged.
  - Do not apply shock to a servo amplifier. Doing so may damage its components, potentially causing the amplifier to malfunction.
  - Do not apply an excessively large force to plastic parts. If a plastic section breaks, it may damage internal parts, thus hindering normal operation or leading to a risk of injury due to a broken section.

- **Be careful about the operating environment of a servo amplifier.**
  - Prevent conductive, combustible, or corrosive foreign matter, mist, or drops of water from entering the inside of the unit. The entry of any such material may cause the unit to explode, break, malfunction, etc.
  - Exercise care to prevent cutting fluid, oil mist, cutting chips, or other foreign matter from attaching to the radiator or fan motor exposed to the outside of the power magnetics cabinet. Otherwise, the servo amplifier may become unable to meet its specifications. The service lives of the fan motor and semiconductors can also be reduced.

- **Clean the heat sink and fan motor on a regular basis.**
  - Replace the filter of the power magnetics cabinet on a regular basis.
  - Before cleaning the heat sink, shut down the power and ensure that the temperature of the heat sink is as cool as the room temperature. The heat sink is very hot immediately after power shutdown, touching it may cause burn injury.
  - When cleaning the heat sink by blowing air, be careful about dust scattering. Conductive dust attached to the servo amplifier or its peripheral equipment can lead to a failure.

NOTE

- **Make sure that there is sufficient maintenance clearance around the doors of the machine and equipment.**

- **Do not step or sit on the servo amplifier, or do not apply shock to it.**

- **Do not remove a nameplate from a motor.**
  - The nameplate is necessary to identify the servo amplifier during maintenance work.
  - If a nameplate comes off, be careful not to lose it.

NOTE

1. This manual is focused on the preventive maintenance work to be performed for a FANUC servo amplifier. The information contained herein may not apply depending on the type or configuration of the machine. When reading this manual, refer to the manual of the machine as well. If you have any questions or doubts, do not act on your own; please contact the machine tool builder or FANUC.
2. For detailed information about a servo amplifier, see the manual list shown earlier and, if necessary, obtain the latest version of the corresponding manual.

1.3.2 Preventive Maintenance of a Servo Amplifier

To use a servo amplifier safely throughout its entire service life, perform daily and periodic inspections.

⚠ CAUTION

1 The preventive maintenance method differs from machine to machine in many respects. Depending on the machine in use, it may be difficult for the user to perform periodic inspection or cleaning. If you are not sure about anything as to preventive maintenance, consult with the machine tool builder and ensure that you can perform periodic inspection and cleaning.

2 The machine should be used within the scope of specification defined by the machine tool builder. Using the machine in any way that is outside the specified scope can reduce the servo amplifier's service life or cause a failure.

Inspection part	Inspection item	Inspection interval		Judgment criterion
		Routine	Periodic	
Operating environment	Ambient temperature	V		Around the power magnetics cabinet: 0°C - 45°C Inside the power magnetics cabinet: 0°C - 55°C
	Humidity	V		90% or below RH (dew condensation not allowed)
	Dust/oil mist	V		There shall be no dust or oil mist attached near the servo amplifier.
	Cooling air path	V		The cooling fan shall be operating normally without the air flow being interrupted.
	Abnormal vibration/noise	V		- No abnormal noise or vibration shall be present that has not been experienced in the past. - Vibration near the servo amplifier shall be 0.5 G or less.
	Supply voltage	V		200-V input type: Within 200 - 240 V 400-V input type: Within 400 - 480 V
Servo amplifier	General	V		There shall be no abnormal noise or smell, and there shall be no dust or oil mist attached.
	Screw		V	There shall be no loose screw.
	Fan motor (NOTE 1, 2)	V		- There shall be no abnormal vibration or noise, and the fan blades shall be rotating normally. - There shall be no dust or oil mist attached.
	Connector		V	There shall be no loose or broken connector.
	Cable		V	There shall be no sign of overheating or sheath deterioration (discoloration pr crack).
CNC	Absolute (NOTE 2) Pulse coder battery	V		The machine operator's panel or screen shall not display the alarm indicating the battery voltage of the absolute Pulsecoder is low.
External equipment	Magnetic contactor		V	The contactor shall not rattle or chatter.
	Ground fault interrupter		V	The interrupter shall be able to trip.
	AC reactor		V	There shall be no hum.

NOTE

1 Fan motors are periodic-replacement parts. It is recommended to inspect fan motors on a routine basis and replace them in a preventive manner.

2 Fan motors and batteries are periodic-replacement parts. It is recommended to keep spare parts.

1.3.3 Maintenance of a Servo Amplifier

1.3.3.1 Display of the servo amplifier operation status

The STATUS LEDs on the front of the servo amplifier indicate the operation status of the servo amplifier (whether it is operating normally, the type of alarm, etc.). Use these LEDs for maintenance, inspection, troubleshooting, etc.

> ⚠ **CAUTION**
> A servo amplifier failure may arise from a combination of multiple causes, in which case it can be difficult to identify all those causes. Handling the failure in an improper way may worsen the problem. It is therefore important to analyze the failure status minutely and identify the true cause or causes of the failure. There may be cases in which the failure appears to have been fixed but later recurs or cause a more serious trouble. If you are not sure about the root cause of or corrective action for a failure, do not act on your own; please contact the machine tool builder or FANUC for instructions on proper action.

See Chapter 4, “CONFIRMATION OF THE OPERATION” in Part I, “START-UP PROCEDURE FOR β*i*SV-B.”

1.3.3.2 Replacement of a fan motor

See Section 1.2, “REPLACEMENT OF A FAN MOTOR” in Part IV, “REPLACING SERVO AMPLIFIER COMPONENTS”

1.4 REPLACING BATTERY FOR ABSOLUTE PULSECODERS

See Section 1.3, “REPLACING BATTERY FOR ABSOLUTE PULSECODERS” in Part IV, “REPLACING SERVO AMPLIFIER COMPONENTS”

VI. MOTOR MAINTENANCE

1 SERVO MOTOR MAINTENANCE

1.1 SERVO MOTOR MAINTENANCE PARTS

1.1.1 Pulsecoder

The following lists the ordering specification numbers for maintenance.

(1) Pulsecoder: ordering specification

Motor model	Motor specification		Pulsecoder: ordering specification		
βiS series βiF series	A06B-0aaa-BccX A06B-2aaa-BccX (aaa, cc : Any)	X=3	A860-2020-T301	βiA128	Standard specification
	A06B-0aaa -BccX #0100 A06B-2aaa -BccX #0100 (aaa, cc : Any)	X=3	A860-2020-T321	βiA128	IP67 specification
βiSc series	A06B-0aaa-BccX A06B-2aaa-BccX (aaa, cc : Any)	X=7	A860-2020-T361	βiA128 (dedicated to the βiSc)	Standard specification
	A06B-0aaa -BccX #0100 A06B-2aaa -BccX #0100 (aaa, cc : Any)	X=7	A860-2020-T371	βiA128 (dedicated to the βiSc)	IP67 specification

(2) Oldham's coupling: ordering specification

Motor model	Motor specification	Oldham's coupling: ordering specification
βiS series βiSc series βiF series	A06B-0aaa-BccX A06B-2aaa-BccX (aaa, cc, X : Any)	A290-0501-V535

NOTE

Following problems that are relative to Pulsecoders should be solved by replacing motors.
(It is not possible to maintain the Pulsecoder alone.)

Motor model	Motor specification	Remark
βiS 0.2/5000	A06B-0111-Bcc3#dddd	Frame size □40
βiS 0.3/5000	A06B-0112-Bcc3#dddd	
βiS 0.4/5000	A06B-0114-Bcc3#dddd A06B-2114-Bcc3#dddd	Frame size □60
βiS 0.5/6000	A06B-0115-Bcc3#dddd A06B-2115-Bcc3#dddd	
βiS 1/6000	A06B-0116-Bcc3#dddd A06B-2116-Bcc3#dddd	

(cc, dddd : Any)

APPENDIX

A SERVO AMPLIFIER FRONT VIEW

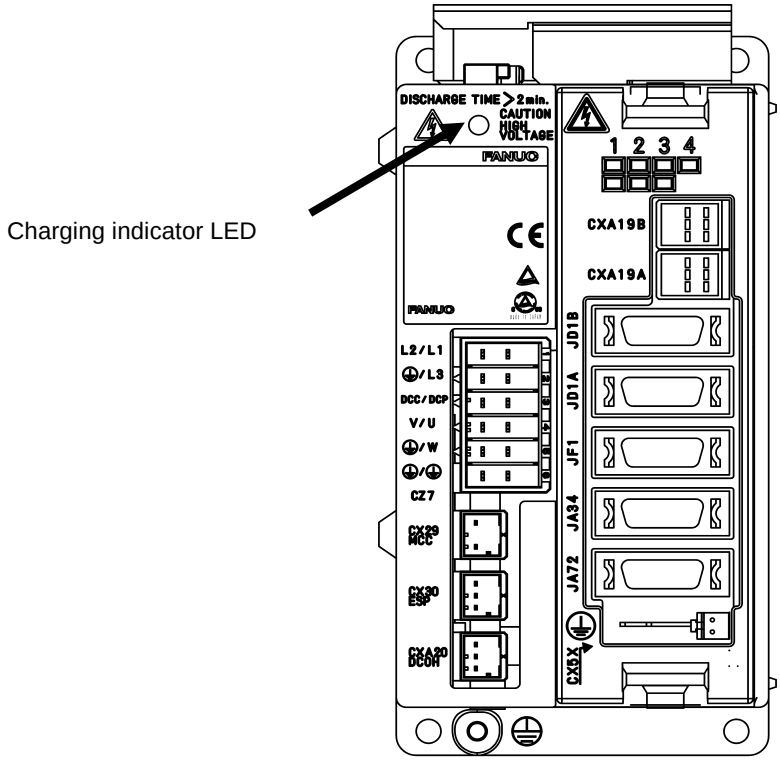


Fig. A(a) βiSV4-B, βiSV20-B

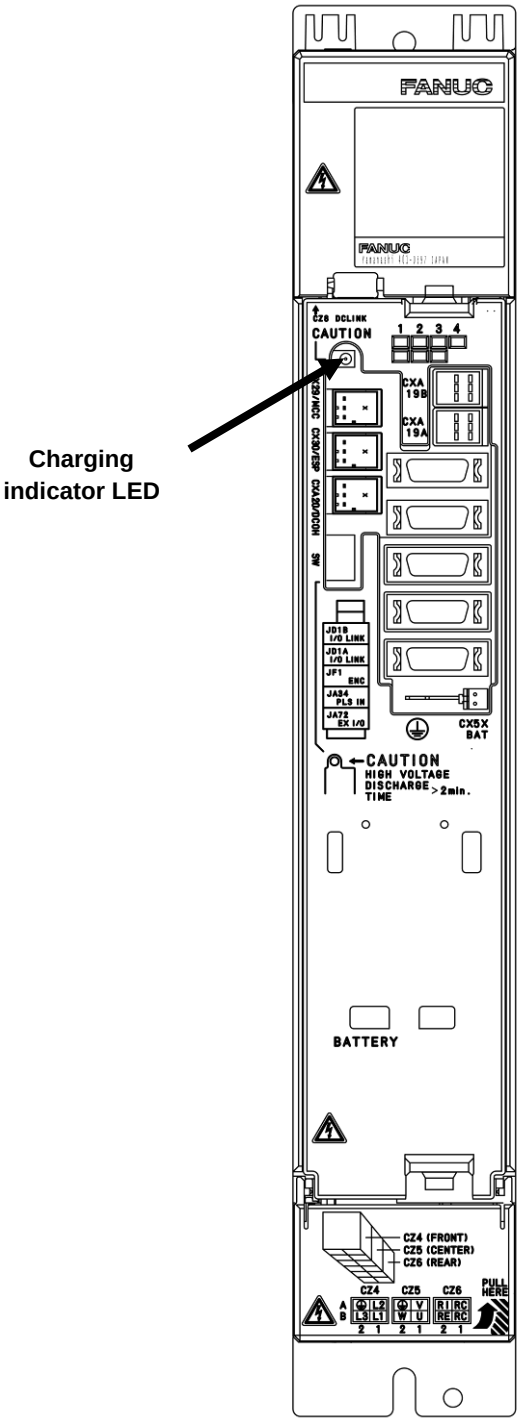


Fig. A(b) βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B

B PARAMETER LIST

Table B (a) Parameter list (in order of classification)

Classification	Parameter number	Reference item
Controlled-axis parameter	000	B.1
Coordinate system and stroke limit parameters	001, 068, 140～145, 147, 154～165, 170	B.2
Feedrate parameters	021, 040, 041, 043～050, 054, 061, 066, 067	B.3
Acceleration/deceleration parameters	002, 055～060	B.4
Input/output signal parameters	003～005, 007, 008, 020, 022～025, 029, 062, 063, 148～152,166～169	B.5
Servo parameters	010～014, 016～019, 030～032, 064, 070～075, 078～096, 099～112, 115, 116, 118, 119, 125, 130, 135～138, 179～182	B.6

Table B (a) Parameter list (in order of parameter number)

Any parameter with its number column shaded is automatically set by setting bit 1 of parameter No. 012 to 0, then turning the power off and then back on.

No.	Description	Related item
000	Controlled-axis	Appendix B.1
	#1 ROTX : Linear axis (0)/Rotation axis (1) #2 RAB2X : Specification of the sign of the absolute command-based rotation direction of the rotation axis is disabled (0)/enabled (1). #6 RABX : The absolute command-based rotation direction of the rotation axis is a direction determined according to a command-specified sign (0)/ a direction in which the distance to a desired point within one revolution is smaller (1). #7 ROAX : The roll-over function of the rotation axis is disabled (0)/enabled (1).	
001	Coordinate system and stroke limit	Appendix B.2
	#1 ZRTN : If a reference position is not set up, an alarm is issued (0)/not issued (1). #2 HOT : The overtravel direct input signals are disabled (0)/enabled (1). #3 SSL1 : Stored stroke limit 1 is invalid (0)/valid (1). #4 N405 : If reference position return cannot be executed correctly, servo alarm No. 405 is issued (0)/not issued (1). #6 EPEXA #7 EPEXB : If input external pulses exceed the upper limit for feedrate commands:	

EPEXB	EPEXA	Description
0	0	The feedrate is clamped (pulses at excessive rates are accumulated).
0	1	Alarm No. 291
1	0	The feedrate is clamped (pulses at excessive rates are discarded).
1	1	Alarm No. 291

No.	Description	Related item
002	Acceleration/deceleration control	Appendix B.4
	#0 RPDE : The acceleration/deceleration type for rapid traverse is linear or bell-shaped (0)/exponential (1). #1 JOGE : The acceleration/deceleration type for jog or cutting feed is linear or bell-shaped (0)/exponential (1). #3 CIPC : Switching between effective areas for in-position check is disabled (0)/enabled (1). #6 RVF2 : For a rapid traverse override, a feedrate is specified in 4 steps of 100%, 50%, 25%, F0 (0)/100%, F1, F2, F0 (1). #7 CSMZ : The SMZX signal is disabled (0)/enabled (1).	
003	Input/output signals	Appendix B.5
	#1 NCLP : Clamping/unclamping is used (0)/not used (1). #2 IGCP : A clamp/unclamp state is checked (0)/ not checked (1). #5 WAT2 : For a wait command, an ID code cannot be specified (0)/can be specified (1). #6 EXPLS : The external pulse function is disabled (0)/enabled (1). #7 STON : The ST signal is detected on the falling edge (0)/rising edge (1).	
004	Input/output signals	Appendix B.5
	#2 ZRNO : Input of a reference position establishment signal is disabled (0)/enabled (1). #3 NEPRM : Writing to EEPROM is performed (0)/not performed (1).	
005	Input/output signals	Appendix B.5
	#0 JNCL : When JOG operation stops, clamping is performed (0)/not performed (1). #1 CLPSVF : The time from clamping to servo-off is set as the time from the point the UCPC2 signal turns off (0)/the time from the point the UCPS2 signal turns off (1). #2 REFDRC : The direction of high-speed reference position return of the rotation axis depends on the sign of the result of subtracting the current position from the reference position (0)/the setting of bit 5 (ZMIX) of parameter No.010 (1). #4 IOH : Manual handle feed over the I/O Link is disabled (0)/enabled (1). #5 MP : Setting of a magnification in 4 steps with the MP1/MP2 signal for manual handle feed is disabled (0)/enabled (1). #6 LDM : Output of the motor current value to response data is disabled (0)/enabled (1). #7 ABSPS : Reading of response data is not synchronized with the host (0)/synchronized with the host (1).	
007	Input/output signals	Appendix B.5
	#0 ABSV : When coordinates are read, allowance for delays including an acceleration/deceleration delay and servo delay is not made (0)/made (1). #1 PSSV : For area signals, allowance for delays including an acceleration/deceleration delay and servo delay is not made (0)/made (1). #2 NZRPO: If a reference position is not established, a turret/magazine number or point number is not output (0)/output (1). #4 VCTLB : The velocity control type for peripheral equipment control is type A (0)/type B(1). #5 ATCR2 : A turret/magazine number is not always output to response data (0)/always output to response data (1).	
008	Input/ Output Singal	Appendix B.5
	#5 DEN2P : For remaining travel in-range signal DEN2, the position used to obtain a remaining travel is Specified position (0)／Actual position (1) #7 CLBAL : In the emergency stop state, clearing alarm 351 by external reset signal ERS is: Disabled (0)／Enabled (1)	

<table>
<tr><th>No.</th><th>Description</th><th>Related item</th></tr>
<tr><td rowspan="2">010</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#0 IINP : When the torque is limited, an in-position check is not made (0)/made (1).
#1 IALM : When the torque is limited, a check for an excessive error is not made (0)/made (1).
#2 IEBL : The torque limit function is disabled (0)/enabled (1).
#5 ZMIX : The initial direction of reference position return and backlash is positive (0)/negative (1).
#6 ECMR : CMR expansion is disabled (0)/enabled (1).
#7 SVFP : During servo-off, follow-up is not performed (0)/performed (1).</td><td></td></tr>
<tr><td rowspan="2">011</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#0 ABSX : The reference position of the absolute-position detector has not been established (0)/has been established (1).
#1 SZRN : Scale return is disabled (0)/enabled (1).
#2 DZRN : Reference position return with dogs is disabled (0)/enabled (1).
#6 MVZPFR : When the reference position on a rotation axis is updated, allowance for a fraction is not made (0)/made (1).
#7 APCX : An absolute-position detector is not provided (0)/provided (1).</td><td></td></tr>
<tr><td rowspan="2">012</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#1 DGPR : Automatic motor settings are made (0)/not made (1).</td><td></td></tr>
<tr><td rowspan="2">016</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#0 PIIP : The velocity loop is subjected to PI control (0)/IP control (1).
#1 LVMD : Low-velocity integration is disabled (0)/enabled (1).
#4 FFVL :
#5 FFAL :
<table>
<tr><th>FFVL</th><th>FFAL</th><th>Description</th></tr>
<tr><td>1</td><td>1</td><td>The feed-forward function is enabled.</td></tr>
<tr><td>0</td><td>*</td><td>The feed-forward function is disabled.</td></tr>
<tr><td>1</td><td>0</td><td>The feed-forward function is disabled.</td></tr>
</table></td><td></td></tr>
<tr><td rowspan="2">017</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#0 HENB : The skip function is disabled (0)/enabled (1).
#1 HEDG : A skip signal is detected on the rising edge (0)/falling edge (1).
#2 SPCO : If no skip signal is input and the end point is reached, skip measurement data is not updated (0)/contains end point data (1).</td><td></td></tr>
<tr><td rowspan="2">018</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#2 VCMD0: The function for quick stop is disabled (0)/enabled (1).
#3 TIM0
#4 TIM1 : MCC off timer settings
<table>
<tr><th>TIM1</th><th>TIM0</th><th>MCC off timer</th></tr>
<tr><td>0</td><td>0</td><td>0 ms</td></tr>
<tr><td>1</td><td>0</td><td>60 ms</td></tr>
<tr><td>1</td><td>1</td><td>100 ms</td></tr>
</table></td><td></td></tr>
<tr><td rowspan="2">019</td><td>Servo</td><td>Appendix B.6</td></tr>
<tr><td>#2 ACLIM : Current compensation function 11 is disabled (0)/enabled (1).
#3 SQLIM : Current compensation function 12 is disabled (0)/enabled (1).</td><td></td></tr>
<tr><td>020</td><td>Response data specification</td><td>Appendix B.5</td></tr>
<tr><td>021</td><td>Feedrate command weight N</td><td>Appendix B.3</td></tr>
<tr><td>022</td><td>ECF and EBSY signal minimum output time</td><td>Appendix B.5</td></tr>
<tr><td>023</td><td>PMM allocation rate at reading continuous data with a direct command</td><td>Appendix B.5</td></tr>
<tr><td>024</td><td>Axis name (1st character)</td><td>Appendix B.5</td></tr>
<tr><td>025</td><td>Axis name (2nd character)</td><td>Appendix B.5</td></tr>
<tr><td>029</td><td>Internal variable (ignore this parameter)</td><td>Appendix B.5</td></tr>
<tr><td>030</td><td>Set 0. Set the motor type number in parameter No. 125.</td><td></td></tr>
<tr><td>031</td><td>Direction of motor rotation (DIRCTL)</td><td>Appendix B.6</td></tr>
<tr><td>032</td><td>Command multiplier (CMR)</td><td>Appendix B.6</td></tr>
</table>

No.	Description	Related item
036	Always set 0.	
037	Always set 0.	
038	Always set 0.	
039	Always set 0.	
040	Rapid traverse rate	Appendix B.3
041	Jog feedrate	Appendix B.3
043	Feedrate upper limit	Appendix B.3
044	Feedrate specified for feedrate code 1	Appendix B.3
045	Feedrate specified for feedrate code 2	Appendix B.3
046	Feedrate specified for feedrate code 3	Appendix B.3
047	Feedrate specified for feedrate code 4	Appendix B.3
048	Feedrate specified for feedrate code 5	Appendix B.3
049	Feedrate specified for feedrate code 6	Appendix B.3
050	Feedrate specified for feedrate code 7	Appendix B.3
054	FL rate for a reference position return	Appendix B.3
055	Linear/bell-shaped/exponential acceleration/deceleration time constant T1 for rapid traverse	Appendix B.4
056	Rapid traverse bell-shaped acceleration/deceleration time constant T2	Appendix B.4
057	Linear/bell-shaped/exponential acceleration/deceleration time constant T1 for jog or cutting feed	Appendix B.4
058	Bell-shaped acceleration/deceleration time constant T2 for jog or cutting feed	Appendix B.4
059	Exponential acceleration/deceleration FL rate for jog or cutting feed	Appendix B.4
060	FL rate for rapid traverse exponential acceleration/deceleration	Appendix B.4
061	F0 rate for rapid traverse override	Appendix B.3
062	External pulse input-based axis movement amount ratio setting 1 (M)	Appendix B.5
063	External pulse input-based axis movement amount ratio setting 2 (N)	Appendix B.5
064	Peak hold time for motor current values and servo positional deviation amounts	Appendix B.6
066	F1 rate for rapid traverse override	Appendix B.3
067	F2 rate for rapid traverse override	Appendix B.3
068	Number of magazines/turrets	Appendix B.2
070	Current loop gain (PK1)	Appendix B.6
071	Current loop gain (PK2)	Appendix B.6
072	Current loop gain (PK3)	Appendix B.6
073	Velocity loop gain (PK1V)	Appendix B.6
074	Velocity loop gain (PK2V)	Appendix B.6
075	Velocity loop gain (PK4V)	Appendix B.6
078	Current compensation 1 (PVPA)	Appendix B.6
079	Current compensation 2 (PALPH)	Appendix B.6
080	Current limit value (TQLIM)	Appendix B.6
081	Overload protection coefficient (POVC1)	Appendix B.6
082	Overload protection coefficient (POVC2)	Appendix B.6
083	Overload protection coefficient (POVCLM)	Appendix B.6
084	Current compensation 3 (AALPH)	Appendix B.6
085	Actual current limit (DBLIM)	Appendix B.6
086	Current compensation 4 (MGSTCM)	Appendix B.6
087	Current compensation 5 (DETQLM)	Appendix B.6
088	Current compensation 6 (NINTCT)	Appendix B.6
089	Current compensation 7 (MFWKCE)	Appendix B.6
090	Current compensation 8 (MFWKBL)	Appendix B.6
091	VCMD polyline speed (P_VCLN)	Appendix B.6
092	Low-speed integration threshold speed (P_LVIN)	Appendix B.6
093	Estimated load torque: torque offset (TCPRLD)	Appendix B.6, Ⅱ6
094	Estimated load torque: dynamic friction compensation (FRCCMP)	Appendix B.6, Ⅱ6

No.	Description	Related item
095	Unexpected disturbance torque detection: retract distance (ABVOF)	Appendix B.6, Ⅱ6
096	Unexpected disturbance torque detection: alarm threshold (ABTSH)	Appendix B.6, Ⅱ6
099	Current compensation 9 (EMFCMP)	Appendix B.6
100	Load inertia ratio (LDINT)	Appendix B.6
101	Acceleration feedback (PK2VAUX)	Appendix B.6
102	Torque command filter (FILTER)	Appendix B.6
103	Feed-forward coefficient (FALPH)	Appendix B.6
104	Velocity feed-forward coefficient (VFFLT)	Appendix B.6
105	Numerator for the number of pulses per motor revolution (SDMR1)	Appendix B.6
106	Denominator for the number of pulses per motor revolution (SDMR2)	Appendix B.6
107	Position loop gain (LPGINX)	Appendix B.6
108	Servo motor torque limit	Appendix B.6
109	Backlash amount (BKLCMP)	Appendix B.6
110	Positional deviation limit value at a stop	Appendix B.6
111	In-position width	Appendix B.6
112	Torque constant	
115	Model constant	
116	Velocity loop gain override during velocity control	Appendix B.6
118	Current compensation 10 (PHDLY1)	Appendix B.6
119	Current compensation 10 (PHDLY2)	Appendix B.6
125	Motor type number	Appendix B.6
130	Unexpected disturbance torque detection alarm timer	Appendix B.6, Ⅱ6
135	Linear acceleration/deceleration time constant for velocity control	Appendix B.6
136	Velocity deviation check limit during velocity control	Appendix B.6
137	Effective area for in-position check during cutting feed	Appendix B.6
138	Expanded CMR	Appendix B.6
140	Machine coordinate for the reference position	Appendix B.2
141	Amount of movement per rotation axis revolution	Appendix B.2
142	Positive machine coordinate for stored stroke limit 1	Appendix B.2
143	Negative machine coordinate for stored stroke limit 1	Appendix B.2
144	Machine coordinate for the second reference position	Appendix B.2
145	Machine coordinate for the third reference position	Appendix B.2
147	Workpiece coordinate for the reference position	Appendix B.2
148	Servo positional deviation monitor amount	Appendix B.5
149	Remaining travel limit for outputting the remaining travel in-range signal (DEN2)	Appendix B.5
150	Coordinates (minimum) for point 1 in the operation range of the area signals	Appendix B.5
151	Coordinates for point 2 in the operation range of the area signals	Appendix B.5
152	Coordinates for point 3 in the operation range of the area signals	Appendix B.5
154	Position for point number 1	Appendix B.2
155	Position for point number 2	Appendix B.2
156	Position for point number 3	Appendix B.2
157	Position for point number 4	Appendix B.2
158	Position for point number 5	Appendix B.2
159	Position for point number 6	Appendix B.2
160	Position for point number 7	Appendix B.2
161	Position for point number 8	Appendix B.2
162	Position for point number 9	Appendix B.2
163	Position for point number 10	Appendix B.2
164	Position for point number 11	Appendix B.2
165	Position for point number 12	Appendix B.2
166	Operation completion signal output time	Appendix B.5
167	Time between servo-on and unclamping	Appendix B.5
168	Time between clamping and servo-off	Appendix B.5

No.	Description	Related item
169	Time allowed before the next sequence is executed without clamping/unclamping	Appendix B.5
170	Index point tolerance	Appendix B.2
179	Numerator for the number of pulses per motor revolution (SDMR1, 32768 or greater)	Appendix B.6
180	Reference counter capacity	Appendix B.6
181	Grid shift amount	Appendix B.6
182	Positional deviation limit value during movement	Appendix B.6

⚠ CAUTION
You must not change any parameters during operation.

NOTE
1 The increment system in the current CNCs corresponds to the user-specified unit in this servo amplifier. For example, when an amount of movement is specified in any of the current CNCs, the weight for a specified value of 1 is determined by parameter switching. In increment system B, the weight for a specified value of 1 is 1 μ. This servo amplifier does not perform parameter switching, but requires the user to determine the weight for a specified value of 1.
2 Do not change the value of a parameter not included in the parameter list because that parameter may be used for an internal variable.
For example, parameter No. 029 is used for an internal variable. Even if this parameter has a nonzero value, ignore the parameter without changing the value.

B.1 CONTROLLED-AXIS PARAMETERS

No.	#7	#6	#5	#4	#3	#2	#1	#0
000	ROAX	RABX				RAB2X	ROTX	

[Size] 1 byte (bit type)
[Standard value] 0

ROTX Specifies whether the controlled axis is a linear or rotation axis, as follows:
0 : Linear axis
1 : Rotation axis

NOTE
For velocity control, set a rotation axis.

RAB2X Specifies whether the specification of the sign of the absolute command-based rotation direction of the rotation axis is valid, as follows:
0 : Invalid
1 : Valid

NOTE
For details, see Section 3.6.2, "Rotation axis rotation direction sign specification function."

RABX Specifies the absolute command-based rotation direction of the rotation axis for movement within one revolution, as follows:
0 : Direction determined according to a command-specified sign
1 : Direction of the smallest distance to a desired point

NOTE
This parameter is valid only when ROAX = 1.

ROAX Specifies whether the roll-over function of the rotation axis is valid, as follows:
0 : Invalid
1 : Valid

NOTE
For velocity control, enable the roll-over function of the rotation axis.

B.2 COORDINATE SYSTEM AND STROKE LIMIT PARAMETERS

No.	#7	#6	#5	#4	#3	#2	#1	#0
001	EPEXB	EPEXA		N405	SSL1	HOT	ZRTN	

[Size] 1 byte (bit type)
[Standard value] 0

ZRTN Specifies whether an alarm is to be issued if a reference position is not set up, as follows:
0 : An alarm is issued.
1 : An alarm is not issued.

HOT Specifies whether the overtravel direct input signals (*+OT and *-OT) are valid, as follows:
0 : Invalid
1 : Valid

SSL1 Specifies whether stored stroke limit 1 is valid, as follows:
0 : Invalid
1 : Valid

NOTE
This parameter is invalid until reference position return is completed.

N405 Specifies whether a servo alarm is to be issued if reference position cannot be executed correctly, as follows:
0 : A servo alarm is issued. (No. 405)
1 : A servo alarm is not issued.

NOTE
If a value in the range of 4 to 96 is set for parameter No. 032 (CMR), servo alarm No. 405 may be issued during reference position return. In this case, prevent the alarm from being issued by setting N405 to "1".

EPEXA, EPEXB Specify the operation that is to occur if the axis movement rate determined according to external pulses exceeds the feedrate upper limit specified in parameter No. 043.

EPEXB	EPEXA	Description
0	0	The feedrate is clamped to the parameter-specified value, and the excessive pulses are treated as accumulated pulses. If the number of accumulated pulses exceeds 99999999, the excessive pulses are discarded.
0	1	Alarm 291 is issued, leading to deceleration and stop.
1	0	The feedrate is clamped to the parameter-specified value, and the excessive pulses are discarded.
1	1	Alarm 291 is issued, leading to deceleration and stop.

No	
068	Number of magazines/turrets

[Size] 2-byte
[Valid data range] 1 to 9999
[Standard value] 0
[Description] Sets up the number of magazines/turrets.

NOTE

Set parameters No. 068 and 141 (Amount of movement per rotation axis revolution) in a range that satisfies the following formula.

(No.141) × [(No.068) × 2 + 1] < 2147483647

Example) When parameter No. 068=1000, parameter No.141 < 1073205.

No.	
140	Machine coordinate of the reference position

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 0
[Description] Sets up the machine coordinate for the reference position.
When setting of the reference position is completed, the machine coordinate is preset to the value specified in the parameter.

No.	
141	Amount of movement per rotation axis revolution

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] Specifies an amount of movement per revolution for the rotation axis. If 0 is specified, the amount of movement is assumed to be 36000.

⚠ CAUTION

1 The amount of motor revolution corresponding to the amount of movement per rotation axis revolution must be 2500 revolutions or less. If the amount of motor revolution corresponding to the amount of movement per rotation axis revolution exceeds 2500 revolutions, reduce the amount of motor revolution to 2500 or below, by reducing the gear reduction ratio or by other means.

2 Set parameters No. 068 (the number of magazines/turrets) and 141 in a range that satisfies the following formula.

(No. 141) × [(No. 068) × 2 + 1] < 2147483647

Example) When parameter No. 141 = 360000, parameter No. 068 < 2982

No.	
142	Positive machine coordinate for stored stroke limit 1

No.	
143	Negative machine coordinate for stored stroke limit 1

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 99999999 (positive machine coordinate),
-99999999 (negative machine coordinate)
[Description] Sets up the positive and negative machine coordinates for stored stroke limit 1. Areas outside the specified ranges are forbidden areas.

No.	
144	Machine coordinate for the second reference position

No.	
145	Machine coordinate for the third reference position

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 0
[Description] Sets up the machine coordinates for the second and third reference positions.

No.	
147	Workpiece coordinate for the reference position

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 0
[Description] Sets up the workpiece coordinate for the reference position. When setting the reference position, either without dogs or externally, is completed, the workpiece coordinate of the reference position is preset to the value specified in the parameter. This parameter is fixed to 0 for the rotation axis.

No.	
154	Position for point number 1

No.	
165	Position for point number 12

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 0
[Description] Specify positions for point numbers 1 to 12 for point positioning.

No.	
170	Index point tolerance

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] When the 1-pitch rotation of ATC/turret control is specified, the index point is preserved if the machine deviates from the index point during clamping/ unclamping, as long as the absolute value for the movement amount is equal to or less than this value. For example, when the machine is to move from index point 1 to 2, it can move to the position of point 2 even if it has deviated from the position of point 1 in the direction opposite from the direction of movement, as long as the movement amount is within the value specified in this parameter.

In ATC/turret control, this parameter is also used to specify a tolerable magazine range when a turret/magazine number is always output to response data.

NOTE
When bit 5 of parameter No.007 is 1 (a turret/magazine number is always output to response data), set a tolerable magazine range in this parameter.

B.3 FEEDRATE PARAMETERS

No.	
021	Feedrate command weight N

[Size] 1 byte
[Unit of data]
[Valid data range] 0 to 8
[Standard value] 3
[Description] Sets up a weight for feedrate parameter Nos. 040, 041, 043 to 050, 054, 059 to 061. Supposing 3 is specified, the feedrate is assumed to be a parameter-specified feedrate multiplied by 10^3 (= 1000).

No.	
040	Rapid traverse rate

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 4000

[Description] Specifies a rapid traverse rate. (N is specified in parameter No. 021.)

No.	
041	Jog feedrate（Jog feedrate）

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (4 user-specified units/MIN or greater)
[Standard value] 2000
[Description] Specifies the feedrate for job feed when the feedrate override value is 100%. (N is specified in parameter No. 021.)

No.	
043	Upper limit for specified feedrate

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535
[Standard value] 4000
[Description] Specifies the upper limit for the feedrate to be specified. If an attempt is made to specify a value larger than the upper limit, the actual feedrate is clamped to the upper limit. (N is specified in parameter No. 021.)

No.	
044	Feedrate specified for feedrate code 1
045	Feedrate specified for feedrate code 2
046	Feedrate specified for feedrate code 3
047	Feedrate specified for feedrate code 4
048	Feedrate specified for feedrate code 5
049	Feedrate specified for feedrate code 6
050	Feedrate specified for feedrate code 7

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (4 user-specified units/MIN or greater)
[Standard value] 2000
[Description] Specify the feedrates corresponding to feedrate codes 1 to 7 for command data 1 for a function code command. (N is specified in parameter No. 021.)

No.	
054	FL rate for a reference position return

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 100
[Description] Specifies a rate of movement to the next grid point during setting of the reference position. (N is specified in parameter No. 021.)

No.	
061	F0 rate for rapid traverse override

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 10
[Description] Specifies the F0 rate for rapid traverse override. (N is specified in parameter No. 021.)

No.	
066	F1 rate for rapid traverse override

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 10
[Description] Specifies the F1 rate for rapid traverse override. (N is specified in parameter No. 021.)

NOTE
This parameter is valid when bit 6 (RVF2) of parameter No. 002 is 1.

No.	
067	F2 rate for rapid traverse override

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 10
[Description] Specifies the F2 rate for rapid traverse override. (N is specified in parameter No. 021.)

NOTE
This parameter is valid when bit 6 (RVF2) of parameter No. 002 is 1.

B.4 ACCELERATION/DECELERATION CONTROL PARAMETERS

No.	#7	#6	#5	#4	#3	#2	#1	#0
002	CSMZ	RVF2			CIPC		JOGE	RPDE

[Size] 1 byte (bit type)
[Standard value] 0

NOTE
In the explanation below, cutting feed means a feed type that is neither rapid traverse nor jog feed.

RPDE Specifies the acceleration/deceleration type for rapid traverse, as follows:
0 : Linear or bell-shaped acceleration/deceleration

NOTE
Bell-shaped acceleration/deceleration is selected if rapid traverse bell-shaped acceleration/deceleration time constant T2 is specified.

1 : Exponential acceleration/deceleration

JOGE Specifies the acceleration/deceleration type for jog or cutting feed, as follows:
0 : Linear or bell-shaped acceleration/deceleration

NOTE
Bell-shaped acceleration/deceleration is selected if jog or cutting feed rapid traverse bell-shaped acceleration/deceleration time constant T2 is specified.

1 : Exponential acceleration/deceleration

CIPC Specifies whether to enable switching between effective areas for in-position check, regardless of whether a direct command specifies rapid traverse or cutting feed for the next block, as follows:
0 : Disabled.
1 : Enabled.

RVF2 For a rapid traverse override, a feedrate is specified in 4 steps of:
0 : 100%, 50%, 25%, F0.
1 : 100%, F1, F2, F0.
The table below lists override values determined by the rapid traverse override signals ROV1 and ROV2.

ROV2	ROV1	Override value	
		RVF2=0	RVF2=1
0	0	100%	100%
0	1	50%	F1
1	0	25%	F2
1	1	F0	F0

NOTE
For F0, F1, and F2, set actual feedrates in parameters No. 061, No. 066, and No. 067, respectively.

CSMZ Specifies whether to enable the output signal SMZX (Yy+7#5) of a direct command, as follows:
0 : Disabled.
1 : Enabled.

No.	
055	Rapid traverse linear acceleration/deceleration time constant or rapid traverse bell-shaped acceleration/deceleration time constant T1
	Rapid traverse exponential acceleration/deceleration time constant

[Size] 2-byte
[Unit of data] msec
[Valid data range] 0 to 4000
[Standard value] 100

[Description] Specifies a rapid traverse acceleration/deceleration time constant. The acceleration/deceleration time constant to be used is determined depending on whether bit 0 of parameter No. 002 (RPDE) and rapid traverse bell-shaped acceleration/deceleration time constant T2 are set.

No.	
056	Rapid traverse bell-shaped acceleration/deceleration time constant T2

[Size] 2-byte
[Unit of data] msec
[Valid data range] 0 to 512
[Standard value] 100
[Description] Specifies rapid traverse bell-shaped acceleration/deceleration time constant T2.

No.	
057	Linear acceleration/deceleration time constant or bell-shaped acceleration/deceleration time constant T1 for jog feed or feed based on feedrate codes 1 to 7
	Exponential acceleration/deceleration time constant for jog feed or feed based on feedrate codes 1 to 7

[Size] 2-byte
[Unit of data] msec
[Valid data range] 0 to 4000
[Standard value] 100
[Description] Specifies an acceleration/deceleration time constant for jog feed or feed based on feedrate codes 1 to 7. The acceleration/deceleration time constant to be used is determined depending on whether bit 1 of parameter No. 002 (JOGE) and bell-shaped acceleration/deceleration time constant T2 for jog feed or feed based on feedrate codes 1 to 7 are set.

No.	
058	Bell-shaped acceleration/deceleration time constant T2 for jog feed or feed based on feedrate codes 1 to 7

[Size] 2-byte
[Unit of data] msec
[Valid data range] 0 to 512
[Standard value] 100
[Description] Specifies bell-shaped acceleration/deceleration time constant T2 for jog feed or feed based on feedrate codes 1 to 7.

No.	
059	Exponential acceleration/deceleration FL rate for jog feed or feed based on feedrate codes 1 to 7

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 10
[Description] Specifies the exponential acceleration/deceleration time constant FL rate for jog feed or feed based on feedrate codes 1 to 7. (N is specified in parameter No. 021.)

No.	
060	FL rate for rapid traverse exponential acceleration/deceleration

[Size] 2-byte
[Unit of data] 10^N User-specified unit/MIN
[Valid data range] 1 to 65535 (7500 user-specified units/MIN or greater)
[Standard value] 10

[Description] Specifies the FL rate for rapid traverse exponential acceleration/deceleration. (N is specified in parameter No. 021.)

B.5 INPUT/OUTPUT SIGNALS PARAMETERS

No.	#7	#6	#5	#4	#3	#2	#1	#0
003	STON	EXPLS	WAT2			IGCP	NCLP	

[Size] 1 byte (bit type)
[Standard value] 1 only for NCLP

NCLP Specifies whether to use clamping/unclamping, as follows:
0 : Clamping/unclamping is used.
1 : Clamping/unclamping is not used.

IGCP Specifies whether to check a clamp/unclamp state (UCPS2) before proceeding to the next sequence, as follows:
0 : A clamp/unclamp state is checked.
1 : A clamp/unclamp state is not checked.

WAT2 Indicates whether an ID code can be specified for a wait function, as follows:
0 : An ID code cannot be specified.
1 : An ID code can be specified.

EXPLS Indicates whether an axis movement function based on external pulses (pulses from a manual pulse generator) is valid, as follows:
0 : Invalid.
1 : Valid.

STON Specifies whether an automatic operation is started at the rising (off to on) or falling (on to off) edge of the automatic operation start (ST) signal, as follows:
0 : Falling edge (on to off)
1 : Rising edge (off to on)

No.	#7	#6	#5	#4	#3	#2	#1	#0
004					NEPRM	ZRNO		

[Size] 1 byte (bit type)
[Standard value] 0

ZRNO Specifies whether to enable input of a reference position establishment signal, as follows:
0 : Disabled.
1 : Enabled.

NEPRM Specifies whether to perform writing to the EEPROM (memory for storing parameter settings) when rewriting parameters using peripheral device control or a direct command, as follows:
0 : Writing is performed.
1 : Writing is not performed.

⚠ **CAUTION**

1 There is a limit to the number of writes to the EEPROM (memory for storing parameter settings) (tens of thousands of writes). For this reason, set NEPR to 1 if parameters are to be rewritten frequently using peripheral device control or a direct command.

2 Those parameters that were rewritten to values different from their initial values when NEPRM was "1" must not be rewritten when NEPRM is "0." Otherwise, an EEPROM parity mismatch occurs, with the result that a parity error occurs and standard settings are loaded when the power is turned OFF and then ON again. If parameters are rewritten from the MDI using the power mate CNC manager (PMM), writing to the EEPROM is performed regardless of the value of NEPRM. Consequently, a parity error also occurs if those parameters that were rewritten using the ladder when NEPRM was "1" are rewritten from the MDI.
(Example)
A parity error occurs and standard settings are loaded if the following is performed:

"3" is set for parameter No. 020 at power on.
↓
a) Set "1" for parameter No. 020 using the ladder when NEPRM is "1."
↓
b) Set "2" for parameter No. 020 using the ladder when NEPRM is "0."
Alternatively,
c) Set "2" for parameter No. 020 from the MDI using the PMM.
↓
Turn the power OFF and then ON again.
↓
Standard settings are loaded.

* If b) or c) is not performed, a parity error is not issued.

No.	#7	#6	#5	#4	#3	#2	#1	#0
005	ABSPS	LDM	MP	IOH		REFDRC	CLPSVF	JNCL

[Size] 1 byte (bit type)
[Standard value] 0

JNCL Specifies whether to use clamping when JOG operation stops, as follows:
0 : Clamping is performed.
1 : Clamping is not performed. (The unclamp state is preserved.)

CLPSVF The time from clamping to servo off (parameter No. 168) is:
0 : Time from the point the unclamping instruction signal (UCPC2) turns off
1 : Time from the point the clamping/unclamp state output signal (UCPS2) turns off.

REFDRC The direction of the high-speed origin return of the rotation axis depends on:
0 : Sign of the result of subtracting the current position from the reference position.
1 : Setting of ZMIX (bit 5 of parameter No. 010).

IOH Specifies whether to enable manual handle feed over the I/O Link, as follows:
0 : Disabled.

1 : Enabled.

NOTE
When this parameter is set to 1, bit 6 (EXPLS) of parameter No. 003 must be set to 0.

MP Specifies whether to enable setting of a magnification in 4 steps with the MP1/MP2 signal for input manual handle pulses for manual handle feed, as follows:
0 : Disabled.
1 : Enabled.

LDM Specifies whether the output of the motor current value is valid to the response data (Xx+3 to Xx+6), as follows:
0 : Invalid.
1 : Valid.

ABSPS Specifies whether the host and a servo amplifier are to be synchronized with each other in the response data read function, as follows:
0 : Not synchronized.
1 : Synchronized. (This makes it possible for the host to read the correct position even during axis movement.)

NOTE
1 For details, see Part II, Section 3.8, "Upgrading the Response Data Read Function."
2 When bit 5 of parameter No.007 is 1 (a turret/magazine number is always output to response data), set this parameter to 1.

No.	#7	#6	#5	#4	#3	#2	#1	#0
007			ATCR2	VCTLB		NZRPO	PSSV	ABSV

[Size] 1 byte (bit type)
[Standard value] 0

ABSV Specifies whether to make allowance for delays including an acceleration/deceleration delay and servo delay when coordinates are read from the host to the servo amplifier, as follows:
0 : Positions where allowance for delays is not made are read.
1 : Positions where allowance for delays is made (actual motor positions) are read.

NOTE
1 This parameter is valid when coordinates are read as described below.
(1) Machine coordinates or workpiece coordinates are output to response data for peripheral equipment control.
(2) A direct command is used to specify any of the following:
- Reading of absolute positions (function code 0x30)
- Reading of machine positions (function code 0x31)
- Reading of absolute positions or machine positions using a continuous data read command (function code 0x41)

2 Due to a delay, for example, in data exchange over the FANUC I/O Link, coordinate positions that are read have a maximum delay of 30 to 40 msec.

PSSV Specifies whether to make allowance for delays including an acceleration/deceleration delay and servo delay when area signals are input, as follows:

0 : Area signals are input at positions where allowance for delays is not made.

1 : Area signals are input at positions where allowance for delays is made (actual motor positions).

NZRPO Specifies whether to output a turret/magazine number or point number when ATC/turret control or point positioning control is performed, if a reference position is not established, as follows:

0 : Not output.

1 : Output.

⚠ CAUTION

When an incremental pulse coder is used with bit 2 (NZRPO) of parameter No. 007 set to 1, be sure to set a coordinate system to establish a relationship between the machine and absolute coordinates, before performing ATC operation or point positioning. If ATC operation or point positioning is performed before a coordinate system is set, positioning to correct machine positions may not occur. A turret/magazine number or point number that is then output may not be correct. This affects all types of positioning, not only ATC operation and point positioning.

NOTE

1 This parameter is valid when parameter No. 020 is set to 1.

2 This parameter is also valid when bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data).

VCTLB Specifies the velocity control type for peripheral equipment control, as follows:

0 : Type A (the torque limit value cannot be specified).

1 : Type B (the torque limit value can be specified).

ATCR2 Specifies when to output a turret/magazine number, as follows:

0 : A turret/magazine number is output when ATC/turret control is performed. (Conventional method)

1 : A turret/magazine number is always output. (New method)

⚠ CAUTION

In the new method, even if a function code for other than ATC/turret control (function code 2) is specified, the turret/magazine number and MINP, +MOR, and -MOR signals corresponding to the current position are always output to response data. Note that, for example, if point positioning is performed, a point number and the MINP, +MOR, and -MOR signals corresponding to the point number are not output to response data.

NOTE

1 To enable the new method, the following conditions must also be satisfied.
- Set parameters as described below to enable ATC/turret control (function code 2).
  Select a rotation axis (bit 1 of parameter No.000 is 1).
  Enable the roll-over function (bit 7 of parameter No.000 is 1).
  Set the number of magazines/turrets (parameter No. 068).
  Set an index point tolerance (parameter No. 170).
- Set parameter No.020 to 1 (an ATC and point number are output to response data).
- Set bit 7 of parameter No.005 to 1 (the host and a servo amplifier are synchronized with each other in the response data read function).

2 In the new method, response data must be read in a synchronous manner. The response data retained is thus based on a position when the logic of ABSWT (XX+1#0) is reversed, and the data is not updated until the next time the ABSWT logic is reversed.

No.	#7	#6	#5	#4	#3	#2	#1	#0
008	CLBAL		DEN2P					

[Size] 1 byte (bit type)
[Standard value] 0

DEN2P For remaining travel in-range signal DEN2, the position used to obtain a remaining travel is:
0 : Specified position (position not in consideration of a delay amount)
1 : Actual position (position in consideration of an acceleration/deceleration amount, servo delay amount, and the like)

NOTE
When in-position signal INPX is "1", remaining travel in-range signal DEN2 does not change. Therefore, set a value larger than an in-position width (parameter No. 111) for parameter No. 149.

CLBAL In the emergency stop state, clearing alarm 351 by external reset signal ERS is:
0 : Disabled.
1 : Enabled.

NOTE
In the emergency stop state, an alarm other than alarm 351 cannot be cleared.

No.	
020	Response data specification (PHOUT)

[Size] 1 byte
[Standard value] 3

PHOUT Specifies whether or what to output as response data (Xx+3 to Xx+6), as follows:
0 : Nothing is output.
1 : An ATC and point No. are output if an ATC cycle and point positioning are involved.
2 : Machine coordinates are output in real time.

3 : Workpiece coordinates are output in real time.
4 : The motor current value is output. The motor current value is 6554, which is the maximum current value for the amplifier.
5 : Measurement data (workpiece coordinates) obtained when a skip signal is input is output.
6 : An actual feedrate is output in real time.
[Unit of data] 10^NUser-specified unit/MIN (N:Parameter No. 021)
7 : An actual speed is output in real time.
[Unit of data] min^{-1}
8 : A torque command is output in real time. The maximum value of a torque command is 6554.
The least significant bit is a signal indicating whether the torque limit is reached.
Least significant bit =
0: The torque limit is not reached.
1: The torque limit is reached.

NOTE
1 An ATC and point number are not output until a reference position is established. When bit 2 (NZRPO) of parameter No. 007 is set to 1, however, an ATC and point number are output even if a reference position is not established.
2 If the motor current value is output as response data, set LDM (bit 6 of parameter No. 005) to "1" and set "4" for parameter No. 020.
3 When bit 5 of parameter No. 007 is 1 (a turret/magazine number is always output to response data), set this parameter to 1.
4 The value of an actual speed is output with a sign. While the motor is being stopped, the motor current may drift, causing the sign to be unstable.

No.	
022	ECF and EBSY signal minimum output time

[Size] 1 byte
[Unit of data] 8msec
[Valid data range] 0 to 127
[Standard value] 5
[Description] Specifies the minimum output time for the ECF and EBSY signals (direct command interface control flag 2). This is valid when the power mate CNC manager is used.

No.	
023	PMM allocation rate assumed when reading continuous data with a direct command

[Size] 1 byte
[Valid data range] 0 to 100
[Standard value] 50
Do not change the parameter from its standard value.

No.	
024	Axis name (1st character)
025	Axis name (2st character)

[Size] 1 byte
[Valid data range] 0, 32 (“ ” space)
48 (“0”) to 57 (“9”)
65 (“A”) to 90 (“Z”)

[Description] Set an axis name using two characters (parameters No. 024 and No. 025).
If a setting is out of range, “ ” (space) is displayed.
When parameter No. 024 is set to 0, an axis name is 1, regardless of the setting of parameter No. 025.

Setting	Displayed character	Setting	Displayed character	Setting	Displayed character	Setting	Displayed character
0	Space	56	8	73	I	83	S
32	Space	57	9	74	J	84	T
48	0	65	A	75	K	85	U
49	1	66	B	76	L	86	V
50	2	67	C	77	M	87	W
51	3	68	D	78	N	88	X
52	4	69	E	79	O	89	Y
53	5	70	F	80	P	90	Z
54	6	71	G	81	Q		
55	7	72	H	82	R		

Example)
To set **X3** as an axis name:
Set parameter No. 024 to 88 and parameter No. 025 to 51.

No.	
029	Internal variable

[Size] 1 byte

Do not change the value of the parameter.

NOTE
1 Even if this parameter has a nonzero value, ignore the parameter without changing the value.
2 There is no problem even if this parameter is rewritten when all parameters are written at once.

No.	
062	External pulse input-based axis movement amount ratio setting 1 (M)
063	External pulse input-based axis movement amount ratio setting 2 (N)

[Size] 2-byte
[Valid data range] 1 to 32767
[Standard value] 1
[Description] Specify a ratio M/N for an axis movement amount based on an external pulse input.

No.	
148	Servo positional deviation monitor amount

[Size] 4-byte
[Unit of data] Detection unit
[Valid data range] 0 to 99999999
[Standard value] 99999999
[Description] Specifies the servo positional deviation monitor amount. The SVERX signal becomes 1 when the servo positional deviation amount becomes larger than the value specified in this parameter.

No.	
149	Remaining travel limit for outputting the remaining travel in-range signal (DEN2)

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] Specifies the absolute value of a remaining travel value used as a limit to output the remaining travel in-range signal (DEN2).

No.	
150	Coordinates (minimum) for point 1 in the operation range of the area signals
151	Coordinates for point 2 in the operation range of the area signal
152	Coordinates for point 3 in the operation range of the area signals

[Size] 4-byte
[Unit of data] User-specified unit
[Valid data range] 0 to ±99999999
[Standard value] 0
[Description] Specify the points for the output range of the area signals using machine coordinates. Area signals PSG1 and PSG2 are output according to the result of comparison between the machine coordinate and a parameter-specified value. The output conditions are listed below. ABSMT represents the current machine coordinate.

Condition	PSG2	PSG1
ABSMT < point 1	0	0
Point 1 ≤ ABSMT < point 2	0	1
Point 2 ≤ ABSMT < point 3	1	0
Point 3 ≤ ABSMT	1	1

NOTE
When bit 1 (PSSV) of parameter No. 007 is 1, area signals can be input at actual motor position where allowance for delays including an acceleration/deceleration delay and motor delay is made.

No.	
166	Operation completion signal output time

[Size] 4-byte
[Unit of data] 8msec
[Valid data range] 0 to 99999999
[Standard value] 5
[Description] Specifies the output time for operation completion signals OPC1 to OPC4.

NOTE
If 0 is set, no operation completion signal is not output.

No.	
167	Time between servo-on and unclamping

[Size] 4-byte
[Unit of data] 8msec
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] Specifies a time interval from the time the servo system is switched on until the machine is unclamped if clamping/unclamping is used.

No.	
168	Time between clamping and servo-off

[Size] 4-byte
[Unit of data] 8msec
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] Specifies a time interval from the time the machine is clamped until the servo system is switched off if clamping/unclamping is used.

No.	
169	Time allowed before the next sequence is executed without clamping/unclamping

[Size] 4-byte
[Unit of data] 8msec
[Valid data range] 0 to 99999999
[Standard value] 0
[Description] Specifies a time interval from the time the clamp/unclamp command (UCPC2) is issued until the next sequence is started, if the clamp/unclamp state signal (UCPS2) is not to be checked. Whether to check the clamp/unclamp state signal (UCPS2) is specified using bit 2 of parameter No. 003 (IGCP).

B.6 SERVO PARAMETERS

No.	#7	#6	#5	#4	#3	#2	#1	#0
010	SVFP	ECMR	ZMIX			IEBL	IALM	IINP

[Size] 1 byte (bit type)
[Standard value] 1 for SVFP only

IINP Specifies whether to make in-position check when the torque is limited, as follows:
0 : In-position check is not made.
1 : In-position check is made.

NOTE
This parameter is valid, when parameter No.0108 is not 0 and IEBL = 1.

IALM Specifies whether to check for a stop- and movement-time excessive error when the torque is limited, as follows:
0 : An error check is not made.
1 : An error check is made.

NOTE
This parameter is valid, when parameter No.0108 is not 0 and IEBL = 1.

IEBL Specifies whether to enable the torque limit function, as follows:
0 : Disabled.
1 : Enabled.

ZMIX Specifies the initial direction of backlash and grid movement in a reference position return without dogs, as follows:
0 :Positive direction
1 :Negative direction

ECMR Specifies whether to enable expansion of the setting range for the command multiplier, as follows:
0 : Disabled. (The setting of parameter No. 032 is valid for the command multiplier.)
1 : Enabled. (The setting of parameter No. 138 is valid for the command multiplier.)

SVFP Specifies whether to perform follow-up, as follows:
0 : Follow-up is not performed.
1 : Follow-up is performed.

No.	#7	#6	#5	#4	#3	#2	#1	#0
011	APCX	MVZPFR				DZRN	SZRN	ABSX

[Size] 1 byte (bit type)
[Standard value] 1 only for APCX

ABSX Indicates whether the absolute position detector has been associated with the machine position, as follows:
0 : Has not been associated
1 : Has been associated

SZRN Specifies the type of positioning to a grid to be performed for a manual reference position return if the feed axis and direction selection signal (+X, -X, or I/O link signal from the host) is 1 for reference position return without dogs, as follows:
0 : Positioning to a grid is performed only once.
1 : Positioning to a grid is performed each time the feed axis and direction selection signal becomes 1.

DZRN Specifies whether the reference position return function with dogs is valid, as follows:
0 : Invalid. (The reference position return function without dogs is selected.)
1 : Valid

⚠ CAUTION
When DZRN = 1, the high-speed interlock signal (*RILK) is invalid.

MVZPFR On a rotation axis where the absolute-position detector is used, when the reference position is updated and the value of the amount of movement has a fractional part:
0 : The reference position is updated, making allowance for the fractional part.
1 : The reference position is updated, without making allowance for the fractional part.

NOTE
Set this parameter to 1 only when a rotation axis uses the absolute-position detector, and a positional error may occur, as described in the notes on parameter No. 032. Otherwise, this parameter must be set to 0.

LIMITATIONS

When this parameter is used, the limits below are imposed on the settings of the amount of movement per rotation axis revolution (parameter No. 141), command multiplier (CMR) (parameter No. 032), and denominator for the number of pulses per motor revolution (SDMR2) (parameter No. 106). If any of the limits is exceeded, this parameter cannot be used.

Amount of movement per rotation axis revolution (parameter No. 141) $\times$ K $\times$ Denominator for the number of pulses per motor revolution (parameter No. 106) $\leq 2^{47} - 1$

where

$$K = \frac{\text{User-specified unit}}{\text{Detection unit}}$$

- When $K \geq 1$, CMR = $2 \times K$ ($1 \leq K \leq 48$).
  (When expanded CMR (parameter No. 138) is used, however, $1 \leq K \leq 200$.)
- When $K < 1$, CMR = $1/K + 100$ ($1/2 \leq K \leq 1/27$).
  If $K \geq 1$, the above conditional expression applies. If $K < 1$, the conditional expression does not require the K term, and is set as follows.
  Amount of movement per rotation axis revolution (parameter No. 141) $\times$ Denominator for the number of pulses per motor revolution (parameter No.106) $\leq 2^{47} - 1$

APCX Indicates whether a detector for an absolute pulse coder is available.
0 :Unavailable
1 :Available

No.	#7	#6	#5	#4	#3	#2	#1	#0
012							DGPR	

[Size] 1 byte (bit type)
[Standard value] 0

DGPR Specifies whether to set motor-specific servo parameters when the power is switched on.
0 : Set.
1 : Do not set.

After a motor type (parameter No. 30) is specified, resetting this bit to 0 automatically sets up the standard values for the motor when the power is turned on. At the same time, the bit is set to 1 again.

No.	#7	#6	#5	#4	#3	#2	#1	#0
016			FFAL	FFVL			LVMD	PIIP

[Size] 1 byte (bit type)
[Standard value] 0

PIIP 0 : Specifies that the velocity loop be subject to PI control.
1 : Specifies that the velocity loop be subject to IP control.

LVMD 0 : Disables the low-velocity integration function.
1 : Enables the low-velocity integration function.

FFVL, FFAL Specify whether to enable the feed-forward function.

The feed-forward function is enabled only when FFVL and FFAL are 1.

FFVL	FFAL	Description
1	1	The feed-forward function is enabled.
0	*	The feed-forward function is disabled regardless of whether FFAL is 1.
1	0	The feed-forward function is disabled.

No.	#7	#6	#5	#4	#3	#2	#1	#0
017						SPCO	HEDG	HENB

[Size] 1 byte (bit type)
[Standard value] 0

HENB Specifies whether to use the skip function.
0 : The skip function is not used.
1 : The skip function is used.

HEDG When a skip signal is used with the skip function:
0 : The skip signal is handled as an input signal on the rising edge (0 → 1).
1 : The skip signal is handled as an input signal on the falling edge(1 → 0).

SPCO During execution of the skip function, if a skip signal (HDI) is not input and the end point is reached:
0 : The data on the last skip measurement is retained.
1 : Specified coordinates of the end point are recorded as skip measurement data.

No.	#7	#6	#5	#4	#3	#2	#1	#0
018				TIM1	TIM0	VCMD0		

[Size] 1 byte (bit type)
[Standard value] 0

VCMD0 The quick stop function is:
0 : Disabled.
1 : Enabled.

TIM1,0 Setting of the MCC off timer
The delay time from the time an emergency stop signal is input until MCC is turned off can be selected with a combination of TIM1 and TIM0. If VCMD0 is 0, the setting is invalid. Usually set it to 60 ms. If a sufficient effect cannot be obtained, set it to 100 ms.

Delay time	TIM1	TIM0
0ms	0	0
60ms	1	0
100ms	1	1

NOTE
1 It is not possible to set a delay time of 100 ms or greater by mounting an additional external timer as in the αi series servo amplifier.
2 Do not turn an emergency stop OFF/ON instantaneously.
3 The timer on the amplifier operates in conjunction with *ESP on connector CX30 or CXA19B. It does not operate only with an emergency stop signal on the FANUC I/O Link between the host and a servo amplifier.

No.	
030	**Set 0. Set the motor type number in parameter No. 125.**

Set parameter No. 030 to 0, and set the motor type number in parameter No. 125.

No.	
031	**Direction of motor rotation (DIRCTL)**

[Size] 1 byte
[Standard value] 111
The direction of motor rotation is specified, as follows:
111: Normal connection (clockwise rotation as viewed from the detector side)
-111: Reverse connection (counterclockwise rotation as viewed from the detector side)

No.	
032	**Command multiplier (CMR)**

[Size] 1 byte
[Valid data range] 2 to 96, 102 to 127

NOTE
Only even numbers in the range of 2 to 96 can be set.

[Standard value] 2

This parameter is used to set up a ratio of the user-specified unit to the detection unit.
Let K be the user-specified unit divided by the detection unit, then enter:

$CMR = 2 \times K$ if $K \geq 1$
$CMR = 1/K + 100$ if $K < 1$

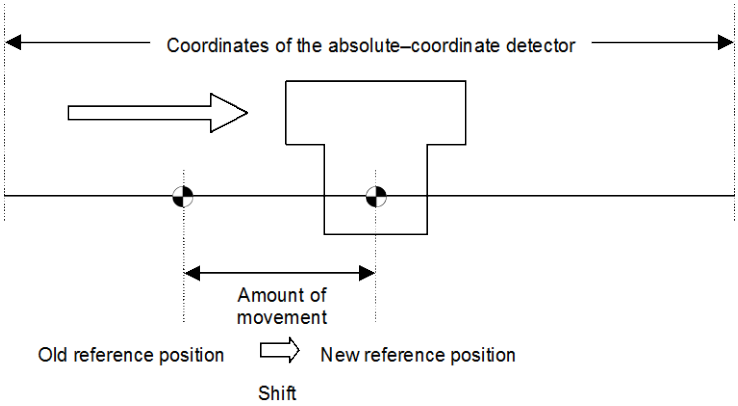
where K is a value from 1 to 48 or from 1/2 to 1/27.

Example 1)
If the least command increment is 10 μm, and the detection increment is 5 μm:
CMR＝10/5×2＝4

Example 2)
If the least command increment is 10 μm, and the detection increment is 20 μm:
CMR = 1/(1/2) + 100 = 102
because K = 10/20 < 1

⚠ **CAUTION**

On an axis where the absolute-position detector is used, the reference position is stored using the coordinates of the absolute-position detector. On a rotation axis, to preserve the positional relationship between the coordinates of the absolute-position detector and the reference position, the coordinates of the absolute-position detector that correspond to the reference position must be shifted each time movement is performed by the amount of movement per rotation axis revolution specified for position parameter No. 141. (See the figure below.)



Because the reference position is stored using the coordinates of the absolute-position detector, the reference position is shifted in the absolute-position detector pulse units corresponding to one revolution.

The formula for converting the amount of movement per rotation axis revolution into the movement amount of the absolute-position detector (Lp) is as follows:

Lp = Amount of movement per rotation axis revolution (parameter No. 141) × K × Denominator for the number of pulses per motor revolution (parameter No. 106)$\times 2^{16}$

÷ Numerator for the number of pulses per motor revolution (parameter No. 105)

Currently, if either of the following two conditions is satisfied during the above conversion, Lp contains a fractional part. Because the servo amplifier rounds off Lp to the nearest integer value, fractional parts are accumulated if revolution in one direction continues, possibly causing a positional error the next time the power is turned on.

(Condition 1) If K is less than 1, the "amount of movement per rotation axis revolution (parameter No. 141) × K" contains a fractional part.

(Condition 2) Lp contains a fractional part.

If either of the conditions is satisfied and the use of the servo amplifier involves continuous revolution in one direction, you can set bit 6 (MVZPFR) of parameter No. 011 to 1. Even if a fractional part exists, this parameter setting makes allowance for the fractional part, and can prevent a positional error from occurring. However, you should see the description of bit 6 (MVZPFR) of parameter No. 011 because there are limitations on the use of the parameter.

NOTE
1 If K is equal to or greater than 2, servo alarm No. 405 may be issued during reference position return. In this case, set N405 (bit 4 of parameter No. 0001) to "1" to prevent the alarm from being issued.
2 When K > 48, bit 6 (ECMR) of parameter No. 010 to 1, and set the expanded command multiplier (EXCMR) in parameter No. 138. Up to 200 can be specified for K.

No.	
064	Peak hold time for motor current values and servo positional deviation amounts

[Size] 2-byte
[Unit of data] sec
[Valid data range] 0 to 60000
[Standard value] 0

Set a peak hold time for motor current values and servo positional deviation amounts for DGN numbers 040 to 045.
When the peak hold value is not updated for a set time, a new peak hold value is obtained from a real-time value and the set value is replaced with the new value.
If a value of 0 is set, DGN numbers 040 to 045 are invalid.

NOTE
Set 0 if DGN numbers 040 to 045 are not used.

No.	
070	Current loop gain (PK1)

[Size] 2-byte
[Valid data range] 1 to 32767
Do not change the standard setting.

No.	
071	Current loop gain (PK2)

[Size] 2-byte
[Valid data range] -1 to -32768
Do not change the standard setting.

No.	
072	Current loop gain (PK3)

[Size] 2-byte
[Valid data range] -1 to -32768
Do not change the standard setting.

No.	
073	Velocity loop gain (PK1V)

[Size] 2-byte
[Valid data range] 1 to 32767

No.	
074	Velocity loop gain (PK2V)

[Size] 2-byte
[Valid data range] -1 to -32768

No.	
075	Velocity loop gain (PK4V)

[Valid data range] -1 to -32768
Do not change the standard setting.

No.	
078	Current compensation 1 (PVPA)

[Size] 2-byte
[Valid data range] -1 to -32768
Do not change the standard setting.

No.	
079	Current compensation 2 (PALPH)

[Size] 2-byte
[Valid data range] -1 to -32768
Do not change the standard setting.

No.	
080	Current limit value (TQLIM)

[Size] 2-byte
[Valid data range] 0 to 7282
Do not change the standard setting.

No.	
081	Overload protection coefficient (POVC1)

[Size] 2-byte
[Valid data range] 0 to 32767
This is a coefficient for an alarm used to protect the motor and servo amplifier from overload.
Do not change the standard setting.

No.	
082	Overload protection coefficient (POVC2)

[Size] 2-byte
[Valid data range] 0 to 32767
This is a coefficient for an alarm used to protect the motor and servo amplifier from overload.
Do not change the standard setting.

No.	
083	Overload protection coefficient (POVCLM)

[Size] 2-byte
[Valid data range] 0 to 32767
This is a coefficient for an alarm used to protect the motor and servo amplifier from overload.

Do not change the standard setting.

No.	
084	Current compensation 3 (AALPH)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
085	Actual current limit (DBLIM)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
086	Current compensation 4 (MGSTCM)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
087	Current compensation 5 (DETQLM)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
088	Current compensation 6 (NINTCT)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
089	Current compensation 7 (MFWKCE)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
090	Current compensation 8 (MFWKBL)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
091	VCMD polyline speed (P_VCLN)

[Size] 2-byte
[Unit of data] 0.01min^{-1}
[Valid data range] 0 to 32767
Setting the parameter to a positive value enables the VCMD polyline function.
If the actual speed of the motor is lower than the speed specified in this parameter, the position loop gain is doubled, thus accelerating positioning.

No.	
092	Low-speed integration threshold speed (P_LVIN)

[Size] 2-byte
[Unit of data] $0.01min^{-1}$
[Valid data range] 0 to 32767
When the low-velocity integration function is enabled, and an actual motor speed becomes higher than the speed set with this parameter, the integration term of the velocity loop becomes 0.

No.	
093	Estimated load torque: torque offset compensation

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] -7282 to 7282 (7282 is the maximum current value of the amplifier)
The setting is added to an estimated load torque, thereby eliminating an effect of stationary torque including gravity.

No.	
094	Estimated load torque: dynamic friction compensation coefficient

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] 0 to 7282 (7282 is the maximum current value of the amplifier)
[Setting value] An estimated load torque at 1000 min^{-1} is measured and set.
The compensation proportional to the speed is added to the estimated load torque, thereby eliminating an effect of dynamic friction.

No.	
095	Unexpected disturbance torque detection: retract distance

[Size] 2-byte
[Unit of data] Detection unit
[Valid data range] 0 to 65535
[Setting value] Set approximately 3 mm.

No.	
096	Unexpected disturbance torque detection: alarm threshold value

[Size] 2-byte
[Unit of data] Torque command unit
[Valid data range] 0 to 7282 (7282 is the maximum current value of the amplifier)
Set a limit (threshold) value at which an unexpected disturbance torque detection alarm is issued. If the setting is 0, processing for unexpected disturbance torque detection is disabled, and alarm detection and calculation of an estimated load torque are not performed.
First set bit 1 (TDOU) of parameter No. 014 to 1 (bit 0 of parameter No.014 must be 0), and observe load torque. Then, set parameter No. 096 to a value greater than the maximum torque value.

No.	
099	Current compensation 9 (EMFCMP)

[Size] 2-byte
[Valid data range] -32768 to 32767
Do not change the standard setting.

No.	
100	Load inertia ratio (LDINT)

[Size] 2-byte
[Valid data range] 0 to 32767
[Setting value] The standard setting range is 0 to 1024.
This parameter specifies the ratio of the machine load inertia to the motor inertia using a value calculated with the following formula as a guideline:

$$\text{Load inertia ratio} = \frac{\text{Machine load inertia}}{\text{Motor inertia}} \times 256$$

Setting this value causes speed loop gains PK1V and PK2V to be multiplied by: 1+ LDINT/256
Setting the parameter to a larger value makes response to speed commands quicker and servo rigidity higher. If the parameter is set to an excessively large value, the servo system may vibrate, and noise may arise, during machine movement.
Usually, the parameter should not be set to more than 500.
If the machine vibrates at a high frequency, the torque command filter parameter (No.102) can be used to solve this.

No.	
101	Acceleration feedback (PK2VAUX)

[Size] 2-byte

This parameter can be used to suppress vibration. If used, it should be set to a value from -10 to -20.

No.	
102	Torque command filter (FILTER)

[Size] 2-byte
[Valid data range] 0 to 2500
[Standard value] 0
This parameter can be used to remove the high-frequency noise induced by a torque command. If the machine vibrates at a high frequency, the use of this parameter may suppress the vibration. The following table lists the relationships between the values specified for the parameter and the corresponding cut-off frequencies.

Cut-off frequency (Hz)	Parameter value
200	1166
150	1596
100	2185
80	2478

The lower the cut-off frequency (the larger the parameter-specified value), the stronger the filter effect. Specifying a filter with an excessively strong effect leads to unstable position control.
First, try a 150 Hz filter (set the parameter to 1596). If this does not suppress high-frequency vibration effectively, increase the parameter value by about 200 and note the effect. Repeat this until the desired effect is obtained, but do not exceed 2500.

No.	
103	Feed-forward coefficient (FALPH)

[Size] 2-byte
[Unit of data] %

[Valid data range] 0 to 100
[Standard value] 0
This is a feed-forward coefficient parameter. 100 specified in the parameter corresponds to a coefficient of 1 (100%).

No.	
104	Velocity feed-forward coefficient (VFFLT)

[Size] 2-byte
[Valid data range] 0 to approximately 400
[Standard value] 0
This is a velocity feed-forward coefficient parameter. For a motor with no load, 100 specified in the parameter corresponds a coefficient of 1 (100%).
If a load inertia is added, set the parameter to a proportionally larger coefficient.

Example)
If the load inertia is doubled:
To set velocity feed-forward to 100%: 100 × (1 + 2) = 300
To set velocity feed-forward to 50%: 50 × (1 + 2) = 150

No.	
105	Numerator for the number of pulses per motor revolution (SDMR1)

[Size] 2-byte
[Valid data range] 0 to 32767
[Standard value] 10000
This parameter specifies the number of pulses per motor revolution for a detection increment, together with parameter No. 106. To be specific, this parameter is used as a numerator.

NOTE
To set the number of pulses per motor revolution to a value greater than 32767, set this parameter to 0, and specify that number in parameter No. 179. Up to 8388607 pulses can be specified.

No.	
106	Denominator for the number of pulses per motor revolution (SDMR2)

[Size] 2-byte
[Valid data range] 1 to 32767
[Standard value] 1
This parameter is used as a denominator for the number of pulses per motor revolution detection increment.
The number of pulses (after CMR) per motor revolution is represented as:

$$\frac{\text{(No. 0105)}}{\text{(No. 0106)}}$$

If the number of pulses per motor revolution is an integer, set parameter No. 0106 to 1.
Example 1)
If a detection increment is set to 1μ in a 10 mm/revolution ball screw machine:
Set parameter No. 105 to 10000, and parameter No. 106 to 1, because the number of pulses per motor revolution is
10 mm/1μ = 10000.
Example 2)
If the detection increment is 0.1° for a motor coupled directly to the rotation axis:
Set parameter No. 105 to 360°, and parameter No. 106 to 1, because the number of pulses per motor revolution is

360° /0.1° = 3600.

NOTE

If the number of pulses per motor revolution (parameter No. 105/parameter No. 106) is remarkably small, a position gain overflow occurs, issuing an illegal parameter setting alarm (417). Check that the number of pulses per motor revolution is greater than the applicable lower limit given in the table below.

Value set for the position gain (No.0107)	Lower limit on the number of pulses per motor revolution
20	41
30	62
40	82

Formula) (Position gain)/(Number of pulses per motor revolution) < 0.488

If the number of pulses per motor revolution is below the applicable lower limit, increase the number of pulses per motor revolution to the lower limit or above, using the procedure below. In this case, the user unit is equal to 1/E and, therefore, the other parameters set with the user unit must be multiplied by E.

(Procedure)

Multiply CMR and the number of pulses per revolution by integer value E, so that the number of pulses per revolution is greater than the lower limit.

No. 032×E

No. 105×E ≥ Lower limit

(Setting example)

If the position gain (parameter No. 107) is 30, CMR (parameter No. 32) is 2, and the number of pulses per motor revolution (Nos. 105 and 106) is 50/1, the lower limit is 62, causing an overflow to occur. Multiply CMR and the denominator for the number of pulses per motor revolution (No. 105) by two to change parameter 32 to 4 and parameter 105 to 100. (The user unit becomes 1/2.)

No.	
107	**Position loop gain (LPGINX)**

[Size] 2-byte
[Valid data range] 1 to 32767
[Standard value] 30

This parameter is related to a position loop time constant. The larger the value set for this parameter, the more quickly the NC responds to commands, and the less time is required for positioning. If the parameter is set to an excessively large value, however, hunting (at 5 to 15 Hz) may occur during movement, or overshoot may occur at a stop. Setting parameter No. 100 (load inertia ratio) to a larger value increases the range of the position loop gain values that can be set up.

No.	
108	**Servo motor torque limit**

[Size] 2-byte
[Valid data range] 0 to 7282
[Standard value] 0

Applying a torque limit to the servo motor enables positioning in reference to a mechanical stopper. Setting bit 2 of parameter No. 010 (IEBL) validates a torque limit based on this parameter. If 0 is specified for this parameter, 100% (7282) is assumed. Calculate the necessary setting, using:

$$\text{Value in parameter No. 108} = \text{torque limit value [\%]} \times \frac{7282}{100}$$

NOTE
This parameter is invalid during velocity control. To limit the torque during peripheral equipment control, use type B (bit 4 (VCTLB) of parameter No. 007 is 1).

No.	
109	Backlash amount (BKLCMP)

[Size] 2-byte
[Unit of data] User-specified unit
[Valid data range] 0 to 32767(Detection unit)
[Standard value] 0
The parameter sets up a backlash amount (User unit). The range will be in the detection increment resulting from multiplying the user unit by the command multiplier (parameter No. 032).

No.	
110	Positional deviation limit value at a stop

[Size] 2-byte
[Valid data range] 0 to 32767
[Standard value] 500
This parameter sets a positional deviation limit value used when the motor is at a stop (detection increment). Alarm 410 is raised if the positional deviation limit is exceeded when the motor is at a stop.

No.	
111	In-position width

[Size] 2-byte
[Valid data range] 0 to 32767
[Standard value] 10
If the positional deviation becomes lower than the value specified in this parameter after the related block ends, an in-position signal is returned to the host.

No.	
112	Torque constant

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
115	Model constant

[Size] 2-byte
[Valid data range] 0 to 32767
Normally, the standard setting need not be changed. The setting should be adjusted only when an estimated load torque is correctly calculated during use of the unexpected disturbance torque detection function.

No.	
116	Velocity loop gain override during velocity control (%)

[Size] 2-byte
[Standard value] 0 (overriding not performed)
Set this parameter if the system is switched between position control and velocity control.

When the system enters velocity control mode, the velocity loop proportional gain and the integral gain that are used in position control are multiplied by the above override.
The relationships among the velocity loop proportional gain, integral gain, load inertia ratio, and the velocity loop gain override during velocity control are explained using the following example:
Assume the following:
Integral gain = 100
Proportional gain = -500
Load inertia ratio = 128
Velocity loop gain override during velocity control = 200%
[Gain during position control]
Integral gain = 100 × (1+128/256) = 150
Proportional gain = -500 × (1+128/256) = -750
[Gain during velocity control]
Integral gain = 100 × (1+128/256) 200/100 = 300
Proportional gain = -500 × (1+128/256) 200/100 = -1500
Thus, the gain with the load inertia ratio taken into consideration is multiplied by the gain override during velocity control.

No.	
118	Current compensation 10 (PHDLY1)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
119	Current compensation 10 (PHDLY2)

[Size] 2-byte
[Valid data range] 0 to 32767
Do not change the standard setting.

No.	
125	Motor type number

[Size] 2-byte
[Valid data range] 1 to 350
Set the type number of a motor to use.
Ensure that parameter No.30 is 0.

The models, drawing numbers, and type numbers of the motors that can be used with the β*i* SV-B are listed below. For an edition with "-" in the table, automatic loading of the standard parameters is not supported. Manually enter the standard parameters listed in Section B.7.

β*i*SV 4-B

Motor model	β*i*S0.2/5000	β*i*S0.3/5000
Motor specification	0111	0112
Motor type number	260	261
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later

βiSV 20-B

Motor model	αiF1/5000	βiS2/4000	αiF2/5000	βiS4/4000	βiS8/3000
Motor specification	0202	0061	0205	0063	0075
Motor type number	252	253	255	256	258
Edition Corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/5000	αiS4/5000	βiS12/2000	αC4/3000i	αC8/2000i
Motor specification	0212	0215	0077	0221	0226
Motor type number	262	265	269	271	276
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS0.4/5000	βiS0.5/6000	βiS1/6000	αiS2/6000	αC12/2000i
Motor specification	0114	0115	0116	0218	0241
Motor type number	280	281	282	284	291
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS4/6000	βiF4/3000	βiF8/2000	βiF12/2000	
Motor specification	0210	0051	0052	0053	
Motor type number	466	483	485	487	
Edition corresponding to the 88A7 series	Edition 01 or later	-	-	-	

βiSV 40-B

Motor model	βiS12/3000	αiF4/4000	βiS22/2000	αiF8/3000	αC22/2000i
Motor specification	0078	0223	0085	0227	0246
Motor type number	272	273	274	277	296
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiF22/2000				
Motor specification	0054				
Motor type number	489				
Edition corresponding to the 88A7 series	-				

βiSV 80-B

Motor model	αiS8/4000	αiS12/4000	αiS8/6000	αiF12/3000	αiF22/3000
Motor specification	0235	0238	0232	0243	0247
Motor type number	285	288	290	293	297
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αC30/1500i	βiS22/3000	βiS30/2000	βiS40/2000	βiF30/1500
Motor specification	0251	0082	0087	0089	0055
Motor type number	301	313	472	474	491
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	-
Motor model	βiF8/4000				
Motor specification	0228				
Motor type number	492				
Edition corresponding to the 88A7 series	-				

βiSV 10 HV-B

Motor model	βiS2/4000HV	αiS2/5000HV	βiS4/4000HV	αiS4/5000HV	βiS8/3000HV
Motor specification	0062	0213	0064	0216	0076
Motor type number	251	263	264	266	267
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/6000HV	αiS4/6000HV			
Motor specification	0219	0214			
Motor type number	287	467			
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later			

βiSV 20 HV-B

Motor model	βiS12/3000HV	αiF4/4000HV	βiS22/2000HV	αiF8/3000HV	
Motor specification	0079	0225	0086	0229	
Motor type number	270	275	278	279	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	

βiSV 40 HV-B

Motor model	αiS8/4000HV	αiS12/4000HV	αiS8/6000HV	αiF12/3000HV	αiF22/3000HV
Motor specification	0236	0239	0233	0245	0249
Motor type number	286	289	292	295	299
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS22/3000HV	βiS30/2000HV	βiS40/2000HV	αiF8/4000HV	
Motor specification	0083	0088	0090	0220	
Motor type number	314	473	475	493	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	-	

No.	
130	**Unexpected disturbance torque detection alarm timer**

[Size] 2-byte
[Unit of data] msec
[Valid data range] 0 to 32767 (200 msec if 0 is set)

Set the time from when an unexpected disturbance torque is detected to when a servo alarm is issued. A fraction smaller than 8 msec is rounded up.

Example) Setting of 30: assumed to be 32 msec

No.	
135	**Linear acceleration/deceleration time constant for velocity control**

[Size] 2-byte
[Unit of data] ms
[Valid data range] 8 to 4000

Specify the time required to reach 4000 min^{-1}.

Example)

If the value specified for velocity is 2000 min^{-1}, and the time required to reach 2000 min^{-1} is to be 1000 msec, the value to be set is calculated as follows:

Value to be set = (4000/2000) × 1000 = 2000

No.	
135	Linear acceleration/deceleration time constant for velocity control

[Size] 2-byte
[Unit of data] min^{-1}
[Valid data range] 0 to 4000
[Standard value] 0 (velocity deviation check not performed)

Set the limit on the velocity deviation check to be performed in velocity control mode.
In velocity control mode, alarm No. 447 is issued if the deviation of the actual velocity from the specified velocity exceeds the value set for this parameter.

No.	
137	Effective are for in-position check during cutting feed

[Size] 2-byte
[Valid data range] 0 to 32767
[Standard value] 10

Set an effective area for in-position check during cutting feed.
This parameter is valid when bit 3 (CIPC) and bit 7 (CSMZ) of parameter No.002 are 1, and RPD is 0 and SMZX is 1 for function code 0x61 or 0x62.

No.	
138	Expanded command multiplier (EXCMR)

[Size] 2-byte
[Valid data range] 2 to 400
[Standard value] 0

Specify a ratio of the user-specified unit to the detection unit.

$$K = \frac{\text{User-specified unit}}{\text{Detection unit}} \quad (K \geq 1)$$

$$EXCMR = 2 \times K$$

Enter an EXCMR value according to the above formula. Note that K can be a value of 1 to 200.

NOTE
1 Always set an even number for EXCMR.
2 When K < 1, set bit 6 (ECMR) of parameter No. 010 to 0, and set the command multiplier in parameter No. 032.
3 See the notes on parameter No. 032 because they are also related to this parameter.
4 When bit 6 (ECMR) of parameter No. 010 is 1, read parameter No. 032 in this manual as parameter No. 138.

No.	
179	Numerator for the number of pulses per motor revolution

[Size] 4-byte
[Valid data range] 0 to 8388607
[Standard value] 0

For the numerator for the number of pulses per motor revolution, the setting of parameter No. 179 is valid when parameter No. 105 is 0. When parameter No. 105 is a nonzero value, the value of parameter No. 105 is valid.
For the denominator for the number of pulses per motor revolution, the setting of parameter No. 106 is always valid.

NOTE

1 If parameter No. 105 is 0 and parameter No. 179 is greater than 8388607, an illegal parameter setting alarm (417) is issued.
2 If parameter No. 105 is 0 and parameter No. 179 is smaller than parameter No. 106, an illegal parameter setting alarm (417) is issued.
3 See the notes on parameter No.105 because they are also related to this parameter.
4 When this parameter is valid (parameter No. 105 is 0), read parameter No. 105 in this manual as parameter No. 179.

No.	
180	Reference counter capacity

[Size] 4-byte
[Valid data range] 1 to 99999999
[Standard value] 10000

This parameter specifies a reference counter capacity.
Reference counter capacity = number of pulses per motor revolution (detection increment)

No.	
181	Grid shift amount

[Size] 4-byte
[Valid data range] 0 to ±99999999
[Standard value] 0

A grid position can be shifted by the amount specified in this parameter so that the reference position can be shifted. The unit of shift is a detection increment. The maximum grid shift amount that can be specified is half or less than the reference counter capacity.

No.	
182	Positional deviation limit value during movement

[Size] 4-byte
[Valid data range] 0 to 99999999
[Standard value] 3333

This parameter specifies a positional deviation limit value used when the motor is rotating. Alarm No. 411 is raised, if this value is exceeded, leading to deceleration and stop.

B.7 DIGITAL SERVO STANDARD PARAMETER TABLE

Symbol	Motor model Motor specification Motor ID No.	βiS 2 4000HV 251	αiF 1 5000 0202 252	βiS 2 4000 0061 253	αiF 2 5000 0205 255	βiS 4 4000 0063 256	βiS 8 3000 0075 258	βiS 0.2 5000 0111 260	βiS 0.3 5000 0112 261
	19	00001100	00001000	00001100	00001000	00001100	00001100	00000000	00000000
PK1	70	348	620	360	760	400	650	123	210
PK2	71	-1676	-3034	-1920	-3743	-1920	-3831	-510	-970
PK3	72	-1232	-1256	-1237	-1283	-1253	-1299	-1069	-1146
PK1V	73	76	64	76	74	109	160	4	4
PK2V	74	-683	-580	-681	-664	-984	-1441	-35	-32
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-10250	0	-10250	-12298	-7694	-5140	0	0
PALPH	79	-1000	0	-1000	-1275	-2800	-3200	0	0
TQLIM	80	6554	7282	6554	7282	7282	7282	7282	7282
POVC1	81	32655	32692	32652	32635	32532	32385	32583	32583
POVC2	82	1411	948	1455	1664	2945	4788	2312	2312
POVCLMT	83	4189	2812	4317	4941	8758	14271	6869	6869
AALPH	84	20480	20480	16384	12288	20480	16384	20480	20480
DBLIM	85	0	0	0	0	0	0	0	0
MGSTCM	86	1048	32	1048	32	780	1807	1	1
DETQLM	87	11600	10260	11600	10280	7790	7930	7710	7700
NINTCT	88	2345	1188	1172	1276	796	1442	379	852
MFWKCE	89	1000	1667	2500	2000	3000	3500	0	3000
MFWKBL	90	3358	3858	3358	3862	3392	1298	0	3880
EMFCMP	99	0	-5130	0	-10	0	-2570	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	119	72	119	109	146	226	7	14
MDLCST	115	1850	1088	1856	951	1284	877	18132	19686
PHDLY1	118	7192	7690	7192	7693	8992	3858	7700	7695
PHDLY2	119	8990	12840	8990	12840	12864	8990	12825	12840

Symbol	Motor model Motor specification Motor ID No.	αiS 2 5000 262	αiS 2 5000HV 0213 263	βiS 4 4000HV 0064 264	αiS 4 5000 0215 265	αiS 4 5000HV 0216 266	βiS 8 3000HV 0076 267	βiS 12 2000 0077 269	βiS 12 3000HV 0079 270
	19	00001000	00001000	00001100	00001000	00001000	00001100	00001100	00001100
PK1	70	530	400	331	420	425	605	547	427
PK2	71	-2543	-2312	-1560	-1748	-1641	-3028	-3289	-2301
PK3	72	-1251	-1251	-1246	-1276	-1266	-1300	-1305	-1302
PK1V	73	38	38	109	63	63	162	225	166
PK2V	74	-341	-342	-986	-560	-560	-1447	-2005	-1488
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-10250	-10252	-7694	-8974	-10262	-5140	-3884	-5140
PALPH	79	-2000	-1600	-2800	-3641	-3300	-3200	-4350	-3500
TQLIM	80	7282	7282	7282	7282	7282	7282	7282	7282
POVC1	81	32650	32652	32537	32373	32373	32381	32284	32492
POVC2	82	1475	1450	2885	4942	4942	4834	6045	3445
POVCLMT	83	4379	4303	8577	14731	14731	14409	18045	10249
AALPH	84	20480	16384	20480	12288	8192	20480	8192	20480
DBLIM	85	0	0	0	0	0	0	0	0
MGSTCM	86	32	40	780	8	40	1807	1	1814
DETQLM	87	8995	10260	7790	10295	10260	7930	3940	7930
NINTCT	88	1137	4548	1592	646	1293	2885	1350	2388
MFWKCE	89	1000	1250	500	1667	3000	1000	4000	3000
MFWKBL	90	3851	3847	3339	3847	5122	1298	280	2056
EMFCMP	99	0	0	0	0	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	117	117	146	127	127	225	315	420
MDLCST	115	1844	1842	1280	1127	1127	872	630	848
PHDLY1	118	7690	7690	8972	7690	7685	3848	3614	5138
PHDLY2	119	12840	12850	12816	12840	12850	8990	8980	6430

Symbol	Motor model / Motor specification / Motor ID No.	αC 4 3000i 271	βiS 12 3000 0078 272	αiF 4 4000 0223 273	βiS 22 2000 0085 274	αiF 4 4000HV 0225 275	αC 8 2000i 0226 276	αiF 8 3000 0227 277	βiS 22 2000HV 0086 278
	19	00001000	00001100	00000000	00001100	00001000	00001000	00000000	00001100
PK1	70	1240	402	993	1184	570	1276	787	1446
PK2	71	-6415	-2217	-4260	-6800	-3578	-6288	-4184	-5822
PK3	72	-1309	-1304	-1311	-1331	-1309	-1326	-1325	-1332
PK1V	73	113	166	104	236	110	146	110	238
PK2V	74	-1009	-1494	-931	-2121	-985	-1310	-985	-2130
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-5915	-5140	-11789	-3612	0	-3854	-6420	-3612
PALPH	79	-1500	-3500	-180	-3000	0	-1236	-2000	-3000
TQLIM	80	7282	7282	8010	7282	7282	7282	8010	7282
POVC1	81	32590	32491	32610	32428	32591	32434	32579	32430
POVC2	82	2225	3465	1979	4249	2216	4170	2363	4227
POVCLMT	83	6612	10311	5879	12656	6583	12420	7020	12588
AALPH	84	12288	16384	8192	16384	12288	8192	8192	8192
DBLIM	85	0	0	15000	0	0	0	15000	0
MGSTCM	86	1289	1814	32	0	1032	1552	776	0
DETQLM	87	3900	7930	5130	2866	0	3880	3870	2866
NINTCT	88	2544	1194	1443	2459	2573	2380	2103	5149
MFWKCE	89	5000	3000	2000	5000	4000	4500	3500	3000
MFWKBL	90	1812	2056	3338	562	3348	1550	1815	562
EMFCMP	99	0	0	-5130	-5130	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	190	418	201	692	190	277	369	689
MDLCST	115	626	845	678	596	641	482	641	593
PHDLY1	118	3855	5138	6670	3350	5130	3860	0	3352
PHDLY2	119	8995	8990	8980	8979	8990	8990	0	8989

Symbol	Motor model / Motor specification / Motor ID No.	αiF 8 3000HV 279	βiS 0.4 5000 0114 280	βiS 0.5 6000 0115 281	βiS 1 6000 0116 282	αiS 2 6000 0218 284	αiS 8 4000 0235 285	αiS 8 4000HV 0236 286	αiS 2 6000HV 0219 287
	19	00001000	00000000	00001000	00001000	00001000	00001000	00001000	00001000
PK1	70	1222	100	138	312	552	550	694	497
PK2	71	-5890	-430	-673	-1360	-2288	-3449	-3858	-2371
PK3	72	-1322	-2463	-1205	-1203	-1252	-1307	-1318	-1249
PK1V	73	110	7	6	6	47	32	33	47
PK2V	74	-984	-59	-57	-51	-419	-287	-298	-419
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-6159	0	0	-15114	-13062	-7685	-7685	-13062
PALPH	79	-1261	0	0	-1200	-1000	-2000	-2000	-1200
TQLIM	80	8010	4660	5826	6554	7282	7282	7282	7282
POVC1	81	32579	32640	32674	32695	32595	32690	32683	32595
POVC2	82	2358	1603	1178	915	2168	978	1056	2164
POVCLMT	83	7007	4759	3497	2714	6441	2901	3134	6430
AALPH	84	12288	20480	20480	20480	20480	0	8192	20480
DBLIM	85	0	0	0	0	0	0	0	0
MGSTCM	86	782	30	25	1556	1555	519	519	1555
DETQLM	87	0	10290	10290	10290	11550	7268	7268	11550
NINTCT	88	4191	400	504	881	1137	2106	5103	2302
MFWKCE	89	6000	0	0	1500	3000	4000	4500	2200
MFWKBL	90	1810	0	0	5135	4112	2580	2580	4112
EMFCMP	99	0	-12850	-12850	-12850	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	369	22	42	89	96	562	541	96
MDLCST	115	642	10651	11014	12232	1507	2197	2113	1507
PHDLY1	118	5150	7690	7690	15400	7690	5150	5150	7690
PHDLY2	119	8990	12820	12820	12840	7740	8990	8990	7740

Symbol	Motor model	αiS 12	αiS 12	αiS 8	αC 12	αiS 8	αiF 12	αiF 12	αC 22
		4000	4000HV	6000	2000i	6000HV	3000	3000HV	2000i
	Motor specification		0239	0232	0241	0233	0243	0245	0246
	Motor ID No.	288	289	290	291	292	293	295	296
	19	00001000	00001000	00001000	00000000	00001000	00000000	00000000	00001000
PK1	70	570	783	460	1875	381	1701	1200	2320
PK2	71	-3358	-4294	-1760	-9137	-1749	-6391	-6059	-10593
PK3	72	-1319	-1333	-1305	-1339	-1305	-1315	-1339	-1347
PK1V	73	51	51	52	273	52	188	188	264
PK2V	74	-454	-458	-466	-2445	-466	-1681	-1686	-2368
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-5898	-5898	-16398	-1804	-16398	-8199	-8203	-2597
PALPH	79	-3000	-3000	-1000	-2500	-1000	-747	-1178	-1942
TQLIM	80	7282	7282	7282	7282	7282	7282	7282	8010
POVC1	81	32653	32651	32554	32317	32554	32552	32550	32348
POVC2	82	1435	1461	2675	5644	2675	2702	2719	5248
POVCLMT	83	4259	4336	7952	16838	7952	8031	8083	15648
AALPH	84	0	8192	8192	8192	8192	8192	12288	4096
DBLIM	85	0	0	0	15000	0	15000	15000	0
MGSTCM	86	521	521	1284	0	1284	32	774	1548
DETQLM	87	6174	6159	10255	2168	10255	0	0	2600
NINTCT	88	1592	4904	801	4150	1600	2388	4787	3695
MFWKCE	89	2000	2000	1000	12000	1400	2000	4000	4000
MFWKBL	90	2575	2575	5388	1044	5390	2568	2320	1046
EMFCMP	99	0	0	0	0	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	696	690	346	350	346	517	516	680
MDLCST	115	1389	1377	1354	258	1354	376	375	267
PHDLY1	118	6174	6174	10250	5150	10260	0	0	2070
PHDLY2	119	8990	8990	12830	8990	12835	0	0	9000

Symbol	Motor model	αiF 22	αiF 22	αC 30	βiS 22	βiS 22	αiS 4	αiS 4	βiS 30
		3000	3000HV	1500i	3000	3000HV	6000	6000HV	2000
	Motor specification		0249	0251	0082	0083	0210	0214	0087
	Motor ID No.	297	299	301	313	314	466	467	472
	19	00000000	00000000	00001000	00001100	00001100	00001000	00001000	00001000
PK1	70	1750	1919	2238	1157	1146	395	432	1650
PK2	71	-6000	-9132	-13330	-5102	-5267	-1606	-1673	-6565
PK3	72	-1345	-1346	-1347	-1332	-1332	-1277	-1266	-2681
PK1V	73	194	192	162	193	188	74	75	209
PK2V	74	-1733	-1723	-1451	-1724	-1681	-662	-671	-1867
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-5136	-5136	-1545	-6174	-6174	-13326	-13326	-4647
PALPH	79	-2800	-2824	-1300	-2843	-2843	-2500	-2500	-3115
TQLIM	80	7282	7282	7282	5462	5462	7282	7282	6554
POVC1	81	32542	32545	32632	32544	32555	32437	32436	32537
POVC2	82	2820	2786	1704	2795	2659	4144	4148	2882
POVCLMT	83	8384	8283	5058	8311	7903	12340	12352	8568
AALPH	84	12288	8192	8192	12288	8192	16384	16384	8192
DBLIM	85	15000	15000	0	0	0	0	0	0
MGSTCM	86	1291	787	2059	1289	1289	3092	3092	1546
DETQLM	87	0	0	2148	7268	7268	8208	8208	4255
NINTCT	88	3272	6547	6680	1967	3894	660	1368	2095
MFWKCE	89	4500	6000	14000	6000	6000	3000	3000	3066
MFWKBL	90	1301	1808	539	2315	2315	4365	4365	1548
EMFCMP	99	0	0	0	0	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0	0
TRQCST	112	929	934	1630	848	869	104	104	1127
MDLCST	115	364	367	435	732	751	922	922	677
PHDLY1	118	0	0	1054	5647	5647	7690	7690	4110
PHDLY2	119	0	0	9000	12820	12820	12830	12830	12814

Symbol	Motor model / Motor specification / Motor ID No.	βiS 30 2000HV 473	βiS 40 2000 0089 474	βiS 40 2000HV 0090 475
	19	00001000	00001000	00001000
PK1	70	1650	1624	1624
PK2	71	-6565	-7197	-7197
PK3	72	-2681	-1341	-1341
PK1V	73	209	203	203
PK2V	74	-1867	-1826	-1826
PK4V	75	-8235	-8235	-8235
PPMAX	76	21	21	21
PDDP	77	1894	1894	1894
PVPA	78	-4647	-3375	-3375
PALPH	79	-3115	-3862	-3862
TQLIM	80	6554	6554	6554
POVC1	81	32536	32537	32537
POVC2	82	2895	2882	2881
POVCLMT	83	8608	8568	8567
AALPH	84	8192	8192	8192
DBLIM	85	0	0	0
MGSTCM	86	1546	263	263
DETQLM	87	4255	3065	3065
NINTCT	88	2095	2712	2712
MFWKCE	89	3066	3354	3354
MFWKBL	90	1548	1038	1038
EMFCMP	99	0	0	0
PK2VAUX	101	0	0	0
TRQCST	112	1127	1503	1503
MDLCST	115	675	692	692
PHDLY1	118	4110	2567	2567
PHDLY2	119	12814	8967	8967

Symbol	Motor model / Motor specification / Motor ID No.	βiF 4 3000 483	βiF 8 2000 0052 485	βiF 12 2000 0053 487	βiF 22 2000 0054 489	βiF 30 1500 0055 491	αiF 8 4000 0228 492	αiF 8 4000HV 0228 493
	19	00001000	00001000	00000000	00001000	00001000	00001000	00001000
PK1	70	1240	1276	1875	2320	2238	526	526
PK2	71	-6415	-6288	-9137	-10593	-13330	-3270	-3270
PK3	72	-1309	-1326	-1339	-1347	-1347	-1322	-1322
PK1V	73	225	293	546	529	324	88	88
PK2V	74	-2019	-2621	-4890	-4737	-2903	-788	-788
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894	1894
PVPA	78	-5915	-3854	-1804	-2597	-1545	-10007	-10007
PALPH	79	-1500	-1236	-2500	-1942	-1300	-1593	-1593
TQLIM	80	7282	7282	7282	7282	7282	7282	7282
POVC1	81	32632	32512	32373	32421	32657	32662	32662
POVC2	82	1705	3197	4942	4342	1382	1328	1328
POVCLMT	83	5062	9509	14732	12933	4100	3942	3942
AALPH	84	12288	8192	8192	4096	8192	12288	12288
DBLIM	85	0	0	15000	0	0	0	0
MGSTCM	86	1289	1552	0	1548	2059	1300	1300
DETQLM	87	3900	3880	2168	2600	2148	6500	6500
NINTCT	88	2544	2380	4150	3695	6680	1631	1631
MFWKCE	89	5000	4500	12000	4000	14000	3139	3139
MFWKBL	90	1812	1550	1044	1046	539	3089	3089
EMFCMP	99	0	0	0	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0	0
TRQCST	112	190	277	350	680	1630	461	461
MDLCST	115	626	482	258	267	435	802	802
PHDLY1	118	3855	3860	5150	2070	1054	5141	5141
PHDLY2	119	8995	8990	8990	9000	9000	8981	8981

C DIAGNOSIS LISTS

Diagnosis is carried out using the diagnosis screen of the power mate CNC manager on the host.

C.1 SIGNALS SENT FROM CNC (HOST) TO SERVO AMPLIFIER

C.1.1 Peripheral Equipment Control Interface (DRC = 0)

(DGN No.)	7	6	5	4	3	2	1	0
000	ST	UCPS2	-X	+X	DSAL	MD4	MD2	MD1
001			DRC	ABSRD	*ILK	SVFX	*ESP	ERS
002	Function code				Command data 1			
003	Command data 2							
004								
005								
006								
007	RT	DRN	ROV2 /MP2	ROV1 /MP1	*OV8	*0V4	*0V2	*0V1

C.1.2 Direct Command Interface (DRC = 1)

(DGN No.)	7	6	5	4	3	2	1	0
000	ST		-X	+X		MD4	MD2	MD1
001			DRC	WFN	*ILK	SVFX	*ESP	ERS
002	RT	DRN	ROV2	ROV1	*OV8	*OV4	*OV2	*OV1
003	INPF							
004	EBUF	EOREND						ECNT
005	Direct command (function code)							
006	Direct command (command data 1)							
007	Direct command (command data 2)							
008	Direct command (command data 3)							
009	Direct command (command data 4)							
010	Direct command (command data 5)							
011	Direct command (command data 6)							
012	Direct command (command data 7)							
013	Direct command (command data 8)							
014	Direct command (command data 9)							
015	Direct command (command data 10)							

NOTE

1 DGN numbers 000 to 015 correspond to signal addresses Yy+ 0 to Yy+15, respectively.
2 DGN numbers 008 to 015 (signal addresses Yy+8 to Yy+15) are not used for the peripheral equipment control interface.
3 See Section 2.2 of Part II for details of the signals.

C.2 SIGNALS SENT FROM SERVO AMPLIFIER TO CNC (HOST)

C.2.1 Peripheral Equipment Control Interface (DRC = 0)

(DGN No.)	7	6	5	4	3	2	1	0
016	OPC4	OPC3	OPC2	OPC1	INPX	SUPX	IPLX	DEN2
017	OP	SA	STL	UCPC2	OPTENB	ZRFX	DRCO	ABSWT
018	MA	AL	DSP2	DSP1	DSALO	TRQM	RST	ZPX
019	Response data							
020								
021								
022								
023		SVERX		PSG2	PSG1	MVX	APBAL	MVDX

C.2.2 Direct Command Interface (DRC = 1)

(DGN No.)	7	6	5	4	3	2	1	0
016					INPX	SUPX	IPLX	DEN2
017	OP	SA	STL		OPTENB	ZRFX	DRCO	WAT
018	MA	AL				TRQM	RST	ZPX
019	INPFO	SVERX		PSG2	PSG1	MVX	APBAL	MVDX
020	EBSY	EOSTB	ECF		USR1	EOPC	DAL	ECONT
021	Direct command (function code)							
022	Reserved				Execution result			
023	Direct command (response data 1)							
024	Direct command (response data 2)							
025	Direct command (response data 3)							
026	Direct command (response data 4)							
027	Direct command (response data 5)							
028	Direct command (response data 6)							
029	Direct command (response data 7)							
030	Direct command (response data 8)							
031	Direct command (response data 9)							

NOTE

1 DGN numbers 016 to 031 correspond to signal addresses Xx+0 to Xx+15, respectively.
2 DGN numbers 024 to 031 (signal addresses Xx+8 to Xx+15) in the peripheral equipment control interface are used as response area for the power mate CNC manager.
3 See Section 2.2 of Part II for details of the signals.

C.3 SERVO POSITIONAL DEVIATION AMOUNT (SERVO AMPLIFIER)

(DGNNo.)	
032	**Servo positional deviation amount (servo amplifier)**

C.4 ACCELERATION/DECELERATION DELAY AMOUNT (SERVO AMPLIFIER)

(DGN 番号)	
033	Acceleration/deceleration delay amount (servo amplifier)

C.5 FUNCTION BIT (SERVO AMPLIFIER)

(DGN 番号)	#7	#6	#5	#4	#3	#2	#1	#0
034					1	0	ABTDTC	1

ABTDTC The unexpected disturbance torque detection function is:
0 : Disabled.
1 : Enabled.

C.6 DIRECT INPUT SIGNAL STATUSES (SERVO AMPLIFIER)

(DGN 番号)	#7	#6	#5	#4	#3	#2	#1	#0
035	*-OT	*+OT		HDI	*RILK/ *DEC		*ESP	

*ESP Status of an emergency stop signal
*RILK/*DEC Status of a high-speed interlock signal (*RILK) or reference position return deceleration signal (*DEC)
HDI Status of a skip signal
*+OT Status of an overtravel signal (positive direction)
*-OT Status of an overtravel signal (negative direction)

NOTE
The status of a reference position return deceleration signal (*DEC) and the status of a high-speed interlock signal (*RILK) are stored in the same bit position. When the function for reference position return with dogs is enabled (bit 2 (DZRN) of parameter No. 011 is 1), the *DEC status is indicated; when that function is disabled (DZRN is 0), the *RILK status is indicated.

C.7 MOTOR CURRENT VALUES (SERVO AMPLIFIER)

(DGN No.)	
040	Motor current value (+ side peak hold value)
041	Motor current value (- side peak hold value)
042	Motor current value (real-time value)

[Size] Signed 2-byte
[Unit of data] ±6554 indicates the maximum current value of the amplifier.
[Valid data range] -6554 to 6554

NOTE
Set a peak hold time in parameter No. 064. If a value of 0 is set, the value is invalid.

C.8 SERVO POSITIONAL DEVIATION AMOUNTS (SERVO AMPLIFIER)

(DGN No.)	
043	Servo positional deviation amount (+ side peak hold value)
044	Servo positional deviation amount (- side peak hold value)
045	Servo positional deviation amount (real-time value)

[Size] Signed 4-byte
[Unit of data] Detection unit
[Valid data range] -99999999 to 99999999

NOTE
1 Set a peak hold time in parameter No. 064. If a value of 0 is set, the value is invalid
2 DGN number 045 indicates the same value as DGN number 032.

D POWER MATE CNC MANAGER FUNCTIONS

D.1 POWER MATE CNC MANAGER FUNCTION (30*i*-B, 31*i*-B, 32*i*-B, 35*i*-B, PM*i*-A, 0*i*-F)

When the I/O Link Option for the FANUC servo unit β*i*SV-B series I/O Link option (called β*i*SV-B below) is used for CNC additional axes (slaves), the Power Mate CNC manager function can be used to display and set up various types of data of these slaves on the CNC.

The Power Mate CNC manager function enables the following display and setting operations:
(1) Current position display (absolute/machine coordinates)
(2) Parameter display and setting
(3) Alarm display
(4) Diagnosis data display
(5) System configuration screen display

Up to eight slaves can be connected to each I/O Link channel.

D.1.1 Screen Display

1 Press the function key [SYSTEM].

2 Press the continuous menu key [▷] several times until the [P.MATE MGR.] soft key is displayed.

3 Pressing the [P.MATE MGR.] soft key displays the absolute coordinate screen, which is the initial screen of the Power Mate CNC manager. On this screen, you can select each of the following items by pressing the corresponding soft key:
ABS: Absolute coordinate display
MACHIN: Machine coordinate display
PARAM: Parameter screen
MSG: Alarm list
DGNOS: Diagnosis screen
SYSTEM: System information
To select another function after one of the functions listed above is selected, press the return menu key [◁] until the soft keys appear as shown above. Then, select the desired function.

4 Terminating the Power Mate CNC manager function
Press the return menu key once or twice. The soft keys of the CNC system appear, and the Power Mate CNC manager terminates.
Alternatively, you can select another function by pressing an MDI function key ([POS], [PROG], [MESSAGE], etc.) to terminate the Power Mate CNC manager function.

Selecting a slave

When slaves are connected to multiple I/O Link channels, pressing [NEXT CHANNEL] or [PREVIOUS CHANNEL] displayed by pressing the [(OPRT)] soft key changes the displayed channel.

In the upper section of the screen, the following information items are displayed for the connected slaves (up to eight slaves):

- I/O Link group number (0 to 15)
- Alarm status

The cursor is positioned at the number of the slave for which to display information (active slave). When multiple slaves are connected, pressing the [NEXT SLAVE] or [PREVIOUS SLAVE] changes the active slave.

You can display the slave status and select a slave on any screen of the Power Mate CNC manager function.

Current position display screen

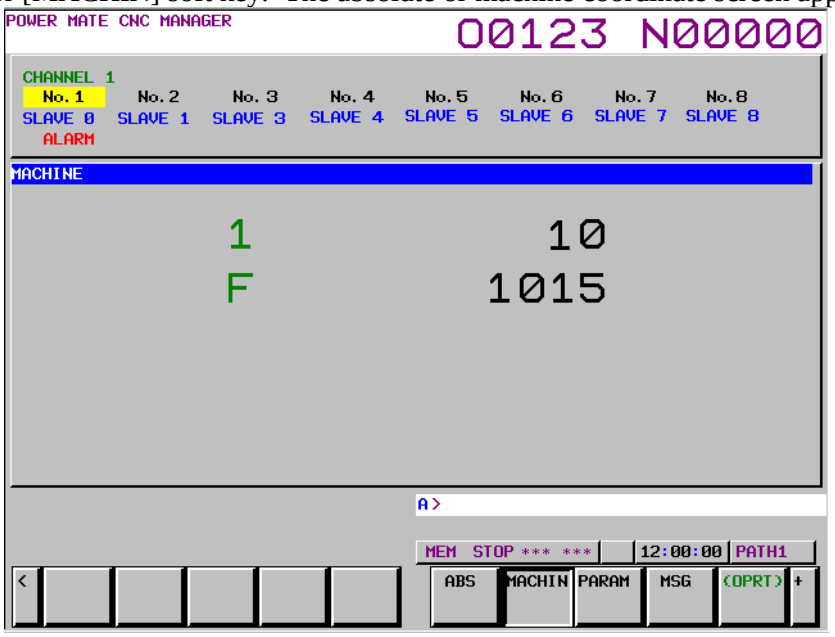
The current position display screen displays the current position and actual feedrate of the slave.

The following current position data is displayed:

- Absolute coordinate (current position in the absolute coordinate system)
- Machine coordinate (current position in the machine coordinate system)

Display method

Press the [ABS] or [MACHIN] soft key. The absolute or machine coordinate screen appears as follows:



Power Mate CNC manager: Machine coordinate screen

Axis name display

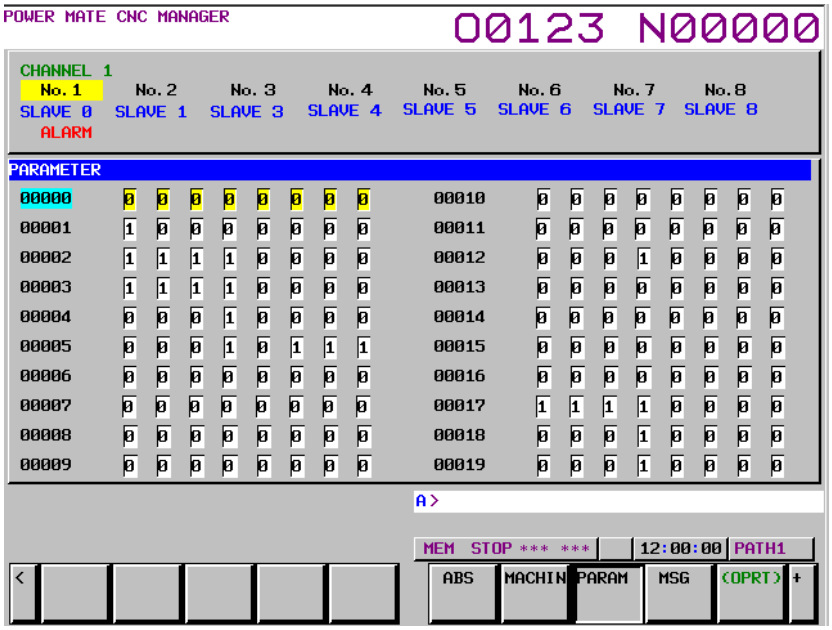
You can change the axis name by setting it in the β*i*SV-B parameters (Nos. 0024 and 0025). Up to two characters can be set. (Use the ASCII codes of 0 to 9 and/or A to Z). When no axis name is set or the setting data is invalid, the axis name is set to 1.

This axis name is used only for position display of the Power Mate CNC manager function and irrelevant to the controlled axis on the CNC.

Parameter screen

The parameters required for the functions of the slave must be specified in advance.

Press the [PARAM] soft key. The following parameter screen appears:



This screen displays only the bit and decimal data.

- Selecting and searching for a parameter
  1 First, select the active slave.
  2 Press the [(OPRT)] soft key. The following soft keys appear:

  3 Enter a parameter number and press the [NO. SRH] soft key. The search starts.
  You can also select a desired parameter number by pressing the cursor keys ↑ ↓ ← → and page keys PAGE ↑ PAGE ↓ and moving the cursor.

- Setting a parameter
  You can directly set β*i*SV-B parameter of the slave from the CNC.
  1 Select a desired parameter using either of the above methods.
  2 Press the [(OPRT)] soft key. The following soft keys appear:

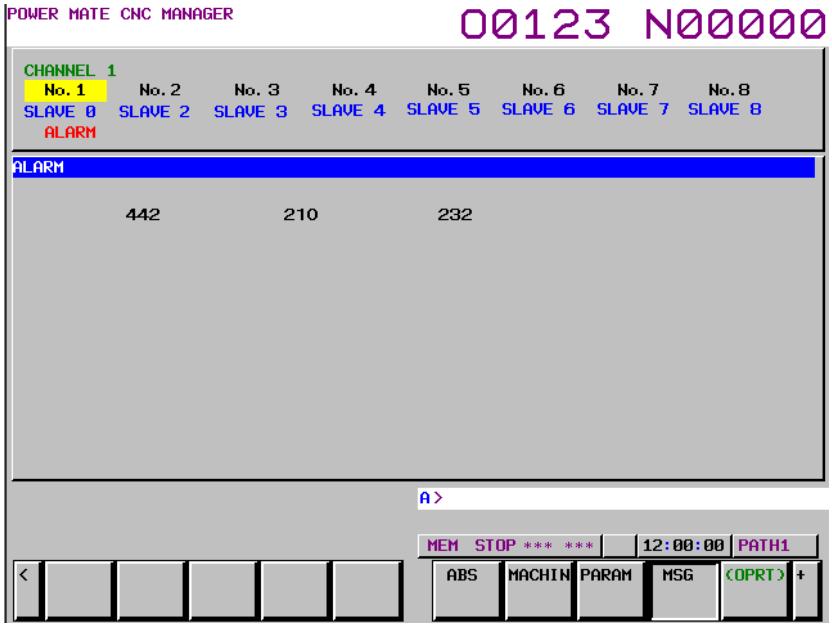
  3 Enter setting data.
  4 Press the [INPUT] soft key or MDI key INPUT.

Alarm screen

If an alarm is issued for the slave, “ALARM” is displayed in the slave status field in the upper section of the screen.
At this time, you can display the alarm screen to check the details of the alarm.
Up to 40 alarm codes are displayed on the screen.

- Display method

Press the [MSG] soft key. On the screen, only error codes are displayed.



Example of displaying alarms for βiSV-B of slave 0

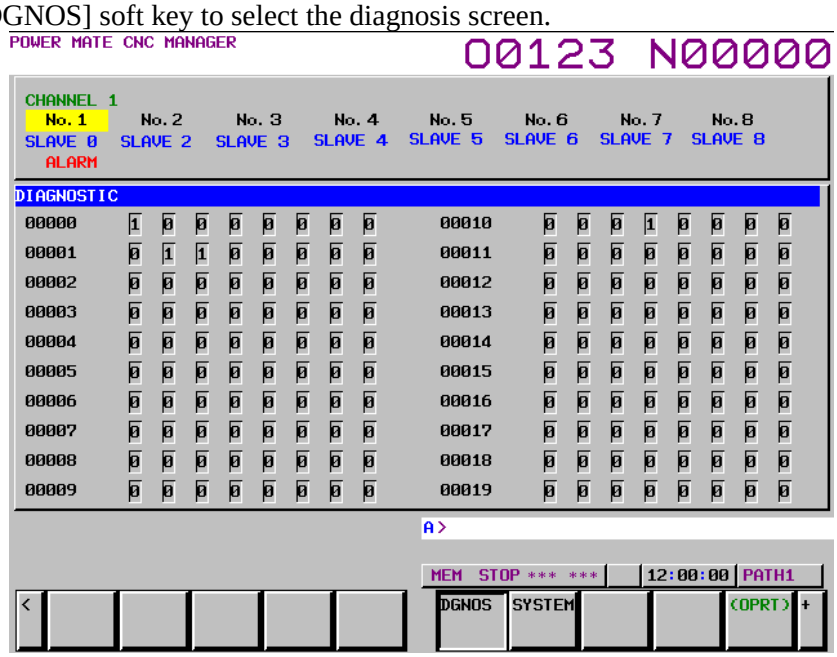
Diagnosis screen

The diagnosis screen displays diagnosis information of the slave.
Diagnosis data is displayed in bit or integer (decimal) representation.

- Display method

1 Press the continuous menu key [▷].

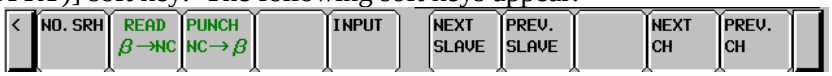
2 Press the [DGNOS] soft key to select the diagnosis screen.



Searching for diagnosis data

1 First, select the active slave.

2 Press the [(OPRT)] soft key. The following soft keys appear:



3 Enter a diagnosis number and press the [NO. SRH] soft key. The search starts.

You can also select a desired parameter number by pressing the cursor keys ↑ ↓ and page keys PAGE ↑ PAGE ↓ and moving the cursor.

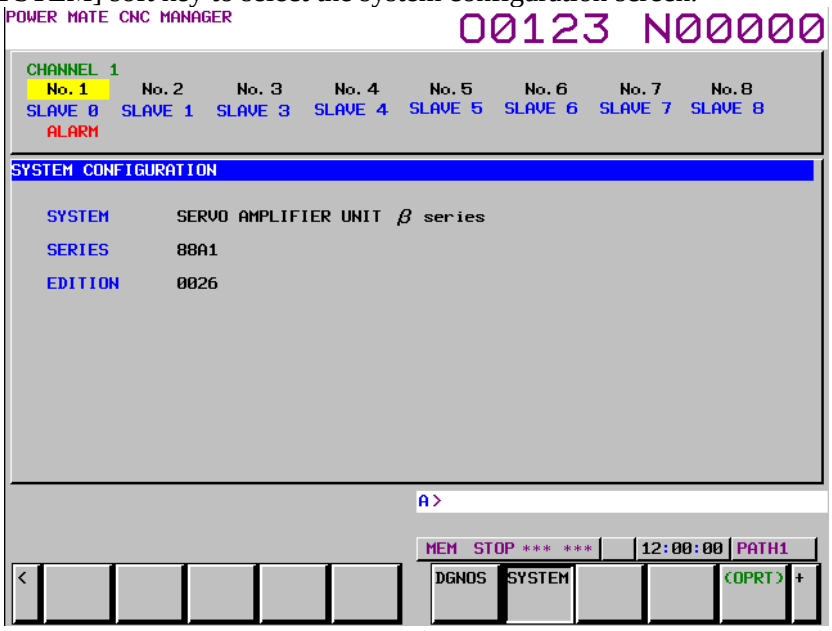
System configuration screen

The system configuration screen displays the system software information of the slave.

- Display method

1 Press the continuous menu key ▷.

2 Press the [SYSTEM] soft key to select the system configuration screen.



Series and edition of the βiSV-B system software

D.1.2 Inputting and Outputting Parameters

Outputting parameters

Parameters are output to the CNC memory or a memory card as a data file in the program format. Set the first registration program number in parameter No. 8760. For each slave, program with a predetermined number is created.

When parameters are output to the CNC memory, a program with the specified program number is created. When parameters are output to a memory card, a file is created, of which file name consists of the specified program number and an extension PMM.

Program number = setting-of-parameter (parameter No. 8760) + (m - 1) × 100 + n × 10

m: Channel number (1 to 4)
n: Group number

Example: When parameter No. 8760 is set to 8000

Channel 1 (βiSV-B: Group 0)
8000 + 0*100 + 0*10 = 8000

Channel 2 (βiSV-B: Group 1)
8000 + 1*100 + 1*10 = 8110

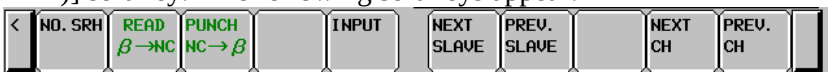
Channel 3 (βiSV-B: Group 2)
8000 + 2*100 + 2*10 = 8220

Channel 4 (β*i*SV-B: Group 3)
8000 + 3*100 + 3*10 = 8330

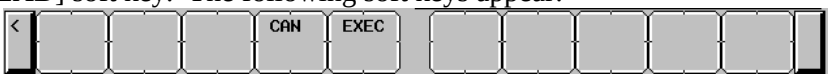
The group number is the slave number displayed in the slave status field in the upper section of the screen in reverse video.
When bit 3 (PMO) of parameter No. 0961 is set to 1, the numbers of the parameters to be output can be set only with a group number.

Select a desired input device using bits 1 (MD1) and 2 (MD2) of parameter No. 0960.
Connect a memory card or check the unused area of the CNC memory, then follow the steps below:

1 For multipath control, display the Power Mate CNC manager screen from the screen for path 1.
2 Select the active slave.
Press the [(OPRT)] soft key. The following soft keys appear:



3 Press the [READ] soft key. The following soft keys appear:



4 Press the [EXEC] soft key.
During input, “INPUT” blinks in the message field.

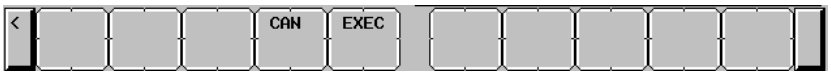
NOTE
1 Parameters can be saved in other than the MEM mode or in the emergency stop status.
2 To save parameters in a memory card, if a file with the same name is found in the memory card, the parameters cannot be saved. Delete the file from the memory card or change the file name by setting parameter No. 8760.
To save parameters in a program area, save operation is performed according to the setting of bit 2 (REP) of parameter No. 3201.

Inputting parameters

A data file of parameters output to the CNC memory or a memory card as a program is input to the slave determined by the program number. The program number and memory device are determined as described in “Outputting parameters.”

1 For multipath control, display the Power Mate CNC manager screen from the screen for path 1.
2 Select the active slave.
3 Press the [(OPRT)] soft key. The following soft keys appear:

4 Press the [PUNCH] soft key. The following soft keys appear:



5 Press the [EXEC] soft key.
During output, “OUTPUT” blinks in the message field.

NOTE
1 Parameters can be input in other than the MEM mode or in the emergency stop status.
2 For multipath control, parameters can be input and output only using the Power Mate CNC manager screen for path 1. They can only be input from and output to the CNC memory for path 1.

D.1.3 Parameters

	#7	#6	#5	#4	#3	#2	#1	#0
0960				PPE	PMN	MD2	MD1	

[Input type] Setting input
[Data type] Bit path

 # 1 MD1
 # 2 MD2 The slave parameters are input from and output to either of the following devices:

Parameter MD2	Parameter MD1	I/O destination
0	0	Program memory
0	1	Memory card

 # 3 PMN The Power Mate CNC manager function is:
0: Enabled.
1: Disabled. (Communication with the slave is not performed.)

 # 4 PPE Setting slave parameters using the Power Mate CNC manager:
0: Can always be performed regardless of the setting of PWE.
1: Follows the setting of PWE.

	#7	#6	#5	#4	#3	#2	#1	#0
0961					PMO			

[Input type] Parameter input
[Data type] Bit

 # 3 PMO The O number of a program for saving and restoring the β*i* SV-B parameter is set based on:
0: Group number and channel number
1: Group number only

8760	Program number of data input/output (Power Mate CNC manager)

[Input type] Setting input
[Data type] 2-word path
[Valid data range] 0 to 99999999
This parameter sets the program numbers of programs to be used for inputting and outputting slave data (parameters) when the Power Mate CNC manager function is used.
For a slave specified with I/O LINK channel m and group n, the following program number is used:
Setting + (m - 1) × 100 + n × 10

If the setting is 0, the parameters of the slave specified with channel 1 and group 0 cannot be input from or output to the CNC memory because the program number is set to 0. The parameters can be input from and output to a memory card.
(Set a value with which any used program number does not exceed 99999999.)

Warning

If an alarm is issued for the Power Mate CNC manager, a warning message is displayed.

Message	Description
DATA ERROR	An attempt was made to execute [PUNCH] (NC → β) for a program not found in the program area.
WRITE PROTECTED	An attempt was made to execute [READ] (β → NC) for a program area when the memory protection signal (KEY) is off.
EDIT REJECTED	An attempt was made to execute [READ] (β → NC) when the program area already contained a program with the same name as that to be created by executing [READ] (β → NC). An attempt was made to execute [READ] (β → NC) when the number of the program to be created by executing [READ] (β → NC) was selected. An attempt was made to execute [READ] (β → NC) when bit 0 (TVC) of CNC parameter No. 0000 was set to 1. (Parameters Nos. 0000 to 0019 are output, but parameter No. 0020 and subsequent parameters are not output.) An attempt was made to execute [PUNCH] (NC → β) when a memory card did not contain any program for which [PUNCH] (NC → β) could be executed. An attempt was made to execute [READ] (β → NC) for a protected memory card.
NO MORE SPACE	An attempt was made to execute [READ] (β → NC) when the program area did not have enough unused space.
FORMAT ERROR	Data other than digits, signs, CAN, and INPUT was entered as the setting of a parameter.
TOO MANY FIGURES	Data consisting of 9 or more digits was entered for a bit-type parameter.
DATA IS OUT OF RANGE	The setting exceeds the valid data range.

D.1.4 Note

I/O Link connection

To use β*i*SV-B as a slave of I/O Link, assign I/O addresses on the CNC side. Since I/O data for slaves is handled in 16-byte units, be sure to specify 128 input/output points.
A maximum of eight slaves can be connected.
The module names are OC021 (16-byte input) and OC020 (16-byte output).
BASE is always 0 and SLOT is always 1.

Power Mate CNC manager neglect function

After necessary data settings and confirmation are made for each of connected slaves, it is possible to stop communication by the Power Mate CNC manager function to precede commands from the ladder on the CNC side to each slave.
When bit 3 (PMN) of parameter No. 960 is set to 1, all communication with slaves over I/O Link is open to the ladder. Setting this parameter to 1 also disables the Power Mate CNC manager function.

Data protection key

When the CNC program data protection key is ON, no parameters can be input to the CNC program memory.

E SERVO TUNING TOOL SERVO GUIDE

(1) Overview

Servo tuning tool "SERVO GUIDE" is an integrated tuning tool for servo and spindle axes that runs on a PC. This tool can be connected to the CNC to observe operation of servo and spindle axes with waveforms.

It also presents examples of observed data. Refer to online help for detailed explanations about how to use the SERVO GUIDE.

(2) Ordering specification of the SERVO GUIDE

Ordering specification	Name
A08B-9010-J900	Package for purchasing the new SERVO GUIDE
A08B-9010-J901	Package for upgrading the SERVO GUIDE

(3) Specification

For observation of β*i*SV-B waveforms, the specification is as follows.

Item	Description
Number of measurement channels (total)	Up to two channels
Sampling Cycle	1msec, 2msec, 4msec, 8msec
Number of points that can be sampled	About 8000 (when 1msec and 1 channel are set) About 4000 (when 1msec and 2 channels are set) * If a number greater than the above is specified, a full buffer error may occur, but the data obtained before the error can be observed. The upper limit varies with the sampling cycle and the operation status of the upper CNC, but the longer the sampling cycle, the longer the sampling time.
Types of data that can be obtained	POSF, VCMD, TCMD, SPEED, ERR, DTRQ, IR, IS, IEFF, IQ, ID See (5).
Trigger	Cannot be used. (Sampling starts instantaneously.)

NOTE

1 β*i*SV-B axes and other CNC axes cannot be measured at the same time.
2 Different β*i*SV-B unit axes cannot be measured at the same time.
3 Origin operation is performed to set the measurement start point of position data such as POSF, but if the axis is moved from the origin until the start of sampling, the sampling position may deviate from the actual position if the travel speed is high.
4 With β*i*SV-B, the Parameter Window, Program Window, and Tuning Navigator cannot be used.

(4) Related parameters

(a) CNC parameters

	#7	#6	#5	#4	#3	#2	#1	#0
960					PMN			

[Input type] Setting input
[Data type] Bit path

 # 3 PMN The Power Mate CNC manager function is:

0: Enabled.
1: Disabled. (Communication with slaves is not transacted.)

NOTE
Measuring function is not available if Power Mate CNC manager function is disabled at all paths.

963	I/O Link channel number of sampling

[Input type] Parameter input
[Data type] Byte
[Valid data range] 1 to 4 (When 0 is set, I/O Link channel number is assumed as 1.)
Set the number for the I/O Link channel to which the β*i* amplifier to be sampled by SERVO GUIDE is connected.

NOTE
In the channel setting screen, you can select the β*i*SV connected to the I/O Link channel specified by this parameter. When this parameter is changed, please reconnect SERVO GUIDE to CNC.

(a) β*i* amplifier's parameter
In case of connecting plural β*i*SV, we recommend setting the axis name parameter to make it easy to distinguish each axis in the channel setting screen of the SERVO GUIDE.

024	Axis name (1st character)

025	Axis name (2nd character)

[Size] 1 byte
[Valid data range] 0, 32 (“ ” space)
48 (“0”) to 57 (“9”)
65 (“A”) to 90 (“Z”)
Set an axis name for β*i*SV by using two characters.
When parameter No. 024 is set to 0, an axis name becomes “1”, regardless of the setting value of parameter No. 025.

(5) Available Data
The types of data that can be measured with β*i*SV are as follows.

Symbol	Meaning of measurement data	Remarks
POSF	Integral value of position feedback	
VCMD	Velocity command	
TCMD	Torque command.	
SPEED	Real speed (Motor speed)	
ERR	Position error	
DTRQ	Estimated disturbance value	Control software 88A7/01 or later
IR	R-phase current	
IS	S-phase current	
IEFF	Actual current	
IQ	Active current	
ID	Reactive current	

(6) Limitations
- During sampling of β*i*SV-B, you cannot open the screen of Power Mate CNC Manager.

- When you open the screen of Power Mate CNC Manager and execute measurement of β*i*SV-B, the screen is not refreshed and you cannot operate the screen.
- When you input or output the parameters of β*i*SV-B from Power Mate CNC Manager, you cannot measure the data of β*i*SV-B.
- If ladder program frequently outputs commands to β*i*SV-B, SERVO GUIDE might not able to get data. In the case, please leave a space between commands.
- If the CNC operation time becomes severe by MACRO EXECUTOR, C-EXECUTOR, or FANUC Touch Panel, the processing time for β*i*SV-B sampling might be longer.

ADDITIONAL INFORMATION

Addition of description to

FANUC SERVO AMPLIFIER βi-B series I/O Link Option MAINTENANCE MANUAL

1. Type of applied technical documents

Name	FANUC SERVO AMPLIFIER βi-B series I/O Link Option MAINTENANCE MANUAL
Spec.No./Version	B-65435EN/01

2. Summary of change

Group	Name / Outline	New, Add, Correct, Delete	Applicable Date
Basic Function			
Optional Function			
Unit	Additional units (A06B-6172-H***, A06B-6173-H***), that correspond to the Servo motor αi-B/βi-B series.	Add	Immediately
Maintenance parts			
Notice			
Correction			
Another			

The Servo Amplifiers (A06B-6172-H*** and A06B-6173-H***) are added to part 2.2.1 "Servo Amplifier" in Chapter I.

2.2.1 Servo Amplifier

Table 2.2.1(a) (200-V type)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
βiSV4-B	A06B-6162-H001	A06B-6162-C001	A20B-2101-0090	A20B-8101-0840
	A06B-6172-H001	A06B-6172-C001		A20B-8102-0050
βiSV20-B	A06B-6162-H002	A06B-6162-C002	A20B-2101-0091	A20B-8101-0840
	A06B-6172-H002	A06B-6172-C002		A20B-8102-0050
βiSV40-B	A06B-6162-H003	A06B-6162-C003	A16B-3200-0512	A20B-8101-0840
	A06B-6172-H003	A06B-6172-C003		A20B-8102-0050
βiSV80-B	A06B-6162-H004	A06B-6162-C004	A16B-3200-0513	A20B-8101-0840
	A06B-6172-H004	A06B-6172-C004		A20B-8102-0050

Table 2.2.1(b) (400-V type)

Model	Order specification	Unit specification	Wiring board specification	Printed circuit board specification
βiSV10HV-B	A06B-6163-H001	A06B-6163-C001	A16B-3200-0515	A20B-8101-0840
	A06B-6173-H001	A06B-6173-C001		A20B-8102-0050
βiSV20HV-B	A06B-6163-H002	A06B-6163-C002	A16B-3200-0516	A20B-8101-0840
	A06B-6173-H002	A06B-6173-C002		A20B-8102-0050
βiSV40HV-B	A06B-6163-H003	A06B-6163-C003	A16B-3200-0517	A20B-8101-0840
	A06B-6173-H003	A06B-6173-C003		A20B-8102-0050

The servo motor αi-B/βi-B series specification is added to 3.4 PARAMETER INITIALIZATION.

3.4 PARAMETER INITIALIZATION

βiSV4-B

Motor model	βiS0.2/5000	βiS0.3/5000
Motor specification	0111	0112
Motor type number	260	261
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later

βiSV20-B

Motor model	αiF1/5000	βiS2/4000	αiF2/5000	βiS4/4000	βiS8/3000
Motor specification	0202	0061	0205	0063	0075
Motor type number	252	253	255	256	258
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/5000	αiS4/5000	βiS12/2000	αiC4/3000	αiC8/2000
Motor specification	0212	0215	0077	0221	0226
Motor type number	262	265	269	271	276
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS0.4/5000	βiS0.5/6000	βiS1/6000	αiS2/6000	αiC12/2000
Motor specification	0114	0115	0116	0218	0241
Motor type number	280	281	282	284	291
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS4/6000				
Motor specification	0210				
Motor type number	466				
Edition corresponding to the 88A7 series	Edition 01 or later				

βiSV20-B

Motor model	αiF1/5000, -B	βiS2/4000, -B	αiF2/5000, -B	βiS4/4000, -B
Motor specification	0202, 2202	0061, 2061	0205, 2205	0063, 2063
Motor type number	252	253	255	256
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS8/3000, -B	αiS2/5000, -B	αiS4/5000, -B	βiS12/2000, -B
Motor specification	0075, 2075	0212, 2212	0215, 2215	0077, 2077
Motor type number	258	262	265	269
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS0.4/5000, -B	βiS0.5/6000, -B	βiS1/6000, -B	αiS2/6000, -B
Motor specification	0114, 2114	0115, 2115	0116, 2116	0218, 2218
Motor type number	280	281	282	284
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiS4/6000, -B	βiSc2/4000, -B	βiS4/4000, -B	βiSc4/4000, -B
Motor specification	0210, 2210	0061-Bxx7 2061-Bxx7	0063-Bxx3 2063-Bxx3	0063-Bxx7 2063-Bxx7
Motor type number	466	306	256	311
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiF4/3000, -B	βiSc8/3000, -B	βiF8/2000, -B	βiS12/2000, -B
Motor specification	0051,2051	0075-Bxx7 2075-Bxx7	0052,2052	0077-Bxx3 2077-Bxx3
Motor type number	483	283	485	269
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/2000, -B	βiF12/2000, -B		
Motor specification	0077-Bxx7 2077-Bxx7	0053,2053		
Motor type number	298	487		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV40-B

Motor model	βiS12/3000	αiF4/4000	βiS22/2000	αiF8/3000	αiC22/2000
Motor specification	0078	0223	0085	0227	0246
Motor type number	272	273	274	277	296
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later

Motor model	βiS12/3000, -B	αiF4/5000, -B	βiS22/2000, -B	αiF8/3000, -B
Motor specification	0078, 2078	0223, 2223	0085, 2085	0227, 2227
Motor type number	272	273	274	277
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/3000, -B	βiSc22/2000, -B	βiF22/2000, -B	
Motor specification	0078-Bxx7 2078-Bxx7	0085-Bxx7 2085-Bxx7	0054,2054	
Motor type number	496	481	489	
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	

βiSV80-B

Motor model	αiS8/4000	αiS12/4000	αiS8/6000	αiF12/3000	αiF22/3000
Motor specification	0235	0238	0232	0243	0247
Motor type number	285	288	290	293	297
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiC30/1500	βiS22/3000	βiS30/2000	βiS40/2000	
Motor specification	0251	0082	0087	0089	
Motor type number	301	313	472	474	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	

Motor model	αiS8/4000, -B	αiS12/4000, -B	αiS8/6000, -B	αiF12/4000, -B
Motor specification	0235, 2235	0238, 2238	0232, 2232	0243, 2243
Motor type number	285	288	290	293
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF22/3000, -B	βiS22/3000, -B	βiS30/2000, -B	βiS40/2000, -B
Motor specification	0247, 2247	0082, 2082	0087, 2087	0089, 2089
Motor type number	297	313	472	474
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF8/4000, -B	βiF30/1500, -B		
Motor specification	0228,2228	0055,2055		
Motor type number	492	491		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV10HV-B

Motor model	βiS2/4000HV	αiS2/5000HV	βiS4/4000HV	αiS4/5000HV	βiS8/3000HV
Motor specification	0062	0213	0064	0216	0076
Motor type number	251	263	264	266	267
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/6000HV	αiS4/6000HV			
Motor specification	0219	0214			
Motor type number	287	467			
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later			

Motor model	βiS2/4000HV, -B	αiS2/5000HV, -B	βiS4/4000HV, -B	αiS4/5000HV, -B
Motor specification	0062, 2062	0213, 2213	0064, 2064	0216, 2216
Motor type number	251	263	264	266
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS8/3000HV, -B	αiS2/6000HV, -B	αiS4/6000HV, -B	βiSc2/4000HV, -B
Motor specification	0076, 2076	0219, 2219	0214, 2214	2062-Bxx7
Motor type number	267	287	467	523
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc4/4000HV, -B	βiSc8/3000HV, -B		
Motor specification	2064-Bxx7	2076-Bxx7		
Motor type number	525	527		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV20HV-B

Motor model	βiS12/3000HV	αiF4/4000HV	βiS22/2000HV	αiF8/3000HV
Motor specification	0079	0225	0086	0229
Motor type number	270	275	278	279
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later

Motor model	βiS12/3000HV, -B	αiF4/5000HV, -B	βiS22/2000HV, -B	αiF8/3000HV, -B
Motor specification	0079, 2079	0225, 2225	0086, 2086	0229, 2229
Motor type number	270	275	278	279
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/3000HV, -B			
Motor specification	2079-Bxx7			
Motor type number	529			
Edition corresponding to the 88A7 series	Edition 04 or later			

βiSV40HV-B

Motor model	αiS8/4000HV	αiS12/4000HV	αiS8/6000HV	αiF12/3000HV	αiF22/3000HV
Motor specification	0236	0239	0233	0245	0249
Motor type number	286	289	292	295	299
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS22/3000HV	βiS30/2000HV	βiS40/2000HV		
Motor specification	0083	0088	0090		
Motor type number	314	473	475		
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later		

Motor model	αiS8/4000HV, -B	αiS12/4000HV, -B	αiS8/6000HV, -B	αiF12/3000HV, -B
Motor specification	0236, 2236	0239, 2239	0233, 2233	0245, 2245
Motor type number	286	289	292	295
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF22/3000HV, -B	βiS22/3000HV, -B	βiS30/2000HV, -B	βiS40/2000HV, -B
Motor specification	0249, 2249	0083, 2083	0088, 2088	0090, 2090
Motor type number	299	314	473	475
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF8/4000HV, -B	αiF12/4000HV, -B		
Motor specification	0220,2220	0245,2245		
Motor type number	493	295		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

The PCB (A02B-8102-0050) is added to part 1.1.1 “Ordering Number of Printed Circuit Board” and part 1.1.2 “Fuse Locations” in Chapter IV.

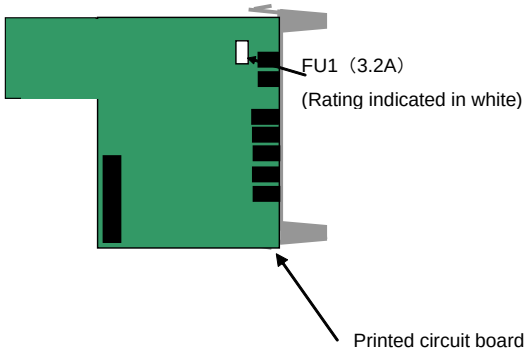
1.1.1 Ordering Number of Printed Circuit Board

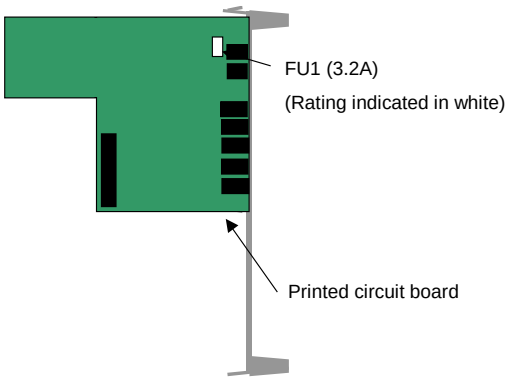
Unit specification	Ordering number
A06B-6172-H001, -H002, -H003, -H004 A06B-6173-H001, -H002, -H003	A20B-8101-0840
A06B-6172-H001, -H002, -H003, -H004 A06B-6173-H001, -H002, -H003	A20B-8102-0050

1.1.2 Fuse Locations

There is one fuse on the β*i*SV-B printed-circuit board.

(1) A20B-8101-0840 or A20B-8102-0050





Fuse specification

Symbol	Ordering number
FU1	A60L-0001-0290#LM32C

The servo motor αi-B/βi-B series are added to Appendix B.6 SERVO PARAMETERS.

B.6 SERVO PARAMETERS

No.	
125	Motor type number

[Size] 2-byte
[Valid data range] 1 to 350
Set the type number of a motor to use.
Ensure that parameter No.30 is 0.

βiSV 4-B

Motor model	βiS0.2/5000	βiS0.3/5000
Motor specification	0111	0112
Motor type number	260	261
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later

βiSV 20-B

Motor model	αiF1/5000	βiS2/4000	αiF2/5000	βiS4/4000	βiS8/3000
Motor specification	0202	0061	0205	0063	0075
Motor type number	252	253	255	256	258
Edition Corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/5000	αiS4/5000	βiS12/2000	αC4/3000i	αC8/2000i
Motor specification	0212	0215	0077	0221	0226
Motor type number	262	265	269	271	276
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS0.4/5000	βiS0.5/6000	βiS1/6000	αiS2/6000	αC12/2000i
Motor specification	0114	0115	0116	0218	0241
Motor type number	280	281	282	284	291
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS4/6000	βiF4/3000	βiF8/2000	βiF12/2000	
Motor specification	0210	0051	0052	0053	
Motor type number	466	483	485	487	
Edition corresponding to the 88A7 series	Edition 01 or later	-	-	-	

βiSV20-B

Motor model	αiF1/5000, -B	βiS2/4000, -B	αiF2/5000, -B	βiS4/4000, -B
Motor specification	0202, 2202	0061, 2061	0205, 2205	0063, 2063
Motor type number	252	253	255	256
Edition Corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS8/3000, -B	αiS2/5000, -B	αiS4/5000, -B	βiS12/2000, -B
Motor specification	0075, 2075	0212, 2212	0215, 2215	0077, 2077
Motor type number	258	262	265	269
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS0.4/5000, -B	βiS0.5/6000, -B	βiS1/6000, -B	αiS2/6000, -B
Motor specification	0114, 2114	0115, 2115	0116, 2116	0218, 2218
Motor type number	280	281	282	284
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiS4/6000, -B	βiSc2/4000, -B	βiS4/4000, -B	βiSc4/4000, -B
Motor specification	0210, 2210	0061-Bxx7 2061-Bxx7	0063-Bxx3 2063-Bxx3	0063-Bxx7 2063-Bxx7
Motor type number	466	306	256	311
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiF4/3000, -B	βiSc8/3000, -B	βiF8/2000, -B	βiS12/2000, -B
Motor specification	0051,2051	0075-Bxx7 2075-Bxx7	0052,2052	0077-Bxx3 2077-Bxx3
Motor type number	483	283	485	269
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/2000, -B	βiF12/2000, -B		
Motor specification	0077-Bxx7 2077-Bxx7	0053,2053		
Motor type number	298	487		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV40-B

Motor model	βiS12/3000	αiF4/4000	βiS22/2000	αiF8/3000	αC22/2000i
Motor specification	0078	0223	0085	0227	0246
Motor type number	272	273	274	277	296
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiF22/2000				
Motor specification	0054				
Motor type number	489				
Edition corresponding to the 88A7 series	-				

βiSV40-B

Motor model	βiS12/3000, -B	αiF4/5000, -B	βiS22/2000, -B	αiF8/3000, -B
Motor specification	0078, 2078	0223, 2223	0085, 2085	0227, 2227
Motor type number	272	273	274	277
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/3000, -B	βiSc22/2000, -B	βiF22/2000, -B	
Motor specification	0078-Bxx7 2078-Bxx7	0085-Bxx7 2085-Bxx7	0054,2054	
Motor type number	496	481	489	
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	

βiSV80-B

Motor model	αiS8/4000	αiS12/4000	αiS8/6000	αiF12/3000	αiF22/3000
Motor specification	0235	0238	0232	0243	0247
Motor type number	285	288	290	293	297
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αC30/1500i	βiS22/3000	βiS30/2000	βiS40/2000	βiF30/1500
Motor specification	0251	0082	0087	0089	0055
Motor type number	301	313	472	474	491
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	-
Motor model	βiF8/4000				
Motor specification	0228				
Motor type number	492				
Edition corresponding to the 88A7 series	-				

Motor model	αiS8/4000, -B	αiS12/4000, -B	αiS8/6000, -B	αiF12/4000, -B
Motor specification	0235, 2235	0238, 2238	0232, 2232	0243, 22443
Motor type number	285	288	290	293
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF22/3000, -B	βiS22/3000, -B	βiS30/2000, -B	βiS40/2000, -B
Motor specification	0247, 2247	0082, 2082	0087, 2087	0089, 2089
Motor type number	297	313	472	474
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiF30/1500, -B	βiF8/4000, -B		
Motor specification	0055,2055	0228,2228		
Motor type number	491	492		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV10HV-B

Motor model	βiS2/4000HV	αiS2/5000HV	βiS4/4000HV	αiS4/5000HV	βiS8/3000HV
Motor specification	0062	0213	0064	0216	0076
Motor type number	251	263	264	266	267
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	αiS2/6000HV	αiS4/6000HV			
Motor specification	0219	0214			
Motor type number	287	467			
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later			

Motor model	βiS2/4000HV, -B	αiS2/5000HV, -B	βiS4/4000HV, -B	αiS4/5000HV, -B
Motor specification	0062, 2062	0213, 2213	0064, 2064	0216, 2216
Motor type number	251	263	264	266
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiS8/3000HV, -B	αiS2/6000HV, -B	αiS4/6000HV, -B	βiSc2/4000HV, -B
Motor specification	0076, 2076	0219, 2219	0214, 2214	2062-Bxx7
Motor type number	267	287	467	523
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc4/4000HV, -B	βiSc8/3000HV, -B		
Motor specification	2064-Bxx7	2076-Bxx7		
Motor type number	525	527		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

βiSV20HV-B

Motor model	βiS12/3000HV	αiF4/4000HV	βiS22/2000HV	αiF8/3000HV	
Motor specification	0079	0225	0086	0229	
Motor type number	270	275	278	279	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	

Motor model	βiS12/3000HV, -B	αiF4/5000HV, -B	βiS22/2000HV, -B	αiF8/3000HV, -B
Motor specification	0079, 2079	0225, 2225	0086, 2086	0229, 2229
Motor type number	270	275	278	279
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	βiSc12/3000HV, -B			
Motor specification	2079-Bxx7			
Motor type number	529			
Edition corresponding to the 88A7 series	Edition 04 or later			

βiSV40HV-B

Motor model	αiS8/4000HV	αiS12/4000HV	αiS8/6000HV	αiF12/3000HV	αiF22/3000HV
Motor specification	0236	0239	0233	0245	0249
Motor type number	286	289	292	295	299
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later	Edition 01 or later
Motor model	βiS22/3000HV	βiS30/2000HV	βiS40/2000HV	αiF8/4000HV	
Motor specification	0083	0088	0090	0220	
Motor type number	314	473	475	493	
Edition corresponding to the 88A7 series	Edition 01 or later	Edition 01 or later	Edition 01 or later	-	

Motor model	αiS8/4000HV, -B	αiS12/4000HV, -B	αiS8/6000HV, -B	αiF12/3000HV, -B
Motor specification	0236, 2236	0239, 2239	0233, 2233	0245, 2245
Motor type number	286	289	292	295
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF22/3000HV, -B	βiS22/3000HV, -B	βiS30/2000HV, -B	βiS40/2000HV, -B
Motor specification	0249, 2249	0083, 2083	0088, 2088	0090, 2090
Motor type number	299	314	473	475
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later	Edition 04 or later	Edition 04 or later
Motor model	αiF8/4000HV, -B	αiF12/4000HV, -B		
Motor specification	0220,2220	0245,2245		
Motor type number	493	295		
Edition corresponding to the 88A7 series	Edition 04 or later	Edition 04 or later		

The servo motor βi-B series are added to DIGITAL SERVO STANDARD PARAMETER TABLE.
Digital Servo Standard Parameter for servo motor αi-B/βi-B series are the same as conventional its parameter.
So, only added motor specification are shown.

B.7 DIGITAL SERVO STANDARD PARAMETER TABLE

Symbol	Motor model Motor Specificatoin Motor ID no.	βiSc2 /4000HV-B 2062-Bxx7 523	βiSc4 /4000HV-B 2064-Bxx7 525	βiSc8 /3000HV-B 2076-Bxx7 527	βiSc12 /3000HV-B 2079-Bxx7 529
	19	00001100	00001100	00001100	00001100
PK1	70	348	331	605	427
PK2	71	-1676	-1560	-3028	-2301
PK3	72	-1232	-1246	-1300	-1302
PK1V	73	76	109	162	166
PK2V	74	-683	-986	-1447	-1488
PK4V	75	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21
PDDP	77	1894	1894	1894	1894
PVPA	78	-10250	-7694	-5140	-5140
PALPH	79	-1000	-2800	-3200	-3500
TQLIM	80	6554	7282	7282	7282
POVC1	81	32655	32537	32671	32699
POVC2	82	1411	2885	1214	864
POVCLMT	83	4189	8577	3602	2562
AALPH	84	20480	20480	20480	20480
DBLIM	85	0	0	0	0
MGSTCM	86	1048	780	1807	1814
DETQLM	87	11600	7790	7930	7930
NINTCT	88	2345	1592	2885	2388
MFWKCE	89	1000	500	1000	3000
MFWKBL	90	3358	3339	1298	2056
EMFCMP	99	0	0	0	0
PK2VAUX	101	0	0	0	0
TRQCST	112	119	146	225	420
MDLCST	115	1850	1280	1745	1697
PHDLY1	118	7192	8972	3848	5138
PHDLY2	119	8990	12816	8990	6430

Symbole	Motor model Motor specification Motor ID No.	βiS22 /3000-B 2082 535	βiS22 /3000HV-B 2083 536	βiS30 /2000-B 2087 537	βiS30 /2000HV-B 2088 538
	19	8	8	8	8
PK1	70	1157	1146	1650	1650
PK2	71	-5102	-5267	-6565	-6565
PK3	72	-1332	-1332	-2681	-2681
PK1V	73	193	188	209	209
PK2V	74	-1724	-1681	-1867	-1867
PK4V	75	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21
PDDP	77	1894	1894	1894	1894
PVPA	78	-6174	-6174	-4647	-4647
PALPH	79	-2843	-2843	-3115	-3115
TQLIM	80	7282	7282	7282	7282
POVC1	81	32544	32555	32537	32536
POVC2	82	2795	2659	2882	2895
POVCLMT	83	8311	7903	8568	8608
AALPH	84	12288	8192	8192	8192
DBLIM	85	0	0	0	0
MGSTCM	86	1289	1289	1546	1546
DETQLM	87	5016	5016	4054	4054
NINTCT	88	1967	3894	2095	2095
MFWKCE	89	6000	6000	3066	3066
MFWKBL	90	2315	2315	1548	1548
EMFCMP	99	0	0	0	0
PK2VAUX	101	0	0	0	0
TRQCST	112	848	869	1127	1127
MDLCST	115	732	751	677	675
PHDLY1	118	5647	5647	4110	4110
PHDLY2	119	12820	12820	12814	12814

Symbol	Motor model Motor specification Motor ID No.	βiS40 /2000-B 2089 539	βiS40 /2000HV-B 2090 540
	19	8	8
PK1	70	1624	1624
PK2	71	-7197	-7197
PK3	72	-1341	-1341
PK1V	73	203	203
PK2V	74	-1826	-1826
PK4V	75	-8235	-8235
PPMAX	76	21	21
PDDP	77	1894	1894
PVPA	78	-3881	-3881
PALPH	79	-3732	-3732
TQLIM	80	7282	7282
POVC1	81	32537	32537
POVC2	82	2882	2881
POVCLMT	83	8568	8567
AALPH	84	8192	8192
DBLIM	85	0	0
MGSTCM	86	263	263
DETQLM	87	2815	2815
NINTCT	88	2712	2712
MFWKCE	89	3354	3354
MFWKBL	90	1038	1038
EMFCMP	99	0	0
PK2VAUX	101	0	0
TRQCST	112	1503	1503
MDLCST	115	692	692
PHDLY1	118	2567	2567
PHDLY2	119	8967	8967

Update of Control Software for FANUC SERVO AMPLIFIER βi-B series I/O Link Option (88A7/07)

1. Type of applied documents

Name	FANUC SERVO AMPLIFIER βi -B series I/O Link Option MAINTENANCE MANUAL
Spec. No./Ver.	B-65435EN/01

2. Summary of Change

Group	Name / Outline	New, Add Correct, Del	Applicable Date
Basic Function	AC SERVO MOTOR (βiS 0.5/6000-B, βiS 1/6000-B, βiS 1.5/6000-B, βiS 0.5/6000HV-B, βiS 1/6000HV-B, βiS 1.5/6000HV-B) have been supported.	Add	2018.11
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

				TITLE Update of Control Software for FANUC SERVO AMPLIFIER βi-B series I/O Link Option (88A7/07)	
01	2018.10.30	Liang	Newly designed	DRAW. No. B-65435EN/01-02	CUST.
Ed.	Date	Design.	Description	FANUC CORPORATION	SHEET 1/2

Update of Control Software for FANUC SERVO AMPLIFIER βi-B series I/O Link Option (88A7/07)

This document reports the update of Control Software 88A7 series for FANUC SERVO AMPLIFIER βi-B series I/O Link Option.

1. Update Edition

ROM series	Old edition	New edition	Applicable model
88A7	06	07	FANUC SERVO AMPLIFIER βi-B series I/O Link Option

2. Contents of change

New βiS-B motors shown in Table 1 as additional lineup have been supported. The standard parameters of the added βiS-B motors are listed in Table 2.

Table 1. βiS-B motor models' lineup

Continuous torque	Ordinary lineup specification		Additional lineup specifications	
	200V	400V	200V	400V
0.4Nm	βiS 0.4/5000-B (A06B-2114-Bxxx)	---	---	---
0.65Nm	βiS 0.5/6000-B (A06B-2115-Bxxx)	---	βiS 0.5/6000-B (A06B-2015-Bxxx)	βiS 0.5/6000HV-B (A06B-2016-Bxxx)
1.2Nm	βiS 1/6000-B (A06B-2116-Bxxx)	---	βiS 1/6000-B (A06B-2017-Bxxx)	βiS 1/6000HV-B (A06B-2018-Bxxx)
1.6Nm	---	---	βiS 1.5/6000-B (A06B-2019-Bxxx)	βiS 1.5/6000HV-B (A06B-2020-Bxxx)

Note)

1. Additional lineup, βiS 0.5/6000-B(A06B-2015-Bxxx) and βiS 1/6000-B(A06B-2017-Bxxx), are different motors from the ordinary lineup, βiS 0.5/6000-B(A06B-2115-Bxxx) and βiS 1/6000-B (A06B-2116-Bxxx).
2. Additional lineup motors cannot be driven using 06 edition nor before of 88A7 series. Please use 07 edition or subsequent editions of 88A7 series to drive the motors.

Table 2. Motor specific standard parameters of the additional βiS-B motor models

βiS series Motor Symbol	Motor model Specification Motor ID No.	βiS0.5/6000-B A06B-2015-Bxxx 545	βiS0.5/6000HV-B A06B-2016-Bxxx 546	βiS1/6000-B A06B-2017-Bxxx 547	βiS1/6000HV-B A06B-2018-Bxxx 548	βiS1.5/6000-B A06B-2019-Bxxx 549	βiS1.5/6000HV-B A06B-2020-Bxxx 550
	19	00000010	00000010	00000010	00000010	00000010	00000010
PK1	70	335	330	640	725	540	485
PK2	71	-1130	-1115	-2400	-2400	-1760	-1550
PK3	72	-1195	-1175	-1219	-1202	-1295	-1230
PK1V	73	10	10	9	9	14	14
PK2V	74	-86	-86	-79	-78	-119	-122
PK4V	75	-8235	-8235	-8235	-8235	-8235	-8235
PPMAX	76	21	21	21	21	21	21
PDDP	77	1894	1894	1894	1894	1894	1894
PVPA	78	-7681	-7681	-12805	-12805	-12806	-12806
PALPH	79	-250	-250	-1500	-1500	-1300	-1300
TQLIM	80	6554	6554	6554	6554	7282	7282
POVC1	81	32670	32670	32687	32687	32618	32609
POVC2	82	1223	1224	1014	1007	1878	1987
POVCLMT	83	3628	3631	3007	2987	5576	5901
AALPH	84	0	0	0	0	0	0
DBLIM	85	0	0	0	0	0	0
MGSTCM	86	262	262	276	276	266	266
DETQLM	87	0	0	0	0	0	0
NINTCT	88	538	1012	1017	1966	1162	1154
MFWKCE	89	512	512	3072	3072	1024	1024
MFWKBL	90	3865	3865	3855	3855	3865	3865
EMFCMP	99	0	0	0	0	0	0
PK2VAUX	101	0	0	0	0	0	0
TRQCST	112	41	41	84	84	82	80
MDLCST	115	7305	7305	8024	8048	5312	5172
PHDLY1	118	10241	10241	5123	5123	8968	8968
PHDLY2	119	6405	6405	15380	15380	14090	14090

INDEX

<A>

ACCELERATION/DECELERATION CONTROL PARAMETERS....200
ACCELERATION/DECELERATION DELAY AMOUNT (SERVO AMPLIFIER)....236
ACTION AGAINST NOISE....140
Alarm....27,64,67,126
Alarm (DAL)....92
ALARM NUMBERS AND BRIEF DESCRIPTIONS.132
Alarms for built-in detectors (α*i* and β*i* Pulsecoders) and troubleshooting actions....173
ATC/Turret Control....51
Automatic Operation....35
Axis Movement Commands....106

<B>

Battery connection modes....158

<C>

Caution.... s-11,s-13,s-4,s-9
CAUTIONS ON USING THE POWER MATE CNC MANAGER....20
Check Procedure....15
Checking the Voltage and Capacity of the Power....7
Clamp and Unclamp (for the Peripheral Equipment Control Interface Only)....36
Command Completion Notification (ECF)....92
COMMAND FORMAT FOR PERIPHERAL EQUIPMENT CONTROL....47
Command timing chart....60,67
CONFIGURATIONS....4
CONFIRMATION OF THE OPERATION....14
Connecting a Protective Ground....8
CONNECTING THE POWER....7
Control of the Point Data External Setting Function....68
CONTROLLED-AXIS PARAMETERS....194
COORDINATE SYSTEM AND STROKE LIMIT PARAMETERS....195
Coordinate System Setting....65

<D>

Deceleration limit switch installation condition....71
DEFINITION OF WARNING, CAUTION, AND NOTE....s-2
DETAILED DESCRIPTION....118
Detailed troubleshooting methods....173
DETAILS OF DIRECT COMMAND FUNCTIONS....94
Details of Function....75,79,86
DETAILS OF FUNCTION CODES....51
Details of the Setup Method....121
DI/DO Signals....76
DIAGNOSIS....126
DIAGNOSIS LISTS....234
DIGITAL SERVO STANDARD PARAMETER TABLE....230
DIRECT COMMAND CONTROL PROCEDURE....91
Direct Command Execution Result....92
DIRECT COMMAND FORMAT....90
Direct Command Function Code and Related Information....40
Direct Command Interface....20,23
Direct Command Interface (DRC = 1)....234,235
DIRECT COMMANDS....90
DIRECT INPUT SIGNAL STATUSES (SERVO AMPLIFIER)....236
Direct Input Signals....45
Disabling of Clamp Processing When Jog Operation is Stopped....75
Display of the servo amplifier operation status....180
DO/DO SIGNALS....21

<E>

Example of program....73
Explanation of Function....70,73,74,75
EXTERNAL PULSE INPUT FUNCTION....118

<F>

FANUC AC SERVO MOTOR β*i* series....s-3
FANUC I/O Link *i* and I/O Link INTERFACE AREA.19
FANUC SERVO AMPLIFIER β*i*-B series....s-8
Feedrate....33
FEEDRATE PARAMETERS....198
For Fan Motors for Internal Agitation for β*i*SV40-B, β*i*SV80-B, β*i*SV10HV-B, β*i*SV20HV-B, and β*i*SV40HV-B....151
For Fan Motors for Internal Agitation for β*i*SV4-B and β*i*SV20-B....150
FUNCTION BIT (SERVO AMPLIFIER)....236
FUNCTION CODES....48
Function for Specifying the Direction of Rotation Axis High-speed Reference Position Return....73
Fuse Locations....149

<H>

HOW TO REPLACE THE FAN MOTOR....150
HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS....147

<I>

IMPROVEMENT OF TURRET/MAGAZINE NUMBER OUTPUT....79
INITIALIZING PARAMETERS (SWITCHES AND DUMMY CONNECTORS)....8
INPUT/OUTPUT SIGNALS PARAMETERS....203
Inputting and Outputting Parameters....242
Instruction Command Control (EBUF, EBSY, and ECNT)....91
INTERFACE....19

Interface Switching 20
Interlock 34

<J>

Jog Feed 28

<L>

LED.....14
LIST OF DIRECT COMMANDS.....93
LIST OF MANUALS RELATED TO MOTORS AND AMPLIFIERS.....166

<M>

Main inspection items 169
Maintenance of βiS servo motor (□40 and □60) Pulsecoders.....175
Maintenance of a Detector 172
Maintenance of a Servo Amplifier 180
MAJOR COMPONENTS 5
MANUAL HANDLE INTERFACE 86
Memory Registration Procedure 117
Mode Selection 28
MOTOR CURRENT VALUES (SERVO AMPLIFIER) 236
MOTOR/DETECTOR/AMPLIFIER PREVENTIVE MAINTENANCE.....165

<N>

Note..... s-10,s-14,s-6,245
Notes 78
Notes on attaching connectors.....160
NOTES ON CONNECTING THE GROUND SYSTEMS.....141
Notes on motor cleaning 172
Notes on Replacing a Battery (Supplementary Explanation) 158
NOTES ON SELECTING THE SPARK KILLER.....143
Notes on the cutting fluid (informational).....172

<O>

Operation Procedure.....117
Optional function 119
Ordering Number of Printed Circuit Board.....148
Others.....64

<P>

Parameter 62,68,72,73,74,75,77,83,89,94,124,127
PARAMETER INITIALIZATION 9
PARAMETER LIST 189
Parameter on the CNC (host) 89
Parameter on the servo amplifier.....89
Parameters.....244
Periodic cleaning of a motor 171
PERIPHERAL EQUIPMENT CONTROL 47
Peripheral equipment control command format 58,66
Peripheral Equipment Control Function Code and Related Information.....37
Peripheral Equipment Control Interface.....20,21
Peripheral Equipment Control Interface (DRC = 0)234,235
PERIPHERAL EQUIPMENT CONTROL PROCEDURE 47
Point Positioning Control.....52
Positioning Control (Absolute/Incremental Specification, for Skip Function) 56
POWER MATE CNC MANAGER FUNCTION (30*i*-B, 31*i*-B, 32*i*-B, 35*i*-B, PM*i*-A, 0*i*-F).....238
POWER MATE CNC MANAGER FUNCTIONS 238
PREFACE p-1
Preparation Completion 26
Preventive Maintenance of a Motor (Common to All Models) 169
Preventive Maintenance of a Servo Amplifier 179
PREVENTIVE MAINTENANCE OF MOTORS AND DETECTORS.....167
PREVENTIVE MAINTENANCE OF SERVO AMPLIFIERS.....176
Pulsecoder.....183

<Q>

QUICK STOP FUNCTION 127

<R>

Receiving Response Data.....48
Reference Position Return.....34,54
REFERENCE POSITION RETURN FUNCTION WITH DOGS.....70
Reference position return operation (grid method) 70
Reference Position Setting (when the Reference Position External Setting Function is Used).....55
Related parameters.....84
Removing the Fan Motor from the Fan Unit（βiSV40-B, βiSV80-B, βiSV10HV-B, βiSV20HV-B, βiSV40HV-B） 154
Removing the Fan Motor from the Fan Unit（βiSV4-B, βiSV20-B） 153
Removing the Fan Units for Cooling the Radiators for βiSV80-B and βiSV40HV-B.....152
Replacement of a fan motor 180
Replacing Batteries 155
REPLACING BATTERY FOR ABSOLUTE PULSECODERS.....155,180
Replacing the Batteries in a Separate Battery Case 156
Replacing the Battery Built into the Servo Amplifier..156
Replacing βiS 0.2 to βiS 0.3 batteries.....160
Reset and Emergency Stop 26
Response Command Control (EOREND, EOSTB, EOPC, USR1, and ECONT).....92
Rewriting of Parameters.....66
Rotation Axis Rotation Direction Sign Specification Function.....73

<S>

SAFETY PRECAUTIONS s-1
Screen Display 238
Selecting the Ground Fault Interrupter That Matches the Leakage Current 8

SERIES AND EDITIONS OF APPLICABLE SERVO SOFTWARE 119,127
Servo Amplifier.....5
SERVO AMPLIFIER INTERFACE.....19
SERVO AMPLIFIER FRONT VIEW 187
SERVO MOTOR MAINTENANCE 183
SERVO MOTOR MAINTENANCE PARTS 183
SERVO PARAMETERS 211
SERVO POSITIONAL DEVIATION AMOUNT (SERVO AMPLIFIER) 235
SERVO POSITIONAL DEVIATION AMOUNTS (SERVO AMPLIFIER) 237
SERVO TUNING TOOL SERVO GUIDE.....246
Servo-off 37
SETTING METHOD 127
SETUP METHOD 120
Signal 64,82,87,124
SIGNAL DESCRIPTIONS 21
SIGNAL DETAILS.....26
Signal on the CNC (host) 88
Signal on the servo amplifier 87
Signal Operation Commands.....94
SIGNALS (LISTED IN GROUPS).....24
SIGNALS SENT FROM CNC (HOST) TO SERVO AMPLIFIER.....234
SIGNALS SENT FROM SERVO AMPLIFIER TO CNC (HOST).....235
Specifications of Fan Units for Maintenance 154
Specifying Operation Using a Function Code.....47
Speed Control.....57
Start of the Timer Counting Until Servo-off in Clamp Processing.....74
START-UP PROCEDURE 6
START-UP PROCEDURE (OVERVIEW) 6
Status Read.....96
Status Signals 29
System configuration 58,66

<T>

Teaching-based Data Setting Control.....69
THIRTY-TWO-BLOCK BUFFERING OPERATION 117
Tip.....71

<U>

UPGRADING OF THE CLAMP/UNCLAMP CONTROL FUNCTION 74
UPGRADING OF THE RESPONSE DATA READ FUNCTION.....75
UPGRADING OF THE ROTATION AXIS CONTROL FUNCTION.....73

<W>

Warning..... s-11,s-12,s-3,s-8
Warnings and Cautions Relating to a Pilot Run s-11
Warnings and Cautions Relating to Maintenance s-12
Warnings and Cautions Relating to Mounting s-8
Warnings, Cautions, and Notes on Operation of Servo Amplifiers 176
Warnings, Cautions, and Notes on Preventive Maintenance of Motors and Detectors.....167

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