Panasonic

# Operating Instructions (Overall)

## AC Servo Motor & Driver
## MINAS A5-series


* This product image is 200W type of A5-series.

- Thank you for purchasing this Panasonic product.
- Before operating this product, please read the instructions carefully, and save this manual for future use.

Thank you for purchasing Digital AC Servo Motor & Driver, MINAS A5-series. This instruction manual contains information necessary to correctly and safely use the MINAS A5-series motor and driver. By reading this instruction manual, you will learn how to identify the model of the motor and driver that will be best suitable your application, how to wire and set up them, how to set parameters, and how to locate possible cause of symptom and to take corrective action.

## 1. Before Using the Products

**Check of the Driver Model ... Installation**

Describes how to identify and select the desired product and components, how to read the specifications, and how to install the equipment.

## 2. Preparation

**Operating requirements and procedure**

Shows the timing chart and the list of parameters, and describes how to make wiring and to use the front panel.

## 3. Connection

**Wiring ... I/O settings**

Shows block diagrams for each control mode and connection diagrams to the host controllor, I/O settings.

## 4. Setup

**Describes parameters ... JOG running**

Shows describes parameters and procedure of test operation.

## 5. Adjustment

**Gain adjustment ... Auto tuning**

Describes various adjusting method including auto tuning and manual gain tuning.

## 6. When in Trouble

Read this section when you encounter trouble or error.

## 7. Supplement

Contains S-T characteristic diagram, dimensional outline drawing, supplemental description on communications and operation.

# Contents

# Safety Precautions

Please observe safety precautions fully.

The following explanations are for things that must be observed in order to prevent harm to people and damage to property.

- Misuses that could result in harm or damage are shown as follows, classified according to the degree of potential harm or damage.

| | |
|---|---|
| **Danger** | Indicates great possibility of death or serious injury. |
| **Caution** | Indicates the possibility of injury or property damage. |

- The following indications show things that must be observed.

| | |
|---|---|
| | Indicates something that must not be done. |
| | Indicates something that must be done. |

## Danger

| | | |
|---|---|---|
| | **Do not subject the Product to water, corrosive or flammable gases, and combustibles.** | Failure to observe this instruction could result in fire. |
| | **Do not place combustibles near by the motor, driver and regenerative resistor.** | |
| | **Don't use the motor in a place subject to excessive vibration or shock.** | Failure to observe this instruction could result in electrical shock, injury or fire. |
| | **Don't use cables soaked in water or oil.** | Failure to observe this instruction could result in electrical shocks, damages and breakdowns. |
| | **Do not place the console close to a heating unit such as a heater or a large wire wound resistor.** | Failure to observe this instruction could result in fire and breakdowns. |
| | **Never connect the motor directly to the commercial power supply.** | |
| | **Don't attempt to carry out wiring or manual operation with wet hand.** | Failure to observe this instruction could result in electrical shock, injury or fire. |
| | **Do not put your hands in the servo driver.** | Failure to observe this instruction could result in burn and electrical shocks. |

| | | |
|---|---|---|
|  | **In the case of the motor with shaft end keyway, do not touch the keyway with bare hands.** | Failure to observe this instruction could result in personal injury. |
| | **Do not touch the rotating portion of the motor while it is running.** | |
| | **Do not touch the motor, servo driver, heat sink and regenerative resistor, since they become very hot.** | Failure to observe this instruction could result in burns. |
| | **Do not drive the motor with external power.** | Failure to observe this instruction could result in fire. |
| | **Do not subject the cables to excessive force, heavy object, or pinching force, nor damage the cables.** | Failure to observe this instruction could result in electrical shocks, damages and breakdowns. |
|  | **Installation area should be free from excessive dust, and from splashing water and oil.** | Failure to heed this precaution will result in electric shock, personal injury, fire, malfunction or damage. |
| | **Mount the motor, driver and regenerative resistor on incombustible material such as metal.** | Installation on a flammable material may cause fire. |
| | **Wiring has to be carried out by the qualified and authorized specialist.** | Allowing a person with no expertise to carry out wiring will result in electrical shocks. |
| | **Correctly run and arrange wiring.** | Incorrect wiring will result in short circuit, electric shock, personal injury, etc. |
| | **After correctly connecting cables, insulate the live parts with insulator.** | Incorrect wiring will result short circuit, electric shock, fire or malfunction. |
| | **Ground the earth terminal of the motor and driver without fail.** | Floating ground circuit will cause electric shock. |
| | **Install and mount the Product and machinery securely to prevent any possible fire or accidents incurred by earthquake.** | Failure to heed this requirement will result in electric shock, personal injury, fire, malfunction or damage. |
| | **Install an emergency stop circuit externally so that you can stop the operation and shut off the power immediately.** | |
| | **Install an overcurrent protection, earth leakage breaker, over-temperature protection and emergency stop apparatus without fail.** | Failure to heed these requirements will result in electric shock, personal injury or fire. |
| | **Check and confirm the safety of the operation after the earthquake.** | |
| | **Before transporting, wiring and inspecting the driver, turn off power and wait for a time longer than that specified on the name plate on the side panel of the product; and make sure that there is no risk of electrical shock.** | Energized circuit will cause electric shock. |

## ⚠ Caution

| | | |
|---|---|---|
| | **Do not hold the motor cable or motor shaft during the transportation.** | Failure to observe this instruction could result in injuries. |
| | **Don't drop or cause topple over of something during transportation or installation.** | Failure to observe this instruction could result in injuries and breakdowns. |
| | **Do not step on the Product nor place the heavy object on them.** | Failure to observe this instruction could result in electrical shocks, injuries, breakdowns and damages. |
| | **Don't use the equipment under direct sunshine.** | Failure to heed these instructions will cause personal injury or fire. |
| | **Do not block the heat dissipating holes or put the foreign particles into them.** | Failure to observe this instruction could result in electrical shocks and fire. |
| | **Do not give strong impact shock to the Product.** | Failure to observe this instruction could result in breakdowns. |
|  | **Do not give strong impact shock to the motor shaft.** | Failure to observe this instruction could result in a failure of the detector etc. |
| | **Do not turn on and off the main power of the driver repeatedly.** | Failure to observe this instruction could result in breakdowns. |
| | **Never run or stop the motor with the electro-magnetic contactor installed in the main power side.** | |
| | **Do not make an extreme gain adjustment or change of the drive.**<br>**Do not keep the machine running/operating unstably.** | Failure to observe this instruction could result in injuries. |
| | **Do not use the built-in brake as a "Braking" to stop the moving load.** | Failure to observe this instruction could result in injuries and breakdowns. |
| | **Do not approach to the machine since it may suddenly restart after the power resumption.**<br>**Design the machine to secure the safety for the operator even at a sudden restart.** | Failure to observe this instruction could result in injuries. |
| | **Never attempt to perform modification, dismantle or repair.** | Failure to heed this instruction will result in fire, electric shock, personal injury or malfunction. |
|  | **Make an appropriate mounting of the Product matching to its wight and output rating.** | Failure to heed these requirements will result in personal injury or malfunction. |

| | | |
|---|---|---|
|  | **Observe the specified mounting method and direction.** | Failure to heed these requirements will result in personal injury or malfunction. |
| | **Use the eye bolt of the motor for transportation of the motor only, and never use this for transportation of the machine.** | Using it for transportation of the machine will cause personal injury or malfunction. |
| | **Don't place any obstacle object around the motor and peripheral, which blocks air passage.** | Temperature rise will cause burn injury or fire. |
|  | **Adjust the motor and driver ambient environmental condition to match the motor operating temperature and humidity.** | Failure to heed these requirements will result in personal injury or malfunction. |
| | **Create the specified clearance between the driver and the control panel inner surface or other devices.** | |
| | **Observe the specified voltage.** | Operation from a voltage outside the rated voltage will cause electric shock, personal injury or fire. |
| | **Connect the brake control relay to the relay which is to shut off at emergency stop in series.** | Missing of one of these devices will result in personal injury or malfunction. |
| | **Provide protection device against idling of electromagnetic brake or gear head, or grease leakage from gear head.** | No protection will cause personal injury, damage, pollution or fire. |
| | **Use the motor and the driver in the specified combination.** | Not using the motor and the driver in the specified combination will result in fire. |
| | **Test-run the securely fixed motor without loading to verify normal operation, and then connect it to the mechanical system.** | Operation using a wrong model or wrong wiring connection will result in personal injury. |
| | **When any error occurs, remove the cause and release the error after securing the safety, then restart.** | Not removing the cause of the error will result in personal injury. |
| | **If the driver fails, shut off the power on the power supply side of the driver.** | Allowing a large current to continue to pass will result in fire. |
| | **Maintenance must be performed by an experienced personnel.** | Wrong wiring will cause personal injury or electric shock. |
| | **Always keep power disconnected when the power is not necessary for a long time.** | Improper operation will cause personal injury. |
| | **When you dispose the batteries, observe any applicable regulations or laws after insulating them with tape.** | |
| | **This Product shall be treated as Industrial Waste when you dispose.** | |

# Conformance to international standards

## Conformed Standards

| | | Driver | Motor |
|---|---|---|---|
| EC Directives | EMC Directives | EN55011<br>EN61000-6-2<br>EN61800-3 | – |
| | Low-Voltage Directives | EN61800-5-1 | EN60034-1<br>EN60034-5 |
| | Functional safety | EN954-1 (Cat. 3)<br>ISO13849-1 (PL d)<br>EN61508 (SIL 2)<br>EN62061 (SIL 2)<br>EN61800-5-2 (STO)<br>IEC61326-3-1 | – |
| UL Standards | | UL508C (E164620) | UL1004-1 (E327868: Small type)<br>UL1004 (E166557: Large type) |
| CSA Standards | | C22.2 No.14 | C22.2 No.100 |

IEC : International Electrotechnical Commission
EN : Europaischen Normen
EMC : Electromagnetic Compatibility
UL : Underwriters Laboratories
CSA : Canadian Standards Association

Pursuant to the directive 2004/108/EC, article 9(2)
Panasonic Testing Centre
Panasonic Service Europe, a division of
Panasonic Marketing Europe GmbH
Winsbergring 15, 22525 Hamburg, F.R. Germany

**Note** For details on compatibility with international standard, refer to P.2-2 Conformance to international standards.

**Routine maintenance and inspection of the driver and motor are essential for the proper and safe operation.**

## Notes on Maintenance and Inspection

1) Turn on and turn off should be done by operators or inspectors themselves.
2) Internal circuit of the driver is kept charged with high voltage for a while even after power-off. Turn off the power and allow 15 minutes or longer after LED display of the front panel has gone off, before performing maintenance and inspection.
3) Disconnect all of the connection to the driver when performing megger test (Insulation resistance measurement) to the driver, otherwise it could result in breakdown of the driver.
4) Do not use benzine, thinner, alcohol, acidic cleaner and alkaline cleaner because they can discolor or damage the exterior case.

## Inspection Items and Cycles

General and normal running condition

**Ambient conditions : 30˚C (annual average), load factor of 80% or lower, operating hours of 20 hours or less per day.**

Perform the daily and periodical inspection as per the items below.

| Type | Cycles | Items to be inspected |
|---|---|---|
| Daily inspection | Daily | • Ambient temperature, humidity, speck, dust or foreign object<br>• Abnormal vibration and noise<br>• Main circuit voltage<br>• Odor<br>• Lint or other particles at air holes<br>• Cleanness at front portion of the driver and connector<br>• Damage of the cables<br>• Loose connection or misalignment between the motor and machine or equipment<br>• Pinching of foreign object at the load |
| Motor with Gear Reducer | Annual | • Loose tightening<br>• Trace of overheat<br>• Damage to the terminal block<br>• Loose fasteners on terminal block |

**Note** **Inspection cycle may change when the running conditions of the above change.**

## Guideline for Parts Replacement

Use the table below for a reference. Parts replacement cycle varies depending on the actual operating conditions. Defective parts should be replaced or repaired when any error have occurred.

| | |
|---|---|
| Prohibited | **Disassembling for inspection and repair should be carried out only by authorized dealers or service company.** |

| Product | Component | Standard replacement cycles (hour) | Note |
|---|---|---|---|
| Driver | Smoothing condenser | Approx. 5 years | These hours or cycles are reference. When you experience any error, replacement is required even before this standard replacement cycle. |
| | Cooling fan | 2 to 3 years (10,000 to 30,000 hours) | |
| | Aluminum electrolytic capacitor (on PCB) | Approx. 5 years | |
| | Rush current preventive relay | Approx. 100,000 times (depending on working condition) | |
| | Rush current preventive resistor | Approx. 20,000 times (depending on working condition) | |
| Motor | Bearing | 3 to 5 years (20,000 to 30,000 hours) | |
| | Oil seal | 5000 hours | |
| | Encoder | 3 to 5 years (20,000 to 30,000 hours) | |
| | Battery for absolute encoder | Life time varies depending on working conditions. Refer to the Operating Instructions attached to the battery for absolute encoder. | |

Related page • P.7-96 “Warranty”

# 1. Before Using the Products

# 1. Introduction

## Outline

The AC Servo Motor & Driver, MINAS A5-series is the latest servo system that meets all demands from a variety of machines which require high speed, high precision and high performance or which require simplified settings.

Compared with the preceding A4-series, product of A5-series offers superior performance while requiring simple setup and adjustment by the user.

Newly designed motors have wide range of outputs from 50 W to 5.0 kW, associated with 20-bit incremental encoder and reduced cogging torque.

They are compatible with 2 closed controls (serial communication type and A-/B-phase output type) and provided with various automatic adjusting functions such as real time auto tuning with many automatic setting parameters to make complex tuning easy.

These motors assure higher stability with low stiffness machine and high-speed, high accurate operation with high stiffness machine. They can be used in combination with a wide variety of machines.

This manual is written as a complete guide for you so that you can fully and correctly make use of all functions available from MINAS A5.

1 Before Using the Products

# 1. Introduction

## On Opening the Product Package

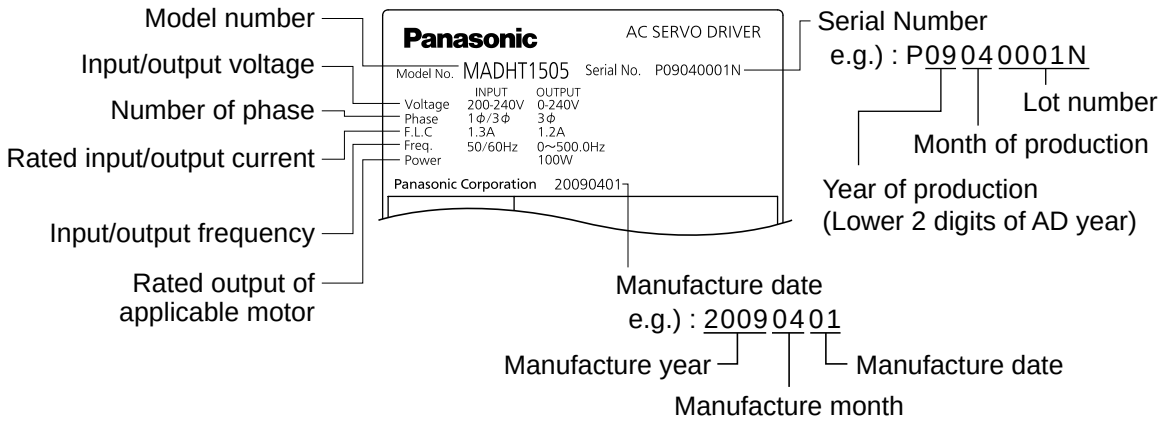
- Make sure that the model is what you have ordered.
- Check if the product is damaged or not during transportation.
- Check if the Operating Instructions (safety) are included or not.
- Check if the power connector, motor connectors, connector for external regenerative resistor connection (only E-frame) and safety by-pass plug are included or not.
  (Neither the power connector nor motor connector are included to F-frame.)

**Contact to a dealer if you find any failures.**

# 2. Driver

## Check of the Model

### Contents of Name Plate




### Model Designation

M A D H T 1 5 0 5 ∗ ∗ ∗

1 to 4 | 5 to 6 | 7 | 8 to 9 | 10 to 12

Special specifications (letters and numbers)

Frame-size symbol

| Symbol | Frame |
|---|---|
| MADH | A5-series, A-frame |
| MBDH | A5-series, B-frame |
| MCDH | A5-series, C-frame |
| MDDH | A5-series, D-frame |
| MEDH | A5-series, E-frame |
| MFDH | A5-series, F-frame |

Max. current rating of power device

| Symbol | Current rating |
|---|---|
| T1 | 10A |
| T2 | 15A |
| T3 | 30A |
| T5 | 50A |
| T7 | 70A |
| TA | 100A |
| TB | 150A |

Current detector rating

| Symbol | Current rating |
|---|---|
| 05 | 5A |
| 07 | 7.5A |
| 10 | 10A |
| 20 | 20A |
| 30 | 30A |
| 40 | 40A |
| 64 | 64A |
| 90 | 90A |
| A2 | 120A |

Power supply

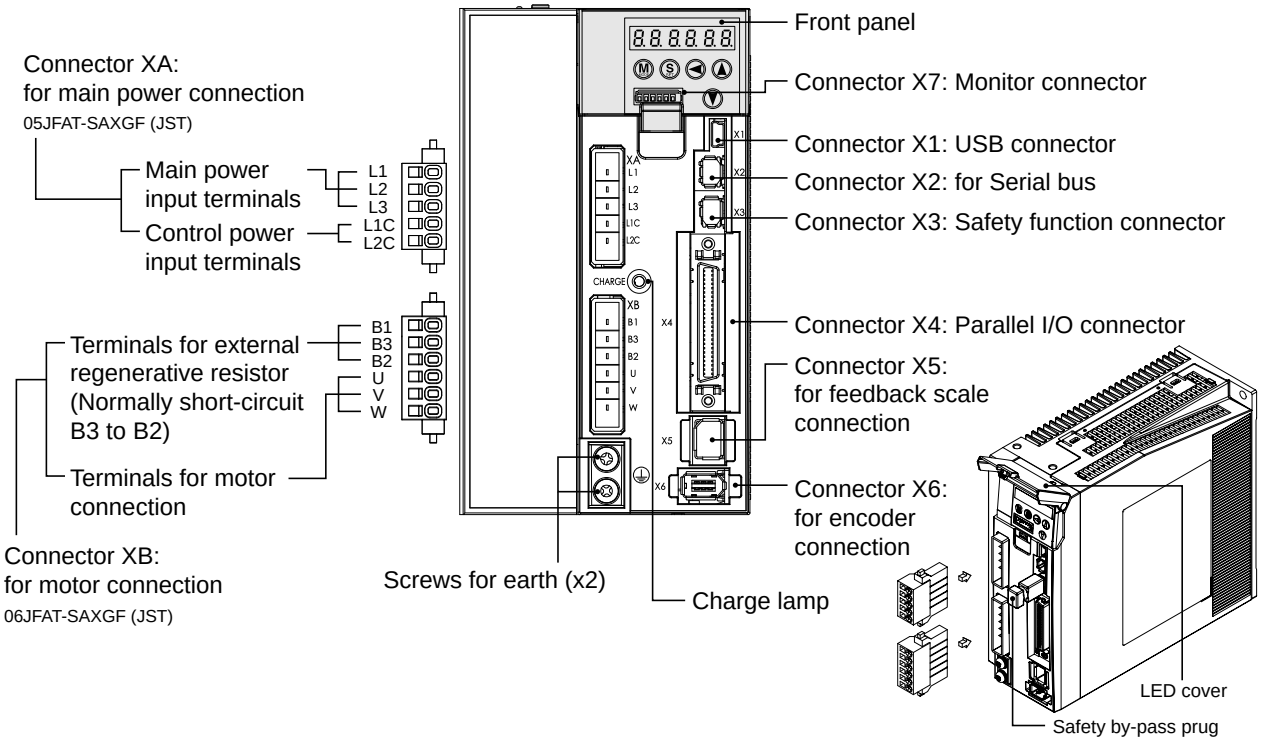
| Symbol | Specifications |
|---|---|
| 1 | Single phase, 100V |
| 3 | 3-phase, 200V |
| 5 | Single/3-phase, 200V |

Related page • P.1-14 “Check of the Combination of the Driver and the Motor”

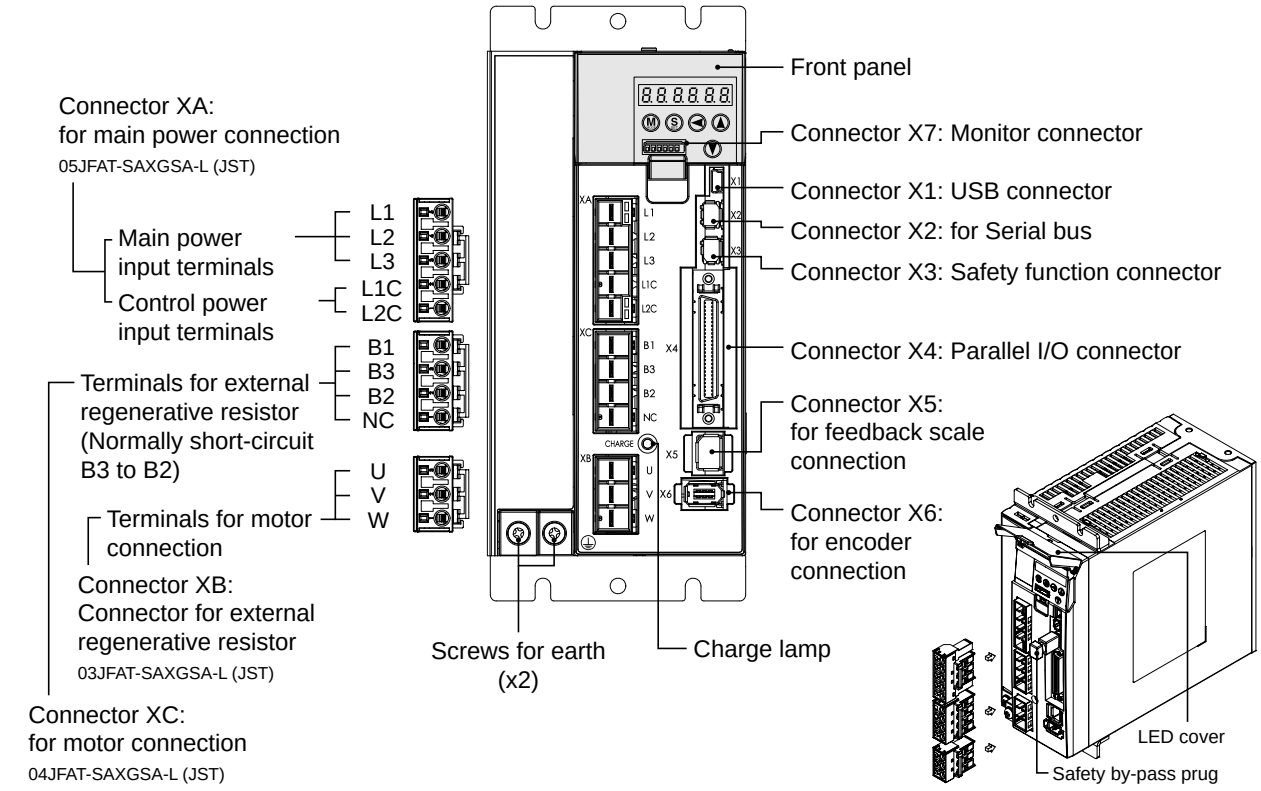
# 2. Driver

## Parts Description

### A to D-frame

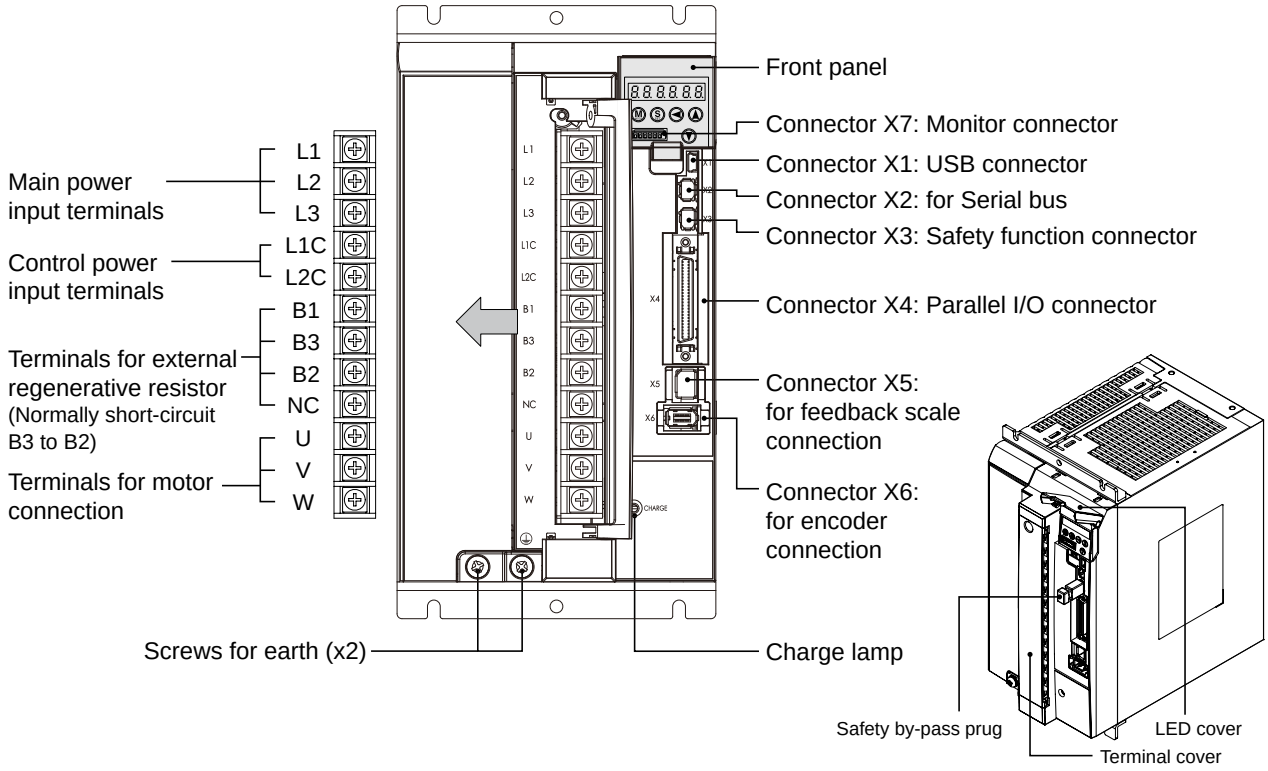



### F-frame




**Note** Connector X1 and X2 are attached in A to D-frame driver.
Connector XA, XB and XC are attached in E-frame driver.

## E-frame




Related page
• P.1-14 “Check of the Combination of the Driver and the Motor”
• P.1-16 “Installation”
• P.2-6 “Driver and List of Applicable Peripheral Equipments”

# 2. Driver

## Specifications

| | | | | | |
|---|---|---|---|---|---|
| Basic Specifications | Input power | 100V | Main circuit | | Single phase, 100 to 120V +10% –15% 50/60Hz |
| | | | Control circuit | | Single phase, 100 to 120V +10% –15% 50/60Hz |
| | | 200V | Main circuit | A to D-frame | Single/3-phase, 200 to 240V +10% –15% 50/60Hz |
| | | | | E to F-frame | 3-phase, 200 to 230V +10% –15% 50/60Hz |
| | | | Control circuit | A to D-frame | Single phase, 200 to 240V +10% –15% 50/60Hz |
| | | | | E to F-frame | Single phase, 200 to 230V +10% –15% 50/60Hz |
| | Withstand voltage | | | | Primary to earth: withstand 1500 VAC, 1 min,(sensed current: 20 mA) |
| | Environment | | temperature | | Ambient temperature: 0˚C to 55˚C (free from freezing)<br>Storage temperature: –20˚C to 65˚C (Max.temperature guarantee: 80˚C for 72 hours) |
| | | | humidity | | Both operating and storage : 20 to 85%RH or less (free from condensation) |
| | | | Altitude | | Lower than 1000m |
| | | | Vibration | | 5.88m/s$^2$ or less, 10 to 60Hz (No continuous use at resonance frequency) |
| | Control method | | | | IGBT PWM Sinusoidal wave drive |
| | Encoder feedback | | | | 17-bit (131072 resolution) absolute encoder, 7-wire serial<br>20-bit (1048576 resolution) incremental encoder, 5-wire serial |
| | Feedback scale feedback | | | | A/B phase, initialization signal defferential input.<br>Manufacturers that support serial communication scale:<br>Mitsutoyo Corp.<br>Sony Manufacturing Systems Corp. |
| | Control signal | | Input | | General purpose 10 inputs<br>The function of general-purpose input is selected by parameters. |
| | | | Output | | General purpose 6 outputs<br>The function of general-purpose input is selected by parameters. |
| | Analog /Digital signal | | Input | | 3 inputs (16Bit A/D : 1 input, 12Bit A/D : 2 inputs) |
| | | | Output | | 3 outputs (Analog monitor: 2 output, Digital monitor: 1 output) |
| | Pulse signal | | Input | | 2 inputs (Photo-coupler input, Line receiver input)<br>Photocoupler input is compatible with both line driver I/F and open collector I/F.<br>Line receiver input is compatible with line driver I/F. |
| | | | Output | | 4 outputs ( Line driver: 3 output, open collector: 1 output)<br>Feed out the encoder pulse (A, B and Z-phase) or feedback scale pulse (EXA, EXB and EXZ-phase) in line driver. Z-phase and EXZ-phase pulse is also fed out in open collector. |
| | Communication function | | USB | | Connection with PC etc. |
| | | | RS232 | | 1 : 1 communication to a host. |
| | | | RS485 | | 1 : n communication up to 31 axes to a host. |
| | Safety function | | | | Used for IEC61800-5-2: STO. |
| | Front panel | | | | (1) 5 keys (MODE, SET, UP, DOWN, SHIFT) (2) LED (6-digit)<br>(3) Analog monitor output (2ch) (4) Digital monitor output (1ch) |
| | Regeneration | | | | A, B-frame: no built-in regenerative resistor (external resistor only)<br>C to F-frame: Built-in regenerative resistor (external resistor is also enabled.) |
| | Dynamic brake | | | | Built-in |
| | Control mode | | | | Switching among the following 7 mode is enabled,<br>(1) Position control (2) Velocity control (3) Toque control (4) Position/Velocity control<br>(5) Position/Torque control (6) Velocity/Torque control (7) Full-closed control |

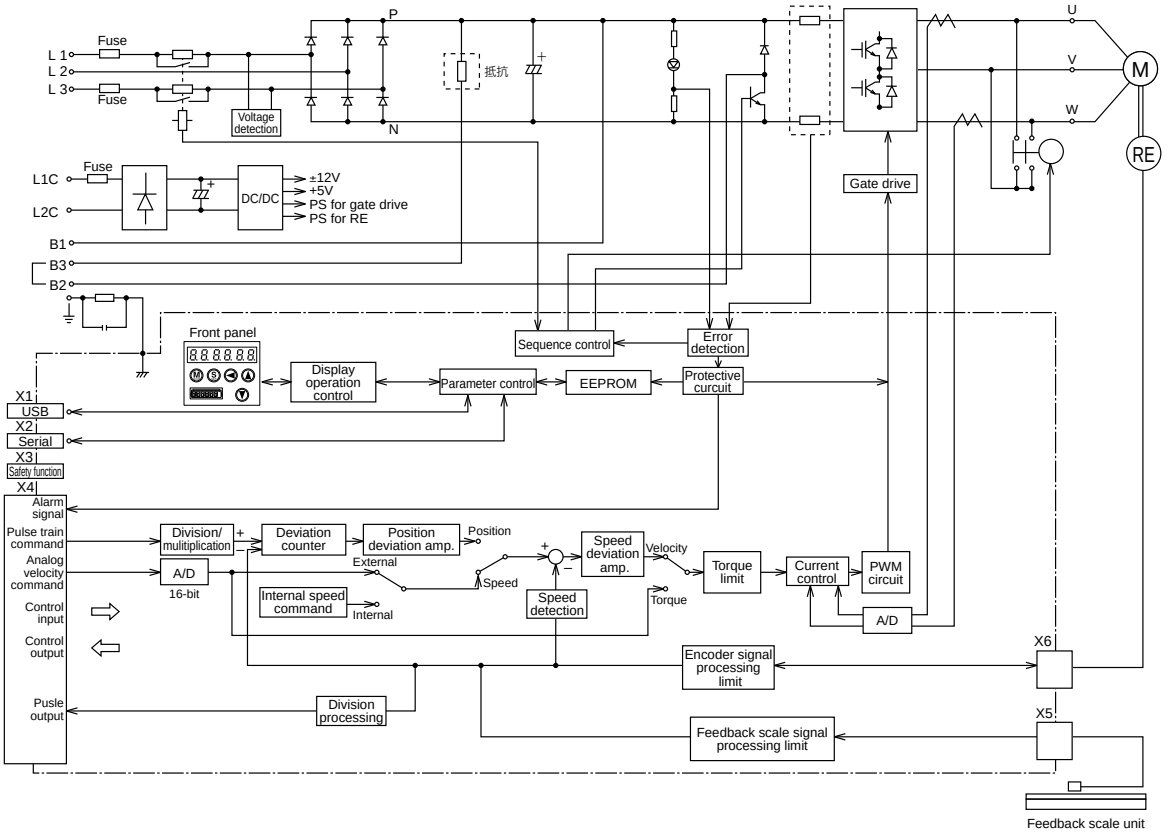
Related page
• P.1-16 “Installation of Driver”
• P.1-20 “Installation of Motor”

| | | | | |
|---|---|---|---|---|
| Function | Position control | Control input | | (1) Deviation counter clear (2) Command pulse inhibition<br>(3) Command dividing gradual increase switching (4) Damping control switching etc. |
| | | Control output | | Positioning complete (In-position) etc. |
| | | Pulse input | Max. command pulse frequency | Exclusive interface for Photo-coupler: 500kpps<br>Exclusive interface for line driver : 4Mpps |
| | | | Input pulse signal format | Differential input. Selectable with parameter. ((1) Positive and Negative direction, (2) A and B-phase, (3) Command and direction) |
| | | | Electronic gear (Division/ Multiplication of command pulse) | Process command pulse frequency × electronic gear ratio $\left(\frac{1 \text{ to } 2^{30}}{1 \text{ to } 2^{30}}\right)$ as positional command input. Use electronic gear ratio in the range 1/1000 to 1000 times. |
| | | | Smoothing filter | Primary delay filter or FIR type filter is adaptable to the command input |
| | | Analog input | Torque limit command input | Individual torque limit for both positive and negative direction is enabled. |
| | | Instantaneous Speed Observer | | Available |
| | | Damping Control | | Available |
| | Velocity control | Control input | | (1) Selection of internal velocity setup 1 (2) Selection of internal velocity setup 2<br>(3) Selection of internal velocity setup 3 (4) Speed zero clamp etc. |
| | | Control output | | Speed arrival etc. |
| | | Analog input | Velocity command input | Speed command input can be provided by means of analog voltage.<br>Parameters are used for scale setting and command polarity. (6V/Rated rotational speed Default) |
| | | | Torque limit command input | Individual torque limit for both positive and negative direction is enabled. |
| | | Internal velocity command | | Switching the internal 8speed is enabled by command input. |
| | | Soft-start/down function | | Individual setup of acceleration and deceleration is enabled, with 0 to 10s/1000r/min. Sigmoid acceleration/deceleration is also enabled. |
| | | Zero-speed clamp | | 0-clamp of internal velocity command with speed zero clamp input is enabled. |
| | | Instantaneous Speed Observer | | Available |
| | | Velocity Control filter | | Available |
| | Torque control | Control input | | Speed zero clamp, Torque command sign input etc. |
| | | Control output | | Speed arrival etc. |
| | | Analog input | Torque command input | Speed command input can be provided by means of analog voltage.<br>Parameters are used for scale setting and command polarity. (3V/rated torque Default) |
| | | Speed limit function | | Speed limit value with parameter t is enabled. |
| | Full-closed control | Control input | | (1) Deviation counter clear (2) Command pulse inhibition<br>(3) Command dividing gradual increase switching (4) Damping control switching etc. |
| | | Control output | | Full-closed positioning complete etc. |
| | | Pulse input | Max. command pulse frequency | Exclusive interface for Photo-coupler: 500kpps<br>Exclusive interface for line driver : 4Mpps |
| | | | Input pulse signal format | Differential input. Selectable with parameter. ((1) Positive and Negative direction, (2) A and B-phase, (3) Command and direction) |
| | | | Electronic gear (Division/ Multiplication of command pulse) | Process command pulse frequency × electronic gear ratio $\left(\frac{1 \text{ to } 2^{30}}{1 \text{ to } 2^{30}}\right)$ as positional command input. Use electronic gear ratio in the range 1/1000 to 1000 times. |
| | | | Smoothing filter | Primary delay filter or FIR type filter is adaptable to the command input |
| | | Analog input | Torque limit command input | Individual torque limit for both positive and negative direction is enabled. |
| | | Setup range of division/ multiplication of feedback scale | | 1/40 to 160 times<br>The ratio of encoder pulse (numerator) to external scale pulse (denominator) can be set to 1 to $2^{20}$ (numerator) to 1 to $2^{20}$ (denominator), but should be set to a ratio within the range shown above. |
| | Common | Auto tuning | | The load inertia is identified in real time by the driving state of the motor operating according to the command given by the controlling device and set up support software “PANATERM”.<br>The gain is set automatically in accordance with the rigidity setting. |
| | | Division of encoder feedback pulse | | Set up of any value is enabled (encoder pulses count is the max.). |
| | | Protective function | Hard error | Over-voltage, under-voltage, over-speed, over-load,<br>over-heat, over-current and encoder error etc. |
| | | | Soft error | Excess position deviation, command pulse division error, EEPROM error etc. |
| | | Traceability of alarm data | | The alarm data history can be referred to. |

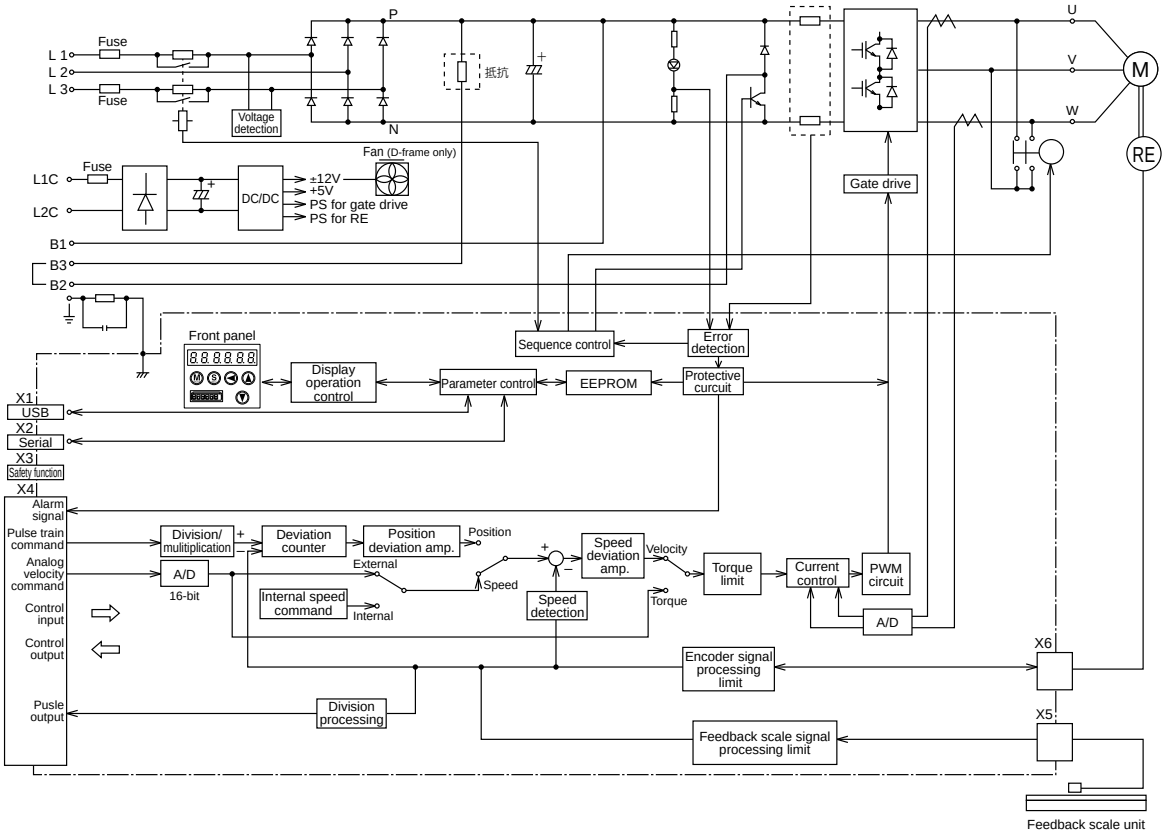
# 2. Driver

## Block Diagram

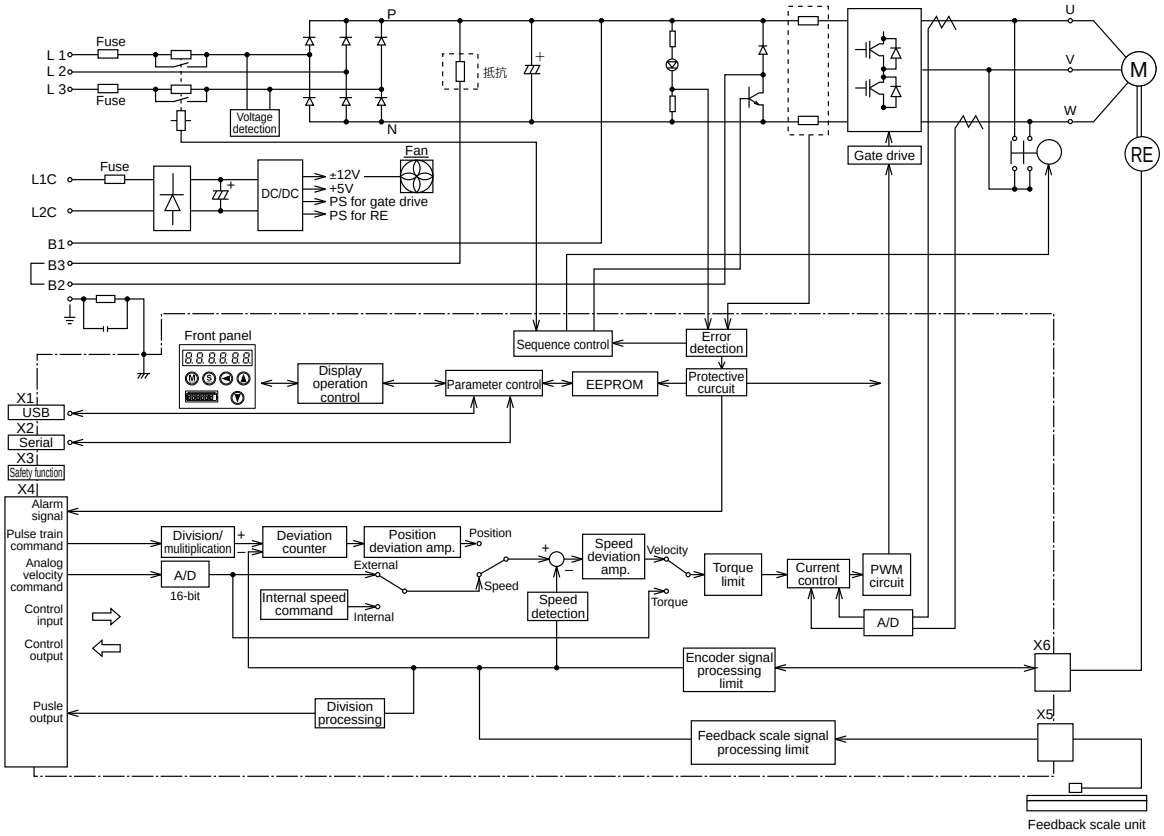
### A, B-frame



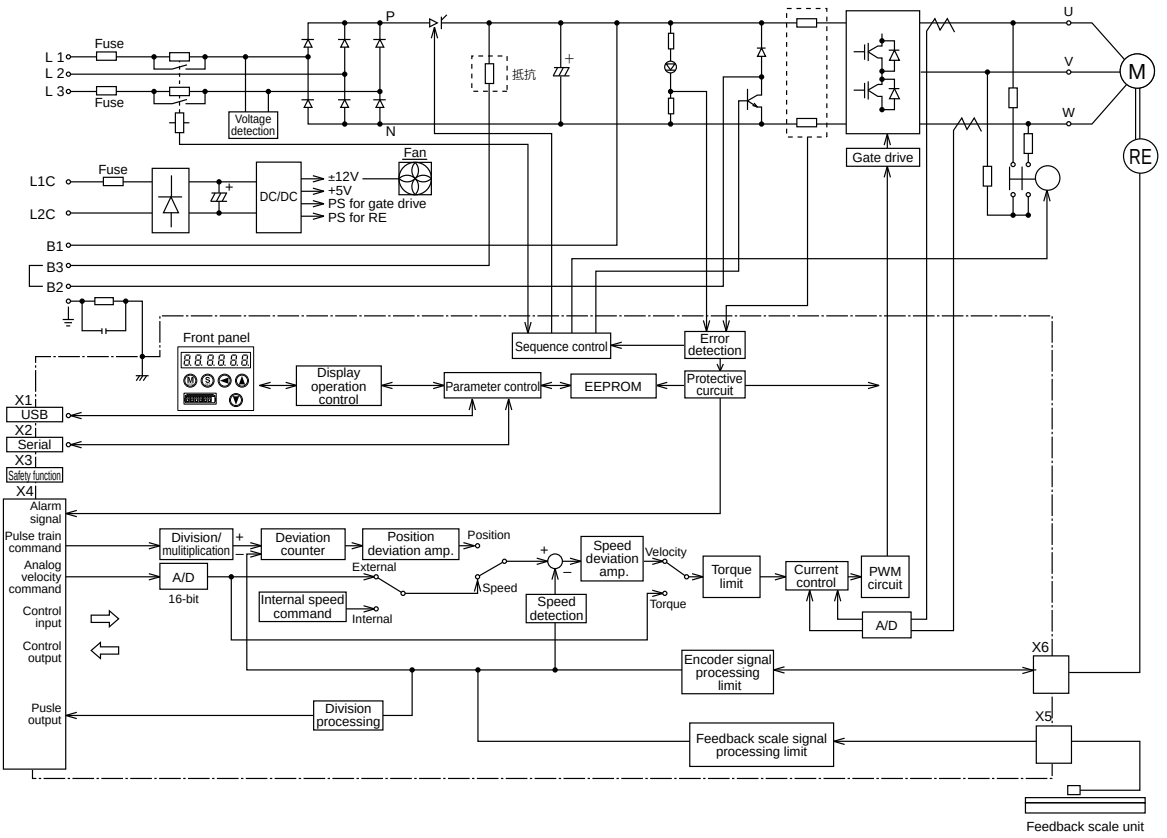

### C, D-frame



## E-frame



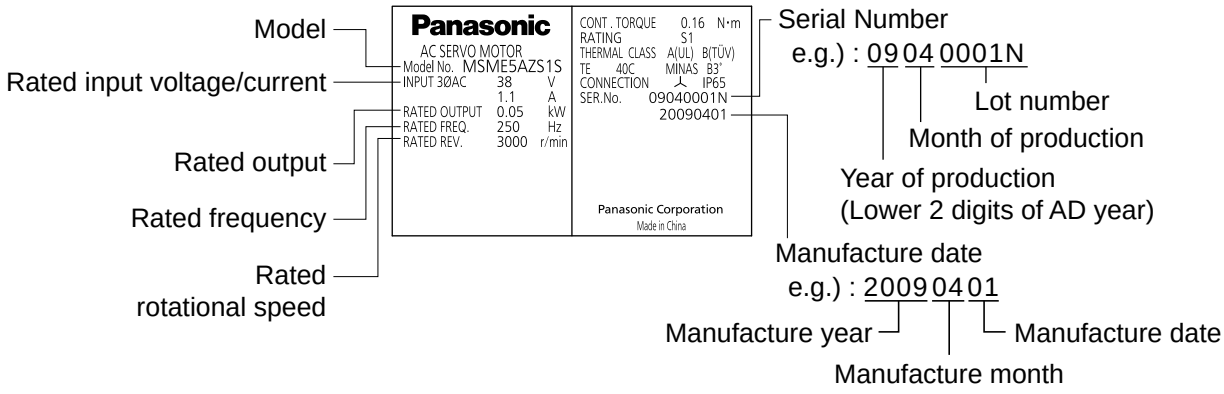

## F-frame



# 3. Motor

## Check of the Model

### Contents of Name Plate



## Model Designation

M S M E 5 A Z S 1 S ∗∗

1 to 4 | 5 to 6 | 7 | 8 | 9 | 10 | 11 to 12

Special specifications

Motor structure

Design order 1: Standard

Type

| Symbol | Specifications |
|---|---|
| MSME | Low inertia (50W to 5.0kW) |
| MDME | Middle inertia (1.0kW to 5.0kW) |
| MGME | Middle inertia (900W to 3.0kW) |
| MHME | High inertia (1.0kW to 5.0kW) |

Motor rated output

| Symbol | Output |
|---|---|
| 5A | 50W |
| 01 | 100W |
| 02 | 200W |
| 04 | 400W |
| 08 | 750W |
| 09 | 900W |
| 10 | 1.0kW |
| 15 | 1.5kW |
| 20 | 2.0kW |
| 30 | 3.0kW |
| 40 | 4.0kW |
| 50 | 5.0kW |

Voltage specifications

| Symbol | Specifications |
|---|---|
| 1 | 100 V |
| 2 | 200 V |
| Z | 100/200 common (50W only) |

Rotary encoder specifications

| Symbol | Specifications | | | |
|---|---|---|---|---|
| | Format | Pulse count | Resolution | Wire count |
| G | Incremental | 20bit | 1,048,576 | 5-wire |
| S | Absolute | 17bit | 131,072 | 7-wire |

Motor structure

MSME (50W to 750W)

| Symbol | Shaft | | Holding brake | | Oil seal | |
|---|---|---|---|---|---|---|
| | Round | Key way | Without | With | Without | With*1 |
| A | ● | | ● | | ● | |
| B | ● | | | ● | ● | |
| S | | ●*2 | ● | | ● | |
| T | | ●*2 | | ● | ● | |

MSME (1.0kW to 5.0kW), MDME, MGME, MHME

| Symbol | Shaft | | Holding brake | | Oil seal | |
|---|---|---|---|---|---|---|
| | Round | Key way | Without | With | Without | With |
| C | ● | | ● | | | ● |
| D | ● | | | ● | | ● |
| G | | ● | ● | | | ● |
| H | | ● | | ● | | ● |

*1 The product with oil seal is a special order product. *2 Key way with center tap

[Products are standard stock items or manufactured by order. For details, inquire the dealer.]

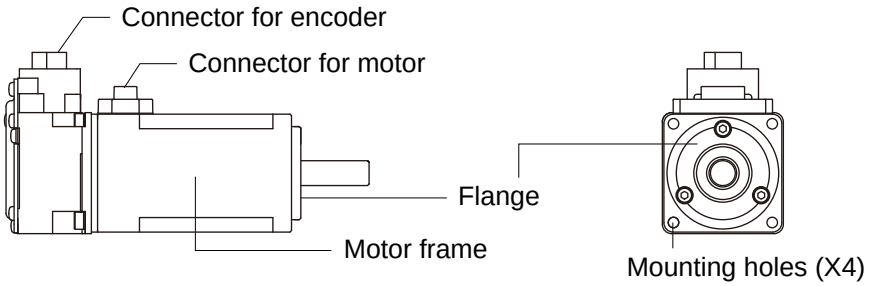
**Note** For details of specific model, refer to the Dimensions of Supplement.

Related page • P.1-14 “Check of the Combination of the Driver and the Motor” • P.7-66 “Dimensions”

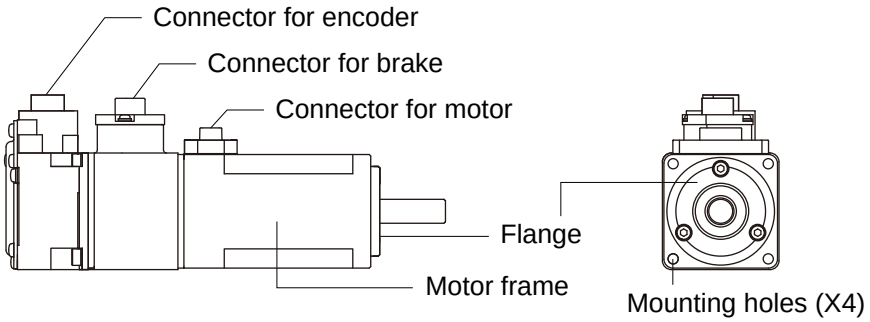
# 3. Motor

## Parts Description

• MSME 50W to 750W

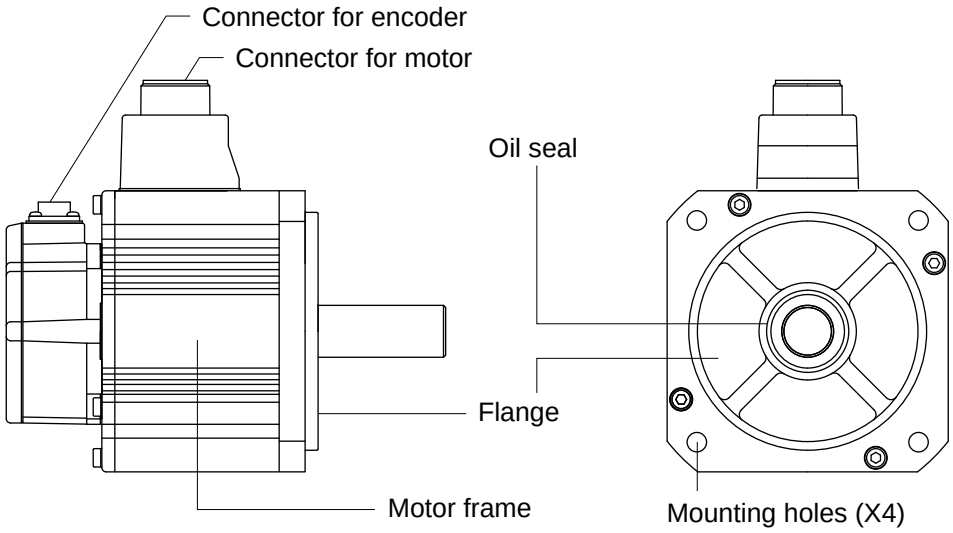



[with Brake]




e.g.) : Low inertia type (MSME series, 50W)

• MSME 1.0kW to 5.0kW
• MDME 1.0kW to 5.0kW
• MGMA 0.9kW to 3.0kW
• MHME 1.0kW to 5.0kW




e.g.) : Middle inertia type (MDME series, 1.0kW)

**Note** For details of specific model, refer to the Dimensions of Supplement. (P.7-66)

# 4. Check of the Combination of the Driver and the Motor

## Incremental Specifications, 20-bit

This driver is designed to be used in a combination with the motor which are specified by us. Check the series name of the motor, rated output torque, voltage specifications and encoder specifications.

**Remarks** **Do not use in other combinations than those listed below.**

| Motor | | | | | Driver | |
|---|---|---|---|---|---|---|
| Power supply | Type | Rated rotational speed | Model | Rated output | Model | Frame |
| Single phase, 100V | MSME Low inertia | 3000r/min | MSME5AZG1* | 50W | MADHT1105 | A-frame |
| | | | MSME011G1* | 100W | MADHT1107 | |
| | | | MSME021G1* | 200W | MBDHT2110 | B-frame |
| | | | MSME041G1* | 400W | MCDHT3120 | C-frame |
| Single/ 3-phase, 200V | | | MSME5AZG1* | 50W | MADHT1505 | A-frame |
| | | | MSME012G1* | 100W | | |
| | | | MSME022G1* | 200W | MADHT1507 | |
| | | | MSME042G1* | 400W | MBDHT2510 | B-frame |
| | | | MSME082G1* | 750W | MCDHT3520 | C-frame |
| | | | MSME102G1* | 1.0kW | MDDHT5540 | D-frame |
| | | | MSME152G1* | 1.5kW | | |
| 3-phase, 200V | | | MSME202G1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MSME302G1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MSME402G1* | 4.0kW | MFDHTB3A2 | |
| | | | MSME502G1* | 5.0kW | | |
| Single/ 3-phase, 200V | MDME Middle inertia | 2000r/min | MDME102G1* | 1.0kW | MDDHT3530 | D-frame |
| | | | MDME152G1* | 1.5kW | MDDHT5540 | |
| 3-phase, 200V | | | MDME202G1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MDME302G1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MDME402G1* | 4.0kW | MFDHTB3A2 | |
| | | | MDME502G1* | 5.0kW | | |
| Single/ 3-phase, 200V | MGME Middle inertia | 1000r/min | MGME092G1* | 0.9kW | MDDHT5540 | D-frame |
| 3-phase, 200V | | | MGME202G1* | 2.0kW | MFDHTA390 | F-frame |
| | | | MGME302G1* | 3.0kW | MFDHTB3A2 | |
| Single/ 3-phase, 200V | MHME High inertia | 2000r/min | MHME102G1* | 1.0kW | MDDHT3530 | D-frame |
| | | | MHME152G1* | 1.5kW | MDDHT5540 | |
| 3-phase, 200V | | | MHME202G1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MHME302G1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MHME402G1* | 4.0kW | MFDHTB3A2 | |
| | | | MHME502G1* | 5.0kW | | |

**Note** Suffix of " * " in the applicable motor model represents the motor structure.

# 4. Check of the Combination of the Driver and the Motor

## Absolute Specifications, 17-bit

This driver is designed to be used in a combination with the motor which are specified by us. Check the series name of the motor, rated output torque, voltage specifications and encoder specifications.

**Remarks** **Do not use in other combinations than those listed below.**

| Motor | | | | | Driver | |
|---|---|---|---|---|---|---|
| Power supply | Type | Rated rotational speed | Model | Rated output | Model | Frame |
| Single phase, 100V | MSME Low inertia | 3000r/min | MSME5AZS1* | 50W | MADHT1105 | A-frame |
| | | | MSME011S1* | 100W | MADHT1107 | |
| | | | MSME021S1* | 200W | MBDHT2110 | B-frame |
| | | | MSME041S1* | 400W | MCDHT3120 | C-frame |
| Single/ 3-phase, 200V | | | MSME5AZS1* | 50W | MADHT1505 | A-frame |
| | | | MSME012S1* | 100W | | |
| | | | MSME022S1* | 200W | MADHT1507 | |
| | | | MSME042S1* | 400W | MBDHT2510 | B-frame |
| | | | MSME082S1* | 750W | MCDHT3520 | C-frame |
| | | | MSME102S1* | 1.0kW | MDDHT5540 | D-frame |
| | | | MSME152S1* | 1.5kW | | |
| 3-phase, 200V | | | MSME202S1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MSME302S1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MSME402S1* | 4.0kW | MFDHTB3A2 | |
| | | | MSME502S1* | 5.0kW | | |
| Single/ 3-phase, 200V | MDME Middle inertia | 2000r/min | MDME102S1* | 1.0kW | MDDHT3530 | D-frame |
| | | | MDME152S1* | 1.5kW | MDDHT5540 | |
| 3-phase, 200V | | | MDME202S1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MDME302S1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MDME402S1* | 4.0kW | MFDHTB3A2 | |
| | | | MDME502S1* | 5.0kW | | |
| Single/ 3-phase, 200V | MGME Middle inertia | 1000r/min | MGME092S1* | 0.9kW | MDDHT5540 | D-frame |
| 3-phase, 200V | | | MGME202S1* | 2.0kW | MFDHTA390 | F-frame |
| | | | MGME302S1* | 3.0kW | MFDHTB3A2 | |
| Single/ 3-phase, 200V | MHME High inertia | 2000r/min | MHME102S1* | 1.0kW | MDDHT3530 | D-frame |
| | | | MHME152S1* | 1.5kW | MDDHT5540 | |
| 3-phase, 200V | | | MHME202S1* | 2.0kW | MEDHT7364 | E-frame |
| | | | MHME302S1* | 3.0kW | MFDHTA390 | F-frame |
| | | | MHME402S1* | 4.0kW | MFDHTB3A2 | |
| | | | MHME502S1* | 5.0kW | | |

**Note**

1) Suffix of " * " in the applicable motor model represents the motor structure.
2) Default of the driver is set for the incremental encoder specifications.
   When you use in absolute, make the following operations.
   a) Install a battery for absolute encoder.
   b) Switch the parameter Pr0.15 (Absolute encoder setup) from "1 (default)" to "0".

# 4. Check of the Combination of the Driver and the Motor

## Junction cable for motor

### Encoder cable

| Motor series | Incremental Specifications, 20-bit Note)1 | Absolute Specifications, 17-bit Note)1 | Detail page |
|---|---|---|---|
| MSME 50W to 750W | MFECA0**0MJD | MFECA0**0MJE | 7-76 |
| MSME 1.0kW to 5.0kW | MFECA0**0ETD | MFECA0**0ETE | 7-77 |
| MDME 1.0kW to 5.0kW | MFECA0**0ETD | MFECA0**0ETE | |
| MGME 0.9kW to 3.0kW | MFECA0**0ETD | MFECA0**0ETE | |
| MHME 1.0kW to 5.0kW | MFECA0**0ETD | MFECA0**0ETE | |

Note)1 " ** " represents the cable length.

### Motor cable/ Brake cable

| Motor series | Motor cable Note)1 | | Brake cable Note)1 | Detail page |
|---|---|---|---|---|
| | | with Brake | | |
| MSME 50W to 750W | MFMCA0**0NJD | — | MFMCB0**0PJT | 7-78<br>7-82 |
| MSME 1.0kW to 2.0kW | MFMCD0**2ECD | MFMCA0**2FCD | — | 7-78<br>⋮<br>7-81 |
| MSME 3.0kW to 5.0kW | MFMCA0**3ECT | MFMCA0**3FCT | | |
| MDME 1.0kW to 2.0kW | MFMCD0**2ECD | MFMCA0**2FCD | — | |
| MDME 3.0kW to 5.0kW | MFMCA0**3ECT | MFMCA0**3FCT | | |
| MGME 0.9kW | MFMCD0**2ECD | MFMCA0**2FCD | — | |
| MGME 2.0kW to 3.0kW | MFMCA0**3ECT | MFMCA0**3FCT | | |
| MHME 1.0kW to 1.5kW | MFMCD0**2ECD | MFMCA0**2FCD | — | |
| MHME 2.0kW | MFMCE0**3ECD | MFMCE0**3FCD | | |
| MHME 3.0kW to 5.0kW | MFMCA0**3ECT | MFMCA0**3FCT | | |

Note)1 " ** " represents the cable length.

Related page • For other cable, connector and connector kit, refer to P.7-72 "Options"

# 5. Installation

## Driver

**Install the driver properly to avoid a breakdown or an accident.**

### Installation Place

1) Install the driver in a control panel enclosed in noncombustible material and placed indoor where the product is not subjected to rain or direct sunlight. The products are not waterproof.
2) Where the products are not subjected to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chloric gas, sulfuric gas, acid, alkaline and salt and so on, and are free from splash of inflammable gas.
3) Where the motor is free from grinding oil, oil mist, iron powder or chips.
4) Well-ventilated and low humidity and dust-free place.
5) Vibration-free place.
6) Do not use benzine, thinner, alcohol, acidic cleaner and alkaline cleaner because they can discolor or damage the exterior case.

### Environmental Conditions

| Item | Conditions |
|---|---|
| Ambient temperature | 0˚C to 55˚C (free from freezing) |
| Ambient humidity | 20% to 85% RH (free from condensation) |
| Storage temperature*1 | –20˚C to 65˚C (Max.temperature guarantee: 80˚C for 72 hours) |
| Storage humidity | 20% to 85% RH (free from condensation) |
| Vibration | Lower than 5.88m/s$^2$ (0.6G), 10 to 60Hz |
| Altitude | Lower than 1000m |

*1 Extreme temperatures are permissible only for short period such as during transportation.

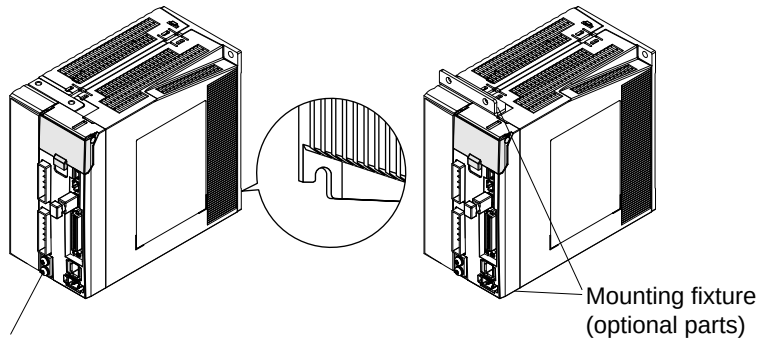
### How to Install

1) Rack-mount type. Install in vertical position, and reserve enough space around the servo driver for ventilation.
2) Base mount (rear mount) is standard for A/B/C/D-frame driver.
3) To change the mounting surface of A/B/C/D-frame driver, use the optional mounting fixture. For choosing the correct optional mounting fixture, refer to P.7-90 “Mounting Bracket”.

A to D-frame

Basemount (Standard)
[Rear mount]

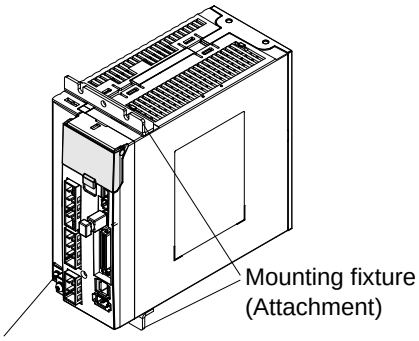
Frontmount
[Use mounting fixture]




Fastening torque of earth screws (M4)
to be 0.7 to 0.8 N·m.

E, F-frame

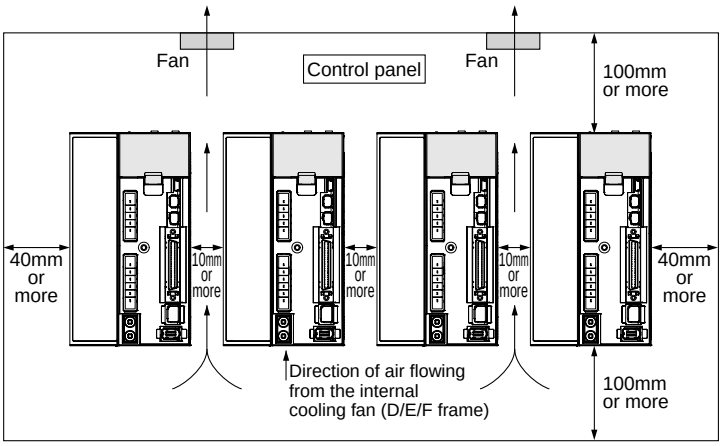
Front or Basemount
[Use mounting fixture]




Fastening torque of earth screws (M5)
to be 1.4 to 1.6 N·m.

## Mounting Direction and Spacing

- Reserve enough surrounding space for effective cooling.
- Install fans to provide uniform distribution of temperature in the control panel.
- D/E/F frame is provided with a cooling fan at the bottom.
- Observe the environmental conditions of the control panel described in the previous page.




**Note** It is recommended to use the conductive paint when you make your own mounting fixture, or repaint after peeling off the paint on the machine for installing the products, in order to make noise countermeasure.

## Caution on Installation

**Caution**

- We have been making the best effort to ensure the highest quality, however, application of exceptionally large external noise disturbance and static electricity, or failure in input power, wiring and components may result in unexpected action. It is highly recommended that you make a fail-safe design and secure the safety in the operative range.
- If stranded wires are used as the cable, bunch the conductors of the cable using a rod terminals or a round terminals. If stranded wires are used as they are, unexpected accidents such as an electric shock and short circuit or injury may result.
- There might be a chance of smoke generation due to the failure of these products. Pay an extra attention when you apply these products in a clean room environment.
- Be sure to ground the protective earth terminal.
  If the product is grounded insufficiently, not only the driver may not deliver its performance sufficiently, but also safety hazards such as a malfunction due to a electrification or a disturbance may be caused.
- If electric wires are bound and run through metal duct, they cannot carry the rated current due to temperature rise. If they are forced to carry the rated current, they may burn. When determining size of the wire.

Related page • P.1-6 “Specifications” • P.1-20 “Installation of motor”
• P.7-63 “Dimensions” • P.7-90 “Mounting fixture”

## Recommended Electric Wires for Driver

- For the main circuit, use electric wire that withstands at least 600 VAC with temperature rating 75°C or higher.
- When using bundled wires running through metallic conduit, the amounts of current determined according to the reduction rate must be subtracted from the nominal allowable current.
- Electric wires

  **<In high ambient temperature>**

  Use heat resistant wire.

  Common polyvinyl chloride wires will deteriorate by heat at a higher rate.

  **<In low ambient temperature>**

  The surface of vinyl chloride insulation becomes hardened and brittle at low temperature and needs specific protective measure when used in cold region.
- Bend radius of the cable must be 10 times or more its finish outside diameter.
- Cables cannot be used for continuous regeneration because they are not designed for such application.

## Relationship between Wire Diameter and Permissible Current

- When selecting a cable, refer to the following selection guide showing relationship between cable specification and current carrying capacity.

**Example: Power supply 3-phase, 200 V, 35 A, ambient temperature 30°C**

Determine the fundamental permissible current according to the cable conductor material (example: stranded copper wire).

(For the purpose of this example, the ampere indicated by ◇ is selected from the table right.)

Next, determine the number of conductors.

(In this example, the cable contains 4 conductors (3 + ground).)

Determine the applicable permissible current using the following formula.

**•Fundamental permissible current**

| | Stranded conductor (nominal cross section: mm²) | Copper wire (unit: A) |
|---|---|---|
| | 2 to 3.5 (excl.) | 27 |
| ◇ | **3.5 to 5.5 (excl.)** | **37** |
| | 5.5 to 8 (excl.) | 49 |
| | 8 to 14 (excl.) | 61 |
| | 14 to 22 (excl.) | 88 |
| | 11 to 30 (excl.) | 115 |
| | 30 to 38 (excl.) | 139 |

**Applicable permissible current**

= fundamental permissible current x current reduction coefficient x current correction coefficient

= 37 x 0.7 x 1.414

≒ 36.6 (A)

This permissible value is larger than 35 A to be carried though the cable. Therefore, according to the list of recommended eco-cables, the cable to be selected for the cable with nominal cross section 3.5 mm² is a polyethylene-insulated heat-resistant 4-conductor power cable having 13.5 mm finish O.D. (approx. 14.5 mm with shield).

**<Supplement>**

- The current correction coefficient is determined using the following formula:

$$\sqrt{(\text{Max. permissible temp.} - \text{ambient temp.}) \div 30}$$

**Caution** The current correction coefficient is determined according to the cable. Check the specification of the cable used.

- The current reduction coefficient is provided for the case where the cable (4-conductor cable in the case of example), is housed in plastic race/sheath, plastic tube, metal race/sheath, metal tube or flexible conduit.

**Caution** Because the neutral conductor is not counted as a wire, the current reduction coefficient for "3 or less" is applied as indicated by (◎) in the table right.

**•Current reduction coefficient**

| No. of wires in a tube | Coefficient |
|---|---|
| ◎ **Up to 3** | **0.70** |
| 4 | 0.63 |
| 5 or 6 | 0.56 |
| 7 to 15 | 0.49 |
| 16 to 40 | 0.43 |
| 41 to 60 | 0.39 |
| 61 or more | 0.34 |

## • Recommended eco-cable

Wire category: 4-conductor polyethylene-insulated power cable with heat-resistant polyethylene sheath (Standard: EM JIS C 3605)
Maximum permissible temperature: 90°C

| Conductor | | | Insulation thickness (mm) | Sheath thickness (mm) | (Reference) Finish O.D. (mm) | Max. conductor resistance (20°C) (W/km) | Test voltage (V/1 min.) | Minimum insulation resistance (MW·km) | (Reference) Approx. mass (kg/km) |
|---|---|---|---|---|---|---|---|---|---|
| Nominal cross section ($mm^2$) | Structure or shape (wires/$mm^2$) | Outside diameter (mm) | | | | | | | |
| 2 | 7/0.6 | 1.8 | 0.8 | 1.5 | 12.0 | 9.42 | 1500 | 2500 | 170 |
| **3.5** | **7/0.8** | **2.4** | **0.8** | **1.5** | **13.5** | **5.30** | **1500** | **2500** | **250** |
| 5.5 | 7/1.0 | 3.0 | 1.0 | 1.5 | 16.0 | 3.40 | 1500 | 2500 | 360 |
| 8 | 7/1.2 | 3.6 | 1.0 | 1.5 | 17.0 | 2.36 | 1500 | 2000 | 475 |
| 14 | Circular compression | 4.4 | 1.0 | 1.5 | 19.0 | 1.34 | 2000 | 1500 | 730 |
| 22 | Circular compression | 5.5 | 1.2 | 1.6 | 23 | 0.849 | 2000 | 1500 | 1100 |
| 38 | Circular compression | 7.3 | 1.2 | 1.8 | 28 | 0.491 | 2500 | 1500 | 1800 |

**Caution** Shield will increase finish outside diameter by approx. 1 mm.

**Note**

- Appropriate cable should be selected to have sufficient allowance for parameters such as operating ambient temperature and current.
- Current reduction coefficient, fundamental permissible current, etc., stated on this page are subject to change due to e.g. standard revision. Consult cable manufacturers for the latest information.

**Related page** • P.1-15 "Junction cable for motor"

# 5. Installation

## Motor

**Install the motor properly to avoid a breakdown or an accident.**

### Installation Place

**Since the conditions of location affect a lot to the motor life, select a place which meets the conditions below.**

1) Indoors, where the products are not subjected to rain or direct sun beam. The products are not waterproof.
2) Where the products are not subjected to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chloric gas, sulfuric gas, acid, alkaline and salt and so on, and are free from splash of inflammable gas.
3) Where the motor is free from grinding oil, oil mist, iron powder or chips.
4) Well-ventilated and humid and dust-free place, far apart from the heat source such as a furnace.
5) Easy-to-access place for inspection and cleaning
6) Vibration-free place.
7) Avoid enclosed place. Motor may gets hot in those enclosure and shorten the motor life.

### Environmental Conditions

| Item | | Conditions |
|---|---|---|
| Ambient temperature*1 | | 0˚C to 40˚C (free from freezing) |
| Ambient humidity | | 20% to 85% RH (free from condensation) |
| Storage temperature*2 | | –20˚C to 65˚C (Max.temperature guarantee: 80˚C for 72 hours) |
| Storage humidity | | 20% to 85% RH (free from condensation) |
| Vibration | Motor only | Lower than 49m/s$^2$ (5G) at running, 24.5m/s$^2$ (2.5G) at stall |
| Impact | Motor only | Lower than 98m/s$^2$ (10G) |
| Enclosure rating | Motor only (Connector type) | IP67 (except rotating portion of output shaft and connecting pin part of the motor connector and the encoder connector)*3*4 |
| Altitude | | Lower than 1000m |

*1 Ambient temperature to be measured at 5cm away from the motor.
*2 Permissible temperature for short duration such as transportation.
*3 These motors conform to the test conditions specified in EN standards (EN60529, EN60034-5). Do not use these motors in application where water proof performance is required such as continuous wash-down operation.
*4 This condition is applied when the connector mounting screw in case of motor 750W or less are tightened to the recommended tightening torque (Refer to 1-16, 2-18, 2-00). Be sure to use mounting screw supplied with the connector.

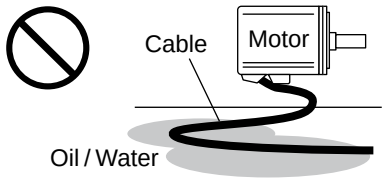
### How to Install

You can mount the motor either horizontally or vertically as long as you observe the followings.

1) Horizontal mounting
   • Mount the motor with cable outlet facing downward for water/oil countermeasure.
2) Vertical mounting
   • Use the motor with oil seal (make-to-order in case of motor 750W or less) when mounting the motor with gear reducer to prevent the reducer oil/grease from entering to the motor.

## Oil/Water Protection

1) Don't submerge the motor cable to water or oil.
2) Install the motor with the cable outlet facing downward.
3) Avoid a place where the motor is always subjected to oil or water.
4) Use the motor with an oil seal when used with the gear reducer, so that the oil may not enter to the motor through shaft.




## Stress to Cables

1) Avoid a stress application to the cable outlet and connecting portion by bending or self-weight.
2) Especially in an application where the motor itself travels, fix the junction cable into the bearer so that the stress by bending can be minimized.
3) Take the cable bending radius as large as possible. (Minimum R20mm)

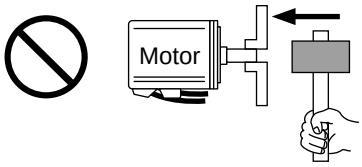
## Permissible Load to Output Shaft

1) Design the mechanical system so that the applied radial load and/or thrust load to the motor shaft at installation and at normal operation can meet the permissible value specified to each model.
2) Pay an extra attention when you use a rigid coupling. (Excess bending load may damage the shaft or deteriorate the bearing life.)
3) Use a flexible coupling with high stiffness designed exclusively for servo application in order to make a radial thrust caused by micro misalignment smaller than the permissible value.

**Note** For permissible load of each model, refer to P.1-23, “Permissible Load at Output Shaft”.

## Notes on Installation

1) Do not apply direct impact to the shaft by hammer while attaching/detaching a coupling to and from the motor shaft.
(Or it may damage the encoder mounted on the other side of the shaft.)
2) Make a full alignment. (incomplete alignment may cause vibration and damage the bearing.)




3) If the motor shaft is not electrically grounded, it may cause electrolytic corrosion to the bearing depending on the condition of the machine and its mounting environment, and may result in the bearing noise. Check and verification by customer is required.

Related page • P.1-15 “Junction cable for motor” • P.1-16 “Installation of driver”
• P.1-23 “Permissible Load at Output Shaft” • P.7-63 “Dimensions”

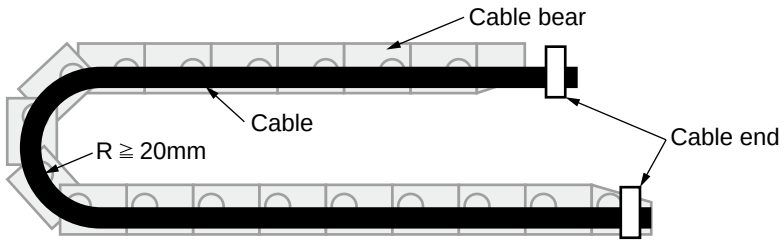
## Wiring Precautions on Movable Section

When wiring cable bear, take the following precautions:

- **Cable bear wiring**

  The bend radius of the cable must be 10 times or more its finish outside diameter.
  The minimum radius: R≧20 mm.
  For finish outside diameter, refer to P.1-18 How to Install, “Relationship between Wire Diameter and Permissible Current” and associated tables.
  Do not fix or bundle wires in the cable bear.
  When securing the cable, fix it only at non-movable ends of the cable bear where the cable is free from any stress (e.g. tension). (Avoid tight lock.)

  [Recommended cable bear wiring]




**Caution** Do not keep the cable loosened (too long) or under tension (too short).
Otherwise, the sheath will be cracked by internal wall of the cable bear, tangled by other cable, etc., causing unpredictable troubles.

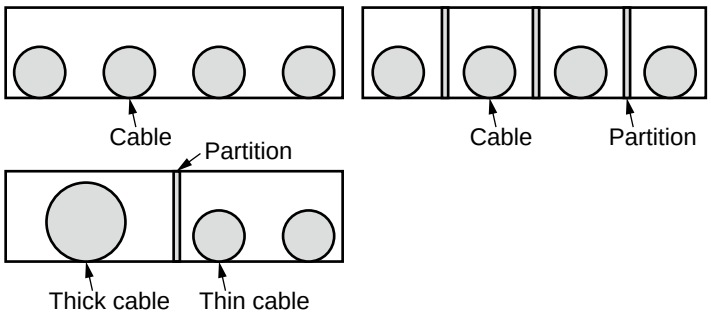
- **Cable distortion**

  Keep the cable free from twists or kinks.
  Distorted cable will cause loose connection, lowering performance and reliability.

- **Lamination factor of cable in cable bear**

  Place cables on a flat surface in parallel without bringing them into contact with each other and measure the dimension necessary to cover these cables. Then select a cable bear which is wider than the measured dimension.
  The lamination factor of cables should be lower than 60% (recommended factor is 30% or below).
  Do not run smaller and larger size cables in the same cable bear. Thin cables may break under the pressure of thick cables. If it is necessary to mix cables of different size, isolate them by using suitable separating material such as partition.

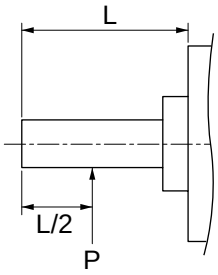
  [Wiring arrangement in cable bear – example]



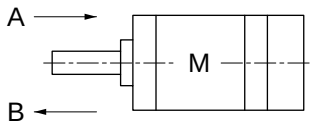
# 6. Permissible Load at Output Shaft

## Motor

Radial load (P) direction



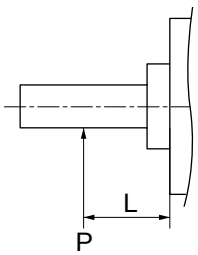

Thrust load (A and B) direction




Unit : N (1kgf=9.8N)

| Motor series | Motor output | At assembly | | | During running | |
|---|---|---|---|---|---|---|
| | | Radial thrust | Thrust load | | Radial thrust | Thrust load A and B-direction |
| | | | A-direction | B-direction | | |
| MSME | 50W, 100W | 147 | 88 | 117.6 | 68.6 | 58.8 |
| | 200W, 400W | 392 | 147 | 196 | 245 | 98 |
| | 750W | 686 | 294 | 392 | 392 | 147 |
| | 1.0kW, 1.5kW, 2.0kW, 3.0kW | 980 | 588 | 686 | 490 | 196 |
| | 4.0kW, 5.0kW | | | | 784 | 343 |
| MDME | 1.0kW to 2.0kW | 980 | 588 | 686 | 490 | 196 |
| | 3.0kW | | | | 784 | 343 |
| | 4.0kW | 1666 | 784 | 980 | | |
| | 5.0kW | | | | | |
| MHME | 1.0kW to 1.5kW | 980 | 588 | 686 | 490 | 196 |
| | 2.0kW to 5.0kW | 1666 | 784 | 980 | 784 | 343 |
| MGME | 0.9kW | 980 | 588 | 686 | 686 | 196 |
| | 2.0kW | 1666 | 784 | 980 | 1176 | 490 |
| | 3.0kW | 2058 | 980 | 1176 | 1470 | |

**Note** When the load point varies, calculate the permissible radial load, P (N) from the distance of the load point, L (mm) from the mounting flange based on the formula of the right table, and make it smaller than the calculated result.




| Motor series | Motor output | Formula of Load and load point relation |
|---|---|---|
| MSME | 50W | $P = \frac{3533}{L+39}$ |
| | 100W | $P = \frac{4905}{L+59}$ |
| | 200W | $P = \frac{14945}{L+46}$ |
| | 400W | $P = \frac{19723}{L+65.5}$ |
| | 750W | $P = \frac{37044}{L+77}$ |
| | 1.0kW to 3.0kW | $P = \frac{20090}{L+13.5}$ |
| | 4.0kW 5.0kW | $P = \frac{36848}{L+14.5}$ |

| Motor series | Motor output | Formula of Load and load point relation |
|---|---|---|
| MDME | 1.0kW to 2.0kW | $P = \frac{20580}{L+14.5}$ |
| | 3.0kW | $P = \frac{36848}{L+14.5}$ |
| | 4.0kW 5.0kW | $P = \frac{42336}{L+19}$ |
| MGME | 0.9kW | $P = \frac{33957}{L+14.5}$ |
| | 2.0kW | $P = \frac{69384}{L+19}$ |
| | 3.0kW | $P = \frac{86730}{L+19}$ |
| MHME | 1.0kW to 1.5kW | $P = \frac{24255}{L+14.5}$ |
| | 2.0kW to 5.0kW | $P = \frac{46256}{L+19}$ |

MEMO

# 2. Preparation

# 1. Conformance to international standards

## EC Directives

### EC Directives

The EC Directives apply to all such electronic products as those having specific functions and have been exported to EU and directly sold to general consumers. Those products are required to conform to the EU unified standards and to furnish the CE marking on the products.

However, our AC servos meet the relevant EC Directives for Low Voltage Equipment so that the machine or equipment comprising our AC servos can meet EC Directives.

### EMC Directives

MINAS Servo System conforms to relevant standard under EMC Directives setting up certain model (condition) with certain locating distance and wiring of the servo motor and the driver. And actual working condition often differs from this model condition especially in wiring and grounding. Therefore, in order for the machine to conform to the EMC Directives, especially for noise emission and noise terminal voltage, it is necessary to examine the machine incorporating our servos.

### Conformity to UL Standards

Observe the following conditions of (1) and (2) to make the system conform to UL508C (E164620).

(1) Use the driver in an environment of Pollution Degree 2 or 1 prescribed in IEC60664-1. (e.g. Install in the control box with IP54 enclosure.)

(2) Make sure to install a circuit breaker or fuse which are UL recognized (Listed ㊊ marked) between the power supply and the noise filter.

**Remarks** Use a copper cable with temperature rating of 75˚C or higher.

**Note** For rated current of circuit breaker and fuse, refer to P.2-6 “Driver and List of Applicable Peripheral Equipments”.

(3) Over-load protection level

Over-load protective function will be activated when the effective current exceeds 115% or more than the rated current based on the time characteristics (see the next page). Confirm that the effective current of the driver does not exceed the rated current. Set up the peak permissible current with Pr0.13 (Setup of 1st torque limit) and Pr5.22 (Setup 2nd torque limit).

**Note** For Overload protection time characterstics, refer to P.6-13.

## Conformed Standards

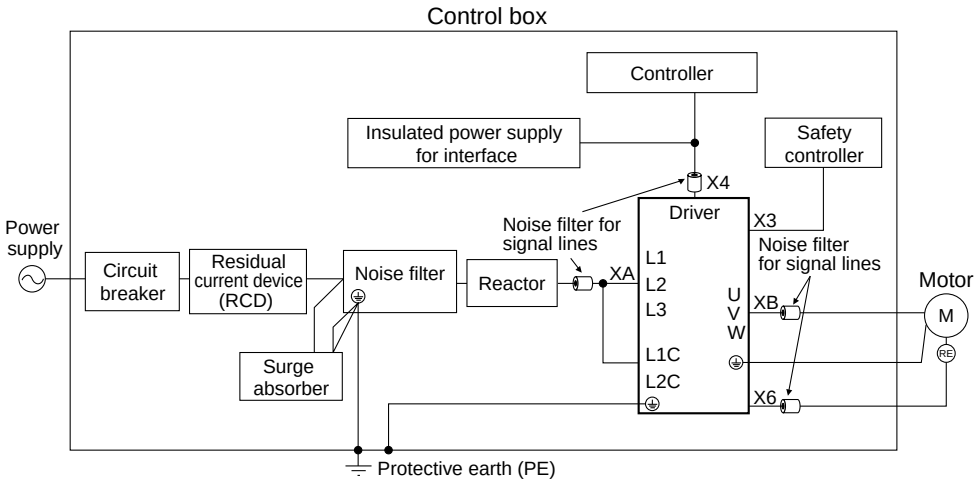
| | | Driver | Motor |
|---|---|---|---|
| EC Directives | EMC Directives | EN55011<br>EN61000-6-2<br>EN61800-3 | – |
| | Low-Voltage Directives | EN61800-5-1 | EN60034-1<br>EN60034-5 |
| | Functional safety | EN954-1 (Cat. 3)<br>ISO13849-1 (PL d)<br>EN61508 (SIL 2)<br>EN62061 (SIL 2)<br>EN61800-5-2 (STO)<br>IEC61326-3-1 | – |
| UL Standards | | UL508C (E164620) | UL1004-1 (E327868: Small type)<br>UL1004 (E166557: Large type) |
| CSA Standards | | C22.2 No.14 | C22.2 No.100 |

IEC : International Electrotechnical Commission
EN : Europaischen Normen
EMC : Electromagnetic Compatibility
UL : Underwriters Laboratories
CSA : Canadian Standards Association

Pursuant to the directive 2004/108/EC, article 9(2)
Panasonic Testing Centre
Panasonic Service Europe, a division of
Panasonic Marketing Europe GmbH
Winsbergring 15, 22525 Hamburg, F.R. Germany

## Installation Environment

Use the servo driver in the environment of Pollution Degree 1 or 2 prescribed in IEC-60664-1 (e.g. Install the driver in control panel with IP54 protection structure.)




**Caution** Use options correctly after reading Operating Instructions of the options to better understand the precautions.
Take care not to apply excessive stress to each optional part.

# 1. Conformance to international standards

## Composition of Peripheral Equipments

### Power Supply

| | | | | | | |
|---|---|---|---|---|---|---|
| 100V type : Single phase, (A to C-frame) | 100V | +10% –15% | to | 120V | +10% –15% | 50/60Hz |
| 200V type : Single/3-phase, (A to D-frame) | 200V | +10% –15% | to | 240V | +10% –15% | 50/60Hz |
| 200V type : 3-phase, (E, F-frame) | 200V | +10% | to | 230V | +10% | 50/60Hz |
| 400V type : 3-phase, | 380V | +10% –15% | to | 480V | +10% –15% | 50/60Hz |

(1) This product is designed to be used in over-voltage category (installation category) III of EN 61800-5-1:2007.

(2) Use an insulated power supply of DC12 to 24V which has CE marking or complies with EN60950.

### Circuit Breaker

Install a circuit breaker which complies with IEC Standards and UL recognized (Listed and Ⓤ marked) between power supply and noise filter.

The short-circuit protection circuit on the product is not for protection of branch circuit. The branch circuit should be protected in accordance with NEC and the applicable local regulations in your area.

### Noise Filter

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Applicable driver (frame) | Manufacturer |
|---|---|---|---|---|
| DV0P4170 | Single phase 100V/200V | SUP-EK5-ER-6 | A and B-frame | Okaya Electric Ind. |
| DV0PM20042 | 3-phase 200V | 3SUP-HU10-ER-6 | A, B-frame | |
| | Single phase 100V/200V 3-phase 200V | | C-frame | |
| DV0P4220 | Single/ 3-phase 200V | 3SUP-HU30-ER-6 | D-frame | |
| DV0PM20043 | 3-phase 200V | 3SUP-HU50-ER-6 | E-frame | |
| DV0P3410 | 3-phase 200V | 3SUP-HL50-ER-6B | F-frame | |

**• Recommended components**

| Model No. | Voltage specifications for driver | Applicable driver (frame) | Manufacturer |
|---|---|---|---|
| RTHN-5010 | 3-phase 200V | A, B, C-frame | TDK-Lambda Corp. |
| RTHN-5030 | | D-frame | |
| RTHN-5050 | | E, F-frame | |

**Remarks**

- Select a noise filter whose capacity is commensurate with the power source capacity (in consideration of the load condition).
- For the detailed specifications of each noise filter, contact the manufacturer.

**Remarks** When performing withstand voltage test of machine and equipment, be sure to remove the surge absorber; otherwise, it will be damaged.

**Related page**
- P.2-6 "Driver and List of Applicable Peripheral Equipments"
- P.7-77 "Option"

## Surge Absorber

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Manufacturer |
|---|---|---|---|
| DV0P1450 | 3-phase 200V | RAV-781BXZ-4 | Okaya Electric Ind. |
| DV0P4190 | Single phase 100V/200V | RAV-781BWZ-4 | Okaya Electric Ind. |

## Noise Filter for Signal Lines

| Option part No. | Manufacturer's part No. | Manufacturer |
|---|---|---|
| DV0P1460 | ZCAT3035-1330 | TDK Corp. |

## Residual current device

Install a type B Residual current device (RCD) at primary side of the power supply.

## Grounding

(1) Connect the protective earth terminal (⏚) of the driver and the protective earth terminal (PE) of the control box without fail to prevent electrical shocks.

(2) Do not make a joint connection to the protective earth terminals (⏚). 2 terminals are provided for protective earth.

**Note** For driver and applicable peripheral equipments, refer to P.2-6 "Driver and List of Applicable Peripheral Equipments".

# 2. System Configuration and Wiring

## Driver and List of Applicable Peripheral Equipments

| Driver | Applicable motor | Voltage | Rated output | Required Power (at the rated load) | Circuit breaker (rated current) | Noise filter | Surge absorber | Noise filter for signal | Magnetic contactor | Cable diameter (main circuit) | Cable diameter (control circuit) | Connection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MADH | MSME | Single phase, 100V | 50W to 100W | approx. 0.4kVA | 10A | DV0P4170 | DV0P4190 | DV0P1460 | 20A (3P+1a) | 0.75mm²/ AWG18 to 2.0mm²/ AWG14 | 0.75mm²/ AWG18 | Connection to exclusive connector |
| | | Single/ 3-phase, 200V | 50W to 200W | approx. 0.5kVA | | DV0P4170 / DV0PM 20042 | DV0P4190 / DV0P1450 | | | | | |
| MBDH | MSME | Single phase, 100V | 200W | approx. 0.5kVA | | DV0P4170 | DV0P4190 | | | | | |
| | | Single/ 3-phase, 200V | 400W | approx. 0.9kVA | | DV0P4170 / DV0PM 20042 | DV0P4190 / DV0P1450 | | | | | |
| MCDH | MSME | Single phase, 100V | 400W | approx. 0.9kVA | | DV0PM 20042 | DV0P4190 | | | | | |
| | | Single/ 3-phase, 200V | 750W | approx. 1.3kVA | 15A | | DV0P4190 / DV0P1450 | | | | | |
| MDDH | MDME | Single/ 3-phase, 200V | 1.0kW | approx. 1.8kVA | | DV0P4220 | | | 30A (3P+1a) | 2.0mm²/ AWG14 | | |
| | MHME | | | | | | | | | | | |
| | MGME | | 900W | approx. 1.8kVA | 20A | | | | | | | |
| | MSME | | 1.0kW | approx. 1.8kVA | | | | | | | | |
| | MHME | | 1.5kW | approx. 2.3kVA | | | | | | | | |
| | MDME | | | | | | | | | | | |
| | MSME | | | | | | | | | | | |
| MEDH | MDME | 3-phase, 200V | 2.0kW | approx. 3.3kVA | 30A | DV0PM 20043 | DV0P1450 | | 50A (3P+1a) | 3.5mm²/ AWG12 | | 11mm or smaller, ø5.3, Terminal block M5 |
| | MSME | | | | | | | | | | | |
| | MHME | | | | | | | | | | | |
| MFDH | MGME | 3-phase, 200V | 2.0kW | approx. 3.8kVA | 50A | DV0P3410 | | | | | | |
| | MDME | | 3.0kW | approx. 4.5kVA | | | | | | | | |
| | MHME | | | | | | | | | | | |
| | MSME | | | | | | | | | | | |
| | MGME | | 4.0kW | approx. 6kVA | | | | | 100A (3P+1a) | | | |
| | MDME | | | | | | | | | | | |
| | MHME | | | | | | | | | | | |
| | MSME | | | | | | | | | | | |
| | MDME | | 5.0kW | approx. 7.5kVA | | | | | | 5.3mm²/ AWG10 | | |
| | MHME | | | | | | | | | | | |
| | MSME | | | | | | | | | | | |

- Select peripheral equipments for single/3phase common specification according to the power source.

[For details of peripheral equipments]

Noise filter..... P.7-72
Surge absover ..... P.7-74
Noise filter for signal lines. P.7-75

- About circuit breaker and magnetic contactor

**To comply to EC Directives, install a circuit breaker between the power and the noise filter without fail, and the circuit breaker should conform to IEC Standards and UL recognized (Listed and Ⓤ marked).**

Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, below the maximum input voltage of the product.

If the short-circuit current of the power supply exceeds this value, install a current limit device (current limiting fuse, current limiting circuit breaker, transformer, etc.) to limit the short-circuit current.

**Remarks**

- Select a circuit breaker and noise filter which match to the capacity of power supply (including a load condition).
- Terminal block and protective earth terminals

Use a copper conductor cables with temperature rating of 75˚C or higher.

The screws of protective earth terminals for Frame A to D are M4 and M5 for Frame E, F.

Fastening torque of earth screws. refer to P.1-16.

Tighten the terminal block screw on frame F with a torque between 1.0 and 2.0 N·m. Application of overtorque (more than 2.0 N·m) will cause damage to terminal block. Maximum allowable torque to the screw securing terminal block cover is 0.19 to 0.21 N·m.

- The cable diameter of an earth cable.

Use an earth cable with the same diameter or larger as that of the main circuit cable.

If the diameter of the main circuit cable is 1.6mm$^2$ or less, use an earth cable with a diameter of 2.0mm$^2$ (AWG14).

- Use the attached exclusive connector for A to E-frame, and maintain the peeled off length of 8 to 9mm. (Refer to P.2-19)
- Tighten the screws of the connector, Connector X4 for the host controller with the torque of 0.3 to 0.35 N·m.

Larger torque than 0.35N·m may damage the connector at the driver side.

**Caution**

Do not turn on power without tightening all terminal block screws properly, otherwise, loose contacts may generate heat (smoking, firing).

# 2. System Configuration and Wiring

## Overall Wiring (Connector type)

### Connecting Example of A to D-frame

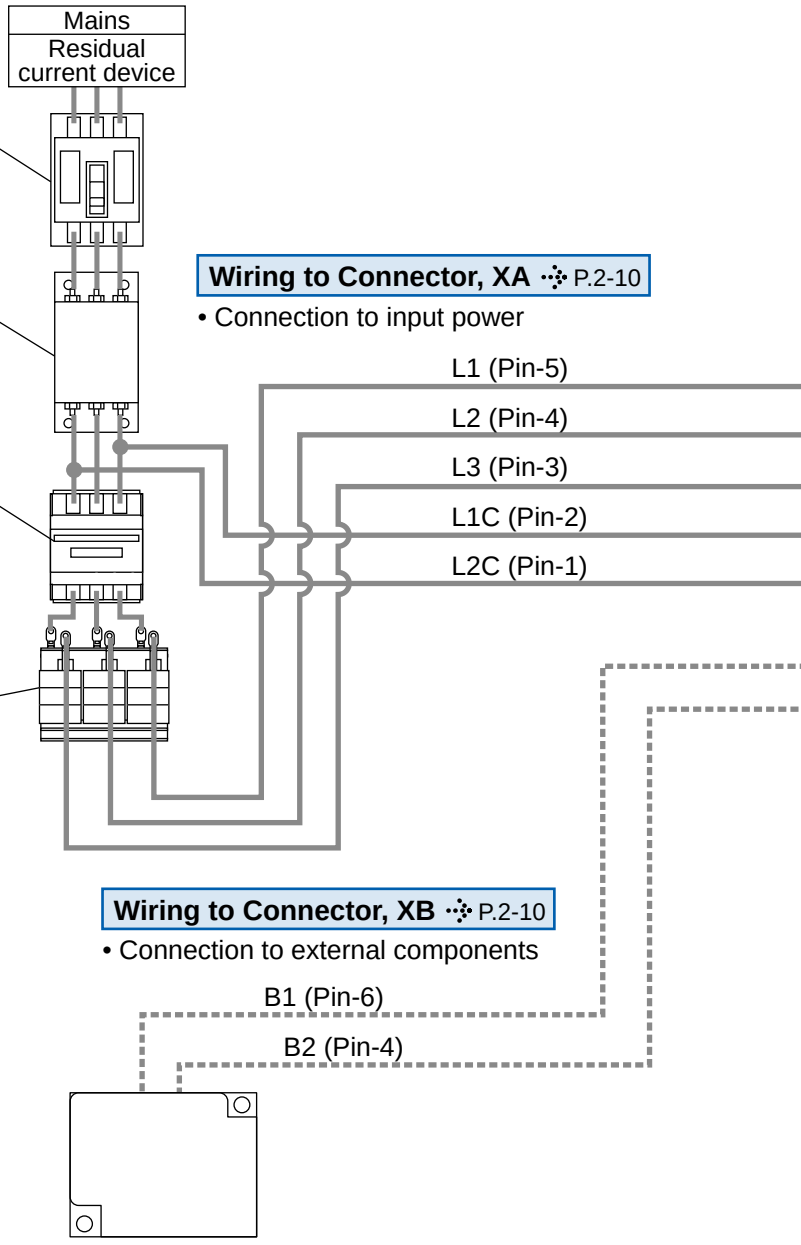
- **Wiring of Main Connector (XA)**

**Circuit Breaker (MCCB)**
To protect power supply line from overloading, install a wiring circuit breaker rated to the capacity of the power supply.

**Noise Filter (NF)**
Removes external noise from the power lines. And reduces an effect of the noise generated by the servo driver.

**Magnetic Contactor (MC)**
Turns on/off the main power of the servo driver.
Use coil surge suppression units together with this.
- **Never start nor stop the servo motor with this Magnetic Contactor.**

**Reactor (L)**
Reduces harmonic current of the main power.




- **Wiring of Motor Connector (XB)**

**Pin B1 (6-pin), B2 (4-pin), and B3 (5-pin)**
- B2 and B3 to be kept shorted for normal operation.
- When you connect an external regenerative resistor, disconnect a short circuit wire between B2 and B3, then connect the external regenerative resistor between B1 and B2, set up Pr0.16 to 1 or 2.

**Note**

Note that no regenerative resistor is equipped in Frame A and B type.

**Regenerative resistor (optional)**

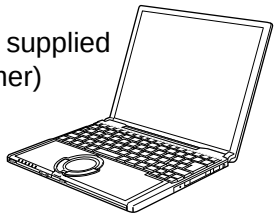
**Remarks**
- When you use an external regenerative resistor, install an external protective apparatus, such as thermal fuse without fail.
- Thermal fuse and thermostat are built in to the regenerative resistor (Option). If the thermal fuse is activated, it will not resume.
- Mount the regenerative resistor on incombustible material such as metal.

**Note** This overall wiring diagram is a typical one. The pages that follow show wiring for specific application.

Related page • P.2-14 “Overall wiring (terminal block type)” • P.7-72 “Options”

: High voltage

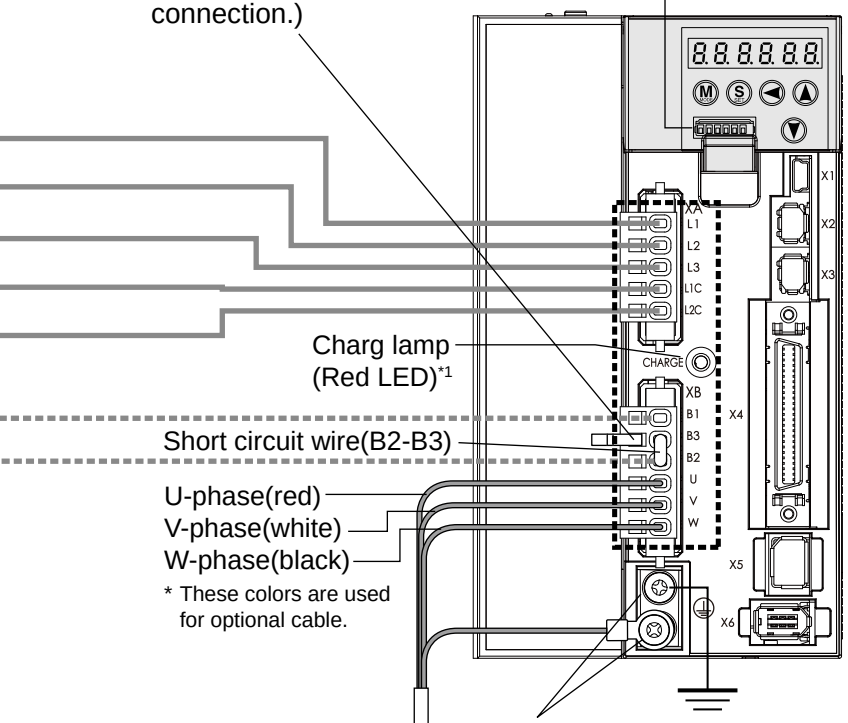
PC (to be supplied by customer)



Setup support software "PANATERM"
Please download from our web site.

Handle lever
Use this for connector connection. Store this after connection for other occasions. (Refer to P.2-19 for connection.)

**Wiring to Connector, X7** P.2-29
• Monitor output




Charg lamp (Red LED)*1

Short circuit wire(B2-B3)

U-phase(red)
V-phase(white)
W-phase(black)
* These colors are used for optional cable.

**Wiring to Connector, X1** P.2-20
• Connection to PC or host controller

**Wiring to Connector, X2** P.2-20
• Connection to RS232, RS485 or host controller

**Wiring to Connector, X3** P.2-22
• Connection to Safety by-pass plug

**Wiring to Connector, X4** P.2-23
• Connection to host controller

**Wiring to Connector, X5** P.2-24
• Connection to feedback scale

**Wiring to Connector, X6** P.2-26
• Connection to encoder

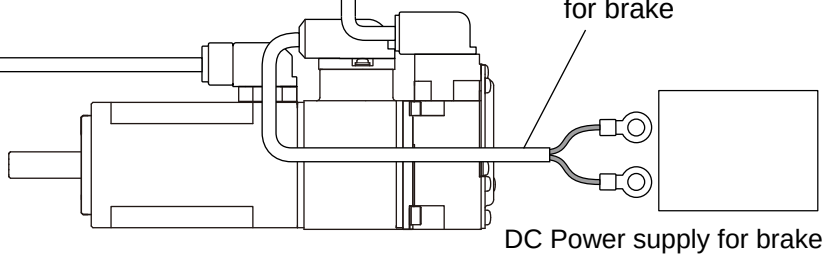
Protective earth terminals
Ground (earth)

Junction cable for encoder

Junction cable for motor

**Wiring to Connector, XB** P.2-10
• Connection to motor driving phase and ground

Junction cable for brake



DC Power supply for brake
DC24V
(to be supplied by customer)

*1 Do not make displacement, wiring or inspection while the LED is lit - cause of electric shock.

Related page • P.2-10 "Wiring of the Main Circuit (Connector type)" • P.2-18 "Specifications of Motor connector"

**Motor Company's WEBsite**
**URL: http://industrial.panasonic.com/jp/i/fa_motor.html**

# 2. System Configuration and Wiring

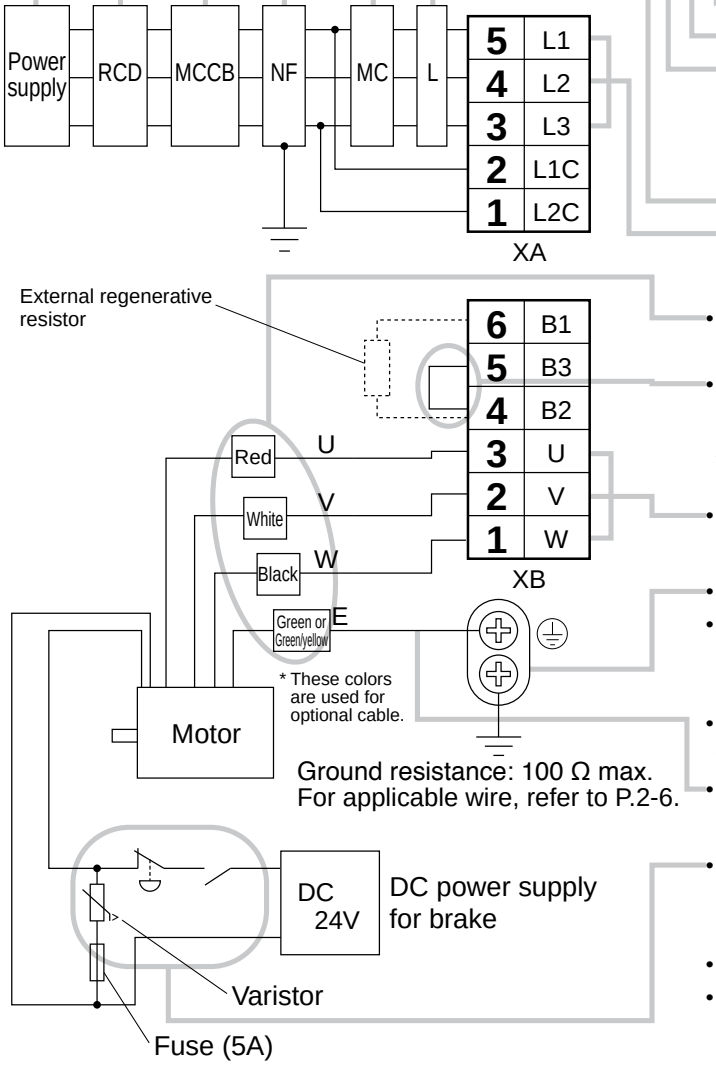
## Wiring of the Main Circuit (Connector type)

### A to D-frame, 100 V / 200 V type

- Wiring should be performed by a specialist or an authorized personnel.
- Do not turn on the power until the wiring is completed.

**• Tips on Wiring**

1) Wire connector (XA and XB).
2) Connect the wired connector to the driver.




- Check the name plate of the driver for power specifications.
- Provide a residual current device. The residual current device to be the one designed for "Inverter" and is equipped with countermeasures for harmonics.
- Provide a circuit breaker.
- Make sure to provide a noise filter.
- Provide coil surge suppression units to the coil of the Magnetic Contactor recommended by manufacturer. **Never start/stop the motor with this Magnetic Contactor.**
- Provide an AC Reactor.
- **Connect L1 and L1C, and L3 and L2C at single phase use (100V and 200V), and don't use L2.**

- Match the colors of the option cables to those of the corresponding motor output terminals (U,V,W).
- Don't disconnect the shorting cable between B2 and B3 (C and D frame type). Shorting cable is not required for A and B frame. Disconnect this only when the external regenerative register is used.
- **Avoid shorting and grounding. Don't connect the main power.**

- **Earth-ground this.**
- Make sure to connect the protective earth terminal (⏚) of the driver and the protective earth (earth plate) of the control panel to prevent electrical shock.
- Don't co-clamp the earth wires to the protective earth terminal (⏚) . Two terminals are provided.
- **Don't connect the earth cable to other inserting slot, nor make them touch.**

- Compose a duplex Brake Control Circuit so that the brake can also be activated by an external immediate stop signal.
- The Electromagnetic Brake has no polarity.
- For the capacity of the electromagnetic brake and how to use it, refer to P.2-34, "Specifications of Built-in Holding Brake".
- Provide a varistor.

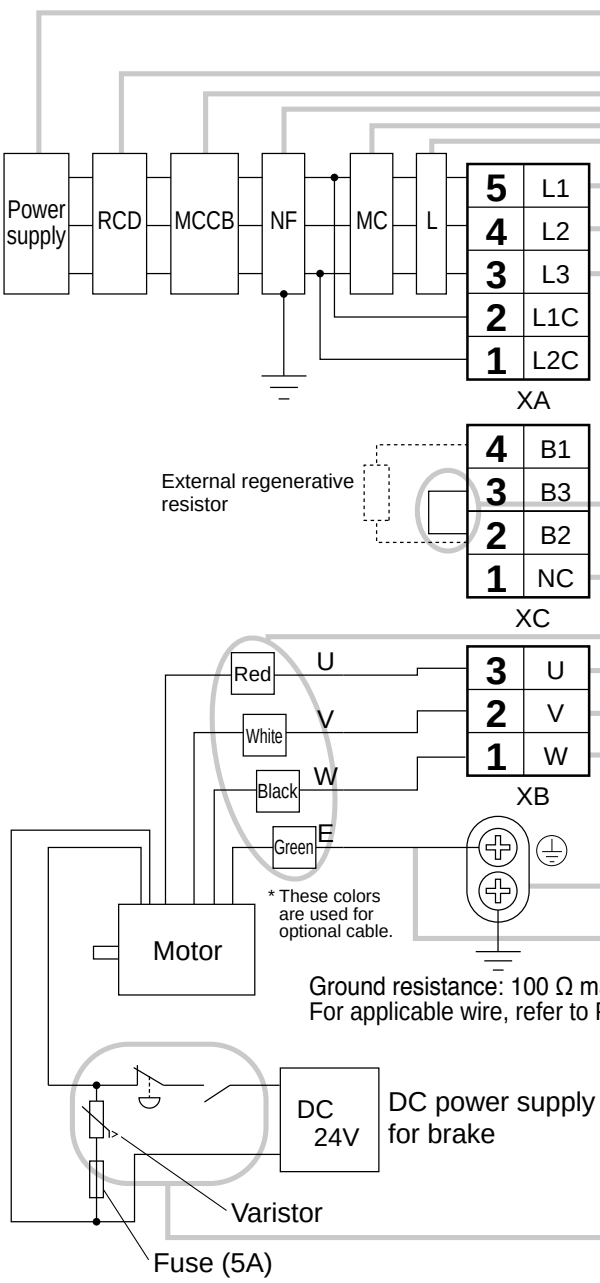
Related page
- P.2-18 “Specifications of Motor connector”
- P.2-19 “Wiring method to connector”
- P.7-85 “Connector kit for XA”
- P.7-86 “Connector kit for XB”

## E-frame, 200 V type

- Wiring should be performed by a specialist or an authorized personnel.
- Do not turn on the power until the wiring is completed.

### • Tips on Wiring

1) Wire connector (XA, XB and XC).
2) Connect the wired connector to the driver.




- Check the name plate of the driver for power specifications.
- Provide a residual current device. The residual current device to be the one designed for "Inverter" and is equipped with countermeasures for harmonics.
- Provide a circuit breaker.
- Make sure to provide a noise filter.
- Provide coil surge suppression units to the coil of the Magnetic Contactor recommended by manufacturer.
  **Never start/stop the motor with this Magnetic Contactor.**
- Provide an AC Reactor.
- **Connect L1 and L1C, and L3 and L2C at single phase use (100V and 200V), and don't use L2.**

- Don't disconnect the shorting cable between B2 and B3. Disconnect this only when the external regenerative register is used.
- Do not connect anything to NC.

- Match the colors of the motor lead wires to those of the corresponding motor output terminals (U,V,W).
- **Avoid shorting and grounding. Don't connect the main power.**

- **Earth-ground this.**
- Make sure to connect the protective earth terminal (⏚) of the driver and the protective earth (earth plate) of the control panel to prevent electrical shock.
- Don't co-clamp the earth wires to the protective earth terminal (⏚) . Two terminals are provided.
- **Don't connect the earth cable to other inserting slot, nor make them touch.**

- Compose a duplex Brake Control Circuit so that the brake can also be activated by an external immediate stop signal.
- The Electromagnetic Brake has no polarity.
- For the capacity of the electromagnetic brake and how to use it, refer to P.2-34, "Specifications of Built-in Holding Brake".
- Provide a varistor.
  Connect a 5A fuse in series with the varistor.

Related page
- P.2-18 “Specifications of Motor connector”
- P.2-19 “Wiring method to connector”
- P.7-85 “Connector kit for XA”
- P.7-86 “Connector kit for XB, XC”

# 2. System Configuration and Wiring

## Wiring Diagram (Connector type)

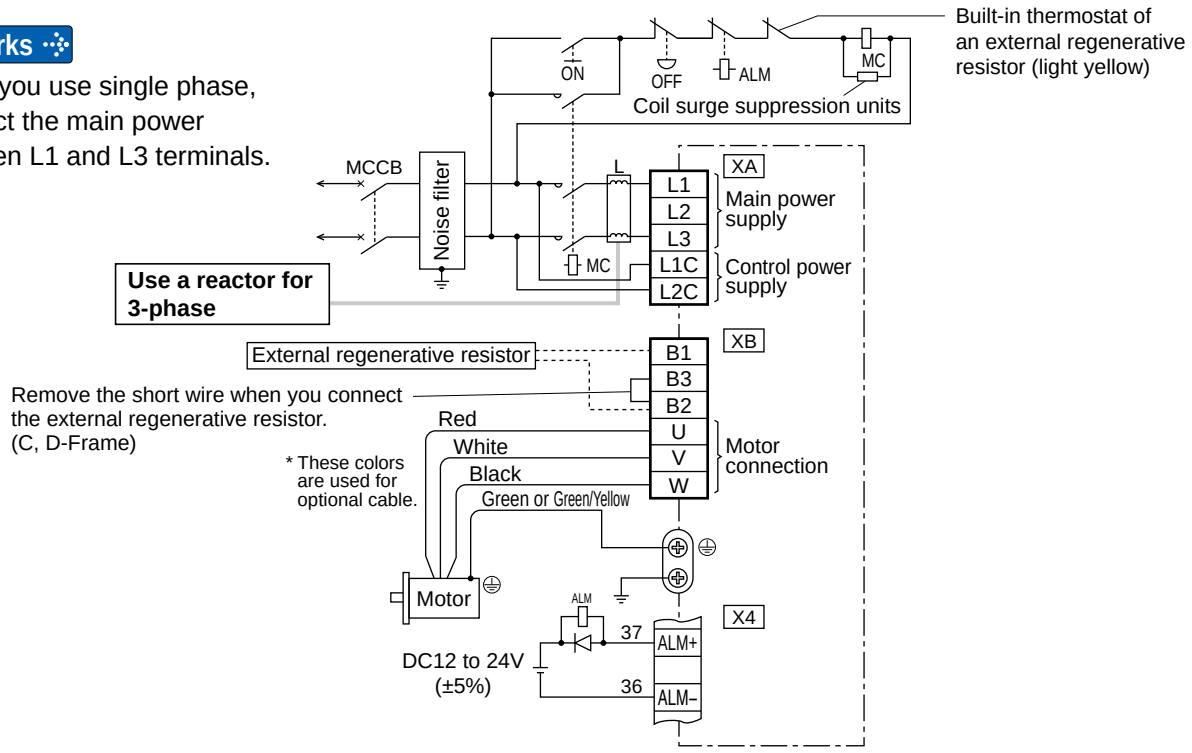
Compose the circuit so that the main circuit power will be shut off when an error occurs.

### In Case of Single Phase, A to D-frame, 100 V / 200 V type

Power supply Single phase, 100V $^{+10\%}_{-15\%}$ to 120V $^{+10\%}_{-15\%}$ Single phase, 200V $^{+10\%}_{-15\%}$ to 240V $^{+10\%}_{-15\%}$

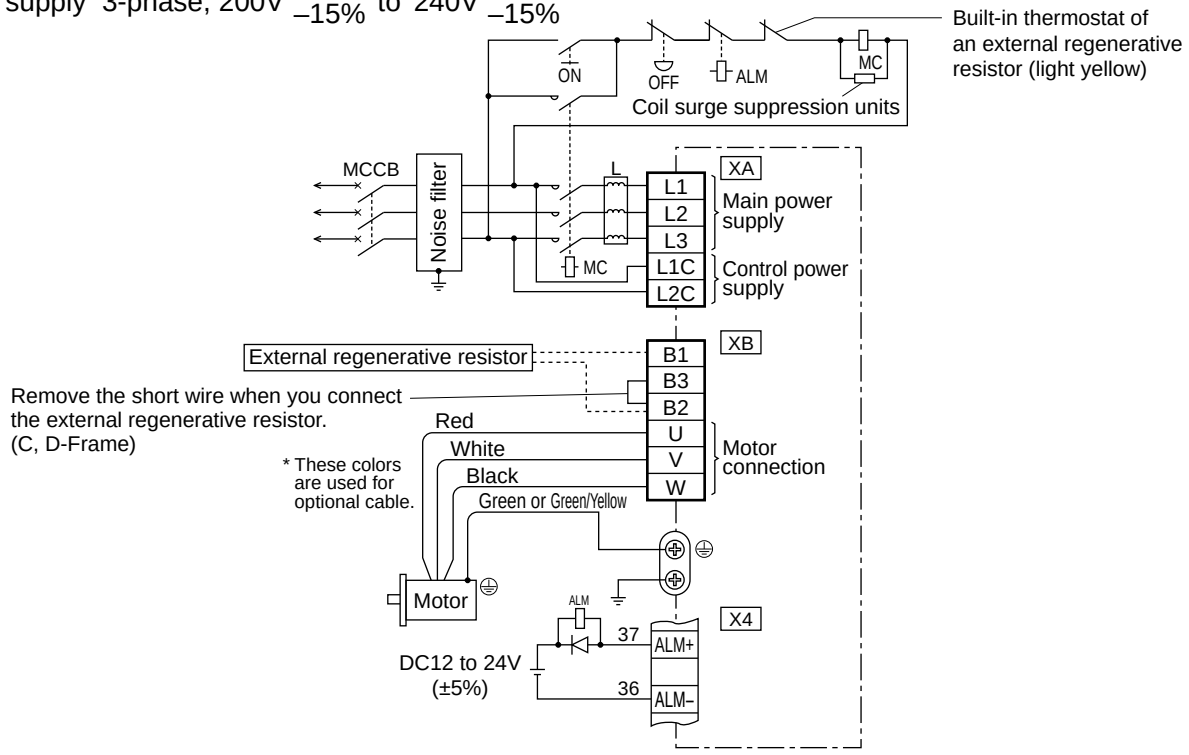
**Remarks**

When you use single phase, connect the main power between L1 and L3 terminals.




### In Case of 3-Phase, A to D-frame, 200 V type

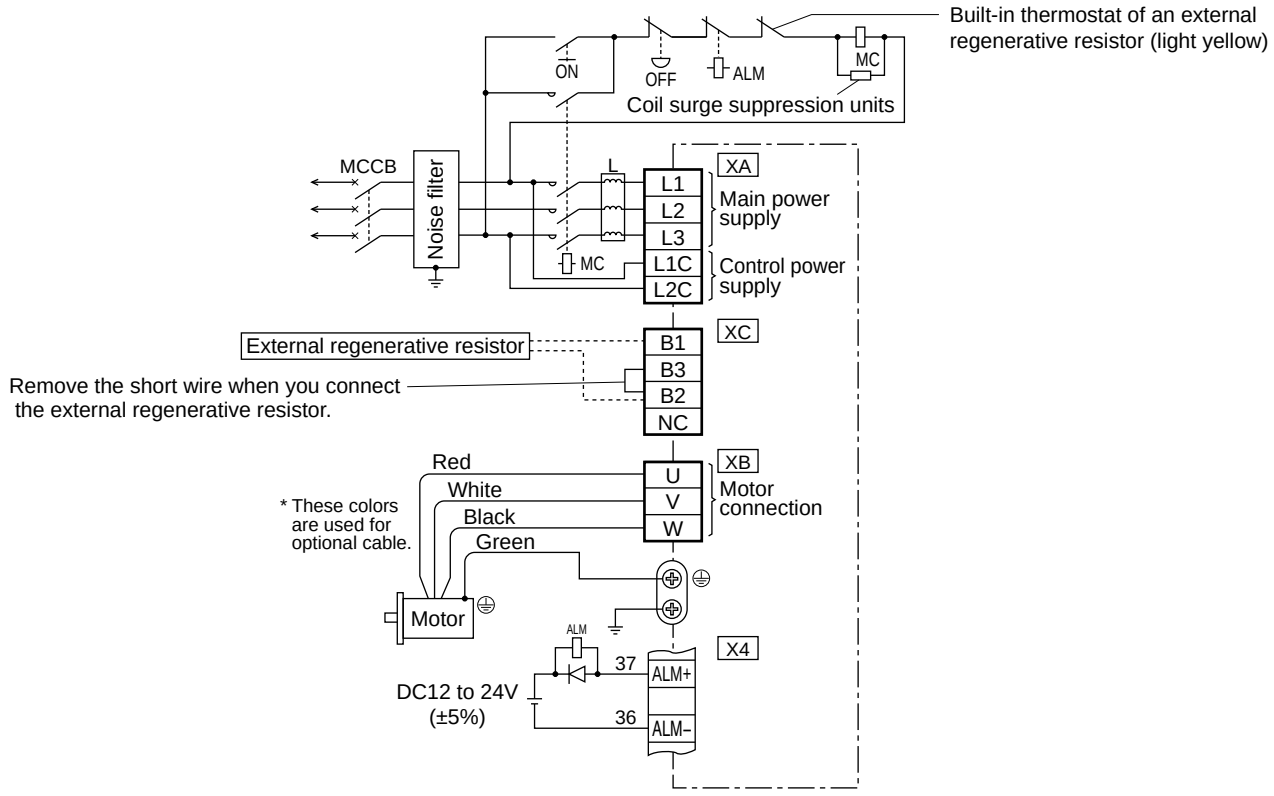
Power supply 3-phase, 200V $^{+10\%}_{-15\%}$ to 240V $^{+10\%}_{-15\%}$




Related page • P.2-18 “Specifications of Motor connector”

## In Case of 3-Phase, E-frame, 200 V type

Power supply 3-phase, 200V $^{+10\%}_{-15\%}$ to 230V $^{+10\%}_{-15\%}$




Related page
• P.2-16 “Specifications of Motor connector”
• P.2-17 “For wiring the motor connector”
• P.2-18 “Specifications of Motor connector”

# 2. System Configuration and Wiring

## Overall Wiring (Terminal block type)

### Connecting Example of F-frame

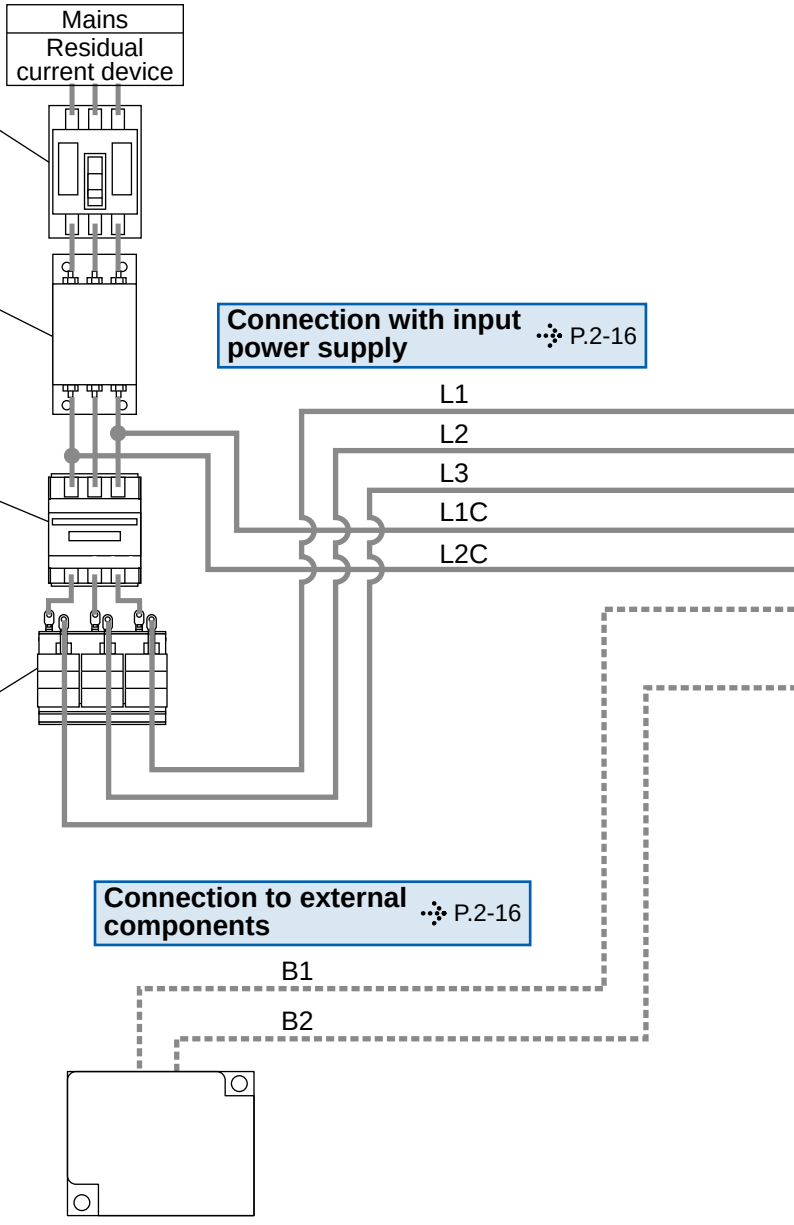
- **Wiring of Main**

**Circuit Breaker (MCCB)**
To protect power supply line from overloading, install a wiring circuit breaker rated to the capacity of the power supply.

**Noise Filter (NF)**
Removes external noise from the power lines. And reduces an effect of the noise generated by the servo driver.

**Magnetic Contactor (MC)**
Turns on/off the main power of the servo driver.
Use coil surge suppression units together with this.
- **Never start nor stop the servo motor with this Magnetic Contactor.**

**Reactor (L)**
Reduces harmonic current of the main power.




- **Wiring of the Main Circuit**

**Pin B1, B2 and B3**
- B1 and B2 to be kept shorted for normal operation.
- When you connect an external regenerative resistor, disconnect a short bar between B1 and B2, then connect the external regenerative resistor between P and B2, set up Pr0.16 to 1 or 2.

**Pin NC**
- Do not connect anything.

**Regenerative resistor (optional)**

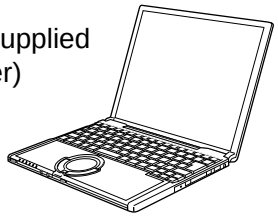
**Remarks**
- When you use an external regenerative resistor, install an external protective apparatus, such as thermal fuse without fail.
- Thermal fuse and thermostat are built in to the regenerative resistor (Option). If the thermal fuse is activated, it will not resume.
- Mount the regenerative resistor on incombustible material such as metal.

**Note** This overall wiring diagram is a typical one. The pages that follow show wiring for specific application.

**Related page** • P.2-8 “Overall wiring (connector type)” • P.7-72 “Options”

: High voltage

PC (to be supplied by customer)



Setup support software “PANATERM”
Please download from our web site.

**Wiring to Connector, X7** P.2-29
• Monitor output

**Wiring to Connector, X1** P.2-20
• Connection to PC or host controller

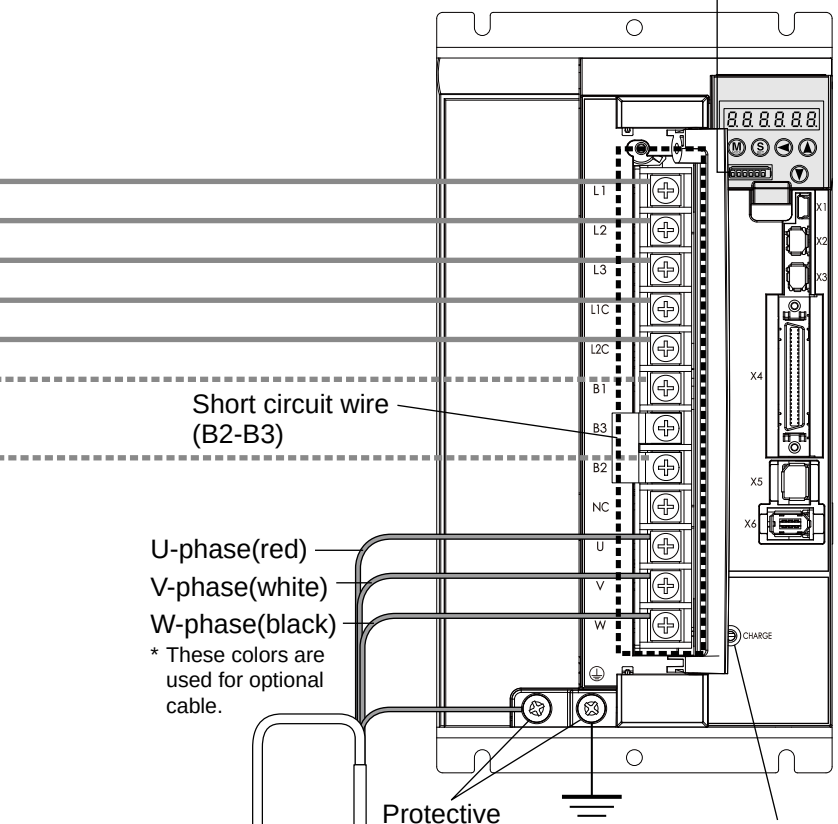
**Wiring to Connector, X2** P.2-20
• Connection to RS232, RS485 or host controller

**Wiring to Connector, X3** P.2-22
• Connection to Safety by-pass plug

**Wiring to Connector, X4** P.2-23
• Connection to host controller

**Wiring to Connector, X5** P.2-24
• Connection to feedback scale

**Wiring to Connector, X6** P.2-26
• Connection to encoder




Short circuit wire
(B2-B3)

U-phase(red)
V-phase(white)
W-phase(black)
* These colors are used for optional cable.

Protective earth terminals

Ground (earth)

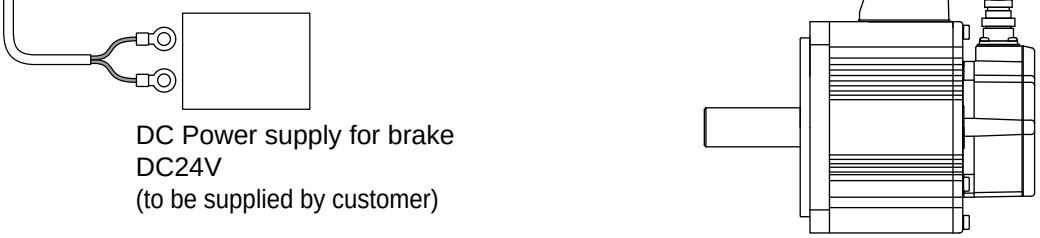
Charg lamp (Red LED)*1

Junction cable for encoder

Junction cable for motor

Junction cable for brake

**Connection to motor driving phase and ground** P.2-16



DC Power supply for brake
DC24V
(to be supplied by customer)

*1 Do not make displacement, wiring or inspection while the LED is lit - cause of electric shock.

Related page • P.2-16 “Wiring of the Main Circuit (Terminal block type)” • P.2-18 “Specifications of Motor connector”

**Motor Company's WEBsite**
**URL: http://industrial.panasonic.com/jp/i/fa_motor.html**

# 2. System Configuration and Wiring

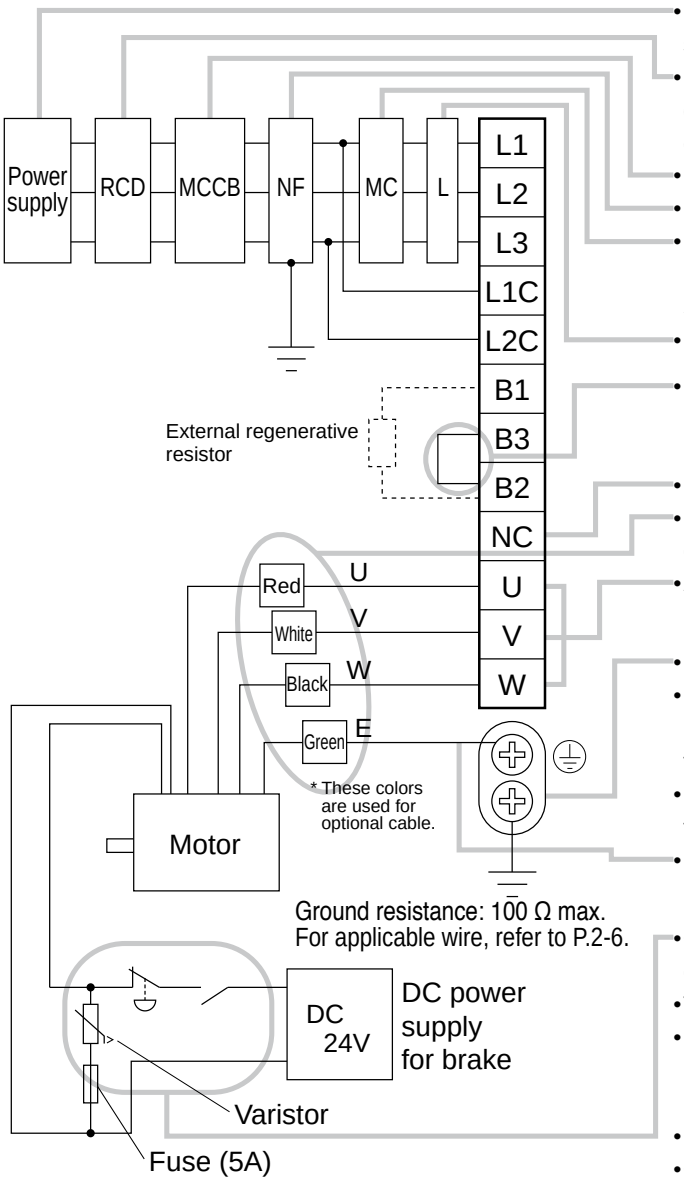
## Wiring of the Main Circuit (Terminal block type)

### F-frame, 200 V type

- Wiring should be performed by a specialist or an authorized personnel.
- Do not turn on the power until the wiring is completed.

**• Tips on Wiring**

1) Take off the cover fixing screws, and detach the terminal cover.
2) Make wiring
   Use clamp type terminals of round shape with insulation cover for wiring to the terminal block. For cable diameter and size, reter to "Driver and List of Applicable Peripheral Equipments" (P.2-6).
   Tighten the terminal block screw with a torque between 1.0 and 2.0 N•m.
3) Attach the terminal cover, and fix with screws.
   Tighten the screw securing the cover with a torque between 0.1 and 0.2 N•m.




- Check the name plate of the driver for power specifications.
- Provide a residual current device. The residual current device to be the one designed for "Inverter" and is equipped with countermeasures for harmonics.
- Provide a circuit breaker.
- Make sure to provide a noise filter.
- Provide coil surge suppression units to the coil of the Magnetic Contactor recommended by manufacturer. **Never start/stop the motor with this Magnetic Contactor.**
- Provide an AC Reactor.
- Don't disconnect the short bar between B1 and B2. Disconnect this only when an external regenerative register is used.
- Do not connect anything to NC.
- Match the colors of the motor lead wires to those of the corresponding motor output terminals (U,V,W).
- **Avoid shorting and grounding.**
  **Don't connect the main power.**
- **Earth-ground this.**
- Make sure to connect the protective earth terminal (⏚) of the driver and the protective earth (earth plate) of the control panel to prevent electrical shock.
- Don't co-clamp the earth wires to the protective earth terminal (⏚) . Two terminals are provided.
- **Don't connect the earth cable to other inserting slot, nor make them touch.**
- Compose a duplex Brake Control Circuit so that the brake can also be activated by an external immediate stop signal.
- The Electromagnetic Brake has no polarity.
- For the capacity of the electromagnetic brake and how to use it, refer to P.2-34, "Specifications of Built-in Holding Brake".
- Provide a varistor.
- Connect a 5A fuse in series with the varistor.

Related page • P.2-18 “Specifications of Motor connector”

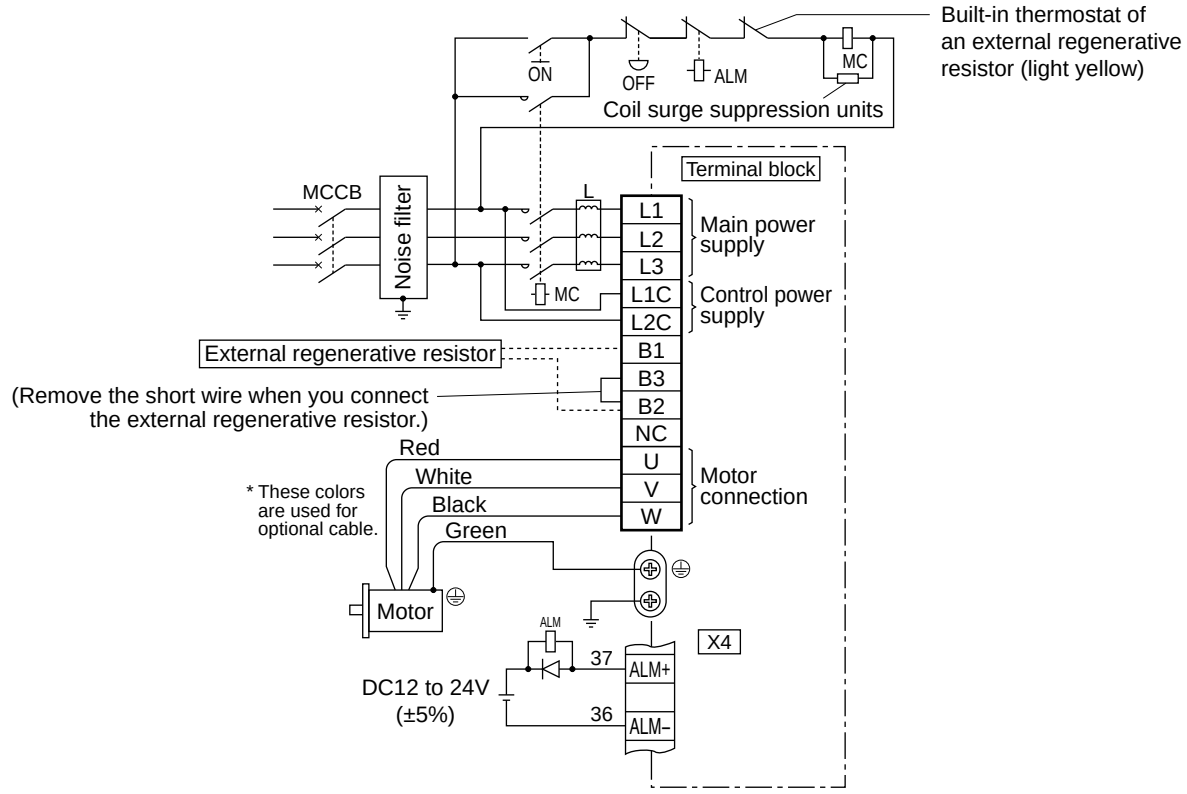
# 2. System Configuration and Wiring

## Wiring Diagram (Terminal block type)

Compose the circuit so that the main circuit power will be shut off when an error occurs.

### In Case of 3-Phase, F-frame, 200 V type

Power supply 3-phase, 200V +10% –15% to 230V +10% –15%




Related page
• P.2-16 “Specifications of Motor connector”
• P.2-17 “For wiring the motor connector”
• P.2-18 “Specifications of Motor connector”

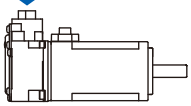
# 2. System Configuration and Wiring

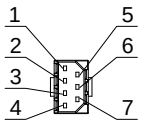
## Specifications of Motor connector

- **When the motors of <MSME (50 W to 750 W)> are used, they are connected as shown below.**

Connector: Made by Japan Aviation Electronics Industry, Ltd. (The figures below show connectors for the motor.)

**Connector for encoder**






JN6CR07PM2

20-bit Incremental

| PIN No. | Application |
|---|---|
| 1 | FG(SHIELD) |
| 2 | — |
| 3 | E0V |
| 4 | $\overline{PS}$ |
| 5 | — |
| 6 | E5V |
| 7 | PS |

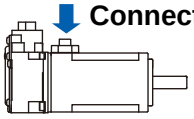
17-bit Absolute

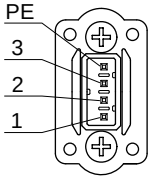
| PIN No. | Application |
|---|---|
| 1 | FG(SHIELD) |
| 2 | BAT– |
| 3 | E0V |
| 4 | $\overline{PS}$ |
| 5 | BAT+ |
| 6 | E5V |
| 7 | PS |

Tightening torque of the screw (M2) 0.19 to 0.21 N·m

* Be sure to use only the screw supplied with the connector, to avoid damage.

**Connector for motor**






JN8AT04NJ1

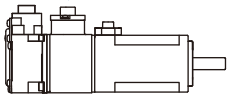
| PIN No. | Application |
|---|---|
| 1 | U-phase |
| 2 | V-phase |
| 3 | W-phase |
| PE | Ground |

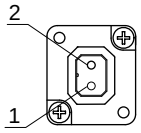
Tightening torque of the screw (M2) 0.085 to 0.095 N·m (screwed to plastic)

* Be sure to use only the screw supplied with the connector, to avoid damage.

[Motor with brake]

**Connector for brake**






JN4AT02PJM-R

| PIN No. | Application |
|---|---|
| 1 | Brake |
| 2 | Brake |

* Electromagnetic brake is a nonpolar device.

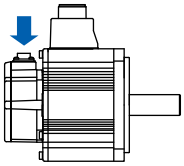
Tightening torque of the screw (M2) 0.19 to 0.21 N·m

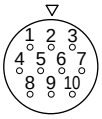
* Be sure to use only the screw supplied with the connector, to avoid damage.

- **When the motors of <MSME (1.0 kW to 5.0 kW), MDME, MGME, MHME> are used, they are connected as shown below.**

Connector: Made by Japan Aviation Electronics Industry, Ltd. (The figures below show connectors for the motor.)

**Connector for encoder**






JN2AS10ML3-R

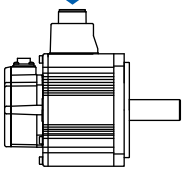
20-bit Incremental

| PIN No. | Application |
|---|---|
| 1 | E0V |
| 2 | NC |
| 3 | PS |
| 4 | E5V |
| 5 | NC |
| 6 | NC |
| 7 | $\overline{PS}$ |
| 8 | NC |
| 9 | FG(SHIELD) |
| 10 | NC |

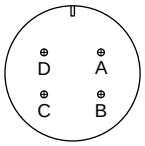
17-bit Absolute

| PIN No. | Application |
|---|---|
| 1 | E0V |
| 2 | NC |
| 3 | PS |
| 4 | E5V |
| 5 | BAT– |
| 6 | BAT+ |
| 7 | $\overline{PS}$ |
| 8 | NC |
| 9 | FG(SHIELD) |
| 10 | NC |

**Connector for motor**



<with Brake>




JL04V-2E20-4PE-B-R

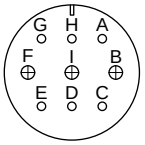
MSME 1.0kW to 2.0kW
MDME 1.0kW to 2.0kW
MGME 0.9kW
MHME 1.0kW to 1.5kW

JL04HV-2E22-22PE-B-R

MSME 3.0kW to 5.0kW
MDME 3.0kW to 5.0kW
MGME 2.0kW to 3.0kW
MHME 2.0kW to 5.0kW

| PIN No. | Application |
|---|---|
| A | U-phase |
| B | V-phase |
| C | W-phase |
| D | Ground |

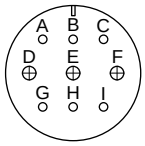
<without Brake>




JL04V-2E20-18PE-B-R

MSME 1.0kW to 2.0kW
MDME 1.0kW to 2.0kW
MGME 0.9kW
MHME 1.0kW to 1.5kW

| PIN No. | Application |
|---|---|
| G | Brake |
| H | Brake |
| A | NC |
| F | U-phase |
| I | V-phase |
| B | W-phase |
| E | Ground |
| D | Ground |
| C | NC |




JL04V-2E24-11PE-B-R

MSME 3.0kW to 5.0kW
MDME 3.0kW to 5.0kW
MGME 2.0kW to 3.0kW
MHME 2.0kW to 5.0kW

| PIN No. | Application |
|---|---|
| A | Brake |
| B | Brake |
| C | NC |
| D | U-phase |
| E | V-phase |
| F | W-phase |
| G | Ground |
| H | Ground |
| I | NC |

**Remarks** Do not connect anything to NC.

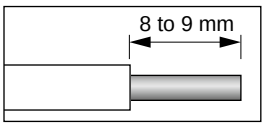
# 2. System Configuration and Wiring

## Wiring method to connector

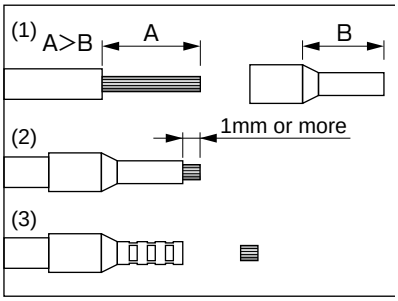
• Follow the procedures below for the wiring connection to the Connector XA, XB and XC.

## How to connect

1. Peel off the insulation cover of the cable.
   • For single wire (Please obey the length in figure.)



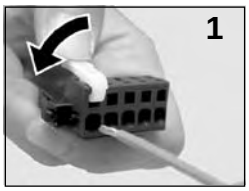
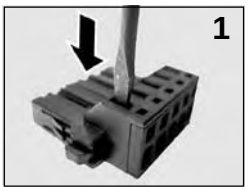
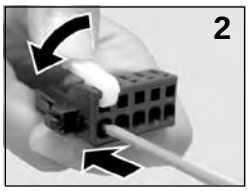
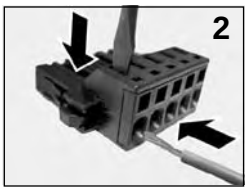
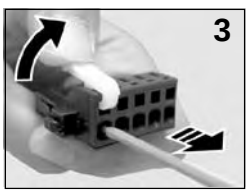
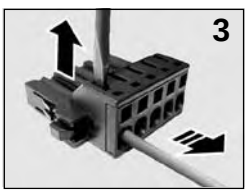

   • For stranded wires (ferrules must be used as illustrated below).
   Example: Ferrules with plastic insulating sleeve (AI series, Phoenix Contact, Ltd.)
   1) Peel off the sheath so that the conductor portion of the cable will protrude from the tip of the ferrule. (It should protrude 1 mm or more from the ferrule.)
   2) Insert the cable into the ferrule and crimp it with an appropriate crimping tool.
   3) After crimping, cut off the cable conductor portion protruding from the ferrule. (The allowable protruding length after cutting should be 0 to 0.5 mm.)




   • Part No. of the crimping tool:
   CRIMPFOX U-D66 (1204436)
   Available from Phoenix Contact, Ltd.

**Caution**
• When peeling off the sheath of the cable, take care not to damage other portions.
• When crimping the ferrule, sufficiently check the status of the ferrule and cable. If the conductors of the cable stick out from the insulation cover or protrude excessively from the tip of the ferrule, accidents such as an electric shock and fire from a short circuit may result.

2. Insert the cable to the connector in the following 2 methods.
   (a) Insert the cable using the supplied handle lever.
   (b) Insert the cable using a flat-blade screwdriver (Edge width: 3.0 to 3.5 mm).

| (a) Using handle lever | | (b) Using screw driver | |
|---|---|---|---|
|   | Attach the handle lever to the handling slot on the upper portion. Press down the lever to push down the spring. |   | Press the screw driver to the handling slot on the upper portion to push down the spring. |
|   | Insert the peeled cable while pressing down the lever, until it hits the insertion slot (round hole). |   | Insert the peeled cable while pressing down the screw driver, until it hits the insertion slot (round hole). |
|   | Release the lever.<br>* You can pull out the cable by pushing down the spring as the above. |   | Release the screw driver. |

**Caution**
• Take off the connector from the Servo Driver before making connection.
• Insert only one cable into each one of cable insertion slot.
• Pay attention to injury by screw driver.

# 3. Wiring to the connector, X1

## Connecting host computer

This is used for USB connection to a personal computer. It is possible to change the parameter setting and perform monitoring.

| Application | Symbol | Connector Pin No. | Contents |
|---|---|---|---|
| USB signal terminal | VBUS | 1 | Use for communication with personal computer. |
| | D– | 2 | |
| | D+ | 3 | |
| | — | 4 | Do not connect. |
| | GND | 5 | Connected to ground of control circuit. |

**Caution** Use commercially available USB mini-B connector for the driver.



# 4. Wiring to the connector, X2

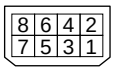
## Connecting communication connector

This is used for connection to the host controller when two or more units are used. RS232 and RS485 interfaces are supplied.

| Application | Symbol | Connector Pin No. | Contents |
|---|---|---|---|
| Signal ground | GND | 1 | Connected to ground of control circuit. |
| NC | – | 2 | Do not connect. |
| RS232 signal | TXD | 3 | RS232<br>The transmission / reception method. |
| | RXD | 4 | |
| RS485 signal | 485– | 5 | RS485<br>The transmission / reception method. |
| | 485+ | 6 | |
| | 485– | 7 | |
| | 485+ | 8 | |
| Frame ground | FG | Shell | Connected with protective earth terminal in the servo driver. |

Connector (plug): 2040008-1 (optional, available from Tyco Electronics AMP)

[Connector pin assignment]



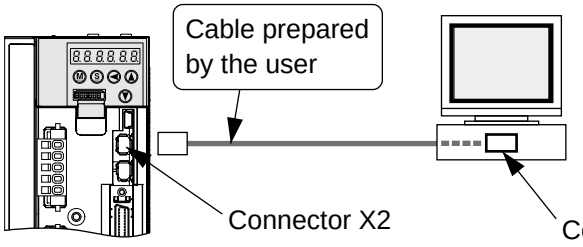

(Viewed from cable)

• This servo driver features 2 kinds of communication function, RS232 and RS485, and you can use in 3 connecting methods.

## To communicate with a single driver through RS232

Connect the host (PC or controller) to an driver through RS232.

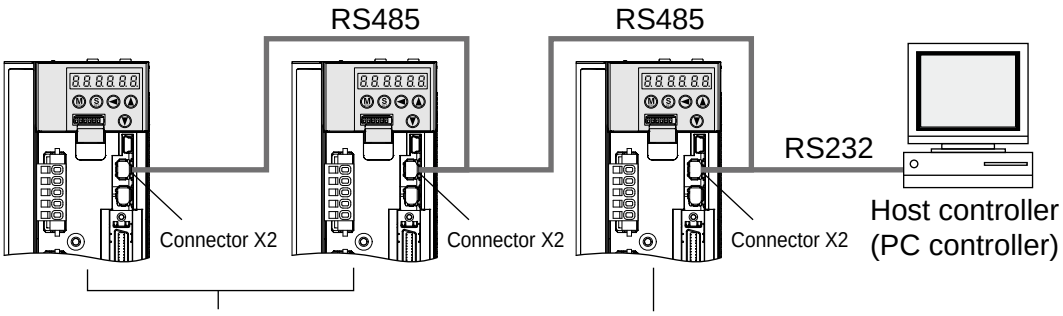
**[How to connect]**




Shut off both powers of the PC andthe driver before inserting/pulling out the connector.

## To communicate with multiple drivers through RS232 and RS485

By connecting the host (PC and host controller) and one driver via RS232 and connecting other drivers via RS485 each other, you can connect multiple drivers.




Set the axis number (Pr5.31) of driver to be connected through RS485 to a value in the range 1 to 31.

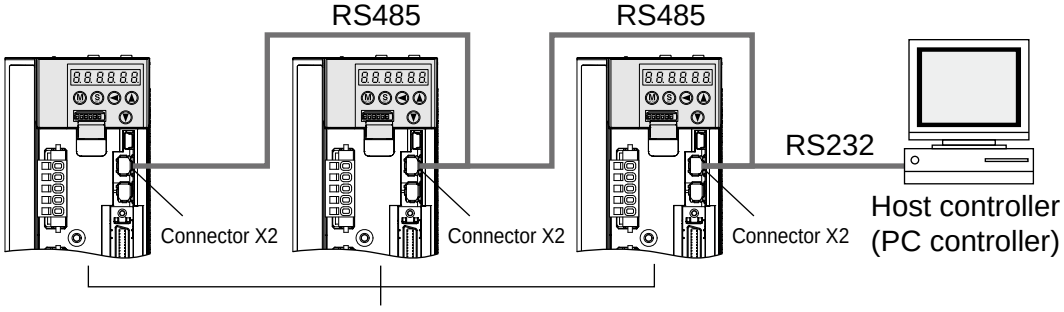
Set the axis number (Pr5.31) of driver to be connected to the host through RS232 to 0.

**Note**

- You can connect up to 32 drivers with the host.
- For details, refer to P.7-28, "Communication"of Supplement.

## To communicate with multiple drivers only through RS485

Communications between the host (PC or controller) and multiple drivers can be made through RS485.




Set the axis number (Pr5.31) of driver to be connected through RS485 to a value in the range 1 to 31.

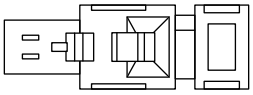
**Note**

- You can connect up to 31 drivers with the host.
- For details, refer to P.7-28, "Communication"of Supplement.

# 5. Wiring to the connector, X3

## Safety function connector

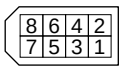
A safety by-pass plug is supplied as standard equipment. Do not disconnect it in normal times.
When controlling the safety function from the connected host controller, accessory connector cannot be used. Prepare and wire the connector (option) as specified below.
Since the standard connector cannot be used when controlling the safety function from the host controller, purchase the optional connector and make connection as shown below.



| Application | Symbol | Connector Pin No. | Contents |
|---|---|---|---|
| NC | – | 1 | Do not connect. |
| | – | 2 | |
| Safety input 1 | SF1– | 3 | These are two independent circuits that turn off the operation signal to the power module to shut off the motor current. |
| | SF1+ | 4 | |
| Safety input 2 | SF2– | 5 | |
| | SF2+ | 6 | |
| EDM output | EDM– | 7 | This is an output for monitoring the failure of the safety function. |
| | EDM+ | 8 | |
| Frame ground | FG | Shell | Connected with protective earth terminal in the servo driver. |

Connector (plug): 2013595-1 (optional, available from Tyco Electronics AMP)

[Connector pin assignment]



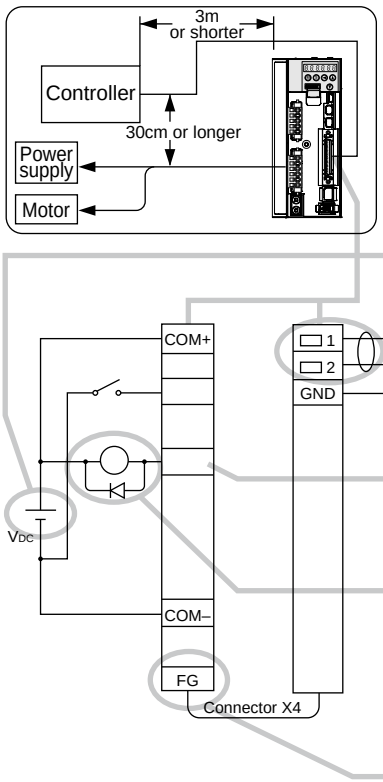

(Viewed from cable)

**Caution** Disconnecting this connector during operation results in immediate stop.

# 6. Wiring to the connector, X4

## Connection to Host Controller

### Tips on wiring




- Peripheral apparatus such as host controller should be located within3m.
- Separate the main circuit at least 30cm away.
  Don't pass them in the same duct, nor bind them together.
- Power supply for control signals (VCC) between COM+ and COM– (VDC) should be prepared by customer.
- Use shield twisted pair for the wiring of command pulse input and encoder signal output.
- Don't apply more than 24V to the control signal output terminals, nor run 50mA or more to them.
- When the relay is directly driven by the control output signals, install a diode in parallel with a relay, and in the direction as the Fig. shows. The driver might be damaged without a diode installment, or by reverse direction.
- Frame ground (FG) is connected to the earth terminal inside of the driver.

Related page • For details, refer to P.3-18, “Wiring Diagram to the connector, X4”.

**• Specifications of the Connector, CN X5**

| Connector at driver side | Connecter to be prepared by customer | | Manufacturer |
|---|---|---|---|
| | Part name | Part No. | |
| 52986-5071 | Connecter (soldering type) | 54306-5019 | Molex Inc. |
| | Connector cover | 54331-0501 | |
| | or | | |
| | Connecter (soldering type) | 10150-3000VE | Sumitomo 3M |
| | Connector cover | 10350-52A0-008 | |

**Note** • For details, refer to P.7-83, “Options” of Supplement.

**Remarks** • Tightening torque of the screws for connector (X4) for the connection to the host to be 0.3 to 0.35N·m. Larger tightening torque than these may damage the connector at the driver side.

# 7. Wiring to the connector, X5

## Connect on to External Scale

Provide a power supply for the external scale on your part or use the following power output (250mA or less).

| Application | Symbol | Connector Pin No. | Contents |
|---|---|---|---|
| Power supply output | EX5V | 1 | Supply the power of external scale or A, B, Z phase encoder. |
| | EX0V | 2 | Connected to ground of control circuit. |
| I/F of external scale signals | EXPS | 3 | Serial signal<br>The transmission / reception method. |
| | /EXPS | 4 | |
| A, B, Z phase Endoder signal input | EXA | 5 | Parallel signal reception |
| | /EXA | 6 | |
| | EXB | 7 | |
| | /EXB | 8 | |
| | EXZ | 9 | |
| | /EXZ | 10 | |
| Frame ground | FG | Shell | Connected with protective earth terminal in the servo driver. |

Connector (plug) sirial external signal: MUF-PK10K-X (by J.S.T. Mfg. Co., Ltd.)

• Caution

1) The manufacturers applicable external scales for this product are as follows.
   • Mitutoyo Corp.
   • Sony Manufacturing Systems Corp.

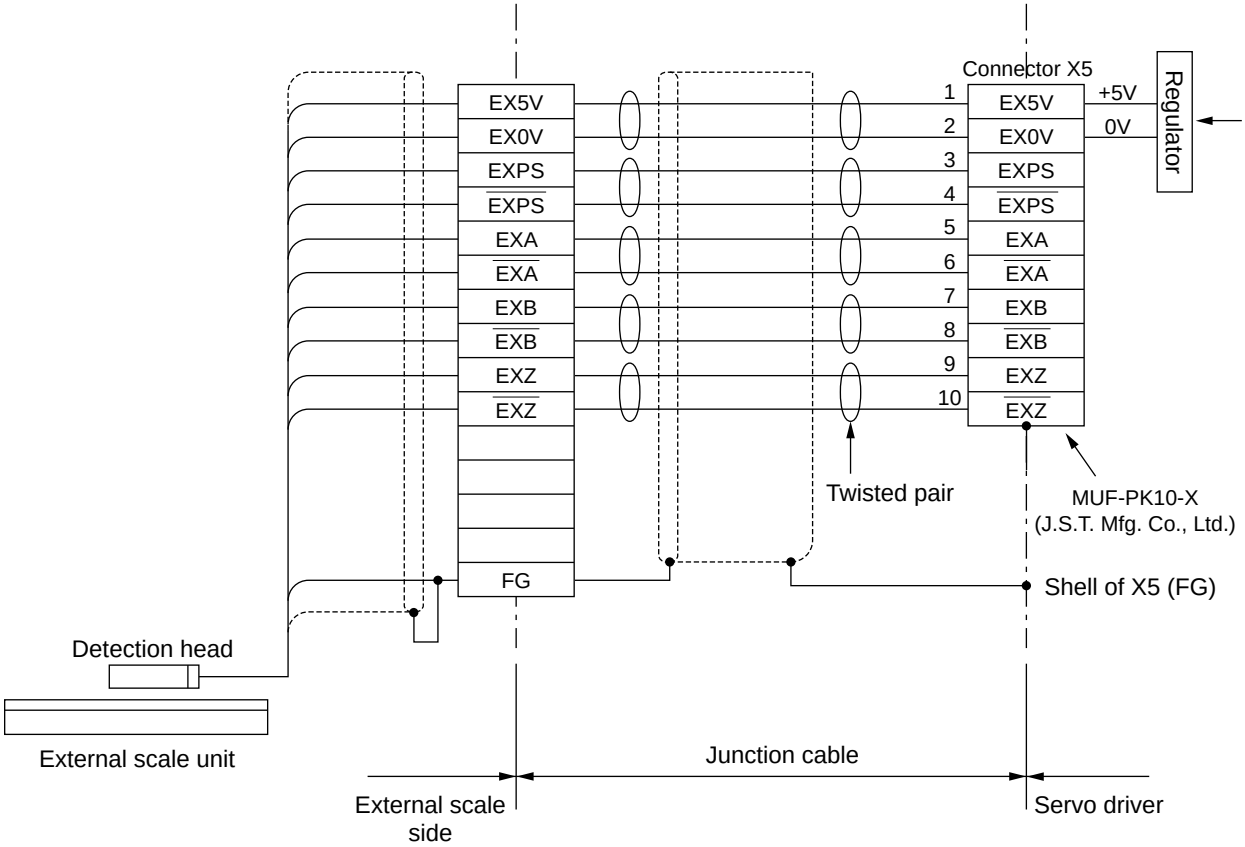
   For the details of the external scale product, contact each company.

2) **Recommended external scale ratio is 1/40 ≤ External scale ratio ≤ 160**

   If you set up the external scale ratio to smaller value than 50/position loop gain (Pr1.00 and Pr.1.05), you may not be able to control per 1 pulse unit, even if within the range as described above. Setup of larger scale ratio may result in larger noise.

Related page
• P.4-12, 4-13 “Details of Parameter”
• P.7-84 “Connector kit”

## Wiring Diagram of X5



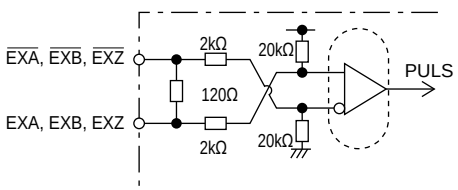

## How to Wiring

Wire the signals from the external scale to the external scale connector, X5.

1) Cable for the external scale to be the twisted pair with bundle shielding and to having the twisted core wire with diameter of 0.18mm$^2$.
2) Cable length to be max. 20m. Double wiring for 5V power supply is recommended when the wiring length is long to reduce the voltage drop effect.
3) Connect the outer film of the shield wire of the external scale to the shield of the junction cable. Also connect the outer film of the shield wire to the shell (FG) of connector X5 of the driver without fail.
4) Separate the wiring to X7 from the power line (L1, L2, L3, B1, B2, B3, U, V. W, ⏚) as much as possible (30cm or more). Do not pass these wires in the same duct, nor bundle together.
5) Do not connect anything to the vacant pins of X5.

## Input circuit

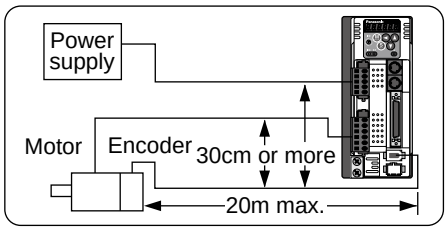
**• EXA, EXB, EXZ input circuit**



# 8. Wiring to the connector, X6

## Connection to Encoder

### Tips on Wiring

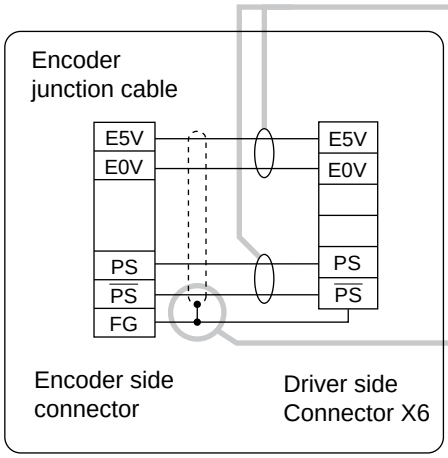



◦Maximum cable length between the driver and the motor to be 20m. Consult with a dealer or distributor if you want to use the longer cable than 20m. (Refer to the back cover.)

◦Keep this wiring away from the main circuit by 30 cm or more. Don't guide this wiring through the same duct with the main, nor bind them together.

◦When you make your own encoder junction cable (for connectors, refer to P.7-86, "Options (Connector Kit for Motor and Encoder connection)" of Supplement.

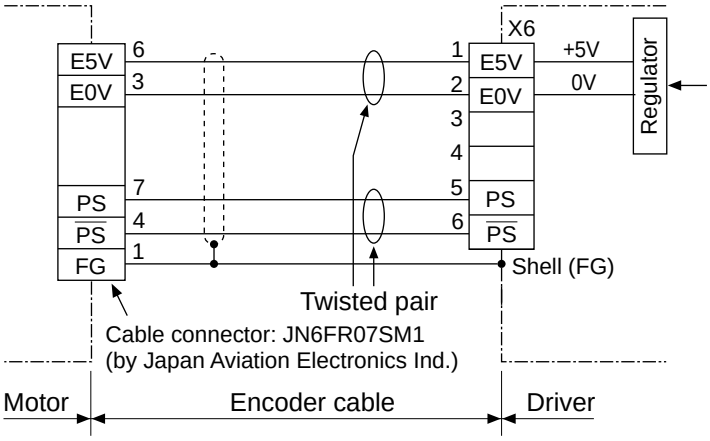
1) Refer to the Wiring Diagram below.
2) Cable to be : Shielded twisted pair cable with core diameter of 0.18mm$^2$ or larger (AWG24), and with higher bending resistance.
3) Use twisted pair cable for corresponding signal/power wiring.
4) Shielding treatment
   - Shield wall of the driver side : Connect to Pin-20 (FG) of Connector X6.
   - Shield wall of the motor side :
     manufactured by JAE
     Small type motor (50W-750W) :connect to 6-pins
     Large type motor (1.0kW-5.0kW) : connect to 9-pins
5) Connect nothing to the empty terminals of each connector.



## Wiring Diagram

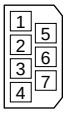
**• In case of 20-bit incremental encoder**

**MSME 50W to 750W**



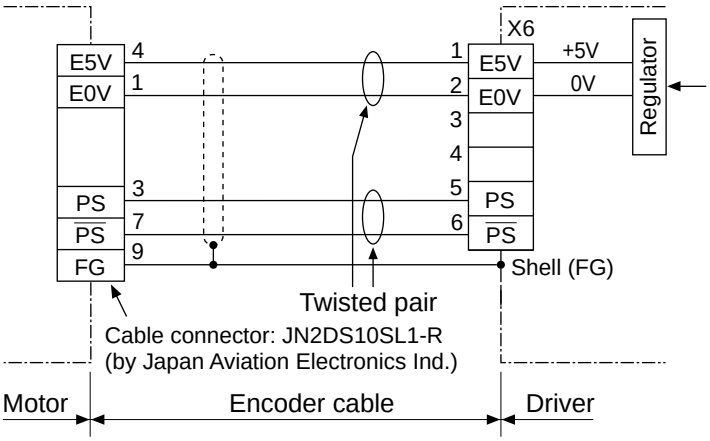

Tighten the motor connector mounting screw (M2) with a torque between 0.19 and 0.21 N·m. To avoid damage, be sure to use only the screw supplied with the connector.

[Connector pin assignment]



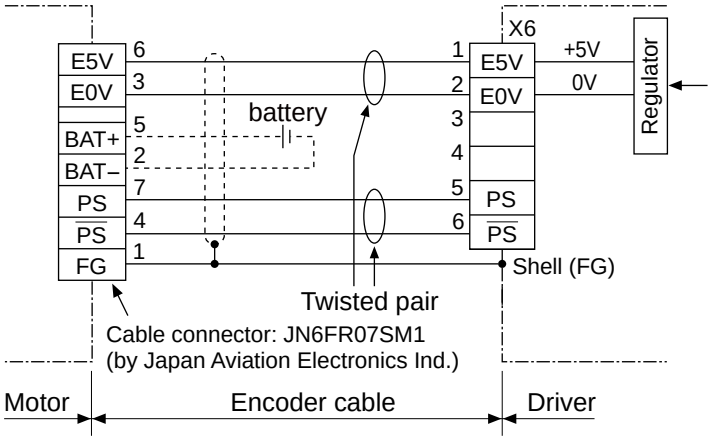

(Viewed from cable)

**MSME 1.0kW to 5.0kW**
**MDME 1.0kW to 5.0kW**
**MHME 1.0kW to 5.0kW**
**MGME 0.9kW to 3.0kW**



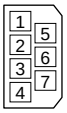
## • In case of 17-bit absolute encoder

**MSME 50W to 750W**



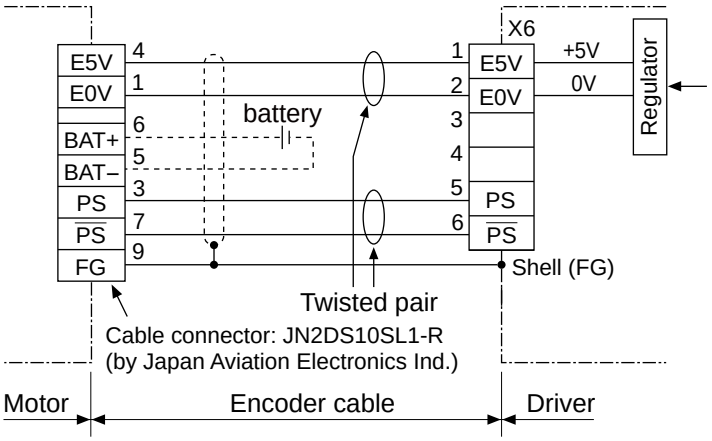

Tighten the motor connector mounting screw (M2) with a torque between 0.19 and 0.21 N·m. To avoid damage, be sure to use only the screw supplied with the connector.

[Connector pin assignment]




(Viewed from cable)

**MSME 1.0kW to 5.0kW**
**MDME 1.0kW to 5.0kW**
**MHME 1.0kW to 5.0kW**
**MGME 0.9kW to 3.0kW**



# 9. Wiring to the connector, X7

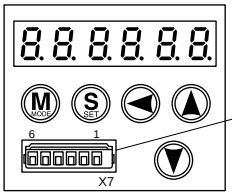
## Monitor output

The connector X7 of the front panel is for monitor output.

Analogue output : 2 systems

Digital output : 1 systems

In both cases, it is possible to switch the output signal by setting parameters.




Connector X7
Manufacturer's part No.: 530140610
Manufacturer: Japan Molex Inc.

| Application | Symbol | Connector Pin No. | Contents |
|---|---|---|---|
| Analogue monitor output 1 | AM1 | 1 | Output the analogue signal for monitor. |
| Analogue monitor output 2 | AM2 | 2 | |
| Signal ground | GND | 3 | Connected to ground of control circuit. |
| Digital monitor output | DM | 4 | Output the digital signal for monitor. |
| NC | – | 5 | Do not connect. |
| NC | – | 6 | Do not connect. |

**• Parameter rerated to monitor output.**

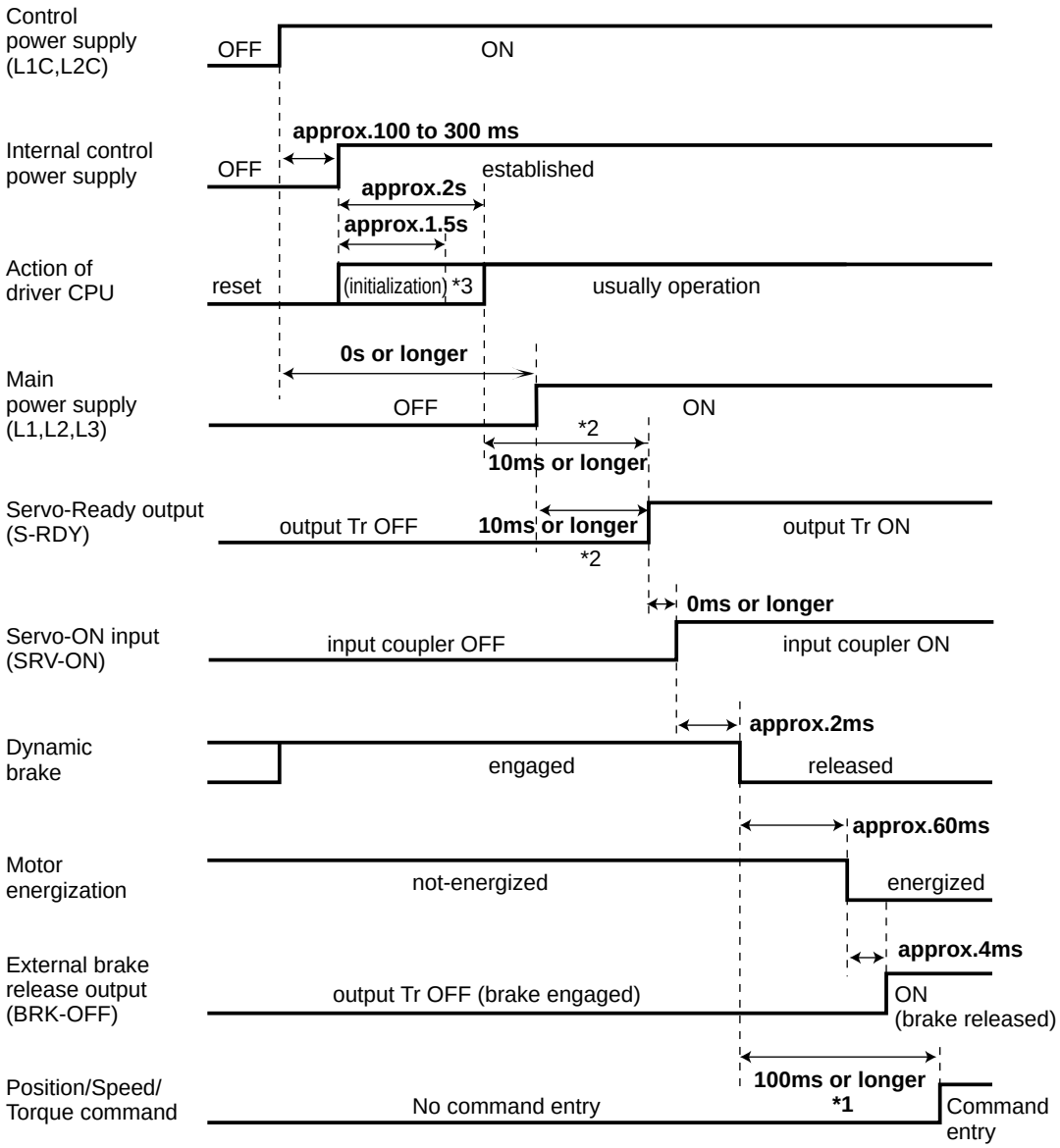
| Parametr No. | | Title | Function |
|---|---|---|---|
| Class | No. | | |
| 4 | 16 | Type of analog monitor 1 | Select the type of monitor for analog monitor 1. |
| 4 | 17 | Analog monitor 1 output gain | Set up the output gain of analog monitor 1. |
| 4 | 18 | Type of analog monitor 2 | Select the type of monitor for analog monitor 2. |
| 4 | 19 | Analog monitor 2 output gain | Set up the output gain of analog monitor 2. |
| 4 | 20 | Type of digital monitor | Select type of the digital monitor. |
| 4 | 21 | Analog monitor output setup | Select output format of the analog monitor. |

**Note** For details of parameters, refer to P.4-35 "Details of parameter".

# 10. Timing Chart

## Timing on power-up

### Servo-on signal accept timing on power-up




- The above chart shows the timing from AC power-ON to command input.
- Activate the external command input according to the above timing chart.

**Caution**

*1. In this term Servo-ON input (SRV-ON) turns ON as a hard ware, but operation command can not be received.

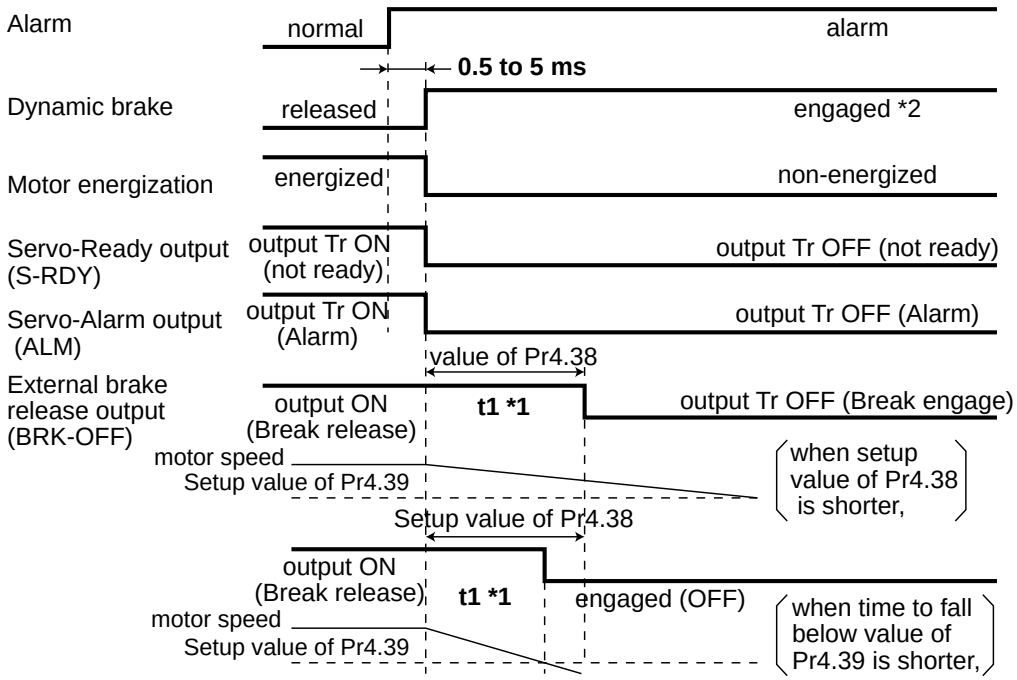
*2. S-RDY output will turn on when both conditions are met, initialization of micro computer has been completed and the main power has been turned on.

*3. After Internal control power supply , protective functions are active from approx. 1.5 sec after the start of initializing microcomputer. Please set the signals, especially for protective function, for example over-travel inhibit input (POT, NOT) or external scale input, so as to decide their logic until this term.
The lapse time can be changed with Pr6.18 Wait time after power-up.

# 10. Timing Chart

## Alarm

### When an Error (Alarm) Has Occurred (at Servo-ON Command)

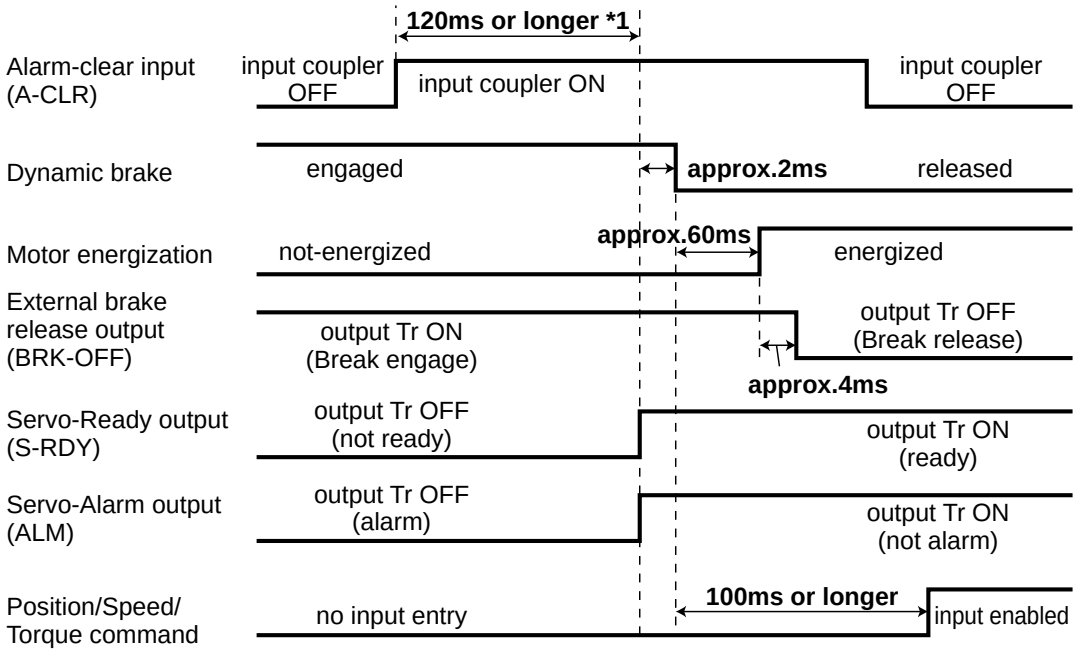



**Caution**

*1. t1 will be a shorter time of either the setup value of Pr4.38[Mechanical brake action at running setup] or elapsing time for the motor speed to fall below Pr4.39[Brake release speed setup].
t1 will be 0 when the motor is in stall regardless of the setup pf Pr4.37.

*2. When an alarm is generated, the dynamic brake operates according to Pr5.10 Sequence at alarm.

### When an Alarm Has Been Cleared (at Servo-ON Command)




**Caution**

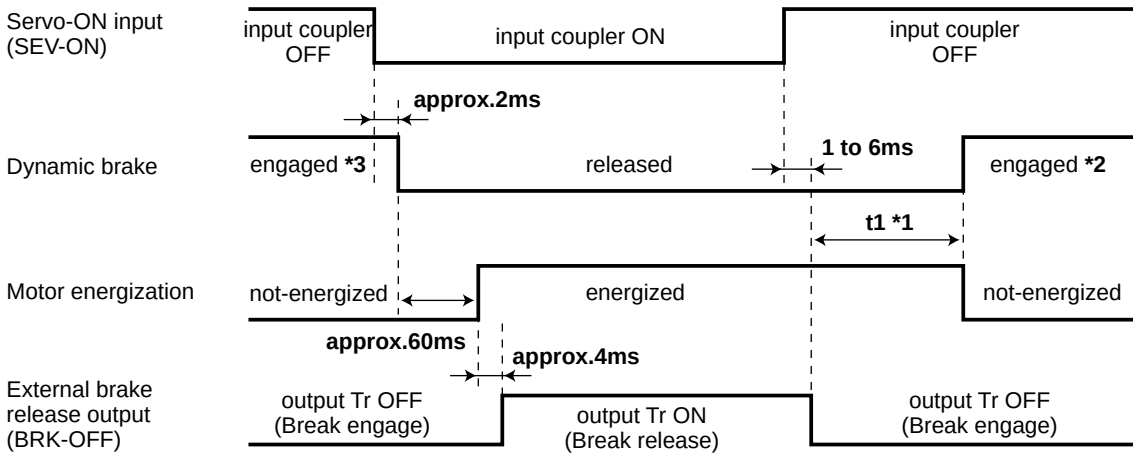
*1. The alarm clear input recognition time can be changed in Pr5.16 Alarm clear input setup.

# 10. Timing Chart

## Servo-Lock

### Servo-ON/OFF Action While the Motor Is at Stall (Servo-Lock)

**Remarks** **To turn on/off the servo during normal operation, first stop the motor.**




**Caution**

*1 t1 depends on the setup value of Pr4.37 Setup of mechanical brake action at stalling.

*2 The operation of dynamic brake during servo off depends on the setup value of Pr5.06 Sequence at servo off.

*3. Servo-ON will not be activated until the motor speed falls below approx. 30r/min.

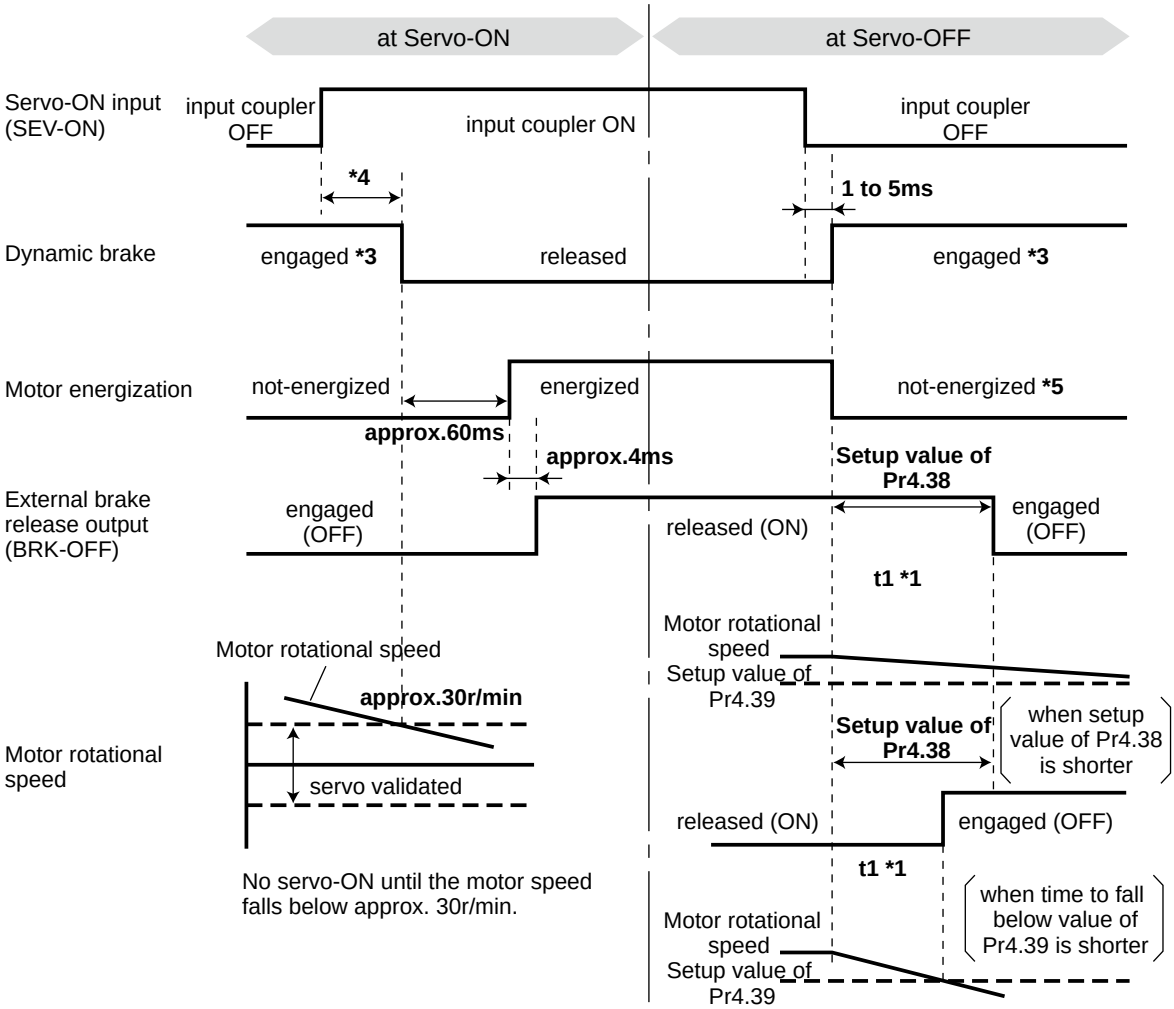
**Related page** • P.4-40 “Details of Parameter”

# 10. Timing Chart

## Servo-ON/OFF

### Servo-ON/OFF Action While the Motor Is in Motion

**Remarks** **Timing at emergency stop or trip. Do not repeat this sequence.**




**Caution**

*1. t1 will be a shorter time of either the setup value of Pr4.38 “Mechanical brake action at running setup” or elapsing time for the motor speed to fall below Pr4.39 “Brake release speed setup”.

*2. Even though the SRV-ON signal is turned on again during the motor deceleration, Servo-ON will not be activated until the motor stops.

*3. For the action of dynamic brake at alarm occurrence, refer to an explanation of Pr5.06, “Sequence at Servo-OFF” as well.

*4. Servo-ON will not be activated until the motor speed falls below approx. 30r/min.

*5. For the motor energization during deceleration at Servo-OFF depends on the setup value of Pr.5.08, “Sequence at Servo-OFF”.

**Related page** • P.2-34 “Dynamic brake”

# 11. Built-in Holding Brake

## Outline

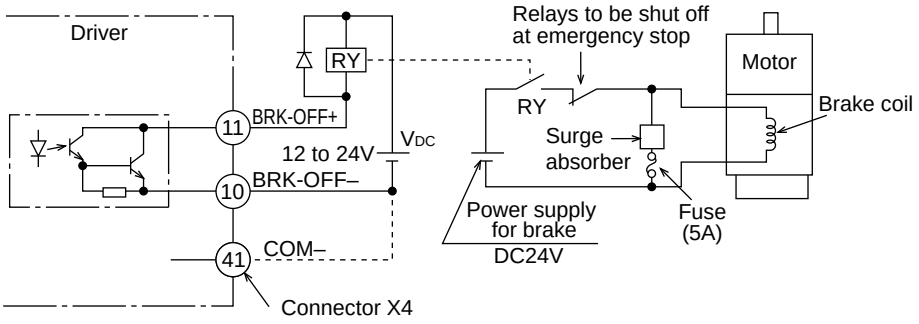
In the applications where the motor drives the vertical axis, this brake would be used to hold and prevent the work (moving load) from falling by gravity while the power to the servo is shut off.

**Caution**

**Use this built-in brake for "Holding" purpose only, that is to hold the stalling status. Never use this for "Brake" purpose to stop the load in motion.**

## Connecting Example

The following shows the example when the brake is controlled by using the brake release output signal (BRK-OFF) of the driver.




**Note**

1. The brake coil has no polarity.

**Caution**

2. Power supply for the brake to be provided by customer. Do not co-use the power supply for the brake and for the control signals (VDC).
3. Install a surge absorber as the above Fig. shows to suppress surge voltage generated by ON/OFF action of the relay (RY). When you use a diode, note that the time from the brake release to brake engagement is slower than that of the case of using a surge absorber.
4. For a surge absorber, refer to P.7-94, "Recommended Components" of Supplement.
5. Recommended components are specified to measure the brake releasing time.
   Reactance of the cable varies depending on the cable length, and it might generate surge voltage.
   Select a surge absorber so that relay coil voltage (max. rating : 30V, 50mA) and terminal voltage may not exceed the rating.

## Output Timing of BRK-OFF Signal

- For the brake release timing at power-on, or braking timing at Servo-OFF/Servo-Alarm while the motor is in motion, refer to P.2-30, "Timing Chart".
- With the parameter, P4.38 (Setup of mechanical brake action while the motor is in motion), you can set up a time between when the motor enters to a free-run from energized status and when BRK-OFF signal turns off (brake will be engaged), when the Servo-OFF or alarm occurs while the motor is in motion.

**Note**

1. The lining sound of the brake (chattering and etc.) might be generated while running the motor with built-in brake, however this does not affect any functionality.
2. Magnetic flux might be generated through the motor shaft while the brake coil is energized (brake is open). Pay an extra attention when magnetic sensors are used nearby the motor.

# 11. Built-in Holding Brake

## Specifications

| Motor series | Motor output | Static friction torque N·m | Rotor inertia x $10^{-4}$ kg·$m^2$ | Engaging time ms | Releasing time ms | Exciting current DC A (at cool-off) | Releasing voltage | Permissible work (J) per one braking | Permissible total work x $10^3$J | Permissible angular acceleration rad/$s^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| MSME | 50W, 100W | 0.29 or more | 0.002 | 35 or less | 20 or less | 0.3 | DC1V or more | 39.2 | 4.9 | 30000 |
| | 200W, 400W | 1.27 or more | 0.018 | 50 or less | 15 or less | 0.36 | | 137 | 44.1 | |
| | 750W | 2.45 or more | 0.075 | 70 or less | 20 or less | 0.42 | | 196 | 147 | |
| | 1.0kW, 1.5kW, 2.0kW | 7.8 or more | 0.33 | 50 or less | 15 or less (100) | 0.81 | DC2V or more | 392 | 490 | 10000 |
| | 3.0kW | 11.8 or more | | 80 or less | | | | | | |
| | 4.0kW, 5.0kW | 16.2 or more | 1.35 | 110 or less | 50 or less (130) | 0.9 | | 1470 | 2200 | |
| MDME | 1.0kW | 4.9 or more | 1.35 | 80 or less | 70 or less (200) | 0.59 | DC2V or more | 588 | 780 | 10000 |
| | 1.5kW, 2.0kW | 13.7 or more | | 100 or less | 50 or less (130) | 0.79 | | 1176 | 1500 | |
| | 3.0kW | 16.1 or more | | 110 or less | | 0.9 | | 1470 | 2200 | |
| | 4.0kW, 5.0kW | 24.5 or more | 4.7 | 80 or less | 25 or less (200) | 1.3 | | 1372 | 2900 | 5440 |
| MHME | 1.0kW | 4.9 or more | 1.35 | 80 or less | 70 or less (200) | 0.59 | DC2V or more | 588 | 780 | 10000 |
| | 1.5kW | 13.7 or more | | 100 or less | 50 or less (130) | 0.79 | | 1176 | 1500 | |
| | 2.0kW to 5.0kW | 24.5 or more | 4.7 | 80 or less | 25 or less (200) | 1.3 | | 1372 | 2900 | 5440 |
| MGME | 900W | 13.7 or more | 1.35 | 100 or less | 50 or less (130) | 0.79 | DC2V or more | 1176 | 1500 | 10000 |
| | 2.0kW | 24.5 or more | 4.7 | 80 or less | 25 or less (200) | 1.3 | | 1372 | 2900 | 5440 |
| | 3.0kW | 58.8 or more | | 150 or less | 50 or less (130) | 1.4 | | | | |

- Excitation voltage is DC24V±10%.
- Releasing time values represent the ones with DC-cutoff using a varistor.
  Values in ( ) represent those measured by using a diode (V03C by Hitachi, Ltd.)
- Above values (except static friction torque, releasing voltage and excitation current) represent typical values.
- Backlash of the built-in holding brake is kept ±1˚or smaller at ex-factory point.
- Service life of the number of acceleration/deceleration with the above permissible angular acceleration is more than 10 million times. (Life end is defined as when the brake backlash drastically changes.)

# 12. Dynamic Brake

## Outline

This driver is equipped with a dynamic brake for emergency stop.
Pay a special attention to the followings.

**Caution**

1. Dynamic brake is only for emergency stop.

**Do not start/stop the motor by turning on/off the Servo-ON signal (SRV-ON).**
**Or it may damage the dynamic brake circuit of the driver.**

**The motor will operate as a generator when externally driven.**
**Short-circuit current will flow during dynamic braking regardless of condition of power supply (ON/OFF), causing the driver to generate smoke or fire if the motor is continuously driven externally.**

2. Dynamic brake is a short-duration rating, and designed for only emergency stop. Allow approx. 3 minutes pause when the dynamic brake is activated during high-speed running.
(Over-current protection (Err.14.0) may be activated when the dynamic brake circuit inside the F-frame amplifier has overheated.)

**• You can activate the dynamic brake in the following cases.**

1) When the main power is turned off
2) At Servo-OFF
3) When one of the protective function is activated.
4) When over-travel inhibit input (NOT, POT) of connector X4 is activated

In the above cases from 1) to 4), you can select either activation of the dynamic brake or making the motor free-run during deceleration or after the stop, with parameter.
Note that when the control power is off, the dynamic brake will be kept activated.

**Related page**
• P.3-38 “Inputs and outputs on connector X4”
• P.4-44... “Details of Parameter”
• P.6-5 “Protective Function”

# 12. Dynamic Brake

## Condition setting chart

### 1) Setup of driving condition from deceleration to after stop by main power-off (Pr5.07)

| Sequence at main power-off (Pr5.0) | Driving condition | | Contents of deviation counter |
|---|---|---|---|
| | During deceleration | After stalling | |
| Setup value of Pr5.07 ↓ | | | |
| 0 | D B | D B | Clear |
| 1 | Free-run | D B | Clear |
| 2 | D B | Free-run | Clear |
| 3 | Free-run | Free-run | Clear |
| 4 | D B | D B | Hold |
| 5 | Free-run | D B | Hold |
| 6 | D B | Free-run | Hold |
| 7 | Free-run | Free-run | Hold |
| 8 | Emergency stop | D B | Clear |
| 9 | Emergency stop | Free-run | Clear |

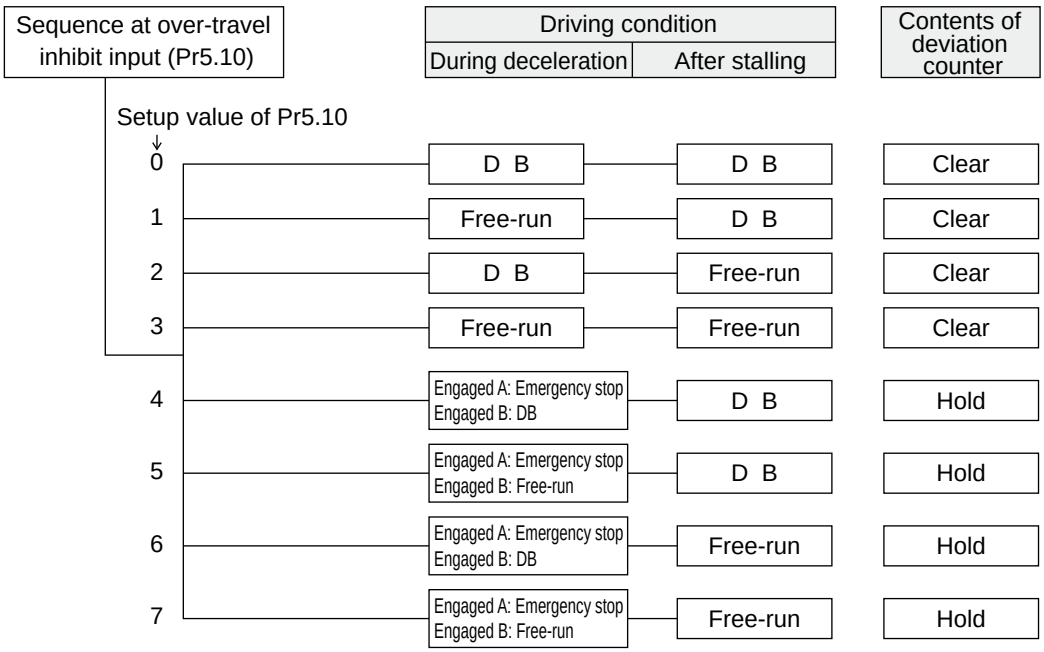
Torque limit value at emergency stop will be that of Pr5.11 (Setup of torque at emergency stop) when the setup value is 8 or 9.

### 2) Setup of driving condition from deceleration to after stop by Servo-OFF (Pr5.06)

| Sequence at main Servo-OFF (Pr5.06) | Driving condition | | Contents of deviation counter |
|---|---|---|---|
| | During deceleration | After stalling | |
| Setup value of Pr5.06 ↓ | | | |
| 0 | D B | D B | Clear |
| 1 | Free-run | D B | Clear |
| 2 | D B | Free-run | Clear |
| 3 | Free-run | Free-run | Clear |
| 4 | D B | D B | Hold |
| 5 | Free-run | D B | Hold |
| 6 | D B | Free-run | Hold |
| 7 | Free-run | Free-run | Hold |
| 8 | Emergency stop | D B | Clear |
| 9 | Emergency stop | Free-run | Clear |

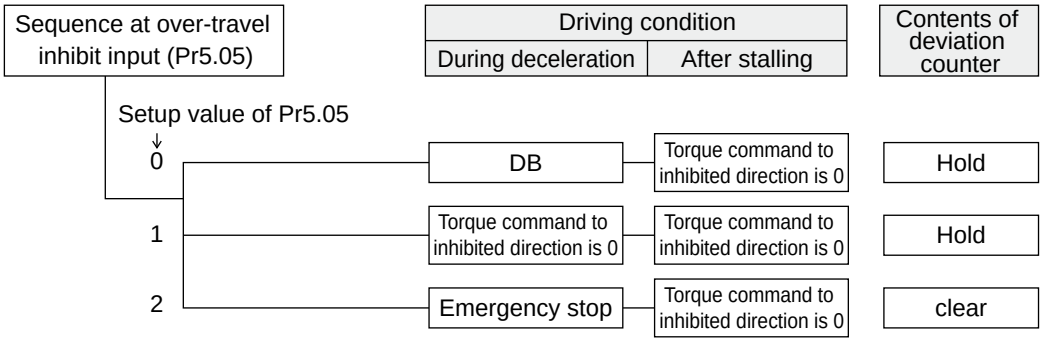
Torque limit value at emergency stop will be that of Pr5.11 (Setup of torque at emergency stop) when the setup value is 8 or 9.

## 3) Setup of driving condition from deceleration to after stop by activation of protective function (Pr5.10)




**When setup value is within the range 4 and 7, the protection function that supports immediate stop acts according to operation A and the function that does not support acts according to operation B.**

## 4) Setup of driving condition from deceleration to after stop by validation of over-travel inhibit input (Pr5.05)




Torque limit value during deceleration will be that of Pr5.11 (Setup of torque at emergency stop) when the setup value is 2.
Changes will be validated after the control power is turned on.

Related page
• P.4-42 “Details of Parameter”
• P.7-26 “Setup support software [PANATERM]”

## Outline of Parameter

This driver is equipped with various parameters to set up its characteristics and functions. This section describes the function and purpose of each parameter. Read and comprehend very well so that you can adjust this driver in optimum condition for your running requirements.

## Setup of Parameter

- You can refer and set up the parameter with either one of the following.
  1) front panel of the driver
  2) combination of the setup support software, "PANATERM" and PC.

**Note** How to control the front panel, refer to P.2-52.

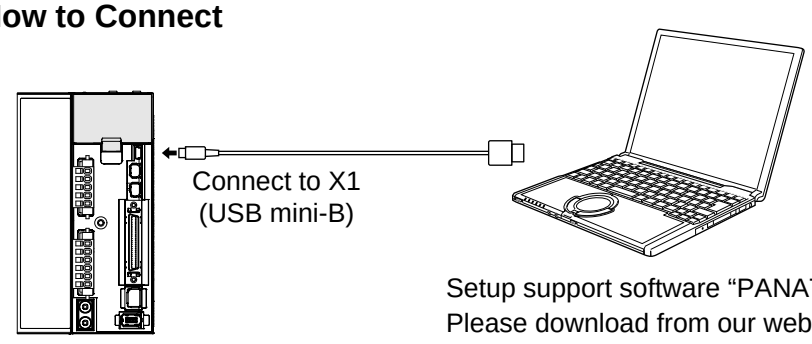
## Setup with the PC

It is possible to connect your personal computer to connector X1 of MINAS A5 using a USB cable for personal computer connection. Downloading the setup support software “PANATERM” from our web site and installing it on your personal computer will allow you to perform the following easily.

- **With the PANATERM, you can execute the followings.**
  1) Setup and storage of parameters, and writing to the memory (EEPROM).
  2) Monitoring of I/O, pulse input and load factor.
  3) Display of the present alarm and reference of the error history.
  4) Data measurement of the wave-form graphic and bringing of the stored data.
  5) Normal auto-gain tuning
  6) Frequency characteristic measurement of the machine system.

**Note** Because no production software such as CD-ROM is available, download the setup support software from our web site and install it on your personal computer.

- **How to Connect**




Setup support software “PANATERM”
Please download from our web site and use after install to the PC.

- **USB cable**

  On the driver, use commercially available USB mini-B connector.
  The connector on the personal computer side should be in accordance with the specifications of the PC.
  When the cable does not have noise filter, attach a signal line noise filter (DV0P1460) to both ends of the cable.

# 13. Setup of Parameter and Mode

## Composition and List of Parameters

**• The parameter No. is displayed in the form of PrX.YY (X: Classification, YY: No.).**

**• For the details on the parameters, refer to the Operating Instructions (Overall).**

| Parametr No. | | Class name | Group | page |
|---|---|---|---|---|
| Class | No.* | | | |
| 0 | 00 to 17 | Basic setting | Parameter for Basic setting | P.2-41 |
| 1 | 00 to 27 | Gain adjustment | Parameter for Gain adjustment | P.2-42 |
| 2 | 00 to 23 | Damping control | Parameter for Damping control | P.2-43 |
| 3 | 00 to 29 | Verocity/ Torque/ Full-closed control | Parameter for Verocity/ Torque/ Full-closed control | P.2-44 |
| 4 | 00 to 44 | I/F monitor setting | Parameter for I/F monitor setting | P.2-45 |
| 5 | 00 to 35 | Enhancing setting | Parameter for Enhancing setting | P.2-46 |
| 6 | 00 to 39 | Special setting | Parameter for Special setting | P.2-48 |

* The Parameter No. consists of 2 digits.

**• In this document, following symbols represent each mode.**

| Symbol | Control mode | Setup value of Pr0.01 |
|---|---|---|
| P | Position control | 0 |
| S | Velocity control | 1 |
| T | Torque control | 2 |
| F | Full-Closed control | 6 |
| P/S | Position (1st)/Velocity (2nd) control | 3 * |
| P/T | Position (1st)/Torque (2nd) control | 4 * |
| S/T | Velocity (1st)/Torque (2nd) control | 5 * |

* When you select the combination mode of 3, 4 or 5, you can select either 1st or 2nd with control mode switching input (C-MODE).
When C-MODE is ON ： 1st mode selection
When C-MODE is OFF： 2nd mode selection
Do not enter the command 10ms before/after the switching.

# 13. Setup of Parameter and Mode

## List of Parameters

### [Class 0] Basic setting

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 0 | 00 | Rotational direction setup | 0 to 1 | 1 | | | – | ○ | | P | S | T | F | 4-4 |
| 0 | 01 | Control mode setup | 0 to 6 | 0 | | | – | ○ | | P | S | T | F | |
| 0 | 02 | Real-time auto-gain tuning setup | 0 to 6 | 1 | | | – | | | P | S | T | F | 4-5 |
| 0 | 03 | Selection of machine stiffness at real-time auto-gain tuning | 0 to 31 | 13 | | 11 | – | | | P | S | T | F | |
| 0 | 04 | Inertia ratio | 0 to 10000 | 250 | | | % | | | P | S | T | F | 4-6 |
| 0 | 05 | Selection of command pulse input | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 0 | 06 | Command pulse rotational direction setup | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | 4-7 |
| 0 | 07 | Command pulse input mode setup | 0 to 3 | 1 | | | – | ○ | | P | S | T | F | |
| 0 | 08 | Command pulse counts per one motor revolution | 0 to $2^{20}$ | 10000 | | | pulse | ○ | | P | S | T | F | 4-8 |
| 0 | 09 | 1st numerator of electronic gear | 0 to $2^{30}$ | 0 | | | – | | | P | S | T | F | |
| 0 | 10 | Denominator of electronic gear | 0 to $2^{30}$ | 10000 | | | – | | | P | S | T | F | |
| 0 | 11 | Output pulse counts per one motor revolution | 1 to 262144 | 2500 | | | P/r | ○ | | P | S | T | F | 4-9 |
| 0 | 12 | Reversal of pulse output logic | 0 to 3 | 0 | | | – | ○ | | P | S | T | F | 4-10 |
| 0 | 13 | 1st torque limit | 0 to 500 | 500*1 | | | % | | | P | S | T | F | |
| 0 | 14 | Position deviation excess setup | 0 to $2^{27}$ | 100000 | | | Command unit | | | P | S | T | F | |
| 0 | 15 | Absolute encoder setup | 0 to 2 | 1 | | | – | ○ | | P | S | T | F | |
| 0 | 16 | External regenerative resistor setup | 0 to 3 | 3 | | 0 | – | ○ | | P | S | T | F | 4-11 |
| 0 | 17 | Load factor of external regenerative resistor selection | 0 to 4 | 0 | | | – | ○ | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control
*1 Default settings depend on the combination of driver and motor. Refer to P. 2-49 “Torque limit setting”.

**Note** Parameter describes of this page is P.4-4 to P.4-11.

## [Class 1] Gain adjustment

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 1 | 00* | 1st gain of position loop | 0 to 30000 | 480 | | 320 | 0.1/s | | | P | S | T | F | 4-12 |
| 1 | 01* | 1st gain of velocity loop | 1 to 32767 | 270 | | 180 | 0.1Hz | | | P | S | T | F | |
| 1 | 02* | 1st time constant of velocity loop integration | 1 to 10000 | 210 | | 310 | 0.1ms | | | P | S | T | F | |
| 1 | 03 | 1st filter of speed detection | 0 to 5 | 0 | | | – | | | P | S | T | F | |
| 1 | 04 | 1st time constant of torque filter | 0 to 2500 | 84 | | 126 | 0.01ms | | | P | S | T | F | |
| 1 | 05* | 2nd gain of position loop | 0 to 30000 | 570 | | 380 | 0.1/s | | | P | S | T | F | 4-13 |
| 1 | 06* | 2nd gain of velocity loop | 1 to 32767 | 270 | | 180 | 0.1Hz | | | P | S | T | F | |
| 1 | 07* | 2nd time constant of velocity loop integration | 1 to 10000 | 10000 | | | 0.1ms | | | P | S | T | F | |
| 1 | 08 | 2nd filter of speed detection | 0 to 5 | 0 | | | – | | | P | S | T | F | |
| 1 | 09* | 2nd time constant of torque filter | 0 to 2500 | 84 | | 126 | 0.01ms | | | P | S | T | F | |
| 1 | 10* | Velocity feed forward gain | 0 to 1000 | 300 | | | 0.10% | | | P | S | T | F | |
| 1 | 11* | Velocity feed forward filter | 0 to 6400 | 50 | | | 0.01ms | | | P | S | T | F | |
| 1 | 12* | Torque feed forward gain | 0 to 1000 | 0 | | | 0.10% | | | P | S | T | F | 4-14 |
| 1 | 13* | Torque feed forward filter | 0 to 6400 | 0 | | | 0.01ms | | | P | S | T | F | |
| 1 | 14 | 2nd gain setup | 0 to 1 | 1 | | | – | | | P | S | T | F | |
| 1 | 15 | Mode of position control switching | 0 to 10 | 0 | | | – | | | P | S | T | F | 4-15 |
| 1 | 16* | Delay time of position control switching | 0 to 10000 | 50 | | | 0.1ms | | | P | S | T | F | 4-16 |
| 1 | 17 | Level of position control switching | 0 to 20000 | 50 | | | – | | | P | S | T | F | |
| 1 | 18 | Hysteresis at position control switching | 0 to 20000 | 33 | | | – | | | P | S | T | F | |
| 1 | 19* | Position gain switching time | 0 to 10000 | 33 | | | 0.1ms | | | P | S | T | F | |
| 1 | 20 | Mode of velocity control switching | 0 to 5 | 0 | | | – | | | P | S | T | F | 4-17 |
| 1 | 21* | Delay time of velocity control switching | 0 to 10000 | 0 | | | 0.1ms | | | P | S | T | F | |
| 1 | 22 | Level of velocity control switching | 0 to 20000 | 0 | | | – | | | P | S | T | F | |
| 1 | 23 | Hysteresis at velocity control switching | 0 to 20000 | 0 | | | – | | | P | S | T | F | |
| 1 | 24 | Mode of torque control switching | 0 to 3 | 0 | | | – | | | P | S | T | F | 4-18 |
| 1 | 25* | Delay time of torque control switching | 0 to 10000 | 0 | | | 0.1ms | | | P | S | T | F | |
| 1 | 26 | Level of torque control switching | 0 to 20000 | 0 | | | – | | | P | S | T | F | |
| 1 | 27 | Hysteresis at torque control switching | 0 to 20000 | 0 | | | – | | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-12 to P.4-18.

## [Class 2] Damping control

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 2 | 00 | Adaptive filter mode setup | 0 to 4 | 0 | | | – | | | P | S | T | F | 4-19 |
| 2 | 01 | 1st notch frequency | 50 to 5000 | 5000 | | | Hz | | | P | S | T | F | |
| 2 | 02 | 1st notch width selection | 0 to 20 | 2 | | | – | | | P | S | T | F | |
| 2 | 03 | 1st notch depth selection | 0 to 99 | 0 | | | – | | | P | S | T | F | |
| 2 | 04 | 2nd notch frequency | 50 to 5000 | 5000 | | | Hz | | | P | S | T | F | |
| 2 | 05 | 2nd notch width selection | 0 to 20 | 2 | | | – | | | P | S | T | F | 2-20 |
| 2 | 06 | 2nd notch depth selection | 0 to 99 | 0 | | | – | | | P | S | T | F | |
| 2 | 07 | 3rd notch frequency | 50 to 5000 | 5000 | | | Hz | | | P | S | T | F | |
| 2 | 08 | 3rd notch width selection | 0 to 20 | 2 | | | – | | | P | S | T | F | |
| 2 | 09 | 3rd notch depth selection | 0 to 99 | 0 | | | – | | | P | S | T | F | |
| 2 | 10 | 4th notch frequency | 50 to 5000 | 5000 | | | Hz | | | P | S | T | F | |
| 2 | 11 | 4th notch width selection | 0 to 20 | 2 | | | – | | | P | S | T | F | 2-21 |
| 2 | 12 | 4th notch depth selection | 0 to 99 | 0 | | | – | | | P | S | T | F | |
| 2 | 13 | Selection of damping filter switching | 0 to 3 | 0 | | | – | | | P | S | T | F | |
| 2 | 14* | 1st damping frequency | 0 to 2000 | 0 | | | 0.1Hz | | | P | S | T | F | 2-22 |
| 2 | 15* | 1st damping filter setup | 0 to 1000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 16* | 2nd damping frequency | 0 to 2000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 17* | 2nd damping filter setup | 0 to 1000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 18* | 3rd damping frequency | 0 to 2000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 19* | 3rd damping filter setup | 0 to 1000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 20* | 4th damping frequency | 0 to 2000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 21* | 4th damping filter setup | 0 to 1000 | 0 | | | 0.1Hz | | | P | S | T | F | |
| 2 | 22* | Positional command smoothing filter | 0 to 10000 | 0 | | | 0.1ms | | | P | S | T | F | 2-23 |
| 2 | 23* | Positional command FIR filter | 0 to 10000 | 0 | | | 0.1ms | | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-19 to P.4-23.

## [Class 3] Verocity/ Torque/ Full-closed control

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 3 | 00 | Speed setup, Internal/External switching | 0 to 3 | 0 | | | – | | | P | S | T | F | 4-24 |
| 3 | 01 | Speed command rotational direction selection | 0 to 1 | 0 | | | – | | | P | S | T | F | |
| 3 | 02 | Input gain of speed command | 10 to 2000 | 500 | | | (r/min)/ V | | | P | S | T | F | 4-25 |
| 3 | 03 | Reversal of speed command input | 0 to 1 | 1 | | | – | | | P | S | T | F | |
| 3 | 04 | 1st speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | 4-26 |
| 3 | 05 | 2nd speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 06 | 3rd speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 07 | 4th speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 08 | 5th speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 09 | 6th speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 10 | 7th speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 11 | 8th speed of speed setup | –20000 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 12 | Acceleration time setup | 0 to 10000 | 0 | | | ms/ (1000r/min) | | | P | S | T | F | |
| 3 | 13 | Deceleration time setup | 0 to 10000 | 0 | | | ms/ (1000r/min) | | | P | S | T | F | |
| 3 | 14 | Sigmoid acceleration/ deceleration time setup | 0 to 1000 | 0 | | | ms | | | P | S | T | F | 4-27 |
| 3 | 15 | Speed zero-clamp function selection | 0 to 3 | 0 | | | – | | | P | S | T | F | |
| 3 | 16 | Speed zero clamp level | 10 to 20000 | 30 | | | r/min | | | P | S | T | F | |
| 3 | 17 | Selection of torque command | 0 to 2 | 0 | | | – | | | P | S | T | F | 4-28 |
| 3 | 18 | Torque command direction selection | 0 to 1 | 0 | | | – | | | P | S | T | F | |
| 3 | 19* | Input gain of torque command | 10 to 100 | 30 | | | 0.1V/100% | | | P | S | T | F | |
| 3 | 20 | Input reversal of torque command | 0 to 1 | 0 | | | – | | | P | S | T | F | |
| 3 | 21 | Speed limit value 1 | 0 to 20000 | 0 | | | r/min | | | P | S | T | F | 4-29 |
| 3 | 22 | Speed limit value 2 | 0 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 3 | 23 | External scale selection | 0 to 2 | 0 | | | – | ○ | | P | S | T | F | |
| 3 | 24 | Numerator of external scale division | 0 to $2^{20}$ | 0 | | | – | ○ | | P | S | T | F | 4-30 |
| 3 | 25 | Denominator of external scale division | 1 to $2^{20}$ | 10000 | | | – | ○ | | P | S | T | F | |
| 3 | 26 | Reversal of direction of external scale | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 3 | 27 | External scale Z phase disconnection detection disable | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 3 | 28 | Hybrid deviation excess setup | 1 to $2^{27}$ | 16000 | | | Command unit | ○ | | P | S | T | F | 4-31 |
| 3 | 29 | Hybrid deviation clear setup | 0 to 100 | 0 | | | Revolution | ○ | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-24 to P.4-31.

## [Class 4] I/F monitor setting

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 4 | 00 | SI1 input selection | 0 to 00FFFFFFh | 8553090 | | | – | ○ | | P | S | T | F | 4-32 |
| 4 | 01 | SI2 input selection | 0 to 00FFFFFFh | 8487297 | | | – | ○ | | P | S | T | F | 4-33 |
| 4 | 02 | SI3 input selection | 0 to 00FFFFFFh | 9539850 | | | – | ○ | | P | S | T | F | |
| 4 | 03 | SI4 input selection | 0 to 00FFFFFFh | 394758 | | | – | ○ | | P | S | T | F | |
| 4 | 04 | SI5 input selection | 0 to 00FFFFFFh | 4108 | | | – | ○ | | P | S | T | F | |
| 4 | 05 | SI6 input selection | 0 to 00FFFFFFh | 197379 | | | – | ○ | | P | S | T | F | |
| 4 | 06 | SI7 input selection | 0 to 00FFFFFFh | 3847 | | | – | ○ | | P | S | T | F | |
| 4 | 07 | SI8 input selection | 0 to 00FFFFFFh | 263172 | | | – | ○ | | P | S | T | F | |
| 4 | 08 | SI9 input selection | 0 to 00FFFFFFh | 328965 | | | – | ○ | | P | S | T | F | |
| 4 | 09 | SI10 input selection | 0 to 00FFFFFFh | 3720 | | | – | ○ | | P | S | T | F | |
| 4 | 10 | SO1 output selection | 0 to 00FFFFFFh | 197379 | | | – | ○ | | P | S | T | F | 4-34 |
| 4 | 11 | SO2 output selection | 0 to 00FFFFFFh | 131586 | | | – | ○ | | P | S | T | F | |
| 4 | 12 | SO3 output selection | 0 to 00FFFFFFh | 65793 | | | – | ○ | | P | S | T | F | |
| 4 | 13 | SO4 output selection | 0 to 00FFFFFFh | 328964 | | | – | ○ | | P | S | T | F | |
| 4 | 14 | SO5 output selection | 0 to 00FFFFFFh | 460551 | | | – | ○ | | P | S | T | F | |
| 4 | 15 | SO6 output selection | 0 to 00FFFFFFh | 394758 | | | – | ○ | | P | S | T | F | |
| 4 | 16 | Type of analog monitor 1 | 0 to 21 | 0 | | | – | | | P | S | T | F | 4-35 |
| 4 | 17 | Analog monitor 1 output gain | 0 to 214748364 | 0 | | | – | | | P | S | T | F | |
| 4 | 18 | Type of analog monitor 2 | 0 to 21 | 4 | | | – | | | P | S | T | F | |
| 4 | 19 | Analog monitor 2 output gain | 0 to 214748364 | 0 | | | – | | | P | S | T | F | |
| 4 | 20 | Type of digital monitor | 0 to 3 | 0 | | | – | | | P | S | T | F | |
| 4 | 21 | Analog monitor output setup | 0 to 2 | 0 | | | – | | | P | S | T | F | 4-37 |
| 4 | 22 | Analog input 1 (AI1) offset setup | –5578 to 5578 | 0 | | | 0.366mV | | | P | S | T | F | |
| 4 | 23* | Analog input 1 (AI1) filter | 0 to 6400 | 0 | | | 0.01ms | | | P | S | T | F | |
| 4 | 24* | Analog input 1 (AI1) overvoltage setup | 0 to 100 | 0 | | | 0.1V | | | P | S | T | F | |
| 4 | 25 | Analog input 2 (AI2) offset setup | –342 to 342 | 0 | | | 5.86mV | | | P | S | T | F | |
| 4 | 26* | Analog input 2 (AI2) filter | 0 to 6400 | 0 | | | 0.01ms | | | P | S | T | F | |
| 4 | 27* | Analog input 2(AI2) overvoltage setup | 0 to 100 | 0 | | | 0.1V | | | P | S | T | F | |
| 4 | 28 | Analog input 3 (AI3) offset setup | –342 to 342 | 0 | | | 5.86mV | | | P | S | T | F | 4-38 |
| 4 | 29* | Analog input 3 (AI3) filter | 0 to 6400 | 0 | | | 0.01ms | | | P | S | T | F | |
| 4 | 30* | Analog input 3 (AI3) overvoltage setup | 0 to 100 | 0 | | | 0.1V | | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-32 to P.4-38.

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 4 | 31 | Positioning complete (In-position) range | 0 to 262144 | 10 | | | Command unit | | | P | S | T | F | 4-38 |
| 4 | 32 | Positioning complete (In-position) output setup | 0 to 3 | 0 | | | – | | | P | S | T | F | |
| 4 | 33 | INP hold time | 0 to 30000 | 0 | | | 1ms | | | P | S | T | F | 4-39 |
| 4 | 34 | Zero-speed | 10 to 20000 | 50 | | | r/min | | | P | S | T | F | |
| 4 | 35 | Speed coincidence range | 10 to 20000 | 50 | | | r/min | | | P | S | T | F | 4-40 |
| 4 | 36 | At-speed (Speed arrival) | 10 to 20000 | 1000 | | | r/min | | | P | S | T | F | |
| 4 | 37 | Mechanical brake action at stalling setup | 0 to 10000 | 0 | | | 1ms | | | P | S | T | F | 4-41 |
| 4 | 38 | Mechanical brake action at running setup | 0 to 10000 | 0 | | | 1ms | | | P | S | T | F | |
| 4 | 39 | Brake release speed setup | 30 to 3000 | 30 | | | r/min | ○ | | P | S | T | F | |
| 4 | 40 | Selection of alarm output 1 | 0 to 10 | 0 | | | – | | | P | S | T | F | 4-42 |
| 4 | 41 | Selection of alarm output 2 | 0 to 10 | 0 | | | – | | | P | S | T | F | |
| 4 | 42 | 2nd Positioning complete (In-position) range | 0 to 262144 | 10 | | | Command unit | | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

## [Class 5] Enhancing setting

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 5 | 00 | 2nd numerator of electronic gear | 0 to $2^{30}$ | 0 | | | – | | | P | S | T | F | 4-43 |
| 5 | 01 | 3rd numerator of electronic gear | 0 to $2^{30}$ | 0 | | | – | | | P | S | T | F | |
| 5 | 02 | 4th numerator of electronic gear | 0 to $2^{30}$ | 0 | | | – | | | P | S | T | F | |
| 5 | 03 | Denominator of pulse output division | 0 to 262144 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 04 | Over-travel inhibit input setup | 0 to 2 | 1 | | | – | ○ | | P | S | T | F | |
| 5 | 05 | Sequence at over-travel inhibit | 0 to 2 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 06 | Sequence at Servo-Off | 0 to 9 | 0 | | | – | | | P | S | T | F | 4-44 |
| 5 | 07 | Sequence at main power OFF | 0 to 9 | 0 | | | – | | | P | S | T | F | |
| 5 | 08 | LV trip selection at main power OFF | 0 to 1 | 1 | | | – | | | P | S | T | F | 4-45 |
| 5 | 09 | Detection time of main power off | 70 to 2000 | 70 | | | 1ms | ○ | | P | S | T | F | |
| 5 | 10 | Sequence at alarm | 0 to 7 | 0 | | | – | | | P | S | T | F | |
| 5 | 11 | Torque setup for emergency stop | 0 to 500 | 0 | | | % | | | P | S | T | F | 4-46 |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Note** Parameter describes of this page is P.4-38 to P.4-46.

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 5 | 12 | Over-load level setup | 0 to 500 | 0 | | | % | | | P | S | T | F | 4-46 |
| 5 | 13 | Over-speed level setup | 0 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 5 | 14* | Motor working range setup | 0 to 1000 | 10 | | | 0.1 revolution | | | P | S | T | F | |
| 5 | 15 | I/F reading filter | 0 to 3 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 16 | Alarm clear input setup | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 17 | Counter clear input mode | 0 to 4 | 3 | | | – | | | P | S | T | F | 4-47 |
| 5 | 18 | Invalidation of command pulse inhibit input | 0 to 1 | 1 | | | – | | | P | S | T | F | |
| 5 | 19 | Command pulse inhibit input reading setup | 0 to 4 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 20 | Position setup unit select | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 21 | Selection of torque limit | 0 to 6 | 1 | | | – | | | P | S | T | F | 4-48 |
| 5 | 22 | 2nd torque limit | 0 to 500 | 500*1 | | | % | | | P | S | T | F | |
| 5 | 23 | Torque limit switching setup 1 | 0 to 4000 | 0 | | | ms/100% | | | P | S | T | F | |
| 5 | 24 | Torque limit switching setup 2 | 0 to 4000 | 0 | | | ms/100% | | | P | S | T | F | |
| 5 | 25 | External input positive direction torque limit | 0 to 500 | 500*1 | | | % | | | P | S | T | F | |
| 5 | 26 | External input negative direction torque limit | 0 to 500 | 500*1 | | | % | | | P | S | T | F | 4-49 |
| 5 | 27* | Input gain of analog torque limit | 10 to 100 | 30 | | | 0.1V/100% | | | P | S | T | F | |
| 5 | 28 | LED initial status | 0 to 35 | 1 | | | – | ○ | | P | S | T | F | |
| 5 | 29 | RS232 baud rate setup | 0 to 6 | 2 | | | – | ○ | | P | S | T | F | |
| 5 | 30 | RS485 baud rate setup | 0 to 6 | 2 | | | – | ○ | | P | S | T | F | 4-50 |
| 5 | 31 | Axis address | 0 to 127 | 1 | | | – | ○ | | P | S | T | F | |
| 5 | 32 | Command pulse input maximum setup | 250 to 4000 | 4000 | | | kpulse/s | ○ | | P | S | T | F | |
| 5 | 33 | Pulse regenerative output limit setup | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 5 | 34 | For manufactuer's use | – | 4 | | | – | | | P | S | T | F | |
| 5 | 35 | Front panel lock setup | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control
*1 Default settings depend on the combination of driver and motor. Refer to P. 2-49 “Torque limit setting”.

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-45 to P.4-50.

## [Class 6] Special setting

| Parametr No. | | Title | Range | Default | | | Unit | Attribute | | Related Control Mode | | | | Detail page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | No. | | | A,B -frame | C -frame | D,E,F -frame | | INI | RO | P | S | T | F | |
| 6 | 00* | Analog torque feed forward conversion gain | 0 to 100 | 0 | | | 0.1V/100% | | | P | S | T | F | 4-51 |
| 6 | 02 | Velocity deviation excess setup | 0 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 6 | 04 | JOG trial run command speed | 0 to 500 | 300 | | | r/min | | | P | S | T | F | |
| 6 | 05* | Position 3rd gain valid time | 0 to 10000 | 0 | | | 0.1ms | | | P | S | T | F | |
| 6 | 06 | Position 3rd gain scale factor | 50 to 1000 | 100 | | | % | | | P | S | T | F | |
| 6 | 07 | Torque command additional value | –100 to 100 | 0 | | | % | | | P | S | T | F | |
| 6 | 08 | Positive direction torque compensation value | –100 to 100 | 0 | | | % | | | P | S | T | F | 4-52 |
| 6 | 09 | Negative direction torque compensation value | –100 to 100 | 0 | | | % | | | P | S | T | F | |
| 6 | 10 | Function expansion setup | 0 to 63 | 0 | | | – | | | P | S | T | F | |
| 6 | 11 | Current response setup | 50 to 100 | 100 | | | % | | | P | S | T | F | |
| 6 | 13 | Current response setup | 0 to 10000 | 250 | | | % | | | P | S | T | F | |
| 6 | 14 | Emergency stop time at alarm | 0 to 1000 | 200 | | | 1ms | | | P | S | T | F | 4-53 |
| 6 | 15 | 2nd over-speed level setup | 0 to 20000 | 0 | | | r/min | | | P | S | T | F | |
| 6 | 16 | For manufacturer's use | – | 0 | | | – | ○ | | P | S | T | F | |
| 6 | 17 | Front panel parameter writing selection | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 6 | 18* | Power-up wait time | 0 to 100 | 0 | | | 0.1s | ○ | | P | S | T | F | |
| 6 | 19 | Encoder Z phase setup | 0 to 32767 | 0 | | | pulse | ○ | | P | S | T | F | |
| 6 | 20 | Z-phase setup of external scale | 0 to 400 | 0 | | | µs | ○ | | P | S | T | F | 4-54 |
| 6 | 21 | Serial absolute external scale Z phase setup | 0 to $2^{28}$ | 0 | | | pulse | ○ | | P | S | T | F | |
| 6 | 22 | A, B phase external scale pulse output method selection | 0 to 1 | 0 | | | – | ○ | | P | S | T | F | |
| 6 | 23 | Disturbance torque compensating gain | –100 to 100 | 0 | | | % | | | P | S | T | F | |
| 6 | 24* | Disturbance observer filter | 10 to 2500 | 53 | | | 0.01ms | | | P | S | T | F | |
| 6 | 27 | Alarm latch time selection | 0 to 10 | 5 | | | s | ○ | | P | S | T | F | |
| 6 | 31 | Real time auto tuning estimation speed | 0 to 3 | 1 | | | – | | | P | S | T | F | 4-55 |
| 6 | 32 | Real time auto tuning custom setup | –32768 to 32767 | 0 | | | – | | | P | S | T | F | |
| 6 | 33 | For manufacturer's use | – | 1000 | | | – | | | P | S | T | F | 4-57 |
| 6 | 34* | Hybrid vibration suppression gain | 0 to 30000 | 0 | | | 0.1/s | | | P | S | T | F | |
| 6 | 35* | Hybrid vibration suppression filter | 0 to 6400 | 10 | | | 0.01ms | | | P | S | T | F | |
| 6 | 37* | Oscillation detecting level | 0 to 1000 | 0 | | | 0.1% | | | P | S | T | F | |
| 6 | 38 | Alarm mask setup | –32768 to 32767 | 4 | | | – | ○ | | P | S | T | F | |
| 6 | 39 | For manufactuer's use | – | 0 | | | – | | | P | S | T | F | |

* Definition of symbols under “Attribute” - INI: turning on of power supply is required, RO: read only
* Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

**Caution** The symbol “ * ” attached to a parameter No. indicates that the digits of setting unit will change if the parameter is set by using the setup support software PANATERM.

**Note** Parameter describes of this page is P.4-51 to P.4-57.

Torque limit setup range is 0 to 300 and default is 300 except the combinations of the motor and the driver listed in the table below.

| Frame | Model No. | Applicable motor | Max. value of torque limit |
|---|---|---|---|
| D | MDDHT5540 | MGME092G** | 225 |
| | | MGME092S** | 225 |
| | MDDHT3420 | MGME094G** | 225 |
| | | MGME094S** | 225 |
| F | MFDHTA390 | MGME202G** | 250 |
| | | MGME202S** | 250 |

| Frame | Model No. | Applicable motor | Max. value of torque limit |
|---|---|---|---|
| F | MFDHTB3A2 | MGME302G** | 250 |
| | | MGME302S** | 250 |
| | MFDHT5440 | MGME204G** | 250 |
| | | MGME204S** | 250 |
| | MFDHTA464 | MGME304G** | 250 |
| | | MGME304S** | 250 |

- The above limit applies to Pr0.13 (1st torque limit), Pr5.22 (2nd torque limit), Pr5.11 (Torque setup for emergency stop), Pr5.25 (External input positive direction torque limit) and Pr5.26(External input negative direction torque limit).

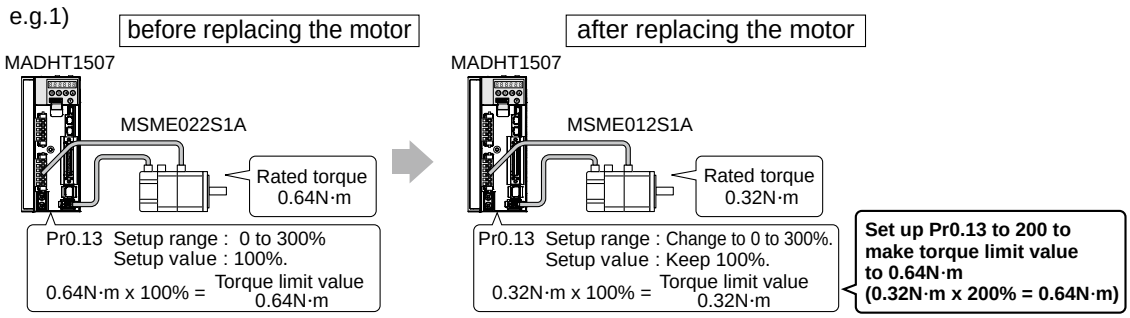
**Caution** When you change the motor model, above max. value may change as well. Check and reset the setup values of Pr0.13, Pr5.22, Pr5.11, Pr5.25 and Pr5.26.

## Cautions on Replacing the Motor

As stated above, torque limit setup range might change when you replace the combination of the motor and the driver. Pay attention to the followings.

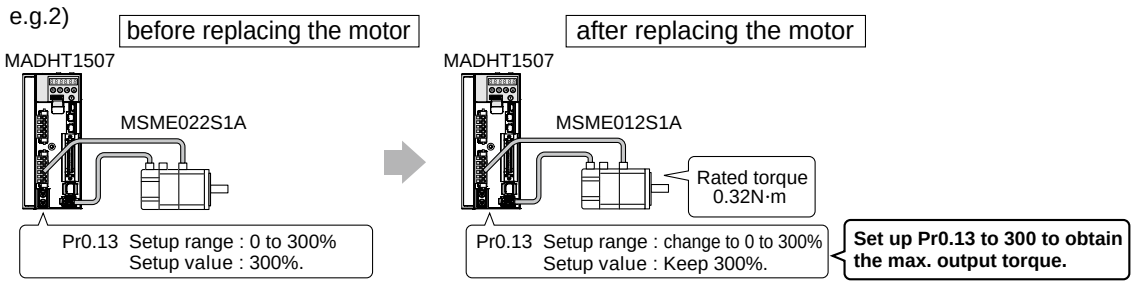
### 1. When the motor torque is limited,

When you replace the motor series or to the different wattage motor, you need to reset the torque limit setup because the rated toque of the motor is different from the previous motor. (see e.g.1)



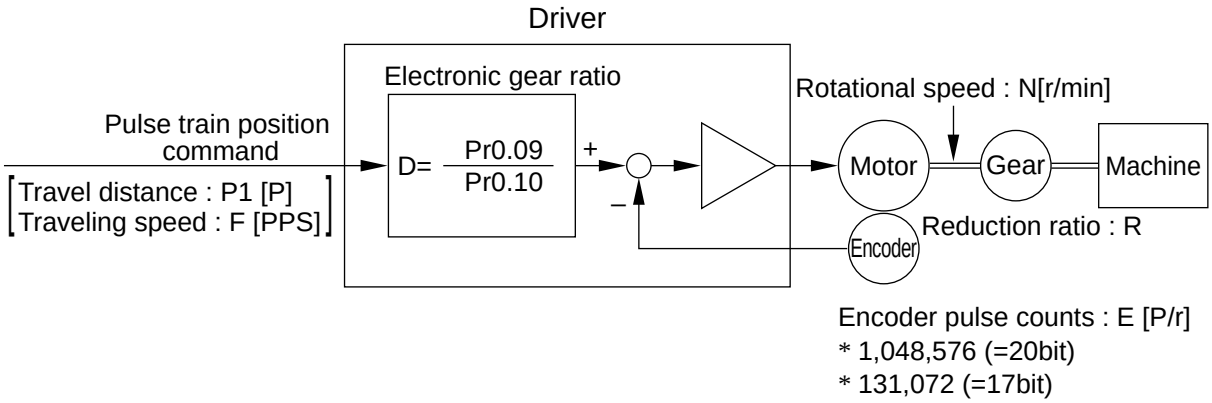

### 2. When you want to obtain the max. motor torque,

You need to reset the torque limiting setup to the upper limit, because the upper limit value might be different from the previous motor. (see e.g.2)



# 14. Setup of command division and multiplication ratio (electronic gear ratio)

## Relation between Electronic Gear and Position Resolution or Traveling Speed




Example of ball screw drive by servo motor

Here we take a ball screw drive as an example of machine.
A travel distance of a ball screw M [mm] corresponding to travel command P1 [P], can be described by the following formula (1) by making the lead of ball screw as L [mm]

**M = P1 x (D/E) x (1/R) x L ..... (1)**

therefore, position resolution (travel distance ΔM per one command pulse) will be described by the formula (2)

**ΔM = (D/E) x (1/R) x L ..... (2)**

modifying the above formula (2), electronic gear ratio can be found in the formula (3).

**D = (ΔM x E x R) x L ..... (3)**

Actual traveling velocity of ball screw, V[mm/s] can be described by the formula (4) and the motor rotational speed, N at that time can be described by the formula (5).

**V = F x (D/E) x (1/R) x L ..... (4)**

**N = F x (D/E) x 60 ..... (5)**

modifying the above formula (5), electronic gear ratio can be found in the formula (6).

**D = (N x E)/ (F x 60) ..... (6)**

**Note**

1) Make a position resolution, Δ M as approx. 1/5 to 1/10 of the machine positioning accuracy, Δε, considering a mechanical error.
2) Set up Pr0.09 and Pr0.10 to any values between 1 to $2^{30}$.
3) You can set up any values to a numerator and denominator, however, action by an extreme division ratio or multiplication ratio cannot be guaranteed. Recommended range is 1/1000 to 1000 times.
4)

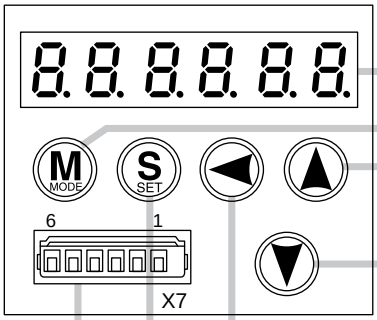
| $2^n$ | Decimal | $2^n$ | Decimal |
|---|---|---|---|
| $2^0$ | 1 | $2^{11}$ | 2048 |
| $2^1$ | 2 | $2^{12}$ | 4096 |
| $2^2$ | 4 | $2^{13}$ | 8192 |
| $2^3$ | 8 | $2^{14}$ | 16384 |
| $2^4$ | 16 | $2^{15}$ | 32768 |
| $2^5$ | 32 | $2^{16}$ | 65536 |
| $2^6$ | 64 | $2^{17}$ | 131072 |
| $2^7$ | 128 | $2^{18}$ | 262144 |
| $2^8$ | 256 | $2^{19}$ | 524288 |
| $2^9$ | 512 | $2^{20}$ | 1048576 |
| $2^{10}$ | 1024 | | |

| | Electronic gear ratio $D = \frac{\Delta M \times E \times R}{L}$ | $D = \frac{Pr0.09}{Pr0.10}$ |
|---|---|---|
| Lead of ball screw, L =10mm<br>Gear reduction ratio, R = 1<br>Position resolution,<br>ΔM =0.005mm<br>Encoder, 17-bit<br>(E= $2^{17}$P/r) | $\frac{0.0005\times2^{17}\times1}{10} = \frac{5\times2^{17}}{10\times10^{4}} = \frac{655360}{100000}$ | Pr0.09 = 655360<br>Pr0.10 = 100000 |
| Lead of ball screw, L =20mm<br>Gear reduction ratio, R = 1<br>Position resolution,<br>ΔM =0.0005mm<br>Encoder, 17-bit<br>(E= $2^{17}$P/r) | $\frac{0.00005\times2^{17}\times1}{20} = 0.32768$<br>D < 1, hence use 120-bit. | "D = 1" is the condition for minimum resolution. |
| Encoder : 20-bit (E = $2^{20}$ P/r) | $\frac{0.00005\times2^{20}\times1}{20} = \frac{5\times2^{20}}{20\times10^{5}} = \frac{5242880}{2000000}$ | Pr0.09 = 5242880<br>Pr0.10 = 2000000 |

| | Motor rotational speed (r/min), $N = F \times \frac{D}{E} \times 60$ | |
|---|---|---|
| Lead of ball screw, L =20mm<br>Gear reduction ratio, R = 1<br>Position resolution,<br>ΔM = 0.0005mm<br>Line driver pulse input,<br>500kpps<br>Encoder, 17-bit | $\cancel{500000} \times \frac{1\times2^{15}}{\cancel{10000}} \times \frac{1}{\cancel{2^{17}}} \times 60$<br>$= 50 \times 60 \times \frac{1}{2^{2}} = 750$ | |
| Ditto<br>To make it to 2000r/min. | Electronic gear ratio $D = \frac{N \times E}{F \times 60}$ | $D = \frac{Pr0.09}{Pr0.10}$ |
| | $D = \frac{2000\times2^{17}}{500000\times60} = \frac{2000\times2^{17}}{30000000} = \frac{262144000}{30000000}$ | Pr0.09 = 262144000<br>Pr0.10 = 30000000 |
| | Travel distance per command pulse (mm)<br>(Position resolution)<br>$\Delta M = \frac{D}{E} \times \frac{1}{R} \times L$ | |
| | $\frac{2^{15}}{3750} \times \frac{1}{2^{17}} \times \frac{1}{1} \times 20 = \frac{1}{3750} \times \frac{20}{2^{2}} = \frac{20}{3750 \times 4} = 0.00133$mm | |

Related page • P.4-6 "Details of Parameter"

## Setup with the Front Panel




**Display LED (6-digit)**
Switch to error display screen when error occurs, and LED will flash (about 2Hz).
LED will flash slowly (about 1Hz) when warning occurs.

**Mode switching button**
(valid at SELECTION display)
Press this to switch 4 kinds of mode.

1) Monitor Mode
2) Parameter Set up Mode
3) EEPROM Write Mode
4) Auxiliary Function Mode

**SET Button** (valid at any time)
Press this to switch SELECTION and EXECUTION display.

Press these to change display and data, select parameters and execute actions.
(Change/Selection/Execution is valid to the digit which decimal point flashes.)
Numerical value increases by pressing, ▲, decreases by pressing ▼.

Shifting of the digit for data changing to higher digit.

X7
Output connector for monitor

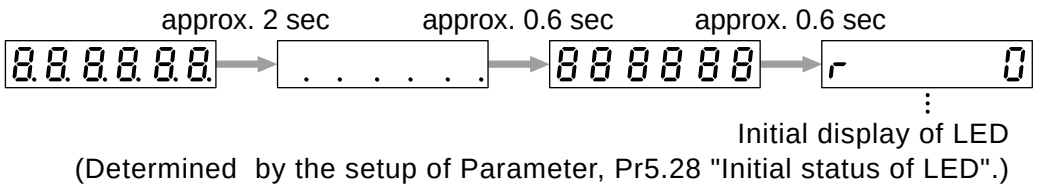
**Note** For connector X7, refer to P.2-27 “Wiring to the connector, X7”.

**Caution**

## Initial Status of the Front Panel Display (7 Segment LED)

### Status

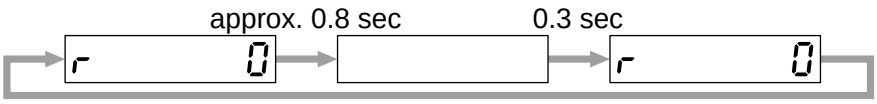
Front panel display shows the following after turning on the power of the driver.




Initial display of LED
(Determined by the setup of Parameter, Pr5.28 "Initial status of LED".)

### Upon Occurrence of an Alarm

If a driver alarm is generated, the front panel display shows the following repeatedly.




Repeatedly(during continuous alarm)

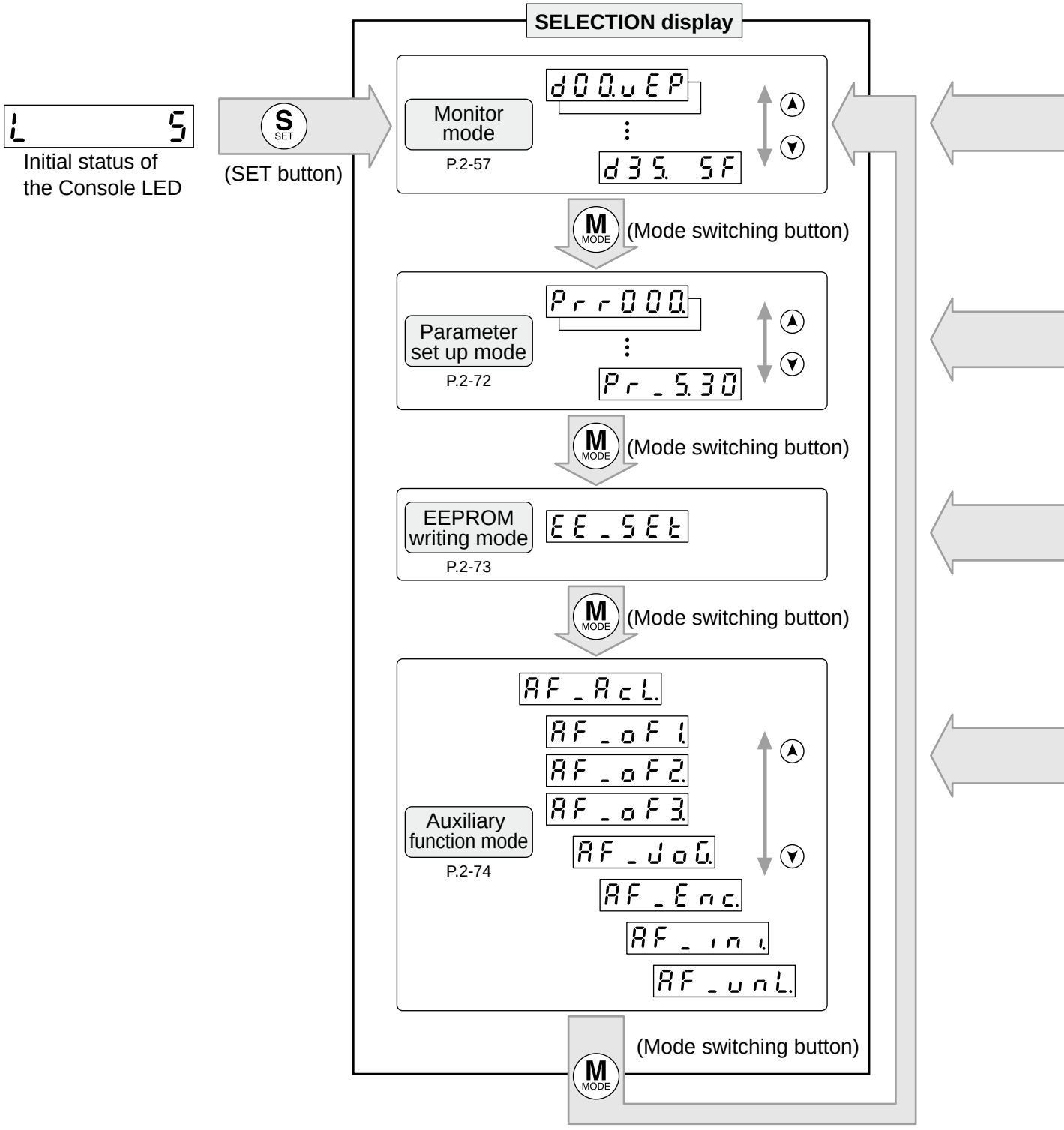
Below shows possible cause of an alarm.

| alarm No. | Alarm | Content |
|---|---|---|
| A0 | Overload protection | Load factor is 85% or more the protection level. |
| A1 | Over-regeneration alarm | Regenerative load factor is 85% or more the protection level. |
| A2 | Battery alarm | Battery voltage is 3.2 V or lower. |
| A3 | Fan alarm | Fan has stopped for 1 sec. |
| A4 | Encoder communication alarm | The number of successive encoder communication errors exceeds the specified value. |
| A5 | Encoder overheat alarm | The encoder detects overheat alarm. |
| A6 | Oscillation detection alarm | Oscillation or vibration is detected. |
| A7 | Lifetime detection alarm | The life expectancy of capacity or fan becomes shorter than the specified time. |
| A8 | External scale error alarm | The feedback scale detects the alarm. |
| A9 | External scale communication alarm | The number of successive feedback scale communication errors exceeds the specified value. |

# 15. How to Use the Front Panel

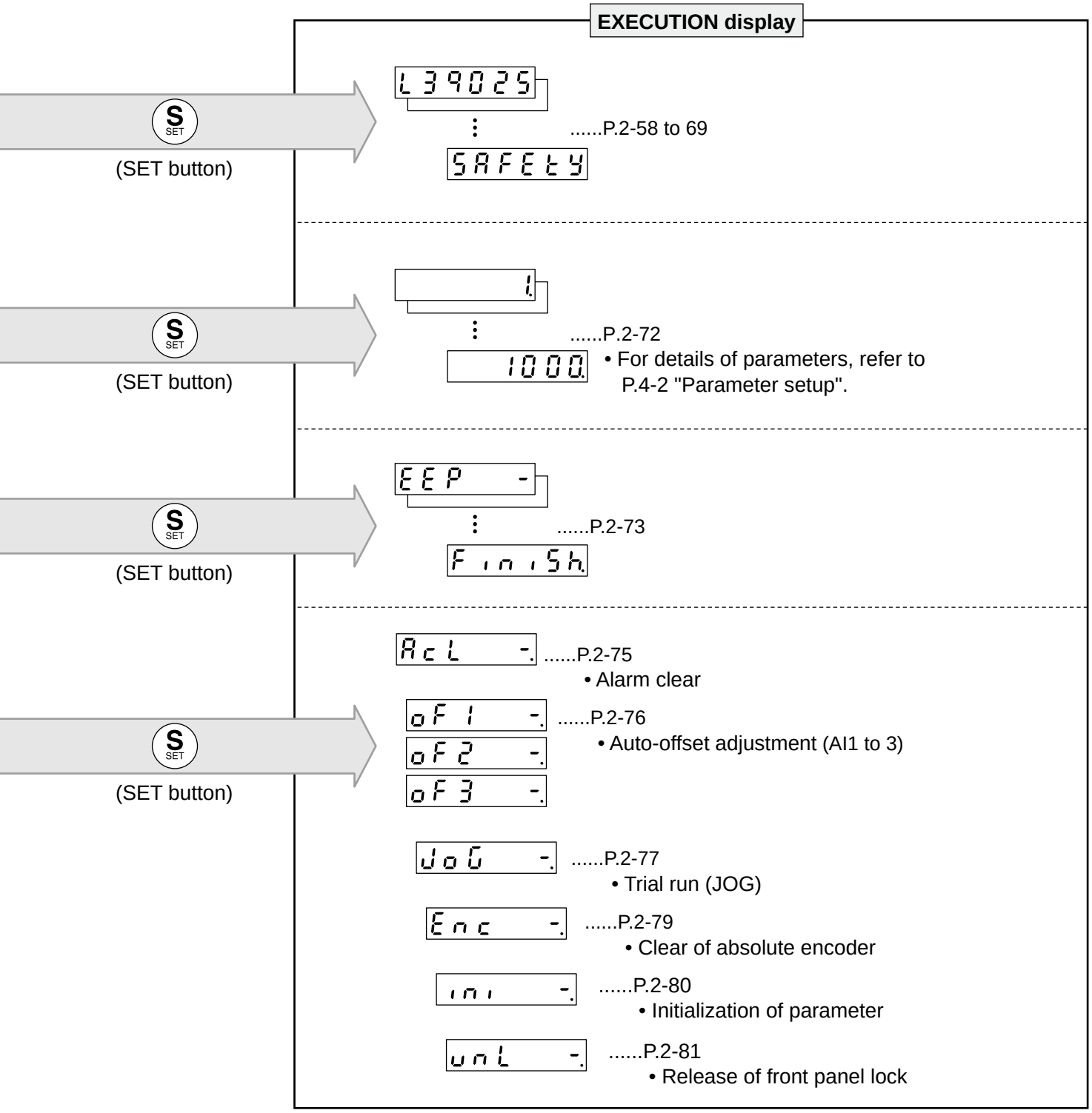
## Structure of Each Mode

Use each button on the touch panel to select the structure and switch the mode.




**Note** You can change the flashing decimal point with ◀, then shift the digit for data change "."

**Caution** On power-up, the monitor mode executed is displayed according to the setup of Pr5.28 LED initial status.


EXECUTION display
L 39025
SAFEty
.....P.2-58 to 69
(SET button)
1.
1000.
.....P.2-72
• For details of parameters, refer to P.4-2 "Parameter setup".
(SET button)
EEP -
FinISh.
.....P.2-73
(SET button)
AcL -.
.....P.2-75
• Alarm clear
oF 1 -.
oF 2 -.
oF 3 -.
.....P.2-76
• Auto-offset adjustment (AI1 to 3)
(SET button)
JoG -.
.....P.2-77
• Trial run (JOG)
Enc -.
.....P.2-79
• Clear of absolute encoder
ini -.
.....P.2-80
• Initialization of parameter
unL -.
.....P.2-81
• Release of front panel lock

# 15. How to Use the Front Panel

## Setup of front panel lock

## Outline

To prevent operational error e.g. unintentional parameter modification, the front panel may be locked.
Once locked, operations on the panel are limited as follows:

| Mode | Locked panel conditions |
|---|---|
| Monitor Mode | No limitation: all monitored data can be checked. |
| Parameter Set up Mode | No parameter can be changed but setting can be checked. |
| EEPROM Write Mode | Cannot be run. (No display) |
| Auxiliary Function Mode | Cannot be run except for “Release of front panel lock”. (No display) |

## How to operate

### • Related parameters

| Parameter No. | | Title | Function |
|---|---|---|---|
| Class | No. | | |
| 5 | 35 | Setup of front panel lock | Locks the operation attempted from the front panel. |

Lock and unlock can be made in one of two ways.

| Procedure | Front panel | Setup support software PANATERM |
|---|---|---|
| Lock | (1) Set Pr5.35 “Front panel lock” to 1, and writ the setting to EEPROM.<br>(2) Turn on power to the driver.<br>(3) The front panel is locked. | |
| Unlock | (1) Execute the auxiliary function mode, front panel lock release function.<br>(2) Turn on power to the driver.<br>(3) The front panel is unlocked. | (1) Set Pr5.35 “Front panel lock” to 0, and writ the setting to EEPROM.<br>(2) Turn on power to the driver.<br>(3) The front panel is unlocked. |

**Note** For details of front panel lock release, refer to P.2-81.

# 15. How to Use the Front Panel

## Monitor Mode (SELECTION display)

To change the monitor display setting, select the display option to be changed from " **SELECTION** display", and press (S) to change to " **EXECUTION** display". After completion of changing, press (S) to return to the selection display,

**Monitor Mode SELECTION display**

| Display example | Description | Pages to refer |
|---|---|---|
| d00.uEP | Positional command deviation | P.2-58 (1) |
| d01.SPd | Motor speed | P.2-58 (2) |
| d02.cSP | Positional command speed | P.2-58 (2) |
| d03.cUL | Velocity control command | P.2-58 (2) |
| d04.tr9 | Torque command | P.2-58 (2) |
| d05.nPS | Feedback pulse sum | P.2-59 (3) |
| d06.cPS | Command pulse sum | P.2-59 (3) |
| d08.FPS | External scale feedback pulse sum | P.2-59 (3) |
| d09.cnt | Control mode | P.2-59 (4) |
| d10. io | I/O signal status | P.2-60 (5) |
| d11.Ain | Analog input value | P.2-61 (6) |
| d12.Err | Error factor and reference of history | P.2-62 (7) |
| d13. rn | Alarm Display | P.2-64 (8) |
| d14. rG | Regenerative load factor | P.2-65 (9) |
| d15. oL | Over-load factor | P.2-65 (9) |
| d16.Jrt | Inertia ratio | P.2-65 (9) |
| d17. ch | Factor of no-motor running | P.2-66 (10) |

| Display example | Description | Pages to refer |
|---|---|---|
| d18. ict | No. of changes in I/O signals | P.2-67 (11) |
| d20.Abs | Absolute encoder data | P.2-67 (12) |
| d21.AES | Absolute external scale position | P.2-68 (13) |
| d22.rEc | No. of encoder/ external scale communication errors monitor | P.2-68 (14) |
| d23. id | Communication axis address | P.2-68 (15) |
| d24.PEP | Encoder positional deviation [Encoder unit] | P.2-68 (16) |
| d25.PFE | External scale deviation [External scale unit] | P.2-69 (17) |
| d26.hYb | Hybrid deviation [Command unit] | P.2-69 (18) |
| d27. Pn | Voltage across PN [V] | P.2-69 (19) |
| d28. no | Software version | P.2-69 (20) |
| d29.ASE | Driver serial number | P.2-69 (21) |
| d30.MSE | Motor serial number | P.2-69 (22) |
| d31. tE | Accumulated operation time | P.2-70 (23) |
| d32.Aud | Automatic motor recognizing function | P.2-70 (24) |
| d33.Ath | Driver temperature | P.2-70 (25) |
| d35. SF | Safety condition monitor | P.2-71 (26) |

<Return to "Positional command deviation".>

**EXECUTION display** ↔ (S) (SET button)

Display shifts toward the arrowed direction by pressing (▲) and reversed direction by pressing (▼).

(M) (Mode switch button)

**Parameter Setup Mode SELECTION display**

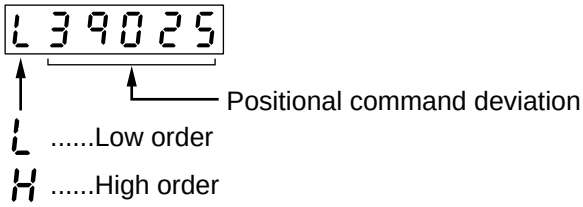
**Note** When you turn on the Product for the first time, display shows r 0. (at motor stall) To change this display, change the setup of Pr5.28 (Initial status of LED).

# 15. How to Use the Front Panel

## Monitor Mode (EXECUTION display)

### (1) Display of positional command deviation [command unit]

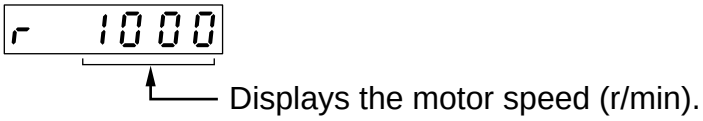
Displays positional deviation of the command unit in High order or Low order.



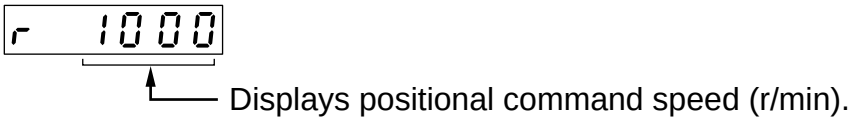

• To switch between Low order (L) and High order (H), press ◄.

### (2) Display of motor speed, positional command speed, velocity control command and torque command

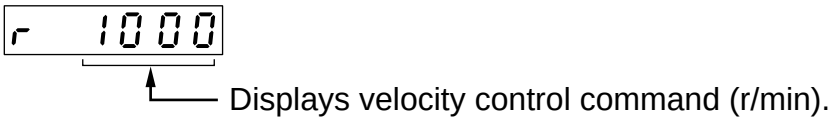
• Motor speed (r/min)



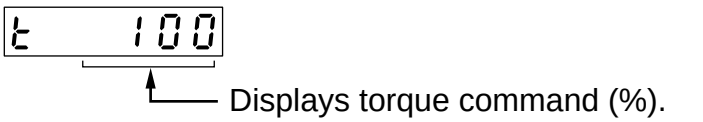

• Positional command speed (r/min)




• Velocity control command (r/min)

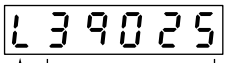



• Torque command (%)



## (3) Display of Feedback Pulse Sum, Command Pulse Sum and External Scale Feedback Pulse Sum

**• Feedback Pulse Sum [Encoder pulse]**



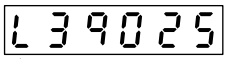

Feedback Pulse Sum

L .....Low order

H .....High order

• To switch between Low order (L) and High order (H), press ◄.


**• Command Pulse Sum [Command Pulse]**



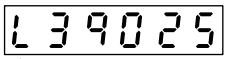

Command Pulse Sum

L .....Low order

H .....High order

• To switch between Low order (L) and High order (H), press ◄.


**• External Scale Feedback Pulse Sum**



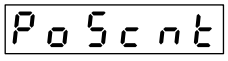

External Scale Feedback Pulse Sum

L .....Low order

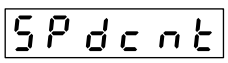
H .....High order

• To switch between Low order (L) and High order (H), press ◄.

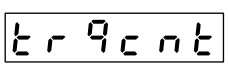

## (4) Display of Control Mode



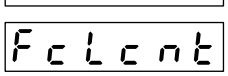

.....Position control mode




.....Velocity control mode



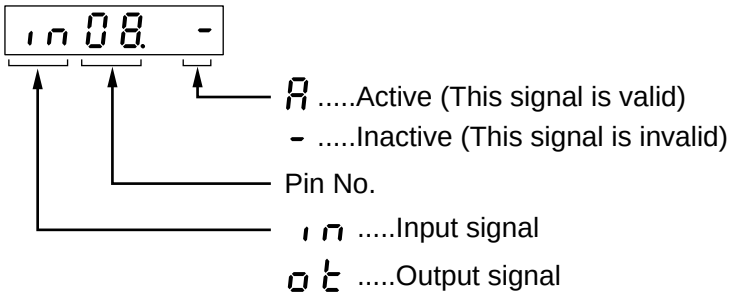

.....Torque control mode



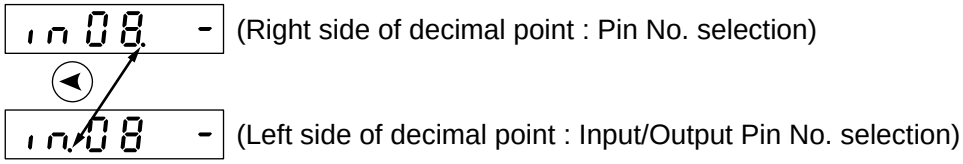

.....Full-closed control mode

## (5) Display of I/O Signal Status

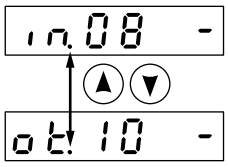
Displays the control input and output signal to be connected to connector X4.
Use this function to check if the wiring is correct or not.



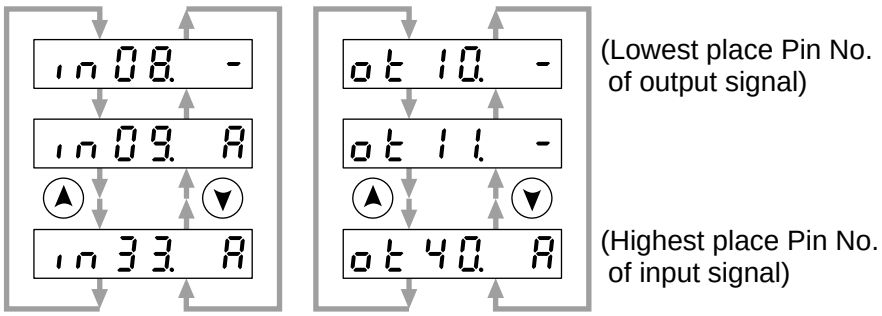

• Shift the flashing decimal point with ◀.




• Select In or Out by pressing ▲ or ▼ button.

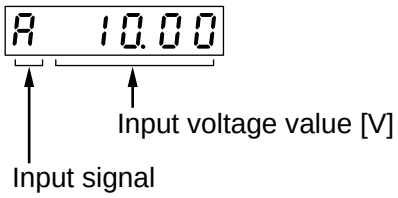



• Select the Pin No. to be monitored by pressing ▲▼.

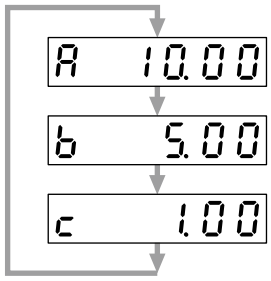



**Note** For detail of input/output signal, refer to P3-30 “Inputs and outputs on connector X4”
For detail of Error Code, refer to P.6-3 “Protective Function”.

## (6) Display of Analog Input Value




•Select the signal No. to be monitored by pressings ▲ ▼.




(Analog input 1 value, unit [V])

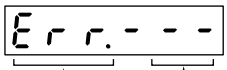
(Analog input 2 value, unit [V])

(Analog input 3 value, unit [V])

Displays the value after offset correction.

**Caution** Voltage exceeding ± 10V can not be displayed correctly.

## (7) Display of Error Factor and Reference of History




Error code No. ( - - - appears if no error occurs)

Err. .....Present error

E-0 .....History 0 (latest error)

E 13 .....History 13 (oldest error)

• You can refer the last 14 error factors (including present one)
Press ▲ ▼ to select the factor to be referred.

**<List of error code No.>**

| Error code | | Protective function | Attribute | | |
|---|---|---|---|---|---|
| Main | Sub | | History | Can be cleared | Immediate stop |
| 11 | 0 | Control power supply under- voltage protection | | ○ | |
| 12 | 0 | Over-voltage protection | ○ | ○ | |
| 13 | 0 | Main power supply under-voltage protection (between P to N) | | ○ | |
| | 1 | Main power supply under-voltage protection (AC interception detection) | | ○ | |
| 14 | 0 | Over-current protection | ○ | | |
| | 1 | IPM error protection | ○ | | |
| 15 | 0 | Over-heat protection | ○ | | ○ |
| 16 | 0 | Over-load protection | ○ | ○*1 | |
| 18 | 0 | Over-regeneration load protection | ○ | | ○ |
| | 1 | Over-regeneration Tr error protection | ○ | | |
| 21 | 0 | Encoder communication disconnect error protection | ○ | | |
| | 1 | Encoder communication error protection | ○ | | |
| 23 | 0 | Encoder communication data error protection | ○ | | |
| 24 | 0 | Position deviation excess protection | ○ | ○ | ○ |
| | 1 | Velocity deviation excess protection | ○ | ○ | ○ |
| 25 | 0 | Hybrid deviation excess error protection | ○ | | ○ |
| 26 | 0 | Over-speed protection | ○ | ○ | ○ |
| | 1 | 2nd over-speed protection | ○ | ○ | |
| 27 | 0 | Command pulse input frequency error protection | ○ | ○ | ○ |
| | 2 | Command pulse multiplier error protection | ○ | ○ | ○ |
| 28 | 0 | Limit of pulse replay error protection | ○ | ○ | ○ |
| 29 | 0 | Deviation counter overflow protection | ○ | ○ | |
| 30 | 0 | Safety detection | | ○ | |
| 33 | 0 | IF overlaps allocation error 1 protection | ○ | | |
| | 1 | IF overlaps allocation error 2 protection | ○ | | |
| | 2 | IF input function number error 1 protection | ○ | | |
| | 3 | IF input function number error 2 protection | ○ | | |
| | 4 | IF output function number error 1 protection | ○ | | |
| | 5 | IF output function number error 2 protection | ○ | | |
| | 6 | CL fitting error protection | ○ | | |
| | 7 | INH fitting error protection | ○ | | |

| Error code | | Protective function | Attribute | | |
|---|---|---|---|---|---|
| Main | Sub | | History | Can be cleared | Immediate stop |
| 34 | 0 | Software limit protection | ○ | ○ | |
| 36 | 0 to 2 | EEPROM parameter error protection | | | |
| 37 | 0 to 2 | EEPROM check code error protection | | | |
| 38 | 0 | Over-travel inhibit input protection | | ○ | |
| 39 | 0 | Analog input1 excess protection | ○ | ○ | ○ |
| | 1 | Analog input2 excess protection | ○ | ○ | ○ |
| | 2 | Analog input3 excess protection | ○ | ○ | ○ |
| 40 | 0 | Absolute system down error protection | ○ | ○ | |
| 41 | 0 | Absolute counter over error protection | ○ | | |
| 42 | 0 | Absolute over-speed error protection | ○ | ○ | |
| 43 | 0 | Initialization failure | ○ | | |
| 44 | 0 | Absolute single turn counter error protection | ○ | | |
| 45 | 0 | Absolute multi-turn counter error protection | ○ | | |
| 47 | 0 | Absolute status error protection | ○ | | |
| 48 | 0 | Encoder Z-phase error protection | ○ | | |
| 49 | 0 | Encoder CS signal error protection | ○ | | |
| 50 | 0 | External scale connection error protection | ○ | | |
| | 1 | External scale communication error protection | ○ | | |
| 51 | 0 | External scale status 0 error protection | ○ | | |
| | 1 | External scale status 1 error protection | ○ | | |
| | 2 | External scale status 2 error protection | ○ | | |
| | 3 | External scale status 3 error protection | ○ | | |
| | 4 | External scale status 4 error protection | ○ | | |
| | 5 | External scale status 5 error protection | ○ | | |
| 55 | 0 | A-phase connection error protection | ○ | | |
| | 1 | B-phase connection error protection | ○ | | |
| | 2 | Z-phase connection error protection | ○ | | |
| 87 | 0 | Compulsory alarm input protection | | ○ | |
| 95 | 0 to 4 | Motor automatic recognition error protection | | | |
| Other number | | Other error | ○ | | |

**Note**

**History**...The error will be stored in the error history.

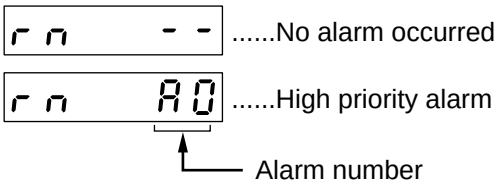
**Can be cleared**...To cancel the error, use the alarm clear input (A-CLR).
If the alarm clear input is not effective, turn off power, remove the cause of the error and then turn on power again.

**Immediate stop**...Instantaneous controlled stop upon occurrence of an error.
(Setting of “Pr.5.10 Sequence at alarm” is also required.)

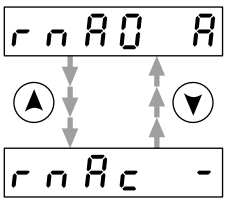
**Caution**

1) Certain alarms are not included in the history. For detailed information on alarms e.g. alarm numbers, refer to P.6-3.
2) When one of the errors which are listed in error history occurs, this error and history o shows the same error No.

## (8) Alarm Display




• To display the alarm occurrence condition, press ▲ or ▼ button.

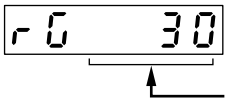



| alarm No. | Alarm | Content | Latched time *1 |
|---|---|---|---|
| A0 | Overload protection | Load factor is 85% or more the protection level. | 1 to 10s or ∞ |
| A1 | Over-regeneration alarm | Regenerative load factor is 85% or more the protection level. | 10s or ∞ |
| A2 | Battery alarm | Battery voltage is 3.2 V or lower. | Fixed at ∞ |
| A3 | Fan alarm | Fan has stopped for 1 sec. | 1 to 10s or ∞ |
| A4 | Encoder communication alarm | The number of successive encoder communication errors exceeds the specified value. | 1 to 10s or ∞ |
| A5 | Encoder overheat alarm | The encoder detects overheat alarm. | 1 to 10s or ∞ |
| A6 | Oscillation detection alarm | Oscillation or vibration is detected. | 1 to 10s or ∞ |
| A7 | Lifetime detection alarm | Life expectancy of capacitor or fan is short. | Fixed at ∞ |
| A8 | External scale error alarm | The feedback scale detects the alarm. | 1 to 10s or ∞ |
| A9 | External scale communication alarm | The number of successive feedback scale communication errors exceeds the specified value. | 1 to 10s or ∞ |

*1 Alarms can be cleared by using the alarm clear. Because the all existing alarms are kept cleared while the alarm clear input (A-CLR) is kept ON, be sure to turn it OFF during normal operation. Either 1-10s or ∞ can be selected by using user parameter.
Exception: Battery alarm is fixed at ∞ because it is latched by the encoder.
Because the end of life alarm means that the life expectancy cannot be extended, the alarm is set at ∞.

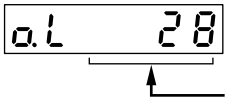
## (9) Display of Regenerative Load Factor, Over-load Factor and Inertia Ratio

• **Regenerative Load Factor**



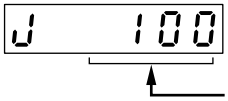

Display the ratio (%) against the alarm trigger level of regenerative protection.
This is valid when Pr0.16 (External regenerative resistor setup) is 0 or 1.

• **Over-load Factor**




Displays the ratio (%) against the rated load.
Refer to P.6-13, "Overload Protection Time Characteristics" of When in Trouble.

• **Inertia Ratio**

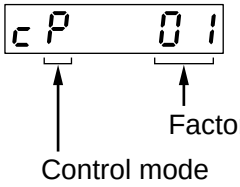



Displays the inertia ratio (%) .
Value of Pr0.04 (Inertia Ratio) will be displayed as it is.

**Note** For alarm function, refer to P.4-41"Pr4.40, Pr4.41".

## 10) Display of the Factor of No-Motor Running

Displays the factor of no-motor running in number.



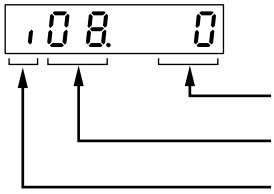

P .....Position control
t .....Torque control
S ..... Velocity control
F ..... Full-closed control

**• Explanation of factor No.**

| Factor No. | Factor | Related Control Mode | | | | Content |
|---|---|---|---|---|---|---|
| | | P | S | T | F | |
| flashing | Occurrence of error/alarm | P | S | T | F | An error is occurring, and an alarm is triggered. |
| 00 | No particular factor | P | S | T | F | No factor is detected for No-motor run.<br>The motor runs in normal case. |
| 01 | Main power shutoff | P | S | T | F | The main power of the driver is not turned on. |
| 02 | No entry of SRV-ON input | P | S | T | F | The Servo-ON input (SRV-ON) is not connected to COM–. |
| 03 | Over-travel inhibition input is valid | P | S | T | F | While Pr5.04 is 0 (Run-inhibition input is valid),<br>• Positive direction over-travel inhibition input (POT) is open and speed command is Positive direction.<br>• Negative direction over-travel inhibition input (NOT) is open and speed command is Negative direction. |
| 04 | Torque limit setup is small | P | S | T | F | Either one of the valid torque limit setup value of Pr0.13 (1st) or Pr5.22 (2nd) is set to 5% or lower than the rating. |
| 05 | Analog torque limit input is valid. | P | S | T | F | While Pr5.21 is 0 (analog torque limit input accepted),<br>• Positive direction analog torque limit input (P-ATL) is negative voltage and speed command is Positive direction.<br>• Negative direction analog torque limit input (N-ATL) is positive voltage and speed command is Negative direction. |
| 06 | INH input is valid. | P | S | T | F | Pr5.18 is 0 (Command pulse inhibition input is valid.), and INH is open. |
| 07 | Command pulse input frequency is low. | P | S | T | F | The position command per each control cycle is 1 pulse or smaller due to,<br>• No correct entry of command pulse<br>• No correct connection to the input selected with Pr0.05.<br>• No matching to input status selected with Pr0.06 pr Pr0.07. |
| 08 | CL input is valid. | P | S | T | F | While Pr5.17 is 0 (Deviation counter clear at level), the deviation counter clear input (CL) is connected to COM–. |
| 09 | ZEROSPD input is valid. | P | S | T | F | While Pr3.15 is 1 (Speed zero clamp is valid.), the speed zero clamp input (ZEROSPD) is open. |
| 10 | External speed command is small. | P | S | T | F | While the analog speed command is selected, the analog speed command is smaller than 0.06[V]. |
| 11 | Internal speed command is 0. | P | S | T | F | While the internal speed command is selected, the internal speed command is set to lower than 30 [r/min] |
| 12 | Torque command is small. | P | S | T | F | The analog torque command input (SPR or P-ATL) is smaller than 5 [%] of the rating. |
| 13 | Speed limit is small. | P | S | T | F | • While Pr3.17 is 0 (speed is limited by 4th speed of internal speed), Pr3.07, (4th speed of speed setup) is set to lower than 30 [r/min].<br>• While Pr3.17 is 1 (speed is limited by SPR input), the analog speed limit input (SPR) is smaller than 0.06 [V]. |
| 14 | Other factor | P | S | T | F | The motor runs at 20 [r/min] or lower even though the factors from 1 to 13 are cleared,<br>(the command is small, the load is heavy, the motor lock or hitting, driver/motor fault etc.) |

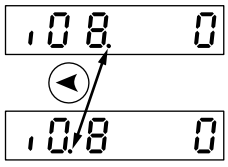
**Note** * Motor might run even though the other number than 0 is displayed.
Refer to "6.In trouble".

## (11) Display of No. of changes in I/O signals



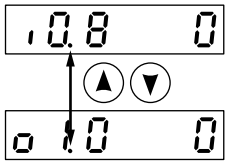

No. of changes in I/O signals (the signal is invalid)
Pin No.
i .....Input signal
o .....Output signal

• Shift the flashing decimal point with ◀.

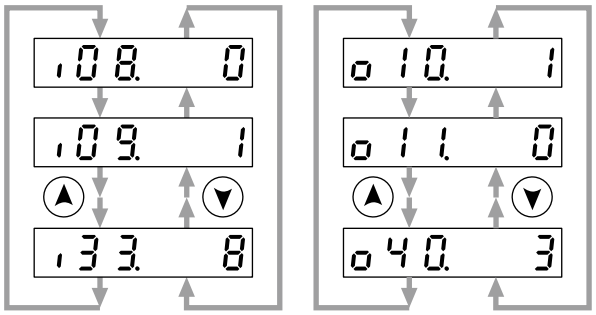



(Left side of decimal point : Pin No. selection)
(Right side of decimal point : Input/Output Pin No. selection)

• The switch of input/output, by pressing ▲ or ▼ button.

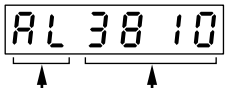



• Select the No. of pin, the number of changes on that pin should be displayed, by pressing ▲ or ▼ button.



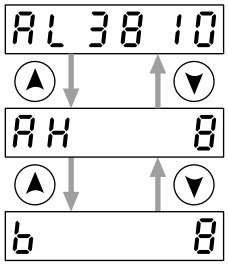

(Lowest place Pin No. of output signal)
(Highest place Pin No. of input signal)

## (12) Display of absolute encoder data



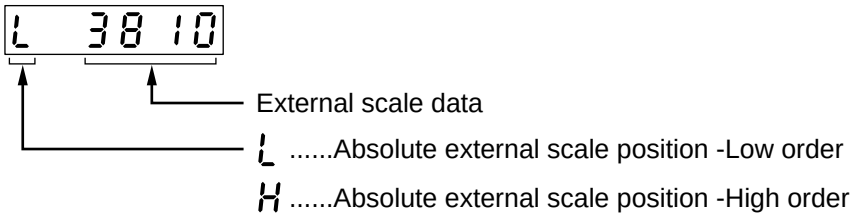

Encoder data
AL .....One revolution data, Low order (L)
AH .....One revolution data, High order (H)
b .....Multi-revolution data

• Select the data to be displayed by pressing ▲ or ▼ button.

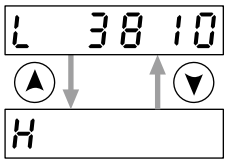


## (13) Display of absolute external scale position

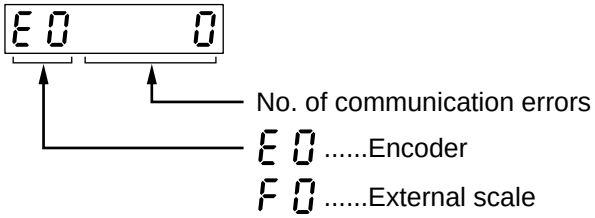
- Displays the absolute position of serial absolute scale.
- If a serial incremental scale, displays the scale position relative to the power on position which is defined as 0.



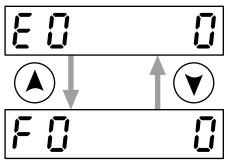

- Select encoder or external scale by pressing ▲ or ▼ button.



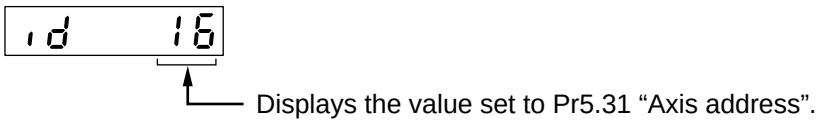

## (14) Display of No. of encoder/ external scale communication errors monitor



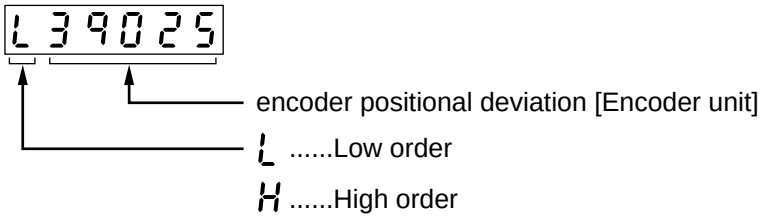

- Select encoder or external scale by pressing ▲ or ▼ button.



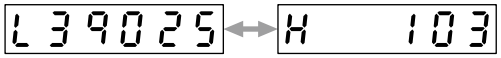

## (15) Display of communication axis address



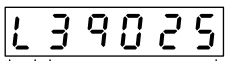

## (16) Display of encoder positional deviation [Encoder unit]




- To switch between Low order (L) and High order (H), press ◄.



## (17) Display of External Scale Deviation [External Scale Unit]

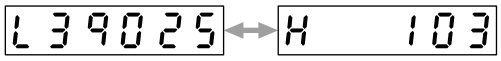



External Scale Deviation [External scale unit]

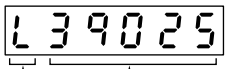
L .....Low order

H .....High order

• To switch between Low order (L) and High order (H), press ◄.




## (18) Display of hybrid deviation [Command unit]

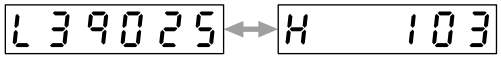



Hybrid deviation [Command unit]

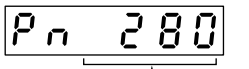
L .....Low order

H .....High order

• To switch between Low order (L) and High order (H), press ◄.

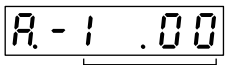



## (19) Display of voltage across PN [V]



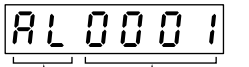

Displays the voltage across PN [V]
(only for reference not an instrument)

## (20) Display of Software Version




Displays the software version of the driver.
(Example of display: Ver 1.00)

## (21) Display of driver serial number

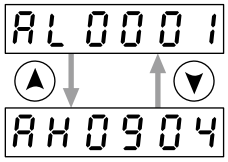



Driver serial number

AL .....Driver serial number- Low order

AH .....Driver serial number- High order

• To switch between Low order (L) and High order (H), press ▲ or ▼.
(Example of display: Serial number 09010001)



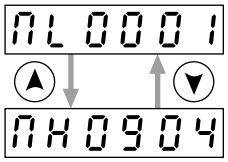
## (22) Display of motor serial number


Motor serial number

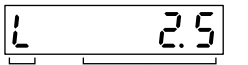
nL .....Motor serial number- Low order

nH .....Motor serial number- High order

• To switch between Low order (L) and High order (H), press ▲ or ▼.
(Example of display: Serial number 09040001)




## (23) Display of accumulated operation time

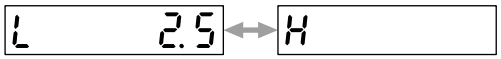



Displays accumulated operation time [h].

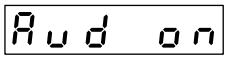
L .....Low order

H .....High order

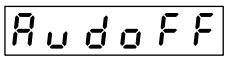
• To switch between Low order (L) and High order (H), press ◄.




## (24) Automatic Motor Recognizing Function

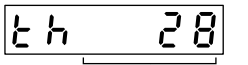



.....Automatic recognition is valid.



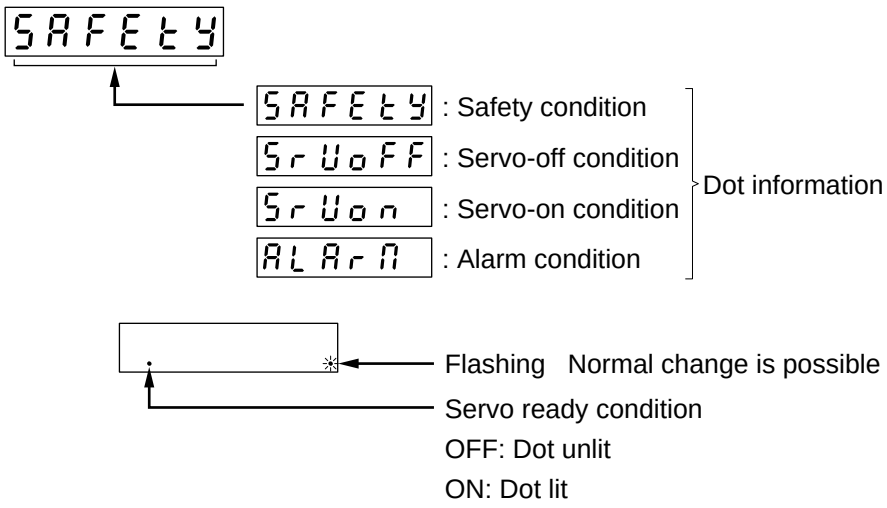

.....Automatic recognition is invalid.

## (25) Display of driver temperature

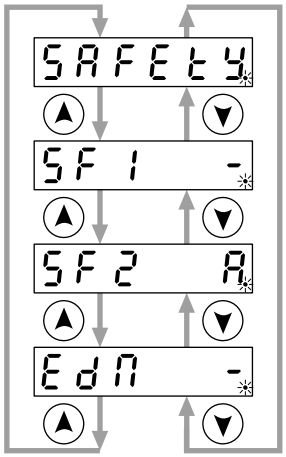



Displays the driver temperature [°C].
(Only for reference not an instrument)

## (26) Display of safety condition monitor




• Select desired monitor option by pressing ▲ or ▼ button.




- ...Input photocoupler OFF A ...Input photocoupler ON

- ...Input photocoupler OFF A ...Input photocoupler ON

- ...Output photocoupler OFF A ...Output photocoupler ON

Related page P.7-2 “safety”.

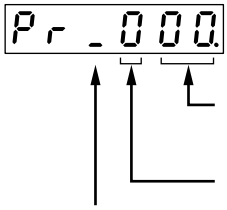
# 15. How to Use the Front Panel

## Parameter Setup Mode

**Monitor Mode** **SELECTION display**

(M) (Mode switch button)

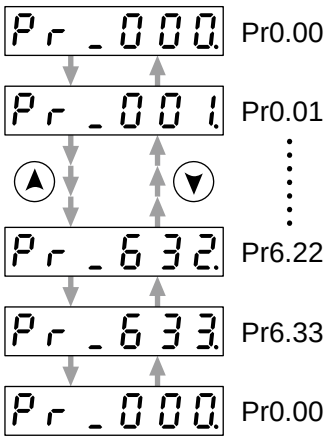
**Parameter Setup Mode** **SELECTION display**



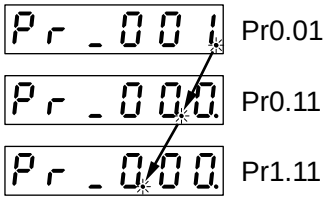

**Note**

For parameters which place is displayed with " r ", the content changed and written to EEPROM becomes valid after turning off the power once.

- Press ▲ or ▼ to select parameter No. to be set.



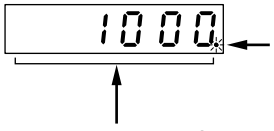

- Press ◄ and the flashing decimal separator shifts to the high order position, allowing the figure at this digit to any other figure.




- Display the No. of parameter to be changed and press (S) to change to EXECUTION display.

(S) (SET button)

**EXECUTION display**




- Press ▲ or ▼ to set up the value of parameter. (Value increases with ▼ decreases with ▲.)
- Press ◄ and the flashing decimal separator shifts to the high order position, allowing the figure at this digit to any other figure.
- Prolonged depression of (S) updates the parameter in the driver. Note that the parameter value selected by ▲ or ▼ is not reflected until (S) is pressed in this way.
- To cancel the value selected by ▲ or ▼, press (M) instead of (S), and the driver internal parameter value is kept unchanged and the display returns to the parameter number display screen.

**Remarks**

After changing the parameter value and pressing , the content will be reflected in the control. Do not extremely change the parameter value which change might affect the motor movement very much (especially velocity loop or position loop gains).

(M) (Mode switch button)

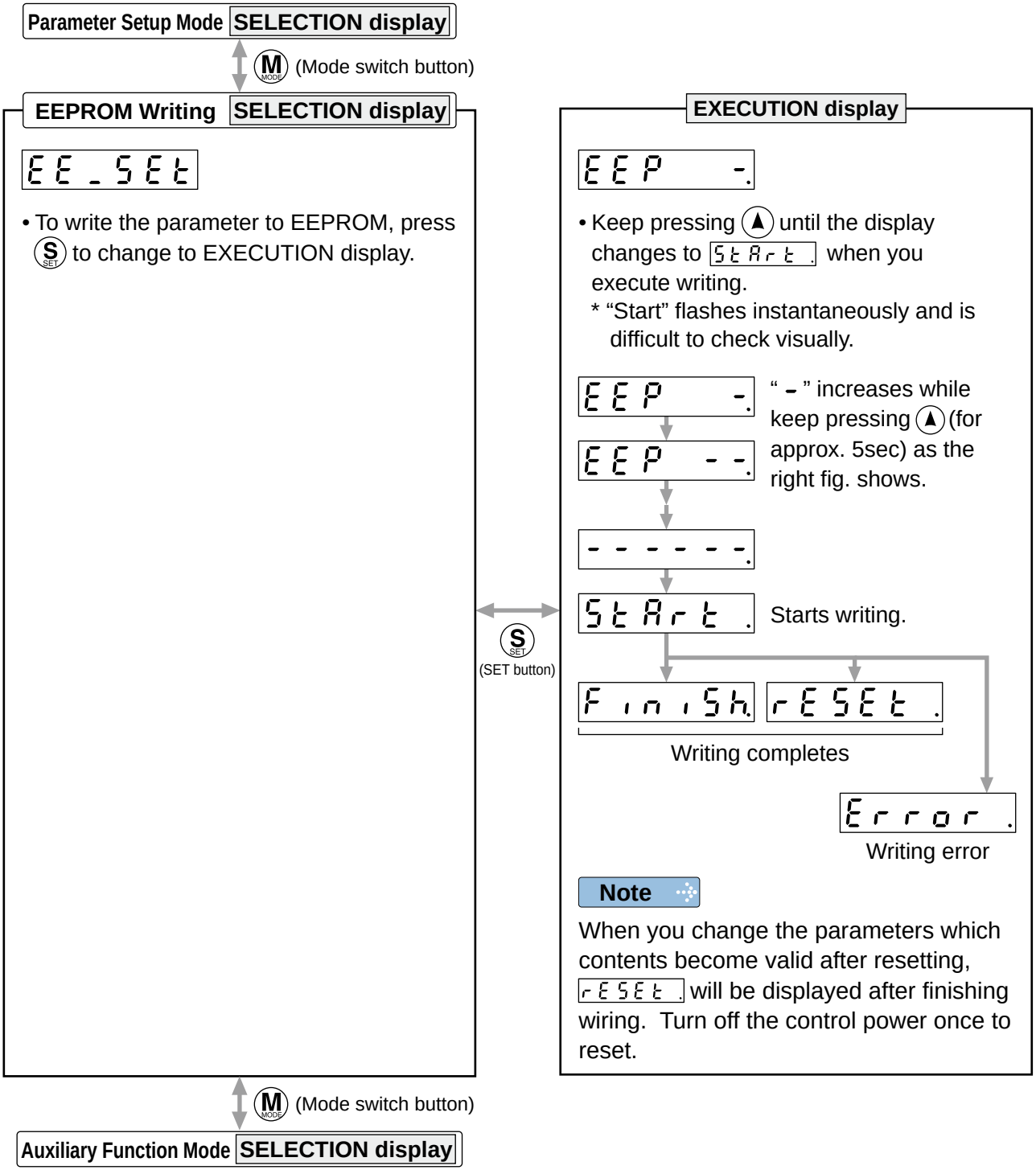
**EEPROM Writing** **SELECTION display**

**Note**

- After setting up parameters, return to SELECT mode, referring to structure of each mode (P.2-54).
- Each parameter has a limit in number of places for upper-shifting.

# 15. How to Use the Front Panel

## EEPROM Writing




**Note**

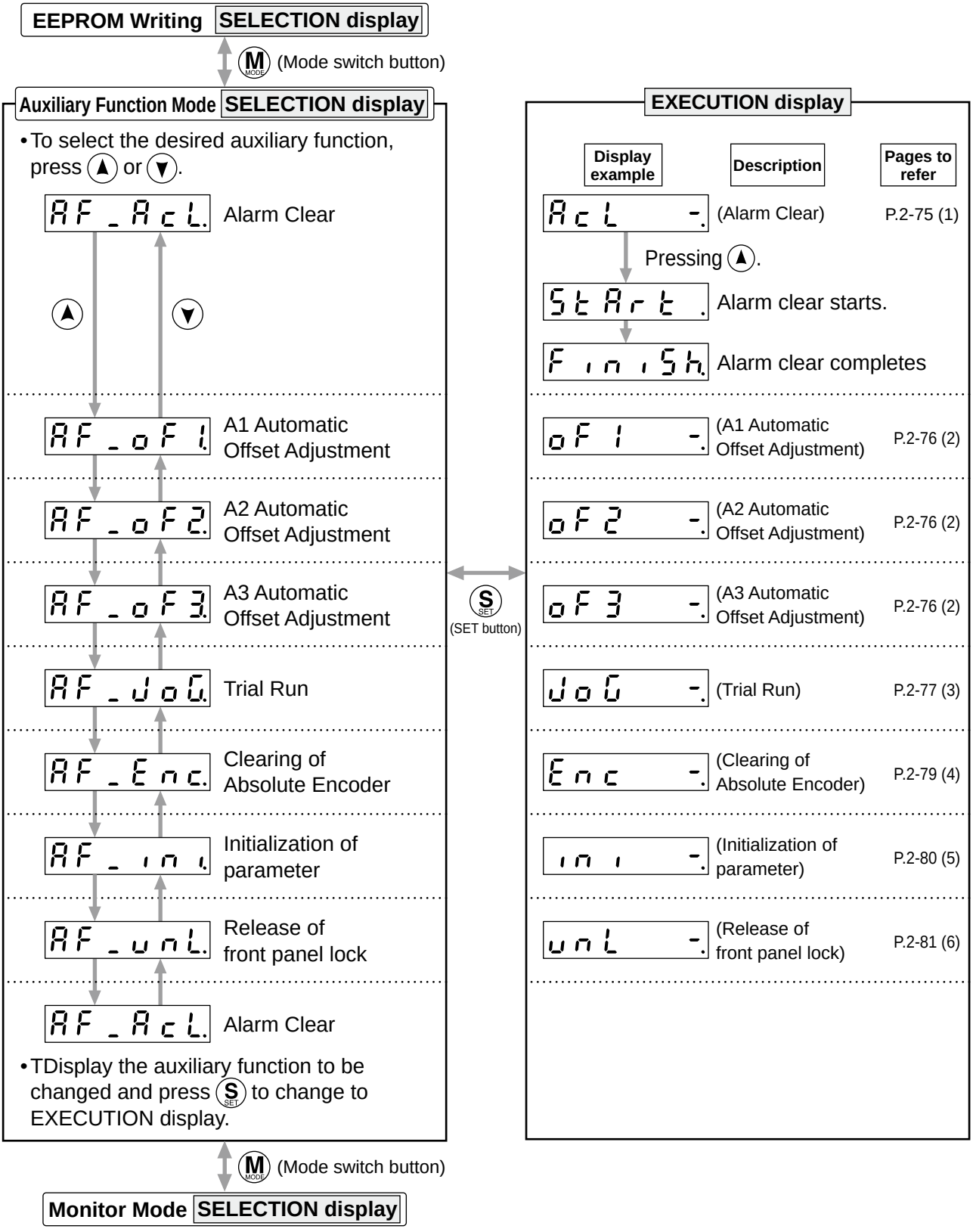
When you change the parameters which contents become valid after resetting, rESEt. will be displayed after finishing wiring. Turn off the control power once to reset.

**Caution**

1. When writing error occurs, make writing again. If the writing error repeats many times, this might be a failure.
2. Don't turn off the power during EEPROM writing. Incorrect data might be written. If this happens, set up all of parameters again, and re-write after checking the data.
3. When the error defined by Err.11.0 "Under voltage protection of control power supply" occurs, Error. is displayed indicating that no writing is made to EEPROM.

# 15. How to Use the Front Panel

## Auxiliary Function Mode (SELECTION display)

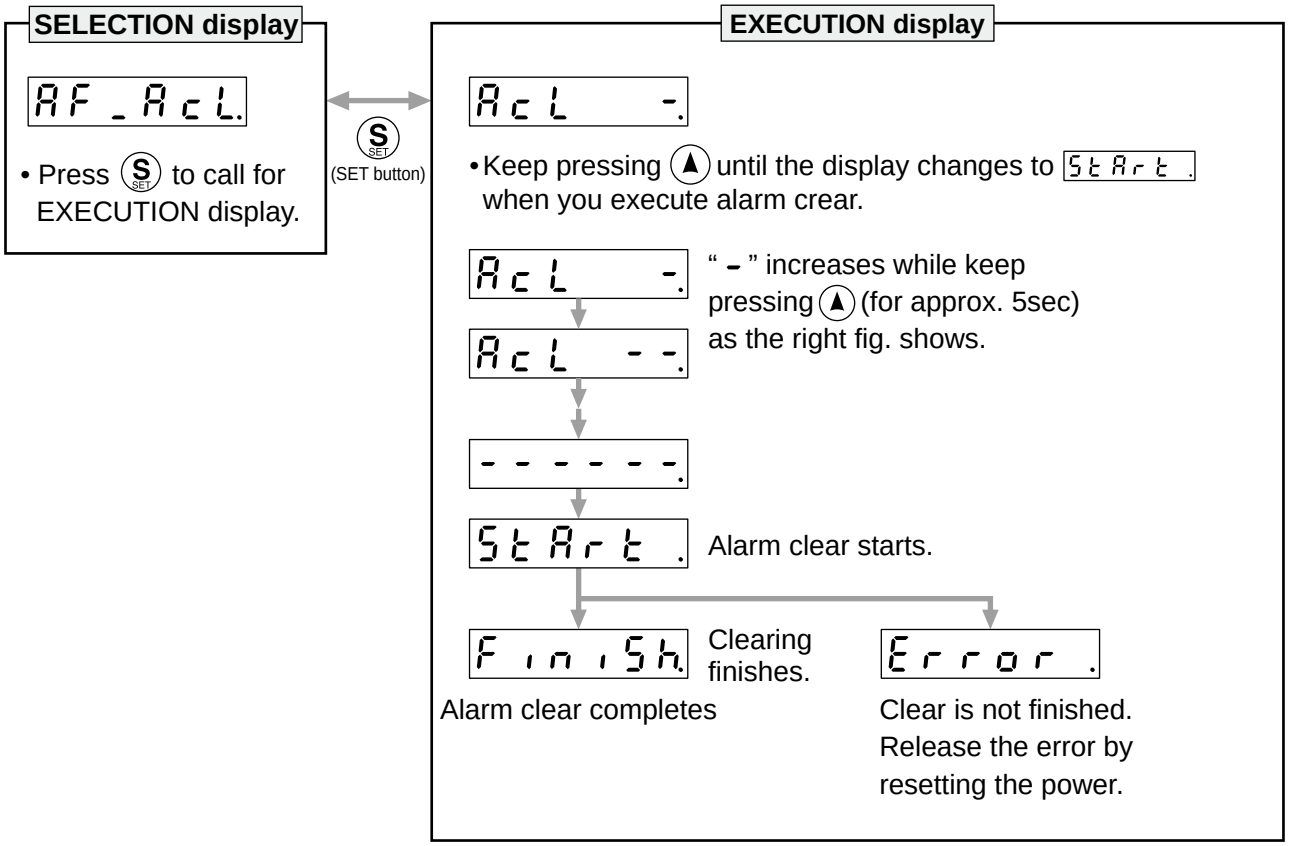


# 15. How to Use the Front Panel

## Auxiliary Function Mode (EXECUTION display)

### 1) Alarm Clear Screen

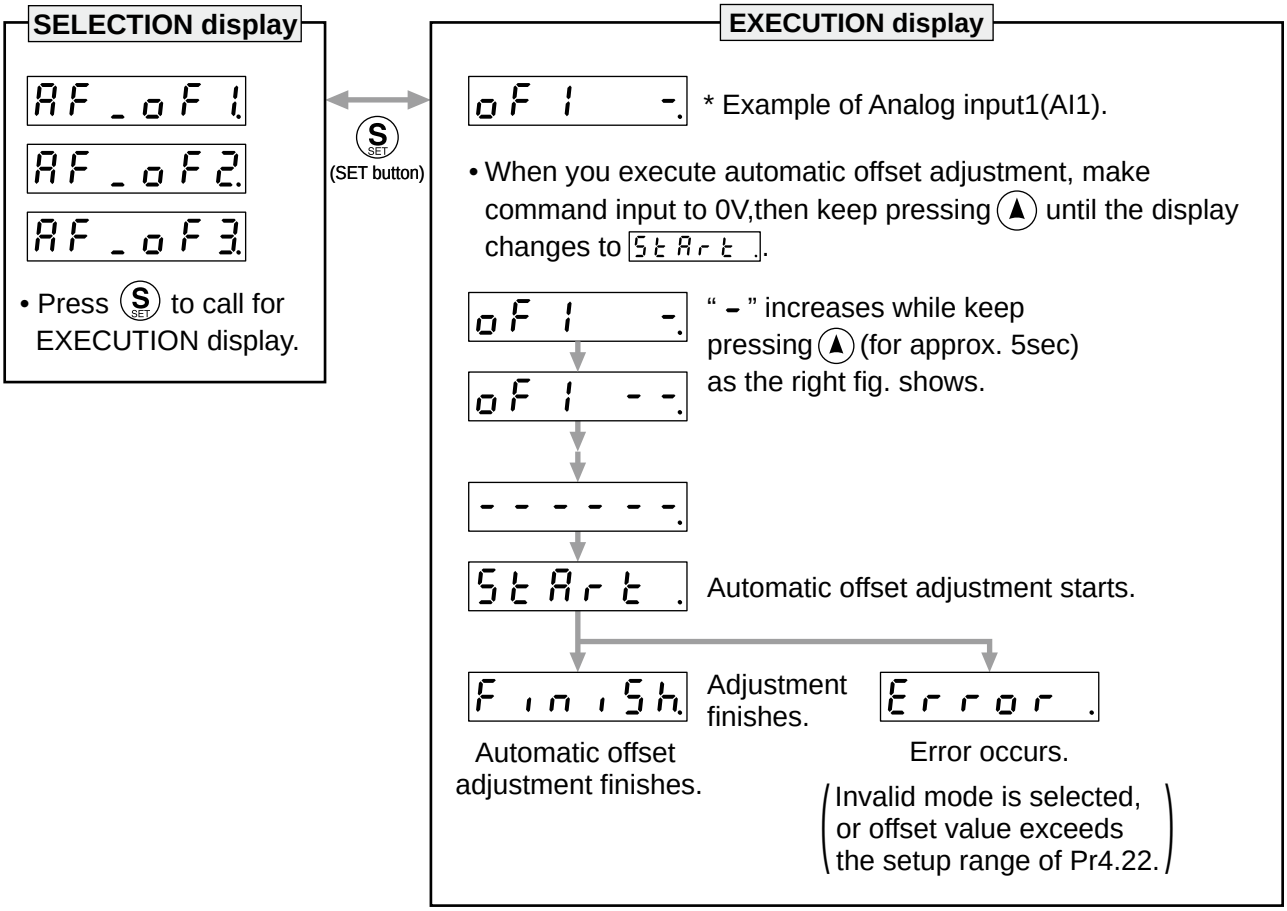
This function releases the current alarm status.
Certain alarms will persist. If this is the case, refer to P.6-3 “When in Trouble - Protective Function”.




**Note** • After alarm cleaning, return to SELECTION display, referring to structure of each mode (P2-54).

## (2) Analog inputs 1 to 3 automatic offset adjustment

This function automatically adjusts offset setting of analog input.
Analog input 1 (AI1).....Pr4.22 (Analog input 1 (AI1) offset setup)
Analog input 2 (AI2).....Pr4.25 (Analog input 2 (AI2) offset setup)
Analog input 3 (AI3).....Pr4.28 (Analog input 1 (AI3) offset setup)




**Remarks**
- This function is invalid at position control mode.
- You cannot write the data only by executing automatic offset adjustment. Execute a writing to EEPROM when you need to reflect the result afterward.

**Note**
- After completion of the automatic offset adjustment, return to SELECTION display by referring to P.2-54 “Structure of Each Mode”.

## (3) Motor trial run

You can make a trial run (JOG run) without connecting the Connector, Connector X4 to the host controller such as PLC.

**Remarks**

- Separate the motor from the load, detach the Connector, Connector X4 before the trial run.
- Bring the user parameter setups (especially Pr0.04 and Pr1.01 to 1.04) to defaults, to avoid oscillation or other failure.

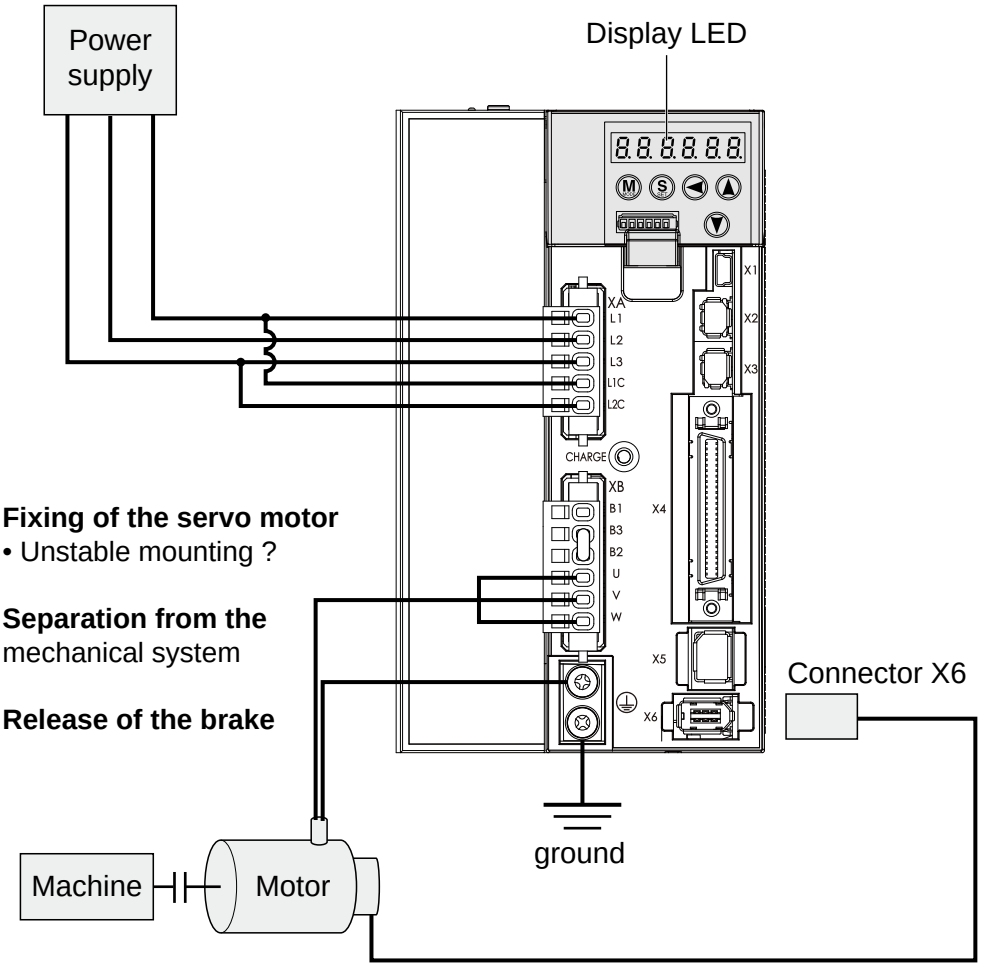
### • Inspection Before Trial Run

**(1) Inspection on wiring**

- Miswiring ? (Especially power input and motor output)
- Short or grounded ?
- Loose connection ?

**(2) Confirmation of power supply and voltage**

- Rated voltage ?




**(3) Fixing of the servo motor**

- Unstable mounting ?

**(4) Separation from the mechanical system**

**(5) Release of the brake**

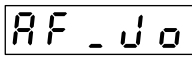
**(6) Turn to Servo-OFF after finishing the trial run by pressing (S).**

**Related page**

- For wiring details, refer to P2-9 “Overall Wiring”.
- P.4-6 “Pr0.04”
- P.4-12 “Pr1.01 to 1.04”

## • Procedure for Trial Run

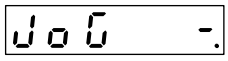
**SELECTION display**



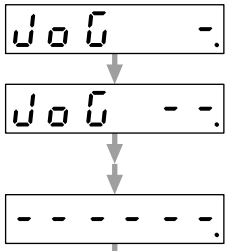

• Press (S SET) to call for EXECUTION display.

(S SET) (SET button)

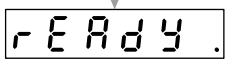
**EXECUTION display**



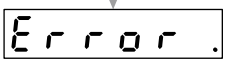

• Keep pressing (▲) until the display changes to rEAdy. when you execute Motor trial run.




" – " increases while keep pressing (▲) (for approx. 5sec) as the right fig. shows.

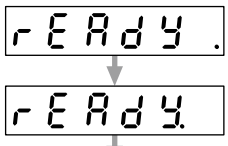



**Preparation step 1**

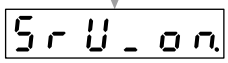



Not a servo-ready status. (Shuts off the main when error occurs.)

• Then keep pressing (◄) until the display of LED changes to SrU_on.




Keep pressing (◄) (approx. 5 sec) to shift the decimal point toward left as the left fig. shows.




**Preparation step 2**


Not a Servo-Ready. Or SRV-ON signal is not entered.

• **After the Servo-ON of preparation step 2 for trial run,** the motor runs at the preset speed with Pr6.04 (JPG speed) to Positive direction direction by pressing (▲) Negative direction by pressing (▼).

**Caution**

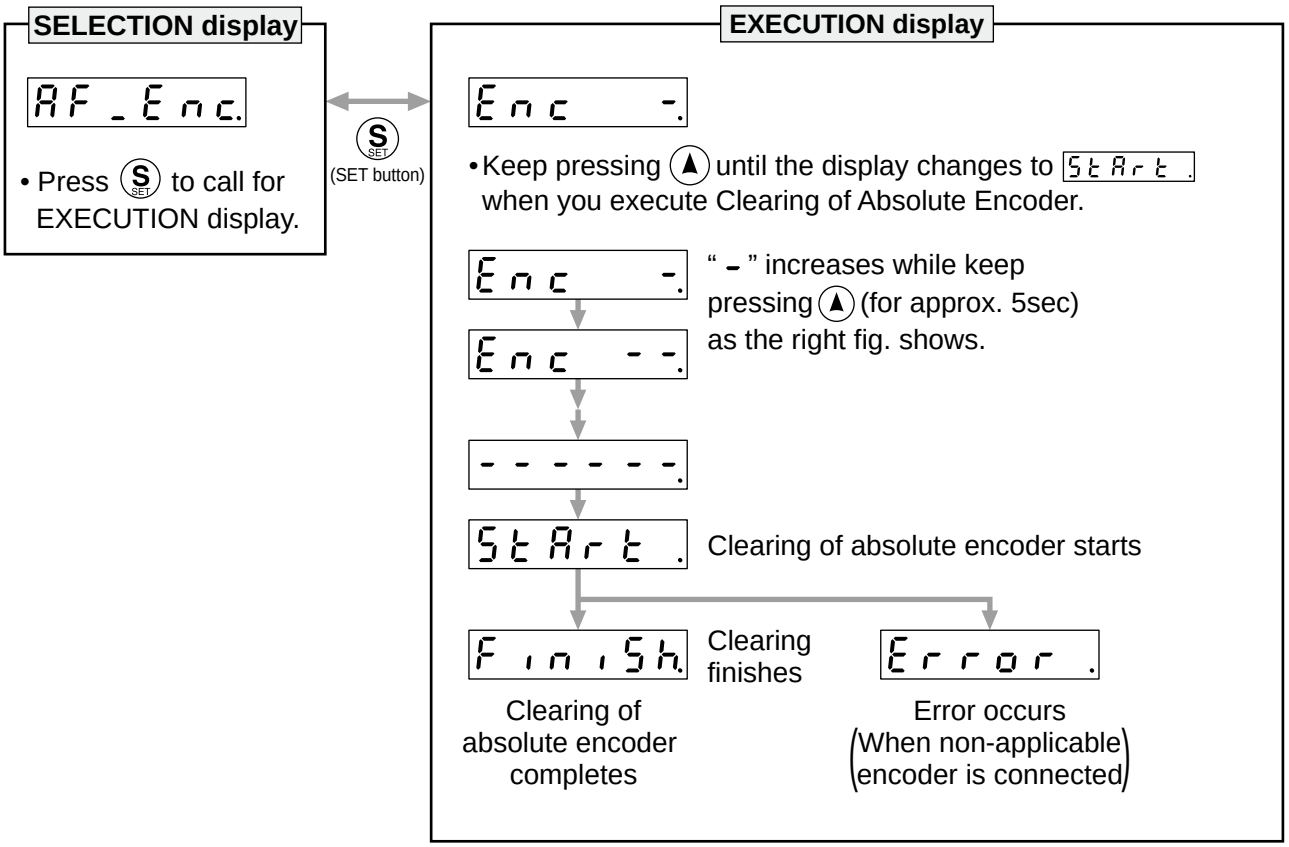
- Before starting the trial run, set the gain-related parameters to appropriate values to avoid problems such as oscillation. If the load is removed, be sure to set Pr0.04 "Inertia Ratio" to 0.
- During the trial run, use the velocity control mode. Various settings including parameters should assure safe and positive operation under appropriate velocity control.
- If SRV-ON becomes valid during trial run, the display changes to Error. which is normal run through external command.
- **If such trouble as disconnection of cable or connector occurs during trial run, the motor makes over-run for maximum 1 sec. Pay an extra attention for securing safety.**

**Note**

- After finished trial running, return to SELECTION display, referring to structure of each mode (P.2-54).

## 4) Clearing of Absolute Encoder

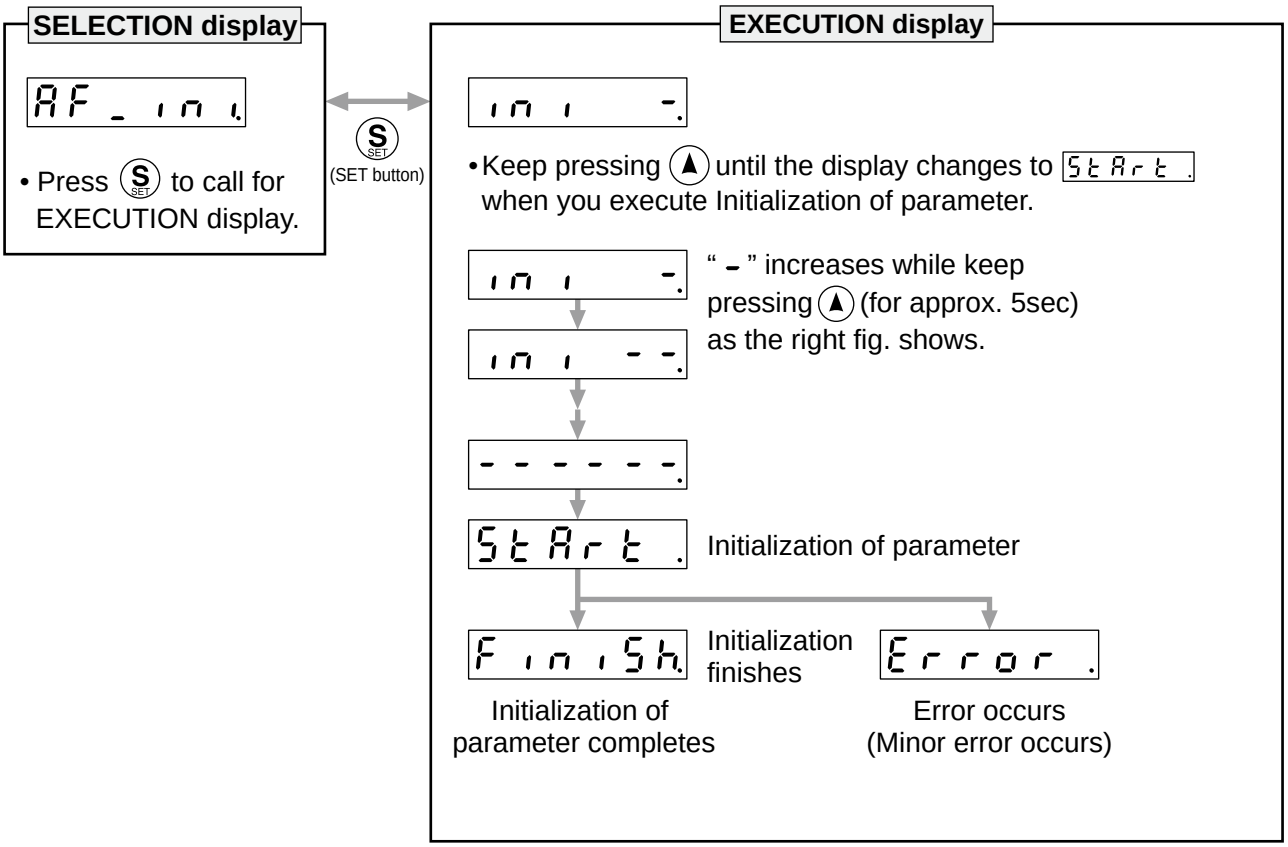
You can clear the multi-turn data of the absolute encoder.




**Note** • After clearing of absolute encoder finishes, return to SELECTION display, referring to structure of each mode (P.2-54).

## (5) Initialization of parameter

Initialize the parameter.

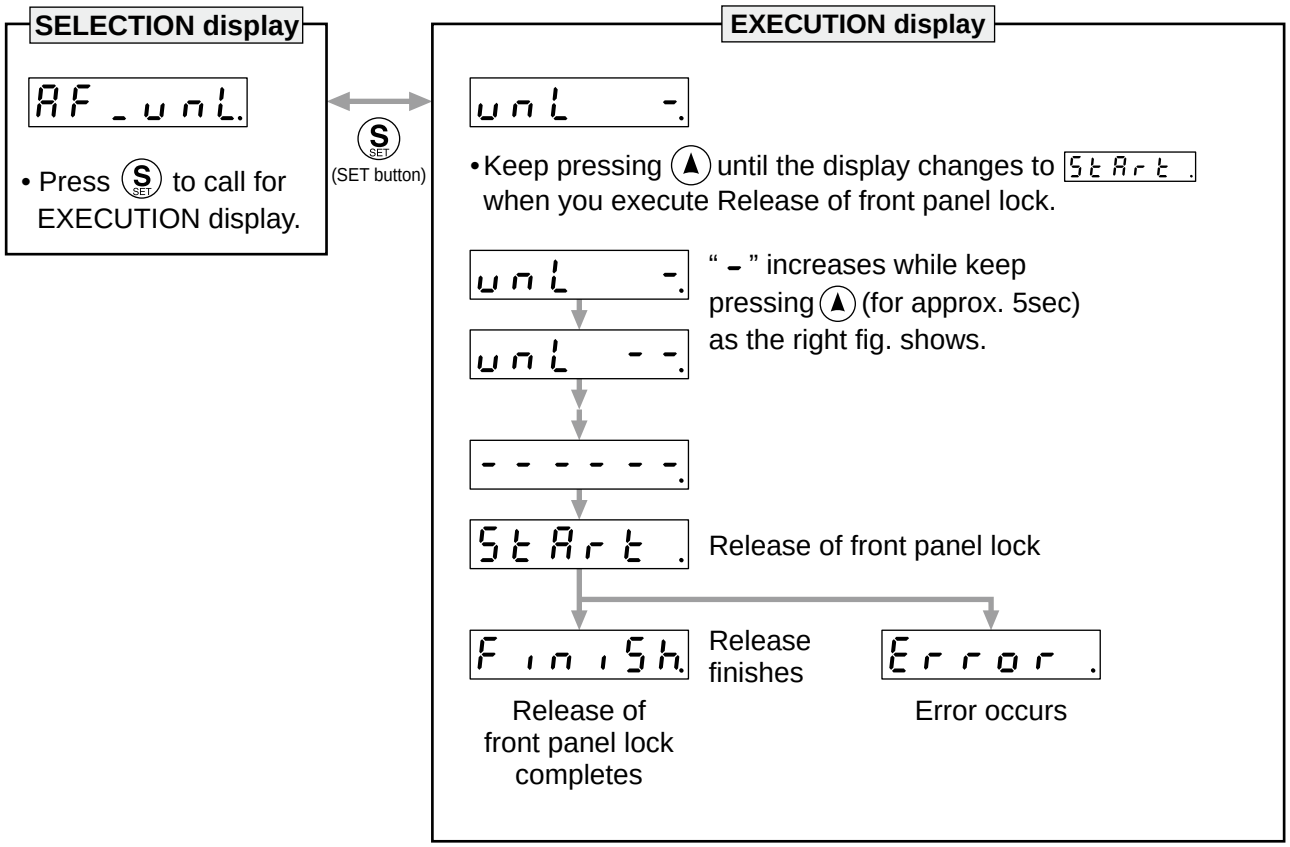



**Caution** • Parameter cannot be initialized when one of the following error occurs: Err11.0 "Under voltage protection of control power supply", EEPROM related errors (Err36.0, Err36.1, Err36.2, Err37.0, Err37.1 and Err37.2) - initialization will result in "Error" display.

**Note** • After initialization of parameter finishes, return to SELECTION display, referring to structure of each mode (P.2-54).

## (6) Release of front panel lock

Release the front panel lock setting.




**Note** • After release of front panel lock finishes, return to SELECTION display, referring to structure of each mode (P.2-54).

MEMO

# 3. Connection

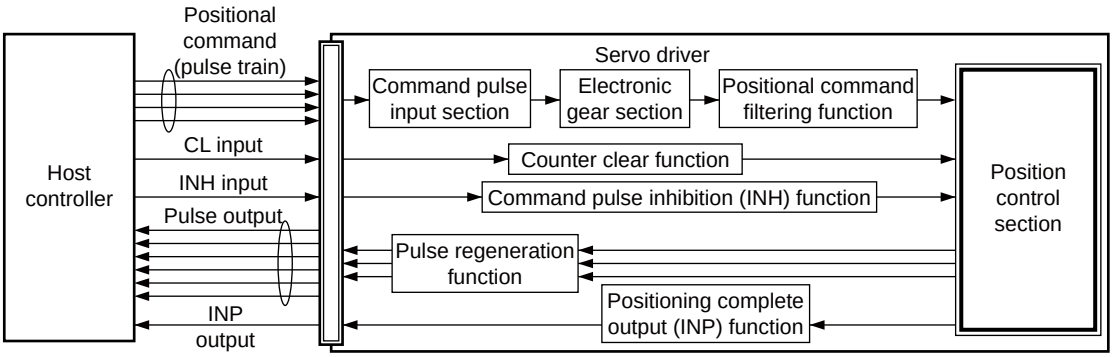
# 1. Outline of mode

## Position Control Mode

## Outline

You can perform position control based on the positional command (pulse train) from the host controller.

This section describes the fundamental setup to be used for the position control.




## Function

### (1) Process of command pulse input

The positional commands of the following 3 types (pulse train) are available.

- 2-phase pulse
- Positive direction pulse/negative direction pulse
- Pulse train + sign

Set the pulse configuration and pulse counting method based on the specification and configuration of installation of the host controller.

The input terminals can accommodate the following 2 systems.

- Input 1 “PULSH1, PULSH2, SIGNH1, SIGNH2” line receiver input (4 Mpps)
- Input 2 “PULS1, PULS2, SIGN1, SIGN2” photocoupler input (500 kpps)

**Caution** For line driver output, “Input 2” can also be used without changing the allowable input frequency.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr0.05 | Selection of command pulse input | 0 to 1 | You can select either the photo-coupler input or the exclusive input for line driver as the command pulse input. |
| Pr0.06 | Command pulse rotational direction setup | 0 to 1 | Sets the counting direction when command pulse is input. |
| Pr0.07 | Command pulse input mode setup | 0 to 3 | Sets the counting method when command pulse is input. |

**Note** For details of these parameters, refer to P.4-6 and 7 “Details of parameter”.

**Related page**
- P.3-14 “Control Block Diagram”
- P.3-18 “Wiring Diagram to the connector, X4”

### (2) Electronic gear function

This function multiplies the input pulse command from the host controller by the predetermined dividing or multiplying factor and applies the result to the position control section as the positional command. By using this function, desired motor rotations or movement distance per unit input command pulse can be set; or the command pulse frequency can be increased if the desired motor speed cannot be obtained due to limited pulse output capacity of the host controller.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr0.08 | Command pulse counts per one motor revolution | 0 to 1048576 | Set the command pulses that causes single turn of the motor shaft. |
| Pr0.09 | 1st numerator of electronic gear | 0 to 1073741824 | Set the numerator of division/multiplication operation made according to the command pulse input. |
| Pr0.10 | Denominator of electronic gear | 1 to 1073741824 | Set the Denominator of division/multiplication operation made according to the command pulse input. |

**Note** For details of these parameters, refer to P.4-8 “Details of parameter”.

### (3) Positional command filtering function

To make the positional command divided or multiplied by the electronic gear smooth, set the command filter.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr2.22 | Positional command smoothing filter | 0 to 10000 | 0.1ms | Set up the time constant of the 1st delay filter in response to the positional command. |
| Pr2.23 | Positional command FIR filter | 0 to 10000 | 0.1ms | Set up the time constant of the 1st delay filter in response to the positional command. |

**Note** For details of these parameters, refer to P.4-22 and 23 “Details of parameter”.

### (4) Pulse regeneration function

The information on the amount of movement can be sent to the host controller in the form of A- and B-phase pulses from the servo driver. When the output source is the encoder, Z-phase signal is output once per motor revolution; or if the feedback scale, the signal is output at absolute zero position. The output resolution, B-phase logic and output source (encoder or feedback scale) can be set with parameters.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr0.11 | Output pulse counts per one motor revolution | 1 to 262144 | P/r | You can set up the output pulse counts per one motor revolution for each OA and OB with the Pr0.11 setup. |
| Pr0.12 | Reversal of pulse output logic | 0 to 3 | — | You can set up the B-phase logic and the output source of the pulse output. With this parameter, you can reverse the phase relation between the A-phase pulse and the B-phase pulse by reversing the B-phase logic. |
| Pr5.03 | Denominator of pulse output division | 0 to 262144 | — | For application where the number of pulses per revolution is not an integer, this parameter can be set to a value other than 0, and the dividing ratio can be set by setting numerator of division to Pr0.11 and denominator of division to Pr5.03. |
| Pr5.33 | Pulse regenerative output limit setup | 0 to 1 | — | Enable/disable detection of Err28.0 Pulse regenerative limit protection. |
| Pr6.20 | Z-phase setup of external scale | 0 to 400 | µs | Set up the Z phase regenerative width of feedback scale in unit of time. |
| Pr6.21 | Serial absolute external scale Z phase setup | 0 to 268435456 | pulse | Full-closed control using serial absolute feedback scale. When outputting pulses by using the feedback scale as the source of the output, set the Z phase output interval in units of A phase output pulses of the feedback scale (before multiplied by 4). |
| Pr6.22 | A, B phase external scale pulse output method selection | 0 to 1 | — | Select the pulse regeneration method of A, B and Z parallel feedback scale. |

**Note** For details of these parameters, refer to P.4-8, 9, 42, 49 and 54 “Details of parameter”.

### (5) Deviation counter clear function

The deviation counter clear input (CL) clears the counts of positional deviation counter at the position control to 0.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr5.17 | Counter clear input mode | 0 to 4 | You can set up the clearing conditions of the counter clear input signal. |

**Note** For details of these parameters, refer to P.4-46 “Details of parameter”.

### (6) Positioning complete output (INP) function

The completion of positioning can be verified by the positioning complete output (INP). When the absolute value of the positional deviation counter at the position control is equal to or below the positioning complete range by the parameter, the output is ON. Presence and absence of positional command can be specified as one of judgment conditions.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr4.31 | Positioning complete (In-position) range | 0 to 262144 | Command unit | Set up the timing of positional deviation at which the positioning complete signal (INP1) is output. |
| Pr4.32 | Positioning complete (In-position) output setup | 0 to 3 | — | Select the condition to output the positioning complete signal (INP1). |
| Pr4.33 | INP hold time | 0 to 30000 | 1ms | Set up the hold time when Pr4.32 Positioning complete output setup = 13. |
| Pr4.42 | 2nd Positioning complete (In-position) range | 0 to 262144 | Command unit | Set up the timing of positional deviation at which the positioning complete signal (INP2) is output. |

**Note** For details of these parameters, refer to P.4-38 and 41 “Details of parameter”.

### (7) Command pulse inhibition (INH) function

The command pulse input counting process can be forcibly terminated by using the command pulse inhibit input signal (INH). When INH input is ON, the servo driver ignores the command pulse, disabling pulse counting function.

The default setting of this inhibition function is disable. To use INH function, change the setting of Pr5.18 “Invalidation of command pulse prohibition input”.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr5.18 | Invalidation of command pulse inhibit input | 0 to 1 | Select command pulse inhibit input enable/disable. |
| Pr5.19 | Command pulse inhibit input reading setup | 0 to 4 | Select command pulse inhibit input enable/disable signal reading period. When the status of several signals read during the predetermined reading period are same, update the signal status. |

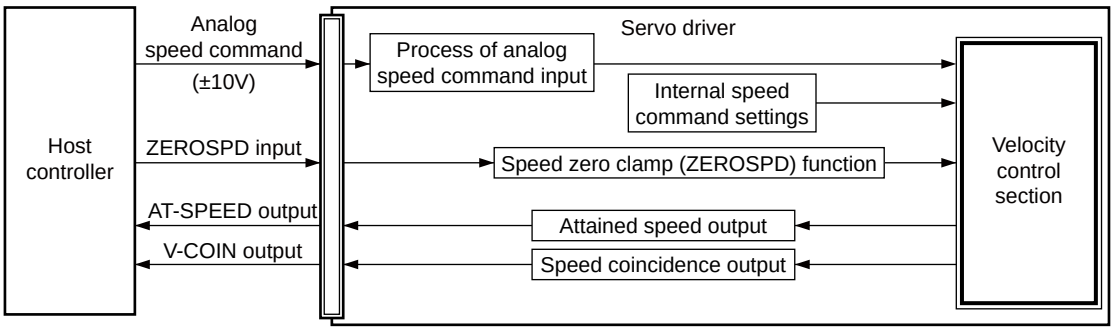
**Note** For details of these parameters, refer to P.4-46 “Details of parameter”.

# 1. Outline of mode

## Velocity Control Mode

## Outline

You can control the speed according to the analog speed command from the host controller or the speed command set in the servo driver.




## Function

### (1) Velocity control by analog speed command

The analog speed command input voltage is converted to equivalent digital speed command. You can set the filter to eliminate noise or adjust the offset.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.00 | Speed setup, Internal/ External switching | 0 to 3 | — | This driver is equipped with internal speed setup function so that you can control the speed with contact inputs only. |
| Pr3.01 | Speed command rotational direction selection | 0 to 1 | — | Select the Positive/Negative direction specifying method. |
| Pr3.02 | Input gain of speed command | 10 to 2000 | (r/min) /V | Based on the voltage applied to the analog speed command (SPR), set up the conversion gain to motor command speed. |
| Pr3.03 | Reversal of speed command input | 0 to 1 | — | Specify the polarity of the voltage applied to the analog speed command (SPR). |
| Pr4.22 | Analog input 1 (AI1) offset setup | –5578 to 5578 | 0.359mV | Set up the offset correction value applied to the voltage fed to the analog input 1. |
| Pr4.23 | Analog input 1 (AI1) filter | 0 to 6400 | 0.01ms | Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 1. |

**Note** For details of these parameters, refer to P.4-24, 25 and 37 “Details of parameter”.

Related page
• P.3-14 “Control Block Diagram”
• P.3-18 “Wiring Diagram to the connector, X4”

### (2) Velocity control by internal speed command

You can control the speed by using the internal speed command set to the parameter. By using the internal speed command selections 1, 2, 3 (INTSPD1, 2, 3), you can select best appropriate one among up to 8 internal speed command settings. Default setting uses the analog speed command. To use the internal speed command, select it through Pr3.00 “Internal/external speed setup”.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.00 | Speed setup, Internal/ External switching | 0 to 3 | — | This driver is equipped with internal speed setup function so that you can control the speed with contact inputs only. |
| Pr3.01 | Speed command rotational direction selection | 0 to 1 | — | Select the Positive/Negative direction specifying method. |
| Pr3.04 | 1st speed of speed setup | –20000 to 20000 | r/min | Set up internal command speeds, 1st to 1st. |
| Pr3.05 | 2nd speed of speed setup | | | Set up internal command speeds, 1st to 2nd. |
| Pr3.06 | 3rd speed of speed setup | | | Set up internal command speeds, 1st to 3rd. |
| Pr3.07 | 4th speed of speed setup | | | Set up internal command speeds, 1st to 4th. |
| Pr3.08 | 5th speed of speed setup | | | Set up internal command speeds, 1st to 5th. |
| Pr3.09 | 6th speed of speed setup | | | Set up internal command speeds, 1st to 6th. |
| Pr3.10 | 7th speed of speed setup | | | Set up internal command speeds, 1st to 7th. |
| Pr3.11 | 8th speed of speed setup | | | Set up internal command speeds, 1st to 8th. |

**Note** For details of these parameters, refer to P.4-24, 25 and 26 “Details of parameter”.

### (3) Speed zero clamp (ZEROSPD) function

You can forcibly set the speed command to 0 by using the speed zero clamp input.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.15 | Speed zero-clamp function selection | 0 to 3 | — | You can set up the function of the speed zero clamp input. |
| Pr3.16 | Speed zero clamp level | 0 to 1 | r/min | elect the timing at which the position control is activated as the Pr3.15 Speed zero-clamp function selection is set to 2 or 3. |

**Note** For details of these parameters, refer to P.4-27 “Details of parameter”.

### (4) Attained speed output (AT-SPEED)

The signal AT-SPEED is output as the motor reaches the speed set to Pr4.36 “Attained speed”.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr4.36 | At-speed (Speed arrival) | 10 to 20000 | r/min | Set the detection timing of the speed arrival output (AT-SPEED). |

**Note** For details of these parameters, refer to P.4-40 “Details of parameter”.

### (5) Speed coincidence output (V-COIN)

This signal is output when the motor speed is equal to the speed specified by the speed command. The motor speed is judged to be coincident with the specified speed when the difference from the speed command before/after acceleration/deceleration is within the range specified by Pr4.35 “Speed coincident range” .

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr4.35 | Speed coincidence range | 10 to 20000 | r/min | Set the speed coincidence (V-COIN) output detection timing. |

**Note** For details of these parameters, refer to P.4-39 “Details of parameter”.

### (6) Speed command acceleration/deceleration setting function

This function controls the speed by adding acceleration or deceleration instruction in the driver to the input speed command.

Using this function, you can use the soft start when inputting stepwise speed command or when using internal speed setup. You can also use S shaped acceleration/deceleration function to minimize shock due to change in speed.

**• Relevant parameters**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.12 | Acceleration time setup | 0 to 10000 | ms/ (1000r/min) | Set up acceleration processing time in response to the speed command input. |
| Pr3.13 | Deceleration time setup | 0 to 10000 | ms/ (1000r/min) | Set up deceleration processing time in response to the speed command input. |
| Pr3.14 | Sigmoid acceleration/ deceleration time setup | 0 to 1000 | ms | Set S-curve time for acceleration/ deceleration process when the speed command is applied. |

**Caution** When the position loop is external to the driver, do not use the acceleration/ deceleration time setting. Set these values to 0.

**Note** For details of these parameters, refer to P.4-26 and 27 “Details of parameter”.

# 1. Outline of mode

## Torque Control Mode



## Outline

The torque control is performed according to the torque command specified in the form of analog voltage. For controlling the torque, the speed limit input is required in addition to the torque command to maintain the motor speed within the speed limit.

With the A5 series, 3 torque control modes are available, each requires different torque command and speed limit as shown in the table below.

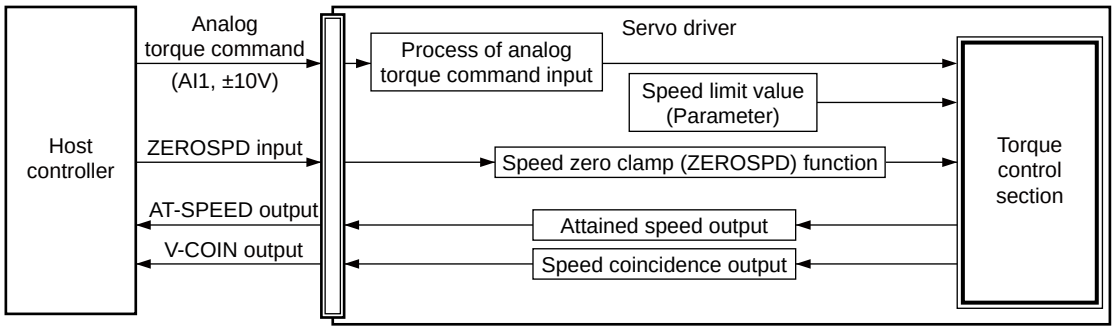
**• Pr3.17 (Selection of torque command)**

| Setup value | | Torque command input | Velocity limit input |
|---|---|---|---|
| 0 | Selection of torque command 1 | Analog input 1 *1 (AI1, 16-bit resolution) | Parameter value (Pr3.25) |
| 1 | Selection of torque command 2 | Analog input 2 (AI2, 12-bit resolution) | Analog input 1 (AI1, 16-bit resolution) |
| 2 | Selection of torque command 3 | Analog input 1 *1 (AI1, 16-bit resolution) | Parameter value (Pr3.25, Pr3.26) |

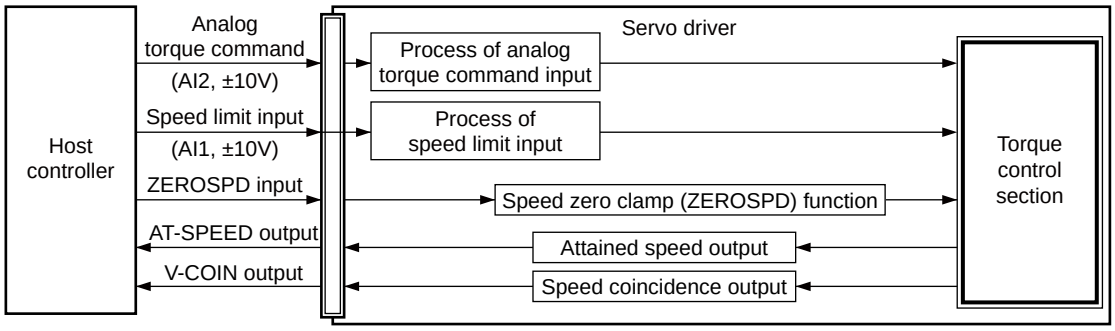
*1 For Pr0.01 Control mode setup = 5 (velocity/torque control), the torque command input is the analog input 2 (AI2, 12-bit resolution).

**Note** For details of these parameters, refer to P.4-28 “Details of parameter”.

**<Selection of torque command 1, 3>**




**<Selection of torque command2>**




**Related page**
• P.3-16 “Control Block Diagram”
• P.3-19 “Wiring Diagram to the connector, X4”

## Function

### (1) Process of analog torque command input

This process converts the analog torque command input (voltage) to the equivalent digital torque command having the same effect. You can set the filter or adjust the offset to eliminate noise.

**• Relevant parameters <Selection of torque command 1, 3>**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.18 | Torque command direction selection | 0 to 1 | — | Select the direction positive/negative direction of torque command. |
| Pr3.19 | Input gain of torque command | 10 to 100 | 0.1V /100% | Based on the voltage (V) applied to the analog torque command (TRQ R), set up the conversion gain to torque command (%). |
| Pr3.20 | Input reversal of torque command | 0 to 1 | — | Set up the polarity of the voltage applied to the analog torque command (TRQR). |
| Pr4.22 | Analog input 1 (AI1) offset setup | –5578 to 5578 | 0.359mV | Set up the offset correction value applied to the voltage fed to the analog input 1. |
| Pr4.23 | Analog input 1 (AI1) filter | 0 to 6400 | 0.01ms | Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 1. |

**• Relevant parameters <Selection of torque command 2>**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.18 | Torque command direction selection | 0 to 1 | — | Select the direction positive/negative direction of torque command. |
| Pr3.19 | Input gain of torque command | 10 to 100 | 0.1V /100% | Based on the voltage (V) applied to the analog torque command (TRQ R), set up the conversion gain to torque command (%). |
| Pr3.20 | Input reversal of torque command | 0 to 1 | — | Set up the polarity of the voltage applied to the analog torque command (TRQR). |
| Pr4.25 | Analog input 2 (AI2) offset setup | –342 to 342 | 5.86mV | Set up the offset correction value applied to the voltage fed to the analog input 2. |
| Pr4.26 | Analog input 2 (AI2) filter | 0 to 6400 | 0.01ms | Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 2. |

**Note** For details of these parameters, refer to P.4-28 and 37 “Details of parameter”.

### (2) Speed limit function

The speed limit is one of protective functions used during torque control.
This function regulates the motor speed so that it does not exceed the speed limit while the torque is controlled.

**Caution**

While the speed limit is used to control the motor, the torque command applied to the motor is not directly proportional to the analog torque command. Torque command should have the following result: the motor speed is equal to the speed limit.

**• Relevant parameters <Selection of torque command 1, 3>**

| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.21 | Speed limit value 1 | 0 to 20000 | r/min | Set up the speed limit used for torque controlling. |
| Pr3.22 | Speed limit value 2 | 0 to 20000 | r/min | |
| Pr3.15 | Speed zero-clamp function selection | 0 to 3 | — | You can set up the function of the speed zero clamp input. |

**• Relevant parameters <Selection of torque command 2>**

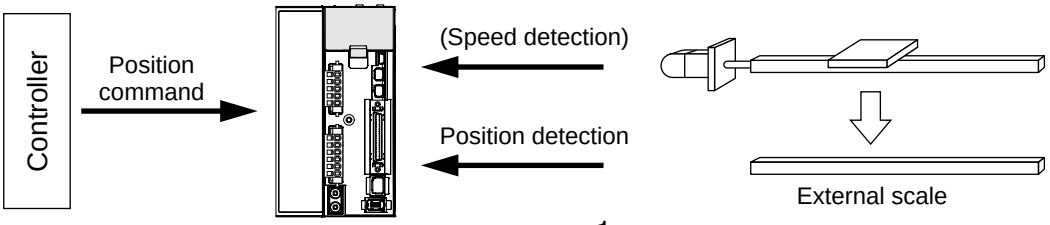
| Parameter No. | Title | Range | Unit | Function |
|---|---|---|---|---|
| Pr3.02 | Input gain of speed command | 10 to 2000 | (r/min) /V | Based on the voltage applied to the analog speed command (SPR), set up the conversion gain to motor command speed. |
| Pr4.22 | Analog input 1 (AI1) offset setup | –5578 to 5578 | 0.359mV | Set up the offset correction value applied to the voltage fed to the analog input 1. |
| Pr4.23 | Analog input 1 (AI1) filter | 0 to 6400 | 0.01ms | Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 1. |
| Pr3.15 | Speed zero-clamp function selection | 0 to 3 | — | You can set up the function of the speed zero clamp input. |

**Note**

For details of these parameters, refer to P.4-25, 27, 29 and 37 “Details of parameter”.

## Full-closed Control Mode

In this full-closed control, you can make a position control by using a external scale mounted externally which detects the position directly and feeds it back. With this control, you can control without being affected by the positional variation due to the ball screw error or temperature and you can expect to achieve a very high precision positioning in sub-micron order.



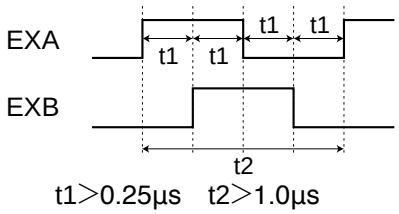
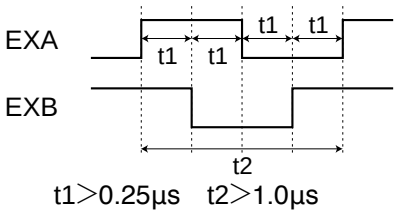

We recommend the external scale division ratio of $\frac{1}{40} \leq$ External scale division ratio $\leq 160$

### Cautions on Full-Closed Control

(1) Enter the command pulses making the external scale as a reference.
If the command pulses do not match to the external scale pulses, use the command division/multiplication function (Pr0.09 to Pr0.10) and setup so that the command pulses after division/multiplication is based on the external scale reference.

(2) The A5 series supports the external scale of A- and B-phase output type and serial communication type. Initialize the parameters according to the following procedures and write to EEPROM and turn on power.

(3) When using a scale of A- and B-phase output type, correctly connect it so that the rotating direction of the motor (CW/CCW) and A-phase and B-phase of the external scale have the following relationship.

| CCW direction | CW direction |
|---|---|
|  |  |
| t1>0.25µs t2>1.0µs | t1>0.25µs t2>1.0µs |



**<How to make an initial setup of parameters related to external scale >**

1) Turn on the power after checking the wiring.
2) Check the values (initial) feedback pulse sum and external scale feedback pulse sum with the front panel or with the setup support software, PANATERM.
3) Move the work and check the travel from the initial values of the above 2).
4) If the travel of the feedback sum and the external scale feedback pulse sum are reversed in positive and negative, set up the reversal of external scale direction (Pr3.26) to 1.
5) Set up the external scale division ratio (Pr3.24, Pr3.25) using the formula below,

$$\text{External scale division ratio} = \frac{\text{Total variation of feedback pulse sum}}{\text{Total variation of external scale feedback pulse sum}} = \frac{\text{Pr3.24}}{\text{Pr3.25}}$$

* If the design value of the external scale division ratio is obtained, set up this value.

Related page • P.3-17 “Control Block Diagram” • P.3-19 “Wiring Diagram to the connector, X4”
• P.3-30 “Inputs and outputs on connector X4” • P.4-3 “Details of parameter”

6) Set up appropriate value of hybrid deviation excess (Pr3.25) in 16 pulse unit of the external scale resolution, in order to avoid the damage to the machine.
   * A5-series driver calculates the difference between the encoder position and the external scale position as hybrid deviation, and is used to prevent the machine runaway or damage in case of the external scale breakdown or when the motor and the load is disconnected.
   If the hybrid deviation excess range is too wide, detection of the breakdown or the disconnection will be delayed and error detection effect will be lost. If this is too narrow, it may detect the normal distortion between the motor and the machine under normal operation as an error.
   * When the external scale division ration is not correct, hybrid deviation excess error (Err25) may occur especially when the work travels long distance, even though the external scale and the motor position matches.
   In this case, widen the hybrid deviation excess range by matching the external scale division ratio to the closest value.

## Function

### (1) Selection of external scale type

Select the type of external scale to be used.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr3.23 | External scale selection | 0 to 2 | Select the type of external scale. |
| Pr3.26 | Reversal of direction of external scale | 0 to 1 | Reverse the direction of external scale, feedback counter. |

**Note** For details of these parameters, refer to P.4-29 and 30 “Details of parameter”.

### (2) Setup of external scale division ratio

Set up the division ratio of encoder resolution and external scale resolution.

**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr3.24 | Numerator of external scale division | 0 to $2^{20}$ | Set up the numerator of the external scale dividing setup. |
| Pr3.25 | Denominator of external scale division | 1 to $2^{20}$ | Set up the Denominator of the external scale dividing setup. |

**Note** For details of these parameters, refer to P.4-30 “Details of parameter”.

### (3) Setup of hybrid excessive deviation

This function detects the positional difference between the motor (encoder) and load (external scale) and enables the hybrid excessive deviation protection if the difference exceeds Pr3.28 “Hybrid excessive deviation setup”.
Hybrid excessive deviation is mainly caused by feedback scale error, wrong connection and loose connection between the motor and load.

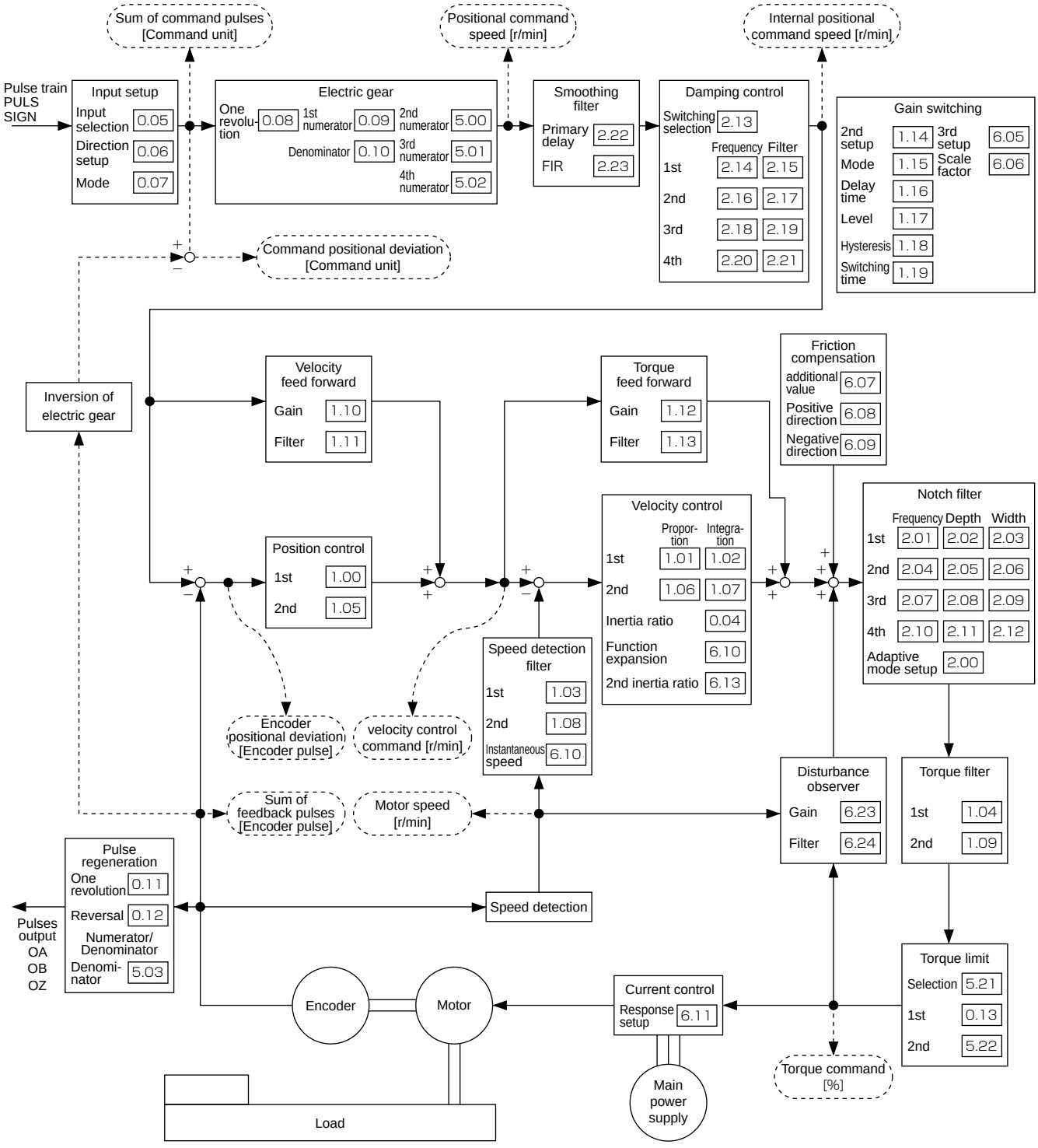
**• Relevant parameters**

| Parameter No. | Title | Range | Function |
|---|---|---|---|
| Pr3.28 | Hybrid deviation excess setup | 1 to $2^{27}$ | You can setup the permissible gap (hybrid deviation) between the present motor position and the present external scale position. |
| Pr3.29 | Hybrid deviation clear setup | 0 to 100 | As the motor turns the number of revolutions set by this parameter, the hybrid deviation is cleared to 0. |

**Note** For details of these parameters, refer to P.4-31 “Details of parameter”.

# 2. Control Block Diagram

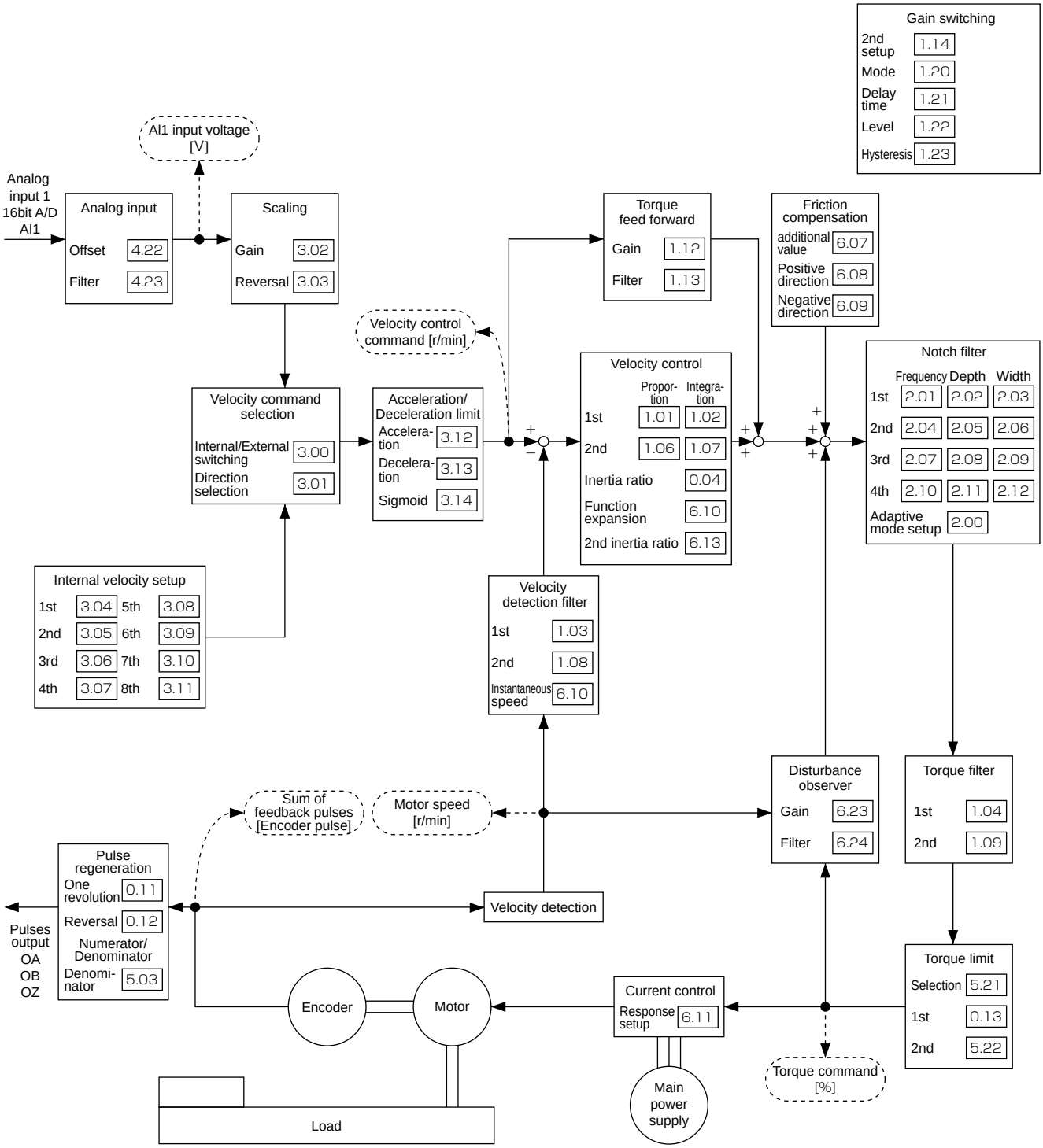
## Position Control Mode




Related page
• P.3-18 “Wiring example of position control mode”
• P.3-20 “Connecting example to host controller”
• P.3-30 “Inputs and outputs on connector X4” • P.4-2 “List of Parameters”

# 2. Control Block Diagram

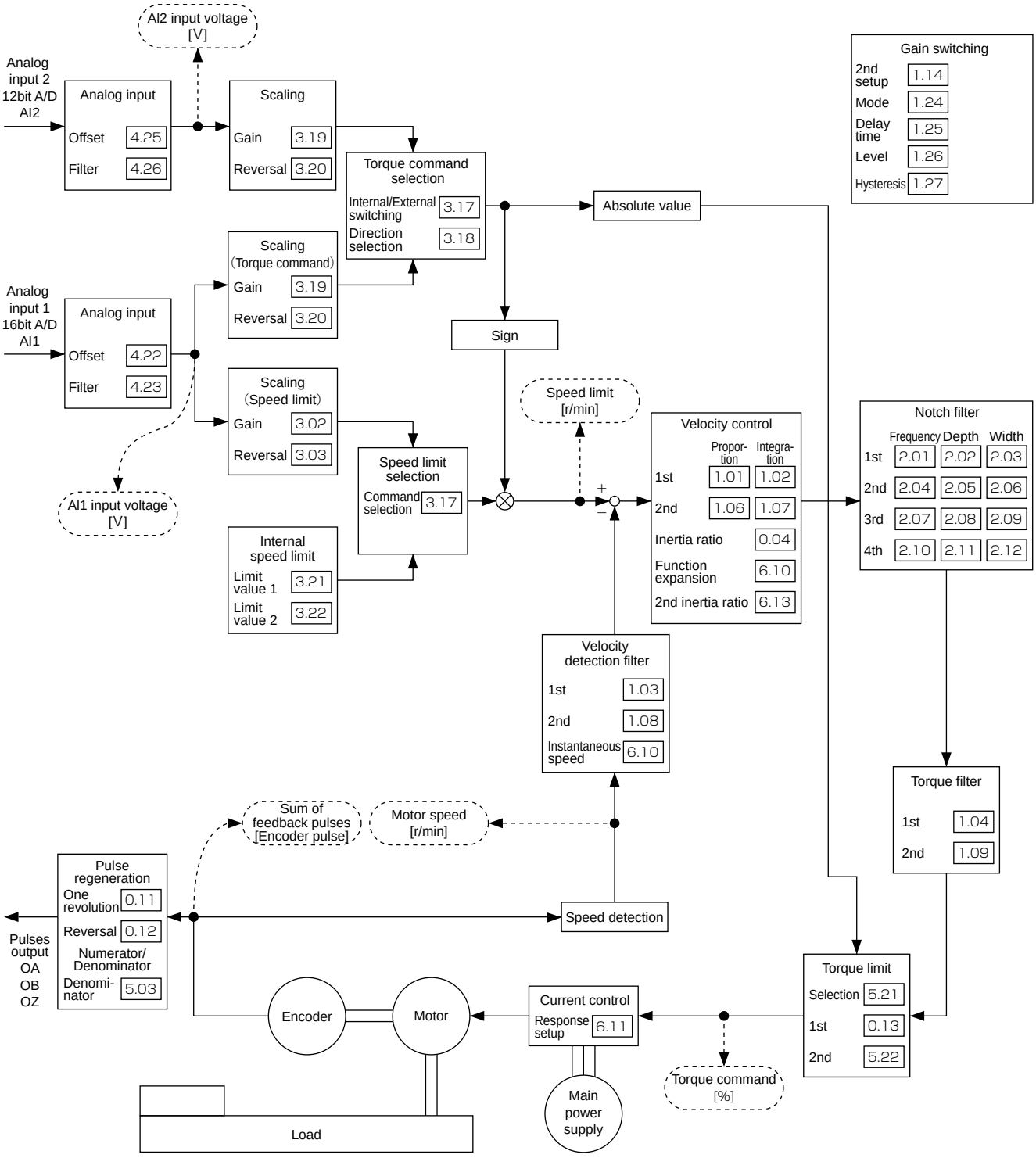
## Velocity Control Mode




Related page • P.3-18 “Wiring example of velocity control mode”

# 2. Control Block Diagram

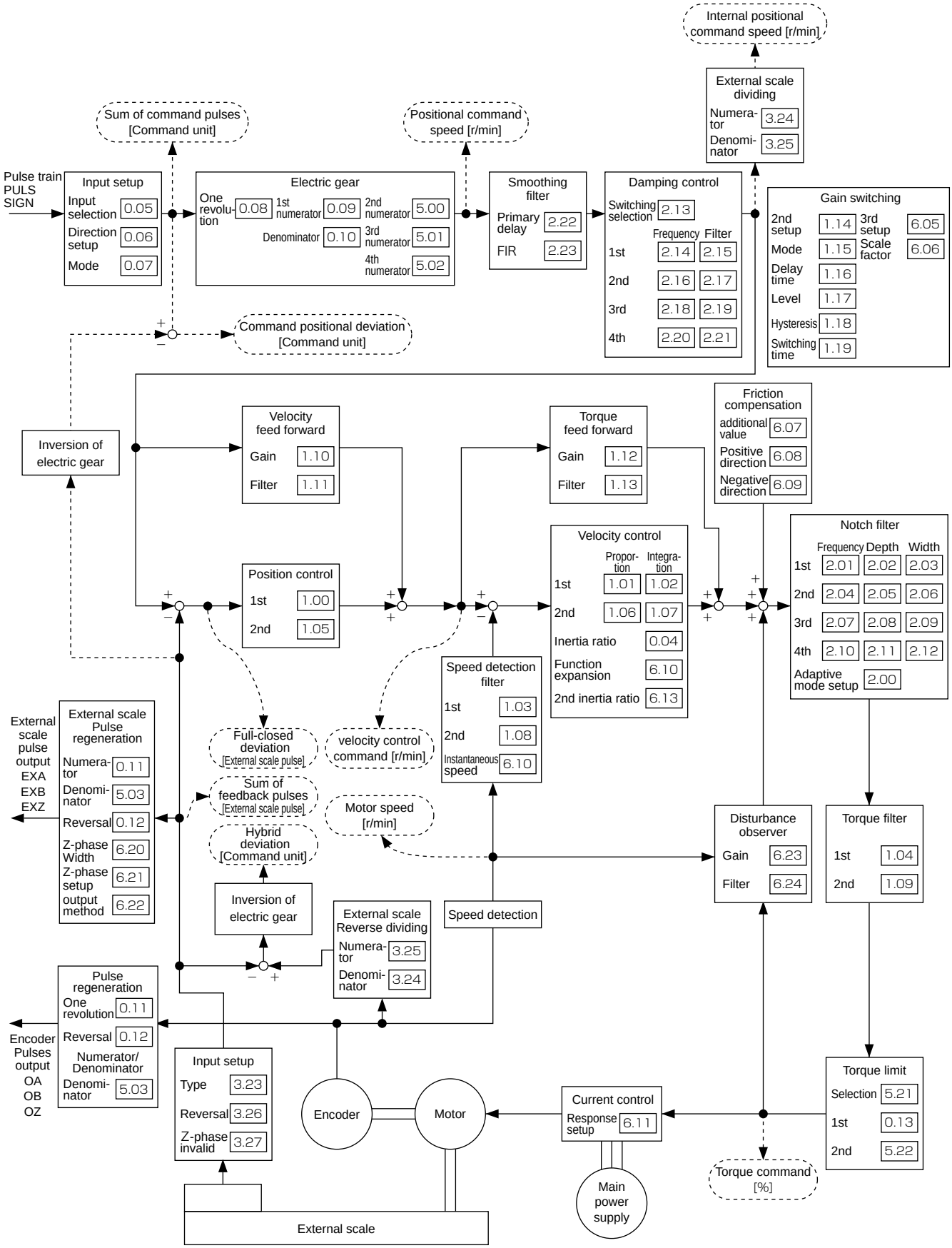
## Torque Control Mode




Related page • P.3-19 “Wiring example of torque control mode”

# 2. Control Block Diagram

## Full-closed Control Mode

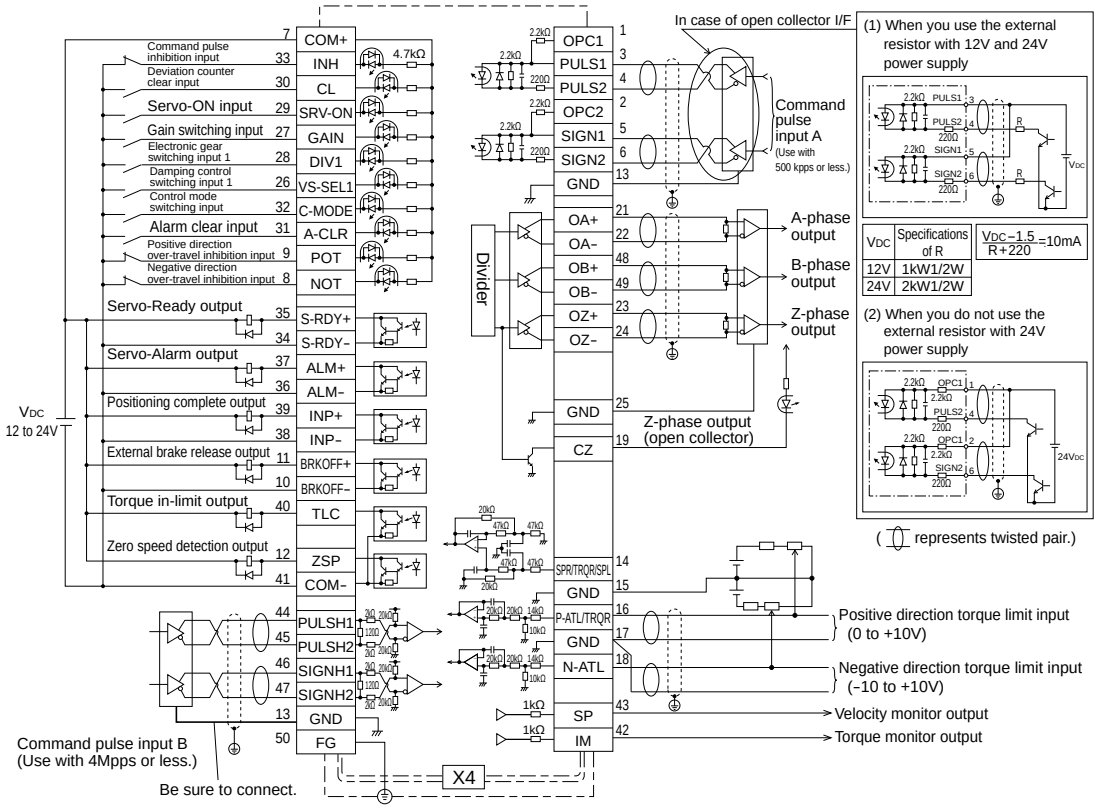



Related page • P.3-19 “Wiring example of full-close control mode”

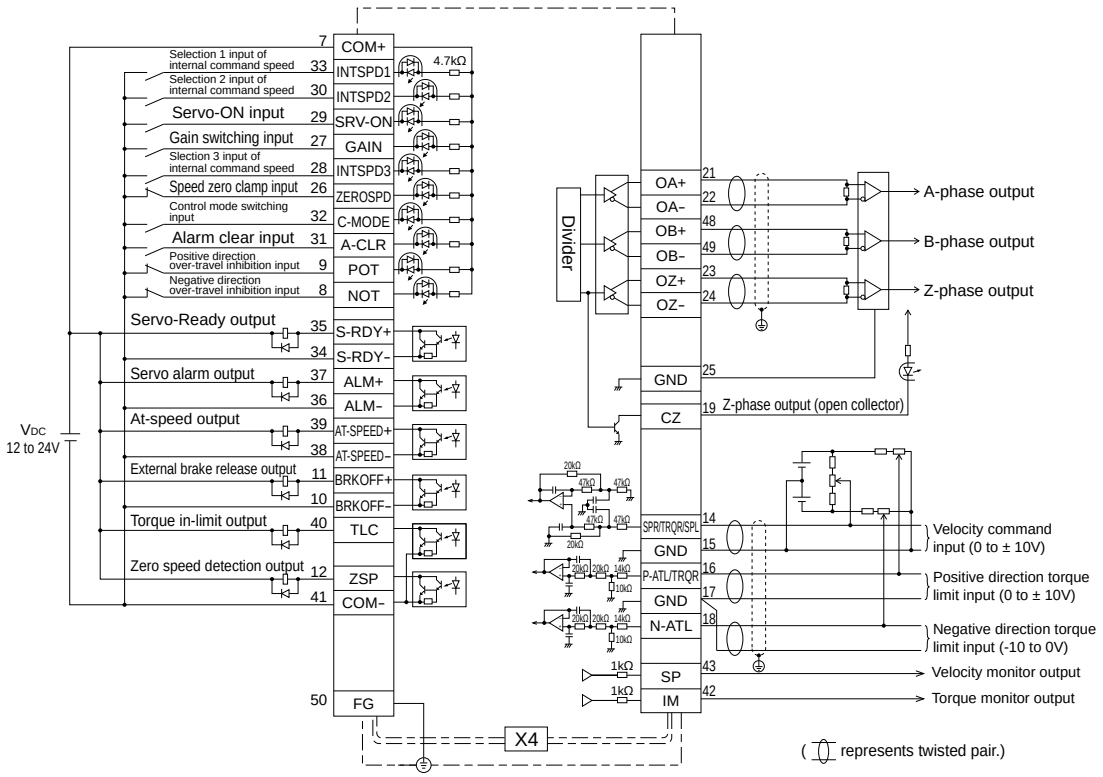
# 3. Wiring Diagram to the connector, X4

## Example of control mode specific wiring

## Wiring Example of Position Control Mode

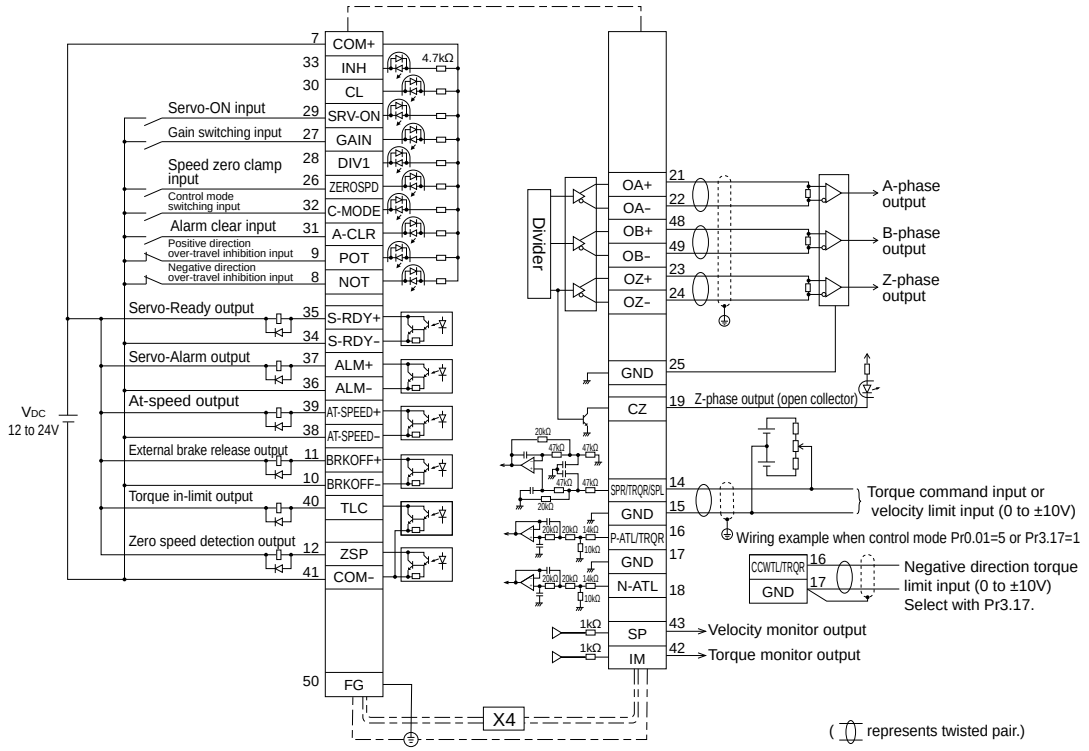



## Wiring Example of Velocity Control Mode

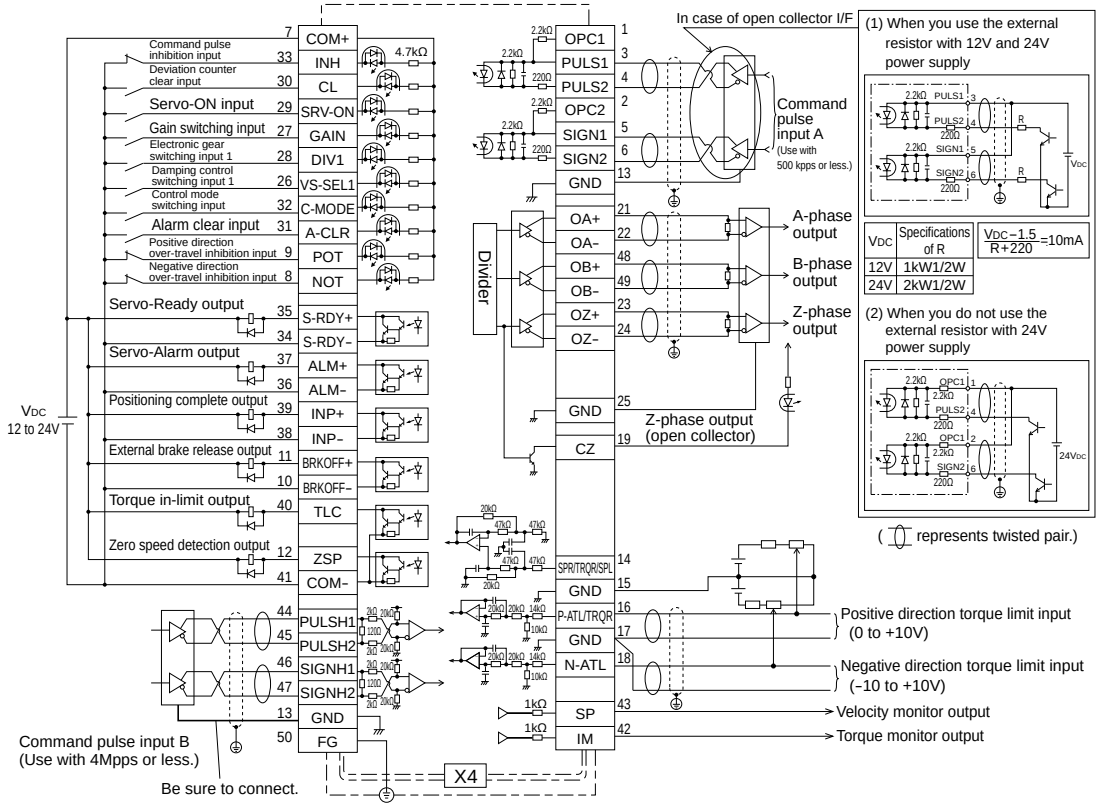



**Note** The functions of the following pin can be changed using parameters. (Refer to P.4-32)
Input(Position): 8, 9, 26, 27, 28, 29, 31, 32 Input(Velocity): 8, 9, 26, 27, 28, 29, 30, 31, 32, 33
Output: 10-11, 12, 34-35, 36-37, 38-39, 40
* Pins in the figure above represent default parameter values.

## Wiring Example of Torque Control Mode




## Wiring Example of Full-closed Control Mode

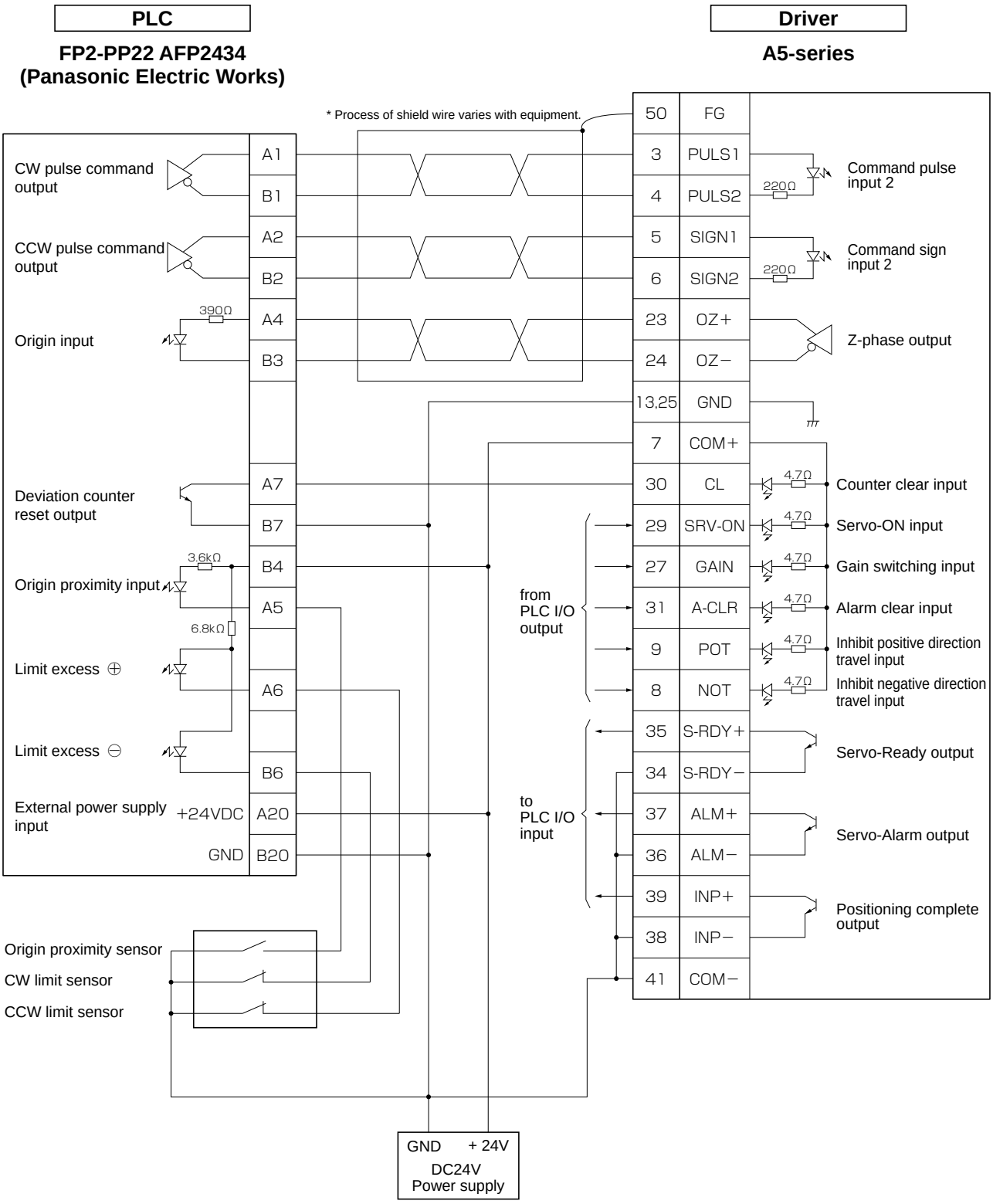



**Note** The functions of the following pin can be changed using parameters. (Refer to P.4-32)
Input(Torque): 8, 9, 26, 27, 28, 29, 30, 31, 32, 33 Input(Full-closed): 8, 9, 26, 27, 28, 29, 31, 32
Output: 10-11, 12, 34-35, 36-37, 38-39, 40
* Pins in the figure above represent default parameter values.

# 3. Wiring Diagram to the connector, X4

## Connecting Example to Host Controller

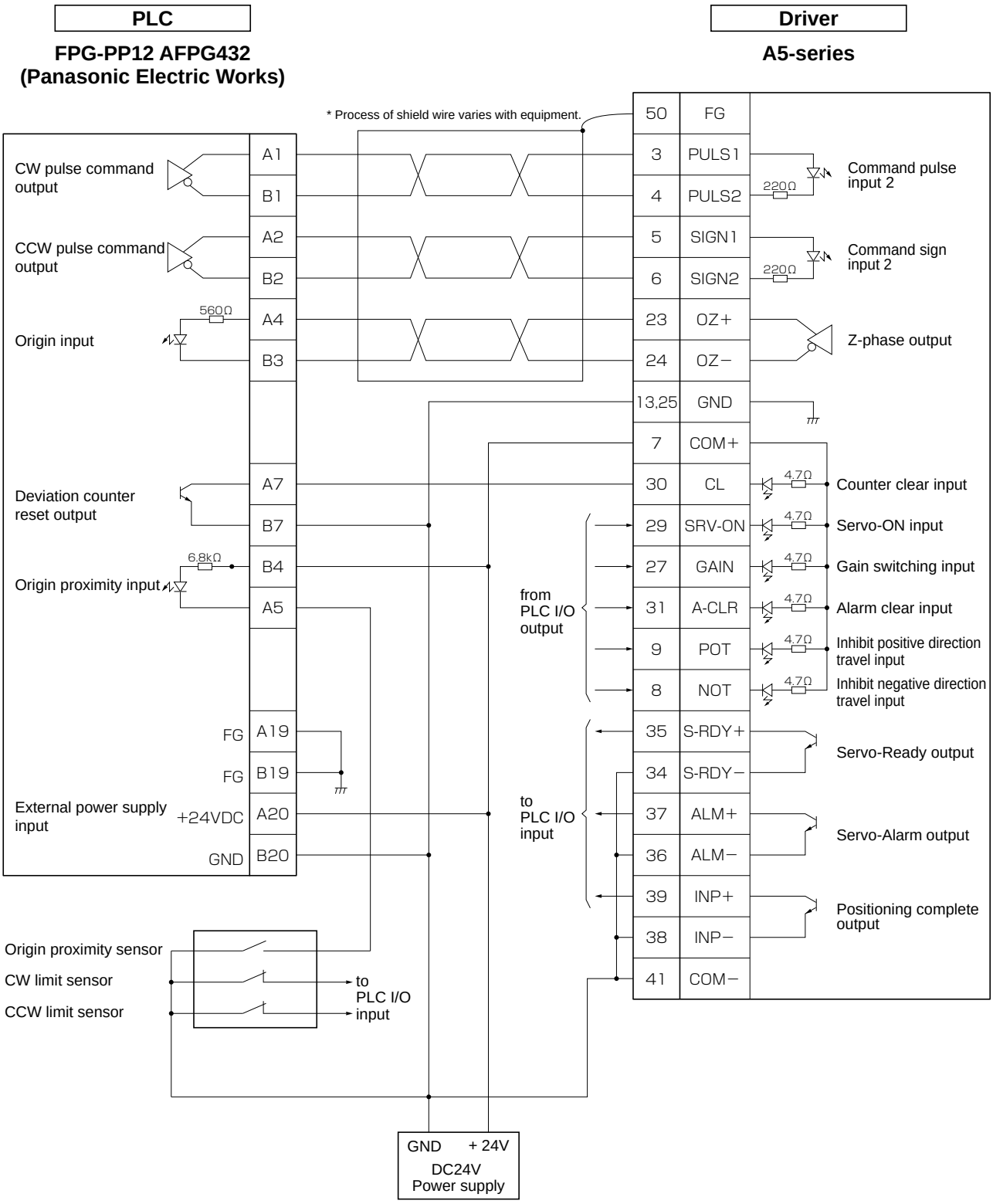
### Connection between MINAS A5 and FP2-PP22 AFP2434 (Panasonic Electric Works)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

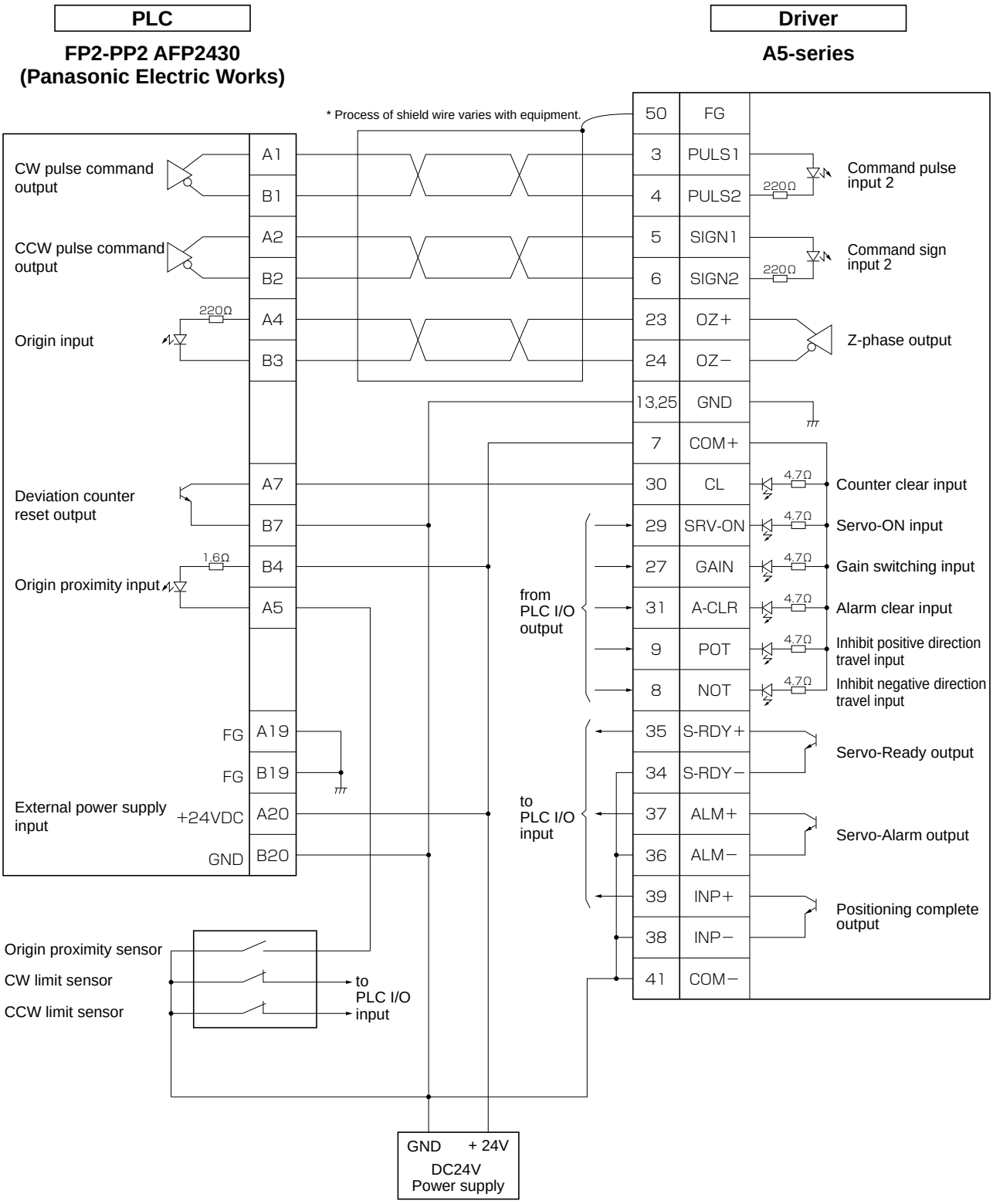
## Connection between MINAS A5 and FPG-PP12 AFPG432 (Panasonic Electric Works)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

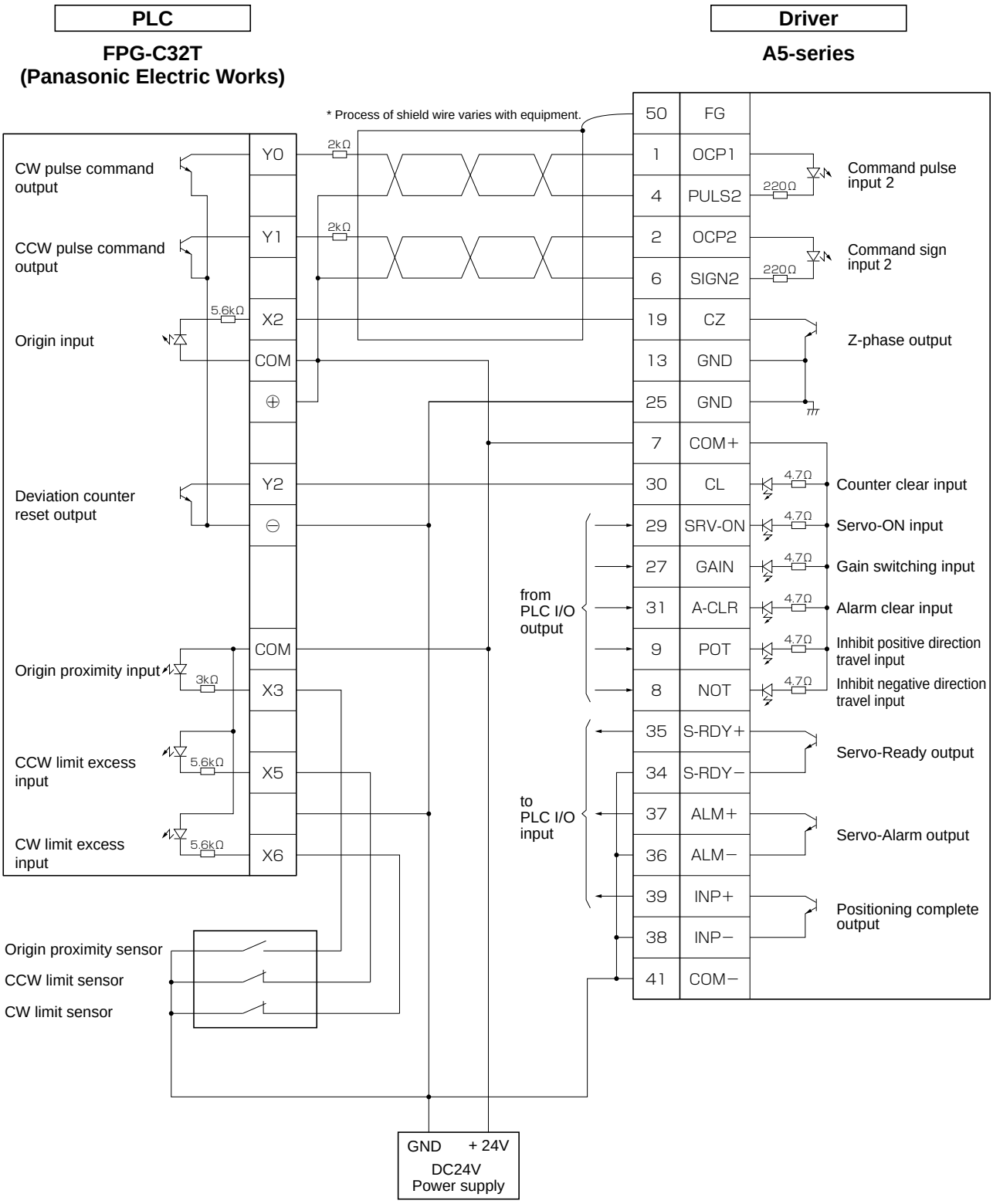
## Connection between MINAS A5 and FP2-PP22 AFP2434 (Panasonic Electric Works)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

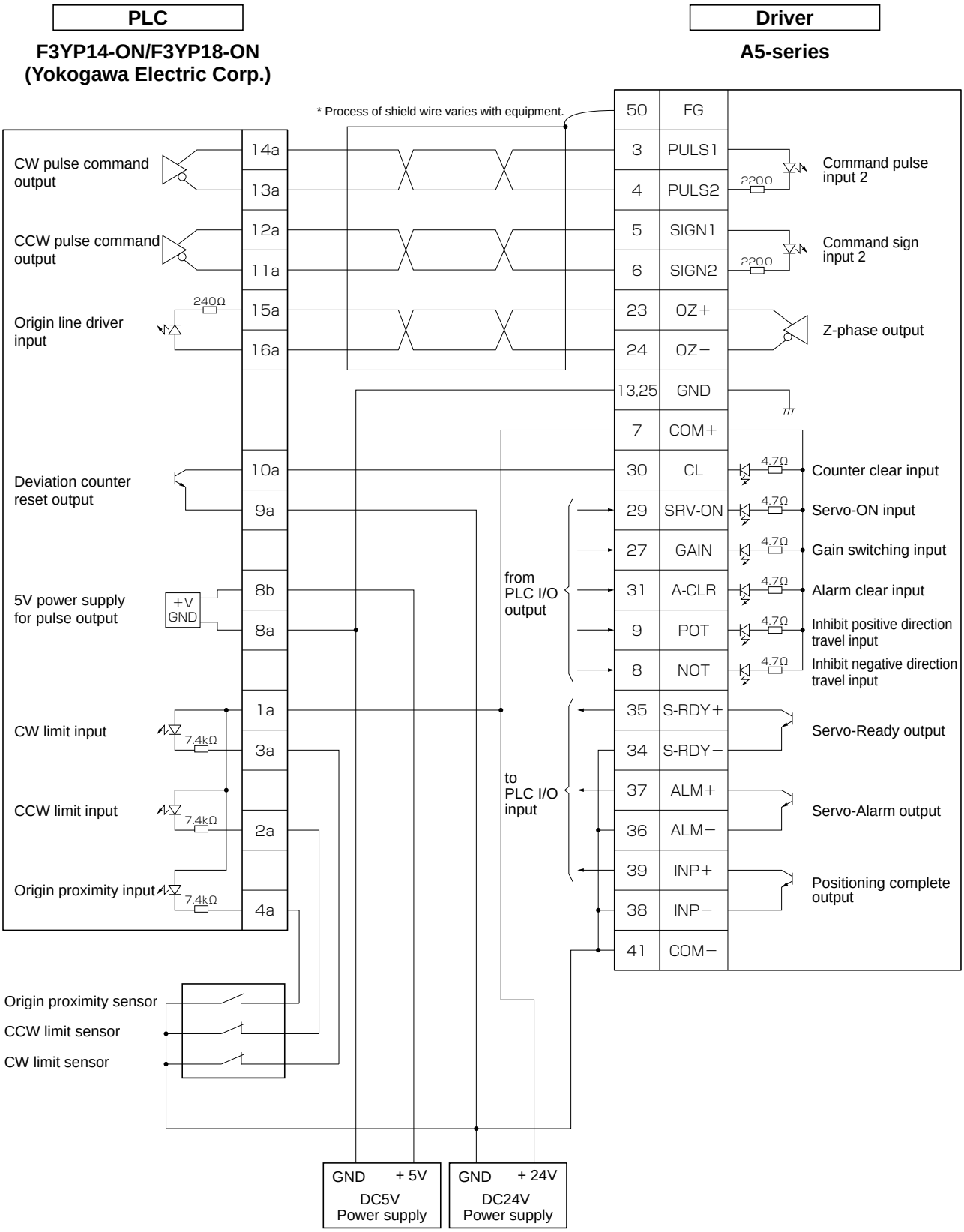
## Connection between MINAS A5 and FPG-C32T (Panasonic Electric Works)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

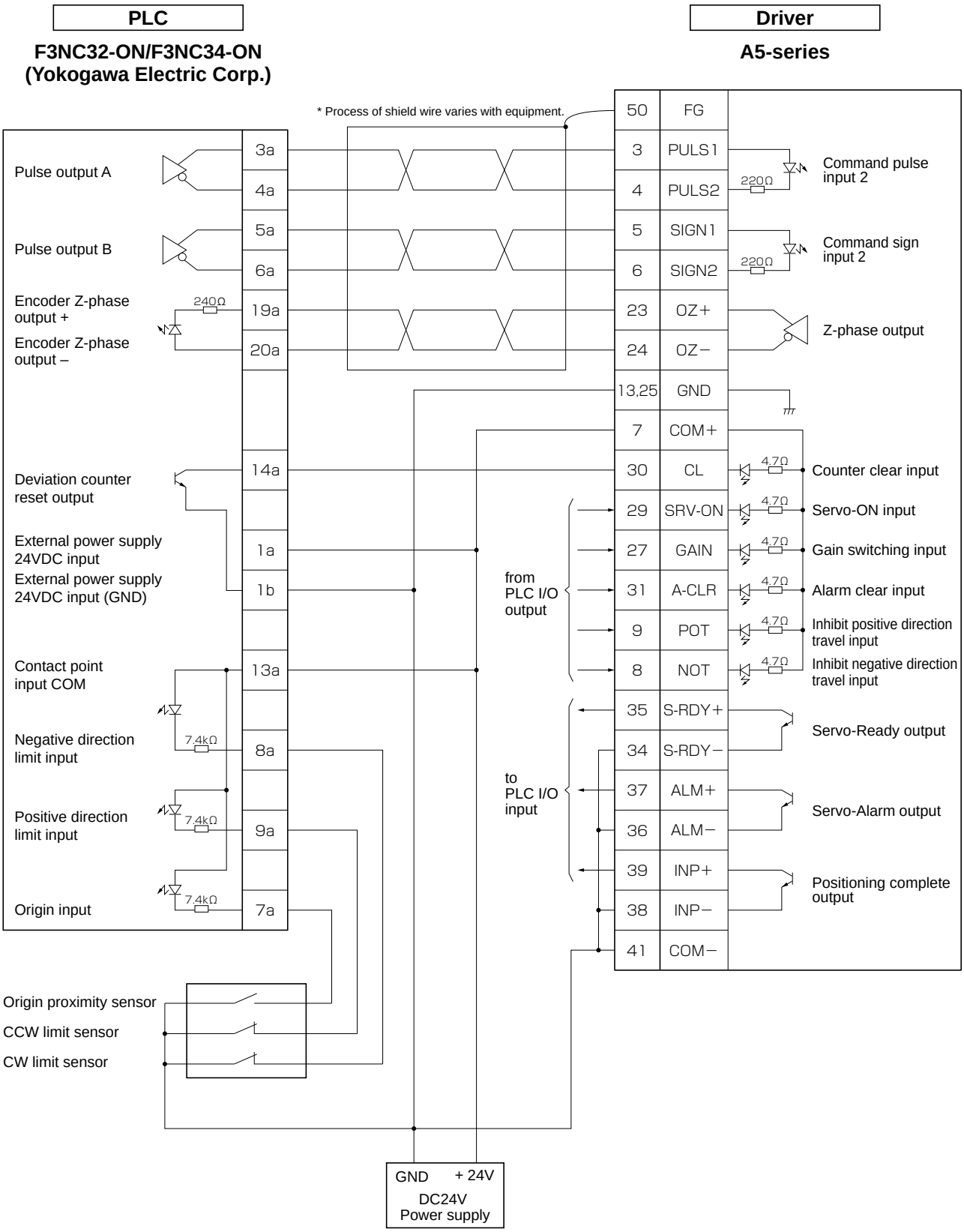
## Connection between MINAS A5 and F3YP14-ON/F3YP18-ON (Yokogawa Electric Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

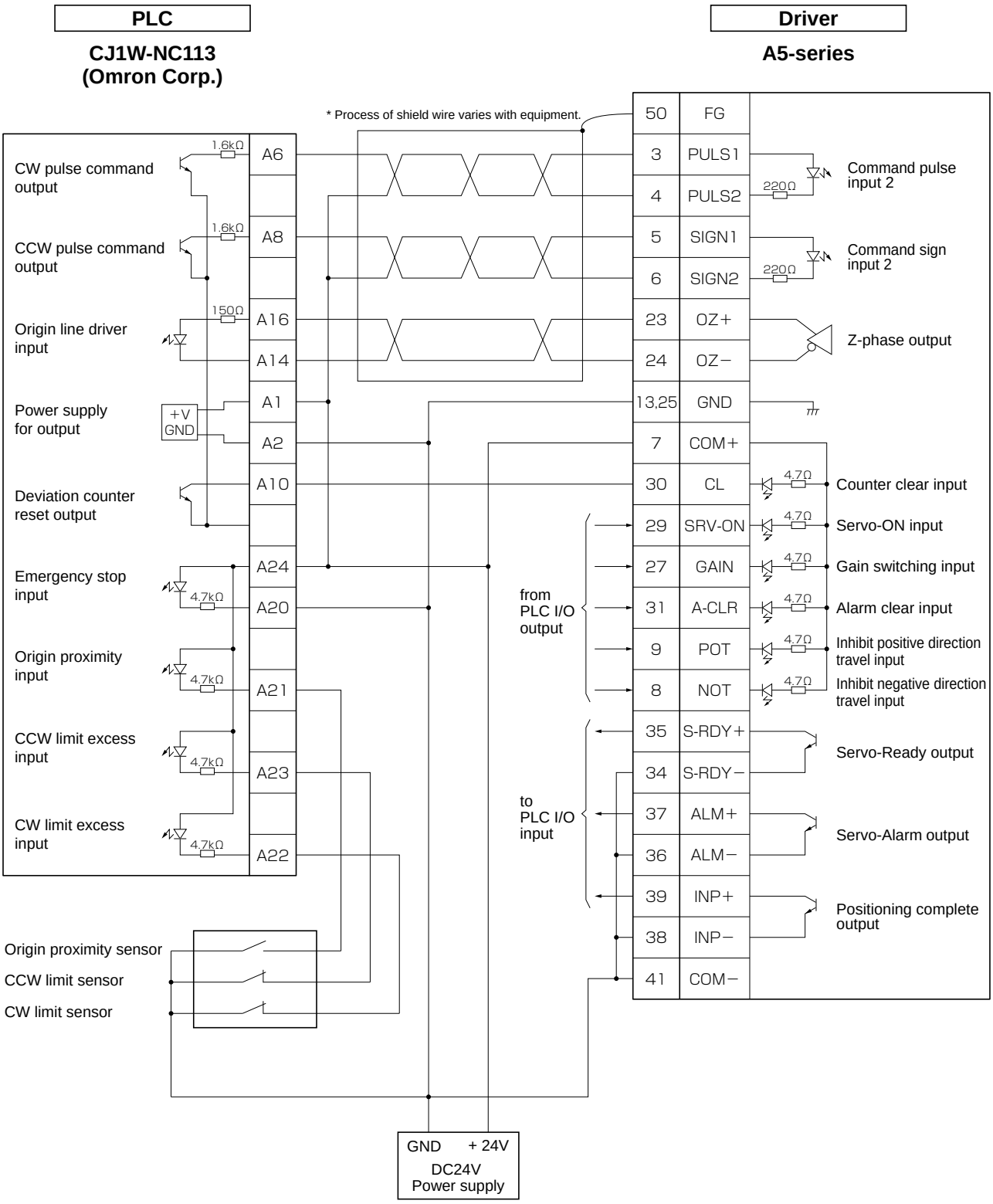
## Connection between MINAS A5 and F3NC32-ON/F3NC34-ON (Yokogawa Electric Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

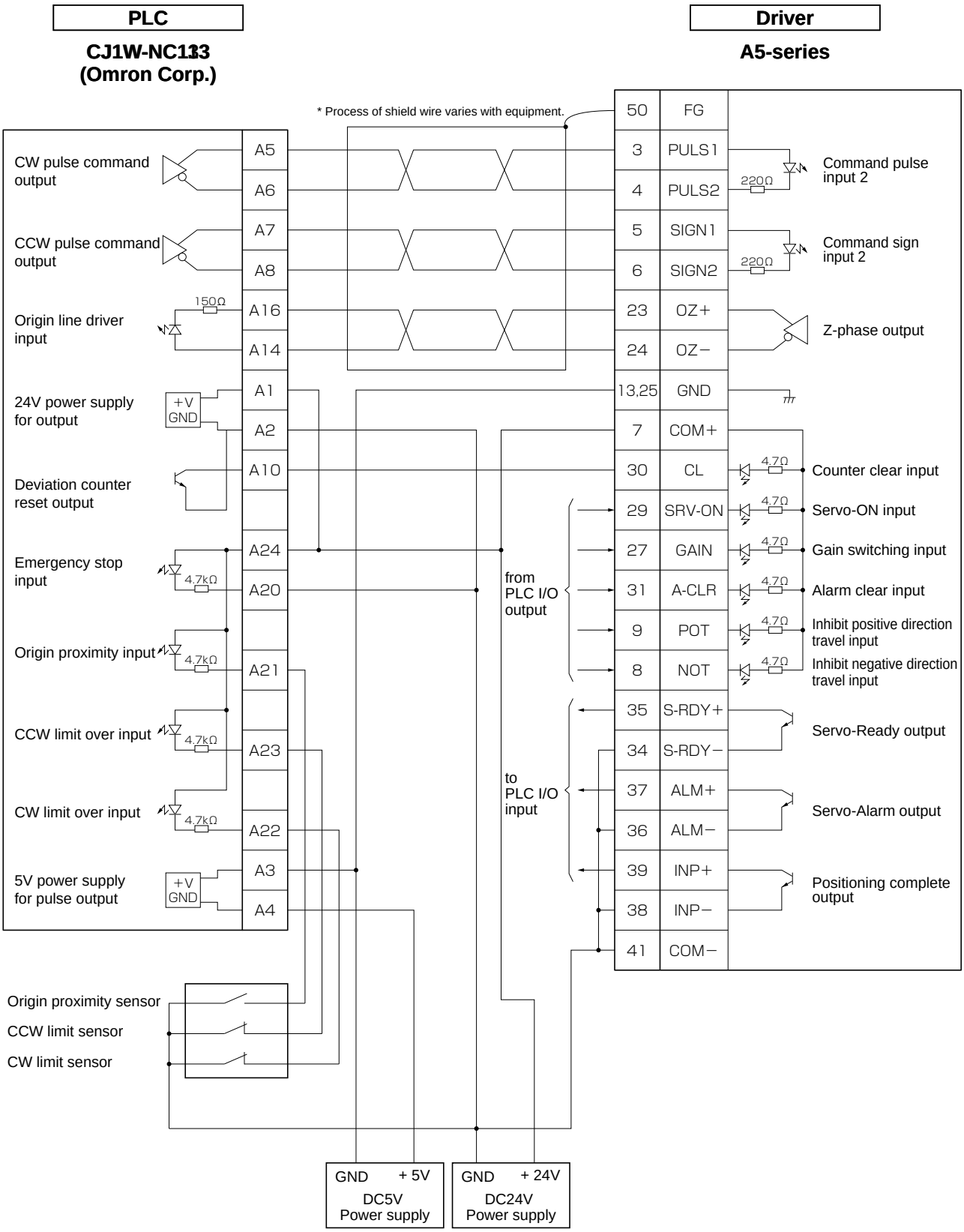
## Connection between MINAS A5 and CJ1W-NC113 (Omron Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

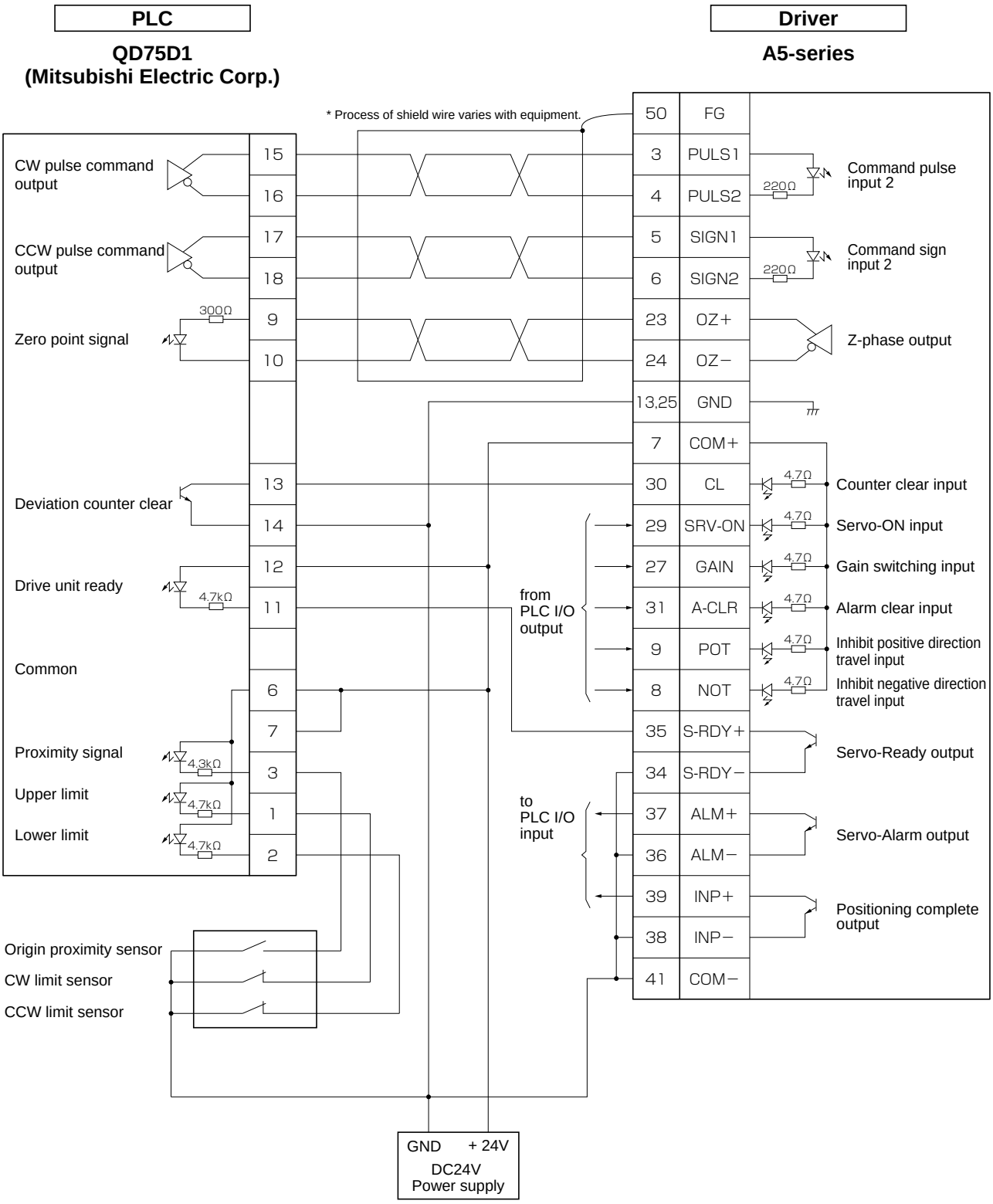
## Connection between MINAS A5 and CJ1W-NC133 (Omron Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

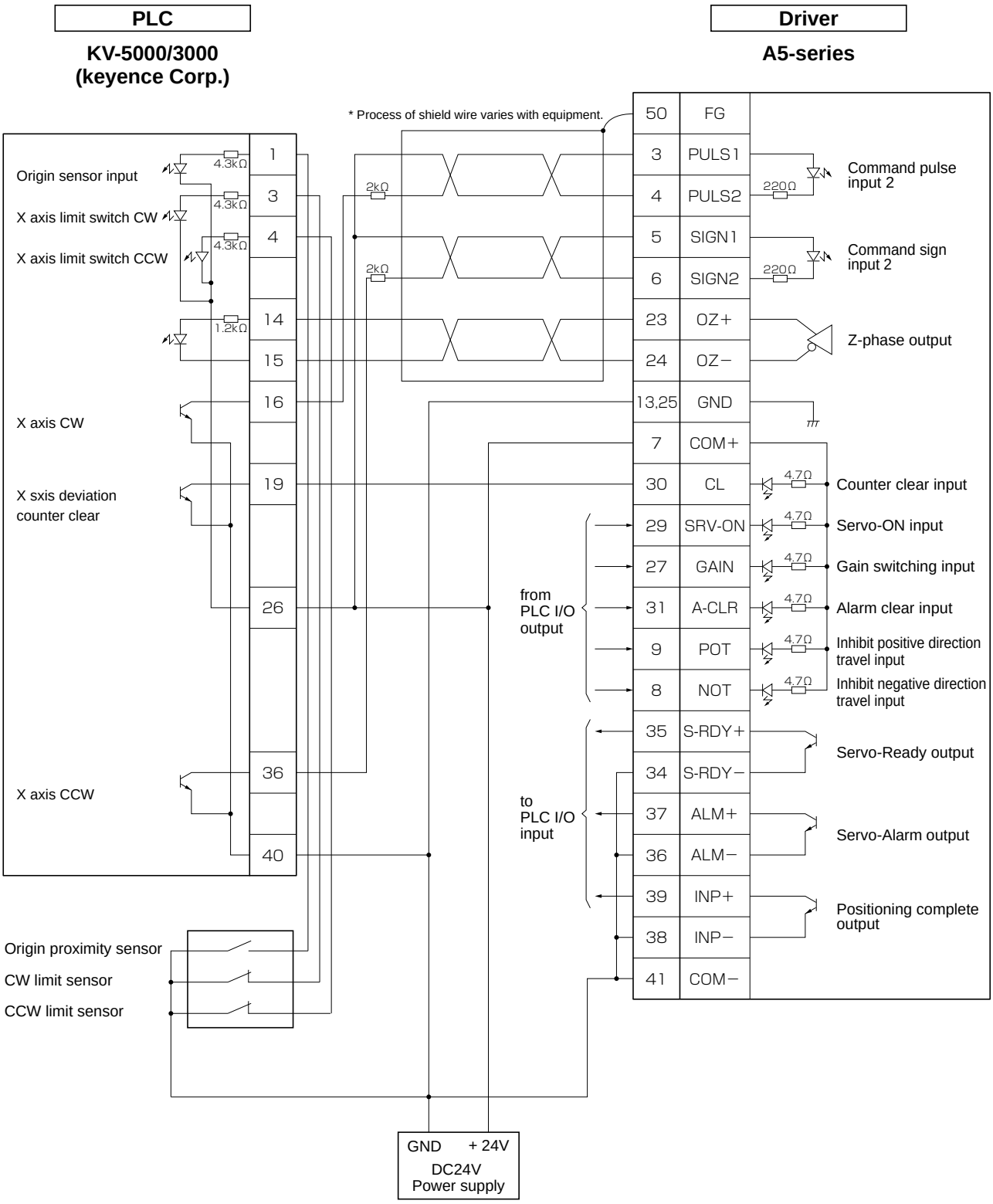
## Connection between MINAS A5 and QD75D1 (Mitsubishi Electric Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

## Connection between MINAS A5 and KV-5000/3000 (keyence Corp.)




**Note** represents twisted pair wire.

Related page • P.3-30 “Inputs and outputs on connector X4”

# 4. Inputs and outputs on connector X4

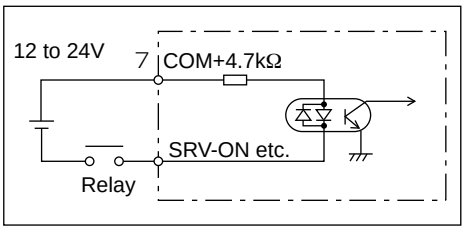
## Interface Circuit (Input)

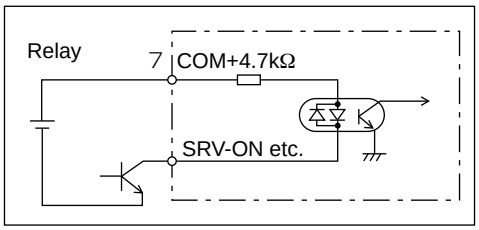
## Input Circuit

### SI — Connection to sequence input signals

Related control mode: P S T F

- Connect to contacts of switches and relays, or open collector output transistors.
- When you use contact inputs, use the switches and relays for micro current to avoid contact failure.
- Make the lower limit voltage of the power supply (12 to 24V) as 11.4V or more in order to secure the primary current for photo-couplers.




### PI1 — Connection to sequence input signals (Pulse train interface)

Related control mode: P S T F

(1) Line driver I/F (Input pulse frequency : max. 500kpps)

- This signal transmission method has better noise immunity. We recommend this to secure the signal transmission.

(2) Open collector I/F (Input pulse frequency : max. 200kpps)

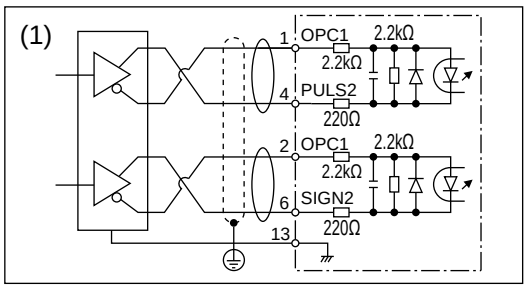
- The method which uses an external control signal power supply (VDC)
- Current regulating resistor (R) corresponding to $V_{DC}$ is required in this case.
- Connect the specified resister as below.
- (R) should be placed close to the driver for effective noise reduction.

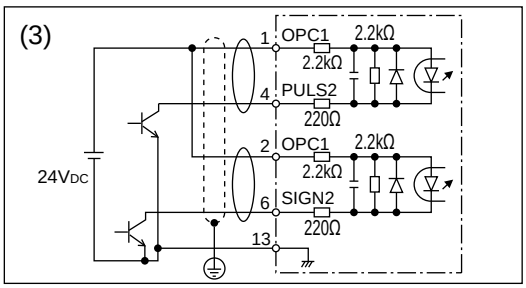
| VDC | Specifications |
|---|---|
| 12V | 1kΩ1/2W |
| 24V | 2kΩ1/2W |

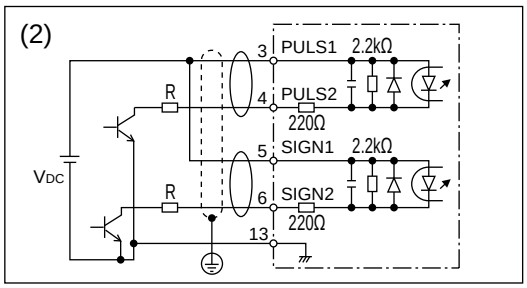
$$\frac{V_{DC} - 1.5}{R + 220} \fallingdotseq 10mA$$

(3) Open collector I/F (Input pulse frequency : max. 200kpps)

- Connecting diagram when a current regulating resistor is not used with 24V power supply.



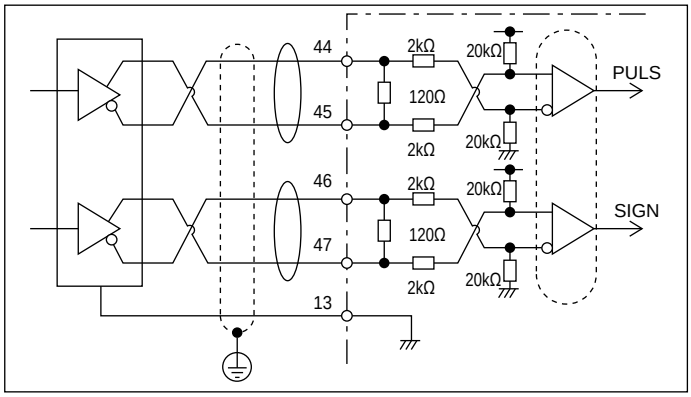

Max.input voltage :
DC24V, Rated current : 10mA

represents twisted pair.

| PI2 | Connection to sequence input signals (Pulse train interface exclusive to line driver) | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|

Line driver I/F (Input pulse frequency : max. 4Mpps)

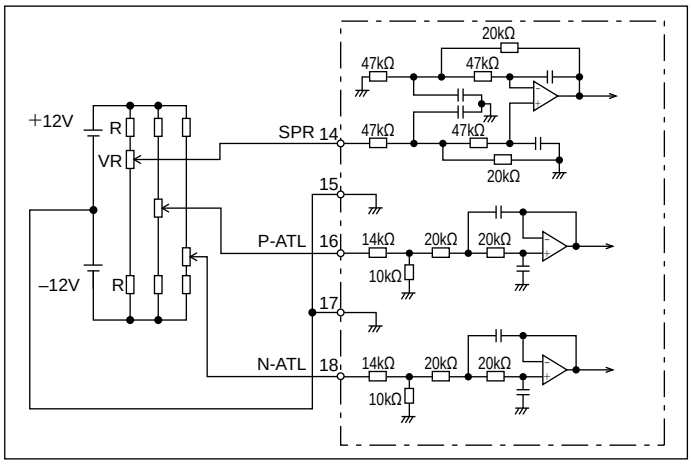
- This signal transmission method has better noise immunity.
  We recommend this to secure the signal transmission when line driver I/F is used.




represents twisted pair.

| AI | Analog command input | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|

- The analog command input goes through 3 routes, SPR (Pin-14), P-ATL (Pin-16) and N-ATL (Pin-18).
- Max. permissible input voltage to each input is ±10V.
  For input impedance of each input, refer to the right Fig.
- When you compose a simple command circuit using variable resistor(VR) and register R, connect as the right Fig. shows. When the variable range of each input is made as –10V to +10V, use VR with 2kW, B-characteristics, 1/2W or larger, R with 200W, 1/2W or larger.
- A/D converter resolution of each command input is as follows.
  (1)ADC1 : 16 bit (SPR/TRQR)
  (2)ADC2 : 12 bit (P-ATL and N-ATL)




represents twisted pair.

# 4. Inputs and outputs on connector X4

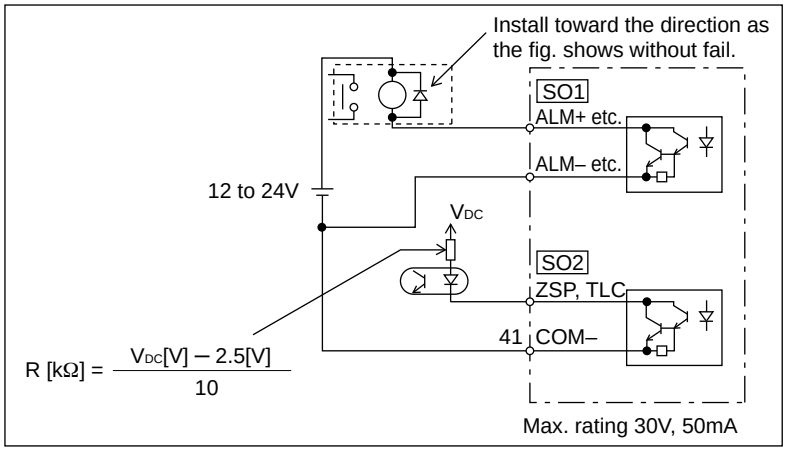
## Interface Circuit (Output)

## Output Circuit

### SO1/SO2 Sequence output circuit

Related control mode: P S T F

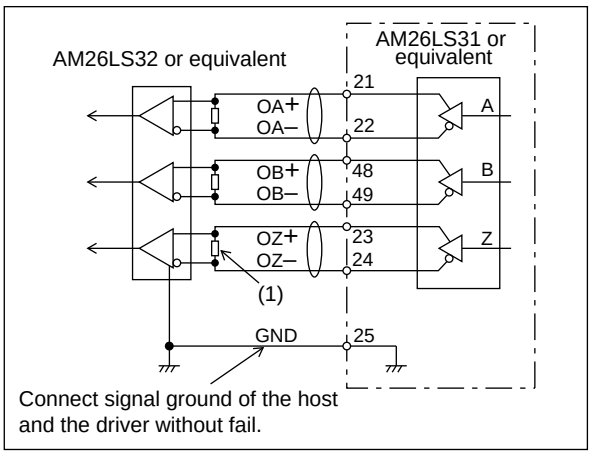
- The output circuit is composed of open collector transistor outputs in the Darlington connection, and connect to relays or photo-couplers.
- There exists collector to emitter voltage, $V_{CE}$ (SAT) of approx. 1V at transistor-ON, due to the Darlington connection of the output or. Note that normal TTL IC cannot be directly connected since it does not meet VIL.
- There are two types of output, one which emitter side of the output transistor is independent and is connectable individually, and the one which is common to – side of the control power supply (COM–).
- If a recommended primary current value of the photo-coupler is 10mA, decide the resistor value using the formula of the right Fig.




### PO1 Line driver (Differential output) output

Related control mode: P S T F

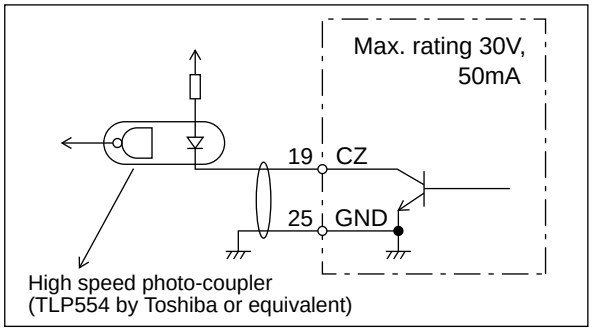
- Feeds out the divided encoder outputs (A, B and Z-phase) in differential through each line driver.
- At the host side, receive these in line receiver. Install a terminal resistor (approx. 330Ω) (figure below (1))between line receiver inputs without fail.
- These outputs are not insulated.




represents twisted pair.

| PO2 | Open collector output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|

- Feeds out the Z-phase signal among the encoder signals in open collector. This output is not insulated.
- Receive this output with high-speed photo couplers at the host side, since the pulse width of the Z-phase signal is narrow.




represents twisted pair.

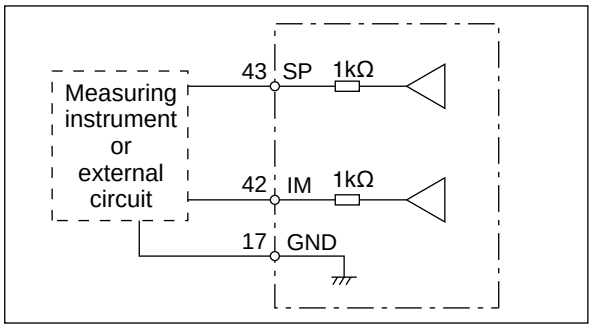
| AO | Analog monitor output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|

- There are two outputs, the speed monitor signal output (SP) and the torque monitor signal output (IM)
- Output signal width is ±10V.
- The output impedance is 1kΩ. Pay an attention to the input impedance of the measuring instrument or the external circuit to be connected.

**<Resolution>**

(1) Speed monitor output (SP)
With a setup of 6V/3000r/min, the resolution converted to speed is 8r/min/16mV.

(2) Torque monitor output (IM)
With a relation of 3V/rated torque (100%), the resolution converted to torque is 0.4%/12mV.



# 4. Inputs and outputs on connector X4

## Input Signal and Pin No.

### Input Signals (common) and Their Functions

| Pin No. | 7 | Title of signal | Power supply for control signal (+) | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | COM+ | I/F circuit | — | | | |

- Connect + of the external DC power supply (12 to 24V).
- Use the power supply voltage of 12V ± 5% – 24V ± 5%

| Pin No. | 41 | Title of signal | Power supply for control signal (-) | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | COM– | I/F circuit | — | | | |

- Connect – of the external DC power supply (12 to 24V).
- The power capacity varies depending on a composition of I/O circuit. 0.5A or more is recommended.

## Input Signals (Pulse Train) and Their Functions

You can select appropriate interface out of two kinds, depending on the command pulse specifications.

**• Pulse train interface exclusive for line driver**

| Pin No. | | Title of signal | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Pin No. | 44<br>45 | Title of signal | **Command pulse input 1** | Related control mode | P | S | T | F |
| | | Symbol | Pin No.44: **PULSH1**<br>Pin No.45: **PULSH2** | I/F circuit | PI2 3-31 page | | | |
| Pin No. | 46<br>47 | Title of signal | **Command pulse sign input 1** | Related control mode | P | S | T | F |
| | | Symbol | Pin No.46: **SIGNH2**<br>Pin No.47: **SIGNH2** | I/F circuit | PI2 3-31 page | | | |

- Input terminal for position command pulse. You can select by setting up Pr0.05 (Selection of command pulse input) to 1.
- This input becomes invalid at such control mode as velocity control or torque control, where no position command is required.
- Permissible max. input frequency is 4Mpps.
- You can select up to 6 command pulse input formats with Pr0.06 (Setup of command pulse rotational direction) and Pr0.07 (Setup of command pulse input mode).
  For details, refer to the table next page, "Command pulse input format".

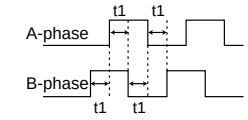
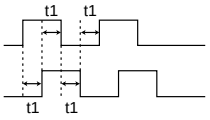
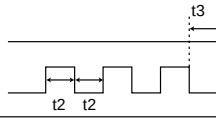
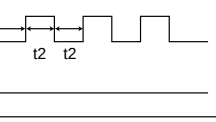
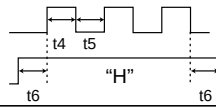
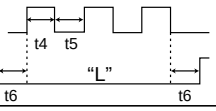
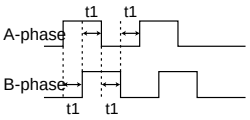
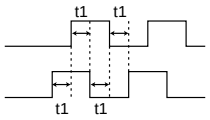
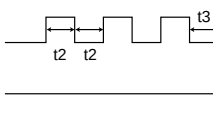
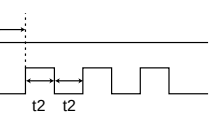
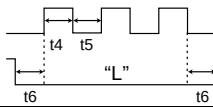
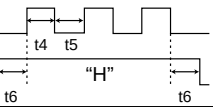
**• Pulse train interface (supports both line driver and open collector)**

| Pin No. | | Title of signal | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Pin No. | 1<br>3<br>4 | Title of signal | **Command pulse input 2** | Related control mode | P | S | T | F |
| | | Symbol | Pin No.1: **OPC1**<br>Pin No.3: **PULS1**<br>Pin No.4: **PULS2** | I/F circuit | PI1 3-30 page | | | |
| Pin No. | 2<br>5<br>6 | Title of signal | **Command pulse sign input 2** | Related control mode | P | S | T | F |
| | | Symbol | Pin No.2: **OPC1**<br>Pin No.5: **SIGN1**<br>Pin No.6: **SIGN2** | I/F circuit | PI1 3-30 page | | | |

- Input terminal for the position command. You can select by setting up Pr0.05 (Selection of command pulse input) to 0.
- This input becomes invalid at such control mode as the velocity control or torque control, where no position command is required.
- Permissible max. input frequency is 500kpps at line driver input and 200kpps at open collector input.
- You can select up to 6 command pulse input formats with Pr0.06 (Setup of command pulse rotational direction) and Pr0.07 (Setup of command pulse input mode).
  For details, refer to the table next page, "Command pulse input format".

Related page
- P.3-30 “Inputs and outputs on connector X4”
- P.4-4 “Details of parameter”

**• Input format command pulse**

| Pr0.06 setup value (Command pulse rotational direction setup) | Pr0.07 setup value (Command pulse input mode setup) | Command pulse format | Signal title | Positive direction command | Negative direction command |
|---|---|---|---|---|---|
| **0** | 0 or 2 | 90˚ phase difference 2-phase pulse (A + B-phase) | PULS SIGN |   B-phase advances to A by 90˚. |   B-phase delays from A by 90˚. |
| **0** | **1** | Positive direction pulse train + Negative direction pulse train | PULS SIGN |   |   |
| **0** | 3 | pulse train + Signal | PULS SIGN |   |   |
| 1 | 0 or 2 | 90˚ phase difference 2-phase pulse (A + B-phase) | PULS SIGN |   B-phase delays from A by 90˚. |   B-phase advances to A by 90˚. |
| 1 | 1 | Positive direction pulse train + Negative direction pulse train | PULS SIGN |   |   |
| 1 | 3 | pulse train + Signal | PULS SIGN |   |   |

- PULS and SIGN represents the outputs of pulse train in put circuit. Refer to the fig. of P.3-30, "Input Circuit".
- In case of negative direction pulse train + positive direction pulse train and pulse train + sign, pulse train will be cap tured at the rising edge.
- In case of 2-phase pulse, pulse train will be captured at each edge.

**• Permissible max. input frequency, and min. necessary time width of command pulse input signal.**

| Input I/F of PULS/SIGN signal | | Permissible max. input frequency | Min. necessary time width (μs) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ |
| Pulse train interface exclusive to line driver | | 4Mpps | 0.25 | 0.125 | 0.125 | 0.125 | 0.125 | 0.125 |
| Pulse train interface | Line driver interface | 500kpps | 2 | 1 | 1 | 1 | 1 | 1 |
| | Open collector interface | 200kpps | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

Make the rising/falling time of the command pulse input signal to 0.1μs or smaller.

Related page • P.4-7 "Details of Parameter"

## Control Input

Control signal having the desired function can be applied to any input pin of I/F connector. The logic can be changed.

### • Default assignment

| | | | | Applicable parameter | Default parameter setting ( ): decimal notation | Default Setup | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Position/ Full-closed control | | Verocity control | | Torque control | |
| | | | | | | Signal | Logic *1 | Signal | Logic *1 | Signal | Logic *1 |
| Pin No. | 8 | Title of signal | SI1 input | Pr4.00 | 00828282h (8553090) | NOT | b-contact | NOT | b-contact | NOT | b-contact |
| | | Symbol | SI1 | | | | | | | | |
| Pin No. | 9 | Title of signal | SI2 input | Pr4.01 | 00818181h (8487297) | POT | b-contact | POT | b-contact | POT | b-contact |
| | | Symbol | SI2 | | | | | | | | |
| Pin No. | 26 | Title of signal | SI3 input | Pr4.02 | 0091918Ah (9539850) | VS-SEL1 | b-contact | ZEROSPD | b-contact | ZEROSPD | b-contact |
| | | Symbol | SI3 | | | | | | | | |
| Pin No. | 27 | Title of signal | SI4 input | Pr4.03 | 00060606h (394758) | GAIN | a-contact | GAIN | a-contact | GAIN | a-contact |
| | | Symbol | SI4 | | | | | | | | |
| Pin No. | 28 | Title of signal | SI5 input | Pr4.04 | 0000100Ch (4108) | DIV1 | b-contact | INTSPD3 | b-contact | — | — |
| | | Symbol | SI5 | | | | | | | | |
| Pin No. | 29 | Title of signal | SI6 input | Pr4.05 | 00030303h (197379) | SRV-ON | a-contact | SRV-ON | a-contact | SRV-ON | a-contact |
| | | Symbol | SI6 | | | | | | | | |
| Pin No. | 30 | Title of signal | SI7 input | Pr4.06 | 00000f07h (3847) | CL | a-contact | INTSPD2 | a-contact | — | — |
| | | Symbol | SI7 | | | | | | | | |
| Pin No. | 31 | Title of signal | SI8 input | Pr4.07 | 00040404h (263172) | A-CLR | a-contact | A-CLR | a-contact | A-CLR | a-contact |
| | | Symbol | SI8 | | | | | | | | |
| Pin No. | 32 | Title of signal | SI9 input | Pr4.08 | 00050505h (328965) | C-MODE | a-contact | C-MODE | a-contact | C-MODE | a-contact |
| | | Symbol | SI9 | | | | | | | | |
| Pin No. | 33 | Title of signal | SI10 input | Pr4.09 | 00000E88h (3720) | INH | b-contact | INTSPD1 | b-contact | — | — |
| | | Symbol | SI10 | | | | | | | | |

• The function depends on parameter setup. Refer to P.4-32, 4-33.
Refer to the next section “Function assignable to general purpose input”.

**Note** *1 Operation of a-contact and b-contact:

a-contact: Input signal disconnected from COM– function disabled (OFF state)
Input signal connected to COM– function enabled (ON state)

b-contact: Input signal disconnected from COM– function enabled (ON state)
Input signal connected to COM function disabled (OFF state)

[—]: No function assigned

## Function allocatable to control input

| Title of signal | Servo-ON input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | SRV-ON | Default assignment | SI6 | I/F circuit | SI | 3-30 page | | |

- This signal turns on/off the servo (motor).

| Title of signal | Positive direction over-travel inhibition input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | POT | Default assignment | SI2 | I/F circuit | SI | 3-30 page | | |

- Positive direction over-travel inhibit input.
- The operation with this input turned ON is set up in Pr5.04 “Setup of over-travel inhibit input”.
- When using this input, set Pr5.04 “Setup of over-travel inhibit input” to a value other than 1 so that the input is ON when the moving portion of the machine exceeds this signal range toward positive direction.

| Title of signal | Negative direction over-travel inhibition input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | NOT | Default assignment | SI1 | I/F circuit | SI | 3-30 page | | |

- Negative direction over-travel inhibit input.
- The operation with this input turned ON is set up in Pr5.04 “Setup of over-travel inhibit input”.
- When using this function, set Pr5.04 “Setup of over-travel inhibit input” to a value other than 1 so that the input is ON when the moving portion of the machine exceeds this signal range toward negative direction.

| Title of signal | Deviation counter clear input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | CL | Default assignment | SI7 | I/F circuit | SI | 3-30 page | | |

- Clears the positional deviation counter.
- Default setup clears the counter at the rising edge of the clear input, To change the setup, modify it in the Pr5.17 “Counter clear input mode”.

**<Signal width and clear timing>**

| Pr5.17 | CL signal width | Deviation clear timing |
|---|---|---|
| 1 | 500 µs or more | Continually clear the counter while the deviation counter clear input is ON. *1 |
| 2 | 1 ms or more | |
| 3 | 100 µs or more | Only once clear the counter at OFF to ON edge of the deviation counter clear input signal. *1 |
| 4 | 1 ms or more | |

*1 Deviation counter clear input ON/OFF = input photocoupler ON/OFF

**Caution** This function can be assigned to only SI7. Allocation of this function to any other pin will cause an error.

Related page • P.4-42 “Details of Parameter”

| Title of signal | Alarm clear input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | A-CLR | Default assignment | SI8 | I/F circuit | SI | 3-30 page | | |

- Clears the alarm condition.
- This input cannot clear some alarms.
- For details, refer to P.6-3 When in Trouble “Protective function”, P.2-63 “(8) Alarm Display” and P.7-25 “Display of Battery Alarm”.

| Title of signal | Command pulse inhibition input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | INH | Default assignment | SI10 | I/F circuit | SI | 3-30 page | | |

- Ignores the positional command pulse.
- When using this feature, set Pr5.18 “Invalidation of command pulse inhibition input” to 0.

Caution This function can be assigned to only SI10. Allocation of this function to any other pin will cause an error.

| Title of signal | Control mode switching input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | C-MODE | Default assignment | SI9 | I/F circuit | SI | 3-30 page | | |

- Selects a control mode.

Caution This signal is required in all control modes. No setting will cause an error.

| Title of signal | Electronic gear (division/multiplication) switching input 1 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | DIV1 | Default assignment | SI5 | I/F circuit | SI | 3-30 page | | |

| Title of signal | Electronic gear (division/multiplication) switching input 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | DIV2 | Default assignment | — | I/F circuit | SI | 3-30 page | | |

- Up to 4 numerators can be used for command dividing/multiplying by using DIV1 and DIV2.

**<DIV1 and DIV2 vs numerator/denominator of selected command dividing/multiplying process>**

| DIV1 | DIV2 | Selected command dividing/multiplying process | |
|---|---|---|---|
| | | Numerator | Denominator |
| OFF | OFF | Pr0.09 | Pr0.10 |
| ON | OFF | Pr5.00 | Pr0.10 |
| OFF | ON | Pr5.01 | Pr0.10 |
| ON | ON | Pr5.02 | Pr0.10 |

| Title of signal | Damping control switching input 1 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | VS-SEL1 | Default assignment | SI3 | I/F circuit | SI | 3-30 page | | |

| Title of signal | Damping control switching input 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | VS-SEL2 | Default assignment | — | I/F circuit | SI | 3-30 page | | |

- Selects applicable frequency for damping control.
  Combination of damping control input changeover 1 and 2 (VS-SEL1, VS-SEL2) enables select of max. 4 options.

Note Also refer to P.4-21 “Pr2.13 [Damping filter switching selection]”.

| Title of signal | Gain switching input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | GAIN | Default assignment | SI4 | I/F circuit | SI | 3-30 page | | |

• Select 1st or 2nd gain.

| Title of signal | Torque limit switching input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | TL-SEL | Default assignment | — | I/F circuit | SI | 3-30 page | | |

• Select 1st or 2nd torque limit.

| Pr5.21 | Torque limit switching input (TL-SEL) | Torque limit switching setup (Pr5.23, Pr5.24) | Positive direction Torque limit | Negative direction Torque limit |
|---|---|---|---|---|
| 0 | | | Analog input *1 | |
| 1 | — | — | Pr0.13 | |
| 2 | — | — | Pr0.13 | Pr5.22 |
| 3 | OFF | Valid | Pr0.13 | |
| | ON | | Pr5.22 | |
| 4 | | | Analog input *1 | |
| 5 | | | | |
| 6 | OFF | — | Pr0.13 | Pr5.22 |
| | ON | | Pr5.25 | Pr5.26 |

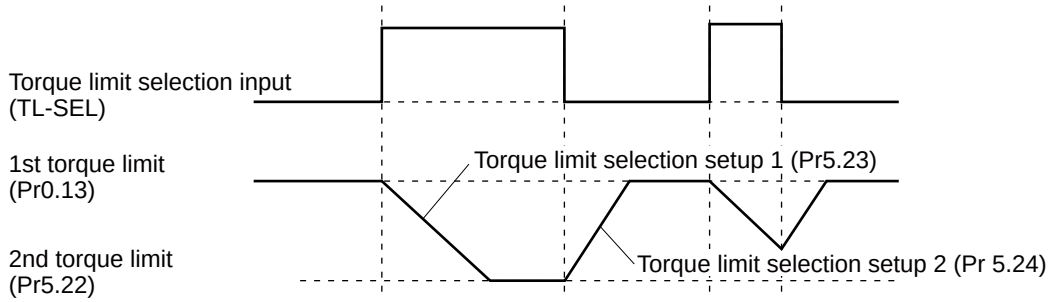
*1 To specify the torque limit value by an analog input, refer to Pr5.21 “Analog torque limit function”.

**• Setup of rate of change after torque limit switchover**

When applying Pr5.21 “Torque limit selection” = 3, changing rate of torque (slope) after selecting new torque limit can be changed.

When changing from the 1st torque limit to 2nd torque limit, the changing rate (slope) set at Pr5.23 “Torque limit selection setup 1” is applied; after changing from the 2nd torque limit to 1st torque limit, the changing rate (slope) set at Pr5.24 “Torque limit selection setup 2” is applied. The sign of the changing rate is automatically selected by the driver according to the difference in value between the 1st and 2nd torque limit.

If Pr5.23 “Torque limit selection setup 1” and Pr5.24 “Torque limit selection setup 2” are set to 0, switchover is instantaneous.




**Caution** When the 1st torque limit (Pr0.13) and 2nd torque limit (Pr5.22) are changed from the front panel or through communication, the changing rate setup is ignored and the new torque limit value is immediately and directly applied. That is, changing rate setting is effective only when the selection is made by using the torque limit select input (TL-SEL).

| Title of signal | Selection 1 input of internal command speed | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | INTSPD1 | Default assignment | SI10 | I/F circuit | SI 3-30 page |

| Title of signal | Selection 2 input of internal command speed | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | INTSPD2 | Default assignment | SI7 | I/F circuit | SI 3-30 page |

| Title of signal | Selection 3 input of internal command speed | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | INTSPD3 | Default assignment | SI5 | I/F circuit | SI 3-30 page |

- Select one of 8 internal command speeds.

**<Relationship between Pr3.00 "Switching between internal and external speed setup" and internal command speed selection 1-3 and the speed command selected>.**

| Pr3.00 | Selection 1 of internal command speed (INTSPD1) | Selection 2 of internal command speed (INTSPD2) | Selection 3 of internal command speed (INTSPD3) | Selection of speed command |
|---|---|---|---|---|
| 1 | OFF | OFF | No effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | 4th speed |
| 2 | OFF | OFF | No effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | Analog speed command |
| 3 | The same as Pr3.00=1 | | OFF | 1st to 4th speed |
| | OFF | OFF | ON | 5th speed |
| | ON | OFF | ON | 6th speed |
| | OFF | ON | ON | 7th speed |
| | ON | ON | ON | 8th speed |

| Title of signal | Speed zero clamp input | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | ZEROSPD | Default assignment | SI3 | I/F circuit | SI 3-30 page |

- Set the speed command to 0.
- When using, set Pr3.15 "Speed zero clamp function selection" to a value other than 0.

| Title of signal | Speed command sign input | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | VC-SIGN | Default assignment | — | I/F circuit | SI 3-30 page |

- Specify the sign of speed command input at velocity control.
  Refer to P.4-24 "Pr3.01 Speed command rotational direction selection"

| Title of signal | Torque command sign input | | | Related control mode | P S T F |
|---|---|---|---|---|---|
| Symbol | TC-SIGN | Default assignment | — | I/F circuit | SI 3-30 page |

- Specify the sign of torque command input at torque control.

| | |
|---|---|
| ON | Negative direction |
| OFF | Positive direction |

Refer to P.4-28 "Pr3.18 Torque command direction selection"

| Title of signal | **Forced alarm input** | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | **E-STOP** | Default assignment | — | I/F circuit | SI | 3-30 page | | |

- Generates Err87.0 “Forced alarm input error”.

| Title of signal | **Inertia ratio switching input** | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | **J-SEL** | Default assignment | — | I/F circuit | SI | 3-30 page | | |

- Selects 1st inertia ratio or 2nd inertia ratio according to the inertia ratio select input (J-SEL).

| Inertia ratio switching input (J-SEL) | Applicable inertia ratio |
|---|---|
| OFF | 1st Inertia ratio (Pr0.04) |
| ON | 2nd Inertia ratio (Pr6.12) |

Refer to P.4-52 “Pr6.10 Function expansion setup”

## Input Signals (Analog Command) and Their Functions

| Pin No. | 16 | Title of signal | **Positive direction Torque limit input** | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | **P-ATL** | I/F circuit | AI | 3-31 page | | |

| Pin No. | 18 | Title of signal | **Negative direction Torque limit input** | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | **N-ATL** | I/F circuit | AI | 3-31 page | | |

- Specify the torque limit for each direction value by the analog voltage.

| Pr5.21 | Positive direction Torque limit input (P-ATL) | Negative direction Torque limit input (N-ATL) | Positive direction Torque limit | Negative direction Torque limit |
|---|---|---|---|---|
| 0 | 0 to 10V | –10 to 0V | P-ATL | N-ATL |
| 1 | — | | Set up through parameter. *1 | |
| 2 | | | | |
| 3 | | | | |
| 4 | 0 to 10V | 0 to 10V | P-ATL | N-ATL |
| 5 | 0 to 10V | No effect | P-ATL | |
| 6 | — | | Setup by parameter *1 | |

*1 When specifying the torque limit value through the parameter, refer to P.4-47 “Torque limit select function”

| Pin No. | 14 | Title of signal | Speed command input | Related control mode | P **S** T F |
|---|---|---|---|---|---|
| | | Symbol | SPR | I/F circuit | AI 3-31 page |

- Input the speed command in the form of analog voltage.
- The table below shows relationship between the combination of Pr3.00 “Switching between internal and external speed setup”, Pr3.01 “Speed command direction selection”, Pr3.03 “Speed command input inversion”, analog speed command (SPR) of I/F connector and speed command sign selection (VC-SIGN) and the motor rotational direction; and the conversion graph of analog speed command input voltage to the speed command.

| Pr3.00 | Pr3.01 | Pr3.03 | Speed command input (SPR) | Speed command sign selection (VC-SIGN) | Motor rotational direction |
|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10V) | No effect | Positive direction |
| | | | –Voltage (–10 to 0V) | No effect | Negative direction |
| | | 1 | +Voltage (0 to 10V) | No effect | Negative direction |
| | | | –Voltage (–10 to 0V) | No effect | Positive direction |
| | 1 | No effect | +Voltage (0 to 10V) | OFF | Positive direction |
| | | | –Voltage (–10 to 0V) | | |
| | | | +Voltage (0 to 10V) | ON | Negative direction |
| | | | –Voltage (–10 to 0V) | | |

| Pin No. | 14<br>16 | Title of signal | Torque command input | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| | | Symbol | TRQR | I/F circuit | AI 3-31 page |

- Input the torque command in the form of analog voltage.
  When Pr3.19 “Torque command selection” = 0, pin No.14
  When Pr3.19 “Torque command selection” = 1, pin No.16

| Pr3.17 | Pr3.18 | Pr3.20 | Torque command input (TRQR) | Torque command sign selection (TC-SIGN) | Motor rotational direction |
|---|---|---|---|---|---|
| 0 | 0 | 0 | +Voltage (0 to 10V) | No effect | Positive direction |
| | | | –Voltage (–10 to 0V) | No effect | Negative direction |
| | | 1 | +Voltage (0 to 10V) | No effect | Negative direction |
| | | | –Voltage (–10 to 0V) | No effect | Positive direction |
| | 1 | No effect | +Voltage (0 to 10V) | OFF | Positive direction |
| | | | –Voltage (–10 to 0V) | | |
| | | | +Voltage (0 to 10V) | ON | Negative direction |
| | | | –Voltage (–10 to 0V) | | |

| Pin No. | 14 | Title of signal | Speed limit input | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| | | Symbol | SPL | I/F circuit | AI 3-31 page |

- When setting Pr3.17 “Torque command selection” to 1, input the speed limit value in the form of analog voltage.

# 4. Inputs and outputs on connector X4

## Output Signal and Pin No.

### Output Signals (Common) and Their Functions

Control output signal of desired function can be assigned to I/F connector. Logic of the output pin cannot be changed.

| | | | | Applicable parameter | Default parameter setting ( ): decimal notation | Default Setup | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Position/ Full-closed control | Verocity control | Torque control |
| | | | | | | Signal | Signal | Signal |
| Pin No. | 10<br>11 | Title of signal | **SO1 output** | Pr4.10 | 00030303h (197379) | BRK-OFF | BRK-OFF | BRK-OFF |
| | | Symbol | Pin No.10: **SO1–**<br>Pin No.11: **SO1+** | | | | | |
| Pin No. | 34<br>35 | Title of signal | **SO2 output** | Pr4.11 | 00020202h (131586) | S-RDY | S-RDY | S-RDY |
| | | Symbol | Pin No.34: **SO2–**<br>Pin No.35: **SO2+** | | | | | |
| Pin No. | 36<br>37 | Title of signal | **SO3 output** *1 | Pr4.12 | 00010101h (65793) | ALM | ALM | ALM |
| | | Symbol | Pin No.36: **SO3–**<br>Pin No.37: **SO3+** | | | | | |
| Pin No. | 38<br>39 | Title of signal | **SO4 output** | Pr4.13 | 00050504h (328964) | INP | AT-SPEED | AT-SPEED |
| | | Symbol | Pin No.38: **SO4–**<br>Pin No.39: **SO4+** | | | | | |
| Pin No. | 12 | Title of signal | **SO5 output** | Pr4.14 | 00070707h (460551) | ZSP | ZSP | ZSP |
| | | Symbol | **SO5** | | | | | |
| Pin No. | 40 | Title of signal | **SO6 output** | Pr4.15 | 00060606h (394758) | TLC | TLC | TLC |
| | | Symbol | **SO6** | | | | | |

- The function is changed by the setting of parameter.
  See “Functions assignable to control output” as shown below.

**Note** *1 Fixed ALM output.
[—]: No function assigned

### Function allocatable to control input

| Title of signal | **Servo-Alarm output** | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | **ALM** | Default assignment | **SO3** | I/F circuit | SO1 | 3-32 page | | |

- This signal shows that the driver is in alarm status..
- Output transistor turns ON when the driver is at normal status, and turns OFF at alarm status.

| Title of signal | **Servo-Ready output** | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | **S-RDY** | Default assignment | **SO2** | I/F circuit | SO1 | 3-32 page | | |

- This signal shows that the driver is ready to be activated.
- Output transistor turns ON when both control and main power are ON but not at alarm status. When in the absolute mode and absolute I/F function is enabled, turns on the output transistor upon completion of the absolute data transfer provided that the conditions shown above are met.

| Title of signal | External brake release signal | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | BRK-OFF | Default assignment | SO1 | I/F circuit | SO1 | 3-32 page | | |

- Feeds out the timing signal which activates the electromagnetic brake of the motor.
- Turns the output transistor ON at the release timing of the electro-magnetic brake.

| Title of signal | Positioning complete | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | INP | Default assignment | SO4 | I/F circuit | SO1 | 3-32 page | | |

| Title of signal | Positioning complete 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | INP2 | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Outputs the positioning complete signal/positioning complete signal 2.
- Turns ON the output transistor upon completion of positioning.

| Title of signal | Speed arrival output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | AT-SPPED | Default assignment | SO4 | I/F circuit | SO1 | 3-32 page | | |

- Outputs thespeed arrival signal.
- Turns ON the output transistor upon arrive of speed.

| Title of signal | Torque in-limit signal output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | TLC | Default assignment | SO6 | I/F circuit | SO2 | 3-32 page | | |

- Outputs thetorque in-limit signal.
- Turns ON the output transistor upon limit of torque.

| Title of signal | Zero-speed detection output signal | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | ZSP | Default assignment | SO5 | I/F circuit | SO2 | 3-32 page | | |

- Outputs the zero-speed detection signal.
- Turns ON the output transistor upon detection of Zero-speed.

| Title of signal | Speed coincidence output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | V-COIN | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Outputs the speed coincidence signal.
- Turns ON the output transistor upon coincidence of speed.

| Title of signal | Alarm output 1 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | WARN1 | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Outputs the warning output signal set to Pr4.40 “Warning output select 1”.
- Turns ON the output transistor upon occurrence of warning condition.

| Title of signal | Alarm output 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | WARN2 | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Outputs the warning output signal set to Pr4.41 “Warning output select 2”.
- Turns ON the output transistor upon occurrence of warning condition.

**• Selection of alarm 1 output and 2 output**

| Alarm No. | Alarm | Content | Pr6.27 *1 | Pr4.40/ Pr4.41 *2 | Pr6.38 Corresponding bit *3 |
|---|---|---|---|---|---|
| A0 | Overload protection | Load factor is 85% or more the protection level. | ○ | 1 | bit7 |
| A1 | Over-regeneration alarm | Regenerative load factor is 85% or more the protection level. | ○ | 2 | bit5 |
| A2 | Battery alarm | Battery voltage is 3.2 V or lower. | Fixed at no time limit. | 3 | bit0 |
| A3 | Fan alarm | Fan has stopped for 1 sec. | ○ | 4 | bit6 |
| A4 | Encoder communication alarm | The number of successive encoder communication errors exceeds the specified value. | ○ | 5 | bit4 |
| A5 | Encoder overheat alarm | The encoder detects overheat alarm. | ○ | 6 | bit3 |
| A6 | Oscillation detection alarm | Oscillation or vibration is detected. | ○ | 7 | bit9 |
| A7 | Lifetime detection alarm | The life expectancy of capacity or fan becomes shorter than the specified time. | Fixed at no time limit. | 8 | bit2 |
| A8 | External scale error alarm | The feedback scale detects the alarm. | ○ | 9 | bit8 |
| A9 | External scale communication alarm | The number of successive feedback scale communication errors exceeds the specified value. | ○ | 10 | bit10 |

*1 The “circle” means that a time in the range 1 to 10s or no time limit can be selected through Pr6.27 “Warning latching time”. Note that the battery warning and the end of life warning have no time limit.

*2 Select the warning output signal 1 (WARN1) or warning output signal 2 (WARN2) through Pr4.40 “Warning output select 1” or Pr4.41 “Warning output select 2”. When the set value is 0, all warnings are ORed before being output. Do not set to any value other than those specified in the table above.

*3 A warning detection can be masked by Pr6.38 “Warning mask setup” Corresponding bits are shown in the table. Warning is masked with bit = 1.

| Title of signal | Positional command ON/OFF output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | P-CMD | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Turns on output transistor with positional command applied.

| Title of signal | Speed in-limit output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | V-LIMIT | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Turns on output transistor when the speed is limited by torque controlling function.

| Title of signal | Alarm attribute output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | ALM-ATB | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

- Turns on output transistor when an alarm that can be cleared generates.

| Title of signal | Speed command ON/OFF output | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| Symbol | V-CMD | Default assignment | — | I/F circuit | SO1 | 3-32 page | | |

• Turns on output transistor when the speed command is applied while the speed is controlled.

## Output Signals (Pulse Train) and Their Functions

| Pin No. | 21<br>22 | Title of signal | A-phase output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | Pin No.21: **OA+**<br>Pin No.22: **OA–** | I/F circuit | PO1 | 3-32 page | | |

| Pin No. | 48<br>49 | Title of signal | B-phase output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | Pin No.48: **OB+**<br>Pin No.49: **OB–** | I/F circuit | PO1 | 3-32 page | | |

| Pin No. | 23<br>24 | Title of signal | Z-phase output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | Pin No.23: **OZ+**<br>Pin No.24: **OZ–** | I/F circuit | PO1 | 3-32 page | | |

• Feeds out the divided encoder signal or feedback scale signal (A, B, Z-phase) in differential. (equivalent to RS422)
• Ground for line driver of output circuit is connected to signal ground (GND) and is not insulated.
• Max. output frequency is 4Mpps (after quadrupled)

| Pin No. | 19 | Title of signal | Z-phase output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | **CZ** | I/F circuit | PO1 | 3-32 page | | |

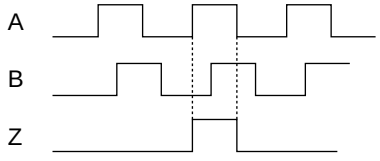
• Open collector output of Z-phase signal
• The emitter side of the transistor of the output circuit is connected to the signal ground (GND) and is not insulated.

**Note**

**• When the output source is the encoder**

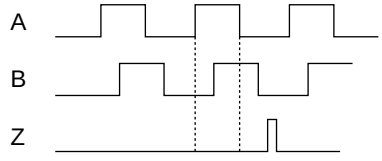
• If the encoder resolution × $\frac{\text{Pr0.11}}{\text{Pr5.03}}$ is multiple of 4, Z-phase will be fed out synchronizing with A-phase. In other case, the Z-phase width will be equal to the encoder resolution, and will not synchronize with A-phase because of narrower width than that of A-phase.

when the encoder resolution × $\frac{\text{Pr0.11}}{\text{Pr5.03}}$ is multiple of 4,




synchronized

when the encoder resolution × $\frac{\text{Pr0.11}}{\text{Pr5.03}}$ is not multiple of 4,




not-synchronized

• In case of the 5-wire, 20-bit incremental encoder, the signal sequence might not follow the above fig. until the first Z-phase is fed out. When you use the pulse output as the control signal, rotate the motor one revolution or more to make sure that the Z-phase is fed out at least once before using.

## Output Signals (Analog) and Their Functions

| Pin No. | 42 | Title of signal | Torque monitor output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | IM | I/F circuit | AO | 3-33 page | | |

- Definition of the output signal varies with the output of Pr4.18 (analog monitor 2 type).
- The output signal is identical to the analog monitor 2 on the front monitor.

| Pin No. | 43 | Title of signal | Speed monitor output | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | SP | I/F circuit | AO | 3-33 page | | |

- Definition of the output signal varies with the output of Pr4.16 (analog monitor 1 type).
- The output signal is identical to the analog monitor 1 on the front monitor.

## Output Signals (Others) and Their Functions

| Pin No. | 13, 15 17, 25 | Title of signal | Signal ground | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | GND | I/F circuit | — | | | |

- Signal ground
- This output is insulated from the control signal power (COM–) inside of the driver.

| Pin No. | 50 | Title of signal | Frame ground | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|
| | | Symbol | FG | I/F circuit | — | | | |

- This output is connected to the earth terminal inside of the driver.

MEMO

# 4. Setup

# 1. Details of parameter

## List of Parameters

| Related Control Mode | | | | Parametr No. | | Title | Detail page |
|---|---|---|---|---|---|---|---|
| P | S | T | F | Class | No. | | |
| P | S | T | F | [Class 0] Basic setting | 00 | Rotational direction setup | 4-4 |
| P | S | T | F | | 01 | Control mode setup | |
| P | S | T | F | | 02 | Real-time auto-gain tuning setup | 4-5 |
| P | S | T | F | | 03 | Selection of machine stiffness at real-time auto-gain tuning | |
| P | S | T | F | | 04 | Inertia ratio | 4-6 |
| P | S | T | F | | 05 | Selection of command pulse input | |
| P | S | T | F | | 06 | Command pulse rotational direction setup | 4-7 |
| P | S | T | F | | 07 | Command pulse input mode setup | |
| P | S | T | F | | 08 | Command pulse counts per one motor revolution | 4-8 |
| P | S | T | F | | 09 | 1st numerator of electronic gear | |
| P | S | T | F | | 10 | Denominator of electronic gear | |
| P | S | T | F | | 11 | Output pulse counts per one motor revolution | 4-9 |
| P | S | T | F | | 12 | Reversal of pulse output logic | 4-10 |
| P | S | T | F | | 13 | 1st torque limit | |
| P | S | T | F | | 14 | Position deviation excess setup | |
| P | S | T | F | | 15 | Absolute encoder setup | |
| P | S | T | F | | 16 | External regenerative resistor setup | 4-11 |
| P | S | T | F | | 17 | Load factor of external regenerative resistor selection | |
| P | S | T | F | [Class 1] Gain adjustment | 00 | 1st gain of position loop | 4-12 |
| P | S | T | F | | 01 | 1st gain of velocity loop | |
| P | S | T | F | | 02 | 1st time constant of velocity loop integration | |
| P | S | T | F | | 03 | 1st filter of speed detection | |
| P | S | T | F | | 04 | 1st time constant of torque filter | |
| P | S | T | F | | 05 | 2nd gain of position loop | 4-13 |
| P | S | T | F | | 06 | 2nd gain of velocity loop | |
| P | S | T | F | | 07 | 2nd time constant of velocity loop integration | |
| P | S | T | F | | 08 | 2nd filter of speed detection | |
| P | S | T | F | | 09 | 2nd time constant of torque filter | |
| P | S | T | F | | 10 | Velocity feed forward gain | |
| P | S | T | F | | 11 | Velocity feed forward filter | |
| P | S | T | F | | 12 | Torque feed forward gain | 4-14 |
| P | S | T | F | | 13 | Torque feed forward filter | |
| P | S | T | F | | 14 | 2nd gain setup | |
| P | S | T | F | | 15 | Mode of position control switching | 4-15 |
| P | S | T | F | | 16 | Delay time of position control switching | 4-16 |
| P | S | T | F | | 17 | Level of position control switching | |
| P | S | T | F | | 18 | Hysteresis at position control switching | |
| P | S | T | F | | 19 | Position gain switching time | |
| P | S | T | F | | 20 | Mode of velocity control switching | 4-17 |
| P | S | T | F | | 21 | Delay time of velocity control switching | |
| P | S | T | F | | 22 | Level of velocity control switching | |
| P | S | T | F | | 23 | Hysteresis at velocity control switching | |
| P | S | T | F | | 24 | Mode of torque control switching | 4-18 |
| P | S | T | F | | 25 | Delay time of torque control switching | |
| P | S | T | F | | 26 | Level of torque control switching | |
| P | S | T | F | | 27 | Hysteresis at torque control switching | |
| P | S | T | F | [Class 2] | 00 | Adaptive filter mode setup | 4-19 |
| P | S | T | F | | 01 | 1st notch frequency | |
| P | S | T | F | | 02 | 1st notch width selection | |
| P | S | T | F | | 03 | 1st notch depth selection | |
| P | S | T | F | | 04 | 2nd notch frequency | |

| Related Control Mode | | | | Parametr No. | | Title | Detail page |
|---|---|---|---|---|---|---|---|
| P | S | T | F | Class | No. | | |
| P | S | T | F | [Class 2] Damping control | 05 | 2nd notch width selection | 4-20 |
| P | S | T | F | | 06 | 2nd notch depth selection | |
| P | S | T | F | | 07 | 3rd notch frequency | |
| P | S | T | F | | 08 | 3rd notch width selection | |
| P | S | T | F | | 09 | 3rd notch depth selection | |
| P | S | T | F | | 10 | 4th notch frequency | |
| P | S | T | F | | 11 | 4th notch width selection | 4-21 |
| P | S | T | F | | 12 | 4th notch depth selection | |
| P | S | T | F | | 13 | Selection of damping filter switching | |
| P | S | T | F | | 14 | 1st damping frequency | 4-22 |
| P | S | T | F | | 15 | 1st damping filter setup | |
| P | S | T | F | | 16 | 2nd damping frequency | |
| P | S | T | F | | 17 | 2nd damping filter setup | |
| P | S | T | F | | 18 | 3rd damping frequency | |
| P | S | T | F | | 19 | 3rd damping filter setup | |
| P | S | T | F | | 20 | 4th damping frequency | |
| P | S | T | F | | 21 | 4th damping filter setup | |
| P | S | T | F | | 22 | Positional command smoothing filter | 4-23 |
| P | S | T | F | | 23 | Positional command FIR filter | |
| P | S | T | F | [Class 3] Verocity/ Torque/ Full-closed control | 00 | Speed setup, Internal/External switching | 4-24 |
| P | S | T | F | | 01 | Speed command rotational direction selection | |
| P | S | T | F | | 02 | Input gain of speed command | 4-25 |
| P | S | T | F | | 03 | Reversal of speed command input | |
| P | S | T | F | | 04 | 1st speed of speed setup | 4-26 |
| P | S | T | F | | 05 | 2nd speed of speed setup | |
| P | S | T | F | | 06 | 3rd speed of speed setup | |
| P | S | T | F | | 07 | 4th speed of speed setup | |
| P | S | T | F | | 08 | 5th speed of speed setup | |
| P | S | T | F | | 09 | 6th speed of speed setup | |
| P | S | T | F | | 10 | 7th speed of speed setup | |
| P | S | T | F | | 11 | 8th speed of speed setup | |
| P | S | T | F | | 12 | Acceleration time setup | |
| P | S | T | F | | 13 | Deceleration time setup | |
| P | S | T | F | | 14 | Sigmoid acceleration/ deceleration time setup | 4-27 |
| P | S | T | F | | 15 | Speed zero-clamp function selection | |
| P | S | T | F | | 16 | Speed zero clamp level | |
| P | S | T | F | | 17 | Selection of torque command | 4-28 |
| P | S | T | F | | 18 | Torque command direction selection | |
| P | S | T | F | | 19 | Input gain of torque command | |
| P | S | T | F | | 20 | Input reversal of torque command | |
| P | S | T | F | | 21 | Speed limit value 1 | 4-29 |
| P | S | T | F | | 22 | Speed limit value 2 | |
| P | S | T | F | | 23 | External scale selection | |
| P | S | T | F | | 24 | Numerator of external scale division | 4-30 |
| P | S | T | F | | 25 | Denominator of external scale division | |
| P | S | T | F | | 26 | Reversal of direction of external scale | |
| P | S | T | F | | 27 | External scale Z phase disconnection detection disable | |
| P | S | T | F | | 28 | Hybrid deviation excess setup | 4-31 |
| P | S | T | F | | 29 | Hybrid deviation clear setup | |

**Note** • Definition of symbols under “Related mode” - P: position control, S: velocity control, T: torque control, F: full closed control

| Related Control Mode | | | | Parametr No. | | Title | Detail page |
|---|---|---|---|---|---|---|---|
| P | S | T | F | Class | No. | | |
| P | S | T | F | [Class 4] I/F monitor setting | 00 | SI1 input selection | 4-32 |
| P | S | T | F | | 01 | SI2 input selection | 4-33 |
| P | S | T | F | | 02 | SI3 input selection | |
| P | S | T | F | | 03 | SI4 input selection | |
| P | S | T | F | | 04 | SI5 input selection | |
| P | S | T | F | | 05 | SI6 input selection | |
| P | S | T | F | | 06 | SI7 input selection | |
| P | S | T | F | | 07 | SI8 input selection | |
| P | S | T | F | | 08 | SI9 input selection | |
| P | S | T | F | | 09 | SI10 input selection | |
| P | S | T | F | | 10 | SO1 output selection | 4-34 |
| P | S | T | F | | 11 | SO2 output selection | |
| P | S | T | F | | 12 | SO3 output selection | |
| P | S | T | F | | 13 | SO4 output selection | |
| P | S | T | F | | 14 | SO5 output selection | |
| P | S | T | F | | 15 | SO6 output selection | |
| P | S | T | F | | 16 | Type of analog monitor 1 | 4-35 |
| P | S | T | F | | 17 | Analog monitor 1 output gain | |
| P | S | T | F | | 18 | Type of analog monitor 2 | |
| P | S | T | F | | 19 | Analog monitor 2 output gain | |
| P | S | T | F | | 20 | Type of digital monitor | |
| P | S | T | F | | 21 | Analog monitor output setup | 4-37 |
| P | S | T | F | | 22 | Analog input 1 (AI1) offset setup | |
| P | S | T | F | | 23 | Analog input 1 (AI1) filter | |
| P | S | T | F | | 24 | Analog input 1 (AI1) overvoltage setup | |
| P | S | T | F | | 25 | Analog input 2 (AI2) offset setup | |
| P | S | T | F | | 26 | Analog input 2 (AI2) filter | |
| P | S | T | F | | 27 | Analog input 2(AI2) overvoltage setup | |
| P | S | T | F | | 28 | Analog input 3 (AI3) offset setup | 4-38 |
| P | S | T | F | | 29 | Analog input 3 (AI3) filter | |
| P | S | T | F | | 30 | Analog input 3 (AI3) overvoltage setup | |
| P | S | T | F | | 31 | Positioning complete (In-position) range | |
| P | S | T | F | | 32 | Positioning complete (In-position) output setup | |
| P | S | T | F | | 33 | INP hold time | 4-39 |
| P | S | T | F | | 34 | Zero-speed | |
| P | S | T | F | | 35 | Speed coincidence range | 4-40 |
| P | S | T | F | | 36 | At-speed (Speed arrival) | |
| P | S | T | F | | 37 | Mechanical brake action at stalling setup | 4-41 |
| P | S | T | F | | 38 | Mechanical brake action at running setup | |
| P | S | T | F | | 39 | Brake release speed setup | |
| P | S | T | F | | 40 | Selection of alarm output 1 | 4-42 |
| P | S | T | F | | 41 | Selection of alarm output 2 | |
| P | S | T | F | | 42 | 2nd Positioning complete (In-position) range | |
| P | S | T | F | [Class 5] Enhancing setting | 00 | 2nd numerator of electronic gear | 4-43 |
| P | S | T | F | | 01 | 3rd numerator of electronic gear | |
| P | S | T | F | | 02 | 4th numerator of electronic gear | |
| P | S | T | F | | 03 | Denominator of pulse output division | |
| P | S | T | F | | 04 | Over-travel inhibit input setup | |
| P | S | T | F | | 05 | Sequence at over-travel inhibit | |
| P | S | T | F | | 06 | Sequence at Servo-Off | 4-44 |
| P | S | T | F | | 07 | Sequence at main power OFF | |
| P | S | T | F | | 08 | LV trip selection at main power OFF | 4-45 |
| P | S | T | F | | 09 | Detection time of main power off | |
| P | S | T | F | | 10 | Sequence at alarm | |
| P | S | T | F | | 11 | Torque setup for emergency stop | 4-46 |
| P | S | T | F | | 12 | Over-load level setup | |

| Related Control Mode | | | | Parametr No. | | Title | Detail page |
|---|---|---|---|---|---|---|---|
| P | S | T | F | Class | No. | | |
| P | S | T | F | [Class 5] Enhancing setting | 13 | Over-speed level setup | 4-46 |
| P | S | T | F | | 14 | Motor working range setup | |
| P | S | T | F | | 15 | I/F reading filter | |
| P | S | T | F | | 16 | Alarm clear input setup | |
| P | S | T | F | | 17 | Counter clear input mode | 4-47 |
| P | S | T | F | | 18 | Invalidation of command pulse inhibit input | |
| P | S | T | F | | 19 | Command pulse inhibit input reading setup | |
| P | S | T | F | | 20 | Position setup unit select | |
| P | S | T | F | | 21 | Selection of torque limit | 4-48 |
| P | S | T | F | | 22 | 2nd torque limit | |
| P | S | T | F | | 23 | Torque limit switching setup 1 | |
| P | S | T | F | | 24 | Torque limit switching setup 2 | |
| P | S | T | F | | 25 | External input positive direction torque limit | |
| P | S | T | F | | 26 | External input negative direction torque limit | 4-49 |
| P | S | T | F | | 27 | Input gain of analog torque limit | |
| P | S | T | F | | 28 | LED initial status | |
| P | S | T | F | | 29 | RS232 baud rate setup | |
| P | S | T | F | | 30 | RS485 baud rate setup | 4-50 |
| P | S | T | F | | 31 | Axis address | |
| P | S | T | F | | 32 | Command pulse input maximum setup | |
| P | S | T | F | | 33 | Pulse regenerative output limit setup | |
| P | S | T | F | | 34 | For manufacturer's use | |
| P | S | T | F | | 35 | Front panel lock setup | |
| P | S | T | F | [Class 6] Special setting | 00 | Analog torque feed forward conversion gain | 4-51 |
| P | S | T | F | | 02 | Velocity deviation excess setup | |
| P | S | T | F | | 04 | JOG trial run command speed | |
| P | S | T | F | | 05 | Position 3rd gain valid time | |
| P | S | T | F | | 06 | Position 3rd gain scale factor | |
| P | S | T | F | | 07 | Torque command additional value | |
| P | S | T | F | | 08 | Positive direction torque compensation value | 4-52 |
| P | S | T | F | | 09 | Negative direction torque compensation value | |
| P | S | T | F | | 10 | Function expansion setup | |
| P | S | T | F | | 11 | Current response setup | |
| P | S | T | F | | 13 | 2nd Inertia ratio | |
| P | S | T | F | | 14 | Emergency stop time at alarm | 4-53 |
| P | S | T | F | | 15 | 2nd over-speed level setup | |
| P | S | T | F | | 17 | Front panel parameter writing selection | |
| P | S | T | F | | 18 | Power-up wait time | |
| P | S | T | F | | 19 | Encoder Z phase setup | |
| P | S | T | F | | 20 | Z-phase setup of external scale | |
| P | S | T | F | | 21 | Serial absolute external scale Z phase setup | 4-54 |
| P | S | T | F | | 22 | A, B phase external scale pulse output method selection | |
| P | S | T | F | | 23 | Disturbance torque compensating gain | |
| P | S | T | F | | 24 | Disturbance observer filter | |
| P | S | T | F | | 27 | Alarm latch time selection | |
| P | S | T | F | | 31 | Real time auto tuning estimation speed | 4-55 |
| P | S | T | F | | 32 | Real time auto tuning custom setup | |
| P | S | T | F | | 34 | Hybrid vibration suppression gain | 4-57 |
| P | S | T | F | | 35 | Hybrid vibration suppression filter | |
| P | S | T | F | | 37 | Oscillation detection level | |
| P | S | T | F | | 38 | Alarm mask setup | |
| P | S | T | F | | 39 | For manufacturer's use | |

# 1. Details of parameter

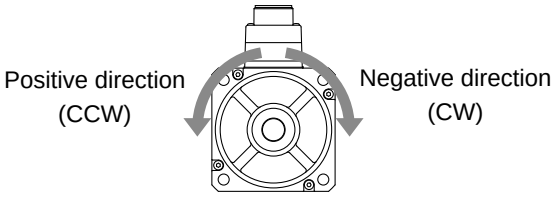
## [Class 0] Basic setting

| Pr0.00 * | Title | Rotational direction setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 1 | | | |

Setup the relationship between the direction of command and direction of motor rotation.

0: Motor turns CW in response to positive direction command (CW when viewed from load side shaft end)

1: Motor turns CCW in response to positive direction command (CCW when viewed from load side shaft end)




Default

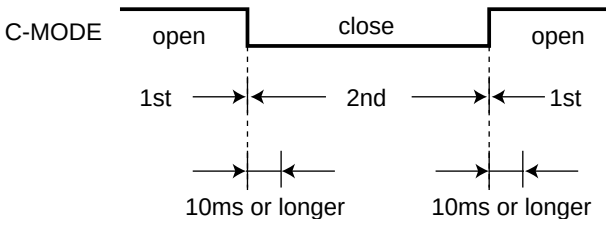
| Setup value | Command direction | Motor rotational direction | Positive direction drive inhibit input | Negative direction drive inhibit input |
|---|---|---|---|---|
| 0 | Positive direction | CW | Valid | — |
| | Negative direction | CCW | — | Valid |
| 1 | Positive direction | CCW | Valid | — |
| | Negative direction | CW | — | Valid |

| Pr0.01 * | Title | Control mode setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6 | Unit | — | Default | 0 | | | |

You can set up the control mode to be used.

| Setup value | Content | |
|---|---|---|
| | 1st mode | 2st mode |
| 0 | Position | — |
| 1 | Velocity | — |
| 2 | Torque | — |
| 3 *1 | Position | Velocity |
| 4 *1 | Position | Torque |
| 5 *1 | Velocity | Torque |
| 6 | Full-closed | — |

*1) When you set up the combination mode of 3, 4 or 5, you can select either the 1st or the 2nd with control mode switching input (C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.
Don't enter commands 10ms before/after switching.




The waveform above shows when logical setting of C-MODE input is a-contact. When b-contact is used, open and short is reversed.

**Note** • **For parameters which No. have a suffix of " * ",** changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr0.02 | Title | Real-time auto-gain tuning setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6 | Unit | — | Default | 1 | | | |

You can set up the action mode of the real-time auto-gain tuning.

| Setup value | Mode | Varying degree of load inertia in motion |
|---|---|---|
| 0 | Invalid | Real-time auto-gain tuning function is disabled. |
| **1** | Standard | Basic mode. Do not use unbalanced load, friction compensation or gain switching. |
| 2 | Positioning *1 | Main application is positioning. It is recommended to use this mode on equipment without unbalanced horizontal axis, ball screw driving equipment with low friction, etc. |
| 3 | Vertical axis *2 | With additional features to the positioning mode - use this mode to positively and effectively compensate for unbalanced load to the vertical axis or minimize variations in setting time. |
| 4 | Friction compensation *3 | With additional features to the vertical axis mode - use this mode to positively and effectively reduce positioning setting time when the belt driving axis has high friction. |
| 5 | Load characteristic measurement | Estimate the load characteristics without changing current parameter setting. This mode requires use of the setup support software. |
| 6 | Customize *4 | Functions of real-time auto-gain tuning can be customized to meet the requirements of the specific application by combining desired functions according to the Pr6.32 “Real-time auto-gain tuning custom setting”. |

*1 Velocity and torque controls are the same as in the standard mode.
*2 Torque control is the same as in the standard mode.
*3 Velocity control is the same as in the vertical axis mode. Torque control is the same as in the standard mode.
*4 Certain function(s) is not available in a specific control mode. Refer to description in Pr6.32.

| Pr0.03 | Title | Selection of machine stiffness at real-time auto-gain tuning | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 31 | Unit | — | Default | A,B,C-frame | | 13 | |
| | | | | | | D,E,F-frame | | 11 | |

You can set up the response while the real-time auto-gain tuning is valid.

low ← machine stiffness → high
low ← servo gain → high
0, 1 - - - - - - - 11 - - 13 - - - - - - - - - - - - 30, 31
low ← response → high

Caution Higher the setup value, higher the velocity response and servo stiffness will be obtained. However, when increasing the value, check the resulting operation to avoid oscillation or vibration.

| Pr0.04 | Title | Inertia ratio | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | % | Default | 250 * | | | |

Set 1st inertia ratio.
You can set up the ratio of the load inertia against the rotor (of the motor) inertia.

Pr0.04 = (load inertia/ rotor inertia) × 100 [%]

The inertia ratio will be estimated at all time while the real-time auto-gain tuning is valid, and its result will be saved to EEPROM every 30 min.

**Caution**

If the inertia ratio is correctly set, the setup unit of Pr1.01 and Pr1.06 becomes (Hz). When the inertia ratio of Pr0.04 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr0.04 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.

| Pr0.05 * | Title | Selection of command pulse input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

You can select either the photo-coupler input or the exclusive input for line driver as the command pulse input.

| Setup value | Content |
|---|---|
| **0** | Photo-coupler input (PULS1, PULS2, SIGN1, SIGN2) |
| 1 | Exclusive input for line driver (PULSH1, PULSH2, SIGNH1, SIGNH2) |

**Note**

- Parameters which default values have a suffix of " * " will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.5-8, "Release of Automatic Gain Adjusting Function" of Adjustment.

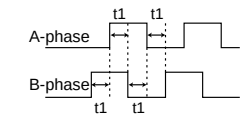
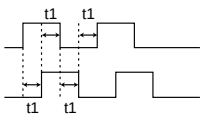
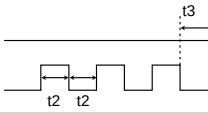
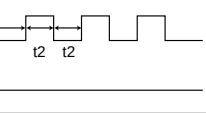
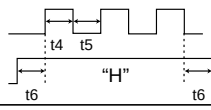
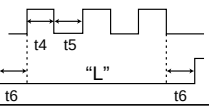
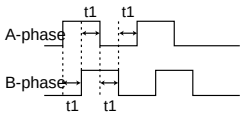
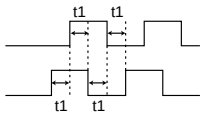
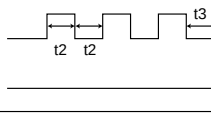
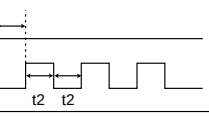
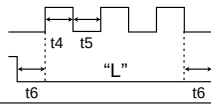
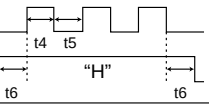
| Pr0.06 * | Title | Command pulse rotational direction setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

| Pr0.07 * | Title | Command pulse input mode setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 1 | | | |

You can set up the rotational direction against the command pulse input, and the command pulse input format.

The table below shows combinations of Pr0.06 Command pulse rotational direction setup and Pr0.07 Command pulse input mode setup.
Pulses are counted at edges indicated by the arrows as shown in the table.

**• Input format command pulse**

| Pr0.06 setup value (Command pulse rotational direction setup) | Pr0.07 setup value (Command pulse input mode setup) | Command pulse format | Signal title | Positive direction command | Negative direction command |
|---|---|---|---|---|---|
| 0 | 0 or 2 | 90˚ phase difference 2-phase pulse (A + B-phase) | PULS SIGN |   B-phase advances to A by 90˚. |   B-phase delays from A by 90˚. |
| | 1 | Positive direction pulse train + Negative direction pulse train | PULS SIGN |   |   |
| | 3 | pulse train + Signal | PULS SIGN |   |   |
| 1 | 0 or 2 | 90˚ phase difference 2-phase pulse (A + B-phase) | PULS SIGN |   B-phase delays from A by 90˚. |   B-phase advances to A by 90˚. |
| | 1 | Positive direction pulse train + Negative direction pulse train | PULS SIGN |   |   |
| | 3 | pulse train + Signal | PULS SIGN |   |   |

**• Permissible max. input frequency, and min. necessary time width of command pulse input signal.**

| Input I/F of PULS/SIGN signal | | Permissible max. input frequency | Min. necessary time width (µs) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ |
| Pulse train interface exclusive to line driver | | 4Mpps | 0.25 | 0.125 | 0.125 | 0.125 | 0.125 | 0.125 |
| Pulse train interface | Line driver interface | 500kpps | 2 | 1 | 1 | 1 | 1 | 1 |
| | Open collector interface | 200kpps | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

Make the rising/falling time of the command pulse input signal to 0.1µs or smaller.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr0.08 * | Title | Command pulse counts per one motor revolution | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 1048576 | Unit | pulse | Default | 10000 |

Set the command pulses that causes single turn of the motor shaft.
When this setting is 0, Pr0.09 1st numerator of electronic gear and Pr0.10 Denominator of electronic gear become valid.

| Pr0.09 | Title | 1st numerator of electronic gear | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to $2^{30}$ | Unit | — | Default | 0 |

Set the numerator of division/multiplication operation made according to the command pulse input.
This setup is enabled when Pr0.08 command pulse counts per one motor revolution = 0.
When the setup value is 0, the numerator is replaced by the encoder resolution.

| Pr0.10 | Title | Denominator of electronic gear | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 1 to $2^{30}$ | Unit | — | Default | 10000 |

Set the Denominator of division/multiplication operation made according to the command pulse input.
This setup is enabled when Pr0.08 command pulse counts per one motor revolution = 0.

| Pr0.08 | Pr0.09 | Pr0.10 | Command division/multiplication operation |
|---|---|---|---|
| **1 to 1048576** | — (Not effect) | — (Not effect) | Command pulse input → Encoder resolution / [Pr0.08 setup value] → Positional command<br>*** Regardless of setup of Pr0.09 and Pr0.10, this operation is processed according to setup value of Pr0.08.** |
| 0 | **0** | **0 to 1073741824** | Command pulse input → Encoder resolution / [Pr0.10 setup value] → Positional command<br>*** When both Pr0.09 and Pr0.09 are set to 0, this operation is processed according to setup value of Pr0.10.** |
| | 1 to 1073741824 | **1 to 1073741824** | Command pulse input → [Pr0.09 setting] / [Pr0.10 setting] → Positional command<br>*** When setup value of Pr0.08 is 0, and Pr0.09≠0, this operation is processed according to setup value of Pr0.09 and Pr0.10.** |

Related page • P4-62 “Setup of Motor Rotational Speed and Input Pulse Frequency”

| Pr0.11 * | Title | Output pulse counts per one motor revolution | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 1 to 262144 | Unit | P/r | Default | 2500 | | | |

You can set up the output pulse counts per one motor revolution for each OA and OB with the Pr0.11 setup. Therefore the pulse output resolution after quadruple can be obtained from the formula below.
The pulse output resolution per one revolution = Pr0.11 setup value × 4

| Pr5.03 * | Title | Denominator of pulse output division | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 262144 | Unit | — | Default | 0 | | | |

For an application where the number of output pulses per one motor revolution is not an integer, set this parameter to a value other than 0; and the dividing ratio can be set by using Pr0.11 as the numerator and Pr5.03 as the denominator.
Therefore the pulse output resolution after quadruple can be obtained from the formula below.

Pulse output resolution per one revolution
= (Pr0.11 setup value / Pr5.03 setup value) × Encoder resolution

**<Combination of Pr0.11 Output pulse counts per one motor revolution and Pr5.03 Denominator of pulse output division>**

<table>
<tr><th>Pr0.11</th><th>Pr5.03</th><th>Pulse reproducing process</th></tr>
<tr><td rowspan="2">1 to 262144</td><td>0</td><td>When the output source is encoder<br>Encoder pulse [pulse] → [Pr0.11 setup value]×4 / Encoder resolution → Output pulse [pulse]<br>* When Pr5.03 = 0, the above process is made according to Pr0.11 setup value.<br>The number of pulses of reproduced pulse output OA and OB are the number of pulses set in Pr0.11. The resolution of pulse output per one revolution is equal to or less the encoder resolution.<br>When the output source is external scale<br>External scale pulse [pulse] → 1 / 1 → Output pulse [pulse]<br>* Division ratio is 1:1.</td></tr>
<tr><td>1 to 262144</td><td>Encoder FB pulse or external scale pulse [pulse] → [Pr0.11 setup value] / [Pr5.03 setup value] → Output pulse [pulse]<br>* If Pr5.03 is not equal to 0, then the above process is performed based on setup value of Pr0.11 and Pr5.03. This feature can be used for application where the number of reproduced pulses (OA, OB) per one motor revolution is not an integer.<br>Note that when the number of pulses per one motor revolution is not an integer, Z-phase output is not synchronized with that of A-phase, reducing pulse width. The pulse output resolution per one revolution cannot become higher than the encoder resolution.</td></tr>
</table>

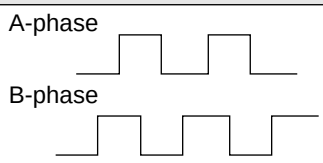
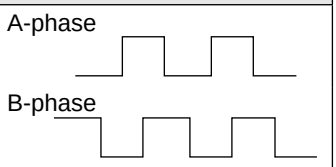
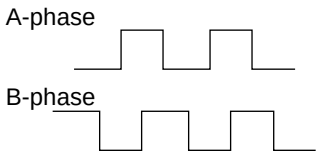
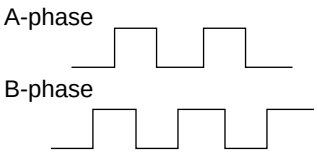
**Note**
- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page
- P.3-30... "Inputs and outputs on connector X4"

| Pr0.12 * | Title | Reversal of pulse output logic | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

You can set up the B-phase logic and the output source of the pulse output. With this parameter, you can reverse the phase relation between the A-phase pulse and the B-phase pulse by reversing the B-phase logic. Encoder or feedback scale can be selected as the output source for full-closed control. The encoder is selected as the source if not for full-closed control.

**<Reversal of pulse output logic>**

| Pr0.12 | B-phase logic | Output source | Positive direction rotation | Negative direction rotation |
|---|---|---|---|---|
| **0** | Non-reversal | Encoder |  |  |
| 2 | | Feedback scale | | |
| 1 | Reversal | Encoder |  |  |
| 3 | | Feedback scale | | |

Caution Setup value 2 and 3 are valid only for full-closed control. Setting must be 0 or 1 if not for full-closed control.

| Pr0.13 | Title | 1st torque limit | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 500 | | | |

You can set up the limit value of the motor output torque.

Note For details of torque limit value, refer to P.2-49.

| Pr0.14 | Title | Position deviation excess setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to $2^{27}$ | Unit | Command unit | Default | 100000 | | | |

- Set excess range of positional deviation by the command unit (default).
- Setup unit can be changed to encoder unit through Pr5.20 (position setup unit selection). If the unit is changed, set up with the encoder pulse counts at the position control and with the feedback scale pulse counts at the full-closed control.
- Err24.0 (Error detection of position deviation excess) becomes invalid when you set up this to 0.

| Pr0.15 * | Title | Absolute encoder setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2 | Unit | — | Default | 1 | | | |

You can set up the using method of 17-bit absolute encoder.

| Setup value | Function |
|---|---|
| 0 | Use as an absolute encoder. |
| **1** | Use as an incremental encoder. |
| 2 | Use as an absolute encoder, but ignore the multi-turn counter over. |

Caution This parameter will be invalidated when 5-wire, 20-bit incremental encoder is used.

| Pr0.16 * | Title | External regenerative resistor setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | A,B-frame | | 3 | |
| | | | | | | C to F-frame | | 0 | |

With this parameter, you can select either to use the built-in regenerative resistor of the driver, or to separate this built-in regenerative resistor and externally install the regenerative resistor (between B1 and B2 of Connector XB in case of A to D-frame, between B1 and B2 of terminal block in case of E, F-frame).

| Setup value | Regenerative resistor to be used | Function |
|---|---|---|
| 0 (C to F-frame) | Built-in resistor | Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (approx. 1% duty). |
| 1 | External resistor | The driver trips due to regenerative overload protection (Err18.0), when regenerative processing circuit is activated and its active ratio exceeds 10%. |
| 2 | External resistor | Regenerative processing circuit is activated, but no regenerative over-load protection is triggered. |
| 3 (A, B-frame) | No resistor | Both regenerative processing circuit and regenerative protection are not activated, and built-in capacitor handles all regenerative power. |

**Remarks** Install an external protection such as thermal fuse when you use the external regenerative resistor.
Otherwise, the regenerative resistor might be heated up abnormally and result in burnout, regardless of validation or invalidation of regenerative over-load protection.

**Caution** When you use the built-in regenerative resistor, never to set up other value than 0. Don't touch the external regenerative resistor.
External regenerative resistor gets very hot, and might cause burning.

| Pr0.17 * | Title | Load factor of external regenerative resistor selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 4 | Unit | — | Default | 0 | | | |

When selecting the external regenerative resistor (Pr0.16 = 1, 2), select the computing method of load factor of regenerative resistor.

| Setup value | Function |
|---|---|
| 0 | Regenerative load factor is 100% when duty factor of external regenerative resistor is 10%. |
| 1 to 4 | For manufacturer's use (do not setup) |

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

**Related page** • P.2-8 "System Configuration and Wiring" • P.3-30... "Inputs and outputs on connector X4"

# 1. Details of parameter

## [Class 1] Gain adjustment

| Pr1.00 | Title | 1st gain of position loop | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 30000 | Unit | 0.1/s | Default | A,B,C-frame | 480 | | |
| | | | | | | D,E,F-frame | 320 | | |

You can determine the response of the positional control system.
Higher the gain of position loop you set, faster the positioning time you can obtain.
Note that too high setup may cause oscillation.

| Pr1.01 | Title | 1st gain of velocity loop | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 1 to 32767 | Unit | 0.1Hz | Default | A,B,C-frame | 270 | | |
| | | | | | | D,E,F-frame | 180 | | |

You can determine the response of the velocity loop.
In order to increase the response of overall servo system by setting high position loop gain, you need higher setup of this velocity loop gain as well. However, too high setup may cause oscillation.

Caution When the inertia ratio of Pr0.04 is set correctly, the setup unit of Pr1.01 becomes (Hz).

| Pr1.02 | Title | 1st time constant of velocity loop integration | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 1 to 10000 | Unit | 0.1ms | Default | A,B,C-frame | 210 | | |
| | | | | | | D,E,F-frame | 310 | | |

You can set up the integration time constant of velocity loop.
Smaller the setup, faster you can dog-in deviation at stall to 0.
The integration will be maintained by setting to "9999".
The integration effect will be lost by setting to "10000".

| Pr1.03 | Title | 1st filter of speed detection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 5 | Unit | — | Default | 0 | | | |

You can set up the time constant of the low pass filter (LPF) after the speed detection, in 6 steps.
Higher the setup, larger the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow. Use with a default value of 0 in normal operation.

| Pr1.04 | Title | 1st time constant of torque filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2500 | Unit | 0.01ms | Default | A,B,C-frame | 84 | | |
| | | | | | | D,E,F-frame | 126 | | |

You can set up the time constant of the 1st delay filter inserted in the torque command portion. You might expect suppression of oscillation caused by distortion resonance.

Caution
- To Panasonic MINAS users: A4 and higher series
  CAUTION: Parameter settings shown in this manual may differ from those applied to your product (s).

Note
- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page
- P.3-30... "Inputs and outputs on connector X4"

| Pr1.05 | Title | 2nd gain of position loop | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 30000 | Unit | 0.1/s | Default | A,B,C-frame 570<br>D,E,F-frame 380 |

| Pr1.06 | Title | 2nd gain of velocity loop | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 1 to 32767 | Unit | 0.1Hz | Default | A,B,C-frame 270<br>D,E,F-frame 180 |

| Pr1.07 | Title | 2nd time constant of velocity loop integration | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 1 to 10000 | Unit | 0.1ms | Default | 10000 |

| Pr1.08 | Title | 2nd filter of speed detection | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 5 | Unit | — | Default | 0 |

| Pr1.09 | Title | 2nd time constant of torque filter | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 2500 | Unit | 0.01ms | Default | A,B,C-frame 84<br>D,E,F-frame 126 |

Position loop, velocity loop, speed detection filter and torque command filter have their 2 pairs of gain or time constant (1st and 2nd).

Related page For details of switching the 1st and the 2nd gain or the time constant, refer to P.5-17 "Gain Switching Function" of Adjustment.
The function and the content of each parameter is as same as that of the 1st gain and time constant.

| Pr1.10 | Title | Velocity feed forward gain | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.10% | Default | 300 |

Multiply the velocity control command calculated according to the internal positional command by the ratio of this parameter and add the result to the speed command resulting from the positional control process.

| Pr1.11 | Title | Velocity feed forward filter | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 50 |

Set the time constant of 1st delay filter which affects the input of velocity feed forward.

**<Usage example of velocity feed forward>**

The velocity feed forward will become effective as the velocity feed forward gain is gradually increased with the velocity feed forward filter set at approx. 50 (0.5 ms). The positional deviation during operation at a constant velocity is reduced as shown in the equation below in proportion to the value of velocity feed forward gain.

Positional deviation [unit of command] = command speed [unit of command/s] / positional loop gain [1/s] × (100 - velocity feed forward gain [%]) / 100

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr1.12 | Title | Torque feed forward gain | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1% | Default | 0 | | | |

- Multiply the torque command calculated according to the velocity control command by the ratio of this parameter and add the result to the torque command resulting from the velocity control process.
- Positional deviation at a constant acceleration/deceleration can be minimized close to 0 by increasing the torque forward gain. This means that positional deviation can be maintained at near 0 over entire operation range while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active.

| Pr1.13 | Title | Torque feed forward filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 0 | | | |

- Set up the time constant of 1st delay filter which affects the input of torque feed forward.
- The torque feed forward will become effective as the torque feed forward gain is gradually increased with the torque feed forward filter is set at approx. 50 (0.5 ms).

**<Usage example of torque feed forward>**

- To use the torque feed forward, correctly set the inertia ratio.
  Use the value that was determined at the start of the real time auto tuning, or set the inertia ratio that can be calculated from the machine specification to Pr0.04 Inertia ratio.
- The torque feed forward will become effective as the torque feed forward gain is gradually increased with the torque feed forward filter is set at approx. 50 (0.5 ms).
- Positional deviation at a constant acceleration/deceleration can be minimized close to 0 by increasing the torque forward gain. This means that positional deviation can be maintained at near 0 over entire operation range while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active .

Caution
Zero positional deviation is impossible in actual situation because of disturbance torque.
As with the velocity feed forward, large torque feed forward filter time constant decreases the operating noise but increases positional deviation at acceleration change point.

| Pr1.14 | Title | 2nd gain setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 1 | | | |

Arrange this parameter when performing optimum adjustment by using the gain switching function.

| Setup value | Gain selection/switching |
|---|---|
| 0 | 1st gain is fixed at a value. By using the gain switching input (GAIN), change the velocity loop operation from PI to P.<br>GAIN input photo-coupler OFF → PI operation<br>GAIN input photo-coupler ON → P operation<br>* The above description applies when the logical setting of GAIN input is a-contact. ON/OFF of photo-coupler is reversed when b-contact. |
| 1 | Enable gain switching of 1st gain (Pr1.00-Pr1.04) and 2nd gain (Pr1.05-Pr1.09). |

Related page
For switching condition of the 1st and the 2nd, refer to P.5-17 "Gain Switching Function" of Adjustment.

| Pr1.15 | Title | Mode of position control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10 | Unit | — | Default | 0 | | | |

Set up the triggering condition of gain switching for position control.

| Setup value | Switching condition | Gain switching condition |
|---|---|---|
| **0** | Fixed to 1st gain | Fixed to the 1st gain (Pr1.00 to Pr1.04). |
| 1 | Fixed to 2nd gain | Fixed to the 2nd gain (Pr1.05 to Pr1.09). |
| 2 | With gain switching input | • 1st gain when the gain switching input (GAIN) is open.<br>• 2nd gain when the gain switching input (GAIN) is connected to COM-.<br>* If no input signal is allocated to the gain switching input (GAIN), the 1st gain is fixed. |
| 3 | Torque command is large | • Shift to the 2nd gain when the absolute value of the torque command exceeded (level + hysteresis) (%) previously with the 1st gain.<br>• Return to the 1st gain when the absolute value of the torque command was kept below (level - hysteresis) (%) previously during delay time with the 2nd gain. |
| 4 | Variation of speed command is large | • Valid only during velocity control.<br>• Shift to the 2nd gain when the absolute value of the speed command variations exceeded (level + hysteresis) (10r/min/s) previously with the 1st gain.<br>• Return to the 1st gain when the absolute value of the speed command variations was kept below (level - hysteresis) (10r/min/s) during delay time previously with the 2nd gain.<br>* The 1st gain is fixed while the velocity control is not applied. |
| 5 | Speed command is large | • Valid for position, velocity and full-closed controls.<br>• Shift to the 2nd gain when the absolute value of the speed command exceeded (level + hysteresis) (r/min) previously with the 1st gain.<br>• Return to the 1st gain when the absolute value of the speed command was kept below (level - hysteresis) (r/min) previously during delay time with the 2nd gain. |
| 6 | Position deviation is large | • Valid for position and full-closed controls.<br>• Shift to the 2nd gain when the absolute value of the positional deviation exceeded (level + hysteresis) (pulse) previously with the 1st gain.<br>• Return to the 1st gain when the absolute value of the positional deviation was kept below (level - hysteresis) (pulse) previously over delay time with the 2nd gain.<br>* Unit of level and hysteresis (pulse) is set as the encoder resolution for positional control and feedback scale resolution for full-closed control. |
| 7 | Position command exists | • Valid for position and full-closed controls.<br>• Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain.<br>• Return to the 1st gain when the positional command was kept 0 previously during delay time with the 2nd gain. |
| 8 | Not in positioning complete | • Valid for position and full-closed controls.<br>• Shift to the 2nd gain when the positioning was not completed previously with the 1st gain.<br>• Return to the 1st gain when the positioning was kept in completed condition previously during delay time with the 2nd gain. |
| 9 | Actual speed is large | • Valid for position and full-closed controls.<br>• Shift to the 2nd gain when the absolute value of the actual speed exceeded (level + hysteresis) (r/min) previously with the 1st gain.<br>• Return to the 1st gain when the absolute value of the actual speed was kept below (level - hysteresis) (r/min) previously during delay time with the 2nd gain. |
| 10 | Position command exists + Actual speed | • Valid for position and full-closed controls.<br>• Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain.<br>• Return to the 1st gain when the positional command was kept at 0 during the delay time and the absolute value of actual speed was kept below (level - hysteresis ) (r/min) previously with the 2nd gain. |

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr1.16 | Title | Delay time of position control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 50 | | | |

For position controlling : When shifting from the 2nd gain to the 1st gain with Pr1.15 Position control switching mode set at 3, 5, 6, 7, 8, 9 or 10, set up the delay time from trigger detection to the switching operation.

| Pr1.17 | Title | Level of position control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 50 | | | |

For position controlling: Set up triggering level when Pr1.15 Position control gain switching mode is set at 3, 5, 6, 9 or 10.
Unit of setting varies with switching mode.

Caution Set the level equal to or higher than the hysteresis.

| Pr1.18 | Title | Hysteresis at position control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 33 | | | |

For position controlling: Set up triggering hysteresis when Pr1.15 Position control gain switching mode is set at 3, 5, 6, 9 or 10.
Unit of setting varies with switching mode.

Caution When level < hysteresis, the hysteresis is internally adjusted so that it is equal to level.

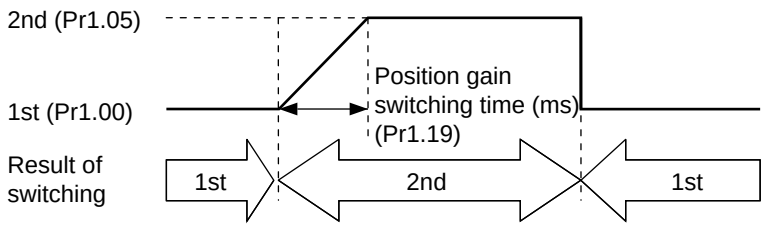
| Pr1.19 | Title | Position gain switching time | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | Mode-dependent | Default | 33 | | | |

For position controlling: If the difference between Pr1.00 1st gain of position loop and Pr1.05 2nd gain of poison loop is large, the increasing rate of position loop gain can be limited by this parameter.
The position loop gain will increase over the time set.

**<Position gain switching time>**
When using position control and full-closed control, gain of position loop rapidly changes, causing torque change and vibration. By adjusting Pr1.19 Position gain switching time, increasing rate of the poison loop gain can be decreased and vibration level can be reduced.

Caution Setting of this parameter does not affect the gain switching time when the gain of position loop is switched to lower level (gain is switched immediately).

Example: 1st (Pr1.00) > 2nd (Pr1.05)



| Pr1.20 | Title | Mode of velocity control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 5 | Unit | — | Default | 0 | | | |

For velocity controlling: Set the condition to trigger gain switching.

| Setup value | Switching condition |
|---|---|
| **0** | Fixed to the 1st gain. |
| 1 | Fixed to the 2nd gain. |
| 2 | Gain switching input |
| 3 | Torque command |
| 4 | Speed command variation is larger. |
| 5 | Command speed is larger |

Related page For the switching level and timing, refer to P.5-18, "Setup of Gain Switching Condition" of Adjustment.

| Pr1.21 | Title | Delay time of velocity control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 0 | | | |

For velocity controlling: When shifting from the 2nd gain to the 1st gain with Pr1.20 Velocity control switching mode set at 3, 4 or 5, set the delay time from trigger detection to the switching operation.

| Pr1.22 | Title | Level of velocity control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 0 | | | |

For velocity controlling: Set up triggering level when Pr1.20 Velocity control gain switching mode is set at 3, 4 or 5.

Caution Unit of setting varies with switching mode.
Set the level equal to or higher than the hysteresis.

| Pr1.23 | Title | Hysteresis at velocity control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 0 | | | |

For velocity controlling: Set up triggering hysteresis when Pr1.20 Velocity control gain switching mode is set at 3, 4 or 5.

Caution Unit of setting varies with switching mode.
When level < hysteresis, the hysteresis is internally adjusted so that it is equal to level.

Note • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr1.24 | Title | Mode of torque control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

For torque controlling: Set the condition to trigger gain switching.

| Setup value | Switching condition |
|---|---|
| **0** | Fixed to the 1st gain. |
| 1 | Fixed to the 2nd gain. |
| 2 | Gain switching input |
| 3 | Torque command |

| Pr1.25 | Title | Delay time of torque control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 0 | | | |

For torque controlling : When shifting from the 2nd gain to the 1st gain with Pr1.24 Torque control switching mode set at 3, set up the delay time from trigger detection to the switching operation.

| Pr1.26 | Title | Level of torque control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 0 | | | |

For torque controlling: Set up triggering level when Pr1.24 Torque control gain switching mode is set at 3.
Unit varies depending on the setup of mode of control switching.

Caution Set the level equal to or higher than the hysteresis.

| Pr1.27 | Title | Hysteresis at torque control switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | Mode-dependent | Default | 0 | | | |

For torque controlling: Set up triggering hysteresis when Pr1.24 Torque control gain switching mode is set at 3.

Caution Unit of setting varies with switching mode.
When level < hysteresis, the hysteresis is internally adjusted so that it is equal to level.

Note • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

# 1. Details of parameter

## [Class 2] Damping control

| Pr2.00 | Title | Adaptive filter mode setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 4 | Unit | — | Default | 0 | | | |

Set up the resonance frequency to be estimated by the adaptive filter and specify the operation after estimation.

| Setup value | Content | |
|---|---|---|
| 0 | Adaptive filter: invalid | Parameters related to the 3rd and 4th notch filter hold the current value. |
| 1 | Adaptive filter: 1 filter is valid | One adaptive filter is enabled. Parameters related to the 3rd notch filter will be updated based on adaptive performance. |
| 2 | Adaptive filter: 2 filters are valid | Two adaptive filters are enabled. Parameters related to the 3rd and 4th notch filters will be updated based on adaptive performance. |
| 3 | Resonance frequency measurement mode | Measure the resonance frequency. Result of measurement can be checked with PANATERM. Parameters related to the 3rd and 4th notch filter hold the current value. |
| 4 | Clear result of adaptation | Parameters related to the 3rd and 4th notch filter are disabled and results of adaptive operation are cleared. |

| Pr2.01 | Title | 1st notch frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 50 to 5000 | Unit | Hz | Default | 5000 | | | |

Set the center frequency of the 1st notch filter.

Caution The notch filter function will be invalidated by setting up this parameter to "5000".

| Pr2.02 | Title | 1st notch width selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20 | Unit | — | Default | 2 | | | |

Set the width of notch at the center frequency of the 1st notch filter.

Caution Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

| Pr2.03 | Title | 1st notch depth selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 99 | Unit | — | Default | 0 | | | |

Set the depth of notch at the center frequency of the 1st notch filter.

Caution Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.

| Pr2.04 | Title | 2nd notch frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 50 to 5000 | Unit | Hz | Default | 5000 | | | |

Set the center frequency of the 2nd notch filter.

Caution The notch filter function will be invalidated by setting up this parameter to "5000".

| Pr2.05 | Title | 2nd notch width selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20 | Unit | — | Default | 2 | | | |

Set the width of notch at the center frequency of the 2nd notch filter.

Caution

Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

| Pr2.06 | Title | 2nd notch depth selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 99 | Unit | — | Default | 0 | | | |

Set the depth of notch at the center frequency of the 2nd notch filter.

Caution

Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.

| Pr2.07 | Title | 3rd notch frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 50 to 5000 | Unit | Hz | Default | 5000 | | | |

Notch frequency is automatically set to the 1st resonance frequency estimated by the adaptive filter.

Caution

In no resonance point is found, the frequency is set to 5000.

| Pr2.08 | Title | 3rd notch width selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20 | Unit | — | Default | 2 | | | |

Set the width of notch at the center frequency of the 3rd notch filter.

Caution

Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.
When the applicable filter function is used, parameter value is automatically set.

| Pr2.09 | Title | 3rd notch depth selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 99 | Unit | — | Default | 0 | | | |

Set the depth of notch at the center frequency of the 3rd notch filter.

Caution

Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.
When the applicable filter function is used, parameter value is automatically set.

| Pr2.10 | Title | 4th notch frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 50 to 5000 | Unit | Hz | Default | 5000 | | | |

Notch frequency is automatically set to the 2nd resonance frequency estimated by the adaptive filter.

Caution

The notch filter function will be invalidated by setting up this parameter to "5000".

Note

- **For parameters which No. have a suffix of " ∗ "**, changed contents will be validated when you turn on the control power.

Related page

- P.3-30... "Inputs and outputs on connector X4"

| Pr2.11 | Title | 4th notch width selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20 | Unit | — | Default | 2 | | | |

Set the width of notch at the center frequency of the 4th notch filter.

Caution

Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

When the applicable filter function is used, parameter value is automatically set.

| Pr2.12 | Title | 4th notch depth selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 99 | Unit | — | Default | 0 | | | |

Set the depth of notch at the center frequency of the 4th notch filter.

Caution

Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.

When the applicable filter function is used, parameter value is automatically set.

| Pr2.13 | Title | Selection of damping filter switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

Among 4 filters select the filters to be used for damping control.

- When setup value is 0: Up to 2 filters can be used simultaneously.
- When setup value is 1 or 2: Select the filter with external input(s) (VS-SEL1 and/or VS-SEL2).

| Setup value | VS-SEL2 | VS-SEL1 | 1st damping | 2nd damping | 3rd damping | 4th damping |
|---|---|---|---|---|---|---|
| 0 | — | — | ○ | ○ | | |
| 1 | — | | ○ | | ○ | |
| | — | ○ | | ○ | | ○ |
| 2 | | | ○ | | | |
| | | ○ | | ○ | | |
| | ○ | | | | ○ | |
| | ○ | ○ | | | | ○ |

- With setup value 3: Select the filter with command direction.

| Setup value | Position command direction | 1st damping | 2nd damping | 3rd damping | 4th damping |
|---|---|---|---|---|---|
| 3 | Positive direction | ○ | | ○ | |
| | Negative direction | | ○ | | ○ |

| Pr2.14 | Title | 1st damping frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.16 | Title | 2nd damping frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.18 | Title | 3rd damping frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.20 | Title | 4th damping frequency | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2000 | Unit | 0.1Hz | Default | 0 | | | |

You can set up the 1st to 4th damping frequency of the damping control which suppress vibration at the load edge.
The driver measures vibration at load edge. Setup unit is 0.1[Hz].

Related page The setup frequency is 1.0 to 200.0[Hz]. Setup of 0 to 9 becomes invalid. Refer to P.5-20, "Damping control" as well before using this parameter.

| Pr2.15 | Title | 1st damping filter setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.17 | Title | 2nd damping filter setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.19 | Title | 3rd damping filter setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1Hz | Default | 0 | | | |

| Pr2.21 | Title | 4th damping filter setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1Hz | Default | 0 | | | |

If torque saturation occurs with damping frequency (1st- 4th) enabled, decrease the setup value, or if the operation is slow, increase it. Usually set it to 0.
The maximum setup value is limited to the applicable damping frequency, and minimum value is limited to a value so that the damping frequency + damping filter setting is equal to or higher than 100.

Caution The maximum setup value is internally limited to the compatible damping frequency..

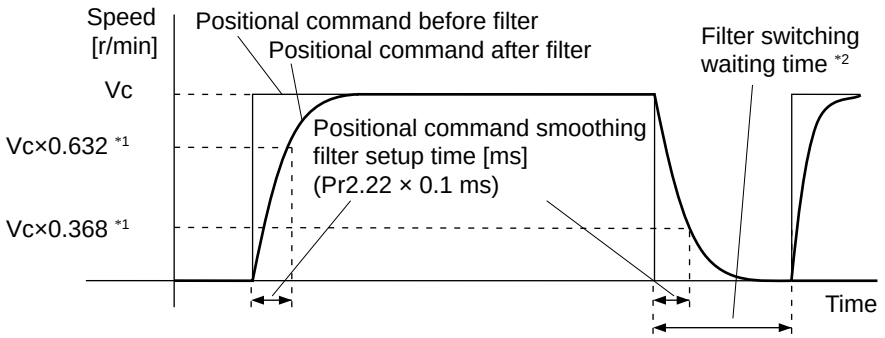
Related page Refer to P.5-24, "Damping control" as well before using this parameter.

**Note** • **For parameters which No. have a suffix of " ∗ "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr2.22 | Title | Positional command smoothing filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 0 | | | |

- Set up the time constant of the 1st delay filter in response to the positional command.
- When a square wave command for the target speed Vc is applied, set up the time constant of the 1st delay filter as shown in the figure below.



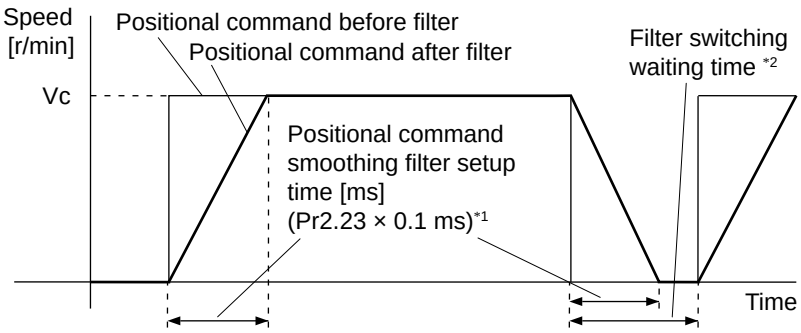

*1 Actual filter time constant (setup value × 0.1 ms) has the maximum absolute error of 0.2 ms for a time constant below 100 ms and the maximum relative error of 0.1% for a time constant 20 ms or more.

*2 Switching of Pr2.22 Positional command smoothing filter is performed on the rising edge of the command with the number of command pulses/0.166 ms is changed from 0 to a value other than 0 while the positioning complete is being output.
If the filter time constant is decreased and positioning complete range is increased, and a many number of plusses are accumulated in the filter (the area equivalent of "value of positional command filter - value of positional command after filter" integrated over the time), at the time of switching, these pulses are discharged at a higher rate, causing the motor to return to the previous position - the motor runs at a speed higher than the command speed for a short time.

*3 Even if Pr2.22 Positional command smoothing filter is changed, it is not applied immediately. If the switching as described in *2 occurs during this delay time, the change of Pr2.22 will be suspended.

| Pr2.23 | Title | Positional command FIR filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 0 | | | |

- Set up the time constant of the 1st delay filter in response to the positional command.
- When a square wave command of the target speed Vc is applied, set up the VC arrival time as shown in the figure below.




*1 The actual average travel time (setup value × 0.1 ms) has the maximum absolute error of 0.1 ms for a time constant below 10 ms and the maximum relative error of 1.6% for a time constant 10 ms or more.

*2 When changing Pr2.23 Positional command FIR filter, stop the command pulse and wait until the filter switching wait time has elapsed. The filter switching wait time is the setup value × 0.1 ms + 0.25 ms when the setup time is 10 ms, and setup value × 0.1 ms × 1.05 when the setup time is 10 ms or more. If Pr2.23 is changed while the command pulse is being input, the change is not reflected until the command pulse-less state has continued for the filter switching wait time.

*3 Even if Pr2.23 Positional command FIR filter is changed, it is not applied immediately. If the switching as described in *2 occurs during this delay time, the change of Pr2.23 will be suspended.

| Pr3.00 | Title | Speed setup, Internal/External switching | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

This driver is equipped with internal speed setup function so that you can control the speed with contact inputs only.

| Setup value | Speed setup method |
|---|---|
| **0** | Analog speed command (SPR) |
| 1 | Internal speed command 1st to 4th speed (Pr3.04 to Pr3.07) |
| 2 | Internal speed command 1st to 3rd speed (Pr3.04 to Pr3.06),<br>Analog speed command (SPR) |
| 3 | Internal speed command 1st to 8th speed (Pr3.04 to Pr3.11) |

**<Relationship between Pr3.00 Internal/external switching speed setup and the internal command speed selection 1, 2 and 3, and speed command to be selected>**

| Setup value | Selection 1 of internal command speed (INTSPD1) | Selection 2 of internal command speed (INTSPD2) | Selection 3 of internal command speed (INTSPD3) | Selection of Speed command |
|---|---|---|---|---|
| 1 | OFF | OFF | No effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | 4th speed |
| 2 | OFF | OFF | No effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | Analog speed command |
| 3 | The same as Pr3.00=1 | | OFF | 1st to 4th speed |
| | OFF | OFF | ON | 5th speed |
| | ON | OFF | ON | 6th speed |
| | OFF | ON | ON | 7th speed |
| | ON | ON | ON | 8th speed |

| Pr3.01 | Title | Speed command rotational direction selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Select the Positive/Negative direction specifying method.

| Setup value | Select speed command sign (1st to 8th speed) | Speed command direction (VC-SIGN) | Position command direction |
|---|---|---|---|
| **0** | + | No effect | Positive direction |
| | – | No effect | Negative direction |
| 1 | Sign has no effect. | OFF | Positive direction |
| | Sign has no effect. | ON | Negative direction |

**Note** • **For parameters which No. have a suffix of " ∗ "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

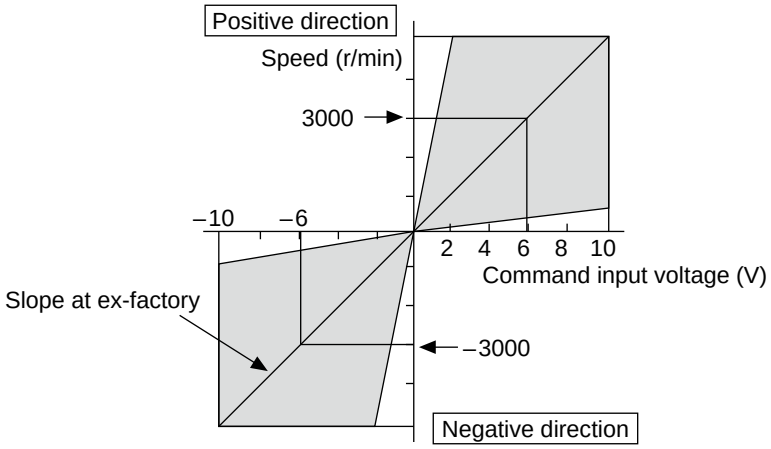
| Pr3.02 | Title | Input gain of speed command | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 2000 | Unit | (r/min)/V | Default | 500 | | | |

Based on the voltage applied to the analog speed command (SPR), set up the conversion gain to motor command speed.

- You can set up a "slope" of the relation between the command input voltage and the motor speed, with Pr3.02.
- Default is set to Pr3.02=500 [r/min], hence input of 6V becomes 3000r/min.

**Caution**

1. Do not apply more than ±10V to the speed command input (SPR).
2. When you compose a position loop outside of the driver while you use the driver in velocity control mode, the setup of Pr3.02 gives larger variance to the overall servo system.
   Pay an extra attention to oscillation caused by larger setup of Pr3.02.




| Pr3.03 | Title | Reversal of speed command input | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 1 | | | |

Specify the polarity of the voltage applied to the analog speed command (SPR).

| Setup value | Motor rotating direction | |
|---|---|---|
| 0 | Non-reversal | "+Voltage" → "Positive direction", "–Voltage" → "Negative direction" |
| 1 | Reversal | "+Voltage" → "Negative direction", "–Voltage" → "Positive direction" |

**Note** Default of this parameter is 1, and the motor turns to CW with (+) signal, this has compatibility to existing MINAS series driver.

**Caution** When you compose the servo drive system with this driver set to velocity control mode and external positioning unit, the motor might perform an abnormal action if the polarity of the speed command signal from the unit and the polarity of this parameter setup does not match.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pr3.04** | Title | **1st speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.05** | Title | **2nd speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.06** | Title | **3rd speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.07** | Title | **4th speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.08** | Title | **5th speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.09** | Title | **6th speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.10** | Title | **7th speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |
| **Pr3.11** | Title | **8th speed of speed setup** | | | Related control mode | P | **S** | T | F |
| | Range | **–20000 to 20000** | Unit | **r/min** | Default | **0** | | | |

Set up internal command speeds, 1st to 8th.

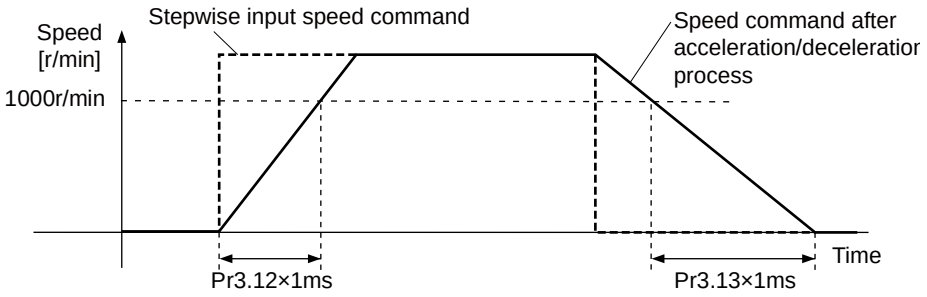
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pr3.12** | Title | **Acceleration time setup** | | | Related control mode | P | **S** | T | F |
| | Range | **0 to 10000** | Unit | **ms/ (1000r/min)** | Default | **0** | | | |
| **Pr3.13** | Title | **Deceleration time setup** | | | Related control mode | P | **S** | T | F |
| | Range | **0 to 10000** | Unit | **ms/ (1000r/min)** | Default | **0** | | | |

Set up acceleration/deceleration processing time in response to the speed command input. Set the time required for the speed command (stepwise input) to reach 1000 r/min to Pr3.12 Acceleration time setup. Also set the time required for the speed command to reach from 1000 r/min to 0 r/min, to Pr3.13 Deceleration time setup.

Assuming that the target value of the speed command is Vc(r/min), the time required for acceleration/deceleration can be computed from the formula shown below.

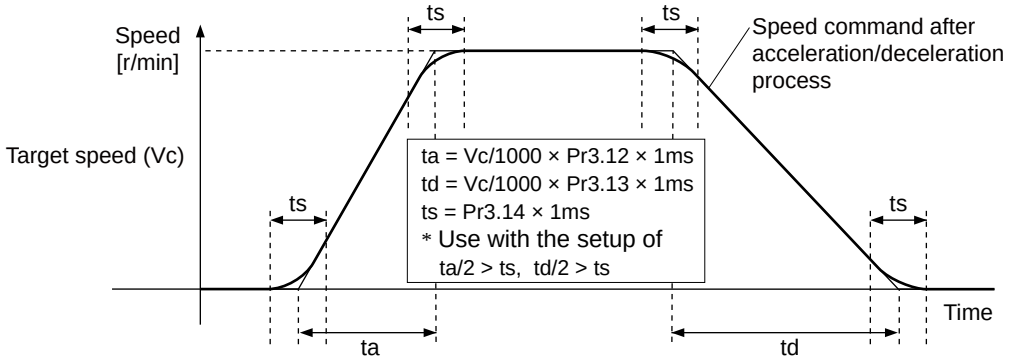
Acceleration time (ms) = Vc/1000 × Pr3.12 × 1 ms

Deceleration time (ms) = Vc/1000 × Pr3.13 × 1 ms



| Pr3.14 | Title | Sigmoid acceleration/ deceleration time setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | ms | Default | 0 | | | |

Set S-curve time for acceleration/deceleration process when the speed command is applied. According to Pr3.12 Acceleration time setup and Pr3.13 Deceleration time setup, set up sigmoid time with time width centering the inflection point of acceleration/deceleration.




| Pr3.15 | Title | Speed zero-clamp function selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

You can set up the function of the speed zero clamp input.

| Setup value | Function of ZEROSPD (Pin-26) |
|---|---|
| **0** | Invalid: Speed zero-clamp input is ignored. |
| 1 | Speed command is forced to 0 when the speed zero clamp (ZEROSPD) input signal is turned ON. |
| 2 | Speed command is forced to 0 when the speed zero clamp (ZEROSPD) input signal is turned ON. And when the actual motor speed drops to Pr3.16 Speed zero clamp level or below, the position control is selected and servo lock is activated at this point. The fundamental operations except for this function (switching to the position control) are identical to those when setup value is 1. |
| 3 | When the speed zero clamp (ZEROSPD) input signal is ON and speed command is below Pr3.16<br>Speed zero clamp level - 10 r/min, then the position control is selected and servo lock is activated at that point. |

| Pr3.16 | Title | Speed zero clamp level | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 20000 | Unit | r/min | Default | 30 | | | |

Select the timing at which the position control is activated as the Pr3.15 Speed zero-clamp function selection is set to 2 or 3.
If Pr3.15 = 3, then hysteresis of 10 r/min is provided for detection.

**Note**
- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page
- P.3-30... "Inputs and outputs on connector X4"

## Pr3.17

| Title | Selection of torque command | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| Range | **0 to 2** | Unit | — | Default | **0** |

You can select the input of the torque command and the speed limit.

| Setup value | Torque command input | Velocity limit input |
|---|---|---|
| **0** | Analog input 1 *1 (AI1, 16-bit resolution) | Parameter value (Pr3.25) |
| 1 | Analog input 2 (AI2, 12-bit resolution) | Analog input 1 (AI1, 16-bit resolution) |
| 2 | Analog input 1 *1 (AI1, 16-bit resolution) | Parameter value (Pr3.25, Pr3.26) |

*1 For Pr0.01 Control mode setup = 5 (velocity/torque control), the torque command input is the analog input 2 (AI2, 12-bit resolution).

## Pr3.18

| Title | Torque command direction selection | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| Range | **0 to 1** | Unit | — | Default | **0** |

Select the direction positive/negative direction of torque command.

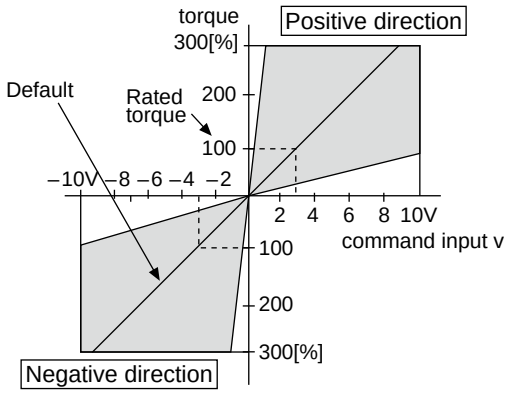
| Setup value | Designation |
|---|---|
| **0** | Specify the direction with the sign of torque command.<br>Example: Torque command input (+) for positive direction, (–) for negative direction |
| 1 | Specify the direction with torque command sign (TC-SIGN).<br>OFF: Positive direction, ON: Negative direction |

## Pr3.19

| Title | Input gain of torque command | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| Range | **10 to 100** | Unit | **0.1V/100%** | Default | **30** |

Based on the voltage (V) applied to the analog torque command (TRQ R), set up the conversion gain to torque command (%).

- Unit of the setup value is [0.1V/100%] and set up input voltage necessary to produce the rated torque.
- Default setup of 30 represents 3V/100%.




## Pr3.20

| Title | Input reversal of torque command | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|
| Range | **0 to 1** | Unit | — | Default | **0** |

Set up the polarity of the voltage applied to the analog torque command (TRQR).

| Setup value | Direction of motor output torque | |
|---|---|---|
| 0 | Non-reversal | “+Voltage” → “Positive direction”, “–Voltage” → “Negative direction” |
| **1** | Reversal | “+Voltage” → “Negative direction”, “–Voltage” → “Positive direction” |

| Pr3.21 | Title | Speed limit value 1 | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|---|
| | Range | **0 to 20000** | Unit | **r/min** | Default | **0** |

Set up the speed limit used for torque controlling.
During the torque controlling, the speed set by the speed limit value cannot be exceeded.
When Pr3.17 = 2, the speed limit is applied upon receiving positive direction command.

| Pr3.22 | Title | Speed limit value 2 | | | Related control mode | P S **T** F |
|---|---|---|---|---|---|---|
| | Range | **0 to 20000** | Unit | **r/min** | Default | **0** |

Speed limit value of negative direction command when Pr3.17 = 2.

| Pr3.17 | Pr3.21 | Pr3.22 | Pr3.15 | Speed zero clamp (ZEROSPD) | Analog torque command direction | Speed limit value |
|---|---|---|---|---|---|---|
| 0 | 0 to 20000 | No effect | 0 | No effect | No effect | Pr3.21 setup value |
| | | | 1 to 3 | OFF | | Pr3.21 setup value |
| | | | | ON | | 0 |
| **2** | **0 to 20000** | **0 to 20000** | **0** | No effect | Positive direction | Pr3.21 setup value |
| | | | | | Negative direction | Pr3.22 setup value |
| | **0 to 20000** | 0 to 20000 | 1 to 3 | OFF | Positive direction | Pr3.21 setup value |
| | | | | | Negative direction | Pr3.22 setup value |
| | **0 to 20000** | 0 to 20000 | 1 to 3 | ON | No effect | 0 |

| Pr3.23 * | Title | External scale selection | | | Related control mode | P S T **F** |
|---|---|---|---|---|---|---|
| | Range | **0 to 2** | Unit | — | Default | **0** |

Select the type of feedback scale.

| Setup value | Feedback scale type | Compatible scale | Compatible speed |
|---|---|---|---|
| **0** | A,B phase output type *1 | Feedback scale of A, B phase output type | to 4Mpps (after quadrupled) |
| 1 | Serial communication type (incremental version) *1 | Sony Manufacturing Systems Corp. SR75, SR85, SL700, SL710 | to 400Mpps |
| 2 | Serial communication type (absolute version) *1 | Mitsutoyo Corp. AT573, ST771A, ST773A Sony Manufacturing Systems Corp. SR77, SR87 | to 400Mpps |

*1 Connect the feedback scale so that it increments the count as the motor shaft turns positive direction, and decrements as the shaft turns negative direction. If this connection arrangement is impossible due to installation condition, etc., use the count reverse function of Pr3.26 Reversal of direction of external scale.

**Caution** When the setup value is 1 or 2 while the A, B phase output type is connected, Err50.0 External scale wiring error protection occurs, and if the setup value is 0 while the serial communication type is connected, Err55.0, 1 or 2 A phase, B phase or Z phase wiring error protection will occur.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4" • P.6-3 "Protective Function"

| Pr3.24 * | Title | Numerator of external scale division | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to $2^{20}$ | Unit | — | Default | 0 | | | |

Set up the numerator of the feedback scale dividing setup.
When setup value = 0, encoder resolution is used as numerator of the division.

| Pr3.25 * | Title | Denominator of external scale division | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 1 to $2^{20}$ | Unit | — | Default | 10000 | | | |

- Check the number of encoder pluses per one motor revolution and the number of feedback scale pulses per one motor revolution, and then set up the numerator of external scale division (Pr3.24) and the denominator of external scale division (Pr3.25) to establish the expression shown below.
- With Pr3.24 set at 0, the encoder resolution is automatically used as numerator.

Example: When ball screw pitch is 10 mm, scale 0.1 _m/pulse, encoder resolution 20 bits (1048.576 pulses);

$$\frac{\text{Pr3.24}\ \boxed{1048576}}{\text{Pr3.25}\ \boxed{100000}} = \frac{\text{Encoder resolution per one motor revolution [pulse]}}{\text{Feedback scale resolution per one motor revolution [pulse]}}$$

**Caution** If this ratio is wrong, the difference between the position calculated based on the encoder pulses and the position calculated based on the feedback scale pulses becomes large over a long travel distance and will activate the excess hybrid deviation error protection.

| Pr3.26 * | Title | Reversal of direction of external scale | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Reverse the direction of feedback scale, feedback counter.

| Setup value | Content |
|---|---|
| **0** | Count value of external scale can be used as it is. |
| 1 | Sign (positive/negative) of count value of external scale should be inverted. |

**Note** For setting method of this parameter, refer to P.3-12 Full closed control mode.

| Pr3.27 * | Title | External scale Z phase disconnection detection disable | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Enable/disable Z-phase disconnection detection when A, B phase output type feedback scale is used.

| Setup value | Content |
|---|---|
| **0** | Valid |
| 1 | Invalid |

| Pr3.28 * | Title | Hybrid deviation excess setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 1 to $2^{27}$ | Unit | Command unit | Default | 16000 | | | |

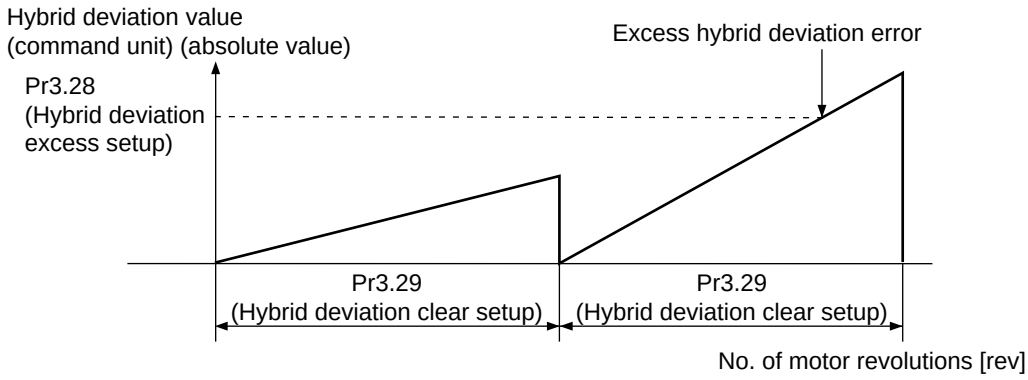
You can setup the permissible gap (hybrid deviation) between the present motor position and the present feedback scale position.

| Pr3.29 * | Title | Hybrid deviation clear setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | Revolution | Default | 0 | | | |

As the motor turns the number of revolutions set by this parameter, the hybrid deviation is cleared to 0. No clearing is made with setup value 0.

**<Hybrid deviation clear feature>**

As the motor reaches the number of revolutions set by Pr3.29 Hybrid deviation clear setup, clear the hybrid deviation to 0. This feature allows the motor to be used in an application where hybrid deviation accumulate due to slippage, etc.




Note: Revolution in the hybrid deviation clear setup is counted by using encoder feedback pulses.

**Caution** To use the hybrid deviation clear, be sure to set Pr3.29 Hybrid deviation clear setup to the appropriate value. If the setup value is too small with respect to the value of Pr3.28 Hybrid deviation excess setup, abnormal operation due to e.g. feedback scale connection error cannot be protected.
Limit sensor should be used to assure safety.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

# 1. Details of parameter

## [Class 4] I/F monitor setting

| Pr4.00 * | Title | SI1 input selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00828282h (8553090) | | | |

Assign functions to SI1 inputs.
These parameters are presented in hexadecimals. *5
Hexadecimal presentation is followed by a specific control mode designation.
0 0 – – – * * h : position/full-closed control
0 0 – – * * – – h : velocity control
0 0 * * – – – – h : torque control
Replace * * with the function number.
For the function number see the table below. Logical setup is also a function number.

| Title | Symbol | Setup value | |
|---|---|---|---|
| | | a-contact | b-contact |
| Invalid | – | 00h | Do not setup. |
| Positive direction over-travel inhibition input | POT | 01h | 81h |
| Negative direction over-travel inhibition input | NOT | 02h | 82h |
| Servo-ON input *1 | SRV-ON | 03h | 83h |
| Alarm clear input | A-CLR | 04h | Do not setup. |
| Control mode switching input *2 | C-MODE | 05h | 85h |
| Gain switching input | GAIN | 06h | 86h |
| Deviation counter clear input *3 | CL | 07h | Do not setup. |
| Command pulse inhibition input *4 | INH | 08h | 88h |
| Torque limit switching input | TL-SEL | 09h | 89h |
| Damping control switching input 1 | VS-SEL1 | 0Ah | 8Ah |
| Damping control switching input 2 | VS-SEL2 | 0Bh | 8Bh |
| Electronic gear switching input 1 | DIV1 | 0Ch | 8Ch |
| Electronic gear switching input 2 | DIV2 | 0Dh | 8Dh |
| Selection 1 input of internal command speed | INTSPD1 | 0Eh | 8Eh |
| Selection 2 input of internal command speed | INTSPD2 | 0Fh | 8Fh |
| Selection 3 input of internal command speed | INTSPD3 | 10h | 90h |
| Speed zero clamp input | ZEROSPD | 11h | 91h |
| Speed command sign input | VC-SIGN | 12h | 92h |
| Torque command sign input | TC-SIGN | 13h | 93h |
| Forced alarm input | E-STOP | 14h | 94h |
| Inertia ratio switching input | J-SEL | 15h | 95h |

**Caution**

- Do not setup to a value other than that specified in the table.
- Do not assign specific function to 2 or more signals. Duplicated assignment will cause Err33.0 I/F input multiple assignment error 1 or Err33.1 I/F input multiple assignment error 2.

*1 Servo-on input signal (SRV-ON) must be used to enable servo-on.

*2 When using control mode switching input (C-MODE), set the signal to all control modes. If the signal is set to only 1 or 2 control modes, Err33.2 I/F input function number error 1 or Err33.3 I/F input function number error 2 will be generated.
- The control input pin set to invalid state does not affect any operation.
- Function (servo-on input, alarm clear, etc.) to be used in multiple control modes must be assigned to the same pin with correct logical arrangement. Incorrect setting will cause Err33.0 I/F input multiple assignment error 1 or Err33.1 I/F input multiple assignment error 2.

*3 Deviation counter clear input (CL) can be assigned only to SI7 input. Wrong assignment will cause Err33.6 Counter clear assignment error.

*4 Command pulse inhibit input (INH) can be assigned only to SI10 input. Wrong assignment will cause Err33.7 Command pulse input inhibit input.

*5 Note that the front panel indicates parameter value in decimal number.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pr4.01 *** | Title | **SI2 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00818181h (8487297)** | | | |
| **Pr4.02 *** | Title | **SI3 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **0091910Ah (9539850)** | | | |
| **Pr4.03 *** | Title | **SI4 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00060606h (394758)** | | | |
| **Pr4.04 *** | Title | **SI5 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **0000100Ch (4108)** | | | |
| **Pr4.05 *** | Title | **SI6 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00030303h (197379)** | | | |
| **Pr4.06 *** | Title | **SI7 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00000f07h (3847)** | | | |

Caution Deviation counter clear (CL) can be set up only with this parameter. If any other parameter is used for this purpose, error code No.33.6 Counter clear assignment error will be issued.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pr4.07 *** | Title | **SI8 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00040404h (263172)** | | | |
| **Pr4.08 *** | Title | **SI9 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00050505h (328965)** | | | |
| **Pr4.09 *** | Title | **SI10 input selection** | | | Related control mode | P | S | T | F |
| | Range | **0 to 00FFFFFFh** | Unit | — | Default | **00000E88h (3720)** | | | |

Assign functions to SI2 to SI10 inputs.
These parameters are presented in hexadecimals.
Setup procedure is the same as described for Pr4.00.

Caution Command pulse inhibition input (INH) can be setup only with this parameter. If any other parameter is used for this purpose, error code No.33.7 INH assignment error will be issued.

Note • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr4.10 * | Title | SO1 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00030303h (197379) | | | |

Assign functions to SO1 outputs.
These parameters are presented in hexadecimals. *1
Hexadecimal presentation is followed by a specific control mode designation.
0 0 – – – – * * h : position/full-closed control
0 0 – – * * – – h : velocity control
0 0 * * – – – – h : torque control
Replace * * with the function number.
For the function number see the table below. Logical setup is also a function number.

| Setup value | Title | Symbol |
|---|---|---|
| 00h | Invalid | – |
| 02h | Servo-Ready output | S-RDY |
| 03h | External brake release signal | BRK-OFF |
| 04h | Positioning complete output | INP |
| 05h | At-speed output | AT-SPPED |
| 06h | Torque in-limit signal output | TLC |
| 07h | Zero-speed detection output signal | ZSP |
| 08h | Speed coincidence output | V-COIN |
| 09h | Alarm output 1 | WARN1 |
| 0Ah | Alarm output 2 | WARN2 |
| 0Bh | Positional command ON/OFF output | P-CMD |
| 0Ch | Positioning complete 2 | INP2 |
| 0Dh | Speed in-limit output | V-LIMIT |
| 0Eh | Alarm attribute output | ALM-ATB |
| 0Fh | Speed command ON/OFF output | V-CMD |

• Same function can be assigned to 2 or more output signals.
• Control output pin set to invalid always has the output transistor turned OFF.
• Do not change the setup value shown in the table.

Caution *1 Note that the setup values are displayed in decimal on the front panel.

| Pr4.11 * | Title | SO2 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00020202h (131586) | | | |

| Pr4.12 * | Title | SO3 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00010101h (65793) | | | |

| Pr4.13 * | Title | SO4 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00050504h (328964) | | | |

| Pr4.14 * | Title | SO5 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00070707h (460551) | | | |

| Pr4.15 * | Title | SO6 output selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 00FFFFFFh | Unit | — | Default | 00060606h (394758) | | | |

Assign functions to SO2 to SO6 outputs.
These parameters are presented in hexadecimals.
Setup procedure is the same as described for Pr4.10.

| Pr4.16 | Title | Type of analog monitor 1 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 21 | Unit | — | Default | 0 | | | |

Select the type of monitor for analog monitor 1. *See the table shown on the next page.

| Pr4.18 | Title | Type of analog monitor 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 21 | Unit | — | Default | 4 | | | |

Select the type of monitor for analog monitor 2. *See the table shown on the next page.

| Pr4.17 | Title | Analog monitor 1 output gain | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 214748364 | Unit | [Monitor unit in Pr4.16] / V | Default | 0 | | | |

Set up the output gain of analog monitor 1.
For Pr4.16 = 0 Motor speed, 1 V is output at the motor speed [r/min] = Pr4.17 setup value.

| Pr4.19 | Title | Analog monitor 2 output gain | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 214748364 | Unit | [Monitor unit in Pr4.16] / V | Default | 0 | | | |

Set up the output gain of analog monitor 2.
For Pr4.18 = 3 Torque command, 1 V is output at the torque command [%] = Pr4.18 setup value.

| Pr4.20 | Title | Type of digital monitor | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

Select type of the digital monitor.

| Setup value | Type of monitor | Digital signal output | |
|---|---|---|---|
| | | L output | H output |
| 0 | Positioning complete condition | Not completed | Completed |
| 1 | Positional command | Without command | With command |
| 2 | Alarm | Not generated | Generated |
| 3 | Gain selected | 1st gain | 2nd gain (including 3rd gain) |

**Note**
- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

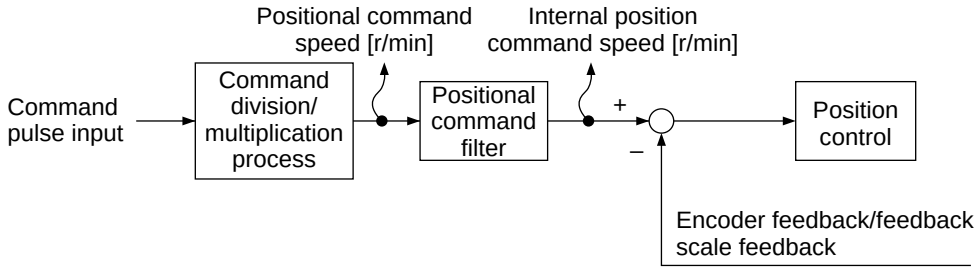
Related page
- P.3-30... "Inputs and outputs on connector X4"

| Pr4.16/Pr4.18 | Type of monitor | Unit | Output gain for setting Pr4.17/Pr4.19 = 0 |
|---|---|---|---|
| 0 | Motor speed | r/min | 500 |
| 1 | Positional command speed *3 | r/min | 500 |
| 2 | Internal positional command speed *3 | r/min | 500 |
| 3 | Velocity control command | r/min | 500 |
| 4 | Torque command | % | 33 |
| 5 | Command positional deviation *4 | pulse (Command unit) | 3000 |
| 6 | Encoder positional deviation *4 | pulse (Encoder unit) | 3000 |
| 7 | Full-closed deviation *4 | pulse (External scale unit) | 3000 |
| 8 | Hybrid deviation | pulse (Command unit) | 3000 |
| 9 | Voltage across PN | V | 80 |
| 10 | Regenerative load factor | % | 33 |
| 11 | Overload factor | % | 33 |
| 12 | Positive direction torque limit | % | 33 |
| 13 | Negative direction torque limit | % | 33 |
| 14 | Speed limit value | r/min | 500 |
| 15 | Inertia ratio | % | 500 |
| 16 | Analog input 1 *2 | V | 1 |
| 17 | Analog input 2 *2 | V | 1 |
| 18 | Analog input 3 *2 | V | 1 |
| 19 | Encoder temperature *5 | °C | 10 |
| 20 | Driver temperature | °C | 10 |
| 21 | Encoder single-turn data *1 | pulse (Encoder unit) | 110000 |

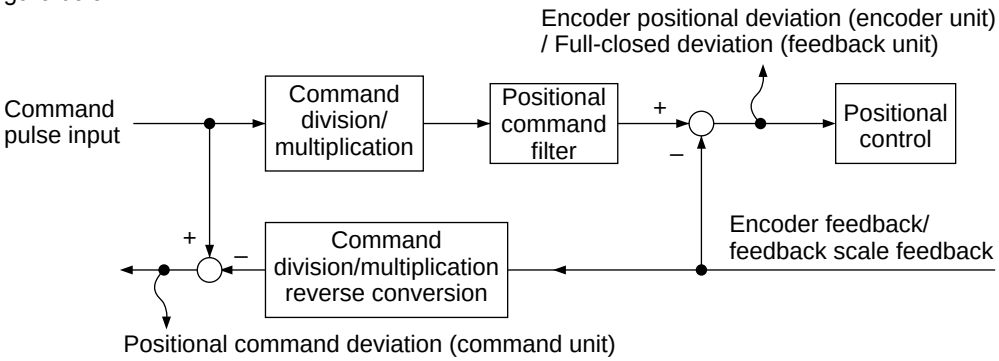
*1 The encoder rotation data CCW is always positive value regardless of Pr0.00 Rotational direction setup. The direction of other monitor data basically follows Pr0.00 Rotational direction setup.

*2 Analog inputs 1, 2 and 3 always output terminal voltage regardless of usage of analog input function.

*3 For the command pulse input, the speed before the command filter (smoothing, FIR filter) is defined as positional command speed and speed after filter is defined as internal command speed.




*4 Command positional deviation is the deviation with respect to the command pulse input and the encoder positional deviation/ full-closed positional deviation is the deviation at the input section of the positional control, as described in the figure below.




*5 Temperature information from the encoder includes value only when it is a 20-bit incremental encoder. Otherwise, the value is always 0.

| Pr4.21 | Title | Analog monitor output setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2 | Unit | — | Default | 0 | | | |

Select output format of the analog monitor.

| Setup value | Output format | |
|---|---|---|
| **0** | Signed data output | –10 V to 10 V |
| 1 | Absolute value data output | 0 V to 10 V |
| 2 | Data output with offset | 0 V to 10 V (5 V at center) |

| Pr4.22 | Title | Analog input 1 (AI1) offset setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –5578 to 5578 | Unit | 0.359mV | Default | 0 | | | |

Set up the offset correction value applied to the voltage fed to the analog input 1.

| Pr4.23 | Title | Analog input 1 (AI1) filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 0 | | | |

Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 1.

| Pr4.24 | Title | Analog input 1 (AI1) overvoltage setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | 0.1V | Default | 0 | | | |

Set up the excessive level of the input voltage of analog input 1 by using the voltage associated with offset.

| Pr4.25 | Title | Analog input 2 (AI2) offset setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –342 to 342 | Unit | 5.86mV | Default | 0 | | | |

Set up the offset correction value applied to the voltage fed to the analog input 2.

| Pr4.26 | Title | Analog input 2 (AI2) filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 0 | | | |

Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 2.

| Pr4.27 | Title | Analog input 2 (AI2) overvoltage setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | 0.1V | Default | 0 | | | |

Set up the excessive level of the input voltage of analog input 2 by using the voltage associated with offset.

**Note**

- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page
- P.3-30... "Inputs and outputs on connector X4"

| Pr4.28 | Title | Analog input 3 (AI3) offset setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –342 to 342 | Unit | 5.86mV | Default | 0 | | | |

Set up the offset correction value applied to the voltage fed to the analog input 3.

| Pr4.29 | Title | Analog input 3 (AI3) filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 0 | | | |

Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 3.

| Pr4.30 | Title | Analog input 3 (AI3) overvoltage setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | 0.1V | Default | 0 | | | |

Set up the excessive level of the input voltage of analog input 3 by using the voltage associated with offset.

| Pr4.31 | Title | Positioning complete (In-position) range | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 262144 | Unit | Command unit | Default | 10 | | | |

Set up the timing of positional deviation at which the positioning complete signal (INP1) is output.

Caution

The command unit is used as the default unit but can be replaced by the encoder unit by using Pr5.20. Positioning unit selection. Note that when the encoder unit is used, unit of Pr0.14 Positional deviation excess setup is also changed.

| Pr4.32 | Title | Positioning complete (In-position) output setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

Select the condition to output the positioning complete signal (INP1).

| Setup value | Action of positioning complete signal |
|---|---|
| **0** | The signal will turn on when the positional deviation is smaller than Pr4.31 (Positioning complete range) |
| 1 | The signal will turn on when there is no position command and the positional deviation is smaller than Pr4.31 (Positioning complete range). |
| 2 | The signal will turn on when there is no position command, the zero-speed detection signal is ON and the positional deviation is smaller than Pr4.31 (Positioning complete range). |
| 3 | The signal will turn on when there is no position command and the positional deviation is smaller than Pr4.31 (Positioning complete range). Then holds "ON" status until the next position command is entered.Subsequently, ON state is maintained until Pr4.33 INP hold time has elapsed. After the hold time, INP output will be turned ON/OFF according to the coming positional command or condition of the positional deviation. |

| Pr4.33 | Title | INP hold time | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 30000 | Unit | 1ms | Default | 0 | | | |

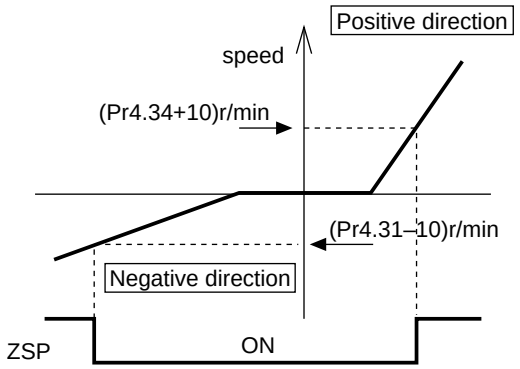
Set up the hold time when Pr4.32 Positioning complete output setup = 13.

| Setup value | State of positioning complete signal |
|---|---|
| 0 | The hold time is maintained definitely, keeping ON state until the next positional command is received. |
| 1 to 30000 | ON state is maintained for setup time (ms) but switched to OFF state as the positional command is received during hold time. |

| Pr4.34 | Title | Zero-speed | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 20000 | Unit | r/min | Default | 50 | | | |

You can set up the timing to feed out the zero-speed detection output signal (ZSP or TCL) in rotational speed [r/min].
The zero-speed detection signal (ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr4.34.
Output the speed coincidence (V-COIN) when the difference between the speed command and the motor speed reduces to a value equal to or below the speed specified by this parameter Pr4.34.

- The setup of Pr61 is valid for both Positive and Negative direction regardless of the motor rotating direction.
- There is hysteresis of 10 [r/min].

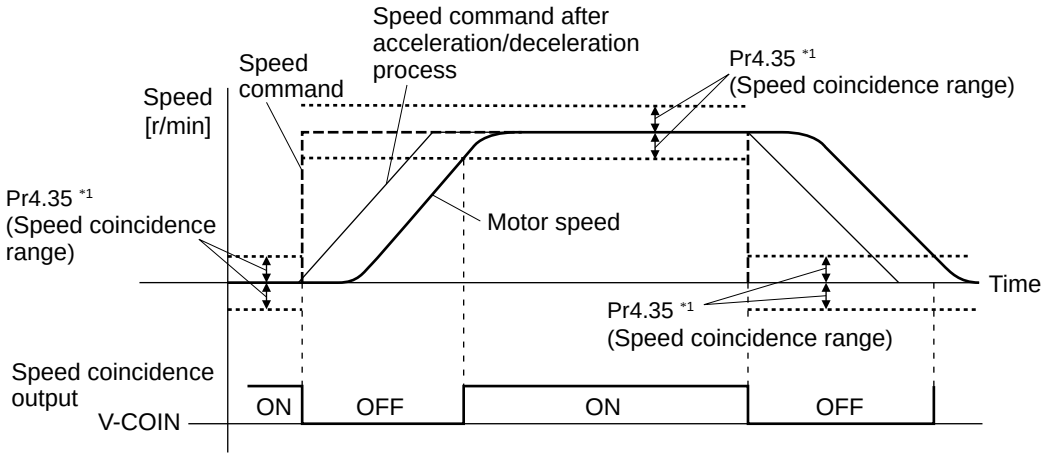



**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr4.35 | Title | Speed coincidence range | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 20000 | Unit | r/min | Default | 50 | | | |

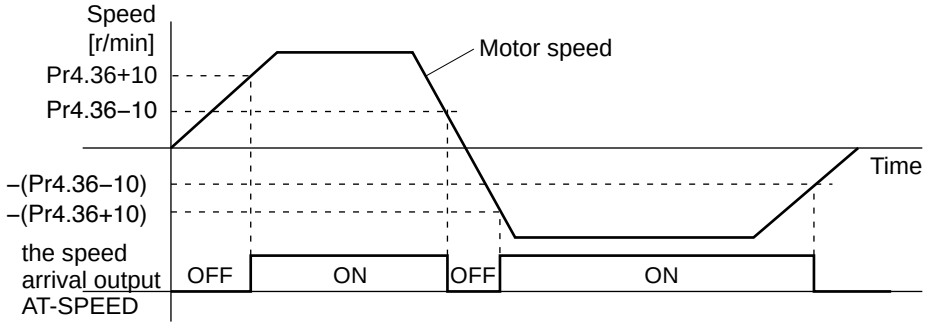
Set the speed coincidence (V-COIN) output detection timing.
Output the speed coincidence (V-COIN) when the difference between the speed command and the motor speed is equal to or smaller than the speed specified by this parameter.




*1 Because the speed coincidence detection is associated with 10 r/min hysteresis, actual detection range is as shown below.
Speed coincidence output OFF → ON timing (Pr4.35 – 10) r/min
Speed coincidence output ON → OFF timing (Pr4.35 + 10) r/min

| Pr4.36 | Title | At-speed (Speed arrival) | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 20000 | Unit | r/min | Default | 1000 | | | |

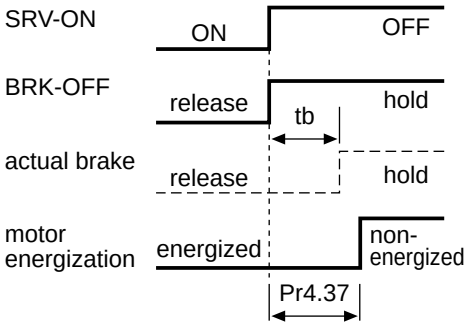
Set the detection timing of the speed arrival output (AT-SPEED).
When the motor speed exceeds this setup value, the speed arrival output (AT-SPEED) is output.
Detection is associated with 10 r/min hysteresis.



| Pr4.37 | Title | Mechanical brake action at stalling setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 1ms | Default | 0 | | | |

You can set up the time from when the brake release signal (BRK-OFF) turns off to when the motor is de-energized (Servo-free), when the motor turns to Servo-OFF while the motor is at stall.

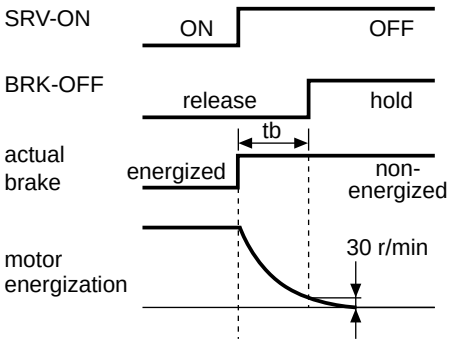
- Set up to prevent a micro-travel/ drop of the motor (work) due to the action delay time (tb) of the brake
- After setting up Pr6a >= tb, then compose the sequence so as the driver turns to Servo-OFF after the brake is actually activated.




| Pr4.38 | Title | Mechanical brake action at running setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 1ms | Default | 0 | | | |

You can set up time from when detecting the off of Servo-ON input signal (SRV-ON) is to when external brake release signal (BRK-OFF) turns off, while the motor turns to servo off during the motor in motion.

- Set up to prevent the brake deterioration due to the motor running.
- At Servo-OFF during the motor is running, tb of the right fig. will be a shorter one of either Pr6B setup time, or time lapse till the motor speed falls below 30r/min.




| Pr4.39 | Title | Brake release speed setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 30 to 3000 | Unit | r/min | Default | 30 | | | |

Set up the speed timing of brake output checking during operation.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4"

| Pr4.40 | Title | Selection of alarm output 1 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10 | Unit | — | Default | 0 | | | |

| Pr4.41 | Title | Selection of alarm output 2 | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10 | Unit | — | Default | 0 | | | |

Select the type of alarm issued as the alarm output 1 or 2.

| Setup value | Alarm | Content |
|---|---|---|
| **0** | — | ORed output of all alarms. |
| 1 | Overload protection | Load factor is 85% or more the protection level. |
| 2 | Over-regeneration alarm | Regenerative load factor is 85% or more the protection level. |
| 3 | Battery alarm | Battery voltage is 3.2 V or lower. |
| 4 | Fan alarm | Fan has stopped for 1 sec. |
| 5 | Encoder communication alarm | The number of successive encoder communication errors exceeds the specified value. |
| 6 | Encoder overheat alarm | The encoder detects overheat alarm. |
| 7 | Oscillation detection alarm | Oscillation or vibration is detected. |
| 8 | Lifetime detection alarm | Life expectancy of capacitor or fan becomes short. |
| 9 | External scale error alarm | The feedback scale detects the alarm. |
| 10 | External scale communication alarm | The number of successive feedback scale communication errors exceeds the specified value. |

Related page For detailed description of alarm types, refer to P.3-46.

| Pr4.42 | Title | 2nd Positioning complete (In-position) range | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 262144 | Unit | Command unit | Default | 10 | | | |

The INP2 turns ON whenever the positional deviation is lower than the value set up in this parameter, without being affected by Pr4.32 Positioning complete output setup. (Presence/absence of positional command is not related to this judgment.)

Caution The command unit is used as the default unit but can be replaced by the encoder unit by using Pr5.20. Positioning unit selection. Note that when the encoder unit is used, unit of Pr0.14 Positional deviation excess setup is also changed.

# 1. Details of parameter

## [Class 5] Enhancing setting

| Pr5.00 | Title | 2nd numerator of electronic gear | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to $2^{30}$ | Unit | — | Default | 0 |

| Pr5.01 | Title | 3rd numerator of electronic gear | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to $2^{30}$ | Unit | — | Default | 0 |

| Pr5.02 | Title | 4th numerator of electronic gear | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to $2^{30}$ | Unit | — | Default | 0 |

Set the 2nd to 4th numerator of division/multiplication operation made according to the command pulse input.
This setup is enabled when Pr0.08 command pulse counts per one motor revolution = 0.
When the setup value is 0, the numerator is replaced by the encoder resolution.

| Pr5.03 * | Title | Denominator of pulse output division | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 10 to 262144 | Unit | — | Default | 0 |

For details, refer to P.4-9 Pr0.11.

| Pr5.04 * | Title | Over-travel inhibit input setup | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 2 | Unit | — | Default | 1 |

Set up the operation of the run-inhibition (POT, NOT) inputs.

| Setup value | Operation |
|---|---|
| 0 | POT → Inhibit positive direction travel<br>NOT → Inhibit negative direction travel |
| **1** | Disable POT, NOT |
| 2 | POT or NOT input activates Err38.0 Run-inhibition input protection. |

| Pr5.05 * | Title | Sequence at over-travel inhibit | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 2 | Unit | — | Default | 0 |

When Pr5.04 Over-travel inhibition = 0, specify the status during deceleration and stop after application of the over-travel inhibition (POT, NOT).

**<Details of Pr5.05 (Sequence at over-travel inhibit)>**

| Pr5.04 | Pr5.05 | During deceleration | After stalling | Deviation counter content |
|---|---|---|---|---|
| 0 | **0** | Dynamic brake action | Torque command=0 towards inhibited direction | Hold |
| | 1 | Torque command=0 towards inhibited direction | Torque command=0 towards inhibited direction | Hold |
| | 2 | Emergency stop | Torque command=0 towards inhibited direction | Clears before/ after deceleration |

**Note**

- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page
- P.3-30... "Inputs and outputs on connector X4"
- P.6-3 "Protective Function"

| Pr5.06 | Title | Sequence at Servo-Off | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 9 | Unit | — | Default | 0 | | | |

Specify the status during deceleration and after stop, after servo-off.

| Setup value | During deceleration *3 | After stalling | Positional deviation/ feedback scale deviation |
|---|---|---|---|
| **0** | Dynamic Brake (DB) action | Dynamic Brake (DB) action | Clear *4 |
| 1 | Free-run (DB OFF) | Dynamic Brake (DB) action | Clear *4 |
| 2 | Dynamic Brake (DB) action | Free-run (DB OFF) | Clear *4 |
| 3 | Free-run (DB OFF) | Free-run (DB OFF) | Clear *4 |
| 4 | Dynamic Brake (DB) action | Dynamic Brake (DB) action | Hold *2 |
| 5 | Free-run (DB OFF) | Dynamic Brake (DB) action | Hold *2 |
| 6 | Dynamic Brake (DB) action | Free-run (DB OFF) | Hold *2 |
| 7 | Free-run (DB OFF) | Free-run (DB OFF) | Hold *2 |
| 8 | Emergency stop *1 | Dynamic Brake (DB) action | Clear *4 |
| 9 | Emergency stop *1 | Free-run (DB OFF) | Clear *4 |

*1 Emergency stop refers to a controlled immediate stop with servo-on.
The torque command value is limited during this process by Pr5.11 Emergency stop torque setup.

*2 If the positional command is kept applied or the motor is kept running with servo-off condition, positional deviation is accumulated, causing Err24.0 Excess positional deviation protection to be issued. If the servo is turned ON while the position or feedback scale is significantly deviating, the motor may rapidly operate to reduce the deviation to 0. Remember these requirements if you want to maintain the positional deviation/feedback scale deviation.

*3 Deceleration period is the time required for the running motor to speed down to 30 r/min. Once the motor speed drops below 30 r/min, it is treated as in stop state regardless of its speed.

*4 Positional deviation/feedback scale deviation is always cleared to 0.

**Caution** If an error occurs during servo-off, follow Pr5.10 Sequence at alarm. If the main power is turned off during servo-off, follow Pr5.07 Sequence during main power interruption.

**Related page** Refer to P.2-32, "Timing Chart"-Servo-ON/OFF action while the motor is at stall" of Preparation as well.

| Pr5.07 | Title | Sequence at main power OFF | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 9 | Unit | — | Default | 0 | | | |

Specify the status during deceleration after main power interrupt or after stoppage.
The relationship between the setup value of Pr5.06 and the operation and process at deviation counters is the same as that for Pr5.07 (sequence at main power OFF).

**Caution** If an error occurs with the main power supply turned off, Pr5.10 Sequence at alarm is applied to the operation.
When the main power supply is turned off with servo-on state, Err13.1 Main power undervoltage error occurs if Pr5.08 LV trip selection with main power off = 1, and the operation follows Pr5.10 Sequence at alarm.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

**Related page** • P.3-30... "Inputs and outputs on connector X4"

| Pr5.08 | Title | LV trip selection at main power OFF | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 1 | | | |

You can select whether or not to activate Err13 (Main power under-voltage protection) function while the main power shutoff continues for the setup of Pr5.09 (Main power-OFF detection time).

| Setup value | Action of main power low voltage protection |
|---|---|
| 0 | When the main power is shut off during Servo-ON, Err13 will not be triggered and the driver turns to Servo-OFF. The driver returns to Servo-ON again after the main power resumption. |
| **1** | When the main power is shut off during Servo-ON, the driver will trip due to Err13 (Main power low voltage protection). |

**Caution** This parameter is invalid when Pr5.09 (Detection time of main power OFF)=1000. Err13 (Main power under-voltage protection) is triggered when setup of P5.09 is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff, regardless of the Pr5.08 setup.

| Pr5.09 * | Title | Detection time of main power off | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 70 to 2000 | Unit | 1ms | Default | 70 | | | |

You can set up the time to detect the shutoff while the main power is kept shut off continuously. The main power off detection is invalid when you set up this to 2000.

| Pr5.10 | Title | Sequence at alarm | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 7 | Unit | — | Default | 0 | | | |

Specify the status during deceleration and after stop, after occurrence of alarm.

| Setup value | During deceleration *3 | After stalling | Positional deviation/ feedback scale deviation |
|---|---|---|---|
| **0** | Dynamic Brake (DB) action | Dynamic Brake (DB) action | Clear *1 |
| 1 | Free-run (DB OFF) | Dynamic Brake (DB) action | Clear *1 |
| 2 | Dynamic Brake (DB) action | Free-run (DB OFF) | Clear *1 |
| 3 | Free-run (DB OFF) | Free-run (DB OFF) | Clear *1 |
| 4 | Action A: Emergency stop<br>Action B: DB action *2 | Dynamic Brake (DB) action | Clear *1 |
| 5 | Action A: Emergency stop<br>Action B: DB OFF *2 | Dynamic Brake (DB) action | Clear *1 |
| 6 | Action A: Emergency stop<br>Action B: DB action *2 | Free-run (DB OFF) | Clear *1 |
| 7 | Action A: Emergency stop<br>Action B: DB OFF *2 | Free-run (DB OFF) | Clear *1 |

*1 Positional deviation/feedback scale deviation is maintained during alarm condition and will be cleared when the alarm is cancelled.

*2 Action of A/B: When an alarm requiring emergency stop occurs, the action A is selected when the setup value in the table is set within the range 4 to 7, causing emergency stop of operation. When an alarm not requiring emergency stop occurs, it triggers dynamic braking (DB) specified by action B, or free-running.

*3 Deceleration period is the time required for the running motor to speed down to 30 r/min.

| Pr5.11 | Title | Torque setup for emergency stop | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 0 | | | |

Set up the torque limit at emergency stop.

**Note** When setup value is 0, the torque limit for normal operation is applied.

| Pr5.12 | Title | Over-load level setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 0 | | | |

- You can set up the over-load level. The overload level becomes 115 [%] by setting up this to 0.
- Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-load level.
- The setup value of this parameter is limited by 115[%] of the motor rating.

| Pr5.13 | Title | Over-speed level setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Default | 0 to 20000 | Unit | r/min | Default | 0 | | | |

- If the motor speed exceeds this setup value, Err26.0 Over-speed protection occurs.
- The over-speed level becomes 1.2 times of the motor max. speed by setting up this to 0.

| Pr5.14 | Title | Motor working range setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1 revolution | Default | 10 | | | |

- You can set up the movable range of the motor against the position command input range.
- When the motor movement exceeds the setup value, software limit protection of Err34.0 will be triggered.

| Pr5.15 * | Title | I/F reading filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 0 | | | |

Select reading period of the control input signal.

| Setup value | Reading period of the signal. |
|---|---|
| **0** | 0.166ms |
| 1 | 0.333ms |
| 2 | 1ms |
| 3 | 1.666ms |

Exclude deviation counter clear input (CL) and command pulse inhibit input (INH).

| Pr5.16 * | Title | Alarm clear input setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Select alarm clear input (A-CLR) recognition time.

| Setup value | Recognition time |
|---|---|
| **0** | 120ms |
| 1 | To Pr5.15 IF reading filter |

| Pr5.17 | Title | Counter clear input mode | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 4 | Unit | — | Default | 3 |

You can set up the clearing conditions of the counter clear input signal.

| Setup value | Clear condition |
|---|---|
| 0 | Invalid |
| 1 | Clear at a level (no reading filter) |
| 2 | Clear at a level (with reading filter) |
| **3** | Clear at an edge (no reading filter) |
| 4 | Clear at an edge (with reading filter) |

**Note** For signal width/timing requiring the deviation counter input, refer to P.3-38.

| Pr5.18 | Title | Invalidation of command pulse inhibit input | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 1 |

Select command pulse inhibit input enable/disable.

| Setup value | INH input |
|---|---|
| 0 | Valid |
| **1** | Invalid |

| Pr5.19 * | Title | Command pulse inhibit input reading setup | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 4 | Unit | — | Default | 0 |

Select command pulse inhibit input enable/disable signal reading period. When the status of several signals read during the predetermined reading period are same, update the signal status.

| Setup value | Signal reading period |
|---|---|
| **0** | 0.166ms |
| 1 | 0.333ms |
| 2 | 1ms |
| 3 | 1.666ms |
| 4 | 0.166 ms (no check for multiple coincidence) |

**Caution** Longer reading period protects against operation error due to noise but decreases response to input signal.

| Pr5.20 * | Title | Position setup unit select | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 |

Specify the unit to determine the range of positioning complete and excessive positional deviation.

| Setup value | Unit |
|---|---|
| **0** | Command unit |
| 1 | Encoder unit |

**Note**
- **For parameters which No. have a suffix of " * ",** changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4" • P.6-3 "Protective Function"

| Pr5.21 | Title | Selection of torque limit | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 6 | Unit | — | Default | 1 |

You can set up the torque limiting method.

| Setup value | Positive direction | Negative direction |
|---|---|---|
| 0 | P-ATL (0 to 10V) | N-ATL (–10 to 0V) |
| **1** | 1st torque limit (Pr0.13) | |
| 2 | 1st torque limit (Pr0.13) | 2nd torque limit (Pr5.22) |
| 3 | TL-SEL OFF → 1st torque limit (Pr0.13)<br>TL-SEL ON → 2nd torque limit (Pr5.22) | |
| 4 | P-ATL (0 to 10V) | N-ATL (0 to 10V) |
| 5 | P-ATL (0 to 10V) | |
| 6 | TL-SEL OFF | |
| | 1st torque limit (Pr0.13) | 2nd torque limit (Pr5.22) |
| | TL-SEL ON | |
| | External input positive direction torque limit (Pr5.25) | External input negative direction torque limit (Pr5.26) |

| Pr5.22 | Title | 2nd torque limit | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 500 |

You can set up the 2nd limit value of the motor output torque.
The value of parameter is limited to the maximum torque of the applicable motor.

**Note** For details of torque limit value, refer to P.2-49.

| Pr5.23 | Title | Torque limit switching setup 1 | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 4000 | Unit | ms/100% | Default | 0 |

Specify the rate of change (slope) from 1st to 2nd during torque limit switching.

| Pr5.24 | Title | Torque limit switching setup 2 | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 4000 | Unit | ms/100% | Default | 0 |

Specify the rate of change (slope) from 2nd to 1st during torque limit switching.

| Pr5.25 | Title | External input positive direction torque limit | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 500 |

Set up positive direction torque limit upon receiving TL-SEL with Pr5.21 Selection of torque limit set at 6.
The value of parameter is limited to the maximum torque of the applicable motor.

**Note** For details of torque limit value, refer to P.2-49.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.3-30... "Inputs and outputs on connector X4" • P.6-3 "Protective Function"

| Pr5.26 | Title | External input negative direction torque limit | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | % | Default | 500 | | | |

Set up negative direction torque limit upon receiving TL-SEL with Pr5.21 Selection of torque limit set at 6.
The value of parameter is limited to the maximum torque of the applicable motor.

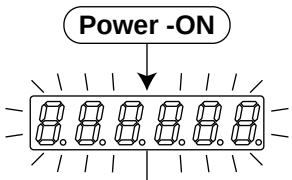
**Note** For details of torque limit value, refer to P.2-49.

| Pr5.27 | Title | Input gain of analog torque limit | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 10 to 100 | Unit | 0.1V/100% | Default | 30 | | | |

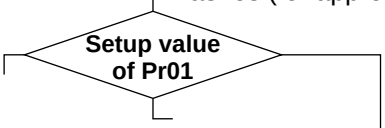
From the voltage [V] applied to the analog torque limit input (P-ATL, N-ATL), set conversion gain to torque limit [%].

| Pr5.28 * | Title | LED initial status | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 35 | Unit | — | Default | 1 | | | |

You can select the type of data to be displayed on the front panel LED (7 segment) at the initial status after power-on.




Flashes (for approx. 2 sec) during initialization




| Setup value | Content | Setup value | Content | Setup value | Content |
|---|---|---|---|---|---|
| 0 | Positional command deviation | 12 | Error factor and reference of history | 24 | Encoder positional deviation [Encoder unit] |
| 1 | Motor speed | 13 | Alarm Display | 25 | External scale deviation [External scale unit] |
| 2 | Positional command speed | 14 | Regenerative load factor | 26 | Hybrid deviation [Command unit] |
| 3 | Velocity control command | 15 | Over-load factor | 27 | Voltage across PN [V] |
| 4 | Torque command | 16 | Inertia ratio | 28 | Software version |
| 5 | Feedback pulse sum | 17 | Factor of no-motor running | 29 | Driver serial number |
| 6 | Command pulse sum | 18 | No. of changes in I/O signals | 30 | Motor serial number |
| 8 | External scale feedback pulse sum | 20 | Absolute encoder data | 31 | Accumulated operation time |
| 9 | Control mode | 21 | Absolute external scale position | 32 | Automatic motor recognizing function |
| 10 | I/O signal status | 22 | No. of encoder/ external scale communication errors monitor | 33 | Driver temperature |
| 11 | Analog input value | 23 | Communication axis address | 35 | Safety condition monitor |

Related page For details of display, refer to P.2-58 "Setup of Parameter and Mode" of Preparation.

| Pr5.29 * | Title | Baud rate setup of RS232 communication | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6 | Unit | — | Default | 2 | | | |

You can set up the communication speed of RS232.

**Note** For baud rate setup value, refer to RS485 setup.

| Pr5.30 * | Title | Baud rate setup of RS485 communication | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6 | Unit | — | Default | 2 | | | |

You can set up the communication speed of RS485.

| Setup value | Baud rate |
|---|---|
| 0 | 2400bps |
| 1 | 4800bps |
| **2** | 9600bps |
| 3 | 19200bps |

| Setup value | Baud rate |
|---|---|
| 4 | 38400bps |
| 5 | 57600bps |
| 6 | 115200bps |

Baud rate error is ±0.5% for 2400 to 38400 bps, and ±2% for 57,600 to 115,200 bps.

| Pr5.31 * | Title | Axis address | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 127 | Unit | — | Default | 1 | | | |

During communication with the host (e.g. PC) to control multiple shafts, the shaft being accessed by the host should be identified.

**Note** When using RS232/RS485, the maximum valid value is 31.

| Pr5.32 * | Title | Command pulse input maximum setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 250 to 4000 | Unit | — | Default | 4000 | | | |

Set the maximum number of pulses to be used as command pulse input. If the number of input pulses is outside the range, Err.27.0 Command pulse input frequency error protection occurs.

**Caution** The number of input pulses received by the driver is always checked. If the frequency of the received pulse is higher than the upper limit of the setting, input pulses are not accurately detected.

| Pr5.33 * | Title | Pulse regenerative output limit setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Enable/disable detection of Err28.0 Pulse regenerative limit protection.

| Setup value | Content |
|---|---|
| **0** | Invalid |
| 1 | Valid |

| Pr5.34 | Title | For manufacturer's use | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | — | Unit | — | Default | 4 | | | |

Fixed to 4.

| Pr5.35 * | Title | Front panel lock setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Lock the operation on the front panel.

| Setup value | Content |
|---|---|
| **0** | No limit on the front panel operation |
| 1 | Lock the operation on the front panel |

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.2-49 "Setup of Torque Limit" • P.3-30... "Inputs and outputs on connector X4" • P.6-3 "Protective Function"

# 1. Details of parameter

## [Class 6] Special setting

| Pr6.00 | Title | Analog torque feed forward conversion gain | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | 0.1V/100% | Default | 0 |

- Set the input gain of analog torque feed forward.
  0 to 9 are invalid.

**<Usage example of Analog torque feed forward>**

- Setting bit 5 place of Pr6.10 Function expansion setup to 1 enables the analog torque feed forward. When the analog input 3 is used by another function (e.g. analog torque limit), the function becomes invalid.
- The voltage (V) applied to the analog input 3 is converted to the torque via Pr6.00 Analog torque feed forward conversion gain setup and added to the torque command (%).
- The conversion of analog input 3, input voltage [V], to the torque command [%] to the motor may be expressed mathematically as follows:

Torque command (%) = 100 × input voltage (V) / (Pr6.00 setup value × 0.1)

| Pr6.02 | Title | Velocity deviation excess setup | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | r/min | Default | 0 |

When the speed deviation (difference between internal positional command and actual speed) exceeds this value, Err24.1 Speed over deviation protection occurs.
This protection is not detected when the setup value is 0.

| Pr6.04 | Title | JOG trial run command speed | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 500 | Unit | r/min | Default | 300 |

Set up the command speed used for JOG trial run (velocity control).

Related page Before using, refer to P.4-58 Preparation Trial Run.

| Pr6.05 | Title | Position 3rd gain valid time | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | 0.1ms | Default | 0 |

- Set up the time at which 3rd gain becomes valid.
- When not using this parameter, set Pr6.05 to 0 and Pr6.06 to 100.
- This is valid for only position control/full-closed control.

| Pr6.06 | Title | Position 3rd gain scale factor | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | 50 to 1000 | Unit | % | Default | 100 |

- Set up the 3rd gain by a multiplying factor of the 1st gain:
- 3rd gain = 1st gain × Pr6.06/100

| Pr6.07 | Title | Torque command additional value | | | Related control mode | P S T F |
|---|---|---|---|---|---|---|
| | Range | –100 to 100 | Unit | % | Default | 0 |

- Set up the offset load compensation value usually added to the torque command in a control mode except for the torque control mode.
- Update this parameter when the vertical axis mode for real time auto-tuning is valid.

| Pr6.08 | Title | Positive direction torque compensation value | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –100 to 100 | Unit | % | Default | 0 | | | |

- Set up the dynamic friction compensation value to be added to the torque command when forward positional command is fed.
- Update this parameter when the friction compensation mode for real time auto-tuning is valid.

| Pr6.09 | Title | Negative direction torque compensation value | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –100 to 100 | Unit | % | Default | 0 | | | |

- Set up the dynamic friction compensation value to be added to the torque command when negative direction positional command is fed.
- Update this parameter when the friction compensation mode for real time auto-tuning is valid.

| Pr6.10 | Title | Function expansion setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 63 | Unit | — | Default | 0 | | | |

Set up the function in unit of bit.

| | Function | Setup value | |
|---|---|---|---|
| | | 0 | 1 |
| bit 0 | Speed observer | Invalid | Valid |
| bit 1 | Disturbance observer | Invalid | Valid |
| bit 2 | Disturbance observer operation setup | Always valid | Valid only when 1st gain is selected. |
| bit 3 | Inertia ratio switching | Invalid | Valid |
| bit 4 | Current response improvement | Invalid | Valid |
| bit 5 | Analog torque FF | Invalid | Valid |

* bit 0 = LSB

| Pr6.11 | Title | Current response setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 50 to 100 | Unit | % | Default | 100 | | | |

Fine tune the current response with respect to default setup (100%).

| Pr6.13 | Title | 2nd Inertia ratio | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10000 | Unit | % | Default | 250 | | | |

Set 1st inertia ratio.
You can set up the ratio of the load inertia against the rotor (of the motor) inertia.

Pr6.13 = (load inertia/ rotor inertia) × 100 [%]

Caution If the inertia ratio is correctly set, the setup unit of Pr1.01 and Pr1.06 becomes (Hz). When the inertia ratio of Pr0.04 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr0.04 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.

| Pr6.14 | Title | Emergency stop time at alarm | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 1ms | Default | 200 | | | |

Set up the time allowed to complete emergency stop in an alarm condition. Exceeding this time puts the system in alarm state.
When setup value is 0, immediate stop is disabled and the immediate alarm stop is enabled.

| Pr6.15 | Title | 2nd over-speed level setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 20000 | Unit | r/min | Default | 0 | | | |

When the motor speed exceeds this setup time during emergency stop sequence in an alarm condition, Err26.1 2nd overspeed protection will be activated.
The over-speed level becomes 1.2 times of the motor max. speed by setting up this to 0.

| Pr6.17 * | Title | Front panel parameter writing selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Specify the EEPROM writing procedure when parameter is edited form the front panel.

| Setup value | Writing |
|---|---|
| 0 | Do not write to EEPROM at the same time |
| 1 | Write to EEPROM at the same time |

| Pr6.18 * | Title | Power-up wait time | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 100 | Unit | 0.1s | Default | 0 | | | |

Set up the standard initialization time (1.5 s + α) after power-up.

| Pr6.19 * | Title | Encoder Z phase setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 32767 | Unit | pulse | Default | 0 | | | |

If the number of output pulses per one motor revolution after division of pulse output is not an integer, fine adjust the width of encoder Z phase.

| Pr6.20 * | Title | Z-phase setup of external scale | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 400 | Unit | μs | Default | 0 | | | |

Set up the Z phase regenerative width of feedback scale in unit of time. Even if the width of Z phase signal cannot be detected because the width equivalent of the travel distance from the feedback scale is too short, the Z phase signal will be output for at least the period set to this parameter.

**Note** • **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page • P.2-73 "EEPROM Writing" • P.3-30... "Inputs and outputs on connector X4" • P.6-3 "Protective Function"

| Pr6.21 * | Title | Serial absolute external scale Z phase setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to $2^{28}$ | Unit | pulse | Default | 0 | | | |

Full-closed control using serial absolute feedback scale. When outputting pulses by using the feedback scale as the source of the output, set the Z phase output interval in units of A phase output pulses of the feedback scale (before multiplied by 4).

| Setup value | Content |
|---|---|
| 0 | Output Z phase only at absolute 0 position of feedback scale. |
| 1 to 268435456 | After the power is fed to the driver, the Z phase, as it crosses the zero at the absolute position of feedback scale, is output in synchronous with the A phase. Subsequently, the Z phase is output at the A phase output pulse intervals set to this parameter. |

| Pr6.22 * | Title | A, B phase external scale pulse output method selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1 | Unit | — | Default | 0 | | | |

Select the pulse regeneration method of A, B and Z parallel feedback scale.

| Setup value | Regenerating method |
|---|---|
| 0 | Directly output the signals from A, B and Z parallel feedback scales. |
| 1 | Output A and B phase signals recovered from A, B and Z parallel feedback scales. Z-phase is output directly. |

| Pr6.23 | Title | Disturbance torque compensating gain | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –100 to 100 | Unit | % | Default | 0 | | | |

- Set up -100 to 100% compensating gain against disturbance torque.
- After setting up Pr6.24, increase Pr6.23.
  The disturbance suppressing capability increases by increasing the gain, but it is associated with increasing volume of operation noise.
  This means that well balanced setup can be obtained by adjusting Pr6.24 and Pr6.23.

| Pr6.24 | Title | Disturbance observer filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 2500 | Unit | 0.01ms | Default | 53 | | | |

- Filter setup 10-2500, 0.01 ms. Set up the filter time constant according to the disturbance torque compensation.
- First, set up Pr6.24 to a larger value and check the operation with Pr6.23 Disturbance torque compensating gain set to a low value, and then gradually decrease the setup value of Pr6.24. A low filter setup value assures disturbance torque estimation with small delay and effectively suppresses effects of disturbance. However, this results in larger operation noise. Well balanced setup is required.

| Pr6.27 * | Title | Alarm latch time selection | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 10 | Unit | — | Default | 5 | | | |

Set up the latch time.

| Setup value | Content |
|---|---|
| 0 | Latch time: infinite |
| 1 to 10 | Latch time: 1 to 10 s |

| Pr6.31 | Title | Real time auto tuning estimation speed | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 3 | Unit | — | Default | 1 | | | |

Set up the load characteristics estimation speed with the real time auto tuning being valid. A higher setup value assures faster response to a change in load characteristics but increases variations in disturbance estimation. Result of estimation is saved to EEPROM every 30 minutes.

| Setup value | Mode | Description |
|---|---|---|
| 0 | No change | Stop estimation of load characteristics. |
| **1** | Almost constant | Response to changes in load characteristics in every minute. |
| 2 | Slower change | Response to changes in load characteristics in every second. |
| 3 * | Faster change | Obtain best suitable estimation in response to changes in load characteristics. |

* If the automatic oscillation detection is enabled by the support software PANATERM, the setup value 3 is used.

| Pr6.32 | Title | Real time auto tuning custom setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –32768 to 32767 | Unit | — | Default | 0 | | | |

When the operation mode of real time auto tuning is set to the customize (Pr0.02 = 6), set the automatic adjusting function as shown below.

| Bit | Content | Description |
|---|---|---|
| 1 to 0 | Load characteristics estimation * | Enable/disable the load characteristics estimation function.<br>**Setup value** / **Function**<br>**0** Disable<br>1 Enable<br>* If the load characteristics estimation is disabled, the current setup cannot be changed even if the inertia ratio is updated according to the estimated value. When the torque compensation is updated by the estimated value, it is cleared to 0 (invalid). |
| 3 to 2 | Inertia ratio update | Set up update to be made based on result of the load characteristics estimation of Pr0.04 Inertia ratio.<br>**Setup value** / **Function**<br>**0** Use the current setup.<br>1 Update by the estimated value. |

(continued)

**Note**
- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.
- The setup support software PANATERM can be downloaded from our web site.

Related page
- P.3-30... "Inputs and outputs on connector X4"

<table>
<tr>
<td>6 to 4</td>
<td>Torque compensation</td>
<td>Set up the update to be made according to the results of load characteristics estimation of Pr6.07 Torque command additional value, Pr6.08 positive direction torque compensation value and Pr6.09 negative direction torque compensation value.
<table>
<tr><th>Setup value</th><th>Function</th><th colspan="3">Compensation setup</th></tr>
<tr><td>0</td><td>Use current setup</td><td>Pr6.07</td><td>Pr6.08</td><td>Pr6.09</td></tr>
<tr><td>1</td><td>Disable torque compensation</td><td>0 clear</td><td>0 clear</td><td>0 clear</td></tr>
<tr><td>2</td><td>Vertical axis mode</td><td>Update</td><td>0 clear</td><td>0 clear</td></tr>
<tr><td>3</td><td>Friction compensation (low)</td><td>Update</td><td>Low</td><td>Low</td></tr>
<tr><td>4</td><td>Friction compensation (middle)</td><td>Update</td><td>Middle</td><td>Middle</td></tr>
<tr><td>5</td><td>Friction compensation (high)</td><td>Update</td><td>High</td><td>High</td></tr>
</table>
</td>
</tr>
<tr>
<td>7</td>
<td>Stiffness setup</td>
<td>Enable/disable the basic gain setup to be made according to Pr0.03 Real time auto tuning mechanical stiffness selection.
<table>
<tr><th>Setup value</th><th>Function</th></tr>
<tr><td>0</td><td>Disable</td></tr>
<tr><td>1</td><td>Enable</td></tr>
</table>
</td>
</tr>
<tr>
<td>8</td>
<td>Fixed parameter setup</td>
<td>Enable/disable the change of parameter that is normally set at a fixed value.
<table>
<tr><th>Setup value</th><th>Function</th></tr>
<tr><td>0</td><td>Use the current setup.</td></tr>
<tr><td>1</td><td>Set to a fixed value.</td></tr>
</table>
</td>
</tr>
<tr>
<td>10 to 9</td>
<td>Gain switching setup</td>
<td>Select the gain switching related parameter to be used when the real time auto tuning is enabled.
<table>
<tr><th>Setup value</th><th>Function</th></tr>
<tr><td>0</td><td>Use the current setup.</td></tr>
<tr><td>1</td><td>Disable gain switching.</td></tr>
<tr><td>2</td><td>Enable gain switching.</td></tr>
</table>
</td>
</tr>
</table>

**Caution** This parameter should be setup bit by bit. To prevent setting error, use of the setup support software is recommended when editing parameter.

**<Setup procedure of bitwise parameter>**

When setting parameter to a value other than 0, calculate the setup value of Pr6.32 in the following procedure.

1) Identify the LSB of the setup.
   Example: LSB of the torque compensation function is 4.
2) Multiply the setup value by power of 2 (LSB).
   Example: To set the torque compensation function to friction compensation (middle):
   $24 \times 4 = 64$.
3) Perform steps 1) and 2) for every setups, sum up the values which are to be Pr6.32 setup value.
   Example: Load characteristics measurement = enable, inertia ratio update = enable, torque compensation = friction compensation (middle), stiffness setup = enable, fixed parameter = set to a fixed value, gain switching setup = enable, then,
   $20 \times 1 + 22 \times 1 + 24 \times 4 + 27 \times 1 + 28 \times 1 + 29 \times 2 = 1477$

| Pr6.34 | Title | Hybrid vibration suppression gain | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 30000 | Unit | 0.1/s | Default | 0 | | | |

Set up the hybrid vibration suppression gain for full-closed controlling.
First set it to the value identical to that of poison loop gain, and then fine tune as necessary.

| Pr6.35 | Title | Hybrid vibration suppression filter | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 6400 | Unit | 0.01ms | Default | 10 | | | |

Set up the time constant of the hybrid vibration suppression filter for full-closed controlling.
While driving under full-closed control, gradually increase the setup value and check changes in the response.

| Pr6.37 | Title | Oscillation detecting level | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | 0 to 1000 | Unit | 0.1% | Default | 0 | | | |

Set up the oscillation detecting level.
Upon detection of a torque vibration whose level is higher than this setup value, the oscillation detection alarm will be issued.

| Pr6.38 * | Title | Alarm mask setup | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | –32768 to 32767 | Unit | — | Default | 0 | | | |

Set up the alarm detection mask. Placing 1 to the corresponding bit position disables detection of the alarm condition.

| Pr6.39 | Title | For manufacturer's use | | | Related control mode | P | S | T | F |
|---|---|---|---|---|---|---|---|---|---|
| | Range | — | Unit | — | Default | 0 | | | |

Fixed to 0.

**Note**

- **For parameters which No. have a suffix of " * "**, changed contents will be validated when you turn on the control power.

Related page

- P.3-30... "Inputs and outputs on connector X4"

# 2.Trial Run (JOG run)

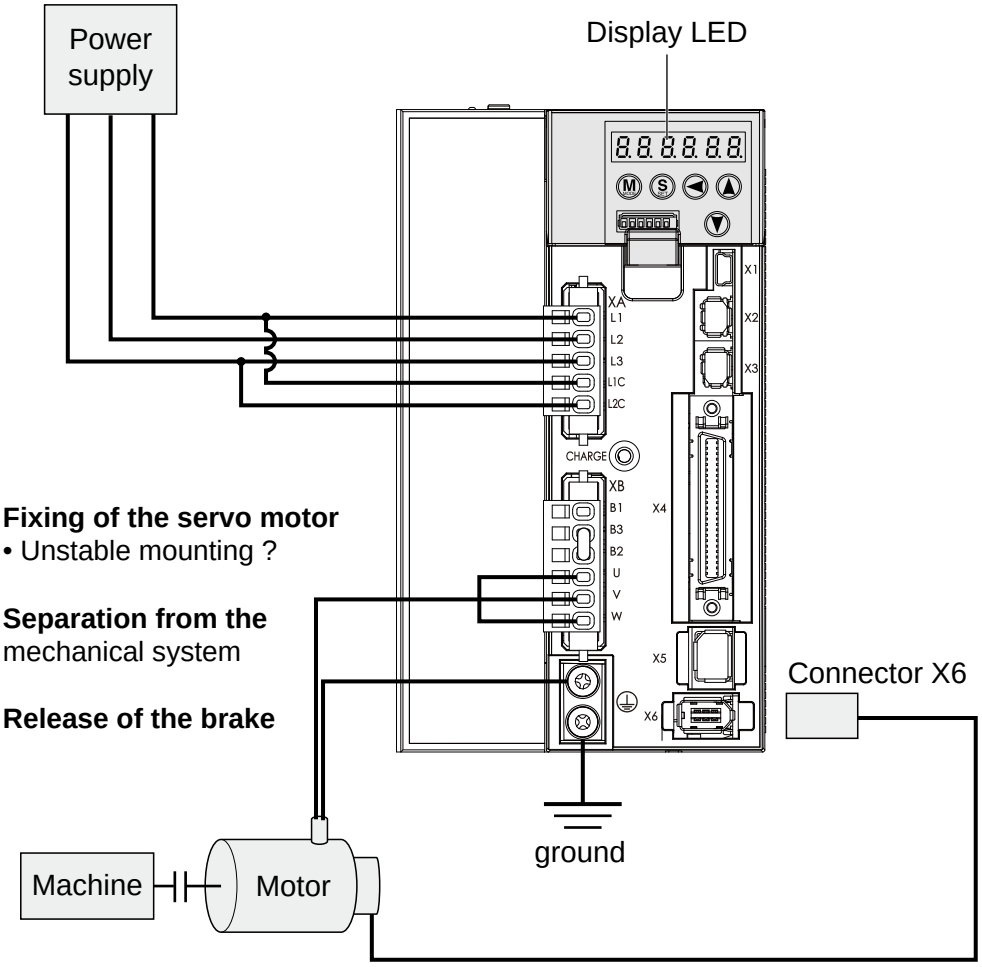
## Inspection Before Trial Run

### (1) Inspection on wiring

- Miswiring ? (Especially power input and motor output)
- Short or grounded ?
- Loose connection ?

### (2) Confirmation of power supply and voltage

- Rated voltage ?




### (3) Fixing of the servo motor

- Unstable mounting ?

### (4) Separation from the mechanical system

### (5) Release of the brake

### (6) Turn to Servo-OFF after finishing the trial run by pressing (S SET).

**Note** Details of wiring, refer to P.2-8 “Overall Wiring”

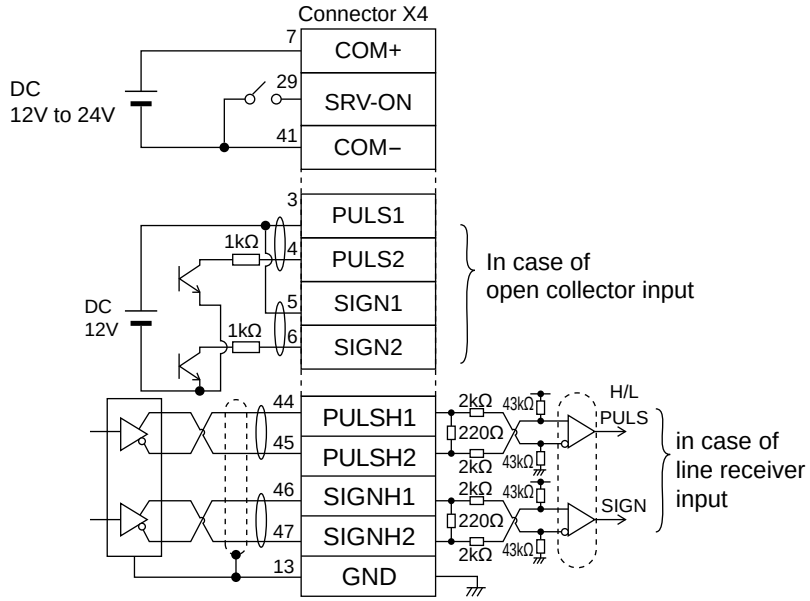
# 2.Trial Run (JOG run)

## Trial Run by Connecting the Connector, CN X4

### Trial Run (JOG run) at Position Control Mode

(1) Connect the Connector X4.
(2) Enter the power (DC12 to 24V) to control signal (COM+, COM–)
(3) Enter the power to the driver.
(4) Confirm the default values of parameters.
(5) Match to the output format of the host controller with Pr0.07 (Command pulse input mode setup).
(6) Write to EEPROM and turn off/on the power (of the driver).
(7) Connect the Servo-ON input (SRV-ON, Connector X4, Pin-29) and COM– (Connector X5, Pin-41) to bring the driver to Servo-ON status and energize the motor.
(8) Enter low frequency from the host controller to run the motor at low speed.
(9) Check the motor rotational speed at monitor mode whether,
rotational speed is as per the setup or not, and
the motor stops by stopping the command (pulse) or not.
(10) If the motor does not run correctly, refer to P.2-64, "Display of Factor for No-Motor Running" of Preparation.

**• Wiring Diagram**




**• Parameter**

| Pr No. | Title | Setup value |
|---|---|---|
| 0.01 | Control mode setup | 0 |
| 5.04 | Over-travel inhibit input setup | 1 |
| 0.05 | Selection of command pulse input | 0/1 |
| 0.07 | Command pulse input mode setup | 1 |
| 5.18 | Invalidation of command pulse inhibit input | 1 |
| 5.17 | Counter clear input mode | 2 |

**• Input signal status**

| No. | Title of signal | Monitor display |
|---|---|---|
| 0 | Servo-ON | +A |

## Trial Run (JOG run) at Velocity Control Mode

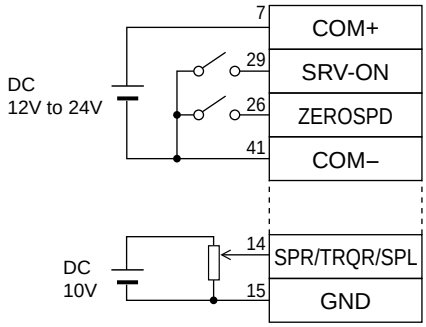
1) Connect the Connector X4.
2) Enter the power (DC12 to 24V) to control signal (COM+, COM–)
3) Enter the power to the driver.
4) Confirm the default values of parameters.
5) Connect the Servo-ON input (SRV-ON, Connector X4, Pin-29) and COM– (Connector X4, Pin-14) to turn to Servo-ON and energize the motor.
6) Close the speed zero clamp input (ZEROSPD) and apply DC voltage between velocity command input , SPR (Connector X4, Pin-14) and GND (Connector X4, Pin-15), and gradually increase from 0V to confirm the motor runs.
7) Confirm the motor rotational speed in monitor mode.
   - Whether the rotational speed is per the setup or not.
   - Whether the motor stops with zero command or not.
8) If the motor does rotate at a micro speed with command voltage of 0.
9) When you want to change the rotational speed and direction, set up the following parameters again.

   Pr3.00: Speed setup, Internal/External switching
   Pr3.01: Speed command rotational direction selection
   Pr3.03: Reversal of speed command input

   Refer to P.4-24, "Parameter Setup" (Parameters for Velocity/Torque Control)

10) If the motor does not run correctly, refer to P.2-64, "Display of Factor for No-Motor Running" of Preparation.

**• Wiring Diagram**




Run with ZEROSPD switch close, and Stop with open

In case of bi-directional operation (Positive/Negative), provide a bipolar power supply, or use with Pr03.15 = 3.

In case of one-directional operation

**• Parameter**

| Pr No. | Title | Setup value |
|---|---|---|
| 0.01 | Control mode setup | 1 |
| 5.04 | Over-travel inhibit input setup | 1 |
| 3.15 | Speed zero-clamp function selection | 1 |
| 3.00 | Speed setup, Internal/External switching | Set up as required |
| 3.01 | Speed command rotational direction selection | |
| 3.02 | Input gain of speed command | |
| 3.03 | Reversal of speed command input | |
| 4.22 | Analog input 1 (AI1) offset setup | |
| 4.23 | Analog input 1 (AI1) filter | |

**• Input signal status**

| No. | Title of signal | Monitor display |
|---|---|---|
| 0 | Servo-ON | +A |
| 5 | Speed zero clamp | — |

## Trial Run (JOG run) at Torque Control Mode

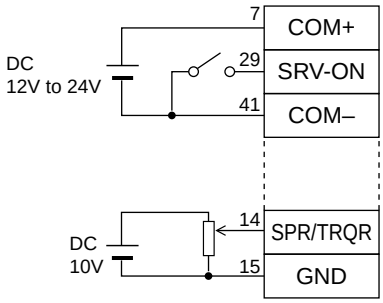
1) Connect the Connector X4.
2) Enter the power (DC12-24V) to control signal (COM+, COM–)
3) Enter the power to the driver.
4) Confirm the default values of parameters.
5) Set a lower value to Pr3.07 (4th speed of speed setup).
6) Energize the motor by connecting the Servo-ON input (SRV-ON, Connector X4, Pin-29) and COM– (Pin-41 of Connector X4) to turn to Servo-ON status.
7) Confirm that the motor runs as per the setup of Pr3.07 by applying DC voltage (positive/negative) between the torque command input (Pin-14 of Connector X4) and GND (Pin-41 of Connector X4).
8) If you want to change the torque magnitude, direction and velocity limit value against the command voltage, set up the following parameters.

Pr3.19: Input gain of torque command
Pr3.20: Input reversal of torque command
Pr3.21: Speed limit value 1

Refer to P.2-28, 29, "Parameter Setup" (Parameters for Velocity/Torque Control)

9) If the motor does not run correctly, refer to P.2-64, "Display of factor for No-motor running" of Preparation.

### • Wiring Diagram




For bi-directional running (Positive/Negative), provide a bipolar power supply.

In case of one way running

### • Parameter

| Pr No. | Title | Setup value |
|---|---|---|
| 0.01 | Control mode setup | 2 |
| 5.04 | Over-travel inhibit input setup | 1 |
| 3.15 | Speed zero-clamp function selection | 0 |
| 3.17 | Selection of torque command | 0 |
| 3.19 | Input gain of torque command | Set up as required |
| 3.20 | Input reversal of torque command | |
| 3.21 | Speed limit value 1 | lower value |

### • Input signal status

| No. | Title of signal | Monitor display |
|---|---|---|
| 0 | Servo-ON | +A |
| 5 | Speed zero clamp | — |

# 2.Trial Run (JOG run)

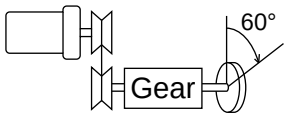
## Setup of Motor Rotational Speed and Input Pulse Frequency

| Input pulse frequency (pps) | Motor rotational speed (r/min) | Pr0.08 | |
|---|---|---|---|
| | | 17-bit | 20-bit |
| 2M | 3000 | $\frac{2^{17}}{40000}$ | $\frac{2^{20}}{40000}$ |
| 500K | 3000 | $\frac{2^{17}}{10000}$ | $\frac{2^{20}}{10000}$ |
| 250K | 3000 | $\frac{2^{17}}{5000}$ | $\frac{2^{20}}{5000}$ |
| 100K | 3000 | $\frac{2^{17}}{2000}$ | $\frac{2^{20}}{2000}$ |
| 500K | 1500 | $\frac{2^{17}}{20000}$ | $\frac{2^{20}}{20000}$ |

**Note** When setting Pr0.08, and encoder resolution is automatically set up as numerators.

**Caution**
- Max. input pulse frequency varies depending on input terminals.
- You can set up any values to numerator and denominator, however, setup of an extreme division ratio or multiplication ratio may result in dangerous action. Recommended ratio is 1/1000 to 1000.

### Relation between the motor rotational speed and input pulse counts




Pulley ratio : $\frac{18}{60}$

Gear ratio : $\frac{12}{73}$

Total reduction ratio : $\frac{18}{365}$

When setting the command division and multiplication ratio as numerator/denominator, express it as Pr0.09/Pr0.10 with Pr0.08 = 0.

e.g.) When you want to rotate the motor by 60° with the load of total reduction ratio of 18/365.

| | Encoder | |
|---|---|---|
| | 17-bit | 20-bit |
| $\frac{\text{Pr0.09}}{\text{Pr0.10}}$ | $\frac{5840}{108}$ | $\frac{5840}{67500}$ |
| Command pulse | To rotate the output shaft by 60°, enter the command of 8192 ($2^{13}$) pulses from the host controller. | To rotate the output shaft by 60°, enter the command of 10000 pulses from the host controller. |
| How to determine parameter | $\frac{365}{18} \times \frac{1\times2^{17}}{2^{13}} \times \frac{60°}{360°} = \frac{5840}{108}$ | $\frac{365}{18} \times \frac{1\times2^{20}}{10000} \times \frac{60°}{360°} = \frac{5840}{67500}$ |

| $2^n$ | Decimal figures |
|---|---|
| $2^0$ | 1 |
| $2^1$ | 2 |
| $2^2$ | 4 |
| $2^3$ | 8 |
| $2^4$ | 16 |
| $2^5$ | 32 |
| $2^6$ | 64 |
| $2^7$ | 128 |
| $2^8$ | 256 |
| $2^9$ | 512 |
| $2^{10}$ | 1024 |
| $2^{11}$ | 2048 |
| $2^{12}$ | 4096 |
| $2^{13}$ | 8192 |
| $2^{14}$ | 16384 |
| $2^{15}$ | 32768 |
| $2^{16}$ | 65536 |
| $2^{17}$ | 131072 |
| $2^{18}$ | 262144 |
| $2^{19}$ | 524288 |
| $2^{20}$ | 1048576 |

*Refer to P.2-50 "Division Ratio for Parameters" of Supplement.

# 5. Adjustment

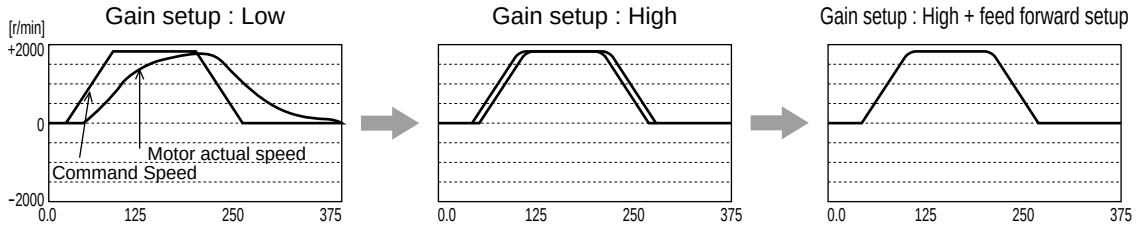
# 1. Gain Adjustment

## Outline

### Purpose

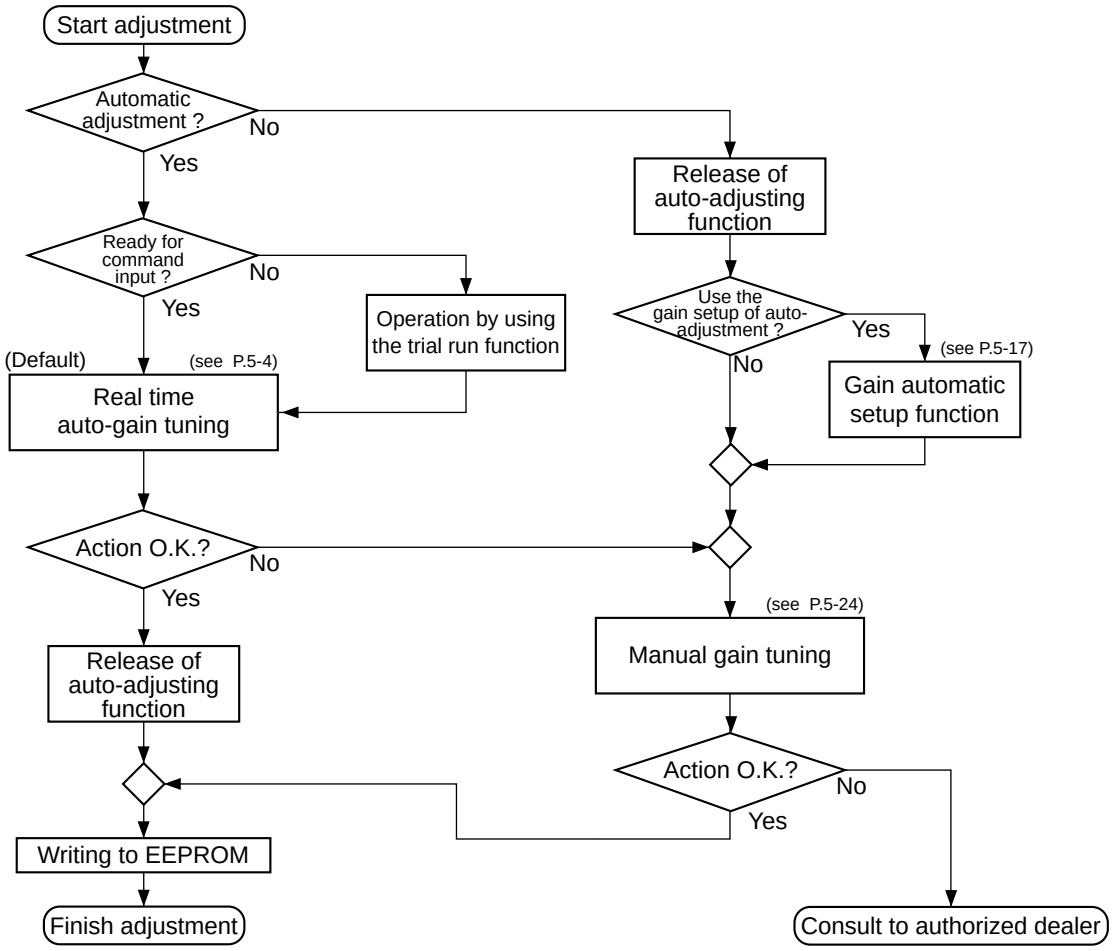
It is required for the servo driver to run the motor in least time delay and as faithful as possible against the commands from the host controller. You can make a gain adjustment so that you can run the motor as closely as possible to the commands and obtain the optimum performance of the machine.

**<e.g. : Ball screw>**




| Gain setup : Low | | Gain setup : High | | Gain setup : High + feed forward setup | |
|---|---|---|---|---|---|
| Position loop gain | : 20 | Position loop gain | : 100 | Position loop gain | : 100 |
| Velocity loop gain | : 100 | Velocity loop gain | : 50 | Velocity loop gain | : 50 |
| Time constant of V-loop integration | : 50 | Time constant of V-loop integration | : 50 | Time constant of V-loop integration | : 50 |
| Velocity loop feed forward | : 0 | Velocity loop feed forward | : 0 | Velocity loop feed forward | : 500 |
| Inertia ratio | : 100 | Inertia ratio | : 100 | Inertia ratio | : 100 |

### Procedures




**Note** For safety operation, first adjust the gain by referring to P.6-15 Setup protective function before gain adjustment.

## Type

| Function | | | Explanation | Pages to refer |
|---|---|---|---|---|
| Automatic adjustment | Real-time auto-gain tuning | | Estimates the load inertia of the machine in real time, and automatically sets up the optimum gain corresponding to this result. | P.5-4 |
| | Adaptive filter | | Reduces the resonance vibration point by automatically setting up the notch filter coefficient which removes the resonance component from the torque command while estimating the resonance frequency from the vibrating component which appears in the motor speed in actual operating condition. | P.5-10 |
| Manual adjustment | Manual gain tuning (basic) | | Execute the manual adjustment or fine-tuning when real-time auto-gain tuning cannot be activated due to the limitation of operation or load condition, or when you want to obtain an optimum response and stability under these conditions. | P.5-13 |
| | | Basic procedure | Adjustment of position control mode | P.5-14 |
| | | | Adjustment of velocity control mode | P.5-15 |
| | | | Adjustment of torque control mode | P.5-15 |
| | | | Adjustment of full-closed control mode | P.5-16 |
| | | Gain switching function | You can expect to reduce vibration at stopping and settling time and to improve command compliance by switching the gains by internal data or external signals. | P.5-17 |
| | | Suppression of machine resonance | When the machine stiffness is low, vibration or noise may be generated due to the distorted axis, hence you cannot set the higher gain. You can suppress the resonance with two kinds of filter. | P.5-20 |
| | Manual gain tuning (application) | | You can obtain the higher performance while you are not satisfied with the performance obtained with the basic adjustment, using the following application functions. | |
| | | Damping control | Function which reduces vibration by removing the vibration frequency component while the front end of the machine vibrates. | P.5-24 |
| | | Feed forward function | Velocity feed forward function improves responsiveness during position control and full closed control. Torque feed forward improves the response of velocity control system. | P.5-26 |
| | | Instantaneous speed observer | Function which obtains both high response and reduction of vibration at stopping by estimating the motor speed with the load model, and hence improves the accuracy of speed detection. | P.5-28 |
| | | Disturbance observer | Function which uses estimated disturbance torque to reduce effects of the disturbance torque and to reduce vibration. | P.5-30 |
| | | 3rd gain switching function | By using this function in addition to the normal gain switching function, the gain can be changed at the moment of stop to further shorten the positioning time. | P.5-32 |
| | | Friction torque compensation | Offset load compensation and dynamic friction compensation are used to reduce effects of mechanical friction. | P.5-34 |
| | | Inertia ratio switching function | This function can be used when selectable 2 inertia ratios are provided. | P.5-36 |
| | | Hybrid vibration damping function | This function, when used in full closed control mode, prevents vibration resulting from torsion on motor and load. | P.5-38 |

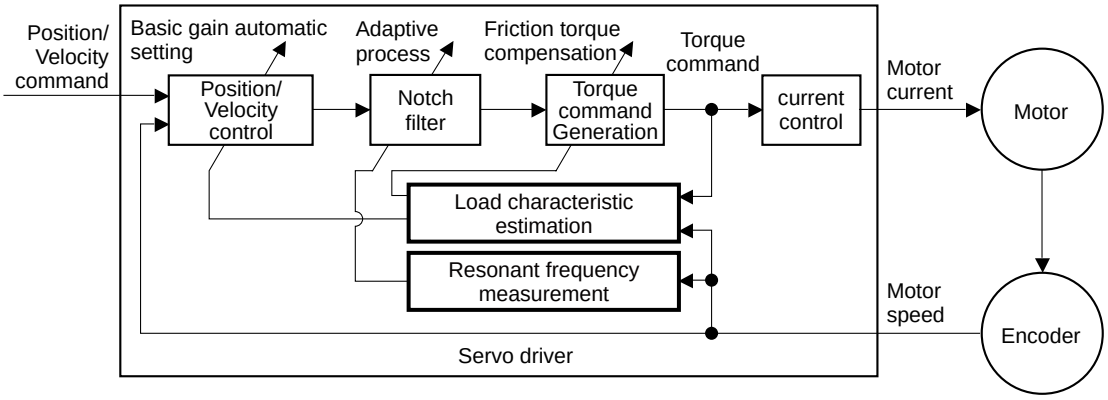
**Remarks** • Pay extra attention to safety, when oscillation (abnormal noise and vibration) occurs, shut off the main power, or turn to Servo-OFF.

# 2. Real-Time Auto-Gain Tuning

## Basic

## Outline

The system estimates the load characteristics in real time, and automatically performs basic gain setting and friction compensation by referring to stiffness parameter.




## Applicable Range

Real time auto-gain tuning is applicable to all control modes.

| | Real-time auto-tuning condition |
|---|---|
| **Control Mode** | Specific real-time auto-tuning mode is selected according to the currently active control mode. For details, refer to the description of Pr0.02 Real-time auto-tuning setup. |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly. |

## Caution

Real-time auto-gain tuning may not be executed properly under the conditions described in the table below. Under these conditions, change the load condition or operation pattern, or start manual gain tuning (see P.5-24).

| | Conditions which obstruct real-time auto-gain tuning action |
|---|---|
| **Load inertia** | • The load is too small or large compared to the rotor inertia. (less than 3 times or more than 20 times).<br>• The load inertia changes too quickly. |
| **Load** | • The machine stiffness is extremely low.<br>• Nonlinear characteristics such as backlash exist. |
| **Action pattern** | • The motor is running continuously at low speed of (100 [r/min] or lower.<br>• Acceleration/deceleration is slow (2000 [r/min] per 1[s] or low).<br>• Acceleration/deceleration torque is smaller than unbalanced weighted/viscous friction torque.<br>• When the speed condition of 100 [r/min] or more and acceleration/deceleration condition of<br>2000 [r/min] per 1 [s] are not maintained for 80 [ms]. |

## How to Operate

1) Bring the motor to stall (Servo-OFF).
2) Set up Pr0.02 (Setup of real-time auto-gain tuning mode) to 1-7.
   Default is set to 1.

| Setup value | Real-time auto-gain tuning |
|---|---|
| 0 | Invalid |
| 1 | Standard |
| 2 | Positioning *1 |
| 3 | Vertical axis *2 |
| 4 | Friction compensation *3 |
| 5 | Load characteristic measurement |
| 6 | Customize *4 |

*1 Velocity and torque controls are the same as in the standard mode.
*2 Torque control is the same as in the standard mode.
*3 Velocity control is the same as in the vertical axis mode. Torque control is the same as in the standard mode.
*4 Certain function(s) is not available in a specific control mode. Refer to description in Pr6.32.

   Control parameter is automatically set according to Pr0.03 Real-time auto-tuning stiffness setup. For details, see P.5-6 and 5-7.
3) Turn on servo, and start the machine.

   Estimation of load characteristics starts.
4) When the load characteristics are determined, Pr0.04 Inertia ratio is updated.
   In a specific mode, the following parameters are changed:
   Pr6.07 Torque command additional value
   Pr6.08 Positive direction torque compensation value
   Pr6.09 Negative direction torque compensation value
5) When value of Pr0.03 Real-time auto-tuning stiffness setup is increased, the motor responsiveness will be improved.
   Determine the most appropriate stiffness in relation to the positioning setup time and vibration condition.
6) To save the result to memory, write the data to EEPROM.

**Caution** If power is turned off within 30 minutes after the end of tuning process, the result of the real-time auto-tuning is not saved. If the result is not saved, manually write parameters to EEPROM and then turn off power.

**Note**
- While the auto-tuning is valid, parameters that are to be automatically adjusted cannot be changed.

**Related page**
- P.2-71 “EEPROM Writing”
- P.4-5, 4-6, 4-51, 4-52, 4-55, 4-56 “Details of parameter”

## Parameters set/changed by real-time auto-gain tuning

**• Parameters which are updated**

The real-time auto-tuning function updates the following parameters according to Pr0.02 Real-time auto-tuning setup and Pr6.32 Real-time auto-tuning custom setup and by using the load characteristic estimate values.

| Class | No. | Title | Function |
|---|---|---|---|
| 0 | 04 | Inertia ratio | Updates this parameter when the real-time auto-tuning inertia ratio update is enabled. |
| 6 | 07 | Torque command additional value | Update this parameter when the vertical axis mode for real time auto-tuning is valid. |
| 6 | 08 | Positive direction torque compensation value | Update this parameter when the friction compensation mode for real time auto-tuning is valid. |
| 6 | 09 | Negative direction torque compensation value | Update this parameter when the friction compensation mode for real time auto-tuning is valid. |

**• Parameters which are updated to setup value corresponding to stiffness setup**

The real-time auto-tuning function updates the following basic gain setup parameters according to Pr0.03 Real-time auto-tuning stiffness setup.

| Class | No. | Title | Function |
|---|---|---|---|
| 1 | 00 | 1st gain of position loop | When stiffness setup is valid, updates the parameter based on the setup value. Refer to P.5-9 Basic gain parameter setup table. |
| 1 | 01 | 1st gain of velocity loop | |
| 1 | 02 | 1st time constant of velocity loop integration | |
| 1 | 04 | 1st time constant of torque filter | |
| 1 | 05 | 2nd gain of position loop | |
| 1 | 06 | 2nd gain of velocity loop | |
| 1 | 07 | 2nd time constant of velocity loop integration | |
| 1 | 09 | 2nd time constant of torque filter | |

**• Parameters which are set to fixed value**

Real-time auto-tuning function sets the following parameters to the fixed value.

| Class | No. | Title | Setup value when fixed parameter setup is valid. |
|---|---|---|---|
| 1 | 03 | 1st filter of speed detection | 0 |
| 1 | 08 | 2nd filter of speed detection | |
| 1 | 10 | Velocity feed forward gain | 300 (30%) |
| 1 | 11 | Velocity feed forward filter | 50 (0.5ms) |
| 1 | 12 | Torque feed forward gain | 0 |
| 1 | 13 | Torque feed forward filter | |

Related page • P.4-6 “Pr0.04” • P.4-12... “Pr1.00...” • P.4-52 “Pr6.07...”

**• Parameters which are set in response to gain switching setup**

The real-time auto-tuning function sets the following parameters as the gain is switched.

| Class | No. | Title | Function |
|---|---|---|---|
| 1 | 14 | 2nd gain setup | Sets to 1 if the current setting is not maintained. |
| 1 | 15 | Mode of position control switching | Sets to 10 to enable the gain switching. Sets to 0 to disable the gain switching. |
| 1 | 16 | Delay time of position control switching | Sets to 50 if the current setting is not maintained. |
| 1 | 17 | Level of position control switching | |
| 1 | 18 | Hysteresis at position control switching | Sets to 33 if the current setting is not maintained. |
| 1 | 19 | Position gain switching time | |
| 1 | 20 | Mode of velocity control switching | Sets to 0 if the current setting is not maintained. |
| 1 | 21 | Delay time of velocity control switching | |
| 1 | 22 | Level of velocity control switching | |
| 1 | 23 | Hysteresis at velocity control switching | |
| 1 | 24 | Mode of torque control switching | |
| 1 | 25 | Delay time of torque control switching | |
| 1 | 26 | Level of torque control switching | |
| 1 | 27 | Hysteresis at torque control switching | |

**• Parameters which are always set to invalid.**

The following settings are always set to invalid when Pr0.02 Real-time auto-tuning setup is not 0.

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 10 | Function expansion setup | Instantaneous speed observer function enable bit (bit 0), disturbance observer function enable bit (bit 1) and inertia ratio switching function enable bit (bit 3) are internally disabled. |
| 6 | 13 | 2nd Inertia ratio | Parameter setup can be changed, but disturbance observer is disabled. |
| 6 | 23 | Disturbance torque compensating gain | |
| 6 | 24 | Disturbance observer filter | |

Related page • P.4-14... “Pr1.14...” • P.4-52... “Pr6.10...”

## Caution

(1) Immediately after the first servo-on upon start up; or after increasing Pr0.03
Real-time auto-tuning stiffness setup, abnormal sound or oscillation may be generated until the load characteristics estimation is stabilized. If such abnormality lasts or repeats for 3 or more reciprocating operations, take the following countermeasures.
1) Lower the setup of Pr0.03 (Selection of machine stiffness at real-time auto-gain tuning).
2) Set Pr0.02 Real-time auto-tuning setup to 0 to disable the real-time auto-tuning.
3) Set Pr0.04 Inertial ratio to the calculational value of the equipment and set Pr6.07 Torque command addition value, Pr6.08 Positive direction compensation value and Pr6.09 Negative direction compensation value to 0.

(2) When abnormal noise and oscillation occur, Pr0.04 (Inertia ratio) or Pr6.07 (Torque command additional value), Pr6.08(Positive direction torque compensation value), Pr6.09(Negative direction torque compensation value) might have changed to extreme values. Take the same measures as the above in these cases.

(3) Among the results of real-time auto-gain tuning, Pr0.04 (Inertia ratio) and Pr6.07 (Torque command additional value), Pr6.08(Positive direction torque compensation value), Pr6.09(Negative direction torque compensation value) will be written to EEPROM every 30 minutes. When you turn on the power again, the auto-gain tuning will be executed using the latest data as initial values.

## Invalidation of Real-Time Auto-Gain Tuning

You can stop the automatic calculation of Pr0.04 (Inertial ratio) and invalidate the real-time auto-gain tuning by setting up Pr0.02 (Real-time auto-gain tuning setup) to 0.
Note that the calculation result of Pr0.04 (Inertia ratio) will be held, and if this parameter becomes abnormal value, use the normal mode auto-gain tuning or set up proper value manually obtained from formula or calculation.

**Caution** If power is turned off within 30 minutes after the end of tuning process, the result of the real-time auto-tuning is not saved. If the result is not saved, manually write parameters to EEPROM and then turn off power.

## Basic gain parameter setup table

| Stiffness | 1st gain | | | | 2nd gain | | | | A4 Series Stiffness setup (reference) *1 |
|---|---|---|---|---|---|---|---|---|---|
| | Pr1.00 | Pr1.01 | Pr1.02 | Pr1.04 *2 | Pr1.05 | Pr1.06 | Pr1.07 | Pr1.09 *2 | |
| | Gain of position loop [0.1/s] | Gain of velocity loop [0.1Hz] | Time constant of velocity loop integration [0.1ms] | Time constant of torque filter [0.01ms] | Gain of position loop [0.1/s] | Gain of velocity loop [0.1Hz] | Time constant of velocity loop integration [0.1ms] | Time constant of torque filter [0.01ms] | |
| 0 | 20 | 15 | 3700 | 1500 | 25 | 15 | 10000 | 1500 | — |
| 1 | 25 | 20 | 2800 | 1100 | 30 | 20 | 10000 | 1100 | — |
| 2 | 30 | 25 | 2200 | 900 | 40 | 25 | 10000 | 900 | — |
| 3 | 40 | 30 | 1900 | 800 | 45 | 30 | 10000 | 800 | — |
| 4 | 45 | 35 | 1600 | 600 | 55 | 35 | 10000 | 600 | — |
| 5 | 55 | 45 | 1200 | 500 | 70 | 45 | 10000 | 500 | — |
| 6 | 75 | 60 | 900 | 400 | 95 | 60 | 10000 | 400 | — |
| 7 | 95 | 75 | 700 | 300 | 120 | 75 | 10000 | 300 | — |
| 8 | 115 | 90 | 600 | 300 | 140 | 90 | 10000 | 300 | 0 |
| 9 | 140 | 110 | 500 | 200 | 175 | 110 | 10000 | 200 | — |
| 10 | 175 | 140 | 400 | 200 | 220 | 140 | 10000 | 200 | — |
| 11 | 320 | 180 | 310 | 126 | 380 | 180 | 10000 | 126 | 1 |
| 12 | 390 | 220 | 250 | 103 | 460 | 220 | 10000 | 103 | 2 |
| 13 | 480 | 270 | 210 | 84 | 570 | 270 | 10000 | 84 | 3 |
| 14 | 630 | 350 | 160 | 65 | 730 | 350 | 10000 | 65 | 4 |
| 15 | 720 | 400 | 140 | 57 | 840 | 400 | 10000 | 57 | 5 |
| 16 | 900 | 500 | 120 | 45 | 1050 | 500 | 10000 | 45 | 6 |
| 17 | 1080 | 600 | 110 | 38 | 1260 | 600 | 10000 | 38 | 7 |
| 18 | 1350 | 750 | 90 | 30 | 1570 | 750 | 10000 | 30 | 8 |
| 19 | 1620 | 900 | 80 | 25 | 1880 | 900 | 10000 | 25 | 9 |
| 20 | 2060 | 1150 | 70 | 20 | 2410 | 1150 | 10000 | 20 | 10 |
| 21 | 2510 | 1400 | 60 | 16 | 2930 | 1400 | 10000 | 16 | 11 |
| 22 | 3050 | 1700 | 50 | 13 | 3560 | 1700 | 10000 | 13 | 12 |
| 23 | 3770 | 2100 | 40 | 11 | 4400 | 2100 | 10000 | 11 | 13 |
| 24 | 4490 | 2500 | 40 | 9 | 5240 | 2500 | 10000 | 9 | 14 |
| 25 | 5000 | 2800 | 35 | 8 | 5900 | 2800 | 10000 | 8 | — |
| 26 | 5600 | 3100 | 30 | 7 | 6500 | 3100 | 10000 | 7 | 15 |
| 27 | 6100 | 3400 | 30 | 7 | 7100 | 3400 | 10000 | 7 | — |
| 28 | 6600 | 3700 | 25 | 6 | 7700 | 3700 | 10000 | 6 | — |
| 29 | 7200 | 4000 | 25 | 6 | 8400 | 4000 | 10000 | 6 | — |
| 30 | 8100 | 4500 | 20 | 5 | 9400 | 4500 | 10000 | 5 | — |
| 31 | 9000 | 5000 | 20 | 5 | 10500 | 5000 | 10000 | 5 | — |

*1 Stiffness setting of A4 series refers to the setup value (0-15) of A4 series parameter Pr22 Real-time auto-tuning machine stiffness selection.

*2 When 17-bit absolute encoder, limited by the minimum value 10.

**Note**

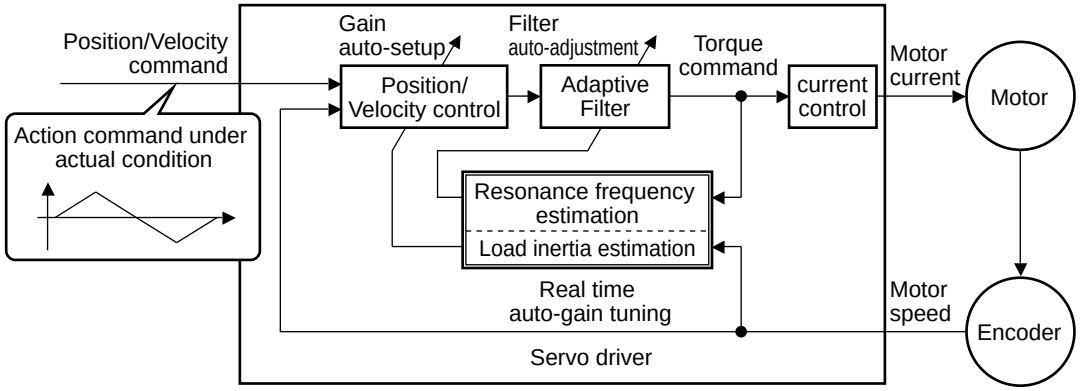
- For details of parameters, refer to P.4-12 “Details of parameter”.
- Download the A4 series manual from the web site shown below.
  http://industrial.panasonic.com/jp/i/25000/motor_fa/motor_fa.html

# 3. Adaptive filter

## Adaptive filter

### Outline

Estimates the resonance frequency out of vibration component presented in the motor speed in motion, then removes the resonance component from the torque command by setting up the notch filter coefficient automatically, hence reduces the resonance vibration.




### Applicable Range

This function works under the following condition.

| | Conditions under which the Adaptive filter is activated |
|---|---|
| **Control Mode** | • Applies to other control modes than torque control. |
| **Others** | • Should be servo-on status.<br>• Elements other than control parameters, such as deviation counter clear command inhibit and torque limit are appropriately set, enabling the motor to run normally. |

### Caution

In the following condition, normal operation may not be expected - manually set the notch filter to prevent resonance.

| | Conditions which obstruct adaptive filter action |
|---|---|
| **Resonance point** | • Resonance frequency is lower than 300[Hz].<br>• Resonance peak is low, or control gain is low where the motor speed is not affected by this.<br>• Multiple resonance points exist. |
| **Load** | • Motor speed variation with high harmonic component is generated due to non-linear factors such as backlash. |
| **Command pattern** | • Acceleration/deceleration is rapid such as 30000[r/min] per 1[s]. |

## How to Operate

Enter the action command with Pr2.00 Adaptive filter mode set to a value other than 0.

If the resonance point affects the motor speed, parameters of 3rd notch filter and/or 4th notch filters are automatically set according to the number of adaptive filters.

et the operation of the adaptive filter to the following parameter.

| Class | No. | Title | Setup value | Function |
|---|---|---|---|---|
| 2 | 00 | Adaptive filter mode setup | 0 | [Adaptive filter: invalid]<br>The adaptive filter is disabled. Parameters related to the 3rd and 4th notch filter hold the current value. |
| | | | 1 | [Adaptive filter: 1 filter is valid]<br>One adaptive filter is enabled. Parameters related to the 3rd notch filter will be updated based on adaptive performance. |
| | | | 2 | [Adaptive filter: 2 filters are valid]<br>Two adaptive filters are enabled. Parameters related to the 3rd and 4th notch filters will be updated based on adaptive performance. |
| | | | 3 | [Resonance frequency measurement mode]<br>Measure the resonance frequency. Result of measurement can be checked with PANATERM. Parameters related to the 3rd and 4th notch filter hold the current value. |
| | | | 4 | [Clear result of adaptation]<br>Parameters related to the 3rd and 4th notch filter are disabled and results of adaptive operation are cleared. |

At the same time, the following parameters are automatically set.

| Class | No. | Title | Function |
|---|---|---|---|
| 2 | 07 | 3rd notch frequency | In no resonance point is found, the frequency is set to 5000. |
| 2 | 08 | 3rd notch width selection | Automatically set when the adaptive filter is active. |
| 2 | 09 | 3rd notch depth selection | |
| 2 | 10 | 4th notch frequency | Notch frequency is automatically set to the 2nd resonance frequency estimated by the adaptive filter.<br>In no resonance point is found, the frequency is set to 5000. |
| 2 | 11 | 4th notch width selection | Automatically set when 2 adaptive filters are active. |
| 2 | 12 | 4th notch depth selection | |

Related page • P.4-19... “Details of parameter”

## Caution

(1) Immediately after the first servo-on at start up; or after increasing stiffness setting with the real-time auto-tuning enabled, abnormal sound or oscillation may be generated until the adaptive filter stabilizes. If such abnormality lasts or repeats for 3 or more reciprocating operations, take the following countermeasures.
   1) Write the parameters which have given the normal operation into EEPROM.
   2) Lower the setup of Pr0.03 (Selection of machine stiffness at real-time auto-gain tuning).
   3) Invalidate the adaptive filter by setting up Pr2.00 (Setup of adaptive filter mode) to 0. (Reset of inertia calculation and adaptive action)
   4) Set up the notch filter manually.

(2) Abnormal sound or oscillation may excessively change the setup value of 3rd and 4th notch filters. If such change occurs, disable the adaptive filter as described in step 3) above, change setup value of Pr2.07 3rd notch frequency and Pr2.10 4th notch frequency to 5000 (disable), and then enable the adaptive filter again.

(3) The 3rd filters (Pr2.07-Pr2.09) and 4th notch filters (Pr2.10-Pr2.12) are written to EEPROM every 30 minutes. Upon power up, these data are used as default values during adaptive process.

Related page • P.4-5... “Details of parameter”

# 4. Manual Gain Tuning (Basic)

## Outline

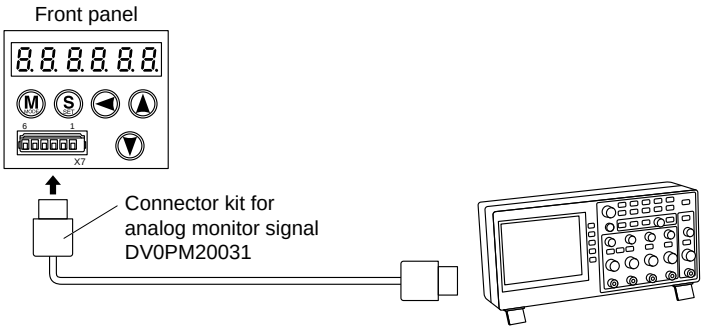
As explained previously, MINAS-A4 series features the automatic gain tuning function, however, there might be some cases where this automatic gain tuning cannot be adjusted properly depending on the limitation on load conditions. Or you might need to readjust the tuning to obtain the optimum response or stability corresponding to each load.
Here we explain this manual gain tuning method by each control mode and function.

## Before Making a Manual Adjustment

By monitoring waveforms using the waveform graphic function of the setup support software PANATERM installed on the PC or by measuring the analog voltage waveform with the help of the monitor function, accurate adjustment can be positively, quickly and easily done when compared with that performed on the front panel.

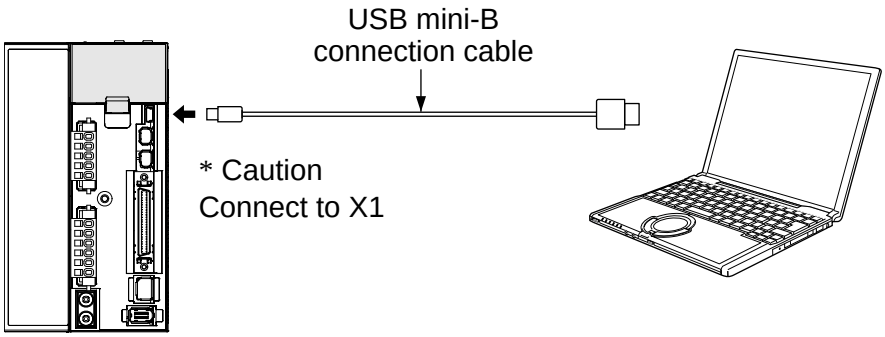
**1. Analog monitor output**

You can measure the actual motor speed, commanded speed, torque and deviation pulses by analog voltage level by using an oscilloscope. Set up the types of the signals or the output voltage level with Pr4.16 (Selection of speed monitor) and Pr4.21 (Selection of torque monitor).




**2. Waveform graphic function of the PANATERM**

You can display the command to the motor, motor movement (speed, torque command and deviation pulses) as a waveform graphic on PC display. Refer to P.7-26, "Outline of the Setup Support Software, PANATERM" of Supplement.




**Caution** Please download the Setup support software “PANATERM”from our web site anduse after install to the PC.

**Related page** • P.4-35, 4-36... “Details of parameter” • P.7-26 “Outline of Setup support software “PANATERM”

# 4. Manual Gain Tuning (Basic)

## Adjustment in Position Control Mode

Position control of MINAS-A5 series is described in Block diagram of P.3-40.
Make adjustment in position control per the following procedures.

(1) Set up the following parameters to the values of the table below.

| Parameter No. (Pr□□) | Title of parameter | Standard value |
|---|---|---|
| 1.00 | 1st gain of position loop | 270 |
| 1.01 | 1st gain of velocity loop | 150 |
| 1.02 | 1st time constant of velocity loop integration | 370 |
| 1.03 | 1st filter of velocity detection | 0 |
| 1.04 | 1st time constant of torque filter time | 152 |
| 1.10 | Velocity feed forward | 0 |
| 1.11 | Time constant of feed forward filter | 0 |
| 1.05 | 2nd gain of position loop | 270 |
| 1.06 | 2nd gain of velocity loop | 150 |
| 1.07 | 2nd time constant of velocity loop integration | 370 |
| 1.08 | 2nd filter of speed detection | 0 |
| 1.09 | 2nd time constant of torque filter | 152 |
| 2.01 | Selection of 1st notch frequency | 5000 |
| 2.02 | Selection of 1st notch width | 2 |

| Parameter No. (Pr□□) | Title of parameter | Standard value |
|---|---|---|
| 0.04 | Inertia ratio | 100 |
| 0.02 | Setup of real time auto-gain tuning mode | 0 |
| 2.00 | Adaptive filter setup mode | 0 |
| 2.14 | 1st damping frequency | 0 |
| 2.15 | Setup of 1st damping filter | 0 |
| 2.16 | 2nd damping frequency | 0 |
| 2.17 | Setup of 2nd damping filter | 0 |
| 1.14 | 2nd gain setup | 0 |
| 1.15 | Mode of position control switching | 0 |
| 1.16 | Delay time of position control switching delay | 0 |
| 1.17 | Level of position control switching | 0 |
| 1.18 | Hysteresis at position control switching | 0 |
| 1.19 | Position gain switching time | 0 |
| 2.22 | Setup of smoothing filter | 1 |
| 2.23 | Setup of FIR filter | 0 |

(2) Enter the inertia ratio of Pr20. Measure the ratio or setup the calculated value.
(3) Make adjustment using the standard values below.

| Order | Parameter No. (Pr□□) | Title | Standard value | How to adjust |
|---|---|---|---|---|
| 1 | Pr11 | 1st gain of velocity loop | 300 | Increase the value within the range where no abnormal noise and no vibration occur. If they occur, lower the value. |
| 2 | Pr14 | 1st time constant of torque filter | 50 | When vibration occurs by changing Pr11, change this value. Setup so as to make Pr11 x Pr14 becomes smaller than 10000. If you want to suppress vibration at stopping, setup larger value to Pr14 and smaller value to Pr11. If you experience too large vibration right before stopping, lower than value of Pr14. |
| 3 | Pr10 | 1st gain of position loop | 500 | Adjust this observing the positioning time. Larger the setup, faster the positioning time you can obtain, but too large setup may cause oscillation. |
| 4 | Pr12 | 1st time constant of velocity loop integration | 250 | Setup this value within the range where no problem occurs. If you setup smaller value, you can obtain a shorter positioning time, but too small value may cause oscillation. If you setup too large value, deviation pulses do not converge and will be remained. Increase the value within the range where no abnormal noise occurs. |
| 5 | Pr15 | Velocity feed forward | 300 | Too large setup may result in overshoot or chattering of position complete signal, hence does not shorten the settling time. If the command pulse is not even,you can improve by setting up Pr16 (Feed forward filter) to larger value. |

Related page • P.4-5... “Details of parameter” • P.3-14... “Control Block Diagram”

# 4. Manual Gain Tuning (Basic)

## Adjustment in Velocity Control Mode

Velocity control of MINAS-A5 series is described in Block Diagram of P.3-15 of Velocity Control Mode.
Adjustment in velocity control is almost same as that in position control described in "Adjustment in Position Control Mode", and make adjustments of parameters per the procedures except the gain setup of position loop and the setup of velocity feed forward.

5 Adjustment

# 4. Manual Gain Tuning (Basic)

## Adjustment in Torque Control Mode

Torque control of MINAS-A5 series is described in P.3-16, "Block Diagram" of Torque Control Mode.
This torque control is based on velocity control while making Pr3.21 [Speed limit value 1], Pr3.22 [Speed limit value 2] or SPR input as a speed limit. Here we explain the setup of speed limiting value.

### • Setup of speed limiting value

**The torque command selection (Pr3.17) specifies the setup method.**

| | |
|---|---|
| **Pr3.17 = 0** | **Set up by using speed limit value 1 (Pr3.21)** |
| **Pr3.17 = 1** | **Set up by using analog input (SPL)** |
| **Pr3.17 = 2** | **For positive direction, set up by using the speed limit value 1 (Pr3.21)**<br>**For negative direction, set up by using the speed limit value 2 (Pr3.22)** |

- When the motor speed approaches to the speed limiting value, torque control following the analog torque command shifts to velocity control based on the speed limiting value.
- In order to stabilize the movement under the speed limiting, you are required to set up the parameters according to the above-mentioned "Adjustment in Velocity Control Mode".
- When the speed limiting value is too low or the velocity loop gain is too low, or when the time constant of the velocity loop integration is 10000 (invalid), the input to the torque limiting portion of the above fig. becomes small and the output torque may not be generated as the analog torque command.

Related page • P.3-43 “Inputs and outputs on connector X4”

# 4. Manual Gain Tuning (Basic)

## Adjustment in Full-Closed Control Mode

Full-closed control of MINAS-A5 series is described in Block diagram of P.3-17 of Full-Closed Control.
Adjustment in full-closed control is almost same as that in position control described in P.3-12 “Adjustment in Position Control Mode”, and make adjustments of parameters per the procedures except cautions of P.5-14, “Outline of Full-Closed Control” (difference of command unit and difference of electronic gear).
Here we explain the setup of feedback scale ratio and hybrid deviation excess of full-closed control.

### 1) Setup of external scale ratio

**Setup the external scale ratio using the numerator of external scale division (Pr3.24) and denominator of external scale division (Pr3.25).**

- Check the encoder pulse counts per one motor revolution and the external scale pulse counts per one motor revolution, then set up the numerator of external scale division (Pr3.24), and denominator of external scale division (Pr3.25) so that the following formula can be established.

$$\frac{\text{Pr3.24}}{\text{Pr3.25}} = \frac{\text{Number of encoder pulses per motor rotation}}{\text{Number of external scale pulses per motor rotation}}$$

- If this ratio is incorrect, a gap between the position calculated from the encoder pulse counts and that of calculated from the external scale pulse counts will be enlarged and hybrid deviation excess (Err25.0) will be triggered when the work or load travels a long distance.
- When you set up Pr3.24 to 0, the encoder pulse counts will be automatically set up.

### 2) Setup of hybrid deviation excess

**Set up the minimum value of hybrid deviation excess (Pr3.28) within the range where the gap between the motor (encoder) position and the load (feedback scale) position will be considered to be an excess.**

- Note that the hybrid deviation excess (Err25.0) may be generated under other conditions than the above 1), such as reversed connection of the external scale or loose connection of the motor and the load.

## Caution

(1) Enter the command pulses based on the feedback scale reference.
(2) The feedback scales to used for full-closed control are as follows.
When A- and B-phase parallel, or serial scale,
  - ABS ST770A, ST770AL, AT573A series by Mitsutoyo Corp.
  - SR77, SR87, SL700, SL710 by Sony Manufacturing Systems Corp.

(3) To prevent the runaway and damage of the machine due to the setup of the feedback scale, setup the hybrid deviation excess (Pr3.28) to the appropriate value, in the unit of feedback scale resolution.

(4) **We recommend the external scale as 1/40 ≤ external scale ratio ≤ 160.**

Even within this range, if you setup the external scale ratio to smaller value than 50/position loop gain (Pr1.00 and 1.05), you may not be able to control by one pulse unit. If you set up too large external scale ratio, you may expect larger noise in movement.

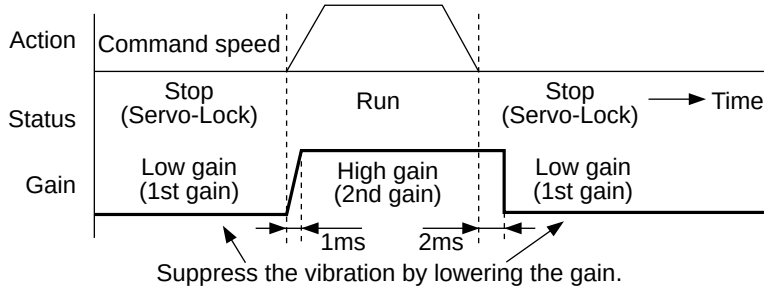
Related page • P.3-30 “Inputs and outputs on connector X4” • P.6-3 “Protective Function”

# 4. Manual Gain Tuning (Basic)

## Gain Switching Function

By selecting appropriate gain based on internal data or external signal, the following effects can be obtained.

- Decrease the gain at the time of stoppage (servo lock) to reduce vibration.
- Increase the gain at the time of stoppage (setting) to shorten the settling time.
- Increase the gain during operation to improve command compliance.
- Based on condition of the equipment, change the gain with external signal.




**<Example>**

Following is the example when you want to reduce the noise at motor in stall (Servo-Lock), by setting up to lower gain after the motor stops.

- Make adjustment referring to the basic gain parameter setup table (P.5-9) as well.

| Parameter No. (Pr□□) | Title of parameter | Execute manual gain-tuning without gain switching | Set up the same value as Pr1.05 to 1.09 (1st gain) to Pr1.00 to 1.04 (2nd gain) | Set up Pr1.05 to 1.09 (Gain switching condition) | Adjust Pr1.01 and 1.04 at stopping (1st gain) |
|---|---|---|---|---|---|
| 1.00 | 1st gain of position loop | 630 | | | |
| 1.01 | 1st gain of velocity loop | 350 | | | 270 |
| 1.02 | 1st time constant of velocity integration | 160 | | | |
| 1.03 | 1st filter of velocity detection | 0 | | | |
| 1.04 | 1st time constant of torque filter | 65 | | | 84 |
| 1.10 | Velocity feed forward | 300 | | | |
| 1.11 | Filter of velocity feed forward | 50 | | | |
| 1.05 | 2nd gain of position loop | | 630 | | |
| 1.06 | 2nd gain of velocity loop | | 350 | | |
| 1.07 | 2nd time constant of velocity integration | | 160 | | |
| 1.08 | 2nd filter of velocity detection | | 0 | | |
| 1.09 | 2nd time constant of torque filter time | | 65 | | |
| 1.14 | Action setup of 2nd gain | 0 | | 1 | |
| 1.15 | 1st mode of control switching | | | 7 | |
| 1.16 | 1st delay time of control switching | | | 30 | |
| 1.17 | 1st level of control switching | | | 0 | |
| 1.18 | 1st hysteresis of control switching | | | 0 | |
| 1.19 | Switching time of position gain | | | 0 | |
| 0.04 | Inertia ration | • Enter the known value from load calculation<br>• Measure the inertia ratio by executing nor mal auto-gain tuning<br>• Default is 250 | | | |

Related page • P.4-5... “Details of parameter”

## Setup of Gain Switching Condition

**• Positing control mode, Full-closed control mode (◯: Corresponding parameter is valid, – : invalid)**

| Setup of gain switching condition | | | Setup parameters at position control, full-closed control | | |
|---|---|---|---|---|---|
| | | | Delay time *1 | Level | Hysteresis *2 |
| Pr1.15 | Switching condition to 2nd gain | Fig. | Pr1.16 | Pr1.17 | Pr1.18 |
| 0 | Fixed to 1st gain | | – | – | – |
| 1 | Fixed to 2nd gain | | – | – | – |
| 2 | Gain switching input | | – | – | – |
| 3 | Torque command | A | ◯ | ◯ [%] | ◯ [%] |
| 4 | Invalid (Fixed to 1st gain) | | – | – | – |
| 5 | Speed command | C | ◯ | ◯ [r/min] | ◯ [r/min] |
| 6 | Position deviation | D | ◯ | ◯ *3 [pulse] | ◯ *3 [pulse] |
| 7 | Position command exists. | E | ◯ | – | – |
| 8 | Not in positioning complete | F | ◯ | – | – |
| 9 | Speed | C | ◯ | ◯ [r/min] | ◯ [r/min] |
| 10 | Command exists + velocity | G | ◯ | ◯ [r/min] *5 | ◯ [r/min] *5 |

**• Velocity control mode**

| Setup of gain switching condition | | | Setup parameters at velocity control mode | | |
|---|---|---|---|---|---|
| | | | Delay time *1 | Level | Hysteresis *2 |
| Pr1.20 | Switching condition to 2nd gain | Fig. | Pr1.16, 1.21 | Pr1.17, 1.22 | Pr1.18, 1.23 |
| 0 | Fixed to 1st gain | | – | – | – |
| 1 | Fixed to 2nd gain | | – | – | – |
| 2 | Gain switching input | | – | – | – |
| 3 | Torque command | A | ◯ | ◯ [%] | ◯ [%] |
| 4 | Variation of speed command is large. | B | – | ◯ *4 [10(r/min)/s] | ◯ *4 [10(r/min)/s] |
| 5 | Speed command | C | ◯ | ◯ [r/min] | ◯ [r/min] |

**• Torque control mode**

| Setup of gain switching condition | | | Setup parameters at torque control mode | | |
|---|---|---|---|---|---|
| | | | Delay time *1 | Level | Hysteresis *2 |
| Pr1.24 | Switching condition to 2nd gain | Fig. | Pr1.16, 1.25 | Pr1.17, 1.26 | Pr1.18, 1.27 |
| 0 | Fixed to 1st gain | | – | – | – |
| 1 | Fixed to 2nd gain | | – | – | – |
| 2 | Gain switching input, GAIN ON | | – | – | – |
| 3 | Variation of torque command is large. | A | ◯ | ◯ [%] | ◯ [%] |

*1 Delay time (Pr1.16, 1.12 and 1.25) will be valid only when returning from 2nd to 1st gain.

*2 Hysteresis (Pr1.18, 1.23 and 1.27) is defined as the fig. below shows.

*3 Designate with either the encoder resolution or the external scale resolution depending on the control mode.

*4 When you make it a condition that there is speed variation of 10r/min in 1s, set up the value to 1.

*5 When Pr1.15=10, the meanings of delay time, level and hysteresis are different from the normal. (refer to Fig. G)

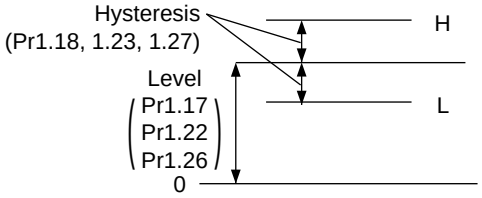


Fig.A

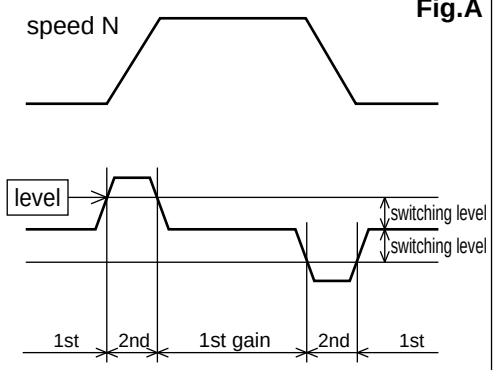



Fig. B

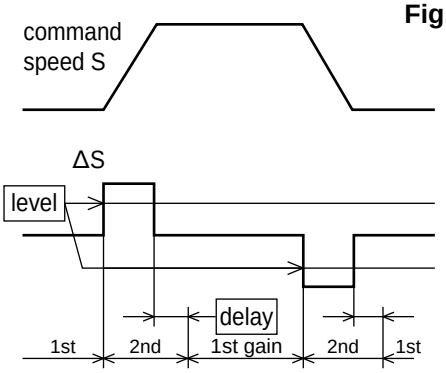



Fig. C

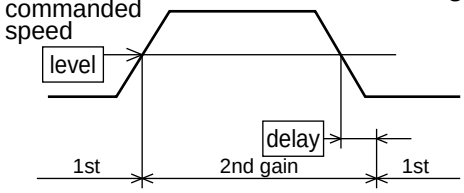



Fig. D

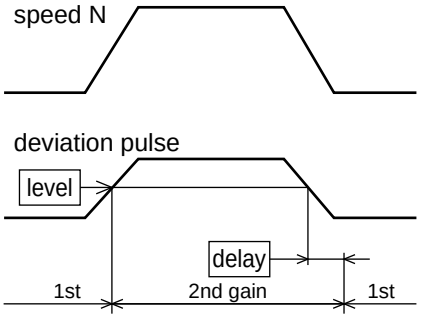



Fig. E

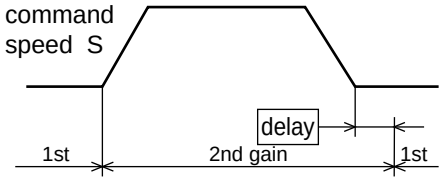



Fig. F

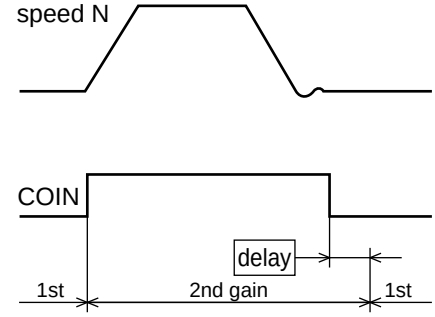
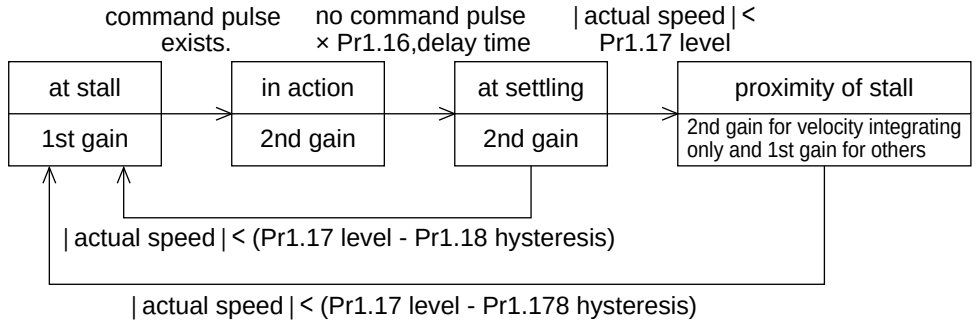



Fig. G




**Caution** Above Fig. does not reflect a timing lag of gain switching due to hysteresis (Pr1.18, 1.23 and 1.27).

# 4. Manual Gain Tuning (Basic)

## Suppression of Machine Resonance

In case of a low machine stiffness, you cannot set up a higher gain because vibration and noise occur due to oscillation caused by axis distortion or other causes. By suppressing the resonance peak at the notch filter, higher gain can be obtained or the level of vibration can be lowered.

### 1. Torque command filter (Pr1.04 and Pr1.09)

Sets up the filter time constant so as to damp the frequency at vicinity of resonance frequency. You can obtain the cut off frequency of the torque command filter in the following formula.

Cut off frequency (Hz) fc = 1 / (2π x parameter setup value x 0.00001)

### 2. Notch filter (Pr2.00, 2.07 to Pr2.12)

**• Adaptive filter**

MINASA-5 series feature the adaptive filter. With this filter you can control vibration of the load which resonance points vary by machine by machine and normal notch filter or torque filter cannot respond. The adaptive filter is validated by setting up Pr23 (Adaptive filter mode setup) to 1. Enter the action command with Pr2.00 Adaptive filter mode set to a value other than 0.

If the resonance point affects the motor speed, parameters of 3rd notch filter and/or 4th notch filters are automatically set according to the number of adaptive filters.

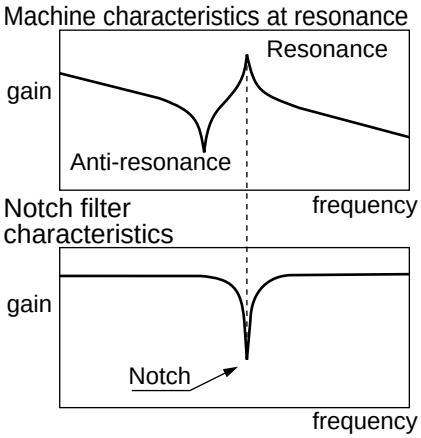
| | | |
|---|---|---|
| **Pr2.00** | Adaptive filter mode | 1: Adaptive filter is valid |
| **Pr2.07** | 3rd notch frequency | In no resonance point is found, the frequency is set to 5000. |
| **Pr2.08** | 3rd notch width selection | Automatically set when the adaptive filter is active. |
| **Pr2.09** | 3rd notch depth selection | |
| **Pr2.10** | 4th notch frequency | Notch frequency is automatically set to the 2nd resonance frequency estimated by the adaptive filter. In no resonance point is found, the frequency is set to 5000. |
| **Pr2.11** | 4th notch width selection | Automatically set when 2 adaptive filters are active. |
| **Pr2.12** | 4th notch depth selection | |

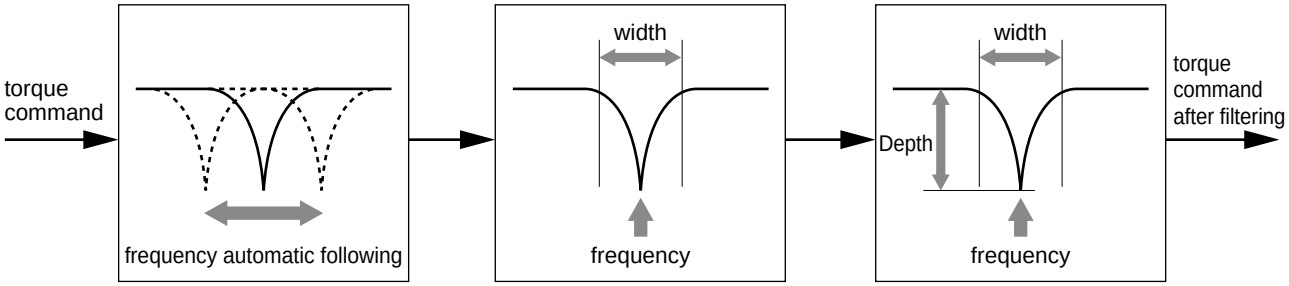
**• Notch filter (Pr2.01 to 2.12)**

MINASA-5 series feature 4 normal notch filters. You can adjust frequency and width and depth.

| | | |
|---|---|---|
| **Pr2.01** | 1st notch frequency | Set the center frequency of the 1st notch filter. *1 |
| **Pr2.02** | 1st notch width selection | Set the width of notch at the center frequency of the 1st notch filter. |
| **Pr2.03** | 1st notch depth selection | Set the depth of notch at the center frequency of the 1st notch filter. |
| **Pr2.04** | 2nd notch frequency | Set the center frequency of the 2nd notch filter. *1 |
| **Pr2.05** | 2nd notch width selection | Set the width of notch at the center frequency of the 2nd notch filter. |
| **Pr2.06** | 2nd notch depth selection | Set the depth of notch at the center frequency of the 2nd notch filter. |
| **Pr2.07** | 3rd notch frequency | Set the center frequency of the 3rd notch filter. *1 |
| **Pr2.08** | 3rd notch width selection | Set the width of notch at the center frequency of the 3rd notch filter. |
| **Pr2.09** | 3rd notch depth selection | Set the depth of notch at the center frequency of the 3rd notch filter. |
| **Pr2.10** | 4th notch frequency | Set the center frequency of the 4th notch filter. *1 |
| **Pr2.11** | 4th notch width selection | Set the width of notch at the center frequency of the 4th notch filter. |
| **Pr2.12** | 4th notch depth selection | Set the depth of notch at the center frequency of the 4th notch filter. |

*1 The notch filter function will be invalidated by setting up this parameter to "5000".




**Adaptive filter**

Suppress resonance point instantaneously.

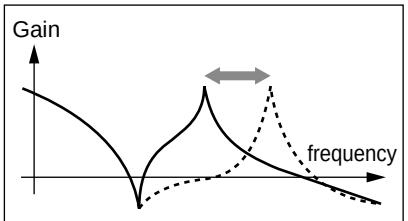
**1st notch filter**

Copying of the setup from the adaptive filter to 1st notch filter is enabled.

**2nd to 4th notch filter**

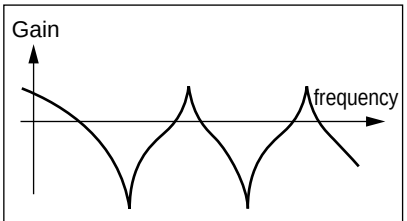
Adjustment of frequency, width and depth is enabled. (refer to P.5-22)

**Example of application machine**



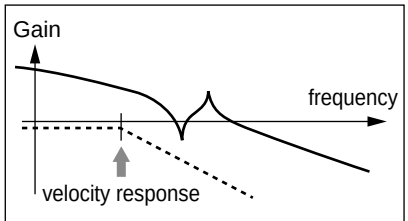

Machine which resonance point varies by each machine or by aging

**daptive filter enabled**




Machine which has multiple resonance points

**Adaptive filter and notch filter enabled**




Machine which has small peak nearby velocity response

**Depth adjustment enabled**

Related page • P.4-12... , P.4-19... “Details of parameter”

## Notch width and depth

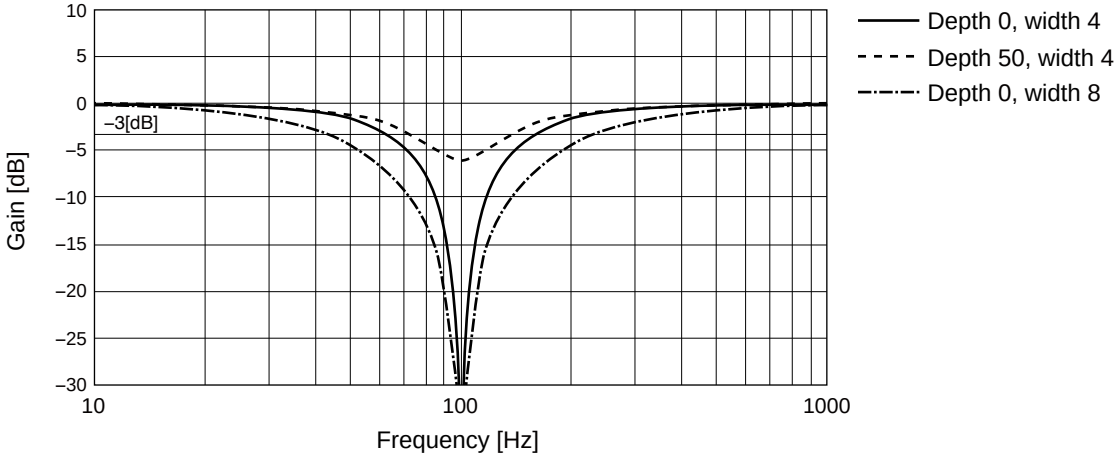
The width of the notch filter is the ratio of the width of –3dB attenuation frequency band with respect to the notch frequency at its center when depth is 0, and the value is as shown in the table below.

The notch filter depth indicates I:O ratio where the input at the center frequency is completely shut with setup value 0 but fully received with setup value 100. The table below shows this value in dB on the right.

| Notch width | Band width/center frequency | |
|---|---|---|
| | A4 series (reference) | A5 series |
| 0 | 0.41 | 0.5 |
| 1 | 0.56 | 0.59 |
| 2 | 0.71 | 0.71 |
| 3 | 0.86 | 0.84 |
| 4 | 1.01 | 1 |
| 5 | — | 1.19 |
| 6 | — | 1.41 |
| 7 | — | 1.68 |
| 8 | — | 2 |
| 9 | — | 2.38 |
| 10 | — | 2.83 |
| 11 | — | 3.36 |
| 12 | — | 4 |
| 13 | — | 4.76 |
| 14 | — | 5.66 |
| 15 | — | 6.73 |
| 16 | — | 8 |
| 17 | — | 9.51 |
| 18 | — | 11.31 |
| 19 | — | 13.45 |
| 20 | — | 16 |

| Notch depth | I/O ratio | [dB] |
|---|---|---|
| 0 | 0 | –∞ |
| 1 | 0.01 | –40 |
| 2 | 0.02 | –34 |
| 3 | 0.03 | –30.5 |
| 4 | 0.04 | –28 |
| 5 | 0.05 | –26 |
| 6 | 0.06 | –24.4 |
| 7 | 0.07 | –23.1 |
| 8 | 0.08 | –21.9 |
| 9 | 0.09 | –20.9 |
| 10 | 0.1 | –20 |
| 15 | 0.15 | –16.5 |
| 20 | 0.2 | –14 |
| 25 | 0.25 | –12 |
| 30 | 0.3 | –10.5 |
| 35 | 0.35 | –9.1 |
| 40 | 0.4 | –8 |
| 45 | 0.45 | –6.9 |
| 50 | 0.5 | –6 |
| 60 | 0.6 | –4.4 |
| 70 | 0.7 | –3.1 |
| 80 | 0.8 | –1.9 |
| 90 | 0.9 | –0.9 |
| 100 | 1 | 0 |

**Notch filter frequency characteristics**



## How to Check the Resonance Frequency of the Machine

(1) Start up the Setup Support Software, "PANATERM" and bring the frequency characteristics measurement screen.
(2) Set up the parameters and measurement conditions. (Following values are standard.)
- Set up Pr1.01 (1st gain of velocity loop) to 25 or so. (to lower the gain and make it easy to identify the resonance frequency)
- Set up the amplitude to 50 (r/min) or so. (not to saturate the torque)
- Make the offset to 100 (r/min) or so. (to increase the speed detecting data and to avoid the measurement error in the vicinity of speed-zero)
- Polarity is made positive direction with "+" and negative direction with "–".
- Setup the sampling rate to 0. (setup range to be 0 to 7.)

(3) Execute the frequency characteristic analysis.

**Remarks**
- Make sure that the revolution does not exceed the travel limit before the measurement.
  Standard revolutions are,
  Offset (r/min) × 0.017 × (sampling rate +1)
  Larger the offset, better measurement result you can obtain, however, revolutions may be increased.
- Set up Pr2.00 (Setup of adaptive filter mode) to 0 while you make measurement.

**Note**
- When you set a larger value of offset than the amplitude setup and make the motor run to the one direction at all time, you can obtain a better measurement result.
- Set up a smaller sampling rate when you measure a high frequency band, and a larger sampling rate when you measure a low frequency band in order to obtain a better measurement result.
- When you set a larger amplitude, you can obtain a better measurement result, but noise will be larger. Start a measurement from 50 [r/min] and gradually increase it.

## Relation of Gain Adjustment and Machine Stiffness

In order to enhance the machine stiffness,
(1) Install the base of the machine firmly, and assemble them without looseness.
(2) Use a coupling designed exclusively for servo application with high stiffness.
(3) Use a wider timing belt. Belt tension to be within the permissible load to the motor shaft.
(4) Use a gear reducer with small backlash.
- Inherent vibration (resonance frequency) of the machine system has a large effect to the gain adjustment of the servo.
  You cannot setup a higher response of the servo system to the machine with a low resonance frequency (machine stiffness is low).

**Note** Please download the Setup support software “PANATERM”from our web site anduse after install to the PC. **http://industrial.panasonic.com/jp/i/fa_motor.html**

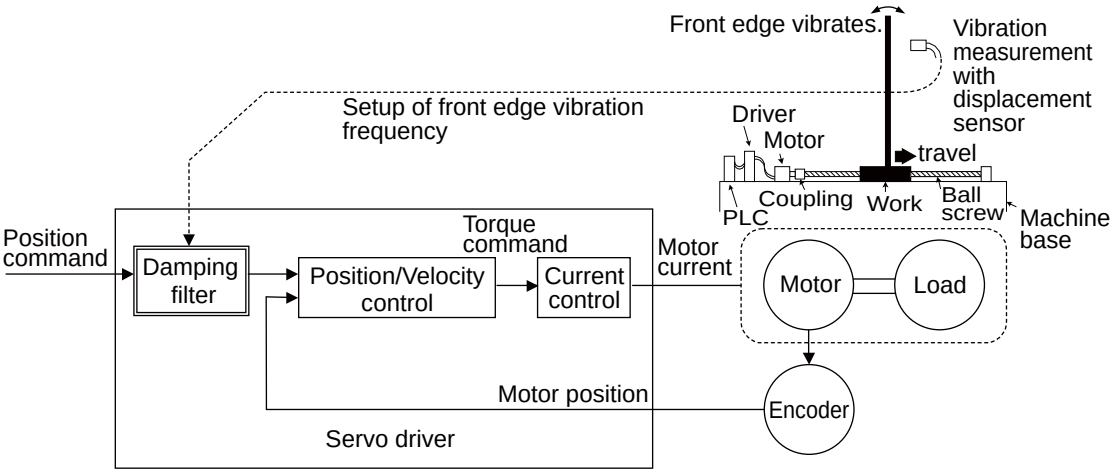
**Related page** • P.7-26 “Outline of Setup support software “PANATERM”

# 5. Manual Gain Tuning (Application)

## Damping Control

## Outline

This function reduces the vibration at the top or on whole of the equipment by removing the vibration frequency components specified by the positional command. Up to 2 among 4 frequency settings can be used at the same time.




## Applicable Range

This function can only be applicable when the following conditions are satisfied.

| | Conditions under which the damping control is activated |
|---|---|
| **Control mode** | • Control mode to be either or both position control or/and full-closed control.<br>Pr02 = 0 : Position control<br>Pr02 = 3 : 1st control mode of position and velocity control<br>Pr02 = 4 : 1st control mode of position control and torque control<br>Pr02 = 6 : Full-closed control |

## Caution

This function does not work properly or no effect is obtained under the following conditions.

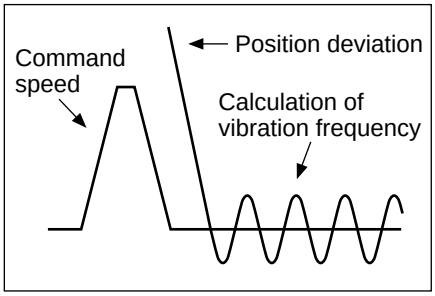
| | Conditions which obstruct the damping control effect |
|---|---|
| **Load** | • Vibration is triggered by other factors than command (such as disturbance).<br>• Ratio of resonance frequency and anti-resonance frequency is large.<br>• Vibration frequency is out of the range of 10.0-200.0 [Hz]. |

Related page • P.4-4 “Details of parameter” • P.7-26 “Outline of Setup support software “PANATERM”

## How to Use

**(1) Setup of damping frequency (1st: Pr2.14, 2nd: Pr2.16, 3rd: Pr2.18, 4th: Pr2.20))**

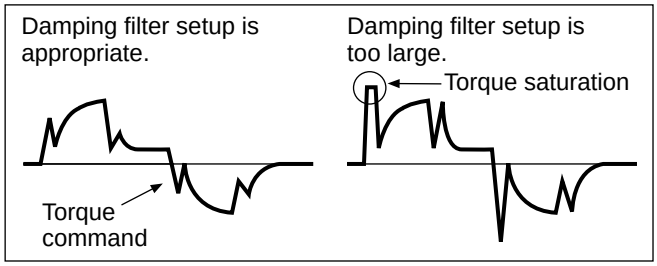
Measure the vibration frequency of the front edge of the machine. When you use such instrument as laser displacement meter, and can directly measure the load end vibration, read out the vibration frequency from the measured waveform and enter it.




**(2) Setup of damping filter (1st: Pr2.15, 2nd: Pr2.17, 3rd: Pr2.19, 4th: Pr2.21))**

First, set up 0.

You can reduce the settling time by setting up larger value, however, the torque ripple increases at the command changing point as the right fig. shows. Setup within the range where no torque saturation occurs under the actual condition. If torque saturation occurs, damping control effect will be lost.




**(3) Setup of damping filter switching selection (Pr2.13)**

You can switch the 1st or the 2nd damping filter depending on the vibration condition of the machine.

| Pr2.13 | VS-SEL2 | VS-SEL1 | 1st damping | 2nd damping | 3rd damping | 4th damping |
|---|---|---|---|---|---|---|
| **0** | — | — | ○ | ○ | | |
| 1 | — | OFF | ○ | | ○ | |
| | — | ON | | ○ | | ○ |
| 2 | OFF | OFF | ○ | | | |
| | OFF | ON | | ○ | | |
| | ON | OFF | | | ○ | |
| | ON | ON | | | | ○ |

| Pr2.13 | Position command direction | 1st damping | 2nd damping | 3rd damping | 4th damping |
|---|---|---|---|---|---|
| 3 | Positive direction | ○ | | ○ | |
| | Negative direction | | ○ | | ○ |

# 5. Manual Gain Tuning (Application)

## Feed forward function

## Outline

When position control or full closed control is used, positional deviation can be further reduced when compared with deviation where control is made only by feedback, and response is also improved, by calculating the velocity control command necessary for operation based on the internal positional command, and by adding velocity feed forward to the speed command calculated by comparison with position feedback.
The response time of the velocity control system is also improved by calculating torque command necessary for operation based on the velocity control command and by adding torque feed forward calculated by comparison with velocity feedback to the torque command.

## Related Parameter

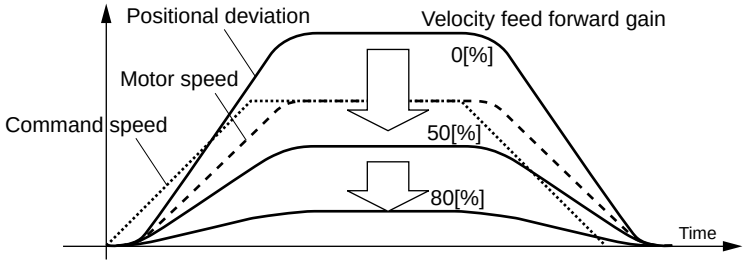
For A 5 series, the velocity feed forward and torque feed forward can be used.

| Class | No. | Title | Function |
|---|---|---|---|
| 1 | 10 | Velocity feed forward gain | Multiply the velocity control command calculated according to the internal positional command by the ratio of this parameter and add the result to the speed command resulting from the positional control process. |
| 1 | 11 | Velocity feed forward filter | Set the time constant of 1st delay filter which affects the input of velocity feed forward. |
| 1 | 12 | Torque feed forward gain | Multiply the torque command calculated according to the velocity control command by the ratio of this parameter and add the result to the torque command resulting from the velocity control process. |
| 1 | 13 | Torque feed forward filter | Set up the time constant of 1st delay filter which affects the input of torque feed forward. |
| 6 | 0 | Analog torque feed forward conversion gain | Set the input gain of analog torque feed forward.<br>0 to 9 are invalid. |
| 6 | 10 | Function expansion setup | Set up the function in unit of bit.<br>bit5 0: Analog torque feed forward is invalid.<br>1: Analog torque feed forward is Valid.<br>* bit 0 = LSB |

## Usage example of velocity feed forward

The velocity feed forward will become effective as the velocity feed forward gain is gradually increased with the velocity feed forward filter set at approx. 50 (0.5 ms). The positional deviation during operation at a constant velocity is reduced as shown in the equation below in proportion to the value of velocity feed forward gain.

Positional deviation [unit of command] = command speed [unit of command/s] / positional loop gain [1/s] × (100 - velocity feed forward gain [%]) / 100

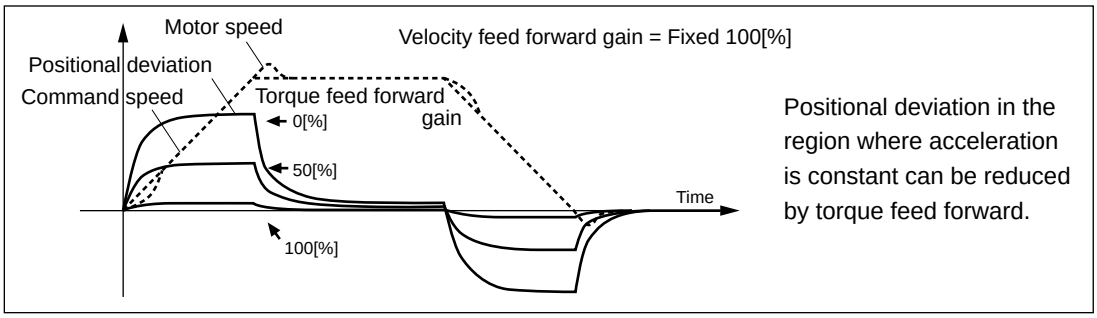



Positional deviation within the constant speed range will reduce as the velocity forward gain is increased.

With the gain set at 100%, calculatory positional deviation is 0, but significant overshoot occurs during acceleration/deceleration.
If the updating cycle of the positional command input is longer than the driver control cycle, or the pulse frequency varies, the operating noise may increase while the velocity feed forward is active. If this is the case, use positional command filter (1st delay or FIR smoothing), or increase the velocity forward filter setup value.

## Usage example of torque feed forward

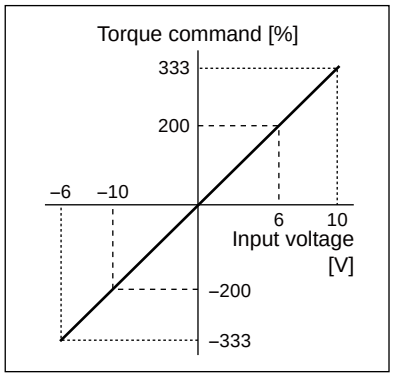
- To use the torque feed forward, correctly set the inertia ratio.
  Use the value that was determined at the start of the real time auto tuning, or set the inertia ratio that can be calculated from the machine specification to Pr0.04 Inertia ratio.
- The torque feed forward will become effective as the torque feed forward gain is gradually increased with the torque feed forward filter is set at approx. 50 (0.5 ms).
- Positional deviation at a constant acceleration/deceleration can be minimized close to 0 by increasing the torque forward gain. This means that positional deviation can be maintained at near 0 over entire operation range while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active .




Zero positional deviation is impossible in actual situation because of disturbance torque. As with the velocity feed forward, large torque feed forward filter time constant decreases the operating noise but increases positional deviation at acceleration change point.

## Usage example of analog torque feed forward

- Setting bit 5 place of Pr6.10 Function expansion setup to 1 enables the analog torque feed forward. When the analog input 3 is used by another function (e.g. analog torque limit), the function becomes invalid.
- The voltage (V) applied to the analog input 3 is converted to the torque via Pr6.00 Analog torque feed forward conversion gain setup and added to the torque command (%).
- The voltage (V) applied to the analog input 3 is converted to the motor torque command (%) through the process as shown in the graph below.
- The slope represents when Pr6.00 = 30. The slope changes as the setup value changes.




Torque command (%) = 100 × input voltage (V) / (Pr6.00 setup value × 0.1)

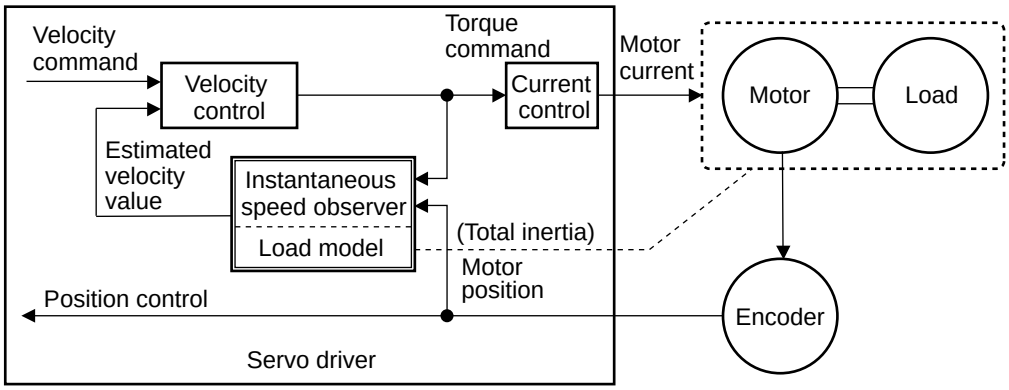
Related page • P.4-13... “Details of parameter”

# 5. Manual Gain Tuning (Application)

## Instantaneous Speed Observer

### Outline

This function enables both realization of high response and reduction of vibration at stopping, by estimating the motor speed using a load model, hence improving the accuracy of the speed detection.




### Applicable Range

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the instantaneous speed observer is activated |
|---|---|
| **Control mode** | • Control mode to be either or both position control or/and velocity control.<br>Pr0.01 = 0 : Position control<br>Pr0.01 = 1 : Velocity control |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly.<br>• Real-time auto-tuning should be disabled. (Pr0.02=0) |

### Caution

This function does not work properly or no effect is obtained under the following conditions.

| | Conditions which obstruct instantaneous speed observer action |
|---|---|
| **Load** | • Gap between the estimated total load inertia (motor + load) and actual machine is large.<br>e.g.) Large resonance point exists in frequency band of 300[Hz] or below. Non-linear factor such as large backlash exists.<br>• Load inertia varies.<br>• Disturbance torque with harmonic component is applied. |
| **Others** | • Settling range is very small. |

Related page • P.4-52 “Details of parameter”

## Related Parameter

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 10 | Function expansion setup | Speed observer enable bit (bit 0) valid/invalid the function.<br>bit0 0: Invalid 1: Valid<br>* bit 0 = LSB |

## How to Use

### (1) Setup of inertia ratio (Pr0.04)

**Set up as exact inertia ratio as possible.**

- When the inertia ratio (Pr20) is already obtained through real-time auto-gain tuning and is applicable at normal position control, use this value as Pr20 setup value.
- When the inertia ratio is already known through calculation, enter this calculated value.
- When the inertia ration is not known, execute the normal mode auto-gain tuning and measure the inertia ratio.

### (2) Adjustment at normal position control

- Adjust the position loop gain, velocity loop gain, etc.

### (3) Setup of instantaneous velocity observer (Pr6.10)

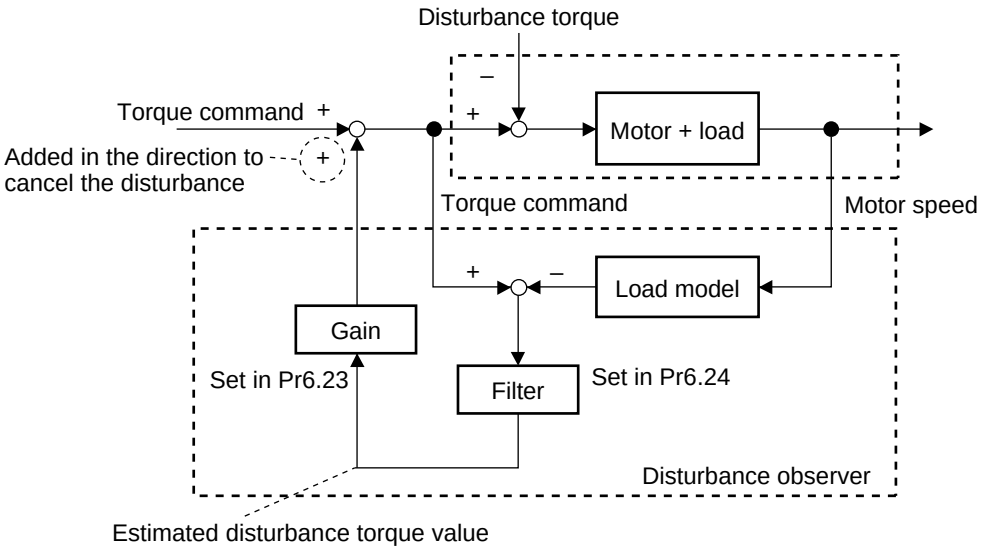
- By enabling instantaneous speed observer function through function expansion setup (Pr6.10), the speed detection method changes to the instantaneous speed observer.
- When you experience a large variation of the torque waveform or noise, return this to 0, and reconfirm the above cautions and (1).
- When you obtain the effect such as a reduction of the variation of the torque waveform and noise, search an optimum setup by making a fine adjustment of Pr0.04 (Inertia ratio) while observing the position deviation waveform and actual speed waveform to obtained the least variation. If you change the position loop gain and velocity loop gain, the optimum value of the inertia ratio (Pr0.04) might have been changed, and you need to make a fine adjustment again.

# 5. Manual Gain Tuning (Application)

## Disturbance observer

### Outline

This function uses the disturbance torque determined by the disturbance observer to reduce effect of disturbance torque and vibration.




### Applicable Range

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the disturbance observer is activated |
|---|---|
| **Control mode** | • Control mode to be either or both position control or/and velocity control.<br>Pr0.01 = 0 : Position control<br>Pr0.01 = 1 : Velocity control |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly.<br>• Real-time auto-tuning should be disabled. (Pr0.02=0)<br>• Instantaneous speed observer should be disabled. (Pr6.10=0)<br>• Gain switchover should be enabled. |

### Caution

Effect may not be expected in the following condition.

| | Conditions which obstruct disturbance observer action |
|---|---|
| **Load** | • Resonant frequency is lower than the cutoff frequency estimated by the disturbance observer.<br>• Disturbance torque contains many high frequency components. |

Related page • P.4-4... , P.4-52 “Details of parameter”

## Related Parameter

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 10 | Function expansion setup | Sets bits related to disturbance observer.<br>bit1 0: Invalid 1: Valid<br>bit2 0: Always valid 1: alid only when 1st gain is selected.<br>* bit 0 = LSB<br>Example)<br>To use the disturbance observer in the enabled mode only when 1st gain is selected:<br>Setup value = 6<br>To use the disturbance observer always in the enabled mode:<br>Setup value = 2 |
| 6 | 23 | Disturbance torque compensating gain | Set up compensating gain against disturbance torque. |
| 6 | 24 | Disturbance observer filter | Set up the filter time constant according to the disturbance torque compensation. |

## How to Use

1) With Pr6.10 Function enhancement setup, set observer enable/disable and operation mode (always enable/enable only when 1st gain is selected).

**2) Setup of Pr6.24 (Disturbance observer filter)**

First, set up Pr6.24 to a larger value and check the operation with Pr6.23 Disturbance torque compensating gain set to a low value, and then gradually decrease the setup value of Pr6.24. A low filter setup value assures disturbance torque estimation with small delay and effectively suppresses effects of disturbance. However, this results in larger operation noise. Well balanced setup is required.

**3) Setup of Pr6.23 (Disturbance torque compensating gain)**

After setting up Pr6.24, increase Pr6.23.

The disturbance suppressing capability increases by increasing the gain, but it is associated with increasing volume of operation noise.

This means that well balanced setup can be obtained by adjusting Pr6.24 and Pr6.23.

# 5. Manual Gain Tuning (Application)

## 3rd gain switching function

## Outline

In addition to the normal gain switching function described on P.5-17, 3rd gain switching function can be set to increase the gain just before stopping. The higher gain shortens positioning adjusting time.

## Applicable Range

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the 3rd gain switching function is activated |
|---|---|
| **Control mode** | • Control mode to be either or both position control or/and full-closed control.<br>Pr0.01 = 0 : Position control<br>Pr0.01 = 6 : Full-closed control |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly. |

## Related Parameter

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 5 | Position 3rd gain valid time | Set up the time at which 3rd gain becomes valid. |
| 6 | 6 | Position 3rd gain scale factor | Set up the 3rd gain by a multiplying factor of the 1st gain:<br>3rd gain = 1st gain × Pr6.06/100 |

Related page • P.4-4... , P.4-51 “Details of parameter”

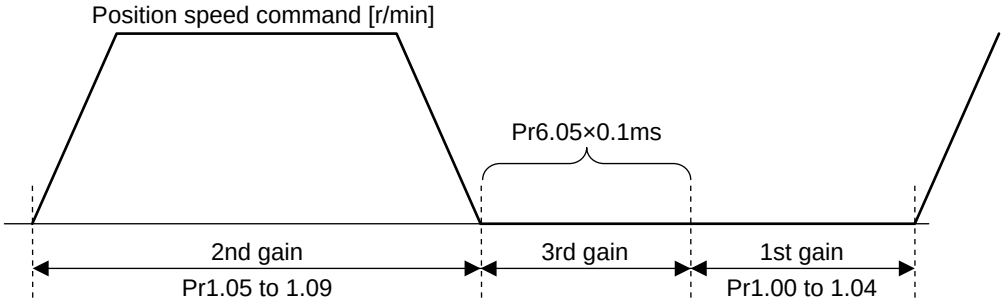
## How to Use

While in the condition under which the normal gain switching functions, set the 3rd gain application time to Pr6.05 Position 3rd gain enable time, and set the 3rd gain (scale factor with reference to 1st gain) to Pr6.06 Position 3rd gain magnification ratio.

- If 3rd gain is not used, set Pr6.05 to 0 and Pr6.06 to 100.
- The 3rd gain is enabled only for position control or full closed control.
- During the 3rd gain period, only position loop gain/speed proportional gain becomes 3rd gain, during other periods, 1st gain setting is used.
- When the 2nd gain switching condition is established during 3rd gain period, 2nd gain is used.
- During transition from 2nd gain to 3rd gain, Pr1.19 Position gain switching time is applied.

**Caution** When the gain is switched from 2nd to 1st by the change in parameter, the 3rd gain period appears.

Example)
Pr1.15 Position control switching mode = 7 switching condition: with positional command:




[3rd gain period]
Position loop gain = Pr1.00 × Pr6.06/100
Speed proportional gain = Pr1.01 × Pr6.06/100
Time constant of velocity integration, speed detection filter and torque filter directly use the

# 5. Manual Gain Tuning (Application)

## Friction torque compensation

### Outline

To reduce effect of friction represented by mechanical system, 2 types of friction torque compensation can be applied: offset load compensation that cancels constant offset torque and the dynamic friction compensation that varies direction as the operating direction varies.

### Applicable Range

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the Friction torque compensation is activated |
|---|---|
| **Control mode** | • Specific to individual functions. Refer to "Related parameters" shown below. |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly. |

### Related Parameter

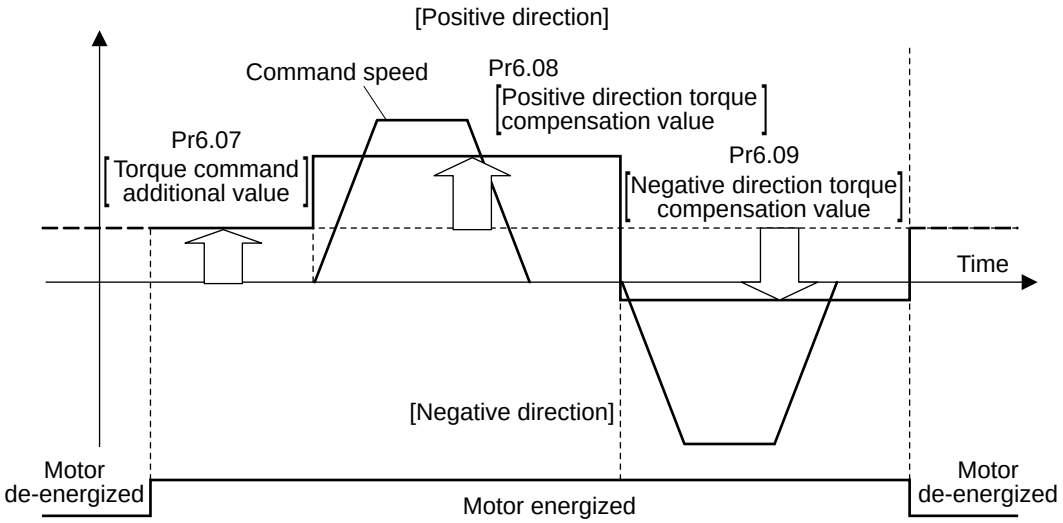
Combine the following 3 parameters to setup appropriate friction torque compensation.

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 7 | Torque command additional value | Set up the offset load compensation value usually added to the torque command in a control mode except for the torque control mode. |
| 6 | 8 | Positive direction torque compensation value | Set up the dynamic friction compensation value to be added to the torque command when forward positional command is fed. |
| 6 | 9 | Negative direction torque compensation value | Set up the dynamic friction compensation value to be added to the torque command when negative direction positional command is fed. |

Related page • P.4-51, P.4-52 “Details of parameter”

## How to Use

The friction torque compensation will be added in response to the entered positional command direction as shown below.




The friction compensation torque is the sum of the offset load compensation value which is set according to the torque command additional value (always constant) and the dynamic friction compensation torque which is set according to positive/negative direction torque compensation value.

The command speed direction is reset upon power-up or when the motor is de-energized.

- Pr6.07 [Torque command additional value] reduces variations in positioning operation (performance is affected by direction of movement). These variations occur when constant offset torque resulting from weight on vertical axis is applied to the motor.
- Certain loads such as belt driven shaft requires high dynamic friction torque, which lengthens positioning setting time or varies positioning accuracy. These problems can be minimized by setting the friction torque of every rotating direction into individual parameters. Pr6.08 [Positive direction torque compensation value] and Pr6.09 [Negative direction torque compensation value] can be used for this purpose.

**Caution** The offset load compensation and dynamic friction compensation can be used individually or in combination. However, some control modes impose limit on application.

- For torque control: Offset load compensation and dynamic friction compensation are set at 0 regardless of parameter setting.
- For velocity control with servo-off: Offset load compensation per Pr6.07 is enabled. Dynamic friction compensation is set at 0 regardless of parameter setting.
- For position control or full closed control with servo-on: Previous offset load compensation and dynamic friction compensation values are maintained until the first positional command is applied where the offset load compensation value is updated according to Pr6.07. The dynamic friction compensation value is updated to parameters Pr.6.08 and Pr6.09 depending on command direction.

# 5. Manual Gain Tuning (Application)

## Inertia ratio switching function

## Outline

Inertia ratio can be switched between No.1 and No.2 by the switching input (J-SEL). This feature is useful in application where the load inertia changes in two steps.

## Applicable Range

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the Inertia ratio switching function is activated |
|---|---|
| **Control mode** | • Can be used in all control modes.<br>Pr0.01 = 0 : Position control<br>Pr0.01 = 1 : Velocity control<br>Pr0.01 = 2 : Torque control<br>Pr0.01 = 3 : Position/Velocity control<br>Pr0.01 = 4 : Position/Torque control<br>Pr0.01 = 5 : Velocity/Torque control<br>Pr0.01 = 6 : Full-closed control |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly.<br>• Real-time auto-tuning should be disabled. (Pr0.02=0)<br>• Adaptive filter should be disabled. (Pr2.00=0)<br>• Instantaneous speed observer should be disabled. (Pr6.10=0)<br>• Disturbance observer should be disabled. (Pr6.24=0 bit1=0) |

## Caution

- Be sure to change the inertia ratio while the motor is in stop state. Otherwise, vibration or oscillation will occur.
- If the difference between the 1st inertial ratio and 2nd inertia ratio is large, vibration, etc., may occur even in stop mode. These potential problems should be identified on the actual model.

Related page • P.3-30 “Inputs and outputs on connector X4” • P.4-4... , P.4-52, 53 “Details of parameter”

## Related Parameter

Combine the following 3 parameters to setup appropriate inertia ratio switching function.

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 10 | Function expansion setup | Sets bits related to inertia ratio switching function.<br>bit1 0: Invalid 1: Valid<br>bit2 0: Always valid 1: alid only when 1st gain is selected.<br>* bit 0 = LSB<br>Example)<br>To enable inertial ratio switching<br>Setup value = 8 |
| 0 | 04 | Inertia ratio | Set 1st inertia ratio.<br>You can set up the ratio of the load inertia against the rotor (of the motor) inertia. |
| 6 | 13 | 2nd Inertia ratio | Set 1st inertia ratio.<br>You can set up the ratio of the load inertia against the rotor (of the motor) inertia. |

## How to Use

- Selects 1st inertia ratio or 2nd inertia ratio according to the inertia ratio select input (J-SEL).

| Inertia ratio switching input (J-SEL) | Applicable inertia ratio |
|---|---|
| OFF | 1st Inertia ratio (Pr0.04) |
| ON | 2nd Inertia ratio (Pr6.12) |

# 5. Manual Gain Tuning (Application)

## Hybrid vibration damping function

## Outline

This function suppresses vibration due to amount of twist between the motor and load in the full closed control mode. This function enables high gain setting.

## Outline

This function can be applicable only when the following conditions are satisfied.

| | Conditions under which the Hybrid vibration damping function is activated |
|---|---|
| **Control mode** | • Full-closed control mode |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly. |

## Caution

The effect of this function will be proportional to the amount of twist between the motor and load.

## Related Parameter

| Class | No. | Title | Function |
|---|---|---|---|
| 6 | 34 | Hybrid vibration suppression gain | Set up the hybrid vibration suppression gain for full-closed controlling.<br>First set it to the value identical to that of poison loop gain, and then fine tune as necessary. |
| 6 | 35 | Hybrid vibration suppression filter | Set up the time constant of the hybrid vibration suppression filter for full-closed controlling. |

## How to Use

[1] Set Pr6.34 Hybrid vibration suppression gain to the value equal to that of positional loop gain.

[2] Driving under full closed control, gradually increase the setup value of Pr6.35 Hybrid vibration suppression filter while checking response change.
When the response is improved, adjust Pr6.34 and Pr6.35 to determine the combination that provides the best response.

Related page • P.4-57 “Details of parameter”

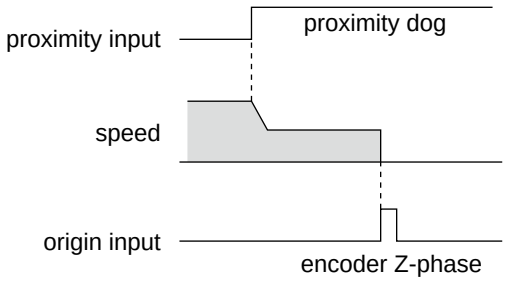
# 6. About Homing Operation

## Caution on Homing Operation

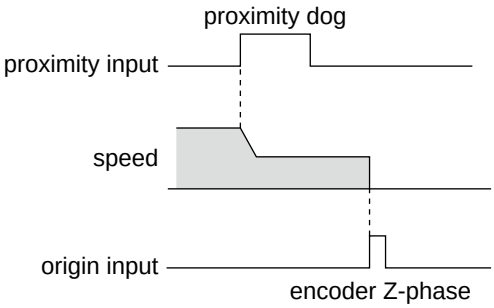
- In homing action by using the host controller, stop position might not be stabilized if the origin input (Z-phase of the encoder) is entered while the motor is not decelerated enough after the proximity input is turned on. Set up the ON-positions of proximity input and the position of origin point, considering the necessary pulse counts for deceleration. Take the positioning action and homing action into account when you set put acceleration/deceleration time with parameter, since this affect these action as well.
  **For the details of homing, observe the instruction manual of the host controller.**

### • Example of Homing Action

Proximity dog on... .Decelerates at an entry of the proximity input, and stops at an entry of the first origin input (Z-phase)




Proximity dog off... .Decelerates at an entry of the proximity input, and stops at an entry of the first origin input (Z-phase) after the input is tuned off

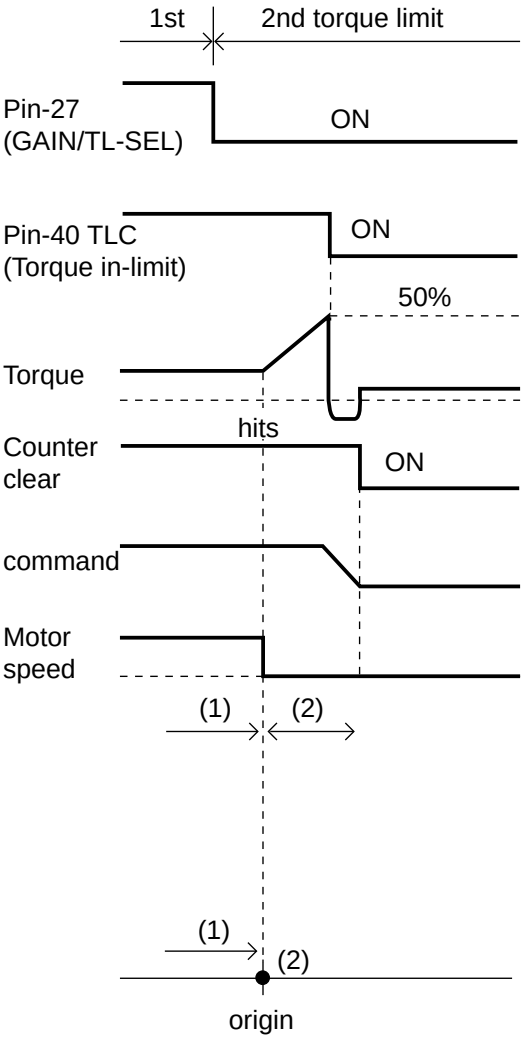


# 6. About Homing Operation

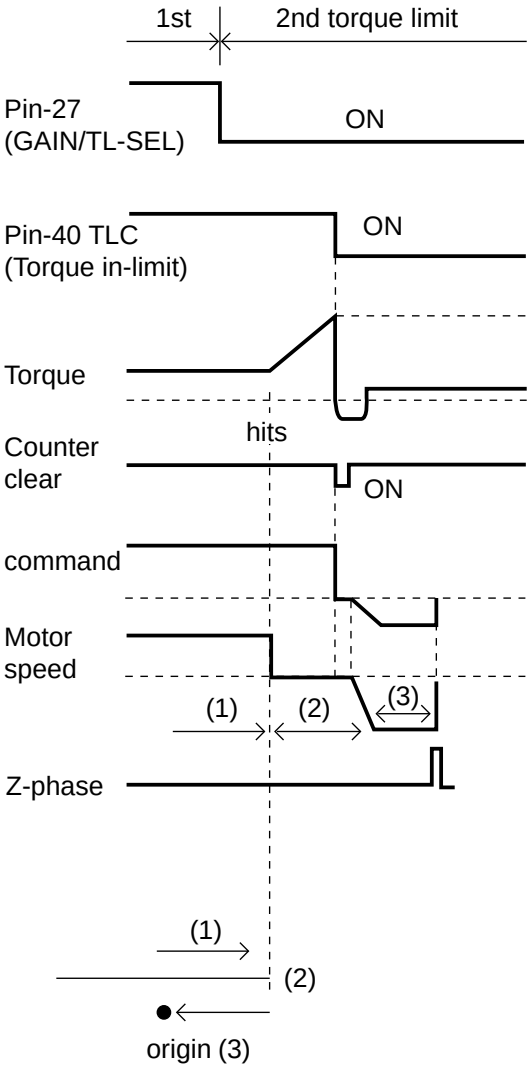
## Homing with Hit & Stop

You can set up the homing position with "Hit & Stop" where it is not easy to install a sensor due to environment.

(1) when you make a point where the work (load) hits as an origin




(2) when you stop the work (load) using Z-phase after making a hitting point as a starting point, then make that stopping point as an origin.




| Parameter No. | Title | Setup example |
|---|---|---|
| 5.22 | Setup of 2nd torque limit | 50 (Set up to less than 100%) |
| 0.14 | Excess setup of position deviation | 25000 |
| 5.13 | Setup of over-speed level | 0 (6000r/min) |
| 5.21 | Selection of torque limit | 3 |

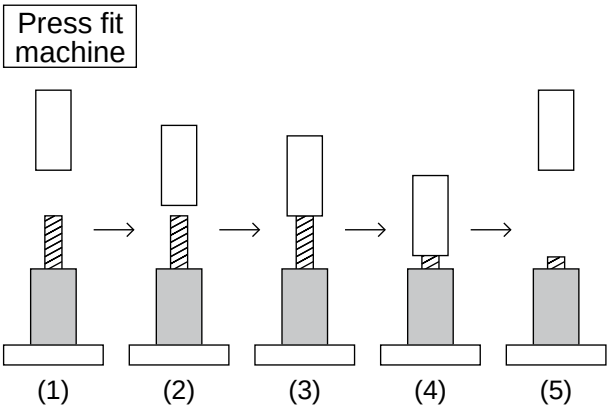
**Remarks** Make the Pin-27 H (Off=Open) after the Hit & Stop Homing is completed.

**Related page** • P.4-10... “Details of parameter”

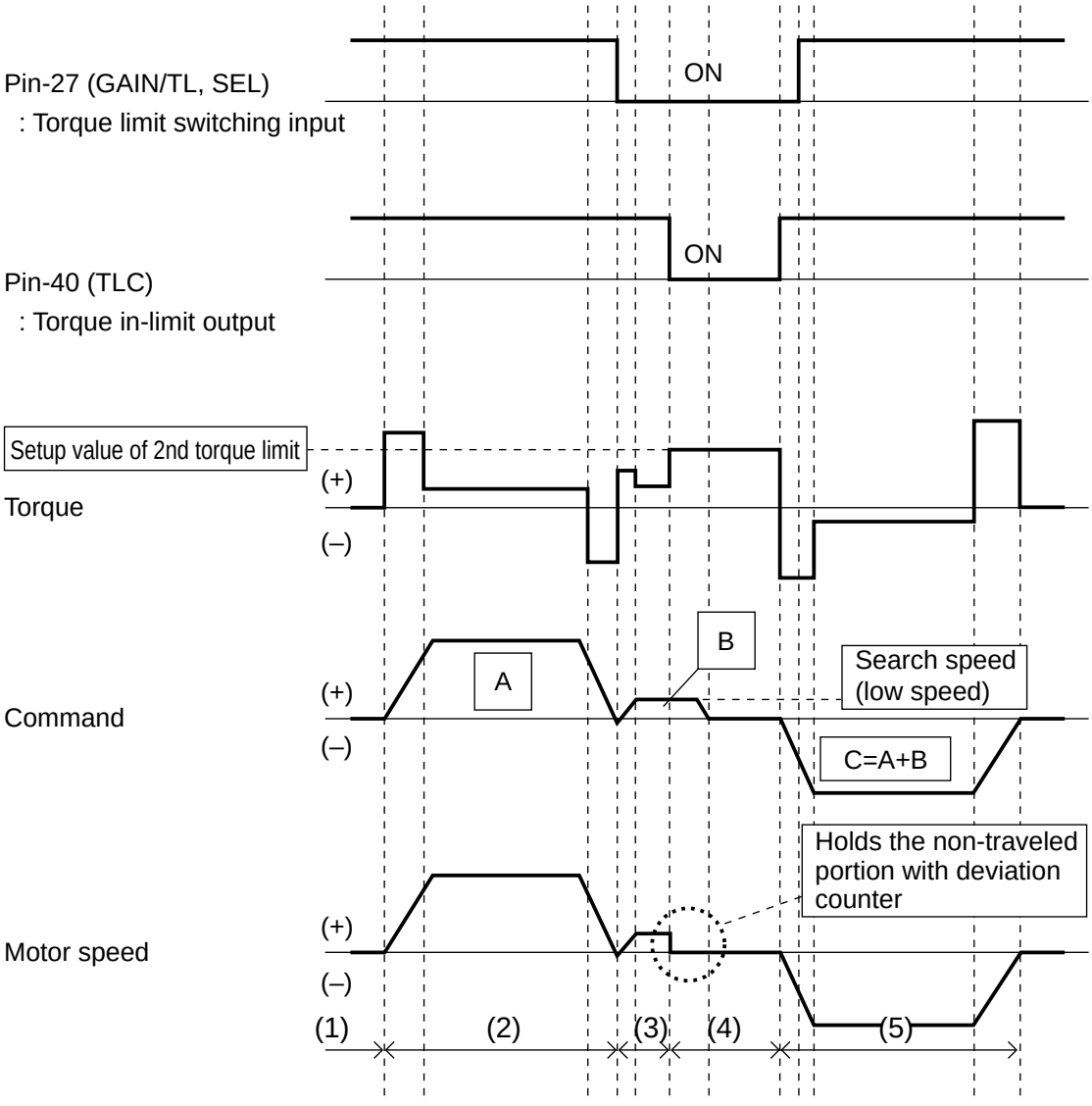
# 6. About Homing Operation

## Press & Hold Control

Application example




| Parameter No. | Title | Setup example |
|---|---|---|
| 5.21 | Setup of 2nd torque limit | 3 |
| 0.13 | Setup of 1st torque limit | 200 |
| 5.22 | Setup of 2nd torque limit | 50 |
| 0.14 | Excess setup of position deviation | 25000 |
| 5.13 | Setup of over-speed level | 0 |

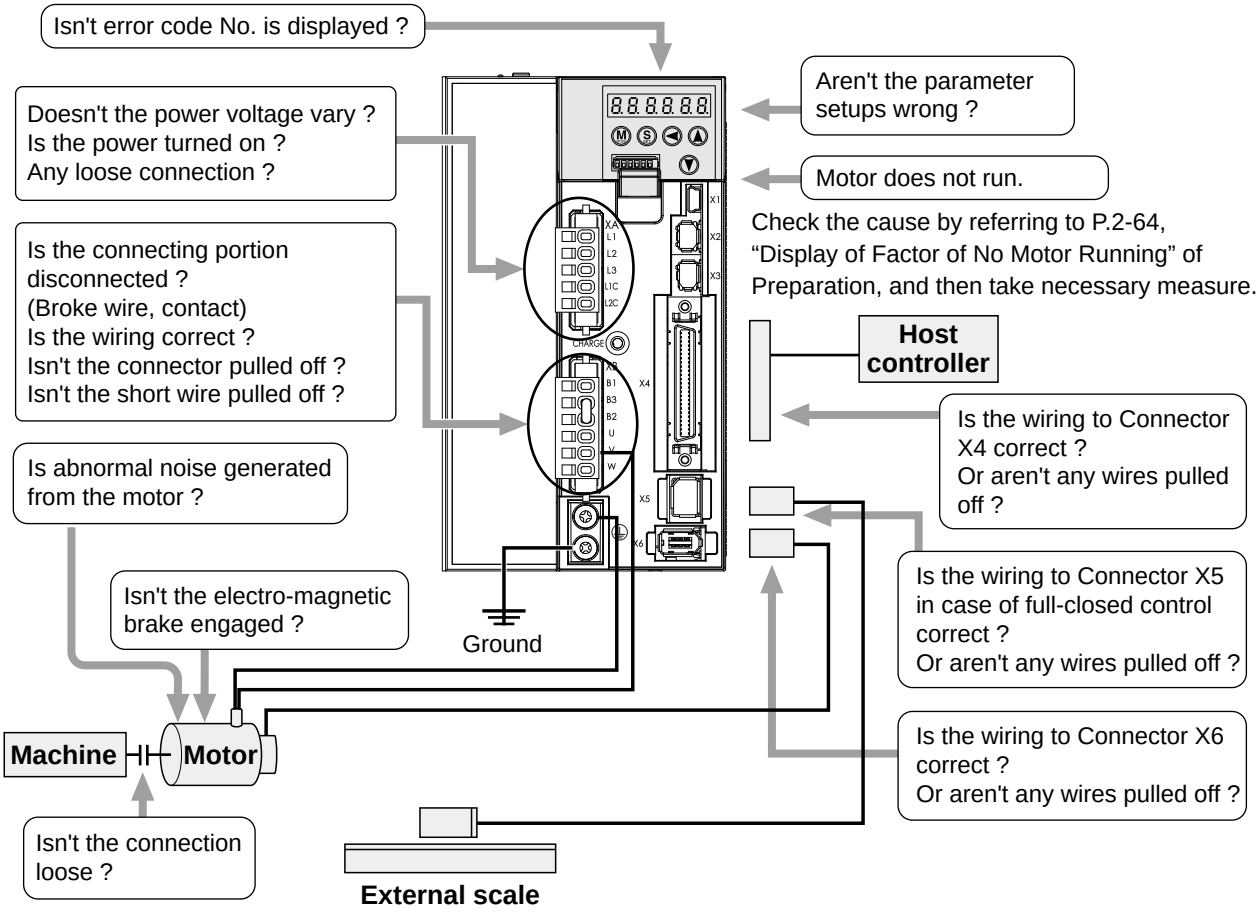


MEMO

# 6. When in Trouble

# 1. When in Trouble

## What to Check ?




6 When in Trouble

# 1. When in Trouble

## Protective Function (What is Error Code ?)

- Various protective functions are equipped in the driver. When these are triggered, the motor will stall due to error, the driver will turn the Servo-Alarm output (ALM) to off (open).
- Error status and their measures
  - During the error status, the error code No. will be displayed on the front panel LED, and you cannot turn Servo-ON.
  - You can clear the error status by Alarm clear input(A-CLR) in 120ms or longer.
  - When overload protection is triggered, you can clear it by Alarm clear input(A-CLR) in 10sec or longer after the error occurs. You can clear the Overload protection time characteristics (refer to P.6-13) by turning off the control power supply of the driver.
  - You can clear the above error by operating the front panel keys and setup support softwear "PANATERM".
  - Be sure to clear the alarm during stop after securing safety.

Related page
- P.2-52 ... "How to Use the Front Panel"
- P.3-30 "Inputs and outputs on connector X4"
- P.7-26 "Outline of Setup support software "PANATERM""

## <List of error code No.>

| Error code | | Protective function | Attribute | | | Detail page |
|---|---|---|---|---|---|---|
| Main | Sub | | History | Can be cleared | Immediate stop | |
| 11 | 0 | Control power supply under-voltage protection | | ○ | | 6-4 |
| 12 | 0 | Over-voltage protection | ○ | ○ | | |
| 13 | 0 | Main power supply under-voltage protection (between P to N) | | ○ | | |
| | 1 | Main power supply under-voltage protection (AC interception detection) | | ○ | | |
| 14 | 0 | Over-current protection | ○ | | | 6-5 |
| | 1 | IPM error protection | ○ | | | |
| 15 | 0 | Over-heat protection | ○ | | ○ | |
| 16 | 0 | Over-load protection | ○ | ○ | | |
| 18 | 0 | Over-regeneration load protection | ○ | | ○ | 6-6 |
| | 1 | Over-regeneration Tr error protection | ○ | | | |
| 21 | 0 | Encoder communication disconnect error protection | ○ | | | |
| | 1 | Encoder communication error protection | ○ | | | |
| 23 | 0 | Encoder communication data error protection | ○ | | | |
| 24 | 0 | Position deviation excess protection | ○ | ○ | ○ | 6-7 |
| | 1 | Velocity deviation excess protection | ○ | ○ | ○ | |
| 25 | 0 | Hybrid deviation excess error protection | ○ | | ○ | |
| 26 | 0 | Over-speed protection | ○ | ○ | ○ | |
| | 1 | 2nd over-speed protection | ○ | ○ | | |
| 27 | 0 | Command pulse input frequency error protection | ○ | ○ | ○ | 6-8 |
| | 2 | Command pulse multiplier error protection | ○ | ○ | ○ | |
| 28 | 0 | Limit of pulse replay error protection | ○ | ○ | ○ | |
| 29 | 0 | Deviation counter overflow protection | ○ | ○ | | |
| 30 | 0 | Safety detection | | ○ | | |
| 33 | 0 | IF overlaps allocation error 1 protection | ○ | | | 6-9 |
| | 1 | IF overlaps allocation error 2 protection | ○ | | | |
| | 2 | IF input function number error 1 protection | ○ | | | |
| | 3 | IF input function number error 2 protection | ○ | | | |
| | 4 | IF output function number error 1 protection | ○ | | | |
| | 5 | IF output function number error 2 protection | ○ | | | |
| | 6 | CL fitting error protection | ○ | | | |
| | 7 | INH fitting error protection | ○ | | | |
| 34 | 0 | Software limit protection | ○ | ○ | | |
| 36 | 0 to 2 | EEPROM parameter error protection | | | | 6-9 |
| 37 | 0 to 2 | EEPROM check code error protection | | | | |
| 38 | 0 | Over-travel inhibit input protection | | ○ | | |
| 39 | 0 | Analog input1 excess protection | ○ | ○ | ○ | 6-10 |
| | 1 | Analog input2 excess protection | ○ | ○ | ○ | |
| | 2 | Analog input3 excess protection | ○ | ○ | ○ | |
| 40 | 0 | Absolute system down error protection | ○ | ○ | | |
| 41 | 0 | Absolute counter over error protection | ○ | | | |
| 42 | 0 | Absolute over-speed error protection | ○ | ○ | | |
| 43 | 0 | Initialization failure | ○ | | | |
| 44 | 0 | Absolute single turn counter error protection | ○ | | | |
| 45 | 0 | Absolute multi-turn counter error protection | ○ | | | |
| 47 | 0 | Absolute status error protection | ○ | | | 6-11 |
| 48 | 0 | Encoder Z-phase error protection | ○ | | | |
| 49 | 0 | Encoder CS signal error protection | ○ | | | |
| 50 | 0 | Feedback scale connection error protection | ○ | | | |
| | 1 | Feedback scale communication error protection | ○ | | | |
| 51 | 0 | Feedback scale status 0 error protection | ○ | | | |
| | 1 | Feedback scale status 1 error protection | ○ | | | |
| | 2 | Feedback scale status 2 error protection | ○ | | | |
| | 3 | Feedback scale status 3 error protection | ○ | | | |
| | 4 | Feedback scale status 4 error protection | ○ | | | 6-12 |
| | 5 | Feedback scale status 5 error protection | ○ | | | |
| 55 | 0 | A-phase connection error protection | ○ | | | |
| | 1 | B-phase connection error protection | ○ | | | |
| | 2 | Z-phase connection error protection | ○ | | | |
| 87 | 0 | Compulsory alarm input protection | | ○ | | |
| 95 | 0 to 4 | Motor automatic recognition error protection | | | | |
| Other number | | Other error | ○ | | | |

**Note**

History...The error will be stored in the error history.
Can be cleared...To cancel the error, use the alarm clear input (A-CLR).
If the alarm clear input is not effective, turn off power, remove the cause of the error and then turn on power again.
Immediate stop...Instantaneous controlled stop upon occurrence of an error.
(Setting of “Pr.5.10 Sequence at alarm” is also required.)

# 1. When in Trouble

## Protective function (Detail of error code)

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| **Control power supply under-voltage protection** | **11** | **0** | Voltage between P and N of the converter portion of the control power supply has fallen below the specified value.<br>1) Power supply voltage is low. Instantaneous power failure has occurred<br>2) Lack of power capacity...Power supply voltage has fallen down due to inrush current at the main power-on.<br>3) Failure of servo driver (failure of the circuit) | Measure the voltage between lines of connector and terminal block (L1C - L2C) .<br>1) Increase the power capacity. Change the power supply.<br>2) Increase the power capacity.<br>3) Replace the driver with a new one. |
| **Over-voltage protection** | **12** | **0** | Voltage between P and N of the converter portion of the control power supply has exceeded the specified value<br>1) Power supply voltage has exceeded the permissible input voltage. Voltage surge due to the phase-advancing capacitor or UPS (Uninterruptible Power Supply) have occurred.<br>2) Disconnection of the regeneration discharge resistor<br>3) External regeneration discharge resistor is not appropriate and could not absorb the regeneration energy.<br>4) Failure of servo driver (failure of the circuit) | Measure the voltage between lines of connector (L1, L2 and L3).<br>1) Enter correct voltage. Remove a phase-advancing capacitor.<br>2) Measure the resistance of the external resistor connected between terminal P and B of the driver. Replace the external resistor if the value is ∞.<br>3) Change to the one with specified resistance and wattage.<br>4) Replace the driver with a new one. |
| **Main power supply under-voltage protection (PN)** | **13** | **0** | Instantaneous power failure has occurred between L1 and L3 for longer period than the preset time with Pr6D (Main power off detecting time) while Pr65 (LV trip selection at the main power-off) is set to 1. Or the voltage between P and N of the converter portion of the main power supply has fallen below the specified value during Servo-ON.<br>1) Power supply voltage is low. Instantaneous power failure has occurred<br>2) Instantaneous power failure has occurred.<br>3) Lack of power capacity...Power supply voltage has fallen down due to inrush current at the main power-on.<br>4) Phase lack...3-phase input driver has been operated with single phase input.<br>5) Failure of servo driver (failure of the circuit) | Measure the voltage between lines of connector (L1, L2 and L3).<br>1) Increase the power capacity. Change the power supply. Remove the causes of the shutdown of the magnetic contactor or the main power supply, then re-enter the power.<br>2) Set up the longer time to Pr5.09 (Main power off detecting time). Set up each phase of the power correctly.<br>3) Increase the power capacity. For the capacity, refer to P.2-6, "Driver and List of Applicable Peripheral Equipments" of Preparation.<br>4) Connect each phase of the power supply (L1, L2 and L3) correctly. For single phase, 100V and 200V driver, use L1 and L3.<br>5) Replace the driver with a new one. |
| **Main power supply under-voltage protection (AC)** | | **1** | | |

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| * **Over-current protection** | **14** | **0** | Current through the converter portion has exceeded the specified value.<br>1) Failure of servo driver (failure of the circuit, IGBT or other components) | 1) Turn to Servo-ON, while disconnecting the motor. If error occurs immediately, replace with a new driver. |
| * **IPM error protection** | | **1** | 2) Short of the motor wire (U, V and W) | 2) Check that the motor wire (U, V and W) is not shorted, and check the branched out wire out of the connector. Make a correct wiring connection. |
| | | | 3) Earth fault of the motor wire | 3) Measure the insulation resistance between motor wires, U, V and W and earth wire. In case of poor insulation, replace the motor. |
| | | | 4) Burnout of the motor | 4) Check the balance of resister between each motor line, and if unbalance is found, replace the motor. |
| | | | 5) Poor contact of the motor wire. | 5) Check the loose connectors. If they are, or pulled out, fix them securely. |
| | | | 6) Timing of pulse input is same as or earlier than Servo-ON. | 6) Enter the pulses 100ms or longer after Servo-ON. |
| * **Over-heat protection** | **15** | **0** | Temperature of the heat sink or power device has been risen over the specified temperature.<br>1) Ambient temperature has risen over the specified temperature.<br>2) Over-load | 1) Improve the ambient temperature and cooling condition.<br>2) Increase the capacity of the driver and motor. Set up longer acceleration/ deceleration time. Lower the load. |
| **Over-load protection** | **16** | **0** | Torque command value has exceeded the over-load level set with Pr5.12 (Setup of over-load level) and resulted in overload protection according to the time characteristics (described later)<br>1) Load was heavy and actual torque has exceeded the rated torque and kept running for a long time.<br>2) Oscillation and hunching action due to poor adjustment.<br>Motor vibration, abnormal noise.<br>Inertia ratio (Pr0.04) setup error.<br>3) Miswiring, disconnection of the motor.<br>4) Machine has collided or the load has gotten heavy. Machine has been distorted.<br>5) Electromagnetic brake has been kept engaged.<br>6) While wiring multiple axes, miswiring has occurred by connecting the motor cable to other axis. | Check that the torque (current) does not oscillates nor fluctuate up an down very much on the graphic screen of the PANATERM. Check the over-load alarm display and load factor with the PANATERM.<br>1) Increase the capacity of the driver and motor. Set up longer acceleration/ deceleration time. Lower the load.<br>2) Make a re-adjustment.<br>3) Make a wiring as per the wiring diagram. Replace the cables.<br>4) Remove the cause of distortion. Lower the load.<br>5) Measure the voltage between brake terminals. Release the brake<br>6) Make a correct wiring by matching the correct motor and encoder wires. |

• The over-load protection time characteristics are described on P.6-13.

**Caution** Once this error occurs, it cannot be cleared at least for 10 sec.

**Note**

- When protective function marked with * in the protective function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

Related page • P.2-8 “System Configuration and Wiring” • P.4-44 “Details of parameter”

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| * **Over-regeneration load protection** | **18** | **0** | Regenerative energy has exceeded the capacity of regenerative resistor.<br>1) Due to the regenerative energy during deceleration caused by a large load inertia, converter voltage has risen, and the voltage is risen further due to the lack of capacity of absorbing this energy of the regeneration discharge resistor.<br>2) Regenerative energy has not been absorbed in the specified time due to a high motor rotational speed.<br>3) Active limit of the external regenerative resistor has been limited to 10% duty. | Check the load factor of the regenerative resistor from the front panel or via communication.<br>Do not use in the continuous regenerative brake application.<br>1) Check the running pattern (velocity monitor). Check the load factor of the regenerative resistor and over-regeneration warning display. Increase the capacity of the driver and the motor, and loosen the deceleration time. Use the external regenerative resistor.<br>2) Check the running pattern (speed monitor). Check the load factor of the regenerative resistor. Increase the capacity of the driver and the motor, and loosen the deceleration time. Lower the motor rotational speed. Use an external regenerative resistor.<br>3) Set up Pr0.16 to 2.<br>**Caution** Install an external protection such as thermal fuse without fail when you set up Pr0.16 to 2. Otherwise, regenerative resistor loses the protection and it may be heated up extremely and may burn out. |
| * **Regenerative transistor error protection** | **18** | **1** | Regenerative driver transistor on the servo driver is defective. | Replace the driver. |
| * **Encoder communication disconnection error protection** | **21** | **0** | Communication between the encoder and the driver has been interrupted in certain times, and disconnection detecting function has been triggered. | Make a wiring connection of the encoder as per the wiring diagram. Correct the miswiring of the connector pins. |
| * **Encoder communication error protection** | | **1** | Communication error has occurred in data from the encoder. Mainly data error due to noise. Encoder cables are connected, but communication data has some errors. | • Secure the power supply for the encoder of DC5V±5% (4.75 to 5.25V)...pay an attention especially when the encoder cables are long.<br>• Separate the encoder cable and the motor cable if they are bound together.<br>• Connect the shield to FG. |
| * **Position deviation excess protection** | **23** | **0** | Data communication between the encoder is normal, but contents of data are not correct.<br>Mainly data error due to noise. Encoder cables are connected, but communication data has some errors. | |

**Note**
- When protective function marked with * in the protective function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

Related page • P.4-6... “Details of parameter”

| Protective function | Error code No. Main | Sub | Causes | Measures |
|---|---|---|---|---|
| **Position deviation excess protection** | **24** | **0** | Deviation pulses have exceeded the setup of Pr0.14.<br>1) The motor movement has not followed the command.<br><br>2) Setup value of Pr0.14 (Position deviation excess setup) is small. | 1) Check that the motor follows to the position command pulses. Check that the output toque has not saturated in torque monitor. Make a gain adjustment. Set up maximum value to Pr0.13 and Pr5.22. Make a encoder wiring as per the wiring diagram. Set up the longer acceleration/deceleration time. Lower the load and speed.<br>2) Set up a larger value to Pr0.14. |
| **Velocity deviation excess protection** | | **1** | The difference between the internal positional command speed and actual speed (speed deviation) exceeds the setup vale of Pr6.02.<br>Note) If the internal positional command speed is forcibly set to 0 due to instantaneous stop caused by the command pulse inhibit input (INH) or CW/CCW over-travel inhibit input, the speed deviation rapidly increases at this moment. Pr6.02 setup value should have sufficient margin because the speed deviation also largely increases on the rising edge of the internal positional command speed. | • Increase the setup value of Pr6.02.<br>• Lengthen the acceleration/deceleration time of internal positional command speed, or improve the follow-up characteristic by adjusting the gain.<br>• Disable the excess speed deviation detection (Pr6.02 = 0). |
| *** Hybrid deviation excess error protection** | **25** | **0** | Position of load by the external scale and position of the motor by the encoder slips larger than the setup pulses with Pr7B (Setup of hybrid deviation excess) at full-closed control. | • Check the connection between the motor and the load.<br>• Check the connection between the external scale and the driver.<br>• Check that the variation of the motor position (encoder feedback value) and the load position (external scale feedback value) is the same sign when you move the load.<br>Check that the numerator and denominator of the external scale division (Pr3.24 and 3.25) and reversal of external scale direction (Pr3.26) are correctly set. |
| **Over-speed protection** | **26** | **0** | The motor rotational speed has exceeded the setup value of Pr5.13. | • Do not give an excessive speed command.<br>• Check the command pulse input frequency and division/multiplication ratio.<br>• Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment.<br>• Make a wiring connection of the encoder as per the wiring diagram. |
| **2nd Over-speed protection** | | **1** | The motor rotational speed has exceeded the setup value of Pr6.15. | |

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| **Command pulse input frequency error protection** | **27** | **0** | The frequency of command pulse input is more than 1.2 times the setting in Pr5.32. | Check the command pulse input for frequency. |
| **Electronic gear error protection** | | **2** | Division and multiplication ratio which are set up with the command pulse counts per single turn and the1st and the 4th numerator/denominator of the electronic gear are not appropriate. | Check the setup value of electronic gear. |
| **Pulse regeneration limit protection** | **28** | **0** | The output frequency of pulse regeneration has exceeded the limit. | • Check the setup values of Pr0.11 and 5.03.<br>• To disable the detection, set Pr5.33 to 0. |
| **Deviation counter overflow protection** | **29** | **0** | Positional deviation of encoder pulse reference has exceeded $2^{29}$ (536870912). | • Check that the motor runs as per the position command pulses.<br>• Check that the output toque has not saturated in torque monitor.<br>• Make a gain adjustment.<br>• Set up maximum value to Pr0.13 and Pr5.22.<br>• Make a wiring connection of the encoder as per the wiring diagram. |
| **Safety input protection** | **30** | **0** | Input photocoupler of both or one of safety input 1 and 2 is OFF. | Check wiring of safety input 1 and 2. |
| *** I/F input duplicated allocation error 1 protection** | **33** | **0** | Input signals (SI1, SI2, SI3, SI4, SI5) are assigned with two functions. | Allocate correct function to each connector pin. |
| *** I/F input duplicated allocation error 2 protection** | | **1** | Input signals (SI6, SI7, SI8, SI9, SI10) are assigned with two functions. | |
| *** I/F input function number error 1 protection** | | **2** | Input signals (SI1, SI2, SI3, SI4, SI5) are assigned with undefined number. | |
| *** I/F input function number error 2 protection** | | **3** | Input signals (SI6, SI7, SI8, SI9, SI10) are assigned with undefined number. | |

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| * **I/F output function number error 1 protection** | **33** | **4** | Output signals (SI1, SI2, SI3) are assigned with undefined number. | Allocate correct function to each connector pin. |
| * **I/F output function number error 2 protection** | | **5** | Output signals (SI4) are assigned with undefined number. | |
| * **CL assignment error** | | **6** | Counter clear function is assigned to a signal number other than SI7. | |
| * **INH assignment error** | | **7** | Command pulse inhibit input function is assigned to a signal number other than SI10. | |
| **Motor working range setup error protection** | **34** | **0** | When a position command within the specified input range is given, the motor operates outside its working range specified in Pr5.14.<br>1) Gain is not appropriate.<br>2) Pr5.14 setup value is low. | 1) Check the gain (balance between position loop gain and speed loop gain) and inertia ratio.<br>2) Increase the setup value of Pr5.14. Or, Set Pr5.14 to 0 to disable the protective function. |
| * **EEPROM parameter error protection** | **36** | **0**<br>**1**<br>**2** | Data in parameter storage area has been damaged when reading the data from EEPROM at power-on. | • Set up all parameters again.<br>• If the error persists, replace the driver (it may be a failure.) Return the product to the dealer or manufacturer. |
| * **EEPROM check code error protection** | **37** | **0**<br>**1**<br>**2** | Data for writing confirmation to EEPROM has been damaged when reading the data from EEPROM at power-on. | Replace the driver. (it may be a failure). Return the product to a dealer or manufacturer. |
| * **Over-travel inhibit input protection** | **38** | **0** | With Pr5.04, over-travel inhibit input setup = 0, both positive and negative over-travel inhibit inputs (POT/NOT) have been ON.<br>With Pr5.04 = 0, positive or negative over-travel inhibit input has turned ON. | Check that there are not any errors in switches, wires or power supply which are connected to positive direction/ negative direction over-travel inhibit input. Check that the rising time of the control power supply (DC12 to 24V) is not slow. |

**Note**

- When protective function marked with * in the protective function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| **Analog input 1 (AI1) excess protection** | **39** | **0** | Higher voltage has been applied to the analog input 1 than the value that has been set by Pr4.24. | • Set up Pr4.24 correctly. Check the connecting condition of the connector X4.<br>• Set up Pr4.24 to 0 and invalidate the protective function. |
| **Analog input 2 (AI2) excess protection** | | **1** | Higher voltage has been applied to the analog input 1 than the value that has been set by Pr4.27. | • Set up Pr4.27 correctly. Check the connecting condition of the connector X4.<br>• Set up Pr4.27 to 0 and invalidate the protective function. |
| **Analog input 3 (AI3) excess protection** | **39** | **2** | Higher voltage has been applied to the analog input 1 than the value that has been set by Pr4.30. | • Set up Pr4.30 correctly. Check the connecting condition of the connector X4.<br>• Set up Pr4.30 to 0 and invalidate the protective function. |
| **Absolute system down error protection** | **40** | **0** | Voltage of the built-in capacitor has fallen below the specified value because the power supply or battery for the 17-bit absolute encoder has been down.<br>**Caution** Once this error occurs, the alarm cannot be cleared until the absolute encoder is reset. | After connecting the power supply for the battery, clear the absolute encoder. |
| * **Absolute counter over error protection** | **41** | **0** | Multi-turn counter of the 17-bit absolute encoder has exceeded the specified value. | • Set Pr0.15 to 2 to ignore the multi-turn counter over.<br>• Limit the travel from the machine origin within 32767 revolutions. |
| **Absolute over-speed error protection** | **42** | **0** | The motor speed has exceeded the specified value when only the supply from the battery has been supplied to 17-bit encoder during the power failure.<br>**Caution** Once this error occurs, the alarm cannot be cleared until the absolute encoder is reset. | • Check the supply voltage at the encoder side (5V±5%)<br>• Check the connecting condition of the connector, CN X2. |
| * **Encoder initialization error protection *1** | **43** | **0** | Encoder initialization error was detected. | Replace the motor. |
| * **Absolute single turn counter error protection *1** | **44** | **0** | Single turn counter error of encoder has been detected. | Replace the motor. |
| * **Absolute multi-turn counter error protection *1** | **45** | **0** | Multi turn counter error of encoder has been detected. | Replace the motor. |

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| * **Absolute status error protection *1** | **47** | **0** | Encoder has been running at faster speed than the specified value at power-on. | Arrange so as the motor does not run at power-on. |
| * **Encoder Z-phase error protection*1** | **48** | **0** | Missing pulse of Z-phase of serial incremental encoder has been detected. The encoder might be a failure. | Replace the motor. |
| * **Encoder CS signal error protection*1** | **49** | **0** | CS signal logic error of serial incremental encoder has been detected. The encoder might be a failure. | Replace the motor. |
| * **Feedback scale wiring error protection** | **50** | **0** | Communication between the external scale and the driver has been interrupted in certain times, and disconnection detecting function has been triggered. | • Make a wiring connection of the external scale as per the wiring diagram.<br>• Correct the miswiring of the connector pins. |
| * **External communi-cation data error protection** | | **1** | Communication error has occurred in data from the external scale. Mainly data error due to noise. External scale cables are connected, but communication date has some error. | • Secure the power supply for the external scale of DC5±5% (4.75 to 5.25V)...pay attention especially when the external scale cables are long.<br>• Separate the external scale cable and the motor cable if they are bound together.<br>• Connect the shield to FG...refer to wiring diagram. |
| * **External scale status 0 error protection *1** | **51** | **0** | Bit 0 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | Remove the causes of the error, then clear the external scale error from the front panel. And then, shut off the power to reset. |
| * **External scale status 1 error protection *1** | | **1** | Bit 1 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | |
| * **External scale status 2 error protection *1** | | **2** | Bit 2 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | |
| * **External scale status 3 error protection *1** | | **3** | Bit 3 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | |

**Note**

- When protective function marked with * in the protective function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

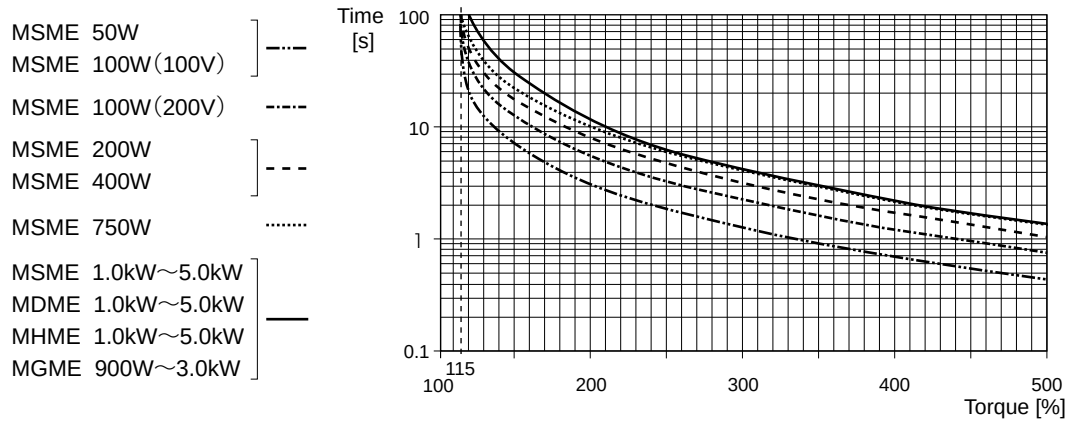
Related page • P.4.6... "Details of parameter"

| Protective function | Error code No. Main | Error code No. Sub | Causes | Measures |
|---|---|---|---|---|
| * **External scale status 4 error protection *1** | **51** | **4** | Bit 4 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | Remove the causes of the error, then clear the external scale error from the front panel. And then, shut off the power to reset. |
| * **External scale status 5 error protection *1** | | **5** | Bit 5 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale. | |
| * **A-phase wiring error protection** | **55** | **0** | A-phase wiring in the external scale is defective, e.g. discontinued. | Check the A-phase wiring connection. |
| * **B-phase wiring error protection** | | **1** | B-phase wiring in the external scale is defective, e.g. discontinued. | Check the B-phase wiring connection. |
| * **Z-phase wiring error protection** | | **2** | Z-phase wiring in the external scale is defective, e.g. discontinued. | Check the Z-phase wiring connection. |
| **Forced alarm input protection** | **87** | **0** | Forced alarm input (E-STOP) is applied. | Check the wiring of forced alarm input (E-STOP). |
| * **Motor automatic recognition error protection** | **95** | **0 to 4** | The motor and the driver has not been matched. | Replace the motor which matches to the driver. |
| * **Other error** | **Other No.** | | Control circuit has malfunctioned due to excess noise or other causes. Some error has occurred inside of the driver while triggering self-diagnosis function of the driver. | • Turn off the power once, then re-enter.<br>• If error repeats, this might be a failure. Stop using the products, and replace the motor and the driver. Return the products to the dealer or manufacturer. |

**Note**

- When protective function marked with * in the protective function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

## Time characteristics of Error code No.16.0 (Overload protection)




**Caution** Use the motor so that actual torque stays in the continuous running range shown in "S-T characteristic" of the motor. For the S-T characteristics, see P.7-56 Motor characteristics (S-T characteristics).

## Software Limit Function (Error code No.34.0)

### 1) Outline

You can make an alarm stop of the motor with software limit protection (Error code No.34) when the motor travels exceeding the movable range which is set up with Pr5.14 (Set up of software limit) against the position command input range.

You can prevent the work from colliding to the machine end caused by motor oscillation.

### 2) Applicable range

This function works under the following conditions.

| | Conditions under which the software limit works |
|---|---|
| **Control mode** | • Position control, Full-closed control |
| **Others** | • Should be in servo-on condition<br>• Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly. |

### 3) Cautions

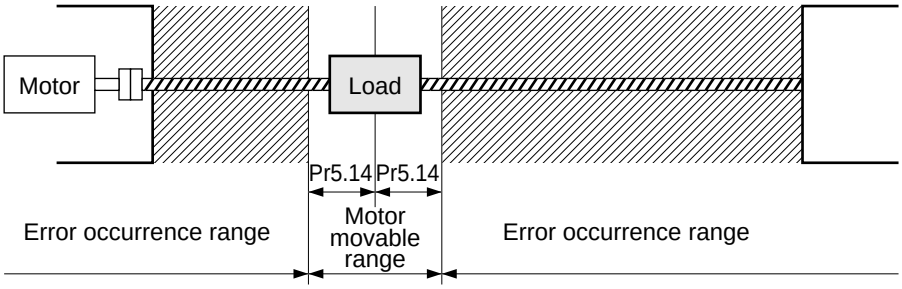
- This function is not a protection against the abnormal position command.
- When this software limit protection is activated, the motor decelerates and stops according to Pr5.14 (Sequence at alarm).
  The work (load) may collide to the machine end and be damaged depending on the load during this deceleration, hence set up the range of Pr5.14 including the deceleration movement.
- This software limit protection will be invalidated during the trial run and frequency characteristics functioning of the PANATERM.

Related page • P.4-44, 4-45 "Details of parameter"

**4) Example of movement**

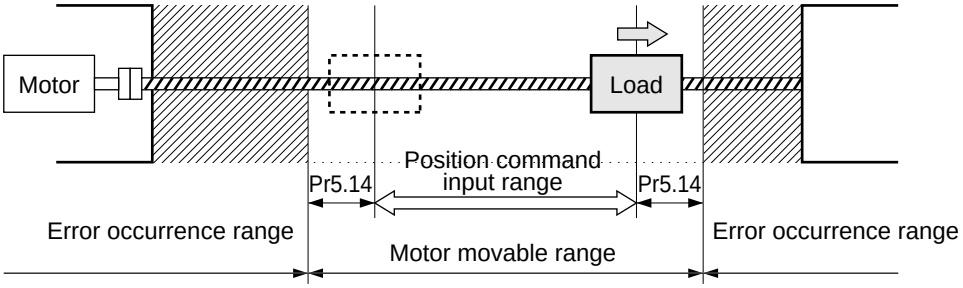
**(1) When no position command is entered (Servo-ON status),**

The motor movable range will be the travel range which is set at both sides of the motor with Pr26 since no position command is entered. When the load enters to the Err34 occurrence range (oblique line range), software limit protection will be activated.



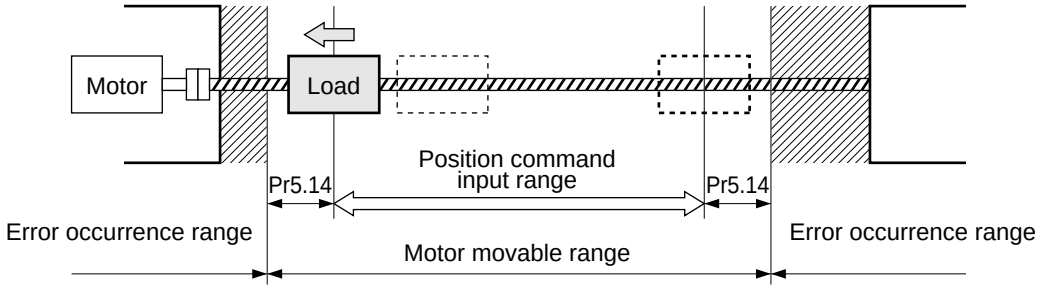

**(2) When the load moves to the right (at Servo-ON),**

When the position command to the right direction is entered, the motor movable range will be expanded by entered position command, and the movable range will be the position command input range + Pr26 setups in both sides.




**(3) When the load moves to the left (at Servo-ON),**

When the position command to the left direction, the motor movable range will be expanded further.




**5) Condition under which the position command input range is cleared**

The position command input range will be 0-cleared under the following conditions.

- when the power is turned on.
- while the position deviation is being cleared (Deviation counter clear is valid, Pr66 (Sequence at over-travel inhibition) is 2 and over-travel inhibition input is valid.)
- At the beginning and ending of trial run via communication.

Related page • P.4-42... “Details of parameter”

# 2. Setup of gain pre-adjustment protection

Before starting gain adjustment, set the following parameters based on the conditions of use, to assure safe operation.

**1) Setup of over-travel inhibit input**

By inputting the limit sensor signal to the driver, the bumping against mechanical end can be prevented. Refer to interface specification, positive/negative direction over-travel inhibit input (POT/NOT). Set the following parameters which are related to over-travel inhibit input.

Pr5.04 Setup of over-travel inhibit input

Pr5.05 Sequence at over-travel inhibit

Related page P.3-38 (POT/NOT), P.4-42 (Pr5.04, Pr5.05)

**2) Setup of torque limit**

By limiting motor maximum torque, damage caused by failure or disturbance such as bite of the machine and collision will be minimized. To apply standardized limit through parameters, set Pr0.13 The 1st torque limit.

If the torque limit setup is lower than the value required during the actual application, the following two protective features will be triggered: over-speed protection when overshoot occurs, and excess positional deviation protection when response to the command delays.

By allocating the torque in-limit output (TLC) of interface specification to the output signal, torque limit condition can be detected externally.

Related page P.3-45 (TLC), P.4-10 (Pr0.13), P.4-47 (Pr5.21)

**3) Setup of over-speed protection**

Generates Err26.0 Over-speed protection when the motor speed is excessively high.

Default setting is the applicable motor maximum speed [r/min] × 1.2.

If your application operates below the motor maximum speed, set Pr5.13 Setup of over-speed level by using the formula below.

Pr5.13 Setup of over-speed level = Vmax × (1.2 to 1.5)
Vmax: motor maximum speed [r/min] in operating condition
Factor in ( ) is margin to prevent frequent activation of over-speed protection.

When running the motor at a low speed during initial adjustment stage, setup the over-speed protection by multiplying the adjusting speed by a certain margin to protect the motor against possible oscillation.

Related page P.4-45 (Pr5.13)

(Continued ...)

**4) Setup of the excess positional deviation protection**

During the position control or full-closed control, this function detects potential excessive difference between the positional command and motor position and issues Err24.0 Excess positional deviation protection.

Excess positional deviation level can be set to Pr0.14 Setup of positional deviation excess. The deviation can be detected through command positional deviation [pulse (command unit)] and encoder positional deviation [pulse (encoder unit)], and one of which can be selected by Pr5.20 Position setup unit select. (See the control block diagram.)

Default setting is 100000[pulse (command unit)].

Because the positional deviation during normal operation depends on the operating speed and gain setting, fill the equation below based on your operating condition and input the resulting value to Pr0.14.

**• When Pr5.20 = 0 (detection through command positional deviation)**

Pr0.14 Setup of positional deviation excess = Vc/kp × (1.2 to 2.0)
Vc: maximum frequency of positional command pulse [pulse (command unit)/s]
Kp: position loop gain [1/s]
Factor in ( ) is margin to prevent frequent activation of excess positional deviation protection.

Note 1) When switching position loop gain Kp, select the smallest value for calculation.
Note 2) When using the positional command filter and damping control, add the following values.
Positional command smoothing filter: Vc × filter time constant [s]
Positional command FIR filter: Vc × filter time constant [s]/2
Damping control: Vc/(π × damping frequency [Hz])

**• When Pr5.20 = 1 (detection through encoder positional deviation, full-closed positional deviation)**

Pr0.14 Setup of positional deviation excess = Ve/Kp × (1.2 to 2.0)
Ve: maximum operation frequency [pulse/s] in encoder unit or full-closed unit
Kp: position loop gain [1/s]

Note 3) When switching position loop gain Kp, select the smallest value for calculation.
Note 4) When Pr5.20 = 1, setups of positional command filter and damping control have no effect.

Related page P.4-10 (Pr0.14), P4-47 (Pr5.20)

**5) Setup of motor working range**

During the position control or full-closed control, this function detects the motor position which exceeds the revolutions set to Pr5.14 Motor working range setup, and issues Err34.0 Motor working range protection.

Related page P.4-15 (Pr5.14)

**6) Setup of hybrid deviation excess error protection**

At the initial operation with full-closed control, operation failure may occur due to reverse connection of external scale or wrong external scale division ratio.

To indicate this type of defect, Err25.0 Hybrid deviation excess error protection is issued when the deviation of motor position (encoder unit) and load position (external scale unit) exceed Pr3.28 Setup of hybrid deviation excess.

Default setting is 16000 pulse (command unit). Because the deviation in normal operation varies with the operation speed and gain setup. Add a margin to this setting according to your operating condition.

Related page P.4-31 (Pr3.28)

# 3. Troubleshooting

## Motor Does Not Run

When the motor does not run, refer to P.2-64, "Display of Factor of No-Motor Running" of Preparation as well.

| Classification | Causes | | Measures |
|---|---|---|---|
| **Parameter** | Setup of the control mode is not correct | Check that the present control mode is correct with monitor mode of the front panel. | 1) Set up Pr0.01 again.<br>2) Check that the input to control mode switching (C-MODE) of the Cnnector X4 is correct, when Pr0.01 is set to 3 to 5. |
| | Selection of torque limit is not correct | Check that the external analog input (N-ATL/ P-ATL) is not used for the torque limit. | 1) Set up Pr05.21 to 0 and apply -9 [V] to N-ATL and +9 [V ] to P-ATL when you use the external input.<br>2) Set up Pr05.21 to 1 and set up the max. value to Pr0.13 when you use the parameter value. |
| | Setup of electronic gear is not correct. (Position/Full-closed) | Check that the motor moves by expected revolution against the command pulses. | 1) Check the setups of Pr0.09, Pr0.01 and Pr5.00 to Pr5.02 again.<br>2) Connect the electronic gear switching input (DIV) of Connector X4 to COM–, or invalidate the division/ multiplication switching by setting up the same value to Pr0.09 and Pr5.00. |
| **Wiring** | Servo-ON input of Connector X4 (SRV-ON) is open. | In the front panel monitor mode, is the Pin No. corresponding to SRV-ON in " - " state? | Check and make a wiring so as to connect the SRV-ON input to COM–. |
| | Positive/negative direction over-travel inhibit input of Connector X4 (NOT/POT) is open. | In the front panel monitor mode, is the Pin No. corresponding to NOT/ POT in " A " state? | 1) Check and make a wiring so as to connect both NOT/POT inputs to COM–.<br>2) Set up Pr5.04 to 1 (invalid) and reset the power. |
| | Command pulse input setup is incorrect. (Position/Full-closed) | Check that the input pulse counts and variation of command pulse sum does not slips, with monitor mode of the front panel. | 1) Check that the command pulses are entered correctly to the direction selected with Pr0.05.<br>2) Check that the command pulses are entered correctly in the format selected with Pr0.07. |
| | Command pulse input inhibition (INH) of Connector X4 is open. (Position/ Full-closed) | In the front panel monitor mode, is the Pin No. corresponding to INH in " A " state? | 1) Check and make a wiring so as to connect the INH input to COM–.<br>2) Set up Pr5.18 to 1 (invalid). |
| | Counter clear input (CL) of Connector X4 is connected to COM–. (Position/ Full-closed) | In the front panel monitor mode, is the Pin No. corresponding to CL in " A " state? | 1) Check and make wiring so as to open the CL input<br>2) Set up Pr5.17 to 2 (invalid). |

Related page • P.2-52 ... "How to Use the Front Panel" • P.3-30 "Inputs and outputs on connector X4"
• P.4-4... "Details of parameter"

When the motor does not run, refer to P.2-64, "Display of Factor of No-Motor Running" of Preparation as well.

| Classification | Causes | | Measures |
|---|---|---|---|
| **Wiring** | Speed command is invalid (Velocity) | Check that the velocity command input method (external analog command/internal velocity command) is correct. | 1) Check the setups of Pr3.02 to Pr3.03 again by setting up Pr3.00 to 0, when you use the external analog command.<br>2) Set up Pr3.04 to Pr3.07 and Pr3.08 to Pr3.11 by setting up Pr3.00 to either one of 1, 2 or 3, when you use the internal speed command. |
| | Speed zero clamp input (ZEROSPD) of Connecter X4 is open. (Velocity/Torque) | In the front panel monitor mode, is the Pin No. corresponding to ZEROSPD in " A " state? | 1) Check and make wiring so as to connect speed zero clamp input to COM–.<br>2) Set up Pr3.15. |
| | Torque command is invalid (Torque) | Check that the torque command input method (SPR/TRQR input, P-ATL/TRQR input) is correct. | 1) Check that the input voltage is applied correctly by setting up Pr3.17 to 0, when you use SPR/TRQR input.<br>2) Check that the input voltage is applied correctly by setting up Pr3.17 to 1, when you use the P-ATL/TRQR input. |
| | Velocity control is invalid (Torque) | Check that the velocity limit input method (parameter velocity, SPR/TRQR/SPL input) is correct. | 1) Set up the desired value to Pr3.21 by setting up Pr3.17 to 0, when you use the parameter speed.<br>2) Check that the input voltage is applied correctly by setting up Pr3.17 to 1, when you use the SPR/TRQR/SPL input. |
| **Installation** | Main power is shut off. | In the front panel monitor mode, is the Pin No. corresponding to S-RDY in " - " state? | Check the wiring/voltage of main power of the driver (L1, L2 and L3). |
| | The motor shaft drags, the motor does not run. | 1)Check that you can turn the motor shaft, after turning off the power and separate it from the machine.<br>2)Check that you can turn the motor shaft while applying DC24V to the brake in case of the motor with electromagnetic brake. | If you cannot turn the motor shaft, consult with the dealer for repair. |

Related page • P.4-24... "Details of parameter" • P.3-30 "Inputs and outputs on connector X4"

# 3. Troubleshooting

## Unstable Rotation (Not Smooth), Motor Runs Slowly Even with Speed Zero at Velocity Control Mode

| Classification | Causes | Measures |
|---|---|---|
| **Parameter** | Setup of the control mode is not correct. | If you set up Pr0.01 to 1(Velocity control mode) by mistake at position control mode, the motor runs slowly at servo-ON due to speed command offset. Change the setup of Pr0.01 to 0. |
| **Adjustment** | Gain adjustment is not proper. | Increase the setup of Pr1.01, 1st velocity loop gain. Enter torque filter of Pr1.04 and increase the setup of Pr1.01 again. |
| | Velocity and position command are not stable. | Check the motor movement with check pin of the front panel or the waveform graphic function of the PANATERM. Review the wiring, connector contact failure and controller. |
| **Wiring** | Each input signal of Connector X4 is chattering.<br>1) Servo-ON signal<br>2) Positive/Negative direction torque limit input signal<br>3) Deviation counter input signal<br>4) Speed zero clamp signal<br>5) Command pulse inhibition input | 1) Check the wiring and connection between Pin29 and 41 of the Connector X4 using the display function of I/O signal status. Correct the wiring and connection so that the Servo-ON signal can be turned on normally. Review the controller.<br>2) Check the wiring and connection between Pin-18 and 17, 16 and 17 of the Connector X4 using tester or oscilloscope. Correct the wiring and connection so that Positive/Negative direction torque limit input can be entered normally.<br>3) Check the wiring and connection between Pin-30 and 41, 16 and 17 of the Connector X4 using display function of I/O signal status. Correct the wiring and connection so that the deviation counter input can be turned on normally. Review the controller.<br>4) Check the wiring and connection between Pin-26 and 41of the Connector X4 using Display function of I/O signal status. Correct the wiring and connection so that the speed zero clamp input can be entered normally. Review the controller.<br>5) Check the wiring and connection between Pin-33 and 41of the Connector X4 using display function of I/O signal status. Correct the wiring and connection so that the command pulse inhibition input can be entered normally. Review the controller. |
| | Noise is on the velocity command. | Use a shield cable for connecting cable to the Connector X4. Separate the power line and signal line (30cm or longer) in the separate duct. |
| | Slip of offset | Check the voltage between Pin-14 and 15 (speed command input) using a tester or an oscilloscope. Adjust the Pr52 value so that the motor stops. |
| | Noise is on the position command. | Use a shield cable for connecting cable to the Connector X4. Separate the power line and signal line (30cm or longer) in the separate duct. |

Related page • P.4-42... “Details of parameter” • P.3-30 “Inputs and outputs on connector X4”
• P.7-26 “Outline of Setup support software “PANATERM”

# 3. Troubleshooting

## Positioning Accuracy Is Poor

| Classification | Causes | Measures |
|---|---|---|
| **System** | Position command is not correct. | Count the feedback pulses with a monitor function of the PANATERM or feedback pulse monitor mode of the console while repeating the movement of the same distance. If the value does not return to the same value, review the controller. Make a noise measure to command pulse. |
| | Captures the positioning complete signal at the edge. | Monitor the deviation at positioning complete signal reception with the Connector X7 or the waveform graphic function of the PANATERM.<br>Make the controller capture the signal not at the edge but with some time allowance. |
| | Shape or width of the command pulse is not per the specifications. | If the shape of the command pulse is broken or narrowed, review the pulse generating circuit. Make a noise measure. |
| | Noise is superposed on deviation counter clear input CL (Connector X4, Pin-5). | Make a noise measure to external DC power supply and make no wiring of the unused signal lines. |
| **Adjustment** | Position loop gain is small. | Check the position deviation with the monitor function of the PANATERM or at the monitor mode of the console.<br>Increase the setup of Pr1.00 within the range where no oscillation occurs. |
| **Parameter** | Setup of the positioning complete range is large. | Lower the setup of Pr4.31 within the range where no chattering of complete signal occurs. |
| | Command pulse frequency have exceeded 500kpps or 4Mpps. | Lower the command pulse frequency. Change the division/ multiplication ratio of 1st and 2nd numerator of command division/ multiplication, Pr0.09 and Pr0.10. Use a pulse line interface exclusive to line driver when pulse line interface is used. |
| | Setup of the division/ multiplication is not correct. | Check if the repetition accuracy is same or not. If it does not change, use a larger capacity motor and driver. |
| | Velocity loop gain is proportion action at motor in stall. | • Set up Pr1.02 and Pr1.07 of time constant of velocity loop integration to 9999 or smaller.<br>• Review the wiring and connection so that the connection between Pin-27 and 41 of the gain switching input connector, Connector X4 becomes off while you set up Pr1.14 of 2nd gain setup, to 1. |
| **Wiring** | Each input signal of Connector X4 is chattering.<br>1) Servo-ON signal<br>2) Deviation counter clear input signal<br>3) Positive/Negative direction torque limit input signal<br>4) Command pulse inhibition input | 1) Check the wiring and connection between Pin29 and 41 of the connector, Connector X4 using the display function of I/O signal status. Correct the wiring and connection so that the servo-On signal can be turned on normally. Review the controller.<br>2) Check the wiring and connection between Pin-30 and 41, 16 and 17 of the connector, Connector X4 using display function of I/O signal status. Correct the wiring and connection so that the deviation counter clear input can be turned on normally. Review the controller.<br>3 Check the wiring and connection between Pin-18 and 17, 16 and 17 of the connector, Connector X4 using tester or oscilloscope. Correct the wiring and connection so that Positive/Negative direction torque limit input can be entered normally.<br>4) Check the wiring and connection between Pin-33 and 41of the connector, Connector X4 using display function of I/O signal status. Correct the wiring and connection so that the command pulse inhibition input can be entered normally. Review the controller. |
| **Installation** | Load inertia is large. | Check the overshoot at stopping with graphic function of the PANATERM. If no improvement is obtained, increase the driver and motor capacity. |

Related page • P.4-4 “Details of parameter” • P.3-30 “Inputs and outputs on connector X4”
• P.7-26 “Outline of Setup support software “PANATERM”

# 3. Troubleshooting

## Origin Point Slips

| Classification | Causes | Measures |
|---|---|---|
| **System** | Z-phase is not detected. | Check that the Z-phase matches to the center of proximity dog. Execute the homing matching to the controller correctly. |
| | Homing creep speed is fast. | Lower the homing speed at origin proximity. Or widen the origin sensor. |
| **Wiring** | Chattering of proximity sensor (proximity dog sensor) output . | Check the dog sensor input signal of the controller with oscilloscope.<br>Review the wiring near to proximity dog and make a noise measure or reduce noise. |
| | Noise is on the encoder line. | Reduce noise (installation of noise filter or ferrite core), shield treatment of I/F cables, use of a twisted pair or separation of power and signal lines. |
| | No Z-phase signal output. | Check the Z-phase signal with oscilloscope. Check that the Pin-13 of the connector, CN X5 is connected to the earth of the controller. Connect the earth of the controller because the open collector interface is not insulated. Replace the motor and driver. Request for repair. |
| | Miswiring of Z-phase output. | Check the wiring to see only one side of the line driver is connected or not. Use a CZ output (open collector if the controller is not differential input. |

6
When in Trouble

# 3. Troubleshooting

## Abnormal Motor Noise or Vibration

| Classification | Causes | Measures |
|---|---|---|
| **Wiring** | Noise is on the speed command. | Measure the speed command inputs of Pin-14 and 15 of the connector, Connector X4 with an oscilloscope. Reduce noise (installation of noise filter or ferrite core), shield treatment of I/F cables, use of a twisted pair, separation of power and signal lines. |
| **Adjustment** | Gain setup is large. | Lower the gain by setting up lower values to Pr1.01 and 1.09, of velocity loop gain and Pr1.00 and Pr1.05 of position loop gain. |
| **Installation** | Resonance of the machine and the motor. | Re-adjust Pr1.04 and 1.09 (Torque filter). Check if the machine resonance exists or not with frequency characteristics analyzing function of the PANATERM. Set up the notch frequency to Pr2.01, Pr2.04, Pr2.07 or Pr2.10 if resonance exists. |
| | Motor bearing | Check the noise and vibration near the bearing of the motor while running the motor with no load. Replace the motor to check. Request for repair. |
| | Electro-magnetic sound, gear noise, rubbing noise at brake engagement, hub noise or rubbing noise of encoder. | Check the noise of the motor while running the motor with no load. Replace the motor to check. Request for repair. |

# 3. Troubleshooting

## Overshoot/Undershoot, Overheating of the Motor (Motor Burn-Out)

| Classification | Causes | Measures |
|---|---|---|
| **Adjustment** | Gain adjustment is not proper. | Check with graphic function of PANATERM or velocity monitor (SP) or torque monitor (IM). Make a correct gain adjustment. Refer to “Adjustment”. |
| **Installation** | Load inertia is large. | Check with graphic function of PANATERM or monitor (Connector X7). Make an appropriate adjustment. Increase the motor and driver capacity and lower the inertia ratio. Use a gear reducer. |
| | Looseness or slip of the machine. | Review the mounting to the machine. |
| | Ambient temperature, environment. | Lower the temperature with cooling fan if the ambient temperature exceeds the predications. |
| | Stall of cooling fan, dirt of fan ventilation duct. | Check the cooling fans of the driver and the machine. Replace the driver fan or request for repair. |
| | Mismatching of the driver and the motor. | Check the name plates of the driver and the motor. Select a correct combination of them referring to the instruction manual or catalogue. |
| | Failure of motor bearing. | Check that the motor does not generate rumbling noise while turning it by hand after shutting off the power. Replace the motor and request for repair if the noise is heard. |
| | Electromagnetic brake is kept engaged (left un-released). | Check the voltage at brake terminals. Apply the power (DC24V) to release the brake. |
| | Motor failure (oil, water or others) | Avoid the installation place where the motor is subject to high temperature, humidity, oil, dust or iron particles. |
| | Motor has been turned by external force while dynamic brake has been engaged. | Check the running pattern, working condition and operating status, and inhibit the operation under the condition of the left. |

6 When in Trouble

# 3. Troubleshooting

## Motor Speed Does Not Reach to the Setup, Motor Revolutions (Travel) Is Too Large or Small

| Classification | Causes | Measures |
|---|---|---|
| **Parameter** | Velocity command input gain is not correct. | Check that the setup of Pr3.02, speed command input gain, is made so as to make the setup of 500 makes 3000 r/min. |
| **Adjustment** | Position loop gain is low. | Set up Pr1.00and Pr1.05, position loop gain to approx. 1000. |
| | Division/Multiplication is not proper. | Set up correct values to Pr0.09, 1st numerator of electronic gear, Pr0.11, numerator multiplier of electronic gear and Pr0.10, denominator of electronic gear. Refer to parameter setup at each mode. |

Related page • P.4-4 “Details of parameter” • P.7-26 “Outline of Setup support software “PANATERM”

# 3. Troubleshooting

## Parameter Returns to Previous Setup

| Classification | Causes | Measures |
|---|---|---|
| **Parameter** | No writing to EEPROM has been carried out before turning off the power. | Refer to P.2-71, “How to Operate-EEPROM Writing” of Preparation. |

# 7. Supplement

# 1. Safety function

## Outline

### Outline description of safe torque off (STO)

The safe torque off (STO) function is a safety function that shuts the motor current and turns off motor output torque by forcibly turning off the driving signal of the servo driver internal power transistor. For this purpose, the STO uses safety input signal and hardware (circuit).

When STO function operates, the servo driver turns off the servo ready output signal (S-RDY) and enters safety state.

This is an alarm condition and the 7-seg LED on the front panel displays the error code number.

### Safety precautions

- When using the STO function, be sure to perform equipment risk assessment to ensure that the system conforms to the safety requirements.
- Even while the STO function is working, the following potential safety hazards exist. Check safety in risk assessment.
  - The motor may move when eternal force (e.g. gravity force on vertical axis) is exerted on it. Provide an external brake, etc., as necessary to secure the motor. Note that the purpose of motor with brake is holding and it cannot be used for braking application.
  - When parameter Pr5.10 Sequence at alarm is set to free run (disable dynamic brake), the motor is free run state and requires longer stop distance even if no external force is applied. Make sure that this does not cause any problem.
  - When power transistor, etc., becomes defective, the motor will move to the extent equivalent of 180 electrical angle (max.). Make sure that this does not cause any problem.
  - The STO turns off the current to the motor but does not turn off power to the servo driver and does not isolate it. When starting maintenance service on the servo driver, turn off the driver by using a different disconnecting device.
- External device monitor (hereafter EDM) output signal is not a safety signal. Do not use it for an application other than failure monitoring.
- Dynamic brake and external brake release signal output are not related to safety function. When designing the system, make sure that the failure of external brake release during STO condition does not result in danger condition.
- When using STO function, connect equipment conforming to the safety standards.

Related page • P.2-2 “Conformance to international standards” • P.2-62 “How to Use the Front Panel”
• P.3-30 “Inputs and outputs on connector X4”

## Safety input/output signal

For list of connector pin numbers, refer to P.2-22,

| Signal | Symbol | Pin No. | Contents | Control mode |
|---|---|---|---|---|
| Safety input 1 | SF1+ | 4 | • Input 1 that triggers STO function. This input turns off the upper arm drive signal of power transistor.<br>• When using the function, connect this pin in a way so that the photocoupler of this input circuit turns off to activate STO function. | Compatible all control mode |
| | SF1– | 3 | | |
| Safety input 2 | SF2+ | 6 | • Input 2 that triggers STO function. This input turns off the lower arm drive signal of power transistor.<br>• When using the function, connect this pin in a way so that the photocoupler of this input circuit turns off to activate STO function. | |
| | SF2– | 5 | | |

Safety input 1 or 2 enables STO to operate within 5 ms, causing motor output torque to turn off.

**Caution**

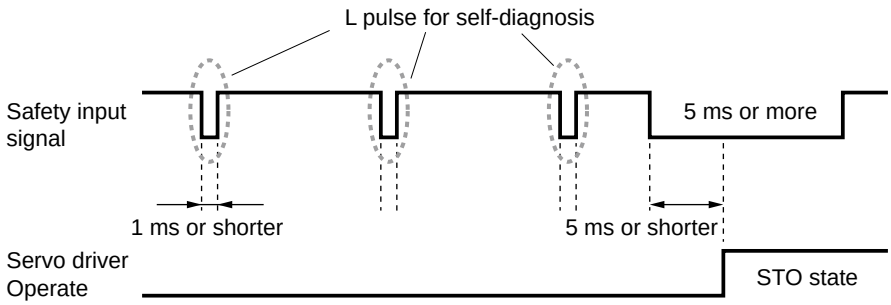
- **Safety equipment self-diagnosis L pulse**

  Safety output signal from the safety controller and safety sensor may include L pulse for self-diagnosis.

  To prevent the L pulse from mis-triggering STO function, the safety input circuit has built-in filter that removes the self-diagnosis L pulse.

  Therefore, if the off period of safety input signal less than 1 ms, the safety input circuit does not detect this “off” event.

  To validate this “off” period, turn off the input signal for more than 5 ms.



## External device monitor (EDM) output signal

The monitor output signal is used by the external device to monitor the state of the safety input signal. Connect the monitor output to the external device monitor terminal of the safety devices such as safety controller and safety sensor.

| Signal | Symbol | Pin No. | Contents | Control mode |
|---|---|---|---|---|
| EDM output | EDM+ | 8 | Outputs monitor signal that is used to check the safety function.<br>Caution ··· This output signal is not a safety output. | Compatible all control mode |
| | EDM– | 7 | | |

## Logical relationship between safety input signal and EDM output signal

When both safety input 1 and 2 are off, i.e. when STO function of 2 safety input channels are active, the photocoupler in EDM output circuit turns on.

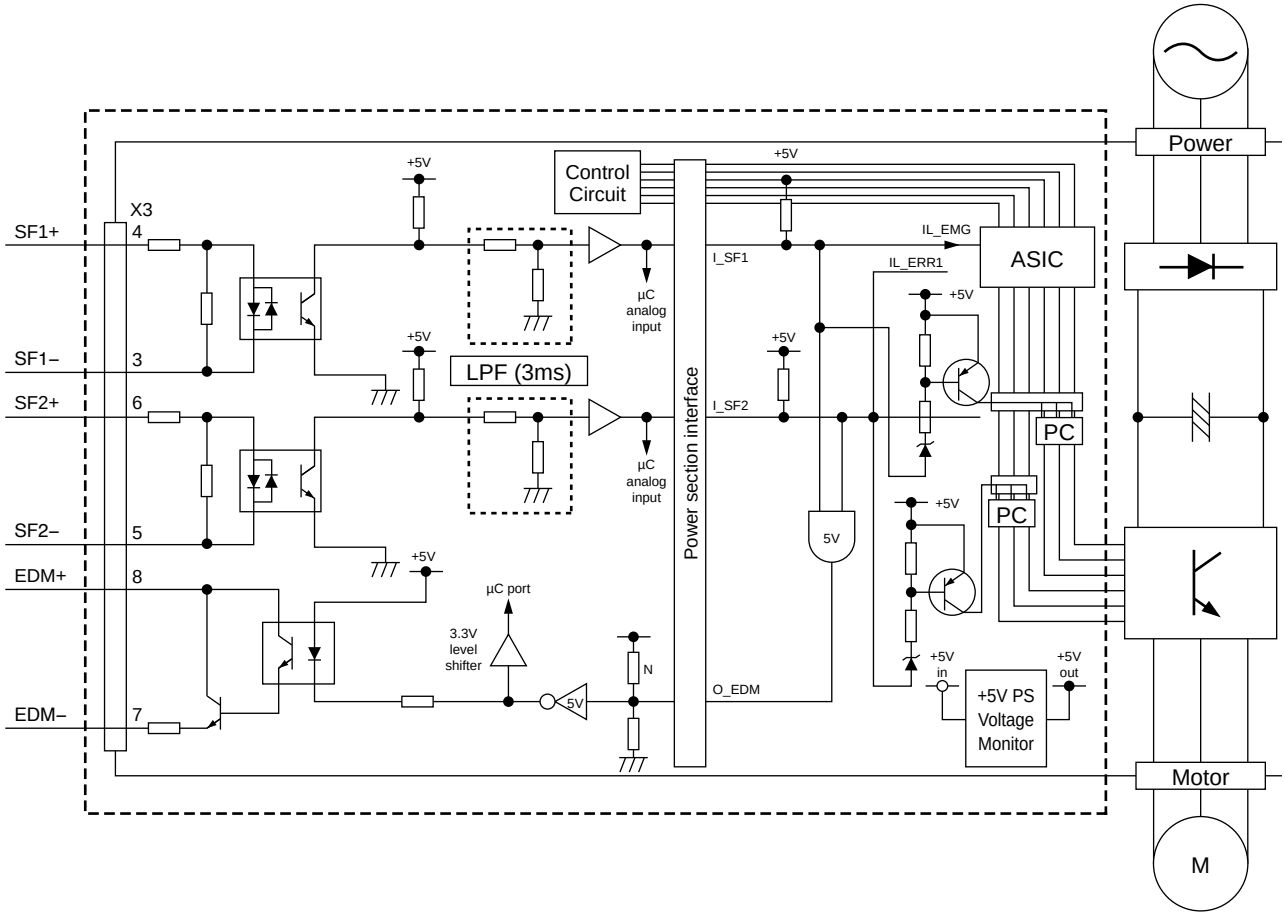
| Signal | Symbol | Photocoupler logic | | | |
|---|---|---|---|---|---|
| Safety input | SF1 | ON | ON | OFF | OFF |
| | SF2 | ON | OFF | ON | OFF |
| EDM output | EDM | OFF | OFF | OFF | ON |

By monitoring the logics (all 4 states) of photocoupler shown in the table above, the external device can determine the status (normal or abnormal) of safety input circuit and EDM output circuit.

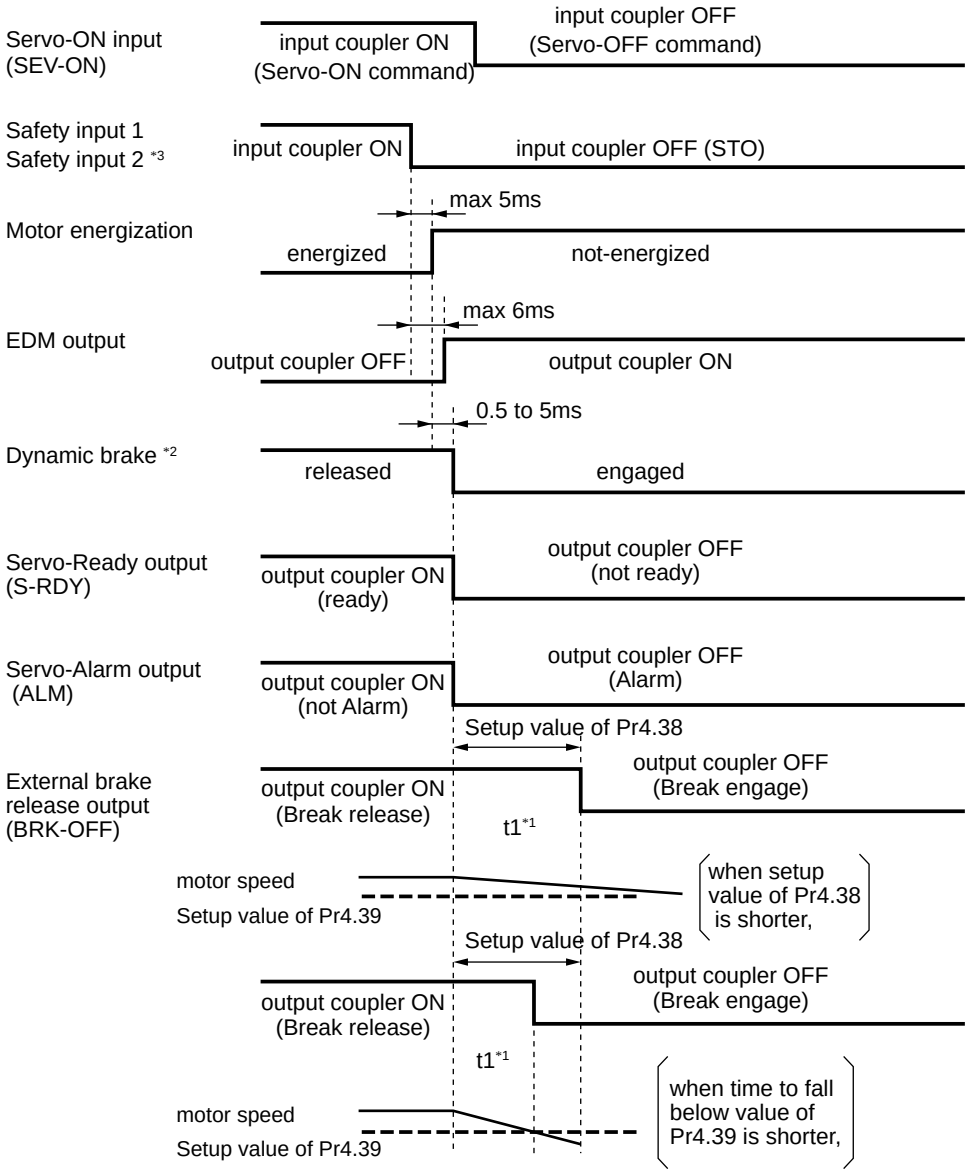
**Note** Maximum delay time from input of safety 1 and 2 signals to output of EDM signal is 6 ms.

# 1. Safety function

## Safety Circuit Block Diagram



## Operating timing for safety status



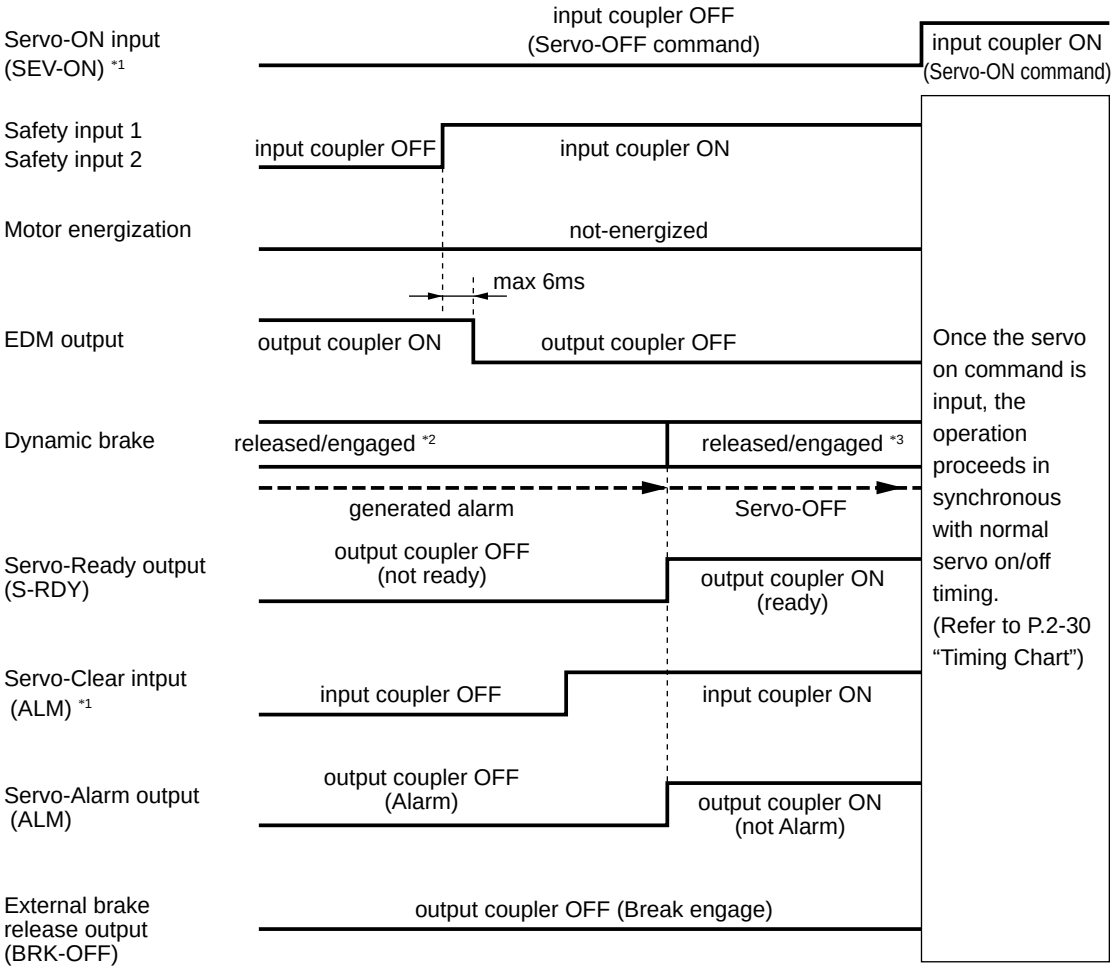

*1 t1 is the value set to Pr4.38 Setup of mechanical brake action at running or the time at which the motor revolution speed drops below the time set to Pr4.39 Brake release speed setup, whichever comes first.

*2 Dynamic brake operates to the setting of Pr5.10 Sequence at alarm.

*3 When safety input 1 or 2 turns off, the state changes to STO condition.

Related page • P.4-41 “Pr4.38, Pr4.39” • P.4-45 “Pr5.10”

## Return timing from safety state




*1 Photocouplers for safety input 1 and 2 should be turned on again with servo-on input turned off. Otherwise, alarm occurs, and should be cleared.
Alarm clear should be performed after the safety input 1 and 2 have been turned back to on.
Otherwise, alarm occurs.

*2 This is an alarm condition and the dynamic brake operates according to Pr5.10 Sequence at alarm.

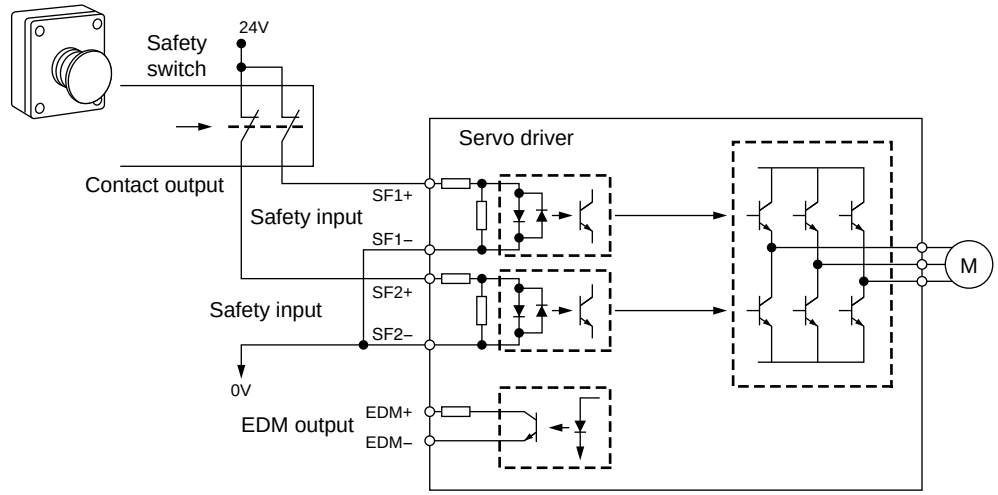
*3 This is normal servo-off condition and the dynamic brake operates according to Pr5.06 Sequence at servo-off.

Related page • P.4-44 “Pr5.06” • P.4-45 “Pr5.10”

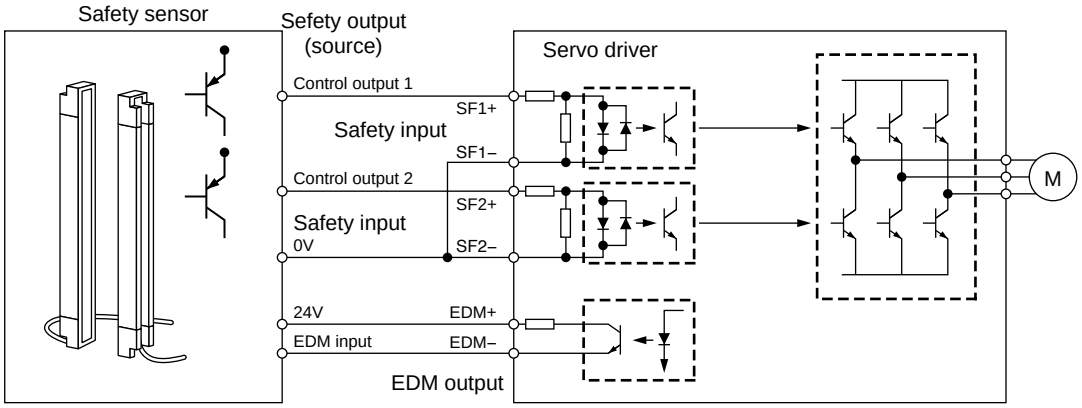
# 1. Safety function

## Example of connection

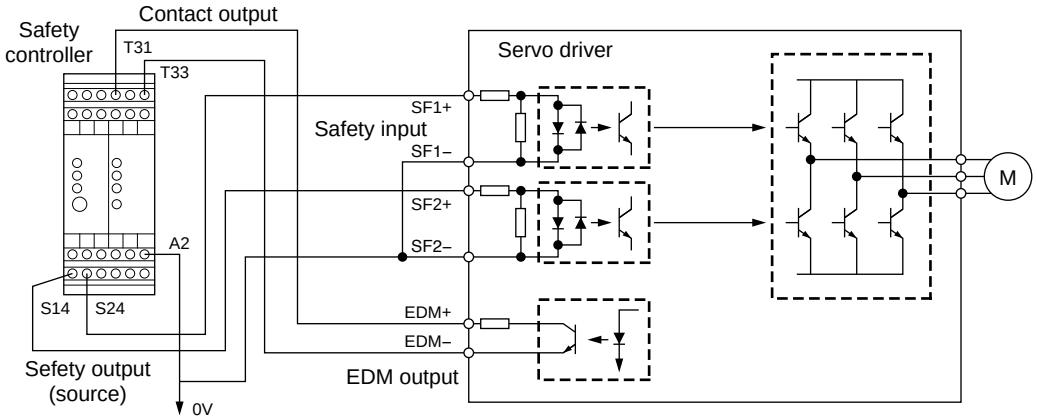
### Example of connection to safety switch



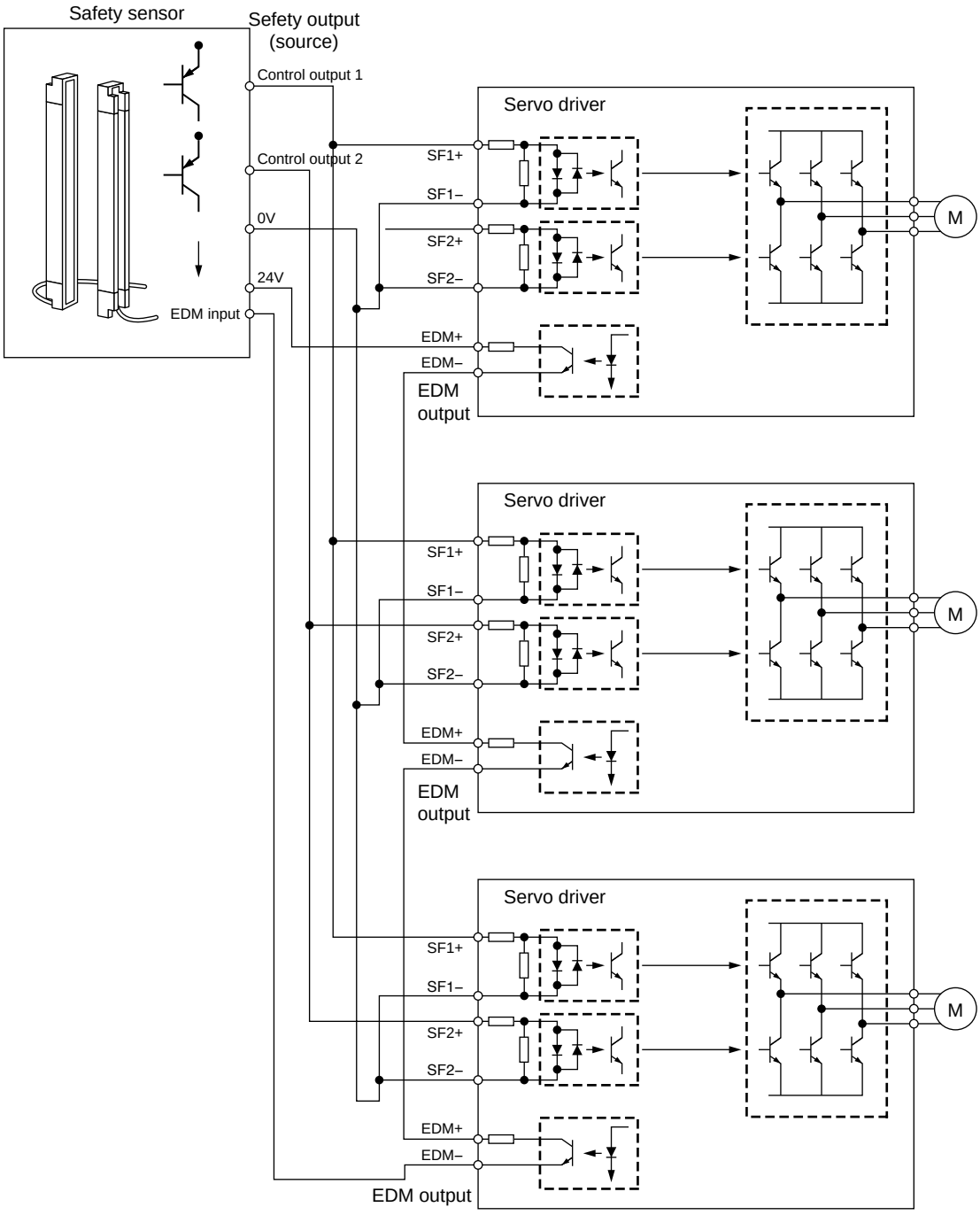

### Example of connection to safety sensor




### Example of connection to safety controller



## Example of connection when using multiple axes




- Capacity requirement per safety output (source) channel: 50 × No. of connected axes (mA)
- 24 VDC supply allowable voltage: 24 V±15%
- Maximum No. of connectable axes: 8

## Outline of Absolute System

When you compose an absolute system using an absolute encoder, you are not required to carry out homing operation at the power-on, and this function suits very well to such an application as a robot.

Connect the host controller with the Minas A5 with absolute specifications. (motor with absolute encoder and driver with absolute spec) and set up the parameter, Pr0.15 to 0 or 2, then connect the battery for absolute encoder to compose an absolute system with which you can capture the exact present position information after the power-ON.

Shift the system to origin once after installing the battery and clear the multi-turn data by clearing the absolute encoder, then you can detect the absolute position without carrying out homing operation.
Via RS232 or RS485 communication, the host controller can connect up to 32 MINAS-A5 and capture the present position information as serial data to obtain the absolute position of each axis by processing. each data.

## Applicable Mode

You can use all of MINAS A5 series driver in absolute specifications by setting up parameter. Use the motor which 8th place (designated for rotary encoder specifications) is “S” (7-wire type).

M ∗ M ∗ ∗ ∗ ∗ S ∗ ∗ ∗ ∗

8th place — Rotary encoder specifications

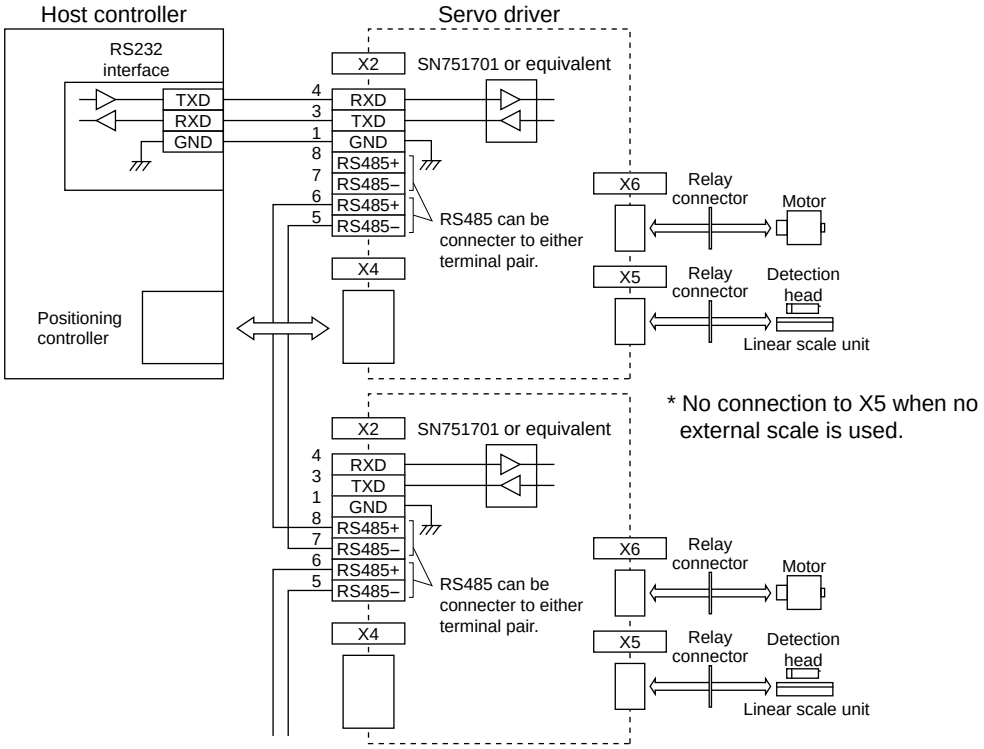
## Absolute Specifications

There are 3 connecting methods of the host controller and MINAS-A5 driver as described below, and select a method depending on the interface of the host controller specs or number of axis to be connected. Designate a module ID to Pr5.31 of each MINAS-A5 driver when you connect multiple MINAS-A5 in communication to one host controller as shown below.

### [Parameter Pr5.31]

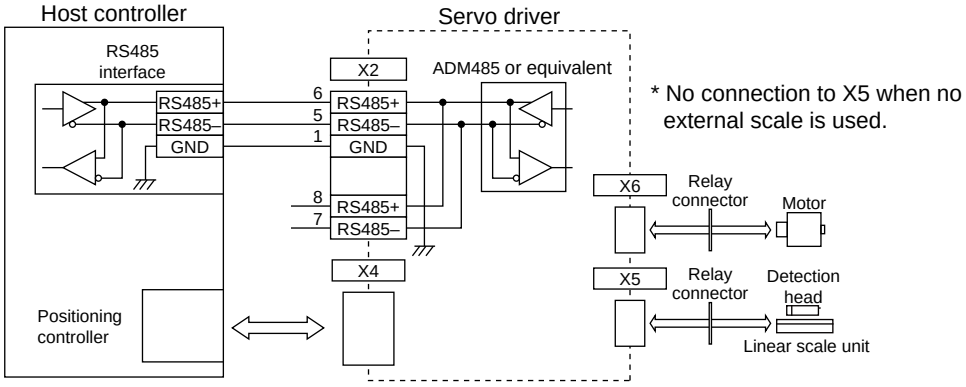
- When you connect each MINAS-A5 to the host separately with RS232 and switch the communication individually, designate 0 to 31 to each MINAS-A5. (Max. 31 axis are connectable.)
- When you connect one MINAS-A5 to the host with RS232 and connect each MINAS-A5 with RS485, designate 0 to the MINAS-A5 connected with the host, and designate 1 to 31 to other MINAS-A5. (Max 32 axis are connectable.)
- When you connect MINAS-A5 to the host with RS485, the host is given module ID of 0, and designate 1 to 31 to MINAS-A5. (Max 31 axis are connectable.)

## Configuration of absolute system of scale using RS232 interface




Related page P.7-28 “Connection of Communication Line”

## Configuration of absolute system of scale using RS485 interface




Related page P.7-29 “Connection of Communication Line”

**Note** * Battery for absolute encoder is required to store the multi-turn data into the encoder. Connect the battery between BAT+ and BAT– of the motor.

# 2. Absolute system

## Battery (for Backup) Installation

### First Installation of the Battery

After installing and connecting the back-up battery to the motor, execute an absolute encoder setup. Refer to P.7-16, "Setup (initialization) of Absolute Encoder ".
It is recommended to perform ON/OFF action once a day after installing the battery for refreshing the battery.
A battery error might occur due to voltage delay of the battery if you fail to carry out the battery refreshment.

**Caution** Use the following battery for absolute encoder.
Battery .....Part No. : DV0P2990 (3.6V 2000mAh)
Battery box .....Part No. : DV0P4430

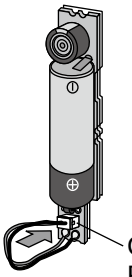
### Replacement of the Battery

It is necessary to replace the battery for absolute encoder when battery alarm occurs.
**Replace while turning on the control power. Data stored in the encoder might be lost when you replace the battery while the control power of the driver is off.**
After replacing the battery, clear the battery alarm. Refer to P.7-25, "How to Clear the Battery Alarm".

**Caution** When you execute the absolute encoder with the front panel (refer to P.2-79 of Preparation), or via communication (refer to P.7-54), all of error and multi-turn data will be cleared together with alarm, and you are required to execute “Setup (Initialization) of absolute encoder” (refer to P.7-16).

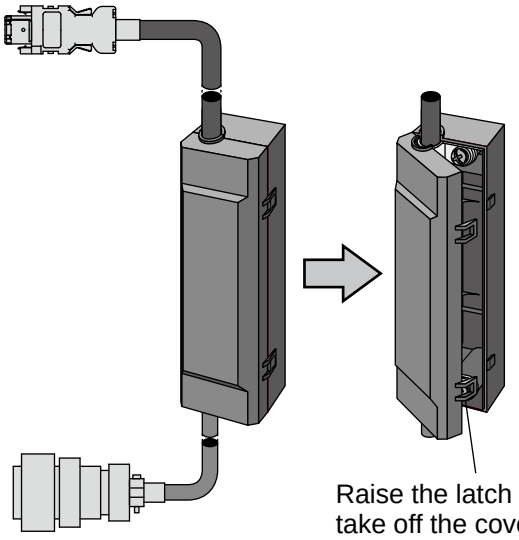
### How to Replace the Battery

**1) Refresh the new battery.**
Connector with lead wire of the battery to CN601 and leave of 5 min. Pull out the connector from CN601 5 min after.



CN601
Pull out after 5 min.
connection

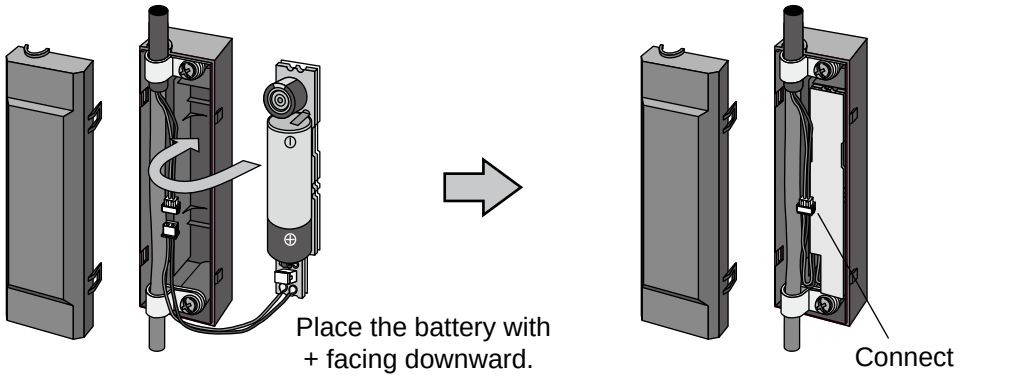
**2) Take off the cover of the battery box.**



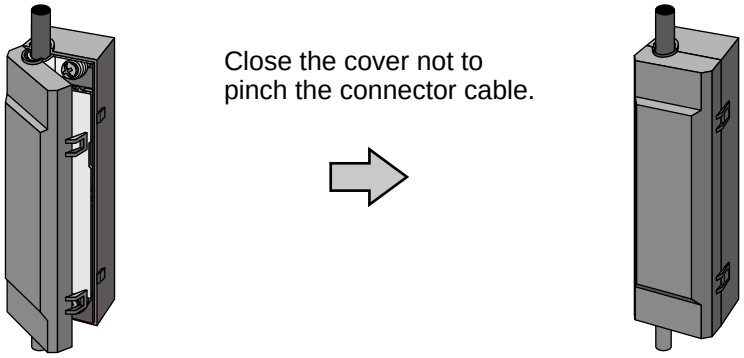
Raise the latch and take off the cover.

Related page • P.7-89 “Battery For Absolute Encoder”

**3) Install the battery to the battery box.**




**4) Close the cover of the battery box.**




**Caution**

- Be absolutely sure to follow the precautions below since improper use of the battery can cause electrolyte to leak from the battery, giving rise to trouble where the product may become corroded, and/or the battery itself may rupture.
  1) Insert the battery with its "+" and "–" electrodes oriented correctly.
  2) Leaving a battery which has been used for a long period of time or a battery which is no longer usable sitting inside the product can cause electrolyte leakage and other trouble. For this reason, ensure that such a battery is replaced at an early date. (As a general guideline, it is recommended that the battery be replaced every two years.)
     - The electrolyte inside the battery is highly corrosive, and if it should leak out, it will not only corrode the surrounding parts but also give rise to the danger of short-circuiting since it is electrically conductive. For this reason, ensure that the battery is replaced periodically.
  3) Do not disassemble the battery or throw it into a fire.
     - Do not disassemble the battery since fragments of the interior parts may fly into your eyes, which is extremely dangerous. It is also dangerous to throw a battery into a fire or apply heat to it as doing to may cause it to rupture.
  4) Do not cause the battery to be short-circuited. Under no circumstances must the battery tube be peeled off.
     - It is dangerous for metal items to make contact with the "+" and "–" electrodes of the battery since such objects may cause a high current to flow all at once, which will not only reduce the battery performance but also generate considerable heat, possibly leading to the rupture of the battery.
  5) This battery is not rechargeable. Under no circumstances must any attempt be made to recharge it.

**Caution**

**The disposal of used batteries after they have been replaced may be subject to restrictions imposed by local governing authorities. In such cases, ensure that their disposal is in accordance with these restrictions.**

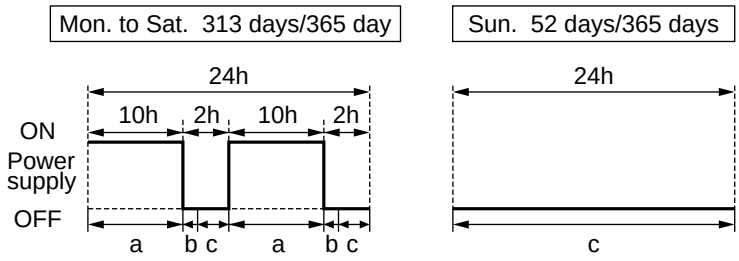
## Life of the battery

Following example shows the life calculation of the back-up battery used in assumed robot operation.
2000[mAh] of battery capacity is used for calculation.

Note that the following value is not a guaranteed value, but only represents a calculated value.

**Caution** The values below were calculated with only the current consumption factored in. The calculations do not factor in electrolyte leakage and other forms of battery deterioration.
Life time may be shortened depending on ambient condition.

**1) 2 cycles/day**




a : Current consumption in normal mode 3.6[μA]
b : Current consumption at power failure timer mode 280[μA]
* Power failure timer mode...Action mode in time period when the motor can respond to max. speed even the power is off (5sec).
c : Current consumption at power failure mode 110[μA]

Annual consumption capacity =
(10h × a + 0.0014h × b + 2h × c) × 2 × 313 days + 24h × c × 52 days =
297.8[mAh] )
Battery life = 2000[mAh]/297.8[mAh] = 6.7 (6.7159) [year]

**2) 1 cycle/day**

(2nd cycle of the above 1) is for rest.

Annual consumption capacity =
(10h × a + 0.0014h × b + 14h × c) × 313 days + 24h × c × 52 days =
640.6[mAh] )
Battery life = 2000[mAh]/630.6[mAh] = 3.1 (3.1715) [year]

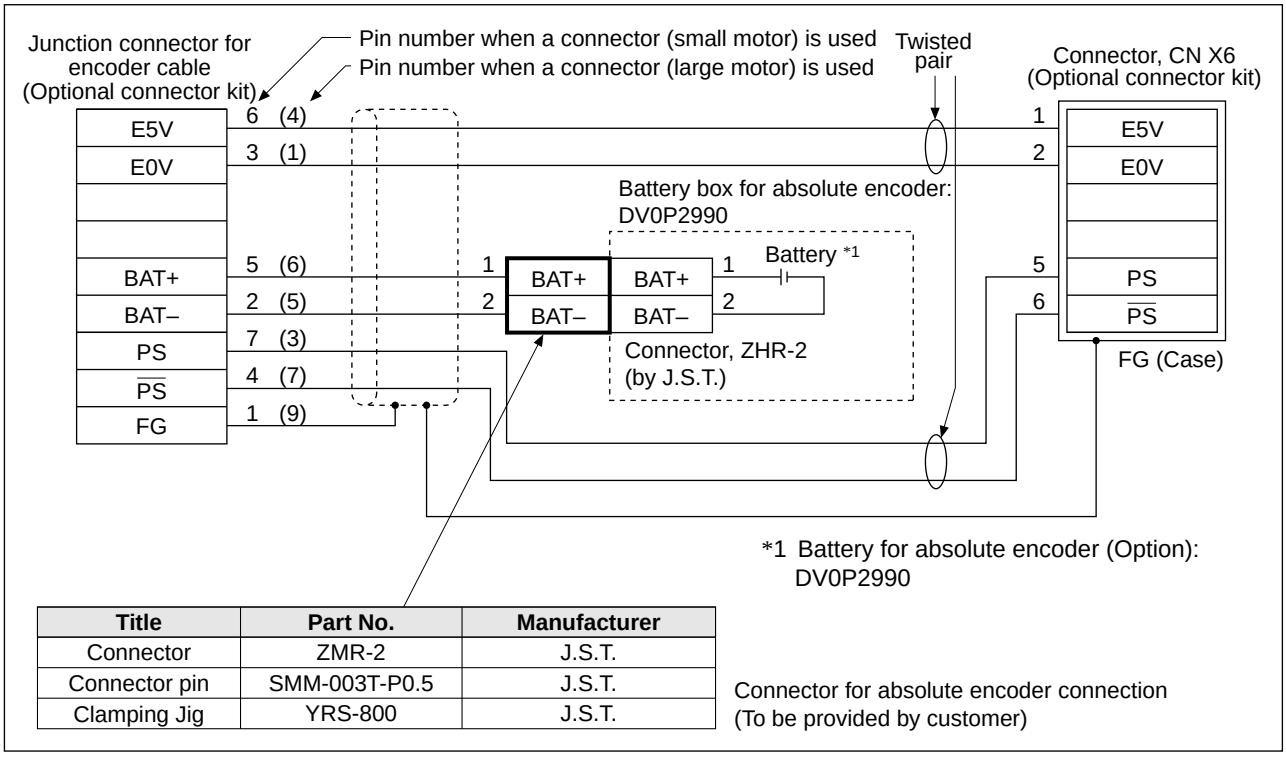
## When you make your own cable for 17-bit absolute encoder

When you make your own cable for 17-bit absolute encoder, connect the optional battery for absolute encoder, DV0P2060 or DV0P2990 as per the wiring diagram below. Connector of the battery for absolute encoder shall be provided by customer as well.

**Caution** Install and fix the battery securely. If the installation and fixing of the battery is not appropriate, it may cause the wire breakdown or damage of the battery.
Refer to the instruction manual of the battery for handling the battery.

- **Installation Place**
  1) Indoors, where the products are not subjected to rain or direct sun beam.
  2) Where the products are not subjected to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, chloric gas, sulfuric gas, acid, alkaline and salt and so on, and are free from splash of inflammable gas, grinding oil, oil mist, iron powder or chips and etc.
  3) Well-ventilated and humid and dust-free place.
  4) Vibration-free place

- **Wiring Diagram**




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | ZMR-2 | J.S.T. |
| Connector pin | SMM-003T-P0.5 | J.S.T. |
| Clamping Jig | YRS-800 | J.S.T. |

Related page • P.7-89 “Battery For Absolute Encoder”

# 2. Absolute system

## Setup (Initialization) of Absolute Encoder

Absolute multi-turn data will be maintained by the absolute encoder battery.
When operating the machine for the first time after installing the battery to the absolute encoder, clear the encoder data (multi-turn data) to 0 at the origin by following the procedure described below.
Clear the absolute encoder from the front panel (see P.2-79) or PANATERM. Turn off power and then on again.



# 2. Absolute system

## Transferring absolute data

Transfer the absolute data (absolute data of external scale) from the servo driver to the host controller: turn on power and wait until the servo ready output (S-RDY) is turned on, and then start transfer.

### Setup of serial communication interface on host controller

**• RS232**

| | |
|---|---|
| **Baud rate** | 2400, 4800, 9600, 19200, 38400, 57600, 115200bps |
| **Data** | 8 bit |
| **Parity** | none |
| **Start bit** | 1 bit |
| **Stop bit** | 1 bit |

The baud rate is set according to Pr5.29 Baud rate setup of RS232 communication.

**• RS485**

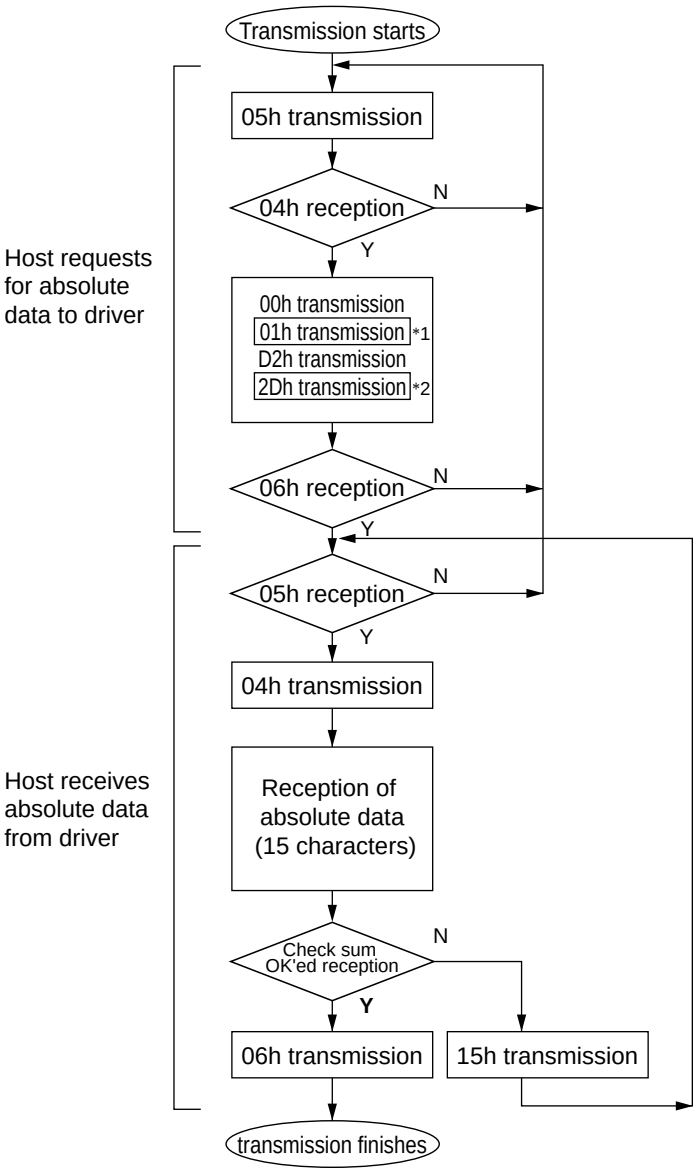
| | |
|---|---|
| **Baud rate** | 2400, 4800, 9600, 19200, 38400, 57600, 115200bps |
| **Data** | 8 bit |
| **Parity** | none |
| **Start bit** | 1 bit |
| **Stop bit** | 1 bit |

The baud rate is set according to Pr5.30 Baud rate setup of RS485 communication.

Related page • P.3-30 “Inputs and outputs on connector X4” • P.4-49 “Details of parameter”

## RS232 Communication Protocol

Refer to the instruction manual of the host for the transmission/reception method of command.




Data of *1 and *2 are determined by the setup of Pr5.31 “Axis address” of the front panel.

| Axis address (example) | Data of *1 | Data of *2 |
|---|---|---|
| 0 | 00h | 2Eh |
| 1 | 01h | 2Dh |
| 2 | 02h | 2Ch |
| 3 | 03h | 2Bh |
| 4 | 04h | 2Ah |
| 5 | 05h | 29h |
| 6 | 06h | 28h |
| 7 | 07h | 27h |
| 8 | 08h | 26h |
| 9 | 09h | 25h |
| 10 | 0Ah | 24h |
| 11 | 0Bh | 23h |
| 12 | 0Ch | 22h |
| 13 | 0Dh | 21h |
| 14 | 0Eh | 20h |
| 15 | 0Fh | 1Fh |
| 16 | 10h | 1Eh |
| 17 | 11h | 1Dh |
| 18 | 12h | 1Ch |
| 19 | 13h | 1Bh |
| 20 | 14h | 1Ah |
| 21 | 15h | 19h |
| 22 | 16h | 18h |
| 23 | 17h | 17h |
| 24 | 18h | 16h |
| 25 | 19h | 15h |
| 26 | 1Ah | 14h |
| 27 | 1Bh | 13h |
| 28 | 1Ch | 12h |
| 29 | 1Dh | 11h |
| 30 | 1Eh | 10h |
| 31 | 1Fh | 0Fh |

Check sum becomes OK'ed when the lower 8-bit of the sum of the received absolute data (15 characters) is 0.

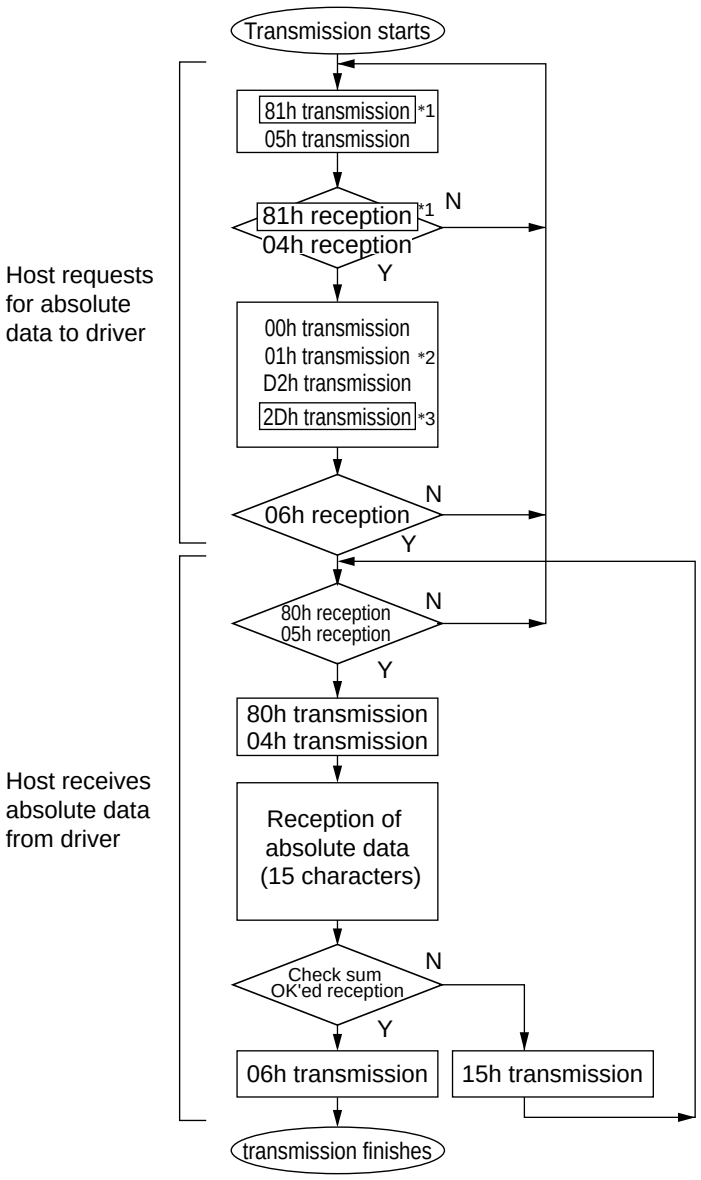
Enter the Pr5.31 value of the driver to which you want to communicate from the host to axis (*1 data) of the command block, and transmit the command according to the RS232 communication protocol. For details of communication, refer to P.7-27, "Communication".

**Caution**

- **Allow 50ms or longer interval for axis switching when you want to capture multiple axes data.**
- **It is recommended for you to repeat the above communication more than 2 times to confirm the absolute data coincide, in order to avoid mis-operation due to unexpected noise.**

## RS485 Communication Protocol

Refer to the instruction manual of the host for the transmission/reception method of command. Following shows the communication example of the driver to Pr5.31 “Axis address = 1”.




Data of *1, *2 and *3are determined by the setup of Pr5.31 “Axis address” of the front panel.

| Axis address (example) | Data of *1 | Data of *2 | Data of *3 |
|---|---|---|---|
| 0 | not usable with RS485 communication | | |
| 1 | 81h | 01h | 2Dh |
| 2 | 82h | 02h | 2Ch |
| 3 | 83h | 03h | 2Bh |
| 4 | 84h | 04h | 2Ah |
| 5 | 85h | 05h | 29h |
| 6 | 86h | 06h | 28h |
| 7 | 87h | 07h | 27h |
| 8 | 88h | 08h | 26h |
| 9 | 89h | 09h | 25h |
| 10 | 8Ah | 0Ah | 24h |
| 11 | 8Bh | 0Bh | 23h |
| 12 | 8Ch | 0Ch | 22h |
| 13 | 8Dh | 0Dh | 21h |
| 14 | 8Eh | 0Eh | 20h |
| 15 | 8Fh | 0Fh | 1Fh |
| 16 | 90h | 10h | 1Eh |
| 17 | 91h | 11h | 1Dh |
| 18 | 92h | 12h | 1Ch |
| 19 | 93h | 13h | 1Bh |
| 20 | 94h | 14h | 1Ah |
| 21 | 95h | 15h | 19h |
| 22 | 96h | 16h | 18h |
| 23 | 97h | 17h | 17h |
| 24 | 98h | 18h | 16h |
| 25 | 99h | 19h | 15h |
| 26 | 9Ah | 1Ah | 14h |
| 27 | 9Bh | 1Bh | 13h |
| 28 | 9Ch | 1Ch | 12h |
| 29 | 9Dh | 1Dh | 11h |
| 30 | 9Eh | 1Eh | 10h |
| 31 | 9Fh | 1Fh | 0Fh |

Check sum becomes OK'ed when the lower 8-bit of the sum of the received absolute data (15 characters) is 0.

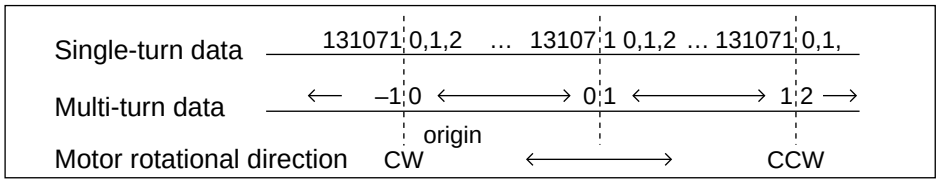
Command from the host will be transmitted to the desired driver based on RS485 transmission protocol. For details of communication, refer to P.7-27, "Communication".

**Caution**

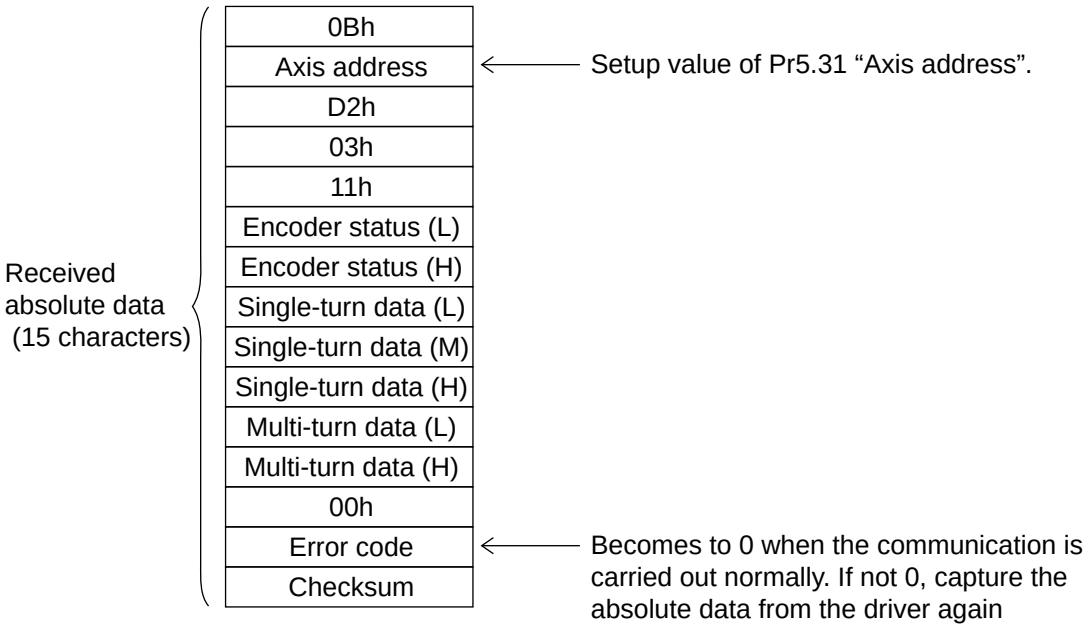
- **Allow 50ms or longer interval for axis switching when you want to capture multiple axes data.**
- **It is recommended for you to repeat the above communication more than 2 times to confirm the absolute data coincide, in order to avoid mis-operation due to unexpected noise.**

## Composition of Absolute Data

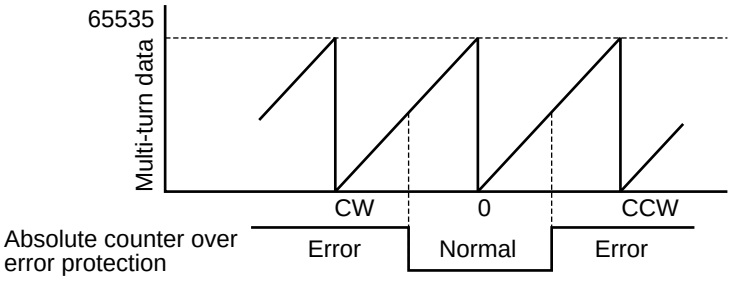
Absolute data consists of singe-turn data which shows the absolute position per one revolution and multi-turn data which counts the number of revolution of the motor after clearing the encoder.




Single-turn data and multi-turn data are composed by using 15-character data (hexadecimal binary code) which are received via RS232 or RS485.




- **Details of multi-turn data**




Single-turn data ← Single-turn data (H)×10000h+Single-turn data (M)×100h+Single-turn data (L)

multi-turn data ← multi-turn data (H) ×100h+multi-turn data (L)

**Remarks** If the multi-turn data of the above fig. is between 32768 to 65535, convert it to signed date after deducting 65536.

• **Encoder status (L)-----1 represents error occurrence.**

| Encoder status (L) | | | | | | | |
|---|---|---|---|---|---|---|---|
| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| | | | 0 | | | | |
| (1) | (2) | (3) | | (4) | (5) | (6) | (7) |

(1) Over-speed → Err42 (Absolute over-speed error protection)
(2) Full absolute status → Err47 (Absolute status error protection)
(3) Counter error → Err44 (Absolute single-turn counter error protection)
(4) Counter overflow → Err41 (Absolute counter over error protection)
(5) Multi-turn error → Err45 (Absolute multi-turn counter error protection)
(6) Battery error → Err40 (Absolute system down error protection)
(7) Battery alarm → Battery alarm

• **Encoder status (L)-----1 represents error occurrence.**

| Encoder status (H) | | | | | | | |
|---|---|---|---|---|---|---|---|
| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| 0 | 0 | | | 0 | 0 | 0 | 0 |

Battery error

One of the following has occurred.
Battery alarm, multi-turn error, counter overflow, counter error, full absolute status, Counter overflow multi-turn error, battery error or battery alarm

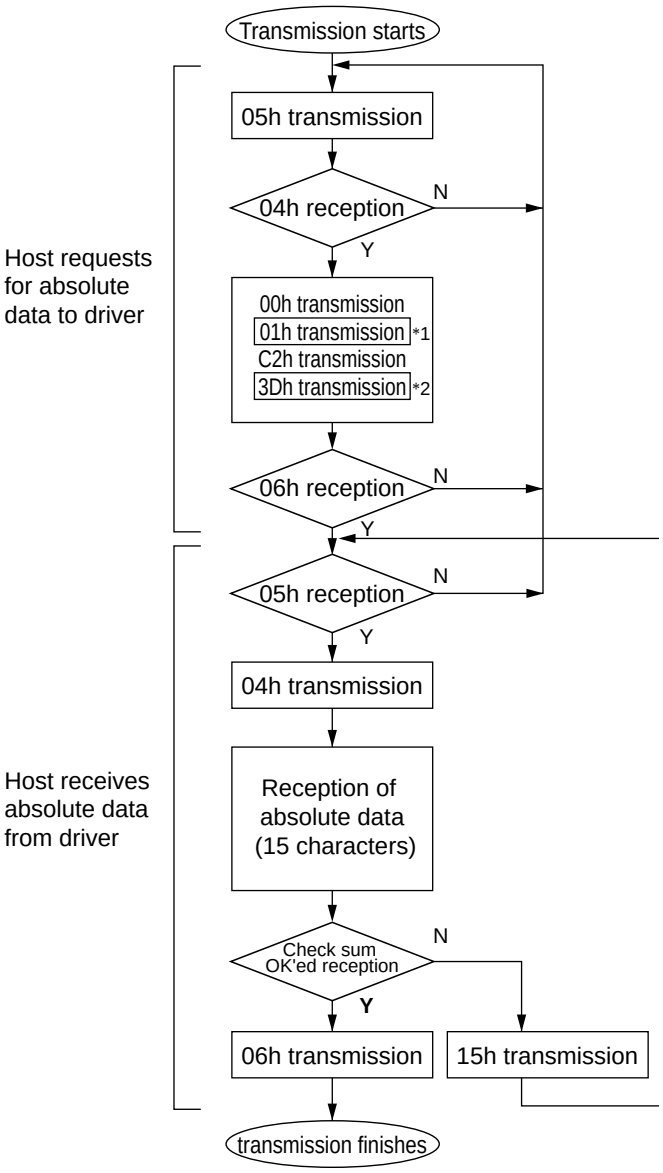
**Remarks** For detail of the Encoder status, refer to the Encoder specification.

**Remarks** **• Transmit the absolute data while fixing the motor with brake by turning to Servo-Off.**

**Related page** • P.6-4 “Protective Function”
• P.7-25 “Display of Battery Alarm”

## External scale RS232 communication procedure

Refer to the instruction manual of the host for the transmission/reception method of command. Following shows the communication example of the driver to Pr5.31 “Axis address = 1”.




Data of *1 and *2 are determined by the setup of Pr5.31 “Axis address” of the front panel.

| Axis address (example) | Data of *1 | Data of *2 |
|---|---|---|
| 0 | 00h | 3Eh |
| 1 | 01h | 3Dh |
| 2 | 02h | 3Ch |
| 3 | 03h | 3Bh |
| 4 | 04h | 3Ah |
| 5 | 05h | 39h |
| 6 | 06h | 38h |
| 7 | 07h | 37h |
| 8 | 08h | 36h |
| 9 | 09h | 35h |
| 10 | 0Ah | 34h |
| 11 | 0Bh | 33h |
| 12 | 0Ch | 32h |
| 13 | 0Dh | 31h |
| 14 | 0Eh | 30h |
| 15 | 0Fh | 2Fh |
| 16 | 10h | 2Eh |
| 17 | 11h | 2Dh |
| 18 | 12h | 2Ch |
| 19 | 13h | 2Bh |
| 20 | 14h | 2Ah |
| 21 | 15h | 29h |
| 22 | 16h | 28h |
| 23 | 17h | 27h |
| 24 | 18h | 26h |
| 25 | 19h | 25h |
| 26 | 1Ah | 24h |
| 27 | 1Bh | 23h |
| 28 | 1Ch | 22h |
| 29 | 1Dh | 21h |
| 30 | 1Eh | 20h |
| 31 | 1Fh | 1Fh |

Check sum becomes OK'ed when the lower 8-bit of the sum of the received absolute data (15 characters) is 0.

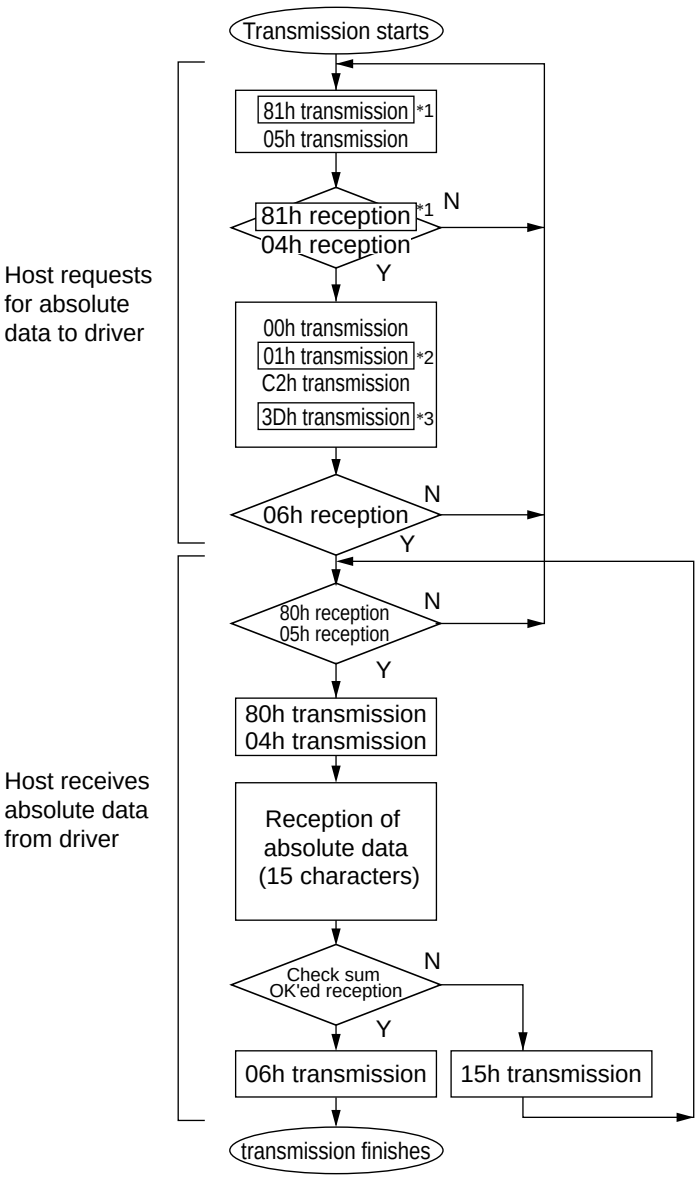
Enter the Pr5.31 value of the driver to which you want to communicate from the host to axis (*1 data) of the command block, and transmit the command according to the RS232 communication protocol. For details of communication, refer to P.7-27, "Communication".

**Caution**

- **Allow 50ms or longer interval for axis switching when you want to capture multiple axes data.**
- **It is recommended for you to repeat the above communication more than 2 times to confirm the absolute data coincide, in order to avoid mis-operation due to unexpected noise.**

## External scale RS485 communication procedure

Refer to the instruction manual of the host for the transmission/reception method of command. Following shows the communication example of the driver to Pr5.31 “Axis address = 1”.




Data of *1, *2 and *3are determined by the setup of Pr5.31 “Axis address” of the front panel.

| Axis address (example) | Data of *1 | Data of *2 | Data of *3 |
|---|---|---|---|
| 0 | Details of parameter | | |
| 1 | 81h | 01h | 3Dh |
| 2 | 82h | 02h | 3Ch |
| 3 | 83h | 03h | 3Bh |
| 4 | 84h | 04h | 3Ah |
| 5 | 85h | 05h | 39h |
| 6 | 86h | 06h | 38h |
| 7 | 87h | 07h | 37h |
| 8 | 88h | 08h | 36h |
| 9 | 89h | 09h | 35h |
| 10 | 8Ah | 0Ah | 34h |
| 11 | 8Bh | 0Bh | 33h |
| 12 | 8Ch | 0Ch | 32h |
| 13 | 8Dh | 0Dh | 31h |
| 14 | 8Eh | 0Eh | 30h |
| 15 | 8Fh | 0Fh | 2Fh |
| 16 | 90h | 10h | 2Eh |
| 17 | 91h | 11h | 2Dh |
| 18 | 92h | 12h | 2Ch |
| 19 | 93h | 13h | 2Bh |
| 20 | 94h | 14h | 2Ah |
| 21 | 95h | 15h | 29h |
| 22 | 96h | 16h | 28h |
| 23 | 97h | 17h | 27h |
| 24 | 98h | 18h | 26h |
| 25 | 99h | 19h | 25h |
| 26 | 9Ah | 1Ah | 24h |
| 27 | 9Bh | 1Bh | 23h |
| 28 | 9Ch | 1Ch | 22h |
| 29 | 9Dh | 1Dh | 21h |
| 30 | 9Eh | 1Eh | 20h |
| 31 | 9Fh | 1Fh | 1Fh |

Check sum becomes OK'ed when the lower 8-bit of the sum of the received absolute data (15 characters) is 0.

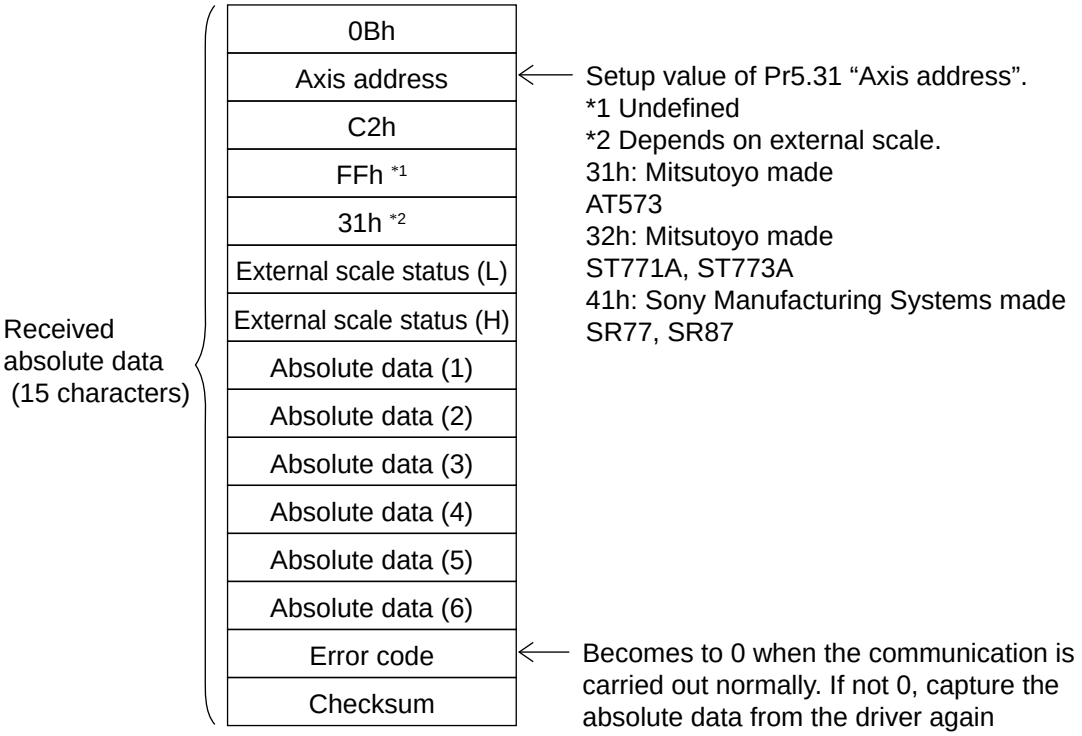
Command from the host will be transmitted to the desired driver based on RS485 transmission protocol. For details of communication, refer to P.7-27, "Communication".

**Caution**

- **Allow 50ms or longer interval for axis switching when you want to capture multiple axes data.**
- **It is recommended for you to repeat the above communication more than 2 times to confirm the absolute data coincide, in order to avoid mis-operation due to unexpected noise.**

## Composition of external scale absolute data

Using 15-character data received through RS232/RS485, organize 1-turn data and multi-turn data.




External scale absolute data

← Absolute data (6)×10000000000h
+Absolute data (5)×100000000h
+Absolute data (4)×1000000h
+Absolute data (3)×10000h
+Absolute data (2)×100h
+Absolute data (1)

Absolute data of external scale is represented as 48 bit number (negative value is represented as two's complement).

**Remarks** If the multi-turn data of the above fig. is between 32768 to 65535, convert it to signed date after deducting 65536.

**• External scale status (L)-----1 represents error occurrence.**

| External scale status (L) | | | | | | | |
|---|---|---|---|---|---|---|---|
| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| | | | 0 | | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |

(1) Alarm No. A8 “External scale error alarm”

(2) Alarm No. A8 “External scale error alarm”

(3) Err51.0 “External scale status 5 error protection”

(4) Err51.0 “External scale status 4 error protection”

(5) Err51.0 “External scale status 3 error protection”

(6) Err51.0 “External scale status 2 error protection”

(7) Err51.0 “External scale status 1 error protection”

(8) Err51.0 “External scale status 0 error protection”

**• External scale status (L)-----1 represents error occurrence.**

| External scale status (H) | | | | | | | |
|---|---|---|---|---|---|---|---|
| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| 0 | 0 | | | 0 | 0 | 0 | 0 |

Logical sum of bit6 and bit 7 of external scale status (L)

Logical sum of bit0 to bit 5 of external scale status (L)

**Remarks** For detail of the external scale status, refer to the external scale specification.

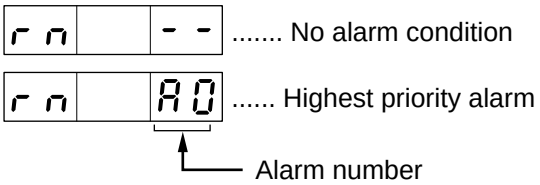
**Remarks** **• Transmit the External scale absolute data while fixing the motor with brake by turning to Servo-Off.**

**Related page**
• P.6-4 “Protective Function”
• Next page “Display of Battery Alarm”

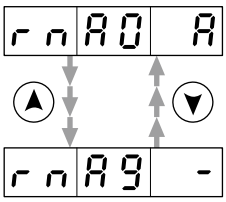
# 2. Absolute system

## Display of Battery Alarm

Following alarm will be displayed when making the front panel to alarm execution mode of monitor mode.




• Press ▲ ▼ to scroll alarm conditions.




**• Kinds of alarm**

| alarm No. | Alarm | Content | Latched time *1 |
|---|---|---|---|
| A0 | Overload protection | Load factor is 85% or more the protection level. | 1 to 10s or ∞ |
| A1 | Over-regeneration alarm | Regenerative load factor is 85% or more the protection level. | 10s or ∞ |
| A2 | Battery alarm | Battery voltage is 3.2 V or lower. | Fixed at ∞ |
| A3 | Fan alarm | Fan has stopped for 1 sec. | 1 to 10s or ∞ |
| A4 | Encoder communication alarm | The number of successive encoder communication errors exceeds the specified value. | 1 to 10s or ∞ |
| A5 | Encoder overheat alarm | The encoder detects overheat alarm. | 1 to 10s or ∞ |
| A6 | Oscillation detection alarm | Oscillation or vibration is detected. | 1 to 10s or ∞ |
| A7 | Lifetime detection alarm | The life expectancy of capacity or fan becomes shorter than the specified time. | Fixed at ∞ |
| A8 | External scale error alarm | The feedback scale detects the alarm. | 1 to 10s or ∞ |
| A9 | External scale communication alarm | The number of successive feedback scale communication errors exceeds the specified value. | 1 to 10s or ∞ |

*1 Alarms can be cleared by using the alarm clear. Because the all existing alarms are kept cleared while the alarm clear input (A-CLR) is kept ON, be sure to turn it OFF during normal operation. Either 1-10s or∞ can be selected by using user parameter.
Exception: Battery alarm is fixed at ∞ because it is latched by the encoder.
Because the end of life alarm means that the life expectancy cannot be extended, the alarm is set at ∞.

## How to Clear the Battery Alarm

Replace the battery for absolute encoder when battery alarm occurs according to P.276, "How to Replace the Battery". After replacement, clear the battery alarm in the following 3 methods.

(a) "Connector X4" Connecting Alarm clear input (A-CLR) to COM– for more than 120ms.
(b) Executing the alarm clear function in auxiliary function mode by using the front panel.
(c) Click the "Battery warning" Clear button, after select the "Absolute encoder" tab in the monitor display window by using the PANATERM (option).

Related page
• P.2-75 “Alarm Clear Screen”
• P.3-30 “Inputs and outputs on connector X4”
• P.7-26 “Outline of Setup Support Software, “PANATERM””

# 3. Outline of Setup Support Software, "PANATERM"

## Setup on the PC

Connector X1 of MINAS A5 can be connected to your PC through USB cable for computer. Once you download the setup support software PANATERM from our web site and install it to your PC, the following tasks can be easily performed.

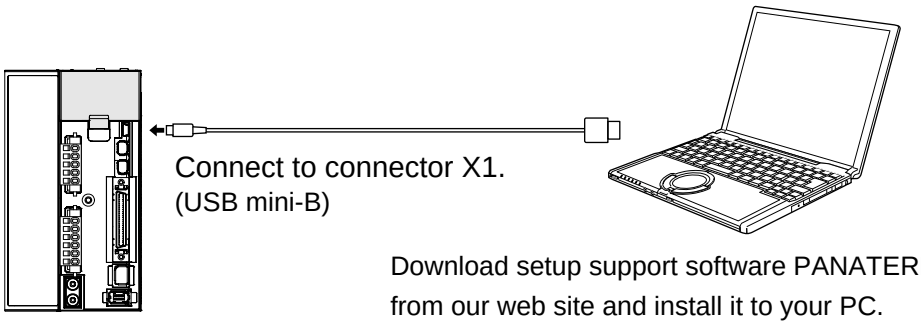
### Outline of PANATERM

With the PANATERM, you can execute the followings.

(1) Setup and storage of parameters, and writing to the memory (EEPROM).
(2) Monitoring of I/O and pulse input and load factor.
(3) Display of the present alarm and reference of the error history.
(4) Data measurement of the wave-form graphic and bringing of the stored data.
(5) Normal auto-gain tuning
(6) Frequency characteristic measurement of the machine system.

**Note** Distribution media such as CD-ROM for this software are not prepared. Download the software from our web site and install it to your PC.

### How to Connect




**• USB cable**

The connection cable should be provided with USB mini-B connector at the driver side and the PC compatible connector on the other end.
If the cable has no noise filter, install a signal noise filter (DVOP1460) to both ends of the cable.

### System required for PANATERM

To use PANATERM, the following system components are required.

**• PC**

| | |
|---|---|
| **OS** | Windows® XP SP3 (32-bit Ver.)<br>Windows® VISTA SP1 (32-bit Ver.)<br>(Japanese, English or Chinese version)<br>Note: Windows® (x64) (64-bit Ver.) is not supported. |
| **CPU** | Pentium III 512 MHz or better |
| **Memory** | 256 MB or more (512 MB recommended) |
| **Hard disk** | 512 MB or more free space |
| **Serial communication** | USB port |

**• Display**

| | |
|---|---|
| **Resolution** | 1024 × 768 pixel or more |
| **No. of colors** | 24-bit color (True Color) or better |

# 4. Communication

## Outline

You can connect up to 32 MINAS-A5 series with your computer or NC via serial communication based on RS232 and RS484, and can execute the following functions.

**(1) Change over of the parameters**
**(2) Referring and clearing of alarm data status and history**
**(3) Monitoring of control conditions such as status and I/O.**
**(4) Referring of the absolute data**
**(5) Saving and loading of the parameter data**

### • Merits

- You can write parameters from the host to the driver in batch when you start up the machine.
- You can display the running condition of machine to improve serviceability.
- You can compose multi-axis absolute system with simple wiring.

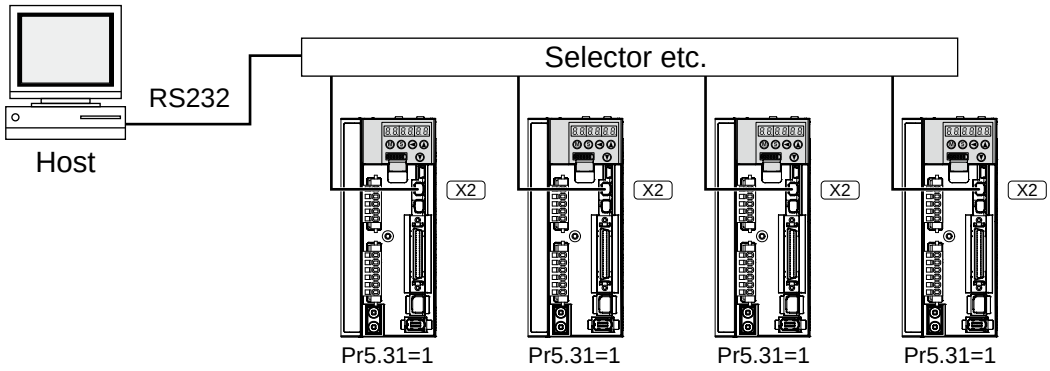
Related page
- P.2-20 “Wiring to the Connector, X1”
- P.7-10 “Absolute system”
- P.7-26 “Outline of Setup Support Software, “PANATERM””

## Connection of Communication Line

MINAS-A5 series provide 2 types of communications ports of RS232 and RS485, and support the following 3 types of connection with the host.

### • RS232 communication

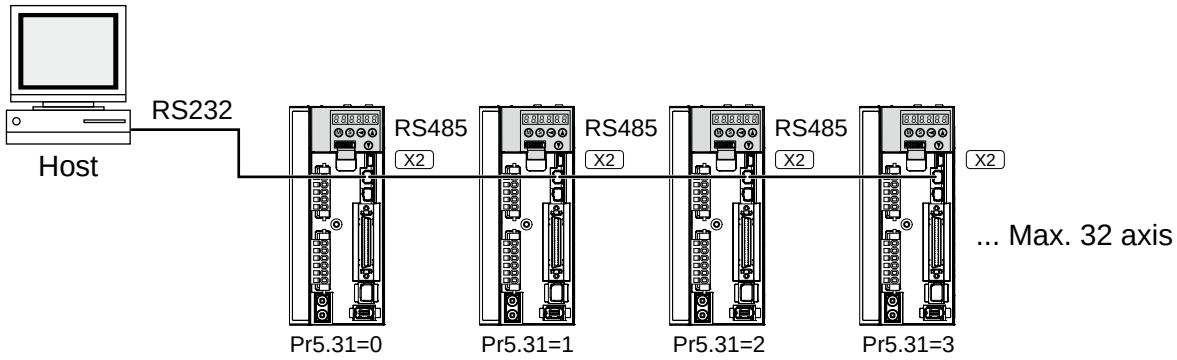
Connect the host and the driver in one to one with RS232, and communicate according to RS232 transmission protocol.




- Set up the module ID of MINAS-A5 to RSW of the front panel. In the above case, you can set any value of 0 to 127. You can set the same module ID as long as the host has no difficulty in control.

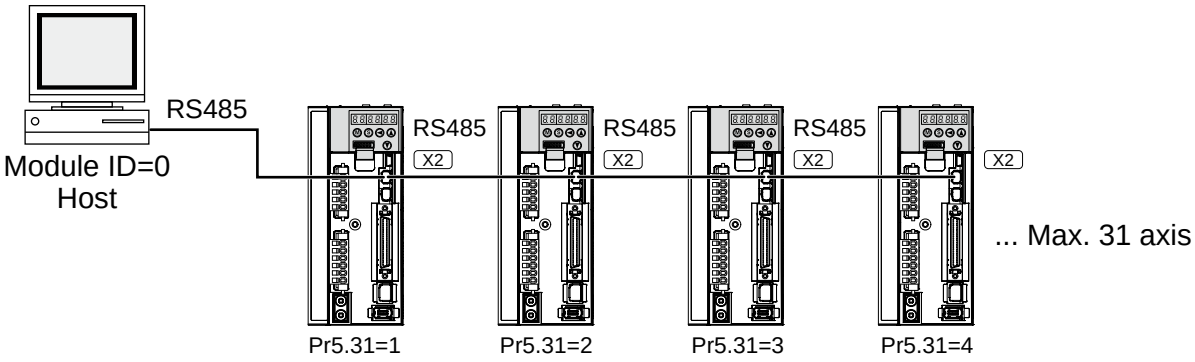
### • RS232 and RS485 communication

When you connect one host to multiple MINAS-A5s, connect the host to connector X2 of one driver with RS232 communication, and connect each MINAS-A5 with RS485 communication. Set up the Pr5.31 of the driver to 0 which is connected to the host, and set up 1 to 127 to other drivers each.



## • RS485 communication

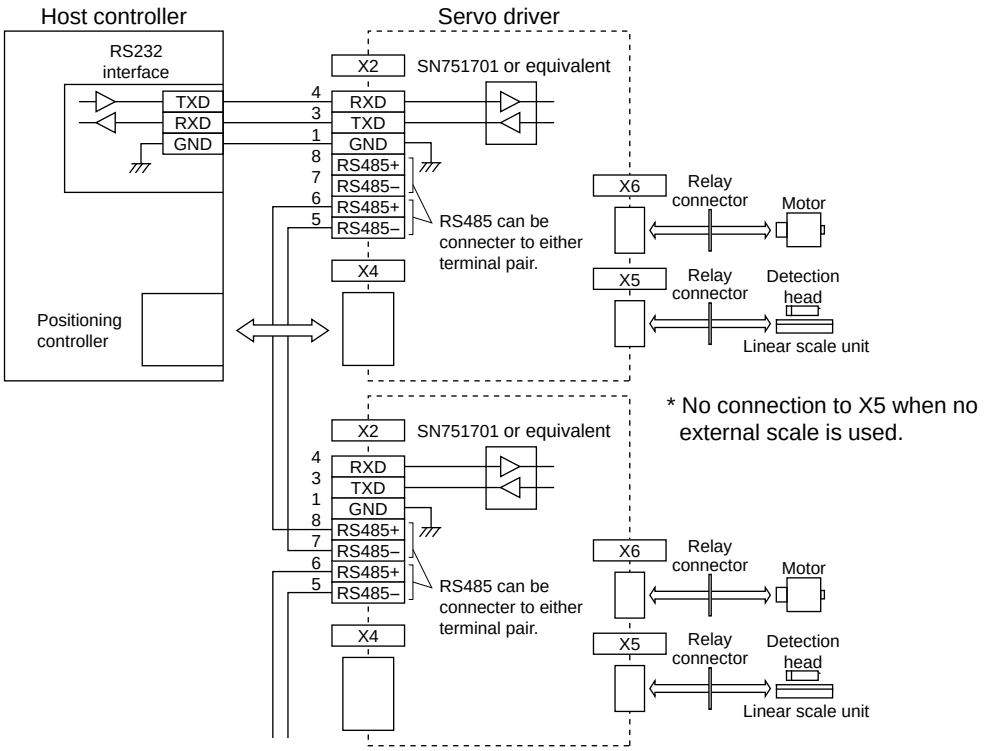
Connect the host to multiple MINAS-A5s with RS485 communication, set up the Pr5.31 of each front panel of MINAS-A5 to 1 to 127.



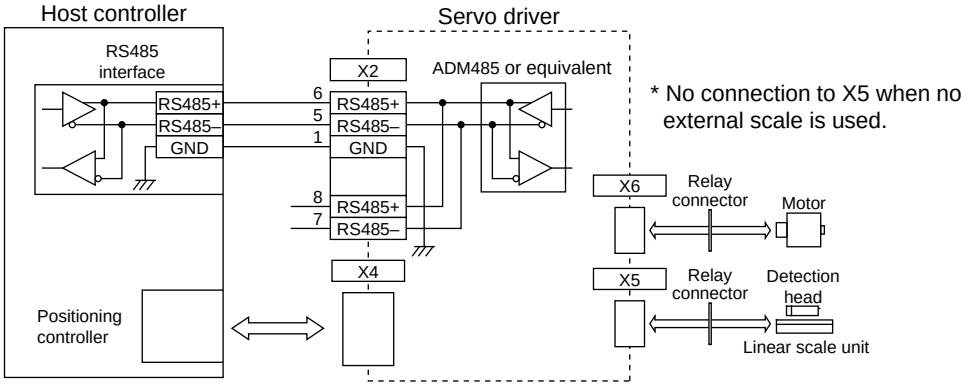

**Allow 50ms or longer interval for switching the axes while capturing data of multiple axes.**

## Interface of Communication Connector

### • Connection to the host with RS232




### • Connection to the host with RS485




## Communication Method

| | RS232 | RS485 |
|---|---|---|
| | Full duplex, asynchronous | Half duplex, asynchronous |
| Communication baud rate | 2400, 4800, 9600, 19200, 38400, 57600, 11520bps | 2400, 4800, 9600, 19200, 38400, 57600, 115200bps |
| Data | 8 bit | 8 bit |
| Parity | none | none |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |

• Set up the RS232 communication baud rate with Pr5.29, and RS485 communication baud rate with Pr5.30. The change of these parameters will be validated after the control power entry. For details, refer to the following list of parameters related to communication.

## List of User Parameters for Communication

| Class | No. | Title | Setup value | Function |
|---|---|---|---|---|
| 5 | 31 | Axis address | 0 to 127 | Set the axis number for serial communication.<br>This parameter setup value has no effect on servo operation. |
| 5 | 29 | Baud rate setup of RS232 communication | 0 to 6 | Set up the communication speed of RS232 communication.<br>0 : 2400[bpps], 1 : 4800[bps], 2 : 9600[bps], 3 : 19200[bps], 4 : 38400[bps], 5 : 57600[bps], 5 : 115200[bps]<br>Updated setup of is validated upon turning on of control power. |
| 5 | 30 | Baud rate setup of RS485 communication | 0 to 6 | Set up the communication speed of RS485 communication.<br>0 : 2400[bpps], 1 : 4800[bps], 2 : 9600[bps], 3 : 19200[bps], 4 : 38400[bps], 5 : 57600[bps], 5 : 115200[bps]<br>Updated setup of is validated upon turning on of control power. |

• Required time for data transmission per 1 byte is calculated in the following formula in case of 9600[bps].

$$1000 / 9600 \times (1 + 8 + 1) = 1.04 \text{ [ms/byte]}$$

Start bit — Data — Stop bit

Note that the time for processing the received command and time for switching the line and transmission/reception control will added to the actual communication time.

### • Handshake code

Following codes are used for line control.

| Title | Code | Function |
|---|---|---|
| ENQ | 05h (Module recognition byte of the transmitted) | Enquire for transmission |
| EOT | 04h (Module recognition byte of the transmitted) | Ready for receiving |
| ACK | 06h | Acknowledgement |
| NAK | 15h | Negative acknowledgement |

ENQ ..... The module (host or driver) sends out ENQ when it has a block to send.
EOT ..... The module (host or driver) sends out EOT when it is ready to receive a block. The line enters to a transmission mode when ENQ is transmitted and EOT is received.
ACK ..... When the received block is judged normal, the module (host or driver) will send out ACK.
NAK ..... When the received block is judged abnormal, NAK will be sent. A judgment is based on checksum and timeout.

**Caution**

1 byte of module recognition is added to ENQ and EOT at RS485 communication.
Module recognition byte... Make the Pr5.31 value of the front panel as a module ID, and data which makes its bit7 as 1, becomes a module recognition byte.

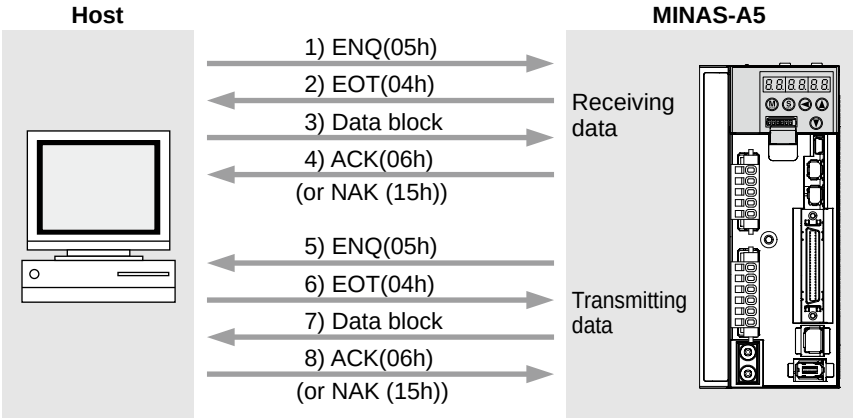
| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | Module ID | | | |

Module ID :
The module ID of the host side will be 0 in case of RS485 communication, therefore set up Pr5.31 of MINAS-A5 to 1- 127.

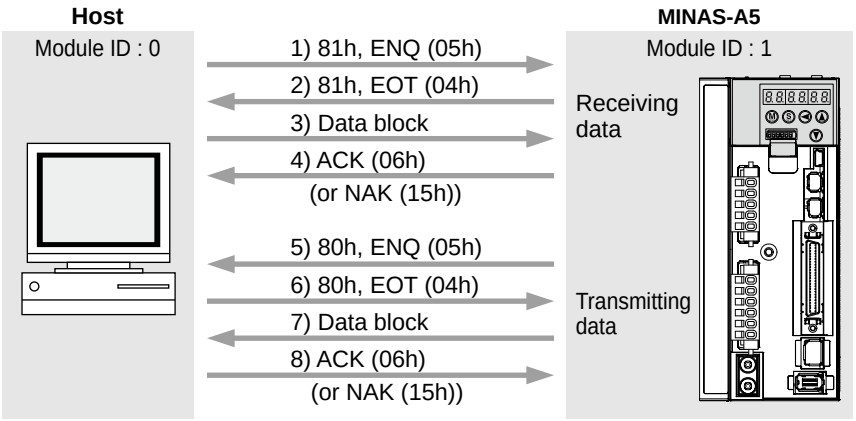
## Transmission Sequence

### • Transmission protocol

#### • In case of RS232




### • In case of RS485




**• Line control**

Decides the direction of transmission and solves the contention.

Reception mode... From when the module (host or driver) returns EOT after receiving ENQ.

Transmission mode... From when the module (host or driver) receives EOT after transmitting ENQ.

At contention of transmission and reception... Slave side will enter to reception mode when it receives ENQ while waiting for EOT after transmitting ENQ, by giving priority to ENQ (of master side).

**• Transmission control**

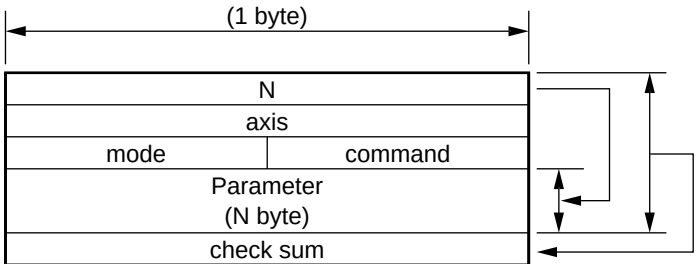
On entering to transmission mode, the module transmits the command block continuously and then waits for ACK reception. Transmission completes at reception of ACK.. ACK may not be returned at transmission failure of command byte counts. If no ACK is received within T2 period, or other code than NAK or ACK is received, sequence will be retried. Retry will start from ENQ.

**• Reception control**

On entering to reception mode, the module receives the transmitted block continuously. It will receive the command byte counts from the first byte, and continuously receive extra 3 bytes. It will return ACK when the received data sum becomes 0, by taking this status as normal. In case of a check sum error or a timeout between characters, it will return NAK.

## • Data Block Composition

Below shows the composition of data block which is transmitted in physical phase.




N : Command byte counts (0 to 240)
Shows the number of parameters which are required by command.

axis : Sets up the value of Pr5.31.(0 to 127)

command : Control command (0 to 15)

mode : Command execution mode (0 to 15)
Contents vary depending on the mode.

check sum : 2's complement of the total number of bytes, ranging from the top to the end of the block

## • Protocol Parameter

Following parameters are used to control the block transmission. You can set any value with the INIT command (described later).

| Title | Function | | Initial value | Setup range | Unit |
|---|---|---|---|---|---|
| T1 | Time out between characters | RS232 | 5 (0.5 sec) | 1 to 255 | 0.1 sec |
| | | RS485 | 1 (0.1 sec) | | |
| T2 | Protocol time out | RS232 | 5 (0.5 sec) | 1 to 255 | 1 sec |
| | | RS485 | 1 (0.1 sec) | | |
| T6 | Driver response time | RS232 | 0 (0ms) | 0 to 255 | 1 ms |
| | | RS485 | 6 (6ms) | 2 to 255 | |
| RTY | Retry limit | | 1 (once) | 1–8 | Once |
| M/S | Master/Slave | | 0 (Slave) | 0, 1 (Master) | |

T1: • Permissible time interval for this driver to receive the consecutive character cods which exists between the module recognition bytes and ENQ/EOT, or in the transmission/reception data block. Time out error occurs and the driver returns NAK to the transmitter when the actual reception time has exceeded this setup time.

T2: • Permissible time interval for the driver to transmit ENQ and to receive EOT. If the actual reception time exceeds this setup, this represents that the receiver is not ready to receive, or it has failed to receive ENQ code in some reason, and the driver will re-transmit ENQ code to the receiver. (retry times)

• Permissible time interval for the driver to transmit EOT and to receive the reception of the 1st character code. The driver will return NAK and finishes the reception mode if the actual reception has exceeded this setup time.

• Permissible time interval for the module to transmit the check sum bytes and to receive ACK. The module will re-transmit ENQ code to the receiver in the same way as the NAK reception, if the actual reception time exceeds this setup time.

T6: • Permissible time interval for the driver to receive ENQ and to transmit EOT; Permissible time interval for the driver to receive the check sum bytes and to transmit ACK; and Permissible time interval for the driver to receive EOT and to transmit the 1st character.

RTY: Maximum value of retry times. Transmission error occurs if the actual retry has exceeds this setup value.

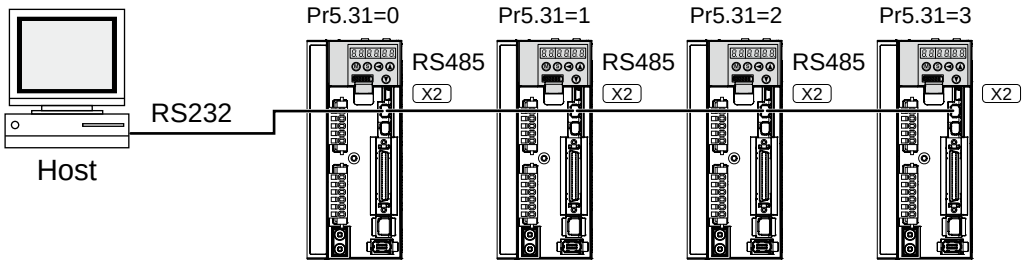
M/S: Switching of master and slave. When contention of ENQ has occurred, the module decides which is to be given priority.
Priority is given to the transmitter which is set up as a master. (0: Slave mode, 1 : Master mode)

## Example of Data Communication

### • e.g. Reference of Absolute Data

When you connect the host to one driver with RS232 communication, and connect multiple MINAS-A5s with RS485 communication. Following flow chart describes the actual flow of the communication data when you want to capture the absolute data of the module ID=1.

**e.g. of system composition**




**e.g. of capturing the absolute data**

Following shows the communication data in time series when you want to capture the absolute data. Data is presented in hexadecimals.

RS232 communication

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Host → | 05 (ENQ) | | 00 | 01 | D2 | 2D | | | 04 (EOT) | | | |
| MINAS-A5 (0) ← | | 04 (EOT) | | | | | 06 (ACK) | 05 (ENQ) | | 0B | 01 | D2 |

Obtain data with RS485 (see the below)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Host → | | | | | | | | | | | | 06 (ACK) |
| MINAS-A5 (0) ← | 03 | 11 | 00 | 00 | D8 | FF | 01 | 00 | 00 | 00 | 00 | 36 |

* RS485 communication

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MINAS-A5 (0) → | 81 (ENQ) | 05 | | 00 | 01 | D2 | 2D | | | | 80 (EOT) | 04 |
| MINAS-A5 (1) ← | | | 81 (EOT) | 04 | | | | 06 (ACK) | 80 (ENQ) | 05 | | |
| MINAS-A5 (0) → | | | | | | | | | | | | |
| MINAS-A5 (1) ← | 0B | 01 | D2 | 03 | 11 | 00 | 00 | D8 | FF | 01 | 00 | 00 |
| MINAS-A5 (0) → | | | | | 06 (ACK) | | | | | | | |
| MINAS-A5 (1) ← | 00 | 00 | 36 | | | | | | | | | |

**Caution** See the below for the captured data. Refer to P.7-48, "Read out of Absolute Encoder " of details of communication command, for the data composition.

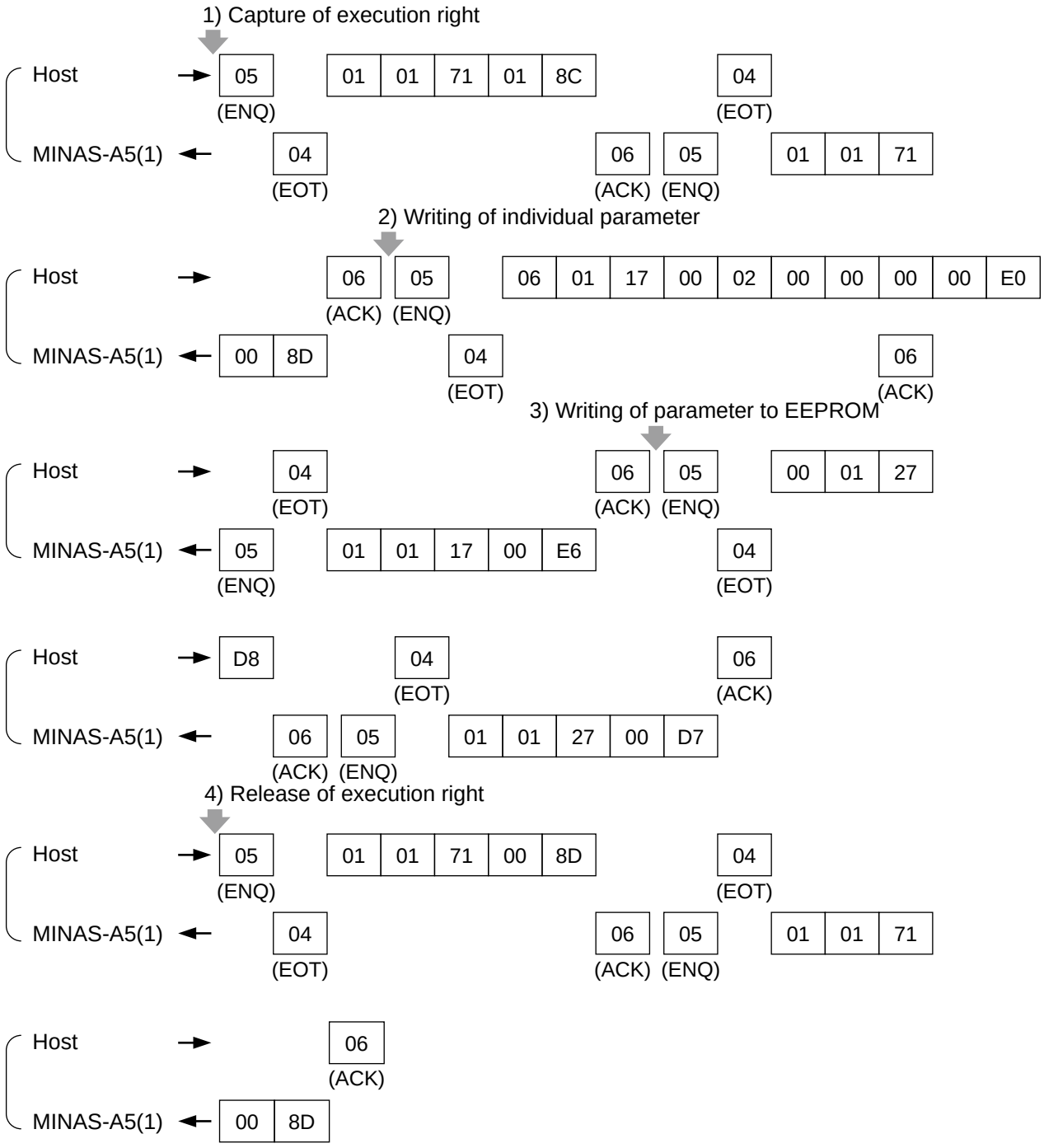
Multi-turn data : 0000h = 0

Single turn data : 01FFD8h = 131032

**Allow 50ms or longer interval for switching the axis while capturing data of multiple axes.**

## • Example of Parameter Change

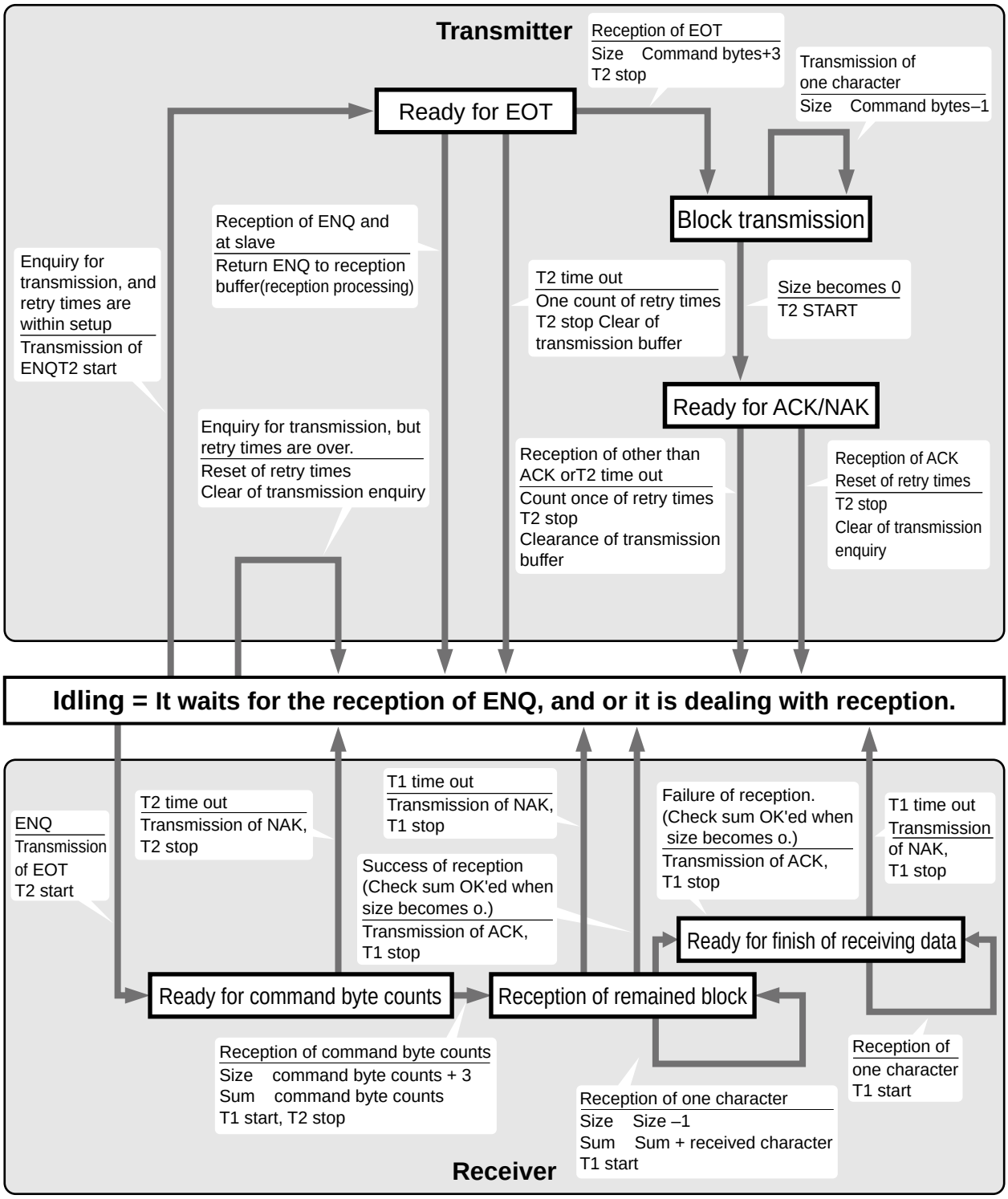
Following shows the communication data in time series when you change parameters. Communication in general will be carried out in sequence of (1) Request for capturing of execution right, (2) Writing of individual parameter, and (3) Writing to EEPROM when saving of data is required, and (4) Release of execution right. Here the hardware connection shows the case that the driver (user ID=1) is directly connected to the host with RS232. Date is presented in hexadecimals.



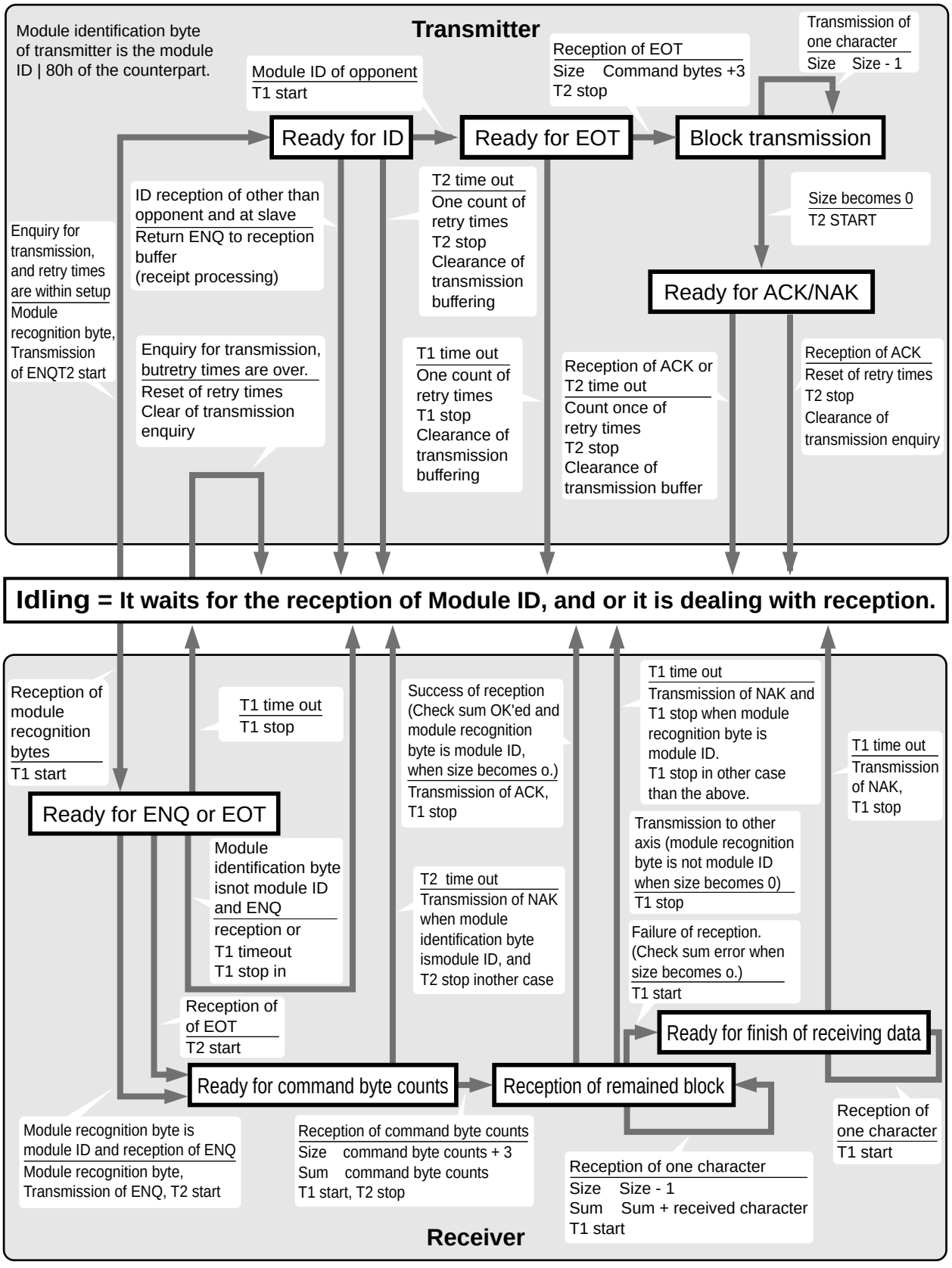

**Caution** For details of command, refer to P.7-40, "Details of Communication Command".

## Status Transition Chart

### • RS232 Communication

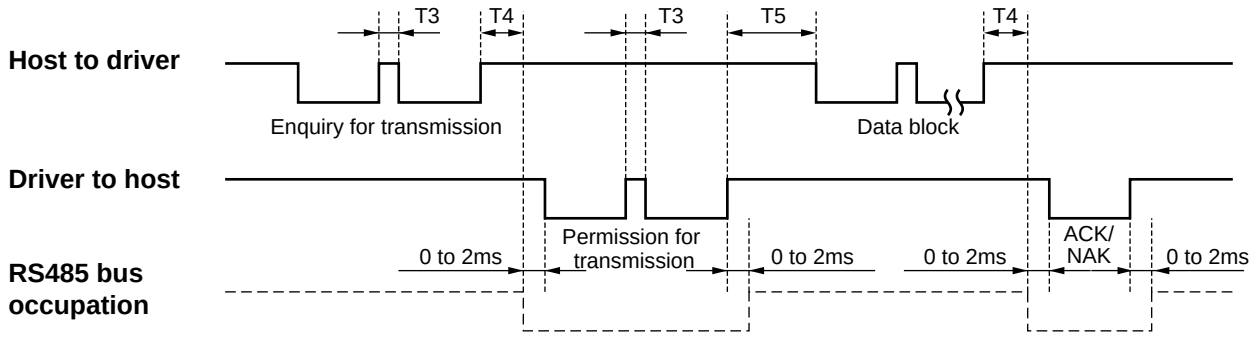


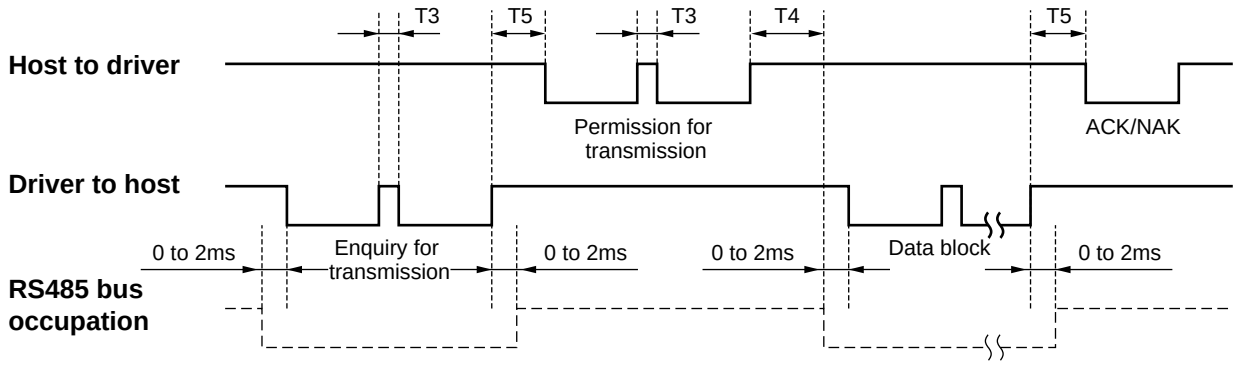
## • RS485 Communication



## Timing of Data Communication

### • In case of RS485 (RS232 to follow)




| Symbol | Title | Minimum | Maximum |
|---|---|---|---|
| T3 | Continuous inter-character time | Stop bit length | Protocol parameter T1 |
| T4 | Response time of driver | Protocol parameter T6 | Protocol parameter T2 |
| T5 | Response time of host | 2ms | Protocol parameter T2 |

**Caution** Above time represents a period from the rising edge of the stop bit.

# 4. Communication

## List of Communication Command

| command | mode | Content |
|---|---|---|
| 0 | | NOP |
| | 1 | Read out of CPU version |
| | 5 | Read out of driver model |
| | 6 | Read out of motor model |
| 1 | | INIT |
| | 7 | Capture and release of execution right |
| | 8 | Setup of RS232 protocol parameter |
| | 9 | Setup of RS485 protocol parameter |
| 2 | | POS, STATUS, I/O |
| | 0 | Read out of status |
| | 1 | Read out of command pulse counter |
| | 2 | Read out of feedback pulse counter |
| | 4 | Read out of present speed |
| | 5 | Read out of present torque output |
| | 6 | Read out of present deviation counter |
| | 7 | Read out of input signal |
| | 8 | Read out of output signal |
| | 9 | Read out of present speed, torque and deviation counter |
| | A | Read out of status, input signal and output signal |
| | C | Read out of external scale |
| | D | Read out of absolute encoder |
| | E | Read out of external scale deviation and sum of pulses |
| 7 | | PARAMETER |
| | 0 | Individual read out of parameter |
| | 1 | Individual writing of parameter |
| | 2 | Writing of parameter to EEPROM |
| | 6 | Individual read out of user parameter |
| | 7 | Read out of two or more user parameter |
| | 8 | Writing of two or more user parameter |
| 9 | | ALARM |
| | 0 | Read out of present alarm data |
| | 2 | Batch read out of alarm history |
| | 3 | Clear of user alarm history |
| | 4 | Alarm clear |
| | B | Absolute clear |

- Use the above commands only. If you use other commands, action of the driver cannot be guaranteed.
- When the reception data counts are not correct in the above command, transmission byte1 (Error code only) will be returned regardless of communication command.

| command | mode |
|---|---|
| 0 | 1 |

## • Read out of CPU version

**Reception data**

| 0 | |
|---|---|
| axis | |
| 1 | 0 |
| checksum | |

**Transmission data**

| 3 | |
|---|---|
| axis | |
| 1 | 0 |
| Version (upper) | |
| Version (lower) | |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Version information will be returned in upper data and lower data.
  (Decimal point will be returned by making the lower 4 bit of the upper dataas 0.)
- Version will be displayed in figures from 0 to 9. (e.g. Version 3.1 will be upper data 30h, lower data 13h.)

| command | mode |
|---|---|
| 0 | 5 |

## • Read out of driver mode

**Reception data**

| 0 | |
|---|---|
| axis | |
| 5 | 0 |
| checksum | |

**Transmission data**

| 0Dh | |
|---|---|
| axis | |
| 5 | 0 |
| Model of driver (upper) | |
| Model of driver (lower) | |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Driver model consist of 12-characters, and will be transmitted in ASCII code.
  (e.g.) "MADHT1105***"

| command | mode |
|---|---|
| 0 | 6 |

## • Read out of Motor Model

**Reception data**

| 0 | |
|---|---|
| axis | |
| 6 | 0 |
| checksum | |

**Transmission data**

| 0Dh | |
|---|---|
| axis | |
| 6 | 0 |
| Model of motor (upper) | |
| Model of motor (lower) | |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Motor model consist of 12-characters, and will be transmitted in ASCII code.
  (e.g.) "MSME012S1***"

| command | mode |
|---|---|
| 1 | 7 |

## • Capture and release of execution right

**Reception data**

| 1 | |
|---|---|
| axis | |
| 7 | 1 |
| mode | |
| checksum | |

**Transmission data**

| 1 | |
|---|---|
| axis | |
| 7 | 1 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | mode error | | | in use |

- Capture the execution right to prevent the conflict of the operation via communication and that with the front panel.
- Enquires for the capture of the execution right at parameter writing and EEPROM writing, and release the execution right after the action finishes.
- mode = 1 : Enquires for the capture of the execution right mode = 0 : Enquires for the release of the execution right
- You cannot operate with the front panel at other than monitor mode while the execution right is captured via communication.
- When the module fails to capture the execution right, it will transmit the error code of in use.

| command | mode |
|---|---|
| 1 | 8 |

## • Setup of RS232 protocol parameter

**Reception data**

| 4 | |
|---|---|
| axis | |
| 8 | 1 |
| T1 | |
| T2 | |
| T6 | |
| 0 | RTY |
| checksum | |

**Transmission data**

| 1 | |
|---|---|
| axis | |
| 8 | 1 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | T6error | RS485 error | RTYerror | T2error | T1error | |

- Until this command completes, previous set up protocol parameter will be processed.
  After this command has been executed, this parameter setup will be valid from the next command.
- RTY is 4-bit.
- Unit... T1 : 0.1s, T2 : 0.1s, T6 : 1ms

| command | mode |
|---|---|
| 1 | 9 |

## • Setup of RS485 protocol parameter

**Reception data**

| 4 | |
|---|---|
| axis | |
| 9 | 1 |
| T1 | |
| T2 | |
| T6 | |
| 0 | RTY |
| checksum | |

**Transmission data**

| 1 | |
|---|---|
| axis | |
| 9 | 1 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | T6error | RS485 error | RTYerror | T2error | T1error | |

- Until this command completes, previously set up protocol parameter will be processed.
  After this command has been executed, this parameter setup will be valid from the next command.
- RTY is 4-bit.
- Unit... T1 : 0.1s, T2 : 0.1s, T6 : 1ms

| command | mode |
|---|---|
| 2 | 0 |

## • Read out of status

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 0 | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 3 | |
| axis | |
| 0 | 2 |
| control mode | |
| status | |
| error code | |
| checksum | |

**status**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| | | | | Positive direction running | Negative direction running | Slower than DB permission | Torque in-limit |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

• Control modes are defined as follows.

| | |
|---|---|
| 0 | Position control mode |
| 1 | Velocity control mode |
| 2 | Torque control mode |
| 3 | Full-closed control mode |

• positive direction/negative direction running : This becomes 1 when motor speed (after converted to r/min) is positive (positive direction) or negative (negative direction).
• Slower than DB permission : This becomes 1 when motor speed (after converted to r/min) is below 30r/min.
• Torque in-limit : This becomes 1 when torque command is limited by analog input or parameter.

| command | mode |
|---|---|
| 2 | 1 |

## • Read out of command pulse counter

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 1 | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 5 | |
| axis | |
| 1 | 2 |
| counter value L | |
| | |
| | |
| H | |
| error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

• Module returns the present position in absolute coordinates from the starting point. (Total sum of accumulated command pulses)
• Counter value in 32 bit.
• Counter value will be "–" for negative direction and "+" for positive direction.

| command | mode |
|---|---|
| 2 | 2 |

## • Read out of feedback pulse counter

**Reception data**

| 0 | |
|---|---|
| axis | |
| 2 | 2 |
| checksum | |

**Transmission data**

| 5 | |
|---|---|
| axis | |
| 2 | 2 |
| counter value L | |
| | |
| | |
| H | |
| error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Module returns the present position of feedback pulse counter in absolute coordinates from the staring point.
- Counter value will be "–" for negative direction and "+" for positive direction.
- Feedback pulse counter is the total pulse counts of the encoder and represents the actual motor position traveled

| command | mode |
|---|---|
| 2 | 4 |

## • Read out of present speed

**Reception data**

| 0 | |
|---|---|
| axis | |
| 4 | 2 |
| checksum | |

**Transmission data**

| 3 | |
|---|---|
| axis | |
| 4 | 2 |
| Data (present speed) L | |
| H | |
| error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Reads out the present speed. (Unit : [r/min])
- Output value in 16 bit
- Speed will be "–" for negative direction and "+" for positive direction.

| command | mode |
|---|---|
| 2 | 5 |

## • Read out of present torque output

**Reception data**

| 0 | |
|---|---|
| axis | |
| 5 | 2 |
| checksum | |

**Transmission data**

| 3 | |
|---|---|
| axis | |
| 5 | 2 |
| Data (present torque) L | |
| H | |
| error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Reads out the present torque output. (Unit : Converted with "Rated motor torque = 2000)
- Output value in 16 bit
- Torque command will be "–" value for negative direction and "+" value for positive direction.

| command | mode |
|---|---|
| 2 | 6 |

## • Read out of present deviation counter

**Reception data**

| 0 | |
|---|---|
| axis | |
| 6 | 2 |
| checksum | |

**Transmission data**

| 5 | |
|---|---|
| axis | |
| 6 | 2 |
| data (deviation) L | |
| | |
| | |
| H | |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Reads out the present deviation counter value. (Unit : [pulse]
- Output value in 32 bit
- Becomes "+" when the encoder is located at negative direction against position command, and "–" when it is located at positive direction.

| command | mode |
|---|---|
| 2 | 7 |

## • Read out of input signal

**Reception data**

| 0 | |
|---|---|
| axis | |
| 7 | 2 |
| checksum | |

**Transmission data**

| 5 | |
|---|---|
| axis | |
| 7 | 2 |
| data L | |
| | |
| | |
| data H | |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

**Data**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | Switching of electronic gear 1 | Speed zero clamp | Control mode switching | CCW over-travel inhibit | CW over-travel inhibit | Alarm clear | Servo-ON |

| bit15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | For manufacturer's use | Internal speed command selection 2 | Internal speed command selection 1 | For manufacturer's use | Counter clear | Gain switching | Command pulse input inhibition |

| bit23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Switching of electronic gear 2 | Damping control switching 2 | Torque limit switching | Internal speed command selection 3 | Damping control switching 1 | For manufacturer's use | For manufacturer's use | For manufacturer's use |

| bit31 | 31 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | For manufacturer's use | For manufacturer's use | Safety input 1 | Safety input 2 | For manufacturer's use | Torque command sign | Speed command sign |

- Logic of input signal is based on assignment set in the parameter.
- Because of the internal logical data after conversion of input, it does not directly correspond to the input signal from the connector X5.
- CW over-travel inhibit input and CCW over-travel inhibit input will change according to the input logic, even if they have been disabled by the parameter,

| command | mode |
|---|---|
| 2 | 8 |

## • Read out of output signal

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 8 | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 7 | |
| axis | |
| 8 | 2 |
| data L | |
| | |
| | |
| data H | |
| alarm data L | |
| H | |
| error code | |
| checksum | |

**error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

**Data**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | In-speed | Torque in-limit | Zero speed detection | Mechanical brake released | Positioning complete (In-position) | Servo-Alarm | Servo-Ready |

| bit15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Excite motor | Control power latch | Dynamic brake engagement | Control inrush suppression relay | Control regeneration brake | Full-closed positioning complete | At-speed | For manufacturer's use |

| bit23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Safety EDM | Speed command ON/OFF | Alarm attribute output | Speed in-limit output | 2nd positioning complete (In-position) | Positional command ON/OFF | Alarm output 2 | Alarm output 1 |

| bit31 | 31 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | For manufacturer's use | For manufacturer's use | For manufacturer's use | For manufacturer's use | For manufacturer's use | For manufacturer's use | For manufacturer's use |

**alarm data**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Overload protection | Fan alarm | Over-regeneration alarm | Encoder communication alarm | Encoder overheat alarm | Lifetime detection alarm | For manufacturer's use | Battery alarm |

| bit15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| For manufacturer's use | For manufacturer's use | For manufacturer's use | | | External scale communication alarm | Oscillation detection alarm | External scale error alarm |

• The table below shows the relation of the signals and actions.

| Signal title | 0 | 1 |
|---|---|---|
| Servo-Ready | Servo-Not Ready | At Servo-Ready |
| Servo-Alarm | Normal | At Servo-Alarm |
| Positioning completed | Positioning not completed | Positioning in-complete |
| Mechanical brake released | Mechanical brake engaged | Mechanical brake released |
| Zero speed detection | Zero speed not detected | Zero speed detected |
| Torque in-limit | Torque not in-limit | Torque in-limit |
| At-speed (Speed arrival) | Not at-speed(Speed not arrived) | Speed arriving |
| In-speed (Speed coincidence) | Not in-speed(Speed not coincided) | In-speed (Speed coincided) |
| Full-closed positioning complete | Full-closed positioning not completed | Full-closed positioning completed |
| Control regeneration brake | Turn off regeneration Tr | Turn on regeneration Tr |
| Control inrush suppression relay | Release inrush suppression relay | Operate inrush suppression relay |
| Dynamic brake engagement | Dynamic brake released | Dynamic brake engaged |
| Control power latch | Release power latch | Power abnormal latching |
| Excite motor | Energize motor | Servo free |

• Because of the internal logical data before output conversion, it does not directly correspond to the output signal to the connector X5.
• Names and functions shown above are for MINAS-A5 (general-purpose model). Some of input signals will have different meaning for different series.

| command | mode |
|---|---|
| 2 | 9 |

## • Read out of present speed, torque and deviation counter

**Reception data**

| |
|---|
| 0 |
| axis |
| 9 \| 2 |
| checksum |

**Transmission data**

| |
|---|
| 9 |
| axis |
| 9 \| 2 |
| data L |
| (speed) H |
| data L |
| (torque) H |
| data L |
| |
| |
| (deviation) H |
| error code |
| checksum |

**Error cod**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Output value of speed and torque are in 16 bit and deviation in 32 bit.
- Unit and sign of the output data is as same as that of command No. 24 (command = 2, mode = 4), 25 (mode = 5) and 26 (mode = 6).

| command | mode |
|---|---|
| 2 | A |

## • Read out of status, input signal and output signal

**Reception data**

| |
|---|
| 0 |
| axis |
| A \| 2 |
| checksum |

**Transmission data**

| |
|---|
| 13 (0Dh) |
| axis |
| A \| 2 |
| control mode |
| status |
| input signal L |
| |
| |
| input signal H |
| output signal L |
| |
| |
| output signal H |
| alarm data L |
| alarm data H |
| error code |
| checksum |

**Error cod**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Meaning of each bit of control mode, status, input signal, output signal and alarm data is as same as that of command No. 20 (command = 2, mode = 0), 27 (mode = 7) and 28 (mode =8).

| command | mode |
|---|---|
| 2 | C |

## • Read out of feedback scale

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| C | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 11 (0Bh) | |
| axis | |
| C | 2 |
| encoder ID (L) | |
| (H) | |
| status (L) | |
| (H) | |
| (L) | |
| absolute position data (48bit) | |
| (H) | |
| error code | |
| checksum | |

**Encoder ID**

| | Encoder ID (L) | Encoder ID (H) |
|---|---|---|
| ST771 | Address "0" data of EEPROM | 32h |
| AT500series | Address "0" data of EEPROM | 31h |

• Command error occurs at other control modes than full-closed control.

**• ST771**

**Status (L)**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Thermal alarm | Signal intensity alarm | Signal intensity error | Transducer error | ABS detection error | Hardware error | Initialization error | Over speed |

**Status (H)**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | Encoder error *1 | Encoder error *2 | 0 | 0 | 0 | 0 |

*1 bit5 : Logical sum of bit0 to bit 5 of status (L) *2 bit4 : logical sum of bit6 and bit 7 of status (L)

**• AT500 series**

**Status (L)**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Thermal alarm | 0 | Communication error | CPU, memory error | Capacity and photoelectric error | Encoder non-matching error | Initialization error | Over speed |

**Status (H)**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | Encoder error *3 | Encoder alarm *4 | 0 | 0 | 0 | 0 |

*3 bit5 : Logical sum of bit0 to bit 5 of status (L) *4 bit4 : logical sum of bit6 and bit 7 of status (L)

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal 1 : Error | | Command error | RS485 error | | | | |

• Absolute position data = 48bit (800000000000 to 7FFFFFFFFFFFh)

| command | mode |
|---|---|
| 2 | D |

## • Read out of absolute encoder

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| D | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 11 (0Bh) | |
| axis | |
| D | 2 |
| encoder ID (L) | |
| (H) | |
| status (L) | |
| (H) | |
| (L) | |
| single-turn data | |
| (H) | |
| multi-turn data (L) | |
| (H) | |
| 0 | |
| Error code | |
| checksum | |

| | Encoder ID (L) | Encoder ID (H) |
|---|---|---|
| 17bit absolute | 3 | 11h |

**Status (L)**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Battery alarm | System down | Multi-turn error | 0 | Counter overflow | Count error | Full absolute status | Over speed |

**Status (H)**

- bit4 : System down
- bit5 : Battery alarm, multi-turn error, counter overflow, count error, full absolute status and logical sum of over speed

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Command error will occur when you use the above encoder or absolute encoder as an incremental encoder.
- Single turn data = 17bit (000000h to 01FFFFh)
- Multi-turn data = 16bit (0000h to FFFFh)

| command | mode |
|---|---|
| 2 | E |

## • Read out of external scale deviation and sum of pulses

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| E | 2 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 9 | |
| axis | |
| E | 2 |
| (L) | |
| external scale | |
| FB pulse sum | |
| (H) | |
| (L) | |
| external scale deviation | |
| | |
| (H) | |
| error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- External scale FB pulse sum will return the present position of the external scale counter in absolute coordinates from the starting point.
- External scale FB pulse sum will be "-" for negative direction and "+" for positive direction.
- External scale deviation becomes "+" when the external scale is positioned at negative direction against position command, and "–" when it is positioned at positive direction.

| command | mode |
|---|---|
| 7 | 0 |

## • Individual read out of parameter

**Reception data**

| 2 |
|---|
| axis |
| 0 \| 7 |
| parameter type |
| parameter No. |
| checksum |

**Transmission data**

| 5 |
|---|
| axis |
| 0 \| 7 |
| (L) |
| parameter value |
| (H) |
| error code |
| checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | No.Error | | | |

- If the parameter type or the parameter No. is outside the range, returns No. error.
- Parameter value is sign-extended to 32 bits and returned.

| command | mode |
|---|---|
| 7 | 1 |

## • Individual writing of parameter

**Reception data**

| 6 |
|---|
| axis |
| 1 \| 7 |
| parameter type |
| parameter No. |
| (L) |
| parameter value |
| (H) |
| checksum |

**Transmission data**

| 1 |
|---|
| axis |
| 1 \| 7 |
| error code |
| checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | Data Error | Command error | RS485 error | No.Error | | | |

- If the parameter type or the parameter No. is outside the range, returns No. error.
- This command change parameters only temporarily. If you want to write into EEPROM, execute the parameter writing to EEPROM (mode = 2).
- Set up parameters not in use to 0 without fail, or it leads to data error. Data error also occurs when the parameter value exceeds the setup range.
- Parameter value should be sign-extended to 32 bits before being transmitted.

| command | mode |
|---|---|
| 7 | 2 |

## • Writing of parameter to EEPROM

**Reception data**

| 0 |
|---|
| axis |
| 2 \| 7 |
| checksum |

**Transmission data**

| 1 |
|---|
| axis |
| 2 \| 7 |
| error code |
| checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | Data Error | Command error | RS485 error | | | Control LV | |

- Writes the preset parameters to EEPROM.
- Transmission data will be returned after EEPROM writing completes. It may take max. 5sec for EEPROM writing (when all parameters have been changed.)
- Data error will occur when writing fails.
- When under-voltage occurs, error code of control LV will be returned instead of executing writing.

| command | mode |
|---|---|
| 7 | 6 |

## • Individual read out of user parameter

**Reception data**

| | |
|---|---|
| 2 | |
| axis | |
| 6 | 7 |
| parameter type | |
| parameter No. | |
| checksum | |

**Transmission data**

| | |
|---|---|
| 17 (11h) | |
| axis | |
| 6 | 7 |
| parameter type | |
| parameter No. | |
| (L) | |
| parameter value | |
| (H) | |
| (L) | |
| MIN value | |
| (H) | |
| (L) | |
| MAX value | |
| (H) | |
| Property L | |
| H | |
| Error code | |
| checksum | |

**Property**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Parameter not in use | Display inhibited | (for special customer) | Change at initialization | System related | | | Front operation protect |

| bit15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| | | | | | | | Read only |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | No.Error | | | |

- If the parameter type or the parameter No. is outside the range, returns No. error.
- Parameter value, MIN value and MAX value should be sign-extended to 32 bits before being transmitted.

| command | mode |
|---|---|
| 7 | 7 |

## • Read out of two or more user parameter

**Reception data**

| 10h (16) |
|---|
| axis |
| 7 \| 7 |
| (1) parameter type |
| (1) parameter No. |
| (2) parameter type |
| (2) parameter No. |
| ≈ |
| (8) parameter type |
| (8) parameter No. |
| checksum |

**Transmission data**

| 129 (81h) |
|---|
| axis |
| 7 \| 7 |
| (1) parameter type |
| (1) parameter No. |
| (L) |
| (1) parameter value |
| (H) |
| (L) |
| (1) MIN value |
| (H) |
| (L) |
| (1) MAX value |
| (H) |
| (1) Property (L) |
| (H) |
| ≈ |
| (8) parameter type |
| (8) parameter No. |
| ⋮ |
| (8) Property (L) |
| (H) |
| error code |
| checksum |

**Property**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Parameter not in use | Display inhibited | (for special customer) | Change at initialization | System related | | | Front operation protect |

| bit15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| | | | | | | | Read only |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | No.Error | | | |

- If the parameter type or the parameter No. is outside the range, returns No. error.
- Parameter value, MIN value and MAX value should be sign-extended to 32 bits before being transmitted.

| command | mode |
|---|---|
| 7 | 8 |

## • Writing of two or more user parameter

**Reception data**

| 30h(48) |
|---|
| axis |
| 8 \| 7 |
| (1) parameter type |
| (1) parameter No. |
| (L) |
| (1) parameter value |
| |
| (H) |
| ≈ |
| (8) parameter type |
| (8) parameter No. |
| (L) |
| (8) parameter value |
| |
| (H) |
| checksum |

**Transmission data**

| 17(11h) |
|---|
| axis |
| 8 \| 7 |
| (1) parameter type |
| (1) parameter No. |
| (2) parameter type |
| (2) parameter No. |
| ≈ |
| (8) parameter type |
| (8) parameter No. |
| Error code |
| checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | Data Error | Command error | RS485 error | No.Error | | | |

- Set 0 to unused parameter. Otherwise data error occurs. When data outside the specified setting range is sent, data error occurs.
- If the parameter type or the parameter No. is outside the range, returns No. error.

| command | mode |
|---|---|
| 9 | 0 |

## • Read out of present alarm data

**Reception data**

| 0 |
|---|
| axis |
| 0 \| 9 |
| checksum |

**Transmission data**

| 3 |
|---|
| axis |
| 0 \| 9 |
| alarm No. (Main) |
| alarm No. (Sub) |
| error code |
| checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- If no alarm occurs, alarm No. becomes 0.
  (For alarm No., refer to P.6-3, "Protective function (What is alarm code ?)" of When in Trouble.

| command | mode |
|---|---|
| 9 | 2 |

## • Individual read out of user alarm history

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 2 | 9 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 29 (1Dh) | |
| axis | |
| 2 | 9 |
| 1st. latest | alarm No. (Main) |
| | alarm No. (Sub) |
| 2nd. latest | alarm No. (Main) |
| | alarm No. (Sub) |
| ≈ | ≈ |
| 14th. latest | alarm No. (Main) |
| | alarm No. (Sub) |
| | error code |
| | checksum |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | Command error | | | | |

• You can read out last 14 error events.

| command | mode |
|---|---|
| 9 | 3 |

## • Batch read out of alarm history

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 3 | 9 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 1 | |
| axis | |
| 3 | 9 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | Data Error | Command error | RS485 error | | | Control LV | |

• Clears the alarm data history.
• Data error will occur when you fail to clear.
• When under-voltage of control power supply occurs, error code of control LV will be returned instead of executing writing.

| command | mode |
|---|---|
| 9 | 3 |

## • Alarm clear

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| 4 | 9 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 1 | |
| axis | |
| 4 | 9 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

• Clears the present alarm. (only those you can clear)

| command | mode |
|---|---|
| 9 | B |

## • Absolute clear

**Reception data**

| | |
|---|---|
| 0 | |
| axis | |
| B | 9 |
| checksum | |

**Transmission data**

| | |
|---|---|
| 1 | |
| axis | |
| B | 9 |
| Error code | |
| checksum | |

**Error code**

| bit7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 : Normal<br>1 : Error | | Command error | RS485 error | | | | |

- Clears absolute encoder error and multi-turn data
- Command error will be returned when you use other encoder than 17bit absolute encoder.

MEMO

# 5. Motor Characteristics (S-T Characteristics)

## MSME series (50W to 100W)

- Note that the motor characteristics may vary due to the existence of oil seal or brake.
- Continuous torque vs. ambient temperature characteristics have been measured with an aluminum flange attached to the motor (approx. twice as large as the motor flange).

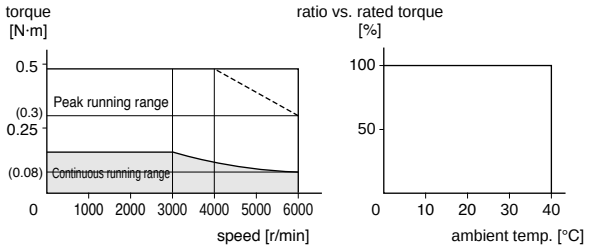
### MSME series (50W to 100W)

#### Without oil seal

**• MSME5AZ * 1 ***

Input voltage to driver: AC100V/200V
(Dotted line represents torque at 10% less voltage.)

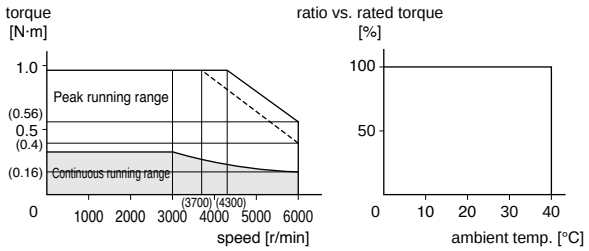
* Continuous torque vs. ambient temp.




**• MSME011 * 1 ***

Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)

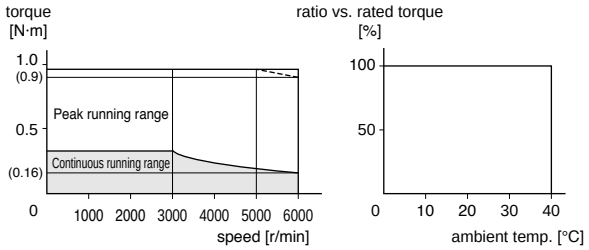
* Continuous torque vs. ambient temp.




**• MSME012 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

* Continuous torque vs. ambient temp.

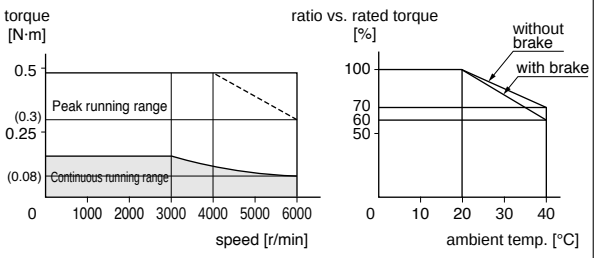



#### With oil seal

**• MSME5AZ * 1 ***

Input voltage to driver: AC100V/200V
(Dotted line represents torque at 10% less voltage.)

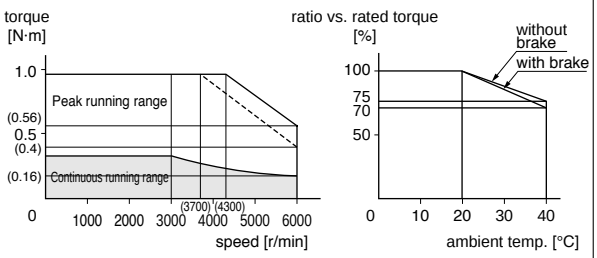
* Continuous torque vs. ambient temp.




**• MSME011 * 1 ***

Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)

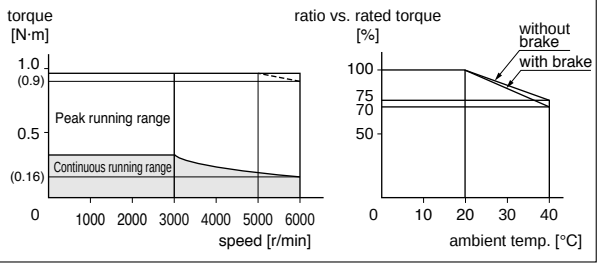
* Continuous torque vs. ambient temp.




**• MSME012 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

* Continuous torque vs. ambient temp.




* These are subject to change. Contact us when you use these values for your machine design.
* Ratio to the rated torque at ambient temperature of 40˚C is 100% in case of without oil seal, without brake.

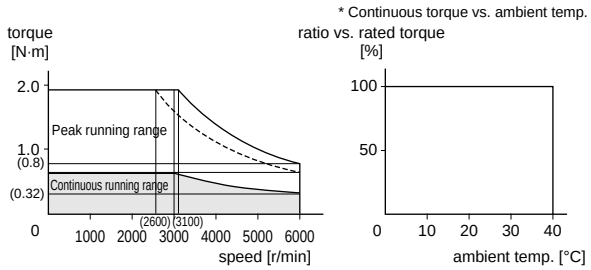
# 5. Motor Characteristics (S-T Characteristics)

## MSME series (200W)

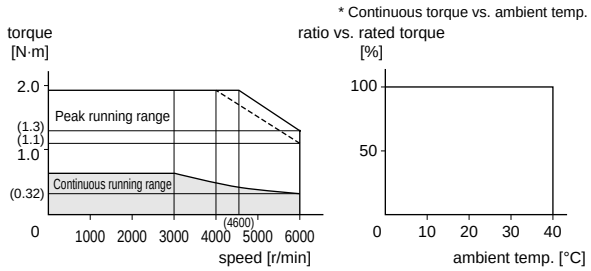
### MSME series (200W to 750W)

#### Without oil seal

• **MSME021 * 1 ***
Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)

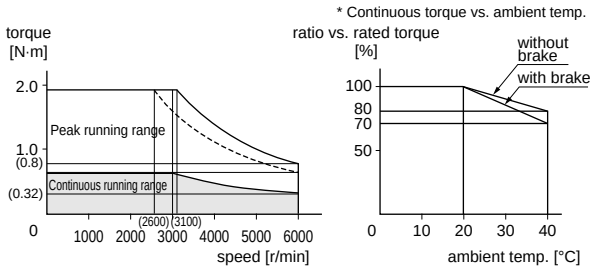



• **MSME022 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

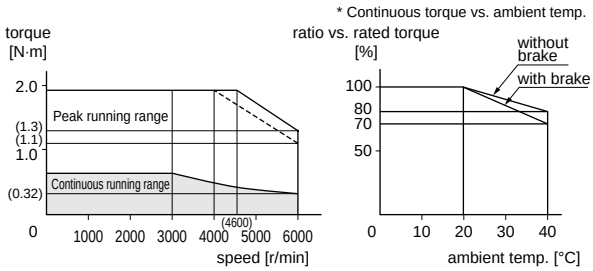



#### With oil seal

• **MSME021 * 1 ***
Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)

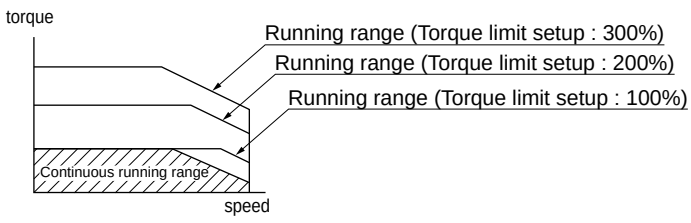



• **MSME022 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




* These are subject to change. Contact us when you use these values for your machine design.

• When you lower the torque limit setup (P0.13 and 5.22), running range at high speed might be lowered as well.



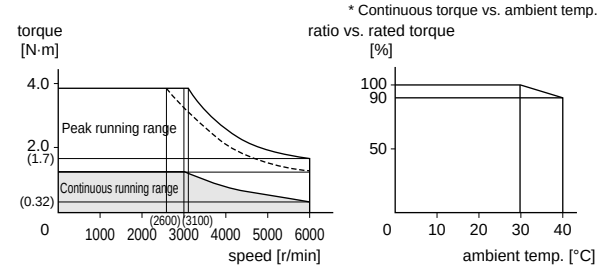
# 5. Motor Characteristics (S-T Characteristics)

## MSME series (400W to 750W)

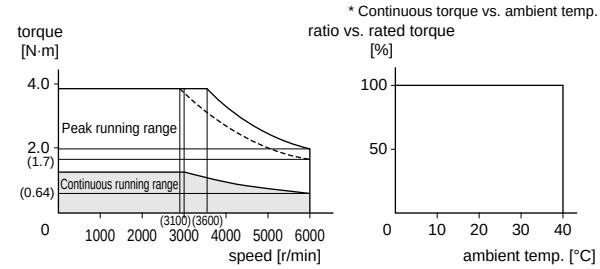
### MSME series (200W to 750W)

#### Without oil seal

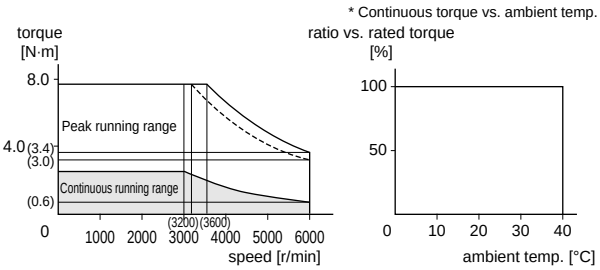
• **MSME041 * 1 ***
Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)




• **MSME042 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

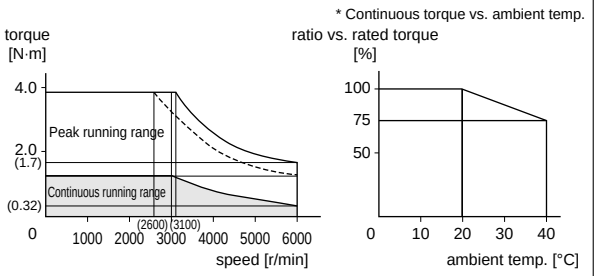



• **MSME082 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

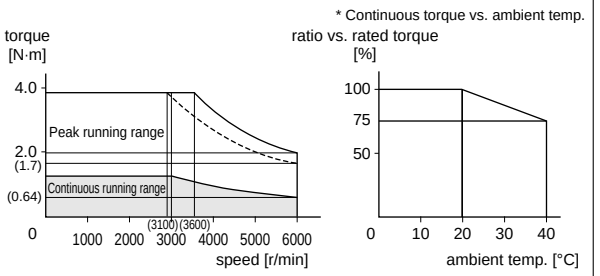



#### With oil seal

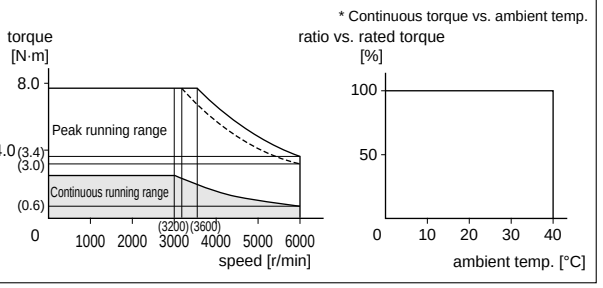
• **MSME041 * 1 ***
Input voltage to driver: AC100V
(Dotted line represents torque at 10% less voltage.)




• **MSME042 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




• **MSME082 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




* These are subject to change. Contact us when you use these values for your machine design.

# 5. Motor Characteristics (S-T Characteristics)

## MSME series (1.0kW to 5.0kW)

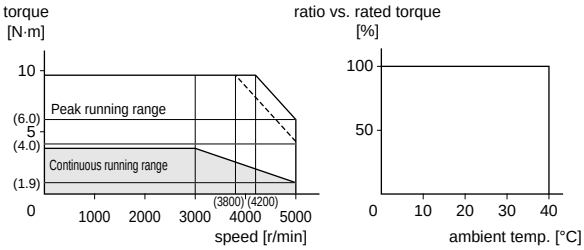
### MSME series (1.0kW to 5.0kW)

**With oil seal**

**• MSME102 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

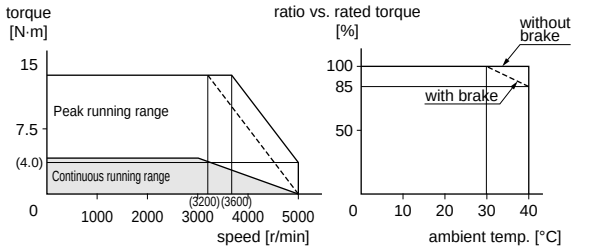
* Continuous torque vs. ambient temp.




**• MSME152 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

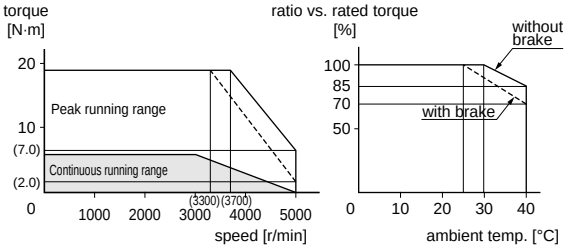
* Continuous torque vs. ambient temp.




**• MSME202 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

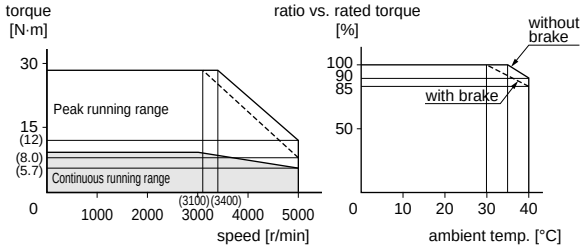
* Continuous torque vs. ambient temp.




**• MSME302 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

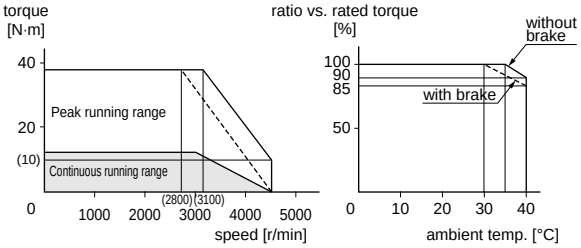
* Continuous torque vs. ambient temp.




**• MSME402 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

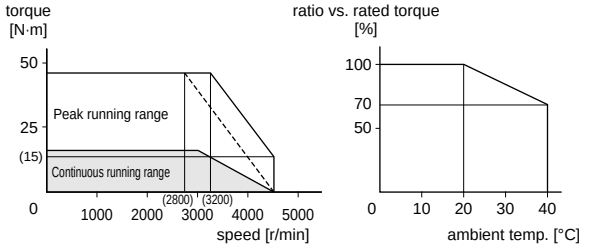
* Continuous torque vs. ambient temp.




**• MSME502 * 1 ***

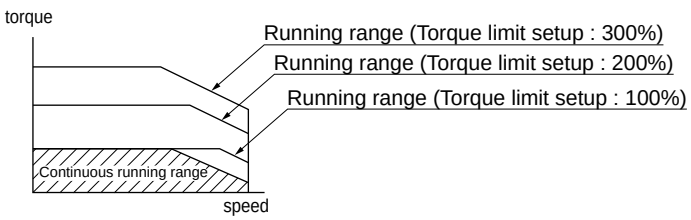
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

* Continuous torque vs. ambient temp.




* These are subject to change. Contact us when you use these values for your machine design.

• When you lower the torque limit setup (P0.13 and 5.22), running range at high speed might be lowered as well.



# 5. Motor Characteristics (S-T Characteristics)

## MDME series (1.0kW to 5.0kW)

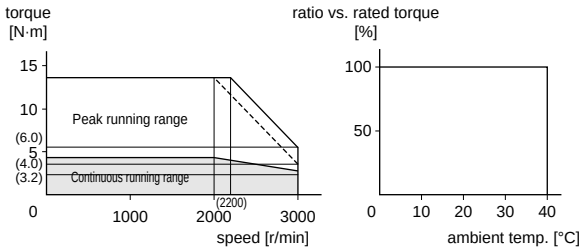
### MDME series (1.0kW to 5.0kW)

#### With oil seal

**• MDME102 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

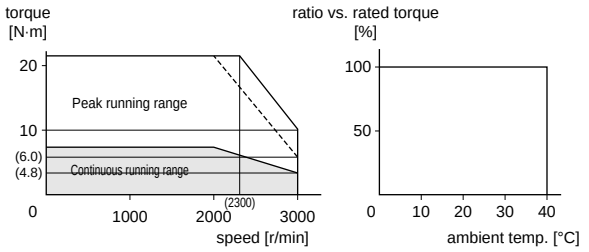
* Continuous torque vs. ambient temp.




**• MDME152 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

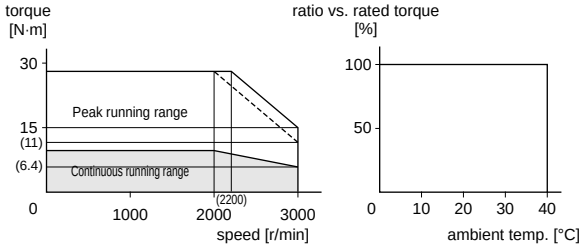
* Continuous torque vs. ambient temp.




**• MDME202 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

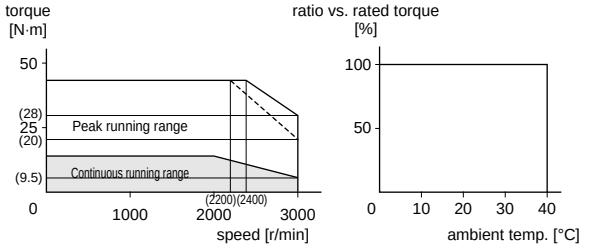
* Continuous torque vs. ambient temp.




**• MDME302 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

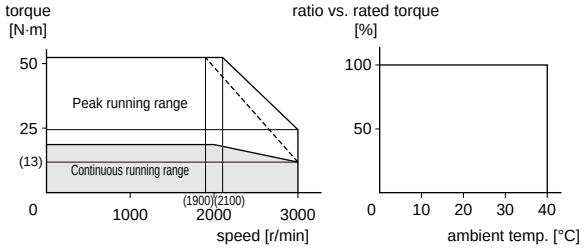
* Continuous torque vs. ambient temp.




**• MDME402 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

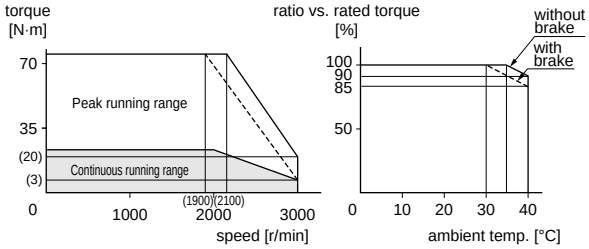
* Continuous torque vs. ambient temp.




**• MDME502 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

* Continuous torque vs. ambient temp.




* These are subject to change. Contact us when you use these values for your machine design.

# 5. Motor Characteristics (S-T Characteristics)

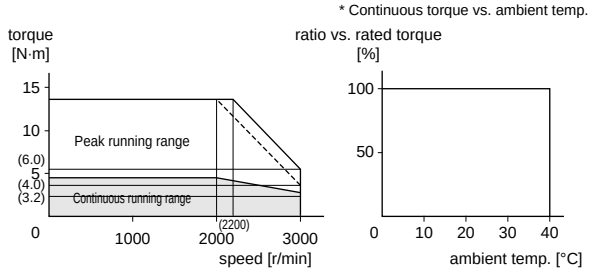
## MHME series (1.0kW to 5.0kW)

### MHME series (1.0kW to 5.0kW)

**With oil seal**

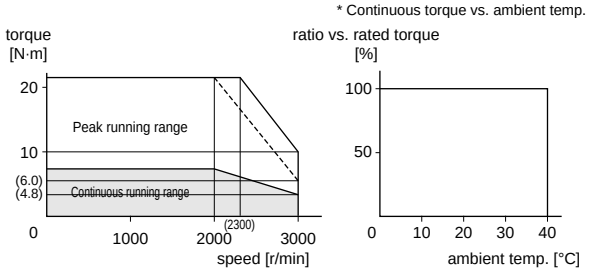
**• MHME102 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)



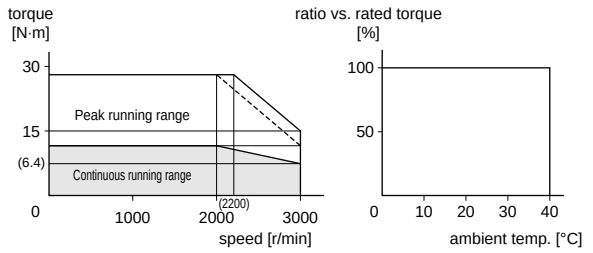

**• MHME152 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)



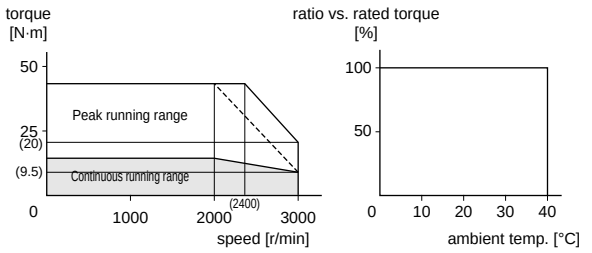

**• MHME202 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)



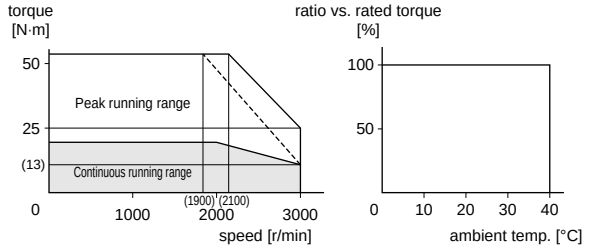

**• MHME302 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)



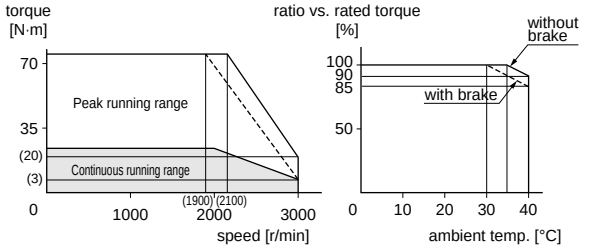

**• MHME402 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)



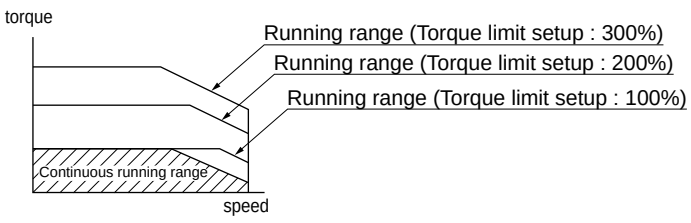

**• MHME502 * 1 ***

Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




* These are subject to change. Contact us when you use these values for your machine design.

• When you lower the torque limit setup (P0.13 and 5.22), running range at high speed might be lowered as well.



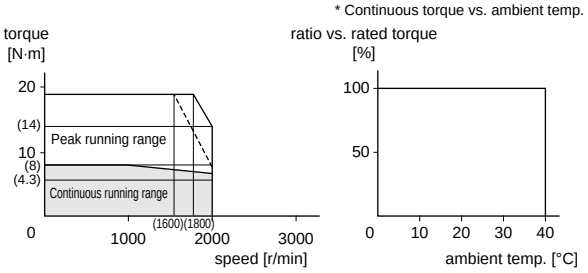
# 5. Motor Characteristics (S-T Characteristics)

## MGME series (0.9kW to 3.0kW)

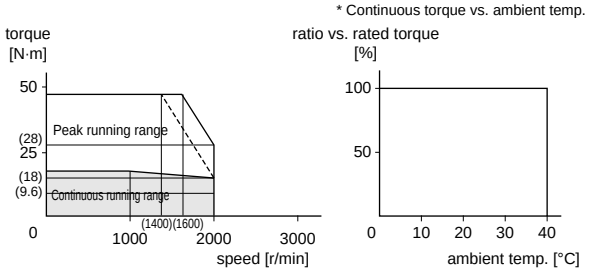
### MGME series (0.9kW to 3.0kW)

**With oil seal**

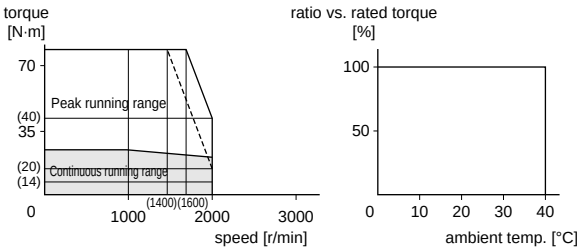
• **MGMA092 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




• **MGMA202 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)

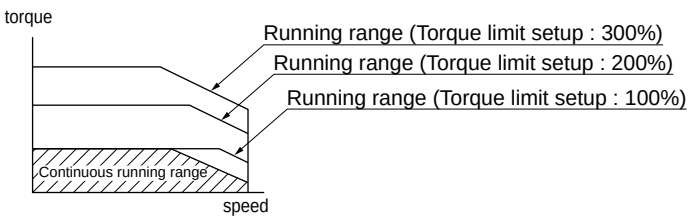



• **MGMA302 * 1 ***
Input voltage to driver: AC200V
(Dotted line represents torque at 10% less voltage.)




* These are subject to change. Contact us when you use these values for your machine design.

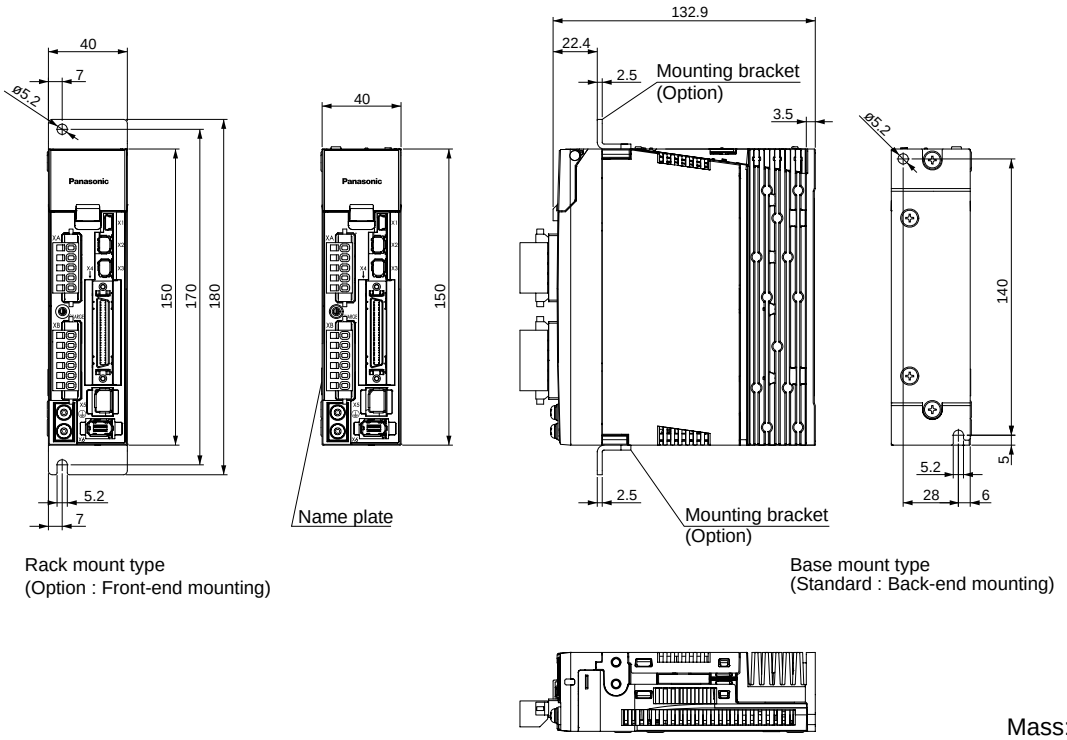
• When you lower the torque limit setup (P0.13 and 5.22), running range at high speed might be lowered as well.



# 6. Dimensions

## Driver

### A-frame

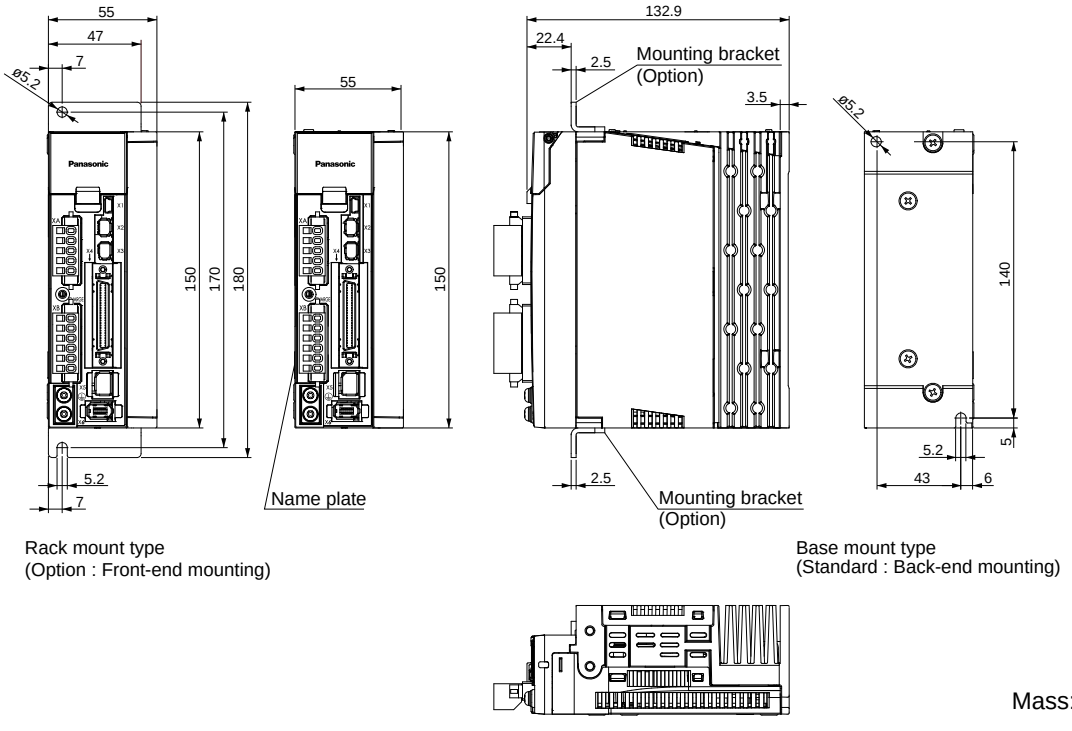



Rack mount type
(Option : Front-end mounting)

Base mount type
(Standard : Back-end mounting)

Mass: 0.8kg

### B-frame



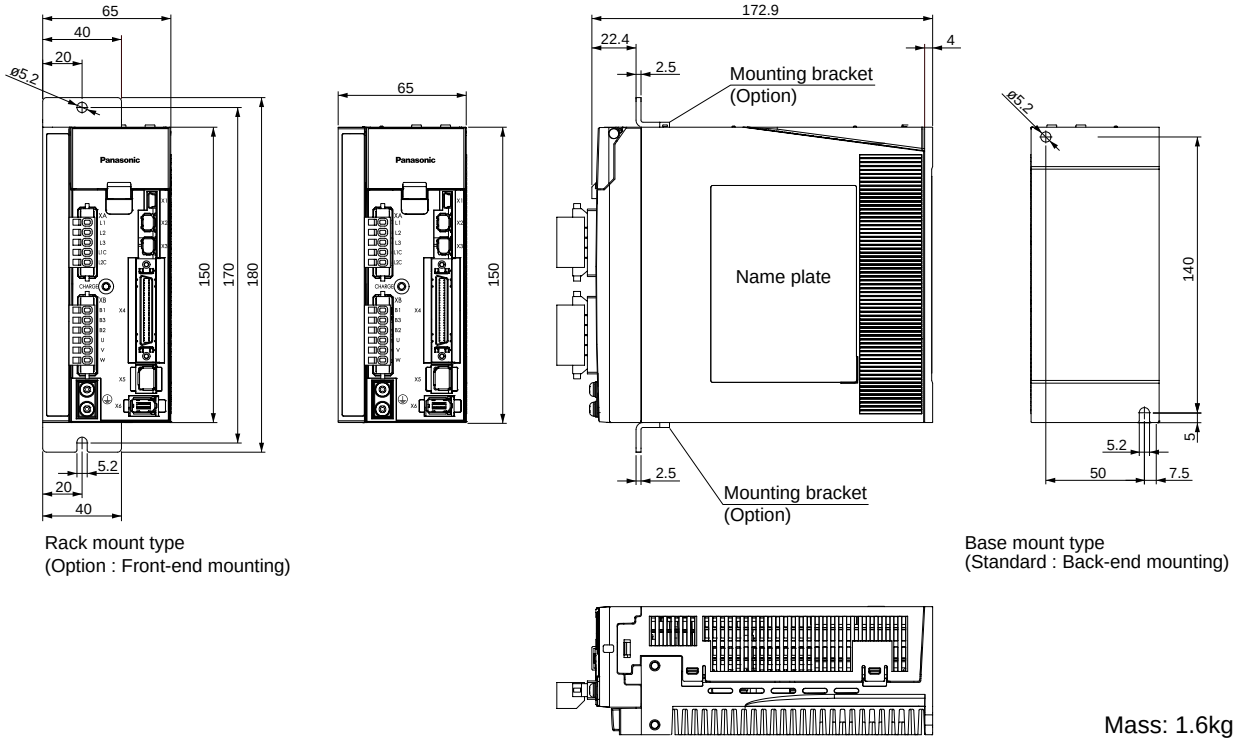

Rack mount type
(Option : Front-end mounting)

Base mount type
(Standard : Back-end mounting)

Mass: 1.0kg

Related page • P.1-3“Driver” • P.1-13 “Driver and List of Applicable Peripheral Equipments”
• P.2-6 “Driver and List of Applicable Peripheral Equipments”

## C-frame

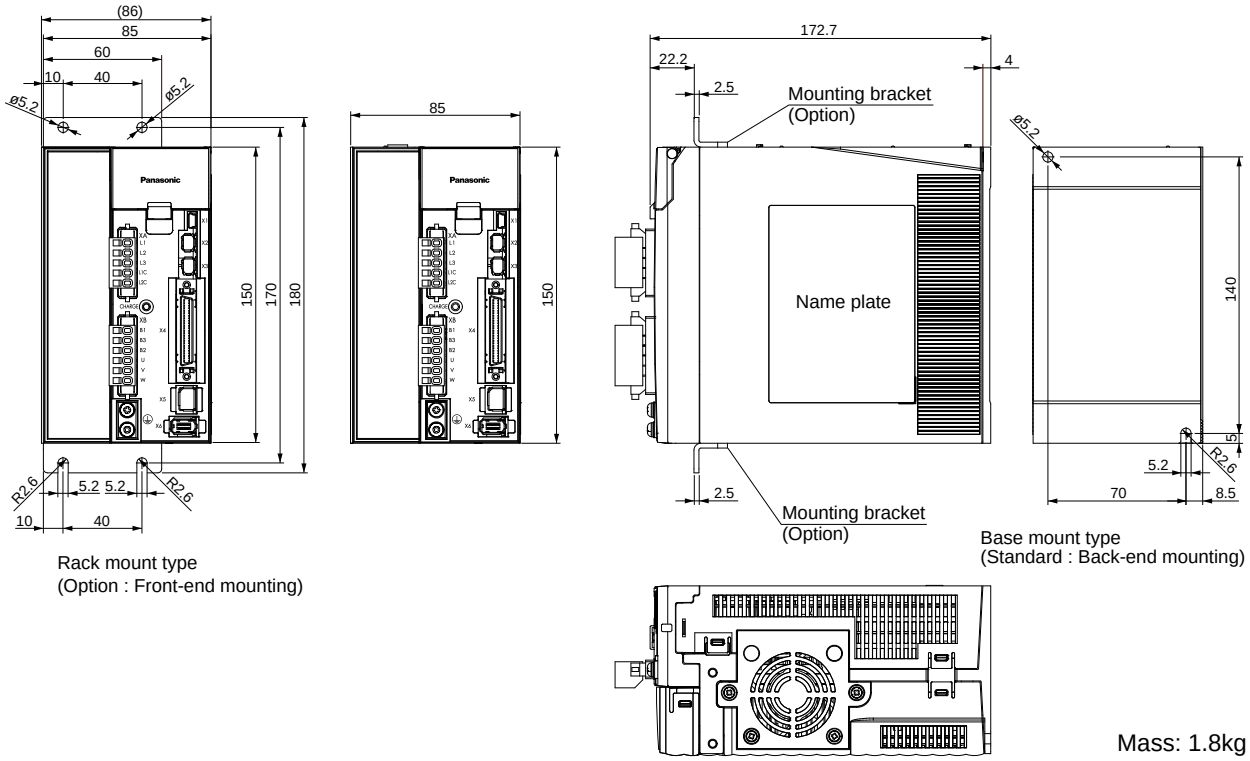



Rack mount type
(Option : Front-end mounting)

Base mount type
(Standard : Back-end mounting)

Mass: 1.6kg

## D-frame



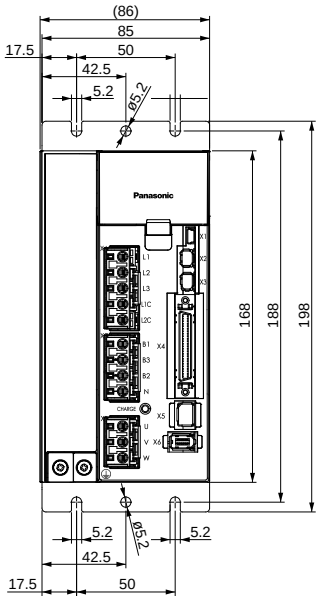

Rack mount type
(Option : Front-end mounting)

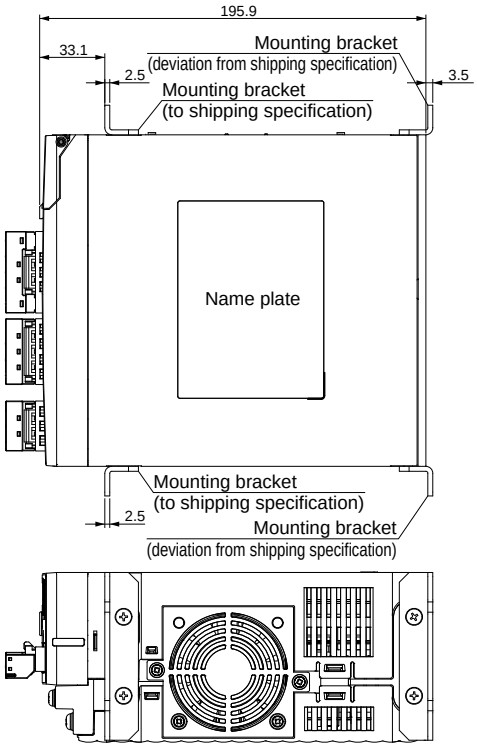
Base mount type
(Standard : Back-end mounting)

Mass: 1.8kg

Related page • P.1-3“Driver” • P.1-13 “Check of the Combination of the Driver and the Motor”
• P.2-6 “Driver and List of Applicable Peripheral Equipments”

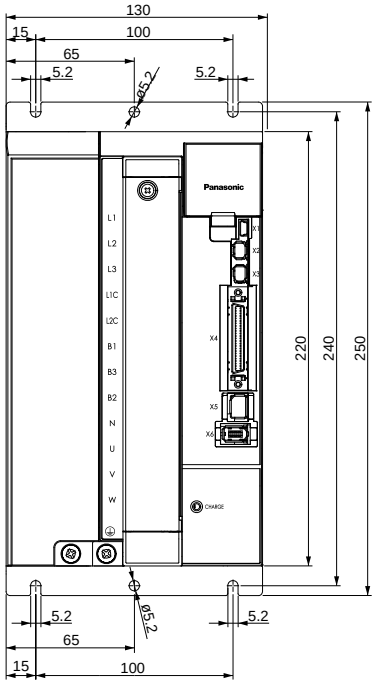
## E-frame

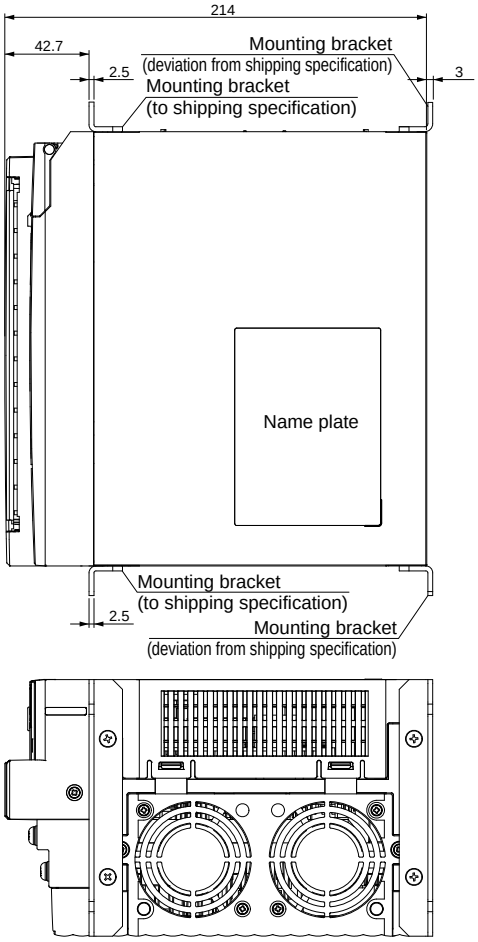



Mass: 2.7kg

## F-frame



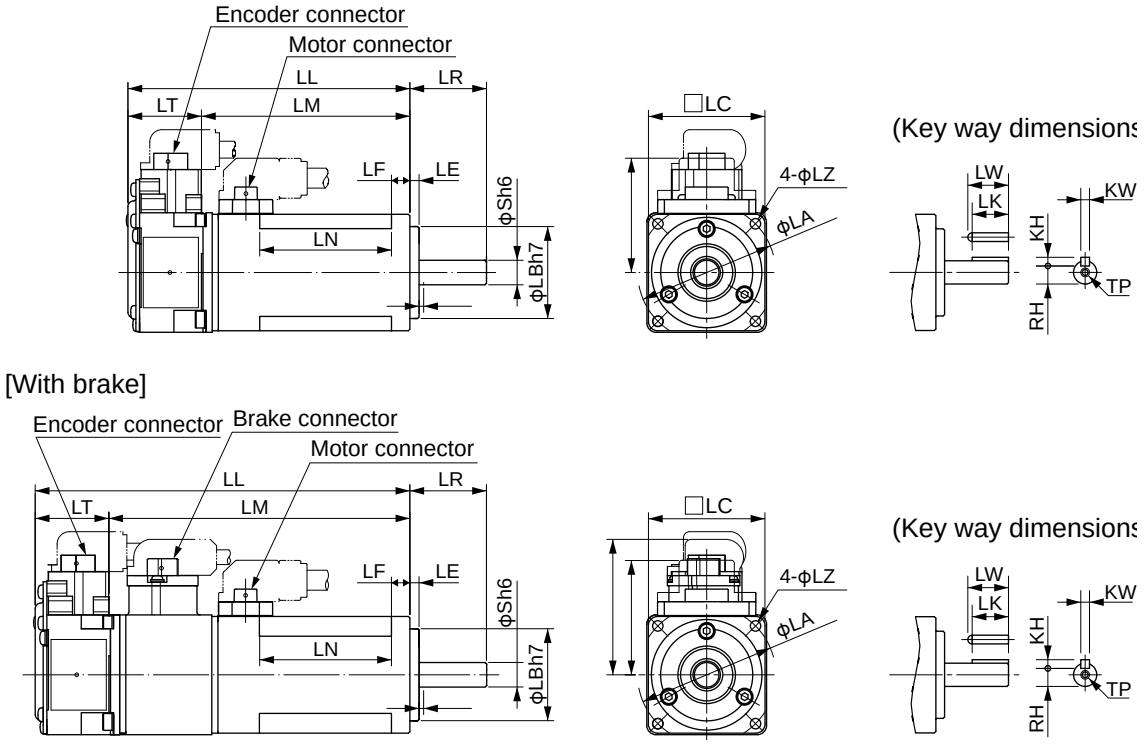




Mass: 4.8kg

# 6. Dimensions

## Motor

### MSME Connector type 50W to 750W




* Dimensions are subject to change without notice. Contact us or a dealer for the latest information.

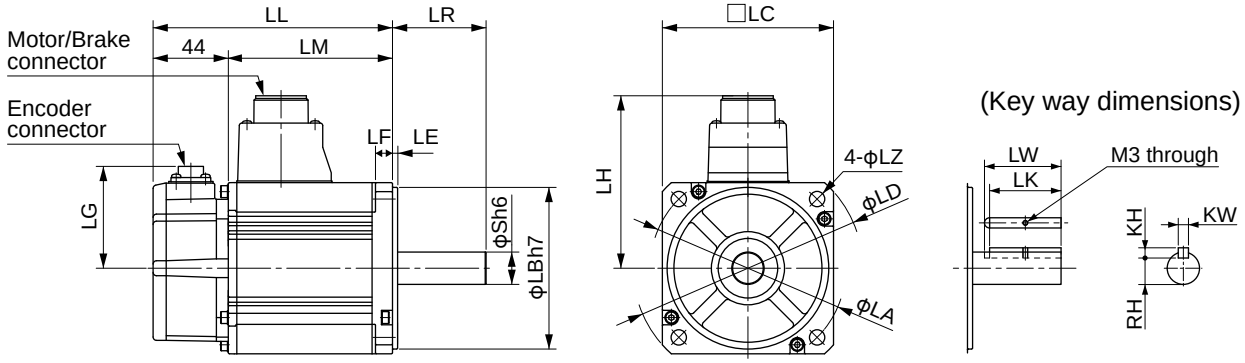
| MSME series (Low inertia) | | | | | | |
|---|---|---|---|---|---|---|
| Motor output | | 50W | 100W | 200W | 400W | 750W |
| Motor model | **MSME** | 5A * * 1 * OP | 01 * * 1 * OP | 02 * * 1 * OP | 04 * * 1 * OP | 08 * * 1 * OP |
| LL | Without brake | 72 | 92 | 79.5 | 99 | 112 |
| | With brake | 102 | 122 | 116 | 135.5 | 148.2 |
| LR | | 25 | | 30 | | 35 |
| S | | 8 | | 11 | 14 | 19 |
| LA | | 45 | | 70 | | 90 |
| LB | | 30 | | 50 | | 70 |
| LC | | 38 | | 60 | | 80 |
| LE | | 3 | | | | |
| LF | | — | | 6.5 | | 8 |
| LH | | 46.6 | | 52.5 | | 61.6 |
| LM | Without brake | 48 | 68 | 56.5 | 76 | 86.2 |
| | With brake | 78 | 98 | 93 | 112.5 | 122.2 |
| LN | | 23 | 43 | — | — | — |
| LT | | 24 | | 23 | | 26 |
| LZ | | 3.4 | | 4.5 | | 6 |
| Key way dimensions | LW | 14 | | 20 | 25 | 25 |
| | LK | 12.5 | | 18 | 22.5 | 22 |
| | KW | 3h9 | | 4h9 | 5h9 | 6h9 |
| | KH | 3 | | 4 | 5 | 6 |
| | RH | 6.2 | | 8.5 | 11 | 15.5 |
| | TP | M3 depth 6 | | M4 depth 8 | M5 depth 10 | |
| Mass (kg) | Without brake | 0.32 | 0.47 | 0.82 | 1.2 | 2.3 |
| | With brake | 0.53 | 0.68 | 1.3 | 1.7 | 3.1 |
| Connector specifications | | Refer to P.2-18 “Specifications of Motor connector” | | | | |

**Caution** Reduce the moment of inertia ratio if high speed response operation is required.

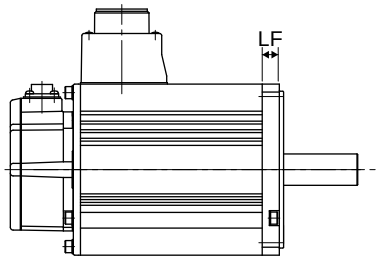
**Related page** • P.1-10 “Check of the Model” • P.1-13 “Check of the Combination of the Driver and the Motor” • P.7-56 “S-T Characteristics”

## MSME 1.0kW to 5.0kW

<MSME 1.0kW to 2.0kW>




<MSME 3.0kW to 5.0kW> * All sizes are identical to those of MSME 1.0 to 2.0 kW versions except for LF.



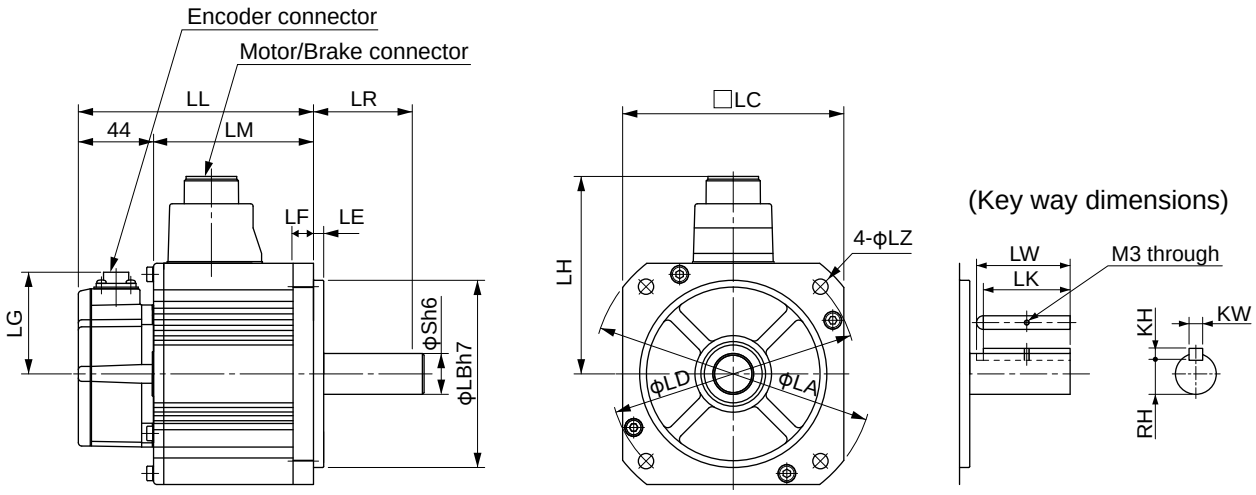

* Dimensions are subject to change without notice. Contact us or a dealer for the latest information.

| MSME series (Low inertia) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Motor output | | | 1.0kW | 1.5kW | 2.0kW | 3.0kW | 4.0kW | 5.0kW |
| Motor model | | **MSME** | 10 * * 1 * | 15 * * 1 * | 20 * * 1 * | 30 * * 1 * | 40 * * 1 * | 50 * * 1 * |
| LL | | Without brake | 141 | 159.5 | 178.5 | 190 | 208 | 243 |
| | | With brake | 168 | 186.5 | 205.5 | 215 | 233 | 268 |
| LR | | | 55 | | | | 65 | |
| S | | | 19 | | | 22 | 24 | |
| LA | | | 115 | | | 145 | | |
| LB | | | 95 | | | 110 | | |
| LC | | | 100 | | | 120 | 130 | |
| LD | | | 135 | | | 162 | 165 | |
| LE | | | 3 | | | | 6 | |
| LF | | | 10 | | | 12 | | |
| LG | | | 60 | | | | | |
| LH | | | 101 | | | 113 | 118 | |
| LM | | Without brake | 97 | 115.5 | 134.5 | 146 | 164 | 199 |
| | | With brake | 124 | 142.5 | 161.5 | 171 | 189 | 224 |
| LZ | | | 9 | | | | | |
| Key way dimensions | LW | | 45 | | | | 55 | |
| | LK | | 42 | | | 41 | 51 | |
| | KW | | 6h9 | | | 8h9 | | |
| | KH | | 6 | | | 7 | | |
| | RH | | 15.5 | | | 18 | 20 | |
| Mass (kg) | | Without brake | 3.5 | 4.4 | 5.3 | 8.3 | 11.0 | 14.0 |
| | | With brake | 4.5 | 5.4 | 6.3 | 9.4 | 12.6 | 16.0 |
| Connector specifications | | | Refer to P.2-18 “Specifications of Motor connector” | | | | | |

**Caution** Reduce the moment of inertia ratio if high speed response operation is required.

Related page • P.1-10 “Check of the Model” • P.1-13 “Check of the Combination of the Driver and the Motor” • P.7-56 “S-T Characteristics”

## MDME 1.0kW to 5.0kW



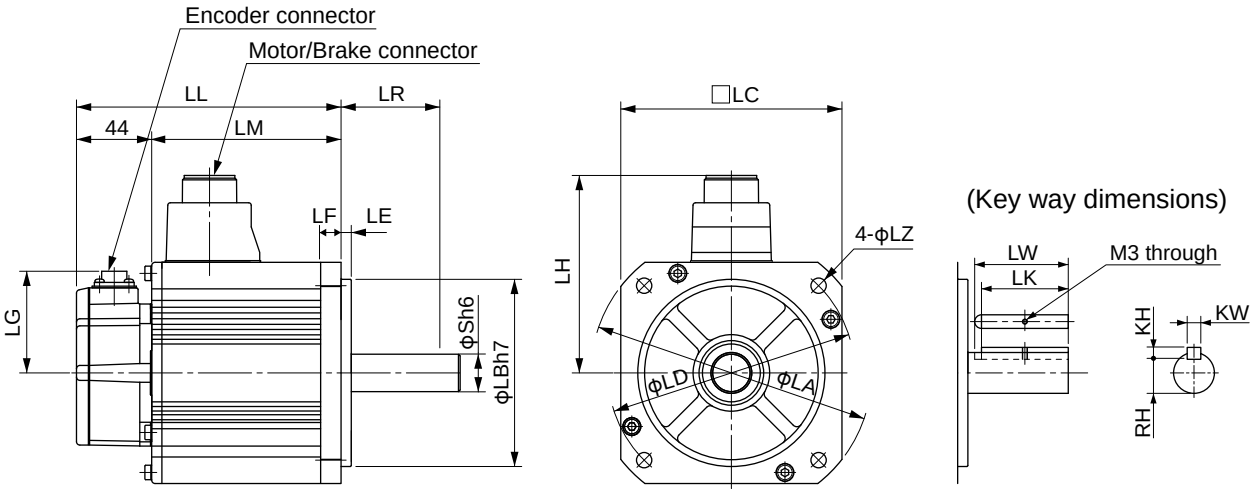

* Dimensions are subject to change without notice. Contact us or a dealer for the latest information.

| MDME series (Middle inertia) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Motor output | | 1.0kW | 1.5kW | 2.0kW | 3.0kW | 4.0kW | 5.0kW |
| Motor model | **MDME** | 10 * * 1 * | 15 * * 1 * | 20 * * 1 * | 30 * * 1 * | 40 * * 1 * | 50 * * 1 * |
| LL | Without brake | 138 | 155.5 | 173 | 208 | 177 | 196 |
| | With brake | 163 | 180.5 | 198 | 233 | 202 | 221 |
| LR | | 55 | | | 65 | 70 | |
| S | | 22 | | | | 35 | |
| LA | | 145 | | | | 200 | |
| LB | | 110 | | | | 114.3 | |
| LC | | 130 | | | | 176 | |
| LD | | 165 | | | | 233 | |
| LE | | 6 | | | | 3.2 | |
| LF | | 12 | | | | 18 | |
| LG | | 60 | | | | | |
| LH | | 116 | | | 118 | 140 | |
| LM | Without brake | 94 | 111.5 | 129 | 164 | 133 | 152 |
| | With brake | 119 | 136.5 | 154 | 189 | 158 | 177 |
| LZ | | 9 | | | | 13.5 | |
| Key way dimensions | LW | 45 | | | 55 | | |
| | LK | 41 | | | 51 | 50 | |
| | KW | 8h9 | | | | 10h9 | |
| | KH | 7 | | | | 8 | |
| | RH | 18 | | | 20 | 30 | |
| Mass (kg) | Without brake | 5.2 | 6.7 | 8.0 | 11.0 | 15.5 | 18.6 |
| | With brake | 6.7 | 8.2 | 9.5 | 12.6 | 18.7 | 21.8 |
| Connector specifications | | Refer to P.2-18 “Specifications of Motor connector” | | | | | |

**Caution** Reduce the moment of inertia ratio if high speed response operation is required.

Related page • P.1-10 “Check of the Model” • P.1-13 “Check of the Combination of the Driver and the Motor” • P.7-56 “S-T Characteristics”

## MGME 900W to 3.0kW



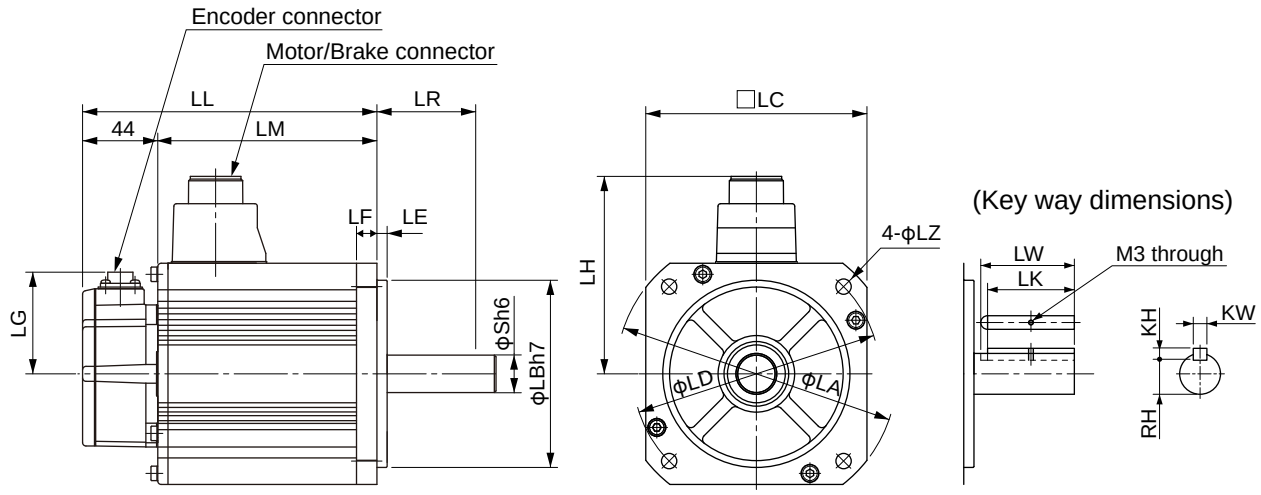

* Dimensions are subject to change without notice. Contact us or a dealer for the latest information.

| MGME series (Middle inertia) | | | | |
|---|---|---|---|---|
| Motor output | | 900W | 2.0kW | 3.0kW |
| Motor model | **MGME** | 09 * * 1 * | 20 * * 1 * | 30 * * 1 * |
| LL | Without brake | 155.5 | 163.5 | 209.5 |
| | With brake | 180.5 | 188.5 | 234.5 |
| LR | | 70 | 80 | |
| S | | 22 | 35 | |
| LA | | 145 | 200 | |
| LB | | 110 | 114.3 | |
| LC | | 130 | 176 | |
| LD | | 165 | 233 | |
| LE | | 6 | 3.2 | |
| LF | | 12 | 18 | |
| LG | | 60 | | |
| LH | | 116 | 140 | |
| LM | Without brake | 111.5 | 119.5 | 165.5 |
| | With brake | 136.5 | 144.5 | 190.5 |
| LZ | | 9 | 13.5 | |
| Key way dimensions | LW | 45 | 55 | |
| | LK | 41 | 50 | |
| | KW | 8h9 | 10h9 | |
| | KH | 7 | 8 | |
| | RH | 18 | 30 | |
| Mass (kg) | Without brake | 6.7 | 14.0 | 20.0 |
| | With brake | 8.2 | 17.5 | 23.5 |
| Connector specifications | | Refer to P.2-18 “Specifications of Motor connector” | | |

**Caution** Reduce the moment of inertia ratio if high speed response operation is required.

Related page • P.1-10 “Check of the Model” • P.1-13 “Check of the Combination of the Driver and the Motor” • P.7-56 “S-T Characteristics”

## MHME 1.0kW to 5.0W




* Dimensions are subject to change without notice. Contact us or a dealer for the latest information.

| MHME series (High inertia) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Motor output | | 1.0kW | 1.5kW | 2.0kW | 3.0kW | 4.0kW | 5.0kW |
| Motor model | **MHME** | 10 * * 1 * | 15 * * 1 * | 20 * * 1 * | 30 * * 1 * | 40 * * 1 * | 50 * * 1 * |
| LL | Without brake | 173 | 190.5 | 177 | 196 | 209.5 | 238.5 |
| | With brake | 198 | 215.5 | 202 | 221 | 234.5 | 263.5 |
| LR | | 70 | | 80 | | | |
| S | | 22 | | 35 | | | |
| LA | | 145 | | 200 | | | |
| LB | | 110 | | 114.3 | | | |
| LC | | 130 | | 176 | | | |
| LD | | 165 | | 233 | | | |
| LE | | 6 | | 3.2 | | | |
| LF | | 12 | | 18 | | | |
| LG | | 60 | | | | | |
| LH | | 116 | | 140 | | | |
| LM | Without brake | 129 | 146.5 | 133 | 152 | 165.5 | 194.5 |
| | With brake | 154 | 171.5 | 158 | 177 | 190.5 | 219.5 |
| LZ | | 9 | | 13.5 | | | |
| Key way dimensions | LW | 45 | | 55 | | | |
| | LK | 41 | | 50 | | | |
| | KW | 8h9 | | 10h9 | | | |
| | KH | 7 | | 8 | | | |
| | RH | 18 | | 30 | | | |
| Mass (kg) | Without brake | 6.7 | 8.6 | 12.2 | 16.0 | 18.6 | 23.0 |
| | With brake | 8.1 | 10.1 | 15.5 | 19.2 | 21.8 | 26.2 |
| Connector specifications | | Refer to P.2-18 “Specifications of Motor connector” | | | | | |

**Caution** Reduce the moment of inertia ratio if high speed response operation is required.

Related page • P.1-10 “Check of the Model” • P.1-13 “Check of the Combination of the Driver and the Motor” • P.7-56 “S-T Characteristics”

MEMO

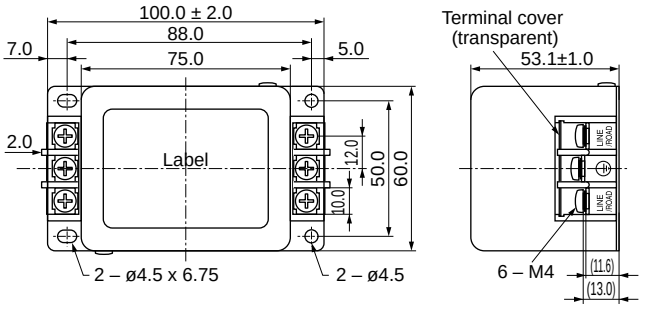
# 7. Options

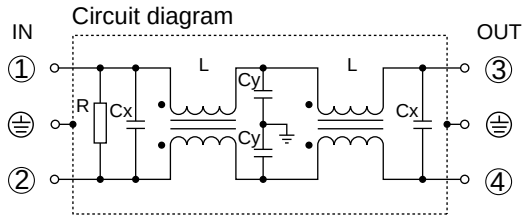
## Noise Filter

When you install one noise filter at the power supply for multi-axes application, contact to a manufacture of the noise filter. If noise margin is required, connect 2 filters in series to emphasize effectiveness.

**• Options**

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Applicable driver (frame) | Manufacturer |
|---|---|---|---|---|
| DV0P4170 | Single phase 100V, 200V | SUP-EK5-ER-6 | A and B-frame | Okaya Electric Ind. |

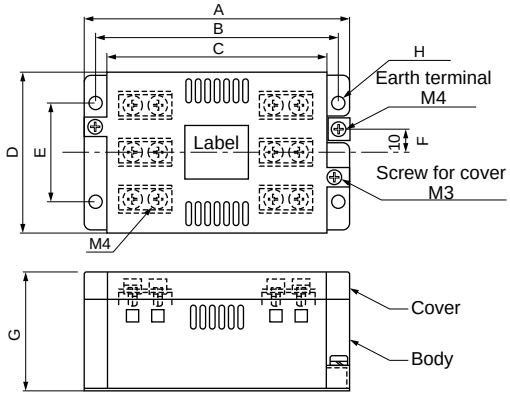


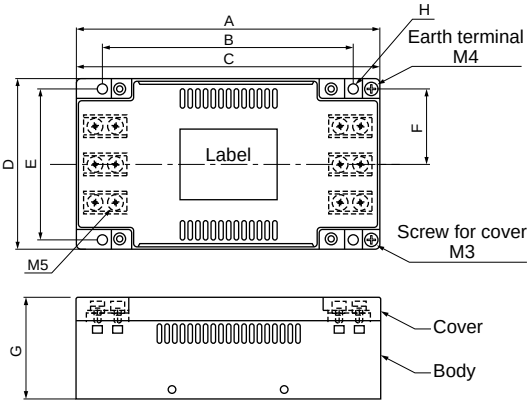

[Unit: mm]

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Applicable driver (frame) | Manufacturer |
|---|---|---|---|---|
| DV0PM20042 | 3-phase 200V | 3SUP-HU10-ER-6 | A and B-frame | Okaya Electric Ind. |
| | Single phase 100V, 200V 3-phase 200V | | C-frame | |
| DV0P4220 | Single/3-phase 200V | 3SUP-HU30-ER-6 | D-frame | |
| DV0PM20043 | 3-phase 200V | 3SUP-HU50-ER-6 | E-frame | |

[DV0PM20042, DV0P4220]



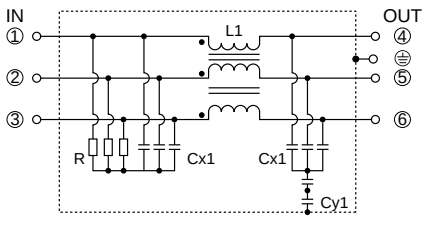

[DV0PM20043]




[Size] [Unit: mm]

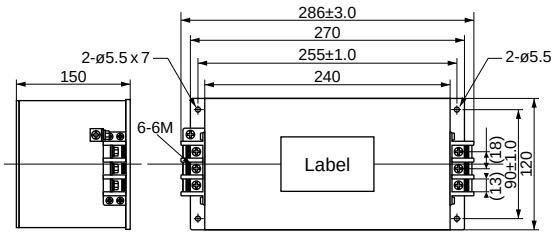
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| DV0PM20042 | 115 | 105 | 95 | 70 | 43 | 10 | 52 | 5.5 |
| DV0P4220 | 145 | 135 | 125 | 70 | 50 | 10 | 52 | 5.5 |
| DV0PM20043 | 165 | 136 | 165 | 90 | 80 | 40 | 54 | 5.5 |

Circuit diagram



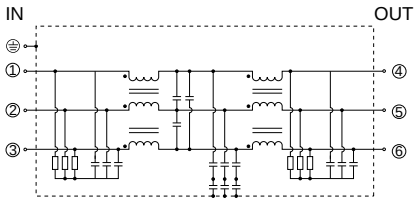

Related page • P.2-2 “Conformance to international standards”
• P.2-6 “Driver and List of Applicable Peripheral Equipments”

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Applicable driver (frame) | Manufacturer |
|---|---|---|---|---|
| DV0P3410 | 3-phase 200V | 3SUP-HL50-ER-6B | F-frame | Okaya Electric Ind. |




[Unit: mm]

Circuit diagram




• **Recommended components**

| part No. | Voltage specifications for driver | Current rating (A) | Manufacturer |
|---|---|---|---|
| RTHN-5010 | 3-phase 200V | 10 | TDK-Lambda Corp. |
| RTHN-5020 | | 20 | |
| RTHN-5030 | | 30 | |
| RTHN-5040 | | 40 | |
| RTHN-5050 | | 50 | |

**Remarks**

- Select a noise filter of capacity that exceeds the capacity of the power source (also check for load condition).
- For detailed specification of the filter, contact the manufacturer.

**Caution**

**Use options correctly after reading operation manuals of the options to better understand the precautions.**
**Take care not to apply excessive stress to each optional part.**

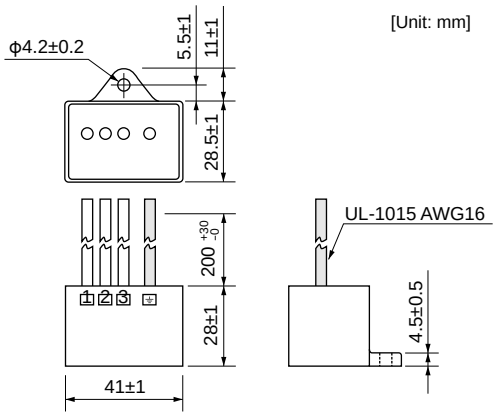
# 7. Options

## Surge Absorber

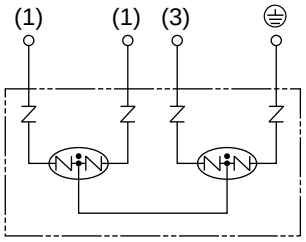
Provide a surge absorber for the primary side of noise filter.

| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Manufacturer |
|---|---|---|---|
| DV0P1450 | 3-phase 200V | RAV-781BXZ-4 | Okaya Electric Ind. |

[Unit: mm]

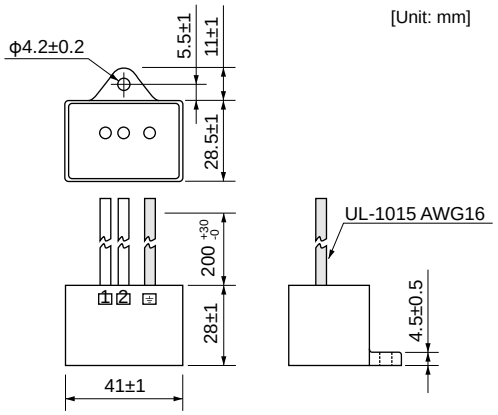



Circuit diagram

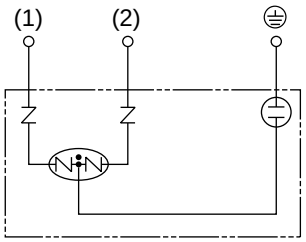



| Option part No. | Voltage specifications for driver | Manufacturer's part No. | Manufacturer |
|---|---|---|---|
| DV0P4190 | Single phase 100V, 200V | RAV-781BWZ-4 | Okaya Electric Ind. |

[Unit: mm]




Circuit diagram




**Remarks** Take off the surge absorber when you execute a dielectric test to the machine or equipment, or it may damage the surge absorber.

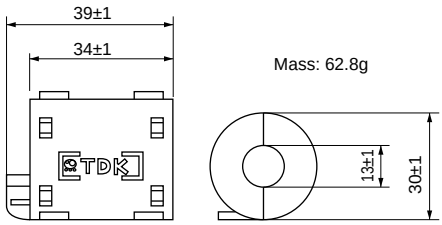
**Related page**
- P.2-2 “Conformance to international standards”
- P.2-6 “Driver and List of Applicable Peripheral Equipments”

# 7. Options

## Noise Filter for Signal Lines

Install noise filters for signal lines to all cables (power cable, motor cable, encoder cable and interface cable)

| Option part No. | Manufacturer's part No. | Manufacturer |
|---|---|---|
| DV0P1460 | ZCAT3035-1330 | TDK Corp. |



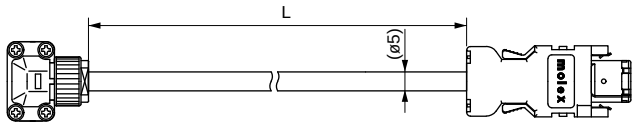

[Unit: mm]

**Remarks** Fix the signal line noise filter in place to eliminate excessive stress to the cables.

# 7. Options

## Junction Cable for Encoder

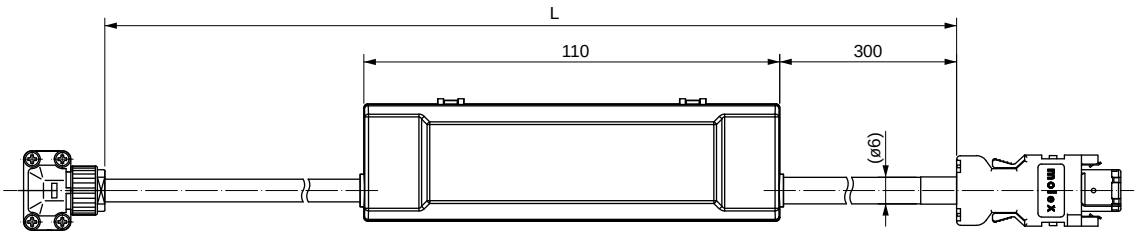
| Part No. | MFECA0 * * 0MJD | Compatible motor output | 50W to 750W |
|---|---|---|---|
| Specifications | For 20-bit incremental encoder (Without battery box) | | |




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | 55100-0670 | Molex Inc |
| Connector | JN6FR07SM1 | Japan Aviation Electronics Ind. |
| Connector pin | LY10-C1-A1-10000 | |
| Cable | AWG24×4P, AWG22×2P | Hitachi Cable, Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFECA0030MJD |
| 5 | MFECA0050MJD |
| 10 | MFECA0100MJD |
| 20 | MFECA0200MJD |

| Part No. | MFECA0 * * 0MJE | Compatible motor output | 50W to 750W |
|---|---|---|---|
| Specifications | For 17-bit absolute encoder (With battery box) | | |

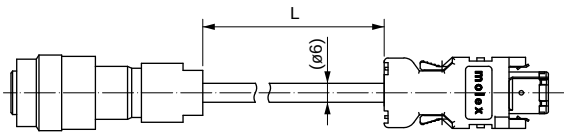



| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | 55100-0670 | Molex Inc |
| Connector | SMM-003T-P0.5 | J.S.T Mfg. Co., Ltd. |
| Connector pin | ZMR-02 | |
| Connector | JN6FR07SM1 | Japan Aviation Electronics Ind. |
| Connector pin | LY10-C1-A1-10000 | |
| Cable | AWG24 ×4P, AWG22×2P | Hitachi Cable, Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFECA0030MJE |
| 5 | MFECA0050MJE |
| 10 | MFECA0100MJE |
| 20 | MFECA0200MJE |

Related page
• P.1-15 “Check of the Combination of the Driver and the Motor”
• P.2-18 “Specifications of Motor connector”

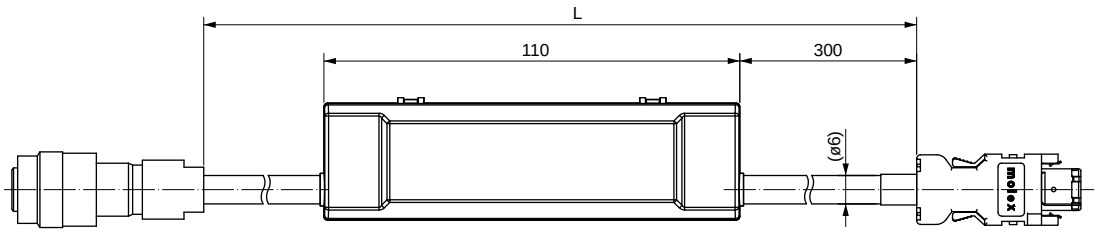
| Part No. | MFECA0 * * 0ETD | Compatible motor output | 0.9kW to 5.0kW |
|---|---|---|---|
| Specifications | For 20-bit incremental encoder (Without battery box) | | |




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | 55100-0670 | Molex Inc |
| Connector | JN2DS10SL1-R | Japan Aviation Electronics Ind. |
| Connector pin | JN1-22-22S-PKG100 | |
| Cable | 0.2mm²×3P | Oki Electric Cable Co., Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFECA0030ETD |
| 5 | MFECA0050ETD |
| 10 | MFECA0100ETD |
| 20 | MFECA0200ETD |

| Part No. | MFECA0 * * 0ETE | Compatible motor output | 0.9kW to 5.0kW |
|---|---|---|---|
| Specifications | For 17-bit absolute encoder (With battery box) | | |




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | 55100-0670 | Molex Inc |
| Connector | ZMR-02 | J.S.T Mfg. Co., Ltd. |
| Connector pin | SMM-003T-P0.5 | |
| Connector | JN2DS10SL1-R | Japan Aviation Electronics Ind. |
| Connector pin | JN1-22-22S-PKG100 | |
| Cable | 0.2mm² ×3P | Oki Electric Cable Co., Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFECA0030ETE |
| 5 | MFECA0050ETE |
| 10 | MFECA0100ETE |
| 20 | MFECA0200ETE |

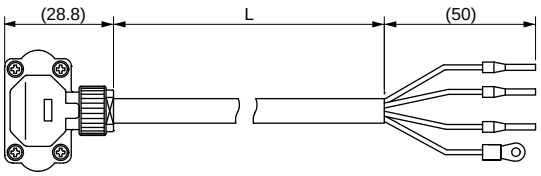
# 7. Options

## Junction Cable for Motor (Without brake)

### ROBO-TOP® 105°C 600V • DP

ROBO-TOP® is a trade mark of Daiden Co.,Ltd.

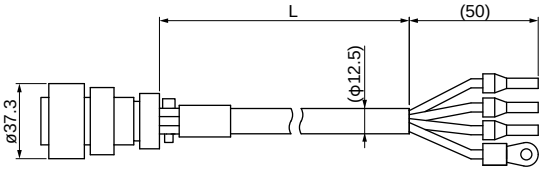
| Part No. | MFMCA0 * * 0NJD | Applicable model | MSME 50W to 750W |
|---|---|---|---|




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | JN8FT04SJ1 | Japan Aviation Electronics Ind. |
| Connector pin | ST-TMH-S-C1B-3500 | |
| Rod terminal | AI0.75-8GY | Phoenix Contact |
| Nylon insulated round terminal | N1.25-M4 | J.S.T Mfg. Co., Ltd. |
| Cable | AWG18×4P | Hitachi Cable, Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCA0030NJD |
| 5 | MFMCA0050NJD |
| 10 | MFMCA0100NJD |
| 20 | MFMCA0200NJD |

| Part No. | MFMCD0 * * 2ECD | Applicable model | MSME 1.0kW to 2.0kW, MDME 1.0kW to 2.0kW<br>MHME 1.0kW to 1.5kW, MGME 900W |
|---|---|---|---|

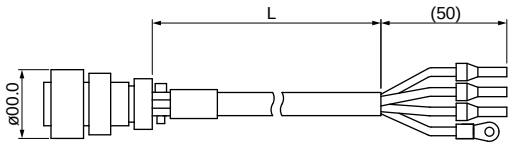



| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | JL04V-6A20-4SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | JL04-2022CK(14)-R | |
| Rod terminal | AI2.5-8BU | Phoenix Contact |
| Nylon insulated round terminal | N2-M4 | J.S.T Mfg. Co., Ltd. |
| Cable | ROBO-TOP 600V 2.0mm$^2$ | Daiden Co.,Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCD0032ECD |
| 5 | MFMCD0052ECD |
| 10 | MFMCD0102ECD |
| 20 | MFMCD0202ECD |

Related page
• P.1-15 “Check of the Combination of the Driver and the Motor”
• P.2-18 “Specifications of Motor connector”

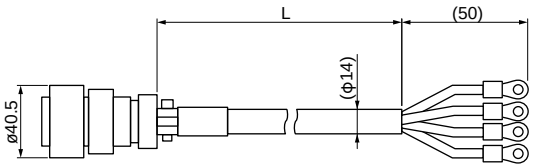
| Part No. | MFMCE0 * * 2ECD | Applicable model | MHME 2.0kW |
|---|---|---|---|




| Title | Part No. | Manufacturer |
|---|---|---|
| Straight plug | JL04V-6A22-22SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | JL04-2022CK(14)-R | |
| Rod terminal | AI2.5-8BU | Phoenix Contact |
| Nylon insulated round terminal | N2-M4 | J.S.T Mfg. Co., Ltd. |
| Cable | ROBO-TOP 600V 2.0mm$^2$ | Daiden Co.,Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCE0032ECD |
| 5 | MFMCE0052ECD |
| 10 | MFMCE0102ECD |
| 20 | MFMCE0202ECD |

| Part No. | MFMCA0 * * 3ECT | Applicable model | MSME 3.0kW to 5.0kW, MDME 3.0kW to 5.0kW<br>MHME 3.0kW to 5.0kW, MGME 2.0kW to 3.0kW |
|---|---|---|---|




| Title | Part No. | Manufacturer |
|---|---|---|
| Straight plug | JL04V-6A22-22SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | JL04-2022CK(14)-R | |
| Nylon insulated round terminal | N5.5-5 | J.S.T Mfg. Co., Ltd. |
| Cable | ROBO-TOP 600V 3.5mm$^2$ | Daiden Co.,Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCA0033ECT |
| 5 | MFMCA0053ECT |
| 10 | MFMCA0103ECT |
| 20 | MFMCA0203ECT |

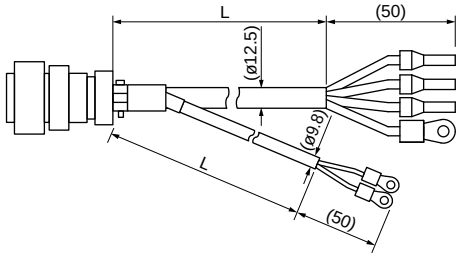
# 7. Options

## Junction Cable for Motor (With brake)

### ROBO-TOP® 105°C 600V • DP

ROBO-TOP® is a trade mark of Daiden Co.,Ltd.

| Part No. | MFMCA0 * * 2FCD | Applicable model | MSME 1.0kW to 2.0kW, MDME 1.0kW to 2.0kW<br>MHME 1.0kW to 1.5kW, MGME 900W |
|---|---|---|---|

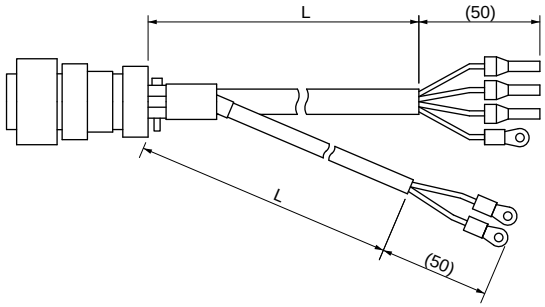



| Title | | Part No. | Manufacturer |
|---|---|---|---|
| Straight plug | | JL04V-6A20-18SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | | JL04-2022CK(14)-R | |
| Rod terminal | | AI2.5-8BU | Phoenix Contact |
| Nylon insulated round terminal | Earth | N2-M4 | J.S.T Mfg. Co., Ltd. |
| | Brake | N1.25-M4 | |
| Cable | | ROBO-TOP 600V 0.75mm² and ROBO-TOP 600V 2.0mm² | Daiden Co.,Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCA0032FCD |
| 5 | MFMCA0052FCD |
| 10 | MFMCA0102FCD |
| 20 | MFMCA0202FCD |

* This cable does not conform to IP67.

| Part No. | MFMCE0 * * 2FCD | Applicable model | MHME 2.0kW |
|---|---|---|---|




| Title | | Part No. | Manufacturer |
|---|---|---|---|
| Straight plug | | JL04V-6A24-11SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | | JL04-2428CK(17)-R | |
| Rod terminal | | AI2.5-8BU | Phoenix Contact |
| Nylon insulated round terminal | Earth | N2-M4 | J.S.T Mfg. Co., Ltd. |
| | Brake | N1.25-M4 | |
| Cable | | ROBO-TOP 600V 0.75mm² and ROBO-TOP 600V 2.0mm² | Daiden Co.,Ltd. |

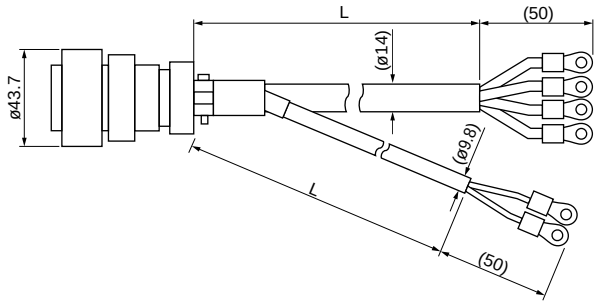
| L (m) | Part No. |
|---|---|
| 3 | MFMCE0032FCD |
| 5 | MFMCE0052FCD |
| 10 | MFMCE0102FCD |
| 20 | MFMCE0202FCD |

Related page
• P.1-15 “Check of the Combination of the Driver and the Motor”
• P.2-18 “Specifications of Motor connector”

# 7. Options

## Junction Cable for Motor (With brake)

| Part No. | MFMCA0 * * 3FCT | Applicable model | MSME 3.0kW to 5.0kW, MDME 3.0kW to 5.0kW<br>MHME 3.0kW to 5.0kW, MGME 2.0kW to 3.0kW |
|---|---|---|---|




| Title | | Part No. | Manufacturer |
|---|---|---|---|
| Straight plug | | JL04V-6A24-11SE-EB-R | Japan Aviation Electronics Ind. |
| Cable clamp | | JL04-2428CK(17)-R | |
| Nylon insulated round terminal | Earth | N5.5-5 | J.S.T Mfg. Co., Ltd. |
| | Brake | N1.25-M4 | |
| Cable | | ROBO-TOP 600V 0.75mm$^2$ and ROBO-TOP 600V 3.5mm$^2$ | Daiden Co.,Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCA0033FCT |
| 5 | MFMCA0053FCT |
| 10 | MFMCA0103FCT |
| 20 | MFMCA0203FCT |

* This cable does not conform to IP67.

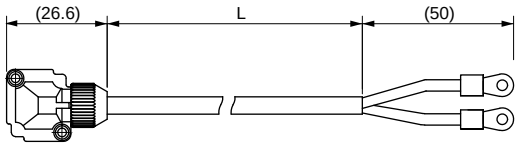
# 7. Options

## Junction Cable for Brake

### ROBO-TOP® 105°C 600V • DP

ROBO-TOP® is a trade mark of Daiden Co.,Ltd.

| Part No. | MFMCB0 * * 0PJT | Applicable model | MSME 50W to 750W |
|---|---|---|---|




| Title | Part No. | Manufacturer |
|---|---|---|
| Connector | JN4FT02SJMR | Japan Aviation Electronics Ind. |
| Connector pin | ST-TMH-S-C1B-3500 | |
| Nylon insulated round terminal | N1.25-M4 | J.S.T Mfg. Co., Ltd. |
| Cable | AWG22 | Hitachi Cable, Ltd. |

| L (m) | Part No. |
|---|---|
| 3 | MFMCB0030PJT |
| 5 | MFMCB0050PJT |
| 10 | MFMCB0100PJT |
| 20 | MFMCB0200PJT |

Related page
• P.1-15 “Check of the Combination of the Driver and the Motor”
• P.2-18 “Specifications of Motor connector”

# 7. Options

## Connector Kit

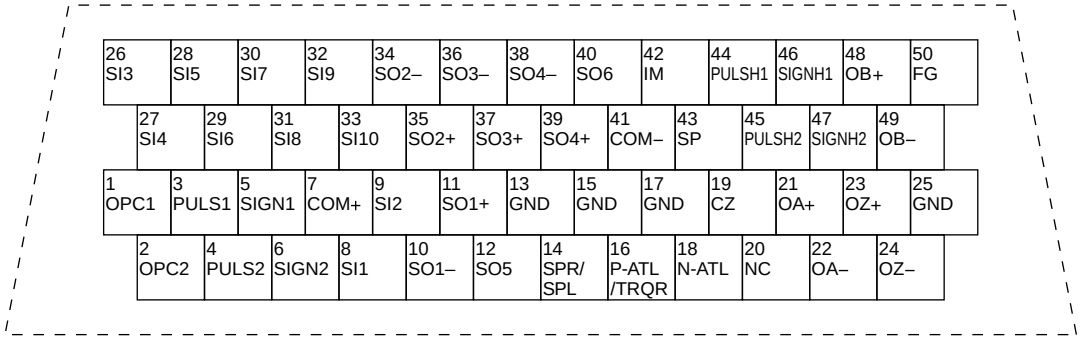
## Connector Kit for Interface

| Part No. | DV0P4350 |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 54306-5019 | 1 | Molex Inc | For Connector X4 (50-pins) |
| Connector cover | 54331-0501 | 1 | | |

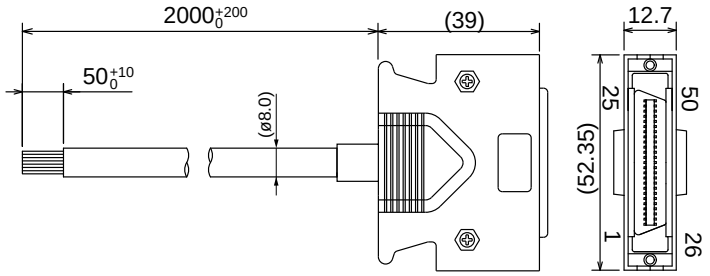
• Pin disposition (50 pins) (viewed from the soldering side)




1) Check the stamped pin-No. on the connector body while making a wiring.
2) For the function of each signal title or its symbol, refer to the wiring example of the connector X4.
3) Do not connect anything to NC pins in the above table.

## Interface Cable

| Part No. | DV0P4360 |
|---|---|




This 2 m connector cable contains AWG28 conductors.

• Table for wiring

| Pin No. | color | Pin No. | color | Pin No. | color | Pin No. | color | Pin No. | color |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Orange (Red1) | 11 | Orange (Black2) | 21 | Orange (Red3) | 31 | Orange (Red4) | 41 | Orange (Red5) |
| 2 | Orange (Black1) | 12 | Yellow (Black1) | 22 | Orange (Black3) | 32 | Orange (Black4) | 42 | Orange (Black5) |
| 3 | Gray (Red1) | 13 | Gray (Red2) | 23 | Gray (Red3) | 33 | Gray (Red4) | 43 | Gray (Red5) |
| 4 | Gray (Black1) | 14 | Gray (Black2) | 24 | Gray (Black3) | 34 | White (Red4) | 44 | White (Red5) |
| 5 | White (Red1) | 15 | White (Red2) | 25 | White (Red3) | 35 | White (Black4) | 45 | White (Black5) |
| 6 | White (Black1) | 16 | Yellow (Red2) | 26 | White (Black3) | 36 | Yellow (Red4) | 46 | Yellow (Red5) |
| 7 | Yellow (Red1) | 17 | Yel (Blk2)/Pink (Blk2) | 27 | Yellow (Red3) | 37 | Yellow (Black4) | 47 | Yellow (Black5) |
| 8 | Pink (Red1) | 18 | Pink (Red2) | 28 | Yellow (Black3) | 38 | Pink (Red4) | 48 | Pink (Red5) |
| 9 | Pink (Black1) | 19 | White (Black2) | 29 | Pink (Red3) | 39 | Pink (Black4) | 49 | Pink (Black5) |
| 10 | Orange (Red2) | 20 | —— | 30 | Pink (Black3) | 40 | Gray (Black4) | 50 | Gray (Black5) |

**<Remarks>**
Color designation of the cable
e.g.) Pin-1 Cable color : Orange (Red1) : One red dot on the cable

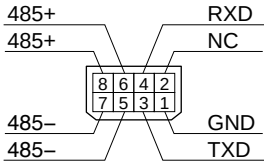
## Connector Kit for Communication Cable (for RS485, RS232)

| Part No. | DV0PM20024 |
|---|---|

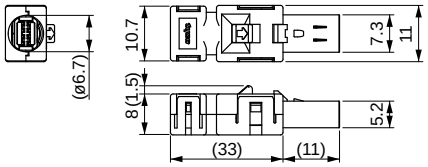
• **Components**

| Title | Part No. | Manufacturer | Note |
|---|---|---|---|
| Connector | 2040008-1 | Tyco Electronics AMP | For Connector X2 (8-pins) |

• Pin disposition of connector, connector X2




• Dimensions



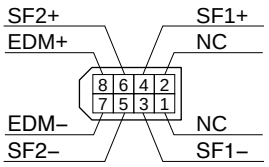

## Connector Kit for Safety

| Part No. | DV0PM20025 |
|---|---|

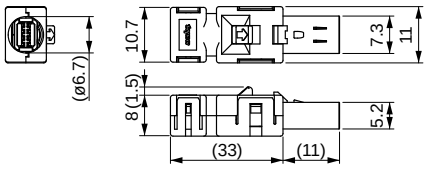
• **Components**

| Title | Part No. | Manufacturer | Note |
|---|---|---|---|
| Connector | 2013595-1 | Tyco Electronics AMP | For Connector X3 (8-pins) |

• Pin disposition of connector, connector X3




• Dimensions



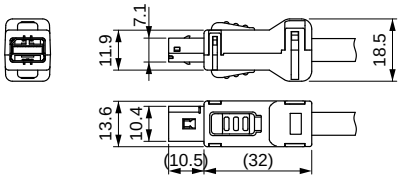

## Connector Kit for External Scale

| Part No. | DV0PM20026 |
|---|---|

• **Components**

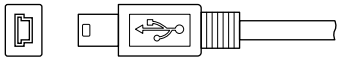
| Title | Part No. | Manufacturer | Note |
|---|---|---|---|
| Connector | MUF-PK10K-X | J.S.T Mfg. Co., Ltd. | For Connector X5 |

• Dimensions




**Remarks** Connector X1: use with commercially available cable.

• Configuration of connector X1: USB mini-B



## Connector Kit for Encoder

| Part No. | DV0PM20010 |
|---|---|

• **Components**

| Title | Part No. | Manufacturer | Note |
|---|---|---|---|
| Connector | 55100-0670 | Molex Inc | For Connector X6 |

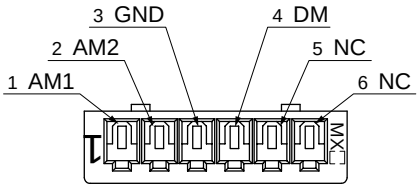
## Connector Kit for Analog Monitor Signal

| Part No. | DV0PM20031 |
|---|---|

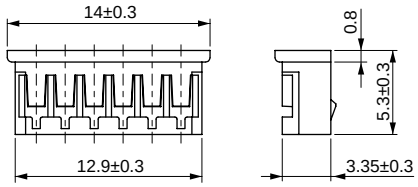
• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 510040600 | 1 | Molex Inc | For Connector X7 (6-pins) |
| Connector pin | 500118100 | 6 | | |

• Pin disposition of connector, connector X7




• Dimensions




## Connector Kit for Power Supply Input

| Part No. | DV0PM20032 (For A to D-frame: Single row type) |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 05JFAT-SAXGF | 1 | J.S.T Mfg. Co., Ltd. | For Connector XA |
| Handle lever | J-FAT-OT | 2 | | |

| Part No. | DV0PM20033 (For A to D-frame: double row type) |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 05JFAT-SAXGSA-C | 1 | J.S.T Mfg. Co., Ltd. | For Connector XA |
| Handle lever | J-FAT-OT | 2 | | |

| Part No. | DV0PM20044 (For E-frame) |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 05JFAT-SAXGSA-L | 1 | J.S.T Mfg. Co., Ltd. | For Connector XA (E-frame) |
| Handle lever | J-FAT-OT-L | 2 | | |

## Connector Kit for Regenerative Resistor Connection (E-frame)

| Part No. | DV0PM20045 |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 04JFAT-SAXGSA-L | 1 | J.S.T Mfg. Co., Ltd. | For Connector XC |
| Handle lever | J-FAT-OT-L | 2 | | |

## Connector Kit for Motor Connection

| Part No. | DV0PM20034 (For A to D-frame) |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 06JFAT-SAXGF | 1 | J.S.T Mfg. Co., Ltd. | For Connector XB |
| Connector pin | J-FAT-OT | 2 | | |

| Part No. | DV0PM20046 (For E-frame) |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 03JFAT-SAXGSA-L | 1 | J.S.T Mfg. Co., Ltd. | For Connector XB (E-frame) |
| Handle lever | J-FAT-OT-L | 2 | | |

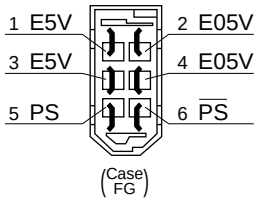
## Connector Kit for Motor/Encoder Connection

| Part No. | DV0PM20035 | Applicable model | MSME 50W to 750W |
|---|---|---|---|

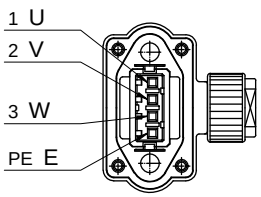
• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 55100-0670 | 1 | Molex Inc | For Connector X6 (6-pins) |
| Encoder plug connector | JN6FR07SM1 | 1 | Japan Aviation Electronics Ind. | For junction cable to encoder (7-pins) |
| Socket contact | LY10-C1-A1-10000 | 7 | | |
| Motor plug connector | JN8FT04SJ1 | 1 | Japan Aviation Electronics Ind. | For junction cable to motor power (4-pins) |
| Socket contact | ST-TMH-S-C1B-3500 | 4 | | |

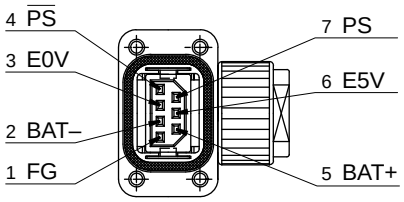
• Pin disposition of connector, connector X3




• Pin disposition of junction cable for motor power




• Pin disposition of junction cable for encoder



| Part No. | DV0PM20036 | Applicable model | MSME 1.0kW to 2.0kW, MDME 1.0kW to 2.0kW<br>MHME 1.0kW to 1.5kW, MGME 0.9kW | Without brake |
|---|---|---|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 55100-0670 | 1 | Molex Inc | For Connector X6 (6-pins) |
| Encoder connector | JN2DS10SL1-R | 1 | Japan Aviation Electronics Ind. | For junction cable to encoder |
| Connector pin | JN1-22-22S-PKG100 | 5 | | |
| Motor connector | JL04V-6A-20-4SE-EB-R | 1 | Japan Aviation Electronics Ind. | For junction cable to motor power |
| Cable clamp | JL04-2022CK(14)-R | 1 | | |

| Part No. | DV0PM20037 | Applicable model | MSME 3.0kW to 5.0kW, MDME 3.0kW to 5.0kW<br>MHME 2.0kW to 5.0kW, MGME 2.0kW to 3.0kW | Without brake |
|---|---|---|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 55100-0670 | 1 | Molex Inc | For Connector X6 (6-pins) |
| Encoder connector | JN2DS10SL1-R | 1 | Japan Aviation Electronics Ind. | For junction cable to encoder |
| Connector pin | JN1-22-22S-PKG100 | 5 | | |
| Motor connector | JL04V-6A22-22SE-EB-R | 1 | Japan Aviation Electronics Ind. | For junction cable to motor power |
| Cable clamp | JL04-2022CK(14)-R | 1 | | |

| Part No. | DV0PM20038 | Applicable model | MSME 1.0kW to 2.0kW, MDME 1.0kW to 2.0kW<br>MHME 1.0kW to 1.5kW, MGME 0.9kW | With brake |
|---|---|---|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 55100-0670 | 1 | Molex Inc | For Connector X6 (6-pins) |
| Encoder connector | JN2DS10SL1-R | 1 | Japan Aviation Electronics Ind. | For junction cable to encoder |
| Connector pin | JN1-22-22S-PKG100 | 5 | | |
| Motor connector | JL04V-6A20-18SE-EB-R | 1 | Japan Aviation Electronics Ind. | For junction cable to motor power |
| Cable clamp | JL04-2022CK(14)-R | 1 | | |

| Part No. | DV0PM20039 | Applicable model | MSME 3.0kW to 5.0kW, MDME 3.0kW to 5.0kW<br>MHME 2.0kW to 5.0kW, MGME 2.0kW to 3.0kW | With brake |
|---|---|---|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | 55100-0670 | 1 | Molex Inc | For Connector X6 (6-pins) |
| Encoder connector | JN2DS10SL1-R | 1 | Japan Aviation Electronics Ind. | For junction cable to encoder |
| Connector pin | JN1-22-22S-PKG100 | 5 | | |
| Motor connector | JL04V-6A24-11SE-EB-R | 1 | Japan Aviation Electronics Ind. | For junction cable to motor power |
| Cable clamp | JL04-2428CK(17)-R | 1 | | |

## Connector Kit for Motor/Brake Connection

| Part No. | DV0PM20040 |
|---|---|

• **Components**

| Title | Part No. | Number | Manufacturer | Note |
|---|---|---|---|---|
| Connector | JN4FT02SJM-R | 1 | Japan Aviation Electronics Ind. | |
| Handle lever | ST-TMH-S-C1B-3500 | 2 | | |

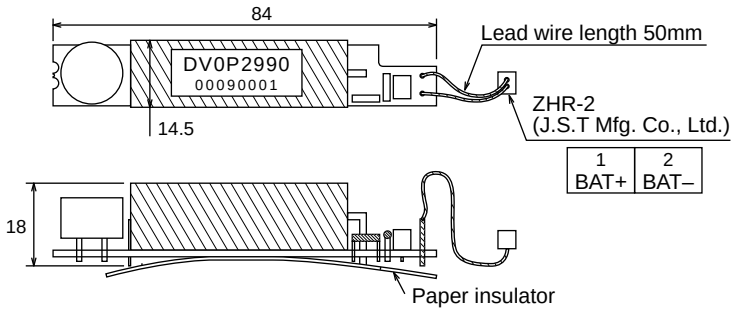
# 7. Options

## Battery For Absolute Encoder

## Battery For Absolute Encoder

| Part No. | DV0P2990 |
|---|---|

• Lithium battery: 3.6V  2000mAh

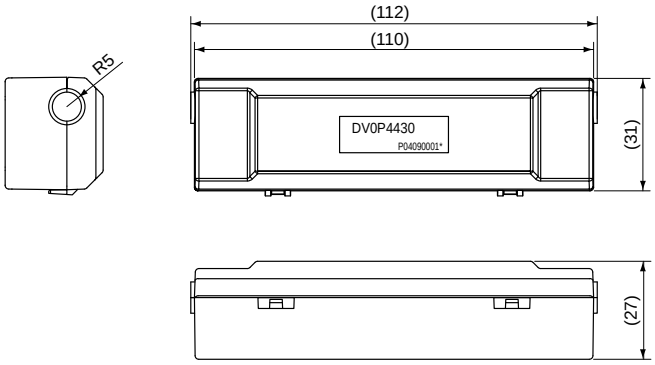



**Caution** This battery is categorized as hazardous substance, and you may be required to present an application of hazardous substance when you transport by air (both passenger and cargo airlines).

## Battery Box For Absolute Encoder

| Part No. | DV0P4430 |
|---|---|

• **Components**




**Related page** • P.7-10 “Absolute system”

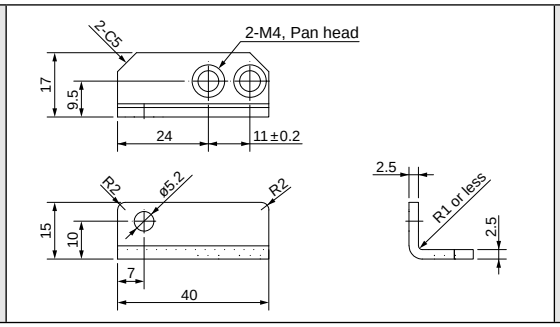
# 7. Options

## Mounting Bracket

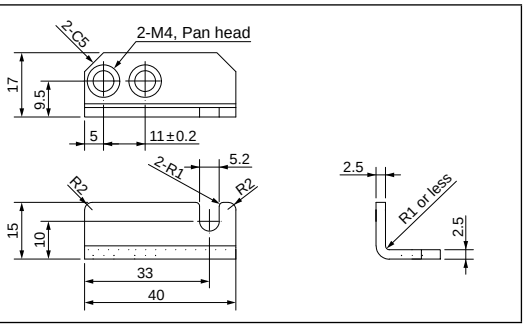
| Part No. | DV0PM20027 | Frame symbol of applicable driver | A-frame | Mounting screw | M4 × L6 Pan head 4pcs |
|---|---|---|---|---|---|

Dimensions

Upper side



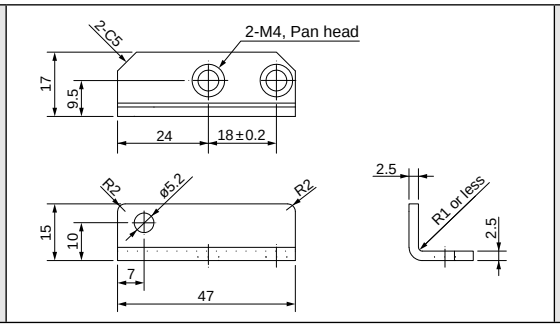

Bottom side



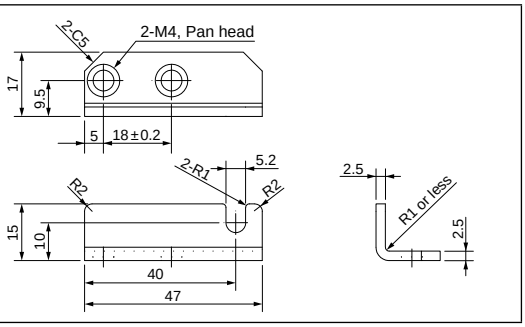

| Part No. | DV0PM20028 | Frame symbol of applicable driver | B-frame | Mounting screw | M4 × L6 Pan head 4pcs |
|---|---|---|---|---|---|

Dimensions

Upper side



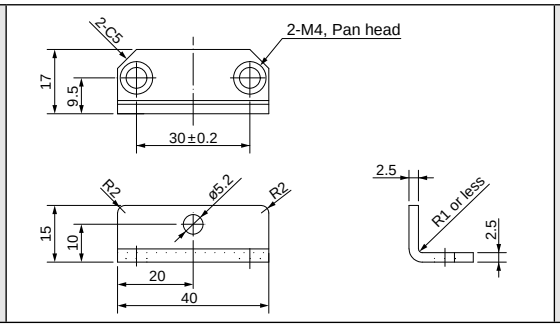

Bottom side



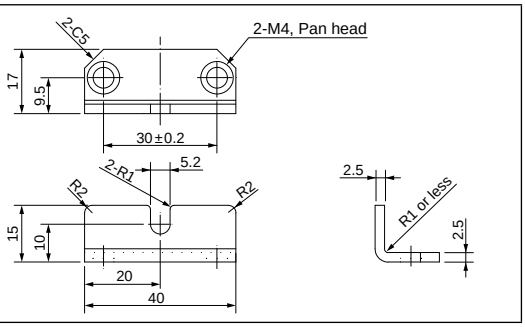

| Part No. | DV0PM20029 | Frame symbol of applicable driver | C-frame | Mounting screw | M4 × L6 Pan head 4pcs |
|---|---|---|---|---|---|

Dimensions

Upper side



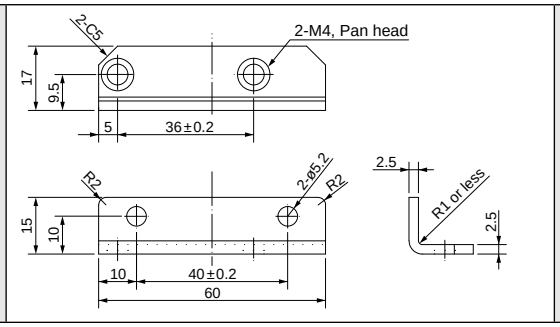

Bottom side



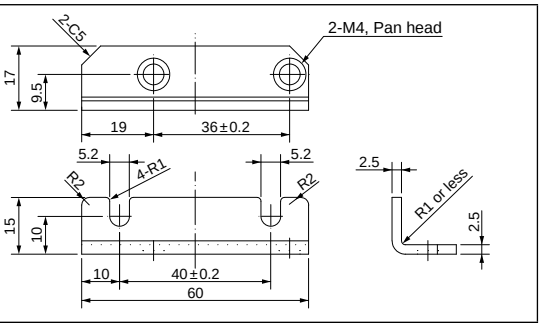

| Part No. | DV0PM20030 | Frame symbol of applicable driver | D-frame | Mounting screw | M4 × L6 Pan head 4pcs |
|---|---|---|---|---|---|

Dimensions

Upper side




Bottom side




**Caution** For E and F-frame, you con make a front end and back end mounting by changing the mounting direction of L-shape bracket (attachment).

Related page • P.7-10 “Dimensions of driver”

# 7. Options

## Reactor

Fig.1

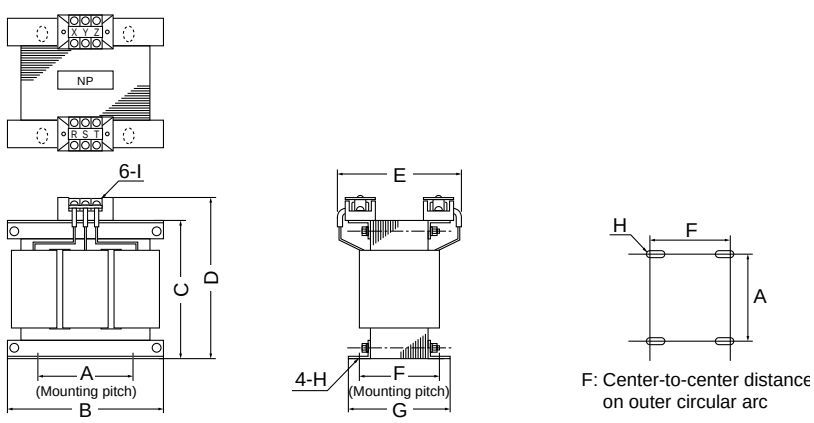
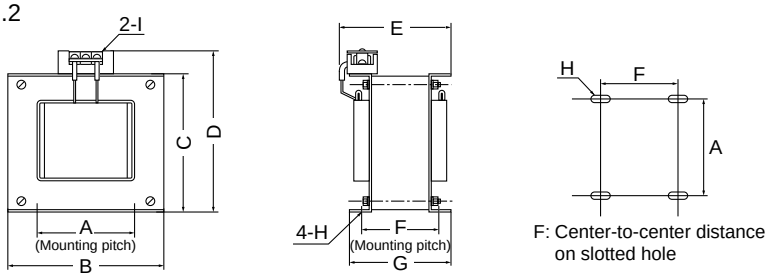



Fig.2




| | Part No. | A | B | C | D | E (Max) | F | G | H | I | Inductance (mH) | Rated current (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fig.1 | **DV0P220** | 65±1 | 125±1 | (93) | 136 Max | 155 | 70+3/–0 | 85±2 | 4-7φ×12 | M4 | 6.81 | 3 |
| | **DV0P221** | 60±1 | 150±1 | (113) | 155 Max | 130 | 60+3/–0 | 75±2 | 4-7φ×12 | M4 | 4.02 | 5 |
| | **DV0P222** | 60±1 | 150±1 | (113) | 155 Max | 140 | 70+3/–0 | 85±2 | 4-7φ×12 | M4 | 2 | 8 |
| | **DV0P223** | 60±1 | 150±1 | (113) | 155 Max | 150 | 79+3/–0 | 95±2 | 4-7φ×12 | M4 | 1.39 | 11 |
| | **DV0P224** | 60±1 | 150±1 | (113) | 160 Max | 155 | 84+3/–0 | 100±2 | 4-7φ×12 | M5 | 0.848 | 16 |
| | **DV0P225** | 60±1 | 150±1 | (113) | 160 Max | 170 | 100+3/–0 | 115±2 | 4-7φ×12 | M5 | 0.557 | 25 |
| Fig.2 | **DV0P227** | 55±0.7 | 80±1 | 66.5±1 | 110 Max | 90 | 41±2 | 55±2 | 4-5φ×10 | M4 | 4.02 | 5 |
| | **DV0P228** | 55±0.7 | 80±1 | 66.5±1 | 110 Max | 95 | 46±2 | 60±2 | 4-5φ×10 | M4 | 2 | 8 |
| Fig.3 | **DV0PM20047** | 55±0.7 | 80±1 | 66.5±1 | 110 Max | 105 | 56±2 | 70±2 | 4-5φ×10 | M4 | 1.39 | 11 |

| Motor series | Power supply | Rated output | Part No. |
|---|---|---|---|
| MSME | Single phase, 100V | 50W to 100W | DV0P227 |
| | | 200W to 400W | |
| MSME | Single phase, 200V | 50W to 200W | |
| | | 400W to 750W | |
| MSME<br>MDME<br>MHME | Single phase, 200V | 1.0kW | DV0P228 |
| | | 1.5kW | DV0PM20047 |
| MGME | Single phase, 200V | 0.9kW | DV0P228 |
| MSME | 3-phase, 200V | 750W | DV0P220 |
| MGME | | 0.9kW | DV0P221 |
| MSME | | 1.0kW<br>1.5kW | DV0P222 |
| MDME | | | |
| MHME | | | |

| Motor series | Power supply | Rated output | Part No. |
|---|---|---|---|
| MSME | 3-phase, 200V | 2.0kW | DV0P223 |
| MDME | | | |
| MHME | | | |
| MGME | | | |
| MSME | | 3.0kW | DV0P224 |
| MDME | | | |
| MHME | | | |
| MGME | | 4.0kW | DV0P225 |
| MSME | | | |
| MDME | | | |
| MHME | | | |

## Harmonic restraint

On September, 1994, “Guidelines for harmonic restraint on heavy consumers who receive power through high voltage system or extra high voltage system” and “Guidelines for harmonic restraint on household electrical appliances and general-purpose articles” established by the Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry (the ex-Ministry of International Trade and Industry). According to those guidelines, the Japan Electrical Manufacturers’ Association (JEMA) have prepared technical documents (procedure to execute harmonic restraint: JEM-TR 198, JEM-TR 199 and JEM-TR 201) and have been requesting the users to understand the restraint and to cooperate with us. On January, 2004, it has been decided to exclude the general-purpose inverter and servo driver from the “Guidelines for harmonic restraint on household electrical appliances and general-purpose articles”. After that, the “Guidelines for harmonic restraint on household electrical appliances and general-purpose articles” was abolished on September 6, 2004.
We are pleased to inform you that the procedure to execute the harmonic restraint on general-purpose inverter and servo driver was modified as follows.

1. All types of the general-purpose inverters and servo drivers used by specific users are under the control of the “Guidelines for harmonic restraint on heavy consumers who receive power through high voltage system or extra high voltage system”. The users who are required to apply the guidelines must calculate the equivalent capacity and harmonic current according to the guidelines and must take appropriate countermeasures if the harmonic current exceeds a limit value specified in a contract demand. (Refer to JEM-TR 210 and JEM-TR 225.)
2. The “Guidelines for harmonic restraint on household electrical appliances and general-purpose articles” was abolished on September 6, 2004. However, based on conventional guidelines, JEMA applies the technical documents JEM-TR 226 and JEM-TR 227 to any users who do not fit into the “Guidelines for harmonic restraint on heavy consumers who receive power through high voltage system or extra high voltage system” from a perspective on enlightenment on general harmonic restraint. The purpose of these guidelines is the execution of harmonic restraint at every device by a user as usual to the utmost extent.

# 7. Options

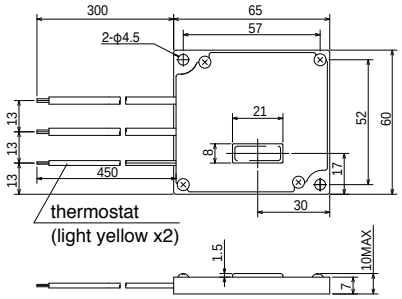
## External Regenerative Resistor

| Part No. | Manufacturer's part No. | Specifications | | | | | | | Activation temperature of built-in thermostat |
|---|---|---|---|---|---|---|---|---|---|
| | | Resistance | cable core outside diameter | Mass | Rated power (reference) * | | | | |
| | | | | | Free air | with fan [W] | | | |
| | | Ω | mm | kg | [W] | 1m/s | 2m/s | 3m/s | |
| **DV0P4280** | RF70M | 50 | ϕ1.27 (AWG18 stranded wire) | 0.1 | 10 | 25 | 35 | 45 | 140±5˚C<br>B-contact<br>Open/Close capacity (resistance load)<br>4A 125VAC 10000 times<br>2.5A 250VAC 10000 times |
| **DV0P4281** | RF70M | 100 | | 0.1 | 10 | 25 | 35 | 45 | |
| **DV0P4282** | RF180B | 25 | | 0.4 | 17 | 50 | 60 | 75 | |
| **DV0P4283** | RF180B | 50 | | 0.2 | 17 | 50 | 60 | 75 | |
| **DV0P4284** | RF240 | 30 | | 0.5 | 40 | 100 | 120 | 150 | |
| **DV0P4285** | RH450F | 20 | | 1.2 | 52 | 130 | 160 | 200 | |

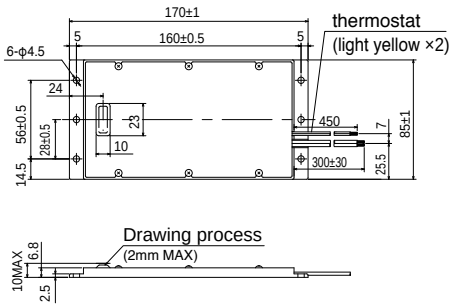
Manufacturer : Iwaki Musen Kenkyusho

* Power with which the driver can be used without activating the built-in thermostat.

### DV0P4280, DV0P4281

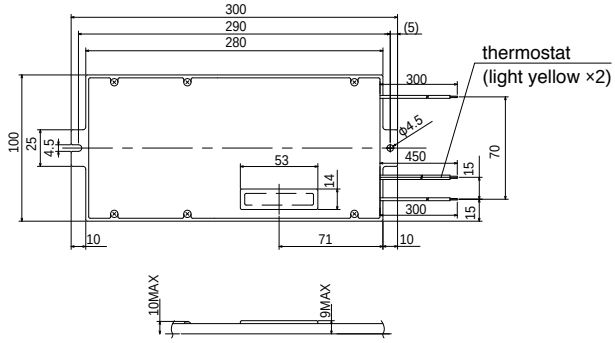



### DV0P4282,DV0P4283

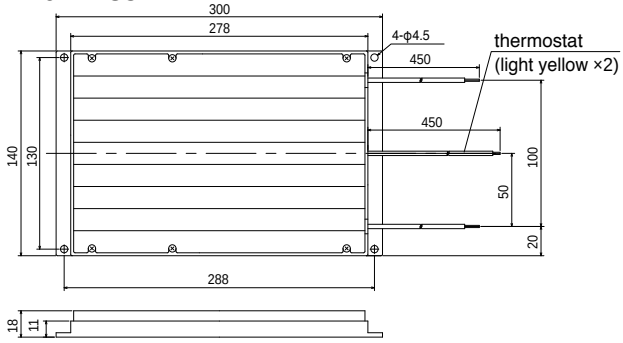



| Frame | Power supply | |
|---|---|---|
| | Single phase, 100V | Single phase, 200V 3-phase, 200V |
| A | DV0P4280 | DV0P4281 |
| B | DV0P4283 | DV0P4283 |
| C | DV0P4282 | |
| D | – | DV0P4284 |
| E | | DV0P4285 |
| F | | Arrange 2 DV0P4285 in a parallel |

### DV0P4284




### DV0P4285




**Remarks** **Thermal fuse is installed for safety. Compose the circuit so that the power will be turned off when the thermostat is activated. The thermal fuse may blow due to heat dissipating condition, working temperature, supply voltage or load fluctuation.**

**Make it sure that the surface temperature of the resistor may not exceed 100˚C at the worst running conditions with the machine, which brings large regeneration (such case as high supply voltage, load inertia is large or deceleration time is short) Install a fan for a forced cooling if necessary.**

**Caution** **Regenerative resistor gets very hot.**

**Take preventive measures for fire and burns. Avoid the installation near inflammable objects, and easily accessible place by hand.**

# 7. Options

## Recommended components

### Surge absorber for motor brake

| Motor | Part No. | Manufacturer |
|---|---|---|
| MSME 50W to 750W | Z15D271 | Ishizuka Electronics Co. |
| MHME 2.0kW to 5.0kW | Z15D151 | Ishizuka Electronics Co. |
| MGME 0.9kW to 2.0kW | | |
| MSME 1.0kW to 5.0kW | | |
| MDME 4.0kW to 5.0kW | | |
| MGME 3.0kW | | |
| MDME 1.0kW to 3.0kW | TND09V-820KB00AAA0 | Nippon Chemi_Con Co. |
| MHME 1.0kW to 1.5kW | | |

# 7. Options

## List of Peripheral Equipments

| Manufacturer | Tel No. / Home Page | Peripheral components |
|---|---|---|
| Automation Controls Company<br>Panasonic Electric Works, Co.,Ltd | 81-6-6908-1131<br>http://panasonic-denko.co.jp/ac | Circuit breaker<br>Surge absorber |
| Iwaki Musen Kenkyusho Co., Ltd. | 81-44-833-4311<br>http://www.iwakimusen.co.jp/ | Regenerative resistor |
| Nippon Chemi-Con Co. | 81-3-5436-7711<br>http://www.chemi_con.co.jp/ | Surge absorber<br>for holding brake |
| Ishizuka Electronics Corp. | 81-3-3621-2703<br>http://www.semitec.co.jp/ | |
| TDK Corp. | 81-3-5201-7229<br>http://www.tdk.co.jp/ | Noise filter for signal lines |
| Okaya Electric Industries Co. Ltd. | 81-3-4544-7040<br>http://www.okayatec.co.jp/ | Surge absorber<br>Noise filter |
| Japan Aviation Electronics Industry, Ltd. | 81-3-3780-2717<br>http://www.jae.co.jp | Connector |
| Sumitomo 3M | 81-3-5716-7290<br>http://www.mmmco.jp | |
| Tyco Electronics AMP k.k, | 81-44-844-8111<br>http://www.tycoelectronics.com/<br>japan/amp | |
| Japan Molex Inc. | 81-462-65-2313<br>http://www.molex.co.jp | |
| J.S.T. Mfg. Co., Ltd. | 81-45-543-1271<br>http://www.jst-mfg.com/index_i.html | |
| Daiden Co., Ltd. | 81-3-5805-5880<br>http://www.dyden.co.jp/ | Cable |
| Mitutoyo Corp. | 81-44-813-8236<br>http://www.mitutoyo.co.jp | External scale |
| Sony Manufacturing Systems Corp. | 81-3-3490-3920<br>http://www.sonysms.co.jp/ | |

**Note** Contact information shown above is as of August 2009.
This list is for reference only and subject to change without notice.

# Warranty

## Warranty period

- The warranty period is one year from the date of purchase or 18 months from the month of manufacture in our plant.
  For a motor with brake, the axis accelerated and decelerated more times than the specified limit is not covered by warranty.

## Warranty information

- Should any defect develop during warranty period under standard service conditions as described in the manual, the company agrees to make repairs free of charge.
  Even during warranty period, the company makes fee-based repair on product containing:
  [1] Failure or damage due to misuse, improper repair or alteration.
  [2] Failure or damage due to falling, or damage during transportation, after the original delivery
  [3] Defects resulting from neglect of the specification in use of the product.
  [4] Failure or damage due to unregulated voltage and fire, and act of natural disasters such as earthquake, lightning, wind, flood and salt pollution.
  [5] Defects resulting from invasion of foreign materials such as water, oil and metal pieces.
- The company shall not be liable for any indirect, incidental or consequential damage or loss of any nature that may arise in connection with the product.

- This product is intended to be used with a general industrial product, but not designed or manufactured to be used in a machine or system that may cause personal death when it is failed.
- Installation, wiring, operation, maintenance, etc., of the equipment should be done by qualified and experienced personnel.
- Apply adequate tightening torque to the product mounting screw by taking into consideration strength of the screw and the characteristics of material to which the product is installed. Overtightening can damage the screw and/or material; undertightening can result in loosening.

  Example) Steel screw into steel section:

  | | |
  |---|---|
  | M4 | 1.35 to 1.65 N·m. |
  | M5 | 2.7 to 3.3 N·m. |
  | M6 | 4.68 to 5.72 N·m. |
  | M8 | 11.25 to 13.75 N·m. |
  | M10 | 22.05 to 26.95 N·m. |
  | M11 | 37.8 to 46.2 N·m. |

- Install a safety equipments or apparatus in your application, when a serious accident or loss of property is expected due to the failure of this product.
- Consult us if the application of this product is under such special conditions and environments as nuclear energy control, aerospace, transportation, medical equipment, various safety equipments or equipments which require a lesser air contamination.
- We have been making the best effort to ensure the highest quality of the products, however, application of exceptionally larger external noise disturbance and static electricity, or failure in input power, wiring and components may result in unexpected action. It is highly recommended that you make a fail-safe design and secure the safety in the operative range.
- If the motor shaft is not electrically grounded, it may cause an electrolytic corrosion to the bearing, depending on the condition of the machine and its mounting environment, and may result in the bearing noise. Checking and verification by customer is required.
- Failure of this product depending on its content, may generate smoke of about one cigarette. Take this into consideration when the application of the machine is clean room related.
- Please be careful when using in an environment with high concentrations of sulfur or sulfric gases, as sulfuration can lead to disconnection from the chip resistor or a poor contact connection.
- Take care to avoid inputting a supply voltage which significantly exceeds the rated range to the power supply of this product. Failure to heed this caution may result in damage to the internal parts, causing smoking and/or a fire and other trouble.
- The user is responsible for matching between machine and components in terms of configuration, dimensions, life expectancy, characteristics, when installing the machine or changing specification of the machine. The user is also responsible for complying with applicable laws and regulations.

**Marketeing Group, Motor Company, Panasonic Corporation**

Tokyo: Kyobashi MID Bldg, 2-13-10 Kyobashi, Chuo-ku, Tokyo 104-0031 TEL (03)3538-2961 FAX (03)3538-2964

Osaka: 1-1, Morofuku 7-chome, Daito, Osaka 574-0044 TEL (072)870-3065 FAX (072)870-3151

# After-Sale Service (Repair)

## Repair

Consult to a dealer from whom you have purchased the product for details of repair.
When the product is incorporated to the machine or equipment you have purchased, consult to the manufacturer or the dealer of the machine or equipment.

## Technical information

Technical information of this product (Operating Instructions, CAD data) can be downloaded from the following web site.

http://industrial.panasonic.com/ww/i_e/25000/motor_fa_e/motor_fa_e.html

For your records:
The model number and serial number of this product can be found on either the back or the bottom of the unit. Please note them in the space provided and keep for future reference.

| | | | |
|---|---|---|---|
| **Model No.** | **M☐DH**_____<br>**M☐ME**_____ | **Serial No.** | |
| **Date of purchase** | | | |
| **Dealer** | Name | | |
| | Address | | |
| | Phone | ( ) - | |


Motor Company, Panasonic Corporation

7-1-1 Morofuku, Daito, Osaka, 574-0044, Japan Phone : +81-72-871-1212

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