MITSUBISHI ELECTRIC

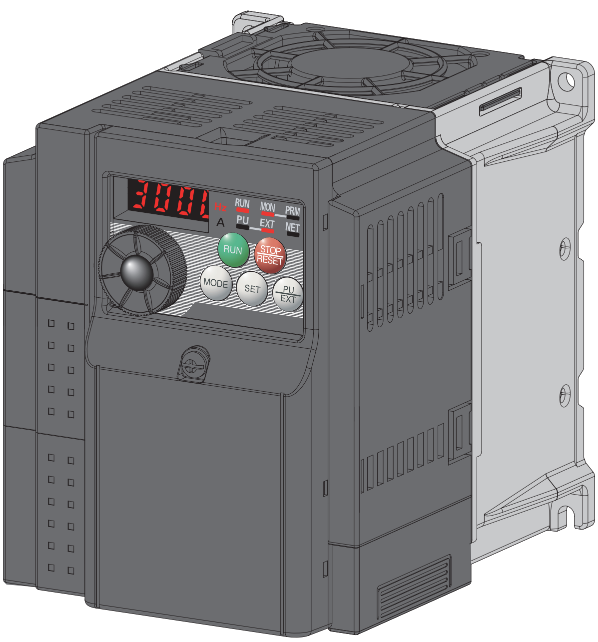
S-PM GEARED MOTOR DRIVE UNIT FR-D700-G

INSTRUCTION MANUAL (Applied)

Simple and compact drive unit

FR-D720-0.2K to 3.7K-G
FR-D740-0.4K to 3.7K-G

According to the motor to be connected, perform PM parameter initialization. Incorrect initial setting of parameters may damage the motor. (*Refer to page 73*.)
The parameters for motor operation are initially set for an S-PM geared motor.



Thank you for choosing this Mitsubishi Electric S-PM geared motor drive unit.
This Instruction Manual (Applied) provides instructions for advanced use of the FR-D700-G series drive units.
Incorrect handling might cause an unexpected fault. Before using the drive unit, always read this Instruction Manual and the Instruction Manual (Basic) [IB-0600477ENG] packed with the product carefully to use the equipment to its optimum performance.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the drive unit until you have read through the Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠WARNING	Incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

The ⚠CAUTION level may even lead to a serious consequence according to conditions. Both instruction levels must be followed because these are important to personal safety.

1. Electric Shock Prevention

⚠WARNING

- While the drive unit power is ON, do not remove the front cover or the wiring cover. Do not run the drive unit with the front cover or the wiring cover removed. Otherwise you may access the exposed high voltage terminals or the charging part of the circuitry and get an electric shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection. You may accidentally touch the charged drive unit circuits and get an electric shock.
- Before wiring or inspection, power must be switched OFF. To confirm that, LED indication of the operation panel must be checked. (It must be OFF.) Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This drive unit must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards). A neutral-point earthed (grounded) power supply for 400V class drive unit in compliance with EN standard must be used.
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The drive unit must be installed before wiring. Otherwise you may get an electric shock or be injured.
- Setting dial and key operations must be performed with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.
- Do not change the cooling fan while power is ON. It is dangerous to change the cooling fan while power is ON.
- Do not touch the printed circuit board or handle the cables with wet hands. Otherwise you may get an electric shock.
- When measuring the main circuit capacitor capacity, the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.
- A PM motor is a synchronous motor with embedded magnets. High-voltage is generated at motor terminals while the motor is running even after the drive unit power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. For applications where the motor is driven by the load, the low-voltage manual contactor, which is installed at the drive unit's output side, must be opened before wiring or inspection. Otherwise you may get an electric shock.

2. Fire Prevention

⚠CAUTION

- The drive unit must be installed on a nonflammable wall without holes (so that nobody touches the drive unit heatsink on the rear side, etc.). Mounting it to or near flammable material can cause a fire.
- If the drive unit has become faulty, the drive unit power must be switched OFF. A continuous flow of large current could cause a fire.
- When using a brake resistor, a sequence that will turn OFF power when a fault signal is output must be configured. Otherwise the brake resistor may overheat due to damage of the brake transistor and possibly cause a fire.
- Do not connect a resistor directly to the DC terminals P/+ and N/-. Doing so could cause a fire.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual. If a product is used without any inspection, a burst, breakage, or a fire may occur.

3.Injury Prevention

⚠CAUTION

- The voltage applied to each terminal must be the ones specified in the Instruction Manual. Otherwise burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise burst, damage, etc. may occur.
- Polarity must be correct. Otherwise burst, damage, etc. may occur.
- While power is ON or for some time after power-OFF, do not touch the drive unit since the drive unit will be extremely hot. Doing so can cause burns.

4. Additional Instructions

Also the following points must be noted to prevent an accidental failure, injury, electric shock, etc.

(1) Transportation and Mounting

⚠CAUTION

- The product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
- Do not stack the boxes containing drive units higher than the number recommended.
- The product must be installed to the position where withstands the weight of the product according to the information in the Instruction Manual.
- Do not install or operate the drive unit if it is damaged or has parts missing.
- When carrying the drive unit, do not hold it by the front cover or setting dial; it may fall off or fail.
- Do not stand or rest heavy objects on the product.
- The drive unit mounting orientation must be correct.
- Foreign conductive objects must be prevented from entering the drive unit. That includes screws and metal fragments or other flammable substance such as oil.
- As the drive unit is a precision instrument, do not drop or subject it to impact.
- The drive unit must be used under the following environment: Otherwise the drive unit may be damaged.

Environment	Surrounding air temperature	-10°C to +50°C (non-freezing)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C *1
	Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/ vibration	Maximum 1000 m. $5.9 m/s^2$ or less at 10 to 55Hz (directions of X, Y, Z axes)

*1 Temperature applicable for a short time, e.g. in transit.

- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi Electric product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfest wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi Electric products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization of disinfection of wooden package should also be performed before packaging the product.

(2) Wiring

⚠CAUTION

- Do not install a power factor correction capacitor or surge suppressor/capacitor type filter on the drive unit output side. These devices on the drive unit output side may be overheated or burn out.
- The connection orientation of the output cables U, V, W to the motor affects the rotation direction of the motor.
- PM motor terminals (U, V, W) hold high-voltage while the PM motor is running even after the power is turned OFF. Before wiring, the PM motor must be confirmed to be stopped. Otherwise you may get an electric shock.
- Never connect a PM motor to the commercial power supply. Applying the commercial power supply to input terminals (U, V, W) of a PM motor will burn the PM motor. The PM motor must be connected with the output terminals (U, V, W) of the drive unit.

(3) Trial run

⚠CAUTION

- Before starting operation, each parameter must be confirmed and adjusted. A failure to do so may cause some machines to make unexpected motions.

(4) Usage

⚠WARNING

- A PM motor and the drive unit must be used in the specified capacity combination.
- Do not use multiple PM motors with one drive unit.
- Any person must stay away from the equipment when the retry function is set as it will restart suddenly after trip.
- Since pressing the STOP/RESET key may not stop output depending on the function setting status, separate circuit and switch that make an emergency stop (power OFF, mechanical brake operation for emergency stop, etc.) must be provided.
- OFF status of the start signal must be confirmed before resetting the drive unit fault. Resetting drive unit alarm with the start signal ON restarts the motor suddenly.
- Do not use a PM motor in an application where a motor is driven by its load and runs at a speed higher than the maximum motor speed.
- According to the motor to be connected, perform PM parameter initialization. Incorrect initial setting of parameters may damage the motor.
  The parameters for motor operation are initially set for an S-PM geared motor.
  When other PM motors are used, set parameters according to the motor.
- Do not use the drive unit for a load other than the PM motor. Connection of any other electrical equipment to the drive unit output may damage the equipment.
- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the product.

⚠CAUTION

- The electronic thermal relay function does not guarantee protection of the motor from overheating. It is recommended to install an external thermal for overheat protection.
- Do not use a magnetic contactor on the drive unit input for frequent starting/stopping of the drive unit. Otherwise, the life of the drive unit decreases.
- The effect of electromagnetic interference must be reduced by using an EMC filter or by other means. Otherwise nearby electronic equipment may be affected.
- Appropriate measures must be taken to suppress harmonics. Otherwise power supply harmonics from the drive unit may heat/damage the power factor correction capacitor and generator.
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to the initial value.
- The drive unit can be easily set for high-speed operation. Before changing its setting, the performances of the motor and machine must be fully examined.
- Stop status cannot be hold by the drive unit's brake function. In addition to the drive unit's brake function, a holding device must be installed to ensure safety.
- Before running a drive unit which had been stored for a long period, inspection and test operation must be performed.
- Static electricity in your body must be discharged before you touch the product. Otherwise the product may be damaged.
- In the system with a PM motor, the drive unit power must be turned ON before closing the contacts of the contactor at the output side.
- If you are installing the drive unit to drive a three-phase device while you are contracted for lighting and power service, consult your electric power supplier.

(5) Emergency stop

⚠CAUTION
● A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous conditions in case of failure of the drive unit or an external device controlling the drive unit. ● When the breaker on the drive unit input side trips, the wiring must be checked for fault (short circuit), and internal parts of the drive unit for a damage, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker. ● When any protective function is activated, appropriate corrective action must be taken, and the drive unit must be reset before resuming operation.

(6) Maintenance, inspection and parts replacement

⚠CAUTION
● Do not carry out a megger (insulation resistance) test on the control circuit of the drive unit. It will cause a failure.

(7) Disposal

⚠CAUTION
● The drive unit must be treated as industrial waste.

General instruction

Many of the diagrams and drawings in this Instruction Manual show the drive unit without a cover or partially open for explanation. Never operate the drive unit in this manner. The cover must be always reinstalled and the instruction in this Instruction Manual must be followed when operating the drive unit.
For more details on a PM motor, ***refer to the Instruction Manual of the PM motor*****.**

CONTENTS

<Abbreviations>

PU	Operation panel and parameter unit (FR-PU07)
Drive unit	FR-D700-G series drive unit for Mitsubishi Electric S-PM geared motor
FR-D700-G	FR-D700-G series drive unit for Mitsubishi Electric S-PM geared motor
Pr.	Parameter number (Number assigned to function)
PU operation	Operation using the PU (operation panel/FR-PU07)
External operation	Operation using the control circuit signals
Combined operation	Operation using both the PU (operation panel/FR-PU07) and External operation
PM motor	Permanent magnet motor: an IPM motor, an SPM motor, or the Mitsubishi Electric GV series S-PM geared motor

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REMARKS :Additional helpful contents and relations with other functions are stated.

NOTE :Contents requiring caution or cases when set functions are not activated are stated.

POINT :Useful contents and points are stated.

Parameters referred to : Related parameters are stated.

<Notes on descriptions in this Instruction Manual>

- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to *page 20*.)

Harmonic suppression guideline (when drive units are used in Japan)
All models of general-purpose drive units used by specific consumers are covered by "The Harmonic Suppression Guideline for Consumers Who Receive High Voltage or Special High Voltage". (For further details, *refer to page 41*.)

1 OUTLINE

This chapter explains the "OUTLINE" for use of this product. Always read the instructions before using the equipment.

1.1 Product checking and parts identification

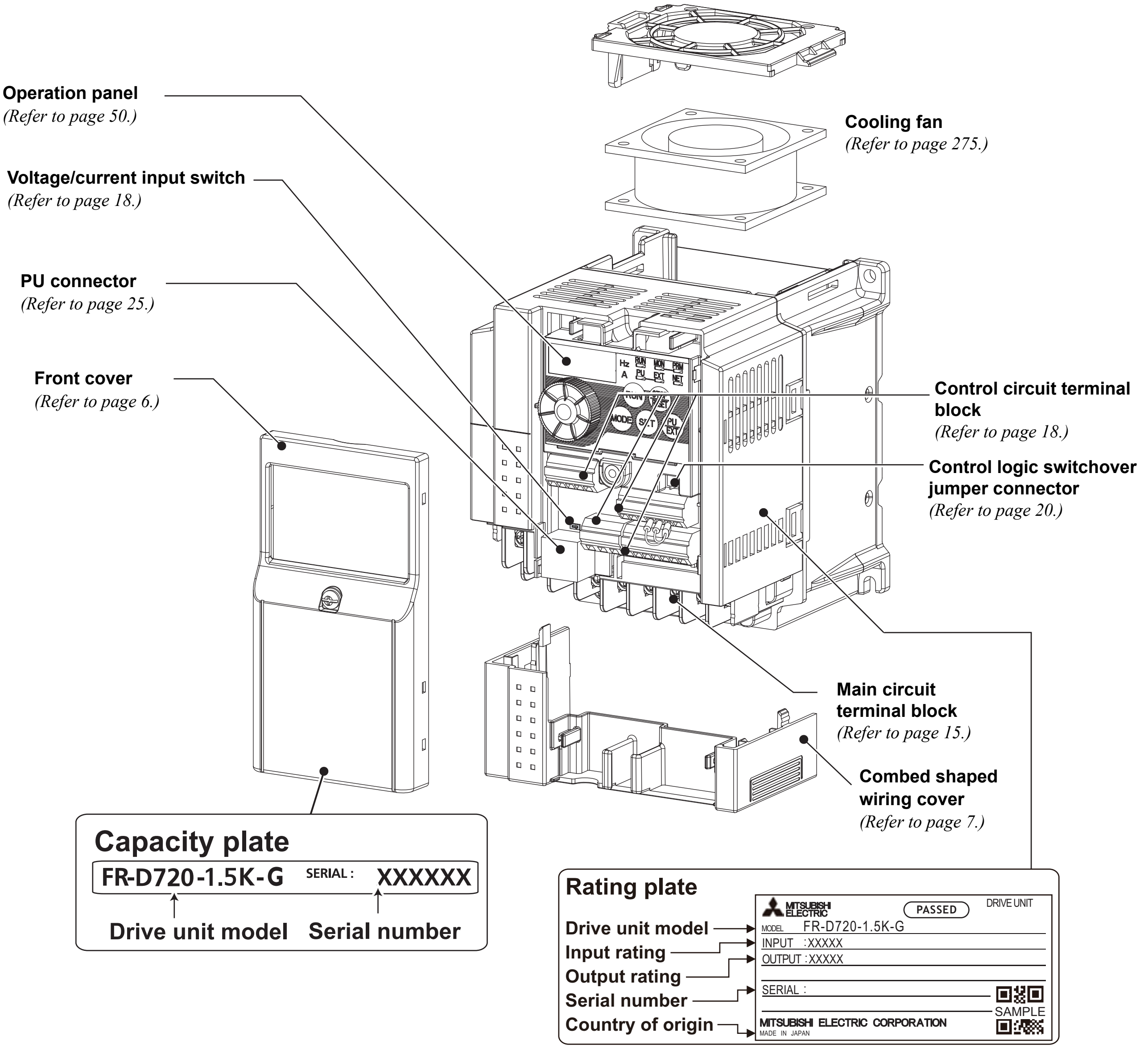
Unpack the drive unit and check the capacity plate on the front cover and the rating plate on the drive unit side face to ensure that the product agrees with your order and the drive unit is intact.

●Drive unit model

FR - D720 - 1.5 K - G

Symbol	Voltage class
D720	Three-phase 200V class
D740	Three-phase 400V class

Represents the drive unit capacity [kW]



● Accessory

·Fan cover fixing screws (M3 × 35mm)

These screws are necessary for compliance with the EU Directive.

Capacity	Quantity
D720-0.2K to 0.75K-G D740-0.4K-G, 0.75K-G	none
D720-1.5K to 3.7K-G D740-1.5K to 3.7K-G	1

1.2 Drive unit and peripheral devices

AC power supply
Use within the permissible power supply specifications of the drive unit. To ensure safety, use a molded case circuit breaker, earth leakage circuit breaker or magnetic contactor to switch power ON/OFF.
(Refer to page 284.)

Molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB), fuse
The breaker must be selected carefully since an in-rush current flows in the drive unit at power on.
(Refer to page 4.)

Magnetic contactor (MC)
Install the magnetic contactor to ensure safety. Do not use this magnetic contactor to start and stop the drive unit. Doing so will cause the drive unit life to be shorten.
(Refer to page 44.)

Reactor (FR-HAL, FR-HEL option)
Reactors (option) must be used when power harmonics measures are taken, the power factor is to be improved or the drive unit is installed near a large power supply system (500kVA or more). The drive unit may be damaged if you do not use reactors. Select the reactor according to the model. Remove the jumpers across terminals P/+ and P1 to connect the DC reactor.

AC reactor (FR-HAL)

DC reactor (FR-HEL) *

Parameter unit (FR-PU07)

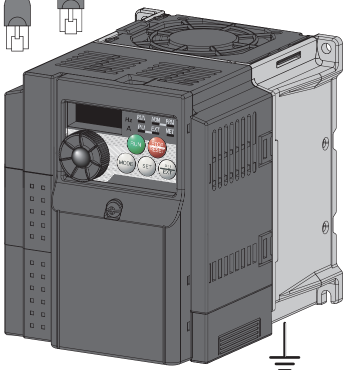
Enclosure surface operation panel (FR-PA07)
By connecting the connection cable (FR-CB2) to the PU connector, operation can be performed from FR-PU07, FR-PA07.
(Refer to page 25.)

RS-232C - RS-485 converter is required when connecting to PC with RS-232C interface.
(Refer to page 181.)

RS-485⇔RS-232C Converter

Brake resistor (FR-ABR, MRS type, MYS type)
Braking capability can be improved. (0.4K or higher)
(Refer to page 27.)

P/+
PR



Drive unit (FR-D700-G)

Earth (Ground)

Noise filter (ferrite core) * **(FR-BSF01, FR-BLF)**
Install a noise filter (ferrite core) to reduce the electromagnetic noise generated from the drive unit. Effective in the range from about 1MHz to 10MHz. When more wires are passed through, a more effective result can be obtained. A wire should be wound four turns or more.

P/+ P1

R/L1 S/L2 T/L3

Noise filter (capacitor) * **(FR-BIF)**
Reduces the radio noise.

P/+ N/-

U V W

Noise filter (ferrite core) (FR-BSF01, FR-BLF)
Install a noise filter (ferrite core) to reduce the electromagnetic noise generated from the drive unit. Effective in the range from about 1MHz to 10MHz. A wire should be wound four turns at a maximum.

Contactor
Example: No-fuse switch (DSN type)
Install a contactor in an application where the PM motor is driven by the load even at power-OFF of the drive unit. Do not open or close the contactor while the drive unit is running (outputting).

Motor

Earth (Ground)

* Filterpack (FR-BFP2), which contains DC reactor and noise filter in one package, is also available.

High power factor converter (FR-HC2)
Power supply harmonics can be greatly suppressed.

Power regeneration common converter (FR-CV)
Great braking capability is obtained.

Brake unit (FR-BU2)

P/+ PR
P/+
PR

Resistor unit (FR-BR)
Discharging resistor (GZG, GRZG)
The regenerative braking capability of the drive unit can be exhibited fully.

: Install this as required.

Devices connected to the output
Do not install a power factor correction capacitor, surge suppressor or noise filter (capacitor) on the output side of the drive unit. When installing a molded case circuit breaker on the output side of the drive unit, contact each manufacturer for selection of the molded case circuit breaker.

Earth (Ground)
To prevent an electric shock, always earth (ground) the motor and drive unit. For reduction of induction noise from the power line of the drive unit, it is recommended to wire the earth (ground) cable by returning it to the earth (ground) terminal of the drive unit.

NOTE

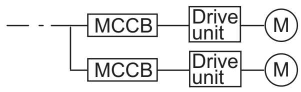
- **The life of the drive unit is influenced by surrounding air temperature. Pay attention to the surrounding air temperature. This must be noted especially when the drive unit is installed in an enclosure.** *(Refer to page 8.)*
- **Wrong wiring might lead to damage of the drive unit. The control signal lines must be kept fully away from the main circuit to protect them from noise.** *(Refer to page 14.)*
- **Do not install a power factor correction capacitor, surge suppressor or noise filter (capacitor) on the drive unit output side. This will cause the drive unit to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are connected, immediately remove them.**
- **Electromagnetic wave interference**
  The input/output (main circuit) of the drive unit includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the drive unit. In this case, install the FR-BIF optional noise filter (capacitor) (for use in the input side only) or FR-BSF01 or FR-BLF noise filter (ferrite core) to minimize interference. *(Refer to page 38.)*
- **Refer to** *the Instruction Manual of each option and peripheral devices* **for details of peripheral devices.**
- **A PM motor cannot be driven by the commercial power supply.**
- **A PM motor is a magnet motor. High-voltage is generated at motor terminals while the motor is running even after the drive unit power is turned OFF. Before closing the contactor on the output side, make sure that the drive unit power is ON and the motor is stopped.**

1.2.1 Peripheral devices

Check the drive unit model of the drive unit you purchased. Appropriate peripheral devices must be selected according to the capacity.
Refer to the following list and prepare appropriate peripheral devices.
(1) S-PM geared motor

Voltage	Applicable Drive Unit Model	Motor Output (kW)	Molded Case Circuit Breaker (MCCB)*1 or Earth Leakage Circuit Breaker (ELB)*2 (NF or NV type)		Input Side Magnetic Contactor*3		Reactor	
			Power factor improving (AC or DC) reactor connection		Power factor improving (AC or DC) reactor connection		FR-HAL	FR-HEL
			Without	With	Without	With		
200V class	FR-D720-0.2K-G	0.1	5A	5A	S-T10	S-T10	0.4K *4	0.4K *4
	FR-D720-0.4K-G	0.2	5A	5A	S-T10	S-T10	0.4K *4	0.4K *4
	FR-D720-0.75K-G	0.4	10A	5A	S-T10	S-T10	0.4K	0.4K
	FR-D720-1.5K-G	0.75	15A	10A	S-T10	S-T10	0.75K	0.75K
	FR-D720-2.2K-G	1.5	20A	15A	S-T10	S-T10	1.5K	1.5K
	FR-D720-3.7K-G	2.2	30A	30A	S-T21	S-T10	2.2K	2.2K
400V class	FR-D740-0.4K-G	0.2	5A	5A	S-T10	S-T10	H0.4K *4	H0.4K *4
	FR-D740-0.75K-G	0.4	5A	5A	S-T10	S-T10	H0.4K	H0.4K
	FR-D740-1.5K-G	0.75	10A	10A	S-T10	S-T10	H0.75K	H0.75K
	FR-D740-2.2K-G	1.5	15A	10A	S-T10	S-T10	H1.5K	H1.5K
	FR-D740-3.7K-G	2.2	20A	15A	S-T10	S-T10	H2.2K	H2.2K

*1 •Select an MCCB according to the power supply capacity.
•Install one MCCB per drive unit.

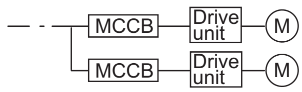


*2 For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Basic), and select an appropriate fuse or molded case circuit breaker (MCCB).
*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the drive unit input side current as JEM1038-AC-3 class rated current.
*4 The power factor may be slightly lower.

(2) Other PM motor (IPM or SPM)

Voltage	Applicable Drive Unit Model	Motor Output (kW)	Molded Case Circuit Breaker (MCCB)*1 or Earth Leakage Circuit Breaker (ELB)*2 (NF or NV type)		Input Side Magnetic Contactor*3		Reactor	
			Power factor improving (AC or DC) reactor connection		Power factor improving (AC or DC) reactor connection		FR-HAL	FR-HEL
			Without	With	Without	With		
200V class	FR-D720-0.2K-G	0.2	5A	5A	S-T10	S-T10	0.4K*4	0.4K*4
	FR-D720-0.4K-G	0.4	5A	5A	S-T10	S-T10	0.4K	0.4K
	FR-D720-0.75K-G	0.75	10A	5A	S-T10	S-T10	0.75K	0.75K
	FR-D720-1.5K-G	1.5	15A	10A	S-T10	S-T10	1.5K	1.5K
	FR-D720-2.2K-G	2.2	20A	15A	S-T10	S-T10	2.2K	2.2K
	FR-D720-3.7K-G	3.7	30A	30A	S-T21	S-T10	3.7K	3.7K
400V class	FR-D740-0.4K-G	0.4	5A	5A	S-T10	S-T10	H0.4K	H0.4K
	FR-D740-0.75K-G	0.75	5A	5A	S-T10	S-T10	H0.75K	H0.75K
	FR-D740-1.5K-G	1.5	10A	10A	S-T10	S-T10	H1.5K	H1.5K
	FR-D740-2.2K-G	2.2	15A	10A	S-T10	S-T10	H2.2K	H2.2K
	FR-D740-3.7K-G	3.7	20A	15A	S-T10	S-T10	H3.7K	H3.7K

*1 •Select an MCCB according to the power supply capacity.
•Install one MCCB per drive unit.



*2 For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Basic), and select an appropriate fuse or molded case circuit breaker (MCCB).

*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the drive unit input side current as JEM1038-AC-3 class rated current.

*4 The power factor may be slightly lower.

NOTE

- **Select a MCCB and a magnetic contactor according to the drive unit model, and cable and reactor according to the motor output.**
- **When the breaker on the drive unit input side trips, check for the wiring fault (short circuit), damage to internal parts of the drive unit, etc. Identify the cause of the trip, then remove the cause and power ON the breaker.**

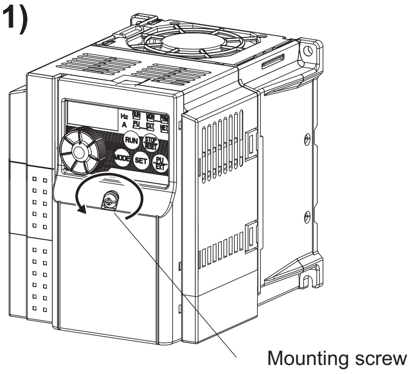
1.3 Removal and reinstallation of the cover

1.3.1 Front cover

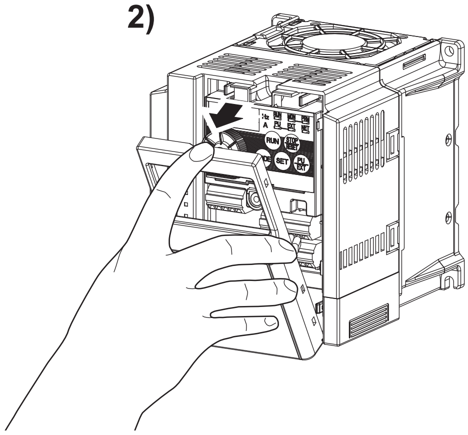
●Removal (Example of FR-D720-1.5K-G)

1) Loosen the mounting screws of the front cover. (The screws cannot be removed.)
2) Remove the front cover by pulling it like the direction of arrow.

1)



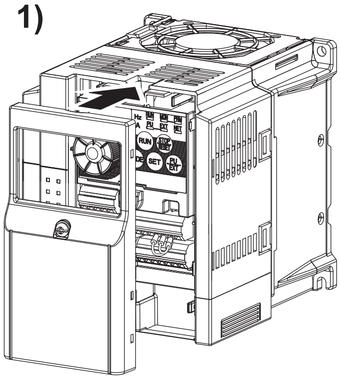
2)



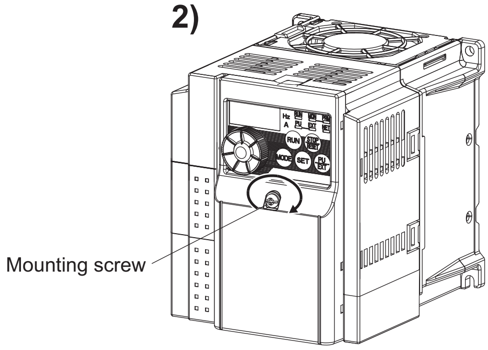
●Reinstallation (Example of FR-D720-1.5K-G)

1) Place the front cover in front of the drive unit, and install it straight.
2) Tighten the mounting screws on the front cover.

1)



2)



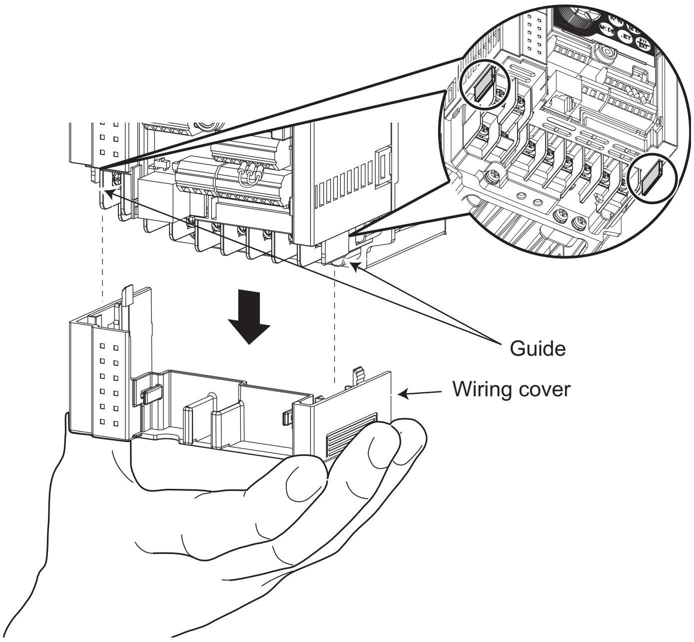
NOTE

- **Fully make sure that the front cover has been reinstalled securely.**
- **The same serial number is printed on the capacity plate of the front cover and the rating plate of the drive unit. Since these plates have the same serial numbers, always reinstall the removed cover onto the original drive unit.**

1.3.2 Wiring cover

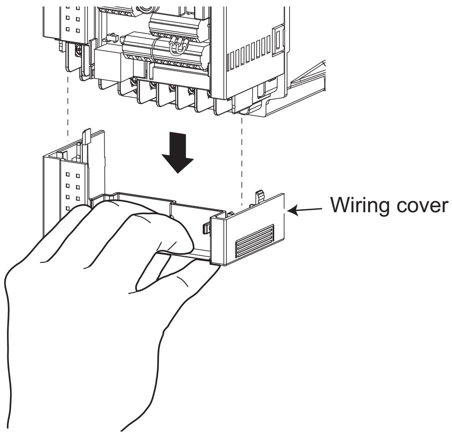
●Removal and reinstallation

- Hold the side of the wiring cover, and pull it downward for removal.
  To reinstall, fit the cover to the drive unit along the guides.



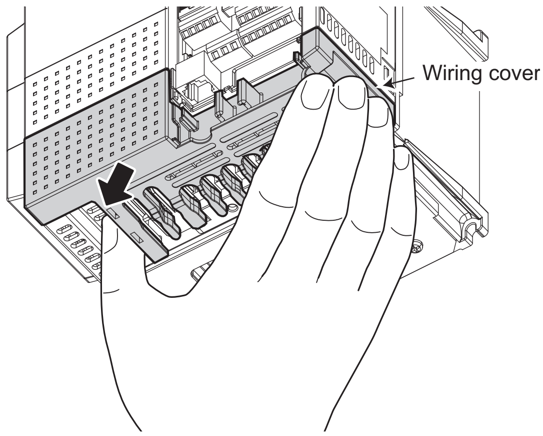
Example of FR-D720-1.5K-G

- Also pull the wiring cover downward by holding a frontal part of the wiring cover.



Example of FR-D720-1.5K-G

- See below diagram for wiring cover of FR-D720-3.7K-G. Hold the dent of the wiring cover (marked with an arrow) with thumb and the side with other fingers and pull downward for removal.



1.4 Installation of the drive unit and enclosure design

When a drive unit enclosure is to be designed and manufactured, heat generated by contained equipment, etc., the environment of an operating place, and others must be fully considered to determine the enclosure structure, size and equipment layout. The drive unit unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the drive unit in the ambient environment that completely satisfies the equipment specifications.

1.4.1 Drive unit installation environment

As the drive unit installation environment should satisfy the standard specifications indicated in the following table, operation in any place that does not meet these conditions not only deteriorates the performance and life of the drive unit, but also causes a failure. Refer to the following points and take adequate measures.

Environmental standard specifications of drive unit

Item	Description
Surrounding air temperature	-10°C to +50°C (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
Maximum altitude	1,000m or less
Vibration	5.9m/s^2 or less at 10 to 55Hz (directions of X, Y, Z axes)

(1) Temperature

The permissible surrounding air temperature of the drive unit is between -10°C and +50°C. Always operate the drive unit within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures so that the surrounding air temperature of the drive unit falls within the specified range.

1) Measures against high temperature
   - Use a forced ventilation system or similar cooling system. *(Refer to page 10.)*
   - Install the panel in an air-conditioned electrical chamber.
   - Block direct sunlight.
   - Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
   - Ventilate the area around the panel well.

2) Measures against low temperature
   - Provide a space heater in the enclosure.
   - Do not power OFF the drive unit. (Keep the start signal of the drive unit OFF.)

3) Sudden temperature changes
   - Select an installation place where temperature does not change suddenly.
   - Avoid installing the drive unit near the air outlet of an air conditioner.
   - If temperature changes are caused by opening/closing of a door, install the drive unit away from the door.

(2) Humidity

Normally operate the drive unit within the 45 to 90% range of the ambient humidity. Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may produce a spatial electrical breakdown. The insulation distance specified in JEM1103 "Control Equipment Insulator" is defined as humidity 45 to 85%.

1) Measures against high humidity
   - Make the panel enclosed, and provide it with a hygroscopic agent.
   - Take dry air into the enclosure from outside.
   - Provide a space heater in the enclosure.

2) Measures against low humidity

   What is important in fitting or inspection of the unit in this status is to discharge your body (static electricity) beforehand and keep your body from contact with the parts and patterns, besides blowing air of proper humidity into the enclosure from outside.

3) Measures against condensation

   Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside-air temperature changes suddenly.

   Condensation causes such faults as reduced insulation and corrosion.
   - Take the measures against high humidity in 1).
   - Do not power OFF the drive unit. (Keep the start signal of the drive unit OFF.)

(3) Dust, dirt, oil mist

Dust and dirt will cause such faults as poor contact of contact points, reduced insulation or reduced cooling effect due to moisture absorption of accumulated dust and dirt, and in-enclosure temperature rise due to clogged filter. In the atmosphere where conductive powder floats, dust and dirt will cause such faults as malfunction, deteriorated insulation and short circuit in a short time.
Since oil mist will cause similar conditions, it is necessary to take adequate measures.

Countermeasures
- Place in a totally enclosed enclosure.
  Take measures if the in-enclosure temperature rises. *(Refer to page 10.)*
- Purge air.
  Pump clean air from outside to make the in-enclosure pressure higher than the outside-air pressure.

(4) Corrosive gas, salt damage

If the drive unit is exposed to corrosive gas or to salt near a beach, the printed board patterns and parts will corrode or the relays and switches will result in poor contact.
In such places, take the measures given in Section 3.

(5) Explosive, flammable gases

As the drive unit is non-explosion proof, it must be contained in an explosion proof enclosure. In places where explosion may be caused by explosive gas, dust or dirt, an enclosure cannot be used unless it structurally complies with the guidelines and has passed the specified tests. This makes the enclosure itself expensive (including the test charges). The best way is to avoid installation in such places and install the drive unit in a non-hazardous place.

(6) Highland

Use the drive unit at the altitude of within 1000m. If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.

(7) Vibration, impact

The vibration resistance of the drive unit is up to 5.9m/s^2 at 10 to 55Hz frequency and 1mm amplitude for the directions of X, Y, Z axes. Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors.
Especially when impact is imposed repeatedly, caution must be taken as the part pins are likely to break.

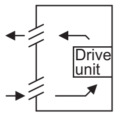
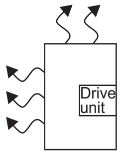
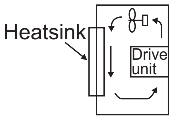
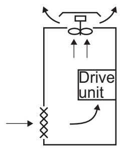
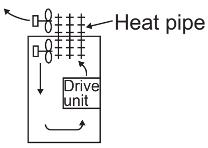
Countermeasures
- Provide the panel with rubber vibration isolators.
- Strengthen the structure to prevent the enclosure from resonance.
- Install the enclosure away from sources of vibration.

1.4.2 Cooling system types for drive unit enclosure

From the enclosure that contains the drive unit, the heat of the drive unit and other equipment (transformers, lamps, resistors, etc.) and the incoming heat such as direct sunlight must be dissipated to keep the in-enclosure temperature lower than the permissible temperatures of the in-enclosure equipment including the drive unit.

The cooling systems are classified as follows in terms of the cooling calculation method.

1) Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)
2) Cooling by heat sink (aluminum fin, etc.)
3) Cooling by ventilation (forced ventilation type, pipe ventilation type)
4) Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

Cooling System		Enclosure Structure	Comment
Natural cooling	Natural ventilation (enclosed, open type)		Low in cost and generally used, but the enclosure size increases as the drive unit capacity increases. For relatively small capacities.
	Natural ventilation (totally enclosed type)		Being a totally enclosed type, the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the drive unit capacity.
Forced cooling	Heatsink cooling		Having restrictions on the heatsink mounting position and area, and designed for relative small capacities.
	Forced ventilation		For general indoor installation. Appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe		Totally enclosed type for enclosure downsizing.

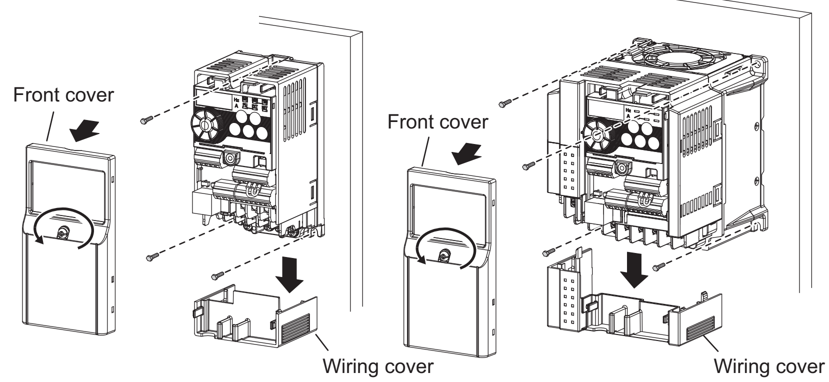
1.5 Drive unit placement

Enclosure surface mounting

Remove the front cover and wiring cover to mount the drive unit to the surface. (Remove the covers in the directions of the arrows.)

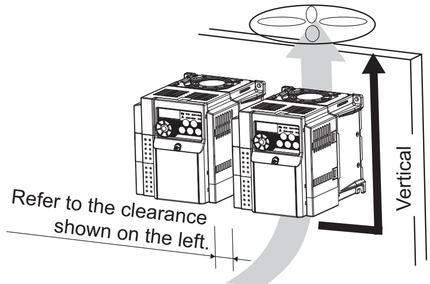
●FR-D720-0.2K to 0.75K-G

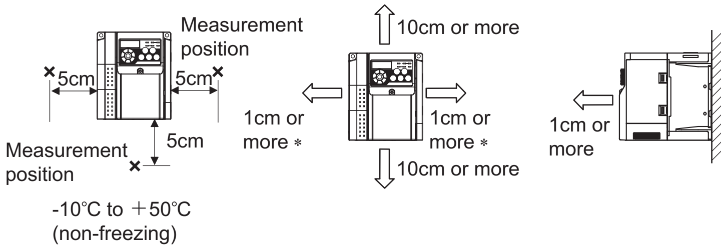
●FR-D720-1.5K to 3.7K-G
●FR-D740-0.4K to 3.7K-G



NOTE

- **When encasing multiple drive units, install them in parallel as a cooling measure.**
- **Install the drive unit vertically.**
- **For heat dissipation and maintenance, allow minimum clearance shown in the figures below from the drive unit to the other devices and to the inner surface of the enclosure.**





* When using the drive units at the surrounding air temperature of 40°C or less, the drive units can be installed without any clearance between them (0cm clearance).

- **When designing or building an enclosure for the drive unit, carefully consider influencing factors such as heat generation of the contained devices and the operating environment.**

1.5.1 Installation precautions

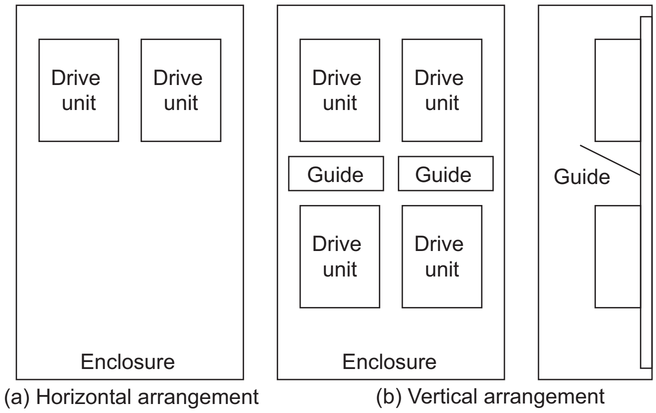
(1) Above drive unit

Heat is blown up from inside the drive unit by the small fan built in the unit. Any equipment placed above the drive unit should be heat resistant.

(2) Arrangement of multiple drive units

When multiple drive units are placed in the same enclosure, generally arrange them horizontally as shown in the right figure (a). When it is inevitable to arrange them vertically to minimize space, take such measures as to provide guides since heat from the bottom drive units can increase the temperatures in the top drive units, causing drive unit failures.

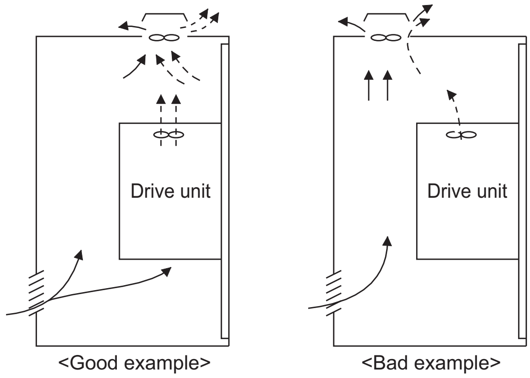
When mounting multiple drive units, fully take caution not to make the surrounding air temperature of the drive unit higher than the permissible value by providing ventilation and increasing the enclosure size.



Arrangement of multiple drive units

(3) Arrangement of ventilation fan and drive unit

Heat generated in the drive unit is blown up from the bottom of the unit as warm air by the cooling fan. When installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the drive unit to cool air.)



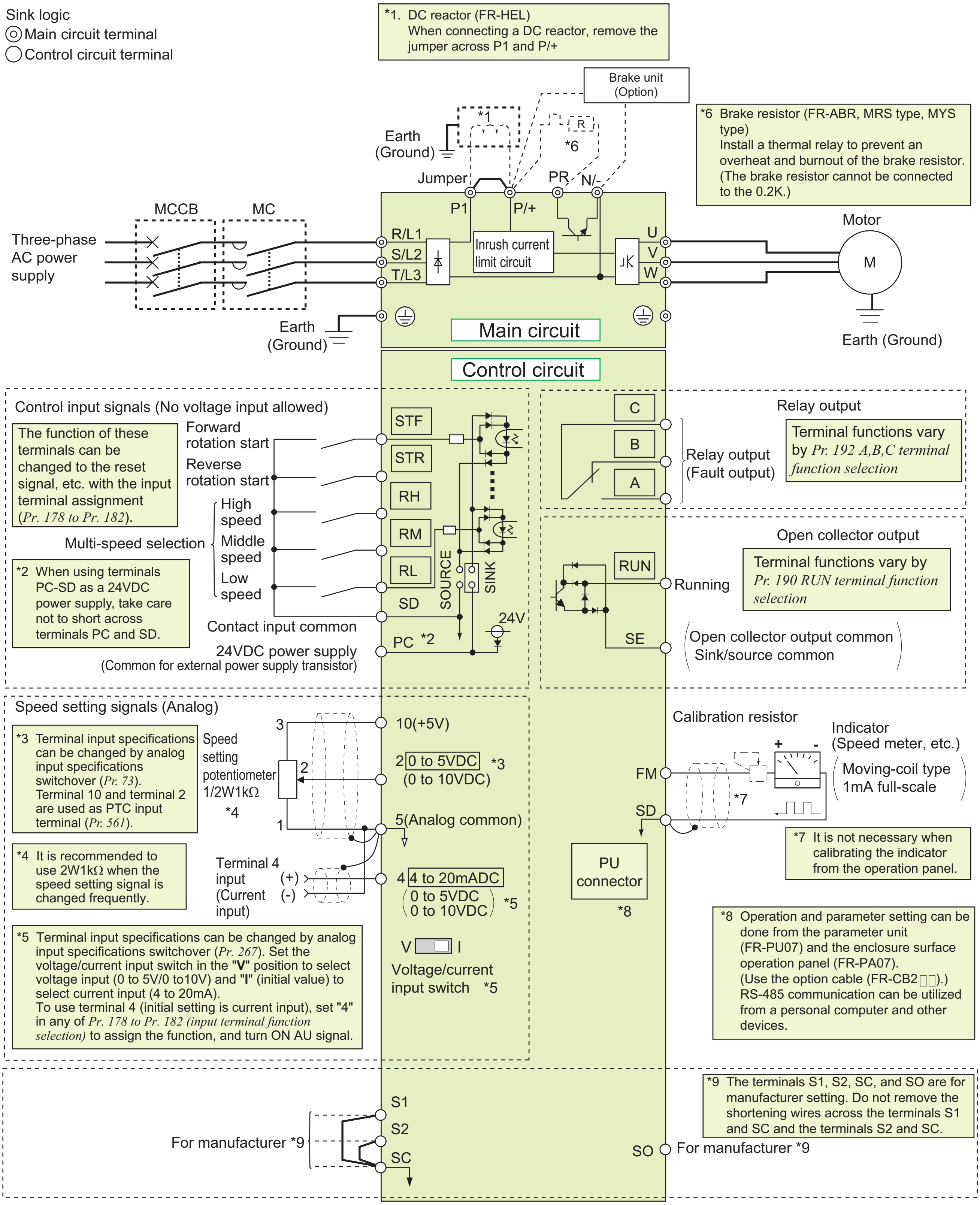
Arrangement of ventilation fan and drive unit

2 WIRING

This chapter describes the basic "WIRING" for use of this product.
Always read the instructions before using the equipment.

2.1 Wiring

2.1.1 Terminal connection diagram



NOTE

- **To prevent a malfunction caused by noise, separate the signal cables more than 10cm from the power cables. Also separate the main circuit wire of the input side and the output side.**
- **After wiring, wire offcuts must not be left in the drive unit.**
  Wire offcuts can cause an alarm, failure or malfunction. Always keep the drive unit clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the drive unit.

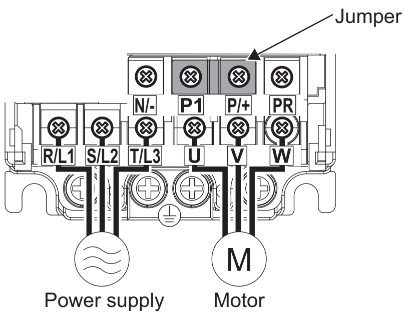
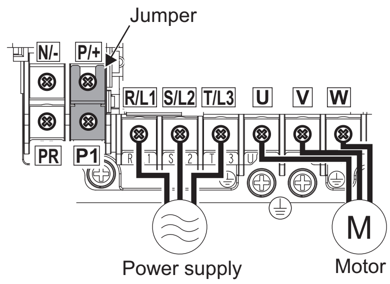
2.2 Main circuit terminal specifications

2.2.1 Specification of main circuit terminal

●Drive unit

Terminal Symbol	Terminal Name	Description	Refer to Page
R/L1, S/L2, T/L3	AC power input	Connect to the commercial power supply. Keep these terminals open when using the high power factor converter (FR-HC2) or power regeneration common converter (FR-CV).	*15*
U, V, W	Drive unit output	Connect a PM motor.	*15*
P/+, PR	Brake resistor connection	Connect a brake resistor (FR-ABR, MRS type, MYS type) across terminals P/+ and PR. (The brake resistor cannot be connected to the 0.2K.)	*27*
P/+, N/-	Brake unit connection	Connect the brake unit (FR-BU2), power regeneration common converter (FR-CV) or high power factor converter (FR-HC2).	*29*
P/+, P1	DC reactor connection	Remove the jumper across terminals P/+ and P1 and connect a DC reactor. When a DC reactor is not connected, the jumper across terminals P/+ and P1 should not be removed.	*33*
⏚	Earth (Ground)	For earthing (grounding) the drive unit chassis. Must be earthed (grounded).	*17*

2.2.2 Terminal arrangement of the main circuit terminal, power supply and the motor wiring

FR-D720-0.2K to 0.75K-G	FR-D720-1.5K to 3.7K-G FR-D740-0.4K to 3.7K-G
	

NOTE

- **Make sure the power cables are connected to the R/L1, S/L2, and T/L3. (Phase need not be matched.) Never connect the power cable to the U, V, and W of the drive unit. Doing so will damage the drive unit.**
- **Connect the motor to U, V, W. Turning ON the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft. The rotation direction of the output shaft may differ depending on the reduction gear. Check the motor specifications.**

2.2.3 Cables and wiring length

(1) Applied wire size

Select the recommended cable size to ensure that a voltage drop will be 2% or less.

If the wiring distance is long between the drive unit and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low speed.

The following table indicates a selection example for the wiring length of 20m.

Three-phase 200V class (when input power supply is 220V)

<table>
<tr><th rowspan="3">Applicable Drive Unit Model</th><th rowspan="3">Terminal Screw Size *4</th><th rowspan="3">Tightening Torque N·m</th><th colspan="2" rowspan="2">Crimp Terminal</th><th colspan="8">Cable Size</th></tr>
<tr><th colspan="3">HIV Cables, etc. (mm^2) *1</th><th colspan="2">AWG *2</th><th colspan="3">PVC Cables, etc. (mm^2) *3</th></tr>
<tr><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>Earthing (grounding) cable</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>Earthing (grounding) cable</th></tr>
<tr><td>FR-D720-0.2K to 0.75K-G</td><td>M3.5</td><td>1.2</td><td>2-3.5</td><td>2-3.5</td><td rowspan="2">2</td><td rowspan="2">2</td><td rowspan="2">2</td><td rowspan="2">14</td><td rowspan="2">14</td><td rowspan="2">2.5</td><td rowspan="2">2.5</td><td rowspan="2">2.5</td></tr>
<tr><td>FR-D720-1.5K to 3.7K-G</td><td>M4</td><td>1.5</td><td>2-4</td><td>2-4</td></tr>
</table>

Three-phase 400V class (when input power supply is 440V)

<table>
<tr><th rowspan="3">Applicable Drive Unit Model</th><th rowspan="3">Terminal Screw Size *4</th><th rowspan="3">Tightening Torque N·m</th><th colspan="2" rowspan="2">Crimp Terminal</th><th colspan="8">Cable Size</th></tr>
<tr><th colspan="3">HIV Cables, etc. (mm^2) *1</th><th colspan="2">AWG *2</th><th colspan="3">PVC Cables, etc. (mm^2) *3</th></tr>
<tr><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>Earthing (grounding) cable</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>R/L1 S/L2 T/L3</th><th>U, V, W</th><th>Earthing (grounding) cable</th></tr>
<tr><td>FR-D740-0.4K to 3.7K-G</td><td>M4</td><td>1.5</td><td>2-4</td><td>2-4</td><td>2</td><td>2</td><td>2</td><td>14</td><td>14</td><td>2.5</td><td>2.5</td><td>2.5</td></tr>
</table>

*1 The cable size is that of the cable (HIV cable (600V class 2 vinyl-insulated cable) etc.) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20m or less.

*2 The recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less. (For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Basic).)

*3 The recommended cable size is that of the cable (PVC cable) with continuous maximum permissible temperature of 70°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less. (Selection example for use mainly in Europe.)

*4 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, PR, P/+, N/-, P1 and a screw for earthing (grounding).

NOTE

- **Tighten the terminal screw to the specified torque. A screw that has been tightened too loosely can cause a short circuit or malfunction. A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breakage.**
- **Use crimp terminals with insulation sleeve to wire the power supply and motor.**

The line voltage drop can be calculated by the following formula:

$$\text{Line voltage drop [V]} = \frac{\sqrt{3} \times \text{wire resistance[m}\Omega\text{/m]} \times \text{wiring distance[m]} \times \text{current[A]}}{1000}$$

Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

(2) Earthing (Grounding) precautions

- Always earth (ground) the motor and drive unit.

1) Purpose of earthing (grounding)

Generally, an electrical apparatus has an earthing (grounding) terminal, which must be connected to the ground before use.

An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flow into the case. The purpose of earthing (grounding) the case of an electrical apparatus is to prevent operator from getting an electric shock from this leakage current when touching it.

To avoid the influence of external noises, this earthing (grounding) is important to audio equipment, sensors, computers and other apparatuses that handle low-level signals or operate very fast.

2) Earthing (grounding) methods and earthing (grounding) work

As described previously, earthing (grounding) is roughly classified into an electrical shock prevention type and a noise-affected malfunction prevention type. Therefore, these two types should be discriminated clearly, and the following work must be done to prevent the leakage current having the drive unit's high frequency components from entering the malfunction prevention type earthing (grounding):

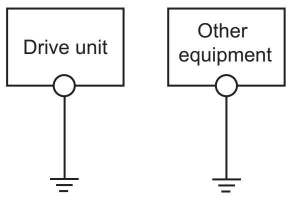
(a)If possible, use (I) independent earthing (grounding) in figure below for the drive unit. If independent earthing (grounding) is not available, use (II) common earthing (grounding) in the figure below where the drive unit is connected with the other equipment at an earthing (grounding) point.
The (III) common earthing (grounding) cable as in the figure below, which drive unit shares a common earthing (grounding) cable with the other equipment, must be avoided.
A leakage current including many high frequency components flows in the earthing (grounding) cables of the drive unit and drive unit-driven motor. Therefore, use the independent earthing (grounding) and separate the earthing (grounding) cable of the drive unit from equipment sensitive to EMI.
In a high building, it may be effective to use the EMI prevention type earthing (grounding) connecting to an iron structure frame, and electric shock prevention type earthing (grounding) with the independent earthing (grounding) together.

(b)This drive unit must be earthed (grounded). Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards).
Use an neutral-point earthed (grounded) power supply for 400V class drive unit in compliance with EN standard.

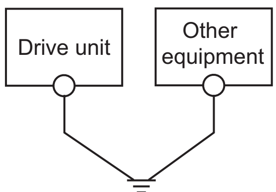
(c)Use the thickest possible earthing (grounding) cable. The earthing (grounding) cable size should be no less than the size indicated in the table on *page 16*.

(d)The earthing (grounding) point should be as close as possible to the drive unit, and the earthing (grounding) cable length should be as short as possible.

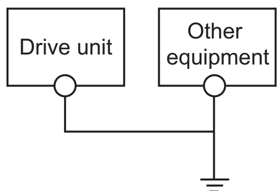
(e)Run the earthing (grounding) cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.



(I)Independent earthing (grounding).......Best



(II)Common earthing (grounding).......Good



(III)Common earthing (grounding) cable.......Not allowed

POINT

To be compliant with the EU Directive (Low Voltage Directive), *refer to the Instruction Manual (Basic).*

(3) Total wiring length

Connect a PM motor within the total wiring length of 30m.
Use one PM motor for one drive unit. Multiple PM motors cannot be connected to a drive unit.

NOTE

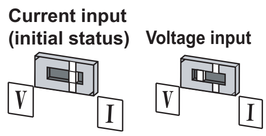
- **Especially for long-distance wiring, the drive unit may be affected by a charging current caused by the stray capacitances of the wiring, leading to a malfunction of the overcurrent protective function or the stall prevention function, or a malfunction or fault of the equipment connected on the drive unit's output side. If malfunction of stall prevention function occurs, increase the stall level.** ***(Refer to page 83 for Pr. 22 Stall prevention operation level*** **and** ***Pr. 156 Stall prevention operation selection.)***

2.3 Control circuit specifications

2.3.1 Control circuit terminal

[ ] indicates that terminal functions can be selected using *Pr. 178 to Pr. 182, Pr. 190, Pr. 192 (I/O terminal function selection)*. *(Refer to page 117.)*

(1) Input signal

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to Page
Contact input	STF	Forward rotation start	Turn ON the STF signal to start forward rotation and turn it OFF to stop.	When the STF and STR signals are turned ON simultaneously, the stop command is given.	Input resistance 4.7kΩ Voltage at opening 21 to 26VDC Current at short-circuited 4 to 6mADC	*121*
	STR	Reverse rotation start	Turn ON the STR signal to start reverse rotation and turn it OFF to stop.			
	RH, RM, RL	Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.			*89*
	SD	Contact input common (sink) (initial setting)	Common terminal for contact input terminal (sink logic) and terminal FM.		—	—
		External transistor common (source)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable currents.			
		24VDC power supply common	Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.			
	PC	External transistor common (sink) (initial setting)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable currents.		Power supply voltage range 22 to 26.5VDC permissible load current 100mA	*21*
		Contact input common (source)	Common terminal for contact input terminal (source logic).			
		24VDC power supply	Can be used as 24VDC 0.1A power supply.			
Speed setting	10	Speed setting power supply	Used as power supply when connecting potentiometer for speed setting from outside of the drive unit. *(Refer to Pr. 73 Analog input selection.)*		5.0V ± 0.2VDC permissible load current 10mA	*147*
	2	Speed setting (voltage)	Inputting 0 to 5VDC (or 0 to 10V) provides the maximum rotation speed at 5V (10V) and makes input and output proportional. Use *Pr. 73* to switch between input 0 to 5VDC input (initial setting) and 0 to 10VDC.		Input resistance10kΩ ± 1kΩ Permissible maximum voltage 20VDC	*147*
	4	Speed setting (current)	Inputting 4 to 20mADC (or 0 to 5V, 0 to 10V) provides the maximum rotation speed at 20mA and makes input and output proportional. This input signal is valid only when the AU signal is ON (terminal 2 input is invalid). Use *Pr. 267* to switch from among input 4 to 20mA (initial setting), 0 to 5VDC and 0 to 10VDC. Set the voltage/current input switch in the "V" position to select voltage input (0 to 5V/0 to 10V). 		Current input: Input resistance 249Ω ± 5Ω Maximum permissible current 30mA Voltage input: Input resistance10kΩ ± 1kΩ Permissible maximum voltage 20VDC	*147*
	5	Speed setting common	Speed setting signal (terminal 2, 4) common terminal. Do not earth (ground).		—	—
Thermistor	10 2	PTC thermistor input	For connecting PTC thermistor output. When PTC thermistor protection is valid (*Pr. 561* ≠ "9999"), terminal 2 is not available for speed setting.		Adaptive PTC thermistor specification Heat detection resistance : 500Ω to 30kΩ (Set by *Pr. 561*)	*101*

NOTE

Set *Pr. 267* and a voltage/current input switch correctly, then input analog signals in accordance with the settings.
Applying a voltage with voltage/current input switch in "I" position (current input is selected) or a current with switch in "V" position (voltage input is selected) could cause component damage of the drive unit or analog circuit of output devices. ***(Refer to page 147 for details.)***

(2) Output signal

Type	Terminal Symbol	Terminal Name	Description	Rated Specifications	Refer to Page
Relay	A, B, C	Relay output (fault output)	1 changeover contact output indicates that the drive unit protective function has activated and the output stopped. Fault: discontinuity across B-C (continuity across A-C), Normal: continuity across B-C (discontinuity across A-C)	Contact capacity:230VAC 0.3A (power factor =0.4) 30VDC 0.3A	*123*
Open collector	RUN	Drive unit running	Switched Low when the drive unit rotation speed is equal to or higher than the 1r/min. Switched High during stop or DC injection brake operation. (Low is when the open collector output transistor is ON (conducts). High is when the transistor is OFF (does not conduct).)	Permissible load 24VDC (maximum 27VDC) 0.1A (a voltage drop is 3.4V maximum when the signal is ON)	*123*
	SE	Open collector output common	Common terminal of terminal RUN.	—	—
Pulse	FM	For meter	Select one e.g. rotation speed from monitor items. Not output during drive unit reset. Not output during drive unit reset. The output signal is proportional to the magnitude of the corresponding monitoring item. Use *Pr. 55* and *Pr. 56* to set full-scale values for monitoring the rotation speed and the output current. *(Refer to page 139.)*	Permissible load current 1mA 1440 pulses/s at 3000r/min	*134*

(3) Communication

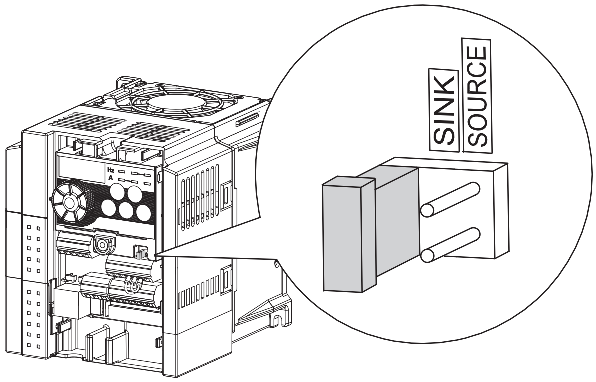
Type	Terminal Symbol	Terminal Name	Description	Refer to Page
Communication	—	PU connector	With the PU connector, communication can be made through RS-485. • Conforming standard: EIA-485 (RS-485) • Transmission format: Multidrop link • Communication speed: 4800 to 38400bps • Overall length: 500m	*181*

NOTE

The terminals S1, S2, SC, and SO are for manufacturer setting. Do not connect anything to these. Doing so may cause a drive unit failure.

Do not remove the shortening wires across the terminals S1 and SC and the terminals S2 and SC. Removing either shortening wire disables the drive unit operation.

2.3.2 Changing the control logic



The input signals are set to sink logic (SINK) when shipped from the factory.

To change the control logic, the jumper connector above the control terminal must be moved to the other position.

- Change the jumper connector in the sink logic (SINK) position to source logic (SOURCE) position using tweezers, a pair of long-nose pliers etc. Change the jumper connector position before switching power ON.

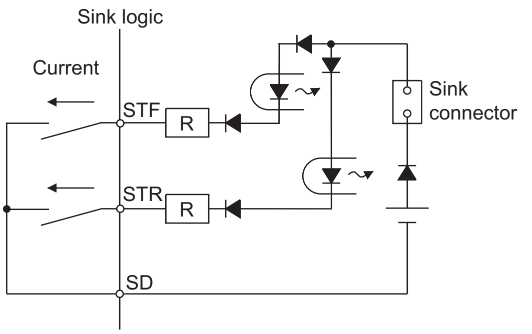
NOTE

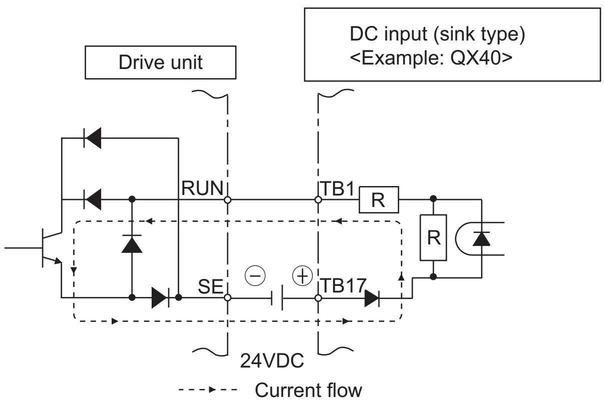
- **Fully make sure that the front cover has been reinstalled securely.**
- **The capacity plate is placed on the front cover and the rating plate is on the drive unit. Since these plates have the same serial numbers, always reinstall the removed cover onto the original drive unit.**
- **The sink-source logic change-over jumper connector must be fitted in only one of those positions. If it is fitted in both positions at the same time, the drive unit may be damaged.**

(1) Sink logic type and source logic type

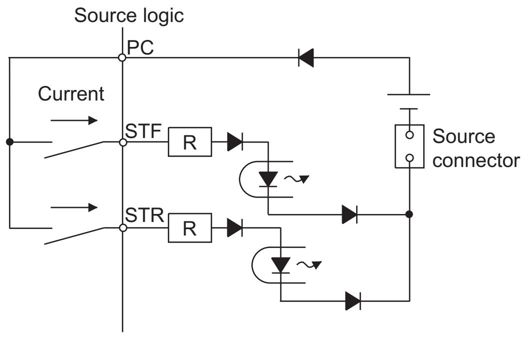
- In sink logic, a signal switches ON when a current flows from the corresponding signal input terminal.
  Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.
- In source logic, a signal switches ON when a current flows into the corresponding signal input terminal.
  Terminal PC is common to the contact input signals. Terminal SE is common to the open collector output signals.

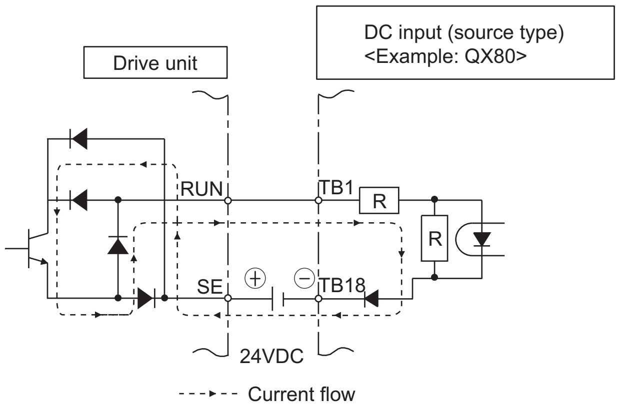
●Current flow concerning the input/output signal when sink logic is selected





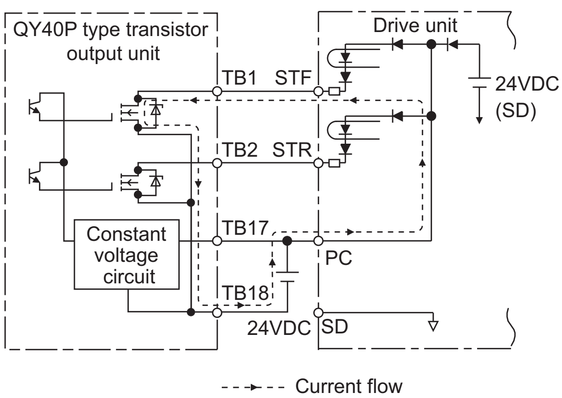
●Current flow concerning the input/output signal when source logic is selected



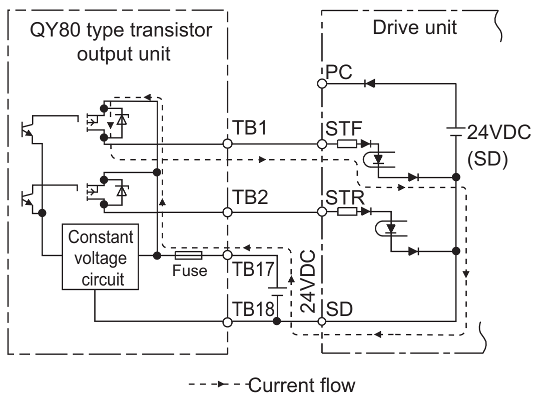


●When using an external power supply for transistor output

- Sink logic type
  Use terminal PC as a common terminal, and perform wiring as shown below. (Do not connect terminal SD of the drive unit with terminal 0V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install an external power supply in parallel with the drive unit. Doing so may cause a malfunction in the drive unit due to undesirable currents.)



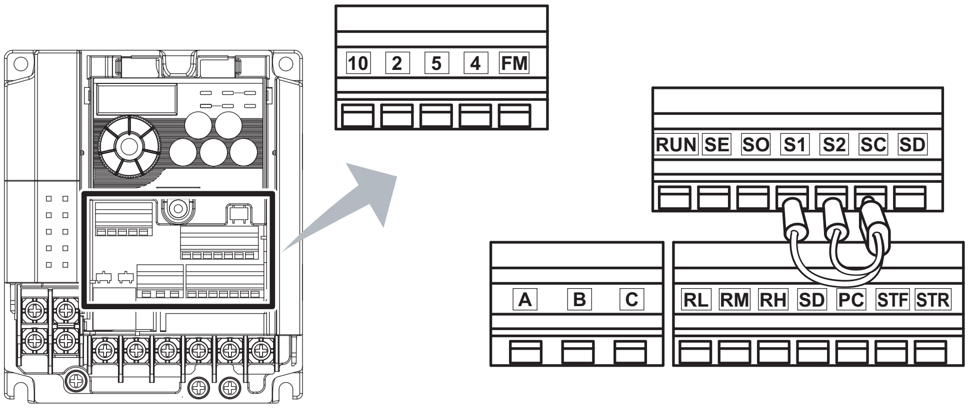
- Source logic type
  Use terminal SD as a common terminal, and perform wiring as shown below. (Do not connect terminal PC of the drive unit with terminal +24V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install an external power supply in parallel with the drive unit. Doing so may cause a malfunction in the drive unit due to undesirable currents.)



2.3.3 Wiring of control circuit

(1) Standard control circuit terminal layout

Recommend wire size:
0.3mm² to 0.75mm²



NOTE

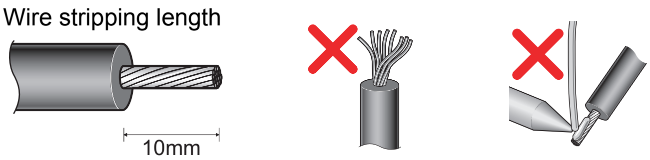
- **Do not remove the shortening wires across the terminals S1 and SC and the terminals S2 and SC. Removing either shortening wire disables the drive unit operation.**

(2) Wiring method

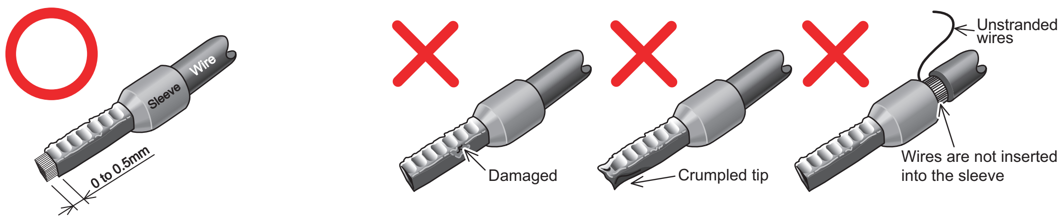
●Wiring

Use a blade terminal and a wire with a sheath stripped off for the control circuit wiring. For a single wire, strip off the sheath of the wire and apply directly.
Insert the blade terminal or the single wire into a socket of the terminal.

1) Strip off the sheath about the length below. If the length of the sheath peeled is too long, a short circuit may occur among neighboring wires. If the length is too short, wires might come off.
   Wire the stripped wire after twisting it to prevent it from becoming loose. In addition, do not solder it.

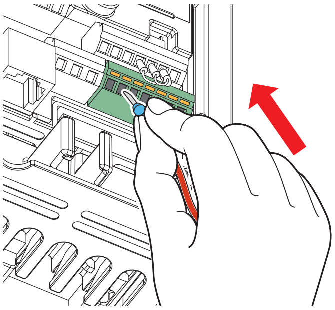


2) Crimp the blade terminal.
   Insert wires to a blade terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve.
   Check the condition of the blade terminal after crimping. Do not use a blade terminal of which the crimping is inappropriate, or the face is damaged.

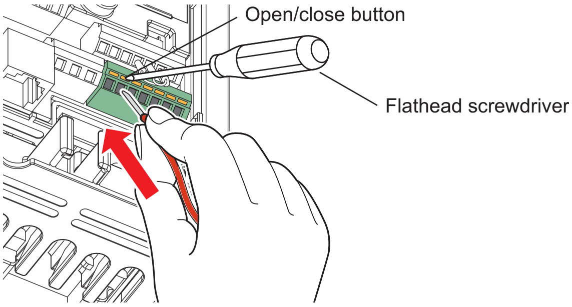


Refer to page 292 for the blade terminals available on the market.

3) Insert the wire into a socket.



When using a single wire or a stranded wire without a blade terminal, push an open/close button all the way down with a flathead screw driver, and insert the wire.

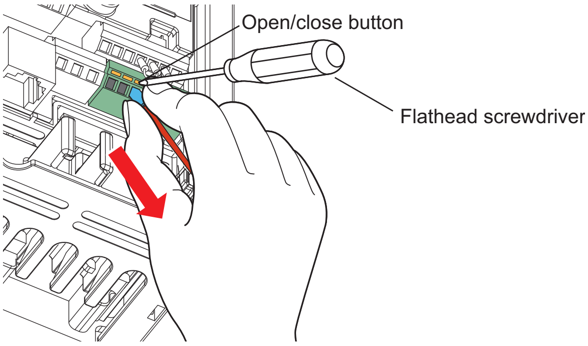


NOTE

- **When using a stranded wire without a blade terminal, twist enough to avoid short circuit with a nearby terminals or wires.**
- **Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause to damage of drive unit or injury.**

●Wire removal

Pull the wire with pushing the open/close button all the way down firmly with a flathead screwdriver.



NOTE

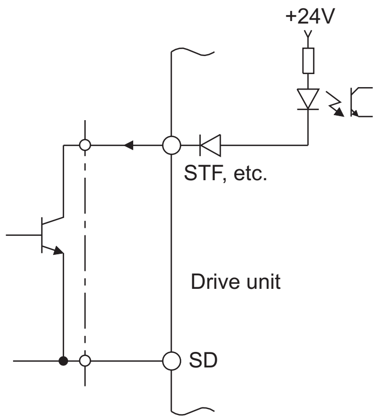
- **Pulling out the terminal block forcefully without pushing the open/close button all the way down may damage the terminal block.**
- **Use a small flathead screwdriver (Tip thickness: 0.4mm/ tip width: 2.5mm).**
  If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.
  Refer to ***page 292*** **for the flathead drivers available on the market.**
- **Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause to damage of drive unit or injury.**

(3) Control circuit common terminals (SD, 5, SE)

- Terminals SD, SE and 5 are common terminals for I/O signals. (All common terminals are isolated from each other.) Do not earth them. Avoid connecting the terminal SD and 5 and the terminal SE and 5.
- Terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, RL) and pulse train output terminal (FM). The open collector circuit is isolated from the internal control circuit by photocoupler.
- Terminal 5 is a common terminal for the speed setting signals (terminal 2 or 4). It should be protected from external noise using a shielded or twisted cable.
- Terminal SE is a common terminal for the open collector output terminal (RUN). The contact input circuit is isolated from the internal control circuit by photocoupler.

(4) Signal inputs by contactless switches

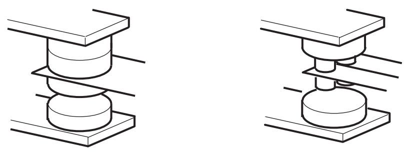
The contacted input terminals of the drive unit (STF, STR, RH, RM, RL) can be controlled using a transistor instead of a contacted switch as shown on the right.



External signal input using transistor

(5) Wiring instructions

- It is recommended to use the cables of 0.3mm^2 to 0.75mm^2 gauge for connection to the control circuit terminals.
- The maximum wiring length should be 30m (200m for terminal FM).
- Do not short across terminals PC and SD. Drive unit may be damaged.
- When using contact inputs, use two or more parallel micro-signal contacts or twin contacts to prevent contact faults since the control circuit input signals are micro-currents.

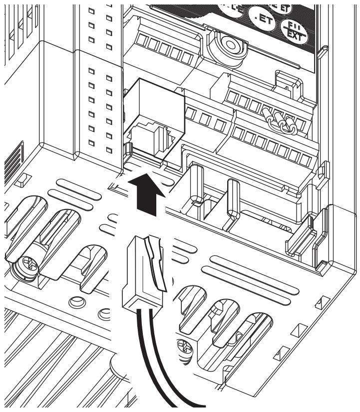


Micro signal contacts   Twin contacts

- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to the terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A, B, C) via a relay coil, lamp, etc.

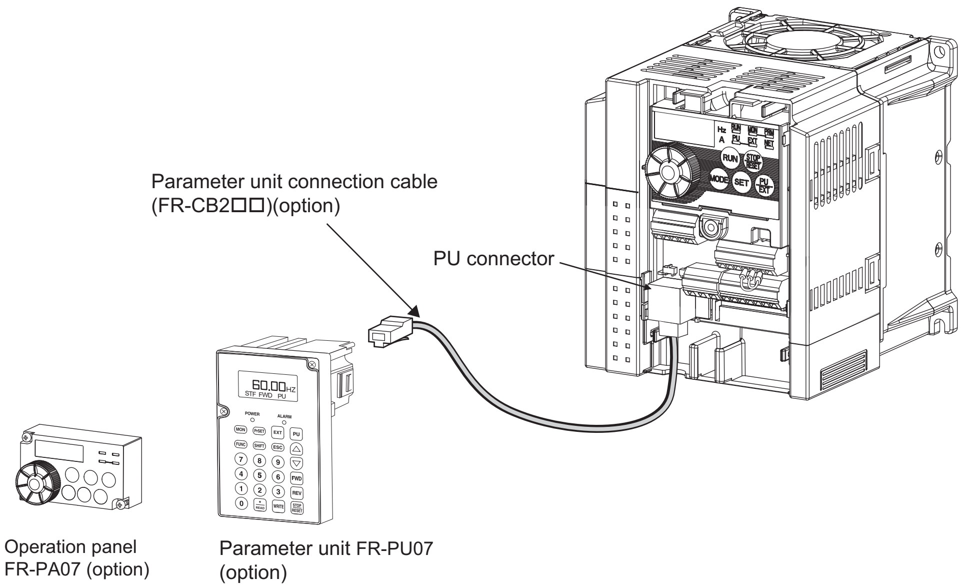
2.3.4 Connection to the PU connector

Using the PU connector, you can perform communication operation from the parameter unit (FR-PU07), enclosure surface operation panel (FR-PA07), or a personal computer, etc.
Remove the drive unit front cover when connecting.



(1) When connecting the parameter unit or enclosure surface operation panel using a connection cable

Use the optional FR-CB2□□ or connector and cable available on the market.
Insert the cable plugs securely into the PU connector of the drive unit and the connection connector of the FR-PU07, FR-PA07 along the guide until the tabs snap into place.
Install the drive unit front cover after connecting.



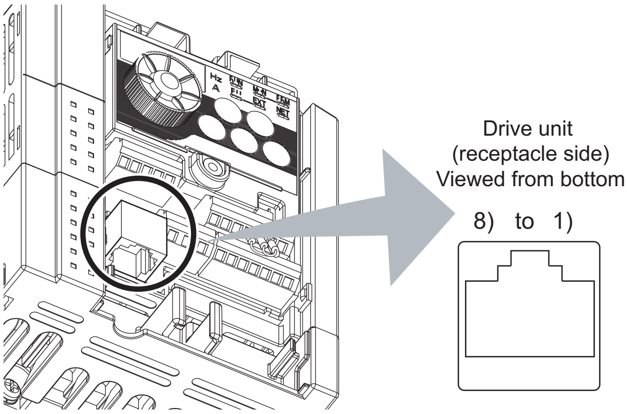
REMARKS

- Refer to *page 292* for the commercially available connection cables and connectors when fabricating a cable on the user side.
- Keep the total cable length within 20m.

●RS-485 communication

When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the drive unit or read and write to parameters.
The protocol can be selected from Mitsubishi Electric drive unit and MODBUS RTU.

- **PU connector pin-outs**



Pin Number	Name	Description
1)	SG	Earth (ground) (connected to terminal 5)
2)	—	Parameter unit power supply
3)	RDA	Drive unit receive+
4)	SDB	Drive unit send-
5)	SDA	Drive unit send+
6)	RDB	Drive unit receive-
7)	SG	Earth (ground) (connected to terminal 5)
8)	—	Parameter unit power supply

NOTE

- **Pins No. 2 and 8 provide power to the parameter unit. Do not use these pins for RS-485 communication.**
- **When making RS-485 communication with a combination of the FR-D700-G series, FR-F500J series, FR-E500 series and FR-S500 series, incorrect connection of pins No.2 and 8 (parameter unit power supply) of the above PU connector may result in the drive unit malfunction or failure.**
- **Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.**

For further details, *Refer to page 181*.

•Conforming standard: EIA-485 (RS-485)
•Transmission form: Multidrop link
•Communication speed: Maximum 38400 bps
•Overall extension: 500m

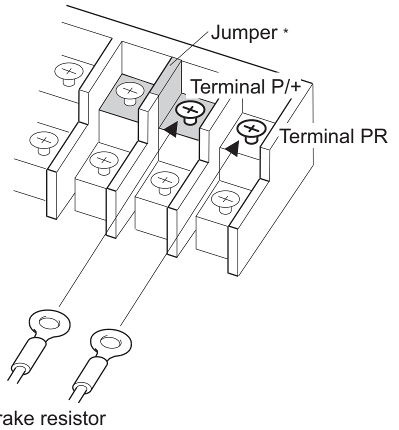
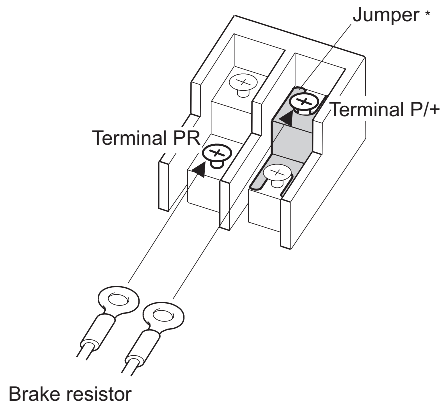
2.4 Connection of stand-alone option unit

The drive unit accepts a variety of stand-alone option units as required.
Incorrect connection will cause drive unit damage or accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

2.4.1 Connection of a dedicated external brake resistor (MRS type, MYS type, FR-ABR) (0.4K or higher)

Install a dedicated brake resistor (MRS type, MYS type, FR-ABR) outside when the motor driven by the drive unit is made to run by the load, quick deceleration is required, etc. Connect a dedicated brake resistor (MRS type, MYS type, FR-ABR) to terminal P/+ and PR. (For the locations of terminal P/+ and PR, refer to the terminal block layout on *page 15*.)
Set parameters below.

Connected Brake Resistor	*Pr. 30 Regenerative function selection* Setting	*Pr. 70 Special regenerative brake duty* Setting	
MRS type, MYS type	0 (initial value)	—	
MYS type (used at 100% torque/6%ED)	1	6%	*Refer to page 114.*
FR-ABR	1	10%	

FR-D720-0.4K-G, 0.75K-G	FR-D720-1.5K to 3.7K-G FR-D740-0.4K to 3.7K-G
Connect the brake resistor across terminals P/+ and PR.	Connect the brake resistor across terminals P/+ and PR.
	

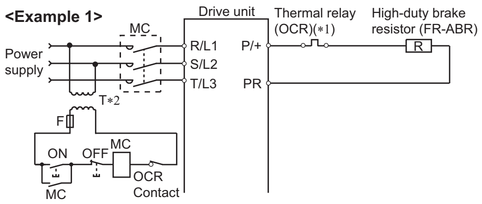
* Do not remove the jumper across terminals P/+ and P1 except when connecting a DC reactor.

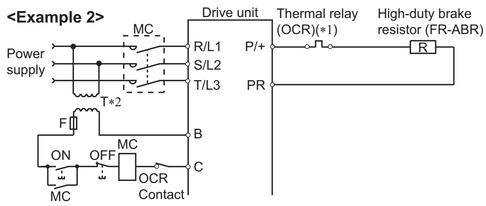
2

WIRING

Connection of stand-alone option unit

It is recommended to configure a sequence, which shuts off power in the input side of the drive unit by the external thermal relay as shown below, to prevent overheat and burnout of the brake resistor (MRS type, MYS type) and high duty brake resistor (FR-ABR) in case the regenerative brake transistor is damaged. (The brake resistor cannot be connected to the 0.2K.)



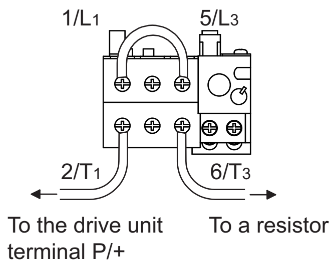


*1 Refer to the table below for the type number of each capacity of thermal relay and the diagram below for the connection.

*2 When the power supply is 400V class, install a step-down transformer.

Power Supply Voltage	Brake Resistor	Thermal Relay Type (Mitsubishi Electric product)	Rated Operating Current
200V	MRS120W200	TH-T25-0.7A	120VAC: 2A (NO contact) / 3A (NC contact), 240VAC: 1A (NO contact) / 2A (NC contact) (AC15 class) 110VDC: 0.2A, 220VDC: 0.1A (DC13 class)
	MRS120W100	TH-T25-1.3A	
	MRS120W60	TH-T25-2.1A	
	MRS120W40	TH-T25-3.6A	
	MYS220W50 (two units in parallel)	TH-T25-5A	

Power Supply Voltage	High-duty Brake Resistor	Thermal Relay Type (Mitsubishi Electric product)	Rated Operating Current
200V	FR-ABR-0.4K	TH-T25-0.7A	120VAC: 2A (NO contact) / 3A (NC contact), 240VAC: 1A (NO contact) / 2A (NC contact) (AC15 class) 110VDC: 0.2A, 220VDC: 0.1A (DC13 class)
	FR-ABR-0.75K	TH-T25-1.3A	
	FR-ABR-2.2K	TH-T25-2.1A	
	FR-ABR-3.7K	TH-T25-3.6A	
400V	FR-ABR-H0.4K	TH-T25-0.24A	
	FR-ABR-H0.75K	TH-T25-0.35A	
	FR-ABR-H1.5K	TH-T25-0.9A	
	FR-ABR-H2.2K	TH-T25-1.3A	
	FR-ABR-H3.7K	TH-T25-2.1A	



NOTE

- **The brake resistor connected should only be the dedicated brake resistor.**
- **Brake resistor cannot be used with the brake unit, high power factor converter, power supply regeneration converter, etc.**
- **Do not use the brake resistor (MRS type, MYS type) with a lead wire extended.**
- **Do not connect a resistor directly to terminals P/+ and N/-. This could cause a fire.**

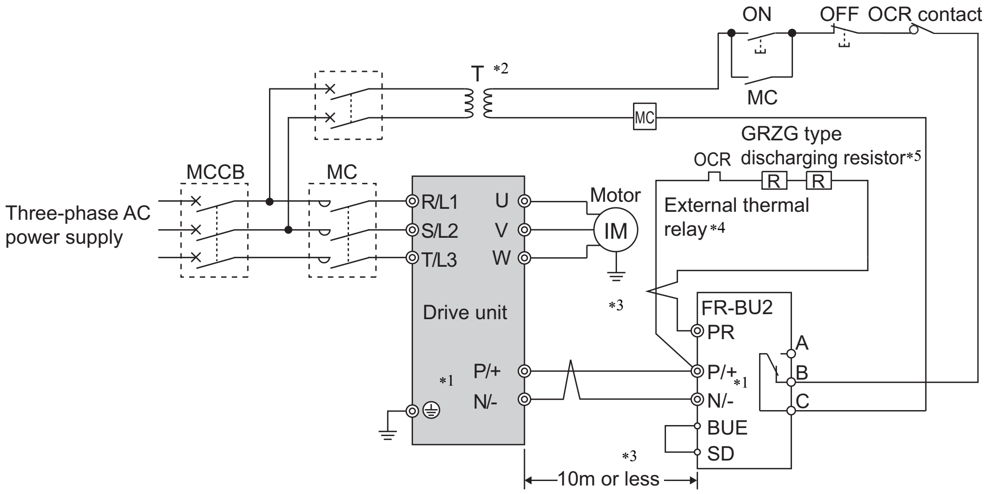
Parameters referred to

Pr. 30 Regenerative function selection ☞ *Refer to page 114.*

2.4.2 Connection of the brake unit (FR-BU2)

Connect the brake unit (FR-BU2) as shown below to improve the braking capability at deceleration. If the transistors in the brake unit should become faulty, the resistor can be unusually hot. To prevent unusual overheat and fire, install a magnetic contactor on the drive unit's input side to configure a circuit so that a current is shut off in case of fault.

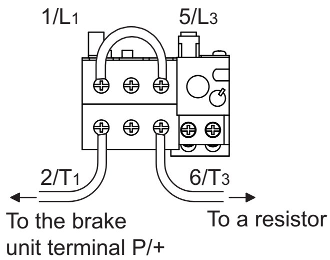
(1) Connection example with the GRZG type discharging resistor



*1 Connect the drive unit terminals (P/+ and N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other. (Incorrect connection will damage the drive unit and brake unit.)
*2 When the power supply is 400V class, install a step-down transformer.
*3 The wiring distance between the drive unit, brake unit (FR-BU2) and discharging resistor should be within 5m. Even when the wiring is twisted, the cable length must not exceed 10m.
*4 It is recommended to install an external thermal relay to prevent overheat of discharging resistor.
*5 Refer to FR-BU2 manual for connection method of discharging resistor.

<Recommended external thermal relay>

Brake Unit	Discharging Resistor	Recommended External Thermal Relay
FR-BU2-1.5K	GZG 300W-50Ω (one)	TH-T25-1.3A
FR-BU2-3.7K	GRZG 200-10Ω (three in series)	TH-T25-3.6A
FR-BU2-H7.5K	GRZG 200-10Ω (six in series)	TH-T25-3.6A



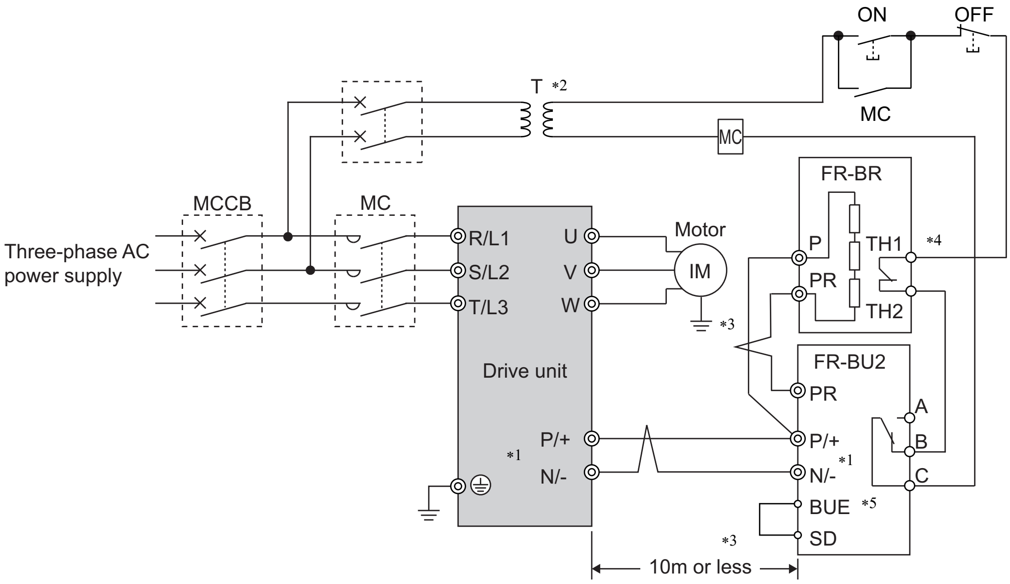
NOTE

- **Set "1" in *Pr. 0 Brake mode selection* of the FR-BU2 to use GRZG type discharging resistor.**
- **Do not remove the jumper across terminals P/+ and P1 except when connecting a DC reactor (FR-HEL).**

2

WIRING

(2) Connection example with the FR-BR(-H) type resistor



*1 Connect the drive unit terminals (P/+ and N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other. (Incorrect connection will damage the drive unit and brake unit.)

*2 When the power supply is 400V class, install a step-down transformer.

*3 The wiring distance between the drive unit, brake unit (FR-BU2) and resistor unit (FR-BR) should be within 5m each. Even when the wiring is twisted, the cable length must not exceed 10m.

*4 The contact between TH1 and TH2 is closed in the normal status and is open at a fault.

*5 A jumper is connected across BUE and SD in the initial status.

NOTE

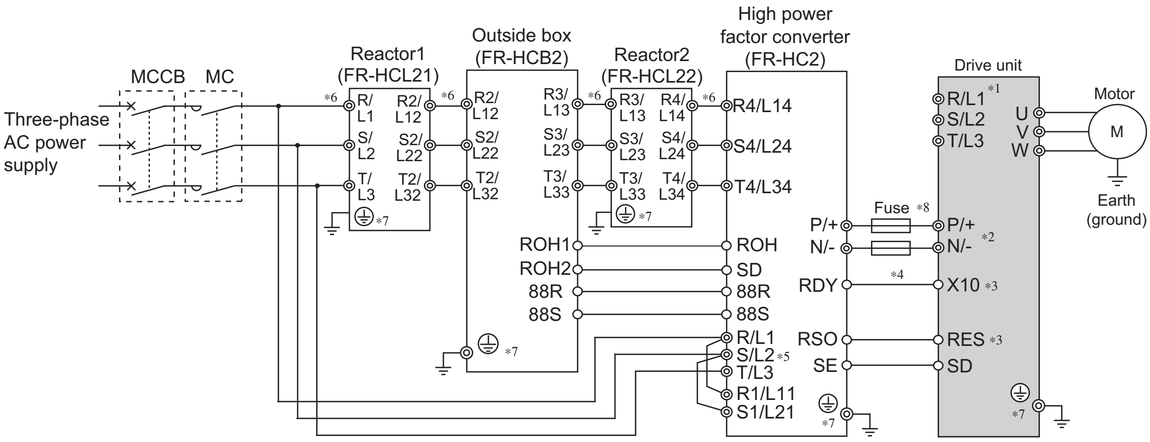
- **Do not remove the jumper across terminals P/+ and P1 except when connecting a DC reactor (FR-HEL).**

2.4.3 Connection of the high power factor converter (FR-HC2)

When connecting the high power factor converter (FR-HC2) to suppress power harmonics, perform wiring securely as shown below. Incorrect connection will damage the high power factor converter and the drive unit.

Perform the wiring securely, and set the following parameter:

Pr. 30 Regenerative function selection = "0" (Initial value).



*1 Do not connect anything to power input terminals (R/L1, S/L2, T/L3). Incorrect connection will damage the drive unit.

*2 Do not install an MCCB for the terminals P/+ and N/- (between terminals P and P/+ or between N and N/-). Connecting the opposite polarity of terminals N/- and P/+ will damage the drive unit.

*3 Assign the X10, RES signal to a terminal using any of *Pr. 178 to Pr. 182 (input terminal function selection).* (*Refer to page 117*.)

*4 Always connect the FR-HC2 terminal RDY to a terminal where the X10 or MRS signal is assigned in the drive unit. Always connect the FR-HC2 terminal SE to the drive unit terminal SD. Not connecting these terminals may damage the FR-HC2.

*5 Always connect the R/L1, S/L2, and T/L3 terminals of FR-HC2 to the power supply. Operating the drive unit without connecting them will damage FR-HC2.

*6 Do not install an MCCB or MC between the reactor 1 terminals (R/L1, S/L2, T/L3) and FR-HC2 terminals (R4/L14, S4/L24, T4/L34). It will not operate properly.

*7 Securely perform grounding (earthing) by using the ground (earth) terminal.

*8 Installation of a fuse is recommended. (*Refer to the Instruction Manual of FR-HC2*.)

NOTE

- **The voltage phases of terminals R/L1, S/L2, and T/L3 and the voltage phases of terminals R4/L14, S4/L24, and T4/L34 must be matched.**
- **Match the control logic (sink logic / source logic) of the FR-HC2 and the drive unit. (*Refer to page 20*.)**
- **Do not connect a DC reactor (FR-HEL) to the drive unit when FR-HC2 is connected.**
- **A Filterpack (FR-BFP2) cannot be connected when FR-HC2 is connected.**

Parameters referred to

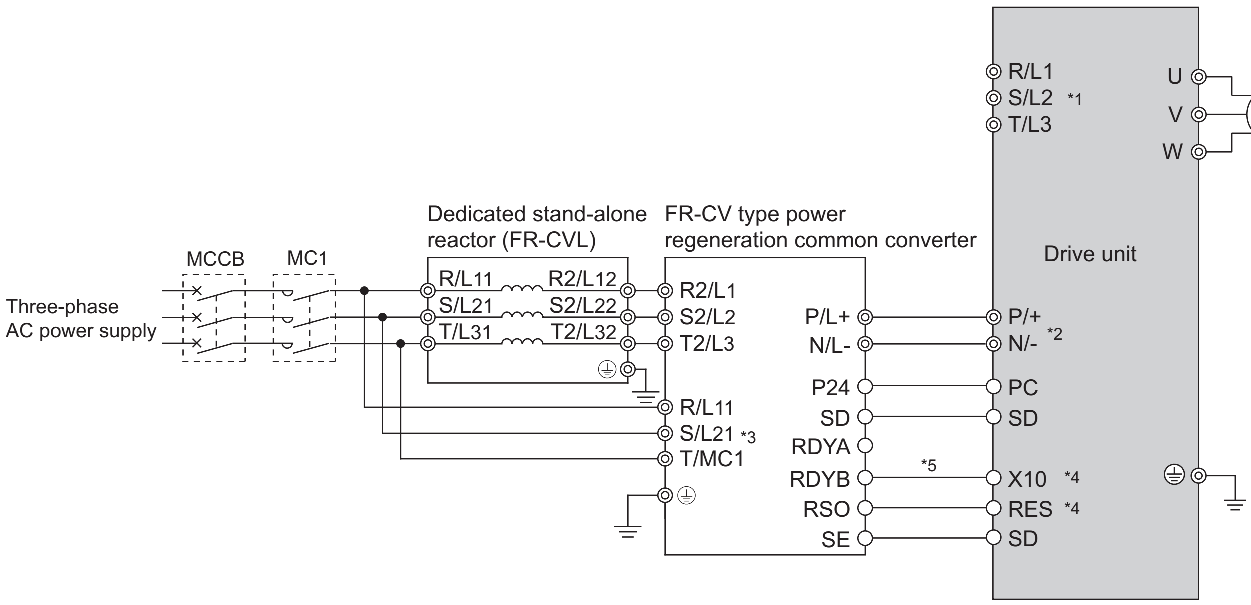
Pr. 30 Regenerative function selection *Refer to page 114.*

2

WIRING

2.4.4 Connection of the power regeneration common converter (FR-CV)

When connecting the power regeneration common converter (FR-CV), connect the drive unit terminals (P/+ and N/-) and power regeneration common converter (FR-CV) terminals as shown below so that their symbols match with each other.



*1 Keep input terminals (R/L1, S/L2, T/L3) open. Incorrect connection will damage the drive unit.

*2 Do not insert an MCCB between the terminals P/+ and N/- (between P/L+ and P/+, between N/L- and N/-). Opposite polarity of terminals N/- and P/+ will damage the drive unit.

*3 Always connect the power supply and terminals R/L11, S/L21, T/MC1.
Operating the drive unit without connecting them will damage the power regeneration common converter.

*4 Use *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the terminals used for the X10, RES signal. *(Refer to page 117.)*

*5 Be sure to connect terminal RDYB of the FR-CV to the X10 signal or MRS signal assigned terminal of the drive unit, and connect terminal SE of the FR-CV to terminal SD of the drive unit. Without proper connecting, FR-CV will be damaged.

NOTE

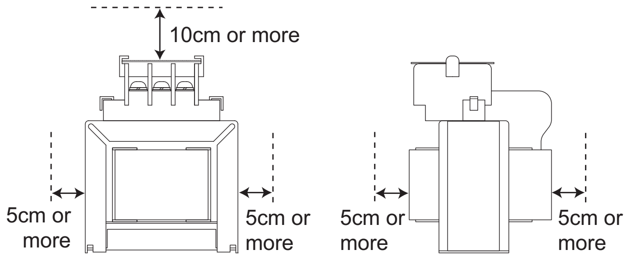
- **The voltage phases of terminals R/L11, S/L21, T/MC1 and terminals R2/L1, S2/L2, T2/L3 must be matched.**
- **Use sink logic (factory setting) when the FR-CV is connected. The FR-CV cannot be connected when source logic is selected.**
- **Do not connect a DC reactor (FR-HEL) to the drive unit when FR-CV is connected.**
- **A Filterpack (FR-BFP2) cannot be connected when FR-CV is connected.**

Parameters referred to

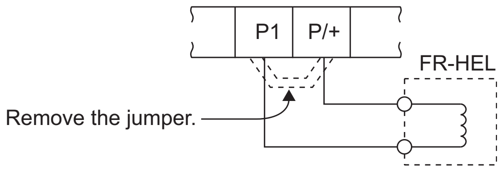
Pr. 30 Regenerative function selection *Refer to page 114.*

2.4.5 Connection of a DC reactor (FR-HEL)

(1) Keep the surrounding air temperature within the permissible range (-10°C to +50°C). Keep enough clearance around the reactor because it heats up. (Take 10cm or more clearance on top and bottom and 5cm or more on left and right regardless of the installation direction.)



(2) When using the DC reactor (FR-HEL), connect it across terminals P/+ and P1.
In this case, the jumper connected across terminals P/+ and P1 must be removed. Otherwise, the reactor will not exhibit its performance.



(3) DC reactor (FR-HEL) is electrically connected to the enclosure through mounting screws when the DC reactor is securely mounted to the enclosure. If the DC reactor is not earthed (grounded) securely enough, an earthing (grounding) cable may be used.
When you are using an earthing (grounding) cable, wire the cable to the mounting hole where varnish is removed. (Refer to the Instruction Manual of FR-HEL.)

NOTE
- **The wiring distance should be within 5m.**
- **The size of the cables used should be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable. (*Refer to page 16*.)**
- **Do not connect a DC reactor (FR-HEL) to the drive unit when FR-HC2 or FR-CV is connected.**

2

WIRING

MEMO

3 PRECAUTIONS FOR USE OF THE DRIVE UNIT

This chapter explains the "PRECAUTIONS FOR USE OF THE DRIVE UNIT" for use of this product.
Always read the instructions before using the equipment.

3.1 EMC and leakage currents

3.1.1 Leakage currents and countermeasures

Static capacitance exists between the drive unit's I/O cables, other cables, and the earth, and in the motor. Because leakage current flows through such static capacitance, take the following measures. Select an earth leakage circuit breaker according to the rated sensitivity current of the leakage current breaker. Do not select it by the carrier frequency.

(1) To-earth (ground) leakage currents

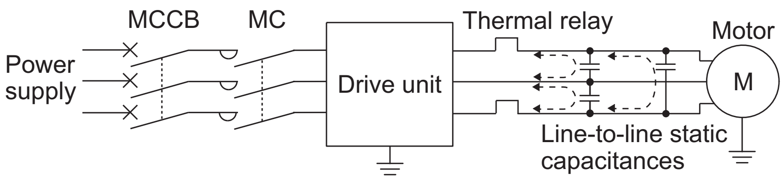
Leakage currents may flow not only into the drive unit's own line but also into the other lines through the earthing (grounding) cable, etc. These leakage currents may operate earth (ground) leakage circuit breakers and earth leakage relays unnecessarily.

●Suppression technique

- Use an earth leakage circuit breaker with a weak sensitivity in the high frequency range.
  The output current of the drive unit contains a high-frequency leakage current component, which gives relatively low impacts to human bodies. The detention level for this high-frequency leakage current component can be set weaker to prevent unnecessary operations.
- Minimize the to-earth stray capacitance.
  Use the cables insulated with low dielectric constant material, and perform wiring to make the wiring length between the drive unit and the motor to be as short as possible.

(2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacitances between the drive unit output cables may operate the external thermal relay unnecessarily.



Line-to-line leakage currents path

●Measures

- Use *Pr. 9 Electronic thermal O/L relay*.
- To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.
- Increase the external thermal overload relay setting by the amount of the leakage current.
- Minimize the stray capacitance between the lines.
  Use the cables insulated with low dielectric constant material, and perform wiring to make the wiring length between the drive unit and the motor to be as short as possible.

●Installation and selection of molded case circuit breaker

Install a moulded case circuit breaker (MCCB) on the power receiving side to protect the wiring of the drive unit input side. Select the MCCB according to the drive unit input side power factor (which depends on the power supply voltage, output frequency and load). Especially for a completely electromagnetic MCCB, one of a slightly large capacity must be selected since its operation characteristic varies with harmonic currents. (Check it in the data of the corresponding breaker.) As an earth leakage current breaker, use the Mitsubishi Electric earth leakage current breaker designed for harmonics and surge suppression.

(3) Selection of rated sensitivity current of earth (ground) leakage current breaker

When using the earth leakage current breaker with the drive unit circuit, select its rated sensitivity current as follows:

- Breaker designed for harmonic and surge suppression
  Rated sensitivity current:
  $I\Delta n \geq 10 \times (Ig1+Ign+Igi+Ig2+Igm)$
- Standard breaker
  Rated sensitivity current:
  $I\Delta n \geq 10 \times \{Ig1+Ign+Igi+3 \times (Ig2+Igm)\}$

Ig1, Ig2: Leakage currents in wire path during commercial power supply operation

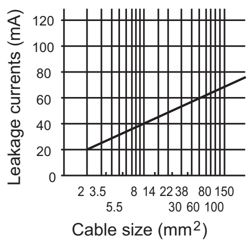
Ign: Leakage current of drive unit input side noise filter

Igm: Leakage current of motor.

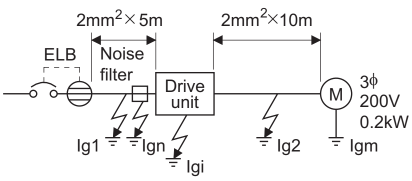
Motor		Leakage Current (mA)
200V class	0.1kW, 0.2kW	0
	0.4kW	0.06
	0.75kW	0.08
	1.5kW	0.13
	2.2kW	0.11
400V class	0.2kW	0.01
	0.4kW	0.06
	0.75kW	0.13
	1.5kW	0.10
	2.2kW	0.09

Igi: Leakage current of drive unit

Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(200V 60Hz)



<Example>



	Breaker Designed for Harmonic and Surge Suppression	Standard Breaker
Leakage current Ig1 (mA)	$20 \times \frac{5m}{1000m} = 0.1$	
Leakage current Ign (mA)	0	
Leakage current Igi (mA)	1	
Leakage current Ig2 (mA)	$20 \times \frac{10m}{1000m} = 0.2$	
Motor leakage current Igm (mA)	0	
Total leakage current (mA)	1.3	1.7
Rated sensitivity current (mA) ($\geq Ig \times 10$)	15	30

NOTE

- **Install the earth leakage breaker (ELB) on the input side of the drive unit.**
- **In the ⅄ connection earthed-neutral system, the sensitivity current is blunt against an earth (ground) fault in the drive unit output side. Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards)**
- **When the breaker is installed on the output side of the drive unit, it may be unnecessarily operated by harmonics even if the effective value is less than the rating.**
  In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.
- **General products indicate the following models. ...... BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F earth leakage relay (except NV-ZHA), NV with AA neutral wire open-phase protection**
  The other models are designed for harmonic and surge suppression ....NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, NV-H

3.1.2 EMC measures

Some electromagnetic noises enter the drive unit to malfunction it and others are radiated by the drive unit to malfunction peripheral devices. Though the drive unit is designed to have high immunity performance, it handles low-level signals, so it requires the following basic techniques. Also, since the drive unit chops outputs at high carrier frequency, that could generate electromagnetic noises. If these electromagnetic noises cause peripheral devices to malfunction, EMI measures should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

(1) Basic techniques

- Do not run the power cables (I/O cables) and signal cables of the drive unit in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
- Earth (Ground) the drive unit, motor, etc. at one point.

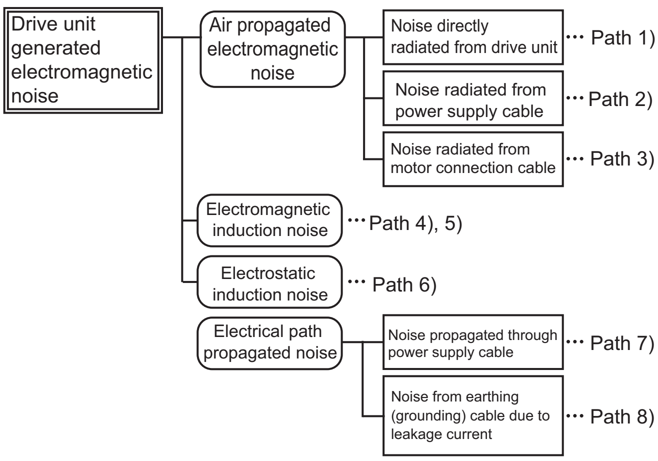
(2) Techniques to reduce electromagnetic noises that enter and malfunction the drive unit (Immunity measures)

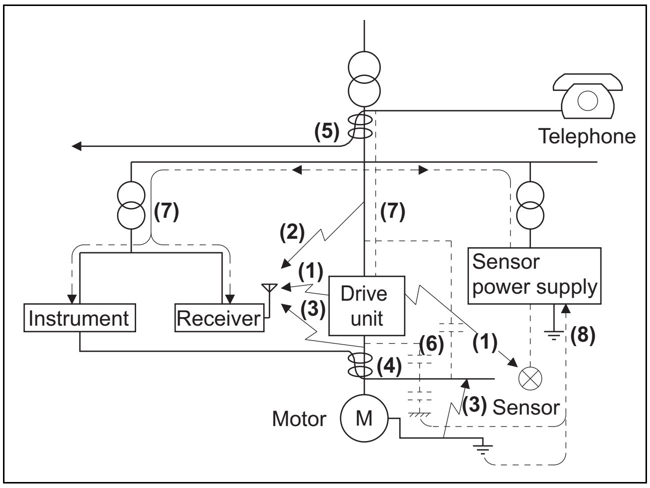
When devices that generate many electromagnetic noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the drive unit and the drive unit may be malfunctioned by electromagnetic noises, the following measures must be taken:

- Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
- Fit data line filters *(page 39)* to signal cables.
- Earth (Ground) the shields of the detector connection and control signal cables with cable clamp metal.

(3) Techniques to reduce electromagnetic noises that are radiated by the drive unit to malfunction peripheral devices (EMI measures)

Drive unit-generated electromagnetic noises are largely classified into those radiated by the cables connected to the drive unit and drive unit main circuits (I/O), those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.



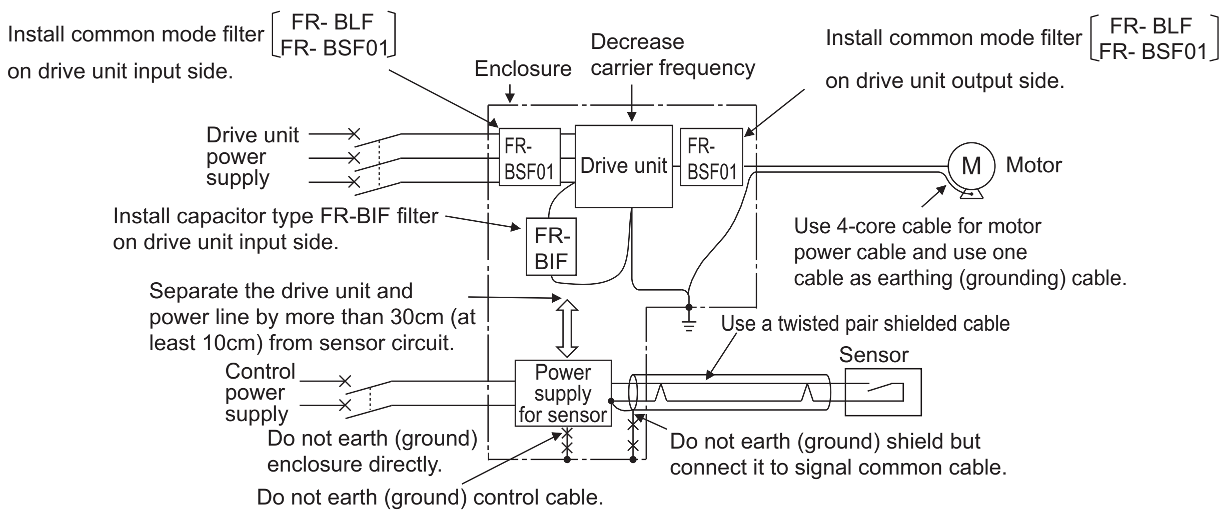


Propagation Path	Measures
(1)(2)(3)	When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the drive unit or when their signal cables are run near the drive unit, the devices may malfunction due to air-propagated electromagnetic noises. The following measures must be taken: • Install easily affected devices as far away as possible from the drive unit. • Run easily affected signal cables as far away as possible from the drive unit and its I/O cables. • Do not run the signal cables and power cables (drive unit I/O cables) in parallel with each other and do not bundle them. • Insert common mode chokes into I/O and capacitors between the input lines to suppress cable-radiated noises. • Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(4)(5)(6)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables which causes the devices to malfunction and the following measures must be taken: • Install easily affected devices as far away as possible from the drive unit. • Run easily affected signal cables as far away as possible from the I/O cables of the drive unit. • Do not run the signal cables and power cables (drive unit I/O cables) in parallel with each other and do not bundle them. • Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(7)	When the power supplies of the peripheral devices are connected to the power supply of the drive unit in the same line, drive unit-generated noises may flow back through the power supply cables to malfunction the devices and the following measures must be taken: • Install the common mode filter (FR-BLF, FR-BSF01) to the power cables (output cable) of the drive unit.
(8)	When a closed loop circuit is formed by connecting the peripheral device wiring to the drive unit, leakage currents may flow through the earthing (grounding) cable of the drive unit to malfunction the device. In such a case, disconnection of the earthing (grounding) cable of the device may cause the device to operate properly.

●Data line filter

Data line filter is effective as an EMC measure. Provide a data line filter for the detector cable, etc.

●EMC measures



NOTE

- **For compliance with the EU EMC Directive, refer to** ***the Instruction Manual (Basic)*****.**

3

PRECAUTIONS FOR USE OF THE DRIVE UNIT

3.1.3 Power supply harmonics

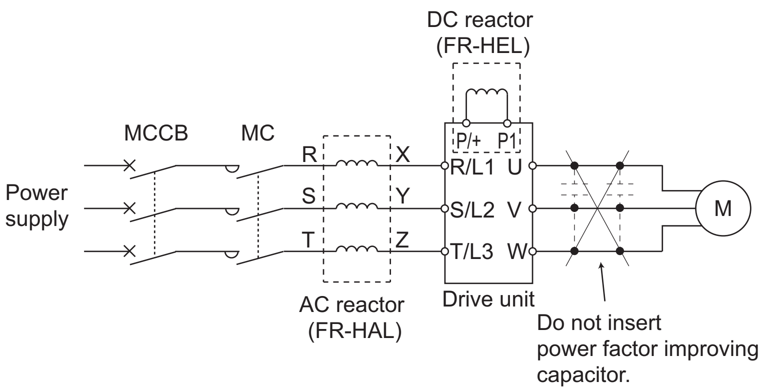
The drive unit may generate power supply harmonics from its converter circuit to affect the power generator, power capacitor etc. Power supply harmonics are different from noise and leakage currents in source, frequency band and transmission path. Take the following countermeasure suppression techniques.

●The differences between harmonics and RF noises are indicated below:

Item	Harmonics	Noise
Frequency	Normally 40th to 50th degrees or less (up to 3kHz or less)	High frequency (several 10kHz to 1GHz order)
Environment	To-electric channel, power impedance	To-space, distance, wiring path
Quantitative understanding	Theoretical calculation possible	Random occurrence, quantitative grasping difficult
Generated amount	Nearly proportional to load capacity	Change with current variation ratio (larger as switching speed increases)
Affected equipment immunity	Specified in standard per equipment	Different depending on maker's equipment specifications
Suppression example	Provide reactor.	Increase distance.

●Suppression technique

The harmonic current generated from the drive unit to the input side differs according to various conditions such as the wiring impedance, whether a reactor is used or not, and output frequency and output current on the load side.
For the output frequency and output current, we understand that this should be calculated in the conditions under the rated load at the maximum operating frequency.



NOTE

The power factor improving capacitor and surge suppressor on the drive unit output side may be overheated or damaged by the harmonic components of the drive unit output. Also, since an excessive current flows in the drive unit to activate overcurrent protection, do not provide a capacitor and surge suppressor on the drive unit output side when the motor is driven by the drive unit. For power factor improvement, install a reactor on the drive unit input side or in the DC circuit.

3.1.4 Harmonic suppression guideline in Japan

Drive units have a converter section (rectifier circuit) and generate a harmonic current.
Harmonic currents flow from the drive unit to a power receiving point via a power transformer. The Harmonic Suppression Guidelines was established to protect other consumers from these outgoing harmonic currents.
The three-phase 200V input specifications 3.7kW or less are previously covered by "Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" and other models are covered by "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". However, the transistorized drive unit has been excluded from the target products covered by "Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" in January 2004 and "Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" was repealed on September 6, 2004.
All capacity and all models of general-purpose drive unit used by specific consumers are covered by "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" (hereinafter referred to as "Specific Consumer").
"Specific Consumer Guidlines"
This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or especially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values are exceeded, this guideline requires the consumer to take certain suppression measures.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power

Received Power Voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

(1) Application for Specific Consumers Guidelines

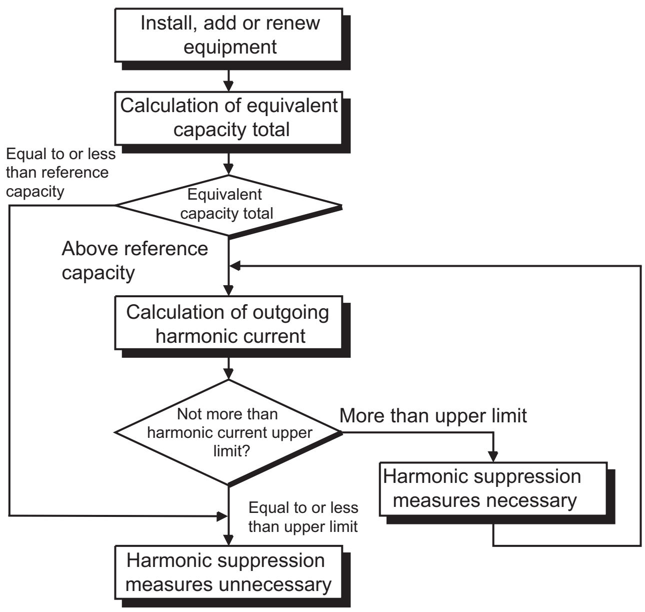


Table 2 Conversion Factors for FR-D700-G Series

Class	Circuit Type		Conversion Factor (Ki)
3	Three-phase bridge (Capacitor smoothing)	Without reactor	K31= 3.4
		With reactor (AC side)	K32 = 1.8
		With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-excitation three-phase bridge	When high power factor converter is used	K5 = 0

Table 3 Equivalent Capacity Limits

Received Power Voltage	Reference Capacity
6.6kV	50kVA
22/33 kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic Contents (Values at the fundamental current of 100%)

	Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Three-phase bridge (Capacitor smoothing)	Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
	Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
	Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
	Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

1) Calculation of equivalent capacity (P0) of harmonic generating equipment

The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

$P0 = \Sigma(Ki \times Pi)$ [kVA]

Ki: Conversion factor (Refer to Table 2.)

Pi: Rated capacity of harmonic generating equipment*[kVA]

i: Number indicating the conversion circuit type

* Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual drive unit drive.

2) Calculation of outgoing harmonic current

Outgoing harmonic current = fundamental wave current (value converted from received power voltage) × operation ratio × harmonic content

- Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
- Harmonic content: Found in Table 4.

Table 5 Rated Capacities and Outgoing Harmonic Currents for Drive Unit Drive

Applicable Motor (kW)	Fundamental Wave Current [A]		Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Outgoing Harmonic Current Converted from 6.6kV (mA) (No reactor, 100% operation ratio)							
	200V	400V			5th	7th	11th	13th	17th	19th	23rd	25th
0.1	0.61	0.30	18	0.22	11.7	7.38	1.53	1.386	0.774	0.558	0.468	0.324
0.2	0.98	0.49	30	0.35	19.5	12.3	2.55	2.31	1.29	0.93	0.78	0.54
0.4	1.61	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74	1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320

3) Application of the guideline for specific consumers

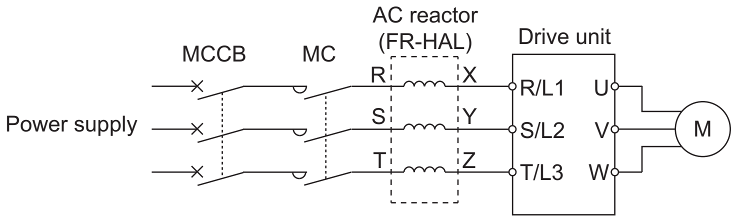
If the outgoing harmonic current is higher than the maximum value per 1kW contract power × contract power, a harmonic suppression technique is required.

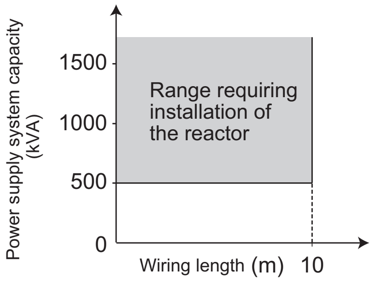
4) Harmonic suppression techniques

No.	Item	Description
1	Reactor installation (FR-HAL, FR-HEL)	Install an AC reactor (FR-HAL) on the AC side of the drive unit or a DC reactor (FR-HEL) on its DC side or both to suppress outgoing harmonic currents.
2	High power factor converter (FR-HC2)	This converter trims the current waveform to be a sine waveform by switching in the rectifier circuit (converter module) with transistors. Doing so suppresses the generated harmonic amount significantly. Connect it to the DC area of an drive unit. The high power factor converter (FR-HC2) is used with the standard accessory.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in 人-Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	Passive filter (AC filter)	A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Active filter (Active filter)	This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

3.2 Installation of power factor improving reactor

When the drive unit is connected near a large-capacity power transformer (500kVA or more) or when a power capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install an optional AC reactor (FR-HAL).





3.3 Power-OFF and magnetic contactor (MC)

(1) Drive unit input side magnetic contactor (MC)

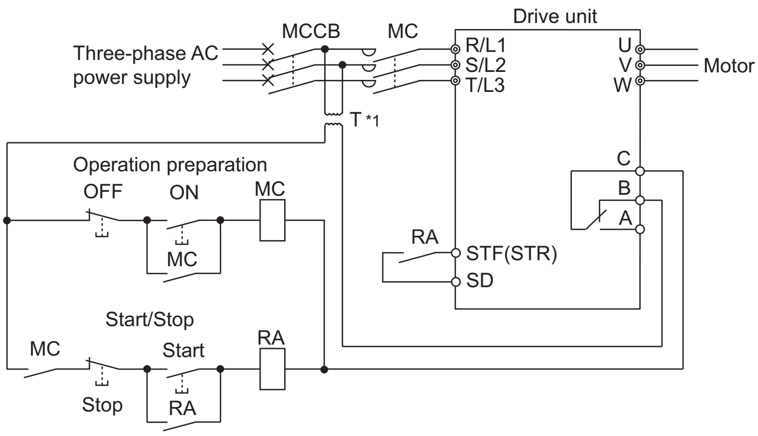
On the drive unit input side, it is recommended to provide an MC for the following purposes.
(Refer to *page 4* for selection.)

1) To release the drive unit from the power supply when the fault occurs or when the drive is not functioning (e.g. emergency stop operation). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.
2) To prevent any accident due to an automatic restart at restoration of power after a drive unit stop made by a power failure
3) To separate the drive unit from the power supply to ensure safe maintenance and inspection work.

If using an MC for emergency stop during operation, select an MC regarding the drive unit input side current as JEM1038-AC-3 class rated current.

REMARKS

- Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times.), frequent starts and stops of the MC must be avoided. Turn ON/OFF the drive unit start controlling terminals (STF, STR) to run/stop the drive unit.



● Drive unit start/stop circuit example

As shown on the left, always use the start signal (ON or OFF of STF(STR) signal) to make a start or stop.

*1 When the power supply is 400V class, install a step-down transformer.

(2) Handling of drive unit output side magnetic contactor

Switch the magnetic contactor between the drive unit and motor only when both the drive unit and motor are at a stop. When the magnetic contactor is turned ON while the drive unit is operating, overcurrent protection of the drive unit and such will activate.

NOTE

- **A PM motor is a synchronous motor with magnets embedded. Motor terminals hold high-voltage while the motor is running even after the drive unit power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications, a low-voltage manual contactor must be connected at the drive unit's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.**

3.4 Precautions for use of the drive unit

This product is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.
Before starting operation, always recheck the following items.

(1) Use crimp terminals with insulation sleeve to wire the power supply and motor.

(2) Application of power to the output terminals (U, V, W) of the drive unit will damage the drive unit. Never perform such wiring.

(3) After wiring, wire offcuts must not be left in the drive unit.
Wire offcuts can cause an alarm, failure or malfunction. Always keep the drive unit clean.
When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the drive unit.

(4) Use cables of the size to make a voltage drop 2% or less.
If the wiring distance is long between the drive unit and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low speed. Refer to *page 16* for the recommended wire sizes.

(5) Keep the total wiring length within the specified length.
Especially for long distance wiring, the equipment connected to the output side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. *(Refer to page 17)*

(6) Electromagnetic wave interference
The input/output (main circuit) of the drive unit includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the drive unit. In this case, install the FR-BIF optional capacitor type filter (for use in the input side only) or FR-BSF01 or FR-BLF line noise filter to minimize interference.

(7) Electrical corrosion of the bearing
When a motor is driven by the drive unit, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing in rare cases depending on: the wiring, load, operating conditions of the motor, or the use of the capacitive filter*1.
The following shows examples of countermeasures for the drive unit.
- Remove the capacitive filter.
- Provide a common mode choke*2 on the output side of the drive unit. (This is effective regardless of the use of the capacitive filter.)

*1 Mitsubishi Electric capacitive filter: FR-BIF, SF[], FR-E5NF-[], FR-BFP2-[]
*2 Recommended common mode choke: FT-3KM F series FINEMET® common mode choke cores manufactured by Hitachi Metals, Ltd.
FINEMET is a registered trademark of Hitachi Metals, Ltd.

(8) Do not install a power factor correction capacitor, surge suppressor or capacitor type filter on the drive unit output side.
This will cause the drive unit to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are connected, immediately remove them.

(9) For some short time after the power is switched OFF, a high voltage remains in the smoothing capacitor.
When accessing the drive unit for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/- of the drive unit is not more than 30VDC using a tester, etc.

(10) A short circuit or earth (ground) fault on the drive unit output side may damage the drive unit module.
- Fully check the insulation resistance of the circuit prior to drive unit operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the drive unit module.
- Fully check the to-earth (ground) insulation and phase to phase insulation of the drive unit output side before power-On. Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance etc.

(11) Do not use the drive unit input side magnetic contactor to start/stop the drive unit.
Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times.), frequent starts and stops of the MC must be avoided. Turn ON/OFF the drive unit start controlling terminals (STF, STR) to run/stop the drive unit. *(Refer to page 44)*

(12) Across terminals P/+ and PR, connect only an external brake resistor.
- Do not connect a mechanical brake.
- The brake resistor cannot be connected to the 0.2K. Do not connect anything to terminals P/+ and PR. Also, never short between these terminals.

(13) Do not apply a voltage higher than the permissible voltage to the drive unit I/O signal circuits.
Application of a voltage higher than the permissible voltage to the drive unit I/O signal circuits or opposite polarity may damage the I/O devices. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short terminals 10 and 5.

(14) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the drive unit's input side and also make up a sequence which will not switch ON the start signal.
If the start signal (start switch) remains ON after a power failure, the drive unit will automatically restart as soon as the power is restored.

(15) Drive unit input side magnetic contactor (MC)
On the drive unit input side, connect a MC for the following purposes. (Refer to *page 4* for selection.)
1) To release the drive unit from the power supply when a fault occurs or when the drive is not functioning (e.g. emergency stop operation). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.
2) To prevent any accident due to an automatic restart at restoration of power after a drive unit stop made by a power failure
3) To separate the drive unit from the power supply to ensure safe maintenance and inspection work.

If using an MC for emergency stop during operation, select an MC regarding the drive unit input side current as JEM1038-AC-3 class rated current.

(16) Handling of drive unit output side magnetic contactor
Switch the magnetic contactor between the drive unit and motor only when both the drive unit and motor are at a stop. When the magnetic contactor is turned ON while the drive unit is operating, overcurrent protection of the drive unit and such will activate.

(17) Countermeasures against drive unit-generated EMI
If electromagnetic noise generated from the drive unit causes speed setting signal to fluctuate and motor rotation speed to be unstable when changing motor speed with analog signal, the following countermeasures are effective.
- Do not run the signal cables and power cables (drive unit I/O cables) in parallel with each other and do not bundle them.
- Run signal cables as far away as possible from power cables (drive unit I/O cables).
- Use shield cables as signal cables.
- Install a ferrite core on the signal cable (Example: ZCAT3035-1330 TDK).

(18) Instructions for overload operation
When performing operation of frequent start/stop of the drive unit, rise/fall in the temperature of the transistor element of the drive unit will repeat due to a repeated flow of large current, shortening the life from thermal fatigue. Since thermal fatigue is related to the amount of current, the life can be increased by reducing current at locked condition, starting current, etc. Decreasing current may increase the life. However, decreasing current will result in insufficient torque and the drive unit may not start. Reducing the current may extend the service life but may also cause torque shortage, which leads to a start failure. An effective measure is to use a drive unit and motor with higher capacities. Doing so will provide a margin to the load.

(19) Make sure that the specifications and rating match the system requirements.

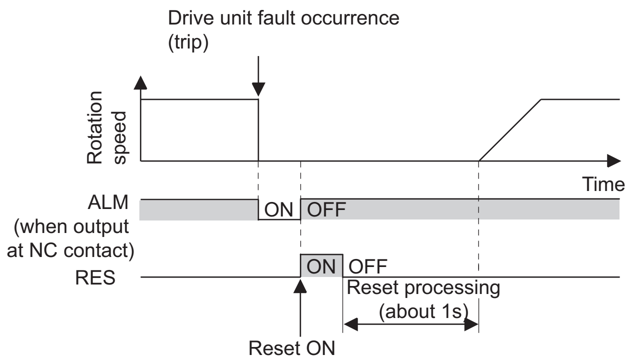
3.5 Failsafe of the system which uses the drive unit

When a fault occurs, the drive unit trips to output a fault signal. However, a fault output signal may not be output at a drive unit fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi Electric assures best quality products, provide an interlock which uses drive unit status output signals to prevent accidents such as damage to machine when the drive unit fails for some reason and at the same time consider the system configuration where failsafe from outside the drive unit, without using the drive unit, is enabled even if the drive unit fails.

(1) Interlock method which uses the drive unit status output signals
By combining the drive unit status output signals to provide an interlock as shown below, a drive unit failure can be detected.

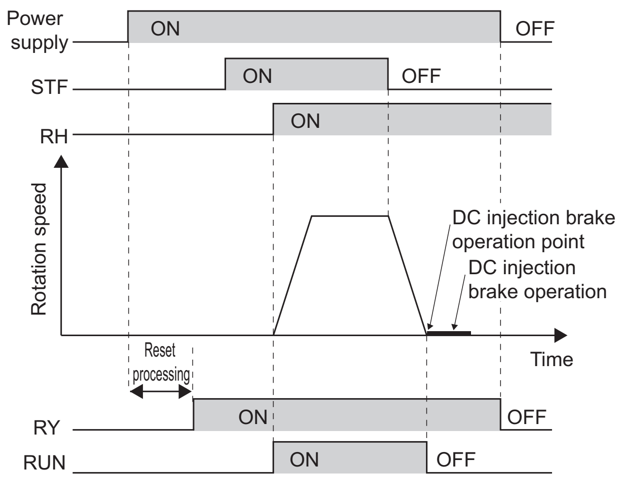
No.	Interlock Method	Check Method	Used Signals	Refer to Page
1)	Drive unit protective function operation	Operation check of an alarm contact Circuit error detection by negative logic	Fault (ALM) signal	*126*
2)	Drive unit operating status	Operation ready signal check	Operation ready (RY) signal	*125*
3)	Drive unit running status	Logic check of the start signal and running signal	Start signal (STF signal, STR signal) Drive unit running (RUN) signal	*121, 125*
4)	Drive unit running status	Logic check of the start signal and output current	Start signal (STF signal, STR signal) Output current detection (Y12) signal	*121, 128*

1) Check by the drive unit fault output signal
When the drive unit's protective function activates and the drive unit trips, the Fault (ALM) signal is output. (The ALM signal is assigned to terminal ABC in the initial setting).
With this signal, you can check if the drive unit is operating properly.
In addition, negative logic can be set (ON when the drive unit is normal, OFF when the fault occurs).



2) Checking the drive unit operating status by the drive unit operation ready completion signal
The Operation ready (RY) signal is output when the drive unit power is ON and the drive unit becomes operative.
Check if the RY signal is output after powering ON the drive unit.

3) Checking the drive unit operating status by the start signal input to the drive unit and drive unit running signal.
The drive unit running (RUN) signal is output when the drive unit is running (The RUN signal is assigned to terminal RUN in the initial setting).
Check if the RUN signal is output when inputting the start signal to the drive unit (forward signal is STF signal and reverse signal is STR signal). For logic check, note that RUN signal is output for the period from the drive unit decelerates until output to the motor is stopped, configure a sequence considering the drive unit deceleration time.



4) Checking the motor operating status by the start signal input to the drive unit and drive unit output current detection signal.
The Output current detection (Y12) signal is output when the drive unit operates and currents flows in the motor. Check if the Y12 signal is output when inputting the start signal to the drive unit (forward signal is STF signal and reverse signal is STR signal). Note that the current level at which Y12 signal is output is set to 150% of the drive unit rated current in the initial setting, it is necessary to adjust the level to around 20% using no load current of the motor as reference with *Pr. 150 Output current detection level*.
For logic check, as same as the Drive unit running (RUN) signal, the drive unit outputs for the period from the drive unit decelerates until output to the motor is stopped, configure a sequence considering the drive unit deceleration time.

Output Signal	*Pr. 190, Pr. 192* Setting	
	Positive logic	Negative logic
ALM	99	199
RY	11	111
RUN	0	100
Y12	12	112

• When using various signals, assign functions to *Pr. 190* and *Pr. 192 (output terminal function selection)* referring to the table on the left.

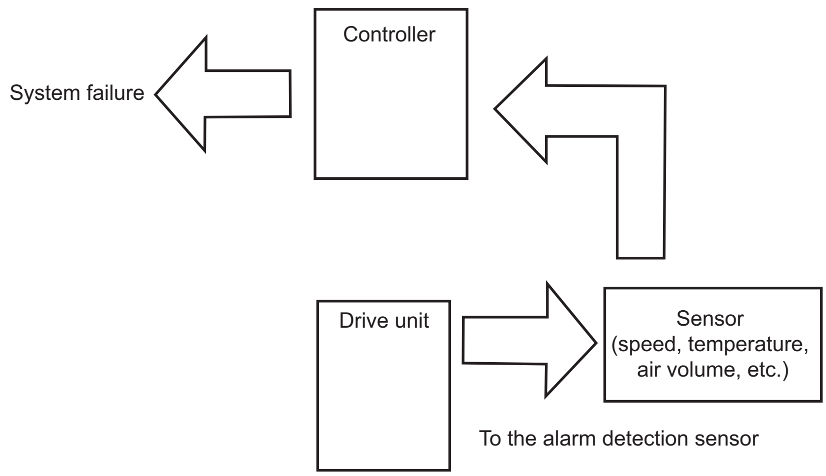
NOTE

• **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

(2) Backup method outside the drive unit
Even if the interlock is provided by the drive unit status signal, enough failsafe is not ensured depending on the failure status of the drive unit itself. For example, when the drive unit CPU fails, even if the interlock is provided using the drive unit fault signal, start signal and RUN signal, there is a case where a fault signal is not output and RUN signal is kept output even if a drive unit fault occurs.
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as checking up as below according to the level of importance of the system.

1) Start signal and actual operation check
Check the motor running and motor current while the start signal is input to the drive unit by comparing the start signal to the drive unit and detected speed of the speed detector or detected current of the current detector. Note that the motor current runs as the motor is running for the period until the motor stops since the drive unit starts decelerating even if the start signal turns OFF. For the logic check, configure a sequence considering the drive unit deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

2) Command speed and actual operation check
Check if there is no gap between the actual speed and commanded speed by comparing the drive unit speed command and detected speed of the speed detector.



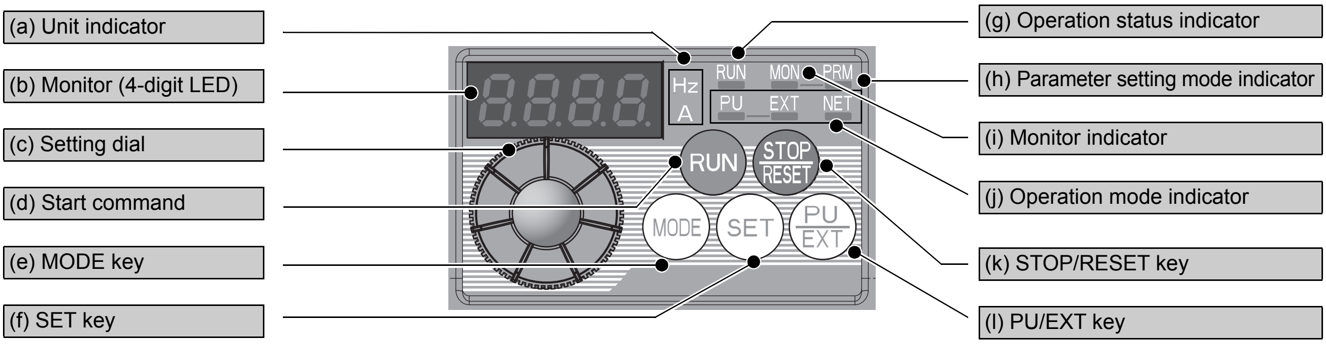
4 PARAMETERS

This chapter explains the "PARAMETERS" for use of this product.
Always read the instructions before using the equipment.

4.1 Operation panel

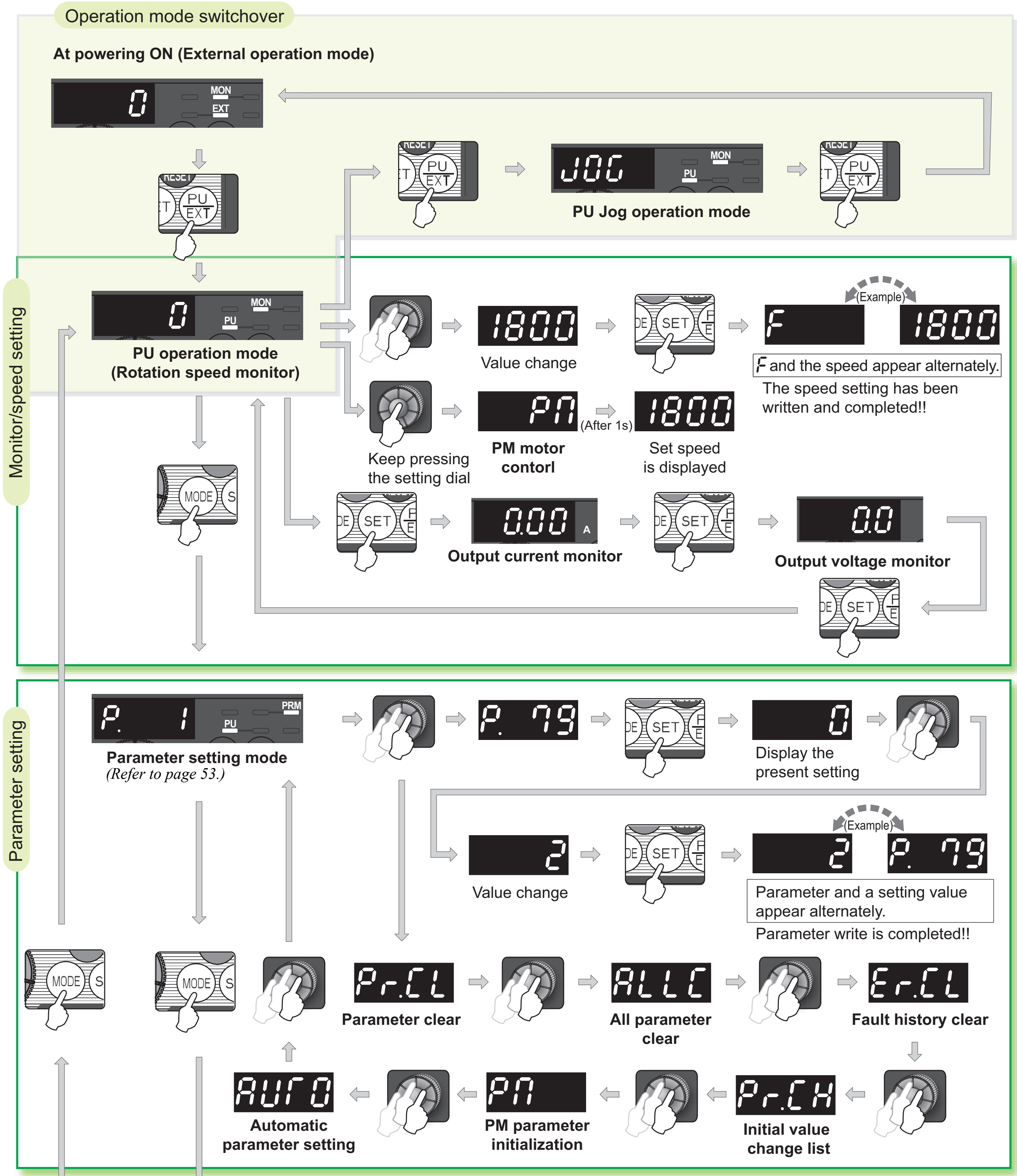
4.1.1 Names and functions of the operation panel

The operation panel cannot be removed from the drive unit.



No.	Component	Name	Description
(a)	Hz A	Unit indicator	Hz: Lit to indicate frequency. (Blinks when the set frequency monitor is displayed.) A: Lit to indicate current. (Both "Hz" and "A" are lit to indicate a value other than frequency or current.)
(b)	8.8.8.8.	Monitor (4-digit LED)	Shows the speed, parameter number, etc. (To monitor the output power, the set speed and other items, set *Pr. 52*.)
(c)		Setting dial	The dial of the Mitsubishi Electric drive unit. The setting dial is used to change the speed and parameter settings. Press to display the following. • The control method (PM motor control) during the monitor mode is displayed. • The set speed is displayed by pressing the setting dial for 1 second or longer when the drive unit is in the PU operation mode or External/PU combined operation mode (*Pr. 79* = "3"). • Present set value is displayed during calibration • Displays the order in the fault history mode
(d)	RUN	Start command	Select the rotation direction in *Pr. 40*.
(e)	MODE	MODE key	Used to switch among different setting modes. Pressing PU/EXT simultaneously changes the operation mode. Holding this key for 2 seconds locks the operation. The key lock is invalid when *Pr. 161* = "0 (initial setting)." *Refer to the page 244.*
(f)	SET	SET key	Used to enter a setting. If pressed during the operation, monitored item changes as the following: Rotation speed → Output current → Output voltage (→ Rotation speed)
(g)	RUN	Operation status indicator	Lit or blinks during drive unit operation.* * Lit: When the forward rotation operation is being performed. Slow blinking (1.4s cycle): When the reverse rotation operation is being performed. Fast blinking (0.2s cycle): When RUN has been pressed or the start command has been given, but the operation cannot be made. • When the speed command is less than the starting speed. • When the MRS signal is being input.
(h)	PRM	Parameter setting mode indicator	Lit to indicate the parameter setting mode.
(i)	MON	Monitor indicator	Lit to indicate the monitor mode.
(j)	PU EXT NET	Operation mode indicator	PU: Lit to indicate the PU operation mode. EXT: Lit to indicate the External operation mode.(EXT is lit at power-ON in the initial setting.) NET: Lit to indicate the Network operation mode. PU and EXT: Lit to indicate EXT/PU combined operation mode 1 and 2 All of these indicators are OFF when the command source is not at the operation panel. *(refer to page 177.)*
(k)	STOP RESET	STOP/RESET key	Used to stop operation commands. Used to reset a fault when the protective function (fault) is activated.
(l)	PU EXT	PU/EXT key	Used to switch between the PU and External operation modes. To use the External operation mode (operation using a separately connected speed setting potentiometer and start signal), press this key to light up the EXT indicator. (Press MODE simultaneously (0.5s), or change the *Pr. 79* setting *(refer to page 52)* to change to the combined operation mode. PU: PU operation mode EXT: External operation mode Used to cancel the PU stop also.

4.1.2 Basic operation (factory setting)



Fault history

E - - -

[Operation for displaying fault history] *(Refer to page 249.)*

The past eight faults can be displayed.

(The latest fault is ended by ".".)

When no fault history exists, E 0 is displayed.

While a fault is displayed:

- The display shifts as follows by pressing (SET): Rotation speed at the fault → Output current→Output voltage→Energization time.
  (After Energization time, it goes back to a fault display.)
- Pressing the setting dial shows the fault history number.

4.1.3 Easy operation mode setting (easy setting mode)

Setting of *Pr. 79 Operation mode selection* according to combination of the start command and speed command can be easily made.

Changing example	Start command: external (STF/STR), speed command: operate with (setting dial)

Operation — **Display**

1. Screen at power-ON

   The monitor display appears.

2. Easy operation mode setting

   Press PU/EXT and MODE for 0.5s.

3. Operation mode selection

   Turn (setting dial) until "79-3" appears.

   (Refer to the table below for other settings.)

Operation Panel Indication	Operation Mode	
	Start command	Speed command
79-1 (PRM blinking, PU blinking)	RUN	(setting dial)
79-2 (PRM blinking, EXT blinking)	External (STF, STR)	Analog voltage input
79-3 (PRM blinking, PU EXT blinking)	External (STF, STR)	(setting dial)
79-4 (PRM blinking, PU EXT blinking)	RUN	Analog voltage input

4. Operation mode setting

   Press SET to set.

Blink ··· Parameter setting complete!!

The monitor display appears after 3s.

REMARKS

? "Er2" is displayed ... Why?

☞ Setting cannot be made during operation. Turn the start switch (RUN, STF or STR) OFF.

- If MODE is pressed before pressing SET, the easy setting mode is terminated and the display goes back to the monitor display. If the easy setting mode is terminated while *Pr. 79* = "0 (initial setting)," the operation mode switches between the PU operation mode and the External operation mode. Check the operation mode.
- Reset can be made with STOP/RESET.
- The priorities of the speed commands when *Pr. 79* = "3" are "Multi-speed operation (RL/RM/RH/REX) > PID control (X14) > terminal 4 analog input (AU) > digital input from the operation panel".

4.1.4 Changing the parameter setting value

Changing example	Change the *Pr. 4 Multi-speed setting (high speed)* setting.

Operation — **Display**

1. Screen at power-ON

The monitor display appears.

2. Changing the operation mode

Press (PU/EXT) to choose the PU operation mode.

PU indicator is lit.

3. Parameter setting mode

Press (MODE) to choose the parameter setting mode.

PRM indicator is lit.

(The parameter number read previously appears.)

4. Selecting the parameter number

Turn the setting dial until "P. 4" (*Pr. 4*) appears.

5. Displaying the setting

Press (SET) to read the present set value.

"3000" (3000r/min (initial value)) appears.

6. Changing the setting value

Turn the setting dial to change the set value to "1800" (1800r/min).

7. Parameter setting

Press (SET) to set.

Blink...Parameter setting complete!!

- Turn the setting dial to read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.
- Press (MODE) twice to return to speed monitor.

REMARKS

? "Er 1" to "Er 4" is displayed...Why?

"Er 1" appears .... Write disable error

"Er 2" appears .... Write error during operation

"Er 3" appears .... Calibration error

"Er 4" appears .... Mode designation error

(For details, *refer to page 254.*)

- The number of digits displayed on the operation panel is four. Only the upper four digits of values can be displayed and set. If the values to be displayed have five digits or more including decimal places, the fifth or later numerals cannot be displayed nor set.
  (Example) For *Pr. 505*
  When 60Hz is set, "60.00" is displayed.
  When 120Hz is set, "120.0" is displayed and second decimal place is not displayed nor set.

4.1.5 Displaying the set speed

Press the setting dial ( ) to display the present control method and the set speed*.

* Appears when PU operation mode or External/PU combined operation mode 1 (*Pr. 79* ="3") is selected.

4 PARAMETERS

4.2 Parameter list

4.2.1 parameter list

For simple variable-speed operation of the drive unit, the initial setting of the parameters may be used. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel.

Parameter	Name	Initial Value	Setting Range	Remarks
160	Extended function display selection	9999	9999	Displays only the simple mode parameters
			0	Displays simple mode + extended parameters

REMARKS

- ◎ indicates simple mode parameters.
- The parameters surrounded by a black border in the table allow its setting to be changed during operation even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Basic functions	◎ 1	Maximum setting	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	*87*	
	◎ 2	Minimum setting	0 to 3600r/min/ 0 to 2400r/min *1	1r/min	0r/min	*87*	
	◎ 4	Multi-speed setting (high speed)	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	*89*	
	◎ 5	Multi-speed setting (middle speed)	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	1500r/min	*89*	
	◎ 6	Multi-speed setting (low speed)	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	300r/min	*89*	
	◎ 7	Acceleration time	0 to 3600s	0.1s	5s	*97*	
	◎ 8	Deceleration time	0 to 3600s	0.1s	5s	*97*	
	◎ 9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated motor current	*101*	
DC injection brake	10	Coasting speed	0 to 3600r/min/ 0 to 2400r/min *1	1r/min	90r/min	*110*	
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	*110*	
—	13	Starting speed	0 to 1800r/min/ 0 to 1200r/min *1	1r/min	15r/min	*99*	
JOG operation	15	Jog speed setting	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	150r/min	*91*	
	16	Jog acceleration/deceleration time	0 to 3600s	0.1s	0.5s	*91*	
—	17	MRS input selection	0, 2, 4	1	0	*119*	
Acceleration/ deceleration time	20	Acceleration/deceleration reference speed	30 to 12000r/min/ 20 to 8000r/min *1	1r/min	3000r/min	*97*	
Stall prevention	22	Stall prevention operation level	0 to 200%	0.1%	150%	*83*	
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	*89*	
	25	Multi-speed setting (speed 5)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	*89*	
	26	Multi-speed setting (speed 6)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	*89*	
	27	Multi-speed setting (speed 7)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	*89*	

Parameter list

- Symbol in the Remarks column.
  Ver.UP ...Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.
- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication. (*Refer to page 184* for RS-485 communication.)
- "○" indicates valid and "×" indicates invalid of "control mode-based correspondence table", "parameter copy", "parameter clear", and "all parameter clear".

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
◎ 1		01	81	0	○	○	○
◎ 2		02	82	0	○	○	○
◎ 4		04	84	0	○	○	○
◎ 5		05	85	0	○	○	○
◎ 6		06	86	0	○	○	○
◎ 7		07	87	0	○	○	○
◎ 8		08	88	0	○	○	○
◎ 9		09	89	0	○	○	○
10		0A	8A	0	○	○	○
11		0B	8B	0	○	○	○
13		0D	8D	0	○	○	○
15		0F	8F	0	○	○	○
16		10	90	0	○	○	○
17		11	91	0	○	○	○
20		14	94	0	○	○	○
22		16	96	0	○	○	○
24		18	98	0	○	○	○
25		19	99	0	○	○	○
26		1A	9A	0	○	○	○
27		1B	9B	0	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
—	29	Acceleration/deceleration pattern selection	0 to 2	1	0	100	
—	30	Regenerative function selection	0, 1	1	0	114	
Speed jump	31	Speed jump 1A	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
Speed jump	32	Speed jump 1B	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
Speed jump	33	Speed jump 2A	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
Speed jump	34	Speed jump 2B	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
Speed jump	35	Speed jump 3A	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
Speed jump	36	Speed jump 3B	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	88	
—	37	Speed display	0, 0.01 to 9998	0.001	0	132	
—	40	RUN key rotation direction selection	0, 1	1	0	241	
Speed detection	41	Up-to-speed sensitivity	0 to 100%	0.1%	10%	127	
Speed detection	42	Speed detection	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	180r/min	127	
Speed detection	43	Speed detection for reverse rotation	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	127	
Second functions	44	Second acceleration/deceleration time	0 to 3600s	0.1s	5s	97	
Second functions	45	Second deceleration time	0 to 3600s, 9999	0.1s	9999	97	
Second functions	48	Second stall prevention operation current	0 to 200%, 9999	0.1%	9999	83	
Monitor functions	52	DU/PU main display data selection	0, 5, 8 to 12, 14, 20, 23 to 25, 52 to 55, 61, 62, 64, 100	1	0	134	
Monitor functions	54	FM terminal function selection	1 to 3, 5, 8 to 12, 14, 21, 24, 52, 53, 61, 62	1	1	134	
Monitor functions	55	Speed monitoring reference	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	139	
Monitor functions	56	Current monitoring reference	0 to 500A	0.01A	Rated motor current	139	
—	59	Remote function selection	0 to 3	1	0	93	
—	65	Retry selection	0 to 5	1	0	143	
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	143	
Retry	68	Retry waiting time	0.1 to 600s	0.1s	1s	143	
Retry	69	Retry count display erase	0	1	0	143	
—	70	Special regenerative brake duty	0 to 30%	0.1%	0%	114	
—	71	Applied motor	1040, 8090, 9090	1	1040	105	
—	73	Analog input selection	0, 1, 10, 11	1	1	147	
—	74	Input filter time constant	0 to 8	1	1	151	
—	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	157	
—	77	Parameter write selection	0 to 2	1	0	160	
—	78	Reverse rotation prevention selection	0 to 2	1	0	161	
—	◎ 79	Operation mode selection	0 to 4, 6, 7	1	0	164, 176	

Parameter list

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
29		1D	9D	0	○	○	○
30		1E	9E	0	○	○	○
31		1F	9F	0	○	○	○
32		20	A0	0	○	○	○
33		21	A1	0	○	○	○
34		22	A2	0	○	○	○
35		23	A3	0	○	○	○
36		24	A4	0	○	○	○
37		25	A5	0	○	○	○
40		28	A8	0	○	○	○
41		29	A9	0	○	○	○
42		2A	AA	0	○	○	○
43		2B	AB	0	○	○	○
44		2C	AC	0	○	○	○
45		2D	AD	0	○	○	○
48		30	B0	0	○	○	○
52		34	B4	0	○	○	○
54		36	B6	0	○	○	○
55		37	B7	0	○	○	○
56		38	B8	0	○	○	○
59		3B	BB	0	○	○	○
65		41	C1	0	○	○	○
67		43	C3	0	○	○	○
68		44	C4	0	○	○	○
69		45	C5	0	○	○	○
70		46	C6	0	○	○	○
71	Ver.UP	47	C7	0	○	○	○
73		49	C9	0	○	×	○
74		4A	CA	0	○	○	○
75		4B	CB	0	○	×	×
77		4D	CD *4	0	○	○	○
78		4E	CE	0	○	○	○
◎ 79		4F	CF *4	0	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Motor constant	80	Motor capacity	0.01 to 3.7kW	0.01kW	Motor capacity *6	105	
	81	Number of motor poles	2, 4, 6, 8, 10, 9999	1	9999	105	
	83	Rated motor voltage	0 to 1000V	0.1V	200V/ 400V*2	105	
	84 *7	Rated motor speed	300 to 6000r/min/ 200 to 4000r/min*1, 9999	1r/min	9999	105	
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	105	
	92	Motor constant (Ld)	0 to 500mH, 9999	0.01mH	9999	105	
	93	Motor constant (Lq)	0 to 500mH, 9999	0.01mH	9999	105	
	96	Auto tuning setting/status	0, 1	1	0	105	
PU connector communication	117	PU communication station number	0 to 31 (0 to 247)	1	0	184,203	
	118	PU communication speed	48, 96, 192, 384	1	192	184,203	
	119	PU communication stop bit length	0, 1, 10, 11	1	1	184	
	120	PU communication parity check	0 to 2	1	2	184,203	
	121	Number of PU communication retries	0 to 10, 9999	1	1	185	
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0s	185,203	
	123	PU communication waiting time setting	0 to 150ms, 9999	1ms	9999	184	
	124	PU communication CR/LF selection	0 to 2	1	1	184	
—	◎ 125	Terminal 2 speed setting gain speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	152	
—	◎ 126	Terminal 4 speed setting gain speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	152	
PID operation	127	PID control automatic switchover speed	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	216	
	128	PID action selection	0, 20, 21	1	0	216	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	216	
	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	216	
	131	PID upper limit	0 to 100%, 9999	0.1%	9999	216	
	132	PID lower limit	0 to 100%, 9999	0.1%	9999	216	
	133	PID action set point	0 to 100%, 9999	0.01%	9999	216	
	134	PID differential time	0.01 to 10s, 9999	0.01s	9999	216	
—	144	Speed setting switchover	2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	104/106 *1	132	
PU	145	PU display language selection	0 to 7	1	0	241	
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	128	
	151	Output current detection signal delay time	0 to 10s	0.1s	0s	128	
	152	Zero current detection level	0 to 200%	0.1%	5%	128	
	153	Zero current detection time	0 to 1s	0.01s	0.5s	128	
—	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	83	
—	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	83	
—	◎ 160	Extended function display selection	0, 9999	1	9999	161	
—	161	Speed setting/key lock operation selection	0, 1, 10, 11	1	0	242	
Current detection	166	Output current detection signal retention time	0 to 10s, 9999	0.1s	0.1s	128	
	167	Output current detection operation selection	0, 1, 10, 11	1	0	128	
—	168	Parameter for manufacturer setting. Do not set.					
—	169						
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999	1	9999	134	
	171	Operation hour meter clear	0, 9999	1	9999	134	

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
80	Ver.UP	50	D0	0	○	○	○
81	Ver.UP	51	D1	0	○	○	○
83	Ver.UP	53	D3	0	○	○	○
84	Ver.UP	54	D4	0	○	○	○
90	Ver.UP	5A	DA	0	○	×	○
92	Ver.UP	5C	DC	0	○	×	○
93	Ver.UP	5D	DD	0	○	×	○
96	Ver.UP	60	E0	0	○	×	○
117		11	91	1	○	○*5	○*5
118		12	92	1	○	○*5	○*5
119		13	93	1	○	○*5	○*5
120		14	94	1	○	○*5	○*5
121		15	95	1	○	○*5	○*5
122		16	96	1	○	○*5	○*5
123		17	97	1	○	○*5	○*5
124		18	98	1	○	○*5	○*5
◎ 125		19	99	1	○	×	○
◎ 126		1A	9A	1	○	×	○
127		1B	9B	1	○	○	○
128		1C	9C	1	○	○	○
129		1D	9D	1	○	○	○
130		1E	9E	1	○	○	○
131		1F	9F	1	○	○	○
132		20	A0	1	○	○	○
133		21	A1	1	○	○	○
134		22	A2	1	○	○	○
144		2C	AC	1	○	○	○
145		2D	AD	1	○	×	×
150		32	B2	1	○	○	○
151		33	B3	1	○	○	○
152		34	B4	1	○	○	○
153		35	B5	1	○	○	○
156		38	B8	1	○	○	○
157		39	B9	1	○	○	○
◎ 160		00	80	2	○	○	○
161		01	81	2	○	×	○
166		06	86	2	○	○	○
167	Ver.UP	07	87	2	○	○	○
168	Parameter for manufacturer setting. Do not set.						
169							
170		0A	8A	2	○	×	○
171		0B	8B	2	×	×	×

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Input terminal function selection	178	STF terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 23 to 25, 60, 62, 64 to 67, 72, 9999	1	60	117	
	179	STR terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 23 to 25, 61, 62, 64 to 67, 72, 9999	1	61	117	
	180	RL terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 23 to 25, 62, 64 to 67, 72, 9999	1	0	117	
	181	RM terminal function selection		1	1	117	
	182	RH terminal function selection		1	2	117	
Output terminal function selection	190	RUN terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 21, 25, 26, 33, 37, 47, 48, 64, 70, 79, 90, 91, 93, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 120, 121, 125, 126, 133, 137, 147, 148, 164, 170, 179, 190, 191, 193, 195, 196, 198, 199, 9999	1	0	123	
	192	A,B,C terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 20, 21, 25, 26, 33, 37, 47, 48, 64, 70, 79, 90, 91, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 120, 121, 125, 126, 133, 137, 147, 148, 164, 170, 179, 190, 191, 195, 196, 198, 199, 9999	1	99	123	
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	233	Multi-speed setting (speed 9)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	234	Multi-speed setting (speed 10)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	235	Multi-speed setting (speed 11)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	236	Multi-speed setting (speed 12)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	237	Multi-speed setting (speed 13)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	238	Multi-speed setting (speed 14)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
	239	Multi-speed setting (speed 15)	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	89	
—	241	Analog input display unit switchover	0, 1	1	0	152	
—	244	Cooling fan operation selection	0, 1	1	1	230	
—	249	Earth (ground) fault detection at start	0, 1	1	0	145	
—	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	116, 121	
—	251	Output phase loss protection selection	0, 1	1	1	145	
Life diagnosis	255	Life alarm status display	(0 to 15)	1	0	231	
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	231	
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	231	
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	231	
	259	Main circuit capacitor life measuring	0, 1 (2, 3, 8, 9)	1	0	231	
—	267	Terminal 4 input selection	0 to 2	1	0	147	
—	268	Monitor decimal digits selection	0, 1, 9999	1	9999	134	
—	269	Parameter for manufacturer setting. Do not set.					

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
178		12	92	2	○	×	○
179		13	93	2	○	×	○
180		14	94	2	○	×	○
181		15	95	2	○	×	○
182		16	96	2	○	×	○
190	Ver.UP	1E	9E	2	○	×	○
192	Ver.UP	20	A0	2	○	×	○
232		28	A8	2	○	○	○
233		29	A9	2	○	○	○
234		2A	AA	2	○	○	○
235		2B	AB	2	○	○	○
236		2C	AC	2	○	○	○
237		2D	AD	2	○	○	○
238		2E	AE	2	○	○	○
239		2F	AF	2	○	○	○
241		31	B1	2	○	○	○
244		34	B4	2	○	○	○
249		39	B9	2	○	○	○
250		3A	BA	2	○	○	○
251		3B	BB	2	○	○	○
255		3F	BF	2	×	×	×
256		40	C0	2	×	×	×
257		41	C1	2	×	×	×
258		42	C2	2	×	×	×
259		43	C3	2	○	○	○
267		4B	CB	2	○	×	○
268		4C	CC	2	○	○	○
269	Parameter for manufacturer setting. Do not set.						

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Electromagnetic brake	281	Brake operation time at start	0 to 1s	0.01s	0s	*112*	
	283	Brake operation time at stop	0 to 1s	0.01s	0s	*112*	
—	295	Magnitude of speed change setting	0, 0.01, 0.10, 1.00, 10.00	0.01	0	*245*	
Password function	296	Password lock level	1 to 6, 101 to 106, 9999	1	9999	*162*	
	297	Password lock/unlock	1000 to 9998 (0 to 5, 9999)	1	9999	*162*	
RS-485 communication	338	Communication operation command source	0, 1	1	0	*177*	
	339	Communication speed command source	0 to 2	1	0	*177*	
	340	Communication startup mode selection	0, 1, 10	1	0	*176*	
	342	Communication EEPROM write selection	0, 1	1	0	*190*	
	343	Communication error count	—	1	0	*203*	
—	374	Overspeed detection level	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3450r/min	*146*	
Remote Output	495	Remote output selection	0, 1, 10, 11	1	0	*130*	
	496	Remote output data 1	0 to 4095	1	0	*130*	
—	502	Stop mode selection at communication error	0 to 3	1	0	*185, 203*	
Maintenance	503	Maintenance timer	0 (1 to 9998)	1	0	*235*	
	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	*235*	
—	505	Speed setting reference	1 to 200Hz	0.01Hz	100Hz/ 150Hz *1	*132*	
—	520	Parameter for manufacturer setting. Do not set.					
Communication	549	Protocol selection	0, 1	1	0	*184*	
	551	PU mode operation command source selection	2, 4, 9999	1	9999	*177*	
PID control	553	PID deviation limit	0 to 100%, 9999	0.1%	9999	*216*	
	554	PID signal operation selection	0 to 3, 10 to 13	1	0	*216*	
Current average monitor	555	Current average time	0.1 to 1s	0.1s	1s	*236*	
	556	Data output mask time	0 to 20s	0.1s	0s	*236*	
	557	Current average value monitor signal output reference current	0 to 500A	0.01A	Rated motor current	*236*	
—	561	PTC thermistor protection level	0.5 to 30kΩ, 9999	0.01kΩ	9999	*101*	
—	563	Energization time carrying-over times	(0 to 65535)	1	0	*134*	
—	564	Operating time carrying-over times	(0 to 65535)	1	0	*134*	
PID control	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	*216*	
	576	Output interruption detection level	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	0r/min	*216*	
	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	*216*	

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
281	Ver.UP	5A	DA	2	○	○	○
283	Ver.UP	5B	DB	2	○	○	○
295		67	E7	2	○	○	○
296		68	E8	2	○	×	○
297		69	E9	2	○	×	○
338		26	A6	3	○	○ *5	○ *5
339		27	A7	3	○	○ *5	○ *5
340		28	A8	3	○	○ *5	○ *5
342		2A	AA	3	○	○	○
343		2B	AB	3	×	×	×
374		4A	CA	3	○	○	○
495		5F	DF	4	○	○	○
496		60	E0	4	×	×	×
502		02	82	5	○	○	○
503		03	83	5	×	×	×
504		04	84	5	○	×	○
505		05	85	5	○	○	○
520	Parameter for manufacturer setting. Do not set.						
549		31	B1	5	○	○ *5	○ *5
551		33	B3	5	○	○ *5	○ *5
553		35	B5	5	○	○	○
554		36	B6	5	○	○	○
555		37	B7	5	○	○	○
556		38	B8	5	○	○	○
557		39	B9	5	○	○	○
561		3D	BD	5	○	×	○
563		3F	BF	5	×	×	×
564		40	C0	5	×	×	×
575		4B	CB	5	○	○	○
576		4C	CC	5	○	○	○
577		4D	CD	5	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Electronic thermal O/L relay	600	Free thermal reduction speed 1	0 to 12000r/min/ 0 to 8000r/min*1, 9999	1r/min	9999	104	
	601	Free thermal reduction ratio 1	1 to 100%	1%	100%	104	
	602	Free thermal reduction speed 2	0 to 12000r/min/ 0 to 8000r/min*1, 9999	1r/min	9999	104	
	603	Free thermal reduction ratio 2	1 to 100%	1%	100%	104	
	604	Free thermal reduction speed 3	0 to 12000r/min/ 0 to 8000r/min*1, 9999	1r/min	9999	104	
—	643	Voltage compensation amount setting	0 to 150%, 9999	1%	9999	82	
—	658	Wiring resistance	0 to 5Ω, 9999	0.001Ω	9999	82	
—	665	Regeneration avoidance speed gain	0 to 200%	0.1%	100%	228	
Adjustment function	672 *7	Lq tuning target current adjustment coefficient	50 to 150%, 9999	0.1%	9999	105	
	702	Maximum motor speed	0 to 6000r/min/ 0 to 4000r/min*1, 9999	1r/min	9999	105	
	706	Induced voltage constant (phi f)	0 to 5000mV/(s/rad), 9999	0.1mV/(s/rad)	9999	105	
	707	Motor inertia (integer)	10 to 999, 9999	1	9999	105	
	711	Motor Ld decay ratio	0 to 100%, 9999	0.1%	9999	105	
	712	Motor Lq decay ratio	0 to 100%, 9999	0.1%	9999	105	
	717 *7	Starting resistance tuning compensation	0 to 200%, 9999	0.1%	9999	105	
	721	Starting magnetic pole position detection pulse width	0 to 6000μs, 9999	0.1μs	9999	105	
	724 *7	Motor inertia (exponent)	4 to 7, 9999	1	9999	105	
	725	Motor protection current level	0 to 500%, 9999	0.1%	9999	105	
	726	Motor induced voltage constant (phi f) exponent	0 to 2, 9999	1	9999	105	
—	736	Electromagnetic brake interlock time	0 to 1s	0.01s	0s	113	
—	779	Operation speed during communication error	0 to 12000r/min/ 0 to 8000r/min *1, 9999	1r/min	9999	203	
—	785	PM control torque boost	0 to 150%, 9999	0.1%	9999	86	
Acceleration/ deceleration time	791	Acceleration time in low-speed range	0 to 3600s, 9999	0.1s	9999	97	
	792	Deceleration time in low-speed range	0 to 3600s, 9999	0.1s	9999	97	
—	795	DC brake torque boost	0 to 150%, 9999	0.1%	9999	110	
—	799	Pulse increment setting for output power	0.1kWh, 1kWh, 10kWh, 100kWh, 1000kWh	0.1kWh	1kWh	131	
—	800	Control method selection	9, 30	1	30	77	
Adjustment function	820	Speed control P gain	0 to 1000%	1%	15%	79	
	821	Speed control integral time	0 to 20s	0.001s	0.333s	79	
	824	Torque control P gain (current loop proportional gain)	0 to 200%, 9999	1%	9999	81	
	825	Torque control integral time (current loop integral time)	0 to 500ms, 9999	0.1ms	9999	81	
—	859	Rated PM motor current	0 to 500A, 9999	0.01A	9999	105	
—	870	Speed detection hysteresis	0 to 150r/min/ 0 to 100r/min *1	1r/min	15r/min	127	
Protective functions	872	Input phase loss protection selection	0, 1	1	0	145	

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
600	Ver.UP	00	80	6	○	○	○
601	Ver.UP	01	81	6	○	○	○
602	Ver.UP	02	82	6	○	○	○
603	Ver.UP	03	83	6	○	○	○
604	Ver.UP	04	84	5	○	○	○
643	Ver.UP	2B	AB	6	○	○	○
658	Ver.UP	3A	BA	6	○	○	○
665		41	C1	6	○	○	○
672 *7	Ver.UP	48	C8	6	○	○	○
702	Ver.UP	02	82	7	○	○	○
706	Ver.UP	06	86	7	○	○	○
707	Ver.UP	07	87	7	○	○	○
711	Ver.UP	0B	8B	7	○	○	○
712	Ver.UP	0C	8C	7	○	○	○
717 *7	Ver.UP	11	91	7	○	○	○
721	Ver.UP	15	95	7	○	○	○
724 *7	Ver.UP	18	98	7	○	○	○
725	Ver.UP	19	99	7	○	○	○
726	Ver.UP	1A	9A	7	○	○	○
736		56	D6	7	○	○	○
779		4F	CF	7	○	○	○
785		55	D5	7	○	○	○
791		5B	DB	7	○	○	○
792		5C	DC	7	○	○	○
795		5F	DF	7	○	○	○
799		63	E3	7	○	○	○
800		00	80	8	○	○	○
820		14	94	8	○	○	○
821		15	95	8	○	○	○
824	Ver.UP	18	98	8	○	○	○
825	Ver.UP	19	99	8	○	○	○
859	Ver.UP	3B	BB	8	○	×	○
870		46	C6	8	○	○	○
872		48	C8	8	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Regeneration avoidance function	882	Regeneration avoidance operation selection	0 to 2	1	0	228	
	883	Regeneration avoidance operation level	300 to 800V	0.1V	400VDC/ 780VDC*2	228	
	885	Regeneration avoidance compensation speed limit value	0 to 900r/min/ 0 to 600r/min *1, 9999	1r/min	180r/min	228	
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	228	
Free parameter	888	Free parameter 1	0 to 9999	1	9999	238	
	889	Free parameter 2	0 to 9999	1	9999	238	
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	134	
Calibration parameters	C0 (900) *3	FM terminal calibration	—	—	—	140	
	C2 (902) *3	Terminal 2 speed setting bias speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	0r/min	152	
	C3 (902) *3	Terminal 2 speed setting bias	0 to 300%	0.1%	0%	152	
	125 (903) *3	Terminal 2 speed setting gain speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	152	
	C4 (903) *3	Terminal 2 speed setting gain	0 to 300%	0.1%	100%	152	
	C5 (904) *3	Terminal 4 speed setting bias speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	0r/min	152	
	C6 (904) *3	Terminal 4 speed setting bias	0 to 300%	0.1%	20%	152	
	126 (905) *3	Terminal 4 speed setting gain speed	0 to 12000r/min/ 0 to 8000r/min *1	1r/min	3000r/min	152	
	C7 (905) *3	Terminal 4 speed setting gain	0 to 300%	0.1%	100%	152	
PID control	C42 (934) *3	PID display bias coefficient	0 to 500, 9999	0.01	9999	216	
	C43 (934) *3	PID display bias analog value	0 to 300%	0.1%	20%	216	
	C44 (935) *3	PID display gain coefficient	0 to 500, 9999	0.01	9999	216	
	C45 (935) *3	PID display gain analog value	0 to 300%	0.1%	100%	216	
PU	990	PU buzzer control	0, 1	1	1	246	
	991	PU contrast adjustment	0 to 63	1	58	246	
—	997	Fault initiation	16 to 18, 32 to 34, 48, 49, 64, 82, 96, 97, 112, 128, 129, 144, 145, 176 to 178, 192, 196, 197, 199, 201, 208, 230, 245, 9999	1	9999	238	
—	998	PM parameter initialization	6004, 6104, 8009, 8109, 9009, 9109	1	6004	73	
—	◎ 999	Automatic parameter setting	10, 9999	1	9999	239	
Clear parameters	◎ Pr.CL	Parameter clear	0, 1	1	0	247	
	◎ ALLC	All parameter clear	0, 1	1	0	247	
	◎ Er.CL	Fault history clear	0, 1	1	0	249	

Parameter list

Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
882		52	D2	8	○	○	○
883		53	D3	8	○	○	○
885		55	D5	8	○	○	○
886		56	D6	8	○	○	○
888		58	D8	8	○	×	×
889		59	D9	8	○	×	×
891		5B	DB	8	○	○	○
C0 (900)		5C	DC	1	○	×	○
C2 (902)		5E	DE	1	○	×	○
C3 (902)		5E	DE	1	○	×	○
125 (903)		5F	DF	1	○	×	○
C4 (903)		5F	DF	1	○	×	○
C5 (904)		60	E0	1	○	×	○
C6 (904)		60	E0	1	○	×	○
126 (905)		61	E1	1	○	×	○
C7 (905)		61	E1	1	○	×	○
C42 (934)		22	A2	9	○	×	○
C43 (934)		22	A2	9	○	×	○
C44 (935)		23	A3	9	○	×	○
C45 (935)		23	A3	9	○	×	○
990		5A	DA	9	○	○	○
991		5B	DB	9	○	×	○
997		61	E1	9	×	×	×
998	Ver.UP	62	E2	9	○	○	○
◎ 999		63	E3	9	×	×	×
◎ Pr.CL		—	FC	—	—	—	—
◎ ALLC		—	FC	—	—	—	—
◎ Er.CL		—	F4	—	—	—	—

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
—	◎ Pr.CH	Initial value change list	—	—	—	248	
—	◎ PM	PM parameter initialization	6004, 8009, 9009 *8	1	6004	73	
—	◎ AUTO	Automatic parameter setting	—	—	—	239	

*1 Differ according to capacities. (2.2K or lower/3.7K)
*2 The initial value differs according to the voltage class. (200V class/400V class)
*3 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07).
*4 Write is disabled in the communication mode (Network operation mode) from the PU connector.
*5 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (*Refer to page 184* for RS-485 communication.)
*6 The capacity of the S-PM geared motor is initially set to the next smaller size than the capacity of the drive unit.
*7 While the parameter settings copied to the latest version drive unit (manufactured in April 2018 or later) are verified against the parameter settings copied to the parameter unit (FR-PU07) from the older version drive unit (manufactured in March 2018 or earlier) after the parameter settings are copied, a verification error about parameters marked with *7 will be displayed. However, these errors are not faults.
Press "0" on the parameter unit to proceed the verification. (For information about Parameter copy and Parameter verification, refer to the Instruction Manual of the parameter unit.)
Copying the parameter settings from the latest version drive unit to the older version drive unit is prohibited. If doing so, reset the copied parameter settings by performing Parameter clear or All parameter clear.
*8 Settings "8009" and "9009" can be displayed after offline auto tuning is performed.

REMARKS

- The unit for parameter setting and its setting range can be changed from "r/min" to "Hz". Use *Pr. 144* to change the setting.
- With operation panel, the value up to 9999 can be set. With parameter unit (FR-PU07), up to the highest value in the setting range can be set.
- If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed.

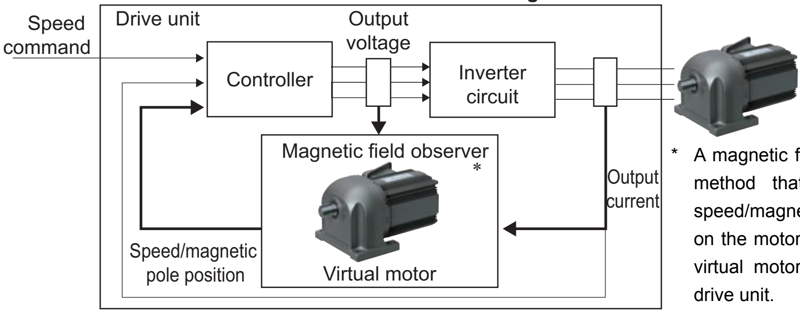
Parameter	Remarks	Instruction Code			Parameter		
		Read	Write	Extended	Copy	Clear	All Clear
◎ Pr.CH		—	—	—	—	—	—
◎ PM	Ver.UP	—	F4	—	—	—	—
◎ AUTO		—	—	—	—	—	—

4.3 Test operation and gain adjustment of the PM sensorless vector control

4.3.1 Outline of the PM sensorless vector control

A PM (magnet) motor is a highly efficient motor compared to an induction motor. With this PM motor, highly efficient motor control and highly accurate motor speed control can be performed.
Without using a speed detector such as an encoder, the motor speed is detected based on the output voltage and current of the drive unit, and highly accurate control can be performed.

PM sensorless vector control image



* A magnetic field observer is a control method that calculates the motor speed/magnetic pole position based on the motor voltage and current of a virtual motor which is set up in the drive unit.

POINT

- The following conditions must be met to perform PM sensorless vector control.
  - · A PM motor must be used.
  - · A specified combination of the S-PM geared motor capacity and the drive unit capacity must be used.
  - · Single-motor operation (one motor run by one drive unit) must be performed.
  - · The overall wiring length with the motor must be 30m or less.

NOTE

- **Constant-speed operation cannot be performed in the low-speed range less than 300r/min. Generally, speed control can be performed in the range that satisfies the ratio, 1:10. (Adjustable with *Pr. 785*.)**
- **The RUN signal is output about 100 ms after turning ON the start command (STF, STR). The delay is due to the magnetic pole detection.**

4.3.2 Automatic parameter setting in accordance with the motor (Pr.998) Ver.UP

- Performing PM parameter initialization automatically adjusts the parameter initial settings and setting ranges required to drive the PM motor being used.
- When using a PM motor other than the S-PM geared motor, perform offline auto tuning. *Refer to page 105* for offline auto tuning.
- Initialization is performed by setting *Pr.998 PM parameter initialization* or by choosing the mode on the operation panel.

Parameter Number	Name	Initial value	Setting range	Operation
998	PM parameter initialization	6004	6004	Parameter settings for an S-PM geared motor (rotations per minute)
			6104	Parameter settings for an S-PM geared motor (frequency)
			8009 *1	Parameter settings for an IPM motor (after tuning) (rotations per minute)
			8109 *1	Parameter settings for an IPM motor (after tuning) (frequency)
			9009 *2	Parameter settings for an SPM motor (after tuning) (rotations per minute)
			9109 *2	Parameter settings for an SPM motor (after tuning) (frequency)

The above parameters can be set when *Pr.160* Extended function display selection = "0". (*Refer to page 161*.)
*1 The setting is not available when *Pr.71* ≠ "8090", *Pr.80* = "9999", *Pr.81* = "9999", *Pr.84* = "9999", or *Pr.859* = "9999".
*2 The setting is not available when *Pr.71* ≠ "9090", *Pr.80* = "9999", *Pr.81* = "9999", *Pr.84* = "9999", or *Pr.859* = "9999".

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

(1) PM parameter initialization *(Pr.998)*

- When *Pr.998* = "6004, 8009, or 9009", the speed is displayed or set using the motor rotations per minute.
  To use frequency to display or set, set *Pr.998* = "6104, 8109, or 9109".

Pr.998 Setting	Description	Operation after Selecting the Parameter Setting Mode on the Operation Panel
6004	Parameter settings for an S-PM geared motor (rotations per minute)	"PM" (PM) → write "6004"
6104	Parameter settings for an S-PM geared motor (frequency)	Invalid
8009	Parameter settings for an IPM motor (after tuning) (rotations per minute)	"PM" (PM) → write "8009"
8109	Parameter settings for an IPM motor (after tuning) (frequency)	Invalid
9009	Parameter settings for an SPM motor (after tuning) (rotations per minute)	"PM" (PM) → write "9009"
9109	Parameter settings for an SPM motor (after tuning) (frequency)	Invalid

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 161.*)

REMARKS

- To set "8009, 8109, 9009, or 9109" in *Pr.998*, offline auto tuning must be performed before setting *Pr.998*. (*Refer to page 105.*)
  When *Pr.71, Pr.80, Pr.81, Pr.84*, or *Pr.859* is not set, *Pr.998* cannot be set. Any value set in *Pr.998* is regarded as a value outside of the setting range.
- Make sure to set *Pr.998* before setting other parameters. If the *Pr.998* setting is changed after setting other parameters, some of those parameters will be initialized too. (Refer to "(3) PM parameter initialization list" for the parameters that are initialized.)
- If the setting of *Pr.998 PM parameter initialization* is changed between "6004, 8009, or 9009 (rotations per minute)" and "6104, 8109, or 9109 (frequency)", all the target parameters are initialized. Use *Pr.144 Speed setting switchover* to change the display units between rotations per minute and frequency. *Pr.144* enables switching of display units between rotations per minute and frequency without initializing the parameter settings.
  Example) Changing the *Pr.144* setting between "6" and "106" switches the display units between frequency and rotations per minute.
- When performing PM parameter initialization by selecting the mode on the operation panel, a value to be written may be the same as the present set value. In that case, write a value different from the present value first before performing the PM parameter initialization. If the parameter number (or "PM") and the setting value do not blink alternately after the setting, parameter writing cannot be performed. Check that the drive unit is in the mode where the parameter writing can be performed, the value to be written is different from the present set value, etc.

(2) PM parameter initialization list

The parameter settings in the following table are changed to the settings required to perform control for the applied PM motor with the parameter setting mode or with *Pr.998 PM parameter initialization* setting. The changed settings differ according to the applied PM motor. For the settings, refer to the PM motor specifications table below.

Parameter Number	Name	Setting Value		Setting Increments	
		PM Motor (Rotations per Minute)	PM Motor (Frequency)		
	Pr.998	6004 (S-PM), 8009 (IPM motor (tuning)), 9009 (SPM motor (tuning))	6104 (S-PM), 8109 (IPM motor (tuning)), 9109 (SPM motor (tuning))	6004, 8009, 9009	6104, 8109, 9109
1	Maximum setting	Maximum motor rotation speed	Maximum motor frequency	1r/min	0.01Hz
4	Multi-speed setting (high speed)	Rated motor rotation speed	Rated motor frequency	1r/min	0.01Hz
5	Multi-speed setting (middle speed)	50% of the rated motor rotation speed	50% of the rated motor frequency	1r/min	0.01Hz
6	Multi-speed setting (low speed)	10% of the rated motor rotation speed	10% of the rated motor frequency	1r/min	0.01Hz
9	Electronic thermal O/L relay	Rated motor current *1		0.01A	
10	Coasting speed	3% of the rated motor rotation speed	3% of the rated motor frequency	1r/min	0.01Hz
13	Starting speed	0.5% of the rated motor rotation speed	0.5% of the rated motor frequency	1r/min	0.01Hz
15	Jog speed setting	5% of the rated motor rotation speed	5% of the rated motor frequency	1r/min	0.01Hz
20	Acceleration/deceleration reference speed	Rated motor rotation speed	Rated motor frequency	1r/min	0.01Hz
22	Stall prevention operation level	150%		0.1%	
37	Speed display	0		1	
42	Speed detection	6% of the rated motor rotation speed	6% of the rated motor frequency	1r/min	0.01Hz
55	Speed monitoring reference	Rated motor rotation speed	Rated motor frequency	1r/min	0.01Hz
56	Current monitoring reference	Rated motor current		0.01A	
71	Applied motor	S-PM:1040 IPM motor: 8090 SPM motor: 9090 *1		1	
80	Motor capacity	S-PM: One rank lower than the drive unit capacity *1		0.01kW	
81	Number of motor poles	9999 *1		1	
84	Rated motor speed	9999 *1		1r/min	0.01Hz

Parameter Number	Name		Setting Value		Setting Increments	
			PM Motor (Rotations per Minute)	PM Motor (Frequency)		
		Pr.998	6004 (S-PM), 8009 (IPM motor (tuning)), 9009 (SPM motor (tuning))	6104 (S-PM), 8109 (IPM motor (tuning)), 9109 (SPM motor (tuning))	6004, 8009, 9009	6104, 8109, 9109
90	Motor constant (R1)		9999 *1		0.001Ω	
92	Motor constant (Ld)		9999 *1		0.01mH	
93	Motor constant (Lq)		9999 *1		0.01mH	
96	Auto tuning setting/status		0 *1		1	
125(903)	Terminal 2 speed setting gain speed		Rated motor rotation speed	Rated motor frequency	1r/min	0.01Hz
126(905)	Terminal 4 speed setting gain speed		Rated motor rotation speed	Rated motor frequency	1r/min	0.01Hz
144	Speed setting switchover		Number of motor poles + 100	Number of motor poles	1	
150	Output current detection level		Short-time motor torque	Short-time motor torque	0.1%	
374	Overspeed detection level		Overspeed detection level rotation speed	Overspeed detection level frequency	1r/min	0.01Hz
505	Speed setting reference		Rated motor frequency		0.01Hz	
557	Current average value monitor signal output reference current		Rated motor current		0.01A	
702	Maximum motor speed		9999 *1		1r/min	0.01Hz
706	Induced voltage constant (phi f)		9999 *1		0.1mV (s/rad)	
707	Motor inertia (integer)		9999 *1		1	
711	Motor Ld decay ratio		9999 *1		0.1%	
712	Motor Lq decay ratio		9999 *1		0.1%	
717	Starting resistance tuning compensation		9999 *1		0.1%	
721	Starting magnetic pole position detection pulse width		9999 *1		1μs	
724	Motor inertia (exponent)		9999 *1		1	
725	Motor protection current level		9999 *1		0.1%	
726	Motor induced voltage constant (phi f) exponent		9999 *1		1	
820	Speed control P gain		15%		1%	
821	Speed control integral time		0.333s		0.001s	
824	Torque control P gain (current loop proportional gain)		9999 *2		1%	
825	Torque control integral time (current loop integral time)		9999 *2		0.1ms	
859	Rated PM motor current		9999 *1		0.01A	
870	Speed detection hysteresis		0.5% of the rated motor rotation speed	0.5% of the rated motor frequency	1r/min	0.01Hz
885	Regeneration avoidance compensation speed limit value		6% of the rated motor rotation speed	6% of the rated motor frequency	1r/min	0.01Hz

*1 The parameter is not automatically set when *Pr.998* = "8009, 8109, 9009, or 9109". (The setting for performing offline auto tuning is retained.)
*2 The value is automatically set when *Pr. 998* = "8009, 8109, 9009, or 9109".

REMARKS

- If PM motor control parameter initialization is performed in frequency (*Pr.998* = "3124 or 6104"), the rotation speed parameters not listed in the table and the monitored items are also set and displayed in frequency.

<PM motor specifications table>

	S-PM (0.1kW to 1.5kW)	S-PM (2.2kW)	IPM motor (after tuning)	SPM motor (after tuning)
Rated motor rotation speed (frequency)	3000r/min (100Hz)	3000r/min (150Hz)	*Pr.84*	
Maximum motor rotation speed (frequency)	3000r/min (100Hz)	3000r/min (150Hz)	*Pr.702* (*Pr.84* when *Pr.702* = "9999")	
Number of motor poles	4	6	*Pr.81*	
Rated motor current	150%	150%	*Pr.859*	
Overspeed detection level rotation speed (frequency)	300r/min (10Hz)	300r/min (15Hz)	Maximum motor frequency +10Hz	

⚠ CAUTION

⚠ **According to the motor to be connected, perform PM parameter initialization. Incorrect initial setting of parameters may damage the motor.**
The parameters for motor operation are initially set for an S-PM geared motor.

4

PARAMETERS

4.3.3 Setting procedure of speed control

Driving an S-PM geared motor

Perform PM parameter initialization. (*Refer to page 73.*)

Select *Pr.998 PM parameter initialization* or "PM" (PM parameter initialization mode) depending on the applied motor.
Setting value "6004": parameter settings for an S-PM geared motor (rotations per minute)
Setting value "6104": parameter settings for an S-PM geared motor (frequency)

Driving a PM motor other than the above

Set the motor. *(Pr.9, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84) (Refer to page 105.)*

Set "8090 (IPM motor)" or "9090 (SPM motor)" in *Pr.71 Applied motor*. Set *Pr.9 Electronic thermal O/L relay*, *Pr.80 Motor capacity*, *Pr.81 Number of motor poles*, *Pr.83 Rated motor voltage*, and *Pr.84 Rated motor speed* according to the motor specifications.

Perform offline auto tuning. *(Pr.96) (Refer to page 105.)*

Set "1" in *Pr.96*, and perform tuning.

Configure the initial setting for the PM sensorless vector control using *Pr.998*. *(Refer to page 73.)*

"8009": Parameter (rotations per minute) settings for an IPM motor
"8109": Parameter (frequency) settings for an IPM motor
"9009": Parameter (rotations per minute) settings for an SPM motor
"9109": Parameter (frequency) settings for an SPM motor

Set parameters such as the acceleration/deceleration time and multi-speed setting.

Set parameters such as the acceleration/deceleration time and multi-speed setting as required.

Set the operation command. *(Refer to page 164.)*

Select the start command and speed command.

Test run

As required

•Adjust the speed control gain. *(Pr.820, 821) (Refer to page 79.)*

4.3.4 PM motor test operation (Pr. 800)

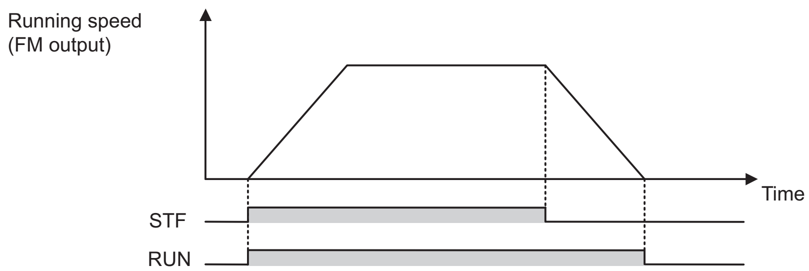
- Without connecting a PM motor, the speed movement can be checked by the monitor or analog signal output.
- Two types of operation can be selected using this parameter: an actual operation by connecting a PM motor, or a test operation without connecting a PM motor to simulate a virtual operation.

Parameter Number	Name	Initial value	Setting range	Operation
800	**Control method selection**	30	9	PM motor test operation (Motor is not driven even if it is connected.)
			30	Normal operation (Motor can be driven.)

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Test operation

- Setting *Pr. 800 Control method selection* = "9" will enable the PM motor test operation.
  Perform a test operation by giving a speed and a start command under each of PU/External/Network operation mode.



REMARKS

· In the test operation, current is not detected and voltage is not output. Related monitor displays of the output current and voltage show "0."

(2) Valid/invalid statuses of I/O terminal functions during the test operation

1) *Input terminal function selection (Pr. 178 to Pr. 182)*
All assignable functions are valid.

2) *Output terminal function selection (Pr. 190, Pr. 192)*
Some functions have restrictions. For details, refer to the table below.

○: Valid, ×: Not output as there is no output current

Signal Name	Function	
RUN	Drive unit running	○
SU	Up to speed	○
OL	Overload alarm	×
FU	Rotation speed detection	○
RBP	Regenerative brake pre-alarm	○
THP	Electronic thermal O/L relay pre-alarm	×
RY	Drive unit operation ready	○
Y12	Output current detection	○
Y13	Zero current detection	○
FDN	PID lower limit	○
FUP	PID upper limit	○
RL	PID forward/reverse rotation output	○
BOF	Brake opening request	○
MBR	Electromagnetic brake interlock	○
FAN	Fan fault output	○
FIN	Heatsink overheat pre-alarm	○

Signal Name	Function	
RY2	Operation ready 2	○
RY3	Operation ready 3	○
PID	During PID control activated	○
Y48	PID deviation limit	○
Y64	During retry	○
SLEEP	PID output interruption	○
Y79	Pulse train output of output power	×
Y90	Life alarm	○
Y91	Fault output 3 (power-off signal)	○
Y92	Energy saving average value updated timing	○
Y93	Current average value monitor signal	○
Y95	Maintenance timer signal	○
REM	Remote output	○
LF	Alarm output	○
ALM	Fault output	○
9999	No function	—

(3) Valid/invalid statuses of monitor outputs during the test operation

○: Valid, ×: Invalid (always displays 0)
△: Displays accumulated value before the test, —: Not monitored

Monitoring Items	Operation Panel/PU Monitor Display	FM Output
Rotation speed	○	○
Output current	×	×
Output voltage	×	×
Fault display	○	—
Speed setting value	○	○
Converter output voltage	○	○
Regenerative brake duty	○	○
Electronic thermal relay load factor	× *2	× *2
Output current peak value	× *2	× *2
Converter output voltage peak value	○	○
Output power	×	×
Cumulative energization time	○	—
Reference voltage output	—	○
Actual operation time	○	—
Motor load factor	×	×
Cumulative power	△	—

Monitoring Items	Operation Panel/PU Monitor Display	FM Output
PID set point	○	○
PID measured value	○	○
PID deviation	○	—
Input terminal status	—/○	—
Output terminal status	—/○	—
Drive unit I/O terminal monitor	○/—	—
Motor thermal load factor	× *2	× *2
Drive unit thermal load factor	× *2	× *2
PTC thermistor resistance	○	—

*1 Monitor output is valid or invalid depending on the monitor type (operation panel display, parameter unit display, or terminal FM/AM). For details, *refer to page 134*.

*2 When the operation is switched to the test operation, "0" is displayed. When the PM sensorless vector control is selected again after a test operation, the following monitored items from the last operation are displayed: output current peak value, motor thermal load factor, drive unit thermal load factor, and the electronic thermal relay load factor.

Parameters referred to

Pr. 52 DU/PU main display data selection ☞ *Refer to page 134.*
Pr. 190, Pr. 192 (Output terminal function selection) ☞ *Refer to page 123.*

4.3.5 Adjusting the speed control gain (Pr. 820, Pr. 821)

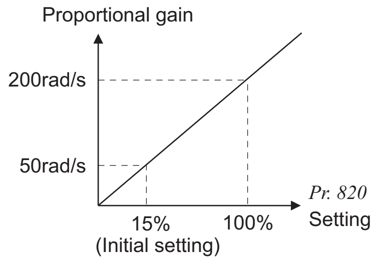
Manual adjustment of gain is useful to exhibit the optimum performance of the machine or to improve unfavorable conditions such as vibration and acoustic noise during the operation with high load inertia or gear backlashes.

Parameter Number	Name	Initial Value	Setting Range	Operation
820	**Speed control P gain**	15%	0 to 1000%	The proportional gain during speed control is set. (Setting this parameter higher improves the trackability for speed command changes. It also reduces the speed fluctuation due to a load fluctuation.)
821	**Speed control integral time**	0.333s	0 to 20s	The integral time during speed control is set. (Setting this parameter lower shortens the return time to the original speed when the speed fluctuates due to a load fluctuation.)

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

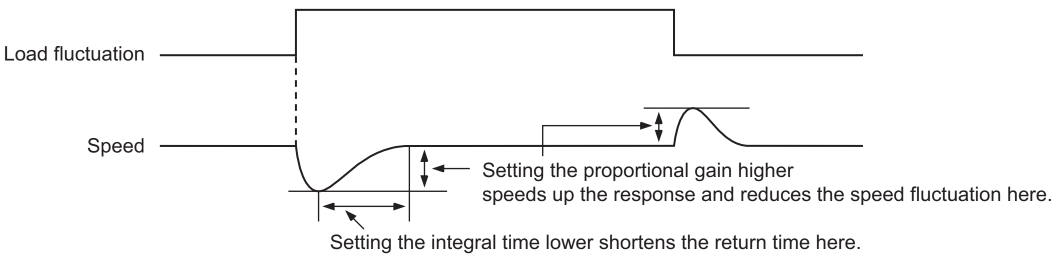
(1) Adjusting the speed control gain manually

·The speed control gain can be adjusted for the conditions such as abnormal machine vibration, acoustic noise, slow response, and overshoot.



- *Pr. 820 Speed control P gain* = "15% (initial setting)" is equivalent to 30rad/s (speed response of a single motor). Setting this parameter higher speeds up the response, but setting this too high causes vibration and acoustic noise.
- Setting *Pr. 821 Speed control integral time* lower shortens the return time to the original speed at a speed fluctuation, but setting it too low causes overshoot.

· Actual speed gain is calculated as below when load inertia is applied.



$$\text{Actual speed gain} = \text{Speed gain of a single motor} \times \frac{JM}{JM+JL}$$

JM: Motor inertia
JL: Load inertia converted as the motor axis inertia

4

PARAMETERS

· Adjust in the following procedure:
  1) Change the *Pr. 820* setting while checking the conditions.
  2) If it cannot be adjusted well, change *Pr. 821* setting, and perform 1) again.

No.	Movement/condition	Adjustment Method	
1	Load inertia is too high.	Set *Pr. 820* and *Pr. 821* higher.	
		Pr. 820	If acceleration is slow, raise the setting by 10%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
		Pr. 821	If overshoots occur, raise the setting by double the setting and set a value that satisfies the following condition: The setting where overshoots stop occurring × 0.8 to 0.9
2	Vibration or acoustic noise is generated from machines.	Set *Pr. 820* lower and *Pr. 821* higher.	
		Pr. 820	Lower the setting by 10%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
		Pr. 821	If overshoots occur, raise the setting by double the setting and set a value that satisfies the following condition: The setting where overshoots stop occurring × 0.8 to 0.9
3	Response is slow.	Set *Pr. 820* higher.	
		Pr. 820	If acceleration is slow, raise the setting by 5%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
4	Return time (response time) is long.	Set *Pr. 821* lower.	
		Lower *Pr. 821* by half the current setting and set a value that satisfies the following condition: The setting immediately before overshoots or unstable movements stop occurring × 0.8 to 0.9	
5	Overshoots or unstable movements occur.	Set *Pr. 821* higher.	
		Raise *Pr. 821* by double the current setting and set a value that satisfies the following condition: The setting immediately before overshoots or unstable movements stop occurring × 0.8 to 0.9	

(2) Troubleshooting

	Condition	Possible Cause	Countermeasure
1	Motor does not run at the correct speed. (Command speed and actual speed differ.)	(1) Speed command from the controller is different from the actual speed. The speed command is affected by noise. (2) The command speed and the speed recognized by the drive unit are different.	(1) Check that the speed command sent from the controller is correct. (Take EMC measures.) (2) Adjust bias and gain *(Pr. 125, Pr. 126, C2 to C7)* of the speed command again.
2	The speed does not accelerate to the command speed.	(1) Torque shortage Stall prevention operation is activated. (2) Only P (proportion) control is performed.	(1) -1 Raise the stall prevention operation level. *(Refer to page 83.)* (1) -2 Capacity shortage (2) Speed deviation occurs under P (proportional) control when the load is heavy. Select PI control.
3	Motor speed fluctuates.	(1) Speed command varies. (2) Torque shortage (3) Speed control gain is not suitable for the machine. (Resonance occurs.)	(1) Check that the speed command sent from the controller is correct. (Take EMC measures.) (2) Raise the stall prevention operation level. *(Refer to page 83.)* (3) Adjust *Pr. 820* and *Pr. 821 (Refer to page 79.)*
4	Hunting (vibration or acoustic noise) occurs in the motor or the machine.	(1) Speed control gain is too high. (2) Motor wiring is incorrect.	(1) Set *Pr. 820* lower and *Pr. 821* higher. (2) Check the wiring.

	Condition	Possible Cause	Countermeasure
5	Acceleration/deceleration time is different from the setting.	(1) Torque shortage (2) Load inertia is too high.	(1) Raise the stall prevention operation level. *(Refer to page 83.)* (2) Set acceleration/deceleration time suitable for the load.
6	Machine movement is unstable.	(1) Speed control gain is not suitable for the machine. (2) Response is slow because of the drive unit's acceleration/deceleration time setting.	(1) Adjust *Pr. 820* and *Pr. 821* *(Refer to page 79.)* (2) Set the optimum acceleration/deceleration time.
7	Rotation ripple occurs during the low-speed operation.	Speed control gain is too low.	Raise *Pr. 820*.

4.3.6 Gain adjustment of current controllers for the d axis and the q axis (Pr.824, Pr.825)

The gain of the current controller can be adjusted.

Parameter Number	Name	Initial Value	Setting Range	Operation	
824 Ver.UP	**Torque control P gain (current loop proportional gain)**	9999	0 to 200%	Set the current loop proportional gain.	
			9999	S-PM geared motor	50% is set.
				IPM motor (after tuning) SPM motor (after tuning)	100% is set.
825 Ver.UP	**Torque control integral time (current loop integral time)**	9999	0 to 500ms	Set current loop integral compensation time.	
			9999	S-PM geared motor	20.0ms is set.
				IPM motor (after tuning) SPM motor (after tuning)	

The above parameters can be set when *Pr.160 Extended function display selection* = "0". (*Refer to page 161*.)

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

(1) Current loop proportional (P) gain adjustment *(Pr. 824)*

Use *Pr.824 Torque control P gain (current loop proportional gain)* to adjust the proportional gain of current controllers for the d axis and the q axis. The 100% gain is equivalent to 1000 rad/s. Setting this parameter higher improves the trackability for current command changes. It also reduces the current fluctuation caused by external disturbances.

(2) Current control integral time adjustment *(Pr. 825)*

Use *Pr.825 Torque control integral time (current loop integral time)* to set the integral time of current controllers for the d axis and the q axis. If the setting value is small, it produces current fluctuation against external disturbances, decreasing time until it returns to original current value.

4.4 Special adjustment function

Purpose	Parameter to Set		Refer to Page
To improve the acceleration/ deceleration characteristics	Wiring resistance	Pr. 658	82
To reduce the unstable movements or the error occurrence	Voltage compensation amount setting	Pr. 643	82

4.4.1 Motor wiring resistance adjustment (Pr. 658) Ver.UP

Adjust if acceleration/deceleration characteristics are unstable. In normal condition, the setting is not required.

Parameter Number	Name	Initial Value	Setting Range	Description
658	Wiring resistance	9999	0 to 5Ω	Set the motor wiring resistance. PM sensorless vector control is performed with the resistance that is sum of the value for motor alone set in *Pr. 71 Applied motor* and the setting value of *Pr. 658*.
			9999	The motor wiring resistance calculated by the drive unit is set. PM sensorless vector control is performed with the calculated resistance.

Ver.UP .... Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

- The motor wiring resistance can be set. The set value is calculated from the following formula.
  Wiring resistance = Resistance per 1m (Ω) × Wiring length (m)
  Reference value

Cable Size		Resistance per 1m (Ω)	Resistance in the Wiring Length (Ω)					
HIV Cables, etc. (mm^2)	AWG		1m	2m	5m	10m	20m	30m
0.75	19	0.029100	0.029	0.058	0.146	0.291	0.582	0.873
0.75	18	0.021800	0.022	0.044	0.109	0.218	0.436	0.654
2	14	0.008573	0.009	0.017	0.043	0.086	0.171	0.257
3.5	12	0.004926	0.005	0.010	0.025	0.049	0.099	0.148

- For special size cables, the value is calculated from the following formula.

$$R\,(\Omega) = \rho \times \frac{\ell}{A}$$

(ρ: constant 1.7241×10^{-2} (Ω · mm^2/m) (copper wire), A: cross section area (mm^2), ℓ: length (m))

4.4.2 Adjustment for motor long-wiring (Pr. 643) Ver.UP

Adjust if the motor rotation is unstable or an error occurs when the high-response operation is set for control gain of the motor having a long wiring.

Parameter Number	Name	Initial Value	Setting Range	Description
643	Voltage compensation amount setting	9999	0 to 150%	Set this parameter according to the motor wiring length. For setting values, refer to the table below.
			9999	Disabled

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

- For special size cables, refer to the following table to set the value.

Motor Wiring Length	Less than 10m	10 to 15m	15 to 20m	20 to 25m	25 to 30m
Reference setting value of *Pr. 643* *1	9999	85%	75%	65%	60%

*1 Differs depending on the cross section area, type, or laying of cable.

- If an unstable movement or error is not corrected, adjust the setting by decreasing the setting value by 5% to about 50%, as a reference.
- If an unstable movement or error persists after the setting value is decreased to less than 50%, it may be caused by interference from the machines due to high responsivity of the motor. After changing the setting value of *Pr. 643* to the reference value in the table above, adjust the setting by decreasing the response level of control gain set in *Pr. 820 Speed control P gain* or *Pr. 821 Speed control integral time*.

4.5 Adjustment of the output torque (current) of the motor

Purpose	Parameter that should be Set		Refer to Page
Limit output current to prevent drive unit trip	Stall prevention operation	Pr. 22, Pr. 48, Pr. 156, Pr. 157	*83*
Improve the torque in the low-speed range	PM control torque boost	Pr. 785	*86*

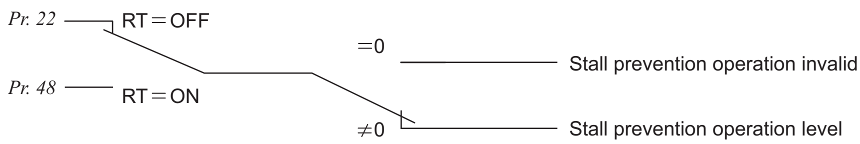
4.5.1 Stall prevention operation (Pr. 22, Pr. 48, Pr. 156, Pr. 157)

This function monitors the output current and automatically changes the rotation speed to prevent the drive unit from tripping due to overcurrent, overvoltage, etc.
If the output current exceeds the stall prevention operation level, the rotation speed of the drive unit is automatically changed to reduce the output current.
Use the following parameters to limit the stall prevention operation during acceleration/deceleration and power driving/regenerative driving.

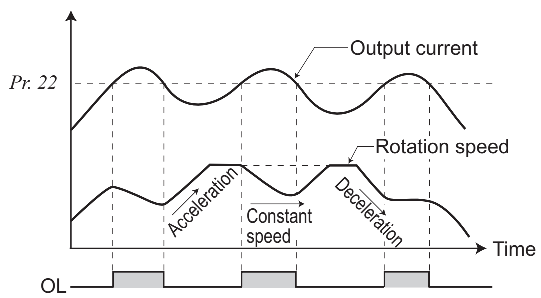
Parameter Number	Name	Initial Value	Setting Range	Description
22	**Stall prevention operation level**	150%	0	Stall prevention operation invalid
			0.1 to 200%	Set the current value to start the stall prevention operation.
48	**Second stall prevention operation current**	9999	0	Stall prevention operation invalid
			0.1 to 200%	Second stall prevention operation level
			9999	Same level as *Pr. 22*.
156	**Stall prevention operation selection**	0	0 to 31, 100, 101	Enables/disables the stall prevention operation
157	**OL signal output timer**	0s	0 to 25s	Output start time of the OL signal output when stall prevention is activated.
			9999	Without the OL signal output

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Block diagram



(2) Setting of stall prevention operation level *(Pr. 22)*



Stall prevention operation example

- Set in *Pr. 22* the percentage of the output current to the rated drive unit current at which stall prevention operation will be performed. Normally set this parameter to 150% (initial value).
- Stall prevention operation stops acceleration (makes deceleration) during acceleration, makes deceleration during constant speed, and stops deceleration (makes acceleration) during deceleration.
- When stall prevention operation is performed, the OL signal is output.
- The stall prevention does not operate in the low-speed range of 300r/min or less.

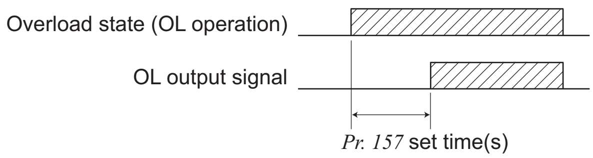
NOTE

- **If an overload status lasts long, a drive unit trip (e.g. electronic thermal O/L relay (E.THM)) may occur.**

(3) Stall prevention operation signal output and output timing adjustment (OL signal, *Pr. 157*)

- When the output current exceeds the stall prevention operation level and stall prevention is activated, the stall prevention operation (OL) signal turns ON for longer than 100ms. When the output current falls to or below the stall prevention operation level, the output signal turns OFF.
- Use *Pr. 157 OL signal output timer* to set whether the OL signal is output immediately or after a preset period of time.
- This operation is also performed when the regeneration avoidance function or oL (overvoltage stall) is executed.
- For the OL signal, set "3 (positive logic) or 103 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* and assign functions to the output terminal.

Pr. 157 Setting	Description
0 (initial value)	Output immediately.
0.1 to 25	Output after the set time (s) has elapsed.
9999	Not output.



NOTE

- **If the speed has fallen to 15r/min by stall prevention operation and remains for 3s, a fault (E.OLT) appears to shutoff the drive unit output.**
- **Changing the terminal assignment using *Pr. 190* or *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(4) Set two types of stall prevention operation levels *(Pr. 48)*

- Turning RT signal ON makes *Pr. 48 Second stall prevention operation current* valid.
- For the terminal used for RT signal input, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **The RT signal acts as the second function selection signal and makes the other second functions valid.** ***(Refer to page 120.)***

(5) Limit the stall prevention operation according to the operating status *(Pr. 156)*

• Refer to the following table and select whether stall prevention operation will be performed or not and the operation to be performed at OL signal output.

Pr. 156 Setting	Stall Prevention Operation Selection ○ : Activated ● : Not activated			OL Signal Output ○: Operation continued ●: Operation not continued *1
	Acceleration	Constant speed	Deceleration	
0 (initial value), 1	○	○	○	○
2, 3	●	○	○	○
4, 5	○	●	○	○
6, 7	●	●	○	○
8, 9	○	○	●	○
10, 11	●	○	●	○
12, 13	○	●	●	○
14, 15	●	●	●	— *2

Pr. 156 Setting	Stall Prevention Operation Selection ○ : Activated ● : Not activated			OL Signal Output ○: Operation continued ●: Operation not continued *1
	Acceleration	Constant speed	Deceleration	
16, 17	○	○	○	●
18, 19	●	○	○	●
20, 21	○	●	○	●
22, 23	●	●	○	●
24, 25	○	○	●	●
26, 27	●	○	●	●
28, 29	○	●	●	●
30, 31	●	●	●	— *2

Pr. 156 Setting		Acceleration	Constant speed	Deceleration	OL Signal Output
100, 101 *3	Power driving	○	○	○	○
	Regeneration	●	●	●	— *2

*1 When "Operation not continued for OL signal output" is selected, the E.OLT fault (stopped by stall prevention) is displayed and operation is stopped.

*2 Since stall prevention is not activated, OL signal and E.OLT are not output.

*3 The settings "100" and "101" allow operations to be performed in the driving and regeneration modes, respectively.

NOTE

- **When the load is heavy or the acceleration/deceleration time is short, stall prevention is activated and acceleration/deceleration may not be made according to the preset acceleration/deceleration time. Set *Pr. 156* and stall prevention operation level to the optimum values.**

⚠ CAUTION

⚠ **Do not set a small value as the stall prevention operation current.**
Otherwise, torque generated will reduce.

⚠ **Test operation must be performed.**
Stall prevention operation during acceleration may increase the acceleration time.
Stall prevention operation performed during constant speed may cause sudden speed changes.
Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.

Parameters referred to

- *Pr. 178 to Pr. 182 (input terminal function selection)* *Refer to page 117.*
- *Pr. 190, Pr. 192 (output terminal function selection)* *Refer to page 123.*

4.5.2 Start torque adjustment (Pr. 785)

Reduction of the motor torque in the low-speed range lower than 10% of the rated speed can be improved.

Parameter Number	Name	Initial Value	Setting Range	Description
785	**PM control torque boost**	9999	0 to 150%	Set the maximum torque generated in the low-speed range lower than 10% of the rated speed.
			9999	Set as 100%

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

- Use *Pr. 785* to set the maximum torque generated in the low-speed range lower than 10% of the rated speed.
- Set a large value to generate a large starting torque.
- Continuous operation at the rotation speed lower than 10% of the rated speed even with no load may cause the motor overload trip fault (E.THM) depending on the operating time because a current flows regardless of load generation.
  For continuous operation at the speed lower than 10% of the rated speed, set *Pr. 785* to the value shown in the following table or lower.

Motor	Drive Unit Model	PM Motor Capacity	*Pr. 785* Setting
S-PM geared motor	FR-D720-0.2K to 1.5K-G	0.1kW to 0.75kW	80% or less
	FR-D720-2.2K to 3.7K-G	1.5kW to 2.2kW	50% or less
	FR-D740-0.4K to 1.5K-G	0.2kW to 0.75kW	80% or less
	FR-D740-2.2K to 3.7K-G	1.5kW to 2.2kW	50% or less
PM motors other than above	FR-D720-0.2K to 3.7K-G FR-D740-0.4K to 3.7K-G	-	50% or less

- In the low speed range lower than 10% of the rated speed, *Pr. 22 Stall prevention operation level* is disabled. Thus, a drive unit failure, such as the overcurrent protection and the loss of synchronism detection, may occur when a torque equal to or larger than the *Pr. 785 setting* is applied.

NOTE

- **Keep the short-time torque to *Pr. 785* setting or lower.**

4.6 Limiting the rotation speed

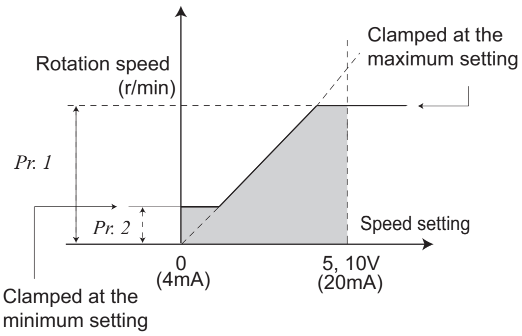
Purpose	Parameter that should be Set		Refer to Page
Set upper limit and lower limit of rotation speed	**Maximum/minimum setting**	**Pr. 1, Pr. 2**	*87*
Perform operation by avoiding mechanical resonance points	**Speed jump**	**Pr. 31 to Pr. 36**	*88*

4.6.1 Maximum/minimum setting (Pr. 1, Pr. 2)

Motor speed can be limited.
Clamp the upper and lower limits of the rotation speed.

Parameter Number	Name	Initial Value	Setting Range	Description
1	**Maximum setting**	3000r/min	0 to 12000r/min / 0 to 8000r/min *1*2	Upper limit of the output speed.
2	**Minimum setting**	0r/min	0 to 3600r/min / 0 to 2400r/min *1*2	Lower limit of the output speed.

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.
*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.



(1) Set maximum speed

- Use *Pr. 1 Maximum setting* to set the maximum rotation speed. If the value of the speed command entered is higher than the setting, the rotation speed is clamped at the maximum speed.
- The speed command is also clamped at the operable speed range of the selected motor.
  If the motor's operable maximum speed < maximum setting, the speed does not increase to the maximum speed.

REMARKS

- Because the speed is limited by the speed command, the upper limit value or a higher value may be displayed on the monitor.

(2) Set minimum speed

- Use *Pr. 2 Minimum setting* to set the minimum rotation speed.
- If the set speed is less than *Pr. 2*, the rotation speed is clamped at *Pr. 2* (will not fall below *Pr. 2*).

REMARKS

- When *Pr. 15 Jog speed setting* is equal to or less than *Pr. 2*, the *Pr. 15* setting has precedence over the *Pr. 2* setting.
- When stall prevention is activated to decrease the rotation speed, the rotation speed may drop to *Pr. 2* or below.
- Because the speed is limited by the speed command, the lower limit value or a lower value may be displayed on the monitor.

⚠ CAUTION

⚠ **Note that when *Pr. 2* is set to any value equal to or more than *Pr. 13 Starting speed*, simply turning ON the start signal will run the motor at the preset speed according to the set acceleration time even if the command speed is not input.**

Parameters referred to

Pr. 13 Starting speed ☞ *Refer to page 99.*
Pr. 15 Jog speed setting ☞ *Refer to page 91.*
Pr. 125 Terminal 2 speed setting gain speed, Pr. 126 Terminal 4 speed setting gain speed ☞ *Refer to page 152.*

4.6.2 Avoiding mechanical resonance points (speed jumps) (Pr. 31 to Pr. 36)

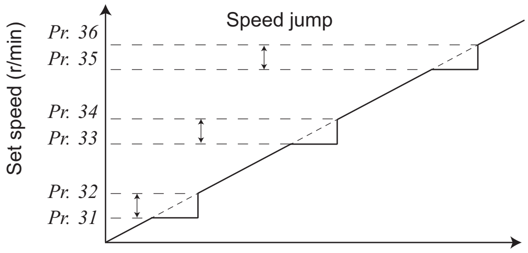
When it is desired to avoid resonance attributable to the natural speed of a mechanical system, these parameters allow resonant frequencies to be jumped.

Parameter Number	Name	Initial Value	Setting Range	Description
31	**Speed jump 1A**	9999	0 to 12000r/min / 0 to 8000r/min *1*2	1A to 1B, 2A to 2B, 3A to 3B are speed jumps 9999: Function invalid
32	**Speed jump 1B**			
33	**Speed jump 2A**			
34	**Speed jump 2B**			
35	**Speed jump 3A**			
36	**Speed jump 3B**			

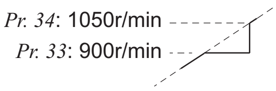
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

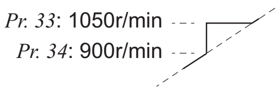
*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.



- Up to three areas may be set, with the jump speeds set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point, and operation in the jump zone is performed at these speeds.



Example 1 To fix the speed to 900r/min in the range of 900r/min to 1050r/min, set 1050r/min in *Pr. 34* and 900r/min in *Pr. 33*.



Example 2 To jump the speed to 1050r/min in the range of 900r/min to 1050r/min, set 1050r/min in *Pr. 33* and 900r/min in *Pr. 34*.

NOTE

During acceleration/deceleration, the running speed within the set area is valid.

4.7 Speed setting by external terminals

Purpose	Parameter that should be Set		Refer to Page
Make speed setting by combination of terminals	**Multi-speed operation**	**Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239**	*89*
Perform Jog operation	**Jog operation**	**Pr. 15, Pr. 16**	*91*
Infinitely variable speed setting by terminals	**Remote setting function**	**Pr. 59**	*93*

4.7.1 *Operation by multi-speed operation (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

Can be used to change the preset speed in the parameter with the contact signals.
Any speed can be selected by merely turning ON-OFF the contact signals (RH, RM, RL, REX signals).

Parameter Number	Name	Initial Value	Setting Range	Description
4	**Multi-speed setting (high speed)**	3000r/min	0 to 12000r/min / 0 to 8000r/min *2*3	Speed when RH turns ON
5	**Multi-speed setting (middle speed)**	1500r/min	0 to 12000r/min / 0 to 8000r/min *2*3	Speed when RM turns ON
6	**Multi-speed setting (low speed)**	300r/min	0 to 12000r/min / 0 to 8000r/min *2*3	Speed when RL turns ON
24 *1	**Multi-speed setting (speed 4)**	9999	0 to 12000r/min / 0 to 8000r/min *2*3, 9999	Speed from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. 9999: not selected
25 *1	**Multi-speed setting (speed 5)**			
26 *1	**Multi-speed setting (speed 6)**			
27 *1	**Multi-speed setting (speed 7)**			
232 *1	**Multi-speed setting (speed 8)**			
233 *1	**Multi-speed setting (speed 9)**			
234 *1	**Multi-speed setting (speed 10)**			
235 *1	**Multi-speed setting (speed 11)**			
236 *1	**Multi-speed setting (speed 12)**			
237 *1	**Multi-speed setting (speed 13)**			
238 *1	**Multi-speed setting (speed 14)**			
239 *1	**Multi-speed setting (speed 15)**			

The above parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

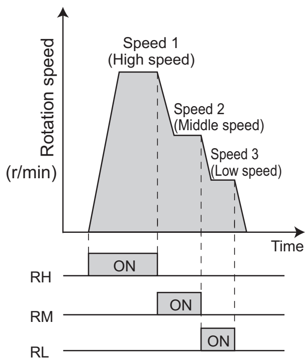
*1 These parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

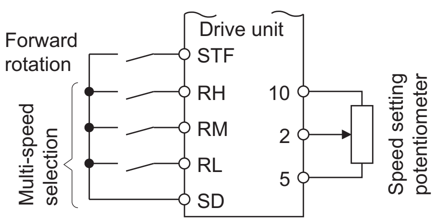
*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*3 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

(1) Multi-speed setting for 3 speeds *(Pr. 4 to Pr. 6)*

- The drive unit operates at speeds set in *Pr. 4* when RH signal is ON, *Pr. 5* when RM signal is ON and *Pr. 6* when RL signal is ON.





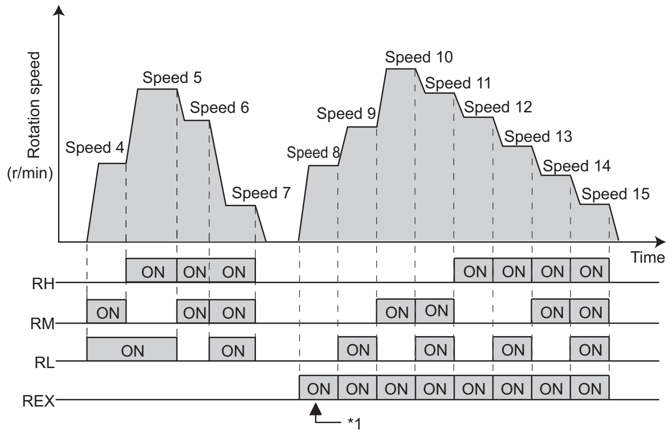
Multi-Speed Operation Connection Example

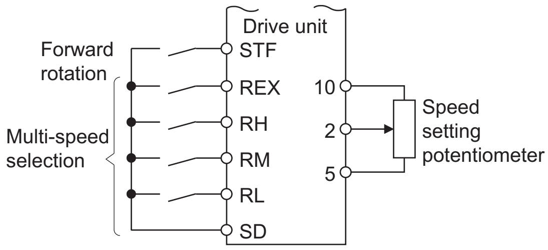
REMARKS

- In the initial setting, if two or three of multi-speed settings are simultaneously selected, priority is given to the set speed of the lower signal.
  For example, when the RH and RM signals turn ON, the RM signal *(Pr. 5)* has a higher priority.
- The RH, RM, RL signals are assigned to the terminal RH, RM, RL in the initial setting. By setting "0 (RL)", "1 (RM)", "2 (RH)" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*, you can assign the signals to other terminals.

(2) Multi-speed setting for 4 or more speeds *(Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

- Speed from 4th speed to 15th speed can be set according to the combination of the RH, RM, RL and REX signals. Set the running speeds in *Pr. 24 to Pr. 27, Pr. 232 to Pr. 239* (In the initial value setting, 4th speed to 15th speed are invalid).
- For the terminal used for REX signal input, set "8" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.





Multi-speed operation connection example

*1 When "9999" is set in *Pr. 232 Multi-speed setting (speed 8)*, operation is performed at speed set in *Pr. 6* when RH, RM and RL are turned OFF and REX is turned ON.

REMARKS

- The priorities of the speed commands by the external signals are "Jog operation > multi-speed operation > terminal 4 analog input > terminal 2 analog input".
  (Refer to *page 152* for the speed command by analog input.)
- Valid in the External operation mode or PU/External combined operation mode (*Pr. 79* = "3" or "4").
- Multi-speed parameters can also be set in the PU or External operation mode.
- *Pr. 24 to Pr. 27* and *Pr. 232 to Pr. 239* settings have no priority between them.
- When *Pr. 59 Remote function selection* ≠ "0", multi-speed setting is invalid as RH, RM and RL signals are remote setting signals.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 15 Jog speed setting ☞ *Refer to page 91.*
Pr. 59 Remote function selection ☞ *Refer to page 93.*
Pr. 79 Operation mode selection ☞ *Refer to page 164.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*

4.7.2 Jog operation (Pr. 15, Pr. 16)

The speed and acceleration/deceleration time for Jog operation can be set. Jog operation can be performed in either of the external and the PU operation mode.
This operation can be used for conveyor positioning, test operation, etc.

Parameter Number	Name	Initial Value	Setting Range	Description
15	**Jog speed setting**	150r/min	0 to 12000r/min / 0 to 8000r/min *1*2	Speed for Jog operation.
16	**Jog acceleration/ deceleration time**	0.5s	0 to 3600s	Acceleration/deceleration time for Jog operation. Acceleration/ deceleration time is the time taken to reach the speed set in *Pr. 20 Acceleration/deceleration reference speed* (initial value is 3000r/min). Acceleration/deceleration time cannot be set separately.

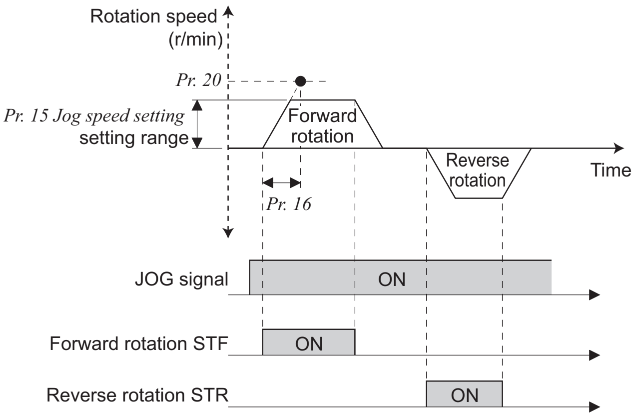
These parameters are displayed as simple mode parameter only when the parameter unit (FR-PU07) is connected. When the parameter unit is not connected, the above parameters can be set by setting *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

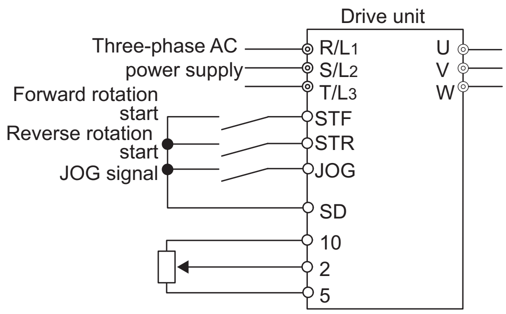
*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

(1) Jog operation from outside

- When the JOG signal is ON, a start and stop can be made by the start signal (STF, STR).
- For the terminal used for Jog operation selection, set "5" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.





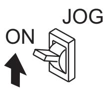
Connection diagram for external Jog operation

Operation — **Display**

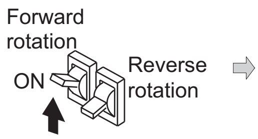
1. Screen at power-ON
   - Confirm that the External operation mode is selected. ([EXT] lit)

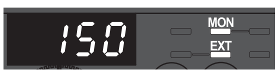
   If not displayed, press PU/EXT to change to the External (EXT) operation mode. If the operation mode still does not change, set *Pr. 79* to change to the External operation mode.

2. Turn the JOG switch ON.



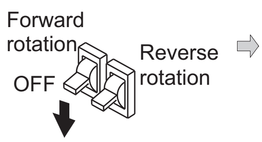
3. Turn the start switch (STF or STR) ON.
   - The motor runs while the start switch (STF or STR) is ON.
   - The motor runs at 150r/min. (initial value of *Pr. 15*)

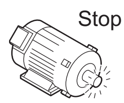




Rotates while ON

4. Turn the start switch (STF or STR) OFF.





REMARKS

- When you want to change the running speed, change *Pr. 15 Jog speed setting*. (initial value "150r/min")
- When you want to change the acceleration/deceleration time, change *Pr. 16 Jog acceleration/deceleration time*. (initial value "0.5s") The acceleration time and deceleration time cannot be set separately for Jog operation.

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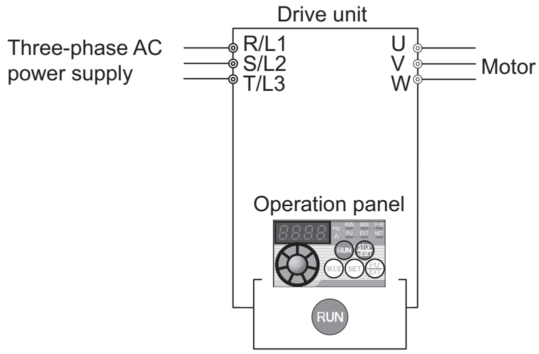
(2) Jog operation from PU

•Select Jog operation mode from the operation panel and the parameter unit (FR-PU07). Operation is performed only while the start button is pressed.



Operation	Display

1. Confirmation of the operating status indicator and operation mode indicator
   - The monitor mode should have been selected.
   - The drive unit should be at a stop.

2. Press (PU/EXT) to choose the PU Jog operation mode.

3. Press (RUN) .
   - While (RUN) is pressed, the motor rotates.
   - The motor runs at 150r/min. (*Pr. 15* initial value)

4. Release (RUN)

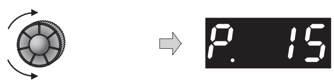
[When changing the speed of PU Jog operation]

5. Press (MODE) to choose the parameter setting mode.

PRM indicator is lit.

(The parameter number read previously appears.)

6. Turn (dial) until *Pr. 15 Jog speed setting* appears.



7. Press (SET) to show the present set value. (150r/min)

8. Turn (dial) to set the value to "300". (300r/min)

9. Press (SET) to set.

Blink...Parameter setting complete!!

10. Perform the operations in steps 1 to 4.
    The motor rotates at 300r/min.

NOTE

- **The *Pr. 15* setting should be equal to or higher than the *Pr. 13 Starting speed.***
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **During Jog operation, the second acceleration/deceleration via the RT signal cannot be selected. (The other second functions are valid. *(Refer to page 227.)*)**
- **When *Pr. 79 Operation mode selection* = "4", pressing RUN of the operation panel and FWD / REV of the parameter unit (FR-PU07) starts the drive unit and pressing STOP/RESET stops the drive unit.**
- **This function is invalid when *Pr. 79* = "3".**

Parameters referred to

- *Pr. 13 Starting speed* *Refer to page 99.*
- *Pr. 20 Acceleration/deceleration reference speed* *Refer to page 97.*
- *Pr. 79 Operation mode selection* *Refer to page 164.*
- *Pr. 178 to Pr. 182 (input terminal function selection)* *Refer to page 117.*

4.7.3 Remote setting function (Pr. 59)

●Even if the operation panel is located away from the enclosure, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

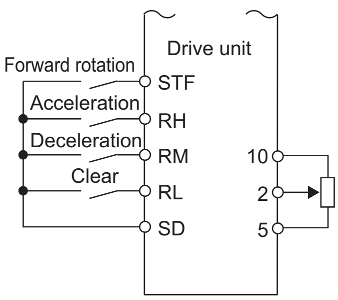
●By merely setting this parameter, you can use the acceleration, deceleration and setting clear functions of the motorized speed setter (FR-FK).

Parameter Number	Name	Initial Value	Setting Range	Description	
				RH, RM, RL signal function	Speed setting storage function
59	Remote function selection	0	0	Multi-speed setting	—
			1	Remote setting	With
			2	Remote setting	Not used
			3	Remote setting	Not used (Turning STF/STR OFF clears remotely-set speed.)

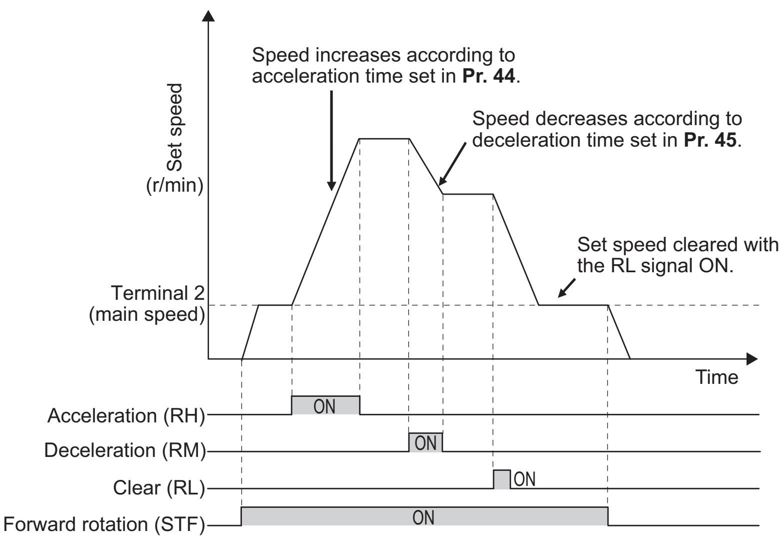
The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 156.)*

•When *Pr. 59* ≠ "0" (remote setting enabled), the functions of the signals are as shown in the following table.

Signal name	Operation status	Description
STF/STR	Forward/reverse	The drive unit accelerates the motor in forward or reverse directions up to the main speed or to the set speed stored by the remote setting function.
RH	Acceleration	The set speed increases according to the time set in *Pr. 44*.
RM	Deceleration	The set speed decreases according to the time set in *Pr. 45*.
RL	Clear	The set speed is cleared and the main speed is applied.
Terminal 2 (analog signal)	Main speed	Set the main speed as a base, and increase it with the RH signal and decrease it with the RM signal.



Connection diagram for remote setting



(1) Main speed

•Set the main speed as a base, and increase it with the RH signal and decrease it with the RM signal.

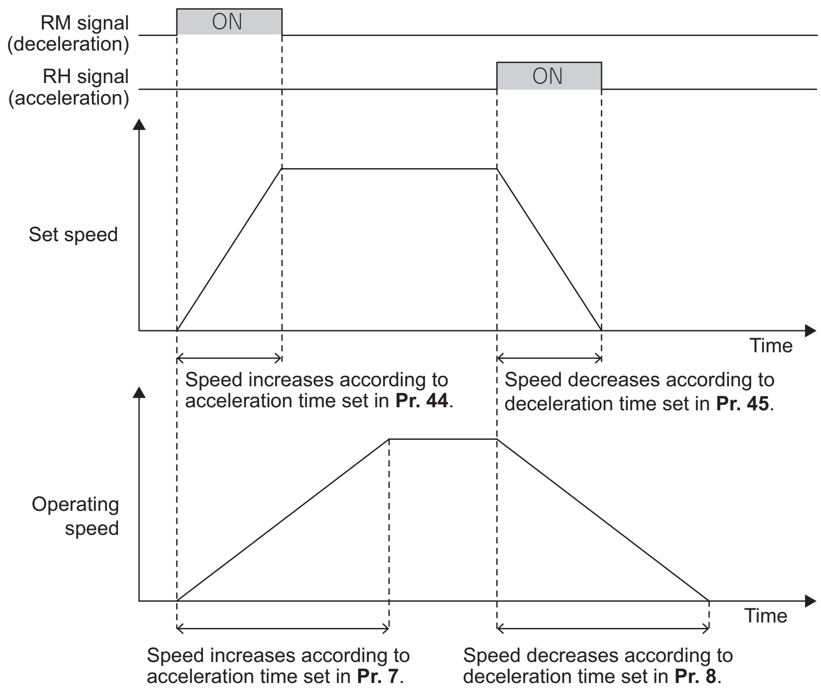
•The method to set the main speed in each of the operation modes below is as follows.

Operation mode	Main speed
PU operation mode / NET operation mode	Digital setting (using the operation panel)
External operation mode / PU/External combined operation mode 2 (*Pr. 79* = "4")	Analog input via terminal 2 or 4
PU/External combined operation mode 1 (*Pr. 79* = "3")	Analog input via terminal 4 (AU signal ON)

(2) Acceleration/deceleration operation

•The set speed (set by remote setting) and the operating speed change according to the setting of the following parameters.

Speed type	Parameter used for acceleration/deceleration	Description
Set speed	*Pr. 44 / Pr. 45*	Increases/decreases according to the setting of *Pr. 44 / Pr. 45* set by remote setting.
Operating speed	*Pr. 7 / Pr. 8*	Increases to / decreases from the set speed according to the setting of *Pr. 7 / Pr. 8*.



(3) Speed setting storage function

•The remotely set speed is stored, held, or cleared. When the drive unit is turned ON again and the operation is resumed, the speed within the parentheses will apply.

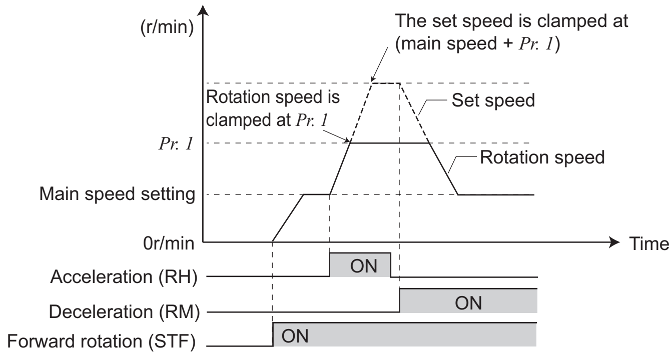
Pr. 59 setting	Power OFF	STF/STR signal OFF
1	Stored (stored set speed)	Held (stored set speed)
2	Cleared (main speed)	Held (stored set speed)
3	Cleared (main speed)	Cleared (main speed)

•Storage conditions

The remotely set speed is stored at the point when the start signal (STF or STR) turns OFF. The remotely set speed is stored every minute after turning OFF (ON) both of the RH and RM signals. Every minute the latest stored speed value is compared with the second latest one. When they are not equal, the latest one is written in the EEPROM. The writing in the EEPROM is not effected by the ON/OFF status of the RL signal.

NOTE

- **The range of speed changeable by RH (acceleration) and RM (deceleration) is 0 to maximum speed (*Pr. 1* or *Pr. 18* setting). Note that the maximum value of set speed is (main speed + maximum speed).**

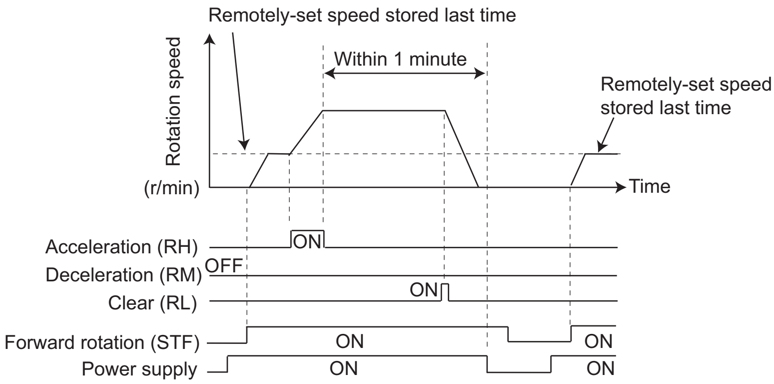


- **The RH or RM signal can be assigned to an input terminal by setting any of *Pr. 178 to Pr. 182 (Input terminal function selection)*. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.**
- **Even if the start signal (STF or STR) is OFF, turning ON the acceleration (RH) or deceleration (RM) signal varies the preset speed. (When *Pr. 59* = "1" or "2")**
- **When switching the start signal from ON to OFF, or changing speed by the RH or RM signal frequently, set the speed setting value storage function (write to EEPROM) invalid (*Pr. 59* = "2, 3"). If set valid (*Pr. 59* = "1"), speed is written to EEPROM speed, this will shorten the life of the EEPROM.**
- **The remote setting is disabled during JOG operation or PID control operation.**
- **The multi-speed operation is disabled when remote setting is enabled.**
- **Also available for the Network operation mode.**

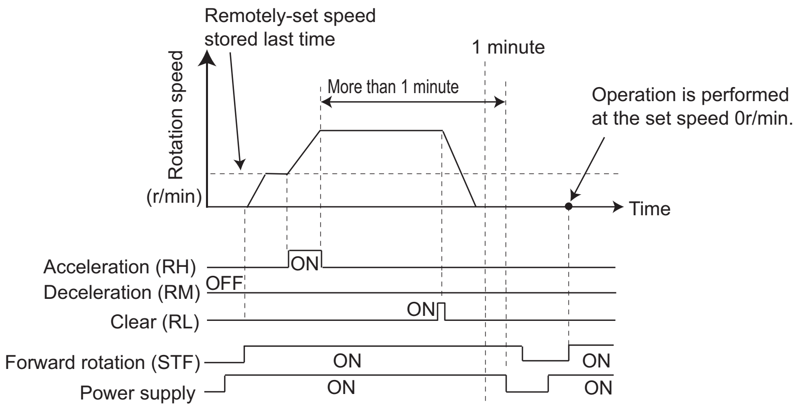
REMARKS

Setting speed is "0"

- Even when the remotely-set speed is cleared by turning ON the RL (clear) signal after turn OFF (ON) of both the RH and RM signals, the drive unit operates at the remotely-set speed stored in the last operation if power is reapplied before one minute has elapsed since turn OFF (ON) of both the RH and RM signals



- When the remotely-set speed is cleared by turning ON the RL (clear) signal after turn OFF (ON) of both the RH and RM signals, the drive unit operates at the speed in the remotely-set speed cleared state if power is reapplied after one minute has elapsed since turn OFF (ON) of both the RH and RM signals.



⚠ CAUTION

⚠ **Before using the remote setting function, set the maximum speed again according to the machine.**

Parameters referred to

Pr. 1 Maximum setting *Refer to page 87.*
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 44 Second acceleration/deceleration time, Pr. 45 Second deceleration time *Refer to page 97.*
Pr. 178 to Pr. 182 (input terminal function selection) *Refer to page 117.*

4.8 Setting of acceleration/deceleration time and acceleration/ deceleration pattern

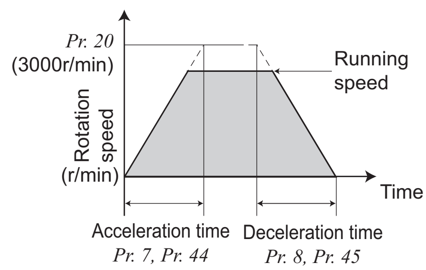
Purpose	Parameter that should be Set		Refer to Page
Motor acceleration/deceleration time setting	**Acceleration/deceleration times**	**Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45, Pr. 791, Pr. 792**	*97*
Set the minimum motor speed	**Starting speed**	**Pr. 13**	*99*
Set acceleration/deceleration pattern suitable for application	**Acceleration/deceleration pattern**	**Pr. 29**	*100*

4.8.1 Setting of the acceleration and deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45, Pr. 791, Pr. 792)

Used to set motor acceleration/deceleration time.
Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.

Parameter Number	Name	Initial Value	Setting Range	Description
7	**Acceleration time**	5s	0 to 3600s	Motor acceleration time.
8	**Deceleration time**	5s	0 to 3600s	Motor deceleration time.
20 *1	**Acceleration/ deceleration reference speed**	3000r/min	30 to 12000r/min / 20 to 8000r/min *2*3	Speed that will be the basis of acceleration/ deceleration time. As acceleration/deceleration time, set the speed change time from stop to *Pr. 20*.
44 *1	**Second acceleration/ deceleration time**	5s	0 to 3600s	Acceleration/deceleration time when the RT signal is ON.
45 *1	**Second deceleration time**	9999	0 to 3600s	Deceleration time when the RT signal is ON.
			9999	Acceleration time = deceleration time
791	**Acceleration time in low-speed range**	9999	0 to 3600s	Acceleration time in the low-speed range (less than 300r/min)
			9999	The acceleration time of *Pr. 7*
792	**Deceleration time in low-speed range**	9999	0 to 3600s	Deceleration time in the low-speed range (less than 300r/min)
			9999	The deceleration time of *Pr. 8*

*1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.
*3 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.



(1) Acceleration time setting *(Pr. 7, Pr. 20)*

- Use *Pr. 7 Acceleration time* to set the acceleration time required to reach *Pr. 20 Acceleration/deceleration reference speed* from 0r/min.
- Set the acceleration time according to the following formula.

$$\text{Acceleration time setting} = \frac{Pr.\ 20}{\text{Maximum operating speed}} \times \text{Acceleration time from stop to maximum operating speed}$$

Example) How to find the setting value for *Pr. 7* when increasing the rotation speed to the maximum speed of 1500r/min in 10s with *Pr. 20* = 3000r/min (initial setting).

$$Pr.\ 7 = \frac{3000\text{r/min}}{1500\text{r/min}} \times 10\text{s} = 20\text{s}$$

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PARAMETERS

(2) Deceleration time setting *(Pr. 8, Pr. 20)*

- Use *Pr. 8 Deceleration time* to set the deceleration time required to reach 0r/min from *Pr. 20 Acceleration/deceleration reference speed*.
- Set the deceleration time according to the following formula.

$$\text{Deceleration time setting} = \frac{Pr.\ 20}{\text{Maximum operating speed}} \times \text{Deceleration time from maximum operating speed to stop}$$

Example) How to find the setting value for *Pr. 8* when decreasing the rotation speed from the maximum speed of 1800r/min in 10s with *Pr. 20* = 3000r/min (initial setting).

$$Pr.\ 8 = \frac{3000\text{r/min}}{1800\text{r/min}} \times 10\text{s} \fallingdotseq 16.7\text{s}$$

(3) Set two kinds of acceleration/deceleration times (RT signal, *Pr. 44, Pr. 45*)

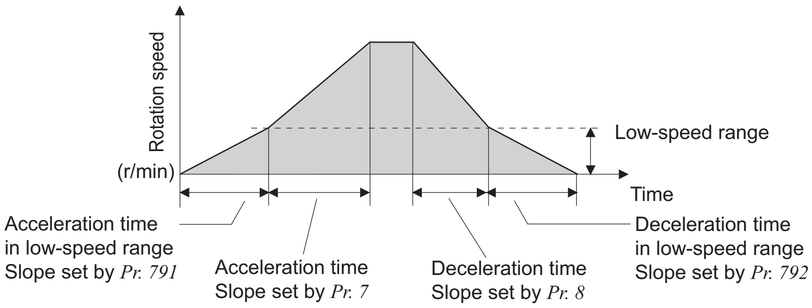
- *Pr. 44* and *Pr. 45* are valid when the RT signal is ON.
- When "9999" is set to *Pr. 45*, the deceleration time becomes equal to the acceleration time *(Pr. 44)*.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

NOTE

- **When the acceleration/deceleration pattern is S-pattern acceleration/deceleration A *(refer to page 100)*, the acceleration/deceleration time is the time required to reach the rated motor speed.**
- **Changing terminal assignment may affect the other functions. Set parameters after confirming the function of each terminal.**

(4) Setting the acceleration/deceleration time in the low-speed range *(Pr. 791, Pr. 792)*

- If torque is required in a low-speed range (lower than 10% of the rated speed), set *Pr. 791 Acceleration time in low-speed range* and *Pr. 792 Deceleration time in low-speed range* settings higher than the *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time* settings so that the mild acceleration/deceleration is performed in the low-speed range.
- The setting value of *Pr. 785 PM control torque boost* is the maximum generatable torque in the low-speed range. *(Refer to page 86.)*
- For the acceleration time, set the time takes to accelerate from a stop to *Pr. 20 Acceleration/deceleration reference speed*. For the deceleration time, set the time takes to decelerate from *Pr. 20 Acceleration/deceleration reference speed* to a stop.



REMARKS

- The RT signal acts as the second function selection signal and makes the other second function valid. *(Refer to page 120.)*
- If the *Pr. 20* setting is changed, the *Pr. 125* and *Pr. 126 (speed setting signal gain speed)* settings do not change. Set *Pr. 125* and *Pr. 126* to adjust the gains.
- Set *Pr. 791* higher than *Pr. 7*, and *Pr. 792* higher than *Pr. 8*. If set as *Pr. 791* < *Pr. 7*, the operation is performed as *Pr. 791* = *Pr. 7*. If set as *Pr. 792* < *Pr. 8*, the operation is performed as *Pr. 792* = *Pr. 8*.
- If the acceleration/deceleration time is set, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system J (moment of inertia) and motor torque.

Parameters referred to

Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 100.*
Pr. 125, Pr. 126 (speed setting gain speed) ☞ *Refer to page 152.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*

4.8.2 Minimum motor rotation speed (Pr. 13)

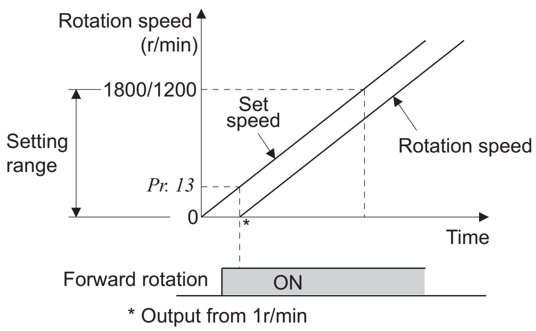
Set the speed where the motor starts running.
Set the deadband in the low-speed range to eliminate noise and offset deviation when setting a speed with analog input.

Parameter Number	Name	Initial Value	Setting Range	Description
13	**Starting speed**	15r/min	0 to 1800r/min / 0 to 1200r/min *1*2	The speed where the motor starts running.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.



- The speed where the PM motor starts running can be set.
- While the speed command is less than the *Pr. 13 Starting speed* setting, the PM motor is stopped.
  When the speed command reaches the *Pr. 13* setting or higher, the PM motor accelerates according to the *Pr. 7 Acceleration time setting.*

CAUTION

Note that when *Pr. 13* is set to any value lower than *Pr. 2 Minimum setting*, simply turning ON the start signal will run the motor at the preset speed even if the command speed is not input.

Parameters referred to

Pr. 2 Minimum setting *Refer to page 87.*
Pr. 7 Acceleration time *Refer to page 97.*

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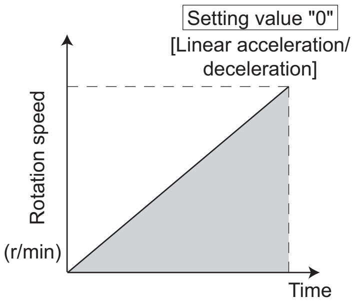
4.8.3 Acceleration/deceleration pattern (Pr. 29)

You can set the acceleration/deceleration pattern suitable for application.

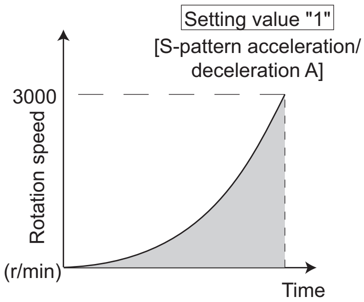
Parameter Number	Name	Initial Value	Setting Range	Description
29	**Acceleration/deceleration pattern selection**	0	0	Linear acceleration/ deceleration
			1	S-pattern acceleration/deceleration A
			2	S-pattern acceleration/deceleration B

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*



(1) Linear acceleration/deceleration (*Pr. 29* setting "0", initial value)

- For the drive unit operation, the rotation speed is made to change linearly (linear acceleration/deceleration) to prevent the motor and drive unit from getting excessive stress to reach the set speed during acceleration, deceleration, etc. when speed changes. Linear acceleration/deceleration has a uniform speed/time slope.

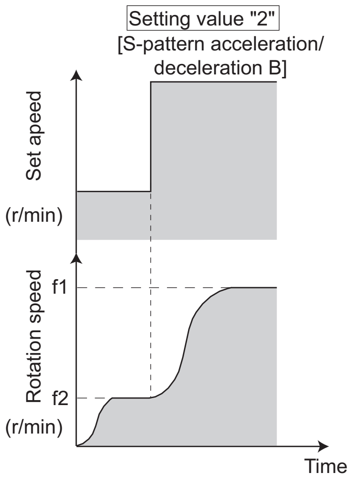


(2) S-pattern acceleration/deceleration A (*Pr. 29* = "1")

- An acceleration/deceleration pattern in which the rated motor speed (3000r/ min) is the point of inflection in an S-pattern curve.

NOTE

- **The acceleration/deceleration time of the S-pattern acceleration/deceleration A is the time period to reach the rated motor speed. It is not the time period to reach *Pr. 20 Acceleration/deceleration reference speed*.**



(3) S-pattern acceleration/deceleration B (*Pr. 29* = "2")

- For prevention of load shifting in conveyor and other applications. Since acceleration/deceleration is always made in an S shape from current speed (f2) to target speed (f1), this function eases shock produced at acceleration/deceleration and is effective for load collapse prevention, etc.

NOTE

- **When the RT signal turns ON during acceleration or deceleration with the S-pattern acceleration/deceleration B enabled, a pattern of acceleration or deceleration changes to linear at the moment.**

Parameters referred to

Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 20 Acceleration/deceleration reference speed *Refer to page 97.*

4.9 Selection and protection of a motor

Purpose	Parameter that should be Set		Refer to Page
Motor protection from overheat	Electronic thermal O/L relay PTC thermistor protection	Pr. 9, Pr. 561	101
To set the overheat protection characteristics for the motor	Free thermal O/L relay setting	Pr.600 to Pr.604	104
To select the motor to be used	Applied motor	Pr.71	105
To run by maximizing the performance of the motor	Offline auto tuning	Pr.9, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.90, Pr.92, Pr.93, Pr.96, Pr.672, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724 to Pr.726, Pr.859	105

4.9.1 Motor overheat protection (Electronic thermal O/L relay, PTC thermistor protection) (Pr. 9, Pr. 561, Pr.600 to Pr.604)

Set the current of the electronic thermal relay function to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Name	Initial Value	Setting Range	Description
9	Electronic thermal O/L relay	Rated motor current *2	0 to 500A	Set the rated motor current.
561*1	PTC thermistor protection level	9999	0.5 to 30kΩ	Set the level (resistance value) for PTC thermistor protection activates.
			9999	PTC thermistor protection is inactive.
600 Ver.UP	Free thermal reduction speed 1	9999	0 to 12000r/min / 0 to 8000r/min *3 *4, 9999	The electronic thermal O/L relay operation level can be changed to match the motor temperature characteristics with the combination of these three points *(Pr.600, Pr.601), (Pr.602, Pr.603), (Pr.604, Pr.9)*. 9999: Free thermal O/L relay invalid.
601 Ver.UP	Free thermal reduction ratio 1	100%	0 to 100%, 9999	
602 Ver.UP	Free thermal reduction speed 2	9999	0 to 12000r/min / 0 to 8000r/min *3 *4, 9999	
603 Ver.UP	Free thermal reduction ratio 2	100%	0 to 100%, 9999	
604 Ver.UP	Free thermal reduction speed 3	9999	0 to 12000r/min / 0 to 8000r/min *3 *4, 9999	

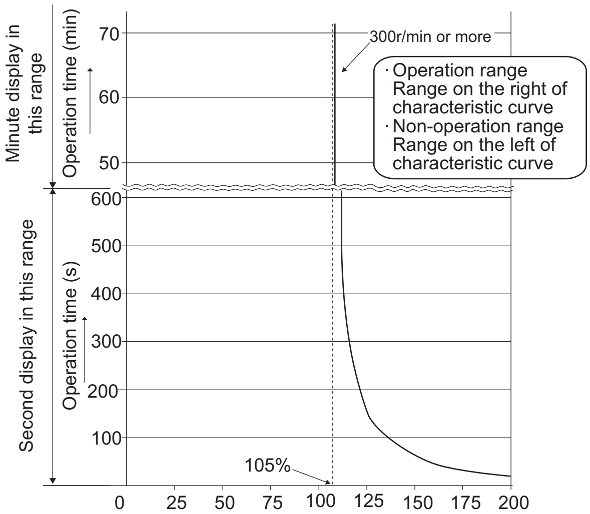
*1 These parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
*2 *Refer to page 288* for the rated motor current.
*3 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.
*4 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

(1) Electronic thermal O/L relay *(Pr. 9)*

This function detects the overload (overheat) of the motor and trips. (The operation characteristic is shown below)

- Set the rated current (A) of the motor in *Pr. 9*.
- Set "0" in *Pr. 9* when you do not want to operate the electronic thermal O/L relay, e.g. when using an external thermal relay with the motor. (Note that the output transistor protection of the drive unit is activated (E.THT).)
- To use the S-PM geared motor, perform the PM parameter initialization to automatically set the rated motor current for the S-PM motor.



The ratio of motor current to *Pr. 9 Electronic thermal O/L relay*

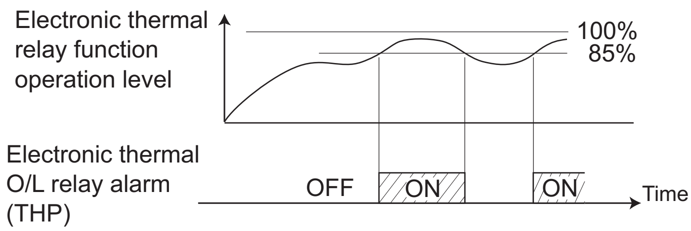
NOTE

- **The internal accumulated heat value of the electronic thermal relay function is reset by the drive unit's power reset or a reset signal input. Avoid unnecessary resets and power-OFFs.**

(2) Electronic thermal relay function pre-alarm (TH) and alarm (THP) signal

- The alarm (THP) signal is output and electronic thermal relay function pre-alarm (TH) is displayed when the electronic thermal O/L relay cumulative value reaches 85% of the level set in *Pr. 9*. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting electronic-thermal relay protection (E.THM) occurs.
- The drive unit does not trip even when the alarm (THP) signal is output.
- For the terminal used for the THP signal output, assign the function by setting "8 (positive logic) or 108 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*.

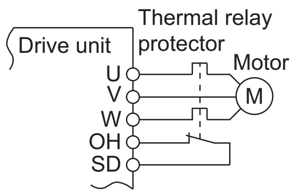
100%: Electronic thermal O/L relay alarm operation value



NOTE

- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(3) External thermal relay input (OH signal)



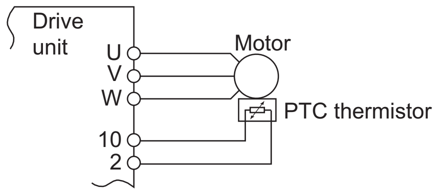
External thermal relay input connection example

- To protect the motor against overheat, use the OH signal when using an external thermal relay or the built-in thermal protector of the motor.
- When the thermal relay operates, the drive unit trips and outputs the fault signal (E.OHT).
- For the terminal used for OH signal input, assign the function by setting "7" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*.

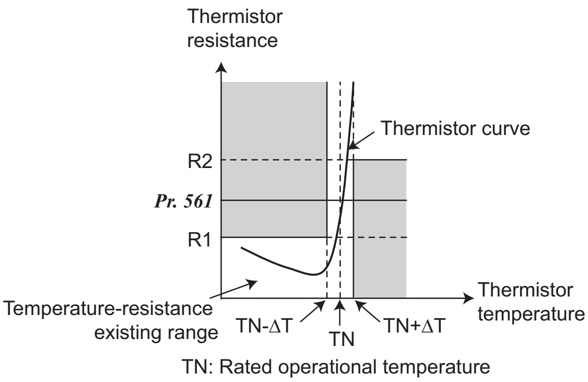
NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(4) PTC thermistor protection (Pr. 561)



PTC thermistor input connection



PTC thermistor characteristics

- PTC thermistor output can be input to the terminals 2 and 10. When the PTC thermistor input reaches the resistance value set in *Pr. 561 PTC thermistor protection level*, drive unit outputs PTC thermistor operation error signal (E.PTC) and trips.
- Check the characteristics of the using PTC thermistor, and set the resistance value within a protection providing temperature TN, just around the center of R1 and R2 in a left figure. If the *Pr. 561* setting is closer to R1 or R2, the working temperature of protection goes higher (protection works later), or lower (protection works earlier).
- PTC thermistor resistance can be displayed in operation panel, parameter unit (FR-PU07) *(refer to page 134)*, or RS-485 communication *(refer to page 181)* when PTC thermistor protection is active (*Pr. 561* ≠ "9999").

REMARKS

- When using terminal 2 as PTC thermistor input (*Pr. 561* ≠ "9999"), terminal 2 is not available for analog speed command. Also unavailable when using terminal 2 for PID control. When PID control is not active (*Pr. 128 PID action selection* = "0"), terminal 4 functions as follows.
  When *Pr. 79* = "4" or in External operation mode................Terminal 4 is active whether AU signal is ON/OFF
  When *Pr. 79* = "3"..Terminal 4 is active for speed command when AU signal is ON
- For the power supply terminal of PTC thermistor input, do not use power supply other than terminal 10 (external power supply, etc). PTC thermistor does not work properly.

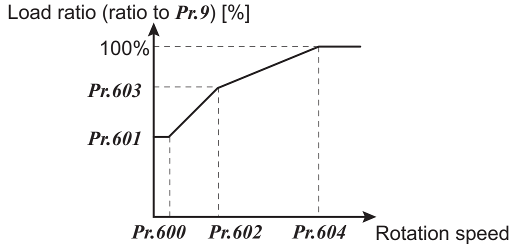
4

PARAMETERS

(5) Overheat protection to match the characteristic of the motor *(Pr.600 to Pr.604)*

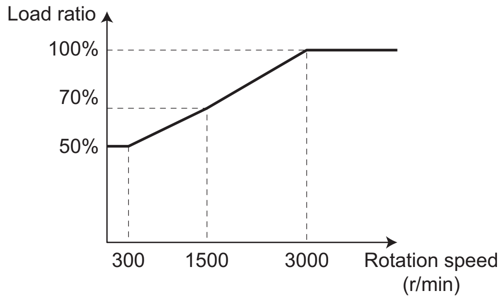
- The activation level of the electronic thermal O/L relay can be varied to match the motor temperature characteristic.
- The electronic thermal O/L relay's activation level can be set using the combination of three points *(Pr.600, Pr.601), (Pr.602, Pr.603), (Pr.604, Pr.9)*. Two or more points are required for setting.

Continuous operation characteristic



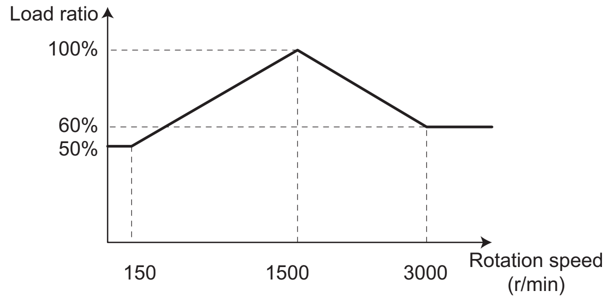
Setting example 1

Pr.9 =100% of the rated motor current
Pr.600 =300r/min
Pr.601 =50%
Pr.602 =1500r/min
Pr.603 =70%
Pr.604 =3000r/min

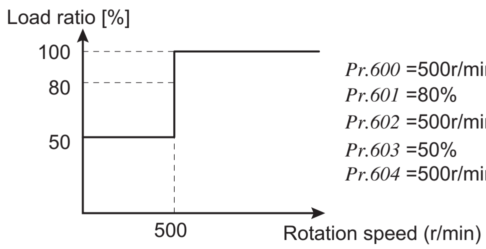


Setting example 2

Pr.600 =3000r/min
Pr.601 =60%
Pr.602 =150r/min
Pr.603 =50%
Pr.604 =1500r/min



- When setting *Pr.600, Pr.602, Pr.604* to the same speed, the following graph's upper level will be applied.



Pr.600 =500r/min
Pr.601 =80%
Pr.602 =500r/min
Pr.603 =50%
Pr.604 =500r/min

NOTE

- **Make sure to set the parameters according to the motor temperature characteristic used.**

Parameters referred to

Pr. 79 Operation mode selection ☞ *Refer to page 164.*
Pr. 128 PID action selection ☞ *Refer to page 216.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 123.*

4.9.2 Applied motor (Pr.71) Ver.UP

Set the applied motor type.
When the S-PM geared motor is used, the motor type is automatically set by PM parameter initialization.

Parameter Number	Name	Initial Value	Setting Range	Description
71	**Applied motor**	1040	1040	S-PM geared motor
			8090	IPM motor
			9090	SPM motor

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

NOTE

- **When the applied motor is not S-PM geared motor offline auto tuning is required by setting *Pr.96 Auto tuning setting/ status*. (For the details on offline auto tuning, *Refer to page 105*.)**

4.9.3 Offline auto tuning (Pr.9, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.90, Pr.92, Pr.93, Pr.96, Pr.672, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724 to Pr.726, Pr.859)

PM motor Ver.UP

When the S-PM geared motor is not used, offline auto tuning is required.

- What is offline auto tuning?
  This function simplifies setting of parameters for driving PM motors. The motor constants used for operation under PM sensorless vector control are measured automatically. (Some motors cannot be driven with the result of offline auto tuning.)

Parameter Number	Name	Initial Value	Setting Range	Description
9	**Electronic thermal O/L relay**	Rated motor current	0 to 500A	Set the rated motor current.
71	**Applied motor**	1040	8090	IPM motor
			9090	SPM motor
			1040	S-PM geared motor
80	**Motor capacity**	Motor capacity ∗2	0.01 to 3.7kW	Set the applied motor capacity.
81	**Number of motor poles**	9999	2, 4, 6, 8, 10	Set the number of motor poles.
			9999	As the internal data of the drive unit is used, set it correctly according to the motor specifications.
83	**Rated motor voltage**	200V / 400V ∗3	0 to 1000V	Set the rated motor voltage (V).
84	**Rated motor speed**	9999	300 to 6000r/min / 200 to 4000r/min ∗1	Set the rated motor speed (r/min).
			9999	As the internal data of the drive unit is used, set it correctly according to the motor specifications.
90	**Motor constant (R1)**	9999	0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Internal data of the drive unit is used.
92	**Motor constant (Ld)**	9999	0 to 500mH, 9999	
93	**Motor constant (Lq)**	9999	0 to 500mH, 9999	
96	**Auto tuning setting/status**	0	0	No offline auto tuning
			1	Perform offline auto tuning.
672	**Lq tuning target current adjustment coefficient**	9999	50 to 150%	Adjust the target current during tuning.
			9999	100%
702	**Maximum motor speed**	9999	0 to 6000r/min / 0 to 4000r/min ∗1	Set the permissible speed (frequency) of the motor.
			9999	The *Pr.84* setting is used.

Parameter Number	Name	Initial Value	Setting Range	Description
706	**Induced voltage constant (phi f)**	9999	0 to 5000mV (s/rad)	Set the value according to the PM motor specifications.
			9999	The value calculated from the settings of the motor constant parameters is used.
707	**Motor inertia (integer)**	9999	10 to 999	Set the motor inertia.
			9999	Internal data of the drive unit is used.
711	**Motor Ld decay ratio**	9999	0 to 100%, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Internal data of the drive unit is used.
712	**Motor Lq decay ratio**	9999	0 to 100%, 9999	
717	**Starting resistance tuning compensation**	9999	0 to 200%, 9999	
721	**Starting magnetic pole position detection pulse width**	9999	0 to 6000μs, 9999	
724	**Motor inertia (exponent)**	9999	4 to 7	Set the motor inertia.
			9999	Internal data of the drive unit is used.
725	**Motor protection current level**	9999	0 to 500%	Set the maximum current (OCT) level of the motor.
			9999	200%
726	**Motor induced voltage constant (phi f) exponent**	9999	0 to 2	Set the exponent n when the induced voltage constant phi f (*Pr. 706*) is multiplied by 10^n.
			9999	n = "0" when *Pr. 706* = "9999".
859	**Rated PM motor current**	9999	0 to 500A	Tuning data (The value measured by offline auto tuning is automatically set.)
			9999	Internal data of the drive unit is used.

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.
*2 The capacity of the S-PM geared motor is initially set to the next smaller size than the capacity of the drive unit.
*3 The value left of the slash is for the 200V class drive unit. The one right of the slash is for the 400V class drive unit.

Ver.UP .... Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

POINT

- When the S-PM geared motor is used, offline auto tuning is not required.
- Tuning is enabled even when a load is connected to the motor.
- Reading/writing of the motor constants tuned by offline auto tuning is enabled. The offline auto tuning data (motor constants) can be copied to another drive unit using a parameter unit.
- The offline auto tuning status can be monitored on an operation panel or a parameter unit.

● Before performing offline auto tuning

Check the following points before performing offline auto tuning:

- A motor is connected. (Check that the motor is not rotated by an external force during tuning.)
- The motor capacity is equal to or one rank lower than the drive unit capacity.
  Using a motor with the rated current substantially lower than the drive unit rated current will cause torque ripples, etc. and degrade the speed and torque accuracies. As a reference, select the motor with the rated motor current that is 40% or higher of the drive unit rated current.
- The wiring length between the drive unit and the motor should be 30m at maximum.
- The motor may run slightly during offline auto tuning. (Tuning performance is unaffected.)
  Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs. (Caution is required especially in vertical lift applications.)
- Tuning may not be available for motors with an extremely low rated speed or motors for which magnetic saturation is difficult to occur.

● Setting

- To perform tuning, set the following parameters about the motor.

Pr.	Name	Setting
80	Motor capacity	Motor capacity (kW)
81	Number of motor poles	The number of motor poles (2 to 10)
9	Electronic thermal O/L relay	Rated motor current (A)
84	Rated motor speed	Rated motor speed (r/min)
83	Rated motor voltage	Rated motor voltage (V)
71*1	Applied motor	8090 (IPM motor) 9090 (SPM motor)
96	Auto tuning setting/status	1

*1 Set *Pr.71 Applied motor* according to the applied motor. (For other setting values of *Pr.71*, *Refer to page 105*.)

- For the tuning accuracy improvement, set the following parameter when the motor constant is known in advance.

Pr.	Name	Setting
702	Maximum motor speed	Maximum motor speed (r/min)
707	Motor inertia (integer)	Motor inertia*1 Jm = *Pr.707* × 10^(- *Pr.724*) (kg·m^2)
724	Motor inertia (exponent)	
725	Motor protection current level	Maximum current level of the motor (%)

*1 The setting is valid only when both of the *Pr.707 and Pr.724* settings are other than "9999".

NOTE

- **The motor constant parameters are valid for other than auto tuning.**
  Do not set the motor constant parameters when the S-PM geared motor is used. Doing so may cause abnormal operation or damage the drive unit and/or the motor.

● Performing tuning

POINT

- Before performing tuning, check the monitor display of the operation panel or parameter unit if the drive unit is in the state ready for tuning. Turning ON the start command while tuning is unavailable starts the motor.

- In the PU operation mode, press RUN on the operation panel.
  For External operation, turn ON the start command (STF or STR signal). Tuning will start.

NOTE

- **Satisfy the required drive unit start conditions to start offline auto tuning. For example, stop the input of MRS signal.**
- **To force tuning to end, use the MRS or RES signal or press STOP/RESET on the operation panel. (Turning the start signal (STF or STR) OFF also ends tuning.)**
- **During offline auto tuning, only the following I/O signals are valid.**
  Input terminals <effective signals>: STOP, OH, MRS, RES, STF, STR, X10, and X12
  Output terminals: RUN, RBP, THP, RY, Y12, MBR, FAN, FIN, Y90, Y95, REM, and LF
- **When the rotation speed or the output frequency is selected for terminal FM, the progress status of offline auto tuning is output in fifteen steps from terminal FM.**
- **During execution of offline auto tuning, do not switch the second function selection (RT) signal between ON and OFF. Auto tuning is not executed properly.**
- **A motor with 12-pole or more cannot be tuned.**
- **Since the drive unit running (RUN) signal turns ON when tuning is started, pay close attention especially when a sequence which releases a mechanical brake by the RUN signal has been designed.**
- **While *Pr.79 Operation mode selection* = "7", turn the PU operation external interlock (X12) signal ON to tune in the PU operation mode.**

- The following shows the monitor display/indicator on the operation panel or the parameter unit (FR-PU07) during tuning.

	Operation Panel Display/Indicator	Parameter Unit (FR-PU07) Display
Pr.96 Setting	1	1
(1) Setting		READ:List TUNE 1 --- STOP PU
(2) During tuning		TUNE 2 STF FWD PU
(3) Normal completion	Blinking 	TUNE 3 COMPLETION STF STOP PU

- When offline auto tuning ends during PU operation, press STOP RESET on the operation panel. During External operation, turn OFF the start signal (STF or STR). This operation resets the offline auto tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)

NOTE

- **The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again. However, performing all parameter clear resets the tuning data.**
- **Changing *Pr.71* after tuning completion will change the motor constant. For example, if the *Pr.71* setting is changed to "9090" after tuned with *Pr.71* = "8090", the tuning data become invalid. To use the tuned data, set "8090" again in *Pr.71*.**

- If offline auto tuning has ended in error (see the table below), the motor constants have not been set.
  Perform a drive unit reset and restart tuning.

Error Code	Cause of Error	Countermeasures
8	Forced end	Set *Pr.96* = "1" and try again.
9	Drive unit protective function operation	• Make the setting again. • Adjust the *Pr.672* setting.
92	The converter output voltage fell to 75% of the rated voltage.	• Check for the power supply voltage fluctuation. • Check the *Pr.83 Rated motor voltage* setting.
93	Calculation error The motor is not connected.	• Check the motor wiring or parameter settings, and perform the tuning again. • Adjust the *Pr.672* setting.

- When tuning is ended forcibly by pressing STOP RESET or turning OFF the start signal (STF or STR) during tuning, offline auto tuning does not end properly. (The motor constants have not been set.)
  Perform a drive unit reset and restart tuning.

REMARKS

- An instantaneous power failure occurring during tuning will result in a tuning error.
  After power is restored, the drive unit starts the normal operation. Therefore, when the STF (or STR) signal is ON, the motor runs in the forward (or reverse) rotation.
- Any alarm occurring during tuning is handled as in the normal operation. However, if the retry function is set, retry is not performed even when a protective function that performs a retry is activated.
- "0Hz" is displayed on the set frequency monitor during the offline auto tuning.

⚠ CAUTION

⚠ Note that the motor may start running suddenly.

● Parameters updated by tuning results after tuning

Pr.	Name	Description
90	Motor constant (R1)	Resistance per phase
92	Motor constant (Ld)	d-axis inductance
93	Motor constant (Lq)	q-axis inductance
711	Motor Ld decay ratio	d-axis inductance decay ratio
712	Motor Lq decay ratio	q-axis inductance decay ratio
717	Starting resistance tuning compensation	
721	Starting magnetic pole position detection pulse width	
859	Rated PM motor current	
96	Auto tuning setting/status	

● Tuning adjustment *(Pr.672)*

- For a motor for which magnetic saturation occurs easily (a motor with a large Lq decay ratio), the overcurrent protective function may be activated or the calculation error may occur (*Pr.96* = "93") during Lq tuning.
  In this case, adjust the target current during tuning by decreasing the setting value of *Pr.672 Lq tuning target current adjustment coefficient* by 10%. The error may be corrected.

● Changing the motor constant

- The motor constants can be set directly when the motor constants are known in advance, or by using the data measured during offline auto tuning.
  If offline auto tuning has ended in error, obtain the information of motor constant from the motor manufacturer to set the motor constants.
- The changed settings are stored in the EEPROM for the motor constant parameters.
- The following motor-constant parameters need to be set.

Pr.	Name	Setting Range	Setting Increments	Initial Value
90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999
92	Motor constant (Ld)	0 to 500mH, 9999	0.1mH	
93	Motor constant (Lq)	0 to 500mH, 9999	0.1mH	
706	Induced voltage constant (phi f)	0 to 5000mV (s/rad), 9999	0.1mV (s/rad)	
726	Motor induced voltage constant (phi f) exponent	0 to 2	1	
859	Rated PM motor current	0 to 500A, 9999	0.01A	

NOTE

- **If "9999" is set, tuning data will be invalid. The drive unit internal constant is used.**
- **The motor constant parameters are valid for other than auto tuning.**
  Do not set the motor constant parameters when the S-PM geared motor is used. Doing so may cause abnormal operation or damage the drive unit and/or the motor.

4.10 Motor brake and stop operation

Purpose	Parameter that should be Set		Refer to Page
Motor braking torque adjustment	**DC injection brake and pre-excitation**	**Pr. 10, Pr. 11, Pr. 795**	*110*
Improve the motor braking torque with an option	**Selection of a regenerative brake**	**Pr. 30, Pr. 70**	*114*
Coast the motor to a stop	**Selection of motor stopping method**	**Pr. 250**	*116*
Activate the electromagnetic brake by the output signal	**Brake opening request signal**	**Pr. 281, Pr. 283**	*112*
	Electromagnetic brake interlock	**Pr. 736**	*113*

4.10.1 DC injection brake and pre-excitation (Pr. 10, Pr. 11, Pr. 795)

At a motor stop, DC injection brake operates to apply braking torque to the motor.

Parameter Number	Name	Initial Value	Setting Range	Description
10	**Coasting speed**	90r/min	0 to 3600r/min / 0 to 2400r/min *1*2	The speed where the motor starts coasting
11	**DC injection brake operation time**	0.5s	0	DC injection brake disabled
			0.1 to 10s	Operation time of the DC injection brake.
795	**DC brake torque boost**	9999	0 to 150%	The maximum torque to be generated during DC injection brake operation (pre-excitation operation)
			9999	50% setting

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

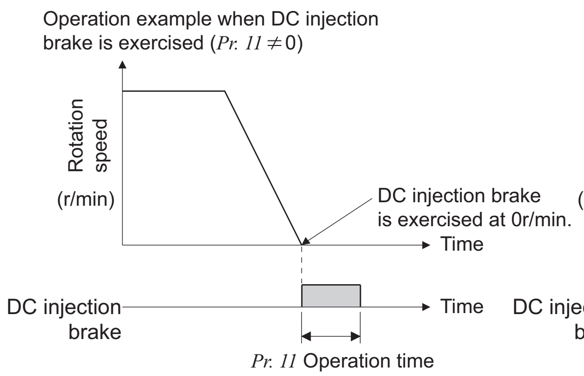
*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

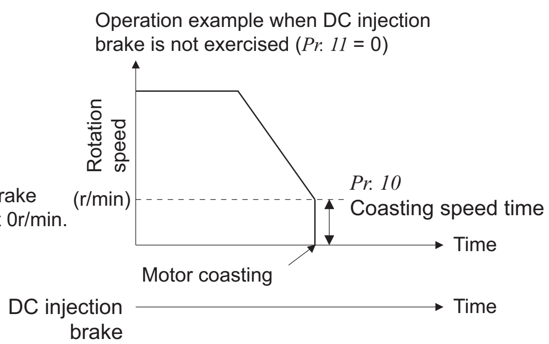
(1) Coasting speed setting *(Pr. 10)*

- When the speed at which coasting starts is set in *Pr. 10*, output is shutoff when this speed is reached during deceleration and motor starts coasting. (This function is valid when *Pr. 11* = "0s")
- When *Pr. 11* ≠ "0", *Pr. 10* is always set to 0r/min.

(2) Operation time setting *(Pr. 11)*

- In *Pr. 11*, set the time of the DC injection brake.
- When *Pr. 11* = "0", the DC injection brake is disabled. (At a stop, the motor coasts.)
- When the motor does not stop due to large load moment (J), increasing the setting produces an effect.



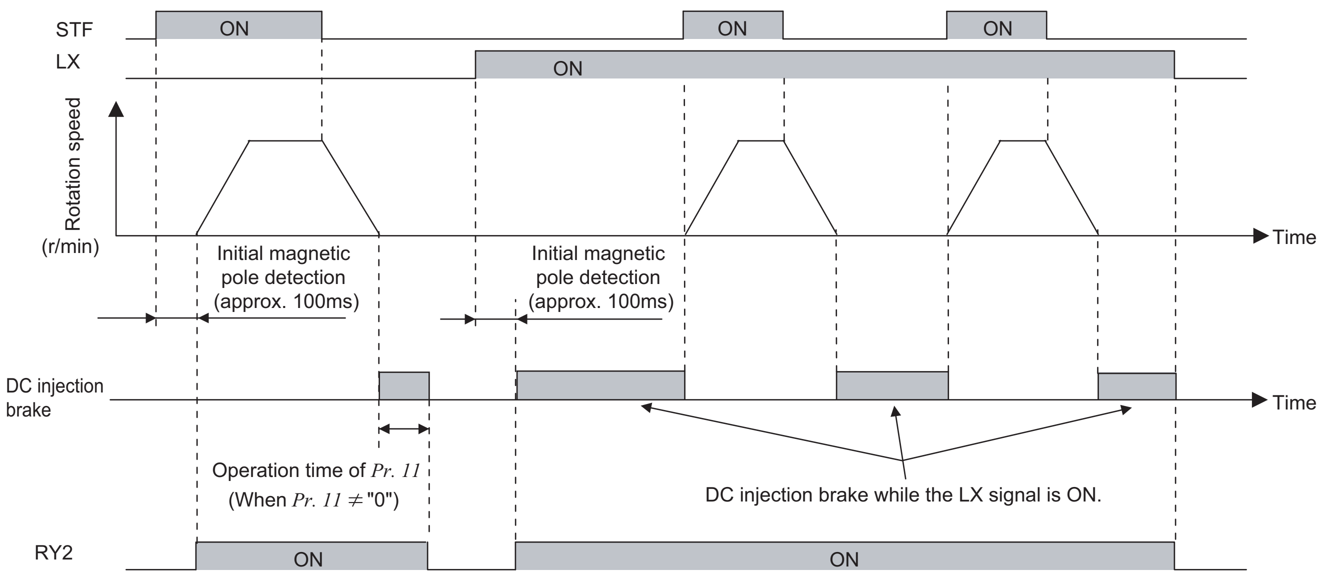


(3) Setting the torque generated during DC injection brake operation *(Pr. 795)*

- In *Pr. 795*, set the maximum torque to be generated during DC injection brake operation (pre-excitation operation).
- A setting value larger than 50% may cause a motor overload trip (E.THM) depending on the DC injection brake time (pre-excitation operation time).

(4) Pre-excitation (LX) signal

- Turning ON the LX signal will apply excitation current during a stop to activate DC injection brake.
- The deceleration-to-a-stop operation commanded by the LX signal decelerates the motor to 0r/min, then performs DC injection brake operation, regardless of the *Pr. 10* and *Pr. 11* settings.
- Performing the initial magnetic pole detection in advance will eliminate the start-up delay caused by the initial magnetic pole detection. (Initial magnetic pole detection is performed when the LX signal is turned OFF and ON during a stop.)
- To input the LX signal, set "23" in one of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function to a terminal.
- The RY2 signal turns ON when the pre-excitation starts.
  The signal stays ON as long as pre-excitation is activated even if the drive unit is in a stop status. The signal is OFF when the output shutoff (MRS) signal is ON.
  For the terminal used for the RY2 signal, set "33 (positive logic)" or "133 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*.



REMARKS

- RUN LED on the operation panel is lit during pre-excitation, which is activated by turning the LX signal ON.

NOTE

- Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* and *Pr. 190* or *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal. *(Refer to page 117.)*

⚠ CAUTION

⚠ Install a mechanical brake to make an emergency stop or to stay stopped for a long time.
After the machine is completely stopped and the motor is immobilized using a mechanical brake, turn OFF the pre-excitation (LX) signal.

⚠ A PM motor is a magnet motor. High-voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.

Parameters referred to

Pr. 13 Starting speed ☞ *Refer to page 99.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*

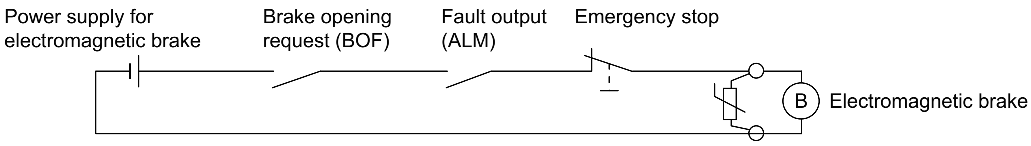
4.10.2 Brake opening request (BOF) signal (Pr. 281, Pr. 283) Ver.UP

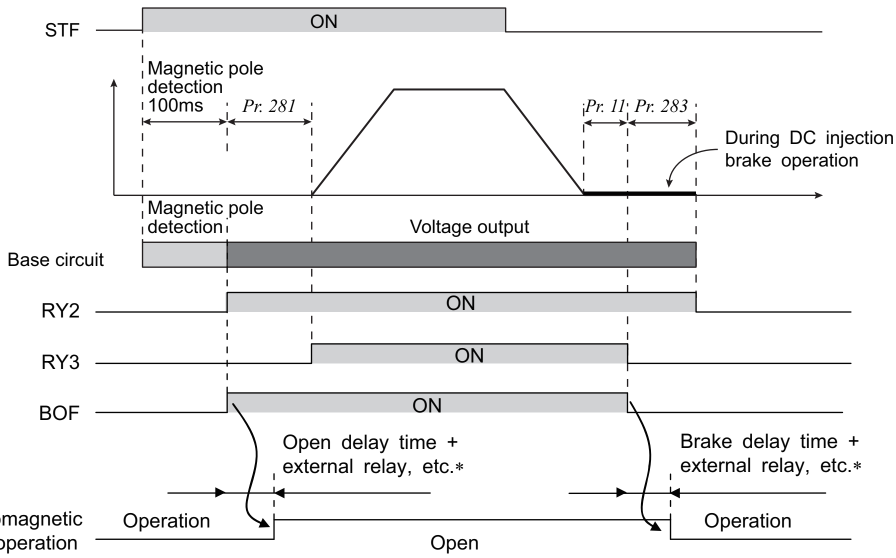
Use the Brake opening request (BOF) signal to activate the electromagnetic brake.
The electromagnetic brake can be opened while voltage is output so that no drop may occur in a lift application.

Parameter Number	Name	Initial Value	Setting Range	Description
281	**Brake operation time at start**	0s	0 to 1s	Set a time from output of the BOF signal to start of the actual operation (the electromagnetic brake open delay time)
283	**Brake operation time at stop**	0s	0 to 1s	Set a time from shutoff of the BOF signal to shutoff of the base circuit (the electromagnetic brake operation delay time)

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

- Interlock can be provided for the electromagnetic brake operation by setting a delay time from output of the Brake opening request (BOF) signal to start of the actual operation in *Pr. 281 Brake operation time at start*.
- Interlock can be provided for the electromagnetic brake operation or the output is shut off after electromagnetic brake operation completes by setting a delay time from shutoff of the BOF signal to shutoff of the base circuit in *Pr. 283 Brake operation time at stop*.
- The delay time set in *Pr. 281* and *Pr. 283* are enabled even if the BOF signal is not assigned. Set "0" in both *Pr. 281* and *Pr. 283* if the delay time setting is not required.
- To use the BOF signal, set "20 (positive logic) or 120 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* to assign the function to an output terminal.
- Additionally configure an external circuit, which can also command an emergency stop to the electromagnetic brake.





* The release of the electromagnetic brake is delayed for the electromagnetic brake release/operation time and the operation time of the relays, etc. in external circuits.

	Start Signal OFF (during a stop)	Initial Magnetic Pole Detection	*Pr. 281*	During Running	During DC Injection Brake Operation	*Pr. 283*	Output Shutoff *
RY	ON	ON	ON	ON	ON	ON	OFF
RY2	OFF	OFF	ON	ON	ON	ON	OFF
RY3	OFF	OFF	OFF	ON	ON	OFF	OFF
RUN	OFF	OFF	OFF	ON	OFF	OFF	OFF
BOF	OFF	OFF	ON	ON	ON	OFF	OFF

* During a fault occurrence, or while the MRS signal is ON

NOTE

- Changing the terminal assignment using *Pr. 190* or *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal. *(Refer to page 123.)*
- The BOF signal is not activated while the main circuit capacitor life is being measured. *(Refer to page 231.)*

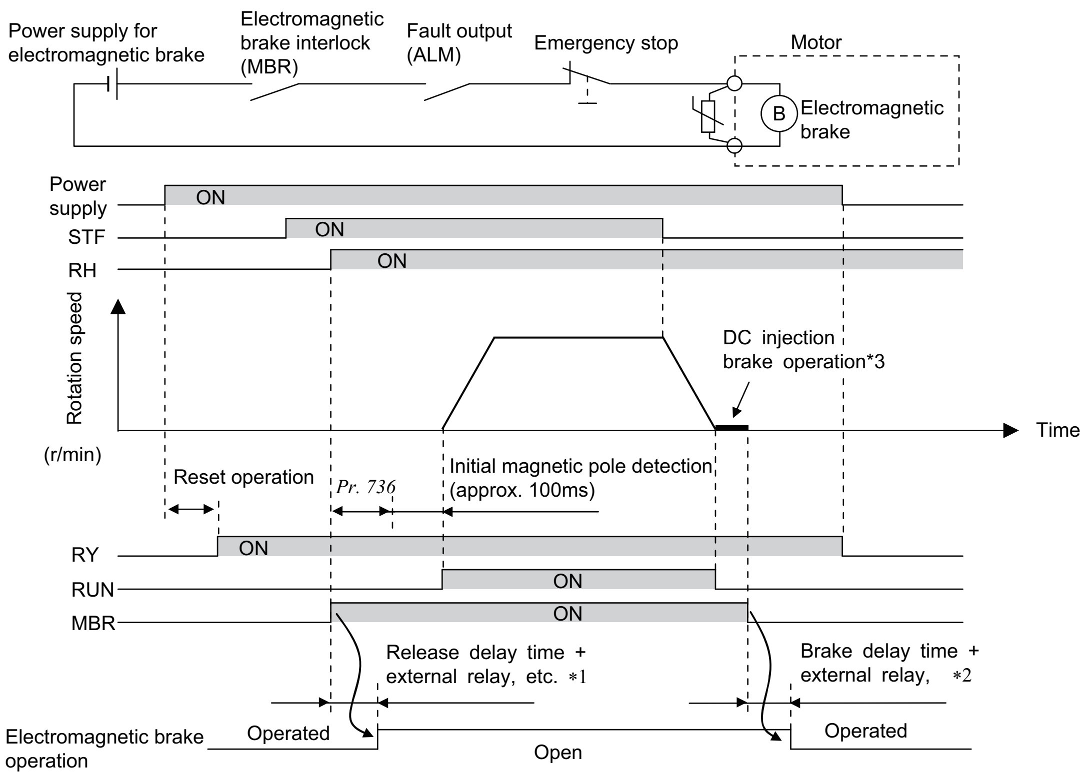
4.10.3 Activating the electromagnetic brake (MBR signal, *Pr. 736*)

Use the Electromagnetic brake interlock (MBR) signal to activate the electromagnetic brake.

Parameter Number	Name	Initial Value	Setting Range	Description
736 *	**Electromagnetic brake interlock time**	0s	0 to 1s	Set the waiting time between the initial magnetic pole detection start and the MBR signal output at drive unit start-up. Set the release delay time (including relay operation delay) of the electromagnetic brake or longer.

* This parameter can be set when *Pr. 160 Extended function display selection* = "0".

- To obtain an interlock with the electromagnetic brake operation, set a delay time between the electromagnetic brake interlock (MBR) signal output and the actual operation start in *Pr. 736 Electromagnetic brake interlock time*.
- The interlock time set in *Pr. 736* is enabled even if the MBR signal is not assigned. Set *Pr. 736* = 0 if the interlock time setting is not required.
- Additionally configure an external circuit, which can also command an emergency stop to the electromagnetic brake.
- For the terminal used for MBR signal, set "21 (positive logic)" or "121 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*.



*1 The release timing of the electromagnetic brake is delayed for the electromagnetic brake release time and the operation time of the relays, etc. in external circuits.

*2 The operation timing of the electromagnetic brake is delayed for the electromagnetic brake delay time and the operation time of the relays, etc. in external circuits.

*3 When the drive unit is set as *Pr. 10* = "0r/min" and *Pr. 11* = "0.0s", its outputs are shut off when the speed reaches 0r/min during dceleration, and the motor starts coasting.

Output Signal \ Drive Unit Status	Start Signal OFF (During a Stop)	Start signal ON: During a Stop (No Speed Setting)	Start signal ON: During a Stop (With a Speed Setting)	Start signal ON: Running	DC Injection Brake Activated	Output Shutoff*
RY	ON	ON	ON	ON	ON	OFF
RUN	OFF	OFF	OFF	ON	OFF	OFF
MBR	OFF	OFF	ON	ON	ON	OFF

* During a fault occurrence, or while the MRS signal is ON.

NOTE

- **Changing the terminal assignment using** *Pr. 190* **or** *Pr. 192 (output terminal function selection)* **may affect the other functions. Set parameters after confirming the function of each terminal.** *(Refer to page 123.)*
- **The MBR signal is disabled while the main circuit capacitor life is being measured.** *(Refer to page 123.)*
- **The motor generates no torque while the electromagnetic brake is in the open status before drive unit operation and after DC injection brake operation. Thus, the motor may be rotated by an external force. Check that no drops or other accidents will occur in an application like a lift, where the motor may rotate in the brake-open status.**

Parameters referred to

Pr. 10 Coasting speed ☞ *Refer to page 110.*
Pr. 11 DC injection brake operation time ☞ *Refer to page 110.*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 123.*

4.10.4 Selection of a regenerative brake (Pr. 30, Pr. 70)

- When making frequent starts/stops, use the optional brake resistor (MRS type, MYS type), high-duty brake resistor (FR-ABR) and brake unit (FR-BU2) to increase the regenerative brake duty.
- Use a power regeneration common converter (FR-CV) for continuous operation in regeneration status.
  Use the high power factor converter (FR-HC2) to reduce harmonics, improve the power factor, or continuously use the regenerative status.

Parameter Number	Name	Initial Value	Setting Range	Description
30	Regenerative function selection	0	0	Drive unit without regenerative function, Brake resistor (MRS type, MYS type), Brake unit (FR-BU2) Power regeneration common converter (FR-CV) High power factor converter (FR-HC2)
			1	Brake resistor (MYS type) used at 100% torque/6%ED, High-duty brake resistor (FR-ABR)
70	Special regenerative brake duty	0%	0 to 30%	Brake duty when using the high-duty brake resistor (FR-ABR)

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) When using the brake resistor (MRS type, MYS type), brake unit (FR-BU2), power regeneration common converter (FR-CV), and high power factor converter (FR-HC2).

- Set *Pr. 30* to "0" (initial value). The *Pr. 70* setting is invalid.
  At this time, the regenerative brake duty is 3%.
- Assign the Drive unit run enable (X10) signal to the contact input terminal. To make protective coordination with the FR-HC2 and FR-CV, use the drive unit operation enable signal to shut off the drive unit output.
  Input the RDY signal of the FR-HC2 (RDYB signal of the FR-CV).
- For the terminal used for X10 signal input, assign its function by setting "10" (X10) to any of *Pr. 178 to Pr. 182*.

(2) Brake resistor (MYS type) used at 100% torque/6%ED (FR-D720-3.7K-G only)

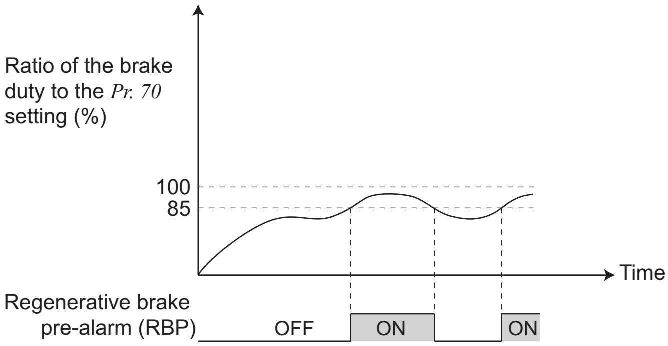
- Set "1" in *Pr. 30*.
- Set "6%" in *Pr. 70*.

(3) When using the high-duty brake resistor (FR-ABR) (0.4K or higher)

- Set "1" in *Pr. 30*.
- Set "10%" in *Pr. 70*.

(4) Regenerative brake duty alarm output and alarm (RBP) signal

100%: regenerative overvoltage protection operation value



- [RB] appears on the operation panel and an alarm (RBP) signal is output when 85% of the regenerative brake duty set in *Pr. 70* is reached. If the regenerative brake duty reaches 100% of the *Pr. 70* setting, a regenerative overvoltage (E.OV1 to E.OV3) occurs. Note that [RB] is not displayed when *Pr. 30* = "0".
- The drive unit does not trip even when the alarm (RBP) signal is output.
- For the terminal used for the RBP signal output, assign the function by setting "7 (positive logic) or 107 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* .

REMARKS

- The MRS signal can also be used instead of the X10 signal. *(Refer to page 119.)*
- Refer to *page 27* to *32* for connecting the brake resistor (MRS type, MYS type), high-duty brake resistor (FR-ABR), brake unit (FR-BU2), high power factor converter (FR-HC2), and power regeneration common converter (FR-CV).

NOTE

- **When terminal assignment is changed using *Pr. 178 to Pr. 182 (input terminal function selection)* and *Pr. 190, Pr. 192 (output terminal function selection)*, the other functions may be affected. Set parameters after confirming the function of each terminal. *(Refer to page 117.)***

WARNING

The value set in *Pr. 70* must not exceed the setting of the brake resistor used.
Otherwise, the resistor can overheat.

Parameters referred to

Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 117.
Pr. 190, Pr. 192 (output terminal function selection) Refer to page 123.

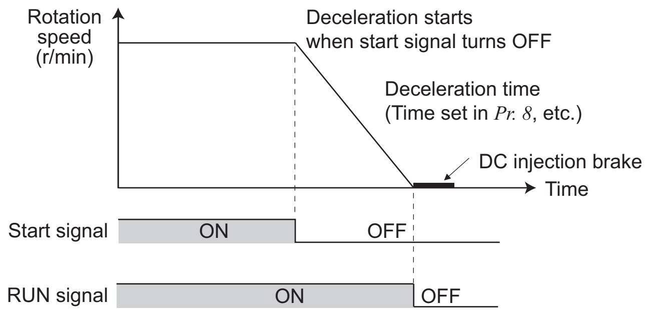
4.10.5 Stop selection (Pr. 250)

Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching OFF of the start signal.
You can also select the operations of the start signals (STF/STR). (Refer to *page 121* for start signal selection.)

Parameter Number	Name	Initial Value	Setting Range	Description: Start signal (STF/STR) *(Refer to page 121.)*	Description: Stop operation
250	**Stop selection**	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF.
			1000s to 1100s	STF signal: Start signal STR signal: Forward/reverse signal	The motor is coasted to a stop (*Pr. 250* - 1000)s after the start signal is turned OFF.
			9999	STF signal: Forward rotation start STR signal: Reverse rotation start	When the start signal is turned OFF, the motor decelerates to stop.
			8888	STF signal: Start signal STR signal: Forward/reverse signal	

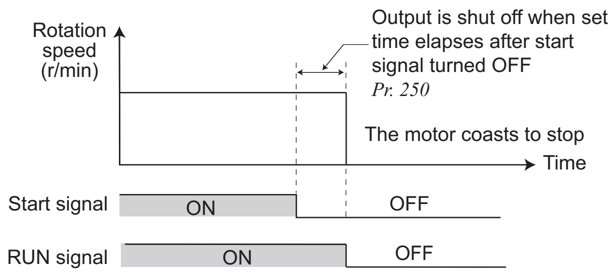
The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Decelerate the motor to a stop



- Set *Pr. 250* to "9999" (initial value) or "8888".
- The motor decelerates to a stop when the start signal (STF/STR) turns OFF.

(2) Coast the motor to a stop



- Use *Pr. 250* to set the time from when the start signal turns OFF until the output is shut off. When any of "1000 to 1100" is set, the output is shut off in (*Pr. 250* - 1000)s.
- The output is shut off when the time set in *Pr. 250* has elapsed after the start signal had turned OFF. The motor coasts to a stop.
- The RUN signal turns OFF when the output stops.

REMARKS

- Stop selection is invalid when the following functions are activated.
  - PU stop (*Pr. 75*)
  - Deceleration stop because of communication error (*Pr. 502*)
  - Jog operation mode
- When setting of *Pr. 250* is not 9999 nor 8888, acceleration/deceleration is performed according to the speed command, until start signal is OFF and output is shut off.
- Turning ON the LX signal during pre-excitation will decelerate the motor to a stop even if the motor is set to coast to a stop.

NOTE

- **When the start signal is turned ON again during motor coasting, the motor starts at *Pr. 13 Starting speed*.**

⚠ CAUTION

⚠ A PM motor is a magnet motor. High-voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.

Parameters referred to

Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 97.*
Pr. 13 Starting speed ☞ *Refer to page 99.*

4.11 Function assignment of external terminal and control

Purpose	Parameter that should be Set		Refer to Page
Assign function to input terminal	**Input terminal function selection**	**Pr. 178 to Pr. 182**	*117*
Set MRS signal (output shutoff) to NC contact specification	**MRS input selection**	**Pr. 17**	*119*
Assign start signal and forward/ reverse command to other signals	**Start signal (STF/STR) operation selection**	**Pr. 250**	*121*
Assign function to output terminal	**Output terminal function selection**	**Pr. 190, Pr. 192**	*123*
Detect rotation speed	**Up-to-speed sensitivity Rotation speed detection Speed detection hysteresis**	**Pr. 41 to Pr. 43, Pr. 870**	*127*
Detect output current	**Output current detection Zero current detection**	**Pr. 150 to Pr. 153, Pr. 166, Pr. 167**	*128*
Remote output function	**Remote output**	**Pr. 495, Pr. 496**	*130*
Detect specified output power	**Pulse train output of output power**	**Pr. 799**	*131*

4.11.1 Input terminal function selection (Pr. 178 to Pr. 182)

Use these parameters to select/change the input terminal functions.

Parameter Number	Name	Initial Value	Initial Signal	Setting Range
178	**STF terminal function selection**	60	STF (forward rotation command)	0 to 5, 7, 8, 10, 12, 14, 16, 24, 25, 60 *1, 61 *2, 62, 64 to 67, 72, 9999
179	**STR terminal function selection**	61	STR (reverse rotation command)	
180	**RL terminal function selection**	0	RL (low-speed operation command)	
181	**RM terminal function selection**	1	RM (middle speed operation command)	
182	**RH terminal function selection**	2	RH (high-speed operation command)	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The setting value "60" is only available for *Pr. 178*.

*2 The setting value "61" is only available for *Pr. 179*.

4

PARAMETERS

(1) Input terminal function assignment

- Using *Pr. 178 to Pr. 182*, set the functions of the input terminals.
- Refer to the following table and set the parameters:

Setting	Signal	Function		Related Parameters	Refer to Page
0	RL	*Pr. 59* = 0 (initial value)	Low-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	*89*
		Pr. 59 ≠ 0 ∗1	Remote setting (setting clear)	Pr. 59	*93*
1	RM	*Pr. 59* = 0 (initial value)	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	*89*
		Pr. 59 ≠ 0 ∗1	Remote setting (deceleration)	Pr. 59	*93*
2	RH	*Pr. 59* = 0 (initial value)	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	*89*
		Pr. 59 ≠ 0 ∗1	Remote setting (acceleration)	Pr. 59	*93*
3	RT	Second function selection		Pr. 44, Pr. 45, Pr. 48	*120*
4	AU	Terminal 4 input selection		Pr. 267	*147*
5	JOG	Jog operation selection		Pr. 15, Pr. 16	*91*
7	OH	External thermal relay input ∗2		Pr. 9	*101*
8	REX	15-speed selection (combination with three speeds RL, RM, RH)		Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	*89*
10	X10	Drive unit run enable signal (FR-HC2, FR-CV connection)		Pr. 30, Pr. 70	*114*
12	X12	PU operation external interlock		Pr. 79	*164*
14	X14	PID control valid terminal		Pr. 127 to Pr. 134	*216*
16	X16	PU/External operation switchover (turning ON X16 selects External operation)		Pr. 79, Pr. 340	*170*
23	LX	Pre-excitation		Pr. 11, Pr. 795	*110*
24	MRS	Output stop		Pr. 17	*119*
25	STOP	Start self-holding selection		—	*121*
60	STF	Forward rotation command (assigned to STF terminal *(Pr. 178)* only)		—	*121*
61	STR	Reverse rotation command (assigned to STR terminal *(Pr. 179)* only)		—	*121*
62	RES	Drive unit reset		—	—
64	X64	PID forward/reverse action switchover		Pr. 127 to Pr. 134	*216*
65	X65	PU/NET operation switchover (turning ON X65 selects PU operation)		Pr. 79, Pr. 340	*171*
66	X66	External/NET operation switchover (turning ON X66 selects NET operation)		Pr. 79, Pr. 340	*171*
67	X67	Command source switchover (turning ON X67 makes *Pr. 338* and *Pr. 339* commands valid)		Pr. 338, Pr. 339	*177*
72	X72	PID integral value reset		Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45	*216*
9999	—	No function		—	—

∗1 When *Pr. 59 Remote function selection* ≠ "0", the functions of the RL, RM and RH signals are changed as given in the table.

∗2 The OH signal turns ON when the relay contact "opens".

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **Same function can be assigned to two or more terminals. In this case, the logic of terminal input is OR.**
- **The priorities of the speed commands are in order of jog > multi-speed setting (RH, RM, RL, REX) > PID (X14).**
- **When the X10 signal (FR-HC2, FR-CV connection-drive unit operation enable signal) is not set or when the PU operation external interlock (X12) signal is not assigned with *Pr. 79 Operation mode selection* set to "7", the MRS signal shares this function.**
- **Same signal is used to assign multi-speed (7 speeds) and remote setting. These cannot be set individually.**
  (Same signal is used since multi-speed (7 speeds) setting and remote setting are not used to set speed at the same time.)
- **Turning the AU signal ON makes terminal 2 (voltage input) invalid.**

(2) Response time of each signal

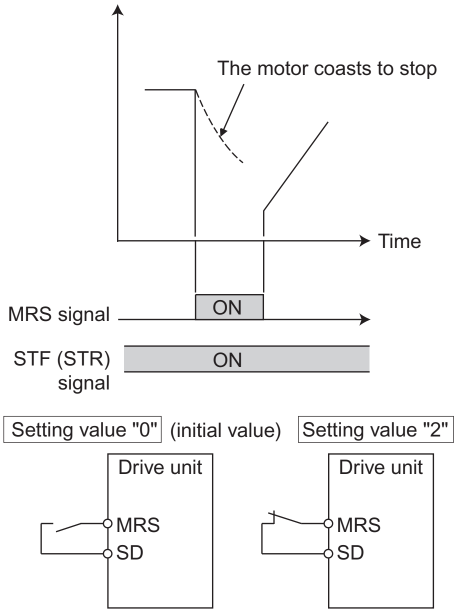
- The response time of the X10 signal and MRS signal is within 2ms.
  The response time of other signals is within 20ms.

4.11.2 Drive unit output shutoff (MRS) signal (Pr. 17)

The drive unit output can be shut off by the MRS signal. Also, logic for the MRS signal can be selected.

Parameter Number	Name	Initial Value	Setting Range	Description
17	**MRS input selection**	0	0	Normally open input
			2	Normally closed input (NC contact input specifications)
			4	External terminal: Normally closed input (NC contact input specifications) Communication: Normally open input

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 161.)*



(1) Output shutoff (MRS) signal

- Turning ON the output shutoff (MRS) signal during drive unit running shuts off the output immediately.
  Set "24" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign a function to the MRS signal.
- MRS signal may be used as described below.

(a) When mechanical brake (e.g. electromagnetic brake) is used to stop motor
  The drive unit output is shut off when the mechanical brake operates.

(b) To provide interlock to disable operation by the drive unit
  With the MRS signal ON, the drive unit cannot be operated if the start signal is entered into the drive unit.

(c) Coast the motor to a stop.
  When the start signal is turned OFF, the drive unit decelerates the motor to a stop in the preset deceleration time, but when the MRS signal is turned ON, the motor coasts to a stop.

(2) MRS signal logic inversion *(Pr. 17)*

- When *Pr. 17* is set to "2", the MRS signal (output stop) can be changed to the normally closed (NC contact) input specification. When the MRS signal turns ON (opens), the drive unit shuts off the output.

(3) Assign a different action for each MRS signal input from communication and external terminal (*Pr. 17* = "4")

- When *Pr. 17* is set to "4", the MRS signal from external terminal (output stop) can be changed to the normally closed (NC contact) input, and the MRS signal from communication can be changed to the normally open (NO contact) input.
  This function is useful to perform operation by communication with MRS signal from external terminal remained ON.

External MRS	Communication MRS	*Pr. 17* Setting		
		0	2	4
OFF	OFF	Operation enabled	Output shutoff	Output shutoff
OFF	ON	Output shutoff	Output shutoff	Output shutoff
ON	OFF	Output shutoff	Output shutoff	Operation enabled
ON	ON	Output shutoff	Operation enabled	Output shutoff

REMARKS

- When using an external terminal to input the MRS signal, the MRS signal shuts off the output in any of the operation modes.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

⚠ CAUTION

⚠ **A PM motor is a magnet motor. High-voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.**

Parameters referred to

Pr. 178 to Pr. 182 (input terminal function selection) *Refer to page 117.*

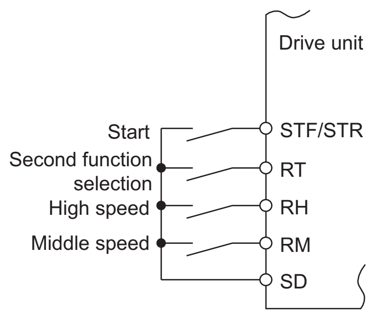
4.11.3 Condition selection of function validity by Second function selection (RT) signal

You can select the second function using the RT signal.

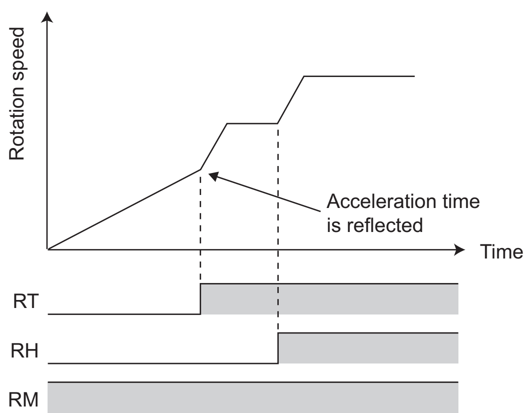
- When the RT signal turns ON, the second function becomes valid.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.
- The second function has the following applications.

(a) Switching between normal use and emergency use
(b) Switching between heavy load and light load
(c) Changing of acceleration/deceleration time by broken line acceleration/deceleration

Second function connection diagram



Second acceleration/deceleration time



- When the RT signal is ON, the following second functions are selected at the same time.

Function	First Function Parameter Number	Second Function Parameter Number	Refer to Page
Acceleration time	Pr. 7	Pr. 44	*97*
Deceleration time	Pr. 8	Pr. 44, Pr. 45	*97*
Stall prevention	Pr. 22	Pr. 48	*83*

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 178 to Pr. 182 (input terminal function selection) *Refer to page 117.*

4.11.4 Start signal operation selection (STF, STR, STOP signal, Pr. 250)

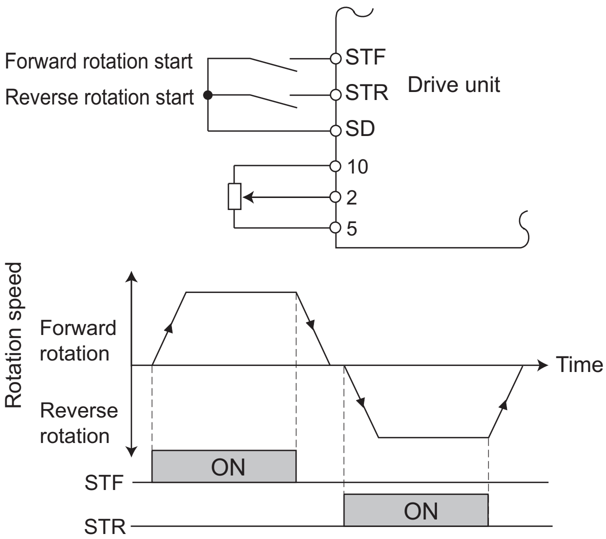
You can select the operation of the start signal (STF/STR).
Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching OFF of the start signal.
(Refer to *page 116* for stop selection.)

Parameter Number	Name	Initial Value	Setting Range	Description	
				Start signal (STF/STR)	Stop operation (*Refer to page 116.*)
250	Stop selection	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF.
			1000s to 1100s	STF signal: Start signal STR signal: Forward/reverse signal	When the setting is any of 1000s to 1100s, the drive unit coasts to a stop in (*Pr. 250* - 1000)s.
			9999	STF signal: Forward rotation start STR signal: Reverse rotation start	When the start signal is turned OFF, the motor decelerates to stop.
			8888	STF signal: Start signal STR signal: Forward/reverse signal	

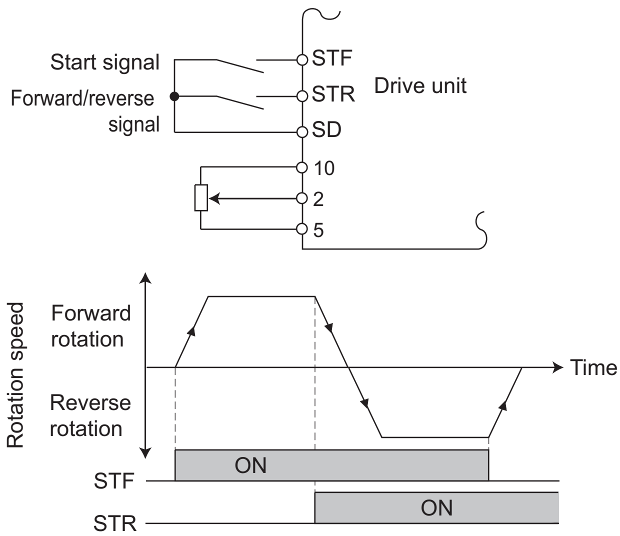
The above parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 161.)*

(1) Two-wire type connection (STF, STR signal)

- The two-wire connection is shown below.
- In the initial setting, the forward/reverse rotation signals (STF/STR) are used as start and stop signals. Turn ON either of the forward and reverse rotation signals to start the motor in the corresponding direction. Switch both OFF (or both ON) the start signal during operation to decelerate the motor to a stop.
- The speed setting signal may either be given by entering 0 to 10VDC across the speed setting input terminals 2 and 5, or by setting the required values in *Pr. 4 to Pr. 6 Multi-speed setting (high, middle, low speeds)*, etc. (For multi-speed operation, refer to *page 89*.)
- When *Pr. 250* is set to any of "1000 to 1100, 8888", the STF signal becomes a start command and the STR signal a forward/reverse command.



2-wire connection example (*Pr. 250* = "9999")



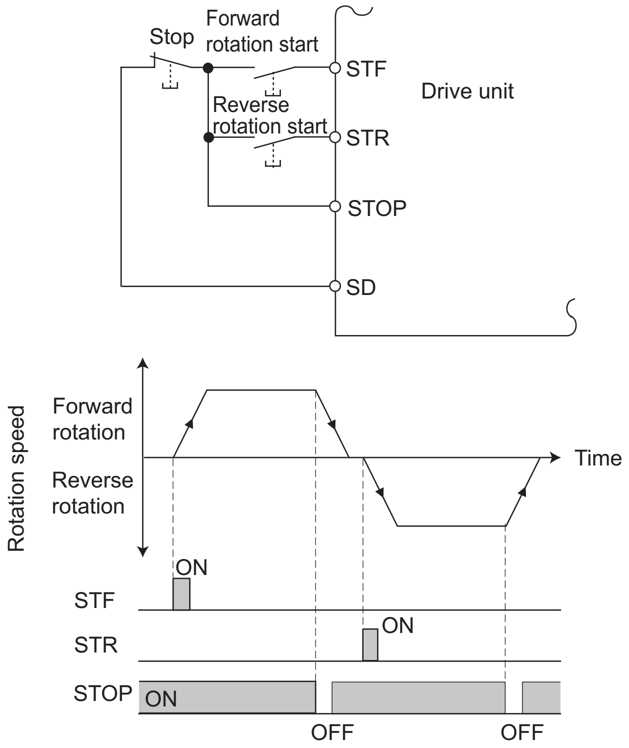
2-wire connection example (*Pr. 250* = "8888")

REMARKS

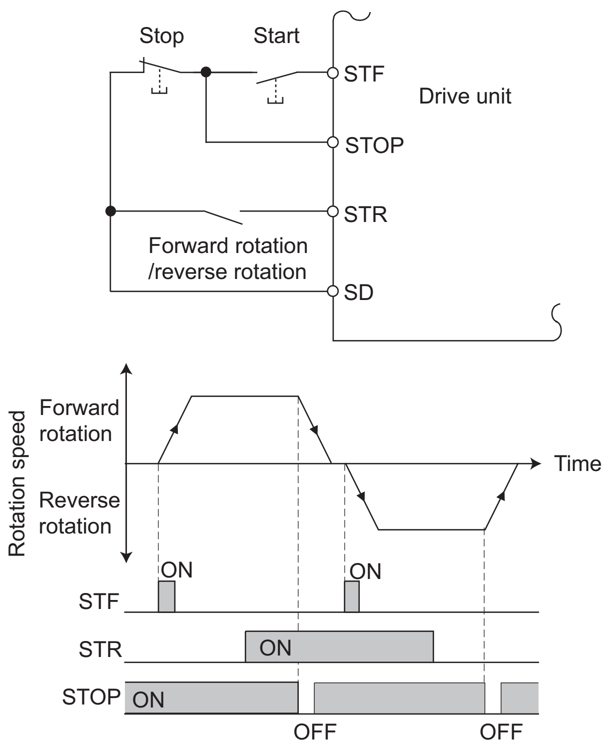
- When *Pr. 250* is set to any of "0 to 100, 1000 to 1100", turning OFF the start command coasts the drive unit to a stop. *(Refer to page 116.)*
- The STF and STR signals are assigned to the STF and STR terminals in the initial setting. The STF signal can be assigned to *Pr. 178 STF terminal function selection*, and the STR signal to *Pr. 179 STR terminal function selection* only.

(2) Three-wire type (STF, STR, STOP signal)

- The three-wire connection is shown below.
- Turning the STOP signal ON makes start self-holding function valid. In this case, the forward/reverse rotation signal is activated only as a start signal.
- If the start signal (STF or STR) is turned ON and then OFF, the start signal is held and makes a start. When changing the direction of rotation, turn STR (STF) ON once and then OFF.
- To stop the drive unit, turning OFF the STOP signal once decelerates it to a stop.
- When using the STOP signal, set "25" in any of *Pr. 178 to Pr. 182* to assign function.



3-wire connection example (*Pr. 250* = "9999")



3-wire connection example (*Pr. 250* = "8888")

REMARKS

- When the JOG signal is turned ON to enable Jog operation, the STOP signal becomes invalid.
- If the MRS signal is turned ON to stop the output, the self-holding function is not canceled.

(3) Start signal selection

STF	STR	*Pr. 250* Setting Drive Unit Status	
		0 to 100s, 9999	1000s to 1100s, 8888
OFF	OFF	Stop	Stop
OFF	ON	Reverse rotation	
ON	OFF	Forward rotation	Forward rotation
ON	ON	Stop	Reverse rotation

Parameters referred to

Pr. 4 to Pr. 6 (multi-speed setting) ☞ *Refer to page 89.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*

4.11.5 Output terminal function selection (Pr. 190, Pr. 192)

You can change the functions of the open collector output terminal and relay output terminal.

Parameter Number	Name		Initial Value	Initial Signal	Setting Range
190 Ver.UP	RUN terminal function selection	Open collector output terminal	0	RUN (drive unit running)	0, 1, 3, 4, 7, 8, 11 to 16, 20, 21, 25, 26, 33, 37, 47, 48, 64, 70, 79, 90, 91, 93*, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 120, 121, 125, 126, 133, 137, 147, 148, 164, 170, 179, 191, 193*, 195, 196, 198, 199, 9999
192 Ver.UP	A,B,C terminal function selection	Relay output terminal	99	ALM (fault output)	

* The setting values "93" and "192" cannot be set in *Pr. 192*.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

Ver.UP.......Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

(1) Output signal list

- You can set the functions of the output terminals.
- Refer to the following table and set the parameters: (0 to 99: positive logic, 100 to 199: negative logic)

Setting		Signal	Function	Operation	Related Parameter	Refer to Page
Positive logic	Negative logic					
0	100	RUN	Drive unit running	This signal is output when the drive unit starts running upon turning ON of the start signal. The signal turns OFF when the DC injection brake activates after the drive unit decelerates to a stop.	—	*125*
1	101	SU	Up to speed *1	Output when the rotation speed is reached to the set speed.	Pr. 41	*127*
3	103	OL	Overload warning	Output while stall prevention function is activated.	Pr. 22, Pr. 48, Pr. 150, Pr. 157	*83*
4	104	FU	Speed detection	Output when the rotation speed reaches the speed set in *Pr. 42* (*Pr. 43* for reverse rotation).	Pr. 42, Pr. 43	*127*
7	107	RBP	Regenerative brake pre-alarm	Output when 85% of the regenerative brake duty set in *Pr. 70* is reached.	Pr. 70	*114*
8	108	THP	Electronic thermal O/L relay pre-alarm	Output when the electronic thermal value reaches 85% of the trip level. (Electronic thermal relay function protection (E.THT/E.THM) activates, when the value reached 100%.	Pr. 9	*101*
11	111	RY	Drive unit operation ready	Output when reset process is completed (when the drive unit can be started by switching the start signal ON or while it is running) after powering ON drive unit.	—	*125*
12	112	Y12	Output current detection	Output when the output current is same as the *Pr. 150* setting or more for the time set in *Pr. 151* or longer.	Pr. 150, Pr. 151	*128*
13	113	Y13	Zero current detection	Output when the output current is same as the *Pr. 152* setting or more for the time set in *Pr. 153* or longer.	Pr. 152, Pr. 153	*128*
14	114	FDN	PID lower limit	Output when the feedback value falls below the lower limit of PID control.	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	*216*
15	115	FUP	PID upper limit	Output when the feedback value rises above the upper limit of PID control		
16	116	RL	PID forward/reverse rotation output	Output when forward rotation is performed in PID control.		
20	120	BOF	Brake opening request	Output to open the electromagnetic brake.	Pr. 281, Pr. 283	*112*
21	121	MBR	Electromagnetic brake interlock	Output to release the electromagnetic brake.	Pr. 736	*113*
25	125	FAN	Fan fault output	Output at the time of a fan fault.	Pr. 244	*230*
26	126	FIN	Heatsink overheat pre-alarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	—	*259*
33	133	RY2	Operation ready 2	Output during pre-excitation and operation.	Pr. 10, Pr. 11	*110, 125*

4

PARAMETERS

Setting		Signal	Function	Operation	Related Parameter	Refer to Page
Positive logic	Negative logic					
37	137	RY3	Operation ready 3	Output during pre-excitation and operation. Turned OFF during interlock operation with the BOF signal.	Pr. 281, Pr. 283	*112, 125*
47	147	PID	During PID control activated	Output during PID control.	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	*216*
48	148	Y48	PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	Pr. 127 to Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45	*216*
64	164	Y64	During retry	Output during retry processing.	Pr. 65, Pr. 67 to Pr. 69	*143*
70	170	SLEEP	PID output interruption	Output when the PID output interruption function is executed.	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	*216*
79	179	Y79	Pulse train output of output power	Output in pulses every time the accumulated output power of the drive unit reaches the *Pr. 799* setting.	Pr. 799	*131*
90	190	Y90	Life alarm	Output when any of the control circuit capacitor, main circuit capacitor and inrush current limit circuit or the cooling fan approaches the end of its service life.	Pr. 255 to Pr. 259	*231*
91	191	Y91	Fault output 3 (power-OFF signal)	Output when a fault occurs due to the internal circuit failure or the drive unit wiring mistake.	—	*126*
93	193	Y93	Current average monitor signal	Average current value and maintenance timer value are output as pulses. The signal cannot be set in *Pr. 192 A,B,C terminal function selection* .	Pr. 555 to Pr. 557	*236*
95	195	Y95	Maintenance timer signal	Output when *Pr. 503* rises to or above the *Pr. 504* setting.	Pr. 503, Pr. 504	*235*
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	Pr. 495, Pr. 496	*130*
98	198	LF	Alarm output	Output when an alarm (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	*184, 230*
99	199	ALM	Fault output	Output when a fault occurs. The signal output is stopped when the fault is reset.	—	*126*
9999		—	No function	—	—	—

*1 Note that when the speed setting is varied using an analog signal or of the operation panel, the output of the SU (up to speed) signal may alternate ON and OFF depending on that varying speed and the timing of the varying speed due to acceleration/deceleration time setting.
(The output will not alternate ON and OFF when the acceleration/deceleration time setting is "0s".)

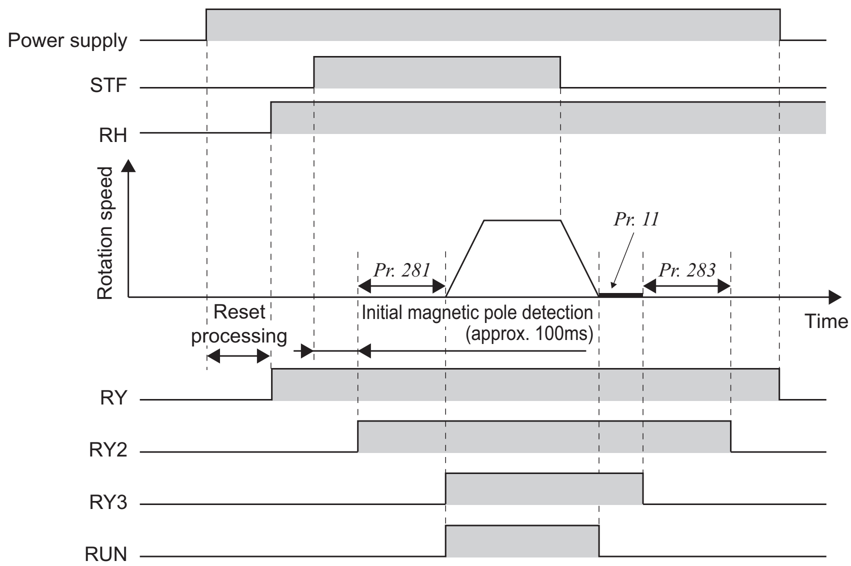
REMARKS

- The same function may be set to more than one terminal.
- When the function is executed, the terminal conducts at the setting of any of "0 to 99", and does not conduct at the setting of any of "100 to 199".

NOTE

- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **Do not assign signals which repeat frequent ON/OFF to A, B, and C. Otherwise, the life of the relay contact decreases.**
- **The common terminal for terminal RUN is terminal SE.**

(2) Drive unit operation ready (RY, RY2, RY3) signal and Drive unit running (RUN) signal



- When the drive unit is ready to operate, the output of the Drive unit operation ready (RY) signal is ON. (It is also ON during drive unit running.)
- When the motor rotation speed reaches 1r/min or more during the drive unit operation, the Drive unit running (RUN) signal turns ON. During a drive unit stop, zero speed control, servo lock, or DC injection brake operation, the signal is OFF.
- The RY2 and RY3 signal turns ON when the pre-excitation starts.
  The signal stays ON as long as pre-excitation is activated even if the drive unit is in a stop status. The output shutoff (MRS) signal is OFF. (*Refer to page 111*.)
  The RY3 signal is OFF during interlock operation with the Brake opening request (BOF) signal (refer to the descriptions of *Pr. 281* and *Pr. 283* on *page 112*).
- When using the RY, RY2, RY3 and RUN signals, assign functions to *Pr. 190* or *Pr. 192 (output terminal selection function)* referring to the table below.

Output Signal	*Pr. 190, Pr. 192* Setting	
	Positive Logic	Negative Logic
RY	11	111
RY2	33	133
RY3	37	137
RUN	0	100

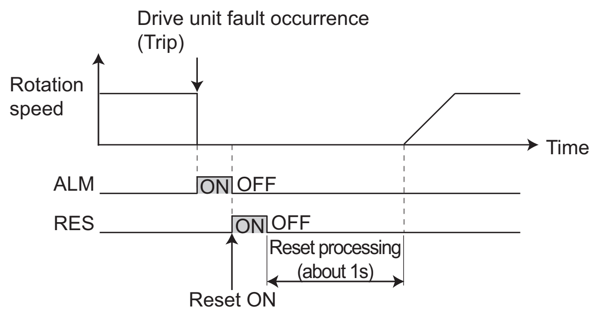
Drive Unit Status / Output Signal	During Stop	During Operation	LX signal ON (pre-excitation)	Under DC Injection Brake (pre-excitation)	During Interlock Operation with *Pr. 281* and *Pr. 283*	Output Shut-off *2
RY *3	ON	ON	ON	ON	ON	OFF
RY2	OFF	ON *1	ON *1	ON	ON	OFF
RY3	OFF	ON *1	ON *1	ON	OFF	OFF
RUN	OFF	ON	OFF	OFF	OFF	OFF

*1 There is a 100ms time delay at ON.
*2 Output is shutoff in conditions like a fault and when the MRS signal is ON.
*3 The signal is OFF while the main circuit power supply is OFF.

REMARKS

- The RUN signal (positive logic) is assigned to the terminal RUN in the initial setting.
- When the start command (STF, STR) is turned ON during PM motor control, the RUN signal is output after *Pr. 736 Electromagnetic brake interlock time* plus about 100ms. This delay is caused by the electromagnetic brake interlock and magnetic pole detection. *(Refer to page 113.)*

(3) Fault output (ALM) signal



- If the drive unit comes to trip, the ALM signal is output.

REMARKS

- The ALM signal is assigned to the ABC contact in the initial setting. By setting "99 (positive logic) or 199 (negative logic) in *Pr. 190* or *Pr. 192 (output terminal function selection)*, the ALM signal can be assigned to the other signal.
- Refer to *page 254* for the drive unit fault description.

(4) Fault output 3 (power-off signal) (Y91) signal

- The Y91 signal is output at occurrence of a fault attributable to the failure of the drive unit circuit or a fault caused by a wiring mistake.
- When using the Y91 signal, set "91 (positive logic)" or "191 (negative logic)" to *Pr. 190, Pr. 192 (output terminal function selection)* to assign the function to the output terminal.
- The following table indicates the faults that will output the Y91 signal. (Refer to *page 253* for the fault description.)

Operation Panel Indication		Name
E. bE	E. BE	Brake transistor alarm detection
E. GF	E.GF	Output side earth (ground) fault overcurrent at start
E. LF	E.LF	Output phase loss
E. PE	E.PE	Parameter storage device fault
E.CPU	E.CPU	CPU fault
E.IOH	E.IOH	Inrush current limit circuit fault

REMARKS

- At occurrence of output side earth (ground) fault overcurrent (E.GF), overcurrent trip during acceleration(E.OC1) may be displayed. At this time, the Y91 signal is output.

Parameters referred to

Pr. 281 Brake operation time at start, Pr. 283 Brake operation time at stop ☞ *Refer to page 112.*

Pr. 736 Electromagnetic brake interlock time ☞ *Refer to page 113.*

4.11.6 Detection of rotation speed (SU, FU signal, Pr. 41 to Pr. 43, Pr. 870)

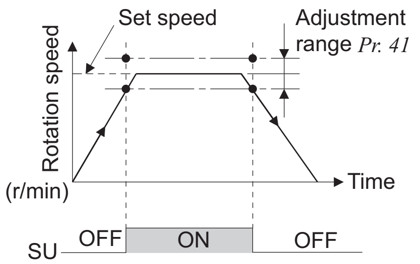
The drive unit rotation speed is detected and output at the output signals.

Parameter Number	Name	Initial Value	Setting Range	Description
41	**Up-to-speed sensitivity**	10%	0 to 100%	Level where the SU signal turns ON.
42	**Speed detection**	180r/min	0 to 12000r/min / 0 to 8000r/min*1*2	Speed where the FU signal turns ON
43	**Speed detection for reverse rotation**	9999	0 to 12000r/min / 0 to 8000r/min*1*2	Speed where the FU signal turns ON during reverse rotation.
			9999	Same as *Pr. 42* setting
870	**Speed detection hysteresis**	15r/min	0 to 150r/min / 0 to 100r/min*1	Set the hysteresis width for the detected speed.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

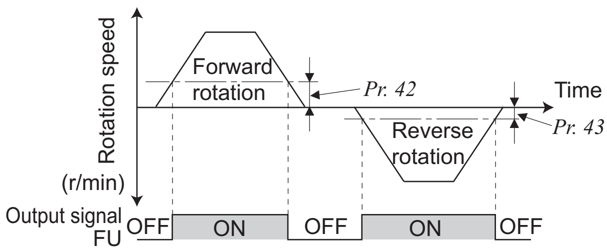
*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.



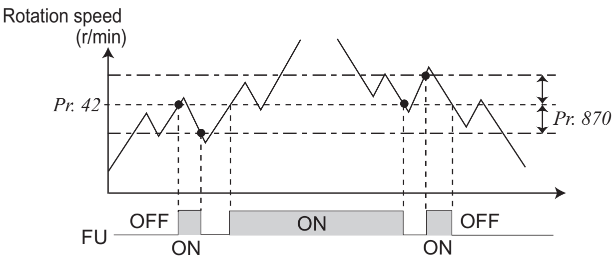
(1) Up-to-rotation speed sensitivity (SU signal, *Pr. 41*)

- When the rotation speed reaches the set speed, the Up-to-speed (SU) signal is output.
- The *Pr. 41* value can be adjusted within the range 0% to ±100% on the assumption that the set speed is 100%.
- This parameter can be used to ensure that the rotation speed has been reached to provide the operation start signal etc. for related equipment.
- When using the SU signal, set "1 (positive logic) or 101 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* to assign function to the output terminal.



(2) Rotation speed detection (FU signal, *Pr. 42, Pr. 43*)

- The rotation speed detection (FU) signal is output when the rotation speed reaches or exceeds the *Pr. 42* setting.
- Speed detection that is dedicated to the reverse operation can be set by setting detection speed to *Pr. 43*.
- When *Pr. 43* ≠ "9999", the *Pr. 42* setting is used for forward rotation and the *Pr. 43* setting is used for reverse rotation.
- When using the FU signal, set "4 (positive logic)" or "104 (negative logic)" to *Pr. 190* or *Pr. 192 (output terminal function selection)* to assign the function to the output terminal.



Example of rotation speed detection (FU) signal

(3) Speed detection hysteresis *(Pr. 870)*

- This function prevents chattering of the speed detection signals. When the rotation speed fluctuates, the Up-to-speed (SU) signal and rotation speed detection (FU) signal may repeat ON/OFF (chatter). Setting hysteresis to the detected speed prevents chattering of these signals.

REMARKS

- Setting a higher value to this parameter slows the response of Speed detection (SU and FU) signals.

REMARKS

- All signals are OFF during DC injection brake.

NOTE

- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) Refer to page 123.

4 PARAMETERS

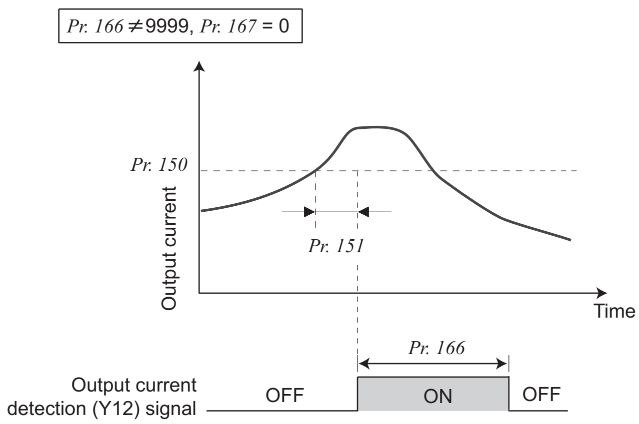
4.11.7 Output current detection function (Y12 signal, Y13 signal, Pr. 150 to Pr. 153, Pr. 166, Pr. 167)

The output current during drive unit running can be detected and output to the output terminal.

Parameter Number	Name	Initial Value	Setting Range	Description
150	**Output current detection level**	150%	0 to 200%	100% is the drive unit rated current.
151	**Output current detection signal delay time**	0s	0 to 10s	Output current detection period. The time from when the output current has risen above the setting until the Output current detection (Y12) signal is output.
152	**Zero current detection level**	5%	0 to 200%	The drive unit rated current is assumed to be 100%.
153	**Zero current detection time**	0.5s	0 to 1s	Period from when the output current drops below the *Pr. 152* value until the Zero current detection (Y13) signal is output.
166	**Output current detection signal retention time**	0.1s	0 to 10s	Set the retention time when the Y12 signal is ON.
			9999	Retain the Y12 signal ON status. The signal is turned OFF at the next start.
167 Ver.UP	**Output current detection operation selection**	0	0, 1, 10, 11	Select the operation when Y12 signal turns ON.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

Ver.UP .... Specifications differ according to the date assembled. *Refer to page 294* to check the SERIAL number.

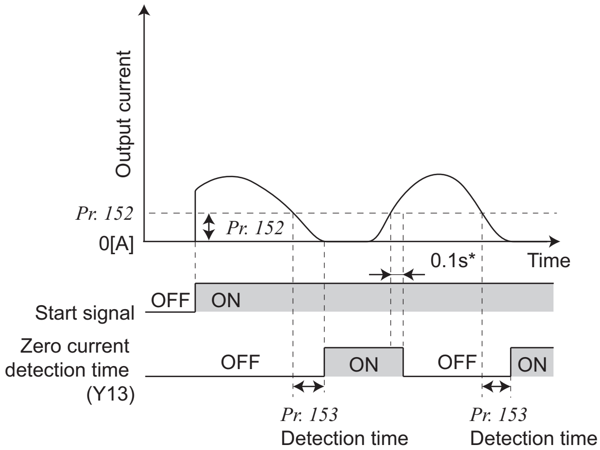


(1) Output current detection (Y12) signal (*Pr. 150, Pr. 151, Pr. 166, Pr. 167*)

- The output current detection function can be used for excessive torque detection, etc.
- If the output during drive unit running is the *Pr. 150* setting or higher for the time set in *Pr. 151* or longer, the Output current detection (Y12) signal is output from the drive unit's open collector or relay output terminal.
- When the Y12 signal turns ON, the ON state is held for the time set in *Pr. 166*.
- When *Pr. 166* = "9999", the ON state is held until a next start.
- Setting *Pr. 167* = "1" while the Y12 signal is ON does not cause E.CDO. The *Pr. 167* setting becomes valid after the Y12 signal is turned OFF.
- For the Y12 signal, set "12 (positive logic) or 112 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* and assign functions to the output terminal.
- Select whether the drive unit output stops or the drive unit operation continues when Y12 signal turns ON, by setting *Pr. 167*.

Pr. 167 Setting	When Y12 Signal Turns ON	Output Current Detection Requirements
0 (initial value)	Continuous operation	• Except during output shutoff∗3
1	Drive unit trip (E.CDO)	
10∗1	Continuous operation	• Except during output shutoff∗3 • During drive unit operation (during motor running) (after completion of start time tuning)∗4 • Except during drive unit operation in a low-speed range
11∗1	Drive unit trip (E.CDO)	

∗1 The setting is not effective in the low-speed range (lower than 10% of the rated speed).
∗2 Detection occurs while all requirements are satisfied.
∗3 The states while a drive unit is reset (the power supply is OFF) and while a drive unit error occurs are included.
∗4 When *Pr. 167* = "10 or 11", output current is not detected in main circuit capacitor life measurement.



* The Zero current detection (Y13) signal holds the signal for approximately 0.1s once turned ON.

(2) Zero current detection (Y13 signal, *Pr. 152, Pr. 153*)

- If the output during drive unit running is the *Pr. 152* setting or lower for the time set in *Pr. 153* or longer, the Zero current detection (Y13) signal is output from the drive unit's open collector or relay output terminal.
- When the drive unit's output current falls to "0", torque will not be generated. This may cause a drop due to gravity when the drive unit is used in vertical lift application.
  To prevent this, the Y13 signal can be output from the drive unit to close the mechanical brake when the output current has fallen to "zero".
- For the Y13 signal, set "13 (positive logic) or 113 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)* and assign functions to the output terminal.

REMARKS

- The response time of Y12 and Y13 signals is approximately 0.1s. Note that the response time changes according to the load condition.
- When *Pr. 152* = "0", detection is disabled.

NOTE

- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

⚠ CAUTION

⚠ **The zero current detection level setting should not be too low, and the zero current detection time setting not too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.**

⚠ **To prevent the machine and equipment from resulting in hazardous conditions detection signal, install a safety backup such as an emergency brake even the zero current detection function is set valid.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 123.*

4.11.8 Remote output selection (REM signal, Pr. 495, Pr. 496)

You can utilize the ON/OFF of the drive unit's output signals instead of the remote output terminal of the programmable logic controller.

Parameter Number	Name	Initial Value	Setting Range	Description	
495	Remote output selection	0	0	Remote output data clear at powering OFF	Remote output data is cleared during an drive unit reset
			1	Remote output data retention at powering OFF	
			10	Remote output data clear at powering OFF	Remote output data is retained during an drive unit reset
			11	Remote output data retention at powering OFF	
496*	Remote output data 1	0	0 to 4095	Refer to the following diagram.	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

* This parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

<**Remote output data**>

Pr. 496

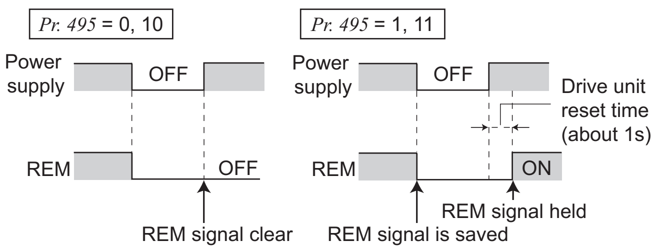
b11											b0
*	*	*	*	SO	*	ABC	*	*	*	*	RUN

* Any

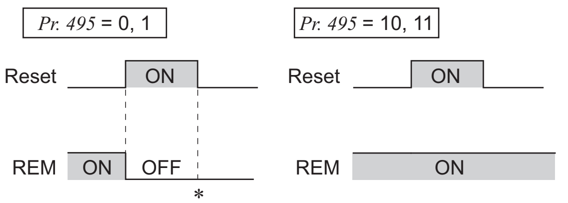
- The output terminal can be turned ON/OFF depending on the *Pr. 496* setting. The remote output selection can be controlled ON/OFF by computer link communication from the PU connector.
- Set "96 (positive logic) or 196 (negative logic)" to *Pr. 190* or *Pr. 192 (output terminal function selection)*, and assign the remote output (REM) signal to the terminal used for remote output.
- When you refer to the diagram on the left and set 1 to the terminal bit (terminal where the REM signal has been assigned) of *Pr. 496*, the output terminal turns ON (OFF for negative logic). By setting 0, the output terminal turns OFF (ON for negative logic).

Example: When "96 (positive logic)" is set in *Pr. 190 RUN terminal function selection* and "1" (H01) is set in *Pr. 496*, the terminal RUN turns ON.

ON/OFF example for positive logic



Signal condition during a reset



* When *Pr. 495* = "1," the signal condition saved in EEPROM (condition of the last power OFF) is applied.

- When *Pr. 495* = "0 (initial value), 10", performing a power ON reset (including a power failure) clears the REM signal output. (The ON/OFF status of the terminals are as set in *Pr. 190* or *Pr. 192*) The *Pr. 496* setting becomes also "0".
  When *Pr. 495* = "1, 11", the remote output data before power OFF is stored into the EEPROM, so the signal output at power recovery is the same as before power OFF. However, it is not stored when the drive unit is reset (terminal reset, reset request through communication).
  (See the chart on the left.)
- When *Pr. 495* = "10 or 11," the signal before the reset is held even during a drive unit reset.

REMARKS

- The output terminal where the REM signal is not assigned using *Pr. 190* or *Pr. 192* does not turn ON/OFF if 0/1 is set to the terminal bit of *Pr. 496*. (It turns ON/OFF with the assigned function.)

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 123.*

4.11.9 Pulse train output of output power (Y79) signal (Pr. 799)

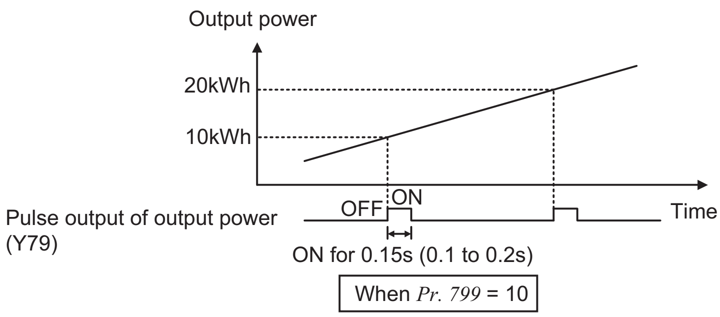
After power ON or drive unit reset, output (Y79) signal is output in pulses every time accumulated output power, which is counted after the *Pr. 799 Pulse increment setting for output power* is set, reaches the specified value (or its integral multiples).

Parameter Number	Name	Initial Value	Setting Range	Description
799	**Pulse increment setting for output power**	1kWh	0.1kWh, 1kWh, 10kWh, 100kWh, 1000kWh	Output signal is output in pulses at every output power (kWh) that is specified.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0".

(1) Pulse increment setting for output power (Y79 signal, *Pr. 799*)

- After power ON or drive unit reset, output (Y79) signal is output in pulses every time accumulated output power of the drive unit exceeds *Pr. 799 Pulse increment setting for output power*.
- The drive unit continues to count the output power at retry function or when automatic restart after instantaneous power failure function works without power OFF of output power (power failure that is too short to cause an drive unit reset), and it does not reset the count.
- If power failure occurs, output power is counted from 0kWh again.
- Assign pulse output of output power (Y79: setting value 79 (positive logic), 179 (negative logic)) to *Pr. 190* or *Pr. 192 (Output terminal function selection)*.



NOTE

- Because the accumulated data in the drive unit is cleared when control power is lost by power failure or at an drive unit reset, the value on the monitor cannot be used to charge electricity bill.
- Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal. *(Refer to page 123.)*

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) Refer to page 123.

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PARAMETERS

4.12 Monitor display and monitor output signal

Purpose	Parameter that should be Set		Refer to Page
Display motor speed Set speed	Speed display and speed setting	Pr. 37, Pr. 144, Pr. 505	132
Change PU monitor display data	Monitor display/PU main display data selection Cumulative monitor clear	Pr. 52, Pr. 54, Pr. 170, Pr. 171, Pr. 268, Pr. 563, Pr. 564, Pr. 891	134
Change the monitor output from terminal FM	Terminal FM function selection	Pr. 54	134
Set the reference of the monitor output from terminal FM	Terminal FM standard setting	Pr. 55, Pr. 56	139
Adjust terminal FM outputs	Terminal FM calibration	Pr. 900	140

4.12.1 Speed display and speed setting (Pr. 37, Pr. 144, Pr. 505)

The increments of the motor speed and the monitored items displayed on the operation panel and PU (FR-PU07) can be switched among frequency, machine speed, etc.

Parameter Number	Name	Initial Value	Setting Range	Description
37	Speed display	0	0	Speed display, setting
			0.01 to 9998*1	Machine speed at *Pr. 505*.
144	Speed setting switchover	104/106 *2	2, 4, 6, 8, 10, 102, 104, 106, 108, 110	Set the number of motor poles when displaying the frequency.
505	Speed setting reference	100Hz/ 150Hz *2	1 to 200Hz	Set the reference speed for *Pr. 37*.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The maximum value of the setting range differs according to the *Pr. 1 Maximum setting*, and it can be calculated from the following formula.

$$\text{Maximum setting value of } Pr.\ 37 < \frac{16777.215 \times Pr.\ 505 \text{ setting}}{\text{Setting value of } Pr.\ 1 \text{ (Hz)}}$$

Note that the maximum setting value of *Pr. 37* is 9998 if the result of the above formula exceeds 9998.

*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

- To display a machine speed, set *Pr. 37* to the machine speed at the frequency set in *Pr. 505*, and set *Pr. 144* to the number of motor poles (4, 6).
  For example, when *Pr. 505* = "100Hz" and *Pr. 37* = "1000", "1000" is displayed on the set frequency monitor when the running frequency is 100Hz. When running frequency is 50Hz, "500" is displayed.
- When the number of motor poles +100 is set in *Pr. 144*, values are displayed in motor speed increments. (When *Pr. 37* = "0")
- To change the display increments to frequency, set the number of motor poles in *Pr. 144*. (When *Pr. 37* = "0")
- A combination of the *Pr. 37* and *Pr. 144* settings determines the monitored item and the setting increment as shown in the table below. (Initial settings are outlined with bold borders)

Pr. 37 Setting	*Pr. 144* Setting	Output Frequency Monitor	Set Frequency Monitor	Running Speed Monitor	Parameter Setting
0 (initial value)	2 to 10	0.01 Hz	0.01 Hz	0.01 Hz *	0.01 Hz
	102 to 110	1 r/min *	1 r/min *	1 r/min *	1 r/min *
0.01 to 9998	2 to 10	0.001 (Machine speed *)	0.001 (Machine speed *)	0.001 (Machine speed *)	0.01 Hz
	102 to 110	0.01 Hz	0.01 Hz	0.01 Hz	0.01 Hz

* Motor speed r/min conversion formula....... frequency × 120/number of motor poles (*Pr. 144*)
Machine speed conversion formula............ *Pr. 37* × frequency/*Pr. 505* setting (Hz)
For *Pr. 144* in the above formula, the value is "*Pr. 144*-100" when "102 to 110" is set in *Pr. 144*.
Pr. 505 is always set as frequency (Hz).

NOTE

- Refer to *Pr. 52* when you want to change the PU main monitor (PU main display).
- Since the panel display of the operation panel is 4 digits in length, the monitor value of more than "9999" is displayed as "----". To display or set the speed of 10000r/min or more on the operation panel for the motor with the maximum rotation speed of 10000r/min or more, change the item for speed display to the frequency.
- When the machine speed is displayed on the FR-PU07, do not change the speed by using an up/down key in the state where the set speed exceeding 65535 is displayed. The set speed may become arbitrary value.
- When the machine speed display is selected, monitored items and speed setting are displayed in machine speed increments, but the values of other parameters related to speed (*Pr. 1*, etc.) are in frequency increments. Set other parameters (*Pr. 1*, etc.) related to speed in increments of frequency.
- Due to the limitations on the resolution of the set frequency, the indication in the second decimal place may differ from the setting.

CAUTION

Make sure that the running speed setting is correct.
Otherwise, the motor might run at extremely high speed, damaging the machine.

Parameters referred to

Pr. 1 Maximum setting Refer to page 87.
Pr. 52 DU/PU main display data selection Refer to page 134.

4

PARAMETERS

4.12.2 Monitor display selection of DU/PU and terminal FM (Pr. 52, Pr. 54, Pr. 170, Pr. 171, Pr. 268, Pr. 563, Pr. 564, Pr. 891)

The monitor to be displayed on the main screen of the operation panel and parameter unit (FR-PU07) can be selected. In addition, signal to be output from the terminal FM (pulse train output) can be selected.

Parameter Number	Name	Initial Value	Setting Range	Description
52 *	**DU/PU main display data selection**	0 (Rotation speed)	0, 5, 8 to 12, 14, 20, 23 to 25, 52 to 55, 61, 62, 64, 100	Select the monitor to be displayed on the operation panel and parameter unit. Refer to the following table for monitor description.
54 *	**FM terminal function selection**	1 (Rotation speed)	1 to 3, 5, 8 to 12, 14, 21, 24, 52, 53, 61, 62	Select the monitor output to terminal FM.
170	**Watt-hour meter clear**	9999	0	Set "0" to clear the watt-hour meter monitor.
			10	Sets the maximum value for monitoring from communication to 9999kWh.
			9999	Sets the maximum value for monitoring from communication to 65535kWh.
171	**Operation hour meter clear**	9999	0, 9999	Set "0" in the parameter to clear the operation time monitor. Setting 9999 does not clear.
268 *	**Monitor decimal digits selection**	9999	0	Displayed as integral value
			1	Displayed in 0.1 increments
			9999	No function
563	**Energization time carrying-over times**	0	0 to 65535 (reading only)	The numbers of cumulative energization time monitor exceeded 65535h is displayed. (Reading only)
564	**Operating time carrying-over times**	0	0 to 65535 (reading only)	The numbers of operation time monitor exceeded 65535h is displayed. (Reading only)
891	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit. Clamp the monitoring value at maximum.
			9999	No shift. Clear the monitor value when it exceeds the maximum value.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

* The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

(1) Monitor description list *(Pr. 52)*

- Set the monitor to be displayed on the operation panel and parameter unit (FR-PU07) in *Pr. 52 DU/PU main display data selection* .
- Set the monitor to be output to the terminal FM (pulse train output) in *Pr. 54 FM terminal function selection*.
- Refer to the following table and set the monitor to be displayed. (The monitor marked with × cannot be selected.)

Types of Monitor	Unit	*Pr. 52* Setting: Operation panel LED	*Pr. 52* Setting: PU main monitor	*Pr. 54* (FM) Setting	Terminal FM Full Scale Value	Description
Rotation speed *6	1 r/min	0/100		1	*Pr. 55*	Displays the Motor speed.
Output current *6	0.01A	0/100		2	*Pr. 56*	Displays the drive unit output current effective value.
Output voltage *6	0.1V	0/100		3	200V class: 400V 400V class: 800V	Displays the drive unit output voltage.
Fault display	—	0/100		×	—	Displays past 8 faults individually.
Speed setting value	1 r/min	5	*1	5	*Pr. 55*	Displays the set speed.
Converter output voltage	0.1V	8	*1	8	200V class: 400V 400V class: 800V	Displays the DC bus voltage value.
Regenerative brake duty	0.1%	9	*1	9	*Pr. 70*	Brake duty set in *Pr. 30, Pr. 70*

Types of Monitor	Unit	*Pr. 52* Setting: Operation panel LED	*Pr. 52* Setting: PU main monitor	*Pr. 54* (FM) Setting	Terminal FM Full Scale Value	Description
Electronic thermal relay function load factor	0.1%	10	*1	10	100%	Displays the thermal cumulative value on the assumption that the thermal operation level is 100% (Larger thermal between the motor thermal and transistor thermal). *6
Output current peak value	0.01A	11	*1	11	*Pr. 56*	Holds and displays the peak value of the output power monitor. (Cleared at every start)
Converter output voltage peak value	0.1V	12	*1	12	200V class: 400V 400V class: 800V	Holds and displays the peak value of the DC bus voltage value. (Cleared at every start)
Output power	0.01kW	14	*1	14	Rated drive unit power × 2	Displays the power on the drive unit output side
Input terminal status	—	—	*1	×	—	Displays the input terminal ON/OFF status on the operation panel. (*Refer to page 137.*)
Output terminal status	—		*1	×	—	Displays the output terminal ON/OFF status on the operation panel. (*Refer to page 137.*)
Cumulative energization time *2	1h	20		×	—	Adds up and displays the energization time after drive unit shipment. You can check the numbers of the monitor value exceeded 65535h with *Pr. 563*.
Reference voltage output	—	—		21	—	Terminal FM: Output 1440 pulse/s
Actual operation time *2, *3	1h	23		×	—	Adds up and displays the drive unit operation time. You can check the numbers of the monitor value exceeded 65535h with *Pr. 564*. Can be cleared by *Pr. 171*. *(Refer to page 138.)*
Motor load factor *7	0.1%	24		24	200%	Displays the torque in percentage on the assumption that the rated motor torque is 100%.
Cumulative power *5	0.01kWh *4	25		×	—	Adds up and displays the power amount based on the output power monitor. Can be cleared by *Pr. 170*. *(Refer to page 137.)*
PID set point	0.1%	52		52	100%	Displays the set point, measured value and deviation during PID control (*Refer to page 221* for details.)
PID measured value	0.1%	53		53	100%	
PID deviation	0.1%	54		×	—	
Drive unit I/O terminal monitor	—	55	×	×	—	Displays the ON/OFF status of the drive unit input terminal and output terminal on the operation panel (*Refer to page 137* for details.)
Motor thermal load factor	0.1%	61		61	Thermal relay operation level (100%)	Motor thermal heat cumulative value is displayed. (Motor overload trip (E.THM) at 100%)
Drive unit thermal load factor	0.1%	62		62	Thermal relay operation level (100%)	Transistor thermal heat cumulative value is displayed. (drive unit overload trip (E.THT) at 100%)
PTC thermistor resistance	0.01kΩ	64		×	—	Displays the PTC thermistor resistance at terminal 2 when PTC thermistor protection is active. (0.10kΩ to 31.5kΩ) *(Refer to page 101.)*

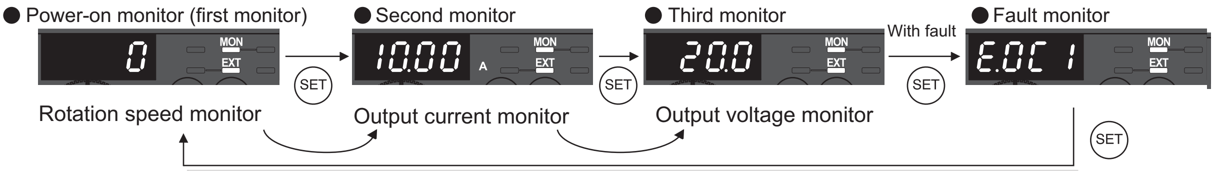
*1 Speed setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU07).
*2 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel is used, the time is displayed up to 65.53 (65530h) in the indication of 1h = 0.001, and thereafter, it is added up from 0.
*3 Actual operation time is not accumulated when the cumulative operation time is less than 1h until turning OFF of the power supply.
*4 When using the parameter unit (FR-PU07), "kW" is displayed.
*5 Since the panel display of the operation panel is 4 digits in length, the monitor value of more than "9999" is displayed as "----".
*6 The monitored values are retained even if a drive unit fault occurs. Resetting will clear the retained values.
*7 The motor load factor is displayed as 0% in the low-speed range lower than 10% of the rated motor speed.

REMARKS

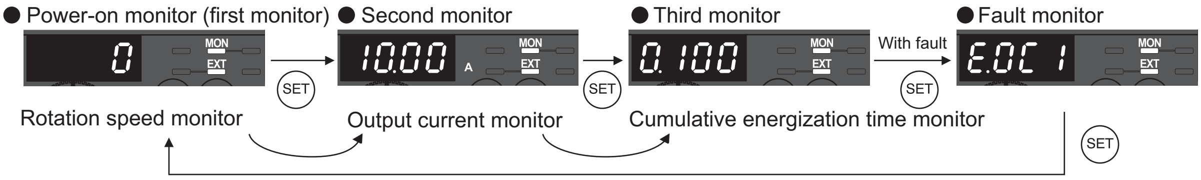
- By setting "0" in *Pr. 52*, the monitoring of output speed to fault display can be selected in sequence by SET.
- When the operation panel is used, the displayed units are Hz and A only, and the others are not displayed.
- The monitor set in *Pr. 52* is displayed in the third monitor position. However, change the output current monitor for the motor load factor.

Initial Value

*The monitor displayed at power-ON is the first monitor. Display the monitor you want to display on the first monitor and hold down SET for 1s. (To return to the rotation speed monitor, hold down SET for 1s after displaying the rotation speed monitor.)



Example)When *Pr. 52* is set to "20" (cumulative energization time), the monitor is displayed on the operation panel as described below.



(2) Display set speed during stop *(Pr. 52)*

- When "100" is set in *Pr. 52*, the set speed and rotation speed are displayed during stop and operation respectively.

	Pr. 52		
	0	100	
	During running/stop	During stop	During running
Rotation speed	Rotation speed	Set speed*	Rotation speed
Output current	Output current		
Output voltage	Output voltage		
Fault display	Fault display		

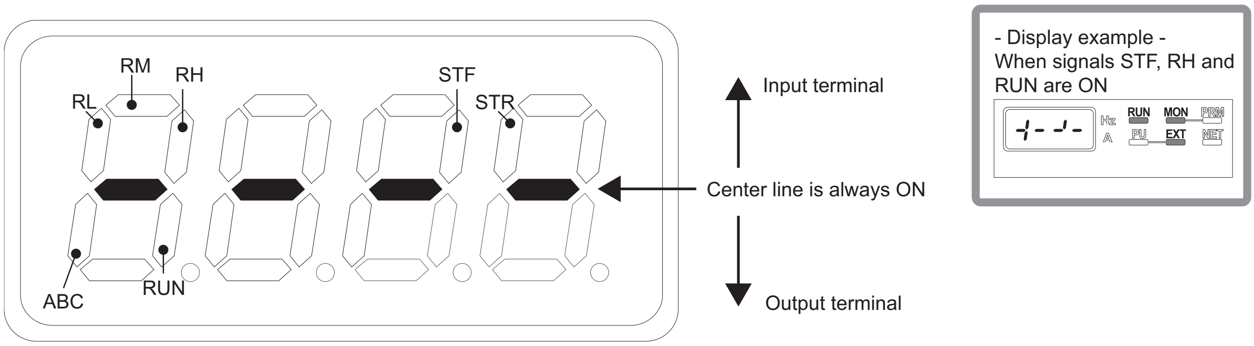
* The set speed displayed indicates the speed to be output when the start command is ON. Different from the speed setting displayed when *Pr. 52* = "5", the value based on maximum/minimum setting and speed jump is displayed.

REMARKS

- During an error, the rotation speed at error occurrence appears.
- During MRS signal is ON, the values displayed are the same as during a stop.

(3) Operation panel I/O terminal monitor *(Pr. 52)*

- When *Pr. 52* = "55", the I/O terminal status can be monitored on the operation panel.
- The I/O terminal monitor is displayed on the third monitor.
- The LED is ON when the terminal is ON, and the LED is OFF when the terminal is OFF. The center line of LED is always ON.
- On the I/O terminal monitor (*Pr. 52* = "55"), the upper LEDs denote the input terminal status and the lower the output terminal status.



(4) Cumulative power monitor and clear *(Pr. 170, Pr. 891)*

- On the cumulative power monitor (*Pr. 52* = "25"), the output power monitor value is added up and is updated in 100ms increments. (The values are saved in EEPROM every hour.)
- The operation panel, parameter unit (FR-PU07) and communication (RS-485 communication) display increments and display ranges are as indicated below.

Operation Panel *1		Parameter Unit *2		Communication		
Range	Unit	Range	Unit	Range		Unit
				Pr. 170 = 10	*Pr. 170* = 9999	
0 to 99.99kWh	0.01kWh	0 to 999.99kWh	0.01kWh	0 to 9999kWh	0 to 65535kWh (initial value)	1kWh/ 0.01kWh *3
100.0 to 999.9kWh	0.1kWh	1000.0 to 9999.9kWh	0.1kWh			
1000 to 9999kWh	1kWh	10000 to 99999kWh	1kWh			

*1 Power is measured in the range of 0 to 9999.99kWh, and displayed in 4 digits.
When the monitor value exceeds "99.99", a carry occurs, e.g. "100.0", so the value is displayed in 0.1kWh increments.

*2 Power is measured in the range of 0 to 99999.99kWh, and displayed in 5 digits.
When the monitor value exceeds "999.99", a carry occurs, e.g. "1000.0", so the value is displayed in 0.1kWh increments.

*3 In monitoring with communication, cumulative power is displayed in 1kWh increments. And cumulative power 2 is displayed in 0.01kWh. (*Refer to page 191* for communication.)

- The monitor data digit can be shifted to the right by the number of *Pr. 891* settings.
  For example, if the cumulative power value is 1278.56kWh when *Pr. 891* = "2", the operation panel display or parameter unit (FR-PU07) display is 12.78 (display in 100kWh increments) and the communication data is 12.
- If the maximum value is exceeded at *Pr. 891* = "0 to 4", the power is clamped at the maximum value, indicating that a digit shift is necessary. If the maximum value is exceeded at *Pr. 891* = "9999", the power returns to 0 and is recounted.
  If the maximum value is exceeded at *Pr. 891* = "9999", the power returns to 0 and is recounted.
- Writing "0" in *Pr. 170* clears the cumulative power monitor.

REMARKS

- If "0" is written to *Pr. 170* and *Pr. 170* is read again, "9999" or "10" is displayed.

(5) Cumulative energization time and actual operation time monitor *(Pr. 171, Pr. 563, Pr. 564)*

- Cumulative energization time monitor (*Pr. 52* = "20") accumulates energization time from shipment of the drive unit every one hour.
- On the actual operation time monitor (*Pr. 52* = "23"), the drive unit running time is added up every hour. (Time is not added up during a stop.)
- If the monitored value exceeds 65535, it is added up from 0. You can check the numbers of cumulative energization time monitor exceeded 65535h with *Pr. 563* and the numbers of actual operation time monitor exceeded 65535h with *Pr. 564*.
- Writing "0" to *Pr. 171* clears the cumulative energization power monitor. (The cumulative time monitor can not be cleared.)

REMARKS

- The cumulative energization time does not increase if the power is ON for less than an hour.
- The actual operation time does not increase if the cumulative running time during power-ON status is less than an hour.
- If "0" is written to *Pr. 171* and *Pr. 171* is read again, "9999" is always displayed. Setting "9999" does not clear the actual operation time meter.

(6) You can select the decimal digits of the monitor *(Pr. 268)*

- As the operation panel display is 4 digits long, the decimal places may vary at analog input, etc. The decimal places can be hidden by selecting the decimal digits.
  In such a case, the decimal digits can be selected by *Pr. 268*.

Pr. 268 Setting	Description
9999 (initial value)	No function
0	For the first or second decimal places (0.1 increments or 0.01 increments) of the monitor, numbers in the first decimal place and smaller are rounded to display an integral value (1 increments).The monitor value smaller than 0.99 is displayed as 0.
1	When 2 decimal places (0.01 increments) are monitored, the 0.01 decimal place is dropped and the monitor displays the first decimal place (0.1 increments). The monitored digits in 1 increments are displayed.

REMARKS

- The number of display digits on the cumulative energization time (*Pr. 52* = "20"), actual operation time (*Pr. 52* = "23") and cumulative power (*Pr. 52* = "25") does not change.

Parameters referred to

Pr. 30 Regenerative function selection, Pr. 70 Special regenerative brake duty ☞ *Refer to page 114.*
Pr. 37 Speed display ☞ *Refer to page 132.*
Pr. 55 Speed monitoring reference, Pr. 56 Current monitoring reference ☞ *Refer to page 139.*

4.12.3 Reference of the terminal FM (pulse train output) (Pr. 55, Pr. 56)

The pulse train output terminal FM is available for monitor output.
Set the reference of the signal output from terminal FM.

Parameter Number	Name	Initial Value	Setting Range	Description
55 *1	**Speed monitoring reference**	3000 r/min	0 to 12000 r/min / 0 to 8000 r/min *2*3	Full-scale value when rotation speed monitor value is output to terminal FM.
56 *1	**Current monitoring reference**	Rated motor current *4	0 to 500A	Full-scale value when current monitor value is output to terminal FM.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 The above parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

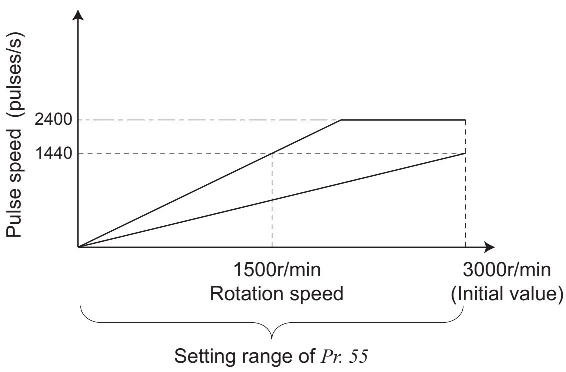
*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*3 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

*4 Refer to page *288* for the rated motor current.

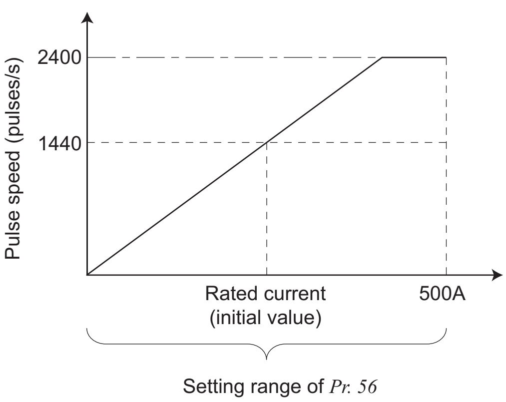
(1) Speed monitor reference *(Pr. 55)*

- Set the full scale value when outputting the speed monitor from terminal FM.
- Set the speed when the optional speed meter (1mA analog meter), which is connected to the terminal FM and SD, shows 1500 r/min or 3000 r/min (shows full scale).
- Set the rotation speed (set speed) at which the pulse speed of the FM output is 1440 pulses/s.
- The pulse speed and rotation speed are proportional to each other. (The maximum pulse train output is 2400 pulses/s.)



(2) Current monitor reference *(Pr. 56)*

- Set the full scale value when outputting the current monitor from terminal FM.
- Set the output current at which the pulse speed of the FM output is 1440 pulses/s.
- The pulse speed and output current monitor value are proportional to each other. (The maximum pulse train output is 2400 pulses/s.)



4

PARAMETERS

4.12.4 Terminal FM calibration (calibration parameter C0 (Pr. 900))

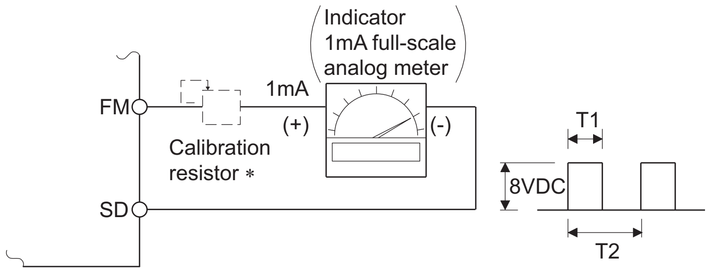
By using the operation panel or parameter unit, you can calibrate terminal FM to full scale deflection.

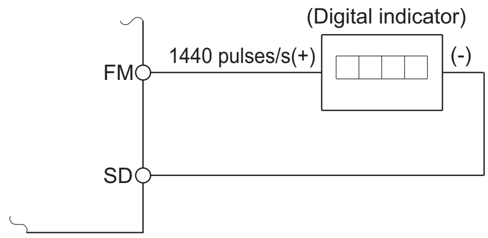
Parameter Number	Name	Initial Value	Setting Range	Description
C0 (900)	FM terminal calibration	—	—	Calibrates the scale of the meter connected to terminal FM.

*1 The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
*2 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07).
*3 The above parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

(1) FM terminal calibration *(C0 (Pr. 900))*

- The terminal FM is preset to output pulses. By setting the *FM terminal calibration C0 (Pr. 900)*, the meter connected to the drive unit can be calibrated by parameter setting without use of a calibration resistor.
- Using the pulse train output of the terminal FM, a digital display can be provided to connect a digital counter.
  The monitor value is 1440 pulses/s output at the full-scale value of monitor description list *(page 134) (Pr. 54 FM terminal function selection)*.





Pulse width T1: Adjust using calibration parameter C0
Pulse cycle T2: Set with *Pr. 55* (speed monitor)
Set with *Pr. 56* (current monitor)

* Not needed when the operation panel or parameter unit (FR-PU07) is used for calibration.
Use a calibration resistor when the indicator (speed meter) needs to be calibrated by a neighboring device because the indicator is located far from the drive unit.
However, the speed meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, perform calibration using the operation panel or parameter unit.

- Calibrate the terminal FM in the following procedure.
  1) Connect an indicator (speed meter) across terminals FM-SD of the drive unit. (Note the polarity. The terminal FM is positive)
  2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
  3) Refer to the monitor description list *(page 134)* and set *Pr. 54*.
     When you selected the running speed or drive unit output current at monitor, preset the running speed or current value, at which the output signal will be 1440 pulses/s, to *Pr. 55 Speed monitoring reference* or *Pr. 56 Current monitoring reference*.
     At 1440 pulses/s, the meter generally deflects to full-scale

REMARKS

- When calibrating a monitor output signal, which cannot be adjusted to 100% value without an actual load and a measurement equipment, set *Pr. 54* to "21" (reference voltage output). 1440 pulses/s are output from the terminal FM.
- The wiring length of the terminal FM should be 200m at maximum.

NOTE

- **The initial value of the calibration parameter C0 *(Pr. 900)* is set to 1mA full scale and 1440 pulses/s terminal FM pulse train output at the drive unit speed of 3000r/min. The maximum pulse train output of terminal FM is 2400 pulses/s.**

Parameters referred to

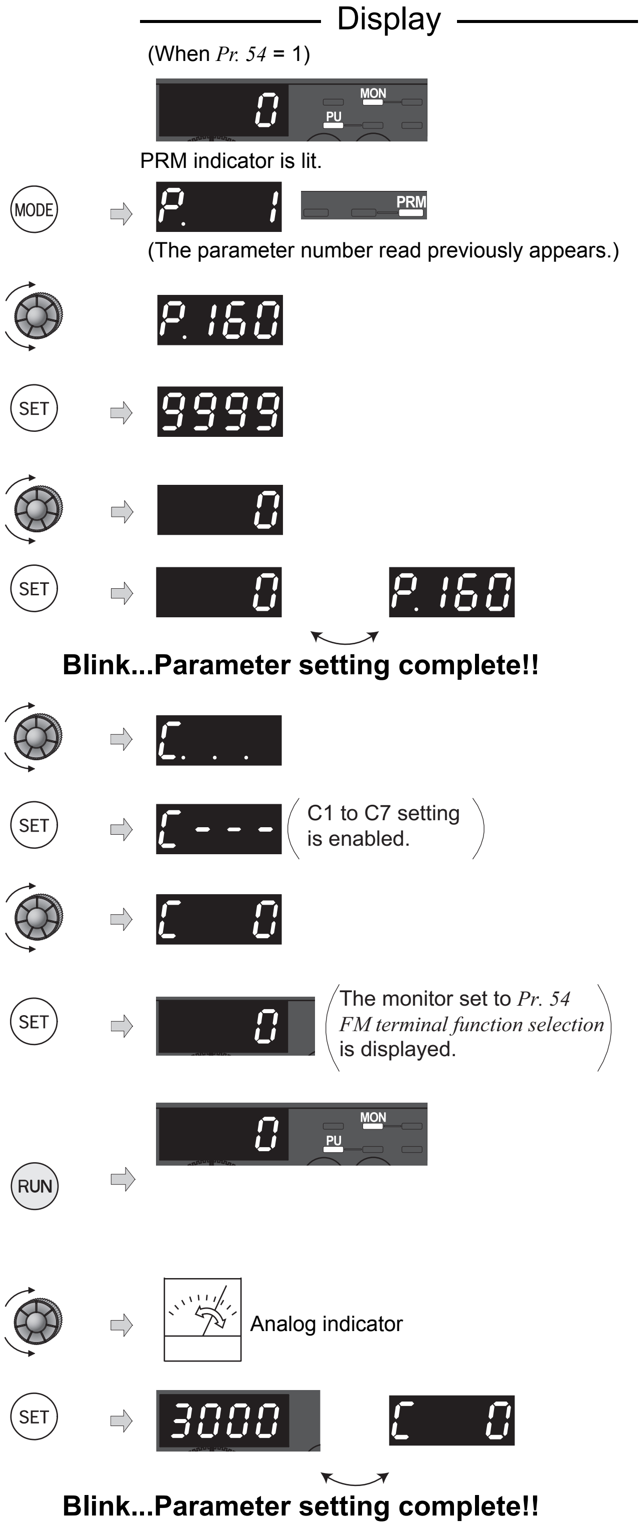
Pr. 54 FM terminal function selection ☞ *Refer to page 134.*
Pr. 55 Speed monitoring reference ☞ *Refer to page 139.*
Pr. 56 Current monitoring reference ☞ *Refer to page 139.*

4.12.5 How to calibrate the terminal FM when using the operation panel

Follow the following procedure to calibrate terminal FM using the operation panel.
Refer to *page 140* for the details of parameters.

Operation

1. Confirm the operation status indicator and operation mode indicator
2. Press MODE to choose the parameter setting mode.
3. Turn until "P. 160" appears.
4. Press SET to read the present set value. "9999" (initial value) appears.
5. Turn to change it to the setting value of "0".
6. Press SET to set.
7. Turn until "C. . ." appears.
8. Press SET to display "C - - -".
9. Turn until "C 0" appears. Set to *C0 FM terminal calibration.*
10. Press SET to enable setting.
11. If the drive unit is at a stop, press the RUN key to start the drive unit. When a monitor that does not require the drive unit operation is set in *Pr. 54*, calibration is also possible during a stop status.
12. Turn to adjust the indicator needle to the desired position.
13. Press SET. Setting is complete.



•Turn to read another parameter.
•Press SET to return to the "C - - -" indication (step 4).
•Press SET twice to show the next parameter ("Pr.CL").

4 PARAMETERS

REMARKS

- Calibration can also be made for External operation. Set the speed in the External operation mode, and make calibration in the above procedure.
- Calibration can be made even during operation.
- For operation from the parameter unit (FR-PU07), *refer to the Instruction Manual* of the parameter unit.

Parameters referred to

Pr. 54 FM terminal function selection ☞ *Refer to page 134.*
Pr. 55 Speed monitoring reference ☞ *Refer to page 139.*
Pr. 56 Current monitoring reference ☞ *Refer to page 139.*
C0 (Pr. 900) FM terminal calibration ☞ *Refer to page 140.*

4.13 Operation setting at fault occurrence

Purpose	Parameter that should be Set		Refer to Page
Recover by retry operation at fault occurrence	Retry operation	Pr. 65, Pr. 67 to Pr. 69	*143*
Do not output input/output phase failure alarm	Input/output phase failure protection selection	Pr. 251, Pr. 872	*145*
Detect an earth (ground) fault at start	Earth (ground) fault detection at start	Pr. 249	*145*

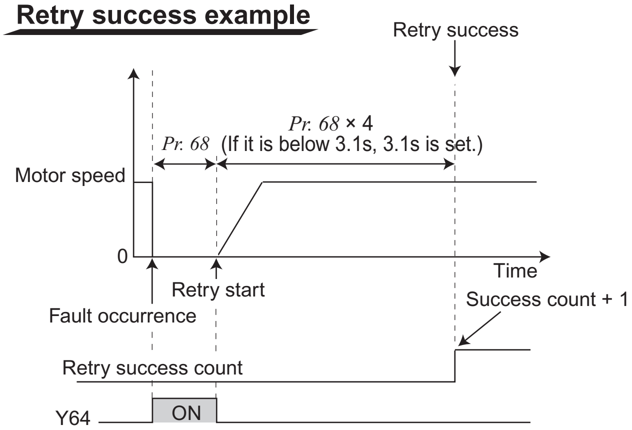
4.13.1 Retry function (Pr. 65, Pr. 67 to Pr. 69)

If a fault occurs, the drive unit resets itself automatically to restart. You can also select the fault for a retry.

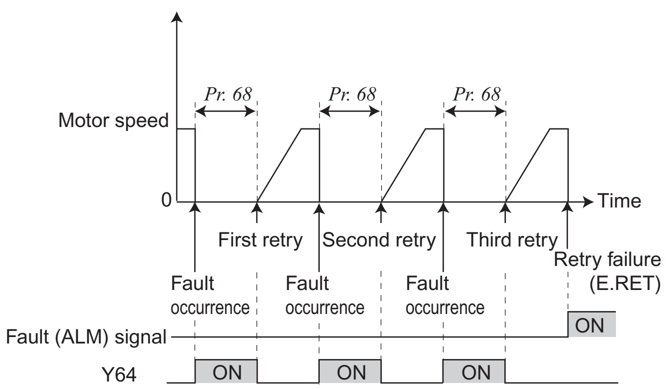
Parameter Number	Name	Initial Value	Setting Range	Description
65	**Retry selection**	0	0 to 5	A fault for retry can be selected. *(Refer to the next page.)*
67	**Number of retries at fault occurrence**	0	0	No retry function
			1 to 10	Set the number of retries at fault occurrence. A fault output is not provided during retry operation.
			101 to 110	Set the number of retries at fault occurrence. (The setting value of minus 100 is the number of retries.) A fault output is provided during retry operation.
68	**Retry waiting time**	1s	0.1 to 600s	Set the waiting time from when an drive unit fault occurs until a retry is made.
69	**Retry count display erase**	0	0	Clear the number of restarts succeeded by retry.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

Retry success example



Retry failure example



- Retry operation automatically resets a fault and restarts the drive unit at the starting speed when the time set in *Pr. 68* elapses after the drive unit is tripped.
- Retry operation is performed by setting *Pr. 67* to any value other than "0". Set the number of retries at fault occurrence in *Pr. 67*.
- When retries fail consecutively equal to or more than the number of times set in *Pr. 67*, a retry count excess fault (E.RET) occurs, resulting in trip of the drive unit. (Refer to retry failure example.)
- Use *Pr. 68* to set the waiting time from when the drive unit trips until a retry is made in the range of 0.1 to 600s.
- Reading the *Pr. 69* value provides the cumulative number of successful restart times made by retry.
  The cumulative count in *Pr. 69* is increased by 1 when a retry is regarded as successful after normal operation continues without faults occurring for more than four times longer than the time (3.1s at shortest) set in *Pr. 68* after a retry start.
  (When retry is successful, cumulative number of retry failure is cleared.)
- Writing "0" to *Pr. 69* clears the cumulative count.
- During a retry, the Y64 signal is ON. For the Y64 signal, assign the function by setting "64 (positive logic)" or "164 (negative logic)" to *Pr. 190* or *Pr. 192 (output terminal function selection)*.

- Using *Pr. 65*, you can select the fault that will cause a retry to be executed. No retry will be made for the fault not indicated. (*Refer to page 254* for the fault description.)
  ● indicates the faults selected for retry.

Fault for Retry	*Pr. 65* Setting					
	0	1	2	3	4	5
E.OC1	●	●		●	●	●
E.OC2	●	●		●	●	
E.OC3	●	●		●	●	●
E.OV1	●		●	●	●	
E.OV2	●		●	●	●	
E.OV3	●		●	●	●	
E.THM	●					
E.THT	●					
E. BE	●				●	
E. GF	●				●	

Fault for Retry	*Pr. 65* Setting					
	0	1	2	3	4	5
E.OHT	●					
E.OS	●				●	
E.PTC	●					
E.OLT	●				●	
E. PE	●				●	
E.ILF	●				●	
E.CDO	●				●	
E.SOT	●	●		●	●	●
E.PID	●				●	

NOTE

- **Use the retry function only when the operation can be resumed after resetting a protective function activation. Making a retry against the protective function, which is activated by an unknown condition, will lead the drive unit and motor to be faulty. Identify in what condition the protective function was activated, and eliminate such condition before resuming the operation.**
- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **The data stored as the error reset for retry is only that of the fault which occurred the first time.**
- **When an drive unit fault is reset by the retry function at the retry time, the accumulated data of the electronic thermal relay function, regeneration brake duty etc. are not cleared. (Different from the power-ON reset.)**
- **Retry is not performed if E.PE (Parameter storage device fault) occurred at power ON.**
- **If a fault that is not selected for a retry occurs during retry operation (retry waiting time), the retry operation stops while the fault indication is still displayed.**
- **The retry function is invalid for the fault initiated by the fault initiation function.**

⚠ CAUTION

⚠ **When you have selected the retry function, stay away from the motor and machine in the case of the drive unit is tripped. The motor and machine will start suddenly (after the reset time has elapsed) after the drive unit trip. When you have selected the retry function, apply in easily visible places the CAUTION stickers supplied by the Instruction Manual (Basic).**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 123.*

4.13.2 Input/output phase loss protection selection (Pr. 251, Pr. 872)

You can choose whether to make Input/output phase loss protection valid or invalid.
- Output phase loss protection is a function to stop the drive unit output if one of the three phases (U, V, W) on the drive unit's output side is lost.
- Input phase loss protection is a function to stop the drive unit output if one of the three phases (R/L1, S/L2, T/L3) on the drive unit's input side is lost.

Parameter Number	Name	Initial Value	Setting Range	Description
251	**Output phase loss protection selection**	1	0	Without output phase loss protection
			1	With output phase loss protection
872	**Input phase loss protection selection**	0	0	Without input phase loss protection
			1	With input phase loss protection

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Output phase loss protection selection *(Pr. 251)*

- If a phase loss occurs at motor start-up or during drive unit operation (except for during DC injection brake operation, or 30r/min or less rotation speed operation), output phase loss protection (E.LF) activates, and the drive unit trips.
- When *Pr. 251* is set to "0", output phase loss protection (E.LF) becomes invalid.

(2) Input phase loss protection selection *(Pr. 872)*

- When *Pr. 872* is set to "1", input phase loss protection (E.ILF) is provided if a phase loss of one phase among the three phases is detected for 1s continuously.

NOTE
- **If an input phase loss under high load continues for a long time, the converter section and capacitor lives of the drive unit will be shorter.**
- **If the load is light or during a stop, lost phase cannot be detected because input phase loss detection is performed based on the fluctuation of bus voltage.**
  During the S-PM geared motor driving operation, lost phase cannot be detected because the drive unit has a one-rank higher capacity compared to the motor, and the load is light for the drive unit capacity. When the load exceeds the rated output, however, phase loss detection may be performed.
- **Phase loss cannot be detected during regeneration load operation.**

4.13.3 Earth (ground) fault detection at start (Pr. 249)

You can choose whether to make earth (ground) fault detection at start valid or invalid. Earth (Ground) fault detection is executed only right after the start signal is input to the drive unit.
Protective function will not activate if an earth (ground) fault occurs during operation.

Parameter Number	Name	Initial Value	Setting Range	Description
249	**Earth (ground) fault detection at start**	0	0	Without earth (ground) fault detection
			1	With earth (ground) fault detection

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

NOTE
- As detection is executed at start, output is delayed for approx. 20ms every start.
- If an earth (ground) fault is detected with "1" set in *Pr. 249*, output side earth (ground) fault overcurrent (E.GF) is detected and the drive unit trips. *(Refer to page 260.)* Even when a ground fault occurs, however, an overcurrent (E.OC3) may be detected first to result in the output shutoff.

4.13.4 Overspeed protection (Pr. 374)

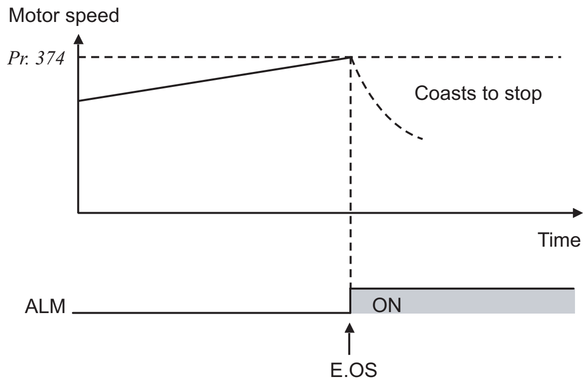
The drive unit outputs can be shut off in case of overspeed.

Parameter Number	Name	Initial Value	Setting Range	Description
374	**Overspeed detection level**	3450r/min	0 to 12000r/min / 0 to 8000r/min *1*2	If the motor speed exceeds the speed set in *Pr. 374*, overspeed (E.OS) occurs, and the drive unit outputs are stopped.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0." *(Refer to page 161.)*

*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

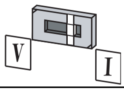
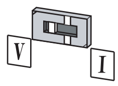


4.14 Speed setting by analog input (terminal 2, 4)

Purpose	Parameter that should be Set		Refer to Page
Selection of voltage/current input (terminal 2, 4) **Perform forward/reverse rotation by analog input.**	**Analog input selection**	**Pr. 73, Pr. 267**	*147*
Noise elimination at the analog input	**Input filter**	**Pr. 74**	*151*
Adjustment (calibration) of analog input speed and voltage (current)	**Bias and gain of speed setting voltage (current)**	**Pr. 125, Pr. 126, Pr. 241, C2 to C7 (Pr. 902 to Pr. 905)**	*152*

4.14.1 Analog input selection (Pr. 73, Pr. 267)

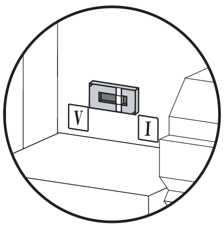
You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal specifications and input signal.

Parameter Number	Name	Initial Value	Setting Range	Description	
73	**Analog input selection**	1	0	Terminal 2 input 0 to 10V	Without reversible operation
			1	Terminal 2 input 0 to 5V	
			10	Terminal 2 input 0 to 10V	With reversible operation
			11	Terminal 2 input 0 to 5V	
267	**Terminal 4 input selection**	0		**Voltage/current input switch**	**Description**
			0		Terminal 4 input 4 to 20mA
			1		Terminal 4 input 1 to 5V
			2		Terminal 4 input 2 to 10V

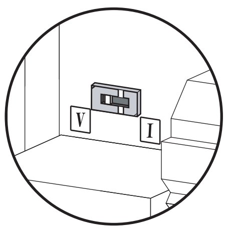
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Selection of analog input specifications

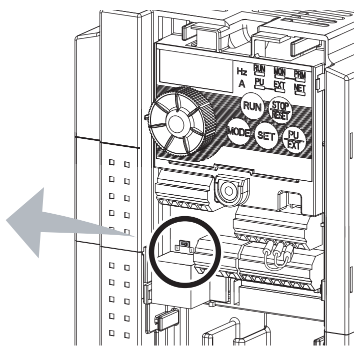
- For the terminal 2 for analog voltage input, 0 to 5V (initial value) or 0 to 10V can be selected.
- Either voltage input (0 to 5V, 0 to 10V) or current input (4 to 20mA initial value) can be selected for terminal 4 used for analog input.
  Change the input specifications to change *Pr. 267* and voltage/current input switch.
- Rated specifications of terminal 4 change according to the voltage/current input switch setting.
  Voltage input: Input resistance 10kΩ ± 1kΩ,
  Maximum permissible input voltage 20VDC
  Current input: Input resistance 249Ω ± 5Ω,
  Maximum permissible input voltage 30mA



Current input (initial setting)



Voltage input



NOTE

- **Set *Pr. 267* and a voltage/current input switch correctly, then input an analog signal in accordance with the setting. Incorrect setting as in the table below could cause component damage. Incorrect settings other than below can cause abnormal operation.**

Setting Causing Component Damage		Operation
Switch setting	Terminal input	
I (current input)	Voltage input	This could cause component damage to the analog signal output circuit of signal output devices. (electrical load in the analog signal output circuit of signal output devices increases)
V (voltage input)	Current input	This could cause component damage of the drive unit signal input circuit. (output power in the analog signal output circuit of signal output devices increases)

•Refer to the following table and set *Pr. 73* and *Pr. 267*.

(indicates main speed setting)

Terminal 4 Input		*Pr. 73* Setting	Terminal 2 Input	Reversible Operation
AU signal				
OFF	—	0	0 to 10V	Not function
		1 (initial value)	0 to 5V	
		10	0 to 10V	Yes
		11	0 to 5V	
ON	According to the *Pr. 267* setting	0	—	Not function
	0: 4 to 20mA (initial value)	1 (initial value)		
	1: 1 to 5V	10	—	Yes
	2: 2 to 10V	11		

- : invalid

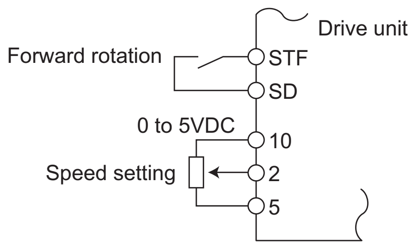
* If the input specification to terminal 4 is changed from the current input (*Pr. 267* = "0") to the 0 to 5V or 0 to 10V voltage input (*Pr. 267* = "1 or 2"), calibrate the input with C6. (*Refer to page 152.*)

REMARKS

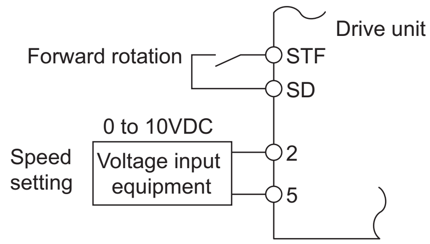
- Turn ON the AU signal to make the terminal 4 function valid. The AU signal is assigned to the terminal AU in the initial setting. By setting "4" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*, the AU signal can be assigned to other terminals.
- Use *Pr. 125 (Pr. 126) (speed setting gain)* to change the maximum rotation speed at input of the maximum rotation speed command voltage (current). At this time, the command voltage (current) need not be input.
  Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference speed, is not affected by the change in *Pr. 73* setting.
- The terminal 2 does not accept analog output speed commands when *Pr. 561 PTC thermistor protection level* ≠ "9999."

NOTE

- **Make sure that the parameter and switch settings are the same. Different setting may cause a fault, failure or malfunction.**
- **Always calibrate the input after changing the voltage/input input signal with *Pr. 267* and the voltage/current input selection switch.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**



Connection diagram using terminal 2 (0 to 5VDC)



Connection diagram using terminal 2 (0 to 10VDC)

(2) Perform operation by analog input selection

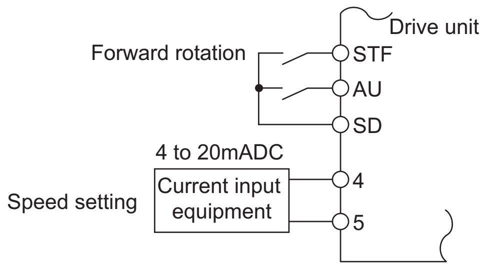
- The speed setting signal inputs 0 to 5VDC (or 0 to 10VDC) across the terminals 2 and 5. The 5V (10V) input is the maximum output.
- The power supply 5V can be input by either using the internal power supply or preparing an external power supply. Prepare an external power supply to input the power supply 10V. For the built-in power supply, terminals 10 and 5 provide 5VDC output.

Terminal	Drive unit Built-in Power Supply Voltage	Speed Setting Resolution	*Pr. 73* (terminal 2 input power)
10	5VDC	6r/min / 3000r/min	0 to 5VDC input

- When inputting 10VDC to the terminal 2, set "0" or "10" in *Pr. 73*. (The initial value is 0 to 5V)
- Setting "1 (0 to 5VDC)" or "2 (0 to 10VDC)" in *Pr. 267* and a voltage/ current input switch in the "V" position changes the terminal 4 to the voltage input specification. When the AU signal turns ON, the terminal 4 input becomes valid.

REMARKS

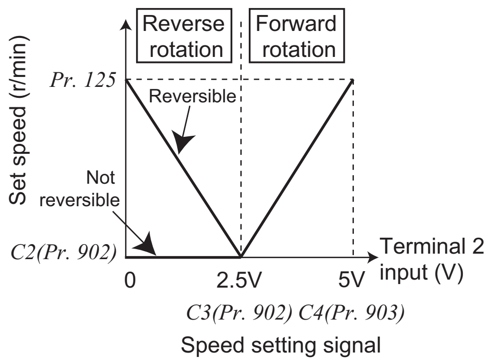
The wiring length of the terminal 10, 2, 5 should be 30m at maximum.



Connection diagram using terminal 4 (4 to 20mADC)

(3) Perform operation by analog input selection

- When the pressure or temperature is controlled constantly by a fan, pump, etc., automatic operation can be performed by inputting the output signal 4 to 20mADC of the adjuster across the terminals 4 and 5.
- The AU signal must be turned ON to use the terminal 4.



Reversible operation example

(4) Perform forward/reverse rotation by analog input (polarity reversible operation)

- Setting "10" or "11" in *Pr. 73* and adjusting *Pr. 125 (Pr. 126) Terminal 2 speed setting gain speed* (*Terminal 4 speed setting gain speed*) and *C2 (Pr. 902) Terminal 2 speed setting bias speed* to *C7 (Pr. 905) Terminal 4 speed setting gain* makes reverse operation by terminal 2 (terminal 4) valid.

Example)When performing reversible operation by terminal 2 (0 to 5V) input

1) Set "11" in *Pr. 73* to make reversible operation valid.
   Set speed at maximum analog input in *Pr. 125 (Pr. 903)*
2) Set 1/2 of the value set in *C4 (Pr. 903)* in *C3 (Pr. 902)*.
3) Reversible operation is performed when 0 to 2.5VDC is input and forward rotation when 2.5 to 5VDC.

NOTE

- **When reversible operation is set, be aware of reverse rotation operation when analog input stops (only the start signal is input).**
- **When reversible operation is valid, reversible operation (0 to 4mA: reverse operation, 4mA to 20mA: forward operation) is performed by terminal 4 in the initial setting.**

Parameters referred to

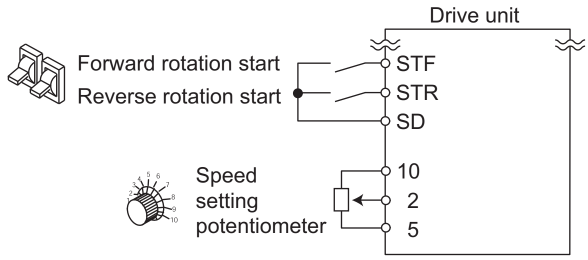
Pr. 125 Terminal 2 speed setting gain speed, Pr. 126 Terminal 4 speed setting gain speed Refer to page 152.
Pr. 561 PTC thermistor protection level Refer to page 101.
C2 (Pr. 902) Terminal 2 speed setting bias speed to C7 (Pr. 905) Terminal 4 speed setting gain Refer to page 152.
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 117.

4.14.2 Setting the speed by analog input (voltage input / current input)

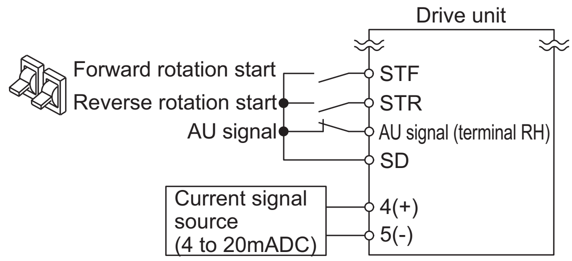
POINT

- Switch ON the STF (STR) signal to give a start command.
- Use the potentiometer (speed setter) (voltage input) or 4 to 20mA input (current input) to set a speed.

[Connection diagram voltage input]
(The dirve unit supplies 5V power to the speed setting potentiometer. (terminal 10))



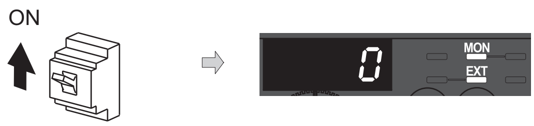
[Connection diagram current input]
Assign the AU signal in any of *Pr. 178 to Pr. 182*.



Operation example | Operate at 3000r/min.

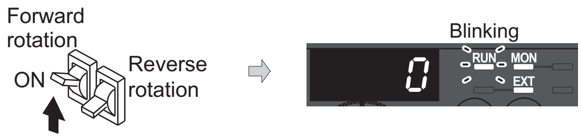
Operation — **Display**

1. Screen at power-ON
   The monitor display appears.



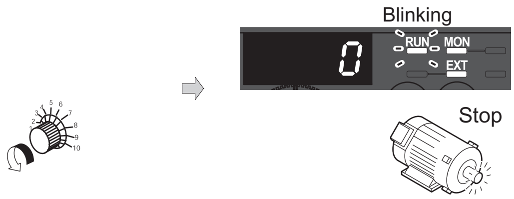
2. Assignment of the AU signal (current input)
   (Refer to the step 3 for voltage input.)
   Set *Pr. 160* to "0" to activate extended parameters.
   To assign the AU signal, set "4" in one of *Pr. 178 to Pr. 182*. (*Refer to page 53* to change the setting.)
   Turn ON the AU signal.

3. Start
   Turn ON the start switch (STF or STR).
   [RUN] indicator blinks fast because the speed command is not given.



4. Acceleration → constant speed
   For voltage input, turn the potentiometer (speed setting potentiometer) clockwise slowly to full.
   For current input, input 20mA.
   The speed value on the display increases in *Pr. 7 Acceleration time*, and "3000" (3000r/min) appears.
   [RUN] indicator is lit during forward rotation operation and blinks slowly during reverse rotation operation.

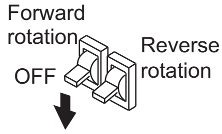
5. Deceleration
   For voltage input, turn the potentiometer (speed setting potentiometer) counterclockwise slowly to full.
   For current input, input 4mA.
   The speed value on the display decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0" (0r/min) displayed.
   [RUN] blinks fast.

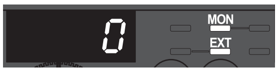


Operation — Display

6. Stop

Turn OFF the start switch (STF or STR).
[RUN] indicator turns OFF.





REMARKS

Pr. 178 STF terminal function selection must be set to "60" (or *Pr. 179 STR terminal function selection* must be set to "61"). (All are initial values.)

? The motor will not rotate ... Why?

☞ Check that [EXT] is lit.
[EXT] is valid when *Pr. 79* = "0" (initial value) or "2."

Use (PU/EXT) to lit [EXT].

☞ Check that wiring is correct. Check once again.

? Change the speed (0r/min) of the minimum value of potentiometer (at 0V initial value)

☞ Adjust the speed in *calibration parameter C2 Terminal 2 speed setting bias speed.* *(Refer to page 152.)*

4.14.3 Response level of analog input and noise elimination (Pr. 74)

The time constant of the primary delay filter can be set for the external speed command (analog input (terminal 2, 4) signal).

Parameter Number	Name	Initial Value	Setting Range	Description
74	**Input filter time constant**	1	0 to 8	Primary delay filter time constant for the analog input. A larger setting results in a larger filter.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

- Valid for eliminating noise of the speed setting circuit.
- Increase the filter time constant if steady operation cannot be performed due to noise.
  A larger setting results in slower response. (The time constant can be set between approximately 5ms to 1s with the setting of 0 to 8.)

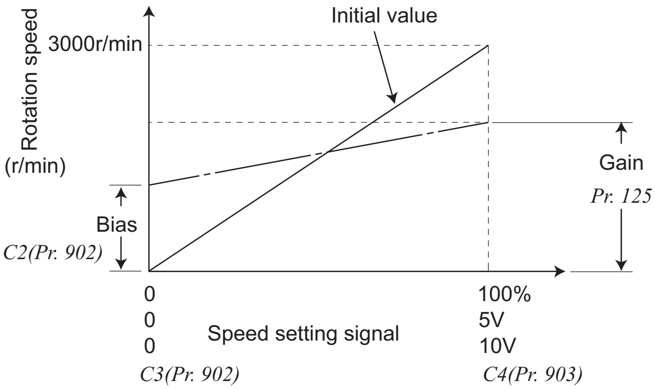
4.14.4 Bias and gain of speed setting voltage (current) (Pr. 125, Pr. 126, Pr. 241, C2 (Pr. 902) to C7 (Pr. 905))

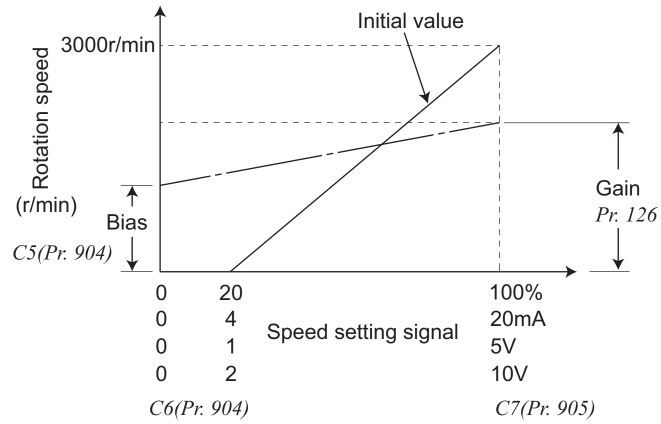
You can set the magnitude (slope) of the rotation speed as desired in relation to the speed setting signal (0 to 5VDC, 0 to 10VDC or 4 to 20mADC).
Set *Pr. 267* and voltage/current input switch to switch among 0 to 5VDC, 0 to 10VDC, and 0 to 20mADC input using terminal 4. *(Refer to page 147.)*

[Speed setting bias/gain parameter]

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th></tr>
<tr><td>125</td><td>Terminal 2 speed setting gain speed</td><td>3000r/min</td><td>0 to 12000r/min / 0 to 8000r/min *4, *5</td><td colspan="2">Speed of terminal 2 input gain (maximum).</td></tr>
<tr><td>126</td><td>Terminal 4 speed setting gain speed</td><td>3000r/min</td><td>0 to 12000r/min / 0 to 8000r/min *4, *5</td><td colspan="2">Speed of terminal 4 input gain (maximum).</td></tr>
<tr><td rowspan="2">241 *1, *3</td><td rowspan="2">Analog input display unit switchover</td><td rowspan="2">0</td><td>0</td><td>Displayed in %</td><td rowspan="2">Unit for analog input display.</td></tr>
<tr><td>1</td><td>Displayed in V/mA</td></tr>
<tr><td>C2 (902) *1, *2</td><td>Terminal 2 speed setting bias speed</td><td>0r/min</td><td>0 to 12000r/min / 0 to 8000r/min *4, *5</td><td colspan="2">Speed on the bias side of terminal 2 input.</td></tr>
<tr><td>C3 (902) *1, *2</td><td>Terminal 2 speed setting bias</td><td>0%</td><td>0 to 300%</td><td colspan="2">Converted % of the bias side voltage of terminal 2 input.</td></tr>
<tr><td>C4 (903) *1, *2</td><td>Terminal 2 speed setting gain</td><td>100%</td><td>0 to 300%</td><td colspan="2">Converted % of the gain side voltage of terminal 2 input.</td></tr>
<tr><td>C5 (904) *1, *2</td><td>Terminal 4 speed setting bias speed</td><td>0r/min</td><td>0 to 12000r/min / 0 to 8000r/min *4, *5</td><td colspan="2">Speed on the bias side of terminal 4 input.</td></tr>
<tr><td>C6 (904) *1, *2</td><td>Terminal 4 speed setting bias</td><td>20%</td><td>0 to 300%</td><td colspan="2">Converted % of the bias side current (voltage) of terminal 4 input.</td></tr>
<tr><td>C7 (905) *1, *2</td><td>Terminal 4 speed setting gain</td><td>100%</td><td>0 to 300%</td><td colspan="2">Converted % of the gain side current (voltage) of terminal 4 input.</td></tr>
</table>

*1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
*2 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07).
*3 This parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
*4 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.
*5 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.





(1) Change the speed at maximum analog input *(Pr. 125, Pr. 126)*

•Set *Pr. 125 (Pr. 126)* when changing speed setting (gain) of the maximum analog input voltage (current) only. (*C2 (Pr. 902)* to *C7 (Pr. 905)* setting need not be changed)

(2) Analog input bias/gain calibration *(C2 (Pr. 902) to C7 (Pr. 905))*

•The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the drive unit to set the rotation speed, e.g. 0 to 5VDC, 0 to 10VDC or 4 to 20mADC, and the rotation speed.

•Set the bias speed of the terminal 2 input using *C2 (Pr. 902)*.
(It is initially set to the speed at 0V)

•Set the rotation speed in *Pr. 125* for the speed command voltage set with *Pr. 73 Analog input selection*.

•Set the bias speed of the terminal 4 input using *C5 (Pr. 904)*.
(It is initially set to the speed at 4mA)

•Using *Pr. 126*, set the rotation speed relative to 20mA of the speed command current (4 to 20mA).

•There are three methods to adjust the speed setting voltage (current) bias/gain.

a) Method to adjust any point by application of a voltage (current) across terminals 2 and 5 (4 and 5) ☞ *page 155*

b) Method to adjust any point without application of a voltage (current) across terminals 2 and 5 (4 and 5) ☞ *page 155*

c) Method to adjust speed only without adjustment of voltage (current) ☞ *page 156*

NOTE

- **When voltage/current input signal for terminal 4 was switched using *Pr. 267* and voltage/current input switch, perform calibration without fail.**

(3) Analog input display unit changing *(Pr. 241)*

- You can change the analog input display unit (%/V/mA) for analog input bias/gain calibration.
- Depending on the terminal input specification set to *Pr. 73*, *Pr. 267*, and voltage/current switch, the display units of *C3 (Pr. 902), C4 (Pr. 903), C6 (Pr. 904), C7 (Pr. 905)* change as shown below.

Analog Command (terminal 2, 4) (depending on *Pr. 73*, *Pr. 267*, and voltage/current input switch)	*Pr. 241* = 0 (initial value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → 0 to 100% (0.1%) display	0 to 100% → 0 to 5V (0.01V) display
0 to 10V input	0 to 10V → 0 to 100% (0.1%) display	0 to 100% → 0 to 10V (0.01V) display
0 to 20mA input	0 to 20mA → 0 to 100%(0.1%) display	0 to 100% → 0 to 20mA (0.01mA) display

Parameters referred to

Pr. 73 Analog input selection, Pr. 267 Terminal 4 input selection ☞ *Refer to page 147.*

4.14.5 Speed setting signal (current) bias/gain adjustment method

Follow the following procedure to adjust the bias and gain of the speed setting voltage (current) using the operation panel. *Refer to page 152* for the details of parameters.

(a)Method to adjust any point by application of voltage (current) across the terminals 2 and 5 (4 and 5).

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The drive unit should be at a stop. ● The drive unit should be in the PU operation mode. (Using PU/EXT)	0 MON PU
2. Press MODE to choose the parameter setting mode.	MODE ⇨ P. 1 PRM PRM indicator is lit. (The parameter number read previously appears.)
3. Turn ⊛ until "C. . ." appears.	⇨ C. . .
4. Press SET to display "C - - -".	SET ⇨ C - - - (C0 to C7 settings are enabled.)
5. Turn ⊛ until "C 4" ("C 7") appears. Set to *C4 Terminal 2 speed setting gain.*	⇨ C 4 Terminal 2 input is selected; C 7 Terminal 4 input is selected
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 Analog voltage (current) value (%) across terminals 2 and 5 (across terminals 4 and 5)
7. Apply a 5V (20mA) voltage (current). (Turn the external potentiometer connected across terminals 2 and 5 (across terminals 4 and 5) to maximum (any position).)	⇨ 100 * * The value is nearly 100 (%) in the maximum position of the potentiometer.

NOTE

After performing operation in step 6, do not touch ⊛ until completion of calibration.

Operation	Display
8. Press SET to set.	SET ⇨ 100* ⇄ C 4 (Terminal 2 input is selected) / C 7 (Terminal 4 input is selected) **Blink...Parameter setting complete!!** * The value is nearly 100 (%) in the maximum position of the potentiometer.

•Turn ⊛ to read another parameter.

•Press SET to return to the "C - - -" indication (step 4).

•Press SET twice to show the next parameter ("Pr.CL").

REMARKS

- If the speed meter (display meter) connected across the terminals FM does not indicate exactly 3000r/min, set the *calibration parameter C0 FM terminal calibration*. *(Refer to page 140.)*
- If the gain and bias of speed setting voltage (current) are too close, an error ("Er3") may be displayed at setting.

(b) Method to adjust any point without application of a voltage (current) across terminals 2 and 5 (4 and 5)
(To change from 4V (80%) to 5V (100%))

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The drive unit should be at a stop. ● The drive unit should be in the PU operation mode. (Use PU/EXT)	0 (MON, PU)
2. Press MODE to choose the parameter setting mode.	MODE ⇨ P. 1 (PRM) PRM indicator is lit. (The parameter number read previously appears.)
3. Turn [dial] until "C. . ." appears.	⇨ C. . .
4. Press SET to display "C - - -".	SET ⇨ C - - - C0 to C7 settings are enabled.
5. Turn [dial] until "C 4" ("C 7") appears. Set to *C4 Terminal 2 speed setting gain*.	⇨ C 4 — Terminal 2 input is selected C 7 — Terminal 4 input is selected
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 Analog voltage (current) value (%) across terminals 2 and 5 (across terminals 4 and 5)
7. Turn [dial] to set gain voltage (%). "0V(0mA) is 0%, 10V(5V, 20mA) is 100%"	⇨ 100 The gain speed is reached when the analog voltage (current) value across terminals 2 and 5 (across terminals 4 and 5) is 100%.

REMARKS

The current setting at the instant of turning [dial] is displayed.
You cannot check after performing operation in step 7.

80

8. Press SET to set.	SET ⇨ 100 ⇄ C 4 (Terminal 2 input is selected) / C 7 (Terminal 4 input is selected)

Blink...Parameter setting complete!!
(Adjustment completed)

- •Turn [dial] to read another parameter.
- •Press SET to return to the "C - - -" indication (step 4).
- •Press SET twice to show the next parameter ("Pr.CL").

REMARKS

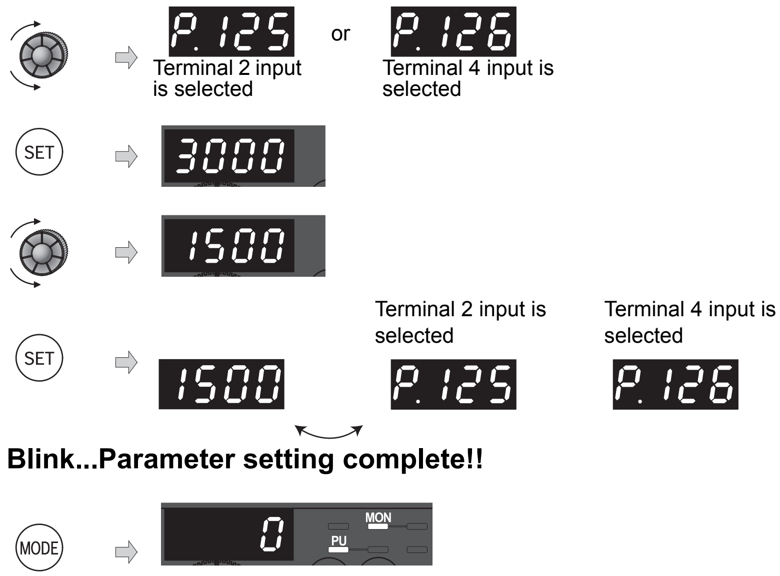
By pressing [dial] after step 6, you can confirm the current speed setting bias/gain setting.
You cannot check after performing operation in step 7.

(c) Adjusting only the speed without adjusting the gain voltage (current).
(When changing the gain speed from 3000r/min to 1500r/min)

Operation

1. Turn the dial until "P.125" *(Pr. 125)* or "P.126" *(Pr. 126)* appears
2. Press SET to show the present set value. (3000r/min)
3. Turn the dial to change the set value to "1500". (1500r/min)
4. Press SET to set.
5. Mode/monitor check
   Press MODE twice to choose the monitor/speed monitor.
6. Apply a voltage across the drive unit terminals 2 and 5 (across 4 and 5) and turn ON the start command (STF, STR).
   Operation starts at 1500r/min.

Display



REMARKS

- Changing *C4 (Pr. 903)* or *C7 (Pr. 905)* (gain adjustment) value will not change the *Pr. 20 Acceleration/deceleration reference speed* setting.
- For operation from the parameter unit (FR-PU07), refer to the Instruction Manual of the FR-PU07.
- Make the bias speed setting using the *calibration parameter C2 (Pr. 902) or C5 (Pr. 904)*. *(Refer to page 153.)*

⚠ CAUTION

⚠ **Be cautious when setting any value other than "0" as the bias speed at 0V (0mA). Even if a speed command is not given, merely turning ON the start signal will start the motor at the preset speed.**

Parameters referred to

Pr. 20 Acceleration/deceleration reference speed ☞ *Refer to page 97.*
Pr. 125 Terminal 2 speed setting gain speed ☞ *Refer to page 152.*
Pr. 126 Terminal 4 speed setting gain speed ☞ *Refer to page 152.*
Pr. 241 Analog input display unit switchover ☞ *Refer to page 152.*
C0 (Pr. 900) FM terminal calibration ☞ *Refer to page 140.*
C2 (Pr. 902) Terminal 2 speed setting bias speed ☞ *Refer to page 152.*
C3 (Pr. 902) Terminal 2 speed setting bias ☞ *Refer to page 152.*
C4 (Pr. 903) Terminal 2 speed setting gain ☞ *Refer to page 152.*
C5 (Pr. 904) Terminal 4 speed setting bias speed ☞ *Refer to page 152.*
C6 (Pr. 904) Terminal 4 speed setting bias ☞ *Refer to page 152.*
C7 (Pr. 905) Terminal 4 speed setting gain ☞ *Refer to page 152.*

4.15 Misoperation prevention and parameter setting restriction

Purpose	Parameter that should be Set		Refer to Page
Limits reset function **Trips when PU is disconnected** **Stops from PU**	**Reset selection/disconnected PU detection/PU stop selection**	**Pr. 75**	*157*
Prevention of parameter rewrite	**Parameter write disable selection**	**Pr. 77**	*160*
Prevention of reverse rotation of the motor	**Reverse rotation prevention selection**	**Pr. 78**	*161*
Displays necessary parameters	**Display of applied parameters**	**Pr. 160**	*161*
Parameter restriction with using password	**Password function**	**Pr. 296, Pr. 297**	*162*
Control of parameter write by communication	**EEPROM write selection**	**Pr. 342**	*190*

4.15.1 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)

You can select the reset input acceptance, disconnected PU (FR-PU07) connector detection function and PU stop function.

Parameter Number	Name	Initial Value	Setting Range	Description
75	**Reset selection/ disconnected PU detection/ PU stop selection**	14	0 to 3, 14 to 17	For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function.

• The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
• The above parameter allows its setting to be changed during operation in any operation mode even if "0 (initial value) or 1" is set in *Pr. 77 Parameter write selection*. Also, if parameter (all) clear is executed, this setting will not return to the initial value.

Pr. 75 Setting	Reset Selection	Disconnected PU Detection	PU Stop Selection
0	Reset input normally enabled	When the PU is disconnected, operation is continued.	Pressing STOP RESET decelerates the motor to a stop only in the PU operation mode.
1	Reset input is enabled only when the fault occurs.		
2	Reset input normally enabled	When the PU is disconnected, the drive unit trips.	
3	Reset input is enabled only when the fault occurs.		
14 (initial value)	Reset input normally enabled	When the PU is disconnected, operation is continued.	Pressing STOP RESET decelerates the motor to a stop in any of the PU, external and communication operation modes.
15	Reset input is enabled only when the fault occurs.		
16	Reset input normally enabled	When the PU is disconnected, the drive unit trips.	
17	Reset input is enabled only when the fault occurs.		

(1) Reset selection

•You can select the enable condition of reset function (RES signal, reset command through communication) input.
•When *Pr. 75* is set to any of "1, 3, 15, 17", a reset can be input only when the drive unit is tripped.

NOTE

- **When the reset (RES) signal is input during operation, the motor coasts since the drive unit being reset shuts off the output.**
- **When reset is performed, cumulative values of electronic thermal O/L relay, and regenerative brake duty are cleared.**
- **The reset key of the PU is only valid when the drive unit is tripped, independently of the *Pr. 75* setting.**

(2) Disconnected PU detection

•This function detects that the PU (FR-PU07) has been disconnected from the drive unit for longer than 1s and causes the drive unit to provide a fault output (E.PUE) and come to trip.
•When *Pr. 75* is set to any of "0, 1, 14, 15", operation is continued even if the PU is disconnected.

REMARKS

- When the PU has been disconnected since before power-ON, it is not judged as a fault.
- To make a restart, confirm that the PU is connected and then reset the drive unit.
- The motor decelerates to a stop when the PU is disconnected during PU Jog operation with *Pr. 75* set to any of "0, 1, 14, 15" (which selects operation to be continued if the PU is disconnected).
- When RS-485 communication operation is performed through the PU connector, the reset selection/PU stop selection function is valid but the disconnected PU detection function is invalid.

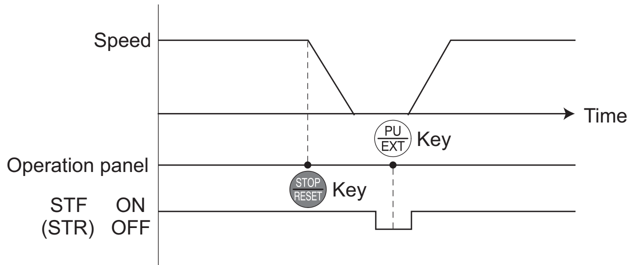
(3) PU stop selection

- In any of the PU operation, External operation and Network operation modes, the motor can be stopped by pressing STOP key of the operation panel or parameter unit (FR-PU07).
- When the drive unit is stopped by the PU stop function, "PS" (PS) is displayed. A fault output is not provided.
- After the motor is stopped from the PU, it is necessary to perform PU stop (PS) reset to restart. PS reset can be made from the unit from which PU stop is made (operation panel, parameter unit (PU07).
- The motor can be restarted by making PS cancel using a power supply reset or RES signal.
- When *Pr. 75* is set to any of "0 to 3", PU stop (PS display) is invalid, and deceleration to a stop by STOP/RESET is valid only in the PU operation mode.

REMARKS

During operation in the PU operation mode through RS-485 communication from the PU connector, the motor decelerates to stop (PU stop) when entered from the operation panel STOP/RESET.

(4) How to restart the motor stopped by STOP/RESET input from the PU in External operation mode (PU stop (PS) reset method)



Stop/restart example for External operation

a) Operation panel

1)After completion of deceleration to a stop, switch OFF the STF or STR signal.

2)Press PU/EXT to display PU .... ("PS" reset)

3)Press PU/EXT to return to EXT .

4)Switch ON the STF or STR signal.

b) Parameter unit (FR-PU07)

1)After completion of deceleration to a stop, switch OFF the STF or STR signal.

2)Press EXT .... ("PS" reset)

3)Switch ON the STF or STR signal.

- The motor can be restarted by making a reset using a power supply reset or RES signal.

REMARKS

- If *Pr. 250 Stop selection* is set to other than "9999" to select coasting to a stop, the motor will not be coasted to a stop but decelerated to a stop by the PU stop function during External operation.

(5) Restart (PS reset) method when PU stop (PS display) is made during PU operation

•PU stop (PS display) is made when the motor is stopped from the unit where control command source is not selected (operation panel, parameter unit (FR-PU07)) in the PU operation mode.

For example, when *Pr. 551 PU mode operation command source selection* = "9999" (initial value) and a parameter unit is mounted, pressing STOP/RESET on the operation panel during PU operation will make the PU stop (PS display).

When the motor is stopped from the PU while the parameter unit (FR-PU07) is selected as control command source.

1) After the motor has decelerated to a stop, press STOP/RESET of the parameter unit (FR-PU07).

2) Press PU/EXT to display EXT. (" PS " reset)

3) Press PU of the parameter unit (FR-PU07) to select the PU operation mode.

4) Press FWD or REV of the parameter unit (FR-PU07).

REMARKS

• When *Pr. 551* = "9999", the priorities of the PU control source is parameter unit (FR-PU07) > operation panel.

⚠ CAUTION

⚠ **Do not reset the drive unit while the start signal is being input.**
Otherwise, the motor will start instantly after resetting, leading to potentially hazardous conditions.

Parameters referred to

Pr. 250 Stop selection *Refer to page 116.*
Pr. 551 PU mode operation command source selection *Refer to page 177.*

4.15.2 Parameter write disable selection (Pr. 77)

You can select whether write to various parameters can be performed or not. Use this function to prevent parameter values from being rewritten by misoperation.

Parameter Number	Name	Initial Value	Setting Range	Description
77	**Parameter write selection**	0	0	Write is enabled only during stop.
			1	Parameter cannot be written.
			2	Parameter write is enabled in any operation mode regardless of operation status.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
Pr. 77 can always be set independently from the operation mode and operation status.

(1) Write parameters only during stop (setting "0" initial value)

- Parameters can be written only during a stop in the PU operation mode.
- The shaded parameters in the parameter list *(page 54)* can always be written regardless of the operation mode and operating status.

(2) Inhibit parameter write *(setting "1")*

- Parameter write is not enabled. (Read is enabled.)
- Parameter clear and all parameter clear cannot be performed, either.
- The parameters given on the right can be written even if *Pr. 77* = "1".

Parameter Number	Name
22	Stall prevention operation level
75	Reset selection/disconnected PU detection/ PU stop selection
77	Parameter write selection
79	Operation mode selection
160	Extended function display selection
296	Password lock level
297	Password lock/unlock
997	Fault initiation

(3) Write parameters during operation (setting "2")

- Parameters can always be written.
- The following parameters cannot be written when the drive unit is running even if *Pr. 77* = "2". Stop the drive unit when changing their parameter settings.

Parameter Number	Name
40	RUN key rotation direction selection
48	Second stall prevention operation current
71	Applied motor
79	Operation mode selection
80	Motor capacity
81	Number of motor poles
82	Motor excitation current
83	Rated motor voltage
84	Rated motor speed
90, 92, 93	(Motor constant)
96	Auto tuning setting/status
178 to 182	(input terminal function selection)
190, 192	(output terminal function selection)
561	PTC thermistor protection level
643	Voltage compensation amount setting
658	Wiring resistance

Parameter Number	Name
672, 702, 706, 707, 711, 712, 717, 721, 724 to 726, 859	(PM motor tuning)
736	Electromagnetic brake interlock time
785	PM control torque boost
795	DC brake torque boost
800	Control method selection
998	PM parameter initialization
999	Automatic parameter setting

4.15.3 Reverse rotation prevention selection (Pr. 78)

This function can prevent reverse rotation fault resulting from the incorrect input of the start signal.

Parameter Number	Name	Initial Value	Setting Range	Description
78	**Reverse rotation prevention selection**	0	0	Both forward and reverse rotations allowed
			1	Reverse rotation disabled
			2	Forward rotation disabled

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

- Set this parameter when you want to limit the motor rotation to only one direction.
- This parameter is valid for all of the reverse rotation and forward rotation keys of the enclosure surface operation panel and of parameter unit (FR-PU07), the start signals (STF, STR signals) via external terminals, and the forward and reverse rotation commands through communication.

4.15.4 Extended parameter display (Pr. 160)

Parameter which can be read from the operation panel and parameter unit can be restricted.
In the initial setting, only the simple mode parameters are displayed.

Parameter Number	Name	Initial Value	Setting Range	Description
160	**Extended function display selection**	9999	9999	Displays only the simple mode parameters
			0	Displays simple mode + extended parameters

The above parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

(1) Display of simple mode parameters and extended parameters *(Pr. 160)*

- When *Pr. 160* = "9999"(initial value), only the simple mode parameters can be displayed on the operation panel and parameter unit (FR-PU07). (Refer to the parameter list *, page 54*, for the simple mode parameters.)
- When *Pr. 160* = "0", simple mode parameters and extended parameters can be displayed.

REMARKS

- When RS-485 communication is used to read the parameters with *Pr. 551 PU mode operation command source selection* ≠ "2", all parameters can be read regardless of the *Pr. 160* setting.
- *Pr. 15 Jog speed setting*, *Pr. 16 Jog acceleration/deceleration time*, and *Pr. 991 PU contrast adjustment* are displayed as simple mode parameter when the parameter unit (FR-PU07) is fitted.

Parameters referred to

Pr. 15 Jog speed setting ☞ *Refer to page 91.*
Pr. 16 Jog acceleration/deceleration time ☞ *Refer to page 91.*
Pr. 551 PU mode operation command source selection ☞ *Refer to page 177.*
Pr. 991 PU contrast adjustment ☞ *Refer to page 246.*

4.15.5 Password function (Pr. 296, Pr. 297)

Registering a 4-digit password can restrict parameter reading/writing.

Parameter Number	Name	Initial Value	Setting Range	Description
296 ∗1	**Password lock level**	9999	1 to 6, 101 to 106	Select restriction level of parameter reading/writing when a password is registered.
			9999	No password lock
297 ∗2	**Password lock/unlock**	9999	1000 to 9998	Register a 4-digit password
			(0 to 5) ∗3	Displays password unlock error count. (Reading only) (Valid when *Pr. 296* = "101" to "106")
			(9999) ∗3	No password lock (Reading only)

∗1 This parameter can be set when *Pr. 160 Extended function display selection* = "0".

∗2 When *Pr. 296* = "9999" (no password lock), set *Pr. 160* = "0" to enable the setting of this parameter. When *Pr. 296* ≠ "9999" (with password lock), *Pr. 297* is always available for setting regardless of *Pr. 160* setting.

∗3 "0 or 9999" can be set to *Pr. 297* at any time although the setting is invalid (the displayed value does not change).

(1) Parameter reading/writing restriction level (*Pr. 296*)

•Level of reading/writing restriction by PU/NET mode operation command can be selected by *Pr. 296*.

Pr. 296 Setting	PU Mode Operation Command ∗3		NET Mode Operation Command ∗4	
	Read ∗1	Write ∗2	Read ∗1	Write ∗2
9999	○	○	○	○
1, 101	○	×	○	×
2, 102	○	×	○	○
3, 103	○	○	○	×
4, 104	×	×	×	×
5, 105	×	×	○	○
6, 106	○	○	×	×

○: enabled, ×: restricted

∗1 If the parameter reading is restricted by the *Pr. 160* setting, those parameters are unavailable for reading even when "○" is indicated.

∗2 If the parameter writing is restricted by the *Pr. 77* setting, those parameters are unavailable for writing even when "○" is indicated.

∗3 Parameter access from unit where parameter is written in PU operation mode (initially set to operation panel, parameter unit) is restricted. (*Refer to page 177* for PU mode operation command source selection.)

∗4 Parameter access in NET operation mode with RS-485 communication is restricted.

(2) Password lock/unlock (*Pr. 296, Pr. 297*)

<Lock>

1) Set parameter reading/writing restriction level.(*Pr. 296* ≠ 9999)

Pr. 296 Setting Value	Restriction of Password Unlock Error	*Pr. 297* Display
1 to 6	No restriction	Always 0
101 to 106	Restricted at fifth error	Displays error count (0 to 5)

* During [*Pr. 296* = "101 to 106"], if password unlock error has occurred 5 times, correct password will not unlock the restriction. All parameter clear can unlock the restriction.
(In this case, parameter settings are cleared.)

2) Write four-digit numbers (1000 to 9998) in *Pr. 297* as a password.
(When *Pr. 296* = "9999", *Pr. 297* cannot be written.)
When password is registered, parameter reading/writing is restricted with the restriction set level in *Pr. 296* until unlocking.

REMARKS

- After registering a password, a read value of *Pr. 297* is always "0" to "5".
- When a password restricted parameter is read/written, "LOCd" is displayed.
- Even if a password is registered, parameters which the drive unit itself writes, such as drive unit parts life, are overwritten as needed.
- Even if a password is registered, *Pr. 991 PU contrast adjustment* can be read/written when a parameter unit (FR-PU07) is connected.

<Unlock>

There are two ways of unlocking the password.

- Enter a password in *Pr. 297*.
  Unlocked when a password is correct. If a password is incorrect, an error occurs and not unlocked.
  During [*Pr. 296* = "101 to 106"], if password unlock error has occurred 5 times, correct password will not unlock the restriction. (During password lock)
- Perform All parameter clear.
  Password lock is unlocked. However, other parameter settings are cleared also.

NOTE

- **If the password has been forgotten, perform All parameter clear to unlock the parameter restriction. In that case, other parameters are also cleared.**
- **All parameter clear cannot be performed during the operation.**

(3) Parameter operation during password lock/unlock

Parameter Operation		Unlocked		Password Registered	Locked
		Pr. 296 = 9999 *Pr. 297* = 9999	*Pr. 296* ≠ 9999 *Pr. 297* = 9999	*Pr. 296* ≠ 9999 *Pr. 297* = 0 to 4 (Read value)	*Pr. 296* = 101 to 106 *Pr. 297* = 5 (Read value)
Pr. 296	Read	○ *1	○	○	○
	Write	○ *1	○ *1	×	×
Pr. 297	Read	○ *1	○	○	○
	Write	×	○	○	○ *3
Performing parameter clear		○	○	×	×
Performing parameter all clear		○	○	○ *2	○ *2
Performing parameter copy		○	○	×	×

○: enabled, ×: restricted

*1 Reading/writing is unavailable when there is restriction to reading by the *Pr. 160* setting.
*2 Unavailable during the operation.
*3 Correct password will not unlock the restriction.

REMARKS

- When *Pr. 296* = "4, 5, 104, 105" and using the parameter unit (FR-PU07), PUJOG operation is unavailable.
- When writing is restricted from PU mode operation command (*Pr. 296* = 1, 2, 4, 5, 101, 102, 104, 105), switching of operation mode by easy setting mode is unavailable.
- During password lock, parameter copy of the parameter unit (FR-PU07) cannot be performed.

Parameters referred to

Pr. 77 Parameter write selection Refer to page 160.
Pr. 160 Extended function display selection Refer to page 161.
Pr. 551 PU mode operation command source selection Refer to page 177.

4.16 Selection of operation mode and operation location

Purpose	Parameter that should be Set		Refer to Page
Operation mode selection	**Operation mode selection**	**Pr. 79**	*164*
Started in Network operation mode	**Operation mode at power-on**	**Pr. 79, Pr. 340**	*176*
Selection of operation location	**Operation command source and speed command source during communication operation, selection of operation location**	**Pr. 338, Pr. 339 Pr. 551**	*177*

4.16.1 Operation mode selection (Pr. 79)

Used to select the operation mode of the drive unit.
Mode can be changed as desired among operation using external command signals (External operation), operation from the operation panel and PU (FR-PU07) (PU operation), combined operation of PU operation and External operation (External/PU combined operation), and Network operation (when RS-485 communication is used).

Parameter Number	Name	Initial Value	Setting Range
79	**Operation mode selection**	0	0 to 4, 6, 7

The above parameter can be changed during a stop in any operation mode.

POINT

- **Use the easy setting mode to set *Pr. 79* in simple steps.** ***(Refer to page 52.)***

Pr. 79 Setting	Description			LED Indication (OFF / ON)	Refer to Page
0 (Initial value)	Use External/PU switchover mode (At power ON, the drive unit is in the External operation mode.) Press PU/EXT to switch between the PU and External operation mode.			PU operation mode: PU External operation mode: EXT NET operation mode: NET	*167*
	Operation mode	**Speed command**	**Start command**		
1	PU operation mode (fixed)	Setting by the operation panel and PU (FR-PU07)	Input by RUN on the operation panel or FWD and REV on PU (FR-PU07)	PU operation mode: PU	*167*
2	External operation mode (fixed) The operation can be performed by switching between the External and NET operation modes.	External signal input (from terminal 2, 4, JOG, multi-speed selection, etc.)	External signal input (from terminal STF and STR)	External operation mode: EXT NET operation mode: NET	*167*
3	External/PU combined operation mode 1	Operation panel and PU (FR-PU07) setting or external signal input (multi-speed setting, across terminals 4 and 5 (valid when AU signal turns ON)). *	External signal input (from terminal STF and STR)	External/PU combined operation mode: PU EXT	*168*
4	External/PU combined operation mode 2	External signal input (Terminal 2, 4, JOG, multi-speed selection, etc.)	Input by RUN on the operation panel or FWD and REV on PU (FR-PU07)	External/PU combined operation mode: PU EXT	*168*
6	Switchover mode Switch among PU operation, External operating, and NET operation while keeping the same operating status.			PU operation mode: PU External operation mode: EXT NET operation mode: NET	*169*
7	External operation mode (PU operation interlock) X12 signal ON: Operation mode can be switched to the PU operation mode. (output stop during External operation) X12 signal OFF: Operation mode cannot be switched to the PU operation mode.				*169*

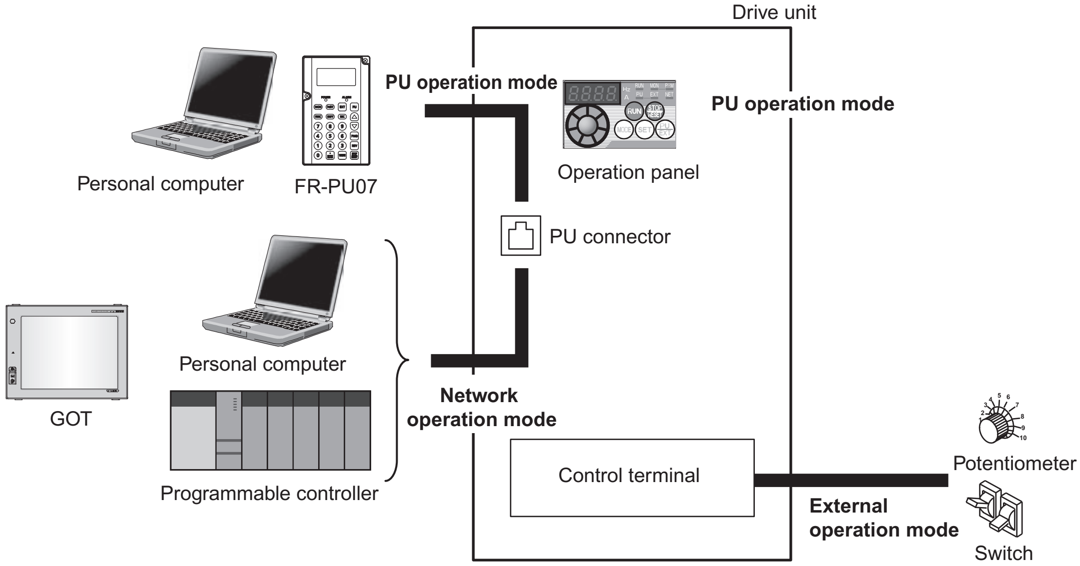
* The priorities of the speed commands when *Pr. 79* = "3" are "Multi-speed operation (RL/RM/RH/REX) > PID control (X14) > terminal 4 analog input (AU) > digital input from the operation panel".

REMARKS

- If switching of the operation mode is invalid even though *Pr. 79* is set, *refer to page 269*.

(1) Operation mode basics

- The operation mode specifies the source of the start command and the speed command for the drive unit.
- Basically, there are following operation modes.
  - External operation mode: For inputting start command and speed command with an external potentiometer and switches which are connected to the control circuit terminal.
  - PU operation mode: For inputting start command and speed command with the operation panel or parameter unit (FR-PU07).
  - Network operation mode (NET operation mode): For inputting start command and speed command with RS-485 communication through PU connector.
- The operation mode can be selected from the operation panel or with the communication instruction code.

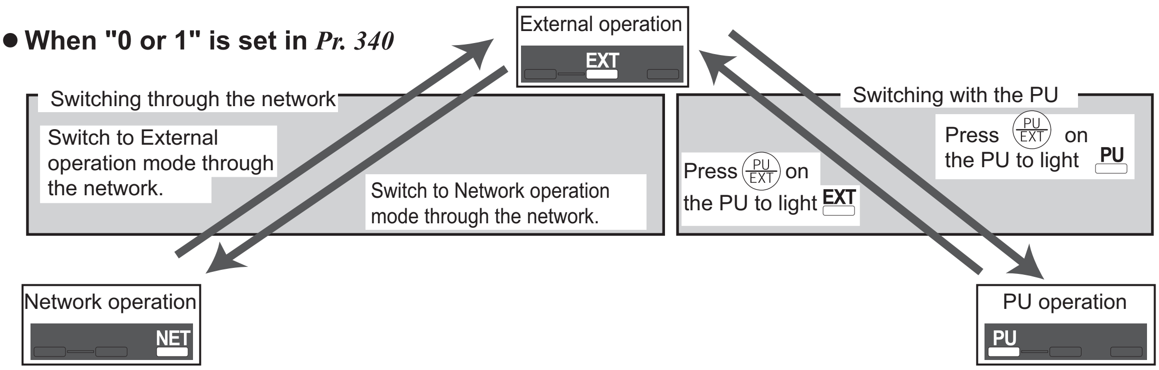


REMARKS

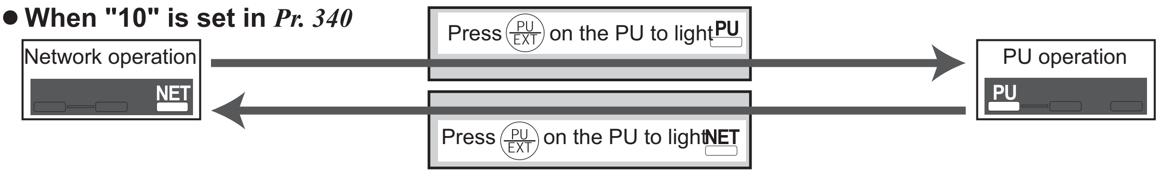
- Either "3" or "4" may be set to select the PU/External combined mode. *Refer to page 164* for details.
- The stop function (PU stop selection) activated by pressing STOP/RESET of the operation panel and parameter unit (FR-PU07) is valid even in other than the PU operation mode in the initial setting.
  (*Refer to Pr. 75 Reset selection/disconnected PU detection/PU stop selection on page 157.)*

(2) Operation mode switching method

● **When "0 or 1" is set in *Pr. 340***



● **When "10" is set in *Pr. 340***



REMARKS

- Refer to the following for switching by the external terminal.
  PU operation external interlock (X12) signal ☞ Refer to page 169.
  PU-External operation switch-over (X16) signal ☞ Refer to page 170.
  External-NET operation switchover (X65) signal, NET-PU operation switchover (X66) signal ☞ Refer to page 171.
  Pr. 340 Communication startup mode selection ☞ Refer to page 176.

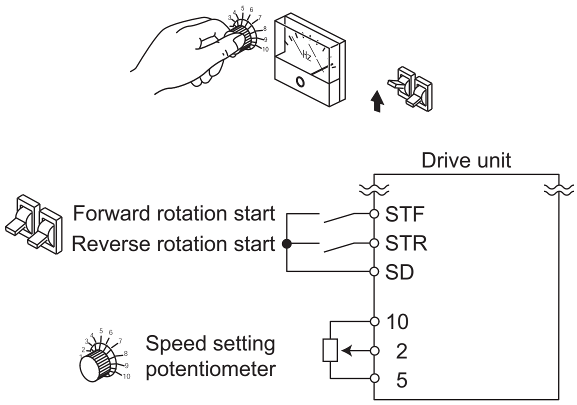
(3) Operation mode selection flow

In the following flowchart, select the basic parameter setting and terminal connection related to the operation mode.

START

Where is the start command source?	Where is the speed command source?	Connection	Parameter setting	Operation
From outside (STF/STR terminal)	From outside (Terminal 2, 4, JOG, multi-speed, etc.)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 117.)* Terminal 2, 4 (analog), RL, RM, RH, JOG, etc.		Speed setting terminal ON STF(STR)-ON
	From the operation panel (digital setting)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 117.)*	*Pr. 79* = "3" (External/PU combined operation 1)	Operation panel, PU digital setting STF(STR)-ON
	From communication (PU connector (RS-485 communication)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 117.)*	*Pr. 338* = "1" *Pr. 340* = "1"	Communication speed setting command sending STF(STR)-ON
From the operation panel (RUN/FWD/REV key)	From outside (terminal 2, 4, JOG, multi-speed, etc.)	Terminal 2, 4 (analog), RL, RM, RH, JOG, etc.	*Pr. 79* = "4" (External/PU combined operation 2)	Speed setting terminal ON RUN/FWD/REV key-ON
	From the operation panel (digital setting)		*Pr. 79* = "1" (fixed to PU operation)	Digital setting RUN/FWD/REV key-ON
	From communication (PU connector (RS-485 communication)	✕ Disabled		
From communication (PU connector (RS-485 communication))	From outside (terminal 2, 4, JOG, multi-speed, etc.)	Terminal 2, 4 (analog), RL, RM, RH, JOG, etc.	*Pr. 339* = "1" *Pr. 340* = "1"	Speed setting terminal ON Communication start command sending
	From the operation panel (digital setting)	✕ Disabled		
	From communication (PU connector (RS-485 communication)		*Pr. 340* = "1"	Communication speed setting command sending Communication start command sending

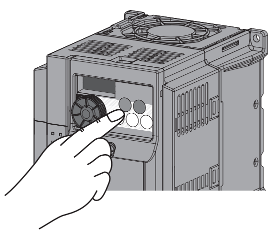
(4) External operation mode *(setting "0" (initial value), "2")*



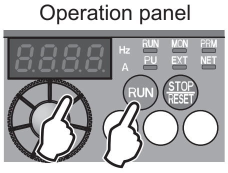
- Select the External operation mode when the start command and the speed command are applied from a speed setting potentiometer, start switch, etc. which are provided externally and connected to the control circuit terminals of the drive unit.
- Generally, parameter change cannot be performed in the External operation mode. (Some parameters can be changed. Refer to the detailed description of each parameter.)
- When "0 or 2" is selected for *Pr. 79*, the drive unit enters the External operation mode at power-ON. (When using the Network operation mode, refer to *page 176*.)
- When parameter changing is seldom necessary, setting "2" fixes the operation mode to the External operation mode.
  When frequent parameter changing is necessary, setting "0" (initial value) allows the operation mode to be changed easily to the PU operation mode by pressing PU EXT of the operation panel. After you switched to the PU operation mode, always return to the External operation mode.
- The STF and STR signal are used as a start command, and the voltage or current signal to terminal 2, 4, multi-speed signal, JOG signal, etc. are used as a speed commands.

☞ *Refer to page 150.*

(5) PU operation mode *(setting "1")*



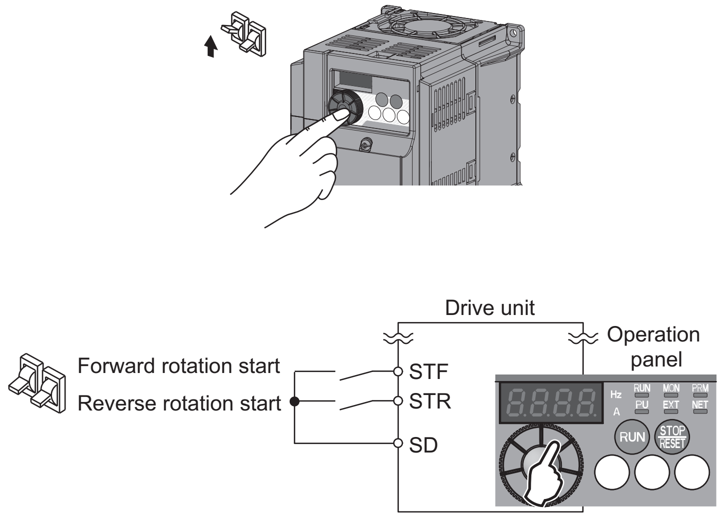
Operation panel



- Select the PU operation mode when applying start and speed command by only the key operation of the operation panel (FR-PU07). Also select the PU operation mode when making communication using the PU connector.
- When "1" is selected for *Pr. 79*, the drive unit enters the PU operation mode at power-ON. You cannot change to the other operation mode.
- The setting dial of the operation panel can be used for setting like a potentiometer. *(Refer to Pr. 161 Speed setting/key lock operation selection on page 242.)*

☞ *Refer to page 172.*

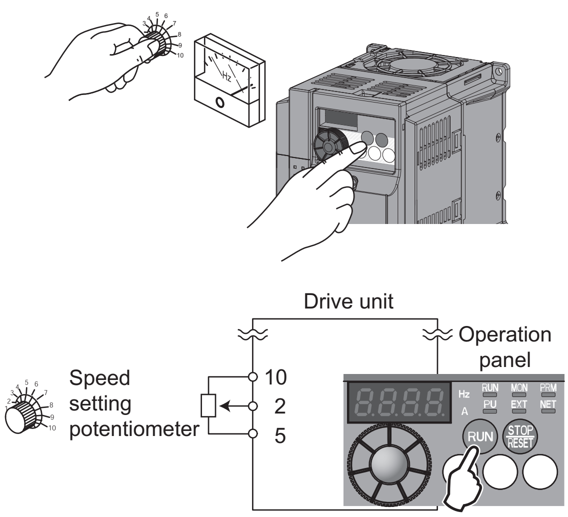
(6) PU/External combined operation mode 1 *(setting "3")*



- Select the PU/External combined operation mode 1 when applying speed command from the operation panel or parameter unit (FR-PU07) and inputting the start command with the external start switch.
- Select "3" for *Pr. 79*. You cannot change to the other operation mode.
- When a speed is applied from the external signal by multi-speed setting, it has a higher priority than the speed command from the PU. When AU is ON, the command signal to terminal 4 is used.

☞ *Refer to page 174*.

(7) PU/External combined operation mode 2 *(setting "4")*



- Select the PU/External combined operation mode 2 when applying speed command from the external potentiometer, multi-speed or JOG signal and inputting the start command by key operation of the operation panel or parameter unit (FR-PU07).
- Select "4" for *Pr. 79*. You cannot change to the other operation mode.

☞ *Refer to page 175*.

(8) Switchover mode *(setting "6")*

•While continuing operation, you can switch among the PU operation, External operation and Network operation (NET operation).

Operation Mode Switching	Switching Operation/Operating Status
External operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. •Rotation direction is the same as that of External operation. •The speed set with the potentiometer (speed command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the drive unit is reset.)
External operation → NET operation	Send the mode change command to the Network operation mode through communication. •Rotation direction is the same as that of External operation. •The value set with the setting potentiometer (speed command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the drive unit is reset.)
PU operation → External operation	Press the external operation key of the operation panel or parameter unit. •The rotation direction is determined by the input signal of the External operation. •The set speed is determined by the external speed command signal.
PU operation → NET operation	Send the mode change command to the Network operation mode through communication. •Rotation direction and set speed are the same as those of PU operation.
NET operation → External operation	Send the mode change command to the External operation mode through communication. •The rotation direction is determined by the input signal of the External operation. •The set speed is determined by the external speed command signal.
NET operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. •The rotation direction and speed command in the Network operation mode are used unchanged.

(9) PU operation interlock *(setting "7")*

•The PU operation interlock function is designed to forcibly change the operation mode to the External operation mode when the PU operation external interlock (X12) signal input turns OFF.
This function prevents the drive unit from being inoperative by the external command if the mode is accidentally left unswitched from PU operation mode.
•Set "7" (PU operation interlock) in *Pr. 79*.
•For the terminal used for X12 signal (PU operation interlock signal) input, set "12" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function. (Refer to *page 117* for *Pr. 178 to Pr. 182*.)
•When the X12 signal is not assigned while MRS signal is assigned, function of the MRS signal switches from output stop to PU operation interlock signal.

X12 (MRS) Signal	Function/Operation	
	Operation Mode	Parameter Write
ON	Operation mode (External, PU, NET) switching enabled Output stop during External operation	Parameter write enabled (depending on *Pr. 77 Parameter write selection* and each parameter write conditions (Refer to *page 54* for the parameter list))
OFF	Forcibly switched to External operation mode External operation allowed Switching between the PU and Network operation mode is enabled	Parameter write disabled with exception of *Pr. 79*

<Function/operation changed by switching ON/OFF the X12 (MRS) signal>

Operating Condition		X12 (MRS) Signal	Operation Mode	Operating Status	Switching to PU, NET Operation Mode
Operation Mode	Status				
PU/NET	During stop	ON → OFF *1	External *2	If external operation speed setting and start signal are entered, operation is performed in that status.	Not allowed
	Running	ON → OFF *1			Not allowed
External	During stop	OFF → ON	External *2	During stop	Allowed
		ON → OFF			Not allowed
	Running	OFF → ON		During operation → output stop	Not allowed
		ON → OFF		Output stop → operation	Not allowed

*1 The operation mode switches to the External operation mode independently of whether the start signal (STF, STR) is ON or OFF. Therefore, the motor is run in External operation mode when the X12 (MRS) signal is turned OFF with either of STF and STR ON.

*2 At fault occurrence, pressing STOP RESET of the operation panel resets the drive unit.

NOTE

- **If the X12 (MRS) signal is ON, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is ON.**
- **When the MRS signal is used as the PU interlock signal, the MRS signal serves as the normal MRS function (output stop) by turning ON the MRS signal and then changing the *Pr. 79* value to other than "7" in the PU operation mode. As soon as "7" is set to *Pr. 79* , the MRS signal acts as the PU interlock signal.**
- **When the MRS signal is used as the PU interlock signal, the logic of the signal is as set in *Pr. 17*. When *Pr. 17* = "2", read ON as OFF and OFF as ON in the above explanation.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(10) Switching of operation mode by external (X16) signal

- When External operation and operation from the operation panel are used together, use of the PU-External operation switchover (X16) signal allows switching between the PU operation mode and External operation mode during a stop (during a motor stop, start command OFF).
- When *Pr. 79* = any of "0, 6, 7", the operation mode can be switched between the PU operation mode and External operation mode. (*Pr. 79* = "6" At Switchover mode, operation mode can be changed during operation)
- For the terminal used for X16 signal input, set "16" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

Pr. 79 Setting		X16 Signal State Operation Mode		Remarks
		ON (External)	OFF (PU)	
0 (initial value)		External operation mode	PU operation mode	Can be switched to External, PU or NET operation mode
1		PU operation mode		Fixed to PU operation mode
2		External operation mode		Fixed to External operation mode (can be switched to NET operation mode)
3, 4		External/PU combined operation mode		External/PU combined mode fixed
6		External operation mode	PU operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
7	X12 (MRS) ON	External operation mode	PU operation mode	Can be switched to External, PU or NET operation mode (output stop in External operation mode)
	X12 (MRS) OFF	External operation mode		Fixed to External operation mode (forcibly switched to External operation mode)

REMARKS

- The operation mode status changes depending on the setting of *Pr. 340 Communication startup mode selection* and the ON/OFF status of the X65 and X66 signals. (For details, refer to *page 171.*)
- The priorities of *Pr. 79* , *Pr. 340* and signals are *Pr. 79* > X12 > X66 > X65 > X16 > *Pr. 340*.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(11) Switching of operation mode by external signals (X65, X66 signals)

- When *Pr. 79* = any of "0, 2, 6", the operation mode switching signals (X65, X66) can be used to change the PU or External operation mode to the Network operation mode during a stop (during a motor stop or start command OFF). (*Pr. 79* = "6" Switchover mode can be changed during operation)
- When switching between the Network operation mode and PU operation mode
  1)Set *Pr. 79* to "0" (initial value) or "6".
  2)Set "10" in *Pr. 340 Communication startup mode selection*.
  3)Set "65" in any of *Pr. 178 to Pr. 182* to assign the PU/NET operation switchover (X65) signal to the terminal.
  4)The operation mode changes to the PU operation mode when the X65 signal turns ON, or to the Network operation mode when the X65 signal turns OFF.

Pr. 340 Setting	*Pr. 79* Setting		X65 Signal State ON (PU)	X65 Signal State OFF (NET)	Remarks
10	0 (initial value)		PU operation mode *1	NET operation mode *2	—
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode		Fixed to NET operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		PU operation mode *1	NET operation mode *2	Operation mode can be switched with operation continued
	7	X12 (MRS) ON	Switching among the External and PU operation mode is enabled *2		Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 NET operation mode when the X66 signal is ON.
*2 PU operation mode when the X16 signal is OFF.
External operation mode when the X16 signal is ON.

- When switching between the Network operation mode and External operation mode
  1) Set *Pr. 79* to "0 (initial value), 2, 6 or 7". (At the *Pr. 79* setting of "7", the operation mode can be switched when the X12 (MRS) signal is ON.)
  2) Set "0 (initial value) or 1" in *Pr. 340 Communication startup mode selection*.
  3) Set "66" in any of *Pr. 178 to Pr. 182* to assign the External/NET operation switchover (X66) signal to the terminal.
  4) The operation mode changes to the Network operation mode when the X66 signal turns ON, or to the External operation mode when the X66 signal turns OFF.

Pr. 340 Setting	*Pr. 79* Setting		X66 Signal State ON (NET)	X66 Signal State OFF (external)	Remarks
0 (initial value), 1	0 (initial value)		NET operation mode	External operation mode *1	—
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode	External operation mode	Cannot be switched to PU operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		NET operation mode	External operation mode *1	Operation mode can be switched with operation continued
	7	X12 (MRS) ON	NET operation mode	External operation mode *1	Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 PU operation mode when the X16 signal is OFF. When the X65 signal has been assigned, the operation mode changes with the ON/OFF state of the X65 signal.

REMARKS

- The priorities of *Pr. 79* , *Pr. 340* and signals are *Pr. 79* > X12 > X66 > X65 > X16 > *Pr. 340*.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

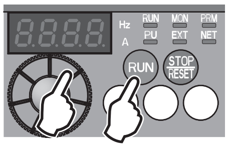
Pr. 15 Jog speed setting Refer to page 91.
Pr. 4 to 6, Pr. 24 to 27, Pr. 232 to Pr. 239 Multi-speed operation Refer to page 89.
Pr. 75 Reset selection/disconnected PU detection/PU stop selection Refer to page 157.
Pr. 161 Speed setting/key lock operation selection Refer to page 242.
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 117.
Pr. 190, Pr. 192 (output terminal function selection) Refer to page 123.
Pr. 340 Communication startup mode selection Refer to page 176.

4.16.2 Setting the speed by the operation panel

POINT

- **Use the operation panel to give a start command and a speed command. (PU operation)**

Operation panel

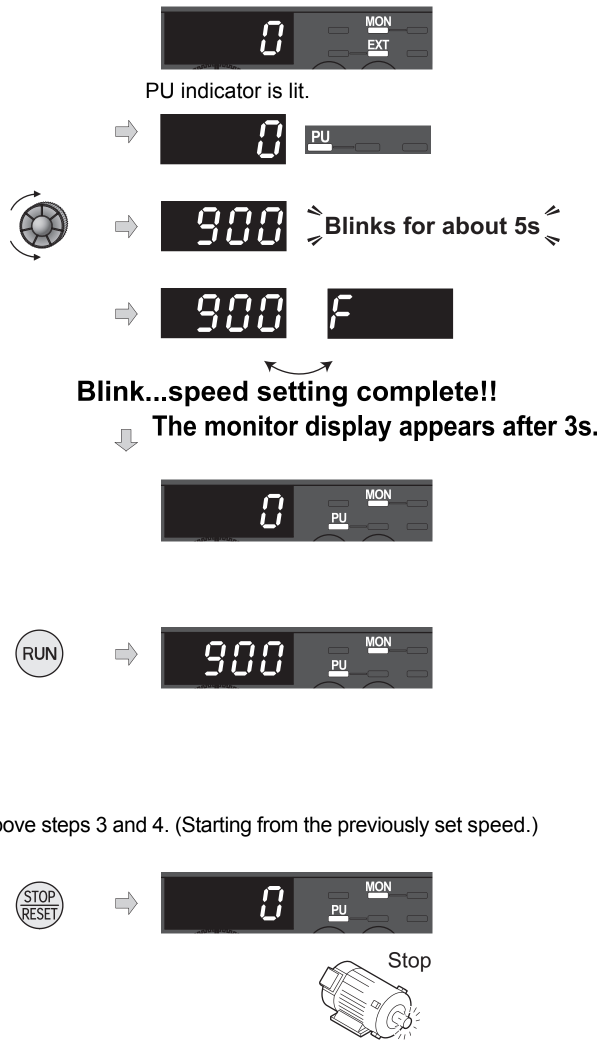


Operation example	Operate at 900r/min.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Change the *Pr. 79* setting to "1".
   (*Refer to page 52* for change of the setting.)
3. Turn (setting dial) to show the speed you want to set.
   The speed blinks for about 5s.
4. While the value is blinking, press SET to set the speed.
   (If SET is not pressed, the indication of the value goes back to "0" (0r/min) after about 5s of blinking. In that case, go back to "operation step 3" and set the speed again.)
   After about 3s of blinking, the indication of the value goes back to "0" (monitor display).
5. Start → acceleration → constant speed
   Press RUN to start operation.
   The speed value on the indication increases in *Pr. 7 Acceleration time,* and "900" (900r/min) appears.
6. To change the set speed, perform the operation in above steps 3 and 4. (Starting from the previously set speed.)
7. Deceleration → stop
   Press STOP/RESET to stop.
   The speed value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0" (0r/min) displayed.

Display



REMARKS

? Operation cannot be performed at the set speed ... Why?

☞ Did you carry out step 4 within 5s after step 3? (Did you press (SET) within 5s after turning ?)

? The speed does not change by turning ... Why?

☞ Check to see if the operation mode selected is the External operation mode. (Press (PU/EXT) to change to the PU operation mode.)

? Operation does not change to the PU operation mode ... Why?

☞ Check that "0" (initial value) is set in *Pr. 79 Operation mode selection*?

☞ Check that the start command is not ON.

? Change acceleration deceleration time

☞ *Pr. 7 (Refer to page 97.)*

? Change deceleration time

☞ *Pr. 8 (Refer to page 97.)*

For example, operation not exceeding 1800r/min

☞ Set "1800r/min" in *Pr. 1*. (*Refer to page 87.)*

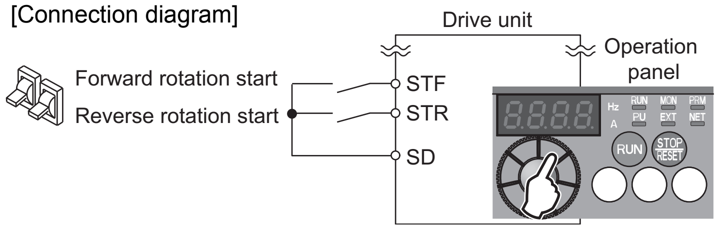
- When you always operate in the PU operation mode at power-ON, set *Pr. 79 Operation mode selection* = "1" to choose PU operation mode always.
- To display the set speed under PU operation mode or External/PU combined operation mode (*Pr. 79 Operation mode selection* = "3"), press ( ) for 1s or longer.
- can also be used like a potentiometer to perform operation. (*Refer to page 242.)*

4.16.3 Setting the speed by the operation panel (Pr. 79 = 3)

POINT

- Switch ON the STF (STR) signal to give a start command.
- Use the operation panel ( ) to give a speed command.
- Set "3" (External/PU combined operation mode 1) in *Pr. 79* .

[Connection diagram]



Operation example	Operate at 900r/min.

Operation / **Display**

1. Screen at power-ON
   The monitor display appears.

2. Change the *Pr. 79* setting to "3". (*Refer to page 52* for change of the setting.)
   [PU] indicator and [EXT] indicator are lit.

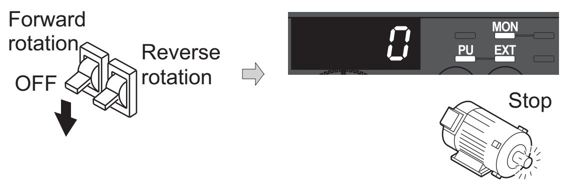
3. Turn to show the speed you want to set.
   The speed blinks for about 5s.

4. While the value is blinking, press SET to set the speed.
   (If you do not press SET, the value blinks for about 5s and the display then returns to "0" (0r/min). At this time, return to "Step 3" and set the speed again.)
   After the value blinked for about 3s, the display returns to "0" (monitor display).

Blink...speed setting complete!!
The monitor display appears after 3s.

5. Start → acceleration → constant speed
   Turn the start switch (STF or STR) ON.
   The speed value on the display increases in *Pr. 7 Acceleration time, and* "900" (900r/min) appears.
   [RUN] indicator is lit during forward rotation operation and blinks during reverse rotation operation.

6. To change the set speed, perform the operation in above steps 3 and 4. (Starting from the previously set speed.)
7. Deceleration → stop
   Turn OFF the start switch (STF or STR). The speed value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0" (0r/min) displayed.
   [RUN] turns OFF.



REMARKS

- *Pr. 178 STF terminal function selection* must be set to "60" (or *Pr. 179 STR terminal function selection* must be set to "61"). (all are initial values)
- When *Pr. 79 Operation mode selection* is set to "3", multi-speed operation *(refer to page 89)* is also valid.

? Pressing STOP RESET to stop the motor and the display shows

.

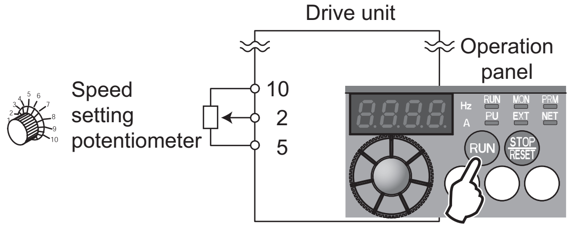
1. Turn the start switch (STF or STR) OFF.
2. The display can be reset by PU EXT.

4.16.4 Setting the speed by analog input (voltage input / current input)

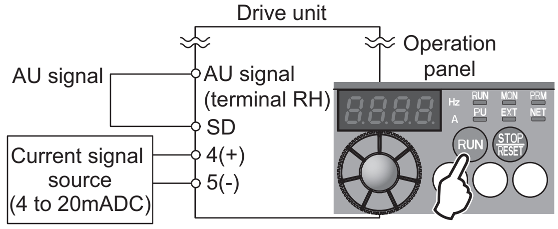
POINT

- Use the operation panel (RUN) to give a start command.
- Use the potentiometer (speed setting potentiometer) to give a speed command.
- Set "4" (External/PU combined operation mode 2) in *Pr. 79 Operation mode selection*.

[Connection diagram voltage input]
(The drive unit supplies 5V of power to the speed setting potentiometer. (terminal 10))



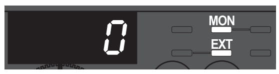
[Connection diagram current input]
Assign the AU signal in one of *Pr. 178 to Pr. 182*.



Operation example	Operate at 3000r/min.

Operation — **Display**

1. Screen at power-ON
   The monitor display appears.

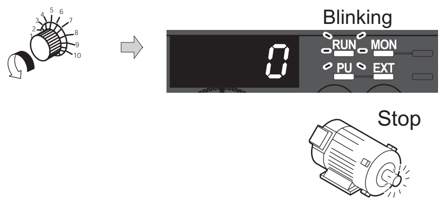


2. Assignment of the AU signal (current input). (Refer to the step 3 for voltage input.)
   Set *Pr. 160* to "0" to activate extended parameters.
   To assign the AU signal, set "4" in one of *Pr. 178 to Pr. 182*. (*Refer to page 53* to change the setting.)
   Turn ON the AU signal.
3. Change the *Pr. 79* setting to "4".
   (*Refer to page 52* for change of the setting.)
   [PU] indicator and [EXT] indicator are lit.

4. Start
   Turn ON RUN.
   [RUN] blinks fast as no speed command is given.

5. Acceleration → constant speed
   For voltage input, turn the potentiometer (speed setting potentiometer) clockwise slowly to full.
   For current input, input 20mA.
   The speed value on the indication increases in *Pr. 7 Acceleration time*, and " 3000 " (3000r/min) appears.
   [RUN] indicator is lit during forward rotation operation and blinks slowly during reverse rotation operation.

6. Deceleration
   For voltage input, turn the potentiometer (speed setting potentiometer) counterclockwise slowly to full.
   For current input, input 4mA.
   The speed value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with " 0 " (0r/min) displayed.
   [RUN] blinks fast.



7. Stop
   Switch power OFF STOP RESET.
   [RUN] turns OFF.

REMARKS

? Change the speed (3000r/min) at the maximum voltage input (5V initial value)
 Adjust the speed in *Pr. 125 Terminal 2 speed setting gain speed*. (*Refer to page 152.)*
? Change the speed (0r/min) at the minimum voltage input (0V initial value)
 Adjust the speed in *calibration parameter C2 Terminal 2 speed setting bias speed. (Refer to page 152.)*

4
PARAMETERS

4.16.5 Operation mode at power-ON (Pr. 79, Pr. 340)

When power is switched ON or when power comes back ON after instantaneous power failure, the drive unit can be started up in the Network operation mode.
After the drive unit has started up in the Network operation mode, parameter write and operation can be performed from a program.
Set this mode for communication operation using PU connector.

Parameter Number	Name	Initial Value	Setting Range	Description
79	**Operation mode selection**	0	0 to 4, 6, 7	Operation mode selection *(Refer to page 166.)*
340 *	**Communication startup mode selection**	0	0	As set in *Pr. 79*.
			1	Network operation mode
			10	Network operation mode Operation mode can be changed between the PU operation mode and Network operation mode from the operation panel.

The above parameters can be changed during a stop in any operation mode.
* This parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Specify operation mode at power-ON *(Pr. 340)*

• Depending on the *Pr. 79* and *Pr. 340* settings, the operation mode at power-ON (reset) changes as described below.

Pr. 340 Setting	*Pr. 79* Setting	Operation Mode at Power-ON, Power Restoration, Reset	Operation Mode Switching
0 (initial value)	0 (initial value)	External operation mode	Switching among the External, PU and NET operation mode is enabled *1
	1	PU operation mode	Fixed to PU operation mode
	2	External operation mode	Switching between the External and NET operation mode is enabled Switching to PU operation mode disabled
	3, 4	External/PU combined mode	Operation mode switching disabled
	6	External operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
	7	External operation mode when X12 (MRS) signal ON	Switching among the External, PU and Net operation mode is enabled *1
		External operation mode when X12 (MRS) signal OFF	Fixed to External operation mode (Forcibly switched to External operation mode.)
1	0	NET operation mode	Same as when *Pr. 340* = "0"
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined mode	
	6	NET operation mode	
	7	NET operation mode when X12 (MRS) signal ON	
		External operation mode when X12(MRS) signal OFF	
10	0	NET operation mode	Switching between the PU and NET operation mode is enabled *2
	1	PU operation mode	Same as when *Pr. 340* = "0"
	2	NET operation mode	Fixed to NET operation mode
	3, 4	External/PU combined mode	Same as when *Pr. 340* = "0"
	6	NET operation mode	Switching between the PU and NET operation mode is enabled while running *2
	7	External operation mode	Same as when *Pr. 340* = "0"

*1 Operation mode cannot be directly changed between the PU operation mode and Network operation mode
*2 Operation mode can be changed between the PU operation mode and Network operation mode with PU/EXT key of the operation panel and X65 signal.

Parameters referred to

Pr. 79 Operation mode selection Refer to page 164.

4.16.6 Start command source and speed command source during communication operation (Pr. 338, Pr. 339, Pr. 551)

When the RS-485 communication with the PU connector is used, the external start command and speed command can be valid. Command source in the PU operation mode can be selected.
From the communication device, parameter unit, etc. which have command source, parameter write or start command can be executed. Parameter read or monitoring can be performed in any operation mode.

Parameter Number	Name	Initial Value	Setting Range	Description
338	**Communication operation command source**	0	0	Start command source communication
			1	Start command source external
339	**Communication speed command source**	0	0	Speed command source communication
			1	Speed command source external
			2	Speed command source external (When there is no external input, the speed command via communication is valid, and the speed command from terminal 2 is invalid.)
551 *	**PU mode operation command source selection**	9999	2	PU connector is the command source when PU operation mode.
			4	Operation panel is the command source when PU operation mode.
			9999	Parameter unit automatic recognition Normally, operation panel is the command source. When the parameter unit is connected to the PU connector, PU is the command source.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

* *Pr. 551* is always write-enabled.

(1) Selects the command source of the PU operation mode *(Pr. 551)*

- Any of the operation panel, PU connector can be specified as the command source in the PU operation mode.
- In the PU operation mode, set *Pr. 551* to "2" when executing parameter write, start command or speed command during the RS-485 communication with PU connector.

PU...PU operation mode, NET...Network operation mode, —...without command source

Pr. 551 Setting	Command Source			Remarks
	Operation panel	Parameter unit	RS-485 communication	
2	—	PU	PU *1	Switching to NET operation mode disabled
4	PU	—	NET	
9999 (initial value)	PU *2	PU *2	NET	

*1 The MODBUS RTU protocol cannot be used in the PU operation mode. When using the MODBUS RTU protocol, set *Pr. 551* ≠ "2".

*2 When *Pr. 551* = "9999", the priorities of the PU control source is parameter unit (FR-PU07) > operation panel.

NOTE

- **When performing the RS-485 communication with the PU connector when *Pr. 551* = "9999", PU mode command source does not automatically change to the PU connector.**
- **When *Pr. 551* = "2" (PU mode PU connector), the operation mode cannot be switched to the Network operation mode.**
- **Changed setting value is valid when powering ON or resetting the drive unit.**
- **The MODBUS RTU protocol cannot be used in the PU operation mode. Select Network operation mode (NET mode command source).**
- **All of the operation mode indicators (PU EXT NET) on the operation panel turn OFF when the command source is not operation panel.**

(2) Controllability through communication

- Controllability through communication in each operation mode is shown below.
- Monitoring and parameter read can be performed from any operation regardless of operation mode.

Operation Location	Condition (*Pr. 551* Setting)	Item \ Operation Mode	PU Operation	External Operation	External/PU Combined Operation Mode 1 (*Pr. 79* = 3)	External/PU Combined Operation Mode 2 (*Pr. 79* = 4)	NET Operation
Control by RS-485 communication from PU connector	2 (PU connector)	Run command (start)	○	×	×	○	×
		Run command (stop)	○	Δ *3	Δ *3	○	×
		Running speed setting	○	×	○	×	×
		Parameter write	○ *4	× *5	○ *4	○ *4	× *5
		Drive unit reset	○	○	○	○	×
	Other than the above	Run command (start)	×	×	×	×	○ *1
		Run command (stop)	×	×	×	×	○ *1
		Running speed setting	×	×	×	×	○ *1
		Parameter write	× *5	× *5	× *5	× *5	○ *4
		Drive unit reset	×	×	×	×	○ *2
Control circuit external terminals	—	Drive unit reset	○	○	○	○	○
		Run command (start, stop)	×	○	○	×	× *1
		Speed setting	×	○	Δ *6	○	× *1

○: Enabled, ×: Disabled, Δ: Some are enabled

*1 As set in *Pr. 338 Communication operation command source* and *Pr. 339 Communication speed command source (Refer to page 177.)*
*2 At occurrence of RS-485 communication error, the drive unit cannot be reset from the computer.
*3 Enabled only when stopped by the PU. At a PU stop, PS is displayed on the operation panel. As set in *Pr. 75 PU stop selection*. *(Refer to page 157.)*
*4 Some parameters may be write-disabled according to the *Pr. 77 Parameter write selection* setting and operating status. *(Refer to page 160.)*
*5 Some parameters are write-enabled independently of the operation mode and command source presence/absence. When *Pr. 77* = "2", write is enabled. (Refer to the parameter list on *page 54*.) Parameter clear is disabled.
*6 Available with multi-speed setting and terminal 4-5 (valid when AU signal is ON).

(3) Operation at error occurrence

Error Definition	Condition (*Pr. 551* setting) \ Operation Mode	PU Operation	External Operation	External/PU Combined Operation Mode 1 (*Pr. 79* = 3)	External/PU Combined Operation Mode 2 (*Pr. 79* = 4)	NET Operation
Drive unit fault	—	Stop				
PU disconnection of the PU	2 (PU connector) 9999 (automatic recognition)	Stop/continued *1, *3				
	Other than the above	Stop/continued *1				
RS-485 communication error of the PU connector	2 (PU connector)	Stop/continued *2	Continued		Stop/continued *2	—
	Other than the above	Continued				Stop/continued *2

*1 Can be selected using *Pr. 75 Reset selection/disconnected PU detection/PU stop selection.*
*2 Can be selected using *Pr. 122 PU communication check time interval*.
*3 In the PU JOG operation mode, operation is always stopped when the PU is disconnected. Whether fault (E.PUE) occurrence is allowed or not is as set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.

(4) Selection of control source in Network operation mode *(Pr. 338, Pr. 339)*

- There are two control sources: operation command source, which controls the signals related to the drive unit start command and function selection, and speed command source, which controls signals related to speed setting.
- In Network operation mode, the commands from the external terminals and communication are as listed below.

Operation Location Selection				*Pr. 338 Communication operation command source*	0: NET			1: External			Remarks
				Pr. 339 Communication speed command source	0: NET	1: External	2: External	0: NET	1: External	2: External	
Fixed function (terminal-equivalent function)				Running speed from communication	NET	—	NET	NET	—	NET	
				Terminal 2	—	External	—	—	External	—	
				Terminal 4	—	External		—	External		
Selective function	*Pr. 178 to Pr. 182* setting	0	RL	Low-speed operation command/remote setting clear	NET	External		NET	External		*Pr. 59* = "0" (multi-speed) *Pr. 59* ≠ "0" (remote)
		1	RM	Middle-speed operation command/remote setting function	NET	External		NET	External		
		2	RH	High-speed operation command/remote setting function	NET	External		NET	External		
		3	RT	Second function selection	NET			External			
		4	AU	Terminal 4 input selection	—	Combined		—	Combined		
		5	JOG	Jog operation selection	—			External			
		7	OH	External thermal relay input	External						
		8	REX	15-speed selection	NET	External		NET	External		*Pr. 59* = "0" (multi-speed)
		10	X10	Drive unit run enable signal	External						
		12	X12	PU operation external interlock	External						
		14	X14	PID control valid terminal	NET	External		NET	External		
		16	X16	PU/External operation switchover	External						
		23	LX	Pre-excitation	NET			External			
		24	MRS	Output stop	Combined			External			*Pr. 79* ≠ "7"
				PU operation interlock	External						*Pr. 79* = "7" When the X12 signal is not assigned
		25	STOP	Start self-holding selection	—			External			
		60	STF	Forward rotation command	NET			External			
		61	STR	Reverse rotation command	NET			External			
		62	RES	Drive unit reset	External						
		64	X64	PID forward/reverse action switchover	NET	External		NET	External		
		65	X65	PU/NET operation switchover	External						
		66	X66	External/NET operation switchover	External						
		67	X67	Command source switchover	External						
		72	X72	PID integral value reset	NET	External		NET	External		

[Explanation of table]

External : Command is valid only from control terminal.
NET : Command only from communication is valid.
Combined : Command from both control terminal and communication is valid.
— : Command from either of control terminal and communication is invalid.

REMARKS

- The command source of communication is as set in *Pr. 551*.
- The *Pr. 338* and *Pr. 339* settings can be changed while the drive unit is running when *Pr. 77* = "2". Note that the setting change is reflected after the drive unit has stopped. Until the drive unit has stopped, communication operation command source and communication speed command source before the setting change are valid.

4
PARAMETERS

(5) Switching of command source by external (X67) signal

- In the Network operation mode, the command source switching (X67) signal can be used to switch the start command source and speed command source.
- Set "67" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the X67 signal to the control terminal.
- When the X67 signal is OFF, the start command source and speed command source are control terminal.

X67 Signal State	Start Command Source	Speed Command Source
No signal assignment	According to *Pr. 338*	According to *Pr. 339*
ON		
OFF	Command is valid only from control terminal.	

REMARKS

- The ON/OFF state of the X67 signal is reflected only during a stop. It is reflected after a stop when the terminal is switched while the drive unit is running.
- When the X67 signal is OFF, a reset via communication is disabled.

NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 59 Remote function selection ☞ Refer to page 93.
Pr. 79 Operation mode selection ☞ Refer to page 164.
Pr. 178 to Pr. 182 (input terminal function selection) ☞ Refer to page 117.

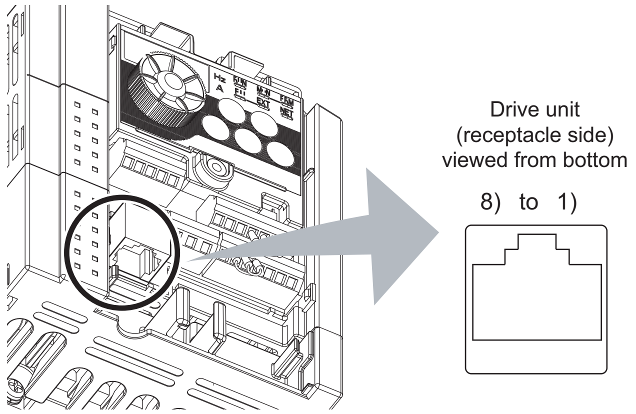
4.17 Communication operation and setting

Purpose	Parameter that should be Set		Refer to Page
Communication operation from PU connector	Initial setting of computer link communication (PU connector)	Pr. 117 to Pr. 124	*184*
	MODBUS RTU communication specifications	Pr. 117, Pr. 118, Pr. 120, Pr. 122, Pr. 343, Pr. 502, Pr. 549, Pr. 779	*203*
Restrictions on parameter write through communication	Communication EEPROM write selection	Pr. 342	*190*
Operation selection at a communication error	Stop mode selection at communication error	Pr. 121, Pr. 122, Pr. 502, Pr. 779	*185*

4.17.1 Wiring and configuration of PU connector

Using the PU connector, you can perform communication operation from a personal computer, etc.
When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the drive unit or read and write to parameters.

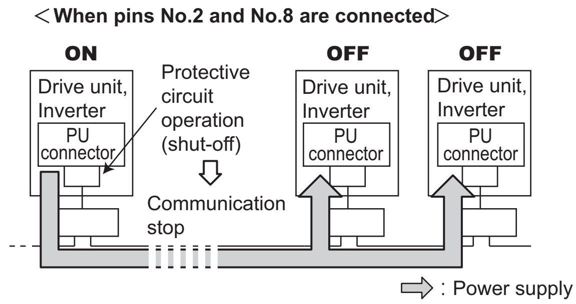
(1) PU connector pin-outs



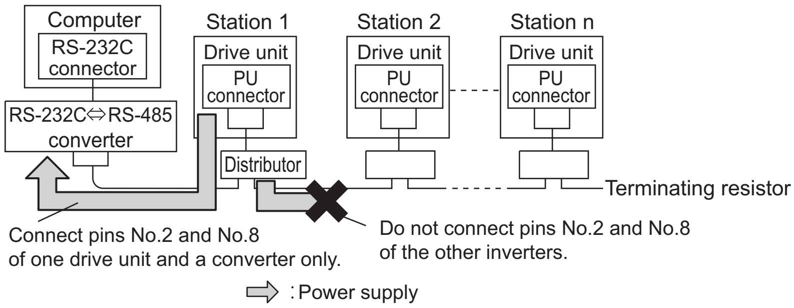
Pin Number	Name	Description
1)	SG	Earth (ground) (connected to terminal 5)
2)	—	Parameter unit power supply
3)	RDA	Drive unit receive+
4)	SDB	Drive unit send-
5)	SDA	Drive unit send+
6)	RDB	Drive unit receive-
7)	SG	Earth (ground) (connected to terminal 5)
8)	—	Parameter unit power supply

NOTE

- **Pins No. 2 and 8 provide power to the parameter unit. Do not use these pins for RS-485 communication.**
- **When making RS-485 communication between the FR-D700-G series, FR-E500 series, FR-S500 series and FR-F500J series, incorrect connection of pins No.2 and No.8 (parameter unit power supply) of the above PU connector may result in the drive unit malfunction or failure.**
- **When multiple drive units are connected using pins No.2 and No.8, power is provided from the drive unit which is powered ON to the drive units which are powered OFF in case drive units which are powered ON and OFF are mixed. In such case, a protective circuit of the drive unit, which is ON, is activated to stop communication.**
  When connecting multiple drive units for RS-485 communication, make sure to disconnect cables from No.2 and No.8 so that pins No.2 and No.8 are not connected between drive units.



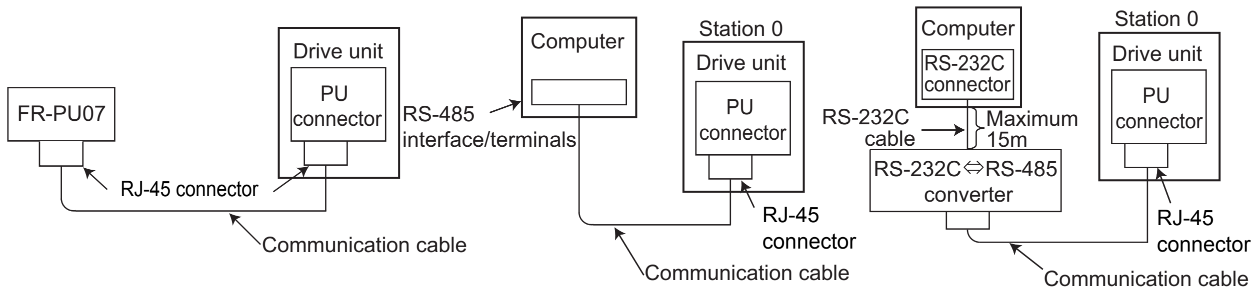
- **When using the RS-485 converter which receives power from the drive unit, make sure that power is provided from one drive unit only. (*Refer to the figure below.*)**



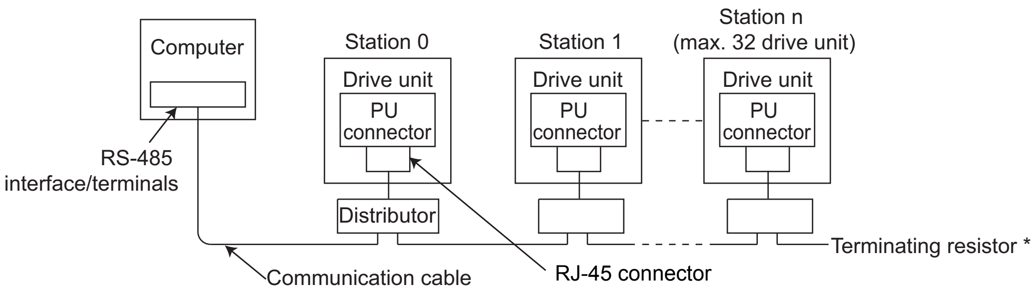
- **Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.**

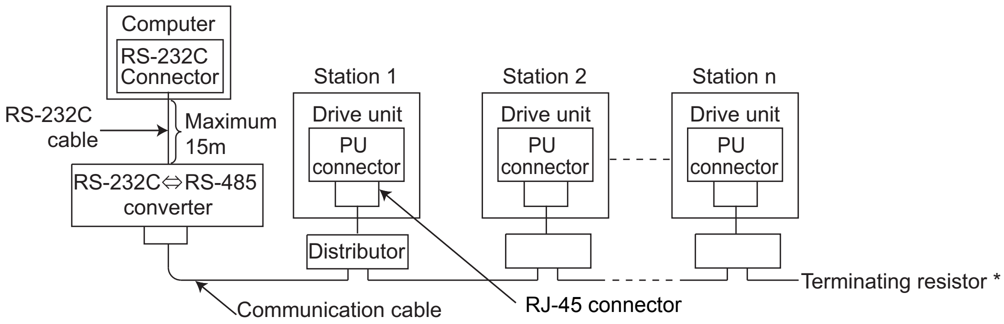
(2) PU connector communication system configuration

●Connection of a computer to the drive unit (1:1 connection)



●Combination of computer and multiple drive units (1:n connection)





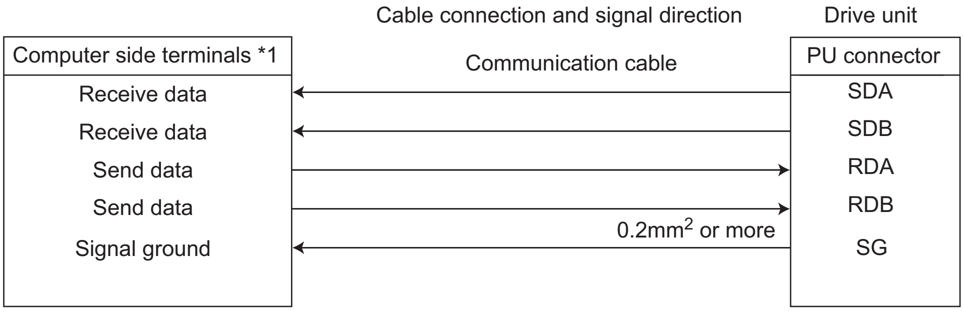
* The drive units may be affected by reflection depending on the transmission speed or transmission distance. If this reflection hinders communication, provide a terminating resistor. If the PU connector is used to make a connection, use a distributor since a terminating resistor cannot be fitted. Connect the terminating resistor to only the drive unit remotest from the computer. (Terminating resistor: 100Ω)

REMARKS

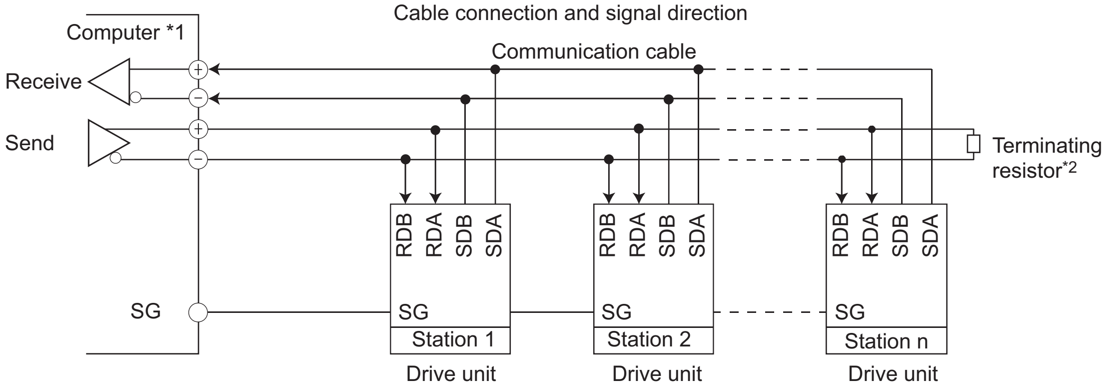
- Computer-drive unit connection cable
  Refer to page 292 for the connection cable (RS232C⇔RS485 converter) between the computer with RS-232C interface and an drive unit.
- *Refer to page 292* to make your own cable.

(3) Connection with RS-485 computer

●Wiring of one RS-485 computer and one drive unit



●Wiring of one RS-485 computer and "n" (multiple) drive units



*1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since these vary with the model.

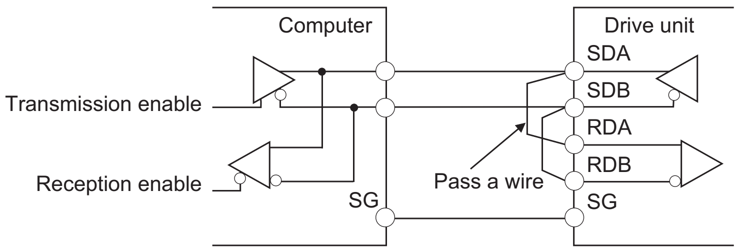
*2 The drive units may be affected by reflection depending on the transmission speed or transmission distance. If this reflection hinders communication, provide a terminating resistor. If the PU connector is used to make a connection, use a distributor since a terminating resistor cannot be fitted. Connect the terminating resistor to only the drive unit remotest from the computer. (Terminating resistor: 100Ω)

NOTE

- **Do not use pins No. 2, 8 of the communication cable.** *(Refer to page 181.)*
- **When making RS-485 communication among the FR-D700-G series, FR-E500 series, FR-S500 series and FR-F500J series, incorrect connection of pins No.2 and 8 (parameter unit power supply) of the above PU connector may result in the drive unit, inverter malfunction or failure.** *(Refer to page 181.)*

(4) Two-wire type connection

If the computer is 2-wire type, a connection from the drive unit can be changed to 2-wire type by passing wires across reception terminals and transmission terminals of the PU connector pin.



REMARKS

- A program should be created so that transmission is disabled (receiving state) when the computer is not sending and reception is disabled (sending state) during sending to prevent the computer from receiving its own data.
- The passed wiring length should be as short as possible.

4.17.2 Initial settings and specifications of RS-485 communication (Pr. 117 to Pr. 120, Pr. 123, Pr. 124, Pr. 549)

The following parameters are used to perform required settings for RS-485 communication between the drive unit and personal computer.

- Use PU connector of the drive unit for communication.
- You can perform parameter setting, monitoring, etc. using Mitsubishi inverter protocol or MODBUS RTU protocol.
- To make communication between the personal computer and drive unit, setting of the communication specifications must be made to the drive unit in advance.
  Data communication cannot be made if the initial settings are not made or there is any setting error.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th></tr>
<tr><td>117</td><td>PU communication station number</td><td>0</td><td>0 to 31 (0 to 247) *1</td><td colspan="2">Drive unit station number specification
Set the drive unit station numbers when two or more drive units are connected to one personal computer.</td></tr>
<tr><td>118</td><td>PU communication speed</td><td>192</td><td>48, 96, 192, 384</td><td colspan="2">Communication speed
The setting value X 100 equals to the communication speed.
Example)19200bps if 192</td></tr>
<tr><td rowspan="5">119</td><td rowspan="5">PU communication stop bit length</td><td rowspan="5">1</td><td></td><td>Stop bit length</td><td>Data length</td></tr>
<tr><td>0</td><td>1 bit</td><td rowspan="2">8 bits</td></tr>
<tr><td>1</td><td>2 bits</td></tr>
<tr><td>10</td><td>1 bit</td><td rowspan="2">7 bits</td></tr>
<tr><td>11</td><td>2 bits</td></tr>
<tr><td rowspan="3">120</td><td rowspan="3">PU communication parity check</td><td rowspan="3">2</td><td>0</td><td colspan="2">Without parity check</td></tr>
<tr><td>1</td><td colspan="2">With odd parity check</td></tr>
<tr><td>2</td><td colspan="2">With even parity check</td></tr>
<tr><td rowspan="2">123</td><td rowspan="2">PU communication waiting time setting</td><td rowspan="2">9999</td><td>0 to 150ms</td><td colspan="2">Set the waiting time between data transmission to the drive unit and response.</td></tr>
<tr><td>9999</td><td colspan="2">Set with communication data.
Waiting time: setting data × 10ms</td></tr>
<tr><td rowspan="3">124</td><td rowspan="3">PU communication CR/LF selection</td><td rowspan="3">1</td><td>0</td><td colspan="2">Without CR/LF</td></tr>
<tr><td>1</td><td colspan="2">With CR</td></tr>
<tr><td>2</td><td colspan="2">With CR/LF</td></tr>
<tr><td rowspan="2">549</td><td rowspan="2">Protocol selection</td><td rowspan="2">0</td><td>0</td><td colspan="2">Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>1</td><td colspan="2">MODBUS RTU protocol</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 When "1" (MODBUS RTU protocol) is set in *Pr. 549*, the setting range within parentheses is applied.

NOTE

- **Always reset the drive unit after making the initial settings of the parameters. After you have changed the communication-related parameters, communication cannot be made until the drive unit is reset.**

4.17.3 Operation selection at communication error occurrence (Pr. 121, Pr. 122, Pr. 502, Pr. 779)

You can select the drive unit operation when a communication line error occurs during RS-485 communication from the PU connector. The operation is active under the Network operation mode.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">121</td><td rowspan="2">Number of PU communication retries</td><td rowspan="2">1</td><td>0 to 10</td><td colspan="4">Number of retries at data receive error occurrence. If the number of consecutive errors exceeds the permissible value, the drive unit will come to trip (depends on Pr. 502).
Valid only Mitsubishi drive unit (computer link operation) protocol</td></tr>
<tr><td>9999</td><td colspan="4">If a communication error occurs, the drive unit will not come to trip. (NET operation mode at initial value)</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">0s</td><td>0s</td><td colspan="4">RS-485 communication can be made. Note that a communication fault (E.PUE) occurs as soon as the drive unit is switched to the operation mode with command source. (NET operation mode at initial value)</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="4">Communication check (signal loss detection) time interval
If a no-communication state persists for longer than the permissible time, the drive unit will come to trip (depends on Pr. 502).</td></tr>
<tr><td>9999</td><td colspan="4">No communication check (signal loss detection)</td></tr>
<tr><td rowspan="5">502</td><td rowspan="5">Stop mode selection at communication error</td><td rowspan="5">0</td><td></td><td>At fault occurrence</td><td>Indication</td><td>Fault output</td><td>At fault removal</td></tr>
<tr><td>0</td><td>Coasts to stop</td><td>E.PUE</td><td>Output</td><td>Stop (E.PUE)</td></tr>
<tr><td>1</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Output after stop</td><td>Stop (E.PUE)</td></tr>
<tr><td>2</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Without output</td><td>Automatic restart functions</td></tr>
<tr><td>3</td><td>Continues running at Pr. 779</td><td>—</td><td>Without output</td><td>Operates in normal condition</td></tr>
<tr><td rowspan="2">779</td><td rowspan="2">Operation speed during communication error</td><td rowspan="2">9999</td><td>0 to 12000r/min / 0 to 8000r/min *1*2</td><td colspan="4">Motor runs at the specified speed at a communication error.</td></tr>
<tr><td>9999</td><td colspan="4">Motor runs at the speed used before the communication error.</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

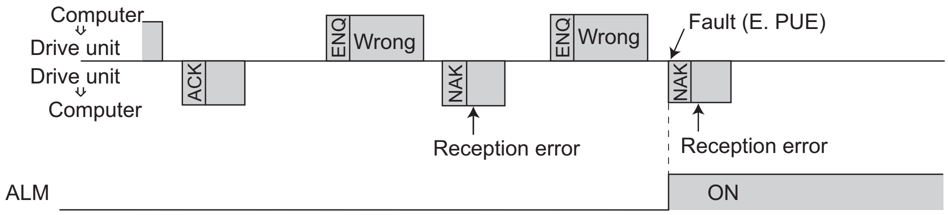
*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

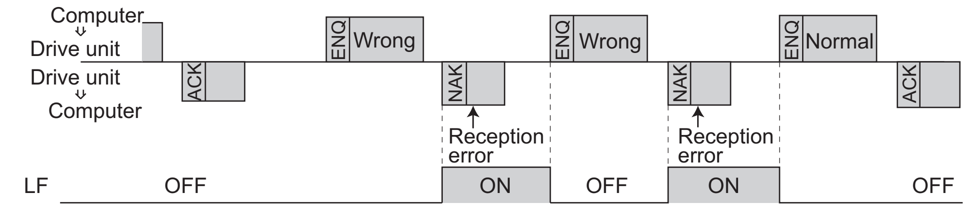
(1) Retry count setting *(Pr.121)*

- Set the permissible number of retries at data receive error occurrence. (Refer to *page 195* for data receive error for retry.)
- When data receive errors occur consecutively and exceed the permissible number of retries set, an drive unit trips (E.PUE) and a motor stops (as set in *Pr. 502*).
- When "9999" is set, a drive unit fault is not provided even if data receive error occurs but an alarm (LF) signal is output.
  For the terminal used for the LF signal output, assign the function by setting "98 (positive logic) or 198 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*.

Example: PU connector communication, *Pr. 121* = "1" (initial value)



Example: PU connector communication, *Pr. 121* = "9999"



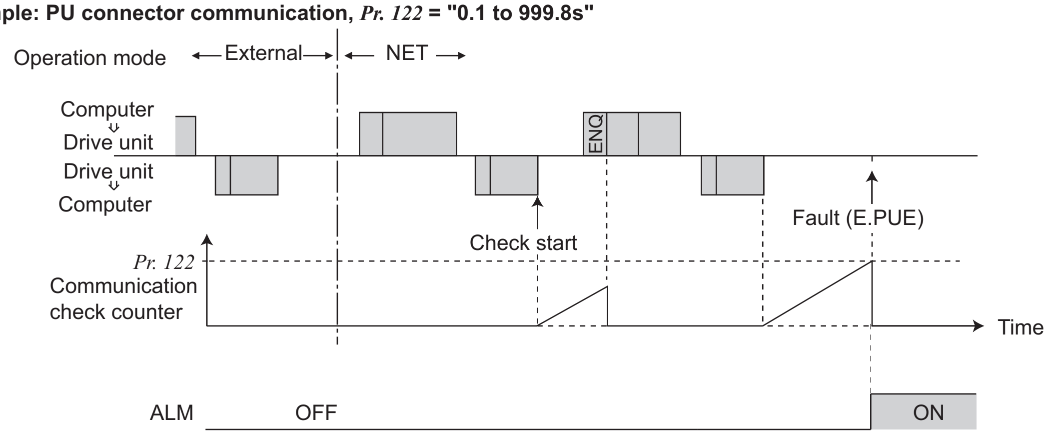
REMARKS

- *Pr. 121* is valid only when Mitsubishi inverter (computer link operation) protocol is selected. *Pr. 121* is not valid when MODBUS RTU communication protocol is selected.
- How the drive unit operates at a communication error differs according to the *Pr. 502 Stop mode selection at communication error* setting.

(2) Signal loss detection *(Pr. 122)*

- If a signal loss (communication stop) is detected between the drive unit and computer as a result of a signal loss detection, a communication fault (E.PUE) occurs and the drive unit trips. (as set in *Pr. 502*).
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting value is "0" (initial value), RS-485 communication can be made. However, a communication fault (E.PUE) occurs as soon as the drive unit is switched to the operation mode (Network operation mode in the initial setting) with the control.
- A signal loss detection is made when the setting is any of "0.1s to 999.8s". To make a signal loss detection, it is necessary to send data (refer to Mitsubishi inverter protocol control code *(page 194)*, MODBUS RTU communication protocol *(page 204)*) from the computer within the communication check time interval. (The drive unit makes communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).
- Communication check is made from the first communication in the operation mode with control source valid (Network operation mode in the initial setting).

Example: PU connector communication, *Pr. 122* = "0.1 to 999.8s"



⚠ CAUTION

⚠ **Always set the communication check time interval before starting operation to prevent hazardous conditions. Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the drive unit cannot be stopped. When the communication check time interval has elapsed, the drive unit trips (E.PUE).**
The motor can be coasted to a stop by turning ON its RES signal or by switching power OFF.

⚠ **If communication is broken due to signal cable breakage, computer fault, etc, the drive unit does not detect such a fault. This should be fully noted.**

(3) Stop operation selection at occurrence of communication fault (*Pr. 502*)

•Stop operation when retry count exceeds (Mitsubishi inverter protocol only) or signal loss detection error occurs can be selected.

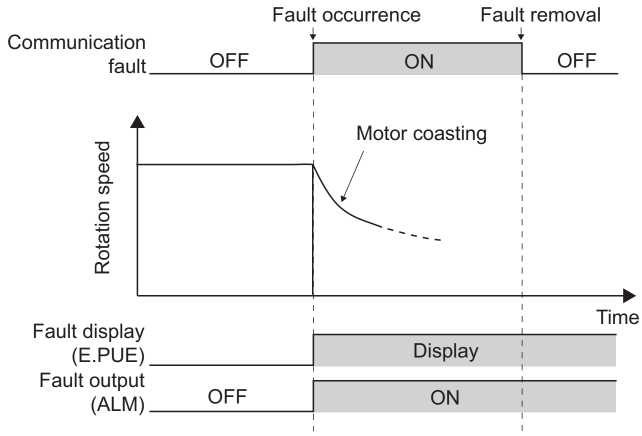
Operation at fault occurrence

Pr. 502 Setting	Operation	Indication	Fault Output
0 (initial value)	Coasts to stop	E. PUE lit	Provided
1	Decelerates to stop	E. PUE lit after stop	Provided after stop
2			Not provided
3	Operates at the speed set in *Pr. 779*	Normal display	Not provided

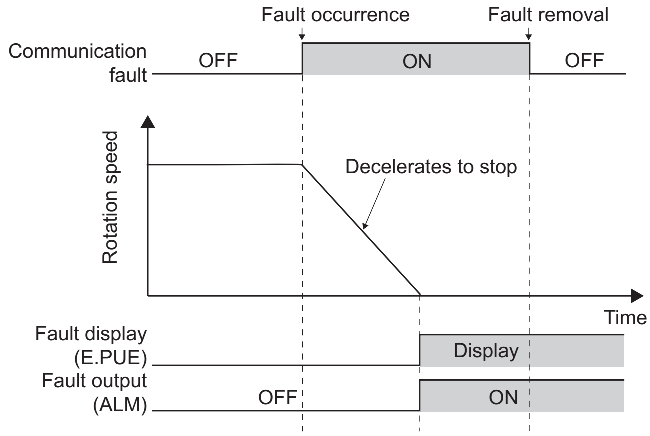
Operation at fault removal

Pr. 502 Setting	Operation	Indication	Fault Output
0 (initial value)	Kept stopped	E. PUE	Kept provided
1			
2	Automatic restart functions	Normal display	Not provided
3	Normal operation	Normal display	Not provided

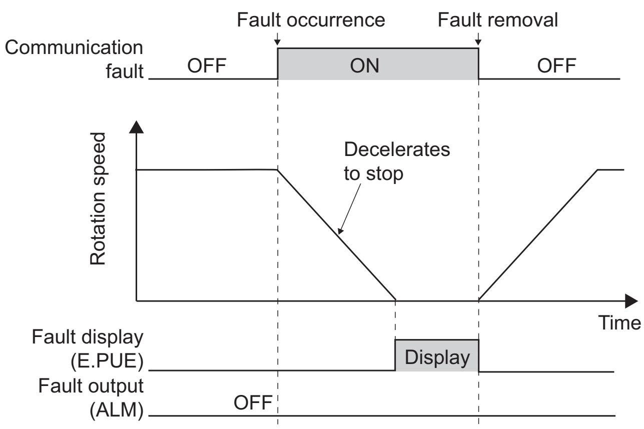
●*Pr. 502* setting = "0" (initial value)



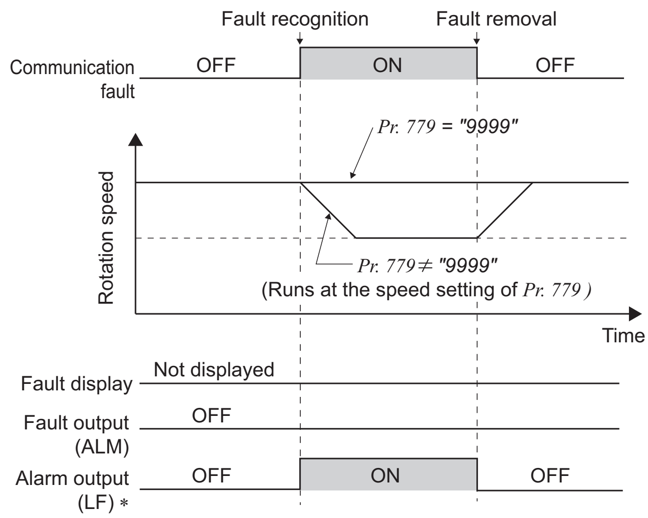
●*Pr. 502* setting = "1"



●*Pr. 502* setting = "2"



●*Pr. 502* setting = "3"



* When a communication error is detected while *Pr. 502* = "3," the alarm (LF) is output to an output terminal of the drive unit. To use the LF signal, assign the function to an output terminal by setting "98 (positive logic) or 198 (negative logic)" in *Pr. 190* or *Pr. 192 (Output terminal function selection)*.

REMARKS

- The fault output indicates fault output (ALM) signal or alarm bit output.
- When the setting was made to provide a fault output, the fault description is stored into the fault history. (The fault description is written to the fault history when a fault output is provided.)
  When no fault output is provided, the fault record overwrites the fault indication of the fault history temporarily, but is not stored. After the fault is removed, the fault indication returns to the ordinary monitor, and the fault history returns to the preceding fault indication.
- When the *Pr. 502* setting is "1, 2 or 3", the deceleration time is the ordinary deceleration time setting (e.g. *Pr. 8, Pr. 44, Pr. 45*). In addition, acceleration time for restart is the normal acceleration time (e.g. *Pr. 7, Pr. 44*).
- When "2, 3" is set in *Pr. 502*, run command/speed command at restart follows the command before an fault occurrence.
- When "2" is set in *Pr. 502* at occurrence of a communication error and the error is removed during deceleration, the drive unit accelerates again at that point.
- If the communication error setting is disabled with *Pr. 502* = "3," *Pr. 121* = "9999," and *Pr. 122* = "9999," the drive unit does not continue its operation with the speed set by *Pr. 779* at a communication error.
- If a communication error occurs while continuous operation at *Pr. 779* is selected with *Pr. 502* = "3," the drive unit operates at the speed set in *Pr. 779* even though the speed command source is at the external terminals.
  Example) If a communication error occurs while *Pr. 339* = "2" and the external terminal RL is ON, the operation is continued at the speed set in *Pr. 779*.
- After a communication error has been removed while *Pr. 502* = "3," the drive unit starts its operation in accordance with the start and speed commands which were set before the error.

Parameters referred to

Pr. 7 Acceleration time, Pr. 8 Deceleration time *Refer to page 97.*
Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 123.*

4

PARAMETERS

4.17.4 Communication EEPROM write selection (Pr. 342)

When parameter write is performed from RS-485 communication with the drive unit PU connector, parameters storage device can be changed from EEPROM + RAM to RAM only. Set when a frequent parameter change is necessary.

Parameter Number	Name	Initial Value	Setting Range	Description
342	**Communication EEPROM write selection**	0	0	Parameter values written by communication are written to the EEPROM and RAM.
			1	Parameter values written by communication are written to RAM.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

- When changing the parameter values frequently, set "1" in *Pr. 342* to write them to the RAM only.
  The life of the EEPROM will be shorter if parameter write is performed frequently with the setting unchanged from "0 (initial value)" (EEPROM write).

REMARKS

- When "1" (write to RAM only) is set in *Pr. 342*, powering OFF the drive unit will erase the changed parameter values. Therefore, the parameter values available when power is switched ON again are the values stored in EEPROM previously.

4.17.5 Mitsubishi inverter protocol (computer link communication)

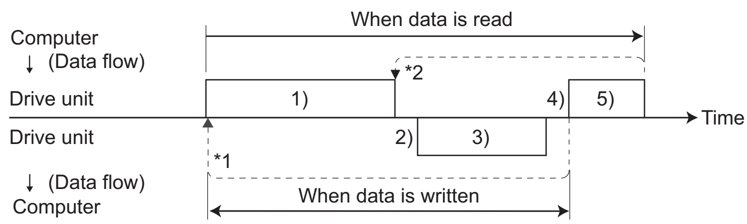
You can perform parameter setting, monitoring, etc. from the PU connector of the drive unit using the Mitsubishi inverter protocol (computer link communication).

(1) Communication

• The communication specifications are given below.

Item		Description	Related Parameter
Communication protocol		Mitsubishi inverter protocol (computer link)	Pr. 549
Conforming standard		EIA-485 (RS-485)	—
Number of connectable devices		1:N (maximum 32 units), setting is 0 to 31 stations	Pr. 117
Communication speed	**PU connector**	Selected among 4800/9600/19200/38400bps	Pr. 118
Control procedure		Asynchronous	—
Communication method		Half-duplex	—
Communication	**Character system**	ASCII (7 bits or 8 bits can be selected)	Pr. 119
	Start bit	1 bit	—
	Stop bit length	1 bit or 2 bits can be selected	Pr. 119
	Parity check	Check (with even or odd parity) or no check can be selected	Pr. 120
	Error check	Sum code check	—
	Terminator	CR/LF (presence/absence selectable)	Pr. 124
Waiting time setting		Selectable between presence and absence	Pr. 123

(2) Communication procedure



- Data communication between the computer and drive unit is made in the following procedure.
  1) Request data is sent from the computer to the drive unit. (The drive unit will not send data unless requested.)
  2) After waiting for the waiting time
  3) The drive unit sends reply data to the computer in response to the computer request.
  4) After waiting for the drive unit data processing time
  5) Answer from the computer in response to reply data 3) of the drive unit is transmitted. (Even if 5) is not sent, subsequent communication is made properly.)

*1 If a data error is detected and a retry must be made, execute retry operation with the user program. The drive unit comes to trip if the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the drive unit returns reply data 3) to the computer again. The drive unit comes to trip if the number of consecutive data errors reaches or exceeds the parameter setting.

(3) Communication operation presence/absence and data format types

- Data communication between the computer and drive unit is made in ASCII code (hexadecimal code).
- Communication operation presence/absence and data format types are as follows:

No.	Operation		Run Command	Operation Speed	Multi Command	Parameter Write	Drive unit Reset	Monitor	Parameter Read
1)	Communication request is sent to the drive unit in accordance with the user program in the computer.		A1	A, A2 *3	A3	A, A2 *3	A	B	B
2)	drive unit data processing time		Present	Present	Present	Present	Present	Present	Present
3)	Reply data from the drive unit (Data 1) is checked for error)	No error *1 (Request accepted)	C	C	C1*4	C	C *2	E, E1, E2, E3 *3	E, E2 *3
		With error (Request rejected)	D	D	D	D	D *2	D	D
4)	Computer processing delay time		10ms or more						
5)	Answer from computer in response to reply data 3). (Data 3) is checked for error)	No error *1 (No drive unit processing)	Absent	Absent	Absent (C)	Absent	Absent	Absent (C)	Absent (C)
		With error (Drive unit outputs 3) again.)	Absent	Absent	F	Absent	Absent	F	F

*1 In the communication request data from the computer to the drive unit, 10ms or more is also required after "no data error (ACK)". *(Refer to page 194.)*

*2 Reply from the drive unit to the drive unit reset request can be selected. *(Refer to page 198.)*

*3 When any of "0.01 to 9998" is set in *Pr. 37* and "01" in instruction code, HFF sets data format to A2 or E2. In addition, data format is always A2 and E2 for read or write of *Pr. 37*.

*4 At mode error, and data range error, C1 data contains an error code. *(Refer to page 202.)* Except for those errors, the error is returned with data format D.

- Data writing format

Communication request data from the computer to the drive unit 1)

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	ENQ *1	Drive unit station number *2		Instruction code		*3	Data				Sum check		*4						
A1	ENQ *1	Drive unit station number *2		Instruction code		*3	Data		Sum check		*4								
A2	ENQ *1	Drive unit station number *2		Instruction code		*3	Data						Sum check		*4				
A3	ENQ *1	Drive unit station number *2		Instruction code		*3	Send data type	Receive data type	Data1				Data2				Sum check		*4

Reply data from the drive unit to the computer 3) (No data error detected)

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C	ACK *1	Drive unit station number *2		*4															
C1	STX *1	Drive unit station number *2		Send data type	Receive data type	Error code 1	Error code 2	Data1				Data2				ETX *1	Sum check		*4

Reply data from the drive unit to the computer 3) (With data error)

Format	Number of Characters				
	1	2	3	4	5
D	NAK ∗1	Drive unit station number ∗2		Error code	∗4

∗1 Indicate a control code
∗2 Specify the drive unit station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.
∗3 Set waiting time. When the *Pr. 123 PU communication waiting time setting* is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
∗4 CR, LF code
When data is transmitted from the computer to the drive unit, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the drive unit according to the computer. Whether the CR and LF codes will be present or absent can be selected using *Pr. 124 PU communication CR/LF selection*.

•Data reading format

Communication request data from the computer to the drive unit 1)

Format	Number of Characters								
	1	2	3	4	5	6	7	8	9
B	ENQ ∗1	Drive unit station number ∗2		Instruction code		∗3	Sum check		∗4

Reply data from the drive unit to the computer 3) (No data error detected)

Format	Number of Characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
E	STX ∗1	Drive unit station number ∗2		Read data				ETX ∗1	Sum check		∗4		
E1	STX ∗1	Drive unit station number ∗2		Read data		ETX ∗1	Sum check		∗4				
E2	STX ∗1	Drive unit station number ∗2		Read data						ETX ∗1	Sum check		∗4

Format	Number of Characters						
	1	2	3	4 to 23	24	25	26	27
E3	STX ∗1	Drive unit station number ∗2		Read data (Drive unit model information)	ETX ∗1	Sum check		∗4

Reply data from the drive unit to the computer 3) (With data error)

Format	Number of Characters				
	1	2	3	4	5
D	NAK ∗1	Drive unit station number ∗2		Error code	∗4

Send data from the computer to the drive unit 5)

Format	Number of Characters			
	1	2	3	4
C (Without data error)	ACK ∗1	Drive unit station number ∗2		∗4
F (With data error)	NAK ∗1	Drive unit station number ∗2		∗4

∗1 Indicate a control code
∗2 Specify the drive unit station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.
∗3 Set waiting time. When the *Pr. 123 PU communication waiting time setting* is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
∗4 CR, LF code
When data is transmitted from the computer to the drive unit, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the drive unit according to the computer. Whether the CR and LF codes will be present or absent can be selected using *Pr. 124 PU communication CR/LF selection*.

(4) Data definitions

1) Control code

Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2) Drive unit station number

Specify the station number of the drive unit which communicates with the computer.

3) Instruction code

Specify the processing request, for example, operation or monitoring, given by the computer to the drive unit. Hence, the drive unit can be run and monitored in various ways by specifying the instruction code as appropriate. *(Refer to page 54.)*

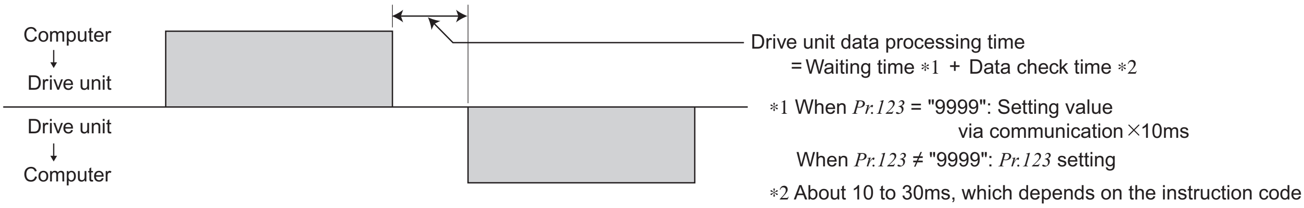
4) Data

Indicates the data such as speed and parameters transferred to and from the drive unit. The definitions and ranges of set data are determined in accordance with the instruction codes. *(Refer to page 54.)*

5) Waiting time

Specify the waiting time between the receipt of data at the drive unit from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments. (example: 1 = 10ms, 2 = 20ms).

When *Pr.123* (waiting time setting)≠ "9999", the *Pr.123* setting is applied to waiting time. Create a communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)



REMARKS

- The data check time changes depending on the instruction code. *(Refer to page 195.)*

6) Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum of the target data converted in ASCII character code.

(Example 1)

Computer → Drive unit	ENQ	Station number		Instruction code		*Waiting time	Data				Sum check code		
		0	1	E	1	1	0	7	A	D	F	4	← Binary code
ASCII Code →	H05	H30	H31	H45	H31	H31	H30	H37	H41	H44	H46	H34	

H30+H31+H45+H31+H31+H30+H37+H41+H44

=H1F4

Sum

* When the *Pr. 123 Waiting time setting* ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

(Example 2)

Drive unit → Computer	STX	Station number		Data read				ETX	Sum check code		
		0	1	1	7	7	0		3	0	← Binary code
ASCII Code →	H02	H30	H31	H31	H37	H37	H30	H03	H33	H30	

H30+H31+H31+H37+H37+H30

= H130

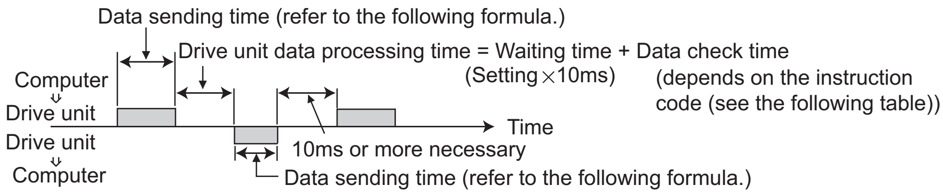
Sum

7) Error code

If any error is found in the data received by the drive unit, its definition is sent back to the computer together with the NAK code.

Error Code	Error Item	Error Description	Drive Unit Operation
H0	Computer NAK error	The number of errors detected consecutively in communication request data from the computer is greater than allowed number of retries.	Brought to trip (E. PUE) if error occurs continuously more than the allowable number of retry times.
H1	Parity error	The parity check result does not match the specified parity	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the drive unit.	
H3	Protocol error	The data received by the drive unit has a grammatical mistake. Alternatively, data reception is not completed within the predetermined time. CR or LF is not as set in the parameter.	
H4	Framing error	The stop bit length differs from the initial setting.	
H5	Overrun error	New data has been sent by the computer before the drive unit completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to trip.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted in other than the computer link operation mode, when operation command source is not selected or during drive unit operation.	Does not accept received data but alarm does not occur.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, speed setting, etc.	
HD	—	—	—
HE	—	—	—
HF	Nomal (no error)	—	—

(5) Response time



[Formula for data sending time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters} \times \text{Communication (Total number of bits)} = \text{data sending time (s)}$$

Number of data characters *(Refer to page 192.)*

Communication (Total number of bits) *(Refer to the following.)*

●Communication specifications

Name		Number of Bits
Stop bit length		1 bit 2 bits
Data length		7 bits 8 bits
Parity check	Present	1 bit
	Absent	0

In addition to the above, 1 start bit is necessary.
Minimum number of total bits.................9 bits
Maximum number of total bits................12 bits

●Data check time

Item	Check Time
Various monitors, operation command, speed setting (RAM)	< 12ms
Parameter read/write, speed setting (EEPROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	No answer

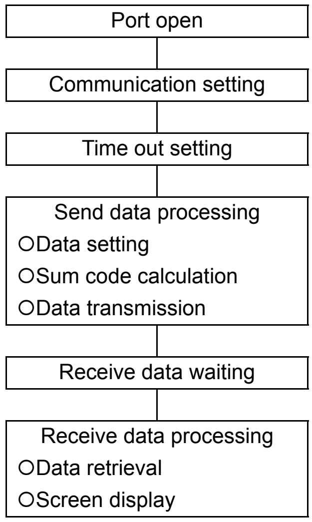
(6) Instructions for the program

1) When data from the computer has any error, the drive unit does not accept that data. Hence, in the user program, always insert a retry program for data error.
2) All data communication, for example, run command or monitoring, are started when the computer gives a communication request. The drive unit does not return any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
3) Program example
   To change the operation mode to computer link operation

Programming example of Microsoft® Visual C++® (Ver.6.0)

```
#include <stdio.h>
#include <windows.h>

void main(void){
        HANDLE          hCom;           //Communication handle
        DCB             hDcb;           //Structure for communication setting
        COMMTIMEOUTS            hTim;   // Structure for time out setting

        char            szTx[0x10];             // Send buffer
        char            szRx[0x10];             // Receive buffer
        char            szCommand[0x10];// Command
        int             nTx,nRx;                // For buffer size storing
        int             nSum;                   // For sum code calculation
        BOOL            bRet;
        int             nRet;
        int             i;

        //**** Opens COM1 port****
        hCom = CreateFile ("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
        if (hCom != NULL) {
                //**** Makes a communication setting of COM1 port****
                GetCommState(hCom,&hDcb);                               // Retrieves current communication information
                hDcb.DCBlength = sizeof(DCB);                           // Structure size setting
                hDcb.BaudRate  = 19200;                                 // Communication speed=19200bps
                hDcb.ByteSize  = 8;                                     // Data length=8 bits
                hDcb.Parity    = 2;                                     // Even parity
                hDcb.StopBits  = 2;                                     // Stop bit=2 bits
                bRet = SetCommState(hCom,&hDcb);                        // Sets the changed communication data
                if (bRet == TRUE) {
                        //**** Makes a time out setting of COM1 port****
                        Get CommTimeouts(hCom,&hTim);                   // Obtains the current time out value
                        hTim.WriteTotalTimeoutConstant = 1000;          // Write time out 1s
                        hTim.ReadTotalTimeoutConstant  = 1000;          // Read time out 1s
                        SetCommTimeouts(hCom,&hTim);                    // Changed time out value setting
                        //**** Sets the command to switch the operation mode of the station 1 drive unit to the Network operation mode ****
                        sprintf(szCommand,"01FB10000");                 // Send data (NET operation write)
                        nTx = strlen(szCommand);                        //Send data size
                        //**** Generates sum code****
                        nSum = 0;                                       // Initialization of sum data
                        for (i = 0;i < nTx;i++) {
                                nSum += szCommand[i];                   // Calculates sum code
                                nSum &= (0xff);                         // Masks data
                        }

                        //**** Generates send data****
                        memset(szTx,0,sizeof(szTx));                    // Initialization of send buffer
                        memset(szRx,0,sizeof(szRx));                    // Initialization of receive buffer
                        sprintf(szTx,"\5%s%02X",szCommand,nSum);// ENQ code+send data+sum code
                        nTx = 1 + nTx + 2;                              // Number of ENQ code+number of send data+number of sum code

                        nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
                        //**** Sending ****
                        if(nRet != 0) {
                                nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
                        //**** Receiving ****
                                if(nRet != 0) {
                                        //**** Displays the receive data ****
                                        for(i = 0;i < nRx;i++) {
                                                printf("%02X ",(BYTE)szRx[i]);// Consol output of receive data
                                                // Displays ASCII coder in hexadecimal. Displays 30 when "0"
                                        }
                                        printf("\n\r");
                                }
                        }
                }
                CloseHandle(hCom);                                      // Close communication port
        }
}
```

General flowchart



(7) Setting items and set data

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

Item		Read/ Write	Instruction Code	Data Definition	Number of Data Digits (Format)
Operation mode		Read	H7B	H0000: Network operation mode H0001: External operation mode, External JOG operation mode H0002: PU operation mode, External/PU combined operation mode 1 and 2, PUJOG operation mode	4 digits (B, E/D)
		Write	HFB	H0000: Network operation mode H0001: External operation mode H0002: PU operation mode (*Pr. 79* = "6")	4 digits (A, C/D)
Monitor	Rotation speed /output frequency	Read	H6F	H0000 to HFFFF: Rotation speed in 1r/min increments Output frequency increments 0.01Hz (when *Pr. 144* = 4, 6 (2, 8, 10)) Machine speed increments 0.001 (when *Pr. 37* = 0.01 to 9998) *2 When "100" is set in *Pr. 52*, the monitor value is different depending on whether the drive unit is at a stop or running. *(Refer to page 134.)*	4 digits (B, E/D), 6 digits (B, E2/D)
	Output current	Read	H70	H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments	4 digits (B, E/D)
	Output voltage	Read	H71	H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments	4 digits (B, E/D)
	Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in instruction code HF3 *2	4 digits (B, E/D), 6 digits (B, E2/D)
	Special monitor Selection No.	Read	H73	H01 to H50: Monitor selection data Refer to the special monitor No. table on *page 200*.	2 digits (B, E1/D)
		Write	HF3		2 digits (A1, C/D)
	Fault records	Read	H74 to H77	H0000 to HFFFF: Two latest fault records b15 b8b7 b0 H74: First fault in past / Latest fault H75: Third fault in past / Second fault in past H76: Fifth fault in past / Fourth fault in past H77: Seventh fault in past / Sixth fault in past Refer to the alarm data table on *page 201*.	4 digits (B, E/D)
Run command (extended)		Write	HF9	Control input commands such as forward rotation (STF) signal and reverse rotation (STR) signal. (For details, *refer to page 201*.)	4 digits (A, C/D)
Run command		Write	HFA		2 digits (A1, C/D)
Drive unit status monitor (extended)		Read	H79	Monitor the states of the output signals such as forward rotation, reverse rotation and Drive unit running (RUN). (For details, *refer to page 202*.)	4 digits (B, E/D)
Drive unit status monitor		Read	H7A		2 digits (B, E1/D)
Set speed (RAM)		Read	H6D	Read the set speed/frequency from the RAM or EEPROM. H0000 to HFFFF: speed setting increments 1r/min. Setting frequency increments 0.01Hz (when *Pr. 144* = 4, 6 (2, 8, 10)) Machine speed increments 0.001 (when *Pr. 37* = 0.01 to 9998) *2	4 digits (B, E/D), 6 digits (B, E2/D)
Set speed (EEPROM)			H6E		
Set speed (RAM)		Write	HED	Write the set speed/frequency into the RAM or EEPROM. H0000 to HFFFF: speed setting increments 1r/min. Setting frequency increments 0.01Hz (when *Pr. 144* = 4, 6 (2, 8, 10)) Machine speed increments 0.001 (when *Pr. 37* = 0.01 to 9998) *2 • To change the set speed/frequency consecutively, write data to the drive unit RAM. (Instruction code: HED)	4 digits (A, C/D), 6 digits (A2, C/D)
Set speed (RAM, EEPROM)			HEE		

*1 *Refer to page 192* for data format (A, A1, A2, A3, B, C, C1, D, E, E1, E2, E3.)
*2 The increment is 0.001 and the data format is E2 or A2 when the following conditions are met: *Pr. 37* = "0.01 to 9998," *Pr. 144* = "2 to 10," and the instruction code HFF = "01."

<table>
<tr><th colspan="2">Item</th><th>Read/ Write</th><th>Instruction Code</th><th>Data Definition</th><th>Number of Data Digits (Format)</th></tr>
<tr><td colspan="2" rowspan="2">Drive unit reset</td><td rowspan="2">Write</td><td rowspan="2">HFD</td><td>H9696: resets the drive unit
• As the drive unit is reset at start of communication by the computer, the drive unit cannot send reply data back to the computer.</td><td>4 digits
(A, C/D)</td></tr>
<tr><td>H9966: resets the drive unit
• When data is sent normally, ACK is returned to the computer and then the drive unit is reset.</td><td>4 digits
(A, D)</td></tr>
<tr><td colspan="2">Fault history batch clear</td><td>Write</td><td>HF4</td><td>H9696: clears the fault history as a batch</td><td>4 digits
(A, C/D)</td></tr>
<tr><td colspan="2">Parameter clear
All clear</td><td>Write</td><td>HFC</td><td>All parameters return to the initial values.
Whether to clear communication parameters or not can be selected according to data. (○: Clear, ×: Not clear)
Refer to page 54 for parameter clear, all clear, and communication parameters.
<table>
<tr><th>Clear Type</th><th>Data</th><th>Communication Pr.</th></tr>
<tr><td rowspan="2">Parameter clear</td><td>H9696</td><td>○</td></tr>
<tr><td>H5A5A</td><td>× *1</td></tr>
<tr><td rowspan="2">All parameter clear</td><td>H9966</td><td>○</td></tr>
<tr><td>H55AA</td><td>× *1</td></tr>
</table>
When clear is executed for H9696 or H9966, communication-related parameter settings also return to the initial values. When resuming operation, set the parameters again.
Executing clear will clear the instruction code HEC, HF3, and HFF settings.
In the password locked status (refer to page 162), only H9966 and H55AA (all parameter clear) are valid.
*1 Turning OFF the power supply while clearing parameters with H5A5A or H55AA also clears the communication parameter settings back to the initial values.</td><td>4 digits
(A, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Parameter</td><td>Read</td><td>H00 to H63</td><td rowspan="2">Refer to the instruction code on page 54 and write and/or read parameter values as required.
When setting Pr. 100 and later, link parameter extended setting must be set.
Data format of Pr. 37 read and write is E2 and A2</td><td>4 digits
(B, E/D),
6 digits
(B, E2/D)</td></tr>
<tr><td>Write</td><td>H80 to HE3</td><td>4 digits
(A, C/D),
6 digits
(A2, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Link parameter extended setting</td><td>Read</td><td>H7F</td><td rowspan="2">Parameter description is changed according to the H00 to H09 setting.
For details of the settings, refer to the parameter instruction code on page 54.</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HFF</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Second parameter changing (instruction code HFF = 1, 9)</td><td>Read</td><td>H6C</td><td rowspan="2">Setting calibration parameter (For calibration parameters, refer to the list of calibration parameters on the next page.)
H00: Speed (The gain speed can also be written using Pr. 125 (instruction code: H99) or Pr. 126 (instruction code: H9A))
H01: Parameter-set analog value
H02: Analog value input from terminal</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HEC</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td colspan="2">Multi command</td><td>Write/ Read</td><td>HF0</td><td>Available for writing 2 commands, and monitoring 2 items for reading data (Refer to page 202 for detail.)</td><td>10 digits
(A3, C1/D)</td></tr>
<tr><td rowspan="2">Drive unit model monitor</td><td>Drive unit model</td><td>Read</td><td>H7C</td><td>Reading drive unit model in ASCII code.
"H20" (blank code) is set for blank area
Example of FR-D720-G
H46, H52, H2D, H44, H37, H32, H30, H2D, H47, H20 ... H20</td><td>20 digits
(B, E3/D)</td></tr>
<tr><td>Capacity</td><td>Read</td><td>H7D</td><td>Reading drive unit capacity in ASCII code.
Data is read in increments of 0.1kW, and rounds down to 0.01kW increments
"H20" (blank code) is set for blank area
Example
0.4K................. "   4" (H20, H20, H20, H20, H20, H34)
0.75K............... "   7" (H20, H20, H20, H20, H20, H37)</td><td>6 digits
(B, E2/D)</td></tr>
</table>

*1 *Refer to page 192* for data format (A, A1, A2, A3, B, C, C1, D, E, E1, E2, E3.)

*2 The increment is 0.001 and the data format is E2 or A2 when the following conditions are met: *Pr. 37* = "0.01 to 9998," *Pr. 144* = "2 to 10," and the instruction code HFF = "01."

4 PARAMETERS

REMARKS

- Set 65520 (HFFF0) as a parameter value "8888" and 65535 (HFFFF) as "9999".
- For the instruction codes HFF, HEC and HF3, their values are held once written but cleared to zero when an drive unit reset or all clear is performed.

Example) When reading the *C3 (Pr. 902)* and *C6 (Pr. 904)* settings from the drive unit of station 0

	Computer Send Data	Drive Unit Send Data	Description
1)	ENQ 00 FF 0 01 7D	ACK 00	Set "H01" to the expansion link parameter.
2)	ENQ 00 EC 0 01 79	ACK 00	Set "H01" to second parameter changing.
3)	ENQ 00 5E 0 0A	STX 00 0000 ETX 20	*C3 (Pr. 902)* is read. 0% is read.
4)	ENQ 00 60 0 F6	STX 00 0000 ETX 20	*C6 (Pr. 904)* is read. 0% is read.

To read/write *C3 (Pr. 902)* and *C6 (Pr. 904)* after drive unit reset or parameter clear, execute from 1) again.

● List of calibration parameters

Parameter	Name	Instruction Code		
		Read	Write	Extended
C2 (902)	Terminal 2 speed setting bias speed	5E	DE	1
C3 (902)	Terminal 2 speed setting bias	5E	DE	1
125 (903)	Terminal 2 speed setting gain speed	5F	DF	1
C4 (903)	Terminal 2 speed setting gain	5F	DF	1
C5 (904)	Terminal 4 speed setting bias speed	60	E0	1
C6 (904)	Terminal 4 speed setting bias	60	E0	1
126 (905)	Terminal 4 speed setting gain speed	61	E1	1
C7 (905)	Terminal 4 speed setting gain	61	E1	1
C42 (934)	PID display bias coefficient	22	A2	9
C43 (934)	PID display bias analog value	22	A2	9
C44 (935)	PID display gain coefficient	23	A3	9
C45 (935)	PID display gain analog value	23	A3	9

[Special monitor selection No.]

Refer to *page 134* for details of the monitor description.

Data	Description	Unit
H01	Rotation speed/Output frequency/ Machine speed *1*4	1/0.01Hz/ 0.001
H02	Output current *4	0.01A
H03	Output voltage *4	0.1V
H05	Rotation speed setting/Frequency setting/Machine speed *1	1/0.01Hz/ 0.001
H08	Converter output voltage	0.1V
H09	Regenerative brake duty	0.1%
H0A	Electronic thermal relay function load factor	0.1%
H0B	Output current peak value	0.01A
H0C	Converter output voltage peak value	0.1V
H0E	Output power	0.01kW
H0F	Input terminal status *2	—
H10	Output terminal status *3	—
H14	Cumulative energization time	1h
H17	Actual operation time	1h
H18	Motor load factor	0.1%
H19	Cumulative power	1kWh
H34	PID set point	0.1%
H35	PID measured value	0.1%
H36	PID deviation	0.1%
H3D	Motor thermal load factor	0.1%
H3E	Drive unit thermal load factor	0.1%
H3F	Cumulative power 2	0.01kWh
H40	PTC thermistor resistance	0.01kΩ
H4D	32-bit cumulative power (lower 16-bit)	1kWh
H4E	32-bit cumulative power (upper 16-bit)	1kWh
H4F	32-bit cumulative power (lower 16-bit)	0.01kWh
H50	32-bit cumulative power (upper 16-bit)	0.01kWh

*1 The data format is 6 digits (E2) when the following conditions are met: *Pr. 37* = "0.01 to 9998," *Pr. 144* = "2 to 10," and the instruction code HFF = "01." (*Refer to page 132* for *Pr. 37* and *Pr. 144*.)

*2 Input terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	RH	RM	RL	—	—	STR	STF

*3 Output terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 The monitored values are retained even if a drive unit fault occurs. Resetting will clear the retained values.

[Fault data]

Refer to *page 253* for details of fault description.

Data	Definition
H00	No fault present
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM

Data	Definition
H40	E.FIN
H52	E.ILF
H60	E.OLT
H61	E.SOT
H70	E.BE
H80	E.GF
H81	E.LF
H90	E.OHT
H91	E.PTC
HB0	E.PE

Data	Definition
HB1	E.PUE
HB2	E.RET
HC0	E.CPU
HC4	E.CDO
HC5	E.IOH
HC7	E.AIE
HC9	E.SAF
HD0	E.OS
HE6	E.PID
HF5	E.5

Fault record display example (instruction code H74)

For read data H3010

(Previous fault ...... THT)

(Latest fault...OC1)

b15 b8b7 b0

0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0

$\underbrace{\text{b15–b8}}_{\text{Previous fault (H30)}}$ $\underbrace{\text{b7–b0}}_{\text{Latest fault (H10)}}$

[Run command]

Item	Instruction Code	Bit Length	Description	Example
Run command	HFA	8 bits	b0: terminal 4 input selection (Fixed) ∗2 b1: forward rotation command (Fixed) b2: reverse rotation command (Fixed) b3: RL (low-speed operation command ∗1 (Variable)) ∗2 b4: RM (middle-speed operation command ∗1 (Variable)) ∗2 b5: RH (high-speed operation command ∗1 (Variable)) ∗2 b6: second function selection (Fixed) ∗2 b7: output stop (Fixed) ∗2	[Example 1] H02... Forward rotation b7 b0 0 0 0 0 0 0 1 0 [Example 2] H00... Stop b7 b0 0 0 0 0 0 0 0 0
Run command (expansion)	HF9	16 bits	b0: terminal 4 input selection (Fixed) ∗2 b1: forward rotation command (Fixed) b2: reverse rotation command (Fixed) b3: RL (low-speed operation command ∗1 (Variable)) ∗2 b4: RM (middle-speed operation command ∗1 (Variable)) ∗2 b5: RH (high-speed operation command ∗1 (Variable)) ∗2 b6: second function selection (Fixed) ∗2 b7: output stop (Fixed) ∗2 b8 to b15: —	[Example 1] H0002... Forward rotation b15 b0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 [Example 2] H0024... Low-speed reverse operation (When *Pr. 182 RH terminal function selection* is set to "0") b15 b0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0

∗1 The signal is the initial setting. The description changes depending on the setting of *Pr. 180 to Pr. 182 (input terminal function selection) (page 117)*.

∗2 When *Pr. 551* = "2" (PU mode control source is PU connector), only forward rotation and reverse rotation can be used.

4

PARAMETERS

[Drive unit status monitor]

Item	Instruction Code	Bit Length	Description	Example
Drive unit status monitor	H7A	8 bits	b0: RUN (drive unit running (Variable)) * b1: Forward rotation (Fixed) b2: Reverse rotation (Fixed) b3: up-to-speed (Fixed) b4: overload (Fixed) b5: — b6: speed detection (Fixed) b7: ABC (fault (Variable)) *	[Example 1] H03... During forward rotation b7 ... b0 0 0 0 0 0 0 1 1 [Example 2] H80... Stop at fault occurrence b7 ... b0 1 0 0 0 0 0 0 0
Drive unit status monitor (expansion)	H79	16 bits	b0: RUN (drive unit running (Variable)) * b1: During forward rotation (Fixed) b2: During reverse rotation (Fixed) b3: up-to-speed (Fixed) b4: overload (Fixed) b5: — b6: speed detection (Fixed) b7: ABC (fault (Variable)) * b8 to b14: — b15: Fault occurrence	[Example 1] H0003... During forward rotation b15 ... b0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 [Example 2] H8080... Stop at fault occurrence b15 ... b0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0

* The signal is the initial setting. The description changes depending on the *Pr. 190, Pr. 192 (output terminal function selection)*.

[Multi command (HF0)]

Sending data format from computer to drive unit

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A3	ENQ	Drive unit station number		Instruction code (HF0)		Waiting time	Send data type*1	Receive data type*2	Data1*3				Data2 *3				Sum check		CR/LF

Reply data format from drive unit to computer (No data error detected)

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C1	STX	Drive unit station number		Send data type*1	Receive data type*2	Error code 1 *5	Error code 2 *5	Data1*4				Data2 *4				ETX	Sum check		CR/LF

*1 Specify the data type of sending data (from computer to drive unit).
*2 Specify the data type of reply data (from drive unit to computer).
*3 Combination of data 1 and data 2 for sending

Data Type	Data 1	Data 2	Remarks
0	Run command (extended)	Set speed (RAM)	Run command (expansion) is same as instruction code HF9 (*Refer to page 201*.) The unit of set speed (frequency) is always by four digits, even when "0.01 to 9998" is set in *Pr. 37* and "01" is set in instruction code HFF.
1	Run command (extended)	Set speed (RAM, EEPROM)	

*4 Combination of data 1 and data 2 for reply

Data Type	Data 1	Data 2	Remarks
0	Drive unit status monitor (extended)	Rotation speed (Output frequency)	Drive unit status monitor (expansion) is same as instruction code H79 (*Refer to page 202*.) Rotation speed (frequency) monitor is in 1 increments. (Numbers after the decimal point are rounded.) Replies the monitor item specified in instruction code HF3 for special monitor.(*Refer to page 200*.)
1	Drive unit status monitor (extended)	Special monitor	

*5 Error code for sending data 1 is set in error code 1, and error code for sending data 2 is set in error code 2.
Mode error (HA), instruction code error (HB), data range error (HC) or no error (HF) is replied. (*Refer to page 195* for more details of the error codes.)

4.17.6 MODBUS RTU communication specifications (Pr. 117, Pr. 118, Pr. 120, Pr. 122, Pr. 343, Pr. 502, Pr. 549, Pr. 779)

Using the MODBUS RTU communication protocol, communication operation or parameter setting can be performed from the PU connector of the drive unit.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">117</td><td rowspan="2">PU communication station number</td><td rowspan="2">0</td><td>0</td><td colspan="4">No reply to the master *1</td></tr>
<tr><td>1 to 247</td><td colspan="4">Drive unit station number specification
Set the drive unit station numbers when two or more drive units are connected to one personal computer.</td></tr>
<tr><td>118</td><td>PU communication speed</td><td>192</td><td>48, 96, 192, 384</td><td colspan="4">Communication speed
The setting value × 100 equals the communication speed.
Example) 9600bps if 96</td></tr>
<tr><td rowspan="3">120</td><td rowspan="3">PU communication parity check</td><td rowspan="3">2</td><td>0</td><td colspan="4">Without parity check
Stop bit length 2 bits</td></tr>
<tr><td>1</td><td colspan="4">With odd parity check
Stop bit length 1 bit</td></tr>
<tr><td>2</td><td colspan="4">With even parity check
Stop bit length 1 bit</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">0s</td><td>0s</td><td colspan="4">RS-485 communication can be made. Note that a communication fault (E.PUE) occurs as soon as the drive unit is switched to the operation mode with command source.</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="4">Communication check (signal loss detection) time interval
If a no-communication state persists for longer than the permissible time, the drive unit is will come to trip (depends on Pr. 502).</td></tr>
<tr><td>9999</td><td colspan="4">No communication check (signal loss detection)</td></tr>
<tr><td>343</td><td>Communication error count</td><td>0</td><td>—</td><td colspan="4">Displays the number of communication errors during MODBUS RTU communication (reading only)</td></tr>
<tr><td rowspan="5">502</td><td rowspan="5">Stop mode selection at communication error</td><td rowspan="5">0</td><td></td><th>At Fault Occurrence</th><th>Indication</th><th>Fault Output</th><th>At Fault Removal</th></tr>
<tr><td>0</td><td>Coasts to stop.</td><td>E.PUE</td><td>Output</td><td>Stop (E.PUE)</td></tr>
<tr><td>1</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Output after stop</td><td>Stop (E.PUE)</td></tr>
<tr><td>2</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Without output</td><td>Automatic restart functions</td></tr>
<tr><td>3</td><td>Continues running at Pr. 779</td><td>—</td><td>Without output</td><td>Operates in normal condition</td></tr>
<tr><td rowspan="2">549</td><td rowspan="2">Protocol selection</td><td rowspan="2">0</td><td>0</td><td colspan="4">Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>1</td><td colspan="4">MODBUS RTU protocol</td></tr>
<tr><td rowspan="2">779</td><td rowspan="2">Operation speed during communication error</td><td rowspan="2">9999</td><td>0 to 12000r/min / 0 to 8000r/min *2*3</td><td colspan="4">Motor runs at the specified speed at a communication error.</td></tr>
<tr><td>9999</td><td colspan="4">Motor runs at the speed used before the communication error.</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 161.*)

*1 When MODBUS RTU communication is performed from the master with address 0 (station number 0) set, broadcast communication is selected and the drive unit does not send a response message. When response from the drive unit is necessary, set a value other than "0" (initial value is 0) in *Pr. 117 PU communication station number*.
Some functions are invalid for broadcast communication. (*Refer to page 206.*)

*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*3 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

NOTE

- **When "1" (MODBUS RTU protocol) is set in *Pr. 549* and "384" (38400bps) in *Pr. 118*, parameter unit (FR-PU07) is disabled. When using the parameter unit (FR-PU07), change parameter using the operation panel.**
- **If a communication error caused by noises occurs while "2" is set in *Pr. 502*, the inverter operation may restart after the deceleration stop operation.**

REMARKS

- Set *Pr. 549 Protocol selection* to "1" to use the MODBUS RTU protocol.
- When PU connector is selected as NET mode operation source (when *Pr. 551 PU mode operation command source selection* ≠"2"), MODBUS RTU communication operation can be performed. *(Refer to page 177.)*

Parameters referred to

Pr. 502 Stop mode selection at communication error ☞ *Refer to page 185.*
Pr. 779 Operation speed during communication error ☞ *Refer to page 185.*

(1) Communication specification

•The communication specifications are given below.

Item		Description	Related Parameter
Communication protocol		MODBUS RTU protocol	Pr. 549
Conforming standard		EIA-485(RS-485)	—
Number of connectable devices		1:N (maximum 32 units), setting is 0 to 247 stations	Pr. 117
Communication speed		Selected among 4800/9600/19200 and 38400bps	Pr. 118
Control procedure		Asynchronous	—
Communication method		Half-duplex	—
Communication	**Character system**	Binary (always 8 bits)	—
	Start bit	1 bit	—
	Stop bit length	Select from the following three types •No parity, stop bit length 2 bits •No odd parity, stop bit length 1 bit •Even parity, stop bit length 1 bit	Pr. 120
	Parity check		
	Error check	CRC code check	—
	Terminator	Not used	—
Waiting time setting		Not used	—

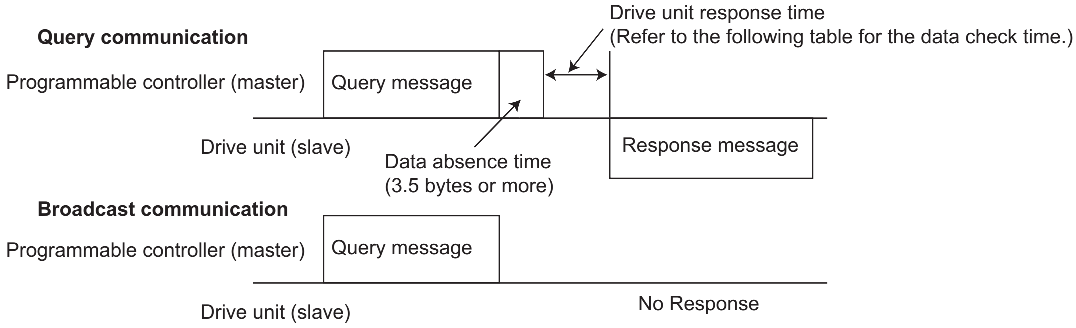
(2) Outline

The MODBUS protocol is the communication protocol developed by Modicon for PLC.
The MODBUS protocol performs serial communication between the master and slave using the dedicated message frame. The dedicated message frame has the functions that can perform data read and write. Using the functions, you can read and write the parameter values from the drive unit, write the input command of the drive unit, and check the operating status. In this product, the drive unit data are classified in the holding register area (register addresses 40001 to 49999). By accessing the assigned holding register address, the master can communicate with the drive unit which is a slave.

REMARKS

There are two different serial transmission modes: ASCII (American Standard Code for Information Interchange) mode and RTU (Remote Terminal Unit) mode. This product supports only the RTU mode in which 1-byte (8-bit) data is transmitted as it is.
Only the communication protocol is defined by the MODBUS protocol, and the physical layer is not stipulated.

(3) Message format



●Data check time

Item	Check Time
Various monitors, operation command, frequency setting (RAM)	<20ms
Parameter read/write, frequency setting (EEPROM)	<50ms
Parameter clear/all clear	<5s
Reset command	No answer

1) Query
The master sends a message to the slave (= drive unit) at the specified address.

2) Normal Response
After receiving the query from the master, the slave executes the requested function and returns the corresponding normal response to the master.

3) Error Response
If an invalid function code, address or data is received, the slave returns it to the master.
When a response description is returned, the error code indicating that the request from the master cannot be executed is added.
No response is returned for the hardware-detected error, frame error and CRC check error.

4) Broadcast
By specifying address 0, the master can send a message to all slaves. All slaves that received the message from the master execute the requested function. In this communication, the slaves do not return a response to the master.

REMARKS
The drive unit performs the function independently of the drive unit station number setting *(Pr. 117)* during broadcast communication.

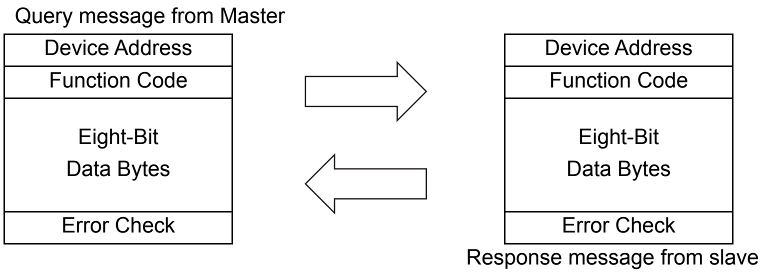
4

PARAMETERS

(4) Message frame (protocol)

●Communication method

Basically, the master sends a query message (question) and the slave returns a response message (response). When communication is normal, Device Address and Function Code are copied, and when communication is abnormal (function code or data code is illegal), bit 7 (= 80h) of Function Code is turned ON and the error code is set to Data Bytes.



The message frame consists of the four message fields as shown above.
By adding the no-data time (T1: Start, End) of 3.5 characters to the beginning and end of the message data, the slave recognizes it as one message.

●Protocol details

The four message fields will be explained below.

Start	1) ADDRESS	2) FUNCTION	3) DATA	4) CRC CHECK		End
				L	H	
T1	8 bits	8 bits	n×8 bits	8 bits	8 bits	T1

<table>
<tr><th>Message Field</th><th>Description</th></tr>
<tr><td>1) ADDRESS field</td><td>The address code is 1 byte long (8 bits) and any of 0 to 247 can be set. Set 0 to send a broadcast message (all-address instruction) or any of 1 to 247 to send a message to each slave.
When the slave responds, it returns the address set from the master.
The value set to Pr. 117 PU communication station number is the slave address.</td></tr>
<tr><td>2) FUNCTION field</td><td>The function code is 1 byte long (8 bits) and any of 1 to 255 can be set. The master sets the function that it wants to request to the slave, and the slave performs the requested operation. The following table gives the supported function codes. An error response is returned if the set function code is other than those in the following table.
When the slave returns a normal response, it returns the function code set by the master. When the slave returns an error response, it returns H80 + function code.
<table>
<tr><th>Code</th><th>Function Name</th><th>Outline</th><th>Broadcast Communication</th></tr>
<tr><td>H03</td><td>Read Holding Register</td><td>Reads the holding register data.</td><td>Not allowed</td></tr>
<tr><td>H06</td><td>Preset Single Register</td><td>Writes data to the holding register.</td><td>Allowed</td></tr>
<tr><td>H08</td><td>Diagnostics</td><td>Function diagnosis (communication check only)</td><td>Not allowed</td></tr>
<tr><td>H10</td><td>Preset Multiple Registers</td><td>Writes data to multiple consecutive holding registers.</td><td>Allowed</td></tr>
<tr><td>H46</td><td>Read Holding Register Access Log</td><td>Reads the number of registers that succeeded in communication last time.</td><td>Not allowed</td></tr>
</table>
Table 1: Function code list</td></tr>
<tr><td>3) DATA field</td><td>The format changes depending on the function code (refer to page 207). Data includes the byte count, number of bytes, description of access to the holding register, etc.</td></tr>
<tr><td>4) CRC CHECK field</td><td>The received message frame is checked for error. CRC check is performed, and 2 byte long data is added to the end of the message. When CRC is added to the message, the low-order byte is added first and is followed by the high-order byte.
The CRC value is calculated by the sending side that adds CRC to the message. The receiving side recalculates CRC during message receiving, and compares the result of that calculation and the actual value received in the CRC CHECK field. If these two values do not match, the result is defined as error.</td></tr>
</table>

(5) Message format types

The message formats corresponding to the function codes in Table 1 on *page 206* will be explained.

- **Read holding register data (H03 or 03)**

Can read the description of **1)** system environment variables, **2)** real-time monitor, **3)** fault history, and **4)** drive unit parameters assigned to the holding register area (refer to the register list on *page 212*).

Query message

1) Slave Address	2) Function	Starting Address		No. of Points		CRC Check	
(8 bits)	H03 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	Byte Count	Data			CRC Check	
(8 bits)	H03 (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 16 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H03.
3) Starting Address	Set the address at which holding register data read will be started. Starting address = Starting register address (decimal)-40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Points	Number of holding registers from which data will be read The number of registers from which data can be read is a maximum of 125.

•Description of normal response

Message	Setting Description
5) Byte Count	The setting range is H02 to HFA (2 to 250). Twice greater than the No. of Point specified at 4) is set.
6) Data: Read data	The number of data specified at 4) is set. Data are read in order of Hi byte and Lo byte, and set in order of starting address data, starting address + 1 data, starting address + 2 data,

Example: To read the register values of 41004 *(Pr. 4)* to 41006 *(Pr. 6)* from the slave address 17 (H11)

Query message

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H11 (8 bits)	H03 (8 bits)	H03 (8 bits)	HEB (8 bits)	H00 (8 bits)	H03 (8 bits)	H77 (8 bits)	H2B (8 bits)

Normal response (Response message)

Slave Address	Function	Byte Count	Data						CRC Check	
H11 (8 bits)	H03 (8 bits)	H06 (8 bits)	H17 (8 bits)	H70 (8 bits)	H0B (8 bits)	HB8 (8 bits)	H03 (8 bits)	HE8 (8 bits)	H2C (8 bits)	HE6 (8 bits)

Read value

Register 41004 *(Pr. 4)*: H1770 (60.00Hz)

Register 41005 *(Pr. 5)*: H0BB8 (30.00Hz)

Register 41006 *(Pr. 6)*: H03E8 (10.00Hz)

- **Write holding register data (H06 or 06)**

Can write the description of 1) system environment variables and 4) drive unit parameters assigned to the holding register area (refer to the register list on *page 212*).

Query message

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Setting of address 0 enables broadcast communication
2) Function	Set H06.
3) Register Address	Address of the holding register to which data will be written Register address = Holding register address (decimal)-40001 For example, setting of register address 0001 writes data to the holding register address 40002.
4) Preset Data	Data that will be written to the holding register The written data is always 2 bytes.

•Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

No response is made for broadcast communication.

Example: To write 60Hz (H1770) to 40014 (running frequency RAM) at slave address 5 (H05).

Query message

Slave Address	Function	Register Address		Preset Data		CRC Check	
H05 (8 bits)	H06 (8 bits)	H00 (8 bits)	H0D (8 bits)	H17 (8 bits)	H70 (8 bits)	H17 (8 bits)	H99 (8 bits)

Normal response (Response message)

Same data as the query message

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the drive unit processing time has elapsed after the previous query.

- **Function diagnosis (H08 or 08)**

A communication check can be made since the query message sent is returned unchanged as a response message (function of sub function code H00).

Sub function code H00 (Return Query Data)

Query message

1) Slave Address	2) Function	3) Subfunction		4) Data		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Subfunction		4) Data		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H08.
3) Subfunction	Set H0000.
4) Data	Any data can be set if it is 2 bytes long. The setting range is H0000 to HFFFF

• Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the drive unit processing time has elapsed after the previous query.

- **Write multiple holding register data (H10 or 16)**

You can write data to multiple holding registers.

Query message

1) Slave Address	2) Function	3) Starting Address		4) No. of Registers		5) ByteCount	6) Data			CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n×2×8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Registers		CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

• Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Setting of address 0 enables broadcast communication
2) Function	Set H10.
3) Starting Address	Address where holding register data write will be started Starting address = Starting register address (decimal)-40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Registers	Number of holding registers where data will be written The number of registers where data can be written is a maximum of 125.
5) Byte Count	The setting range is H02 to HFA (2 to 250). Set a value twice greater than the value specified at 4).
6) Data	Set the data specified by the number specified at 4). The written data are set in order of Hi byte and Lo byte, and arranged in order of the starting address data, starting address + 1 data, starting address + 2 data

- **Description of normal response**

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

Example: To write 0.5s (H05) to 41007 *(Pr. 7)* at the slave address 25 (H19) and 1s (H0A) to 41008 *(Pr. 8)*.

Query message

Slave Address	Function	Starting Address		No. of Registers		Byte Count	Data				CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H04 (8 bits)	H00 (8 bits)	H05 (8 bits)	H00 (8 bits)	H0A (8 bits)	H86 (8 bits)	H3D (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Registers		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

- **Read holding register access log (H46 or 70)**

A response can be made to a query made by the function code H03 or H10.
The starting address of the holding registers that succeeded in access during previous communication and the number of successful registers are returned.
In response to the query for other than the above function code, 0 is returned for the address and number of registers.

Query message

1) Slave Address	2) Function	CRC Check	
(8 bits)	H46 (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8 bits)	H46 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- **Query message setting**

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H46.

- **Description of normal response**

Message	Setting Description
3) Starting Address	The starting address of the holding registers that succeeded in access is returned. Starting address = Starting register address (decimal)-40001 For example, when the starting address 0001 is returned, the address of the holding register that succeeded in access is 40002.
4) No. of Points	The number of holding registers that succeeded in access is returned.

Example: To read the successful register starting address and successful count from the slave address 25 (H19).

Query message

Slave Address	Function	CRC Check	
H19 (8 bits)	H46 (8 bits)	H8B (8 bits)	HD2 (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

Success of two registers at starting address 41007 *(Pr. 7)* is returned.

- **Error response**

An error response is returned if the query message received from the master has an illegal function, address or data. No response is returned for a parity, CRC, overrun, framing or busy error.

NOTE

No response message is sent in the case of broadcast communication also.

Error response (Response message)

1) Slave Address	2) Function	3) Exception Code	CRC Check	
			L	H
(8 bits)	H80 + Function (8 bits)	(8 bits)	(8 bits)	(8 bits)

Message	Setting Description
1) Slave Address	Address received from the master
2) Function	Master-requested function code + H80
3) Exception Code	Code in the following table

Error code list

Code	Error Item	Error Description
01	ILLEGAL FUNCTION	The set function code in the query message from the master cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS *1	The set register address in the query message from the master cannot be handled by the drive unit. (No parameter, parameter read disabled, parameter write disabled)
03	ILLEGAL DATA VALUE	The set data in the query message from the master cannot be handled by the drive unit. (Out of parameter write range, mode specified, other error)

*1 An error will not occur in the following cases.

1) Function code H03 (Read holding register data)
   When the No. of Points is 1 or more and there is one or more holding registers from which data can be read
2) Function code H10 (Write multiple holding register data)
   When the No. of Registers is 1 or more and there is 1 or more holding registers to which data can be written

Namely, when the function code H03 or H10 is used to access multiple holding registers, an error will not occur if a non-existing holding register or read disabled or write disabled holding register is accessed.

REMARKS

An error will occur if all accessed holding registers do not exist.
Data read from a non-existing holding register is 0, and data written there is invalid.

- **Message data mistake detection**

To detect the mistakes of message data from the master, error item are checked for the following errors.
If an error is detected, a trip will not occur.

Error check item

Error Item	Error Description	Drive unit Operation
Parity error	The data received by the drive unit differs from the specified parity (*Pr. 120* setting).	1) *Pr. 343* is increased by 1 at error occurrence. 2)The terminal LF is output at error occurrence.
Framing error	The data received by the drive unit differs from the specified stop bit length (*Pr. 120*).	
Overrun error	The following data was sent from the master before the drive unit completes data receiving.	
Message frame error	The message frame data length is checked, and the received data length of less than 4 bytes is regarded as an error.	
CRC check error	A mismatch found by CRC check between the message frame data and calculation result is regarded as an error.	

(6) MODBUS registers

The following shows the MODBUS registers for system environment variables (read/write), real time monitor items (read), parameters (read/write), fault history data (read/write), and model information monitor items (read).

- System environment variable

Register	Definition	Read/write	Remarks
40002	Drive unit reset	Write	Any value can be written
40003	Parameter clear	Write	Set H965A as a written value.
40004	All parameter clear	Write	Set H99AA as a written value.
40006	Parameter clear *1	Write	Set H5A96 as a written value.
40007	All parameter clear *1	Write	Set HAA99 as a written value.
40009	Drive unit status/control input instruction *2	Read/write	See below.
40010	Operation mode/drive unit setting *3	Read/write	See below.
40014	Running speed (RAM value)	Read/write	According to the *Pr. 37* and *Pr. 144* settings, the selectable speed and frequency are in 0.01Hz increments.
40015	Running speed (EEPROM value)	Write	

*1 The communication parameter values are not cleared.
*2 For write, set the data as a control input instruction.
For read, data is read as an drive unit operating status.
*3 For write, set data as the operation mode setting.
For read, data is read as the operation mode status.

<Drive unit status/control input instruction>

Bit	Definition	
	Control input instruction	Drive unit status
0	Stop command (Fixed)	RUN (drive unit running *2 (Variable))
1	Forward rotation command (Fixed)	During forward rotation (Fixed)
2	Reverse rotation command (Fixed)	During reverse rotation (Fixed)
3	RH (high-speed operation command *1 (Variable))	Up-to-speed (Fixed)
4	RM (middle-speed operation command *1 (Variable))	Overload (Fixed)
5	RL (low-speed operation command *1 (Variable))	0
6	0	Speed detection (Fixed)
7	Second function selection (Fixed)	ABC (fault*2 (Variable))
8	Terminal 4 input selection (Fixed)	0
9	0	0
10	Output stop (Fixed)	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	Fault occurrence

<Operation mode/drive unit setting>

Mode	Read Value	Written Value
EXT	H0000	H0010 *3
PU	H0001	H0011 *3
EXT JOG	H0002	—
PU JOG	H0003	—
NET	H0004	H0014
PU+EXT	H0005	—

The restrictions depending on the operation mode changes according to the computer link specifications.

*1 The signal is the initial setting. Definitions change according to the *Pr. 180 to Pr. 182 (input terminal function selection) (refer to page 117)*.
Each assigned signal is valid or invalid depending on NET. *(Refer to page 177.)*
*2 The signal is the initial setting. Definitions change according to the *Pr. 190, Pr. 192 (output terminal function selection) (refer to page123)*.
*3 Writing is available depending on the *Pr. 79* and *Pr. 340* setting. *Refer to page 176* for details.

- Real time monitor

Refer to page 134 for details of the monitor description.

Register	Description	Unit
40201	Rotation speed/Machine speed/ Output frequency *1*4	1/1/0.01Hz
40202	Output current *4	0.01A
40203	Output voltage *4	0.1V
40205	Rotation speed setting/Machine speed/Frequency setting *1	1/1/0.01Hz
40208	Converter output voltage	0.1V
40209	Regenerative brake duty	0.1%
40210	Electronic thermal relay function load factor	0.1%
40211	Output current peak value	0.01A
40212	Converter output voltage peak value	0.1V
40214	Output power	0.01kW
40215	Input terminal status *2	—
40216	Output terminal status *3	—
40220	Cumulative energization time	1h
40223	Actual operation time	1h

Register	Description	Unit
40224	Motor load factor	0.1%
40225	Cumulative power	1kWh
40252	PID set point	0.1%
40253	PID measured value	0.1%
40254	PID deviation	0.1%
40261	Motor thermal load factor	0.1%
40262	Drive unit thermal load factor	0.1%
40263	Cumulative power 2	0.01kWh
40264	PTC thermistor resistance	0.01kΩ
40277	32-bit cumulative power (lower 16-bit)	1kWh
40278	32-bit cumulative power (upper 16-bit)	1kWh
40279	32-bit cumulative power (lower 16-bit)	0.01kWh
40280	32-bit cumulative power (upper 16-bit)	0.01kWh

*1 Use *Pr. 37* to set 1 increments, and use *Pr. 144* to set 0.01Hz increments. (*Refer to page 132* for *Pr. 37* and *Pr. 144*.)

*2 Input terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15 … b0

—	—	—	—	—	—	—	—	—	RH	RM	RL	—	—	STR	STF

*3 Output terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15 … b0

—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 The monitored values are retained even if a drive unit fault occurs. Resetting will clear the retained values.

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PARAMETERS

- Parameter

Parameter	Register	Parameter Name	Read/ Write	Remarks
0 to 999	**41000 to 41999**	Refer to the parameter list *(page 54)* for the parameter names.	Read/write	The parameter number + 41000 is the register number.
C2 (902)	**41902**	Terminal 2 speed setting bias (Speed)	Read/write	
C3 (902)	**42092**	Terminal 2 speed setting bias (Analog value)	Read/write	The analog value (%) set to *C3 (902)* is read.
	43902	Terminal 2 speed setting bias (Terminal analog value)	Read	The analog value (%) of the voltage applied to the terminal 2 is read.
125 (903)	**41903**	Terminal 2 speed setting gain (Speed)	Read/write	
C4 (903)	**42093**	Terminal 2 speed setting gain (Analog value)	Read/write	The analog value (%) set to *C4 (903)* is read.
	43903	Terminal 2 speed setting gain (Terminal analog value)	Read	The analog value (%) of the voltage applied to the terminal 2 is read.
C5 (904)	**41904**	Terminal 4 speed setting bias (Speed)	Read/write	
C6 (904)	**42094**	Terminal 4 speed setting bias (Analog value)	Read/write	The analog value (%) set to *C6 (904)* is read.
	43904	Terminal 4 speed setting bias (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
126 (905)	**41905**	Terminal 4 speed setting gain (Speed)	Read/write	
C7 (905)	**42095**	Terminal 4 speed setting gain (Analog value)	Read/write	The analog value (%) set to *C7 (905)* is read.
	43905	Terminal 4 speed setting gain (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
C42 (934)	**41934**	PID display bias coefficient	Read/write	
C43 (934)	**42124**	PID display bias analog value	Read/write	The analog value (%) set to *C43 (934)* is read.
	43934	PID display bias analog value (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
C44 (935)	**41935**	PID display gain coefficient	Read/write	
C45 (935)	**42125**	PID display gain analog value	Read/write	The analog value (%) set to *C45 (935)* is read.
	43935	PID display gain analog value (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.

- Fault history

Register	Definition	Read/write	Remarks
40501	Fault history 1	Read/write	Being 2 bytes in length, the data is stored as "H00○○". Refer to the lowest 1 byte for the error code. Performing write using the register 40501 batch-clears the fault history. Set any value as data.
40502	Fault history 2	Read	
40503	Fault history 3	Read	
40504	Fault history 4	Read	
40505	Fault history 5	Read	
40506	Fault history 6	Read	
40507	Fault history 7	Read	
40508	Fault history 8	Read	

Fault code list

Data	Definition
H00	No fault present
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM

Data	Definition
H40	E.FIN
H52	E.ILF
H60	E.OLT
H61	E.SOT
H70	E.BE
H80	E.GF
H81	E.LF
H90	E.OHT
H91	E.PTC
HB0	E.PE

Data	Definition
HB1	E.PUE
HB2	E.RET
HC0	E.CPU
HC4	E.CDO
HC5	E.IOH
HC7	E.AIE
HC9	E.SAF
HD0	E.OS
HE6	E.PID
HF5	E.5

* *Refer to page 253* for details of fault description.

- Model information monitor

Register	Definition	Read/Write	Remarks
44001 to 44010	Drive unit model	Read	Reading drive unit model in ASCII code. "H20" (blank code) is set for blank area Example of FR-D720-G H46, H52, H2D, H44, H37, H32, H30, H2D, H47, H20................ H20
44011 to 44013	Capacity	Read	Reading drive unit capacity in ASCII code. Data is read in increments of 0.1kW, and rounds down to 0.01kW increments "H20" (blank code) is set for blank area Example 0.75K ...." 7" (H20, H20, H20, H20, H20, H37)

(7) *Pr. 343 Communication error count*

You can check the cumulative number of communication errors.

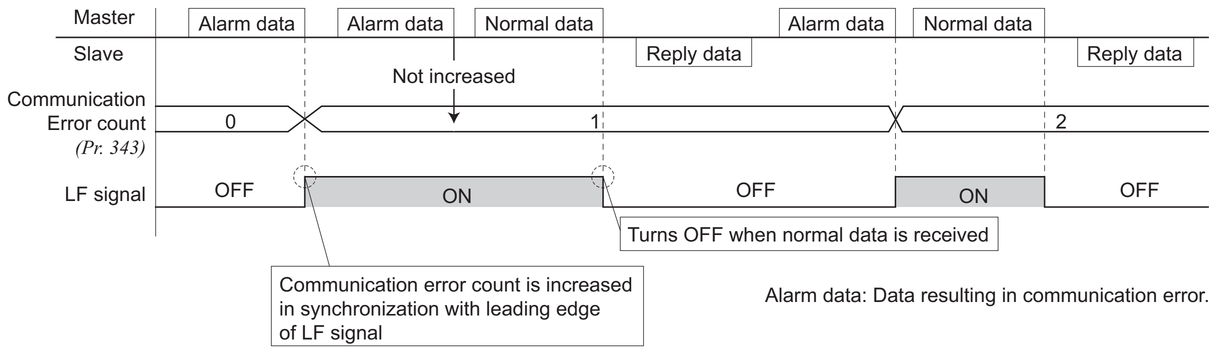
Parameter	Setting Range	Minimum Setting Range	Initial Value
343	(Reading only)	1	0

NOTE

The number of communication errors is temporarily stored into the RAM. As it is not stored into the EEPROM performing a power supply reset or drive unit reset clears the value to 0.

(8) Output terminal LF "alarm output (communication error warnings)"

During a communication error, the alarm (LF) signal is output by open collector output. Assign the used terminal using *Pr. 190* or *Pr. 192 (output terminal function selection)*.



NOTE

The LF signal can be assigned to the output terminal using *Pr. 190* or *Pr. 192*. Changing the terminal assignment may affect the other functions. Set parameters after confirming the function of each terminal.

4

PARAMETERS

4.18 Special operation and speed control

Purpose	Parameter that should be Set		Refer to Page
Perform process control such as pump and air volume.	**PID control**	**Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45**	*216*
Avoid overvoltage alarm due to regeneration by automatic adjustment of rotation speed	**Regeneration avoidance function**	**Pr. 882, Pr. 883, Pr. 885, Pr. 886**	*228*

4.18.1 PID control (Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45)

The drive unit can be used to perform process control, e.g. flow rate, air volume or pressure.
The terminal 2 input signal or parameter setting is used as a set point and the terminal 4 input signal used as a feedback value to constitute a feedback system for PID control.

Parameter Number	Name	Initial Value	Setting Range	Description	
127	**PID control automatic switchover speed**	9999	0 to 12000r/min / 0 to 8000r/min *2*3	Speed at which the control is automatically changed to PID control.	
			9999	Without PID automatic switchover function	
128	**PID action selection**	0	0	PID action is not performed	
			20	PID reverse action	Measured value (terminal 4)
			21	PID forward action	Set value (terminal 2 or *Pr. 133*)
129 *1	**PID proportional band**	100%	0.1 to 1000%	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, for example, hunting occurs. Gain Kp= 1/proportional band	
			9999	No proportional control	
130 *1	**PID integral time**	1s	0.1 to 3600s	When deviation step is input, time (Ti) is the time required for integral (I) action to provide the same manipulated variable as the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.	
			9999	No integral control.	
131	**PID upper limit**	9999	0 to 100% *4	Maximum value If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999	No function	
132	**PID lower limit**	9999	0 to 100% *4	Minimum speed If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999	No function	
133 *1	**PID action set point**	9999	0 to 100% *4	Used to set the set point for PID control.	
			9999	Terminal 2 input is the set point.	
134 *1	**PID differential time**	9999	0.01 to 10s	For deviation ramp input, time (Td) is required for providing only the manipulated variable for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.	
			9999	No differential control.	
553	**PID deviation limit**	9999	0 to 100.0% *4	Y48 signal is output when the absolute value of deviation amount exceeds the deviation limit value.	
			9999	No function	
554	**PID signal operation selection**	0	0 to 3, 10 to 13	Select the operation to be performed at the detection of upper, lower, and deviation limit for the measured value input. The operation for PID output suspension function can be selected.	
575	**Output interruption detection time**	1s	0 to 3600s	The drive unit stops operation if the rotation speed after PID operation remains at less than the *Pr. 576* setting for longer than the time set in *Pr. 575*.	
			9999	Without output interruption function	
576	**Output interruption detection level**	0r/min	0 to 12000r/min / 0 to 8000r/min *2*3	Set the speed at which the output interruption processing is performed.	

Parameter Number	Name	Initial Value	Setting Range	Description
577	**Output interruption cancel level**	1000% *4	900 to 1100% *4	Set the level (*Pr. 577* minus 1000%) at which the PID output interruption function is canceled.
C42 (934) *5	**PID display bias coefficient**	9999	0 to 500.00	Set the coefficient on bias (minimum) side of terminal 4 input.
			9999	Displayed in %.
C43 (934) *5	**PID display bias analog value**	20%	0 to 300.0%	Set the converted % on bias (minimum) side current /voltage of terminal 4 input.
C44 (935) *5	**PID display gain coefficient**	9999	0 to 500.00	Set the coefficient on gain (maximum) side of the terminal 4 input.
			9999	Displayed in %.
C45 (935) *5	**PID display gain analog value**	100%	0 to 300.0%	Set the converted % on gain (maximum) side of current/voltage of terminal 4 input.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

*1 *Pr. 129, Pr. 130, Pr. 133* and *Pr. 134* can be set during operation. These can also be set independently of the operation mode.

*2 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

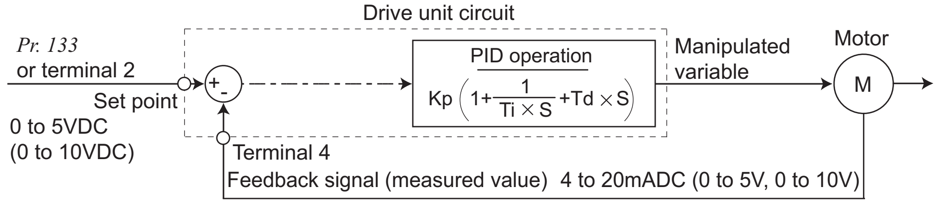
*3 If a value exceeding the upper speed limit of the motor is set, the actual operation will be limited at the maximum rotation speed. The setting range is for the S-PM motor. The maximum setting value differs depending on the number of poles of the applied motor.

*4 If *C42 (Pr. 934)* and *C44 (Pr. 935)* are both set to values other than "9999", the setting range for *Pr. 131 to Pr. 133* and *Pr. 553* become only "9999", and % is not displayed in the setting range of *Pr. 577*. (Values set in *Pr. 553* and *Pr. 577* are converted as differentials.)

*5 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07).

(1) PID control basic configuration

•*Pr. 128* = "20, 21" (measured value input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

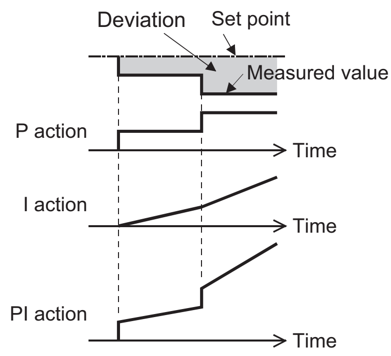
(2) PID action overview

1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of measured value]

(Note) PI action is the sum of P and I actions.

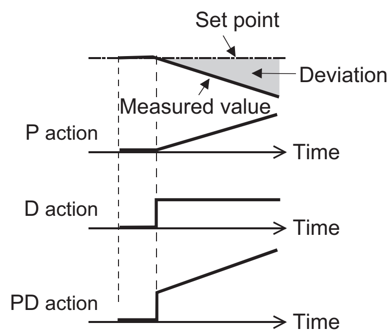


2) PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.

[Operation example for proportional changes of measured value]

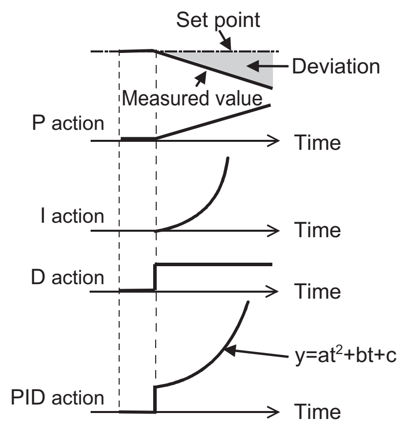
(Note) PD action is the sum of P and D actions.



3) PID action

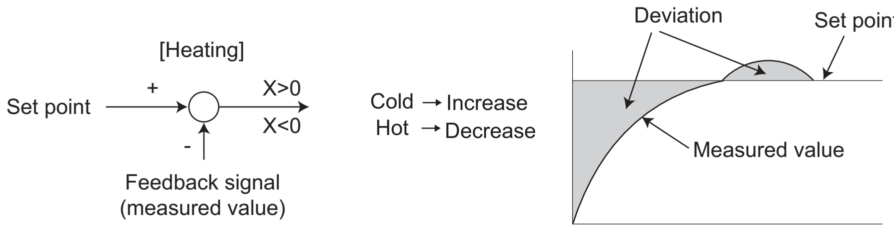
The PI action and PD action are combined to utilize the advantages of both actions for control.

(Note) PID action is the sum of P, I and D actions.



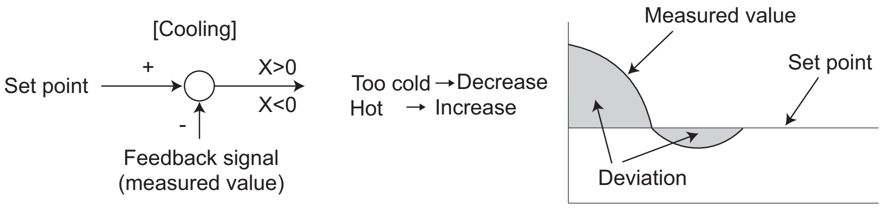
4) Reverse operation

Increases the manipulated variable (rotation speed) if deviation X = (set point - measured value) is positive, and decreases the manipulated variable if deviation is negative.



5) Forward action

Increases the manipulated variable (rotation speed) if deviation X = (set point - measured value) is negative, and decreases the manipulated variable if deviation is positive.

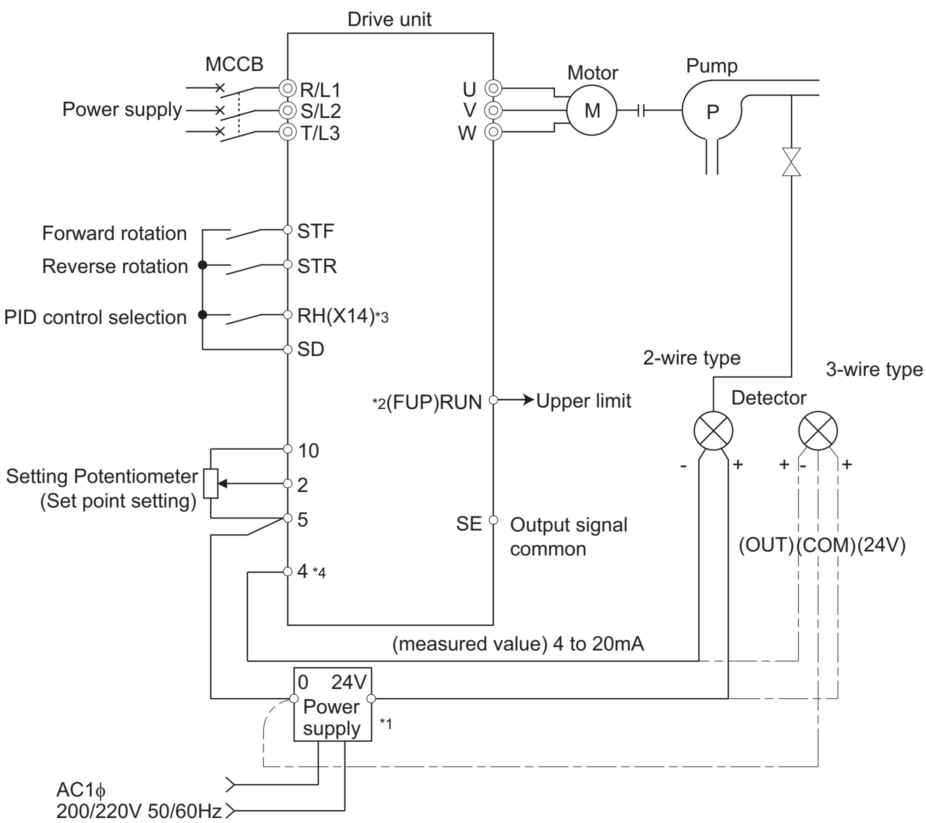


Relationships between deviation and manipulated variable (rotation speed)

	Deviation	
	Positive	Negative
Reverse action	↗	↘
Forward action	↘	↗

(3) Connection diagram

- •Sink logic
- •*Pr. 128* = 20
- •*Pr. 182* = 14
- •*Pr. 190* = 15



*1 The power supply must be selected in accordance with the power specifications of the detector used.

*2 The used output signal terminal changes depending on the *Pr. 190* and *Pr. 192 (output terminal selection)* settings.

*3 The used input signal terminal changes depending on the *Pr. 178 to Pr. 182 (input terminal selection)* settings.

*4 The AU signal need not be input.

(4) I/O signals and parameter setting

- Set "20, 21" in *Pr. 128* to perform PID operation.
- Set "14" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign PID control selection (X14) signal to turn the X14 signal ON.
  When the X14 signal is not assigned, only the *Pr. 128* setting makes PID control valid.
- Enter the set point using the drive unit terminal 2 or *Pr. 133* and enter the measured value to terminal 4.

REMARKS

- When *Pr. 128* = "0" or X14 signal is OFF, normal drive unit operation is performed without PID action.
- Turning ON/OFF of bit of the terminal, to which X14 signal is assigned through network as RS-485 communication, enables PID control.

Signal		Terminal Used	Function	Description	Parameter Setting
Input	X14	Depending on *Pr. 178 to Pr. 182*	PID control selection	Turn ON X14 signal to perform PID control. *1	Set 14 in any of *Pr. 178* to *Pr. 182*.
	X64		PID forward/ reverse action switchover	By turning ON X64, forward action can be selected for PID reverse action (*Pr. 128* = 20), and reverse action for forward action (*Pr. 128* = 21).	Set 64 in any of *Pr. 178 to Pr. 182*.
	X72		PID integral value reset	ON: Integral and differential values are reset OFF: Normal processing	Set 72 in any of *Pr. 178 to Pr. 182*.
	2	2 *5	Set point input	You can input the set point for PID control.*4	*Pr. 128* = 20, 21, *Pr. 133* = 9999
				0 to 5V ....0 to 100%	*Pr. 73* = 1 *2, 11
				0 to 10V ....0 to 100%	*Pr. 73* = 0, 10
	PU	—	Set point input	Set the set point *(Pr. 133)* from the operation panel.	*Pr. 128* = 20, 21 *Pr. 133* = 0 to 100%
	4	4 *5	Measured value input	Input the signal from the detector (measured value signal).	*Pr. 128* = 20, 21
				4 to 20mA ....0 to 100%	*Pr. 267* = 0 *2
				1 to 5V ....0 to 100%	*Pr. 267* = 1
				2 to 10V ....0 to 100%	*Pr. 267* = 2
Output	FUP	Depending on *Pr. 190* or *Pr. 192*	Upper limit output	Output to indicate that the measured value signal exceeded the maximum value *(Pr. 131)*.	*Pr. 128* = 20, 21 *Pr. 131* ≠ 9999 Set 15 or 115 in *Pr. 190* or *Pr. 192*. *3
	FDN		Lower limit output	Output when the measured value signal falls below the minimum value *(Pr. 132)*.	*Pr. 128* = 20, 21 *Pr. 132* ≠ 9999 Set 14 or 114 in *Pr. 190* or *Pr. 192*. *3
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	Set 16 or 116 in *Pr. 190* or *Pr. 192*. *3
	PID		During PID control activated	Turns ON during PID control.	Set 47 or 147 in *Pr. 190* or *Pr. 192*. *3
	SLEEP		PID output interruption	Turns ON when the PID output interruption function is performed.	*Pr. 575* ≠ 9999 Set 70 or 170 in *Pr. 190* or *Pr. 192*. *3
	Y48		PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	*Pr. 553* ≠ 9999 Set 48 or 148 in any of *Pr. 190* or *Pr. 192*. *3
	SE	SE	Output terminal common	Common terminal for open collector output terminal.	

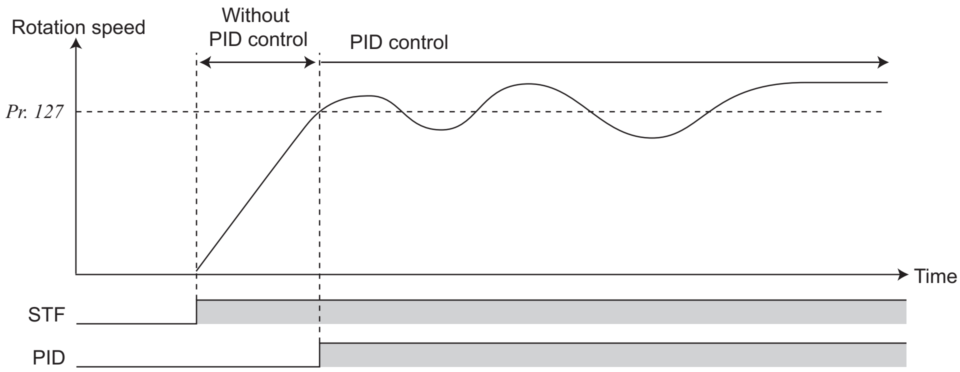
*1 When the X14 signal is not assigned, only the *Pr. 128* setting makes PID control valid.
*2 The shaded area indicates the parameter initial value.
*3 When 100 or larger value is set in any of *Pr. 190* and *Pr. 192 (output terminal function selection)*, the terminal output has negative logic. *(Refer to page 123 for details.)*
*4 When *Pr. 561 PTC thermistor protection level* ≠"9999", terminal 2 is not available for set point input. Use *Pr. 133* for set point input.
*5 When the voltage/current input specifications were changed using *Pr. 73* and *Pr. 267*, be sure to make calibration. *(Refer to page 224 for calibration examples for PID control.)*

NOTE

- **Changing the terminal function using any of *Pr. 178 to Pr. 182, Pr. 190, Pr. 192,* and *Pr. 197* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **When the *Pr. 267* setting was changed, check the voltage/current input switch setting. Different setting may cause a fault, failure or malfunction. (*Refer to page 147* for setting.)**
- **Make sure to perform calibration after changing the voltage/current input signal assigned to the terminal 4 with *Pr. 267* setting and the voltage/current input switchover.**

(5) PID automatic switchover control *(Pr. 127)*

- The system can be started up without PID control only at a start.
- When the speed is set to *Pr. 127 PID control automatic switchover speed*, the drive unit starts up without PID control from a start until rotation speed is reached to the set speed of *Pr. 127*, and then it shifts to PID control. Once the system has entered PID control operation, it continues PID control even if the rotation speed falls to or below *Pr.127*.



(6) Selecting operation to be performed at the output of Upper limit (FUP) signal, Lower limit (FDN) signal, and PID deviation limit (Y48) signal (*Pr. 554*)

You can select the operation to be performed at the detection of upper, lower and deviation limit for the measured value input. With *Pr. 554 PID signal operation selection*, signal output or signal output + alarm stop (E.PID) can be selected for each of upper limit output (FUP) signal, lower limit output (FDN) signal, and PID deviation limit (Y48) signal.

Pr. 554 Setting	FUP Signal, FDN Signal *	Y48 Signal *	SLEEP Function
0 (Initial value)	Only signal output	Only signal output	Drive unit coasts to a stop at the start of SLEEP operation
1	Signal output + stop by fault (E.PID)		
2	Only signal output	Signal output + stop by fault (E.PID)	
3	Signal output + stop by fault (E.PID)		
10	Only signal output	Only signal output	Drive unit decelerates to a stop at the start of SLEEP operation
11	Signal output + stop by fault (E.PID)		
12	Only signal output	Signal output + stop by fault (E.PID)	
13	Signal output + stop by fault (E.PID)		

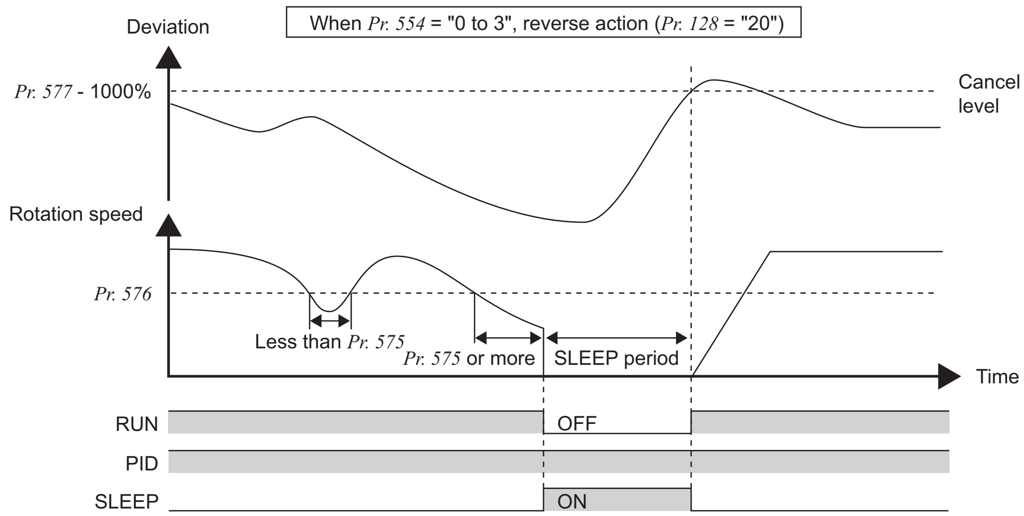
* When the settings for *Pr. 131 PID upper limit*, *Pr. 132 PID lower limit*, and *Pr. 553 PID deviation limit*, which corresponds with FUP, FDN, and Y48 signals, are "9999" (no function), the signal is not output, or the alarm stop is not performed.

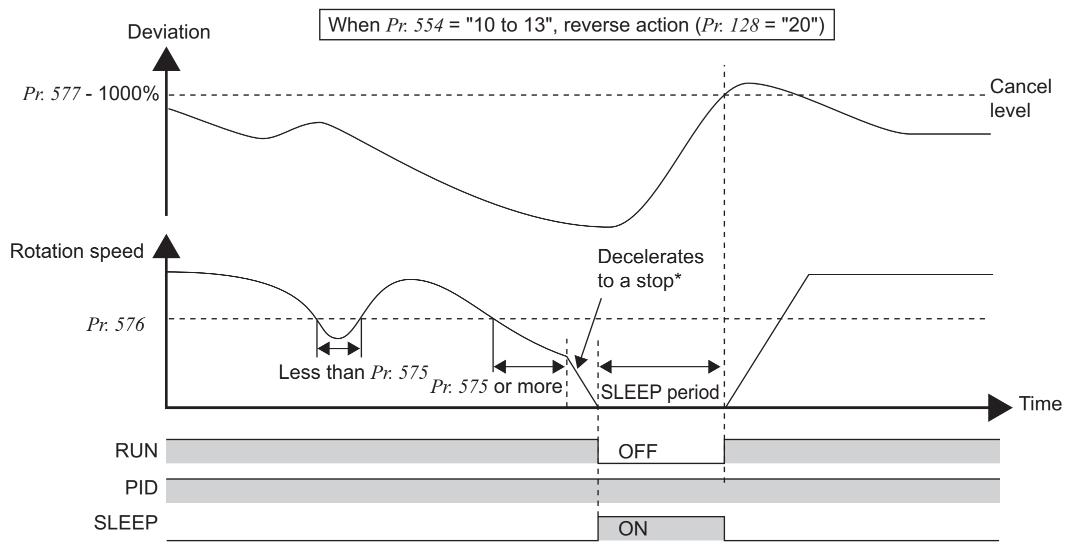
(7) PID output suspension function (SLEEP function) (SLEEP signal, *Pr. 554, Pr. 575 to Pr. 577*)

- The drive unit stops operation if the rotation speed after PID operation remains at less than the *Pr. 576 Output interruption detection level* setting for longer than the time set in *Pr. 575 Output interruption detection time*. (In this condition, setting *Pr. 554 PID signal operation selection* = "0 to 3" coasts the motor (output shutoff) to a stop at SLEEP operation start, and setting "10 to 13" decelerates the motor at SLEEP operation start according to the set deceleration time (*Pr. 8* setting, etc.).) This function can reduce energy consumption in the low-efficiency, low-speed range.

Pr. 554 Setting	SLEEP Function	FUP Signal, FDN Signal	Y48 Signal
0 (Initial value)	Drive unit coasts to a stop at the start of SLEEP operation	Only signal output	Only signal output
1		Signal output + stop by fault (E.PID)	
2		Only signal output	Signal output + stop by fault (E.PID)
3		Signal output + stop by fault (E.PID)	
10	Drive unit decelerates to a stop at the start of SLEEP operation	Only signal output	Only signal output
11		Signal output + stop by fault (E.PID)	
12		Only signal output	Signal output + stop by fault (E.PID)
13		Signal output + stop by fault (E.PID)	

- When the deviation (= set point - measured value) reaches the PID output shutoff cancel level (*Pr. 577* setting -1000%) while the PID output interruption function is ON, the PID output interruption function is canceled and PID control operation is resumed automatically.
- While the PID output interruption function is ON, the PID output interruption (SLEEP) signal is output. At this time, the Drive unit running (RUN) signal is OFF, and the PID control operating (PID) signal is ON.
- For the terminal used for the SLEEP signal output, assign the function by setting "70" (positive logic) or "170" (negative logic) in *Pr. 190* or *Pr. 192 (output terminal function selection)*.





* When the output rises to the output interruption cancel level during deceleration to a stop, output interruption gets cancelled, and the drive unit accelerates again to continue PID control. *Pr. 576 Output interruption detection level* is invalid during deceleration.

(8) PID monitor function

- The PID control set point, measured value and deviation value can be displayed on the operation panel and output from terminal FM.
- In the deviation monitor, a negative percent can be displayed as an integer, like 0% as 1000 and so on. (The deviation monitor cannot be output from the terminal FM.)
- For each monitor, set the following value in *Pr. 52 DU/PU main display data selection* and *Pr. 54 FM terminal function selection*.

Setting	Monitor Description	Minimum Increments *	Terminal FM Full Scale *	Remarks
52	**PID set point**	0.1	100%/*C42 (Pr. 934)* or *C44 (Pr. 935)*	—
53	**PID measured value**	0.1		
54	**PID deviation**	0.1	—	Value cannot be set to *Pr. 54*. Displays 1000 when the PID deviation is 0%.

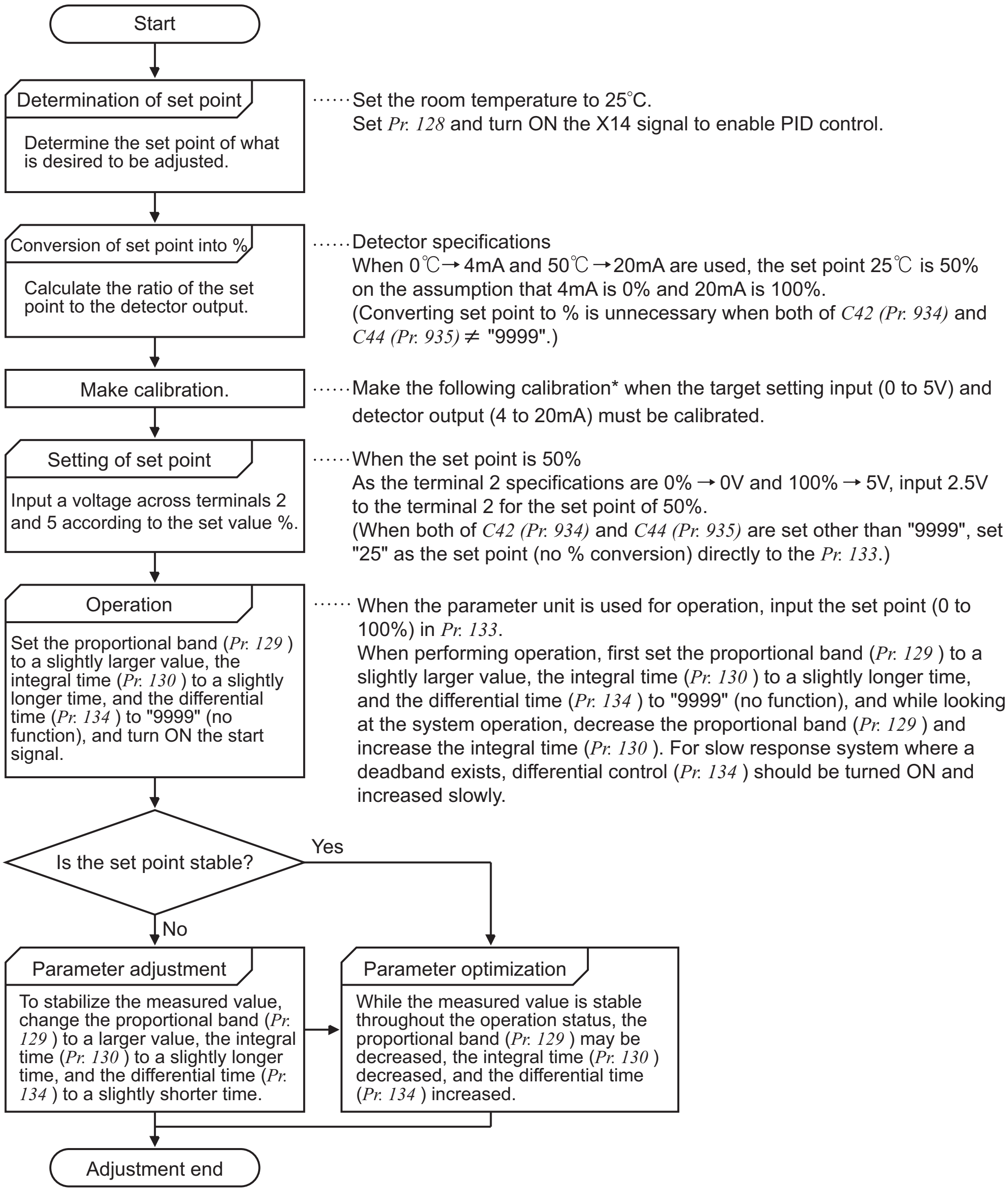
* When neither of *C42 (Pr. 934)* nor *C44 (Pr. 935)* setting is "9999", minimum increment changes from % to no unit, and the full scale value for the terminal FM changes from 100% to the larger value between *C42 (Pr. 934) PID display bias coefficient* and *C44 (Pr. 935) PID display gain coefficient*. (The smaller value between *C42 (Pr. 934)* and *C44 (Pr. 935)* becomes the minimum value.)

(9) Adjustment procedure

Parameter setting	Adjust the PID control parameters, *Pr. 127* to *Pr. 134*, *Pr. 553*, *Pr. 554* or *Pr. 575 to Pr. 577*.
Terminal setting	Set the I/O terminals for PID control (*Pr. 178* to *Pr. 182 (input terminal function selection), Pr. 190* and *Pr. 192 (output terminal function selection)*)
Turn ON the X14 signal.	When X14 signal is not assigned, setting a value other than "0" in *Pr. 128* activates PID operation.
Operation	

(10) Calibration example

A detector of 4mA at 0°C and 20mA at 50°C is used to adjust the room temperature to 25°C under PID control.
The set point is given to across drive unit terminals 2 and 5 (0 to 5V).



* When calibration is required
Using calibration *Pr. 902* and *Pr. 903* (terminal 2) or *Pr. 904* and *Pr. 905* (terminal 4), calibrate the detector output and target setting input.
(For the details of *Pr. 902* to *Pr. 905*, *refer to page 152*.)
However, use *Pr. 934* and *Pr. 935* instead of *Pr. 904* and *Pr. 905* when both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999".
(For the details of *Pr. 934* and *Pr. 935*, *refer to page 225*.)
Make calibration in the PU mode during an drive unit stop.

<Set point input calibration>

1) Setting with terminal 2 input

1.Apply the input voltage of 0% set point setting (e.g. 0V) across terminals 2 and 5.
2.Enter in *C2 (Pr. 902)* the speed which should be output by the drive unit at the deviation of 0% (e.g. 0r/min).
3.In *C3 (Pr. 902)*, set the voltage value at 0%.
4.Apply the voltage of 100% set point (e.g. 5V) across terminals 2 and 5.
5.Enter in *Pr. 125* the speed which should be output by the drive unit at the deviation of 100% (e.g. 3000r/min).
6.In *C4 (Pr. 903)*, set the voltage value at 100%.

2) Setting with *Pr. 133*

(When both or one of *C42 (Pr. 934) and C44 (Pr. 935)* is "9999".)
For the set point, set a % converted value in the range of 0 to 100%.
(When both of *C42 (Pr. 934) and C44 (Pr. 935)* ≠ "9999".)
For the set point, set PID coefficient, which corresponds with 0 to 100%.

<Measured value calibration>

1) When both or one of *C42 (Pr. 934)* and *C44 (Pr. 935)* is "9999"

1.Apply the input current of 0% measured value (e.g. 4mA) across terminals 4 and 5.
2.Make calibration using *C6 (Pr. 904)*.
3.Apply the input current of 100% measured value (e.g. 20mA) across terminals 4 and 5.
4.Make calibration using *C7 (Pr. 905)*.

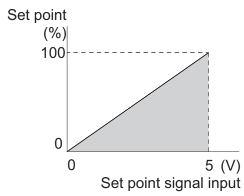
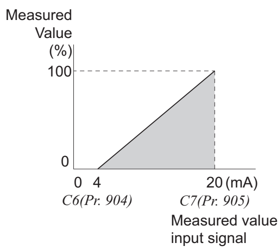
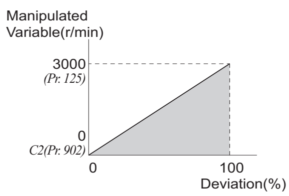
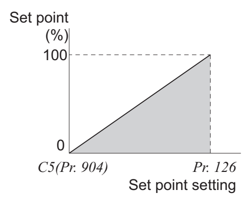
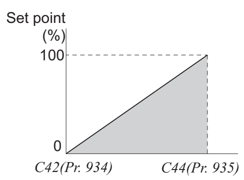
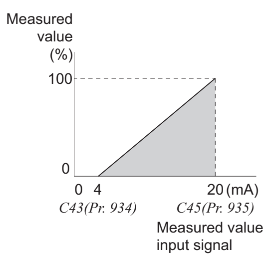
2) When both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999"

1. Apply the input current of 0% measured value (e.g. 4mA) across terminals 4 and 5.
2. Set PID display value at 0% measured value (example: 15(°C)) to *C42 (Pr. 934)* , and calibrate *C43 (Pr. 934)*.
3. Apply the input current of 100% measured value (e.g. 20mA) across terminals 4 and 5.
4. Set PID display value at 100% measured value (example: 35(°C)) to *C44 (Pr. 935)*, and calibrate *C45 (Pr. 935)*.

REMARKS

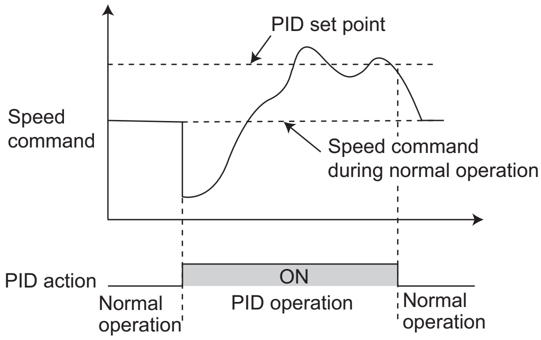
- The speed set in *C5 (Pr. 904)* and *Pr. 126* should be the same as set in *C2 (Pr. 902)* and *Pr. 125* .

The results of the above calibration are as shown below:

<table>
<tr><th>Pr. 133 Setting</th><th>Pr. 934, Pr. 935 Setting</th><th>Set Point Setting</th><th>Measured Value (Terminal 4)</th><th>Manipulated Variable</th></tr>
<tr><td>9999</td><td>—</td><td>(Terminal 2)
</td><td rowspan="2"></td><td rowspan="3"></td></tr>
<tr><td rowspan="2">Other than 9999</td><td>Both or one is 9999</td><td>(Pr. 133)

Set a % converted value in the range of 0 to 100%.</td></tr>
<tr><td>Other than 9999</td><td>(Pr. 133)

Set PID coefficient corresponding with 0 to 100%.</td><td></td></tr>
</table>

NOTE

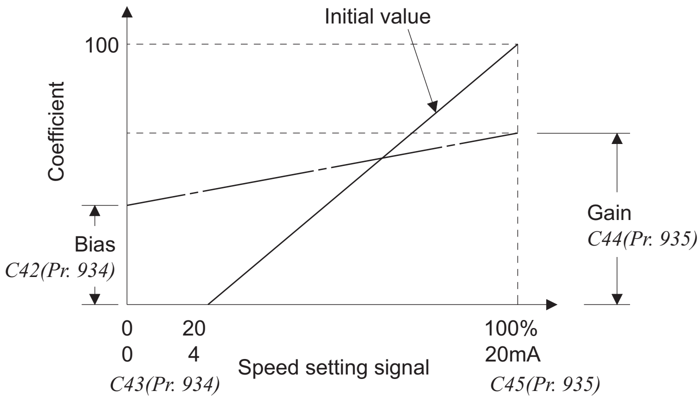
- **If the RH, RM, RL, REX signal (multi-speed) or JOG signal (Jog operation) is entered with the X14 signal ON, PID control is stopped and multi-speed or Jog operation is started.**
- **If the setting is as follows, PID control becomes invalid.**
  Pr. 79 Operation mode selection **= "6" (Switchover mode)**
  The drive unit is at a stop with *Pr. 261 Power failure stop selection* **selected.**
- **Changing the terminal function using any of** *Pr. 178 to Pr. 182, Pr. 190, Pr. 192* **may affect the other functions. Set parameters after confirming the function of each terminal.**
- **When PID control is selected, the minimum speed is the speed set in** *Pr. 902* **and the maximum speed is the speed set in** *Pr. 903*.
  (*Pr. 1 Maximum setting* **and** *Pr. 2 Minimum setting* **settings are also valid.)**
- **The remote operation function is invalid during PID operation.**
- **When the control is switched to PID control during normal operation, the speed command value calculated by PID operation using 0r/min as standard is used without the speed during the operation.**



Operation when control is switched to PID control during normal operation

(11) Bias and gain calibration for PID displayed values (*C42 (Pr. 934) to C45 (Pr. 935)*)

- When both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999", bias/gain calibration is available for analog value of set point, measured value, deviation value to perform PID control.
- "Bias" / "gain" function can adjust the relation between PID displayed coefficient and measured value input signal. Examples of measured value input signals are 0 to 5VDC, 0 to 10VDC, or 4 to 20mADC, and they are externally input.
- Set PID display bias coefficient for terminal 4 input with *C42 (Pr. 934)*.
  (Initial value is the coefficient for 4mA.)
- Set PID display gain coefficient for 20mA of the speed command current (4 to 20mA) with *C44 (Pr. 935)*.
- When both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999" and *Pr. 133* is set as the set point, the setting of *C42 (Pr. 934)* is treated as 0%, and *C44 (Pr. 935)* as 100%.



- Three methods of bias/gain adjustment for PID displayed values are the following.
  (a)Method to adjust any point by application of voltage (current) across the terminals 4 and 5.
  (b)Method to adjust any point without application of voltage (current) across terminals 4 and 5.
  (c)Method to adjust only the speed without adjusting the voltage (current).
  (For the detail of (a) to (c), *refer to page 152*.
  Make adjustment by assuming *C7 (Pr. 905)* as *C45 (Pr. 935)*, and *Pr. 126* as *C44 (Pr. 935)*.)

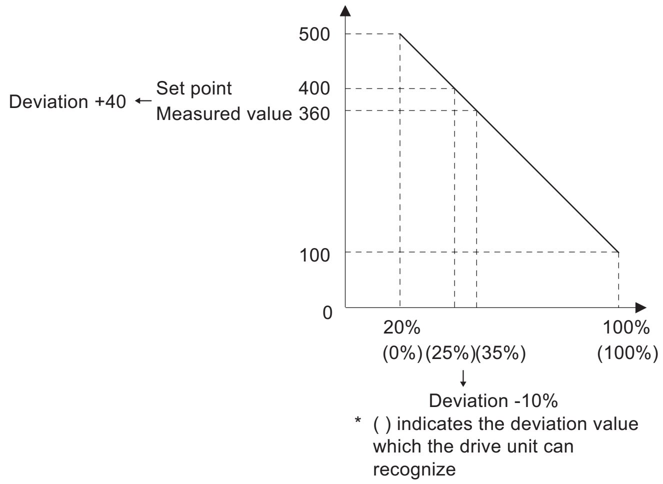
NOTE

- **When the voltage/current input specifications are changed with voltage/current input switch and using** *Pr. 73* **and** *Pr. 267***, be sure to make calibration.**

- Take caution when the following condition is satisfied because the drive unit recognizes the deviation value as a negative (positive) value even though a positive (negative) deviation is given:
  Pr. 934 PID display bias coefficient > *Pr. 935 PID display gain coefficient*
  To perform a reverse operation, set the forward operation in *Pr. 128 PID action selection*. To perform a forward operation, set the reverse operation in *Pr. 128*. In this case, the PID output shutoff release level is (1000 - *Pr. 577*).

Pr. 934 < *Pr. 935* (normal setting)		*Pr. 934* ≥ *Pr. 935*	
Reverse operation	Reverse operation setting to *Pr. 128*	Reverse operation	Forward operation setting to *Pr. 128*
Forward operation	Forward operation setting to *Pr. 128*	Forward operation	Reverse operation setting to *Pr. 128*
PID output shutoff release level	*Pr. 577* - 1000	PID output shutoff release level	1000 - *Pr. 577*

(Example) Set the following: *Pr. 934* = "500" and 20% (4mA is applied), *Pr. 935* = "100" and 100% (20mA is applied).
When the set point=400 and the measured value=360, the deviation is +40 (>0), but the drive unit recognizes the deviation with -10% (<0). Because of this, operation amount does not increase in the reverse operation setting.
The operation amount increases when the forward operation is set.
To perform PID output shutoff release at deviation of +40 or higher, set *Pr. 577* = "960."



(12) Analog input display unit changing *(Pr. 241)*

- You can change the analog input display unit (%/V, mA) for analog input bias/gain calibration.
- Depending on the terminal input specification set to *Pr. 73*, *Pr. 267*, and voltage/current input switch the display units of *C43 (Pr. 934), C45 (Pr. 935)* change as shown below.
- If the *Pr. 241* setting is changed, the units of *C3 (Pr. 902), C4 (Pr. 903), C6 (Pr. 904), and C7 (Pr. 905)* will change too. *(Refer to page 153.)*

Analog Command (terminal 4) (depending on *Pr. 73*, *Pr. 267*, and voltage/current input switch)	*Pr. 241* = 0 (initial value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → 0 to 100% (0.1%) display	0 to 100% → 0 to 5V (0.01V) display
0 to 10V input	0 to 10V → 0 to 100% (0.1%) display	0 to 100% → 0 to 10V (0.01V) display
0 to 20mA input	0 to 20mA → 0 to 100%(0.1%) display	0 to 100% → 0 to 20mA (0.01mA) display

Parameters referred to

Pr. 59 Remote function selection ☞ *Refer to page 93.*
Pr. 73 Analog input selection ☞ *Refer to page 147.*
Pr. 79 Operation mode selection ☞ *Refer to page 164.*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 117.*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 123.*
Pr. 561 PTC thermistor protection level ☞ *Refer to page 101.*
C2 (Pr. 902) to C7 (Pr. 905) Speed setting voltage (current) bias/gain ☞ *Refer to page 152.*

4.18.2 Regeneration avoidance function (Pr. 665, Pr. 882, Pr. 883, Pr. 885, Pr. 886)

This function detects a regeneration status and increases the speed to avoid the regenerative status.

- Possible to avoid regeneration by automatically increasing the speed to continue operation if the fan happens to rotate faster than the set speed due to the effect of another fan in the same duct.

Parameter Number	Name	Initial Value	Setting Range	Description
882	**Regeneration avoidance operation selection**	0	0	Regeneration avoidance function invalid
			1	Regeneration avoidance function is always valid
			2	Regeneration avoidance function is valid only during a constant speed operation
883	**Regeneration avoidance operation level**	200V class: 400 VDC 400V class: 780 VDC	300 to 800V	Bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvoltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the "power supply voltage × $\sqrt{2}$".
885	**Regeneration avoidance compensation speed limit value**	180r/min	0 to 900r/min / 0 to 600r/min *1*2	Limit value of speed which rises at activation of regeneration avoidance function.
			9999	Speed limit invalid
886	**Regeneration avoidance voltage gain**	100%	0 to 200%	Responsiveness at activation of regeneration avoidance. A larger setting will improve responsiveness to the bus voltage change. However, the rotation speed could become unstable. When vibration is not suppressed by decreasing the *Pr. 886* setting, set a smaller value in *Pr. 665*.
665	**Regeneration avoidance speed gain**	100%	0 to 200%	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

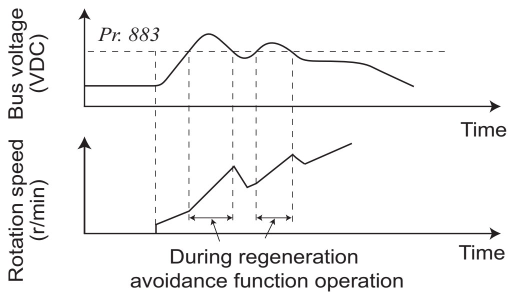
*1 The value left of the slash is for the 2.2K drive unit or lower. The one right of the slash is for the 3.7K drive unit.

*2 The maximum value of the setting ranges are for the S-PM motor. It differs depending on the number of poles of the applied motor.

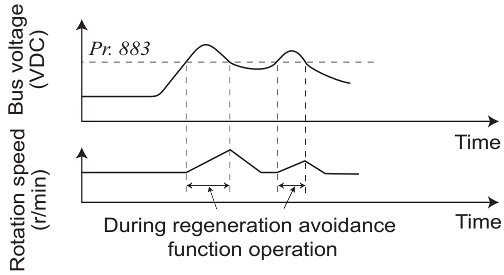
(1) What is regeneration avoidance function? *(Pr. 882, Pr. 883)*

- When the regeneration load is large, the DC bus voltage rises and an overvoltage fault (E. OV□) may occur. When this bus voltage rise is detected and the bus voltage level reaches or exceeds *Pr. 883*, increasing the speed avoids the regeneration status.
- The regeneration avoidance function is always ON when "1" is set in *Pr. 882*, and activated only during a constant speed when "2" is set in *Pr. 882*.

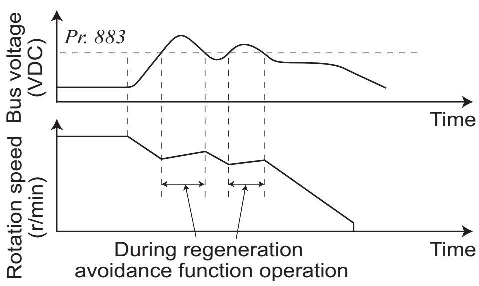
Regeneration avoidance operation example for acceleration



Regeneration avoidance operation example for constant speed



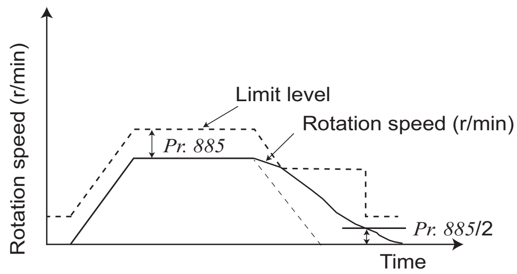
Regeneration avoidance operation example for deceleration



REMARKS

- The acceleration/deceleration ramp while the regeneration avoidance function is operating changes depending on the regeneration load.
- DC bus voltage of the drive unit is usually about $\sqrt{2}$ of the normal input voltage.
  When the input voltage is 220VAC, bus voltage is approximately 311VDC.
  When the input voltage is 440VAC, bus voltage is approximately 622VDC.
  However, it varies with the input power supply waveform.
- The *Pr. 883* setting should be kept higher than the DC bus voltage level. Otherwise, the regeneration avoidance function is always ON even in the non-regeneration status and the speed increases.
- While overvoltage stall (oL) is activated only during deceleration and stops the rotation speed, the regeneration avoidance function is always ON (*Pr. 882* = "1") or activated only during a constant speed (*Pr. 882* = "2") and increases the speed according to the regeneration amount.

(2) Limit regeneration avoidance operation speed *(Pr. 885)*



You can limit the rotation speed compensated (increased) by the regeneration avoidance function.

- The speed is limited to the rotation speed (speed prior to regeneration avoidance operation) + *Pr. 885 Regeneration avoidance compensation speed limit value* during acceleration or constant speed.
  If the regeneration avoidance speed exceeds the limit value during deceleration, the limit value is held until the rotation speed falls to 1/2 of *Pr. 885*.
- When the speed increased by regeneration avoidance function has reached *Pr. 1 Maximum setting*, it is limited to the maximum speed.
- When *Pr. 885* is set to "9999", regeneration avoidance function operation speed setting is invalid.

(3) Regeneration avoidance function adjustment *(Pr. 665, Pr. 886)*

- If the speed becomes instable during regeneration avoidance operation, decrease the setting of *Pr. 886 Regeneration avoidance voltage gain*. Reversely, if sudden regeneration causes an overvoltage alarm, increase the setting.
  When vibration is not suppressed by decreasing the *Pr. 886* setting, set a smaller value in *Pr. 665 Regeneration avoidance speed gain*.

NOTE

- **The regeneration avoidance function does not work in a speed range of 7.5 % of the rated motor speed or lower.**
- **When regeneration avoidance operation is performed, oL (overvoltage stall) is displayed and the OL signal is output. Set the operation pattern at an OL signal output using *Pr. 156 Stall prevention operation selection*. Set the output timing of the OL signal using *Pr. 157 OL signal output timer*.**
- **When regeneration avoidance operation is performed, stall prevention is also activated at the same time.**
- **The regeneration avoidance function cannot shorten the actual deceleration time taken to stop the motor. The actual deceleration time depends on the regeneration energy consumption capability. To shorten the deceleration time, consider using the regeneration unit (FR-BU2, FR-CV, FR-HC2) and brake resistor (MRS type, MYS type, FR-ABR etc.) to consume regeneration energy at a constant speed.**
- **When using the regeneration unit (FR-BU2, FR-CV, FR-HC2) and brake resistor (MRS type, MYS type, FR-ABR etc.), set *Pr. 882* to "0 (initial value)" (regeneration avoidance function invalid). When using the regeneration unit, etc. to consume regeneration energy at deceleration, set *Pr. 882* to "2" (regeneration avoidance function valid only at a constant speed).**

Parameters referred to

Pr. 1 Maximum setting Refer to page 87.
Pr. 8 Deceleration time Refer to page 97.
Pr. 22 Stall prevention operation level Refer to page 83.

4.19 Useful functions

Purpose	Parameter that should be Set		Refer to Page
To increase cooling fan life	Cooling fan operation selection	Pr. 244	230
To determine the maintenance time of parts	Drive unit part life display	Pr. 255 to Pr. 259	231
	Maintenance output function	Pr. 503, Pr. 504	235
	Current average value monitor signal	Pr. 555 to Pr. 557	236
Freely available parameter	Free parameter	Pr. 888, Pr. 889	238
To initiate a fault alarm	Fault initiation	Pr. 997	238
To save time for parameter setting	Automatic parameter setting	Pr. 999	239

4.19.1 Cooling fan operation selection (Pr. 244)

You can control the operation of the cooling fan (1.5K or higher) built in the drive unit.

Parameter Number	Name	Initial Value	Setting Range	Description
244	Cooling fan operation selection	1	0	Operates in power-ON status. Cooling fan ON/OFF control invalid (the cooling fan is always ON at power-ON)
			1	Cooling fan ON/OFF control valid The fan is always ON while the drive unit is running. During a stop, the drive unit status is monitored and the fan switches ON/OFF according to the temperature.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

- In either of the following cases, fan operation is regarded as faulty as [FN] is shown on the operation panel, and the fan fault (FAN) and alarm (LF) signals are output.
  - *Pr. 244* = "0"
    When the fan comes to a stop with power-ON.
  - *Pr. 244* = "1"
    When the drive unit is running and the fan stops during fan ON command.

- For the terminal used for FAN signal output, set "25 (positive logic) or 125 (negative logic)" to *Pr. 190* or *Pr. 192 (output terminal function selection)*, and for the LF signal, set "98 (positive logic) or 198 (negative logic)".

NOTE

- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 123.*

4.19.2 Display of the lives of the drive unit parts (Pr. 255 to Pr. 259)

Degrees of deterioration of main circuit capacitor, control circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed by a monitor.
When any part has approached to the end of its life, an alarm can be output by self diagnosis to prevent a fault.
(Use the life check of this function as a guideline since the life except the main circuit capacitor is calculated theoretically.)
For the life check of the main circuit capacitor, the alarm (Y90) signal will not be output if a measuring method of (4) is not performed.

Parameter Number	Name	Initial Value	Setting Range	Description
255	**Life alarm status display**	0	(0 to 15)	Displays whether the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit have reached the life alarm output level or not. (Reading only)
256	**Inrush current limit circuit life display**	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. (Reading only)
257	**Control circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. (Reading only)
258	**Main circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the main circuit capacitor. (Reading only) The value measured by *Pr. 259* is displayed.
259	**Main circuit capacitor life measuring**	0	0, 1 (2, 3, 8, 9)	Setting "1" and turning the power supply OFF starts the measurement of the main circuit capacitor life. When the *Pr. 259* value is "3" after powering ON again, the measuring is completed. Writes deterioration degree in *Pr. 258*.

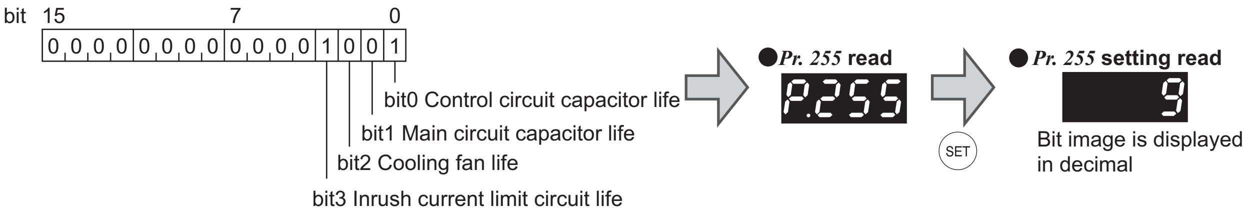
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 161.)*

REMARKS

Since repeated inrush currents at power-ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided.

(1) Life alarm display and signal output (Y90 signal, *Pr. 255*)

- Whether any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit has reached the life alarm output level or not can be checked by *Pr. 255 Life alarm status display* and Life alarm (Y90) signal.



Pr. 255 (decimal)	Bit (binary)	Inrush Current Suppression Circuit Life	Cooling Fan Life	Main Circuit Capacitor Life	Control Circuit Capacitor Life
15	1111	O	O	O	O
14	1110	O	O	O	×
13	1101	O	O	×	O
12	1100	O	O	×	×
11	1011	O	×	O	O
10	1010	O	×	O	×
9	1001	O	×	×	O
8	1000	O	×	×	×
7	0111	×	O	O	O
6	0110	×	O	O	×
5	0101	×	O	×	O
4	0100	×	O	×	×
3	0011	×	×	O	O
2	0010	×	×	O	×
1	0001	×	×	×	O
0	0000	×	×	×	×

O: With warnings, ×: Without warnings

- The Life alarm (Y90) signal turns ON when any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit reaches the life alarm output level.
- For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) to *Pr. 190* or *Pr. 192 (output terminal function selection)*.

NOTE

- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(2) Inrush current limit circuit life display *(Pr. 256)*

- The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in *Pr. 256*.
- Activation of inrush current limit resistor circuit is counted. It is counted every 10,000 times (1%) and counts down from 100% (0 time).
  As soon as 10% (900,000 times) is reached, *Pr. 255* bit 3 is turned ON and also an alarm is output to the Y90 signal.
  The inrush current limit resistor circuit activates under the following conditions:
  - At power-ON
  - At undervoltage occurrence *(Refer to page 256.)*
  - At drive unit reset

(3) Control circuit capacitor life display *(Pr. 257)*

- The deterioration degree of the control circuit capacitor is displayed in *Pr. 257* as a life.
- In the operating status, the control circuit capacitor life is calculated from the energization time and temperature, and is counted down from 100%.
  As soon as the control circuit capacitor life falls below 10%, *Pr. 255* bit 0 is turned ON and also an alarm is output to the Y90 signal.

(4) Main circuit capacitor life display *(Pr. 258, Pr. 259)*

- The deterioration degree of the control circuit capacitor is displayed in *Pr. 258* as a life.
- On the assumption that the main circuit capacitor capacitance at factory shipment is 100%, the capacitor life is displayed in *Pr. 258* every time measurement is made.
  When the measured value falls to or below 85%, *Pr. 255* bit 1 is turned ON and also an alarm is output to the Y90 signal.
- Measure the capacitor capacity according to the following procedure and check the deterioration level of the capacitor capacity.
  1) Check that the motor is connected and at a stop.
  2) Set "1" (measuring start) in *Pr. 259.*
  3) Switch power OFF. The drive unit applies DC voltage to the motor to measure the capacitor capacity when the drive unit turns OFF.
  4) After confirming that the LED of the operation panel is OFF, power ON again.
  5) Check that "3" (measuring completion) is set in *Pr. 259*, read *Pr. 258*, and check the deterioration degree of the main circuit capacitor.

Pr. 259	Description	Remarks
0	No measurement	Initial value
1	Measurement start	Measurement starts when the power supply is switched OFF.
2	During measurement	Only displayed and cannot be set
3	Measurement complete	
8	Forced end	
9	Measurement error	

REMARKS

- When the main circuit capacitor life is measured under the following conditions, "forced end" (*Pr. 259* = "8") or "measuring error" (*Pr. 259* ="9") occurs or it remains in "measuring start" (*Pr. 259* = "1"). Therefore, do not measure in such case.
  In addition, even when "measurement completion" (*Pr. 259* = "3") is confirmed under the following conditions, normal measurement cannot be done.
  (a) FR-HC2 or FR-CV is connected.
  (b) DC power supply is connected to the terminal P/+ and N/-.
  (c) The power supply switched ON during measurement.
  (d) The motor is not connected to the drive unit.
  (e) The motor is running (coasting)
  (f) The drive unit is tripped or a fault occurred when power is OFF.
  (g) The drive unit output is shut off with the MRS signal.
  (h) The start command is given while measuring.
  (i) The parameter unit (FR-PU07) is connected.
  (j) Use terminal PC as power supply.
  (k) I/O terminal of the control terminal block is ON (continuity).
  (l) During PM motor test operation (*Pr. 800* = "9")
- Turning the power ON during measuring before LED of the operation panel turns OFF, it may remain in "measuring" (*Pr. 259* = "2") status. In such case, carry out operation from step 2.
- The motor shaft may move during measuring. Before measuring, make sure that no problem will occur even if the motor shaft moves.

POINT

For accurate life measurement of the main circuit capacitor, wait 3 hours or longer after turning OFF. The temperature left in the main circuit capacitor affects measurement.

WARNING

When measuring the main circuit capacitor capacity (*Pr. 259 Main circuit capacitor life measuring* = "1"), the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.

(5) Cooling fan life display

- The cooling fan speed of 50% or less is detected and "FN" is displayed on the operation panel and parameter unit (FR-PU07). As an alarm display, *Pr. 255* bit 2 is turned ON and also an alarm is output to the Y90 signal.

NOTE

- **For replacement of each part, contact the nearest Mitsubishi Electric FA center.**

Parameters referred to

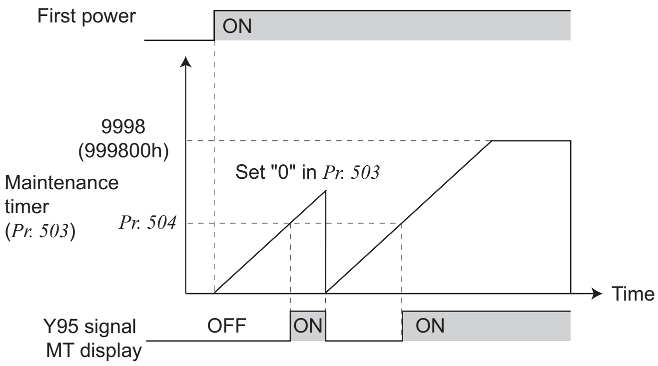
Pr. 800 Control method selection *Refer to page 77.*

4.19.3 Maintenance timer alarm (Pr. 503, Pr. 504)

When the cumulative energization time of the drive unit reaches the parameter set time, the maintenance timer output (Y95) signal is output. (MT) is displayed on the operation panel.
This can be used as a guideline for the maintenance time of peripheral devices.

Parameter Number	Name	Initial Value	Setting Range	Description
503	**Maintenance timer**	0	0 (1 to 9998)	Displays the cumulative energization time of the drive unit in 100h increments. (Reading only) When *Pr. 503* = "1 to 9998", writing the setting value of "0" clears the cumulative energization time. (Writing is disabled when *Pr. 503* = "0".)
504	**Maintenance timer alarm output set time**	9999	0 to 9998	Time taken until when the maintenance timer alarm output (Y95) signal is output.
			9999	No function

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*



- The cumulative energization time of the drive unit is stored into the EEPROM every hour and is displayed in *Pr. 503 Maintenance timer* in 100h increments. *Pr. 503* is clamped at 9998 (999800h).
- When the *Pr. 503* value reaches the time set to *Pr. 504 Maintenance timer alarm output set time* (100h increments), the maintenance timer alarm output (Y95) signal is output.
- For the terminal used for the Y95 signal output, assign the function by setting "95" (positive logic) or "195" (negative logic) to *Pr. 190* or *Pr. 192 (output terminal function selection)*.

NOTE

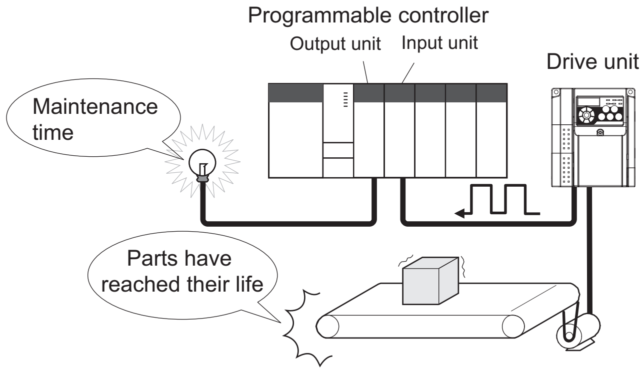
- **The cumulative energization time is counted every hour. The energization time of less than 1h is not counted.**
- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 123.*

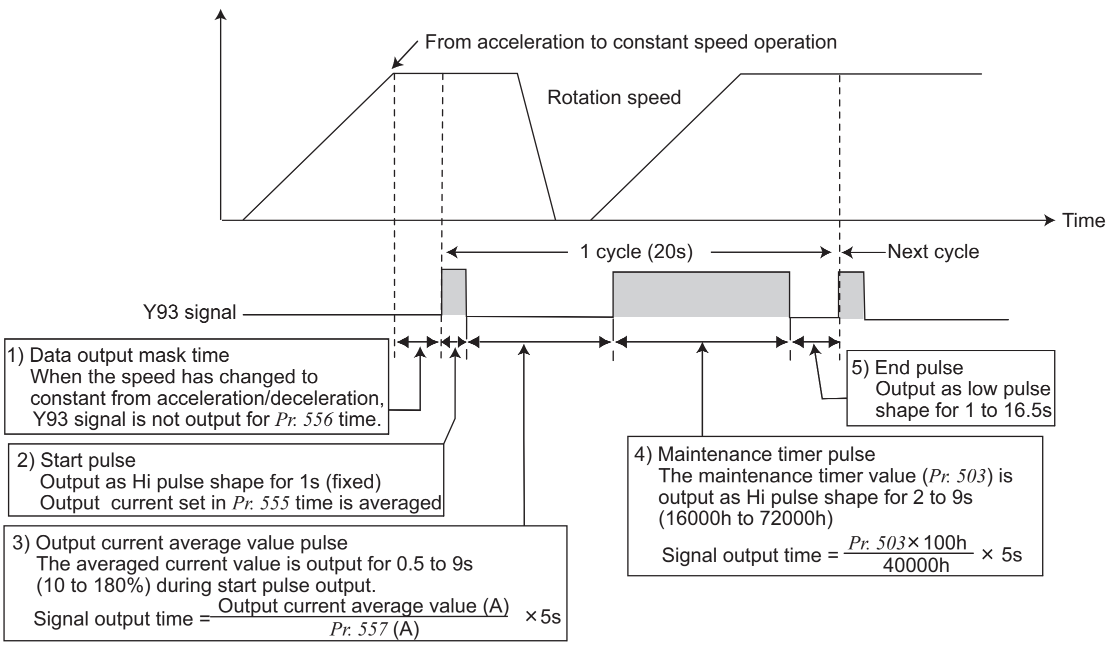
4.19.4 Current average value monitor signal (Pr. 555 to Pr. 557)

The average value of the output current during constant speed operation and the maintenance timer value are output as a pulse to the Current average monitor (Y93) signal.
The pulse width output to the I/O module of the programmable controller or the like can be used as a guideline to know abrasion of machines, elongation of belt and the maintenance time for aged deterioration of devices.
The Current average monitor (Y93) signal is output as pulse for 20s as 1 cycle and repeatedly output during constant speed operation.



Parameter Number	Name	Initial Value	Setting Range	Description
555	**Current average time**	1s	0.1 to 1s	Time taken to average the current during start pulse output (1s).
556	**Data output mask time**	0s	0 to 20s	Time for not obtaining (mask) transient state data.
557	**Current average value monitor signal output reference current**	Rated motor current *	0 to 500A	Reference (100%) for outputting the signal of the current average value.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
The above parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
* *Refer to page 288* for the rated motor current.



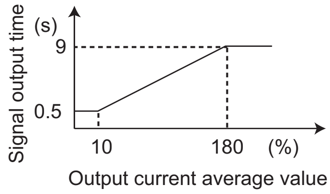
- The pulse output of the Current average monitor (Y93) signal is shown above.
- For the terminal used for the Y93 signal output, assign the function by setting "93" (positive logic) or "193" (negative logic) to *Pr. 190 RUN terminal function selection*. The function cannot be assigned to *Pr. 192 A,B,C terminal function selection*.

1) Setting of *Pr. 556 Data output mask time*
   The output current is unstable (transient state) right after the operation is changed from the acceleration/deceleration state to the constant speed operation. Set the time for not obtaining (mask) transient state data in *Pr. 556*.
2) Setting of *Pr. 555 Current average time*
   The average output current is calculated during Hi output of start pulse (1s). Set the time taken to average the current during start pulse output in *Pr. 555*.

3) Setting of *Pr. 557 Current average value monitor signal output reference current*
Set the reference (100%) for outputting the signal of the current average value. Obtain the time to output the signal from the following calculation.

$$\frac{\textbf{Output current average value}}{\textbf{\textit{Pr. 557} setting}} \times \textbf{5s (Output current average value 100\%/5s)}$$

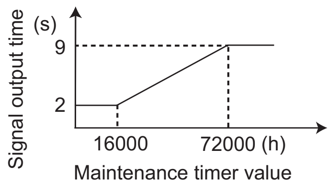
Note that the output time range is 0.5 to 9s and the output time is either of the following values when the output current average value is the corresponding percentage of the *Pr. 557* setting.
Less than 10% ... 0.5s, more than 180% ... 9s
Example) when *Pr. 557* = 10A and the average value of output current is 15A
As 15A/10A x 5s = 7.5, the current average value monitor signal is output as low pulse shape for 7.5s.



4) Setting of *Pr. 503 Maintenance timer*
After the output current average value is output as low pulse shape, the maintenance timer value is output as high pulse shape. The output time of the maintenance timer value is obtained from the following calculation.

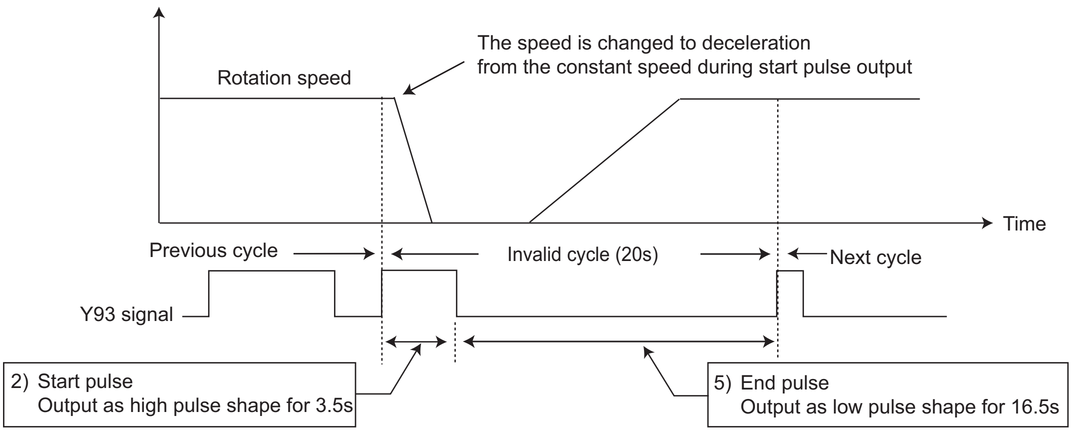
$$\frac{\textbf{\textit{Pr. 503}} \times \textbf{100}}{\textbf{40000h}} \times \textbf{5s} \quad \textbf{(Maintenance timer value 100\%/5s)}$$

Note that the output time range is 2 to 9s, and it is 2s when the *Pr. 503* setting is less than 16000h and 9s when exceeds 72000h.



REMARKS

- Mask of data output and sampling of output current are not performed during acceleration/deceleration.
- When the speed is changed to acceleration/deceleration from constant speed during start pulse output, the data is judged as invalid. The start pulse is output as high pulse shape for 3.5s, and the end signal is output as low pulse shape for 16.5s.
  The signal is output for at least 1 cycle even when acceleration/deceleration state continues after the start pulse output is completed.



- If the drive unit output is in OFF-state after one cycle of the signal output, the Y93 signal is not output until the next constant speed operation.
- If the motor is being accelerated/decelerated after one cycle of the signal output, the Y93 signal maintains a low output (no data output) for 20 seconds.

NOTE

- **Changing the terminal assignment using *Pr. 190* and *Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 123.*
Pr. 503 Maintenance timer ☞ *Refer to page 235.*

4.19.5 Free parameter (Pr. 888, Pr. 889)

You can input any number within the setting range of 0 to 9999.
For example, the number can be used:
- As a unit number when multiple units are used.
- As a pattern number for each operation application when multiple units are used.
- As the year and month of introduction or inspection.

Parameter Number	Name	Initial Value	Setting Range	Description
888	**Free parameter 1**	9999	0 to 9999	Any values can be set. Data is held even if the drive unit power is turned OFF.
889	**Free parameter 2**	9999	0 to 9999	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
The above parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

REMARKS

Pr. 888 and *Pr. 889* do not influence the drive unit operation.

4.19.6 Initiating a fault (Pr. 997)

A fault is initiated by setting the parameter.
This function is useful to check how the system operates at a fault.

Parameter Number	Name	Initial Value	Setting Range	Description
997	**Fault initiation**	9999	16 to 18, 32 to 34, 48, 49, 64, 82, 96, 97, 112, 128, 129, 144, 145, 176 to 178, 192, 196, 197, 199, 201, 208, 230, 245	The setting range is same with the one for fault data codes of the drive unit (which can be read through communication). Written data is not stored in EEPROM.
			9999	The read value is always "9999." This setting does not initiate a fault.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

(1) Fault initiation *(Pr. 997)*

- To initiate a fault, set the assigned number of the fault you want to initiate in *Pr. 997 Fault initiation*.
- The value set in *Pr. 997 Fault initiation* is not stored in EEPROM.
- When a fault occurs, the drive unit trips, and the fault is output (ALM).
- While the initiated fault is occurring, the fault is displayed as the latest fault in the fault history. After a reset, the fault history goes back to the previous status. (The fault generated by the fault initiation function is not saved in the fault history.)
- Perform drive unit reset to cancel the fault.

●Setting for *Pr. 997 Fault initiation* and corresponding faults

Setting (Data code)	Fault
16 (H10)	E.OC1
17 (H11)	E.OC2
18 (H12)	E.OC3
32 (H20)	E.OV1
33 (H21)	E.OV2
34 (H22)	E.OV3
48 (H30)	E.THT
49 (H31)	E.THM
64 (H40)	E.FIN
82 (H52)	E.ILF

Setting (Data code)	Fault
96 (H60)	E.OLT
97 (H61)	E.SOT
112 (H70)	E.BE
128 (H80)	E.GF
129 (H81)	E.LF
144 (H90)	E.OHT
145 (H91)	E.PTC
176 (HB0)	E.PE
177 (HB1)	E.PUE
178 (HB2)	E.RET

Setting (Data code)	Fault
192 (HC0)	E.CPU
196 (HC4)	E.CDO
197 (HC5)	E.IOH
199 (HC7)	E.AIE
201 (HC9)	E.SAF
208 (HD0)	E.OS
230 (HE6)	E.PID
245 (HF5)	E.5

REMARKS

- If a fault is already occurring in the drive unit, a fault cannot be initiated by *Pr. 997*.
- The retry function is invalid for the fault initiated by the fault initiation function.
- If another fault occurs after a fault has been initiated, the fault indication does not change.
  The fault is not saved in the fault history either.

4.19.7 Batch setting Mitsubishi Electric HMI (GOT) connection parameters (Pr. 999)

- Communication parameters for the Mitsubishi Electric HMI (GOT) connection can be set as a batch.
- Multiple parameters are changed automatically. Users do not have to consider each parameter number. (Parameter setting mode)

Parameter Number	Name	Initial Value	Setting Range	Description
999	**Automatic parameter setting**	9999 ∗	10	GOT initial setting (PU connector)
			9999	No action

∗ The read value is always "9999."

(1) Automatic parameter setting *(Pr. 999)*

- Setting *Pr. 999* = "10" will automatically set the communication parameters required to connect a GOT to the PU connector.
- To operate in the parameter setting mode, go to "AUTO" → "GOT", then write "1".

The following tables show which parameters are changed in each of the automatic parameter settings.

NOTE

- If the automatic setting is performed with *Pr. 999* or the parameter setting mode, the listed settings including the changed parameter settings (changed from the initial setting) will be automatically changed. Before performing the automatic setting, confirm that changing the listed parameters will not cause any problem.

●GOT initial setting (PU connector) (*Pr. 999* = “10”)

Parameter Number	Name	Initial Value	Automatically Set to	Refer to Page
79	Operation mode selection	0	0	*164*
118	PU communication speed	192	192	*184*
119	PU communication stop bit length	1	10	*184*
120	PU communication parity check	2	1	*184*
121	Number of PU communication retries	1	9999	*184*
122	PU communication check time interval	0	9999	*184*
123	PU communication waiting time setting	9999	0ms	*184*
124	PU communication CR/LF selection	1	1	*184*
340	Communication startup mode selection	0	1	*176*
549	Protocol selection	0	0	*203*

REMARKS

- Always perform a drive unit reset after the initial setting.

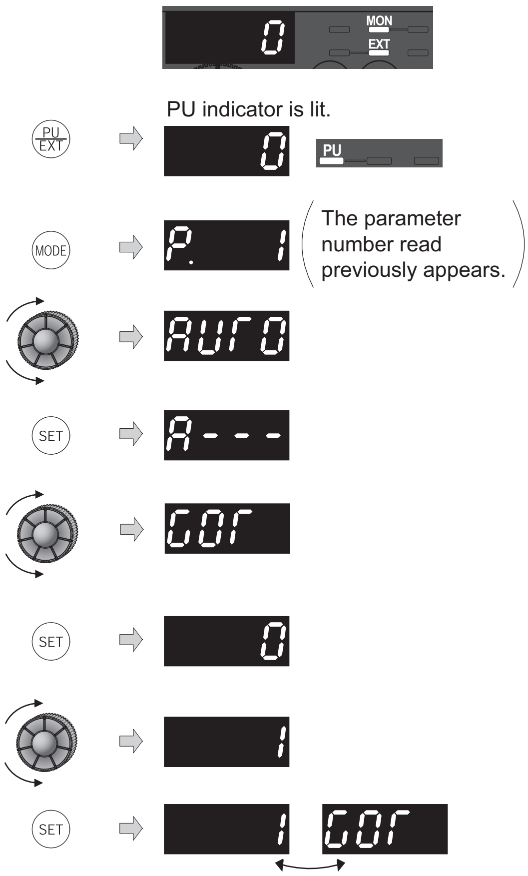
(2) Automatic parameter setting using the operation panel (parameter setting mode)

Operation example	The communication setting parameters for the GOT connection with a PU connector are automatically set.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Press (MODE) to choose the parameter setting mode.
4. Turn the dial until "AUTO" (AUTO) appears.
5. Press (SET) to enter the automatic parameter setting mode.
6. Turn the dial until "GOT" (GOT) appears.
7. Press (SET) to read the present set value.
   "0" appears.
8. Turn the dial to change it to the set value "1".
9. Press (SET) to set.

Display



Blink · · · Parameter setting complete!!

- Turn the dial to read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.

? "1" ⇄ "Er4" are displayed alternately ... Why?

☞ The drive unit is not in the PU operation mode.

1. Press (PU/EXT).

   PU is lit and the monitor (4-digit LED) displays "0". (When *Pr. 79* ="0 (initial setting)")
2. Carry out operation from step 3 again.

4.20 Setting the parameter unit and operation panel

Purpose	Parameter that should be Set		Refer to Page
Selection of rotation direction by RUN of the operation panel	RUN key rotation direction selection	Pr. 40	241
Switch the display language of the parameter unit	PU display language selection	Pr. 145	241
Use the setting dial of the operation panel like a potentiometer for speed setting Key lock of operation panel	Operation panel operation selection	Pr. 161	242
Change the magnitude of change of speed setting by the setting dial of the operation panel	Magnitude of speed change setting	Pr. 295	245
Control of the parameter unit buzzer	PU buzzer control	Pr. 990	246
Adjust LCD contrast of the parameter unit	PU contrast adjustment	Pr. 991	246

4.20.1 RUN key rotation direction selection (Pr. 40)

Used to choose the direction of rotation by operating RUN of the operation panel.

Parameter Number	Name	Initial Value	Setting Range	Description
40	RUN key rotation direction selection	0	0	Forward rotation
			1	Reverse rotation

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

4.20.2 PU display language selection (Pr. 145)

You can switch the display language of the parameter unit (FR-PU07) to another.

Parameter Number	Name	Initial Value	Setting Range	Description
145	PU display language selection	0	0	Japanese
			1	English
			2	German
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

4.20.3 Operation panel speed setting/key lock selection (Pr. 161)

The setting dial of the operation panel can be used for setting like a potentiometer.
The key operation of the operation panel can be disabled.

Parameter Number	Name	Initial Value	Setting Range	Description	
161	**Speed setting/key lock operation selection**	0	0	Setting dial speed setting mode	Key lock invalid
			1	Setting dial potentiometer mode	
			10	Setting dial speed setting mode	Key lock valid
			11	Setting dial potentiometer mode	

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

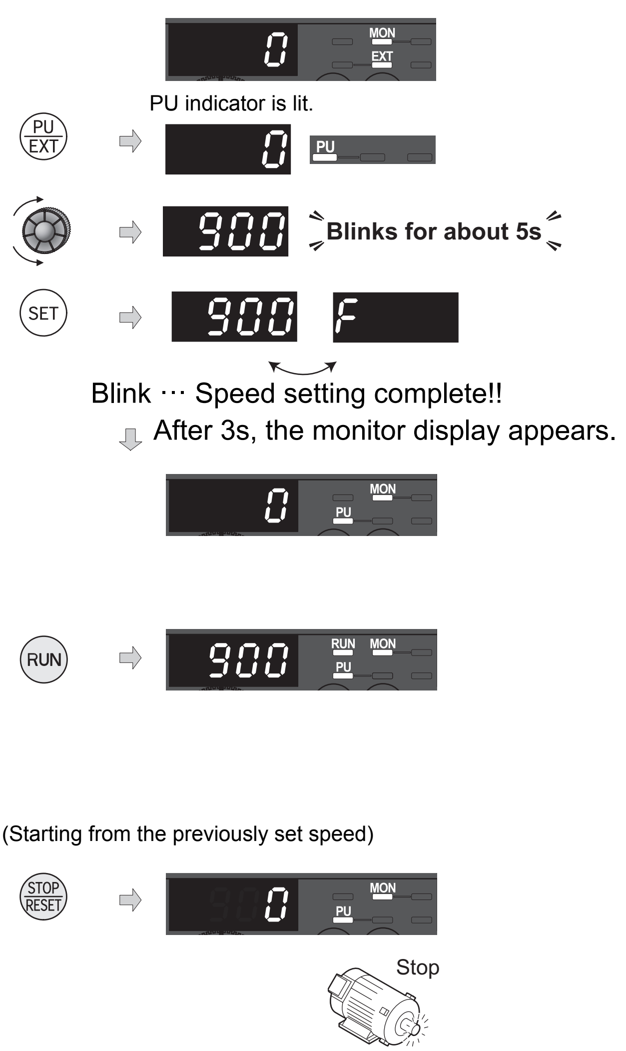
(1) Speed setting using the setting dial

Operation example: Operate at 900r/min

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Turn the setting dial to display the speed you want to set.
   The speed blinks for about 5s.
4. While the value is blinking, press (SET) to set the speed.
   (If you do not press (SET), the value blinks for about 5s and the display then returns to "0" (0r/min). In that case, go back to "operation step 3" and set the speed again.)
   The value blinks for about 3s and the display then returns to "0" (monitor display).
5. Start → acceleration → constant speed
   Press (RUN) to start the operation.
   The speed value on the monitor increases in *Pr. 7 Acceleration time*, and "900" (900r/min) appears.
6. To change the set speed, perform the steps 3 and 4. (Starting from the previously set speed)
7. Deceleration → Stop
   Press (STOP/RESET) to stop the operation.
   The speed value on the monitor decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0" (0r/min) displayed.

Display



REMARKS

- If (SET) is not pressed within 5s after the setting dial is turned, the operation may not performed at the set speed.

(2) Using the setting dial like a potentiometer to set the speed

Operation example Changing the speed from 0r/min to 1800r/min during operation

Operation	Display
1. Screen at power-ON The monitor display appears.	0 (MON, EXT)
2. Press (PU/EXT) to choose the PU operation mode.	PU indicator is lit. (PU/EXT) ⇨ 0 (PU)
3. Press (MODE) to choose the parameter setting mode.	PRM indicator is lit. (MODE) ⇨ P. 1 (PRM) (The parameter number read previously appears.)
4. Turn the setting dial until "P. 160" (*Pr. 160*) appears.	⇨ P. 160
5. Press (SET) to read the present set value. "9999"(initial value) appears.	(SET) ⇨ 9999
6. Turn the setting dial to change it to the set value "0".	⇨ 0
7. Press (SET) to set.	(SET) ⇨ 0 ↔ P. 160 **Blink Parameter setting complete!!**
8. Change *Pr. 161* to the setting value of " 1 " in the similar manner. (Refer to step 4 to 7.)	(SET) ⇨ 1 ↔ P. 161 **Blink Parameter setting complete!!**
9. Mode/monitor check Press (MODE) twice to choose the monitor/speed monitor.	(MODE) ⇨ 0 (MON, PU)
10. Press (RUN) to start the drive unit.	(RUN) ⇨ 0 (RUN, MON, PU)
11. Turn the setting dial until " 1800 " appears. The blinking speed is the set speed. You need not press (SET) .	The speed blinks for about 5s. ⇨ 0 → 1800

REMARKS

- If the display changes from blinking "1800" to "0", the setting of *Pr. 161 Speed setting/key lock operation selection* may not be "1".
- Independently of whether the drive unit is running or at a stop, the speed can be set by merely turning the dial.
- When the speed is changed, it will be stored in EEPROM as the set speed after 10s.

NOTE

- **When setting speed by turning setting dial, the speed goes up to the set value of *Pr. 1 Maximum setting* (initial value: 3000r/min). Adjust *Pr. 1 Maximum setting* setting according to the application.**

(3) Disable the setting dial and key operation of the operation panel (Press [MODE] long (2s))

- Operation using the setting dial and key of the operation panel can be invalid to prevent parameter change, and unexpected start or speed setting.
- Set "10 or 11" in *Pr. 161*, then press MODE for 2s to make the setting dial and key operation invalid.
- When the setting dial and key operation are invalid, "HOLd" appears on the operation panel. If dial or key operation is attempted while dial and key operation are invalid, "HOLd" appears. (When dial or key is not touched for 2s, monitor display appears.)
- To make the setting dial and key operation valid again, press MODE for 2s.

REMARKS

- Even if the setting dial and key operation are disabled, the monitor display and STOP/RESET are valid.

NOTE

- **Release the operation lock to release the PU stop by key operation.**

4.20.4 Magnitude of speed change setting (Pr. 295)

Setting this parameter increases the magnitude of speed which changes according to the rotated amount of the setting dial, improving operability.

Parameter Number	Name	Initial Value	Setting Range	Description
295	**Magnitude of speed change setting**	0	0	Function invalid
			0.01 *	The minimum varying width when the set speed is changed by the setting dial can be set.
			0.1 *	
			1	
			10	

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*

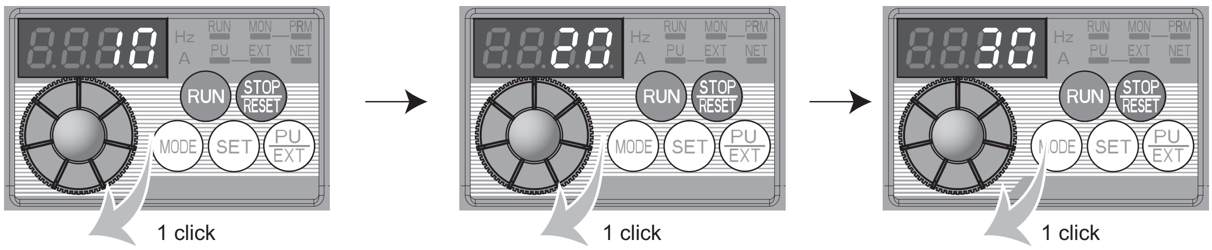
* Valid when the frequency increments or machine speed increments is selected with *Pr. 37* or *Pr. 144*. (*Refer to page 132*.)

(1) Basic operation

When a value other than "0" is set in *Pr. 295*, the minimum varying width when the set speed is changed by the setting dial can be set.

For example, when "10" is set in *Pr. 295*, one click (one dial gauge) of the setting dial changes the speed in increments of 10r/min→20r/min→30r/min.

When *Pr. 295* = "10"



*One rotation of the setting dial equals to 24 clicks (24 dial gauges).

REMARKS

- When machine speed display is selected with *Pr. 37*, the minimum increments of the magnitude of change is determined by *Pr. 295* as well. Note that the setting value may differ as speed setting changes the set machine speed and converts it to the speed display again.
- When the set speed is 100 or more, speed is displayed in 0.1 increments. Therefore, the minimum varying width is 0.1 even when *Pr. 295* < 0.1.
- When the machine speed setting is 1000 or more, speed is displayed in 1 increments. Therefore, the minimum varying width is 1 even when *Pr. 295* < 1.

NOTE

- **For *Pr. 295*, unit is not displayed .**
- **This parameter is valid only in the set speed mode. When other speed-related parameters are set, it is not activated.**
- **While the frequency setting is being selected, setting "10" changes the frequency setting in 10Hz increments. Be cautions of the excess speed. (in potentiometer mode)**

Parameters referred to

Pr. 37 Speed display Refer to page 132.
Pr. 144 Speed setting switchover Refer to page 132.

4.20.5 Buzzer control (Pr. 990)

You can make the buzzer "beep" when you press the key of the parameter unit (FR-PU07).

Parameter Number	Name	Initial Value	Setting Range	Description
990	**PU buzzer control**	1	0	Without buzzer sound
			1	With buzzer sound

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 161.)*
The above parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

REMARKS

- Drive unit alert faults with buzzer sounds when this parameter is set to activate the buzzer sound.

4.20.6 PU contrast adjustment (Pr. 991)

Contrast adjustment of the LCD of the parameter unit (FR-PU07) can be performed.
Decreasing the setting value makes the contrast lighter.

Parameter Number	Name	Initial Value	Setting Range	Description
991	**PU contrast adjustment**	58	0 to 63	0: Light ↓ 63: Dark

The above parameter is displayed as simple mode parameter only when the parameter unit FR-PU07 is connected.
The above parameter allows its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

4.21 Parameter clear/ All parameter clear

POINT

- Set "1" in *Pr.CL Parameter clear, ALLC all parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection*.)
- Refer to the extended parameter list on *page 54* for parameters cleared with this operation.

Operation	Display
1. Screen at power-ON The monitor display appears.	0 (MON, EXT)
2. Press (PU/EXT) to choose the PU operation mode.	PU indicator is lit. (PU/EXT) ⇨ 0 (PU)
3. Press (MODE) to choose the parameter setting mode.	PRM indicator is lit. (MODE) ⇨ P. 1 (PRM) (The parameter number read previously appears.)
4. Turn (dial) until "Pr.CL" ("ALLC") appears.	⇨ Parameter clear: Pr.CL All parameter clear: ALLC
5. Press (SET) to read the present set value. "0"(initial value) appears.	(SET) ⇨ 0
6. Turn (dial) to change it to the set value "1".	⇨ 1
7. Press (SET) to set.	(SET) ⇨ 1 Parameter clear: Pr.CL All parameter clear: ALLC

Blink ··· Parameter setting complete!!

- Turn (dial) to read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.

Setting	Description
0	Clear is not executed.
1	Sets parameters back to the initial values. (Parameter clear sets back all parameters except *calibration parameters, terminal function selection parameters* to the initial values.) *Refer to the parameter list on page 54* for availability of parameter clear and all parameter clear.

REMARKS

? 1 and Er-4 are displayed alternately ... Why?

☞ The drive unit is not in the PU operation mode.

☞ PU connector is used.

1. Press (PU/EXT). [PU] is lit and the monitor (4-digit LED) displays "1". (When *Pr. 79* = "0" (initial value))
2. Carry out operation from step 6 again.

4

PARAMETERS

4.22 Initial value change list

Displays and sets the parameters changed from the initial value.

Operation / **Display**

1. Screen at power-ON
   The monitor display appears.
   Display: 0 (MON, EXT)

2. Press (PU/EXT) to choose the PU operation mode.
   PU indicator is lit.
   Display: 0 (PU)

3. Press (MODE) to choose the parameter setting mode.
   PRM indicator is lit.
   Display: P. 1 (PRM)
   (The parameter number read previously appears.)

4. Turn the setting dial until "P.r.CH" appears.
   Display: P.r.CH

5. Pressing (SET) changes to the initial value change list screen.
   Display: P.- - -
   * It may take several seconds for creating the initial value change list. "P.- - -" blinks while creating the list.

6. Turning the setting dial displays the parameter number changed.
   Display: P. 7
   - Press (SET) to read the present set value.
     Display: 3.0

   Turn the setting dial and press (SET) to change the setting
   (Refer to step 6 and 7 on page 53.)
   Display: 4.0 ⇄ P. 7
   Blink ··· Parameter setting complete!!

   - Turn the setting dial to read another parameter.
     Display: P. 11
   - The display returns to "P.- - -" after all parameters are displayed.
     Display: P.- - -

7. Pressing (SET) in "P.- - -" status returns to the parameter setting mode.
   Display: P.r.CH
   - Turning the setting dial sets other parameters.
   - Pressing (SET) displays the change list again.

NOTE

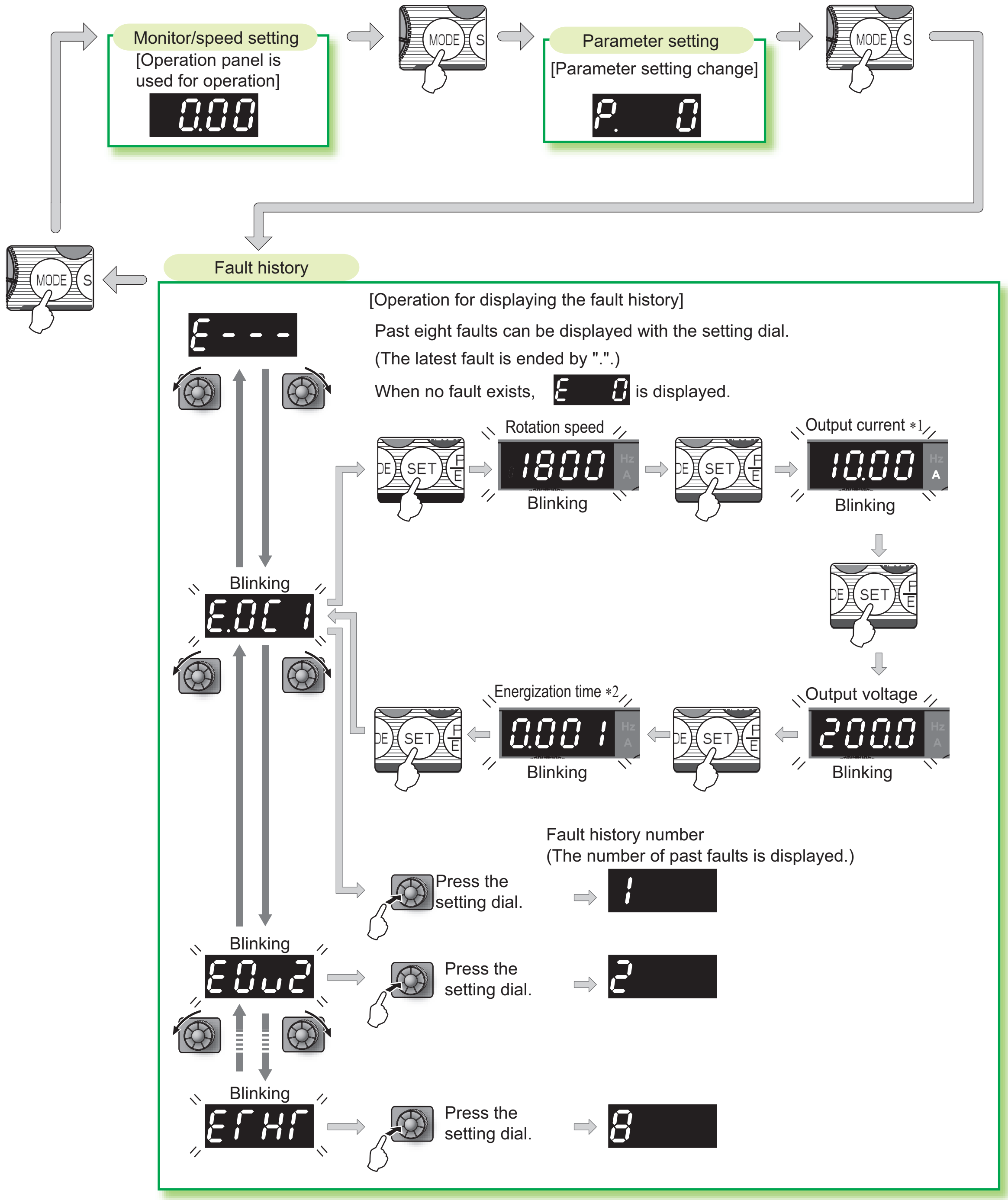
- **Calibration parameters *(C0 (Pr. 900) to C7 (Pr. 905))* are not displayed even when these are changed from the initial settings.**
- **Only simple mode parameter is displayed when simple mode is set (*Pr. 160* = "9999" (initial value))**
- ***Pr. 160* is displayed independently of whether the setting value is changed or not.**
- **When parameter setting is changed after creating the initial value change list, the setting will be reflected to the initial value change list next time.**

Parameters referred to

Pr. 160 Extended function display selection *Refer to page 161.*
C0 (Pr. 900) FM terminal calibration *Refer to page 140.*
C2 (Pr. 902) to C7 (Pr. 905) (Speed setting bias/gain parameter) *Refer to page 152.*

4.23 Check and clear of the fault history

(1) Check for the fault history



*1 When an overcurrent trip occurs by an instantaneous overcurrent, the monitored current value saved in the fault history may be lower than the actual current that has flowed.

*2 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel is used, the time is displayed up to 65.53 (65530h) in the indication of 1h = 0.001, and thereafter, it is added up from 0.

(2) Clearing procedure

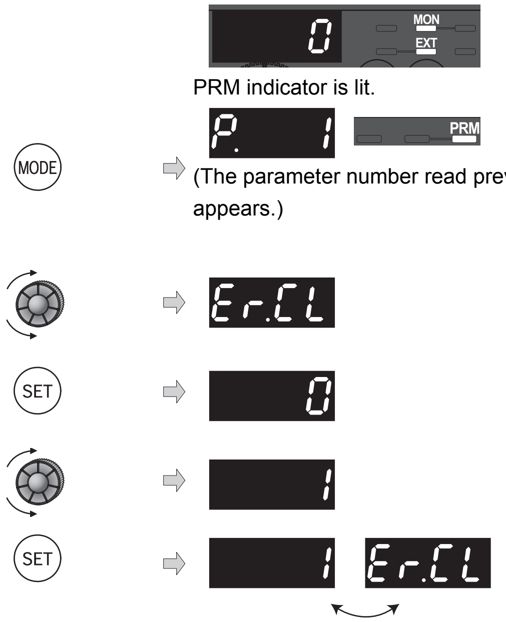
POINT

- Set "1" in *Er.CL Fault history clear* to clear the fault history.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press MODE to choose the parameter setting mode.
3. Turn the setting dial until "Er.CL" (fault history clear) appears.
4. Press SET to read the present set value. "0" (initial value) appears.
5. Turn the setting dial to change it to the set value "1".
6. Press SET to set.

Display



Blink...Fault history clear complete!!

- Turn the setting dial to read another parameter.
- Press SET to show the setting again.
- Press SET twice to show the next parameter.

Parameters referred to

Pr. 77 Parameter write selection *Refer to page 160.*

5 TROUBLESHOOTING

This chapter provides the "TROUBLESHOOTING" of this product.
Always read the instructions before using the equipment.

When a fault occurs in the drive unit, the drive unit output is shut off and the PU display automatically changes to one of the following fault or alarm indications.
If the fault does not correspond to any of the following faults or if you have any other problem, please contact your sales representative.

- Retention of fault output signal... When the magnetic contactor (MC) provided on the input side of the drive unit is opened when a fault occurs, the drive unit's control power will be lost and the fault output will not be held.
- Fault or alarm indication .... When a fault or alarm occurs, the operation panel display automatically switches to the fault or alarm indication.
- Resetting method .... When a fault occurs, the drive unit output is kept stopped. Unless reset, therefore, the drive unit cannot restart. *(Refer to page 252.)*
- When any fault occurs, take the appropriate corrective action, then reset the drive unit, and resume operation. Not doing so may lead to the drive unit fault and damage.

Drive unit fault or alarm indications are roughly categorized as below.

(1) Error message
A message regarding operational fault and setting fault by the operation panel and parameter unit (FR-PU07) is displayed. The drive unit does not trip.

(2) Warning
The drive unit output is not shut off even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.

(3) Alarm
The drive unit output is not shut off. You can also output an alarm signal by making parameter setting.

(4) Fault
When a fault occurs, the drive unit output is shut off and a fault signal is output.

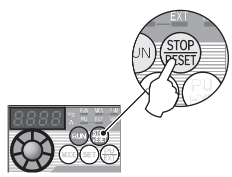
REMARKS

- Past eight faults can be displayed using the setting dial. (*Refer to page 51* for the operation.)

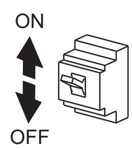
5.1 Reset method of protective function

The drive unit can be reset by performing any of the following operations. Note that the internal accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the drive unit.
Drive unit recovers about 1s after the reset is released.

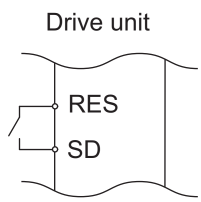
Operation 1: ...... Using the operation panel, press STOP/RESET to reset the drive unit.
(This may only be performed when a fault occurs (*refer to page 257* for fault).)



Operation 2: .... Switch power OFF once. After the indicator of the operation panel turns OFF, switch it ON again.



Operation 3: . ..... Turn ON the reset (RES) signal for more than 0.1s. (If the RES signal is kept ON, "Err." appears (blinks) to indicate that the drive unit is in a reset status.)



NOTE

- **OFF status of the start signal must be confirmed before resetting the drive unit fault. Resetting drive unit fault with the start signal ON restarts the motor suddenly.**

5.2 List of fault or alarm indications

	Operation Panel Indication	Name	Faut Data Code	Refer to Page
Error message	E---	Fault history	—	249
Error message	HOLD	Operation panel lock	—	254
Error message	LOCD	Password locked	—	254
Error message	Er1 to Er4	Parameter write error	—	254
Error message	Err.	Drive unit reset	—	255
Warning	OL	Stall prevention (overcurrent)	—	255
Warning	oL	Stall prevention (overvoltage)	—	255
Warning	RB	Regenerative brake pre-alarm	—	256
Warning	TH	Electronic thermal relay function pre-alarm	—	256
Warning	PS	PU stop	—	256
Warning	MT	Maintenance signal output	—	256
Warning	UV	Undervoltage	—	256
Warning	SA	SA	—	257
Alarm	FN	Fan alarm	—	257
Fault	E.OC1	Overcurrent trip during acceleration	16 (H10)	257
Fault	E.OC2	Overcurrent trip during constant speed	17 (H11)	257
Fault	E.OC3	Overcurrent trip during deceleration or stop	18 (H12)	258
Fault	E.OV1	Regenerative overvoltage trip during acceleration	32 (H20)	258
Fault	E.OV2	Regenerative overvoltage trip during constant speed	33 (H21)	258
Fault	E.OV3	Regenerative overvoltage trip during deceleration or stop	34 (H22)	258
Fault	E.THT	Drive unit overload trip (electronic thermal O/L relay function)	48 (H30)	259
Fault	E.THM	Motor overload trip (electronic thermal O/L relay function)	49 (H31)	259
Fault	E.FIN	Heatsink overheat	64 (H40)	259
Fault	E.ILF	Input phase loss	82 (H52)	260
Fault	E.OLT	Stall prevention stop	96 (H60)	260
Fault	E.SOT	Loss of synchronism detection	97 (H61)	260
Fault	E. BE	Brake transistor alarm detection	112 (H70)	260
Fault	E.GF	Output side earth (ground) fault overcurrent at start	128 (H80)	260
Fault	E.LF	Output phase loss	129 (H81)	261
Fault	E.OHT	External thermal relay operation	144 (H90)	261
Fault	E.PTC	PTC thermistor operation	145 (H91)	261
Fault	E.PE	Parameter storage device fault	176 (HB0)	261
Fault	E.PUE	PU disconnection	177 (HB1)	262
Fault	E.RET	Retry count excess	178 (HB2)	262
Fault	E.5	CPU fault	245 (HF5)	262
Fault	E.CPU	CPU fault	192 (HC0)	262
Fault	E.CDO	Output current detection value exceeded	196 (HC4)	262
Fault	E.IOH	Inrush current limit circuit fault	197 (HC5)	262
Fault	E.AIE	Analog input fault	199 (HC7)	262
Fault	E.OS	Overspeed occurrence	208 (HD0)	263
Fault	E.PID	PID signal fault	230 (HE6)	263
Fault	E.SAF	E.SAF	201 (HC9)	263

If faults other than the above appear, contact your sales representative.

TROUBLESHOOTING

5

5.3 Causes and corrective actions

(1) Error message

A message regarding operational troubles is displayed. Output is not shut off.

Operation panel indication	HOLD	HOLd
Name	Operation panel lock	
Description	Operation lock mode is set. Operation other than STOP/RESET is invalid. *(Refer to page 244.)*	
Check point	——	
Corrective action	Press MODE for 2s to release lock.	

Operation panel indication	LOCD	LOCd
Name	Password locked	
Description	Password function is active. Display and setting of parameter is restricted.	
Check point	——	
Corrective action	Enter the password in *Pr. 297 Password lock/unlock* to unlock the password function before operating. *(Refer to page 162.)*	

Operation panel indication	Er1	Er 1
Name	Write disable error	
Description	• You attempted to make parameter setting when *Pr. 77 Parameter write selection* has been set to disable parameter write. • Speed jump setting range overlapped. • The PU and drive unit cannot make normal communication.	
Check point	• Check the setting of *Pr. 77 Parameter write selection*. *(Refer to page 160.)* • Check the settings of *Pr. 31 to Pr. 36 (speed jump)*. *(Refer to page 88.)* • Check the connection of the PU and drive unit.	

Operation panel indication	Er2	Er2
Name	Write error during operation	
Description	When parameter write was performed during operation with a value other than "2" (writing is enabled independently of operation status in any operation mode) is set in *Pr. 77* and the STF (STR) is ON.	
Check point	• Check the *Pr. 77* setting. *(Refer to page 160.)* • Check that the drive unit is not operating.	
Corrective action	• Set "2" in *Pr. 77.* • After stopping operation, make parameter setting.	

Operation panel indication	Er3	Er3
Name	Calibration error	
Description	Analog input bias and gain calibration values are too close.	
Check point	Check the settings of *C3, C4, C6 and C7 (calibration functions)*. *(Refer to page 152.)*	

Operation panel indication	Er4	Er4
Name	Mode designation error	
Description	• Appears if a parameter setting is attempted in the External or NET operation mode with *Pr. 77* ≠ "2". • Appears if a parameter setting is attempted when the command source is not at the operation panel.	
Check point	• Check that operation mode is PU operation mode. • Check the *Pr. 77* setting. *(Refer to page 160.)* • Check if a parameter unit (FR-PU07) is connected when *Pr. 551* = "9999 (initial setting)." • Check the *Pr. 551* setting.	
Corrective action	• After setting the operation mode to the "PU operation mode", make parameter setting. *(Refer to page 164.)* • After setting *Pr. 77* = "2", make parameter setting. • Disconnect the parameter unit (FR-PU07), and make parameter setting. • After setting *Pr. 551* = "4", make parameter setting. (*Refer to page 177.)*	

Operation panel indication	**Err.**	Err.
Name	Drive unit reset	
Description	• Executing reset using RES signal, or reset command from communication or PU • Displays at powering OFF.	
Corrective action	• Turn OFF the reset command	

(2) Warning

When a warning occurs, the output is not shut off.

Operation panel indication	**OL**	OL	**FR-PU07**	**OL**
Name	Stall prevention (overcurrent)			
Description	During acceleration	When the output current of the drive unit exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the increase in speed until the overload current decreases to prevent the drive unit from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the speed again.		
	During constant-speed operation	When the output current of the drive unit exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function reduces speed until the overload current decreases to prevent the drive unit from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the speed up to the set value.		
	During deceleration	When the output current of the drive unit exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the decrease in speed until the overload current decreases to prevent the drive unit from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function decreases the speed again.		
Check point	• Check that the *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time* settings are not too small. • Check that the load is not too heavy. • Are there any failure in peripheral devices? • Check that the *Pr. 22 Stall prevention operation level* is appropriate • Check if the operation was performed without connecting a motor.			
Corrective action	• Set a larger value in *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. *(Refer to page 97.)* • Reduce the load weight. • Check the peripheral devices. • Set stall prevention operation current in *Pr. 22 Stall prevention operation level*. (The initial value is 150%.) The acceleration/deceleration time may change. Increase the stall prevention operation level with *Pr. 22 Stall prevention operation level*, or disable stall prevention with *Pr. 156 Stall prevention operation selection*. (Operation at OL occurrence can be selected using *Pr. 156*.) • Check the connection of the PM motor.			

Operation panel indication	**oL**	oL	**FR-PU07**	**oL**
Name	Stall prevention (overvoltage)			
Description	During deceleration	• If the regenerative energy of the motor becomes excessive to exceed the regenerative energy consumption capability, this function stops the decrease in speed to prevent overvoltage trip. As soon as the regenerative energy has reduced, deceleration resumes. • If the regenerative energy of the motor becomes excessive when regeneration avoidance function is selected (*Pr. 882* = 1), this function increases the speed to prevent overvoltage trip. *(Refer to page 228.)*		
Check point	• Check for sudden speed reduction. • Check that regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886)* is used. *(Refer to page 228.)*			
Corrective action	Increase the deceleration time using *Pr. 8 Deceleration time*.			

Operation panel indication	PS	PS	FR-PU07	PS
Name	PU stop			
Description	Stop with STOP/RESET of the PU is set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. (For *Pr. 75 refer to page 157*.)			
Check point	Check for a stop made by pressing STOP/RESET of the operation panel.			
Corrective action	Turn the start signal OFF and release with PU/EXT.			

Operation panel indication	RB	rb	FR-PU07	RB
Name	Regenerative brake pre-alarm			
Description	Appears if the regenerative brake duty reaches or exceeds 85% of the *Pr. 70 Special regenerative brake duty* value. When the setting of *Pr. 70 Special regenerative brake duty* is the initial value (*Pr. 70* = "0"), this warning does not occur. If the regenerative brake duty reaches 100%, a regenerative overvoltage (E. OV_) occurs. The RBP signal can be simultaneously output with the [RB] display. For the terminal used for the RBP signal output, assign the function by setting "7 (positive logic) or 107 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*. *(Refer to page 123.)*			
Check point	• Check that the brake resistor duty is not high. • Check that the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* settings are correct.			
Corrective action	• Increase the deceleration time. • Check that the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* settings.			

Operation panel indication	TH	TH	FR-PU07	TH
Name	Electronic thermal relay function pre-alarm			
Description	Appears when the accumulated electronic thermal value reaches 85% of the *Pr.9* setting. When the accumulated electronic thermal value reaches 100% of the *Pr.9* setting, the protection circuit is activated and the drive unit is shut off. The THP signal can be simultaneously output with the [TH] display. For the terminal used for THP signal output, assign the function by setting "8 (positive logic) or 108 (negative logic)" in *Pr. 190* or *Pr. 192 (output terminal function selection)*. *(Refer to page 123.)*			
Check point	• Check for large load or sudden acceleration. • Is the *Pr. 9 Electronic thermal O/L relay* setting is appropriate? *(Refer to page 101.)*			
Corrective action	• Reduce the load and frequency of operation. • Set the rated motor current in *Pr. 9 Electronic thermal O/L relay*. *(Refer to page 101.)*			

Operation panel indication	MT	MT	FR-PU07	MT
Name	Maintenance signal output			
Description	Indicates that the cumulative energization time of the drive unit has reached a given time. When the setting of *Pr. 504 Maintenance timer alarm output set time* is the initial value (*Pr. 504* = "9999"), this warning does not occur.			
Check point	The *Pr. 503 Maintenance timer* setting is larger than the *Pr. 504 Maintenance timer alarm output set time* setting. *(Refer to page 235.)*			
Corrective action	Setting "0" in *Pr. 503 Maintenance timer* erases the signal.			

Operation panel indication	UV	Uv	FR-PU07	——
Name	Undervoltage			
Description	If the power supply voltage of the drive unit decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below about 160VAC (about 320VAC for 400V class), this function stops the drive unit output and displays Uv. An alarm is reset when the voltage returns to normal.			
Check point	Check that the power supply voltage is normal.			
Corrective action	Check the power supply system equipment such as power supply.			

Operation panel indication	**SA**	SA	**FR-PU07**	——
Name	SA			
Description	Appears when the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Check point	Check if the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Corrective action	Short across the terminals S1 and SC and the terminals S2 and SC with shortening wires.			

(3) Alarm

When an alarm occurs, the output is not shut off. You can also output an alarm signal by making parameter setting. (Set "98" in *Pr. 190* or *Pr. 192 (output terminal function selection)*. *Refer to page 123.*)

Operation panel indication	**FN**	Fn	**FR-PU04 FR-PU07**	**FN**
Name	Fan alarm			
Description	For the drive unit that contains a cooling fan, Fn appears on the operation panel when the cooling fan stops due to an alarm or different operation from the setting of *Pr. 244 Cooling fan operation selection*.			
Check point	Check the cooling fan for an alarm.			
Corrective action	Check for fan alarm. Please contact your sales representative.			

(4) Fault

When a fault occurs, the drive unit trips and a fault signal is output.

Operation panel indication	**E.OC1**	E.OC1	**FR-PU07**	**OC During Acc**
Name	Overcurrent trip during acceleration			
Description	When the drive unit's output current reaches or exceeds approximately 200% of it's rated current or approximately 250% of the rated motor current during acceleration, the protective circuit is activated and the drive unit trips.			
Check point	• Check for sudden acceleration. • Check that the downward acceleration time is not long for the lift. • Check for output short-circuit/ground fault. • Check if the stall prevention operation level is set too high. • Check that the drive unit capacity matches with the motor capacity. • Check if a start command is given to the drive unit while the motor is coasting.			
Corrective action	• Increase the acceleration time. (Shorten the downward acceleration time for the lift.) • When "E.OC1" is always lit at starting, disconnect the motor once and start the drive unit. If "E.OC1" is still lit, contact your sales representative. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Lower the setting of stall prevention operation level *(refer to page 83)*. • Choose drive unit and motor capacities that match. • Input a start command after the motor stops.			

Operation panel indication	**E.OC2**	E.OC2	**FR-PU07**	**Stedy Spd OC**
Name	Overcurrent trip during constant speed			
Description	When the drive unit's output current reaches or exceeds approximately 200% of it's rated current or approximately 250% of the rated motor current during constant-speed operation, the protective circuit is activated and the drive unit trips.			
Check point	• Check for sudden load change. • Check for output short-circuit/ground fault. • Check if the stall prevention operation level is set too high. • Check that the drive unit capacity matches with the motor capacity. • Check if a start command is given to the drive unit while the motor is coasting.			
Corrective action	• Keep load stable. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Lower the setting of stall prevention operation level (*refer to page 83).* • Choose drive unit and motor capacities that match. • Input a start command after the motor stops.			

Operation panel indication	E.OC3		FR-PU07	OC During Dec
Name	Overcurrent trip during deceleration or stop			
Description	When the drive unit's output current reaches or exceeds approximately 200% of it's rated current or approximately 250% of the rated motor current during deceleration (other than acceleration and constant-speed state), the protective circuit is activated and the drive unit trips.			
Check point	• Check for sudden speed reduction. • Check for output short-circuit/ground fault. • Check for too fast operation of the motor's mechanical brake. • Check if the stall prevention operation level is set too high. • Check that the drive unit capacity matches with the motor capacity. • Check if a start command is given to the drive unit while the motor is coasting.			
Corrective action	• Increase the deceleration time. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Check the mechanical brake operation. • Lower the setting of stall prevention operation level *(refer to page 83).* • Choose drive unit and motor capacities that match. • Input a start command after the motor stops.			

Operation panel indication	E.OV1		FR-PU07	OV During Acc
Name	Regenerative overvoltage trip during acceleration			
Description	If regenerative energy causes the drive unit's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated and the drive unit trips. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for too slow acceleration. (e.g. during downward acceleration in vertical lift load) • Check that the setting of *Pr. 22 Stall prevention operation level* is not too small.			
Corrective action	• Decrease the acceleration time. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886). (Refer to page 228.)* • Set the *Pr. 22 Stall prevention operation level* correctly.			

Operation panel indication	E.OV2		FR-PU07	Stedy Spd OV
Name	Regenerative overvoltage trip during constant speed			
Description	If regenerative energy causes the drive unit's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the drive unit output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for sudden load change. • Check that the setting of *Pr. 22 Stall prevention operation level* is not too small.			
Corrective action	• Keep load stable. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886). (Refer to page 228.)* • Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required. • Set the *Pr. 22 Stall prevention operation level* correctly.			

Operation panel indication	E.OV3		FR-PU07	OV During Dec
Name	Regenerative overvoltage trip during deceleration or stop			
Description	If regenerative energy causes the drive unit's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the drive unit output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	Check for sudden speed reduction.			
Corrective action	• Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load) • Make the brake cycle longer. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886). (Refer to page 228.)* • Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required.			

Operation panel indication	E.THT		FR-PU07	Inv. Overload
Name	Drive unit overload trip (electronic thermal O/L relay function) *1			
Description	If the temperature of the output transistor element exceeds the protection level under the condition that a current not less than the drive unit rated current flows and overcurrent trip does not occur (200% or less), the electronic thermal relay activates to stop the drive unit output. (Overload capacity 150% 60s, 200% 0.5s)			
Check point	• Check that acceleration/deceleration time is not too short. • Check the motor for use under overload. • Check for too high surrounding air temperature.			
Corrective action	• Increase acceleration/deceleration time. • Adjust the *Pr. 785 PM control torque boost* and *Pr. 795 DC brake torque boost* settings. • Reduce the load weight. • Set the surrounding air temperature to within the specifications.			

*1 Resetting the drive unit initializes the internal accumulated heat value of the electronic thermal relay function.

Operation panel indication	E.THM		FR-PU07	Motor Ovrload
Name	Motor overload trip (electronic thermal O/L relay function) *1			
Description	The electronic thermal relay function in the drive unit detects motor overheat due to overload or reduced cooling capability during low-speed operation, and pre-alarm (TH display) is output when the integrated value reaches 85% of the *Pr. 9 Electronic thermal O/L relay* setting, and the protection circuit is activated to stop the drive unit output when the integrated value reaches the specified value.			
Check point	• Check the motor for use under overload. • Check that stall prevention operation setting is correct.			
Corrective action	• Reduce the load weight. • Adjust the *Pr. 785 PM control torque boost* and *Pr. 795 DC brake torque boost* settings. • Check that stall prevention operation setting is correct. *(Refer to page 83.)*			

*1 Resetting the drive unit initializes the internal accumulated heat value of the electronic thermal relay function.

Operation panel indication	E.FIN		FR-PU07	H/Sink O/Temp
Name	Heatsink overheat			
Description	If the heatsink overheats, the temperature sensor is actuated and the drive unit trips. The FIN signal can be output when the temperature becomes approximately 85% of the heatsink overheat protection operation temperature. For the terminal used for the FIN signal output, assign the function by setting "26 (positive logic) or 126 (negative logic)" in any of *Pr. 190* or *Pr. 192 (output terminal function selection)*. *(Refer to page 123.)*			
Check point	• Check for too high surrounding air temperature. • Check for heatsink clogging. • Check that the cooling fan is not stopped (Check that Fn is not displayed on the operation panel).			
Corrective action	• Set the surrounding air temperature to within the specifications. • Clean the heatsink. • Replace the cooling fan.			

Operation panel indication	E.ILF	E.I LF	FR-PU07	Input phase loss
Name	Input phase loss			
Description	Drive unit trips when function valid setting (=1) is selected in *Pr. 872 Input phase loss protection selection* and one phase of the three phase power input is lost. *(Refer to page 145.)* It may function if phase-to-phase voltage of the three-phase power input becomes largely unbalanced. When the setting of *Pr. 872 Input phase loss protection selection* is the initial value (*Pr. 872* ="0"), this warning does not occur.			
Check point	• Check for a break in the cable for the three-phase power supply input. • Check that phase-to-phase voltage of the three-phase power input is not largely unbalanced.			
Corrective action	• Wire the cables properly. • Repair a break portion in the cable. • Check the *Pr. 872 Input phase loss protection selection* setting. • Set *Pr. 872* = "0" (without input phase loss protection) when three-phase input voltage is largely unbalanced.			

Operation panel indication	E.OLT	E.OLT	FR-PU07	Stll Prev STP
Name	Stall prevention stop			
Description	If the rotation speed has fallen to 15r/min by stall prevention operation and remains for 3s, a fault (E.OLT) appears and the drive unit trips. OL appears while stall prevention is being activated. E.OLT may not occur if stall prevention (OL) is activated during output phase loss.			
Check point	Check the motor for use under overload. *(Refer to page 84.)*			
Corrective action	Reduce the load weight. (Check the *Pr. 22 Stall prevention operation level* setting.)			

Operation Panel Indication	E.SOT	E.SOT	FR-PU07	Motor step out
Name	Loss of synchronism detection			
Description	Stops the output when the operation is not synchronized.			
Check point	• Check that the PM motor is not driven overloaded. • Check if a start command is given to the drive unit while the PM motor is coasting. • Check if a motor other than the PM motor (S-PM geared motor) is driven. • Check that the operation is performed with a motor connected.			
Corrective action	• Set the acceleration time longer. • Reduce the load. • Input a start command after the motor stops. • When driving a PM motor other than the S-PM geared motor, offline auto tuning must be performed. (*Refer to page 105*.) • Check the connection of the PM motor. Set the PM motor test operation. (*Refer to page 77*.)			

Operation panel indication	E.BE	E. bE	FR-PU07	Br. Cct. Fault
Name	Brake transistor alarm detection			
Description	When a brake transistor alarm has occurred due to the large regenerative energy from the motor etc., the brake transistor alarm is detected and the drive unit trips. In this case, the drive unit must be powered OFF immediately.			
Check point	• Reduce the load inertia. • Check that the frequency of using the brake is proper. • Check that the brake resistor selected is correct.			
Corrective action	Replace the drive unit.			

Operation panel indication	E.GF	E. GF	FR-PU07	Ground Fault
Name	Output side earth (ground) fault overcurrent at start			
Description	The drive unit trips if an earth (ground) fault overcurrent flows at start due to an earth (ground) fault that occurred on the drive unit's output side (load side). Whether this protective function is used or not is set with *Pr. 249 Earth (ground) fault detection at start*. When the setting of *Pr. 249 Earth (ground) fault detection at start* is the initial value *(Pr. 249 =0)*", this warning does not occur.			
Check point	Check for a ground fault in the motor and connection cable.			
Corrective action	Remedy the ground fault portion.			

Operation panel indication	E.LF	E. LF	FR-PU07	E.LF
Name	Output phase loss			
Description	If one of the three phases (U, V, W) on the drive unit's output side (load side) is lost during drive unit operation (except during DC injection brake operation and when the output speed is 30r/min or less), the drive unit stops the outputs. Whether the protective function is used or not is set with *Pr. 251 Output phase loss protection selection*.			
Check point	• Check the wiring. (Check that the motor is normal.) • Check if the correct drive unit capacity is connected with the motor. • Check if a start command is given to the drive unit while the motor is coasting.			
Corrective action	• Wire the cables properly. • Choose the drive unit and motor capacities that match. • Input a start command after the motor stops.			

Operation panel indication	E.OHT	E.OHT	FR-PU07	OH Fault
Name	External thermal relay operation			
Description	If the external thermal relay provided for motor overheat protection or an internally provided thermal relay in the motor, etc. switches ON (contacts open), the drive unit outputs are stopped. This function is available when "7" (OH signal) is set in any of *Pr. 178 to Pr. 182 (input terminal function selection)*. When the initial value (without OH signal assigned) is set, this protective function is not available.			
Check point	• Check for motor overheating. • Check that the value of 7 (OH signal) is set correctly in any of *Pr. 178 to Pr. 182 (input terminal function selection)*.			
Corrective action	• Reduce the load and frequency of operation. • Even if the relay contacts are reset automatically, the drive unit will not restart unless it is reset.			

Operation panel indication	E.PTC	E.PTC	FR-PU07	PTC activated
Name	PTC thermistor operation			
Description	Drive unit trips when resistance of PTC thermistor connected between terminal 2 and terminal 10 is more than the value set in *Pr. 561 PTC thermistor protection level*. This protective function does not function when *Pr. 561* setting is initial value (*Pr. 561* = "9999").			
Check point	• Check the connection of the PTC thermistor. • Check the *Pr. 561 PTC thermistor protection level* setting. • Check the motor for operation under overload.			
Corrective action	Reduce the load weight.			

Operation panel indication	E.PE	E. PE	FR-PU07	Corrupt Memry
Name	Parameter storage device fault (control circuit board)			
Description	Appears when a fault occurred in the stored parameters. (EEPROM fault)			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative. When performing parameter write frequently for communication purposes, set "1" in *Pr. 342* to enable RAM write. Note that powering OFF returns the drive unit to the status before RAM write.			

Operation panel indication	E.PUE		FR-PU07	PU Leave Out
Name	PU disconnection			
Description	• This function stops the drive unit output if communication between the drive unit and PU is suspended, e.g. the parameter unit (FR-PU07) is disconnected, when "2", "3", "16" or "17" was set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. • This function stops the drive unit output when communication errors occurred consecutively for more than permissible number of retries when a value other than "9999" is set in *Pr. 121 Number of PU communication retries* during the RS-485 communication with the PU connector (use *Pr. 502 Stop mode selection at communication error* to change). • This function also stops the drive unit output if communication is broken within the period of time set in *Pr. 122 PU communication check time interval* during the RS-485 communication with the PU connector.			
Check point	• Check that the parameter unit cable is connected properly. • Check the *Pr. 75* setting. • Check that RS-485 communication data is correct. And check that the settings of communication parameter at drive unit match settings of the computer. • Check that data is transmitted from the computer within a time set in *Pr. 122 PU communication check time interval*.			
Corrective action	• Connect the parameter unit cable securely. • Check the communication data and communication settings. • Increase the *Pr. 122 PU communication check time interval* setting. Or set "9999" (no communication check).			

Operation panel indication	E.RET		FR-PU07	Retry No Over
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function trips the drive unit. This function is available only when *Pr. 67 Number of retries at fault occurrence* is set. When the initial value (*Pr. 67* = "0") is set, this protective function does not function.			
Check point	Find the cause of fault occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation panel indication	E.5		FR-PU07	Fault 5
	E.CPU			CPU Fault
Name	CPU fault			
Description	Stops the drive unit output if the communication fault of the built-in CPU occurs.			
Check point	Check for devices producing excess electrical noises around the drive unit.			
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the drive unit. • Please contact your sales representative.			

Operation panel indication	E.CDO		FR-PU07	OC detect level
Name	Output current detection value exceeded			
Description	This function is activated when the output current exceeds the *Pr. 150 Output current detection level* setting.			
Check point	Check the settings of *Pr. 150 Output current detection level*, *Pr. 151 Output current detection signal delay time*, *Pr. 166 Output current detection signal retention time*, *Pr. 167 Output current detection operation selection*. (*Refer to page 128.*)			

Operation panel indication	E.IOH		FR-PU07	Inrush overheat
Name	Inrush current limit circuit fault			
Description	This function is activated when the resistor of the inrush current limit circuit overheats. The inrush current limit circuit fault			
Check point	Check that frequent power ON/OFF is not repeated.			
Corrective action	Configure a circuit where frequent power ON/OFF is not repeated. If the problem still persists after taking the above measure, please contact your sales representative.			

Operation panel indication	E.AIE		FR-PU07	Analog in error
Name	Analog input fault			
Description	Appears if voltage(current) is input to terminal 4 when the setting in *Pr. 267 Terminal 4 input selection* and the setting of voltage/current input switch are different.			
Check point	Check the setting of *Pr. 267 Terminal 4 input selection* and voltage/current input switch. *(Refer to page 147.)*			
Corrective action	Either give a speed command by current input or set *Pr. 267 Terminal 4 input selection*, and voltage/current input switch to voltage input.			

Operation panel indication	**E.OS**	E. 0S	**FR-PU07**	**E.OS**
Name	Overspeed occurrence			
Description	Trips the drive unit if the motor speed exceeds *Pr. 374 Overspeed detection level*.			
Check point	Check that *Pr. 374 Overspeed detection level* is appropriate.			
Corrective action	Set *Pr. 374 Overspeed detection level* appropriately.			

Operation panel indication	**E.PID**	E.PId	**FR-PU07**	**PID Signal Error**
Name	PID signal fault			
Description	If any of upper limit (FUP), lower limit (FDN), and deviation limit (Y48) turns ON during PID control, drive unit shuts off the output. This function is active under the following parameter settings: *Pr. 554 PID signal operation selection* ≠ "0,10", *Pr. 131 PID upper limit* ≠ "9999", *Pr. 132 PID lower limit* ≠ "9999", and *Pr. 553 PID deviation limit* ≠ "9999". This protective function is not active in the initial setting (*Pr. 554* = "0", *Pr. 131* = "9999", *Pr. 132* = "9999", *Pr. 553* = "9999").			
Check point	• Check if the measured PID value is greater than the upper limit *(Pr. 131)* or smaller than the lower limit *(Pr. 132)*. • Check if the absolute PID deviation value is greater than the limit value *(Pr. 553)*.			
Corrective action	Make correct settings for *Pr. 131 PID upper limit*, *Pr. 132 PID lower limit*, *Pr. 553 PID deviation limit*. *(Refer to page 216.)*			

Operation panel indication	**E.SAF**	E.SAF	**FR-PU07**	**Fault** **E.SAF**
Name	E.SAF			
Description	• Appears when internal circuits are malfunctioning. • Appears when one of the lines between S1 and SC, or between S2 and SC is opened.			
Check point	Check if the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Corrective action	Short across the terminals S1 and SC and the terminals S2 and SC with shortening wires.			

NOTE

- **If faults other than the above appear, contact your sales representative.**

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5.4 Correspondences between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel:

Actual	Digital
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Actual	Digital
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
L	

Actual	Digital
M	
N	
O	
o	
P	
S	
T	
U	
V	
r	
-	

5.5 Check first when you have a trouble

POINT

- If the cause is still unknown after every check, it is recommended to initialize the parameters (initial value) then set the required parameter values and check again.

5.5.1 Motor does not start

Check Points	Possible Cause	Countermeasures	Refer to Page
Main Circuit	Appropriate power supply voltage is not applied. (Operation panel display is not provided.)	Power ON moulded case circuit breaker (MCCB), an earth leakage circuit breaker (ELB), or a magnetic contactor (MC).	—
		Check for the decreased input voltage, input phase loss, and wiring.	
	Motor is not connected properly.	Check the wiring between the drive unit and the motor.	*15*
	The jumper across P/+ to P1 is disconnected.	Securely fit a jumper across P/+ to P1. To use a DC reactor (FR-HEL) or Filterpack, remove the jumper across the terminals P/+ and P1, then connect the DC reactor or Filterpack.	*33*
Input Signal	Start signal is not input.	Check the start command source, and input a start signal. PU operation mode: RUN External operation mode : STF/STR signal	*166*
	Both the forward and reverse rotation start signals (STF, STR) are input simultaneously.	Turn ON only one of the forward and reverse rotation start signals (STF or STR). If the STF and STR signals are turned ON simultaneously in the initial setting, a stop command is given.	*18*
	Speed command is zero. (RUN LED on the operation panel is blinking.)	Check the speed command source and enter a speed command.	*166*
	AU signal is not ON when terminal 4 is used for speed setting. (RUN LED on the operation panel is blinking.)	Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input.	*147*
	Output stop (MRS) signal or reset (RES) signal is ON. (RUN LED on the operation panel blinks while MRS signal is ON.)	Turn MRS or RES signal OFF. Drive unit starts the operation with a given start command and a speed command after turning OFF MRS or RES signal. Before turning OFF, ensure the safety.	*119, 252*
	Jumper connector of sink - source is wrongly selected. (RUN LED on the operation panel is blinking.)	Check that the control logic switchover jumper connector is correctly installed. If it is not installed correctly, input signal is not recognized.	*20*
	Shorting wires between S1 and SC, S2 and SC are disconnected.	Short between S1 and SC, S2 and SC with shorting wires.	*19*
	Voltage/current input switch is not correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA). (RUN LED on the operation panel is blinking.)	Set *Pr. 73, Pr. 267*, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.	*18*
	STOP RESET was pressed. (Operation panel indication is PS (PS).)	During the External operation mode, check the method of restarting from a STOP RESET input stop from PU.	*256*
	Two-wire or three-wire type connection is wrong.	Check the connection. Connect STOP signal when three-wire type is used.	*121*

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Check Points	Possible Cause	Countermeasures	Refer to Page
Parameter Setting	*Pr. 78 Reverse rotation prevention selection* is set.	Check the *Pr. 78* setting. Set *Pr. 78* when you want to limit the motor rotation to only one direction.	*161*
	Pr. 79 Operation mode selection setting is wrong.	Select the operation mode which corresponds with input methods of start command and speed command.	*166*
	Bias and gain *(calibration parameter C2 to C7)* settings are improper.	Check the bias and gain *(calibration parameter C2 to C7)* settings.	*152*
	Pr. 13 Starting speed setting is greater than the running speed.	Set running speed higher than *Pr. 13*. The drive unit does not start if the speed setting signal is less than the value set in *Pr. 13*.	*99*
	Speed settings of various running speed (such as multi-speed operation) are zero. Especially, *Pr. 1 Maximum setting* is zero.	Set the speed command according to the application. Set *Pr. 1* higher than the actual speed used.	*87*
	Pr. 15 Jog speed setting setting is lower than *Pr. 13 Starting speed*.	Set *Pr. 15 Jog speed setting* higher than *Pr. 13 Starting speed*	*91*
	Operation mode and a writing device do not match.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*164*, *177*
	Start signal operation selection is set by the *Pr. 250 Stop selection*	Check *Pr. 250* setting and connection of STF and STR signals.	*121*
	Performing offline auto tuning.	When offline auto tuning ends, press STOP RESET of the operation panel for the PU operation. For the External operation, turn OFF the start signal (STF or STR). This operation resets the offline auto tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)	*105*, *107*
	PM motor test operation is selected.	Set "30" in *Pr. 800 Regenerative function selection*.	*77*
Load	Load is too heavy.	Reduce the load.	—
	Shaft is locked.	Inspect the machine (motor).	—
Others	Operation panel display shows an error (e.g. E.OC1).	When any fault occurs, take an appropriate corrective action, then reset the drive unit, and resume the operation.	*253*

5.5.2 Motor or machine is making abnormal acoustic noise

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	Disturbance due to EMI when speed command is given from analog input (terminal 2, 4).	Take countermeasures against EMI.	*38*
Parameter Setting		Increase the *Pr. 74 Input filter time constant* if steady operation cannot be performed due to EMI.	*151*
Parameter Setting	Resonance occurs. (Rotation speed)	Set *Pr. 31 to Pr. 36 (speed jump)*. When it is desired to avoid resonance attributable to the natural speed of a mechanical system, these parameters allow resonant speeds to be jumped.	*88*
	Offline auto tuning is not performed when driving a motor other than S-PM geared motor.	Perform offline auto tuning.	*105*
	Gain adjustment during PID control is insufficient.	To stabilize the measured value, change the proportional band (*Pr. 129*) to a larger value, the integral time (*Pr. 130*) to a slightly longer time, and the differential time (*Pr. 134*) to a slightly shorter time. Check the calibration of set point and measured value.	*216*
	Speed control gain is too high.	Check *Pr. 820 Speed control P gain* setting.	*79*
Others	Mechanical looseness	Adjust machine/equipment so that there is no mechanical looseness.	—
Motor	Operating with output phase loss	Check the motor wiring.	—
	Please contact your sales representative.		

5.5.3 Drive unit generates abnormal noise

Check Points	Possible Cause	Countermeasures	Refer to Page
Fan	Fan cover was not correctly installed when a cooling fan was replaced.	Install the fan cover correctly. Install the fan cover securely with the enclosed fan cover fixing screws.	*276*

5.5.4 Motor generates heat abnormally

Check Points	Possible Cause	Countermeasures	Refer to Page
Motor	Motor fan is not working (Dust is accumulated.)	Clean the motor fan. Improve the environment.	—
	Phase to phase insulation of the motor is insufficient.	Check the insulation of the motor.	—
Main Circuit	The drive unit output voltage (U, V, W) are unbalanced.	Check the output voltage of the drive unit. Check the insulation of the motor.	*273*
—	Motor current is large.	Refer to "5.5.11 Motor current is too large".	*269*

5.5.5 Motor rotates in the opposite direction

Check Points	Possible Cause	Countermeasures	Refer to Page
Main Circuit	Phase sequence of output terminals U, V and W is incorrect.	Connect phase sequence of the output cables (terminal U, V, W) to the motor correctly	*15*
	The rotation direction of the output shaft is changed by the reduction gear.	Check the rotation direction of the motor's output shaft.	*15*
Input Signal	The start signals (forward rotation, reverse rotation) are connected improperly.	Check the wiring. (STF: forward rotation, STR: reverse rotation)	*18*
	Adjustment by the rotation speed is improper during the reversible operation with *Pr. 73 Analog input selection* setting.	Check the setting of *Pr. 125, Pr. 126, C2 to C7.*	*149*
Parameter Setting	*Pr. 40 RUN key rotation direction selection* setting is incorrect.	Check the *Pr. 40* setting.	*241*

5.5.6 Speed greatly differs from the setting

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	Speed setting signal is incorrectly input.	Measure the input signal level.	—
	The input signal lines are affected by external EMI.	Take countermeasures against EMI such as using shielded wires for input signal lines.	*38*
Parameter Setting	*Pr. 1, Pr. 2, calibration parameter C2 to C7* settings are improper.	Check the settings of *Pr. 1 Maximum setting, Pr. 2 Minimum setting.*	*87*
		Check the *calibration parameter C2 to C7* settings.	*152*
		The maximum speed is limited to the maximum speed of the PM motor.	*288*
	Pr. 31 to Pr. 36 (speed jump) settings are improper.	Narrow down the range of speed jump.	*88*
Load	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
Parameter Setting		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*83*
Motor		Check the capacities of the drive unit and the motor.	—

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5.5.7 Acceleration/deceleration is not smooth

Check Points	Possible Cause	Countermeasures	Refer to Page
Parameter Setting	Acceleration/deceleration time is too short.	Increase acceleration/deceleration time.	97
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	83
		Check the capacities of the drive unit and the motor.	—
	Regeneration avoidance operation is performed	If the speed becomes unstable during regeneration avoidance operation, decrease the setting of *Pr. 886 Regeneration avoidance voltage gain*.	228
	Pr. 791 and *Pr. 792 (Acceleration/deceleration time in low-speed range)* are set.	Check the *Pr. 791* and *Pr. 792 (Acceleration/deceleration time in low-speed range)* settings.	97
	When any mechanical looseness or load fluctuation exists, the motor resistance calculated by the drive unit is inaccurate.	Set the wiring resistance value in *Pr. 658 Wiring resistance*.	82
Others	The machine is unstable, or the load fluctuates.	Adjust machine/equipment so that there is no mechanical looseness. Eliminate the load fluctuation. Use *Pr. 156 Stall prevention operation selection* to disable stall prevention operation.	83

5.5.8 Speed varies during operation

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	The speed setting signal is affected by EMI.	Set filter to the analog input terminal using *Pr. 74 Input filter time constant*.	151
		Take countermeasures against EMI, such as using shielded wires for input signal lines.	38
	Malfunction is occurring due to the undesirable current generated when the transistor output unit is connected.	Use terminal PC (terminal SD when source logic) as a common terminal to prevent a malfunction caused by undesirable current.	21
	Multi-speed command signal is chattering.	Take countermeasures to suppress chattering.	—
Parameter Setting	The setting of *Pr.998 PM parameter initialization (Pr.80 Motor capacity and Pr.81 Number of motor poles)* is not appropriate according to the applied motor.	Set *Pr.998 (Pr.80 and Pr.81)* correctly.	73, 105
	Offline auto tuning is not performed when driving a motor other than S-PM geared motor.	Perform offline auto tuning.	105
	Hunting occurs by the generated vibration, for example, when structural rigidity at load side is insufficient.	Disable automatic control functions, such as regeneration avoidance function and stall prevention. During the PID control, set smaller values to *Pr. 129 PID proportional band* and *Pr. 130 PID integral time*. During the PID control, set smaller values to *Pr. 129 PID proportional band* and *Pr. 130 PID integral time*. Lower the control gain, and adjust to increase the stability.	—

5.5.9 Operation mode is not changed properly

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	Start signal (STF or STR) is ON.	Check that the STF and STR signals are OFF. When either is ON, the operation mode cannot be changed.	*164*
Parameter Setting	*Pr. 79* setting is improper.	When *Pr. 79 Operation mode selection* setting is "0" (initial value), the drive unit is placed in the External operation mode at input power ON. To switch to the PU operation mode, press PU/EXT on the operation panel (press PU when the parameter unit (FR-PU07) is used). At other settings (1 to 4, 6, 7), the operation mode is limited accordingly.	*164*
	Operation mode and a writing device do not correspond.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*164, 177*

5.5.10 Operation panel display is not operating

Check Points	Possible Cause	Countermeasures	Refer to Page
Main Circuit	Wiring or installation is improper.	Check for the wiring and the installation.	*14*
		Make sure that the connector is fitted securely across terminal P/+ to P1.	
Main Circuit Control Circuit	Power is not input.	Input the power.	*14*
Parameter Setting	Command sources at the PU operation mode is not at the operation panel. (None of the operation mode displays (PU EXT NET) is lit.)	Check the setting of *Pr. 551 PU mode operation command source selection.* (If parameter unit (FR-PU07) is connected while *Pr. 551* = "9999" (initial setting), all the operation mode displays (PU EXT NET) turn OFF.)	*177*

5.5.11 Motor current is too large

Check Points	Possible Cause	Countermeasures	Refer to Page
Parameter Setting	PM control torque boost setting is improper.	Lower the *Pr. 785 PM control torque boost* setting. (Lowering it too much may cause torque shortage.)	*86*
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*83*
		Check the capacities of the drive unit and the motor.	—
	Offline auto tuning is not performed when driving a motor other than S-PM geared motor.	Perform offline auto tuning.	*105*

5.5.12 Speed does not accelerate

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	Start command and speed command are chattering.	Check if the start command and the speed command are correct.	—
	The wiring length used for analog speed command is too long, and it is causing a voltage (current) drop.	Perform analog input bias/gain calibration.	*152*
	Input signal lines are affected by external EMI.	Take countermeasures against EMI, such as using shielded wires for input signal lines.	*38*
Parameter Setting	*Pr. 1, Pr. 2, calibration parameter C2 to C7* settings are improper.	Check the settings of *Pr. 1 Maximum setting* and *Pr. 2 Minimum setting*.	*87*
		Check the *calibration parameter C2 to C7* settings.	*152*
		The maximum speed is limited to the maximum speed of the PM motor.	*288*
	The maximum voltage (current) input value is not set during the External operation. *(Pr. 125, Pr. 126)*	Check the *Pr. 125 Terminal 2 speed setting gain speed* and *Pr. 126 Terminal 4 speed setting gain speed* settings.	*87*、*152*
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*83*
		Check the capacities of the drive unit and the motor.	—
	Offline auto tuning is not performed when driving a motor other than S-PM geared motor.	Perform offline auto tuning.	*105*
	During PID control, rotation speed is automatically controlled to make measured value = set point.		*216*
Main Circuit	Brake resistor is connected between terminal P/+ and P1 by mistake.	Connect an optional brake transistor (MRS type, MYS type, FR-ABR) between terminal P/+ and PR.	*27*

5.5.13 Unable to write parameter setting

Check Points	Possible Cause	Countermeasures	Refer to Page
Input Signal	Operation is being performed (signal STF or STR is ON).	Stop the operation. When *Pr. 77* = "0" (initial value), write is enabled only during a stop.	*160*
Parameter Setting	You are attempting to set the parameter in the External operation mode.	Choose the PU operation mode. Or, set *Pr. 77* = "2" to enable parameter write regardless of the operation mode.	*160*
	Parameter is disabled by the *Pr. 77 Parameter write selection* setting.	Check *Pr. 77 Parameter write selection* setting.	*160*
	Key lock is activated by the *Pr. 161 Speed setting/key lock operation selection* setting.	Check *Pr. 161 Speed setting/key lock operation selection* setting.	*242*
	Operation mode and a writing device do not correspond.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*164*, *177*

6 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter provides the "PRECAUTIONS FOR MAINTENANCE AND INSPECTION" of this product.
Always read the instructions before using the equipment.

The drive unit is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

●Precautions for maintenance and inspection

For some short time after the power is switched OFF, a high voltage remains in the smoothing capacitor. When accessing the drive unit for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/- of the drive unit is not more than 30VDC using a tester, etc.

6.1 Inspection items

6.1.1 Daily inspection

Basically, check for the following faults during operation.

(1) Motor operation fault
(2) Improper installation environment
(3) Cooling system fault
(4) Abnormal vibration, abnormal noise
(5) Abnormal overheat, discoloration

6.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.
For a periodic inspection, contact your sales representative.

(1) Check for cooling system fault............Clean the air filter, etc.
(2) Tightening check and retightening......The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them.
Tighten them according to the specified tightening torque *(refer to page 16)*.
(3) Check the conductors and insulating materials for corrosion and damage.
(4) Measure insulation resistance.
(5) Check and change the cooling fan and relay.

6.1.3 Daily and periodic inspection

Area of Inspection	Inspection Item	Description	Interval: Daily	Interval: Periodic *3	Corrective Action at Alarm Occurrence	Customer's Check
General	Surrounding environment	Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.	○		Improve environment	
	Overall unit	Check for unusual vibration and noise.	○		Check alarm location and retighten	
		Check for dirt, oil, and other foreign material.*1	○		Clean	
	Power supply voltage	Check that the main circuit voltages are normal.*2	○		Inspect the power supply	
Main circuit	General	(1) Check with megger (across main circuit terminals and earth (ground) terminal).		○	Contact the manufacturer	
		(2) Check for loose screws and bolts.		○	Retighten	
		(3) Check for overheat traces on parts.		○	Contact the manufacturer	
		(4) Check for stains.		○	Clean	
	Conductors, cables	(1) Check conductors for distortion.		○	Contact the manufacturer	
		(2) Check cable sheaths for breakage and deterioration (crack, discoloration, etc.)		○	Contact the manufacturer	
	Terminal block	Check for damage.		○	Stop the device and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor	(1) Check for liquid leakage.		○	Contact the manufacturer	
		(2) Check for safety valve projection and bulge.		○	Contact the manufacturer	
		(3) Visual check and judge by the life check of the main circuit capacitor *(refer to page 274)*.		○		
	Relay	Check that the operation is normal and no chatter is heard.		○	Contact the manufacturer	
Control circuit, Protective circuit	Operation check	(1) Check that the output voltages across phases with the drive unit operated alone is balanced		○	Contact the manufacturer	
		(2) Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer	
	Parts check: Overall	(1) Check for unusual odors and discoloration.		○	Stop the device and contact the manufacturer.	
		(2) Check for serious rust development		○	Contact the manufacturer	
	Parts check: Aluminum electrolytic capacitor	(1) Check for liquid leakage in a capacitor and deformation trace		○	Contact the manufacturer	
		(2) Visual check and judge by the life check of the main circuit capacitor *(refer to page 274)*.		○		
Cooling system	Cooling fan	(1) Check for unusual vibration and noise.	○		Replace the fan	
		(2) Check for loose screws and bolts		○	Fix with the fan cover fixing screws	
		(3) Check for stains.		○	Clean	
	Heatsink	(1) Check for clogging		○	Clean	
		(2) Check for stains.		○	Clean	
Display	Indication	(1) Check that display is normal.	○		Contact the manufacturer	
		(2) Check for stains.		○	Clean	
	Meter	Check that reading is normal	○		Stop the device and contact the manufacturer.	
Load motor	Operation check	Check for vibration and abnormal increase in operation noise	○		Stop the device and contact the manufacturer.	

*1 The oil component of the heat dissipation grease used inside the drive unit may leak out. The oil component, however, is not flammable, corrosive, nor conductive and is not harmful to humans. Wipe off such an oil component with a cloth, etc.
*2 It is recommended to install a device to monitor voltage for checking the power supply voltage to the drive unit.
*3 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment.
For a periodic inspection, contact your sales representative.

NOTE

Continuous use of a leaked, deformed, or degraded smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst, breakage, or a fire. Replace such a capacitor without delay.

6.1.4 Display of the life of the drive unit parts

The self-diagnostic alarm is output when the life span of the control circuit capacitor, cooling fan and each parts of the inrush current limit circuit is near its end. It gives an indication of replacement time.

The life alarm output can be used as a guideline for life judgement.

Parts	Judgement Level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated remaining life 10%
Inrush current limit circuit	Estimated remaining life 10% (Power ON: 100,000 times left)
Cooling fan	Less than 50% of the predetermined speed

POINT

Refer to page 231 to perform the life check of the drive unit parts.

6.1.5 Checking the inverter and converter modules

<Preparation>

(1) Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W).

(2) Prepare a tester. (Use 100Ω range.)

<Checking method>

Change the polarity of the tester alternately at the drive unit terminals R/L1, S/L2, T/L3, U, V, W, P/+ and N/-, and check for continuity.

NOTE

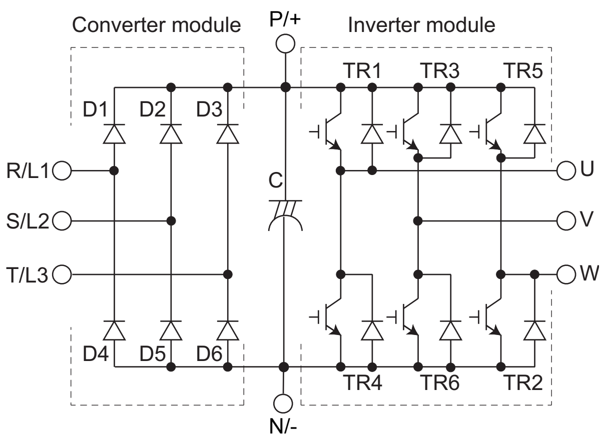
1. Before measurement, check that the smoothing capacitor is discharged.

2. At the time of discontinuity, the measured value is almost ∞. When there is an instantaneous continuity, due to the smoothing capacitor, the tester may not indicate ∞. At the time of continuity, the measured value is several to several tens-of ohms depending on the module type, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Measured Value		Tester Polarity		Measured Value
		⊕	⊖			⊕	⊖	
Converter module	D1	R/L1	P/+	Discontinuity	D4	R/L1	N/-	Continuity
		P/+	R/L1	Continuity		N/-	R/L1	Discontinuity
	D2	S/L2	P/+	Discontinuity	D5	S/L2	N/-	Continuity
		P/+	S/L2	Continuity		N/-	S/L2	Discontinuity
	D3	T/L3	P/+	Discontinuity	D6	T/L3	N/-	Continuity
		P/+	T/L3	Continuity		N/-	T/L3	Discontinuity
Inverter module	TR1	U	P/+	Discontinuity	TR4	U	N/-	Continuity
		P/+	U	Continuity		N/-	U	Discontinuity
	TR3	V	P/+	Discontinuity	TR6	V	N/-	Continuity
		P/+	V	Continuity		N/-	V	Discontinuity
	TR5	W	P/+	Discontinuity	TR2	W	N/-	Continuity
		P/+	W	Continuity		N/-	W	Discontinuity

(Assumes the use of an analog meter.)



6.1.6 Cleaning

Always run the drive unit in a clean status.
When cleaning the drive unit, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

NOTE

Do not use solvent, such as acetone, benzene, toluene and alcohol, as these will cause the drive unit surface paint to peel off. The display, etc. of the operation panel and parameter unit (FR-PU07) are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

6.1.7 Replacement of parts

The drive unit consists of many electronic parts such as semiconductor devices.
The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the drive unit. For preventive maintenance, the parts must be replaced periodically.
Use the life check function as a guidance of parts replacement.

Part Name	Estimated Lifespan *1	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years *2	Replace (as required)
On-board smoothing capacitor	10 years *2	Replace the board (as required)
Relays	—	as required

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C
(without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
*2 Output current: 80% of the drive unit rated current

NOTE

For parts replacement, contact the nearest Mitsubishi Electric FA Center.

PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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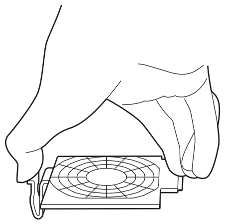
(1) Cooling fan

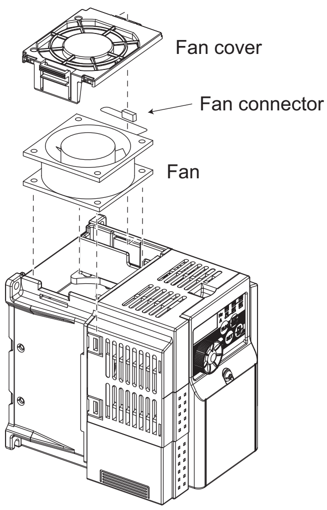
The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately.

●Removal

1) Push the hooks from above and remove the fan cover.

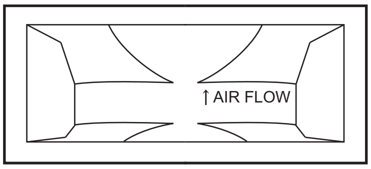


2) Disconnect the fan connectors.
3) Remove the fan.



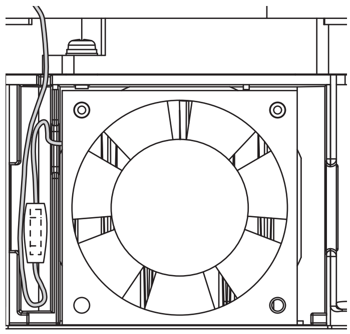
●Reinstallation

1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

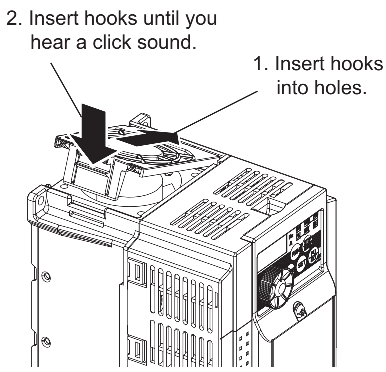


<Fan side face>

2) Reconnect the fan connectors.
3) When wiring, avoid the cables being caught by the fan.



4) Reinstall the fan cover.



Example for FR-D720-1.5K-G

NOTE

- **Installing the fan in the opposite of air flow direction can cause the drive unit life to be shorter.**
- **Prevent the cable from being caught when installing a fan.**
- **Switch the power OFF before replacing fans. Since the drive unit circuits are charged with voltage even after power OFF, replace fans only when the drive unit cover is on the drive unit to prevent an electric shock accident.**

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc. The replacement intervals greatly vary with the surrounding air temperature and operating conditions. When the drive unit is operated in air-conditioned and normal environment conditions, replace the capacitors about every 10 years.
When a certain period of time has elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon).
The appearance criteria for inspection are as follows:
1) Case: Check the side and bottom faces for expansion
2) Sealing plate: Check for remarkable warp and extreme crack.
3) Check for external crack, discoloration, liquid leakage, etc. Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 80% of the rating.

POINT

Refer to page 231 to perform the life check of the main circuit capacitor.

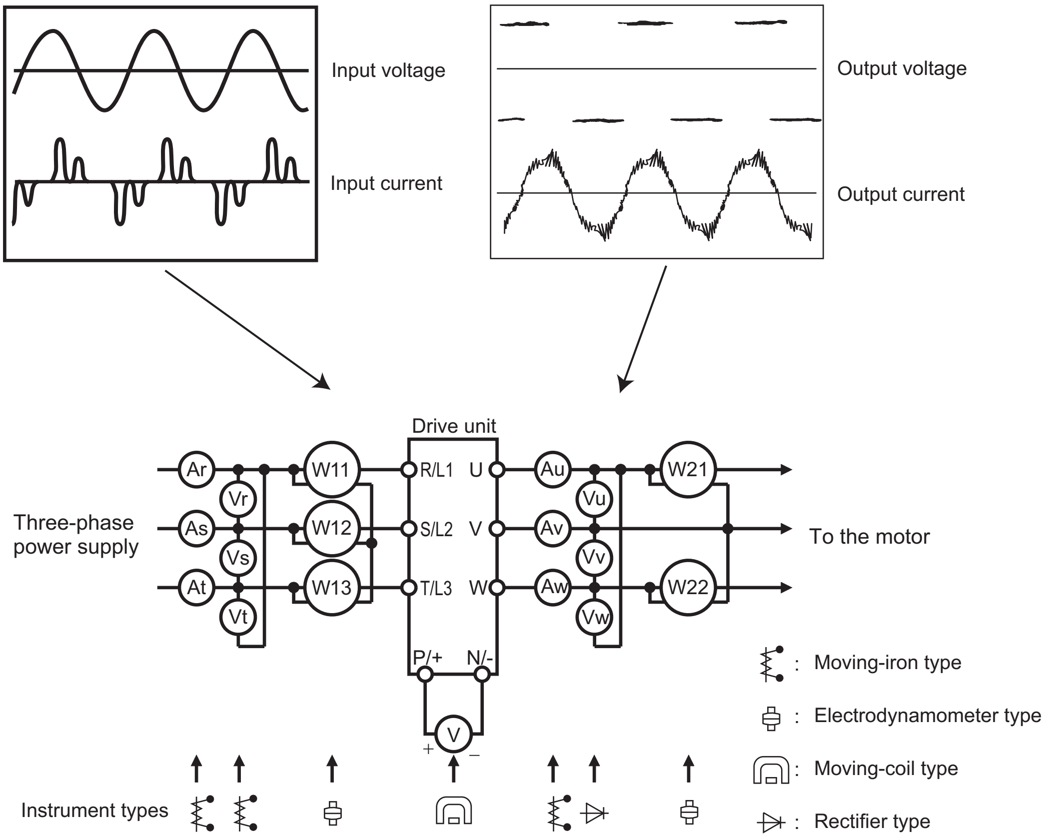
(3) Relay output terminals

To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

6.2 Measurement of main circuit voltages, currents and powers

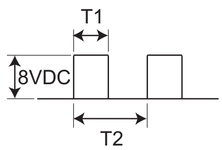
Since the voltages and currents on the drive unit power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured.
When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the next page.

- When installing meters etc. on the drive unit output side
  When the drive unit-to-motor wiring length is large, especially in the 400V class, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating.
  To measure and display the output voltage and output current of the drive unit, it is recommended to use the terminal FM output function of the drive unit.



Examples of Measuring Points and Instruments

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)
Power supply voltage V1	R/L1 and S/L2 S/L2 and T/L3 T/L3 and R/L1	Moving-iron type AC voltmeter *3	Commercial power supply Within permissible AC voltage fluctuation *(refer to page 284).*
Power supply side current I1	R/L1, S/L2, T/L3 line current	Moving-iron type AC ammeter *3	
Power supply side power P1	R/L1, S/L2, T/L3 and R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1	Digital power meter (designed for inverter) or electrodynamic type single-phase wattmeter	P1=W11+W12+W13 (3-wattmeter method)
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100$ %		
Output side voltage V2	Across U and V, V and W, and W and U	Rectifier type AC voltage meter *1 *3 (moving-iron type cannot measure)	Difference between the phases is within 1% of the maximum output voltage.
Output side current I2	U, V and W line currents	Moving-iron type AC ammeter *3	Difference between the phases is 10% or lower of the drive unit rated current.
Output side power P2	U, V, W and U and V, V and W	Digital power meter (designed for inverter) or electrodynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)
Output side power factor Pf2	Calculate in similar manner to power supply side power factor. $Pf_2 = \frac{P_2}{\sqrt{3}V_2 \times I_2} \times 100$ %		
Converter output	Across P/+ and N/-	Moving-coil type (such as tester)	Drive unit LED display is lit. 1.35 × V1
Frequency setting signal	Across 2(+) and 5 Across 4(+) and 5	Moving-coil type (tester and such may be used) (internal resistance 50kΩ or more)	0 to 10VDC, 4 to 20mADC "5" is common
Frequency setting power supply	Across 10(+) and 5		5.2VDC "5" is common
Frequency meter signal	Across FM(+) and SD		Approximately 5VDC at maximum frequency (without frequency meter)  Pulse width T1 : Adjust with *C0 (Pr. 900)* Pulse cycle T2 : Set with *Pr. 55* (frequency monitor only) "SD" is common.
Start signal Select signal	Across SD and STF, STR, RH, RM, or RL(+)		When open 20 to 30VDC ON voltage: 1V or less "SD" is common.
Fault signal	Across A and C Across B and C	Moving-coil type (such as tester)	Continuity check *2 <Normal> <Fault> Across A and C: Discontinuity / Continuity Across B and C: Continuity / Discontinuity

*1 Use an FFT to measure the output voltage accurately. An FA tester or general measuring instrument cannot measure accurately.
*2 When the setting of *Pr. 192 A,B,C terminal function selection* is positive logic
*3 A digital power meter (designed for inverter) can also be used to measure.

PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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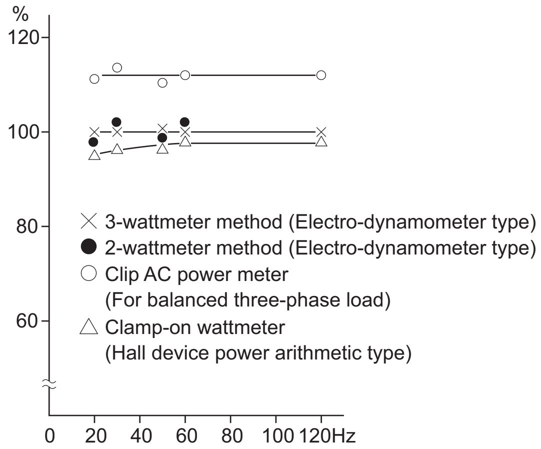
6.2.1 Measurement of powers

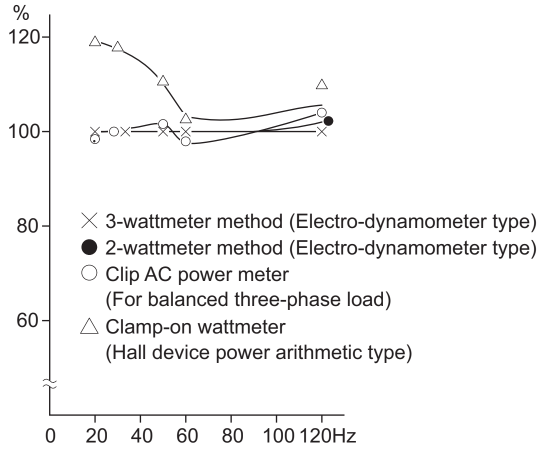
Use digital power meters (for inverter) for the both of drive unit input and output side. Alternatively, measure using electrodynamic type single-phase wattmeters for the both of drive unit input and output side in two-wattmeter or three-wattmeter method. As the current is liable to be imbalanced especially in the input side, it is recommended to use the three-wattmeter method.
Examples of process value differences produced by different measuring meters are shown below.
An error will be produced by difference between measuring instruments, e.g. power calculation type and two- or three-wattmeter type three-phase wattmeter. When a CT is used in the current measuring side or when the meter contains a PT on the voltage measurement side, an error will also be produced due to the frequency characteristics of the CT and PT.

[Measurement conditions]
Constant output of 60Hz or higher with a constant torque (100%). The value obtained by the 3-wattmeter method with a 4-pole 3.7kW induction motor is assumed to be 100%.



Example of
Measuring Drive Unit Input Power

[Measurement conditions]
Constant output of 60Hz or higher with a constant torque (100%). The value obtained by the 3-wattmeter method with a 4-pole 3.7kW induction motor is assumed to be 100%.



Example of
Measuring Drive Unit Output Power

6.2.2 Measurement of voltages and use of PT

(1) Drive unit input side

As the input side voltage has a sine wave and it is extremely small in distortion, accurate measurement can be made with an ordinary AC meter.

(2) Drive unit output side

Since the output side voltage has a PWM-controlled rectangular wave, always use a rectifier type voltmeter. A needle type tester cannot be used to measure the output side voltage as it indicates a value much greater than the actual value. A moving-iron type meter indicates an effective value which includes harmonics and therefore the value is larger than that of the fundamental wave. The value monitored on the operation panel is the drive unit-controlled voltage itself. Hence, that value is accurate and it is recommended to monitor values using the operation panel.

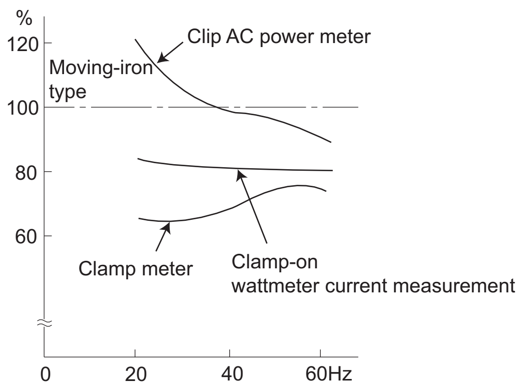
(3) PT

No PT can be used in the output side of the drive unit. Use a direct-reading meter. (A PT can be used in the input side of the drive unit.)

6.2.3 Measurement of currents

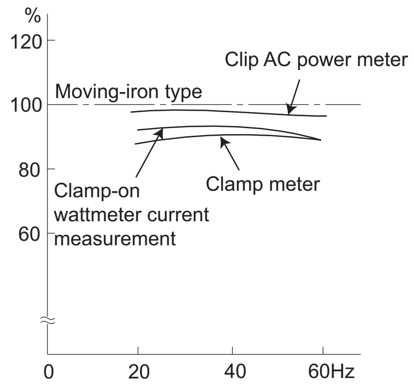
Use moving-iron type meters on both the input and output sides of the drive unit.
Since current on the drive unit input side tends to be unbalanced, measurement of three phases is recommended. Correct value cannot be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output side current should be within 10%.
When a clamp ammeter is used, always use an effective value detection type. A mean value detection type produces a large error and may indicate an extremely smaller value than the actual value. The value monitored on the operation panel is accurate if the output frequency varies, and it is recommended to monitor values (provide analog output) using the operation panel.
Examples of process value differences produced by different measuring meters are shown below.

[Measurement conditions]
Value indicated by moving-iron type ammeter is 100%.



Example of measuring input current

[Measurement conditions]
Value indicated by moving-iron type ammeter is 100%.



Example of measuring output current

6.2.4 Use of CT and transducer

A CT may be used in both the input and output sides of the drive unit, but the one used should have the largest possible VA ability because an error will increase if the frequency gets lower.
When using a transducer, use the effective value calculation type which is immune to harmonics.

6.2.5 Measurement of drive unit input power factor

Calculate using effective power and apparent power. A power-factor meter cannot indicate an exact value.

$$\text{Total power factor of the drive unit} = \frac{\text{Effective power}}{\text{Apparent power}}$$

$$= \frac{\text{3-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

6.2.6 Measurement of converter output voltage (across terminals P/+ and N/-)

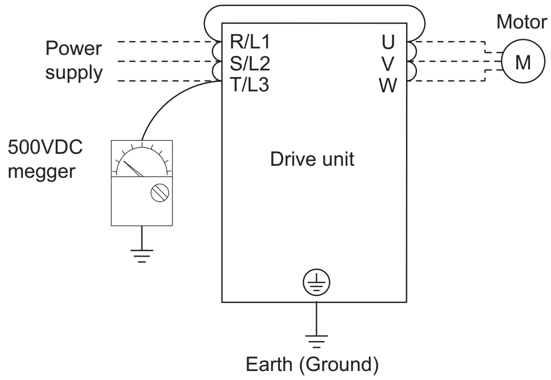
The output voltage of the converter is developed across terminals P/+ and N/- and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 270VDC to 300VDC (540VDC to 600VDC for the 400V class) is output when no load is connected and voltage decreases during driving load operation.
When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 400VDC to 450VDC (800VDC to 900VDC for the 400V class) maximum.

6.2.7 Measurement of drive unit output frequency

A pulse train proportional to the output frequency is output across the frequency meter signal output terminal FM-SD of the drive unit. This pulse train output can be counted by a frequency counter, or a meter (moving-coil type voltmeter) can be used to read the mean value of the pulse train output voltage. When a meter is used to measure the output frequency, approximately 5VDC is indicated at the maximum frequency.
For detailed specifications of the frequency meter signal output terminal FM, refer to *page 140*.

6.2.8 Insulation resistance test using megger

- For the drive unit, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



NOTE

- **Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the drive unit so that the test voltage is not applied to the drive unit.**
- **For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.**

6.2.9 Pressure test

Do not conduct a pressure test. Deterioration may occur.

7 SPECIFICATIONS

This chapter provides the "SPECIFICATIONS" of this product. Always read the instructions before using the equipment.

7.1 Rating

● Three-phase 200V power supply

Model FR-D720-□K-G		0.2	0.4	0.75	1.5	2.2	3.7
Output	Rated capacity (kVA)*1	0.3	0.6	1.0	1.7	2.8	4.0
	Rated current (A)	1.4	2.5	4.2	7.0	10.0	16.5
	Overload current rating	150% 60s, 200% 0.5s (Rated motor current, inverse-time characteristics)					
Power supply	Rated input AC voltage/frequency	Three-phase 200 to 240V 50Hz/60Hz					
	Permissible AC voltage fluctuation	170 to 264V 50Hz/60Hz					
	Permissible frequency fluctuation	±5%					
	Power supply capacity (kVA)*2	0.4	0.7	1.2	2.1	4.0	5.5
Protective structure (JEM1030)		Enclosed type (IP20)					
Cooling system		Self-cooling			Forced air cooling		
Approximate mass (kg)		0.5	0.8	1.0	1.4	1.4	1.8

● Three-phase 400V power supply

Model FR-D740-□K-G		0.4	0.75	1.5	2.2	3.7
Output	Rated capacity (kVA)*1	0.4	0.9	1.7	2.7	3.8
	Rated current (A)	1.2	2.2	3.6	5.0	8.0
	Overload current rating	150% 60s, 200% 0.5s (Rated motor current, inverse-time characteristics)				
Power supply	Rated input AC voltage/frequency	Three-phase 380 to 480V 50Hz/60Hz				
	Permissible AC voltage fluctuation	325 to 528V 50Hz/60Hz				
	Permissible frequency fluctuation	±5%				
	Power supply capacity (kVA)*2	0.9	1.5	2.5	5.5	9.5
Protective structure (JEM1030)		Enclosed type (IP20)				
Cooling system		Natural		Forced air		
Approximate mass (kg)		1.3	1.3	1.4	1.5	1.5

*1 The rated output capacity assumes the following output voltages: 230V for three-phase 200V, and 440V for three-phase 400V.
*2 The power supply capacity varies with the value of the power supply side drive unit impedance (including those of the input reactor and cables).

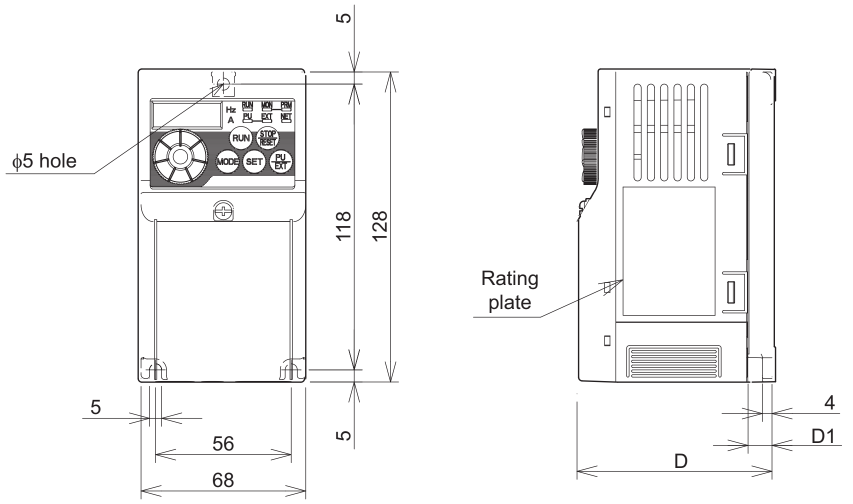
7.2 Common specifications

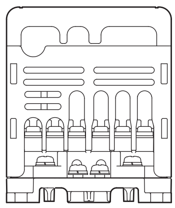
Control specifications	Control method		PM sensorless vector control (low-speed range: current synchronization operation)
	Carrier frequencies		5kHz
	Maximum speed		3000r/min (at 100Hz for the 1.5kW S-PM geared motor or lower, or 150Hz for the 2.2kW S-PM geared motor)*6
	Speed setting resolution	Analog input	3r/min/3000r/min (terminal2, 4: 0 to 10V/10 bits) 6r/min/3000r/min (terminal2, 4: 0 to 5V/9 bits) 3r/min/3000r/min (terminal4: 0 to 20mA/10 bits)
		Digital input	1r/min
	Frequency accuracy	Analog input	Within ±1% of the max. output frequency (25°C ±10°C)
		Digital input	Within 0.01% of the set output frequency
	PM sensorless vector control range		1:10 (300r/min to 3000r/min*6)
	Starting torque		100% (initial value)
	Torque boost		PM control torque boost, DC injection brake torque boost
	Acceleration/deceleration time setting		0.1 to 3600s (acceleration and deceleration can be set individually), Linear and S-pattern acceleration/deceleration modes are available.
	Initial magnetic pole detection time		Approx. 0.1s (performed at start, at LX signal ON.)
	Stall prevention operation level		Stall operation current level (0 to 200%), and whether to use the function or not can be selected
Operation specifications	Frequency setting signal	Analog input	Two terminals Terminal 2: 0 to 10V and 0 to 5V are available Terminal 4: 0 to 10V, 0 to 5V, and 4 to 20mA are available
		Digital input	The signal is entered from the operation panel or parameter unit. Frequency setting increment can be set.
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signal (five terminals)		The following signals can be assigned to *Pr. 178* to *Pr. 182 (input terminal function selection)*: multi-speed selection, remote setting, second function selection, terminal 4 input selection, JOG operation selection, external thermal input, drive unit run enable signal, PU operation external interlock, PID control valid terminal, PU-External operation switchover, pre-excitation, output stop, start self-holding selection, forward rotation, reverse rotation command, drive unit reset, PID forward/reverse action switchover, PU-NET operation switchover, External-NET operation switchover, command source switchover and PID integral value reset.
	Operational functions		Upper/lower limit setting, speed jump operation, external thermal relay input selection, forward/reverse rotation prevention, remote setting, second function, multi-speed operation, regeneration avoidance, operation mode selection, PID control, computer link operation (RS-485), MODBUS RTU
	Output signal Open collector output (two terminals) Relay output (one terminal)	Operating status	The following signals can be assigned to *Pr. 190, Pr. 192 (output terminal function selection)*: drive unit running, up-to-speed, overload alarm, speed detection, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, drive unit operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, brake opening request, electromagnetic brake interlock, fan alarm, heatsink overheat pre-alarm, operation ready 2, operation ready 3, PID control activated, PID deviation limit, during retry, PID output interruption, pulse train output of output power, life alarm, fault output 3, current average value monitor, maintenance timer alarm, remote output, alarm output and fault output.
		For meter Pulse train output (MAX 2.4kHz: one terminal)	The following signals can be assigned to *Pr.54 FM terminal function selection*: rotation speed (output frequency), output current (steady), output voltage, speed setting (frequency setting), converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, output power, reference voltage output, motor load factor (torque monitor), PID set point, PID measured value, motor thermal load factor, and drive unit thermal load factor. Pulse train output (1440 pulses/s/full scale)
Indication	Operation panel Parameter unit (FR-PU07)	Operating status	The following operating status can be displayed: rotation speed (output frequency), output current (steady), output voltage, speed setting (frequency setting), converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, output power, cumulative energization time, actual operation time, motor load factor (torque monitor), cumulative power, PID set point, PID measured value, PID deviation, drive unit I/O terminal monitor, motor thermal load factor, drive unit thermal load factor, and PTC thermistor resistance.
		Fault record	Fault record is displayed when a fault occurs. Past 8 fault records (output voltage/current/rotation speed (frequency)/cumulative energization time right before the fault occurs) are stored.
		Interactive guidance *2	Function (help) for operation guide *2
Protective/warning function		Protective function	Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, drive unit protection thermal operation, motor protection thermal operation, heatsink overheat, input phase loss*3, output side earth (ground) fault overcurrent at start*3, output short circuit, output phase loss, external thermal relay operation *3, PTC thermistor operation*3, parameter error, PU disconnection, retry count excess *3, CPU fault, brake transistor alarm, inrush resistance overheat, analog input error, PID signal fault*3, stall prevention operation, output current detection value exceeded*3, loss of synchronism detection, overspeed occurrence *3
		Warning function	Fan alarm*1, overcurrent stall prevention, overvoltage stall prevention, PU stop, parameter write error, regenerative brake pre-alarm *3, electronic thermal relay function pre-alarm, maintenance output *3, undervoltage, operation panel lock, password locked *3, drive unit reset
Environment	Surrounding air temperature		-10°C to +50°C maximum (non-freezing)*4
	Ambient humidity		90%RH or less (non-condensing)
	Storage temperature*5		-20°C to +65°C
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration		Maximum 1000m, 5.9m/s ^{2} or less at 10 to 55Hz (directions of X, Y, Z axes)

*1 As the 0.75K or lower are not provided with the cooling fan, this alarm does not function.
*2 This operation guide is only available with option parameter unit (FR-PU07). (Some functions are not supported.)
*3 This protective function is not available in the initial status.
*4 When using the drive units at the surrounding air temperature of 40°C or less, the drive units can be installed closely attached (0cm clearance).
*5 Temperatures applicable for a short time, e.g. in transit.
*6 The maximum speed varies by motor type (rating) when a motor other than the S-PM geared motor is used.

7.3 Outline dimension drawings

●FR-D720S-0.2K to 0.75K-G

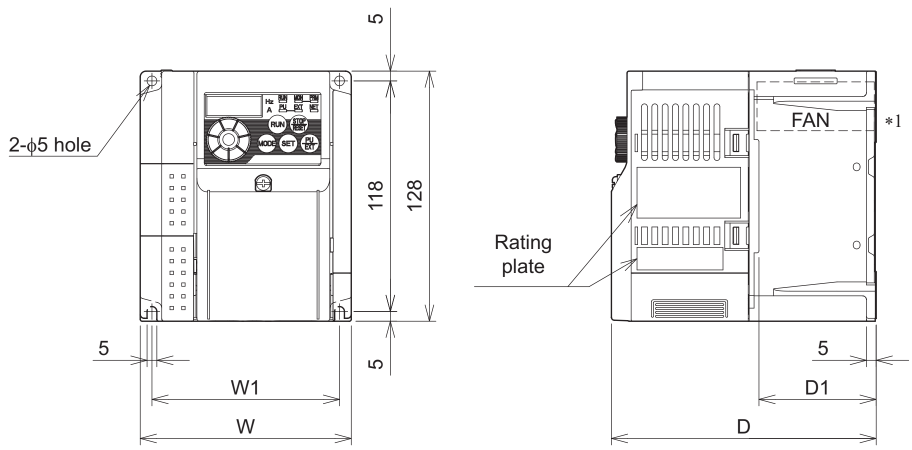




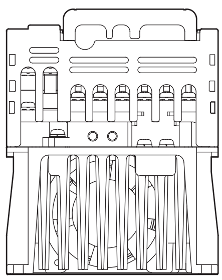
Drive Unit Model	D	D1
FR-D720-0.2K-G	80.5	10
FR-D720-0.4K-G	112.5	42
FR-D720-0.75K-G	132.5	62

(Unit: mm)

●FR-D720-1.5K to 3.7K-G
●FR-D740-0.4K to 3.7K-G



*1 FR-D740-0.4K, 0.75K are not provided with the cooling fan.

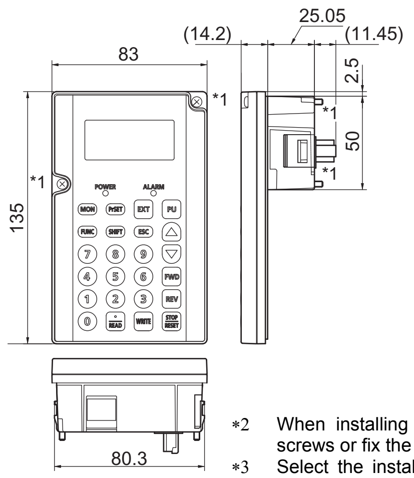


<table>
<tr><th>Drive Unit Model</th><th>W</th><th>W1</th><th>D</th><th>D1</th></tr>
<tr><td>FR-D720-1.5K-G, 2.2K-G
FR-D740-1.5K-G</td><td rowspan="4">108</td><td rowspan="4">96</td><td>135.5</td><td>60</td></tr>
<tr><td>FR-D740-0.4K-G, 0.75K-G</td><td>129.5</td><td>54</td></tr>
<tr><td>FR-D740-2.2K-G</td><td>155.5</td><td rowspan="2">60</td></tr>
<tr><td>FR-D740-3.7K-G</td><td>165.5</td></tr>
<tr><td>FR-D720-3.7K-G</td><td>170</td><td>158</td><td>142.5</td><td>66.5</td></tr>
</table>

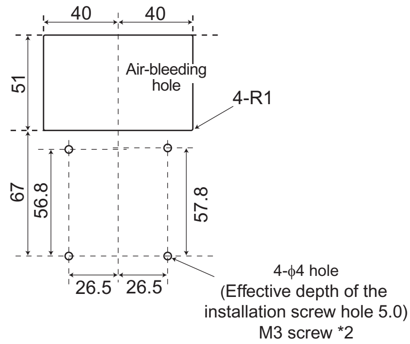
(Unit: mm)

●Parameter unit (option) (FR-PU07)

<Outline drawing>



<Panel cut dimension drawing>



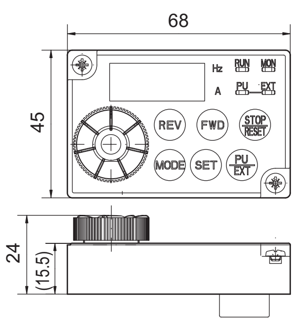
*2 When installing the FR-PU07 on the enclosure, etc., remove screws or fix the screws to the FR-PU07 with M3 nuts.

*3 Select the installation screw whose length will not exceed the effective depth of the installation screw hole.

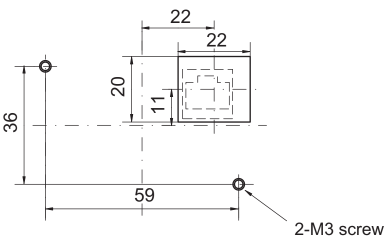
(Unit: mm)

●Enclosure surface operation panel (option) (FR-PA07)

<Outline drawing>



<Panel cut dimension drawing>



(Unit: mm)

SPECIFICATIONS

7

7.4 Specifications of the S-PM geared motors

7.4.1 Motor specifications

●Model names of S-PM geared motors

GV-S*1 0.4kW 150r/min 200V

Series
GV-S (parallel shaft, fixed load)
GV-SSY (right-angled shaft, fixed load)
GV-SHY (right-angled shaft, medium load)

Output	Voltage
0.1 to 2.2kW	200V class
0.2 to 2.2kW	400V class

Speed
Speed at output shaft *2 (3000r/min / nominal reduction ratio)

Voltage
200V class
400V class

*1 For the model names of the flange types and brake-equipped types, refer to the catalog.
*2 For the detail of the output-shaft rotation speed (reduction ratio), refer to the catalog.

●200V class

Motor model	GV-□□kW	0.1	0.2	0.4	0.75	1.5	2.2
Compatible drive unit	FR-D720-□K-G	0.2	0.4	0.75	1.5	2.2	3.7
Continuous characteristic *1	Rated output (kW)	0.1	0.2	0.4	0.75	1.5	2.2
	Rated torque (N•m) *2	0.32	0.64	1.27	2.39	4.78	7.00
Rated speed (r/min) *3		3000					
Maximum speed (r/min) *3		3000					
Number of poles		4					6
Maximum torque		150% 60s					
Rated current (A)		0.55	1.05	1.6	2.8	5.5	9.4
Structure		Totally enclosed self-cooling *4				Totally-enclosed fan-cooled	
Protective structure		IP44 (indoors), IP44 (outdoors) for semi-standard models					
Environment	Surrounding air temperature and humidity	0°C to +40°C (non-freezing), 90RH or less (non-condensing)					
	Vibration	4.9m/s^2 (0.5G) for continuous operation, 9.8m/s^2 (1G) for instantaneous operation					

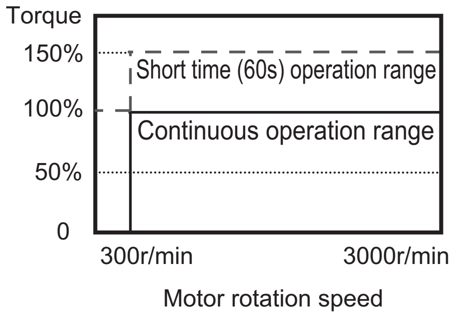
●400V class

Motor model	GV-□□kW	0.2	0.4	0.75	1.5	2.2
Compatible drive unit	FR-D740-□K-G	0.4	0.75	1.5	2.2	3.7
Continuous characteristic *1	Rated output (kW)	0.2	0.4	0.75	1.5	2.2
	Rated torque (N•m) *2	0.64	1.27	2.39	4.78	7.00
Rated speed (r/min) *3		3000				
Maximum speed (r/min) *3		3000				
Number of poles		4				6
Maximum torque		150% 60s				
Rated current (A)		0.5	0.75	1.4	2.8	4.7
Structure		Totally enclosed self-cooling *4			Totally-enclosed fan-cooled	
Protective structure		IP44 (indoors), IP44 (outdoors) for semi-standard models				
Environment	Surrounding air temperature and humidity	0°C to +40°C (non-freezing), 90RH or less (non-condensing)				
	Vibration	4.9m/s^2 (0.5G) for continuous operation, 9.8m/s^2 (1G) for instantaneous operation				

*1 The above characteristics apply when the rated AC voltage is input from the drive unit *(refer to page 284)*. Output and rated motor speed are not guaranteed when the power supply voltage drops.
*2 The value at the motor shaft. The torque at the output shaft changes according to the reduction ratio and the reduction gear efficiency.
*3 The value at the motor shaft. The speed of the output shaft changes according to the reduction ratio.
*4 The 0.75kW motor with a brake has the totally enclosed fan-cooled type structure.

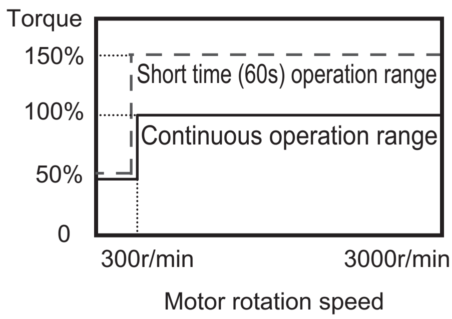
7.4.2 Motor torque characteristic

<<Initial setting (*Pr. 785* = 9999 (=100%))>>



- In the low-speed range (less than 300r/min), the torque output can be increased up to 100% of the setting, but continuous operation is not possible.
- When the input voltage is low, the torque may be reduced.
- The operatable speed range at constant torque is 300r/min to 3000r/min.
  Continuous operation cannot be performed in 300r/min or less.

<<When *Pr. 785* = 50%>>



- Setting *Pr. 785 PM control torque boost* to 50%* or less enables continuous operation at the speed less than 300r/min. However, keep the short-time torque to *Pr. 785* setting or lower.
  * 80% for the FR-D720-1.5K-G or lower and the FR-D740-1.5K-G or lower
- When the input voltage is low, the torque may be reduced.
- The operatable speed range at constant torque is 300r/min to 3000r/min.

MEMO

APPENDIX

This chapter provides the "APPENDIX" of this product.
Always read the instructions before using the equipment.

Appendix 1 Options and products available on the market

	Name	Model	Applications, Specifications, etc.	Applicable Drive Unit
Stand-alone Type	Parameter unit (Eight languages)	FR-PU07	Interactive parameter unit with LCD display	Applicable for all models
	Enclosure surface operation panel	FR-PA07	This operation panel enables drive unit operation and monitoring of rotation speed, etc. from the enclosure surface	Applicable for all models
	Parameter unit connection cable	FR-CB20☐	Cable for connection of operation panel or parameter unit ☐ indicates a cable length. (1m, 3m, 5m)	Applicable for all models
	DIN rail attachment	FR-UDA01 to 03	Attachment for installation on DIN rail	Applicable for the certain capacities
	Heatsink protrusion attachment	FR-E7CN01, 02	This attachment dissipates about 70% of the drive unit's heat by setting the drive unit heatsink to be protruded from the back side of the enclosure.	Applicable for the certain capacities
	AC reactor	FR-HAL	For harmonic current reduction and drive unit input power factor improvement.	Applicable for the certain capacities
	DC reactor	FR-HEL		
	EMC Directive compliant EMC filter	SF1306, SF1309	An EMC filter that complies with the EMC Directive (EN61800-3 C3)	Applicable for the certain capacities
	EMC filter installation attachment	FR-E5T	An attachment used to mount an EMC compliant EMC filter (SF1309) to a drive unit.	Applicable for the certain capacities
	Radio noise filter	FR-BIF	For radio noise reduction (connect to the input side)	Applicable for all models
	Line noise filter	FR-BSF01 FR-BLF	For line noise reduction	Applicable for all models
	Filterpack	FR-BFP2	A Filterpack that contains a power factor improving DC reactor, common mode choke, capacitive filter (radio noise filter) in one.	For the 0.4K or higher
	Brake resistor	MRS type, MYS type	For increasing the regenerative braking capability (permissible duty 3%/6%ED)	Applicable for the certain capacities
	High-duty brake resistor	FR-ABR	For increasing the regenerative braking capability (permissible duty 10%/ 6%ED)	Applicable for the certain capacities
	Brake unit Discharging resistor	FR-BU2 GZG, GRZG type	For increasing the braking capability of the drive unit (for highinertia load or negative load) Brake unit, electrical-discharge resistor and resistor unit are used in combination	Applicable for the certain capacities
	Power regeneration common converter Stand-alone reactor dedicated for FR-CV	FR-CV FR-CVL	Unit which can return motor-generated braking energy back to the power supply in common converter system	Applicable for the certain capacities
	High power factor converter	FR-HC2	The high power factor converter switches the converter section ON/OFF to reshape an input current waveform into a sine wave, greatly suppressing harmonics. (Used in combination with the standard accessory.)	Applicable for the certain capacities

Name		Model	Applications, Specifications, etc.	Applicable Drive Unit
FR Series Manual Controller/Speed Controller	Manual controller	FR-AX	For independent operation. With frequency meter, frequency potentiometer and start switch.	Applicable for all models
	DC tach. follower	FR-AL	For synchronous operation (1VA) by external signal (0 to 5V, 0 to 10V DC) *1	
	Three speed selector	FR-AT	For three speed switching, among high, middle and low speed operation (1.5VA) *1	
	Motorized speed setter	FR-FK	For remote operation. Allows operation to be controlled from several places (5VA)*1	
	Ratio setter	FR-FH	For ratio operation. The ratios of five drive units can be set (3VA) *1	
	Speed detector	FR-FP	For tracking operation by a pilot generator (PG) signal (3VA) *1	
	Master controller	FR-FG	Master controller (5VA) for parallel operation of multiple (maximum 35) drive units.*1	
	Soft starter	FR-FC	For soft start and stop. Enables acceleration/deceleration in parallel operation (3VA) *1	
	Deviation detector	FR-FD	For continuous speed control operation. Used in combination with a deviation sensor or synchro (5VA) *1	
	Preamplifier	FR-FA	Used as an A/V converter or arithmetic amplifier (3VA) *1	
Others	Pilot generator	QVAH-10	For tracking operation. 70V/35VAC 500Hz (at 2500r/min)	
	Deviation sensor	YVGC-500W-NS	For continuous speed control operation (mechanical deviation detection). Output 90VAC/90°	
	Frequency setting potentiometer	WA2W 1kΩ	For frequency setting. Wire-wound 2W 1kΩ type B characteristic	
	Frequency meter (64mm × 60mm)	YM206NRI 1mA	Dedicated frequency meter (graduated to 120Hz). Moving-coil type DC ammeter	
	Calibration resistor	RV24YN 10kΩ	For frequency meter calibration. Carbon film type B characteristic	

*1 Rated power consumption.The power supply specifications of the FR series manual controllers and speed controllers are 200VAC 50Hz, 220/220VAC 60Hz, and 115VAC 60Hz.

Commercially available products (as of Jan. 2017)

Name	Model	Manufacturer	Structure, Specifications, etc.
Communication connector	5-554720-3	Tyco Electronics Corporation	RJ-45 connector
Communication cable	SGLPEV-T (Cat5e/300m) 24AWG × 4	Mitsubishi Cable Industries, Ltd.	Cat.5e cable that is compatible with TIA/EIA standards. (10BASE-T/100BASE-T/1000BASE-T)
Flathead screwdriver	SZF 0-0,4 × 25	Phoenix Contact Co., Ltd.	A flathead screwdriver suitable to push the open/close button when wiring to the control circuit.

●Blade terminal

•Phoenix Contact Co., Ltd.

Cable Size (mm^2)	Ferrule Terminal Model			Crimping Tool Name
	With Insulation Sleeve	Without Insulation Sleeve	For UL Wire*1	
0.3	AI 0,34-10TQ	—	—	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB	
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB	
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB	
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB *2	
0.75 (for two cables)	AI-TWIN 2 × 0,75-10GY	—	—	

•NICHIFU Co.,Ltd.

Cable Size (mm^2)	Blade Terminal Product Number	Insulation Cap Product Number	Crimping Tool Product Number
0.3 to 0.75	BT 0.75-11	VC 0.75	NH 69

Contact the manufacturer regarding the delivery schedule, price, specifications, and other information of the products listed here.

*1 A ferrule terminal with a insulation sleeve compatible with MTW wire which has a thick wire insulation.

*2 Applicable for the terminal ABC.

Appendix 2 Precautions for use of the S-PM geared motor

Installation

- When a suspension tool is provided for a motor, carry the motor using the suspension tool.
- When a motor is used for a lift, install a safety device on the machine side. There is a risk that a lifted cargo, etc. may fall off.
- If any oil component, grease, etc. may leak out in case of a fault and adversely affect the environment adversely, prepare an oil pan (oil catcher) or other device to prevent leakage of oil or grease.
- Provide a safety cover for components such as belts, chains, or gears.
- If small pieces of foreign matter enters through or water causes rust at the oil seal section of the output shaft, grease may leak out. Take necessary precautions. Do not use the motor in a place that may be wet with water.

Operation

- The motor shaft may move at start.
- Do not use the motor in an application in which an excessive impact torque is generated during stopping (example: stop-on contact at high speed). Doing so may damage the motor.
- Always stop the operation and inspect the motor when any abnormal noise or vibration is generated during operation, or when the specified characteristics cannot be achieved.
- In the case of variable load, a sound generated by the effect of end play of the motor shaft may be heard, but it will not cause any performance problem.

Brake

- When using a motor with a brake, always adopt the separate braking method or the direct current (quick) braking method for the brake wiring connection.
- Do not operate a manual releasing mechanism of the brake while an object is suspended. There is a risk that a lifted cargo, etc. may fall off.
- Before starting operation of a geared motor with a one-touch manual releasing brake, always fix the releasing lever on the lever receiver.
- For a lift application, adopt the direct current (quick) braking method for the circuit.
- In the initial use condition, the specified brake torque may not be achieved for the reason of the friction surfaces. In such a case, repeat turning ON/OFF of the brake with a lightest possible load as a running-in process for the friction surfaces.
- A lining rubbing sound may be generated because of the brake structure, but it will not affect performance.
- For the connection with the separate braking method, it is necessary to match the operation timings between the motor and the brake. If the operation timings are different, there is a risk of falling, crashing, or brake damage.

Appendix 3 Specification change

For the production date of the drive unit, check the serial number printed on the rating plate or on package. For how to find the SERIAL, refer to *page 2*.

● Changed functions

(1) The following functions are available for the drive units manufactured in April 2016 or later.

Item	Changed Functions
Added parameters	*Pr. 281, Pr. 283, Pr. 643, Pr. 658*
Changed parameter setting ranges	Addition of setting values "20, 37, 120, 137" of *Pr. 190, Pr. 192* Addition of setting value "10, 11" of *Pr. 167*

(2) The following functions are available for the drive units manufactured in April 2018 or later.

Item	Changed Functions
Added parameters	*Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.90, Pr.92, Pr.93, Pr.96, Pr.600 to Pr.604, Pr.672, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724 to Pr.726, Pr.824, Pr.825, Pr.859, Pr.998*

Appendix 4 Index

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REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Jul. 2012	IB(NA)-0600478ENG-A	First edition
Aug. 2016	IB(NA)-0600478ENG-B	Addition • FR-D740-0.4K to 3.7K-G • *Pr. 281 Brake operation time at start* • *Pr. 283 Brake operation time at stop* • *Pr. 643 Voltage compensation amount setting* • *Pr. 658 Wiring resistance* • Setting values "10, 11" of *Pr. 167 Output current detection operation selection* • Setting values "20, 37, 120, 137" of *Pr. 190* and *Pr. 192*
Jun. 2018	IB(NA)-0600478ENG-C	Addition • Compatibility with IPM motors and SPM motors other than the Mitsubishi Electric GV series S-PM geared motors. • *Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.90, Pr.92, Pr.93, Pr.96, Pr.600 to Pr.604, Pr.672, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724 to Pr.726, Pr.824, Pr.825, Pr.859, Pr.998*

⚠ For Maximum Safety

- Mitsubishi Electric drive units are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi Electric sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.
- Please do not use this product for loads other than three-phase induction motors.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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