



**MITSUBISHI
ELECTRIC**

SENSORLESS SERVO DRIVE UNIT

FR-E700EX

INSTRUCTION MANUAL (BASIC)

FR-E720EX-0.1K to 3.7K

Thank you for choosing this Mitsubishi drive unit.
This Instruction Manual (Basic) provides handling information and precautions for use of the equipment.
Please forward this Instruction Manual (Basic) to the end user.

According to the motor to be connected perform PM parameter initialization. Incorrect initial setting of parameters may damage the motor. (Refer to page 19)
In the initial setting, an MM-GKR motor is set for FR-E720EX-0.1K to 0.75K, and an S-PM geared motor is set for FR-E720EX-1.5K to 3.7K.
Do not use a motor that is not a dedicated PM motor (MM-GKR motor or S-PM geared motor).

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To obtain the Instruction Manual (Applied)

Contact where you purchased the drive unit, your Mitsubishi sales representative, or the nearest Mitsubishi FA Center for the following manual:

- *Instruction Manual (Applied) [IB(NA)-0600507ENG]*

This manual is required if you are going to utilize functions and performance.

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This Instruction Manual (Basic) provides handling information and precautions for use of the equipment.
Please forward this Instruction Manual (Basic) to the end user.

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 (Basic) 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 (Basic), 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 open 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 536 class 1 and other applicable standards).
- 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.
- 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. Do not use a magnetic contactor at the drive unit's output side.

2. Fire Prevention

⚠ CAUTION

- 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.
- Daily and periodic inspections must be performed as instructed in the Instruction Manual. If the product is used without receiving any inspection, it may cause a burst, break, or fire.

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 as they 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 *
	Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/vibration	Maximum 1,000m above sea level. 5.9m/s ² or less at 10 to 55Hz (directions of X, Y, Z axes)

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

- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfect wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization or 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.
- Correctly connect the output side terminals (terminals U, V, and W).
- 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.
- Only one PM motor can be connected to a 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  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 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 both an external thermal and PTC thermistor 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 a noise 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.
- 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.
In the initial setting, FR-E720EX-0.1K to 0.75K is set for an MM-GKR motor, and FR-E720EX-1.5K to 3.7K is set for an S-PM geared motor.
Only use a motor that is a dedicated PM motor (MM-GKR motor or S-PM geared motor).
- 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.

(5) Emergency stop

CAUTION

- A safety backup such as an emergency brake must be provided to prevent hazardous condition to the machine and equipment in case of drive unit failure.
- 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 (Basic) 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 (Basic) must be followed when operating the drive unit. For more details on a dedicated PM motor, refer to the Instruction Manual of the dedicated PM motor and the sensorless servo catalog.

<Abbreviation>

- PU: Operation panel and parameter unit (FR-PU07)
- Drive unit: Mitsubishi sensorless servo drive unit FR-E700EX series
- FR-E700EX: Mitsubishi sensorless servo drive unit FR-E700EX series
- 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 the PU (FR-PU07) and External operation
- PM motor, motor: The dedicated magnet motor (MM-GKR motor or S-PM geared motor)

<Trademark>

- Company and product names herein are the trademarks and registered trademarks of their respective owners.

<Mark>



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




Note: Contents requiring caution or cases when set functions are not activated are written.



POINT: Useful contents and points are written.

<Notes on descriptions in this Instruction Manual>

- Connection diagrams in this Instruction Manual are in the sink logic, unless otherwise specified. (For the control logic,  refer to the *Instruction Manual (Applied)*.)


<Related document>



Refer to the *Instruction Manual (Applied)* for further information on the following points.

- Removal and reinstallation of the cover
- Connection of stand-alone option unit
- EMC and leakage currents
- Detailed explanation on parameters
- Troubleshooting
- Check first when you have trouble
- Inspection items (life diagnosis, cooling fan replacement)
- Measurement of main circuit voltages, currents and powers

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 Chapter 3 of the *Instruction Manual (Applied)*.)

1 OUTLINE

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-**E720EX**-**1.5K**

Symbol	Voltage class	Represents the drive unit capacity [kW]
E720EX	Three-phase 200V class	

Cooling fan

The cooling fan is removable.
(Refer to the Instruction Manual (Applied))

Operation panel

(Refer to page 2)

PU connector

(Refer to page 9)

Voltage/current input switch

(Refer to page 9)

USB connector cover

Front cover

Refer to the Instruction Manual (Applied) for installation/removal.

PU connector cover

Refer to the Instruction Manual (Applied) for how to open the cover.

Control logic switchover jumper connector

The jumper connector is in the sink logic (SINK) when shipped from the factory. Move the jumper connector to change to the source logic (SOURCE). Always fit the jumper connector to the either position.

(Refer to the Instruction Manual (Applied))

USB connector (mini-B connector)

(Refer to page 9)

Connector for plug-in option connection

(Refer to the instruction manual of options.)

Control circuit terminal block

(Refer to page 10)

Main circuit terminal block

(Refer to page 10)

Combed shaped wiring cover

Refer to the Instruction Manual (Applied) for installation/removal.

Capacity plate

FR-E720EX-1.5K ← Drive unit model

SERIAL : XXXXXX ← Serial number

Example of FR-E720EX-1.5K

Production year and month

Rating plate

Drive unit model

Input rating

Output rating

Serial number

MITSUBISHI	DATE UNIT DATE 0000XX
MODEL	FR-E720EX-1.5K
INPUT :	XXXXXX
OUTPUT :	XXXXXX
SERIAL :	
MITSUBISHI ELECTRIC CORPORATION	PASSED
DATE 00 0000	

●Accessory

- Fan cover fixing screws (FR-E720EX-1.5K to 3.7K) (M3 × 35mm) 1

These screws are necessary for compliance with the EU Directive. (Refer to page 47)

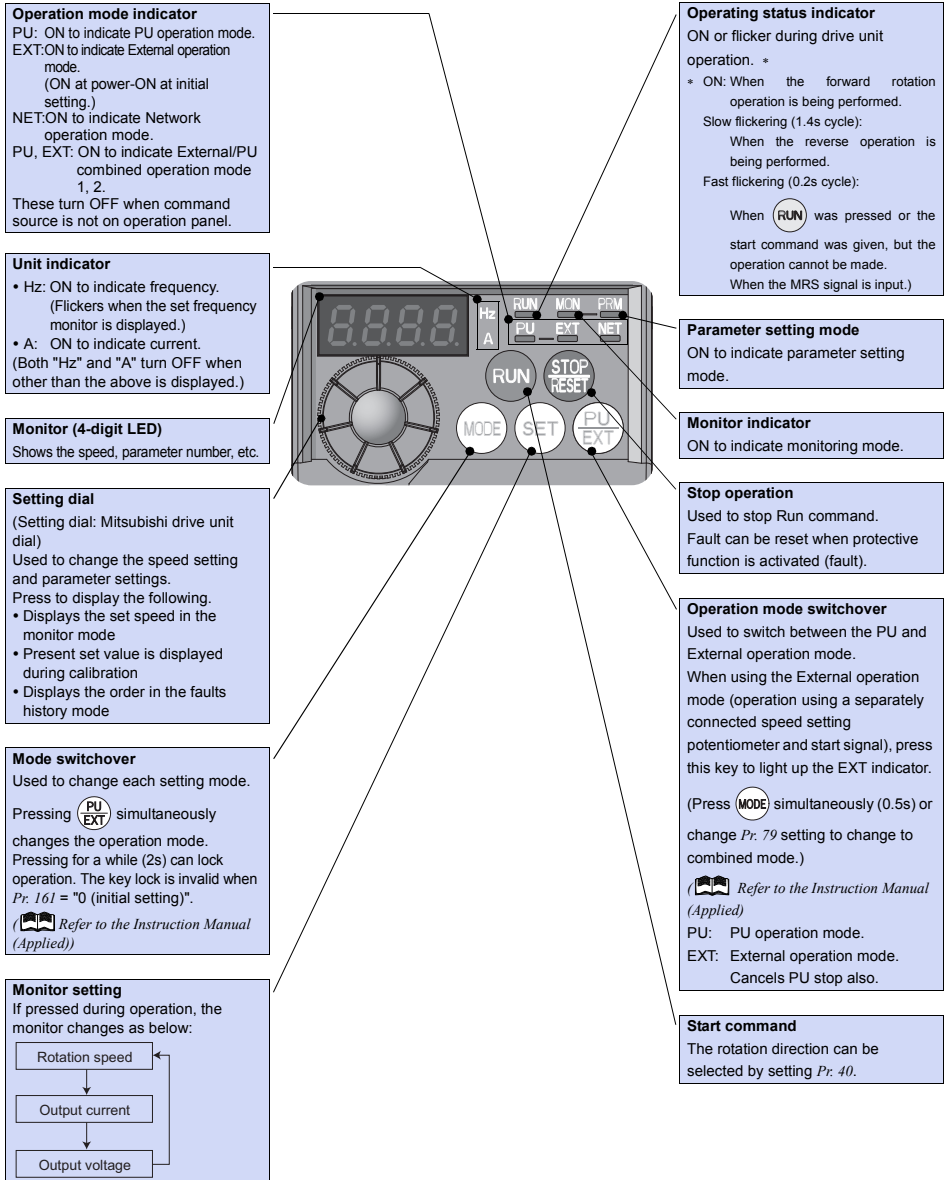
REMARKS

- For how to find the SERIAL number, refer to page 50.
- Caution stickers are enclosed with this instruction manual. These caution stickers include stickers that are used for the automatic restart after instantaneous power failure function, which are not required for FR-E700EX.
- When using a plug-in option, attach the model name label on the front cover for the plug-in option. The label is enclosed with this product.

1.2 Operation panel

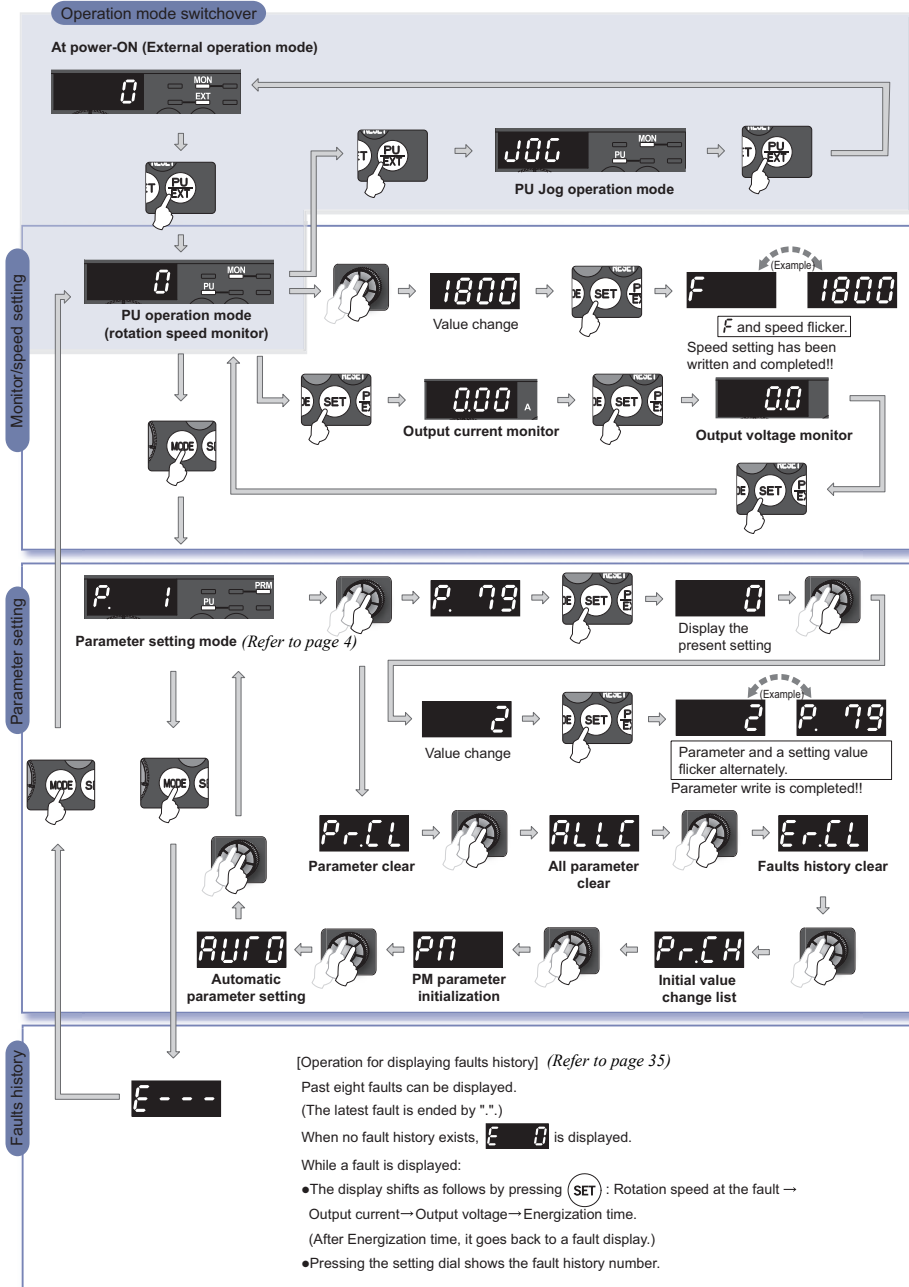
1.2.1 Names and functions of the operation panel

The operation panel cannot be removed from the drive unit.









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1.2.2 Basic operation (factory setting)








1.2.3 Changing the parameter setting value

Changing example Change the Pr. 1 Maximum setting setting.

Operation	
1.	Screen at power-ON The monitor display appears.
2.	Changing the operation mode Press  to choose the PU operation mode. [PU] indicator is ON.
3.	Parameter setting mode Press  to choose the parameter setting mode.
4.	Selecting the parameter number Turn  until P. 1 (Pr. 1) appears.
5.	Reading the set value Press  to read the present set value. "3000"(3000r/min (initial value)) appears.
6.	Changing the setting value Turn  to change the set value to 1800 (1800r/min)
7.	Setting the parameter Press  to set. The parameter number and the setting value flicker alternately.




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 the Instruction Manual (Applied).)
 • 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. 1 (when Pr. 144 = "10 (frequency setting)")
 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.

1.2.4 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 of  the Instruction Manual (Applied) for parameters cleared with this operation.

Operation	
1.	Screen at power-ON The monitor display appears.
2.	Changing the operation mode Press  to choose the PU operation mode. [PU] indicator is ON.
3.	Parameter setting mode Press  to choose the parameter setting mode.
4.	Selecting Parameter Clear (All Parameter Clear) Turn  until Pr.CL (ALLC) appears.
5.	Selecting the setting value Press  to read the present set value. "0"(initial value) appears. Turn  to change it to the set value "1".
6.	Executing parameter clear Press  to set. "1" and Pr. CL (ALLC) indications flicker alternately.



REMARKS

? **1** and **Er 4** are displayed alternately ... Why?
 The drive unit is not in the PU operation mode.
 PU connector is used. (Parameter unit (FR-PU07) is in use.)
 Remove the PU cable and the USB cable, and carry out the operation from step 2 again.

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 of  the Instruction Manual (Applied) for availability of parameter clear and all parameter clear.

2 INSTALLATION AND WIRING



AC power supply

Use within the permissible power supply specifications of the drive unit. To ensure safety, use a moulded case circuit breaker, earth leakage circuit breaker or magnetic contactor to switch power ON/OFF. (Refer to page 41)

Moulded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB), fuse

The breaker must be selected carefully since an inrush current flows in the drive unit at power on. (Refer to page 7)

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 shortened. (Refer to page 7)

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.



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.

USB connector

A personal computer and a drive unit can be connected with a USB (Ver.1.1) cable.



Brake resistor (FR-ABR, MRS type, MYS type)

Braking capability can be improved. (0.4K or higher) Always install a thermal relay when using a brake resistor whose capacity is 11K or higher. (Refer to page 15)



AC reactor (FR-HAL)

DC reactor (FR-HEL) *

Drive unit (FR-E700EX)



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.

Magnetic motor starter (DSN type)

Install a magnetic motor starter 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 magnetic motor starter while the drive unit is running (outputting)



Motor (S-PM) 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.

Noise filter (capacitor) * (FR-BIF)

Reduces the radio noise.



Power supply cable (Servo motor power supply cable (option))



Motor (MM-GKR)

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 moulded case circuit breaker on the output side of the drive unit, contact each manufacturer for selection of the moulded 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 earthing (grounding) cable by returning it to the earth (ground) terminal of the drive unit.



High power factor converter (FR-HC2)

Power supply harmonics can be greatly suppressed. Install this as required.



Power regeneration common converter (FR-CV)

Great braking capability is obtained. Install this as required.



Brake unit (FR-BU2)

The regenerative braking capability of the drive unit can be exhibited fully. Install this as required.

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



NOTE

- The life of the drive unit is influenced by surrounding air temperature. The surrounding air temperature should be as low as possible within the permissible range. 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 9)
- 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 Chapter 3 of the Instruction Manual (Applied))
- 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 magnetic motor starter at the output side, make sure that the drive unit power is ON and the motor is stopped.
- Do not use a magnetic contactor at the drive unit's output side.

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) MM-GKR motor

Applicable drive unit Model	Motor Output (kW)	Moulded Case Circuit Breaker (MCCB) *1 or Earth Leakage Circuit Breaker (ELB) *2 (NF, NV type)		Magnetic Contactor (MC) *3		Reactor	
		Reactor connection		Reactor connection		FR-HAL	FR-HEL
		without	with	without	with		
FR-E720EX-0.1K	0.1	5A	5A	S-N10	S-N10	0.4K *4	0.4K *4
FR-E720EX-0.2K	0.2	5A	5A	S-N10	S-N10	0.4K *4	0.4K *4
FR-E720EX-0.4K	0.4	5A	5A	S-N10	S-N10	0.4K	0.4K
FR-E720EX-0.75K	0.75	10A	10A	S-N10	S-N10	0.75K	0.75K

*1 *Select an MCCB according to the power supply capacity.

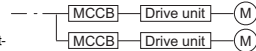
*Install one MCCB per drive unit.

*2 For the use in the United States or Canada, select a UL and cUL certified fuse with Class T fuse equivalent cut-off speed or faster with the appropriate rating for branch circuit protection. Alternatively, select a UL489 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) S-PM geared motor

Applicable drive unit Model	Motor Output (kW)	Moulded Case Circuit Breaker (MCCB) *1 or Earth Leakage Circuit Breaker (ELB) *2 (NF, NV type)		Magnetic Contactor (MC) *3		Reactor	
		Reactor connection		Reactor connection		FR-HAL	FR-HEL
		without	with	without	with		
FR-E720EX-0.2K	0.1	5A	5A	S-N10	S-N10	0.4K*4	0.4K*4
FR-E720EX-0.4K	0.2	5A	5A	S-N10	S-N10	0.4K*4	0.4K*4
FR-E720EX-0.75K	0.4	10A	5A	S-N10	S-N10	0.4K	0.4K
FR-E720EX-1.5K	0.75	15A	10A	S-N10	S-N10	0.75K	0.75K
FR-E720EX-2.2K	1.5	20A	15A	S-N10	S-N10	1.5K	1.5K
FR-E720EX-3.7K	2.2	30A	30A	S-N20, S-N21	S-N10	2.2K	2.2K

*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, select a UL and cUL certified fuse with Class T fuse equivalent cut-off speed or faster with the appropriate rating for branch circuit protection. Alternatively, select a UL489 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

- When using the S-PM geared motor, select an MCCB and a magnetic contactor according to the drive unit model, and select cables and reactors 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.

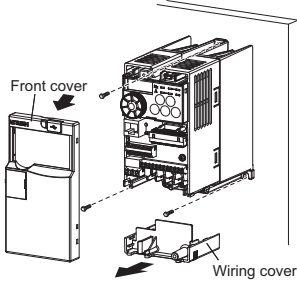
2.2 Installation of the drive unit and instructions

(1) Installation of the drive unit

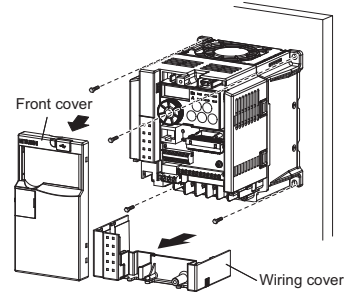
Enclosure surface mounting

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

●FR-E720EX-0.1K to 0.75K

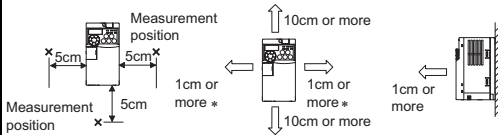


●FR-E720EX-1.5K to 3.7K



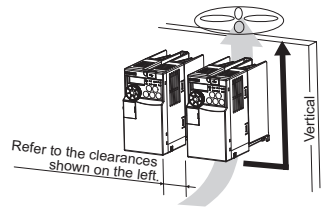
Note

- When encasing multiple drive units, install them in parallel as a cooling measure.
- Install the drive unit vertically.
- For heat dissipation and maintenance, take at least the clearances shown in the table below from the drive unit to the other devices and to the enclosure surface.



-10°C to +50°C
(non-freezing)

- * 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).



(2) Environment

Before installation, check that the environment meets the specifications on page 41.

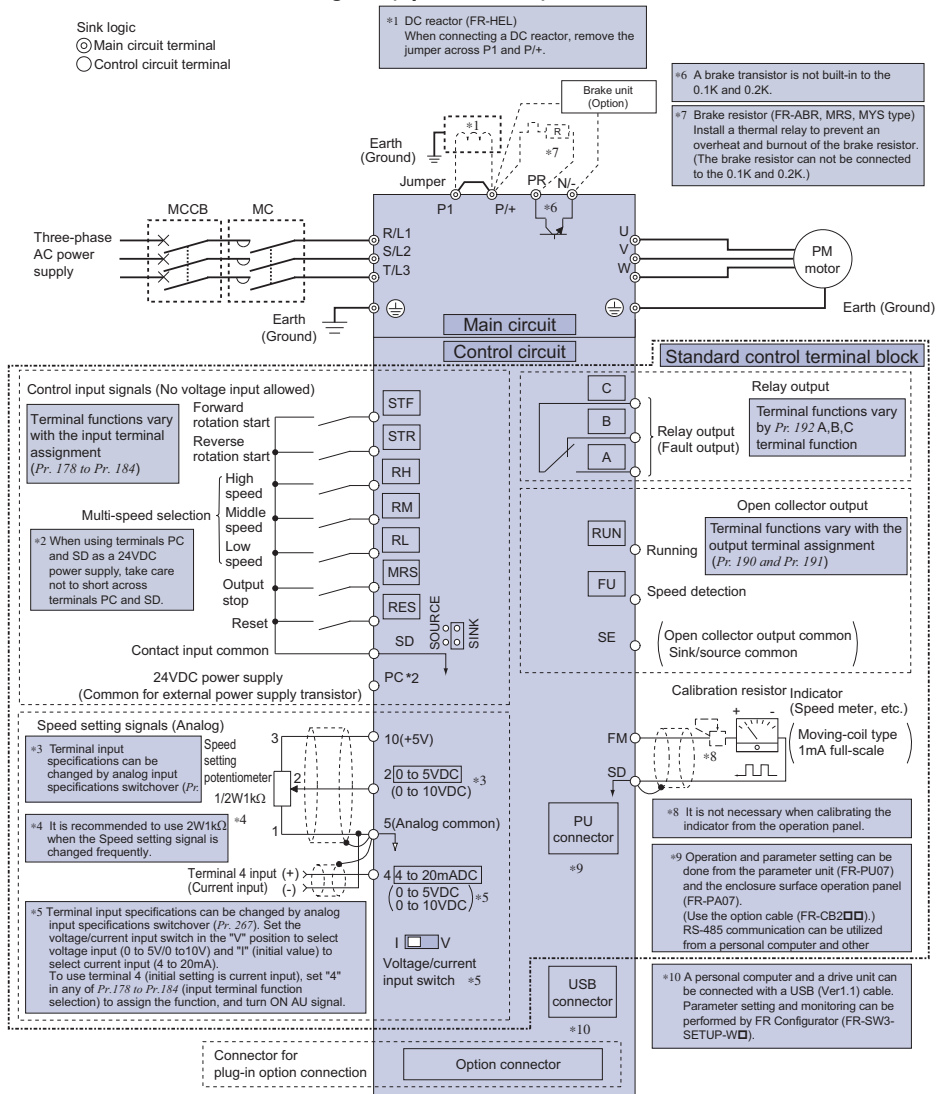


Note

- Install the drive unit on a strong surface securely and vertically with bolts.
- Leave enough clearances and take cooling measures.
- Avoid places where the drive unit is subjected to direct sunlight, high temperature and high humidity.
- Install the drive unit on a nonflammable wall surface.

2.3 Wiring




2.3.1 Terminal connection diagram (Speed control)



NOTE

- For the terminal connection diagram for the position control, refer to the Instruction Manual (Applied).
 - 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 cutoffs must not be left in the drive unit.
- Wire cutoffs 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.

2.3.2 Terminal specifications

Type	Terminal Symbol	Terminal Name	Description			
Main circuit	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).			
	U, V, W	Drive unit output	Connect a PM motor.			
	P/+, PR	Brake resistor connection	Connect a brake resistor (MRS type, MYS type, FR-ABR) across terminals P/+ and PR. (The brake resistor can not be connected to the 0.1K or 0.2K)			
	P/+, N/-	Brake unit connection	Connect the brake unit (FR-BU2), power regeneration common converter (FR-CV) or high power factor converter (FR-HC2).			
		DC power input	Connect the plus side of the power supply to terminal P/+ and minus side to terminal N/-.			
	P/+, P1	DC reactor connection	Remove the jumper across terminals P/+ and P1 and connect a DC reactor			
		Earth (Ground)	For earthing (grounding) the drive unit chassis. Must be earthed (grounded).			
Control circuit/input signal	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.	
		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.		
		MRS	Output stop	Turn ON the MRS signal (20ms or more) to stop the drive unit output. Use to shut off the drive unit output when stopping the motor by electromagnetic brake.		
		RES	Reset	Used to reset alarm output provided when protective circuit is activated. Turn ON the RES signal for more than 0.1s, then turn it OFF. Initial setting is for reset always. By setting Pr. 75, reset can be set to enabled only at fault occurrence. Recover about 1s after reset is cancelled.		
	Contact input	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 current.		
			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 current.		
			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.	5.2VDC ± 0.2V permissible load current 10mA	
			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 (initial setting) and 0 to 10VDC input.	Input resistance 10kΩ ± 1kΩ Permissible maximum voltage 20VDC
		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). To use terminal 4 (initial setting is current input), set "4" to any of Pr. 178 to Pr. 184 (input terminal function selection), and turn AU signal ON. Use Pr. 267 to switch 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).	Voltage input: Input resistance 10kΩ ± 1kΩ Permissible maximum voltage 20VDC Current input: Input resistance 233Ω ± 5Ω Maximum permissible current 30mA.	
				<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Current input (initial status)</p>  </div> <div style="text-align: center;"> <p>Voltage input</p>  </div> </div>		
5	Speed setting common	Common terminal for the speed setting signals (terminals 2 and 4). Do not earth (ground).				

2

Type	Terminal Symbol	Terminal Name	Description
Control circuit/output signal	Relay	A, B, C	Relay output (fault output) 1 changeover contact output indicates that the drive unit fault occurs. 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
		RUN	Drive unit running Switched Low when the drive unit rotation speed is equal to or higher than the starting speed (initial value 15r/min). Switched High during stop or DC injection brake operation.*
	Open collector	FU	Speed detection Switched Low when the drive unit rotation speed is equal to or higher than the preset detected speed and High when less than the preset detected speed.*
		SE	Open collector output common Common terminal of terminal RUN and FU.
	Pulse	FM	For meter Used to output a selected monitored item (such as rotation speed) among several monitored items. (Not output during drive unit reset.) The output signal is proportional to the magnitude of the corresponding monitoring item.
Communication	—	PU connector With the PU connector, RS-485 communication can be established. · Conforming standard: EIA-485 (RS-485) · Transmission format: Multi-drop link · Communication speed: 4800 to 38400bps · Overall extension: 500m	
	—	USB connector FR Configurator can be operated by connecting the drive unit to the personal computer through USB. · Interface: conforms to USB1.1 · Transmission Speed: 12Mbps · Connector: USB mini B connector (receptacle mini B type)	

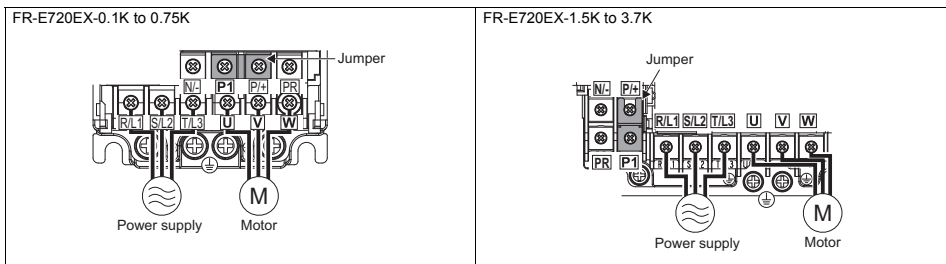


Note

- Under position control, some terminals have different functions. (Refer to the Instruction Manual (Applied).)
- Set Pr. 267 and a voltage/current input switch correctly, then input an analog signal in accordance with the setting. 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.
- The drive unit will be damaged if power is applied to the drive unit output terminals (U, V, W). Never perform such wiring.
- indicates that terminal functions can be selected using Pr. 178 to Pr. 192 (I/O terminal function selection).
- Terminal names and terminal functions are those of the factory set.
- When connecting the DC power supply, be sure to connect the plus side of the power supply to terminal P/+ and minus side to terminal N/-. Opposite polarity will damage the drive unit.

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

Three-phase 200V



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 cables to the U, V, and W of the drive unit. Doing so will damage the drive unit.
- Connect the motor to U, V, and W. Turning ON the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft.

(1) Cable size and other specifications of the main circuit terminals and the earthing terminal

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

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

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

(1) MM-GKR motor

Applicable drive unit Model	Terminal Screw Size *4	Tightening Torque N·m	Crimping Terminal		Cable Size							
					HIV Cables, etc. (mm ²) *1			AWG *2		PVC Cables, etc. (mm ²) *3		Earthing (grounding) cable
					R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	
FR-E720EX-0.1K to 0.75K	M3.5	1.2	2-3.5	1.25-3.5	2	- (*5)	2	14	- (*5)	2.5	- (*5)	2.5

- *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. (Selection example for use mainly in the United States.)
- *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).
- *5 The size is 0.75mm² (AWG19 or AWG18) when using the motor power supply cable for MM-GKR motor (MR-PWS1CBL□M-A□-□).
When the wiring length of the power supply cable for the motor is 10 m or longer, extend the cable using MR-PWS2CBL03M-A_-L and an HIV wire of 1.25 mm² (AWG 16)
For compliance with UL/CSA standards, extend the power supply cable for the motor using MR-PWS2CBL03M-A_-L and an HIV wire of 2 mm² (AWG 14).

(2) S-PM geared motor

Applicable drive unit Model	Terminal Screw Size *4	Tightening Torque N·m	Crimping Terminal		Cable Size							
					HIV Cables, etc. (mm ²) *1			AWG *2		PVC Cables, etc. (mm ²) *3		Earthing (grounding) cable
					R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	
FR-E720EX-0.2K to 0.75K	M3.5	1.2	2-3.5	2-3.5	2	2	2	14	14	2.5	2.5	2.5
FR-E720EX-1.5K to 3.7K	M4	1.5	2-4	2-4								

- *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. (Selection example for use mainly in the United States.)
- *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 tighten too loosely can cause a short circuit or malfunction. A screw that has been tighten too tightly can cause a short circuit or malfunction due to the unit breakage.
- Use crimping 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) Wiring length

Connect a PM motor within the total wiring length of 30m.

Use one dedicated PM motor for one drive unit. Multiple PM motors cannot be connected to a drive unit.

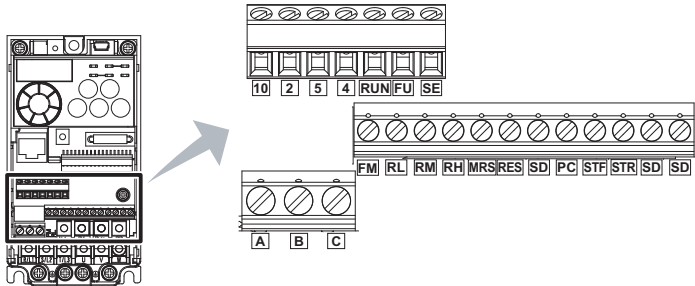
2.3.4 Wiring of control circuit

● Terminal layout

Terminal screw size

M3: (Terminal A, B, C)

M2: (Other than the above)



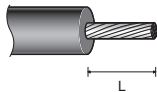
● Wiring method

- 1) Strip off the sheath of the cable of the control circuit to wire.

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. Use a blade terminal as necessary.

Wire stripping length



	L(mm)
Terminal A, B, C	6
Other than the above	5

Blade terminals available on the market: (as of Feb. 2012)

•Phoenix Contact Co.,Ltd

Terminal Screw Size	Wire Size (mm ²)	Blade Terminal Model		Blade terminal crimping tool
		With Insulation Sleeve	Without Insulation Sleeve	
M3 (terminal A, B, C)	0.3, 0.5	AI 0,5-6WH	A 0,5-6	CRIMPFOX 6
	0.75	AI 0,75-6GY	A 0,75-6	
M2 (other than the above)	0.3, 0.5	AI 0,5-6WH	A 0,5-6	

•NICHIFU Co.,Ltd.

Terminal Screw Size	Wire Size (mm ²)	Blade terminal product number	Insulation product number	Blade terminal crimping tool
M3 (terminal A, B, C)	0.3 to 0.75	BT 0.75-7	VC 0.75	NH 69
M2 (other than the above)				

- 2) Loosen the terminal screw and insert the wire into the terminal.
- 3) Tighten the screw to the specified torque.

Undertightening can cause wire disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.

Tightening torque: 0.5N·m to 0.6N·m (terminal A, B, C)

0.22N·m to 0.25N·m (other than the above)

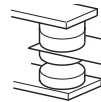
Screwdriver: ⊖Small flathead screwdriver (Tip thickness: 0.4mm/tip width: 2.5mm)

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

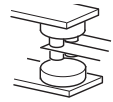
- Terminals SD, SE and 5 are common terminals for I/O signals. (All common terminals are isolated from each other.) Do not earth them. Avoid connecting the terminals SD and 5 and the terminals SE and 5.
- Terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, RL, MRS, RES) and pulse train output signal (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 wire.
- Terminal SE is a common terminal for the open collector output terminal (RUN, FU). The contact input circuit is isolated from the internal control circuit by photocoupler.

(2) Wiring instructions

- It is recommended to use the wires 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 terminals PC and SD. Drive unit may be damaged.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.



Micro signal contacts



Twin contacts

2

- To minimize EMI, use shielded or twisted cables for connection to the control circuit terminals and place 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 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.
- Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
- Always apply a voltage to the fault output terminals (A, B, C) via a relay coil, lamp, etc.

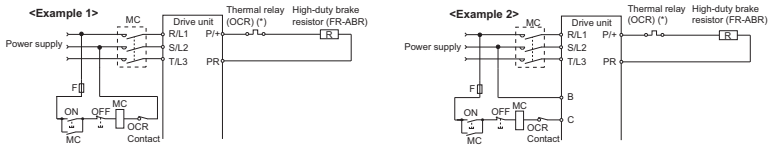
2.4 Connection of a dedicated external brake resistor (MRS type, MYS type, FR-ABR)(0.4K or higher)

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 to terminals P/+ and PR. (For the locations of terminal P/+ and PR, refer to the terminal block layout (page 11).)

Set parameters below. (Refer to the Instruction Manual (Applied) for the parameter details.)

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%
FR-ABR	1	10%

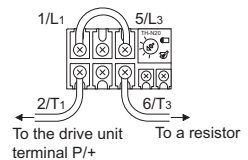
- It is recommended to configure a sequence, which shuts off power in the input side of the drive unit by the external thermal relay as shown below, to prevent overheat and burnout of the brake resistor (MRS type, MYS type) and high duty brake resistor (FR-ABR) in case the regenerative brake transistor is damaged. (The brake resistor can not be connected to the 0.1K or 0.2K.)



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

Power Supply Voltage	Brake Resistor	Thermal Relay Type (Mitsubishi product)	Contact Rating
200V	MRS120W200	TH-N20CXHZ-0.7A	110VAC 5A, 220VAC 2A (AC11 class) 110VDC 0.5A, 220VDC 0.25A (DC11 class)
	MRS120W100	TH-N20CXHZ-1.3A	
	MRS120W60	TH-N20CXHZ-2.1A	
	MRS120W40	TH-N20CXHZ-3.6A	
	MYS220W50 (two units in parallel)	TH-N20CXHZ-5A	

Power Supply Voltage	Brake Resistor	Thermal Relay Type (Mitsubishi product)	Contact Rating
200V	FR-ABR-0.4K	TH-N20CXHZ-0.7A	110VAC 5A, 220VAC 2A (AC11 class) 110VDC 0.5A, 220VDC 0.25A (DC11 class)
	FR-ABR-0.75K	TH-N20CXHZ-1.3A	
	FR-ABR-2.2K	TH-N20CXHZ-2.1A	
	FR-ABR-3.7K	TH-N20CXHZ-3.6A	



NOTE

- The brake resistor connected should only be the dedicated brake resistor.
- Perform wiring and operation according to the Instruction Manual of each option unit.
- Brake resistor can not 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 the resistor directly to the terminals P/+ and N/-. This could cause a fire.

3 PRECAUTIONS FOR USE OF THE DRIVE UNIT

The FR-E700EX series is a highly reliable product, but using incorrect peripheral circuits or incorrect operation/handling methods may shorten the product life or damage the product.

Before starting operation, always recheck the following points.

(1) Use crimping 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 appropriate size to make a voltage drop of 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 12 for the recommended wire sizes.

(5) The wiring length should be 30m or less.

(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 options among the capacitor type noise filter FR-BIF (for use in the input side only), the ferrite core type noise filter FR-BSF01/FR-BLF, Filterpack, and noise filter to minimize the interference.

(7) 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.

(8) 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 no more than 30VDC using a tester, etc.

(9) Do not perform wiring or inspection while the 24 V external power is supplied.

When FR-E7DS is installed, if "EV" is displayed on the operation panel, turn OFF the 24 V external power supply before wiring and inspection.

(10) A short circuit or earth (ground) fault on the drive unit output side may damage the inverter module.

- Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits may damage the inverter modules. These short circuits may be caused by peripheral circuit inadequacy, an earth (ground) fault caused by wiring inadequacy, or reduced motor insulation resistance.
- 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 a hostile atmosphere, securely check the motor insulation resistance etc.

(11) Do not use the magnetic contactor at the drive unit input side 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 the Instruction Manual (Applied)*)

(12) Across terminals P/+ and PR, connect only an external brake resistor.

Do not connect a mechanical brake.

The brake resistor can not be connected to the 0.1K or 0.2K. Leave terminals P/+ and PR open.

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 7* 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 magnetic motor starter at the drive unit output side

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

(17) Countermeasures against EMI generated by the drive unit

If electromagnetic noise generated from the drive unit causes speed setting signal to fluctuate and motor rotation speed to be unstable when changing motor rotation 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. 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.

4 FAILSAFE OF THE SYSTEM WHICH USES THE DRIVE UNIT

When a fault occurs, the drive unit trips and outputs a fault signal. However, a fault signal may not be output at a drive unit fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi 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. At the same time, consider the system configuration where failsafe from outside the drive unit, without using the drive unit, is enabled in case 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 alarm 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 output signal (ALM signal)	Refer to Chapter 4 of the Instruction Manual (Applied).
2)	Drive unit running status	Operation ready signal check	Operation ready signal (RY signal)	Refer to Chapter 4 of the Instruction Manual (Applied).
3)	Drive unit running status	Logic check of the start signal and running signal	Start signal (STF signal, STR signal) Running signal (RUN signal)	Refer to Chapter 4 of the Instruction Manual (Applied).
4)	Drive unit running status	Logic check of the start signal and output current	Start signal (STF signal, STR signal) Output current detection signal (Y12 signal)	Refer to Chapter 4 of the Instruction Manual (Applied).

(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 output signal, start signal and RUN signal output, there is a case where a fault output signal is not output and RUN signal is kept output even if a drive unit fault occurs.

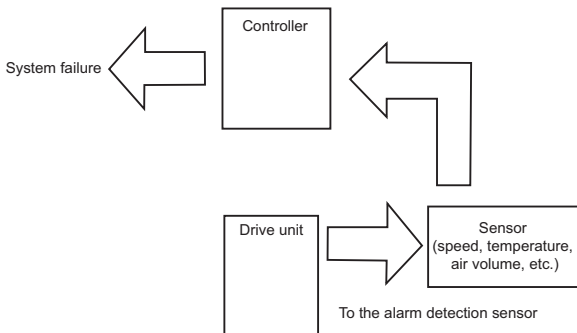
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as checking up as below according to the level of importance of the system.

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

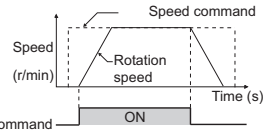
Check if there is no gap between the actual speed and commanded speed by comparing the drive unit speed command and detected speed of the speed detector.



5 DRIVING THE MOTOR (SPEED CONTROL)

To drive a PM motor by the drive unit, set parameters, a speed command, and a start command in accordance with the motor.

A speed command (set speed) determines the rotation speed of the motor. Turning ON the start command starts the motor to rotate.



REMARKS

- Set the required parameters according to the load and operating conditions. (Refer to page 28.)
- For the position control, refer to the Instruction Manual (Applied).

5.1 Initializing the parameters required to drive an PM motor (Pr.998)

- Performing PM parameter initialization automatically adjusts the parameter initial settings and setting ranges required to drive the PM motor being used.
- 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	Description
998	PM parameter initialization	3024/6004 *1	3024 *2	Parameter settings for a MM-GKR motor (rotations per minute)
			3124 *2	Parameter settings for a MM-GKR motor (frequency)
			6004 *3	Parameter settings for a S-PM geared motor (rotations per minute)
			6104 *3	Parameter settings for a S-PM geared motor (frequency)

*1 This parameter allows its setting to be changed in any operation mode even if "0 (initial value)" is set in Pr. 160 Extended function display selection. refer to the Instruction Manual (Applied)

*2 The setting is available only with the 0.1K to 0.75K class.

*3 The setting is available only with the 0.2K to 3.7K class.

(1) PM parameter initialization (Pr.998)

- When Pr. 998 = "3024 or 6004," the monitor is displayed and the speed is set using the motor rotations per minute. To use frequency to display or set, set Pr. 998 = "3124 or 6104."

Pr.998 Setting	Description	Operation in the parameter setting mode
3024	Parameter settings for a MM-GKR motor (rotations per minute)	"PM" ⇒ Write "3024"
3124	Parameter settings for a MM-GKR motor (frequency)	Invalid
6004	Parameter settings for a S-PM geared motor (rotations per minute)	"PM" ⇒ Write "6004"
6104	Parameter settings for a S-PM geared motor (frequency)	Invalid

REMARKS

- 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 the Instruction Manual (Applied) for the parameters that are initialized.)
- To change back to the parameter settings required to drive a general-purpose motor, perform parameter clear or all parameter clear.
- If the setting of Pr. 998 PM parameter initialization is changed from "3024, 6004 (rotations per minute)" to "3124, 6104 (frequency)," all the target parameters are initialized. The purpose of Pr. 998 is not to change the display units. 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.

CAUTION






- ⚠ According to the motor to be connected perform PM parameter initialization. Incorrect initial setting of parameters may damage the motor. In the initial setting, an MM-GKR motor is set for FR-E720EX-0.1K to 0.75K, and an S-PM geared motor is set for FR-E720EX-1.5K to 3.7K. Do not use a motor that is not a dedicated PM motor (MM-GKR motor or S-PM geared motor).

5.2 Start/stop from the operation panel (PU operation)



POINT

From where is the speed command given?








- Operation at the speed set in the speed setting mode of the operation panel  refer to 5.2.1 (Refer to page 20)
- Operation using the setting dial as the potentiometer  refer to 5.2.2 (Refer to page 21)
- Change of speed with ON/OFF switches connected to terminals  refer to 5.2.3 (Refer to page 22)
- Perform speed setting using voltage input signal  refer to 5.2.4 (Refer to page 23)
- Perform speed setting using current input signal  refer to 5.2.4 (Refer to page 23)

5.2.1 Setting the speed by the operation panel





Operation example Operate at 900r/min.

Operation

1. Screen at power-ON
The monitor display appears.
2. Operation mode change
Press  to choose the PU operation mode. PU indicator is ON.
3. Speed setting
Turn  to show the speed " 900 " (900r/min) you want to set. The speed flickers for about 5s. While the value is flickering, press  to set the speed. " F " and " 900 " flicker alternately. After about 3s of flickering, the indication of the value goes back to " 0 " (0r/min) (monitor display). (If  is not pressed, the indication of the value goes back to " 0 " (0r/min) after about 5s of flickering. In that case, turn  again, and set the speed.)
4. Start → acceleration → constant speed
Press  to start operation.
The speed value on the indication increases in Pr. 7 Acceleration time, and " 900 " (900r/min) appears.
(To change the set speed, perform the operation in above step 3. The previously set speed is displayed at first.)
5. Deceleration → stop
Press  to stop. The speed value on the indication decreases in Pr. 8 Deceleration time, and the motor stops rotating with " 0 " (0r/min) displayed.



REMARKS

-  can also be used like a potentiometer to perform operation. ( Refer to Chapter 4 of the Instruction Manual (Applied).)
- To always operate in the PU operation mode at power-ON, set Pr.79 Operation mode selection = "1" (PU operation mode).

5.2.2 Using the setting dial like a potentiometer to perform operation







POINT

- Set "0" (extended parameter valid) in Pr. 160 Extended function display selection.
- Set "1" (setting dial potentiometer mode) in Pr. 161 Speed setting/key lock operation selection.



Operation example Change the speed from 0r/min to 1800r/min during operation

Operation

1.	Screen at power-ON The monitor display appears.
2.	Operation mode change Press  to choose the PU operation mode. PU indicator is ON.
3.	Selecting the setting dial mode Change the Pr. 160 setting to "0" and the Pr. 161 setting to "1". (Refer to Refer to page 4 for change of the setting.)
4.	Start Press  to start the drive unit.
5.	Speed setting Turn  until "1800" (1800/min) appears. The flickering speed is the set speed. You need not to press  .



REMARKS

- If flickering "1800" turns to "0", the Pr. 161 Speed setting/key lock operation selection setting may not be "1".
 - Independently of whether the drive unit is running or at a stop, the speed can be set by simply turning the .
- (The magnitude of speed change obtained by turning the  can be adjusted with Pr. 295 setting.)




Note

- When setting a speed by turning the setting dial, the speed goes up to the set value of Pr. 1 Maximum setting (initial value:3000r/min). Adjust Pr. 1 Maximum setting according to the application.

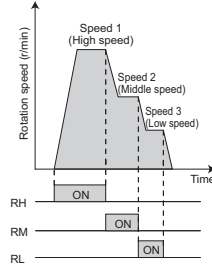
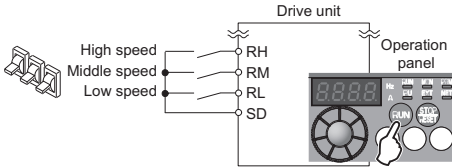
5.2.3 Setting the speed by switches (three-speed setting) (Pr. 4 to Pr. 6)



POINT







- Use the operation panel () to give a start command.
- Switch ON the RH, RM, or RL signal to give a speed command.
- Set "4" (External/PU combined operation mode 2) in Pr. 79 Operation mode selection.

[Connection diagram]




Operation example Operation at low speed (300r/min)

Operation

- Screen at power-ON
The monitor display appears.
- Easy operation mode setting
Press  and  for 0.5s. "79 - -" appears, and the [PRM] indicator flickers.
- Operation mode selection
Turn  until "79 - 4" appears. [PU] and [PRM] indicators flicker.
- Operation mode setting
Press  to enter the setting. (Set "4" in Pr.79.)
"79 - 4" and "79 - -" flicker alternately. [PU] and [EXT] indicators are ON.
- Speed setting
Turn ON the low-speed switch (RL).
Start → acceleration → constant speed
- Press  to start running.
The speed value on the indication increases in Pr. 7 Acceleration time, and "300" (300r/min) appears.
[RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
- Deceleration → stop
Press  to stop.
The speed value on the indication decreases in Pr. 8 Deceleration time, and the motor stops rotating with "0" (0r/min) displayed.
- Speed setting OFF
Turn OFF the low-speed switch (RL).



REMARKS

- The initial values of the terminals RH, RM, RL are 3000r/min, 1500r/min, and 300r/min. (Use Pr. 4, Pr. 5 and Pr. 6 to change.)
- In the initial setting, when 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.
- Maximum of 15-speed operation can be performed. ( Refer to Chapter 4 of the Instruction Manual (Applied).)

5.2.4 Setting the speed by analog input (voltage input/current input)

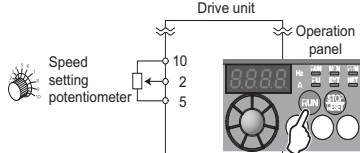


POINT

- Use the operation panel (**ⓇUN**) to give a start command.
- Use the (speed setting) potentiometer (voltage input) or 4-to-20mA input (current input) to give a speed command.
- Set "4" (External/PU combined operation mode 2) in Pr. 79 Operation mode selection.

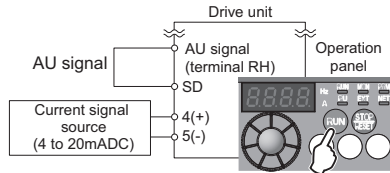
[Connection diagram for voltage input]

(The drive unit supplies 5V power to the speed setting potentiometer. (terminal 10))



[Connection diagram for current input]

Assign the AU signal in any of Pr. 178 to Pr. 184.



Operation example Operate at 3000r/min.

Operation

1.	<p>Screen at power-ON</p> <p>The monitor display appears.</p>
2.	<p>Assignment of the AU signal (current input) (Refer to the step 3 for voltage input.)</p> <p>Set Pr. 160 to "0" to activate extended parameters.</p> <p>To assign the AU signal, set "4" in one of Pr. 178 to Pr. 184. (Refer to Refer to page 4 to change the setting.)</p> <p>Turn ON the AU signal.</p>
3.	<p>Easy operation mode setting</p> <p>Press ⓇU EXT and ⓂODE for 0.5s. "ⓇⓂ - -" appears, and the [PRM] indicator flickers.</p>
4.	<p>Operation mode selection</p> <p>Turn ⓇⓂ until "ⓇⓂ - 4" appears. [PU] and [PRM] indicators flicker.</p>
5.	<p>Operation mode setting</p> <p>Press ⓈET to enter the setting. (Set "4" in Pr.79.)</p> <p>"ⓇⓂ - 4" and "ⓇⓂ - -" flicker alternately. [PU] and [EXT] indicators are ON.</p>
6.	<p>Start</p> <p>Press ⓇUN. The zero speed (0r/min) operation is performed as no speed command is given.</p> <p>[RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.</p>
7.	<p>Acceleration → constant speed</p> <p>For voltage input, turn the potentiometer (speed setting potentiometer) clockwise slowly to full.</p> <p>For current input, input 20mA.</p> <p>The speed value on the indication decreases in Pr. 7 Acceleration time, and "3000" (3000r/min) appears.</p> <p>[RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.</p>
8.	<p>Deceleration</p> <p>For voltage input, turn the potentiometer (speed setting potentiometer) counterclockwise slowly to full.</p> <p>For current input, input 4mA.</p> <p>The speed value on the on the indication decreases in Pr. 8 Deceleration time, and the zero speed (0r/min) operation is performed as no speed command is given.</p> <p>[RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.</p>
9.	<p>Stop</p> <p>Press ⓈTOP RESET. [RUN] indicator turns OFF.</p>



REMARKS





- The speed at the full clockwise turn of the potentiometer (speed setting potentiometer) (maximum potentiometer setting) is 3000r/min in the initial setting. (To change the setting, use Pr.125.) (Refer to page 27.)
- For current input, the speed at 20mA input is 3000r/min in the initial setting. (To change the setting, use Pr. 126.)
- (Refer to Chapter 4 of the Instruction Manual (Applied).)
- To input a 10VDC to the terminal 2, set Pr. 73 Analog input selection = "0". The initial value is "1 (0 to 5V input)"
- (Refer to Chapter 4 of the Instruction Manual (Applied).)

5.3 Start and stop using terminals (External operation)



POINT


From where is the speed command given?

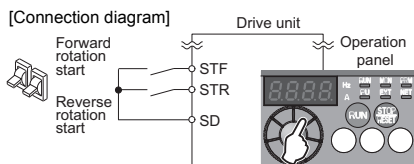
- Operation at the speed set in the speed setting mode of the operation panel  refer to 5.3.1 (Refer to page 24)
- Give a speed command by switch (multi-speed setting)  refer to 5.3.2 (Refer to page 25)
- Perform speed setting by a voltage input signal  refer to 5.3.3 (Refer to page 26)
- Perform speed setting by a current input signal  refer to 5.3.3 (Refer to page 26)

5.3.1 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.



Operation example Operate at 900r/min.

Operation

1.	Screen at power-ON The monitor display appears.
2.	Easy operation mode setting Press  and  for 0.5s. "79 - -" appears, and the [PRM] indicator flickers.
3.	Operation mode selection Turn  until "79 - 3" appears. [EXT] and [PRM] indicators flicker.
4.	Operation mode setting Press  to enter the setting. (Set "3" in Pr.79.) "79 - 3" and "79 - -" flicker alternately. [PU] and [EXT] indicators are ON.
5.	Speed setting Turn  to show the speed "900" you want to set. The speed flickers for about 5s. While the value is flickering, press  to set the speed. "F" and "900" flicker alternately. After about 3s of flickering, the indication of the value goes back to "" (monitor display). (If  is not pressed, the indication of the value goes back to "0" (0r/min) after about 5s of flickering. In that case, turn  again, and set the speed.)
6.	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 ON during forward rotation operation and flickers during reverse rotation operation. (To change the set speed, perform the operation in above step 5. 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.

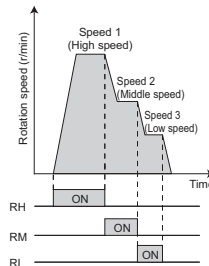
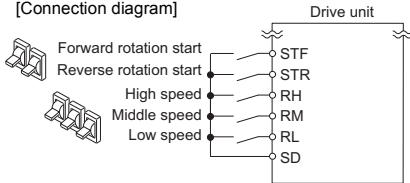
5.3.2 Setting the speed by switches (three-speed setting) (Pr. 4 to Pr. 6)



POINT

- Switch ON the STF (STR) signal to give a start command.
- Switch ON the RH, RM, or RL signal to give a speed command.

[Connection diagram]



Operation example Operation at high speed (3000r/min)

Operation

1.	Screen at power-ON The monitor display appears.
2.	Speed setting Turn ON the high-speed switch (RH).
3.	Start → acceleration → constant speed Turn ON the start switch (STF or STR). The speed value on the indication increases in Pr. 7 Acceleration time, and "3000" (3000r/min) appears. [RUN] indicator is ON during forward rotation operation and flickers during reverse rotation operation. ● When RM is turned ON, 1500r/min is displayed. When RL is turned ON, 300r/min is displayed.
4.	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.
5.	Speed setting (OFF) Turn OFF the high-speed switch (RH)



REMARKS

- To always select the External operation mode, set Pr.79 Operation mode selection = "2 (External operation mode)".
- Initial values of terminals RH, RM, and RL are 3000r/min, 1500r/min, and 300r/min. (To change, set Pr. 4, Pr. 5 and Pr. 6.)
- In the initial setting, when 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.
- Maximum of 15-speed operation can be performed. (Refer to Chapter 4 of the Instruction Manual (Applied).)

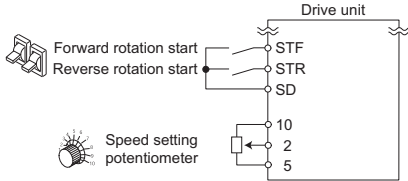
5.3.3 Setting the speed by analog input (voltage input/current input)



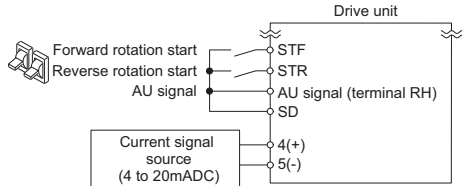
POINT

- Turn ON the STF(STR) signal to give a start command.
- Use the potentiometer (speed setting potentiometer) (voltage input) or 4-to-20mA input (current input) to give a speed command.

[Connection example for voltage input]
 (The drive unit supplies 5V power to the speed setting potentiometer. (terminal 10))



[Connection example for current input]
 Assign the AU signal in any of Pr. 178 to Pr. 184.



Operation example Operate at 3000r/min.

Operation

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. 184. (Refer to page 4 to change the setting.) Turn ON the AU signal.
3.	Start Turn the start switch (STF or STR) ON. The zero speed (0r/min) operation is performed as no speed command is given. [RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
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 ON during forward rotation operation and flickers 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 zero speed (0r/min) operation is performed as no speed command is given. [RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
6.	Stop Turn the start switch (STF or STR) OFF. [RUN] turns OFF.



REMARKS






- For voltage input, the speed (maximum potentiometer setting) at the full right turn of the (speed setting) potentiometer is 3000r/min in the initial setting. (To change the setting, use Pr.125.) (Refer to page 27.)
- For current input, the speed at 20mA input is 3000r/min in the initial setting. (To change the setting, use Pr. 126.)
 (Refer to Chapter 4 of the Instruction Manual (Applied).)
- To input a 10VDC to the terminal 2, set Pr.73 Analog input selection = "0". The initial value is "1 (0 to 5V input)".
 (Refer to Chapter 4 of the Instruction Manual (Applied).)
- To always select the External operation mode, set Pr. 79 Operation mode selection = "2 (External operation mode)".

5.3.4 Setting the speed at the maximum potentiometer indication

< How to change the maximum speed >

Changing example


To use 0 to 5VDC input speed setting potentiometer to change the speed at 5V from 3000r/min (initial value) to 2100r/min, make adjustment to output "2100r/min" at 5V voltage input. Set "2100r/min" in Pr. 125.

Operation	
Parameter selection	
1.	Turn  until "P. 125" (Pr. 125) appears. Press  to show the present set value "3000" (3000r/min).
Changing the maximum speed	
2.	Turn  to change the set value to "2100" (2100r/min). Press  to enter. "2100" and "P. 125" flicker alternately.
Mode/monitor check	
3.	Press  twice to choose the monitor/speed monitor.
Start	
4.	Turn the start switch (STF or STR) ON. The zero speed (0r/min) operation is performed as no speed command is given. [RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
Acceleration → constant speed	
5.	Turn the potentiometer (speed setting potentiometer) clockwise slowly to full. The speed value on the display increases in Pr. 7 Acceleration time, and "2100" (2100r/min) appears. [RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
Deceleration	
6.	Turn the potentiometer (speed setting potentiometer) counterclockwise slowly to full. The speed value on the display decreases in Pr. 8 Deceleration time, and the zero speed (0r/min) operation is performed as no speed command is given. [RUN] indicator is ON during forward rotation operation and flickers slowly during reverse rotation operation.
Stop	
7.	Turn the start switch (STF or STR) OFF. [RUN] turns OFF.




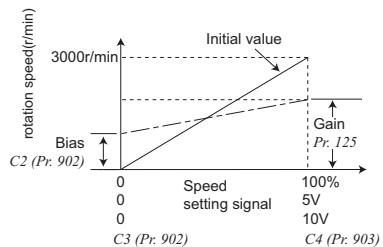
REMARKS


- Use calibration parameter C2 to set a speed at 0V and calibration parameter C0 to adjust the meter.

( Refer to Chapter 4 of the Instruction Manual (Applied).)



- To input a 10VDC to the terminal 2, set Pr.73 Analog input selection = "0". The initial value is "1 (0 to 5V input)".

( Refer to Chapter 4 of the Instruction Manual (Applied).)





- As other adjustment methods of speed setting voltage gain, there are methods to adjust with a voltage applied to across terminals 2 and 5 and a method to adjust at any point without a voltage applied. ( Refer to Chapter 4 of the Instruction Manual (Applied) for the setting method of calibration parameter C4.)


? Change the speed (3000r/min) at the maximum current input (20mA in the initial setting)

 Adjust it with Pr.126 Terminal 4 speed setting gain speed. ( Refer to Chapter 4 of the Instruction Manual (Applied).)

? Change the speed (0r/min) at the minimum current input (4mA in the initial setting)

 Adjust with the calibration parameter C5 Terminal 4 speed setting bias speed. ( Refer to Chapter 4 of the Instruction Manual (Applied).)

6 PARAMETERS

Simple variable-speed operation can be performed with the drive unit in the initial settings. Set the required parameters according to the load and operating conditions. Use the operation panel to set or change a parameter. (Refer to  Chapter 4 of the Instruction Manual (Applied) for the detailed description of parameters.)

6.1 Simple mode parameters



POINT

In the initial setting, only the simple mode parameters are displayed by the Pr. 160 Extended function display selection setting. Change the Pr. 160 Extended function display selection setting as required. (Refer to page 4 for parameter change)

Parameter Number	Name	Unit	Initial Value	Range	Application
1	Maximum setting	1r/min	3000r/min	0 to 4800r/min*1	Use this parameter to set the upper limit for the rotation speed.
2	Minimum setting	1r/min	0r/min	0 to 4800r/min*1	Use this parameter to set the lower limit for the rotation speed.
4	Multi-speed setting (high speed)	1r/min	3000r/min	0 to 4800r/min*1	Use these parameters to change among pre-set operation speeds with the terminals. The speeds are preset with parameters.
5	Multi-speed setting (middle speed)	1r/min	1500r/min	0 to 4800r/min*1	
6	Multi-speed setting (low speed)	1r/min	300r/min	0 to 4800r/min*1	
7	Acceleration time	0.01s	5s	0 to 360s	Use these parameters to set the acceleration/deceleration time.
8	Deceleration time	0.01s	5s	0 to 360s	
9	Electronic thermal O/L relay	0.01A	Rated motor current*4	0 to 500A	With this parameter, the drive unit protects the motor from heat. Set the rated motor current.
79	Operation mode selection	1	0	0	External/PU switchover mode
				1	Fixed to PU operation mode
				2	Fixed to External operation mode
				3	External/PU combined operation mode 1 (Start command from External, speed command from PU)
				4	External/PU combined operation mode 2 (Speed command from External, start command from PU)
				6	Switchover mode
				7	External operation mode (PU operation interlock)
125	Terminal 2 speed setting gain speed	1r/min	3000r/min	0 to 4800r/min*1	Use this parameter to change the speed at the maximum potentiometer setting (5V in the initial setting)
126	Terminal 4 speed setting gain speed	1r/min	3000r/min	0 to 4800r/min*1	Use this parameter to change the speed at the maximum current input (20mA in the initial setting)
160	Extended function display selection	1	0	0 9999	Simple mode + extended mode parameters are displayed. Only the simple mode parameters can be displayed.
998	PM parameter initialization	1	3024/ 6004*2	3024, 3124, 6004, 6104*3	Performing PM parameter initialization sets the parameters required to drive the motor being used.
999	Automatic parameter setting	1	9999	10, 9999	Use this parameter to batch set the communication parameters for the Mitsubishi's human machine interface (GOT).
Pr.CL	Parameter clear	1	0	0, 1	Setting "1" returns all parameters except calibration parameters to the initial values.
ALLC	All parameter clear	1	0	0, 1	Setting "1" returns all parameters to the initial values.
Er.CL	Fault history clear	1	0	0, 1	Setting "1" clears eight past faults.
Pr.CH	Initial value change list	—	—	—	Displays and sets the parameters changed from the initial value.

*1 When an S-PM geared motor is used, the maximum setting value differs depending on the drive unit capacity. (1200r/min for the 0.2K to 2.2K, 8000r/min for the 3.7K)

*2 The initial value differs according to the drive unit capacity. (0.75K or lower/1.5K or higher)

*3 The setting value differs according to the capacity. ("3024/3124" for the 0.1K, "3024/3124/6004/6104" for the 0.2K to 0.75K, and "6004/6104" for the 1.5K to 3.7K.)

*4 The setting value differs according to the capacity. (0.75K or lower: rated current of MM-GKR motor (Refer to page 42.), 1.5K or higher: rated current of S-PM geared motor (Refer to page 44.))

6.2 Parameter list



REMARKS

- ● indicates simple mode parameters.
- The parameters surrounded by a black border in the table allow their settings to be changed during operation even if "0" (initial value) is set in Pr. 77 Parameter write selection.
- Refer to Chapter 4 of the Instruction Manual (Applied) for the detailed description of parameters.

Parameter	Name	Setting Range	Initial Value
● 1	Maximum setting	0 to 4800r/min ⁺¹	3000r/min
● 2	Minimum setting	0 to 4800r/min ⁺¹	0r/min
● 4	Multi-speed setting (high speed)	0 to 4800r/min ⁺¹	3000r/min
● 5	Multi-speed setting (middle speed)	0 to 4800r/min ⁺¹	1500r/min
● 6	Multi-speed setting (low speed)	0 to 4800r/min ⁺¹	300r/min
● 7	Acceleration time	0 to 360s	5s
● 8	Deceleration time	0 to 360s	5s
● 9	Electronic thermal O/L relay	0 to 500A	Rated motor current ⁺⁷
10	Coasting speed	0 to 4800r/min ⁺¹	90r/min
11	DC injection brake operation time	0 to 10s	0.5s
13	Starting speed	0 to 4800r/min ⁺¹	15r/min
15	Jog speed setting	0 to 4800r/min ⁺¹	150r/min
16	Jog acceleration/ deceleration time	0 to 360s	0.5s
17	MRS input selection	0, 2, 4	0
20	Acceleration/deceleration reference speed	12 to 4800r/min ⁺¹	3000r/min
22	Torque limit level	0 to 200%, 9999	200/150% ⁺²
24	Multi-speed setting (speed 4)	0 to 4800r/min ⁺¹ , 9999	9999
25	Multi-speed setting (speed 5)	0 to 4800r/min ⁺¹ , 9999	9999
26	Multi-speed setting (speed 6)	0 to 4800r/min ⁺¹ , 9999	9999
27	Multi-speed setting (speed 7)	0 to 4800r/min ⁺¹ , 9999	9999
29	Acceleration/deceleration pattern selection	0, 1, 2	0
30	Regenerative function selection	0, 1	0
31	Speed jump 1A	0 to 4800r/min ⁺¹ , 9999	9999
32	Speed jump 1B	0 to 4800r/min ⁺¹ , 9999	9999
33	Speed jump 2A	0 to 4800r/min ⁺¹ , 9999	9999
34	Speed jump 2B	0 to 4800r/min ⁺¹ , 9999	9999
35	Speed jump 3A	0 to 4800r/min ⁺¹ , 9999	9999
36	Speed jump 3B	0 to 4800r/min ⁺¹ , 9999	9999
37	Speed display	0, 0.01 to 9998	0

Parameter	Name	Setting Range	Initial Value
40	RUN key rotation direction selection	0, 1	0
41	Up-to-speed sensitivity	0 to 100%	10%
42	Speed detection	0 to 4800r/min ⁺¹	180r/min
43	Speed detection for reverse rotation	0 to 4800r/min ⁺¹ , 9999	9999
44	Second acceleration/ deceleration time	0 to 360s	5s
45	Second deceleration time	0 to 360s, 9999	9999
48	Second torque limit level	0 to 200%, 9999	9999
52	DU/PU main display data selection	0, 5, 8 to 12, 14, 19, 20, 23 to 31, 36, 37, 52 to 55, 61, 62, 100	0
54	FM terminal function selection	1 to 3, 5, 8 to 12, 14, 21, 24, 36, 37, 52, 53, 61, 62	1
55	Speed monitoring reference	0 to 4800r/min ⁺¹	3000r/min
56	Current monitoring reference	0 to 500A	Rated motor current ⁺⁷
59	Remote function selection	0, 1, 2, 3	0
65	Retry selection	0 to 5	0
67	Number of retries at fault occurrence	0 to 10, 101 to 110	0
68	Retry waiting time	0.1 to 360s	1s
69	Retry count display erase	0	0
70	Special regenerative brake duty	0 to 30%	0%
71 ⁺¹¹	Parameter for manufacturer setting. These parameters will not be displayed.		
72 ⁺¹¹	Parameter for manufacturer setting. These parameters will not be displayed.		
73	Analog input selection	0, 1, 10, 11	1
74	Input filter time constant	0 to 8	1
75	Reset selection/ disconnected PU detection/PU stop selection	0 to 3, 14 to 17	14
77	Parameter write selection	0, 1, 2	0
78	Reverse rotation prevention selection	0, 1, 2	0
● 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	0
80 ⁺¹¹	Parameter for manufacturer setting. These parameters will not be displayed.		
110	Acceleration time for home position return	0.01 to 360s	5s
111	Deceleration time for home position return	0.01 to 360s	5s
117 ⁺¹⁰	PU communication station number	0 to 31 (0 to 247)	0
118 ⁺¹⁰	PU communication speed	48, 96, 192, 384	192

Parameter	Name	Setting Range	Initial Value
119 *10	PU communication stop bit length	0, 1, 10, 11	1
120 *10	PU communication parity check	0, 1, 2	2
121	Number of PU communication retries	0 to 10, 9999	1
122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0
123 *10	PU communication waiting time	0 to 150ms, 9999	9999
124 *10	PU communication CR/LF selection	0, 1, 2	1
⊙ 125	Terminal 2 speed setting gain speed	0 to 4800r/min +1	3000r/min
⊙ 126	Terminal 4 speed setting gain speed	0 to 4800r/min +1	3000r/min
127	PID control automatic switchover speed	0 to 4800r/min +1, 9999	9999
128	PID action selection	0, 20, 21, 50, 51, 60, 61	0
129	PID proportional band	0.1 to 1000%, 9999	100%
130	PID integral time	0.1 to 3600s, 9999	1s
131	PID upper limit	0 to 100%, 9999	9999
132	PID lower limit	0 to 100%, 9999	9999
133	PID action set point	0 to 100%, 9999	9999
134	PID differential time	0.01 to 10s, 9999	9999
144	Speed setting switchover	2, 4, 6, 8, 10, 102, 104, 106, 108, 110	110/104/106 *3
147	Acceleration/deceleration time switching speed	0 to 4800r/min +1, 9999	9999
148	Torque limit level at 0mA input	0 to 200%	150%
149	Torque limit level at 20mA input	0 to 200%	200%
150	Output current detection level	0 to 200%	150%
151	Output current detection signal delay time	0 to 10s	0s
152	Zero current detection level	0 to 200%	5%
153	Zero current detection time	0 to 1s	0.5s
156	Torque limit selection	0 to 31, 100, 101	0
157	OL signal output timer	0 to 25s, 9999	0s
⊙ 160	Extended function display selection	0, 9999	0
161	Speed setting/key lock operation selection	0, 1, 10, 11	0
168	Parameter for manufacturer setting. Do not set.		
169			
170	Watt-hour meter clear	0, 10, 9999	9999
171	Operation hour meter clear	0, 9999	9999

Parameter	Name	Setting Range	Initial Value
178	STF terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 23 to 25, 29, 30, 44, 60 (Pr.178), 61 (Pr.179), 62, 65 to 67, 76, 86 to 89, 9999	60
179	STR terminal function selection		61
180	RL terminal function selection		0
181	RM terminal function selection		1
182	RH terminal function selection		2
183	MRS terminal function selection		24
184	RES terminal function selection		62
190	RUN terminal function selection		0
191	FU terminal function selection		4
192	A,B,C terminal function selection		99
232	Multi-speed setting (speed 8)	0 to 4800r/min +1, 9999	9999
233	Multi-speed setting (speed 9)	0 to 4800r/min +1, 9999	9999
234	Multi-speed setting (speed 10)	0 to 4800r/min +1, 9999	9999
235	Multi-speed setting (speed 11)	0 to 4800r/min +1, 9999	9999
236	Multi-speed setting (speed 12)	0 to 4800r/min +1, 9999	9999
237	Multi-speed setting (speed 13)	0 to 4800r/min +1, 9999	9999
238	Multi-speed setting (speed 14)	0 to 4800r/min +1, 9999	9999
239	Multi-speed setting (speed 15)	0 to 4800r/min +1, 9999	9999
241	Analog input display unit switchover	0, 1	0
244	Cooling fan operation selection	0, 1	1
249	Earth (ground) fault detection at start	0, 1	0
250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	9999
251	Output phase loss protection selection	0, 1	1
255	Life alarm status display	(0 to 15)	0
256	Inrush current limit circuit life display	(0 to 100%)	100%
257	Control circuit capacitor life display	(0 to 100%)	100%
258	Main circuit capacitor life display	(0 to 100%)	100%
259	Main circuit capacitor life measuring	0, 1(2, 3, 8, 9)	0

Parameter	Name	Setting Range	Initial Value
267	Terminal 4 input selection	0, 1, 2	0
268	Monitor decimal digits selection	0, 1, 9999	9999
269	Parameter for manufacturer setting. Do not set.		
285	Excessive speed deviation detection speed	0 to 360r/min *4, 9999	9999
295	Magnitude of speed change setting	0, 0.01, 0.1, 1, 10	0
296	Password lock level	0 to 6, 100 to 106, 9999	9999
297	Password lock/unlock	(0 to 5), 1000 to 9998, 9999	9999
338	Communication operation command source	0, 1	0
339	Communication speed command source	0, 1, 2	0
340 *10	Communication startup mode selection	0, 1, 10	0
342	Communication EEPROM write selection	0, 1	0
343	Communication error count	—	0
374	Overspeed detection level	0 to 4800r/min *1	3450r/min
375	Faulty acceleration rate detection level	0 to 4800r/min *1/ms, 9999	9999
420	Command pulse multiplication numerator (electronic gear numerator)	1 to 32767	1
421	Command pulse multiplication denominator (electronic gear denominator)	1 to 32767	1
422	Position control gain	0 to 150sec ⁻¹	20sec ⁻¹
423	Position feed forward gain	0 to 100%	0%
426	In-position width	0 to 32767 pulses	100 pulse
427	Excessive level error	0 to 400K pulse	40K pulse
430	Pulse monitor selection	4, 5, 100 to 105, 9999	9999
446	Model position control gain	0 to 150sec ⁻¹	0sec ⁻¹
453	High speed during home position return	0 to 4800r/min *1	300r/min
455	Home position return shifting speed	0 to 4800r/min *1	1500r/min
463	Position control rotation direction selection	0, 1	0
464	Position control sudden stop deceleration time	0.01 to 360s	0.01s

Parameter	Name	Setting Range	Initial Value
465	First target position lower 4 digits	0 to 9999	0
466	First target position upper 4 digits		
467	Second target position lower 4 digits		
468	Second target position upper 4 digits		
469	Third target position lower 4 digits		
470	Third target position upper 4 digits		
471	Fourth target position lower 4 digits		
472	Fourth target position upper 4 digits		
473	Fifth target position lower 4 digits		
474	Fifth target position upper 4 digits		
475	Sixth target position lower 4 digits		
476	Sixth target position upper 4 digits		
477	Seventh target position lower 4 digits		
478	Seventh target position upper 4 digits		
495	Remote output selection		
496	Remote output data 1	0 to 4095	0
502	Stop mode selection at communication error	0, 1, 2, 3	0
503	Maintenance timer	0(1 to 9998)	0
504	Maintenance timer alarm output set time	0 to 9998, 9999	9999
505 *11	Parameter for manufacturer setting. These parameters will not be displayed.		
506	Position detection hysteresis width	0 to 32767	0
507	Rough match output range	0 to 32767	0
508	Home position shift amount lower 4 digits	0 to 9999	0
509	Home position shift amount upper 4 digits	0 to 9999	0
510	Position detection lower 4 digits	0 to 9999	0
511	Position detection upper 4 digits	0 to 9999	0
512	Stopper control function selection	0, 1, 10, 11, 12	0
513	Stopper control torque limit	0 to 200%	40%
514	Stopper control switchover position lower 4 digits	0 to 9999	0
515	Stopper control switchover position upper 4 digits	0 to 9999	0

Parameter	Name	Setting Range	Initial Value
525	First positioning sub-function	0, 1, 10, 11, 100, 101, 110, 111	10
526	Second positioning sub-function		
527	Third positioning sub-function		
528	Fourth positioning sub-function		
529	Fifth positioning sub-function		
530	Sixth positioning sub-function		
531	Seventh positioning sub-function	0, 10, 100, 110	10
532	Home position return selection	2, 3, 4, 6	4
533	Home position return stopper torque	0 to 200%	40%
534	Home position return stopper duration	0 to 10s	0.5s
535	Position control terminal input selection	0, 1, 10, 11, 100, 101, 110, 111	0
536	Position detection selection	0, 1, 2	0
537	Roll feed mode selection	0, 1	0
547 *10	USB communication station number	0 to 31	0
548 *10	USB communication check time interval	0 to 999.8s, 9999	9999
549 *10	Protocol selection	0, 1	0
550 *10	NET mode operation command source selection	0, 2, 9999	9999
551 *10	PU mode operation command source selection	2 to 4, 9999	9999
555	Current average time	0.1 to 1.0s	1s
556	Data output mask time	0 to 20s	0s
557	Current average value monitor signal output reference current	0 to 500A	Rated motor current *7
563	Energization time carrying-over times	(0 to 65535)	0
564	Operating time carrying-over times	(0 to 65535)	0

Parameter	Name	Setting Range	Initial Value
578	First positioning acceleration time	0.01 to 360s	5s
579	First positioning deceleration time		
580	Second positioning acceleration time		
581	Second positioning deceleration time		
582	Third positioning acceleration time		
583	Third positioning deceleration time		
584	Fourth positioning acceleration time		
585	Fourth positioning deceleration time		
586	Fifth positioning acceleration time		
587	Fifth positioning deceleration time		
588	Sixth positioning acceleration time		
589	Sixth positioning deceleration time		
590	Seventh positioning acceleration time		
591	Seventh positioning deceleration time		
658	Wiring resistance	0 to 5 Ω , 9999	9999
665	Regeneration avoidance speed gain	0 to 200%	100
698	Speed control D gain	0 to 100%	0%
730	Speed estimation P gain	0 to 300%, 9999	9999
736	Electromagnetic brake interlock time	0 to 1s	0s
785	PM control torque boost	0 to 150%, 9999	9999
791	Acceleration time in low-speed range	0 to 360s, 9999	9999
792	Deceleration time in low-speed range	0 to 360s, 9999	9999
795	DC brake torque boost	0 to 150%, 9999	9999
800	Control method selection	9, 10, 13	10
802	Pre-excitation selection (brake operation selection)	0, 1	0
820	Speed control P gain	0 to 1000%	100/15% *2
821	Speed control integral time	0 to 20s	0.2s/ 0.333s *2
824	Torque control P gain	0 to 200%, 9999	9999
825	Torque control integral time	0 to 50ms, 9999	9999
828	Model speed control gain	0 to 1000%	60%
853	Speed deviation time	0 to 100s	1s
862	Notch filter time constant	0, 10 to 625	0
863	Notch filter depth	0 to 3	0
870	Speed detection hysteresis	0 to 180r/min *5	15r/min
871	Notch filter width	0 to 3	0
872	Input phase loss protection selection	0, 1	0
877	Feed forward control/ model adaptive control selection	0 to 2	0

Parameter	Name	Setting Range	Initial Value
878	Speed feed forward filter	0 to 1s	0s
879	Speed feed forward torque limit	0 to 400%	150%
880	Load inertia ratio	0 to 200 times	7
881	Speed feed forward gain	0 to 1000%	0%
882	Regeneration avoidance operation selection	0, 1, 2	0
883	Regeneration avoidance operation level	300 to 800V	DC400V
885	Regeneration avoidance compensation speed limit value	0 to 540r/min *6, 9999	180r/min
886	Regeneration avoidance voltage gain	0 to 200%	100%
888	Free parameter 1	0 to 9999	9999
889	Free parameter 2	0 to 9999	9999
C0 (900) *8	FM terminal calibration	—	—
C2 (902) *8	Terminal 2 speed setting bias speed	0 to 4800r/min *1	0r/min
C3 (902) *8	Terminal 2 speed setting bias	0 to 300%	0%
125 (903) *8	Terminal 2 speed setting gain speed	0 to 4800r/min *1	3000r/min
C4 (903) *8	Terminal 2 speed setting gain	0 to 300%	100%
C5 (904) *8	Terminal 4 speed setting bias speed	0 to 4800r/min *1	0r/min
C6 (904) *8	Terminal 4 speed setting bias	0 to 300%	20%
126 (905) *8	Terminal 4 speed setting gain speed	0 to 4800r/min *1	3000r/min
C7 (905) *8	Terminal 4 speed setting gain	0 to 300%	100%
990	PU buzzer control	0, 1	1
991	PU contrast adjustment	0 to 63	58
997	Fault initiation	16 to 18, 32 to 34, 48, 49, 64, 82, 96, 97, 112, 128, 129, 144, 160, 161, 176 to 179, 192, 197, 199 to 201, 208, 209, 211, 221, 241, 245 to 247, 253, 9999	9999
998 *11	PM parameter initialization	3024, 3124, 6004, 6104 *9	3024/6004 *2
999	Automatic parameter setting	10, 9999	9999

Parameter	Name	Setting Range	Initial Value
Pr.CL	Parameter clear	0, 1	0
ALLC	All parameter clear	0, 1	0
Er.CL	Fault history clear	0, 1	0
Pr.CH	Initial value change list	—	—

- *1 When an S-PM geared motor is used, the maximum setting value differs depending on the drive unit capacity. (12000r/min for the 1.5K and 2.2K, 8000r/min for the 3.7K)
- *2 Differs according to the drive unit capacity. (0.75K or lower/1.5K or higher)
- *3 Differs according to the drive unit capacity. (0.75K or lower/1.5K and 2.2K/3.7K)
- *4 When an S-PM geared motor is used, the maximum setting value differs depending on the drive unit capacity. (900r/min for the 1.5K and 2.2K, 600r/min for the 3.7K)
- *5 When an S-PM geared motor is used, the maximum setting value differs depending on the drive unit capacity. (450r/min for the 1.5K and 2.2K, 300r/min for the 3.7K)
- *6 When an S-PM geared motor is used, the maximum setting value differs depending on the drive unit capacity. (1350r/min for the 1.5K and 2.2K, 900r/min for the 3.7K)
- *7 The setting value differs according to the drive unit capacity. (0.75K or lower: rated current of MM-GKR motor (Refer to page 42.), 1.5K or higher: rated current of S-PM geared motor (Refer to page 44.))
- *8 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07).
- *9 The setting value differs according to the drive unit capacity. "3024/3124" for the 0.1K, "3024/3124/6004/6104" for the 0.2K to 0.75K, and "6004/6104" for the 1.5K to 3.7K.
- *10 The setting is applied after a drive unit reset or power-ON.
- *11 A verification error may occur during parameter verification of the parameters copied using the parameter unit (FR-PU07). A verification error on the manufacturer setting parameters will not affect the operation. Press the "0" key on the parameter unit and proceed with the operation. (Refer to the Instruction Manual of the parameter unit.)



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, a value up to 9999 can be set.
- With parameter unit (FR-PU07) or FR Configurator, up to the highest value in the setting range can be set.
- A value exceeding 3000r/min can be also set, but the actual operation will be limited at 3000r/min, which is the upper speed limit of the motor.

7 TROUBLESHOOTING

When a fault occurs in the drive unit, the drive unit trips 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 34)
- 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 does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
- (3) Alarm
The drive unit does not trip. You can also output an alarm signal by making parameter setting.
- (4) Fault
When a fault occurs, the drive unit trips and a fault signal is output.


REMARKS

- For the details of fault displays and other malfunctions, also  refer to the *Instruction Manual (Applied)*.
- Past eight faults can be displayed using the setting dial. (Refer to page 3 for the operation.)

7.1 Reset method of protective function

(1) Resetting the drive unit

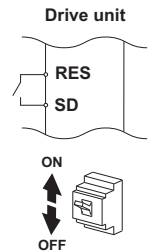
The drive unit can be reset by performing any of the following operations. Note that the internal accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the drive unit. Drive unit recovers about 1s after the reset is released.

Operation 1: Using the operation panel, press  to reset the drive unit.

(This may only be performed when a fault occurs (Refer to page 35 for fault.))




Operation 2: Turn ON the reset signal (RES) for more than 0.1s. (If the RES signal is kept ON, "Err." appears (flickers) to indicate that the drive unit is in a reset status.)



Operation 3: Switch power OFF once. After the indicator of the operation panel turns OFF, switch it ON again.

NOTE

- Use the operation 1 or 2 to reset when using the 24V external power supply. (Inverter with FR-E7DS mounted.)  refer to the *Instruction Manual (Applied)*.
- 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.

7.2 List of fault displays




When a fault occurs in the drive unit, the drive unit trips and the PU display automatically changes to one of the following fault or alarm indications.

The error message shows an operational error. The drive unit output is not shut off.

Warnings are messages given before faults occur. The drive unit output is not shut off.

Alarms warn the operator of failures with output signals. The drive unit output is not shut off.

When faults occur, the protective functions are activated to trip the drive unit and output a fault signal.

Function Name	Detail	Corrective action	Display	
Error message	Operation panel lock	Operation has been attempted during the operation panel lock.	Press  for 2s to release the lock.	HOLd
	Operation panel lock	Reading/writing of a password-restricted parameter has been attempted.	Enter the password in Pr. 297 Password lock/unlock to unlock the password function before operating.	LOCd
	Write disable error	<ul style="list-style-type: none"> Parameter setting has been attempted although parameter writing is set to be disabled. Overlapping range has been set for the speed jump. PU and the drive unit cannot make normal communication. 	<ul style="list-style-type: none"> Check the setting of Pr. 77 Parameter write selection Check the settings of Pr. 31 to Pr. 36 (speed jump). Check the connection of PU and the drive unit. 	Er 1
	Write error during operation	Parameter writing has been attempted while a value other than "2" is set in Pr. 77 Parameter write selection and the STF (STR) is ON.	<ul style="list-style-type: none"> Set "2" in Pr. 77 Parameter write selection. After stopping the operation, set parameters. 	Er 2
	Calibration error	Analog input bias and gain calibration values have been set too close.	Check the settings of calibration parameters C3, C4, C6 and C7 (calibration functions).	Er 3
	Mode designation error	<ul style="list-style-type: none"> Parameter setting has been attempted in the External or NET operation mode when Pr.77 Parameter write selection is not "2." Parameter writing has been attempted when the command source is not at the operation panel. 	<ul style="list-style-type: none"> After setting the operation mode to the "PU operation mode," set parameters. Set "2" in Pr.77 Parameter write selection Disconnect FR Configurator (USB connector) and the parameter unit (FR-PU07), then set Pr. 551 PU mode operation command source selection = "9999 (initial setting)." Set Pr. 551 PU mode operation command source selection = "4." 	Er 4
	Drive unit reset	The reset signal (RES signal) is ON. (Drive unit output is shutdown.)	Turn OFF the reset command.	Err.
Warning	Under torque limit	The torque limit operation has been activated.	<ul style="list-style-type: none"> Set the acceleration/deceleration time longer. Reduce the load. Check the peripheral devices for faults. Set the stall prevention operation current in Pr. 22 Torque limit level. (The acceleration/deceleration time may change.) Increase the stall prevention operation level with Pr. 22 Torque limit level, or disable stall prevention with Pr. 156 Torque limit selection. (Operation at OL occurrence can be selected using Pr. 156 Torque limit selection.) Check the connection of the PM motor. 	OL
	Stall prevention	The stall prevention function has been activated. (This warning is also output during the regeneration avoidance operation.)	Set the deceleration time longer.	oL
	Regenerative brake pre-alarm *2	The regenerative brake duty has reached 85% of the Pr. 70 Regenerative function selection setting or higher.	<ul style="list-style-type: none"> Set the deceleration time longer. Check the Pr.30 Regenerative function selection and Pr. 70 Regenerative function selection settings. 	r b
	Electronic thermal relay function pre-alarm *1	The cumulative value of the electronic thermal O/L relay has reached 85% of the Pr. 9 Regenerative function selection setting or higher.	<ul style="list-style-type: none"> Reduce the load and speed of operation. Set an appropriate value in Pr. 9 Regenerative function selection. 	fH
	PU stop	 on the operation panel has been pressed during the External operation.	Turn the start signal OFF and release with  .	P5
	Maintenance signal output *2	The cumulative energization time has exceeded the maintenance output timer set value.	Setting "0" in Pr. 503 Maintenance timer erases the signal.	MT
	Home position return error	An error has occurred during the home position return operation under position control.	Check the parameter setting, and check that the input signal is correct.	HP 1 , HP 2
	Undervoltage	The voltage at the main circuit power has been lowered.	Investigate the devices on the power supply line such as the power supply itself.	UV
	24V external power supply operation	Flickers when the main circuit power supply is not supplied and the 24V external power is supplied.	<ul style="list-style-type: none"> Turn ON the power supply for the drive unit (main circuit). If UV appears by turning ON the power supply of the drive unit (main circuit) while the external 24V power is supplied, check the power supply (for the main circuit). Check if the jumper is installed securely between terminal P/+ and P1. 	EU
	Stroke limit warning	Appears when the LSP signal (forward rotation stroke end) or the LSN signal (reverse rotation stroke end) has turned OFF.	Turn ON the LSP or LSN signal.	LP

Function Name	Detail	Corrective action	Display	
Alarm				
Fan alarm	Appears when the cooling fan remains stopped when operation is required or when the speed has decreased.	Check for fan alarm. Please contact your sales representative.	F_n	
Fault	Overcurrent trip during acceleration	Overcurrent has occurred during acceleration.	<ul style="list-style-type: none"> Set the acceleration time longer. (Shorten the downward acceleration time in vertical lift application.) If "E.OC1" always appears at start, disconnect the motor once and restart the drive unit. If "E.OC1" still appears, the drive unit may be faulty. Contact your sales representative. Check the wiring for output short circuit and ground fault. Lower the torque limit operation level. Activate the torque limit operation and the fast-response current limit operation. (Pr.156) Choose drive unit and motor capacities that match. If the motor is coasting, stop the motor, then input a start command. 	$E.OC1$
	Overcurrent trip during constant speed	Overcurrent has occurred during constant speed operation.	<ul style="list-style-type: none"> Keep the load stable. Check the wiring to avoid output short circuit or ground fault. Lower the torque limit operation level. Activate the torque limit operation and the fast-response current limit operation. (Pr.156) Choose drive unit and motor capacities that match. If the motor is coasting, stop the motor, then input a start command. 	$E.OC2$
	Overcurrent trip during deceleration or stop	Overcurrent has occurred during deceleration or at a stop.	<ul style="list-style-type: none"> Set the deceleration time longer. Check the wiring to avoid output short circuit or ground fault. Check if the mechanical brake is set to be activated too early. Lower the torque limit operation level. Activate the torque limit operation and the fast-response current limit operation. (Pr.156) Choose drive unit and motor capacities that match. If the motor is coasting, stop the motor, then input a start command. 	$E.OC3$
	Regenerative overvoltage trip during acceleration	Overvoltage has occurred during acceleration.	<ul style="list-style-type: none"> Set the acceleration time shorter. Use the regeneration avoidance function (Pr. 882, Pr. 883, Pr.885, Pr.886) 	$E.O.v1$
	Regenerative overvoltage trip during constant speed	Overvoltage has occurred during constant speed operation.	<ul style="list-style-type: none"> Keep the load stable. Use the regeneration avoidance function (Pr. 882, Pr. 883, Pr.885, Pr.886). Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required. 	$E.O.v2$
	Regenerative overvoltage trip during deceleration or stop	Overvoltage has occurred during deceleration or at a stop.	<ul style="list-style-type: none"> Set the deceleration time longer. (Set the deceleration time which matches the moment of inertia of the load.) Make the brake cycle longer. Use the regeneration avoidance function (Pr. 882, Pr. 883, Pr.885, Pr.886) Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required. 	$E.O.v3$
	Drive unit overload trip (electronic thermal O/L relay function) *1	The electronic thermal relay function for drive unit element protection has been activated.	<ul style="list-style-type: none"> Set the acceleration time longer. Reduce the load. Set the surrounding air temperature to within the specifications. 	$E.F.Hr$
	Motor overload trip (electronic thermal O/L relay function) *1	The electronic thermal relay function for motor protection has been activated.	<ul style="list-style-type: none"> Reduce the load. Set the torque limit operation level accordingly. 	$E.F.Hn$
	Heatsink overheat	The heatsink has overheated.	<ul style="list-style-type: none"> Set the surrounding air temperature to within the specifications. Clean the heatsink. Replace the cooling fan. 	$E.F1_n$
	Input phase loss *2	One of the three phases on the drive unit input side has been lost. It may also appear if phase-to-phase voltage of the three-phase power input has become largely unbalanced.	<ul style="list-style-type: none"> Wire the cables properly. Repair a break portion in the cable. Check the Pr. 872 <i>Input phase loss protection selection</i> setting. Set Pr. 872 <i>Input phase loss protection selection</i> = "0" (without input phase loss protection) when three-phase input voltage is largely unbalanced. 	$E1.LF$
Stop by the torque limit	The rotation speed has dropped to 18r/min as a result of deceleration due to the excess motor load.	Reduce the load. (Check the Pr. 22 <i>Torque limit level</i> setting.)	$E.O.Lr$	

Function Name	Detail	Corrective action	Display	
Fault	Loss of synchronism detection	<ul style="list-style-type: none"> Operation has gone out of synchronism. Operation was performed without connecting a motor. 	<ul style="list-style-type: none"> Set the acceleration time longer. Reduce the load. If the motor is coasting, stop the motor, then input a start command. Alternatively, use the automatic restart after instantaneous power failure/flying start function. Drive the dedicated PM motor (MM-GKR motor or S-PM geared motor). Check the connection of the PM motor. Set the PM motor test operation. 	E.SOF
	Brake transistor alarm detection	A fault has occurred in the brake circuit, such as a brake transistor breakage.(In this case, the drive unit must be powered off immediately.)	Replace the drive unit.	E. bE
	Output side earth (ground) fault overcurrent *2	An earth (ground) fault has occurred on the drive unit's output side (detected only at a start).	Remedy the ground fault portion.	E. GF
	Output phase loss	One of the three phases (U, V, W) on the drive unit's output side (load side) has been lost during drive unit operation.	<ul style="list-style-type: none"> Wire the cables properly. If the motor is coasting, stop the motor, then input a start command. 	E. LF
	External thermal relay operation *2	The external thermal relay connected to the OH signal has been activated.	<ul style="list-style-type: none"> Reduce the load and operate less frequently. Even if the relay contacts are reset automatically, the drive unit will not restart unless it is reset. 	E.OHF
	Option fault	A communication option has been connected while Pr.296 Password lock level="0, 100".	<ul style="list-style-type: none"> To apply the password lock when installing a communication option, set Pr.296 Password lock level="0, 100". If the problem still persists after taking the above measure, contact your sales representative. 	E.OPF
	Communication option fault	A communication line error has occurred in the communication option.	<ul style="list-style-type: none"> Check the option function setting, etc. Connect the plug-in option securely. Check the connection of communication cable Connect the terminating resistor properly. 	E.OP1
	Option fault	A contact fault or others has occurred in the connector between the drive unit and the plug-in option. Or, the switch for manufacturer setting has been changed on the plug-in option.	<ul style="list-style-type: none"> Connect the plug-in option securely. Take measures against noises if there are devices producing excess electrical noises around the drive unit. If the problem still persists after taking the above measure, contact your sales representative. Set the switch on the plug-in option, which is for manufacturer setting, back to the initial setting. (Refer to the Instruction Manual of each option.) 	E. 1
	Parameter storage device fault	Operation of the component where parameters are stored (control circuit board) has become abnormal.	Please contact your sales representative. When performing parameter writing frequently for communication purposes, set "1" in Pr.342 Communication EEPROM write selection to enable RAM write. Note that powering OFF returns the drive unit to the status before RAM write.	E. PE
	Internal board fault	The control circuit board and the main circuit board do not match.	Please contact your sales representative. (For parts replacement, consult the nearest Mitsubishi FA Center.)	E.PE2
	PU disconnection	<ul style="list-style-type: none"> A communication error has occurred between the PU and the drive unit. The communication interval has exceeded the permissible time period during RS-485 communication via the PU connector. The number of communication errors has exceeded the number of retries. 	<ul style="list-style-type: none"> 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). 	E.PUE
	Retry count excess *2	Operation restart within the set number of retries has failed.	Eliminate the cause of the error preceding this error indication.	E.rEF
	CPU fault	An error has occurred in the CPU and in the peripheral circuits.	<ul style="list-style-type: none"> Take measures against noises if there are devices producing excess electrical noises around the drive unit. Check the connection between the terminals PC and SD. (E6/E7) If the situation does not improve after taking the above measure, please contact your sales representative. 	E. S to E. 7 E.CPU
Inrush current limit circuit fault	The resistor of the inrush current limit circuit has overheated.	Configure a circuit where frequent power ON/OFF is not repeated. If the situation does not improve after taking the above measure, please contact your sales representative.	E! OH	
Analog input fault	A voltage (current) has been input to terminal 4 when the setting in Pr. 267 Terminal 4 input selection and the setting of voltage/current input switch are different.	Give a speed command by a current input or set Pr.267 Terminal 4 input selection, and set the voltage/current input switch to voltage input.	E.R1 E	
Overspeed occurrence	The motor speed has exceeded the Pr. 374 Overspeed detection level.	Check that the Pr. 374 Overspeed detection level value is correct.	E. OS	


Function Name	Detail	Corrective action	Display	
Fault	Speed deviation excess detection	The speed command has differed from the motor speed by the amount of Pr. 285 <i>Excessive speed deviation detection speed</i> for Pr. 853 <i>Speed deviation time</i> or longer.	<ul style="list-style-type: none"> • Keep the load stable. • Check the peripheral devices for faults. • Correctly set Pr. 285 <i>Excessive speed deviation detection speed</i> and Pr. 853 <i>Speed deviation time</i>. 	E05d
	Excessive position fault	Under position control, the difference between the position command (before the electronic gear) and the current position (after the electronic gear) has exceeded the Pr.427 <i>Excessive level error</i> .	<ul style="list-style-type: none"> • Reduce the load weight. • Set Pr.427 <i>Excessive level error</i> properly. 	E. 0d
	Acceleration error	The acceleration rate of the motor rotation speed has exceeded the Pr.375 <i>Faulty acceleration rate detection level</i> .	<ul style="list-style-type: none"> • Keep the load stable. • Set Pr.375 <i>Faulty acceleration rate detection level</i> appropriately. • If the acceleration/deceleration rate is great and an error occurs during normal operation, set Pr.375="9999 (no error detection)". 	E. 0R
	USB communication fault	The communication has been broken for Pr. 548 <i>USB communication check time interval</i> .	<ul style="list-style-type: none"> • Check the Pr.548 <i>USB communication check time interval</i> setting. • Check the USB communication cable. • Increase the Pr.548 <i>USB communication check time interval</i> setting, or set "9999." 	E5b
	Internal circuit fault	An internal circuit fault has occurred.	Please contact your sales representative.	E. 13 ESRF

*1 Resetting the drive unit initializes the internal cumulative heat value of the electronic thermal relay function.

*2 This protective function is not available in the initial status.

7.3 Check first when you have a trouble

Description	Countermeasure
Motor does not start.	Check start and speed command sources and enter a start command (STF, etc.) and a speed command.
Motor or machine is making abnormal acoustic noise.	Take EMC measures if a steady operation cannot be performed due to EMI. Alternatively, set the Pr.74 <i>Input filter time constant</i> setting higher.
Drive unit generates abnormal noise.	Install the fan cover correctly.
Motor generates heat abnormally.	Improve the motor environment.
Motor rotates in the opposite direction.	Connect phase sequence of the output cables (terminal U, V, W) to the motor correctly. Alternatively, check the connection of the start signal. (STF: forward rotation, STR: reverse rotation)
Speed greatly differs from the setting.	Check the settings of Pr.1 <i>Maximum setting</i> , Pr.2 <i>Maximum setting</i> , and calibration parameters C2 to C7.
Acceleration/deceleration is not smooth.	Reduce the load. Alternatively, increase the acceleration/deceleration time. Eliminate the load fluctuation. Use Pr.156 <i>Torque limit selection</i> to disable torque limit operation. Set the wiring resistance value in Pr.658 <i>Wiring resistance</i> .
Speed varies during operation.	Check the speed setting signals. If the load fluctuates, select Advanced magnetic flux vector control or General-purpose magnetic flux vector control.
Operation mode is not changed properly.	Turn OFF the start signal (STF or STR). Check if Pr.79 <i>Operation mode selection</i> is set appropriately.
Operation panel display is not operating.	Check the wiring and the installation.
Speed does not accelerate.	Check the settings of Pr.1 <i>Maximum setting</i> , Pr.2 <i>Maximum setting</i> , and calibration parameters C2 to C7.
Unable to write parameter setting.	Check Pr.77 <i>Parameter write selection</i> setting.

* For further information on troubleshooting, refer to the  *Instruction Manual (Applied)*.

8 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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.



REMARKS

For maintenance/inspection and parts life, also refer to the *Instruction Manual (Applied)*.

●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.

8.1 Inspection items

Area of Inspection	Inspection Item	Description	Interval		Corrective Action at Alarm Occurrence	Customer's Check	
			Daily	Periodic *2			
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.*3	○		Clean		
	Power supply voltage	Check that the main circuit voltages are normal.*1	○		Inspect the power supply		
Main circuit	General	(1) Check with megger (across main circuit terminals and earth (ground) terminal). (2) Check for loose screws and bolts. (3) Check for overheat traces on the parts. (4) Check for stain.		○	Contact the manufacturer Retighten Contact the manufacturer Clean		
		Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).		○	Contact the manufacturer Contact the manufacturer	
			Terminal block	Check for damage.		○	Stop the device and contact the manufacturer.
		Smoothing aluminum electrolytic capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Visual check and judge by the life check of the main circuit capacitor (Refer to Chapter 4 of the Instruction Manual (Applied).)		○	Contact the manufacturer Contact the manufacturer	
	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. (2) Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer Contact the manufacturer		
		Parts check	Overall	(1) Check for unusual odor and discoloration. (2) Check for serious rust development.		○	Stop the device and contact the manufacturer. Contact the manufacturer
	Aluminum electrolytic capacitor		(1) Check for liquid leakage in a capacitor and deformation trace. (2) Visual check and judge by the life check of the main circuit capacitor (Refer to Chapter 4 of the Instruction Manual (Applied).)		○	Contact the manufacturer	
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose screws and bolts (3) Check for stain	○	○	Replace the fan Fix with the fan cover fixing screws Clean		
	Heatsink	(1) Check for clogging. (2) Check for stain.		○	Clean Clean		
Display	Indication	(1) Check that display is normal. (2) Check for stain.	○	○	Contact the manufacturer Clean		
	Meter	Check that reading is normal.	○		Stop the device and contact the manufacturer.		

Area of Inspection	Inspection Item	Description	Interval		Corrective Action at Alarm Occurrence	Customer's Check
			Daily	Periodic *2		
Load motor	Operation check	Check for vibration and abnormal increase in operation noise.	○		Stop the device and contact the manufacturer.	

- *1 It is recommended to install a device to monitor voltage for checking the power supply voltage to the drive unit.
- *2 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.
- *3 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.



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.

8.2 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, consult the nearest Mitsubishi FA Center.

9 SPECIFICATIONS

9.1 Rating

●Three-phase 200V power supply

Model FR-E720EX-□K		0.1	0.2	0.4	0.75	1.5	2.2	3.7
Output	Rated current (A)	0.8	1.5	3	5	8	11	17.5
	Overload current rating	150% 60s, 200% 3s (reference rated motor current, inverse-time characteristics)						
Power supply	Rated input	Three-phase 200 to 240V 50Hz/60Hz						
	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%						
Protective structure		Enclosed type (IP20)						
Cooling system		Self-cooling				Forced air cooling		
Approximate mass (kg)		0.5	0.5	0.7	1.0	1.4	1.4	1.7

9.2 Common specifications

Motor		MM-GKR motor		S-PM geared motor		
Control specifications	Control method	PM sensorless vector control (low-speed range: current synchronization operation)		PM sensorless vector control (low-speed range: current synchronization operation)		
	Carrier frequency	10kHz (when driving an MM-GKR motor)		5kHz		
	Starting torque	200% (initial value)		100% (initial value)		
	Torque boost	—		PM control torque boost, DC injection brake torque boost		
	Initial magnetic pole detection time	Approx. 0.1s (performed at start, at SON/LX signal ON.)				
	Torque limit operation level	Operation current level can be set (0 to 200% adjustable), whether to use the function or not can be selected.				
	Speed control	Speed fluctuation ratio	±0.05% +1			
		Speed control range	Full speed range (speed ratio at digital input 1:1000)		PM sensorless vector control range 1:10	
		Speed setting resolution	Analog input	3r/min/3000r/min (terminal2, 4: 0 to 10V/10-bit)		
				6r/min/3000r/min (terminal2, 4: 0 to 5V/9-bit)		
				3r/min/3000r/min (terminal4: 0 to 20mA/10-bit)		
		Analog speed command input	Digital input	1r/min		
				Two terminals Terminal 2: 0 to 10V, 0 to 5V can be selected Terminal 4: 0 to 10V, 0 to 5V, 4 to 20mA can be selected		
	Acceleration/ deceleration time setting	0.01 to 360.00s (acceleration and deceleration can be set individually).				
Acceleration/ deceleration time pattern	Selectable between the linear acceleration/deceleration and the S-pattern acceleration/deceleration					
Digital speed command input	Input from the operation panel or parameter unit. Frequency setting increment is selectable.					
Position control	Command input method	Point table method. Position control by an absolute position command is available after home position return.		—		
	Motor internal command resolution	5120 [pulses/rev]		—		
	Positioning accuracy	±1.8° (mechanical angle of 200 [pulses/rev] resolution equivalent; input voltage of 200V; and wiring length of 5m or less)		—		
Communication specification	Built-in to the drive unit : RS-485 communication (Mitsubishi inverter protocol, Modbus-RTU communication) Option: CC-Link communication					
Environment	Surrounding air temperature	-10°C to +50°C (non-freezing) *2				
	Ambient humidity	90%RH or less (non-condensing)				
	Storage temperature *3	-20°C to +65°C				
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)				
	Altitude/vibration	Maximum 1000m above sea level, 5.9m/s ² or less at 10 to 55Hz (directions of X, Y, Z axes)				

*1 During the load fluctuation of 0 to 100%

*2 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).

*3 Temperatures applicable for a short time, e.g. in transit.

9.3 Specifications of the dedicated PM motor [MM-GKR motor]

9.3.1 Motor specifications

MM-GKR 1 3

Symbol	Rated output (kW)	Symbol	Rated speed (r/min)	Symbol	Oil seal	Symbol	Reduction gear ^{*3}	Symbol	Shaft end
1 to 7	Refer to the following section.	3	3000	—	Without	—	Without	—	Standard (straight shaft)
				J	With ^{*1*2}	G0	For general industrial machine (flange mounting)	K	Key shaft (with key) ^{*3}
								D	D-cut shaft ^{*3}

*1 The reduction gear equipped models do not have the oil seal.

*2 The oil seal model has an outline dimension different from the standard motor.

For the details, please contact your sales representative.

*3 For the applicable models and detailed specifications, refer to the sensorless servo catalog.

●Standard specifications

Motor model	MM-GKR□□	13	23	43	73
Compatible drive unit	FR-E720EX-□K	0.1	0.2	0.4	0.75
Power supply capacity (kVA) ^{*2}		0.3	0.5	0.9	1.3
Continuous characteristic	Rated output (kW)	0.1	0.2	0.4	0.75
	Rated torque (N·m) ^{*3}	0.32	0.64	1.3	2.4
Maximum torque (N·m)		0.64	1.3	2.5	4.8
Rated speed (r/min)		3000			
Maximum speed (r/min)		3000			
Instantaneous permissible speed (r/min)		3450			
Power rate at continuous constant-torque (kW/s)		15.0	21.7	43.7	46.0
Number of poles		10			
Rated current (A)		0.65	1.08	1.94	3.34
Maximum current (A)		1.3	2.2	3.9	6.7
Moment of inertia ($\times 10^{-4}$ kg·m ²)		0.0676	0.187	0.371	1.24
Recommended load inertia moment ratio ^{*4}		10 times or lower			
Speed/position detector		None			
Oil seal		Not available (the oil seal model is also available. (MM-GKR_J))			
Heat-resistant class		130 (B)			
Structure		Totally enclosed self-cooling			
Protective structure		IP65 ^{*5}			
Environment ^{*7}	Surrounding air temperature	0°C to +40°C (non-freezing), in storage: -15°C to +70°C (non-freezing)			
	Ambient humidity	80%RH or less (non-condensing), in storage: 90%RH or less (non-condensing)			
	Atmosphere	Indoors (avoid direct sunlight), free from corrosive gas, flammable gas, oil mist, dust and dirt			
	Altitude	Maximum 1,000m above sea level			
Vibration ^{*6}		X: 49m/s ² , Y: 49m/s ²			
Vibration rank		V10 ^{*8}			
Permissible load on the shaft ^{*9}	L (mm)	25	30	30	40
	Radial (N)	88	245	245	392
	Thrust (N)	59	98	98	147
Mass (kg)		0.4	0.77	1.3	2.7

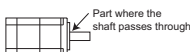
*1 The above characteristics apply when the rated AC voltage is input from the drive unit (Refer to page 41). Output and rated motor speed are not guaranteed when the power supply voltage drops.

*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).

*3 For a machine that produces unbalanced torque, such as a lift axis, the recommended unbalanced torque is the 70% of the rated torque or lower.

*4 This is the ratio of the moment of load inertia to the moment of motor inertia under position control. If the load inertia moment ratio exceeds the described value, please contact your sales representative.

*5 This excludes the part where the shaft passes through. For the reduction gear equipped model, the protective structure is equivalent to IP44.

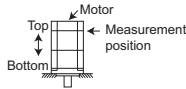


Specifications of the dedicated PM motor [MM-GKR motor]

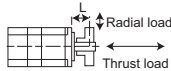
- *6 X indicates the direction of the motor's output shaft, and Y indicates the direction vertical to the motor's output shaft. Usually, the indicated value is of the non-load side bracket where the vibration is the greatest. Bearing is subject to fretting while the motor is stopped. Suppress the vibration to about the half of the permissible value.



- *7 The standard motor may not be used under the condition where it is constantly exposed to oil mist, oil, or water. For the details, please contact your sales representative.
- *8 "V10" means that the vibration amplitude of the single motor is 10 μ m or lower. The following figure shows the installation orientation of the motor and measurement position at the vibration degree measurement.



- *9 For the permissible load on the shaft, refer to the following figure. On the shaft, do not apply a load exceeding the value in the table. Each value in the table shows the permissible value for the single load application.



L: Distance from the flange mounting surface to the center of the load

●Reduction gear equipped model specifications

Reduction gear equipped model for general industrial machines: G0

Model	Output (W)	Reduction ratio	Actual reduction ratio	Moment of inertia J ($\times 10^{-4}$ kg·m ²) ^{*1}	Permissible load inertia moment ratio ^{*2} (calculation at motor shaft)	Mass (kg)	Lubrication method	Installation orientation
MM-GKR13G0	100	1/5	42/221	0.0720	10 times or lower of the moment of motor inertia	1.3	Grease (already filled)	Any orientation
		1/12	9/104	0.0706		1.3		
		1/20	12/247	0.0703		1.3		
		1/30	24/713	0.0768		2.4		
MM-GKR23G0	200	1/5	44/217	0.222		2.8		
		1/12	48/589	0.204		2.8		
		1/20	32/651	0.201		2.8		
		1/30	24/713	0.200		2.8		
MM-GKR43G0	400	1/5	15/77	0.406		3.2		
		1/12	9/110	0.390		3.2		
		1/20	9/189	0.399		4.3		
		1/30	12/351	0.398		4.3		
MM-GKR73G0	750	1/5	19/95	1.37		5.5		
		1/12	40/475	1.32		5.5		
		1/20	14/285	1.29		7.3		
		1/30	25/722	1.28		7.3		

Item	Specifications
Installation method	Flange mounting
Rotation direction of output axis	Same as that of the motor output axis
Backlash ^{*4}	60 minutes or less at the output shaft of the reduction gear
Maximum torque	Twice of the rated torque (For the rated torque, refer to page 42)
Permissible speed (motor axis)	3000r/min (Instantaneous permissible speed: 3450r/min)
IP rating	Equivalent to IP44
Vibration resistance	X: 29.4 m/s ² , Y: 29.4 m/s ²
Reduction gear efficiency ^{*3}	80% or higher

*1 This value is a value at the shaft of the motor with a reduction gear.

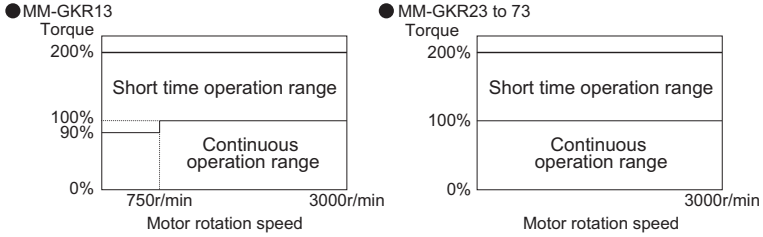
*2 If the value exceeds the described value, please contact your sales representative.

*3 The reduction gear efficiency differs depending on the reduction ratio. Additionally, the reduction gear efficiency varies depending on operating conditions, such as the output torque, rotation speed, and temperature.

The value in the table is a typical value for the rated torque at the rated speed and at a room temperature, but not a guaranteed value.

*4 The following conversion formula is used for the unit conversion of the backlash: 1 minute = 0.0167°.

9.3.2 Motor torque characteristic

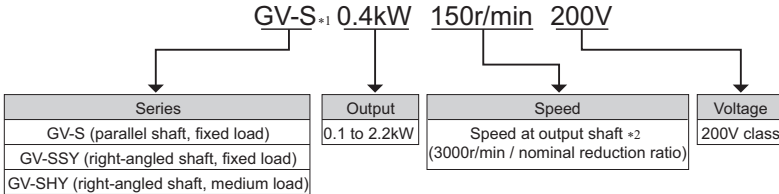


- When the input voltage is low, the torque may be reduced.
- The continuous operation torque becomes 80% at 6r/min or lower.

9.4 Specifications of the dedicated PM motor [S-PM geared motor]

9.4.1 Motor specifications

● Model names of S-PM geared motors



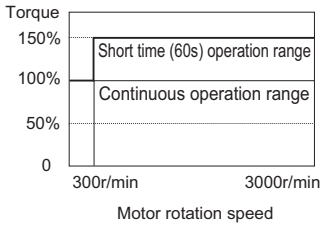
- *1 For the model names of the flange types and brake-equipped types, refer to the catalog.
- *2 For the detail of the output-shaft rotation speed (reduction ratio), refer to the catalog.

Motor model	GV-□□kW	0.1	0.2	0.4	0.75	1.5	2.2
Compatible drive unit	FR-E720EX-□K	0.2	0.4	0.75	1.5	2.2	3.7
Power supply system capacity (kVA) *4		0.4	0.7	1.2	2.1	4.0	5.5
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				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 41). 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 power supply capacity varies with the value of the power supply side drive unit impedance (including those of the input reactor and cables).

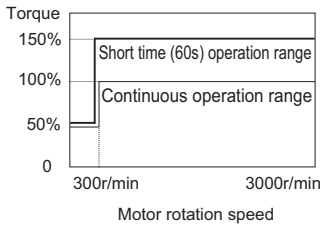
9.4.2 Motor torque characteristic

<<Initial setting($Pr.785 = 9999 (=100\%)$)>>



- The short-time torque can be up to 100% in low speed (300r/min) operation, but continuous operation is not available.
- 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.

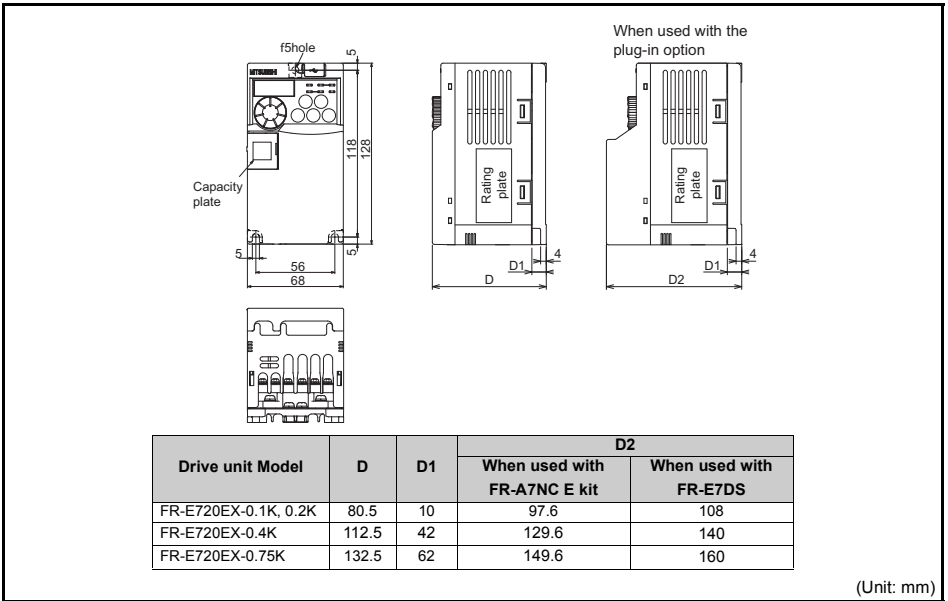
<<When $Pr.785 = 50\%$ >>



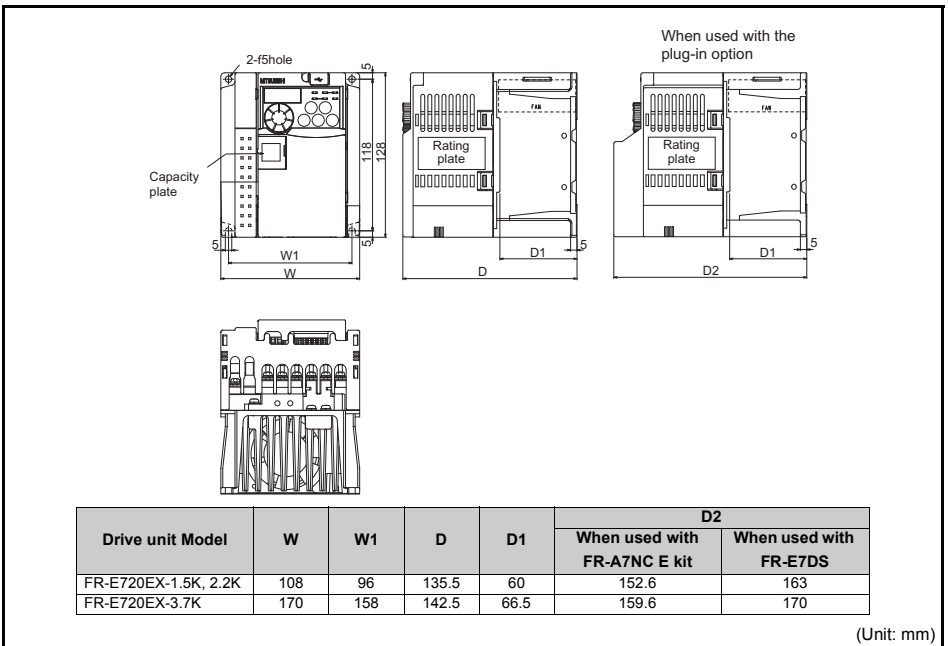
- Setting $Pr.785$ PM control torque boost = 50% or less* will enable continuous operation at 300r/min or lower. However, the keep the short-time torque to $Pr.785$ setting or lower.
* For FR-E720EX-1.5K or lower, it is 80% or lower.
- When the input voltage is low, the torque may be reduced.
- The operatable speed range at constant torque is 300r/min to 3000r/min.

9.5 Outline dimension drawings

●FR-E720EX-0.1K to 0.75K



●FR-E720EX-1.5K to 3.7K



APPENDIX

Appendix 1 Instructions for compliance with the EU Directives

The EU Directives are issued to standardize different national regulations of the EU Member States and to facilitate free movement of the equipment, whose safety is ensured, in the EU territory.

Since 1996, compliance with the EMC Directive that is one of the EU Directives has been legally required. Since 1997, compliance with the Low Voltage Directive, another EU Directive, has been also legally required. When a manufacturer confirms its equipment to be compliant with the EMC Directive and the Low Voltage Directive, the manufacturer must declare the conformity and affix the CE marking.

● The authorized representative in the EU

The authorized representative in the EU is shown below.

Name: Mitsubishi Electric Europe B.V.

Address: Gothaer Strasse 8, 40880 Ratingen, Germany

● Note

We declare that this drive unit, when equipped with the dedicated EMC filter, conforms with the EMC Directive in industrial environments and affix the CE marking on the drive unit. When using the drive unit in a residential area, take appropriate measures and ensure the conformity of the drive unit used in the residential area.

(1) EMC Directive

We declare that this drive unit, when equipped with the EMC Directive compliant EMC filter, conforms with the EMC Directive and affix the CE marking on the drive unit.

- EMC Directive: 2004/108/EC
- Standard(s): EN61800-3:2004 (0.1K to 0.75K EMI: PDS Category "C3", EMS: Second Environment, 1.5K to 3.7K EMI: PDS Category "C2", EMS: Second Environment)

Note: First environment

Environment including residential buildings. Includes building directly connected without a transformer to the low voltage power supply network which supplies power to residential buildings.

Second environment

Environment including all buildings except buildings directly connected without a transformer to the lower voltage power supply network which supplies power to residential buildings.

● Note

- * Set the EMC Directive compliant EMC filter to the drive unit. Insert line noise filters and ferrite cores to the power and control cables as required. When a drive unit has a capacity of 1.5K to 3.7K, install it in an enclosure.
- * Connect the drive unit to an earthed power supply.
- * The cable length between the drive unit and the motor is 5m maximum.
- * Confirm that the final integrated system with the drive unit conforms with the EMC Directive.

(2) Low Voltage Directive

We have self-confirmed our drive units as products compliant to the Low Voltage Directive (Conforming standard EN 61800-5-1) and affix the CE marking on the drive units.

● Outline of instructions

- * Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth securely.
- * Wire the earth (ground) terminal independently. (Do not connect two or more cables to one terminal.)
- * Use the cable sizes on *page 12* under the following conditions.
 - Surrounding air temperature: 40°C maximum

If conditions are different from above, select appropriate wire according to EN60204 ANNEX C TABLE 5.

- * Use a tinned (plating should not include zinc) crimping terminal to connect the earth cable. When tightening the screw, be careful not to damage the threads.

For use as a product compliant with the Low Voltage Directive, use PVC cable on *page 12*.

- * Use the moulded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- * When using an earth leakage circuit breaker, use a residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). If not, provide double or reinforced insulation between the drive unit and other equipment, or put a transformer between the main power supply and drive unit.
- * Use the drive unit under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III specified in IEC664.
 - To use the drive unit under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.

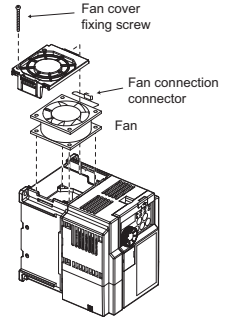
- * To use the drive unit outside of an enclosure in the environment of pollution degree 2, fix a fan cover with fan cover fixing screws enclosed.

Note, the protection structure of the Drive unit units is considered to be an IP00.

- * On the input and output of the drive unit, use cables of the type and size set forth in EN60204 Appendix C.
- * The operating capacity of the relay outputs (terminal symbols A, B, C) should be 30VDC, 0.3A. (Relay output has basic isolation from the drive unit internal circuit.)
- * Control circuit terminals on *page 9* are safely isolated from the main circuit.
- * Environment

	Running	In Storage	During Transportation
Ambient Temperature	-10°C to +50°C	-20°C to +65°C	-20°C to +65°C
Humidity	90% RH or less	90% RH or less	90% RH or less
Maximum Altitude	1000m	1000m	10000m

Details are given in the technical information "Low Voltage Directive Conformance Guide" (BCN-A21041-203). Please contact your sales representative.



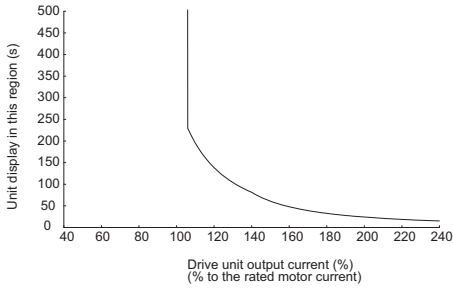
Example for FR-E720EX-2.2K

- * Select a UL and cUL certified fuse with Class T fuse equivalent cut-off speed or faster with the appropriate rating for branch circuit protection, or a UL489 molded case circuit breaker (MCCB) in accordance with the table below.

FR-E720EX-□□K		0.1	0.2	0.4	0.75	1.5	2.2	3.7
Rated fuse voltage(V)		240V or more						
Fuse Maximum allowable rating (A)*	Without power factor improving reactor	15	15	15	20	30	40	60
	With power factor improving reactor	15	15	15	20	20	30	50
Molded case circuit breaker (MCCB) Maximum allowable rating (A)*		15	15	15	15	20	25	40

* Maximum allowable rating by US National Electrical Code. Exact size must be chosen for each installation.

- * When using the electronic thermal relay function as motor overload protection, set the rated motor current to Pr. 9 "Electronic thermal O/L relay".



This function detects the overload (overheat) of the motor, stops the operation of the drive unit's output transistor, and stops the output.
(The operation characteristic is shown on the left.)

- * Short circuit ratings

Suitable For Use in A Circuit Capable of Delivering Not More Than 5 kA rms Symmetrical Amperes, 264 V Maximum.

Appendix 2 Instructions for UL and cUL

(Standard to comply with: UL 508C, CSA C22.2 No. 14)

1. General Precaution

CAUTION - Risk of Electric Shock -

The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.

ATTENTION - Risque de choc électrique -

La durée de décharge du condensateur de bus est de 10 minutes. Avant de commencer le câblage ou l'inspection, mettez l'appareil hors tension et attendez plus de 10 minutes.

2. Installation

Drive unit have been approved as products for use in enclosure and approval tests were conducted under the following conditions. Design the enclosure so that the surrounding air temperature, humidity and ambience of the drive unit will satisfy the above specifications.

Wiring protection

For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable provincial codes.

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. As specified on *page 48*, UL Class T fuses or any faster acting fuse with the appropriate rating or Listed UL 489 Molded Case Circuit Breaker (MCCB) must be employed.

3. Short circuit ratings

Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 264 V Maximum.

4. Wiring

For wiring the input (R/L1, S/L2, T/L3) and output (U, V, W) terminals of the drive unit, use the UL Listed copper, stranded wires (rated at 75°C) and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

When complying with UL/CSA standard, extend the wire using MR-PWS2CBL03M-A_-L and HIV wire of 2 mm² (AWG 14).

5. Motor overload protection

When using the electronic thermal relay function as motor overload protection, set the rated motor current to *Pr: 9 "Electronic thermal O/L relay"*. (Refer to *page 49*)



Note

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

Appendix 3 SERIAL number check on the drive unit

Check the SERIAL number indicated on the drive unit rating plate or package. (Refer to *page 1*)

Rating plate example

□	○	○	○○○○○○
Symbol	Year	Month	Control number

SERIAL

The SERIAL consists of one symbol, two characters indicating production year and month, and six characters indicating control number.

The last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z

(December.)

MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Mar. 2013	IB(NA)-0600506ENG-A	First edition
Oct. 2013	IB(NA)-0600506ENG-B	<p>Addition</p> <ul style="list-style-type: none"> Setting values "9999" for Pr.22 Setting values "19", "26 to 31", "36", "37" for Pr.52 Setting values "50", "51", "60", "61" for Pr.128 Setting values "29", "30", "76", "86 to 89" for Pr.178 to Pr.184 Setting values "24, 124", "25, 125", "36, 136", "38, 138", "55, 155", "56, 156", "60, 160", "61, 161", "63, 163", "68, 168" for Pr.190 to Pr.192 Setting value "13" Pr.800 Setting values "211", "221", "245" for Pr.997 Position control function FR-E720EX-1.5K to 3.7K Compatibility with the S-PM geared motor. Pr.148, Pr.149, Pr.244, Pr.785, Pr.795, Pr.998, Pr.999 <p>Modification</p> <ul style="list-style-type: none"> Pr.22 initial value
Feb. 2014	IB(NA)-0600506ENG-C	<p>Addition</p> <ul style="list-style-type: none"> Pr.658 <p>Modification</p> <ul style="list-style-type: none"> Appendix 1 Instructions for compliance with the EU Directives Motor specifications <ul style="list-style-type: none"> Standard MM-GKR (power rate at continuous constant-torque, moment of inertia) Reduction gear equipped MM-GKR (mass)



For Maximum Safety

- Mitsubishi 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 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.

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