

# **Frequency Inverter**

## **Installation Guideline**

### **FR-A741-5.5K to 55K**



Thank you for choosing this Mitsubishi Inverter.

Please read through this Installation Manual and the Instruction Manual to operate this inverter correctly  
Do not use this product until you have a full knowledge of the equipment, the safety information and the instructions.

Please forward this manual to the end user.

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### This section is specifically about safety matters

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

#### **WARNING**

Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

#### **CAUTION**

Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that even the  **CAUTION** level may lead to a serious consequence according to conditions. Please follow strictly the instructions of both levels because they are important to personnel safety.

### Electric Shock Prevention

#### **WARNING**

- While power is on or when the inverter is running, do not open the front cover or wiring cover. Otherwise you may get an electric shock.
- Do not run the inverter with the front 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 access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, check to make sure that the operation panel indicator is off, 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 inverter must be earthed (grounded). Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Perform setting dial and key operations with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.
- Do not replace the cooling fan while power is on. It is dangerous to replace the cooling fan while power is on.
- Do not touch the printed circuit board with wet hands. 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.

### Fire Prevention

#### **CAUTION**

- Install the inverter on a nonflammable wall without holes (so that nobody can touch the inverter heatsink on the rear side, etc.). Mounting it to or near combustible material can cause a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- When using a brake resistor, make up a sequence that will turn off power when an alarm signal is output. Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor and such, causing a fire.
- Do not connect a resistor directly to the DC terminals P, N. This could cause a fire and destroy the inverter. The surface temperature of braking resistors can far exceed 100°C for brief periods. Make sure that there is adequate protection against accidental contact and a safe distance is maintained to other units and system parts.

### Injury Prevention

#### **CAUTION**

- Apply only the voltage specified in the instruction manual to each terminal. Otherwise, burst, damage, etc. may occur.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent damage, etc. Otherwise, burst, damage, etc. may occur.
- While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

### Additional Instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

### Transportation and Installation

#### **CAUTION**

- Transport the product using the correct method that corresponds to the weight. Failure to observe this could lead to injuries.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the instruction manual.
- Do not install or operate the inverter if it is damaged or has parts missing. This can result in breakdowns.
- When carrying the inverter, 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.
- Check the inverter mounting orientation is correct.
- Prevent other conductive bodies such as screws and metal fragments or other flammable substance such as oil from entering the inverter.
- As the inverter is a precision instrument, do not drop or subject it to impact.
- Use the inverter under the following environmental conditions. Otherwise, the inverter may be damaged.

|                     |                     |                                                                           |
|---------------------|---------------------|---------------------------------------------------------------------------|
| Operating condition | Ambient temperature | −10°C to +50°C (non-freezing)                                             |
|                     | Ambient humidity    | 90% RH or less (non-condensing)                                           |
|                     | Storage temperature | −20°C to +65°C ①                                                          |
|                     | Atmosphere          | Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt) |
|                     | Altitude            | Maximum 1000m above sea level for standard operation.                     |
|                     | Vibration           | 5.9m/s <sup>2</sup> or less                                               |

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

## Wiring

### CAUTION

- Do not install assemblies or components (e. g. power factor correction capacitors) on the inverter output side, which are not approved from Mitsubishi.
- The direction of rotation of the motor corresponds to the direction of rotation commands (STF/STR) only if the phase sequence (U, V, W) is maintained.

## Test operation and adjustment

### CAUTION

- Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

## Operation

### WARNING

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The  key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately to make an emergency stop (power off, mechanical brake operation for emergency stop, etc).
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The inverter can be started and stopped via the serial port communications link or the field bus. However, please note that depending on the settings of the communications parameters it may not be possible to stop the system via these connections if there is an error in the communications system or the data line. In configurations like this it is thus essential to install additional safety hardware that makes it possible to stop the system in an emergency (e.g. controller inhibit via control signal, external motor contactor etc). Clear and unambiguous warnings about this must be posted on site for the operating and service staff.
- Performing pre-excitation (LX signal and X13 signal) under torque control (real sensorless vector control) may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the inverter as well as the equipment.
- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the inverter.

### CAUTION

- The electronic thermal relay function does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference and follow the accepted EMC procedures for proper installation of frequency inverters. Otherwise nearby electronic equipment may be affected.
- Take appropriate measures regarding harmonics. Otherwise this can endanger compensation systems or overload generators.
- When a 400V class motor is inverter-driven, please use an insulation-enhanced motor or measures taken to suppress surge voltages. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all clear is performed, set again the required parameters before starting operations. Each parameter returns to the initial value.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- The DC braking function of the frequency inverter is not designed to continuously hold a load. Use an electro-mechanical holding brake on the motor for this purpose.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.
- For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

## Emergency stop

### CAUTION

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.
- When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
- When the protective function is activated (i. e. the frequency inverter switches off with an error message), take the corresponding corrective action as described in the inverter manual, then reset the inverter, and resume operation.

## Maintenance, inspection and parts replacement

### CAUTION

- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

## Disposing of the inverter

### CAUTION

- Treat as industrial waste.

## General instructions

Many of the diagrams and drawings in instruction manuals show the inverter without a cover, or partially open. Never run the inverter in this status. Always replace the cover and follow instruction manuals when operating the inverter.

# 1 INSTALLATION OF THE INVERTER AND INSTRUCTIONS

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

## 1.1 Inverter Type

FR - A741 - 5.5 - K

| Symbol | Voltage Class             | Symbol          | Type number                        |
|--------|---------------------------|-----------------|------------------------------------|
| A741   | Three-phase<br>400V class | 5.5<br>to<br>55 | Indicate inverter<br>capacity [kW] |

Capacity plate example

### Capacity plate

FR-A741-5.5-K ← Inverter type  
SERIAL: XXXXXX ← Serial number

Rating plate example

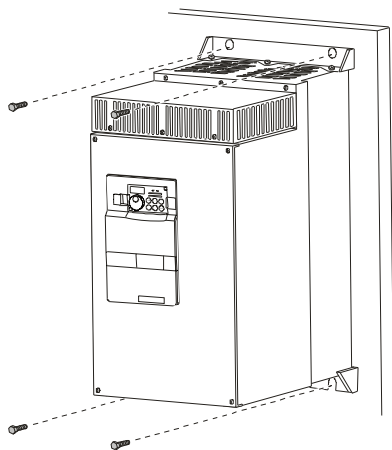
### Rating plate

Inverter type  
Input rating  
Output rating  
Serial number

|                     |               |
|---------------------|---------------|
| MITSUBISHI INVERTER |               |
| MODEL               | FR-A741-5.5-K |
| INPUT : XXXXX       |               |
| OUTPUT : XXXXX      |               |
| SERIAL :            |               |
| PASSED              |               |

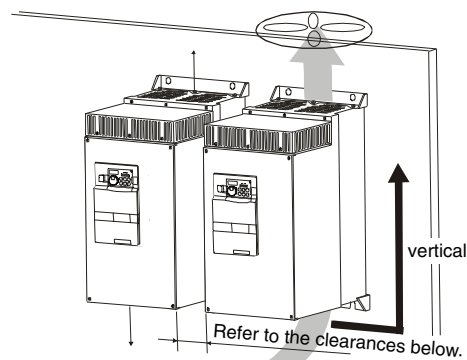
## 1.2 Installation of the inverter

Enclosure surface mounting

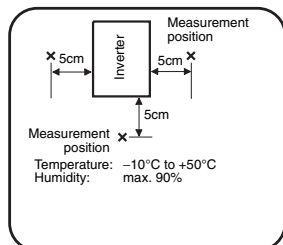


### CAUTION

- When encasing multiple inverters, install them in parallel as a cooling measure.
- Install the inverter vertically.

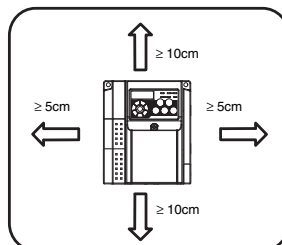


Ambient air temperature and humidity

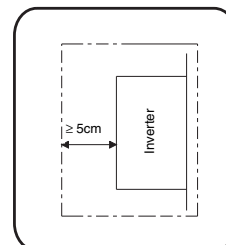


Leave enough clearances and take cooling measures.

Clearances (side)



Clearances (front)





## 1.3 General Precaution

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.

## 1.4 Environment

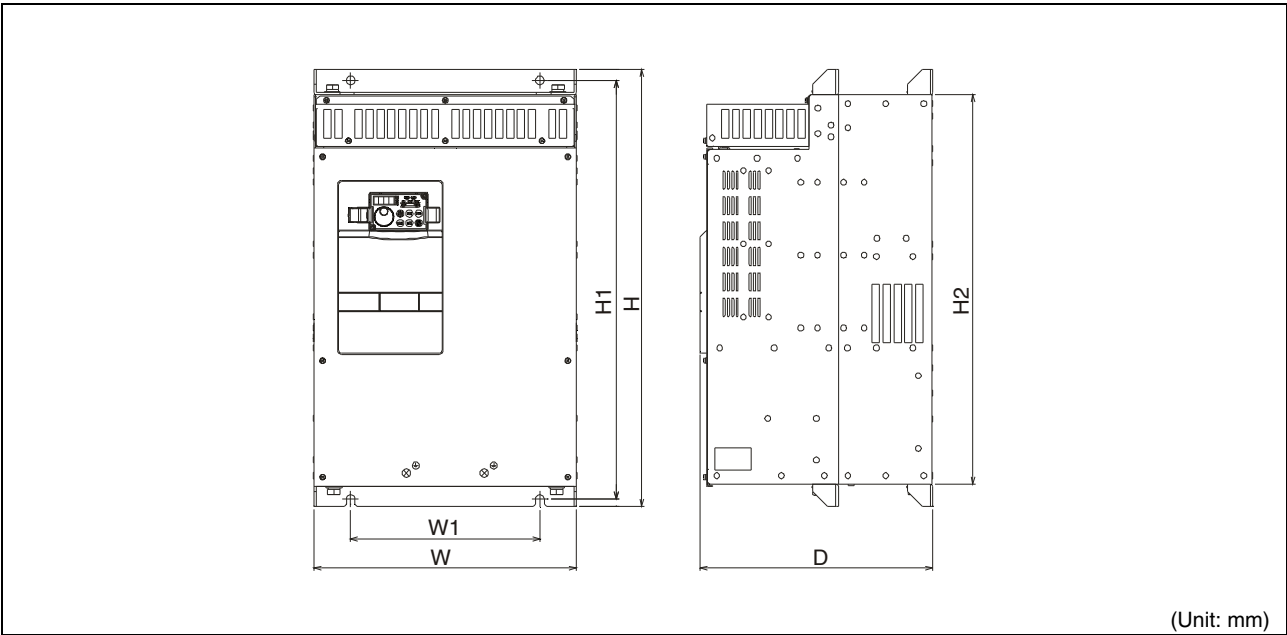
Before installation, check that the environment meets following specifications.

|                            |                                                                  |
|----------------------------|------------------------------------------------------------------|
| <b>Ambient temperature</b> | -10°C to +50°C (non-freezing)                                    |
| <b>Ambient humidity</b>    | 90 % RH or less (non-condensing)                                 |
| <b>Atmosphere</b>          | Free from corrosive and explosive gases, free from dust and dirt |
| <b>Maximum altitude</b>    | Maximum 1000 m above sea level                                   |
| <b>Vibration</b>           | 5.9m/s <sup>2</sup> or less                                      |

### CAUTION

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

# 2 OUTLINE DIMENSION DRAWING



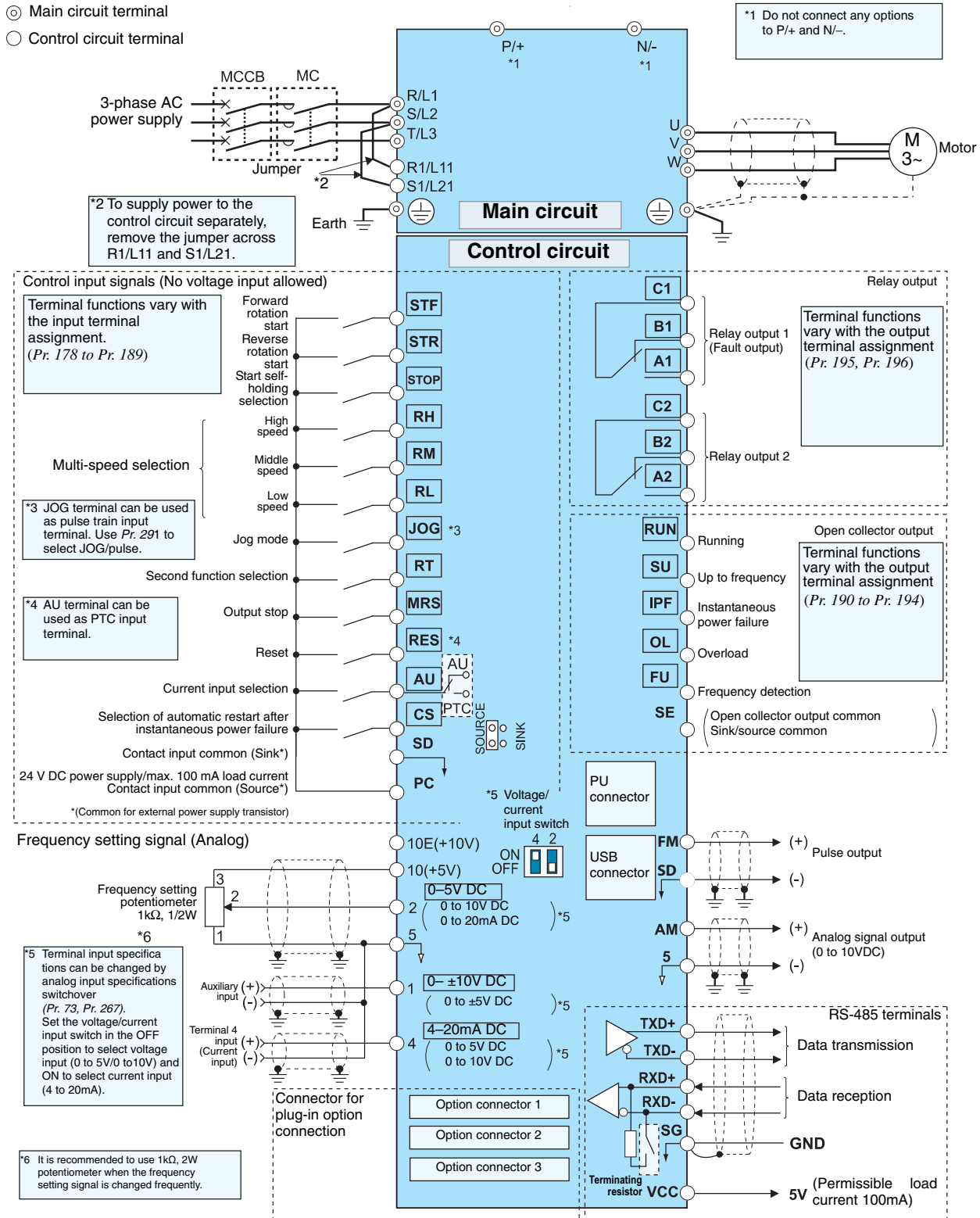
| Inverter Type | W   | W1  | H   | H1  | H2  | D   |
|---------------|-----|-----|-----|-----|-----|-----|
| FR-A741-5.5K  | 250 | 190 | 470 | 454 | 425 | 270 |
| FR-A741-7.5K  |     |     |     |     |     |     |
| FR-A741-11K   | 300 | 220 | 600 | 575 | 540 | 294 |
| FR-A741-15K   |     |     |     |     |     |     |
| FR-A741-18.5K | 360 | 260 | 600 | 575 | 535 | 320 |
| FR-A741-22K   |     |     |     |     |     |     |
| FR-A741-30K   | 450 | 350 | 700 | 675 | 635 | 340 |
| FR-A741-37K   | 470 | 370 | 700 | 670 | 630 | 368 |
| FR-A741-45K   |     |     |     |     |     |     |
| FR-A741-55K   | 600 | 480 | 900 | 870 | 830 | 405 |

# 3 WIRING

## 3.1 Terminal connection diagram

### Source logic

- ⊙ Main circuit terminal
- Control circuit terminal

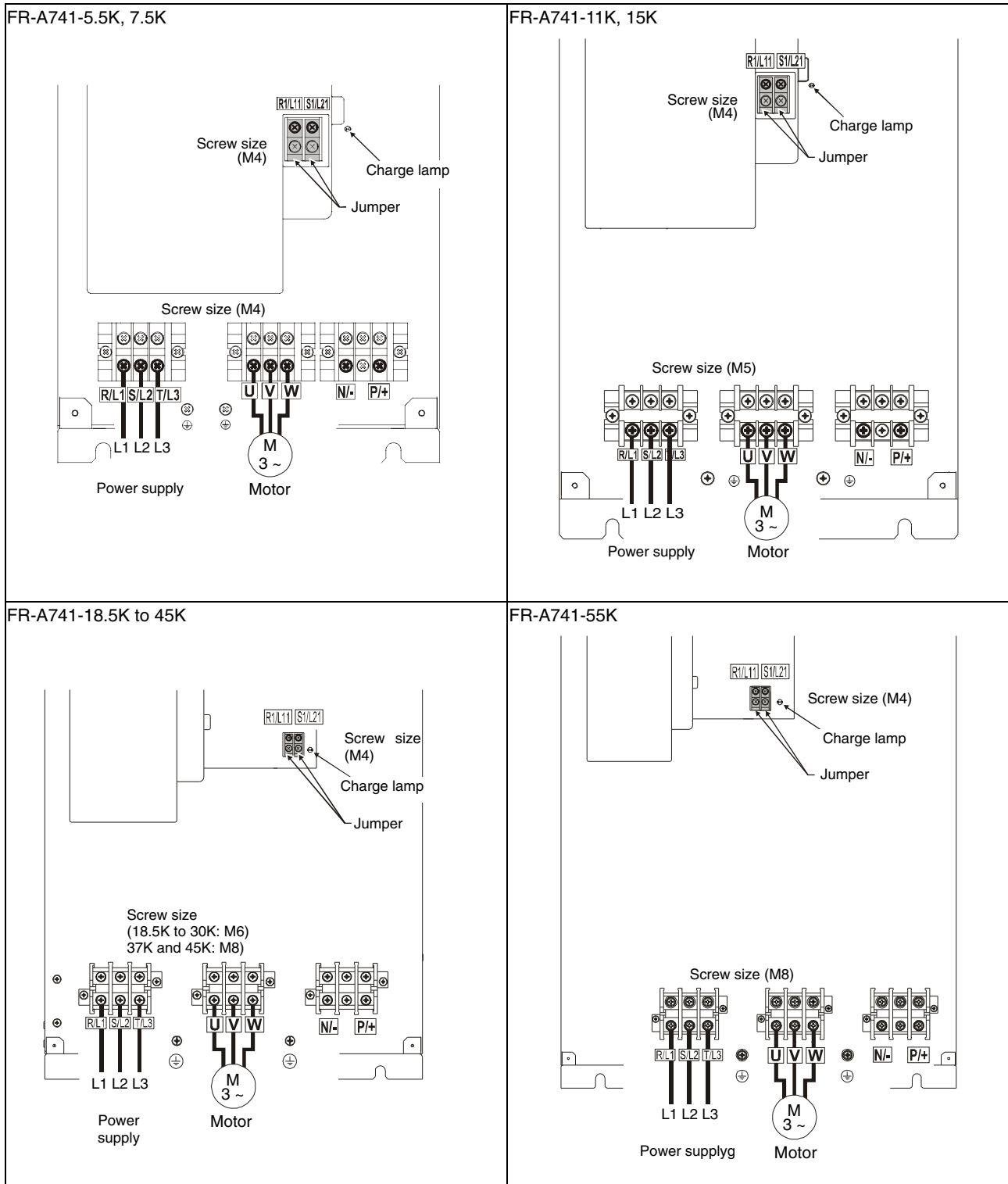


### CAUTION

- To prevent a malfunction due to noise, keep the signal cables more than 10cm away from the power cables. Also separate the main circuit wire of the input side and the output side.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Different setting may cause a fault, failure or malfunction.

## 3.2 Main circuit terminal specifications

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



#### ACHTUNG

- The power supply cables must be connected to R/L1, S/L2, T/L3. (Phase sequence needs not to be matched.) Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.
- Connect the motor to U, V, W. At this time turning on the forward rotation switch (signal) rotates the motor in the clockwise direction when viewed on the motor shaft.



### 3.3 Cables and wiring length

#### 3.3.1 Applied cable size

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

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

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

#### 400V class (when input power supply is 440V)

| Applicable Inverter Type | Terminal Screw Size *1 | Tightening Torque [Nm] | Crimping Terminal       |         |
|--------------------------|------------------------|------------------------|-------------------------|---------|
|                          |                        |                        | R/L1, S/L2, T/L3, P1, + | U, V, W |
| FR-A741-5.5K             | M4                     | 1.5                    | 2-4                     | 2-4     |
| FR-A741-7.5K             | M4                     | 1.5                    | 5.5-4                   | 5.5-4   |
| FR-A741-11K              | M5                     | 2.5                    | 5.5-5                   | 5.5-5   |
| FR-A741-15K              | M5                     | 2.5                    | 8-5                     | 8-5     |
| FR-A741-18.5K            | M6                     | 4.4                    | 14-6                    | 8-6     |
| FR-A741-22K              | M6                     | 4.4                    | 14-6                    | 14-6    |
| FR-A741-30K              | M6                     | 4.4                    | 22-6                    | 22-6    |
| FR-A741-37K              | M8                     | 7.8                    | 22-8                    | 22-8    |
| FR-A741-45K              | M8                     | 7.8                    | 38-8                    | 38-8    |
| FR-A741-55K              | M8                     | 7.8                    | 60-8                    | 60-8    |

\*1 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, and a screw for earthing (grounding).

#### Selection example for the wiring length of 20m

| Applicable Inverter Type | Cable Sizes               |         |             |                             |          |                           |         |             |
|--------------------------|---------------------------|---------|-------------|-----------------------------|----------|---------------------------|---------|-------------|
|                          | HIV [mm <sup>2</sup> ] *1 |         |             | AWG ([mm <sup>2</sup> ]) *2 |          | PVC [mm <sup>2</sup> ] *3 |         |             |
|                          | R/L1, S/L2, T/L3, P1, +   | U, V, W | Earth Cable | R/L1, S/L2, T/L3, P1, +     | U, V, W  | R/L1, S/L2, T/L3, P1, +   | U, V, W | Earth Cable |
| FR-A741-5.5K             | 2                         | 2       | 3.5         | 12 (3.3)                    | 14 (2.1) | 2.5                       | 2.5     | 4           |
| FR-A741-7.5K             | 3.5                       | 3.5     | 3.5         | 12 (3.3)                    | 12 (3.3) | 4                         | 4       | 4           |
| FR-A741-11K              | 5.5                       | 5.5     | 8           | 10 (5.3)                    | 10 (5.3) | 6                         | 6       | 10          |
| FR-A741-15K              | 8                         | 8       | 8           | 8 (8.4)                     | 8 (8.4)  | 10                        | 10      | 10          |
| FR-A741-18.5K            | 14                        | 8       | 14          | 6 (13.3)                    | 8 (8.4)  | 16                        | 10      | 16          |
| FR-A741-22K              | 14                        | 14      | 14          | 6 (13.3)                    | 6 (13.3) | 16                        | 16      | 16          |
| FR-A741-30K              | 22                        | 22      | 14          | 4 (21.1)                    | 4 (21.1) | 25                        | 25      | 16          |
| FR-A741-37K              | 22                        | 22      | 14          | 4 (21.1)                    | 4 (21.1) | 25                        | 25      | 16          |
| FR-A741-45K              | 38                        | 38      | 22          | 1 (42.4)                    | 2 (33.6) | 50                        | 50      | 25          |
| FR-A741-55K              | 60                        | 60      | 22          | 1/0 (42.4/53.4)             |          | 50                        | 50      | 25          |

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

\*2 For the 45K or less, the recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less.

For the 55K, the recommended cable size is that of the cable (THHN cable) with continuous maximum permissible temperature of 90°C. Assumes that the surrounding air temperature is 40°C or less and wiring is performed in an enclosure. (Selection example for use mainly in the United States (AWG = American Wire Gauge). The values in parentheses indicate the cable sizes in mm<sup>2</sup>.)

\*3 For the 45K or less, the recommended cable size is that of the cable (PVC cable) with continuous maximum permissible temperature of 70°C. Assumes that the ambient temperature is 40°C or less and the wiring distance is 20m or less.

For the 55K, the recommended cable size is that of the cable (XLPE cable) with continuous maximum permissible temperature of 90°C. Assumes that the ambient temperature is 40°C or less and wiring is performed in an enclosure. (Selection example for use mainly in Europe.)

#### NOTE

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

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

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

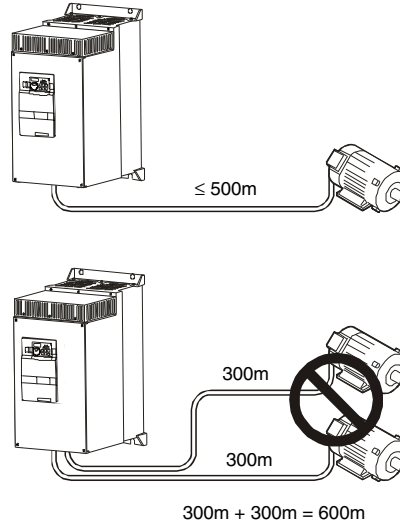
Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

### 3.3.2 Maximum permissible motor wiring length

The overall wiring length for connection of a single motor or multiple motors should be within 500m. (The wiring length should be 100m maximum for vector control.)

The lengths in the following table are for unshielded cables. When shielded cables are used divide the values listed in the table by 2. Note that the values are for the total wiring length – if you connect more than one motor in parallel you must add the lengths of the individual motor cables.

Total wiring length



Note that the motor windings in three-phase AC motors are subject to far more stress when operated via frequency inverters than with mains operation. The motor must have been approved by the manufacturer for operation on a frequency inverter.

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially for a 400V class motor, the surge voltage may deteriorate the insulation. When the 400V class motor is driven by the inverter, consider the following measures:

- Use a "400V class inverter-driven insulation-enhanced motor" and set frequency in *Pr. 72 PWM frequency selection* according to wiring length.

|                   | ≤ 50m     | 50m–100m | ≥ 100m |
|-------------------|-----------|----------|--------|
| Carrier frequency | ≤ 14.5kHz | ≤ 9kHz   | ≤ 4kHz |

- Limiting the voltage rise speed of the frequency inverter output voltage (dU/dT):  
If the motor requires a rise speed of 500V/μs or less you must install a filter in the output of the inverter. Please contact your Mitsubishi dealer for more details.

#### CAUTION

- Especially for long-distance wiring, the inverter may be affected by a charging current caused by the stray capacitances of the wiring, leading to a malfunction of the overcurrent protective function or fast response current limit function or a malfunction or fault of the equipment connected on the inverter output side. If fast response current limit function malfunctions, disable this function. (For *Pr. 156 Stall prevention operation selection*, refer to the Instruction Manual.)
- For details of *Pr. 72 PWM frequency selection*, refer to the Instruction Manual.

### 3.3.3 Cable size of the control circuit power supply (terminal R1/L11, S1/L21)

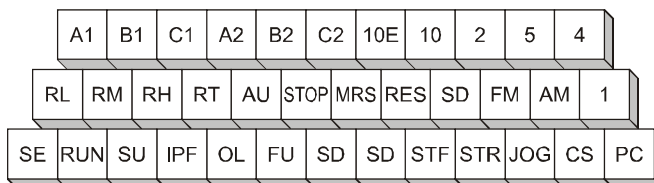
- Terminal screw size: M4
- Cable size: 0.75mm<sup>2</sup> to 2mm<sup>2</sup>
- Tightening torque: 1.5Nm



## 3.4 Control circuit specification

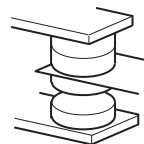
### 3.4.1 Standard control circuit terminal layout

Terminal screw size: M3.5  
Tightening torque: 1.2Nm

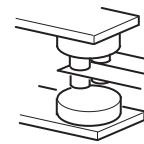


### 3.4.2 Wiring instruction

- Terminals PC, 5, and SE are all common terminals (0V) for I/O signals and are isolated from each other. Avoid connecting the terminal PC and 5 and the terminal SE and 5 (ground). Terminal PC is a common terminal for the contact input terminals (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS).
- Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 230V relay sequence circuit).
- Use two or more parallel micro-signal contacts or twin contacts to prevent a contact faults when using contact inputs since the control circuit input signals are micro-currents.



Micro signal contacts



Twin contacts

- Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
- Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp, etc.
- It is recommended to use the cables of 0.3mm<sup>2</sup> to 0.75mm<sup>2</sup> gauge for connection to the control circuit terminals. If the cable gauge used is 1.25mm<sup>2</sup> or more, the front cover may be lifted when there are many cables running or the cables are run improperly, resulting in a fall off of the operation.
- The wiring length should be 30m maximum.
- The level of the control signals can be switched over between positive (SOURCE) and negative (SINK) logic. The input signals are set to source logic when shipped from the factory. To change the control logic, the jumper connector on the back of the control circuit terminal block must be moved to the other position.

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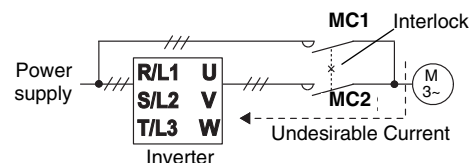
## 4 PRECAUTIONS FOR USE OF THE INVERTER

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The FR-A701 series is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.

Before starting operation, always recheck the following items.

- Use crimping terminals with insulation sleeve to wire the power supply and motor.
- Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in a control box etc., take care not to allow chips and other foreign matter to enter the inverter.
- Use cables of the size to make a voltage drop 2% maximum.  
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.  
Refer to *page 6* for the recommended cable size.
- The overall wiring length should be 500m maximum.  
Especially for long distance wiring, the fast-response current limit function may be reduced or the equipment connected to the inverter output side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. (Refer to *page 7*)
- Electromagnetic Compatibility  
Operation of the frequency inverter can cause electromagnetic interference in the input and output that can be propagated by cable (via the power input lines), by wireless radiation to nearby equipment (e.g. AM radios) or via data and signal lines. Install an optional filter if present to reduce air propagated interference on the input side of the inverter. Use AC or DC reactors to reduce line propagated noise (harmonics). Use shielded motor power lines to reduce output noise.
- Do not install a power factor correction capacitor, varistor or arrester on the inverter output side. This will cause the inverter to trip or the capacitor, varistor, or arrester to be damaged. If any of the above devices is installed, immediately remove it.
- Before starting wiring or other work after the inverter is operated, 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.
- A short circuit or earth fault on the inverter output side may damage the inverter modules.
  - Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter modules.
  - Fully check the to-earth insulation and inter-phase insulation of the inverter output side before power-on.  
Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance etc.
- Do not use the inverter input side magnetic contactor to start/stop the inverter.  
Always use the start signal (ON/OFF of STF and STR signals) to start/stop the inverter.
- Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits. Application of a voltage higher than the permissible voltage to the inverter 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 10E- or 10-5.
- Provide electrical and mechanical interlocks for MC1 and MC2 which are used for bypass operation.  
When the wiring is incorrect or if there is a bypass circuit as shown below, the inverter will be damaged by leakage current from the power supply due to arcs generated at the time of switch-over or chattering caused by a sequence error.
- If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter'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 inverter will automatically restart as soon as the power is restored.





- Instructions for overload operation  
When performing operation of frequent start/stop of the inverter, increase/decrease in the temperature of the transistor element of the inverter may repeat due to a continuous 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 bound current, starting current, etc. Decreasing current may increase the life. However, decreasing current will result in insufficient torque and the inverter may not start. Therefore, increase the inverter capacity to have enough allowance for current.
- Make sure that the specifications and rating match the system requirements.
- A motor with encoder is necessary for vector control. In addition, connect the encoder directly to the backlash-free motor shaft. (An encoder is not necessary for real sensorless vector control.)
- When the motor speed is unstable, due to change in the frequency setting signal caused by electromagnetic noises from the inverter, take the following measures when applying the motor speed by the analog signal.
  - Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.
  - Run signal cables as far away as possible from power cables (inverter I/O cables).
  - Use shield cables as signal cables.
  - Install a ferrite core on the signal cable (Example: ZCAT3035-1330 TDK).

## 5 FAILSAFE OF THE SYSTEM WHICH USES THE INVERTER

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

### Interlock method which uses the inverter status output signals

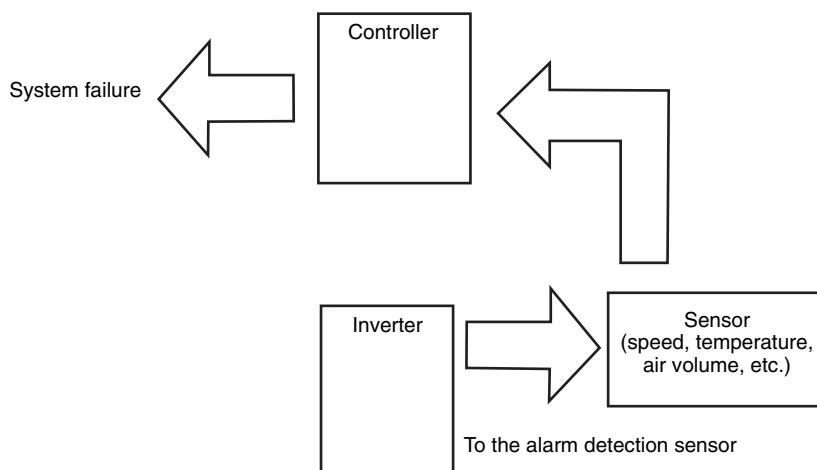
By combining the inverter status output signals to provide an interlock as shown below, an inverter alarm can be detected.

| Interlock Method                       | Check Method                                                                     | Used Signals                                                                          | Refer to Page                                          |
|----------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------|
| Inverter protective function operation | Operation check of an alarm contact<br>Circuit error detection by negative logic | Fault output signal (ALM signal)                                                      | Refer to chapter "Parameter" of the Instruction Manual |
| Inverter running status                | Operation ready signal check                                                     | Operation ready signal (RY signal)                                                    |                                                        |
|                                        | Logic check of the start signal and running signal                               | Start signal (STF signal, STR signal)<br>Running signal (RUN signal)                  |                                                        |
|                                        | Logic check of the start signal and output current                               | Start signal (STF signal, STR signal)<br>Output current detection signal (Y12 signal) |                                                        |

### Backup method outside the inverter

Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, even if the interlock is provided using the inverter 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 an inverter 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. Check the motor running and motor current while the start signal is input to the inverter by comparing the start signal to the inverter 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 inverter starts decelerating even if the start signal turns off. For the logic check, configure a sequence considering the inverter deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.



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

## 6 PARAMETER

For simple variable-speed operation of the inverter, the initial setting of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel. For details of parameters, refer to the instruction manual.

In the initial setting, all parameters are displayed. Set *Pr. 160 Extended function display selection* as required.

| Parameter | Name                      | Initial Value | Setting Range | Remarks                                                        |
|-----------|---------------------------|---------------|---------------|----------------------------------------------------------------|
| 160       | User group read selection | 0             | 9999          | Only the simple mode parameters can be displayed.              |
|           |                           |               | 0             | Simple mode and extended mode parameters can be displayed.     |
|           |                           |               | 1             | Only parameters registered in the user group can be displayed. |

### Remarks

- The parameters marked © are the simple mode parameters.
- The parameters marked with   in the table allow its setting to be changed during operation even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

| Parameter | Name                                           | Setting Range          | Initial Value                 |
|-----------|------------------------------------------------|------------------------|-------------------------------|
| © 0       | Torque boost                                   | 0 to 30%               | 3/2% *1                       |
| © 1       | Maximum frequency                              | 0 to 120Hz             | 120Hz                         |
| © 2       | Minimum frequency                              | 0 to 120Hz             | 0Hz                           |
| © 3       | Base frequency                                 | 0 to 400Hz             | 60Hz                          |
| © 4       | Multi-speed setting (high speed)               | 0 to 400Hz             | 60Hz                          |
| © 5       | Multi-speed setting (middle speed)             | 0 to 400Hz             | 30Hz                          |
| © 6       | Multi-speed setting (low speed)                | 0 to 400Hz             | 10Hz                          |
| © 7       | Acceleration time                              | 0 to 3600/360s         | 5s/15s *1                     |
| © 8       | Deceleration time                              | 0 to 3600/360s         | 5s/15s *1                     |
| © 9       | Electronic thermal O/L relay                   | 0 to 500A              | Rated inverter output current |
| 10        | DC injection brake operation frequency         | 0 to 120Hz, 9999       | 3Hz                           |
| 11        | DC injection brake operation time              | 0 to 10s, 8888         | 0.5s                          |
| 12        | DC injection brake operation voltage           | 0 to 30%               | 4/2% *1                       |
| 13        | Starting frequency                             | 0 to 60Hz              | 0.5Hz                         |
| 14        | Load pattern selection                         | 0 to 5                 | 0                             |
| 15        | Jog frequency                                  | 0 to 400Hz             | 5Hz                           |
| 16        | Jog acceleration/ deceleration time            | 0 to 3600/360s         | 0.5s                          |
| 17        | MRS input selection                            | 0, 2, 4                | 0                             |
| 18        | High speed maximum frequency                   | 120 to 400Hz           | 120Hz                         |
| 19        | Base frequency voltage                         | 0 to 1000V, 8888, 9999 | 9999                          |
| 20        | Acceleration/ deceleration reference frequency | 1 to 400Hz             | 60Hz                          |

| Parameter | Name                                                                 | Setting Range        | Initial Value |
|-----------|----------------------------------------------------------------------|----------------------|---------------|
| 21        | Acceleration/ deceleration time increments                           | 0, 1                 | 0             |
| 22        | Stall prevention operation level (torque limit level )               | 0 to 400%            | 150%          |
| 23        | Stall prevention operation level compensation factor at double speed | 0 to 200%, 9999      | 9999          |
| 24–27     | Multi-speed setting 4 speed to 7 speed                               | 0 to 400Hz, 9999     | 9999          |
| 28        | Multi-speed input compensation selection                             | 0, 1                 | 0             |
| 29        | Acceleration/ deceleration pattern selection                         | 0 to 5               | 0             |
| 31        | Frequency jump 1A                                                    | 0 to 400Hz, 9999     | 9999          |
| 32        | Frequency jump 1B                                                    |                      |               |
| 33        | Frequency jump 2A                                                    |                      |               |
| 34        | Frequency jump 2B                                                    |                      |               |
| 35        | Frequency jump 3A                                                    |                      |               |
| 36        | Frequency jump 3B                                                    |                      |               |
| 37        | Speed display                                                        | 0, 1 to 9998         | 0             |
| 41        | Up-to-frequency sensitivity                                          | 0 to 100%            | 10%           |
| 42        | Output frequency detection                                           | 0 to 400Hz           | 6Hz           |
| 43        | Output frequency detection for reverse rotation                      | 0 to 400Hz, 9999     | 9999          |
| 44        | Second acceleration/ deceleration time                               | 0 to 3600/360s       | 5s            |
| 45        | Second deceleration time                                             | 0 to 3600/360s, 9999 | 9999          |
| 46        | Second torque boost                                                  | 0 to 30%, 9999       | 9999          |
| 47        | Second V/F (base frequency)                                          | 0 to 400Hz, 9999     | 9999          |
| 48        | Second stall prevention operation current                            | 0 to 220%            | 150%          |
| 49        | Second stall prevention operation frequency                          | 0 to 400Hz, 9999     | 0Hz           |

| Parameter | Name                                                        | Setting Range                                                    | Initial Value                 |
|-----------|-------------------------------------------------------------|------------------------------------------------------------------|-------------------------------|
| 50        | Second output frequency detection                           | 0 to 400Hz                                                       | 30Hz                          |
| 51        | Second electronic thermal O/L relay                         | 0 to 500A, 9999                                                  | 9999                          |
| 52        | DU/PU main display data selection                           | 0, 5 to 8, 10 to 14, 17 to 20, 22 to 25, 32 to 35, 50 to 57, 100 | 0                             |
| 54        | FM terminal function selection                              | 1 to 3, 5 to 8, 10 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53   | 1                             |
| 55        | Frequency monitoring reference                              | 0 to 400Hz                                                       | 60Hz                          |
| 56        | Current monitoring reference                                | 0 to 500A                                                        | Rated inverter output current |
| 57        | Restart coasting time                                       | 0, 0.1 to 5s, 9999                                               | 9999                          |
| 58        | Restart cushion time                                        | 0 to 60s                                                         | 1s                            |
| 59        | Remote function selection                                   | 0, 1, 2, 3                                                       | 0                             |
| 60        | Energy saving control selection                             | 0, 4                                                             | 0                             |
| 61        | Reference current                                           | 0 to 500A, 9999                                                  | 9999                          |
| 62        | Reference value at acceleration                             | 0 to 220%, 9999                                                  | 9999                          |
| 63        | Reference value at deceleration                             | 0 to 220%, 9999                                                  | 9999                          |
| 64        | Starting frequency for elevator mode                        | 0 to 10Hz, 9999                                                  | 9999                          |
| 65        | Retry selection                                             | 0 to 5                                                           | 0                             |
| 66        | Stall prevention operation reduction starting frequency     | 0 to 400Hz                                                       | 60Hz                          |
| 67        | Number of retries at fault occurrence                       | 0, 1 to 10, 101 to 110                                           | 0                             |
| 68        | Retry waiting time                                          | 0 to 10s                                                         | 1s                            |
| 69        | Retry count display erase                                   | 0                                                                | 0                             |
| 71        | Applied motor                                               | 0 to 8, 13 to 18, 30, 33, 34, 40, 43, 44, 50, 53, 54             | 0                             |
| 72        | PWM frequency selection                                     | 0 to 15                                                          | 2                             |
| 73        | Analog input selection                                      | 0 to 7, 10 to 17                                                 | 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                            |
| 76        | Alarm code output selection                                 | 0, 1, 2                                                          | 0                             |
| 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        | Motor capacity                                              | 0.4 to 55kW, 9999                                                | 9999                          |
| 81        | Number of motor poles                                       | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 9999                         | 9999                          |
| 82        | Motor excitation current                                    | 0 to 500A, 9999                                                  | 9999                          |

| Parameter | Name                                      |                                            | Setting Range                 | Initial Value |
|-----------|-------------------------------------------|--------------------------------------------|-------------------------------|---------------|
| 83        | Rated motor voltage                       |                                            | 0 to 1000V                    | 400V          |
| 84        | Rated motor frequency                     |                                            | 10 to 120Hz                   | 60Hz          |
| 89        | Speed control gain (magnetic flux vector) |                                            | 0 to 200%, 9999               | 9999          |
| 90        | Motor constant (R1)                       |                                            | 0 to 50Ω, 9999                | 9999          |
| 91        | Motor constant (R2)                       |                                            |                               | 9999          |
| 92        | Motor constant (L1)                       |                                            | 0 to 50Ω, (0 to 1000mH), 9999 | 9999          |
| 93        | Motor constant (L2)                       |                                            |                               | 9999          |
| 94        | Motor constant (X)                        |                                            | 0 to 500Ω, (0 to 100%), 9999  | 9999          |
| 95        | Online auto tuning selection              |                                            | 0 to 2                        | 0             |
| 96        | Auto tuning setting/status                |                                            | 0, 1, 101                     | 0             |
| 100       | Adjustable 5 points V/F                   | V/F1 (first frequency)                     | 0 to 400Hz, 9999              | 9999          |
| 101       |                                           | V/F1 (first frequency voltage)             | 0 to 1000V                    | 0V            |
| 102       |                                           | V/F2 (second frequency)                    | 0 to 400Hz, 9999              | 9999          |
| 103       |                                           | V/F2 (second frequency voltage)            | 0 to 1000V                    | 0V            |
| 104       |                                           | V/F3 (third frequency)                     | 0 to 400Hz, 9999              | 9999          |
| 105       |                                           | V/F3 (third frequency voltage)             | 0 to 1000V                    | 0V            |
| 106       |                                           | V/F4 (fourth frequency)                    | 0 to 400Hz, 9999              | 9999          |
| 107       |                                           | V/F4 (fourth frequency voltage)            | 0 to 1000V                    | 0V            |
| 108       |                                           | V/F5 (fifth frequency)                     | 0 to 400Hz, 9999              | 9999          |
| 109       |                                           | V/F5 (fifth frequency voltage)             | 0 to 1000V                    | 0V            |
| 110       | Third functions                           | Third acceleration/ deceleration time      | 0 to 3600/360s, 9999          | 9999          |
| 111       |                                           | Third deceleration time                    |                               | 9999          |
| 112       |                                           | Third torque boost                         | 0 to 30%, 9999                | 9999          |
| 113       |                                           | Third V/F (base frequency)                 | 0 to 400Hz, 9999              | 9999          |
| 114       |                                           | Third stall prevention operation current   | 0 to 220%                     | 150%          |
| 115       |                                           | Third stall prevention operation frequency | 0 to 400Hz                    | 0             |
| 116       |                                           | Third output frequency detection           | 0 to 400Hz                    | 60Hz          |
| 117       | PU communication station number           |                                            | 0 to 31                       | 0             |
| 118       | PU communication speed                    |                                            | 48, 96, 192, 384              | 192           |



| Parameter | Name                                        | Setting Range                                                    | Initial Value                  |
|-----------|---------------------------------------------|------------------------------------------------------------------|--------------------------------|
| 119       | PU communication stop bit length            | 0, 1, 10, 11                                                     | 1                              |
| 120       | 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                                           | 9999                           |
| 123       | PU communication waiting time setting       | 0 to 150ms, 9999                                                 | 9999                           |
| 124       | PU communication CR/LF selection            | 0, 1, 2                                                          | 1                              |
| Ⓒ 125     | Terminal 2 frequency setting gain frequency | 0 to 400Hz                                                       | 60Hz                           |
| Ⓒ 126     | Terminal 4 frequency setting gain frequency | 0 to 400Hz                                                       | 60Hz                           |
| 127       | PID operation                               | PID control automatic switchover frequency                       | 0 to 400Hz, 9999               |
| 128       |                                             | PID action selection                                             | 10, 11, 20, 21, 50, 51, 60, 61 |
| 129       |                                             | PID proportional band                                            | 0.1 to 1000%, 9999             |
| 130       |                                             | PID integral time                                                | 0.1 to 3600s, 9999             |
| 131       |                                             | PID upper limit                                                  | 0 to 100%, 9999                |
| 132       |                                             | PID lower limit                                                  | 0 to 100%, 9999                |
| 133       |                                             | PID action set point                                             | 0 to 100%, 9999                |
| 134       |                                             | PID differential time                                            | 0.01 to 10.00s, 9999           |
| 135       | Bypass                                      | Electronic bypass sequence selection                             | 0, 1                           |
| 136       |                                             | MC switchover interlock time                                     | 0 to 100s                      |
| 137       |                                             | Start waiting time                                               | 0 to 100s                      |
| 138       |                                             | Bypass selection at a fault                                      | 0, 1                           |
| 139       |                                             | Automatic switchover frequency from inverter to bypass operation | 0 to 60Hz, 9999                |
| 140       | Backlash measures                           | Backlash acceleration stopping frequency                         | 0 to 400Hz                     |
| 141       |                                             | Backlash acceleration stopping time                              | 0 to 360s                      |
| 142       |                                             | Backlash deceleration stopping frequency                         | 0 to 400Hz                     |
| 143       |                                             | Backlash deceleration stopping time                              | 0 to 360s                      |
| 144       | Speed setting switch-over                   | 0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110                       | 4                              |
| 145       | PU                                          | PU display language selection                                    | 0 to 7                         |

| Parameter | Name                                            | Setting Range                                                          | Initial Value                                                  |
|-----------|-------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------|
| 148       | Current detection                               | Stall prevention level at 0V input                                     | 0 to 220%                                                      |
| 149       |                                                 | Stall prevention level at 10V input                                    | 0 to 220%                                                      |
| 150       |                                                 | Output current detection level                                         | 0 to 220%                                                      |
| 151       |                                                 | Output current detection signal delay time                             | 0 to 10s                                                       |
| 152       |                                                 | Zero current detection level                                           | 0 to 220%                                                      |
| 153       |                                                 | Zero current detection time                                            | 0 to 1s                                                        |
| 154       |                                                 | Voltage reduction selection during stall prevention operation          | 0, 1                                                           |
| 155       |                                                 | RT signal function validity condition selection                        | 0, 10                                                          |
| 156       |                                                 | Stall prevention operation selection                                   | 0 to 31, 100, 101                                              |
| 157       |                                                 | OL signal output timer                                                 | 0 to 25s, 9999                                                 |
| 158       |                                                 | AM terminal function selection                                         | 1 to 3, 5 to 8, 10 to 14, 17, 18, 21, 24, 32 to 34, 50, 52, 53 |
| 159       |                                                 | Automatic switchover frequency range from bypass to inverter operation | 0 to 10Hz, 9999                                                |
| Ⓒ 160     |                                                 | User group read selection                                              | 0, 1, 9999                                                     |
| 161       |                                                 | Frequency setting/key lock operation selection                         | 0, 1, 10, 11                                                   |
| 162       | Automatic restart functions                     | Automatic restart after instantaneous power failure selection          | 0, 1, 2, 10, 11, 12                                            |
| 163       |                                                 | First cushion time for restart                                         | 0 to 20s                                                       |
| 164       |                                                 | First cushion voltage for restart                                      | 0 to 100%                                                      |
| 165       |                                                 | Stall prevention operation level for restart                           | 0 to 220%                                                      |
| 166       |                                                 | Output current detection signal retention time                         | 0 to 10s, 9999                                                 |
| 167       |                                                 | Output current detection operation selection                           | 0, 1                                                           |
| 168       | Parameter for manufacturer setting. Do not set. |                                                                        |                                                                |
| 169       |                                                 |                                                                        |                                                                |
| 170       |                                                 | Watt-hour meter clear                                                  | 0, 10, 9999                                                    |
| 171       |                                                 | Operation hour meter clear                                             | 0, 9999                                                        |
| 172       |                                                 | User group registered display/batch clear                              | 9999, (0 to 16)                                                |
| 173       |                                                 | User group registration                                                | 0 to 999, 9999                                                 |

| Parameter | Name                                              | Setting Range                                                                                                                                                                                             | Initial Value |
|-----------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 174       | User group clear                                  | 0 to 999, 9999                                                                                                                                                                                            | 9999          |
| 178       | STF terminal function selection                   | 0 to 9, 12 to 20, 22 to 28, 42 to 44, 60, 62, 64 to 69, 74, 9999                                                                                                                                          | 60            |
| 179       | STR terminal function selection                   | 0 to 9, 12 to 20, 22 to 28, 42 to 44, 61, 62, 64 to 69, 74, 9999                                                                                                                                          | 61            |
| 180       | RL terminal function selection                    | 0 to 9, 12 to 20, 22 to 28, 42 to 44, 62, 64 to 69, 74, 9999                                                                                                                                              | 0             |
| 181       | RM terminal function selection                    |                                                                                                                                                                                                           | 1             |
| 182       | RH terminal function selection                    |                                                                                                                                                                                                           | 2             |
| 183       | RT terminal function selection                    |                                                                                                                                                                                                           | 3             |
| 184       | AU terminal function selection                    | 0 to 9, 12 to 20, 22 to 28, 42 to 44, 62 to 69, 74, 9999                                                                                                                                                  | 4             |
| 185       | JOG terminal function selection                   | 0 to 9, 12 to 20, 22 to 28, 42 to 44, 62, 64 to 69, 74, 9999                                                                                                                                              | 5             |
| 186       | CS terminal function selection                    |                                                                                                                                                                                                           | 6             |
| 187       | MRS terminal function selection                   |                                                                                                                                                                                                           | 24            |
| 188       | STOP terminal function selection                  |                                                                                                                                                                                                           | 25            |
| 189       | RES terminal function selection                   |                                                                                                                                                                                                           | 62            |
| 190       | RUN terminal function selection                   | 0 to 6, 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84, 90 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184, 190 to 199, 9999                   | 0             |
| 191       | SU terminal function selection                    | 0 to 6, 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84, 90 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184, 190 to 199, 9999                   | 1             |
| 192       | IPF terminal function selection                   |                                                                                                                                                                                                           | 2             |
| 193       | OL terminal function selection                    |                                                                                                                                                                                                           | 3             |
| 194       | FU terminal function selection                    |                                                                                                                                                                                                           | 4             |
| 195       | ABC1 terminal function selection                  | 0 to 6, 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 64, 70, 84, 90, 91, 94 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 164, 170, 184, 190, 191, 194 to 199, 9999 | 99            |
| 196       | ABC2 terminal function selection                  |                                                                                                                                                                                                           | 9999          |
| 232–239   | Multi-speed setting (8 speed to 15 speed)         | 0 to 400Hz, 9999                                                                                                                                                                                          | 9999          |
| 240       | Soft-PWM operation selection                      | 0, 1                                                                                                                                                                                                      | 1             |
| 241       | Analog input display unit switchover              | 0, 1                                                                                                                                                                                                      | 0             |
| 242       | Terminal 1 added compensation amount (terminal 2) | 0 to 100%                                                                                                                                                                                                 | 100%          |
| 243       | Terminal 1 added compensation amount (terminal 4) |                                                                                                                                                                                                           | 75%           |
| 244       | Cooling fan operation selection                   | 0, 1                                                                                                                                                                                                      | 1             |

| Parameter | Name                                                               | Setting Range                                    | Initial Value                        |
|-----------|--------------------------------------------------------------------|--------------------------------------------------|--------------------------------------|
| 245       | Slip compensation                                                  | Rated slip                                       | 0 to 50%, 9999                       |
| 246       |                                                                    | Slip compensation time constant                  | 0.01 to 10s                          |
| 247       |                                                                    | Constant-power range slip compensation selection | 0, 9999                              |
| 250       | Stop selection                                                     |                                                  | 0 to 100s, 1000 to 1100s, 8888, 9999 |
| 251       | Output phase loss protection selection                             |                                                  | 0, 1                                 |
| 252       | Frequency compensation function                                    | Override bias                                    | 0 to 200%                            |
| 253       |                                                                    | Override gain                                    | 0 to 200%                            |
| 255       | Life alarm status display                                          |                                                  | (0 to 15)                            |
| 256       | Inrush current limit circuit life display                          |                                                  | (0 to 100%)                          |
| 257       | Control circuit capacitor life display                             |                                                  | (0 to 100%)                          |
| 258       | Main circuit capacitor life display                                |                                                  | (0 to 100%)                          |
| 259       | Main circuit capacitor life measuring                              |                                                  | 0, 1 (2, 3, 8, 9)                    |
| 261       | Power failure stop selection                                       |                                                  | 0, 1, 2, 11, 12                      |
| 262       | Subtracted frequency at deceleration start                         |                                                  | 0 to 20Hz                            |
| 263       | Subtraction starting frequency                                     |                                                  | 0 to 120Hz, 9999                     |
| 264       | Power-failure deceleration time 1                                  |                                                  | 0 to 3600/360s                       |
| 265       | Power-failure deceleration time 2                                  |                                                  | 0 to 3600/360s, 9999                 |
| 266       | Power failure deceleration time switchover frequency               |                                                  | 0 to 400Hz                           |
| 267       | Terminal 4 input selection                                         |                                                  | 0, 1, 2                              |
| 268       | Monitor decimal digits selection                                   |                                                  | 0, 1, 9999                           |
| 269       | Parameter for manufacturer setting. Do not set.                    |                                                  |                                      |
| 270       | Stop-on contact/load torque high-speed frequency control selection |                                                  | 0, 1, 2, 3                           |
| 271       | Load torque high speed frequency control                           | High-speed setting maximum current               | 0 to 220%                            |
| 272       |                                                                    | Middle-speed setting minimum current             |                                      |
| 273       |                                                                    | Current averaging range                          | 0 to 400Hz, 9999                     |
| 274       |                                                                    | Current averaging filter time constant           | 1 to 4000                            |
| 275       | Stop-on contact excitation current low-speed multiplying factor    |                                                  | 0 to 1000%, 9999                     |
| 276       | PWM carrier frequency at stop-on contact                           |                                                  | 0 to 9, 9999                         |



| Parameter | Name                                                                       | Setting Range                  | Initial Value |
|-----------|----------------------------------------------------------------------------|--------------------------------|---------------|
| 278       | Brake opening frequency                                                    | 0 to 30Hz                      | 3Hz           |
| 279       | Brake opening current                                                      | 0 to 220%                      | 130%          |
| 280       | Brake opening current detection time                                       | 0 to 2s                        | 0.3s          |
| 281       | Brake operation time at start                                              | 0 to 5s                        | 0.3s          |
| 282       | Brake operation frequency                                                  | 0 to 30Hz                      | 6Hz           |
| 283       | Brake operation time at stop                                               | 0 to 5s                        | 0.3s          |
| 284       | Deceleration detection function selection                                  | 0, 1                           | 0             |
| 285       | Overspeed detection frequency (Speed deviation excess detection frequency) | 0 to 30Hz, 9999                | 9999          |
| 286       | Droop gain                                                                 | 0 to 100%                      | 0%            |
| 287       | Droop filter time constant                                                 | 0 to 1s                        | 0.3s          |
| 288       | Droop function activation selection                                        | 0, 1, 2, 10, 11                | 0             |
| 291       | Pulse train I/O selection                                                  | 0, 1, 2, 10, 11, 20, 21, 100   | 0             |
| 292       | Automatic acceleration/deceleration                                        | 0, 3, 5 to 8, 11               | 0             |
| 293       | Acceleration/deceleration separate selection                               | 0 to 2                         | 0             |
| 294       | UV avoidance voltage gain                                                  | 0 to 200%                      | 100%          |
| 299       | Rotation direction detection selection at restarting                       | 0, 1, 9999                     | 0             |
| 331       | RS-485 communication station number                                        | 0 to 31 (0 to 247)             | 0             |
| 332       | RS-485 communication speed                                                 | 3, 6, 12, 24, 48, 96, 192, 384 | 96            |
| 333       | RS-485 communication stop bit length                                       | 0, 1, 10, 11                   | 1             |
| 334       | RS-485 communication parity check selection                                | 0, 1, 2                        | 2             |
| 335       | RS-485 communication retry count                                           | 0 to 10, 9999                  | 1             |
| 336       | RS-485 communication check time interval                                   | 0 to 999.8s, 9999              | 0s            |
| 337       | RS-485 communication waiting time setting                                  | 0 to 150ms, 9999               | 9999          |
| 338       | Communication operation command source                                     | 0, 1                           | 0             |
| 339       | Communication speed command source                                         | 0, 1, 2                        | 0             |
| 340       | Communication startup mode selection                                       | 0, 1, 2, 10, 12                | 0             |

| Parameter | Name                                                   | Setting Range    | Initial Value |
|-----------|--------------------------------------------------------|------------------|---------------|
| 341       | RS-485 communication CR/LF selection                   | 0, 1, 2          | 1             |
| 342       | Communication EEPROM write selection                   | 0, 1             | 0             |
| 343       | Communication error count                              | —                | 0             |
| 350 *2    | Stop position command selection                        | 0, 1, 9999       | 9999          |
| 351 *2    | Orientation speed                                      | 0 to 30Hz        | 2Hz           |
| 352 *2    | Creep speed                                            | 0 to 10Hz        | 0.5Hz         |
| 353 *2    | Creep switchover position                              | 0 to 16383       | 511           |
| 354 *2    | Position loop switchover position                      | 0 to 8191        | 96            |
| 355 *2    | DC injection brake start position                      | 0 to 255         | 5             |
| 356 *2    | Internal stop position command                         | 0 to 16383       | 0             |
| 357 *2    | Orientation in-position zone                           | 0 to 255         | 5             |
| 358 *2    | Servo torque selection                                 | 0 to 13          | 1             |
| 359 *2    | Encoder rotation direction                             | 0, 1             | 1             |
| 360 *2    | 16 bit data selection                                  | 0 to 127         | 0             |
| 361 *2    | Position shift                                         | 0 to 16383       | 0             |
| 362 *2    | Orientation position loop gain                         | 0.1 to 100       | 1             |
| 363 *2    | Completion signal output delay time                    | 0 to 5s          | 0.5s          |
| 364 *2    | Encoder stop check time                                | 0 to 5s          | 0.5s          |
| 365 *2    | Orientation limit                                      | 0 to 60s, 9999   | 9999          |
| 366 *2    | Recheck time                                           | 0 to 5s, 9999    | 9999          |
| 367 *2    | Speed feedback range                                   | 0 to 400Hz, 9999 | 9999          |
| 368 *2    | Feedback gain                                          | 0 to 100         | 1             |
| 369 *2    | Number of encoder pulses                               | 0 to 4096        | 1024          |
| 374       | Overspeed detection level                              | 0 to 400Hz       | 140Hz         |
| 376 *2    | Encoder signal loss detection enable/disable selection | 0, 1             | 0             |

| Parameter | Name                                      | Setting Range                                            | Initial Value           |
|-----------|-------------------------------------------|----------------------------------------------------------|-------------------------|
| 380       | S-pattern acceleration/<br>deceleration C | Acceleration S-pattern 1                                 | 0 to 50%                |
| 381       |                                           | Deceleration S-pattern 1                                 | 0 to 50%                |
| 382       |                                           | Acceleration S-pattern 2                                 | 0 to 50%                |
| 383       |                                           | Deceleration S-pattern 2                                 | 0 to 50%                |
| 384       | Pulse train input                         | Input pulse division scaling factor                      | 0 to 250                |
| 385       |                                           | Frequency for zero input pulse                           | 0 to 400Hz              |
| 386       |                                           | Frequency for maximum input pulse                        | 0 to 400Hz              |
| 393 *2    | Orientation control                       | Orientation selection                                    | 0, 1, 2                 |
| 396 *2    |                                           | Orientation speed gain (P term)                          | 0 to 1000               |
| 397 *2    |                                           | Orientation speed integral time                          | 0 to 20s                |
| 398 *2    |                                           | Orientation speed gain (D term)                          | 0 to 100                |
| 399 *2    |                                           | Orientation deceleration ratio                           | 0 to 1000               |
| 419 *2    | Position control                          | Position command source selection                        | 0, 2                    |
| 420 *2    |                                           | Command pulse scaling factor numerator                   | 0 to 32767              |
| 421 *2    |                                           | Command pulse scaling factor denominator                 | 0 to 32767              |
| 422 *2    |                                           | Position loop gain                                       | 0 to 150s <sup>-1</sup> |
| 423 *2    |                                           | Position feed forward gain                               | 0 to 100%               |
| 424 *2    |                                           | Position command acceleration/deceleration time constant | 0 to 50s                |
| 425 *2    |                                           | Position feed forward command filter                     | 0 to 5s                 |
| 426 *2    |                                           | In-position width                                        | 0 to 32767 pulse        |
| 427 *2    |                                           | Excessive level error                                    | 0 to 400k               |
| 428 *2    |                                           | Command pulse selection                                  | 0 to 5                  |
| 429 *2    |                                           | Clear signal selection                                   | 0, 1                    |
| 430 *2    |                                           | Pulse monitor selection                                  | 0 to 5, 9999            |

| Parameter | Name                                                   | Setting Range                           | Initial Value                                              |
|-----------|--------------------------------------------------------|-----------------------------------------|------------------------------------------------------------|
| 450       | Second motor constants                                 | Second applied motor                    | 0 to 8, 13 to 18, 30, 33, 34, 40, 43, 44, 50, 53, 54, 9999 |
| 451       |                                                        | Second motor control method selection   | 10, 11, 12, 20, 9999                                       |
| 453       |                                                        | Second motor capacity                   | 0.4 to 55kW, 9999                                          |
| 454       |                                                        | Number of second motor poles            | 2, 4, 6, 8, 10, 9999                                       |
| 455       |                                                        | Second motor excitation current         | 0 to 500A, 9999                                            |
| 456       |                                                        | Rated second motor voltage              | 0 to 1000V                                                 |
| 457       |                                                        | Rated second motor frequency            | 10 to 120Hz                                                |
| 458       |                                                        | Second motor constant (R1)              | 0 to 50Ω, 9999                                             |
| 459       |                                                        | Second motor constant (R2)              |                                                            |
| 460       |                                                        | Second motor constant (L1)              | 0 to 50Ω, (0 to 1000mH), 9999                              |
| 461       |                                                        | Second motor constant (L2)              |                                                            |
| 462       |                                                        | Second motor constant (X)               | 0 to 500Ω, (0 to 100%), 9999                               |
| 463       |                                                        | Second motor auto tuning setting/status | 0, 1, 101                                                  |
| 464 *2    | Digital position control sudden stop deceleration time |                                         | 0 to 360,0s                                                |
| 465 *2    | 1. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 466 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 467 *2    | 2. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 468 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 469 *2    | 3. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 470 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 471 *2    | 4. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 472 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 473 *2    | 5. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 474 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 475 *2    | 6. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 476 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |
| 477 *2    | 7. Position feed amount                                | Lower 4 digits                          | 0 to 9999                                                  |
| 478 *2    |                                                        | Upper 4 digits                          | 0 to 9999                                                  |



| Parameter | Name                                            |                                                | Setting Range     | Initial Value |
|-----------|-------------------------------------------------|------------------------------------------------|-------------------|---------------|
| 479 *2    | 8. Position feed amount                         | Lower 4 digits                                 | 0 to 9999         | 0             |
| 480 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 481 *2    | 9. Position feed amount                         | Lower 4 digits                                 | 0 to 9999         | 0             |
| 482 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 483 *2    | 10. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 484 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 485 *2    | 11. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 486 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 487 *2    | 12. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 488 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 489 *2    | 13. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 490 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 491 *2    | 14. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 492 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 493 *2    | 15. Position feed amount                        | Lower 4 digits                                 | 0 to 9999         | 0             |
| 494 *2    |                                                 | Upper 4 digits                                 | 0 to 9999         | 0             |
| 495       | Remote output selection                         |                                                | 0, 1, 10, 11      | 0             |
| 496       | Remote output data 1                            |                                                | 0 to 4095         | 0             |
| 497       | Remote output data 2                            |                                                | 0 to 4095         | 0             |
| 503       | Maintenance timer                               |                                                | 0 (1 to 9998)     | 0             |
| 504       | Maintenance timer alarm output set time         |                                                | 0 to 9998, 9999   | 9999          |
| 505       | Speed setting reference                         |                                                | 1 to 120Hz        | 60Hz          |
| 516       | S-pattern acceleration/ deceleration D          | S-pattern time at a start of acceleration      | 0.1 to 2.5s       | 0.1s          |
| 517       |                                                 | S-pattern time at a completion of acceleration |                   |               |
| 518       |                                                 | S-pattern time at a start of deceleration      |                   |               |
| 519       |                                                 | S-pattern time at a completion of deceleration |                   |               |
| 539       | Modbus-RTU communication check time interval    |                                                | 0 to 999.8s, 9999 | 9999          |
| 547       | Parameter for manufacturer setting. Do not set. |                                                |                   |               |
| 548       |                                                 |                                                |                   |               |

| Parameter | Name                                  |                                                               | Setting Range       | Initial Value                 |
|-----------|---------------------------------------|---------------------------------------------------------------|---------------------|-------------------------------|
| 549       | Communication                         | Protocol selection                                            | 0, 1                | 0                             |
| 550       |                                       | NET mode operation command source selection                   | 0, 1, 9999          | 9999                          |
| 551       |                                       | PU mode operation command source selection                    | 1, 2                | 2                             |
| 555       | Current average value monitor         | Current average time                                          | 0.1 to 1.0s         | 1s                            |
| 556       |                                       | Data output mask time                                         | 0.0 to 20s          | 0s                            |
| 557       |                                       | Current average value monitor signal output reference current | 0 to 500A           | Rated inverter output current |
| 563       | Energization time carrying-over times |                                                               | (0 to 65535)        | 0                             |
| 564       | Operating time carrying-over times    |                                                               | (0 to 65535)        | 0                             |
| 569       | Second motor speed control gain       |                                                               | 0 to 200%, 9999     | 9999                          |
| 571       | Holding time at a start               |                                                               | 0.0 to 10.0s, 9999  | 9999                          |
| 574       | Second motor online auto tuning       |                                                               | 0, 1                | 0                             |
| 575       | PID control                           | Output interruption detection time                            | 0 to 3600s, 9999    | 1s                            |
| 576       |                                       | Output interruption detection level                           | 0 to 400Hz          | 0Hz                           |
| 577       |                                       | Output interruption cancel level                              | 900 to 1100%        | 1000%                         |
| 611       | Acceleration time at a restart        |                                                               | 0 to 3600s, 9999    | 5s                            |
| 665       | Regeneration avoidance frequency gain |                                                               | 0 to 200%           | 100                           |
| 684       | Tuning data unit switchover           |                                                               | 0, 1                | 0                             |
| 800       | Control method selection              |                                                               | 0 to 5, 9 to 12, 20 | 20                            |
| 802 *2    | Pre-excitation selection              |                                                               | 0, 1,               | 0                             |
| 803       | Torque command                        | Constant power range torque characteristic selection          | 0, 1                | 0                             |
| 804       |                                       | Torque command source selection                               | 0, 1, 3 to 6        | 0                             |
| 805       |                                       | Torque command value (RAM)                                    | 600 to 1400%        | 1000%                         |
| 806       |                                       | Torque command value (RAM, EEPROM)                            |                     |                               |
| 807       | Speed limit selection                 |                                                               | 0, 1, 2             | 0                             |
| 808       | Forward rotation speed limit          |                                                               | 0 to 120Hz          | 60Hz                          |
| 809       | Reverse rotation speed limit          |                                                               | 0 to 120Hz, 999     | 9999                          |

| Parameter | Name                                    | Setting Range    | Initial Value |
|-----------|-----------------------------------------|------------------|---------------|
| 810       | Torque limit input method selection     | 0, 1             | 0             |
| 811       | Set resolution switchover               | 0, 1, 10, 11     | 0             |
| 812       | Torque limit level (regeneration)       | 0 to 400%, 9999  | 9999          |
| 813       | Torque limit level (3rd quadrant)       | 0 to 400%, 9999  | 9999          |
| 814       | Torque limit level (4th quadrant)       | 0 to 400%, 9999  | 9999          |
| 815       | Torque limit level 2                    | 0 to 400%, 9999  | 9999          |
| 816       | Torque limit level during acceleration  | 0 to 400%, 9999  | 9999          |
| 817       | Torque limit level during deceleration  | 0 to 400%, 9999  | 9999          |
| 818       | Easy gain tuning response level setting | 1 to 15          | 2             |
| 819       | Easy gain tuning selection              | 0 to 2           | 0             |
| 820       | Speed control P gain 1                  | 0 to 1000%       | 60%           |
| 821       | Speed control integral time 1           | 0 to 20s         | 0.333s        |
| 822       | Speed setting filter 1                  | 0 to 5s, 9999    | 9999          |
| 823 *2    | Speed detection filter 1                | 0 to 0.1s        | 0.001         |
| 824       | Torque control P gain 1                 | 0 to 200%        | 100%          |
| 825       | Torque control integral time 1          | 0 to 500ms       | 5ms           |
| 826       | Torque setting filter 1                 | 0 to 5s, 9999    | 9999          |
| 827       | Torque detection filter 1               | 0 to 0.1s        | 0s            |
| 828       | Model speed control gain                | 0 to 1000%       | 60%           |
| 830       | Speed control P gain 2                  | 0 to 1000%, 9999 | 9999          |
| 831       | Speed control integral time 2           | 0 to 20s, 9999   | 9999          |
| 832       | Speed setting filter 2                  | 0 to 5s, 9999    | 9999          |
| 833 *2    | Speed detection filter 2                | 0 to 0.1s, 9999  | 9999          |
| 834       | Torque control P gain 2                 | 0 to 200%, 9999  | 9999          |
| 835       | Torque control integral time 2          | 0 to 500ms, 9999 | 9999          |
| 836       | Torque setting filter 2                 | 0 to 5s, 9999    | 9999          |
| 837       | Torque detection filter 2               | 0 to 0.1s, 9999  | 9999          |

| Parameter | Name                                     | Setting Range      | Initial Value |
|-----------|------------------------------------------|--------------------|---------------|
| 840 *2    | Torque bias selection                    | 0 to 3, 9999       | 9999          |
| 841 *2    | Torque bias 1                            | 600 to 1400%, 9999 | 9999          |
| 842 *2    | Torque bias 2                            |                    |               |
| 843 *2    | Torque bias 3                            |                    |               |
| 844 *2    | Torque bias filter                       | 0 to 5s, 9999      | 9999          |
| 845 *2    | Torque bias operation time               | 0 to 5s, 9999      | 9999          |
| 846 *2    | Torque bias balance compensation         | 0 to 10V, 9999     | 9999          |
| 847 *2    | Fall-time torque bias terminal 1 bias    | 0 to 400%, 9999    | 9999          |
| 848 *2    | Fall-time torque bias terminal 1 gain    | 0 to 400%, 9999    | 9999          |
| 849       | Analog input offset adjustment           | 0 to 200%          | 100%          |
| 850       | Brake operation selection                | 0, 1               | 0             |
| 853       | Speed deviation time                     | 0 to 100s          | 1s            |
| 854       | Excitation ratio                         | 0 to 100%          | 100%          |
| 858       | Terminal 4 function assignment           | 0, 1, 4, 9999      | 0             |
| 859       | Torque current                           | 0 to 500A, 9999    | 9999          |
| 860       | Second motor torque current              |                    | 9999          |
| 862       | Notch filter time constant               | 0 to 60            | 0             |
| 863       | Notch filter depth                       | 0, 1, 2, 3         | 0             |
| 864       | Torque detection                         | 0 to 400%          | 150%          |
| 865       | Low speed detection                      | 0 to 400Hz         | 1.5Hz         |
| 866       | Torque monitoring reference              | 0 to 400%          | 150%          |
| 867       | AM output filter                         | 0 to 5s            | 0.01s         |
| 868       | Terminal 1 function assignment           | 0 to 6, 9999       | 0             |
| 872       | Input phase failure protection selection | 0, 1               | 1             |
| 873 *2    | Speed limit                              | 0 to 120Hz         | 20Hz          |
| 874       | OLT level setting                        | 0 to 200%          | 150%          |
| 875       | Fault definition                         | 0, 1               | 0             |



| Parameter | Name                            | Setting Range                                                         | Initial Value       |
|-----------|---------------------------------|-----------------------------------------------------------------------|---------------------|
| 877       | Control method functions        | Speed feed forward control/<br>model adaptive speed control selection | 0, 1, 2             |
| 878       |                                 | Speed feed forward filter                                             | 0 to 1s             |
| 879       |                                 | Speed feed forward torque limit                                       | 0 to 400%           |
| 880       |                                 | Load inertia ratio                                                    | 0 to 200            |
| 881       |                                 | Speed feed forward gain                                               | 0 to 1000%          |
| 882       | Regeneration avoidance function | Regeneration avoidance operation selection                            | 0, 1, 2             |
| 883       |                                 | Regeneration avoidance operation level                                | 300 to 800V         |
| 884       |                                 | Regeneration avoidance at deceleration detection sensitivity          | 0 to 5              |
| 885       |                                 | Regeneration avoidance compensation frequency limit value             | 0 to 10Hz, 9999     |
| 886       |                                 | Regeneration avoidance voltage gain                                   | 0 to 200%           |
| 888       | Free parameter 1                |                                                                       | 9999                |
| 889       | Free parameter 2                |                                                                       | 9999                |
| 891       | Energy saving monitor           | Cumulative power monitor digit shifted times                          | 0 to 4, 9999        |
| 892       |                                 | Load factor                                                           | 30 to 150%          |
| 893       |                                 | Energy saving monitor reference (motor capacity)                      | 0.1 to 55kW         |
| 894       |                                 | Control selection during commercial power-supply operation            | 0, 1, 2, 3          |
| 895       |                                 | Power saving rate reference value                                     | 0, 1, 9999          |
| 896       |                                 | Power unit cost                                                       | 0 to 500, 9999      |
| 897       |                                 | Power saving monitor average time                                     | 0, 1 to 1000h, 9999 |
| 898       |                                 | Power saving cumulative monitor clear                                 | 0, 1, 10, 9999      |
| 899       |                                 | Operation time rate (estimated value)                                 | 0 to 100%, 9999     |

| Parameter    | Name                                           | Setting Range | Initial Value |
|--------------|------------------------------------------------|---------------|---------------|
| C0 (900) *3  | FM terminal calibration                        | —             | —             |
| C1 (901) *3  | AM terminal calibration                        | —             | —             |
| C2 (902) *3  | Terminal 2 frequency setting bias frequency    | 0 to 400Hz    | 0Hz           |
| C3 (902) *3  | Terminal 2 frequency setting bias              | 0 to 300%     | 0%            |
| 125 (903) *3 | Terminal 2 frequency setting gain frequency    | 0 to 400Hz    | 60Hz          |
| C4 (903) *3  | Terminal 2 frequency setting gain              | 0 to 300%     | 100%          |
| C5 (904) *3  | Terminal 4 frequency setting bias frequency    | 0 to 400Hz    | 0Hz           |
| C6 (904) *3  | Terminal 4 frequency setting bias              | 0 to 300%     | 20%           |
| 126 (905) *3 | Terminal 4 frequency setting gain frequency    | 0 to 400Hz    | 60Hz          |
| C7 (905) *3  | Terminal 4 frequency setting gain              | 0 to 300%     | 100%          |
| C12 (917) *3 | Terminal 1 bias frequency (speed)              | 0 to 400Hz    | 0Hz           |
| C13 (917) *3 | Terminal 1 bias (speed)                        | 0 to 300%     | 0%            |
| C14 (918) *3 | Terminal 1 gain frequency (speed)              | 0 to 400Hz    | 60Hz          |
| C15 (918) *3 | Terminal 1 gain (speed)                        | 0 to 300%     | 100%          |
| C16 (919) *3 | Terminal 1 bias command (torque/magnetic flux) | 0 to 400%     | 0%            |
| C17 (919) *3 | Terminal 1 bias (torque/magnetic flux)         | 0 to 300%     | 0%            |
| C18 (920) *3 | Terminal 1 gain command (torque/magnetic flux) | 0 to 400%     | 150%          |
| C19 (920) *3 | Terminal 1 gain (torque/magnetic flux)         | 0 to 300%     | 100%          |
| C38 (932) *3 | Terminal 4 bias command (torque/magnetic flux) | 0 to 400%     | 0%            |

| Parameter                     | Name                                                     | Setting Range | Initial Value |
|-------------------------------|----------------------------------------------------------|---------------|---------------|
| <b>C39</b><br><b>(932)</b> *3 | Terminal 4 bias<br>(torque/magnetic flux)                | 0 to 300%     | 20%           |
| <b>C40</b><br><b>(933)</b> *3 | Terminal 4 gain com-<br>mand (torque/mag-<br>netic flux) | 0 to 400%     | 150%          |
| <b>C41</b><br><b>(933)</b> *3 | Terminal 4 gain<br>(torque/magnetic flux)                | 0 to 300%     | 100%          |
| <b>989</b>                    | Parameter for manufacturer setting. Do not set.          |               |               |

| Parameter    | Name                      | Setting Range | Initial Value |
|--------------|---------------------------|---------------|---------------|
| <b>990</b>   | PU buzzer control         | 0, 1          | 1             |
| <b>991</b>   | PU contrast<br>adjustment | 0 to 63       | 58            |
| <b>Pr.CL</b> | Parameter clear           | 0, 1          | 0             |
| <b>ALLC</b>  | All parameter clear       | 0, 1          | 0             |
| <b>Er.CL</b> | Faults history clear      | 0, 1          | 0             |
| <b>Pr.CH</b> | Parameter copy            | 0, 1, 2, 3    | 0             |

\*1 Differ according to capacities. (7.5K or less/11K or more)

\*2 Setting can be made only when the FR-A7AP is mounted.

\*3 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).

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## 7 TROUBLESHOOTING

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When an fault occurs in the inverter, the protective function is activated bringing the inverter to an alarm stop and the PU display automatically changes to any of the following fault (alarm) indications.

If your 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 inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Fault or alarm display .....When a fault or alarm occurs, the operation panel display automatically switches to the fault or alarm indication.
- Resetting method .....When a protective function of the inverter is activated, the power output of the inverter is blocked (motor is coasting). The inverter cannot start up again unless an automatic restart has been configured or the inverter is reset. Please observe carefully the warnings contained below in the configuration of an automatic restart or the execution of a reset.
- If protective functions were activated (i. e. the inverter switched off with an error message) follow the instructions for error correction provided in the manual for the inverter. Especially in the case of short circuits or earth contacts in the inverter output and mains overvoltages the cause of the fault must be determined prior to switching on again as a recurrence of such faults at short intervals can lead to premature aging of components or even the complete breakdown of the device. After the cause of the fault has been found and corrected the inverter can be reset and operations continue.

Inverter fault or alarm indications are roughly divided as below.

- Error Message  
A message regarding operational fault and setting fault by the operation panel and parameter unit (FR-PU04/FR-PU07) is displayed. The inverter does not shut off output.
- Warnings  
The inverter does not shut off output even when a warning is displayed. However, failure to take appropriate measures will lead to a major fault.
- Alarm  
The inverter does not shut off output. You can also output an alarm signal by making parameter setting.
- Fault  
When the protective function is activated, the inverter output is shut off and an fault signal is output.

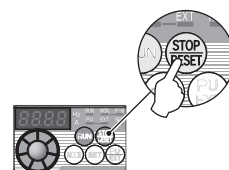
### 7.1 Reset method of protective function

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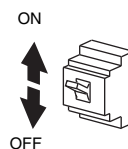
The inverter can be reset by performing any of the following operations. Note that the internal thermal integrated value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter. Recover about 1 s after reset is cancelled.

Three different methods can be used to reset an inverter.

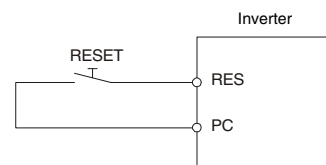
- Using the operation panel, press the STOP/RESET key to reset the inverter.  
(This may only be performed when a fault occurs.)



- Switch power off once, then switch it on again.



- Turn on the reset signal (RES) for more than 0.1 s. (If the RES signal is kept on, "Err." appears (flickers) to indicate that the inverter is in a reset status.)



## 7.2 List of alarm display

| Operation Panel Indication |                | Meaning                                                              |
|----------------------------|----------------|----------------------------------------------------------------------|
| Error messages             | $E---$         | E --- Faults history                                                 |
|                            | $HOLD$         | HOLD Operation panel lock                                            |
|                            | $Er1$ to $Er4$ | Er1 to 4 Parameter write error                                       |
|                            | $rE1$ to $rE4$ | rE1 to rE4 Copy operation error                                      |
|                            | $Err.$         | Err. Inverter reset                                                  |
| Warnings                   | $OL$           | OL Stall Prevention (overcurrent)                                    |
|                            | $oL$           | oL Stall prevention (overvoltage)                                    |
|                            | $TH$           | TH Electronic thermal relay function prealarm                        |
|                            | $PS$           | PS PU Stop                                                           |
|                            | $MT$           | MT Maintenance signal output                                         |
|                            | $CP$           | CP Parameter copy                                                    |
|                            | $SL$           | SL Speed limit indication (Output during speed limit)                |
| Alarm                      | $Fn$           | FN Fan alarm                                                         |
| Fault                      | $E.OC1$        | E.OC1 Overcurrent shut-off during acceleration                       |
|                            | $E.OC2$        | E.OC2 Overcurrent shut-off during constant speed                     |
|                            | $E.OC3$        | E.OC3 Overcurrent shut-off during deceleration or stop               |
|                            | $E.OV1$        | E.OV1 Regenerative overvoltage shut-off during acceleration          |
|                            | $E.OV2$        | E.OV2 Regenerative overvoltage shut-off during constant speed        |
|                            | $E.OV3$        | E.OV3 Regenerative overvoltage shut-off during deceleration or stop  |
|                            | $E.THT$        | E.THT Inverter overload shut-off (electronic thermal relay function) |
|                            | $E.THM$        | E.THM Motor overload shut-off (electronic thermal relay function)    |
|                            | $E.FIN$        | E.FIN Fin overheat                                                   |
|                            | $E.IPF$        | E.IPF Instantaneous power failure                                    |
|                            | $E.UVT$        | E.UVT Undervoltage                                                   |
|                            | $E.ILF$        | E.ILF* Input phase failure                                           |
|                            | $E.OLT$        | E.OLT Stall prevention                                               |
|                            | $E.GF$         | E.GF Output side earth (ground) fault overcurrent                    |
|                            | $E.LF$         | E.LF Output phase loss                                               |
|                            | $E.OHT$        | E.OHT External thermal relay operation                               |

| Operation Panel Indication |                     | Meaning                                                                                |
|----------------------------|---------------------|----------------------------------------------------------------------------------------|
| $E.PTC$                    | E.PTC*              | PTC thermistor operation                                                               |
| $E.OPT$                    | E.OPT               | Option alarm                                                                           |
| $E.OP3$                    | E.OP3               | Communication option alarm                                                             |
| $E.1$ to $E.3$             | E.1 to E.3          | Option fault                                                                           |
| $E.PE$                     | E.PE                | Parameter storage device fault                                                         |
| $E.PUE$                    | E.PUE               | PU disconnection                                                                       |
| $E.RET$                    | E.RET               | Retry count excess                                                                     |
| $E.PE2$                    | E.PE2*              | Parameter storage device fault                                                         |
| $E.6$ to $E.7$             | E.6<br>E.7<br>E.CPU | CPU error                                                                              |
| $E.CTE$                    | E.CTE               | Operation panel power supply short circuit, RS-485 terminal power supply short circuit |
| $E.P24$                    | E.P24               | 24V DC power output short circuit                                                      |
| $E.CDO$                    | E.CDO*              | Output current detection value exceeded                                                |
| $E.IOH$                    | E.IOH*              | Inrush current limit circuit fault                                                     |
| $E.SER$                    | E.SER*              | Communication error (inverter)                                                         |
| $E.AIE$                    | E.AIE*              | Analog input error                                                                     |
| $E.OS$                     | E.OS                | Overspeed occurrence                                                                   |
| $E.OSD$                    | E.OSD               | Speed deviation excess detection                                                       |
| $E.ECT$                    | E.ECT               | Signal loss detection                                                                  |
| $E.OD$                     | E.OD                | Excessive position error                                                               |
| $E.MB1$ to $E.MB7$         | E.MB1 to E.MB7      | Brake sequence error                                                                   |
| $E.EP$                     | E.EP                | Encoder phase error                                                                    |
| $E.4$                      | E.4                 | Converter overcurrent                                                                  |
| $E.8$                      | E.8                 | Power supply fault                                                                     |
| $E.10$                     | E.10                | Converter transistor protection thermal operation (electronic thermal)                 |
| $E.11$                     | E.11                | Opposite rotation deceleration fault                                                   |
| $E.13$                     | E.13                | Internal circuit error                                                                 |
| $E.15$                     | E.15                | Converter circuit fault                                                                |

\* If an E.ILF, E.PTC, E.PE2, E.CDO, E.IOH or E.AIE fault occurs when using the FR-PU04, "Fault 14" is displayed on the FR-PU04.

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# A APPENDIX

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## A.1 Instructions for Compliance with the European Directives

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### A.1.1 EMC Directive

- Our view of transistorized inverters for the EMC Directive  
A transistorized inverter is a component designed for installation in an enclosure and for use with the other equipment to control the equipment/device. Therefore, we understand that the EMC Directive does not apply directly to transistorized inverters. For this reason, we do not place the CE mark on the transistorized inverters. (The CE mark is placed on inverters in accordance with the Low Voltage Directive.) CEMEP
- Compliance  
We understand that the general-purpose inverters are not covered directly by the EMC Directive. However, the EMC Directive applies to machines/equipment into which inverters have been incorporated, and these machines and equipment must carry the CE marks. EMC Installation Guidelines BCN-A21041-202
- Outline of installation method  
Install an inverter using the following methods:
  - Use the inverter with an European Standard-compliant noise filter.
  - For wiring between the inverter and motor, use shielded cables or run them in a metal piping and ground the cables on the inverter and motor sides with the shortest possible distance.
  - Insert a line noise filter and ferrite core into the power and control lines as required.Full information including the European Standard-compliant noise filter specifications are written in the technical information "EMC Installation Guidelines" (BCN-A21041-202). Please contact your sales representative.

### A.1.2 Low Voltage Directive

We have self-confirmed our inverters as products compliant to the Low Voltage Directive (Conforming standard EN 61800-5-1) and placed the CE mark on the inverters.

#### Outline of instructions

- Do not use a residual current operated protective device (RCD) as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth securely.
- Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
- Use the cable sizes on *page 6* at the ambient temperature indicated there.  
If the ambient temperature is different, select appropriate wire according to EN60204 ANNEX C TABLE 5.
- 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 whose size is indicated on *page 6*.
- Use the moulded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- Use the residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). However, be aware that also AC/DC sensitive earth leakage circuit breakers can be activated when turning the main power on and off and that this behaviour can be improved through the use of AC/DC sensitive earth leakage circuit breakers with adapted triggering curve designed for the inverter. If not, provide double or reinforced insulation between the inverter and other equipment, or put a transformer between the main power supply and inverter.
- Use the inverter under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earthed-neutral system power supply, 400 V class only) specified in IEC664.
- To use the inverter under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
- On the input and output of the inverter, 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 30 V DC, 0.3 A. (Relay outputs are basically isolated from the inverter internal circuit.)
- Control circuit terminals on *page 4* are safely isolated from the main circuit

#### Environment

|                     | During Operation | In Storage     | During Transportation |
|---------------------|------------------|----------------|-----------------------|
| Ambient temperature | –10°C to + 50°C  | –20°C to +65°C | –20°C to +65°C        |
| Ambient humidity    | 90% RH or less   | 90% RH or less | 90% RH or less        |
| Maximum altitude    | 1000m            | 1000m          | 10000m                |

## Wiring protection

Provide the appropriate UL and cUL listed class T type fuse that are suitable for branch circuit protection in accordance with the table below

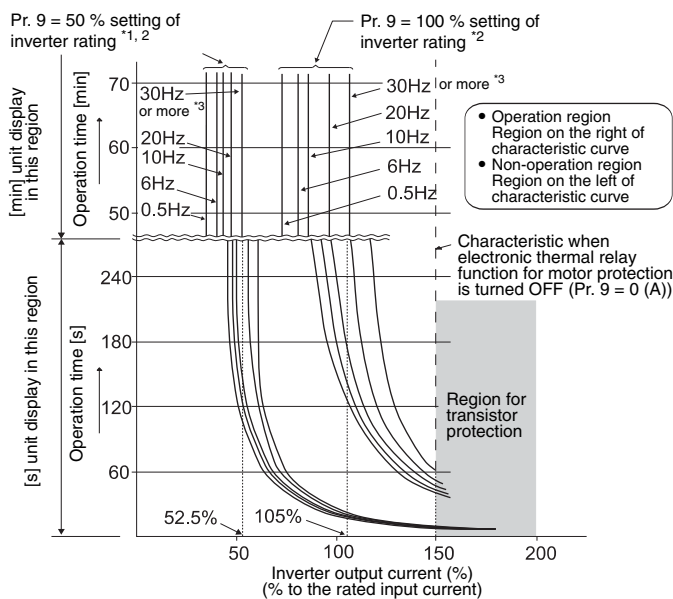
| FR-A741-□□□-K                       | 5.5          | 7.5 | 11 | 15 | 018.5 | 22  | 30  | 37  | 45  | 55  |
|-------------------------------------|--------------|-----|----|----|-------|-----|-----|-----|-----|-----|
| Rated voltage [V]                   | 480V or more |     |    |    |       |     |     |     |     |     |
| Fuse maximum allowable rating [A] * | 40           | 70  | 80 | 90 | 110   | 150 | 175 | 200 | 250 | 300 |

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

## Motor overload protection

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

### Electronic thermal relay function characteristic



This function detects the overload (overheat) of the motor, stops the operation of the inverter's output transistor, and stops the output.

When using the Mitsubishi constant-torque motor set "1" or any of "13 to 18", "50", "53" or "54" in Pr. 71. This provides a 100 % continuous torque characteristic in the low-speed range. Set the rated current of the motor in Pr. 9.

<sup>1</sup> When a value 50 % of the inverter rated output current (current value) is set in Pr. 9.

<sup>2</sup> The % value denotes the percentage to the inverter rated output current. It is not the percentage to the motor rated current.

<sup>3</sup> When you set the electronic thermal relay function dedicated to the Mitsubishi constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.

## CAUTION

- Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-off.
- When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal relay function. Install an external thermal relay to each motor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use a external thermal relay.
- Electronic thermal relay does not function when 5 % or less of inverter rated current is set to electronic thermal relay setting.

## A.1.3 Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 5 kA rms symmetrical amperes, 528 V maximum.



## A.2 Instructions for UL and cUL

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

### A.2.1 General precaution

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.

### A.2.2 Installation

The below types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions.

Design an enclosure so that the inverter ambient temperature, humidity and atmosphere satisfy the specifications. (Refer to *page 2*).

#### 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 Canada Electrical Code and any applicable provincial codes.

As specified, UL Class T fuses or any faster acting fuse with the appropriate rating must be employed.

| FR-A741-□□□-K                       | 5.5          | 7.5 | 11 | 15 | 018.5 | 22  | 30  | 37  | 45  | 55  |
|-------------------------------------|--------------|-----|----|----|-------|-----|-----|-----|-----|-----|
| Rated voltage [V]                   | 480V or more |     |    |    |       |     |     |     |     |     |
| Fuse maximum allowable rating [A] * | 40           | 70  | 80 | 90 | 110   | 150 | 175 | 200 | 250 | 300 |

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

### A.2.3 Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 528 V maximum.

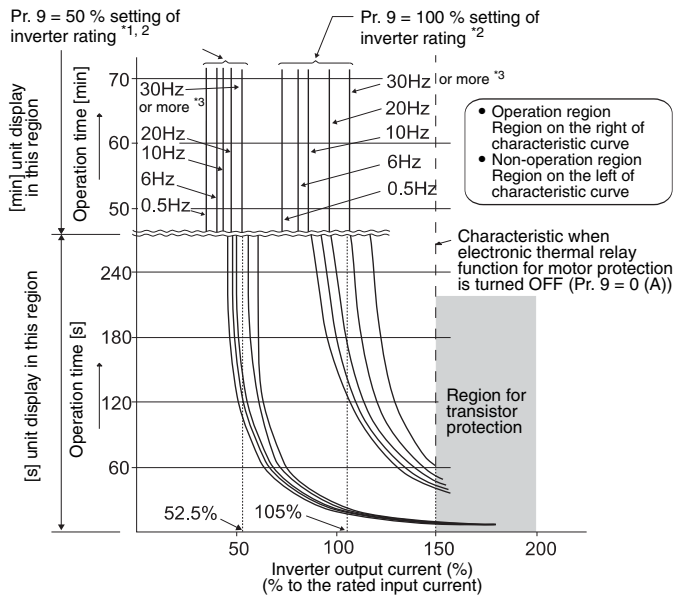
### A.2.4 Wiring

- The cables used should be 75 °C copper cables.
- Tighten the terminal screws to the specified torques.  
Undertightening can cause a short or misoperation.  
Overtightening can cause the screws and unit to be damaged, resulting in a short or misoperation.
- Use the UL approved round crimping terminals. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

## A.2.5 Motor overload protection

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

### Electronic thermal relay function characteristic



This function detects the overload (overheat) of the motor, stops the operation of the inverter's output transistor, and stops the output.

When using the Mitsubishi constant-torque motor set "1" or any of "13 to 18", "50", "53" or "54" in Pr. 71. This provides a 100 % continuous torque characteristic in the low-speed range. Set the rated current of the motor in Pr. 9.

<sup>\*4</sup> When a value 50 % of the inverter rated output current (current value) is set in Pr. 9.

<sup>\*5</sup> The % value denotes the percentage to the inverter rated output current. It is not the percentage to the motor rated current.

<sup>\*6</sup> When you set the electronic thermal relay function dedicated to the Mitsubishi constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.

### CAUTION

- Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-off.
- When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal relay function. Install an external thermal relay to each motor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use a external thermal relay.
- Electronic thermal relay does not function when 5 % or less of inverter rated current is set to electronic thermal relay setting.





| HEADQUARTERS                                                                                                                                                                                 |                               |
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| AKHNATON<br>4 Andrej Ljapchev Blvd. Pb 21<br><b>BG-1756 Sofia</b><br>Phone: +359 (0)2 / 817 6004<br>Fax: +359 (0)2 / 97 44 06 1                                                              | <b>BULGARIA</b>               |
| INEA CR d.o.o.<br>Losinjska 4 a<br><b>HR-10000 Zagreb</b><br>Phone: +385 (0)1 / 36 940 - 01 / -02 / -03<br>Fax: +385 (0)1 / 36 940 - 03                                                      | <b>CROATIA</b>                |
| AutoCont C.S. s.r.o.<br>Technologická 374/6<br><b>CZ-708 00 Ostrava-Pustkovec</b><br>Phone: +420 595 691 150<br>Fax: +420 595 691 199                                                        | <b>CZECH REPUBLIC</b>         |
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| Beijer Electronics A/S<br>Lykkegårdsvej 17, 1.<br><b>DK-4000 Roskilde</b><br>Phone: +45 (0)46 / 75 76 66<br>Fax: +45 (0)46 / 75 56 26                                                        | <b>DENMARK</b>                |
| Beijer Electronics Eesti OÜ<br>Pärnu mnt.160i<br><b>EE-11317 Tallinn</b><br>Phone: +372 (0)6 / 51 81 40<br>Fax: +372 (0)6 / 51 81 49                                                         | <b>ESTONIA</b>                |
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| MELTRADE Ltd.<br>Fertő utca 14.<br><b>HU-1107 Budapest</b><br>Phone: +36 (0)1 / 431-9726<br>Fax: +36 (0)1 / 431-9727                                                                         | <b>HUNGARY</b>                |
| Beijer Electronics SIA<br>Vestienas iela 2<br><b>LV-1035 Riga</b><br>Phone: +371 (0)784 / 2280<br>Fax: +371 (0)784 / 2281                                                                    | <b>LATVIA</b>                 |
| Beijer Electronics UAB<br>Savanoriu Pr. 187<br><b>LT-02300 Vilnius</b><br>Phone: +370 (0)5 / 232 3101<br>Fax: +370 (0)5 / 232 2980                                                           | <b>LITHUANIA</b>              |
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| Koning & Hartman b.v.<br>Haarlerbergweg 21-23<br><b>NL-1101 CH Amsterdam</b><br>Phone: +31 (0)20 / 587 76 00<br>Fax: +31 (0)20 / 587 76 05                                                   | <b>NETHERLANDS</b>            |
| Beijer Electronics AS<br>Postboks 487<br><b>NO-3002 Drammen</b><br>Phone: +47 (0)32 / 24 30 00<br>Fax: +47 (0)32 / 84 85 77                                                                  | <b>NORWAY</b>                 |
| MPL Technology Sp. z o.o.<br>Ul. Krakowska 50<br><b>PL-32-083 Balice</b><br>Phone: +48 (0)12 / 630 47 00<br>Fax: +48 (0)12 / 630 47 01                                                       | <b>POLAND</b>                 |
| Sirius Trading & Services srl<br>Aleea Lacul Morii Nr. 3<br><b>RO-060841 Bucuresti, Sector 6</b><br>Phone: +40 (0)21 / 430 40 06<br>Fax: +40 (0)21 / 430 40 02                               | <b>ROMANIA</b>                |
| Craft Con. & Engineering d.o.o.<br>Bulevar Svetog Cara Konstantina 80-86<br><b>SER-18106 Nis</b><br>Phone: +381 (0)18 / 292-24-4/5<br>Fax: +381 (0)18 / 292-24-4/5                           | <b>SERBIA</b>                 |
| INEA SR d.o.o.<br>Izletnicka 10<br><b>SER-113000 Smederevo</b><br>Phone: +381 (0)26 / 617 163<br>Fax: +381 (0)26 / 617 163                                                                   | <b>SERBIA</b>                 |
| AutoCont Control s.r.o.<br>Radlinského 47<br><b>SK-02601 Dolny Kubin</b><br>Phone: +421 (0)43 / 5868210<br>Fax: +421 (0)43 / 5868210                                                         | <b>SLOVAKIA</b>               |
| CS MTrade Slovensko, s.r.o.<br>Vajanskeho 58<br><b>SK-92101 Piestany</b><br>Phone: +421 (0)33 / 7742 760<br>Fax: +421 (0)33 / 7735 144                                                       | <b>SLOVAKIA</b>               |
| INEA d.o.o.<br>Stegne 11<br><b>SI-1000 Ljubljana</b><br>Phone: +386 (0)1 / 513 8100<br>Fax: +386 (0)1 / 513 8170                                                                             | <b>SLOVENIA</b>               |
| Beijer Electronics AB<br>Box 426<br><b>SE-20124 Malmö</b><br>Phone: +46 (0)40 / 35 86 00<br>Fax: +46 (0)40 / 35 86 02                                                                        | <b>SWEDEN</b>                 |
| Econotec AG<br>Hinterdorfstr. 12<br><b>CH-8309 Nürensdorf</b><br>Phone: +41 (0)44 / 838 48 11<br>Fax: +41 (0)44 / 838 48 12                                                                  | <b>SWITZERLAND</b>            |
| GTS<br>Darülaceze Cad. No. 43 KAT. 2<br><b>TR-34384 Okmeydanı-Istanbul</b><br>Phone: +90 (0)212 / 320 1640<br>Fax: +90 (0)212 / 320 1649                                                     | <b>TURKEY</b>                 |
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| Kazpromautomatiks Ltd.<br>Mustafina Str. 7/2<br><b>KAZ-470046 Karaganda</b><br>Phone: +7 7212 / 50 11 50<br>Fax: +7 7212 / 50 11 50                                                          | <b>KAZAKHSTAN</b>             |
| CONSYS<br>Promyshlennaya st. 42<br><b>RU-198099 St. Petersburg</b><br>Phone: +7 812 / 325 36 53<br>Fax: +7 812 / 325 36 53                                                                   | <b>RUSSIA</b>                 |
| ELECTROTECHNICAL SYSTEMS<br>Derbenevskaya st. 11A, Office 69<br><b>RU-115114 Moscow</b><br>Phone: +7 495 / 744 55 54<br>Fax: +7 495 / 744 55 54                                              | <b>RUSSIA</b>                 |
| ELEKTROSTILY<br>Rubzovskaya nab. 4-3, No. 8<br><b>RU-105082 Moscow</b><br>Phone: +7 495 / 545 3419<br>Fax: +7 495 / 545 3419                                                                 | <b>RUSSIA</b>                 |
| RPS-AUTOMATIKA<br>Budennovskiy 97, Office 311<br><b>RU-344007 Rostov on Don</b><br>Phone: +7 8632 / 22 63 72<br>Fax: +7 8632 / 219 45 51                                                     | <b>RUSSIA</b>                 |
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