# EQ Series EQ5

# AC Drive Operations Manual


## Constant Torque 0.5 - 600 HP
## Variable Torque 0.5 - 800 HP

**Caution**

- Read all operating instructions before installing, connecting (wiring), operating, servicing, or inspecting the inverter.
- Ensure that this instruction manual is made available to the final user of the inverter.
- Store this manual in a safe, convenient location.
- The product is subject to change without prior notice.

Document: TWMC-EQ5OM
Revision: 001P0

**Preface**
Thank you for purchasing our EQ5 series inverter. This product is used to drive a 3-phase electric motor at variable speed. As incorrect use of this product may result in personal injury and/or property damage, please read all safety and operating instructions before using.

## Safety Instructions

Please read this manual carefully before installing, connecting (wiring), operating, servicing, or inspecting the inverter. Also please familiarize yourself with all safety features before using the inverter.

In this manual, safety messages are classified as follows:

| | |
|---|---|
| **Danger** | Improper operation may result in serious personal injury or death. |
| **Caution** | Improper operation may result in slight to medium personal injury or property damage. |

Situations more serious than those covered by CAUTION will depend on prevailing circumstances. Always follow instructions.

**Instructions on use:**

**Danger**

- This inverter is designed to drive a 3-phase induction motor and is not suitable for a single-phase motor or any other types, **as fire may result.**
- This inverter may not be used (as is) as a component of a life-support system or other medical device directly affecting the personal welfare of the user.
- This inverter is manufactured under strict quality control standards. However, safety equipment must be installed if the failure of this device may result in personal injury and/or property damage.
- **There is a risk of accident.**

**Instructions on installation:**

**Danger**

- Mount this inverter on an incombustible material such as metal. **There is a risk of fire.**
- Do not place combustible or flammable material near this inverter, **as fire may result.**

**Caution**

- Do not hold or carry this inverter by the surface cover. Inverter may be dropped **causing injury.**
- Ensure that the inverter and heat sink surfaces are kept free of foreign matter (lint, paper dust, small chips of wood or metal, and dust), **as fire or accident may result.**
- Do not install or operate a damaged inverter or an inverter with missing parts, **as injury may result.**

**Instructions on wiring:**

| **Danger** |
|---|
| • Connect the inverter to power via a line-protection molded-case circuit breaker or fuse, **otherwise fire may result.**<br>• Always connect a ground wire, **otherwise electric shock or fire may result.**<br>• A licensed specialist must perform the wiring, **otherwise electric shock may result.**<br>• Turn off the power before starting the wiring, **otherwise electric shock may result.**<br>• Wire the inverter after installation is complete, **otherwise electric shock or injury may occur.** |

| **Caution** |
|---|
| • Confirm that the phases and rated voltage of this product match those of the AC power supply, **otherwise injury may result.**<br>• Do not connect the AC power supply to the output terminals (U,V,and W), **otherwise injury may result.**<br>• Do not connect a braking resistor directly to the DC terminals (P(+)and N(-)),**otherwise fire may result.**<br>• Ensure that the noise generated by the inverter, motor, or wiring does not adversely affect peripheral sensors and equipment, **otherwise accident may result.** |

**Instructions on operation:**

| **Danger** |
|---|
| • Be sure to install the surface cover before turning on power (closed). Do not remove the cover while power to the inverter is on. **Otherwise electric shock may occur.**<br>• Do not operate switches with wet hands, **otherwise electric shock may result.**<br>• When the retry function is selected, the inverter may restart automatically after tripping. Design the machine to ensure personal safety in the event of restart. **Accident may result.**<br>• When the torque limiting function is selected, operating conditions may differ from preset conditions (acceleration/deceleration time or speed). In this case, personal safety must be assured. **Otherwise accident may result.**<br>• As the STOP key is effective only when a function setting has been established, install an emergency switch independently, and when an operation via the external signal terminal is selected, the STOP key on the keypad panel will be disabled. **Otherwise accident may result.**<br>• As operations start suddenly if an alarm is reset with a running signal input, confirm that no running signal is input before resetting alarm. **Otherwise accident may result.**<br>• Do not touch inverter terminals when energized even if inverter has stopped. **Otherwise electric shock may result.** |

| **Caution** |
|---|
| • Do not start or stop the inverter using the main circuit power. **Failure may result.**<br>• Do not touch the heat sink or braking resistor because they can be extremely hot. **Burns may result.**<br>• Carefully check the performance of motor or machine before operating at high speed. **Injury may result.**<br>• Do not use the inverter braking function for mechanical holding. **Otherwise injury may result.** |

**Instructions on maintenance, inspection, and replacement:**

| **Danger** |
| --- |
| • Wait a minimum of five minutes (30HP/CT, 40HP/VT or less) or ten minutes (40HP/CT, 50HP/VT or more) after power has been turned off (open) before starting an inspection. (Also confirm that the charge lamp is off and that DC voltage between terminals P (+) and N (-) does not exceed 25V.) **Otherwise electrical shock may result.**<br>• Only authorized personnel should perform maintenance, inspection, and replacement operations.(Take off metal jewelry such as watches and rings and use insulated tools.) **Otherwise electric shock or injury may result.** |

**Instructions on disposal:**

| **Caution** |
| --- |
| • Treat as industrial waste when disposing it. **Otherwise injury may result.** |

**Other instructions:**

| **Danger** |
| --- |
| • Never modify the product. **Otherwise electric shock or injury may result.** |

## Compliance with UL/cUL standards [Applicable to products with UL/cUL mark]

### Caution

Tightening torque and wire range: Refer to Table 2-3-5 in Section 2

Apply the following power supply specifications to the inverter:

| Inverter Model | Maximum input voltage | Input source current |
|---|---|---|
| EQ5 - 20P2 - N1 to EQ5 - 2032 - N1 | AC240V | Not more than 100,000A |
| EQ5 - 2040 - C to EQ5 - 2150 - C | | |
| EQ5 - 40P5 - N1 to EQ5 - 4032 - N1 | AC480V | |
| EQ5 - 4040 - C to EQ5 - 4800 - C | | |

### Caution

* [CAUTION] Hazard of electrical shock. Disconnect incoming power before working on this control.
* [CAUTION] Dangerous voltage exists until charge light is off.
* [WARNING]
* More than one live parts inside the inverter.
* Type1 “INDOOR USE ONLY”
  The inverter is approved as a part used inside a panel. Install it inside a panel.
* Suitable for use on a circuit capable of delivering not more than 100,000rms symmetrical amperes.
* Use 60/75C copper wire only.
* A Class2 circuit wired with class1 wire.
* Field wiring connections must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.
* Connect the power supply to main power supply terminals via the Molded-case circuit breaker (MCCB) or a ground fault circuit interrupter (GFCI) to conform to the UL Listing Mark.
  (See Instruction Manual basic connection diagram Fig.2-3-1).
* When using auxiliary control-power input (R0, T0), connect as per Basic connection diagram Fig.2-3-1.
* Solid state motor overload protection is provided in each model.

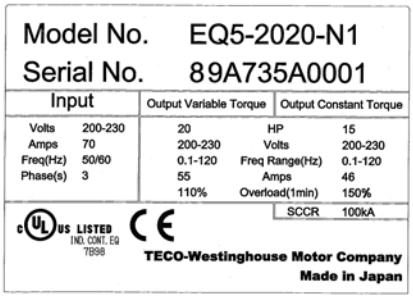
## Contents

# 1. Before Using This Product

## 1-1 Receiving Instructions

Unpack and check the product as explained below.

*If you have any questions about the product, contact the nearest TWMC sales office or your local distributor where you purchased the unit.*




1. Check the ratings on the nameplate to confirm that the delivered product is the one that was ordered.

**TYPE** : Inverter type

EQ – X XXX - XX
- C = Open Chassis, N1= Nema 1
- HP Rating (Variable Torque)
- 2 = 230V, 4 = 460V
- Product Type

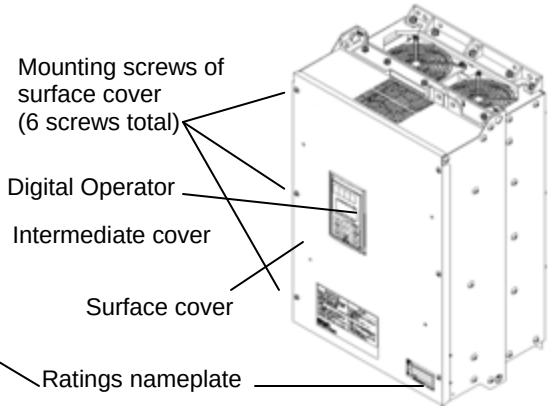
**SOURCE** : Power rating
**OUTPUT** : Output rating
**MASS** : Mass (not indicated for products with 30HP/CT, 40HP/VT or less)
**SER.No.** : Serial number

8 5 XXXXXXXXXXXX
- Production lot serial number
- Production month:1 to 9: January to September, X: October, Y: November, Z: December
- Production year: Last digit of year (7 --> 2007)

2. Check for damaged and/or missing parts.
3. In addition to the drive unit and this manual, the package contains rubber bushings (for products of 30HP/CT, 40HP/VT or less) and a terminating resistor (1/2 W, 120Ω) which is packed separately. The terminating resistor for products rated 40HP/CT, 50HP/VT or more, is installed internally. The terminating resistor is required for RS485 communication and can remain installed regardless of RS-485 communication status.

## 1-2 Appearance


30HP/CT, 40HP/VT or Less




40HP/CT, 50HP/VT or More

### 1-3 Handling the Product

1. Removing the cover

   For drives rated 30HP/CT, 40HP/VT or less, loosen the mounting screws of the cover, then remove by pulling the top (see Fig. 1.3.1).

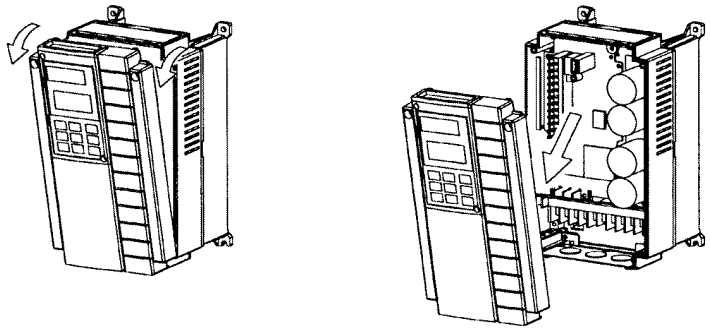


**Fig. 1-3-1 Removing the Surface Cover (for inverters rated 30HP/CT, 40HP/VT or less)**

   For drives of 40HP/CT, 50HP/VT or more, first remove the six mounting screws, then remove the cover (see Fig. 1-3-2).

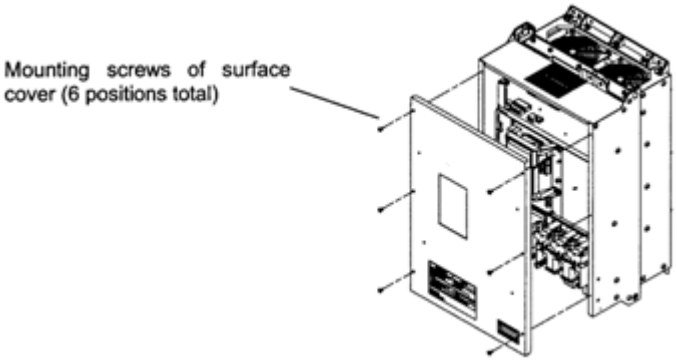



**Fig. 1-3-2 Removing the Surface Cover (for inverters rated 40HP/CT, 50HP/VT or more)**

2. Removing the digital operator

   After removing the cover as explained in (1.), loosen the mounting screws of the digital operator and remove as shown in Fig.1.3.3.

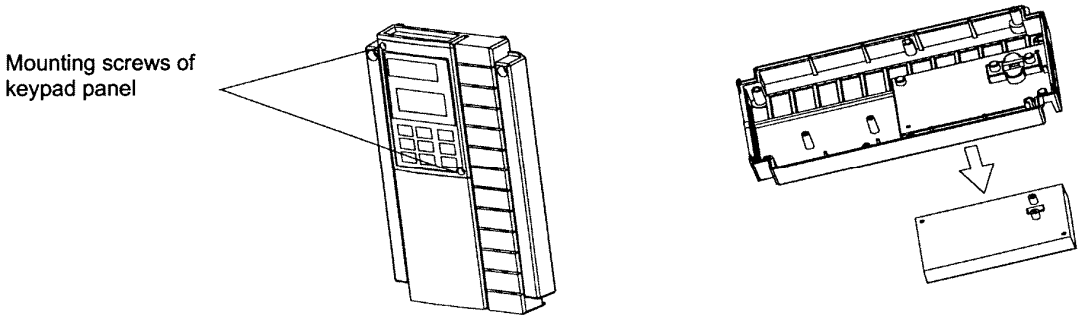



**Fig. 1-3-3 Removing the Digital Operator (30HP/CT, 40HP/VT or less)**

For drives 40HP/CT, 50HP/VT or more, loosen the mounting screws of the digital operator and remove using the finger holds on the digital operator case (see Fig. 1-3-4).

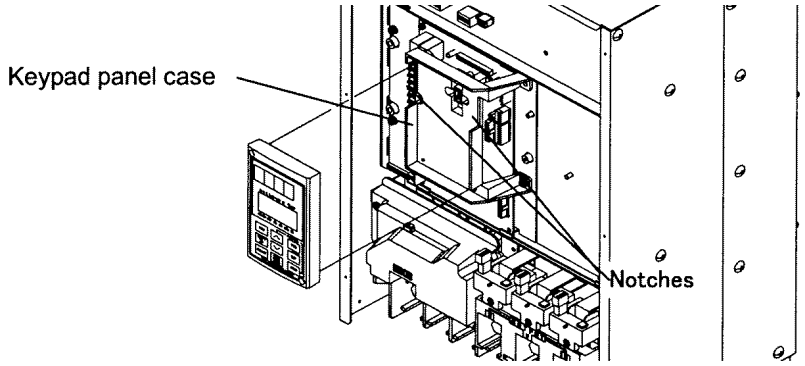



**Fig. 1-3-4 Removing the Digital Operator (40HP/CT, 50HP/VT or more)**

### 1-4 Carrying and Moving the Product

1. Carry the product by the main body.
   ***Do not carry the product while holding the cover or parts other than the main body.***
2. Use a crane or hoist to carry a product equipped with handling hooks.

### 1-5 Storage

***Temporary Storage***

Temporary storage of this product must meet those conditions listed in Table 1-5-1.

**Table 1-5-1 Storage Environment**

| Item | Specifications | |
|---|---|---|
| Ambient temperature | -10 (14°F) to +50 (122°F) | Condensation or freezing must not occur as a result of sudden temperature changes. |
| Storage temperature | -25 (-13°F) to +65 (149°F) Note1 | |
| Relative humidity | 5 to 95% Note2 | |
| Atmosphere | The product must not be exposed to dust, direct sunlight, corrosive gas, oil mist, vapor, or water. There must be a minimum salt content in the atmosphere. Do not store where condensation may occur as a result of sudden changes in temperature. | |

*Note1: The storage temperature applies only to short periods of time such as when transporting the equipment .*

*Note2: As a large change in temperature within this humidity range may result in condensation or freezing, do not store where such temperature changes may occur.*

1. Do not place this product directly on a floor.
2. To store the product in an extreme environment, pack in vinyl sheeting, etc.
3. If the product is stored in a high-humidity environment, insert a drying agent (e.g., silica gel) and pack the product in vinyl sheeting.

## *Long-term Storage*

If the product is to be stored for an extended period of time after purchase, the method of storage depends primarily on storage location.
The general long-term storage method is as follows:

1. The above conditions for temporary storage must be satisfied.
   When the storage period exceeds three months, the upper limit of ambient temperature must be reduced to 30º (86ºF) to prevent the deterioration of the electrolytic capacitors.
2. Pack the product thoroughly to eliminate exposure to moisture and include a drying agent to ensure a relative humidity of about 70% or less.
3. If the product is mounted on equipment or a control panel and is not being unused and is exposed to the elements such as like moisture or dust (particularly on a construction site), remove the product and store in a suitable environment.
4. Electrolytic capacitors not provided with voltage for extended periods of time will deteriorate. Do not store electrolytic capacitors longer than one year without providing voltage to them.

*NOTES*

# 2. Installation and Electrical Connections

## 2-1 Operating Environment

Install this product in a location that meets the conditions listed in Table 2-1-1

**Table 2-1-1 Operating Environment**

| Item | Specifications |
|---|---|
| Location | Indoors |
| Ambient temperature | -10C° to +50°C (14°F to 122°F) - For products of 30HP/CT, 40HP/VT or less, the ventilating covers must be removed if the ambient temperature exceeds +40°C (104°F) |
| Relative humidity | 5 to 95% non-condensing |
| Atmosphere | The product must not be exposed to dust, direct sunlight, corrosive gas, oil mist, vapor, or water. There must be a minimum salt content in the atmosphere. Do not store where condensation may occur as a result of sudden changes in temperature. |
| Altitude | 1000 m (3300 feet) or lower - For altitudes above 1000 m (3300 feet), see Table 2-1-2. |
| Vibration | 3mm peak from 2 to 9Hz, 9.8m/s$^2$ from 9 to 20Hz, 2m/s$^2$ from 20-55Hz, 1m/s$^2$ from 55 to 200Hz. |

**Table 2-1-2 Output Current Reduction Rate Based on Altitude**

| Altitude | Output current reduction rate |
|---|---|
| 3300ft or lower (1000m) | 1.00 |
| 3300-4950ft (1000 to 1500m) | 0.97 |
| 4950-6600ft (1500 to 2000m) | 0.95 |
| 6600-8250ft (2000 to 2500m) | 0.91 |
| 8250-9900ft (2500 to 3000m) | 0.88 |

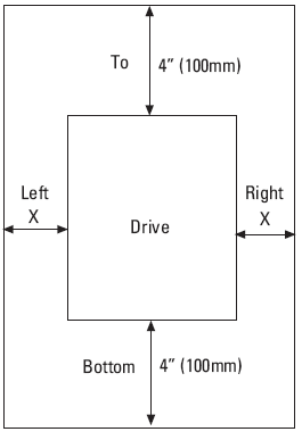



**Fig. 2-2-1**

30HP/CT, 40HP/VT or less:
Gap X can be 0.
(side-by- side installation)

40HP/CT, 50HP/VT or more:

Gap X >= 2.0" (50mm)

## 2-2 Installation Method

1. Mounting, dimensional and weight information for all of the inverter models, is covered in Sec. 8-3 of this manual. Select the model being used and prepare the installation.
2. Securely fasten the product in a vertical upright position on a solid structure with the product logo facing the front. Do not mount the product upside down or install in a horizontal position as proper ventilation will be inhibited.
3. As heat is generated during inverter operation, the spaces shown in Fig. 2-2-1 are required to ensure sufficient cooling. Since heat radiates upward, do not install the product beneath heat sensitive equipment.
4. During operation, the heat sink may reach a temperature of 90°C (194°F), therefore ensure that the material surrounding the product can withstand this temperature.

| | |
|---|---|
| **DANGER** | Install this product on nonflammable material such as metal. |

5. When installing this product in a control panel, ensure that the ventilation is sufficient to prevent the ambient temperature of the inverter from exceeding the specified value. Do not install the product in an area where there is inadequate ventilation,
6. If two or more inverters must be installed in the same equipment or control panel, arrange the units horizontally (side by side) to minimize the effect of heat. If two or more inverters must be installed vertically (one on top of the other), place an insulated plate between the inverters to minimize the effect of heat.
7. When shipped from the factory, inverters provide internal cooling inside panel. An inverter of 30HP/CT, 40HP/VT or less can be converted to an external cooling simply by adding an optional mounting adapter.

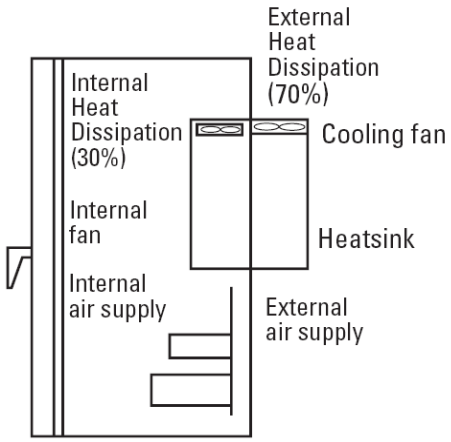



**Fig.2-2-2**

In an external cooling system, the heat sink radiates about 70% of total inverter heat (total loss) and can be placed outside the control panel (see Fig. 2-2-2). When doing this, ensure that heat sink surfaces are kept free of foreign matter.

| | |
|---|---|
| **DANGER** | · In the case of external cooling system, cover the back of the inverter in order to prevent the exposure of the power capacitor and braking resistor as ***electric shock may result*.**<br>· Ensure that the inverter and heat sink surfaces are kept free of foreign matter such as lint, paper dust, small chips of wood or metal, and dust, as ***fire may result.*** |

An inverter of 40HP/CT, 50HP/VT or more can be converted to an external cooling type simply by moving
upper and lower mounting brackets as shown in Fig. 2-2-3. Remove the M6 bracket screws, move the brackets, then secure the brackets using the M5 case mounting screws. (The bracket screws are no longer required after changing the bracket mounting position.)

**Quantity of Mounting Screws**

| Voltage Series | Inverter Type | Bracket Screws | Case Mounting Screws |
|---|---|---|---|
| 230V | EQ5 - 2040 - C to EQ5 - 2100 - C | 5 (M6x20) | 5 (M5x16) |
| | EQ5 - 2125 - C | 7 (M6x20) | 5 (M5x16) |
| | EQ5 - 2150 - C | 6 (M6x20) | 6 (M5x16) |
| 460V | EQ5 - 4040 - C to EQ5 - 4125 - C | 5 (M6x20) | 5 (M5x16) |
| | EQ5 - 4150 - C to EQ5 - 4200 - C | 7 (M6x20) | *1 5 (M5x16) |
| | EQ5 - 4250 - C to EQ5 - 4300 - C | 7 (M6x20) | 7 (M5x16) |
| | EQ5 - 4350 - C to EQ5 - 4400 - C | 6 (M6x20) | *1 6 (M5x16) |
| | *3 EQ5 - 4450 - C to EQ5 - 4600 - C | 6 (M8x20) | *2 |
| | *3 EQ5 - 4150 - C to EQ5 - 4200 - C | 8 (M8x20) | *2 |

*1 Secure the brackets changing the screws, size:M5, length:20mm.
*2 Secure the brackets using the brackets screws.

*3 Do not use the bottom brackets in the bottom surface mount Installation.

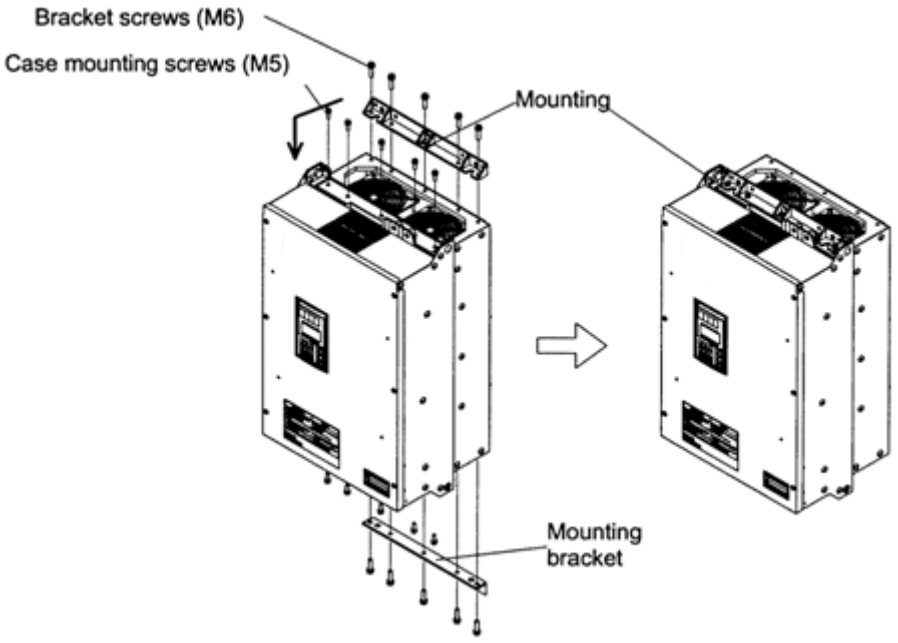



**Fig. 2-2-3 40HP/CT, 50HP/VT or more Removing Upper and Lower Brackets**

8. For inverters of 30HP/CT, 40HP/VT or less, remove the ventilating covers if ambient temperature exceeds +40°C (104°F)

(1) Removing the ventilating covers:
One ventilating cover is mounted on top of the inverter and the other two or three are mounted at the bottom.

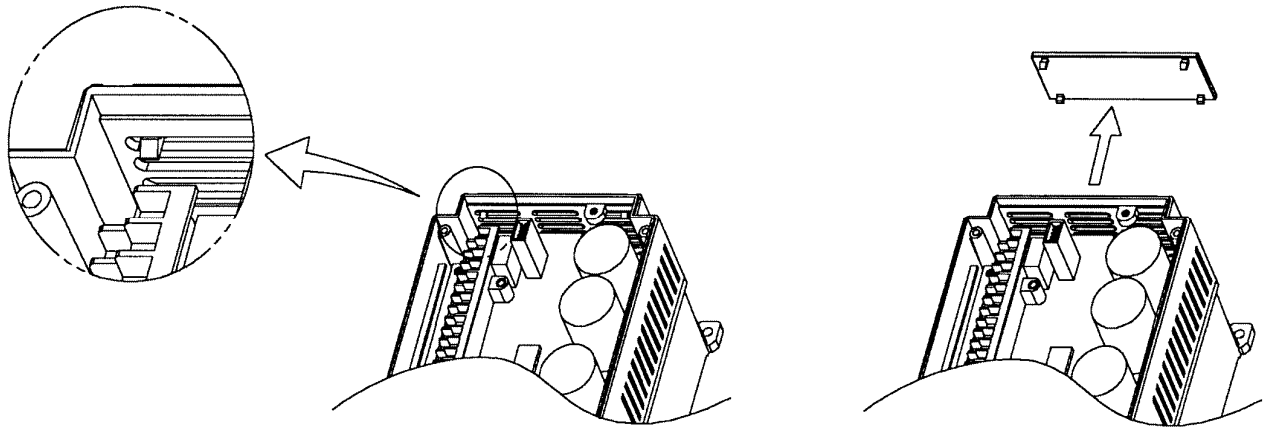


**Fig. 2-2-4 30HP/CT, 40HP/VT or Less Removing Ventilating Covers**

## 2-3 Electrical Connections

To access the terminal blocks remove the cover in accordance with the instructions in this manual.

### 2-3-1 Basic Power Electrical Connections

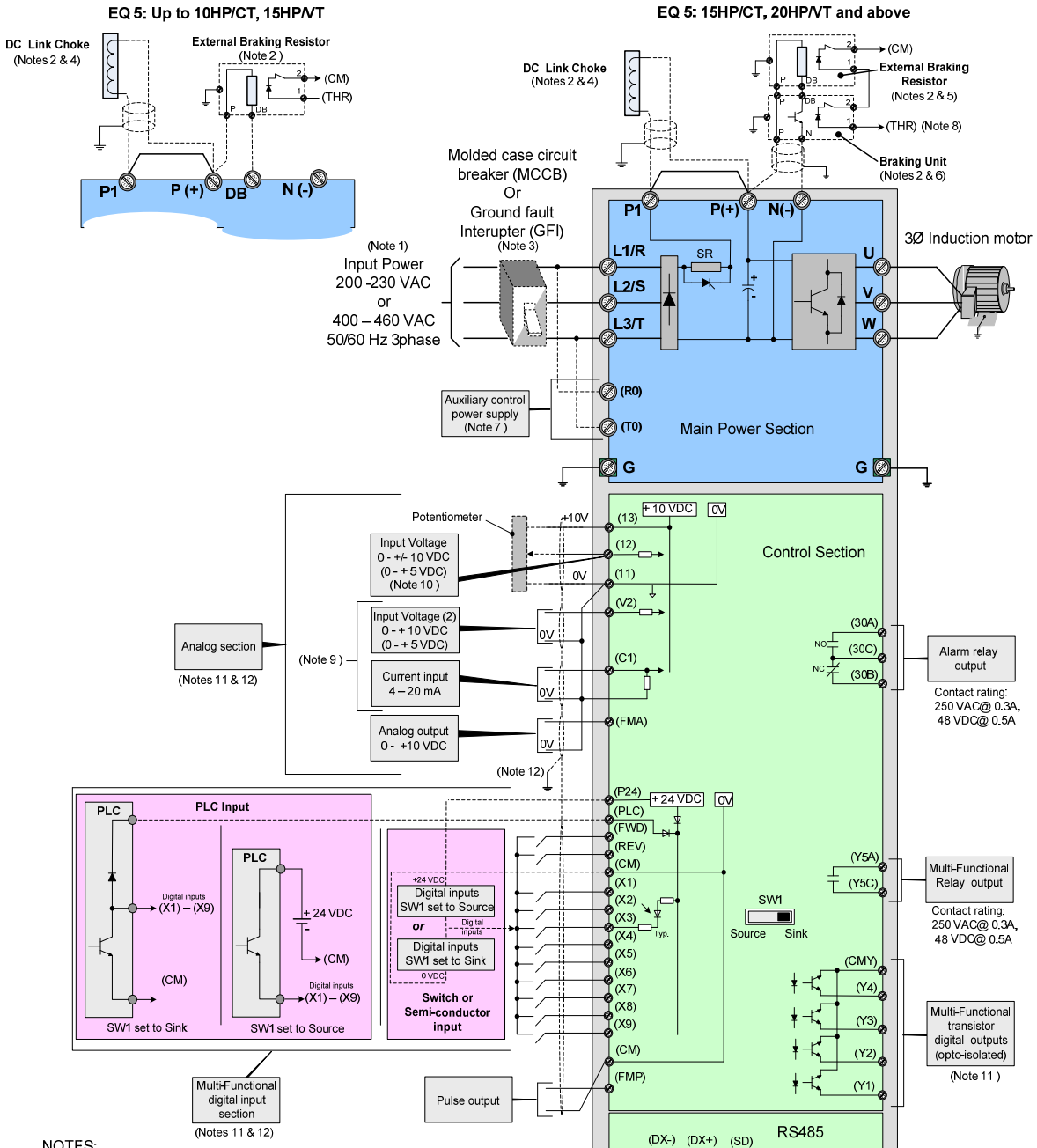
1. Always connect input power to the main circuit power terminals L1/R, L2/S, and L3/T of the inverter. Check that the input voltage to be applied is within the maximum allowable voltage marked on the nameplate.
2. Always connect the power output terminals U, V, and W to the motor. Check that output voltage rating is correct for the motor being used.

**DANGER- Do not connect the input voltage to the motor terminals U, V, and W as extreme damage and / or injury may result.**

3. Using the proper wire size and type, always bond the ground terminal to a reliable ground connection to prevent dangerous situations such as the possibility of fire or electrical shock and to minimize electrical noise.
4. Use a secure reliable cable crimp connection between the terminal and a cable.
5. After terminating the wiring connection, ensure the following:
   a. The connection is correct.
   b. All necessary connections have been made.
   c. There is no short-circuit or ground fault between terminals and cables.
6. If a wiring change needs to be made after power-up, wait at least 5 minutes before making any wiring changes. Also ensure that the charge indicating LED is *off.* This is necessary because the DC power section capacitor(s) does not discharge immediately after power-down and maintains lethal voltages. The actual DC voltage may also be checked with a multimeter and should be 25VDC or less. If short circuiting the DC voltage after power-down, sparks may occur.

| | |
|---|---|
| **DANGER** | • Always properly ground the inverter otherwise **electric shock or fire may result.**<br>• Ensure that a licensed specialist performs all wiring and that all codes are met.<br>• Confirm that the power is turned *off* and that the charge indicator is *off* (Wait 5 minutes for 30HP/CT, 40HP/VT and less, 10 minutes for 40HP/CT, 50HP/VT or above) before removing any protective covers as lethal voltages are present and **electrical shock may result.** |

*NOTES*



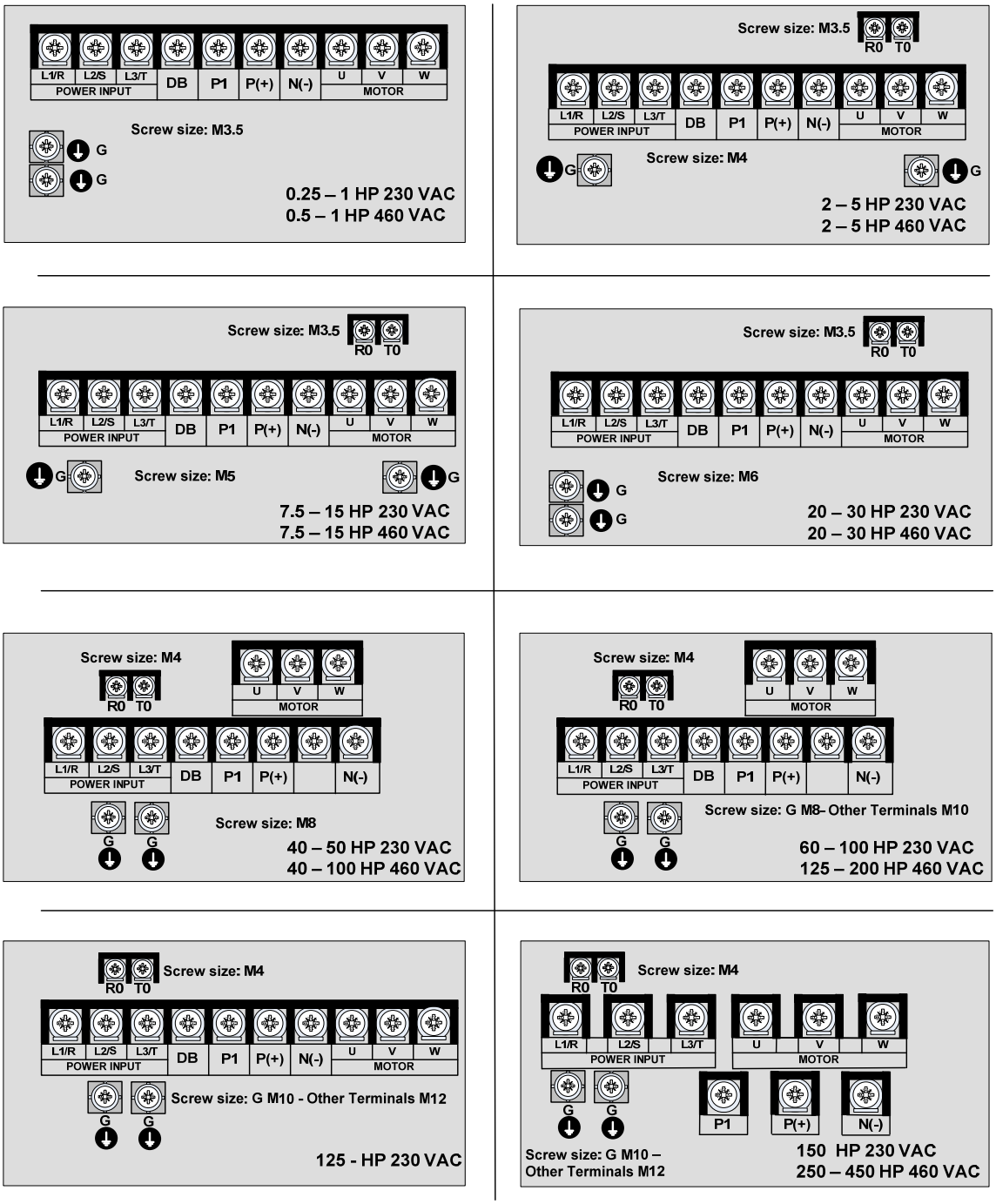

NOTES:

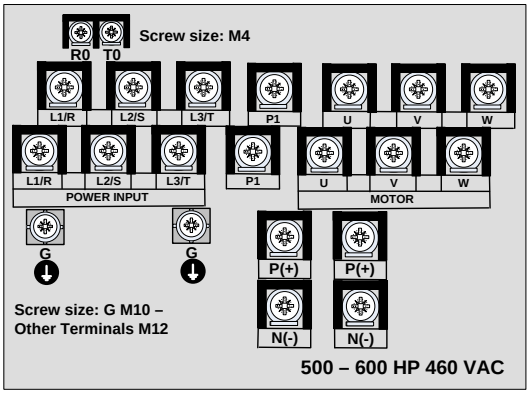
1 - Ensure that the input voltage and power match the drive being used.
2 - The installation of this device is optional.
3 - The use of this peripheral equipment depends on the application requirements.
4 - Remove the jumper between P1 and P(+) before installing the DC link choke.
5 - Install the braking unit option when using the external braking resistor.
6 - Connect the braking unit to P(+) and N(-). The auxiliary terminals I and 2 are polarity sensitive and must be connected as shown.
7 - The drive can be operated without connecting the auxiliary control power supply.
8 - One of the digital inputs (X1) to (X9) can be set to 9 (THR) – Braking unit thermal trip.
9 - Analog inputs V2 or C1 can not be used at the same time as a reference signal .
10 - The analog input signal to terminal (12) can be either from a potentiometer as shown or a external 0 - +10 VDC or 0 - +5 VDC source.
11 - Common points (11) analog input, (CM) digital input, and (CMY) digital output are electrically isolated from each other.
12 - All control signal input wiring should be shielded twisted pair with the shield connected to ground at the inverter end only.

**Fig. 2-3-1 EQ5 Basic Wiring Diagram**

### 2-3-2 Connecting the Input Power, Motor Output Power, and Ground Terminals

The following shows the terminal arrangements for the various HP ranges of the EQ5. The terminal screw sizes are also shown for reference.





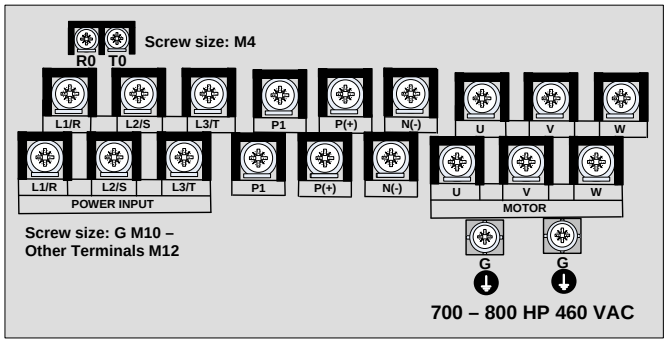




**Table 2-3-1 Functions of Main Circuit Terminals and Ground Terminals**

| Symbol | Terminal Name | Description |
|---|---|---|
| L1/R, L2/S, L3/T | Main circuit input power terminals. | Connects to a 3-phase power supply. |
| U, V, W | Inverter output terminals | Connects to a 3-phase motor. |
| R0, T0 | Auxiliary control-power input terminals. | Connects a backup AC power supply to the control circuit. (Not applicable to inverters of 1HP or less) |
| P1, P (+) | DC link reactor terminal connection. | Connects a power-factor correcting DC link reactor. (optional) |
| P (+), DB | External braking resistor terminal connections. | Connects an external braking resistor for inverters 10HP/CT, 15HP/VT or less. |
| P (+), N (-) | DC link circuit terminals | Supplies DC link voltage to the external braking or power regeneration unit (optional). |
| ⏚ G | Inverter ground terminal | Inverter chassis (case) ground. |

1. Main circuit input power terminals (L1/R, L2/S, L3/T)
   a. For circuit (wiring) protection, connect these terminals to the input power supply using a molded-case circuit breaker or a ground-fault circuit interrupter. Phase-sequence matching is unnecessary.
   b. To ensure safety, a magnetic contactor should be connected to disconnect the inverter from the input power supply when the inverter protective function activates.
   c. The main circuit input power should be used to start or stop the inverter only if absolutely necessary and then should not be used more than once every hour.
   d. If you need to connect these terminals to a single-phase power supply, please consult the factory.

2. Inverter output terminals (U, V, W)
   a. Connect these terminals to a 3-phase motor in the correct phase sequence. If the direction of motor rotation is incorrect, swap any two of the U, V, and W phases.
   b. Do not connect a power factor correction capacitor or surge suppressor to the inverter output.
   c. If the cable from the inverter to the motor is excessively long, a high-frequency current can be generated by stray capacitance between the cables and result in an overcurrent trip of the inverter, an increase in leakage current, or a reduction in current indication precision.
   d. When a motor is driven by a PWM-type inverter, the motor terminals may be subject to surge voltage generated by PWM switching. If the motor cables are excessively long, particularly the 460V series units, the surge voltage will deteriorate motor insulation over time. To prevent this, use the following guidelines:

| **Inverters 7.5HP/CT, 10HP/VT and Higher** | | | |
|---|---|---|---|
| Motor Insulation Rating | 1000V | 1300V | 1600V |
| 460 VAC Input Voltage | 66 ft (20 m) | 328 ft (100 m) | 1312 ft (400 m) * |
| 230 VAC Input Voltage | 1312 ft (400 m) * | 1312 ft (400 m) * | 1312 ft (400 m) * |
| **Inverters 5HP/CT/VT and Smaller** | | | |
| Motor Insulation Rating | 1000V | 1300V | 1600V |
| 460 VAC Input Voltage | 66 ft (20 m) | 165 ft (50 m) * | 165 ft (50 m) * |
| 230 VAC Input Voltage | 328 ft (100 m) * | 328 ft (100 m) * | 328 ft (100 m) * |
| * In this case the cable length is determined by secondary effects and not voltage spiking. | | | |

*Note: When a motor protective thermal O/L relay is inserted between the inverter and the motor, the thermal O/L relay may malfunction (particularly in the 460V series units), even when the cable length is 165 feet (50m) or less. To correct this, insert a filter or reduce the PWM carrier frequency. (Use function code "F26 Motor sound".)*

3. Auxiliary control-power input terminals (R0 and T0)

The inverter will operate even if power is not provided to these terminals. If a protective circuit is activated and the magnetic contactor on the inverter power input side is opened (off), the inverter control circuit power, the alarm output (30A, B, and C), and the keypad display will lose power. To prevent this, the same AC power as supplied to the main input circuit must be supplied (as auxiliary control power) to the auxiliary control - power input terminals (R0 and T0). (see Fig. 2-3-2)

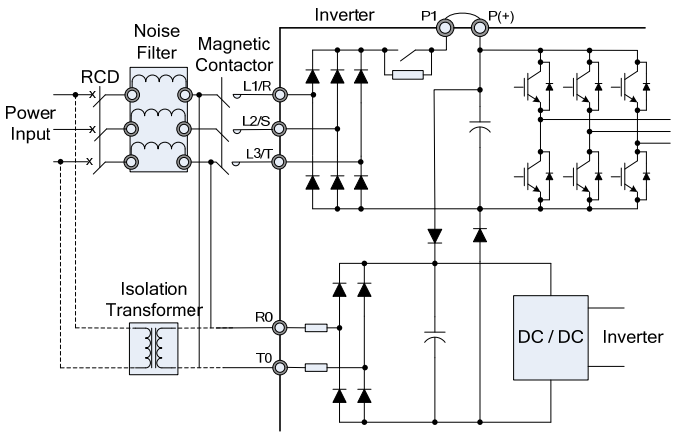



**Fig. 2-3-2 Connecting the Auxiliary Control-Power Input Terminals**

a. To ensure effective noise reduction when using an input noise filter, the output from the filter must go to the auxiliary control-power input terminals. If these terminals are connected to the input side of the filter, the noise reduction is much less effective.

b. When the RCD (Residual-current Protective Device) is installed (30HP/CT, 40HP/VT or less), the terminal R0
and T0 should be connected to the output side of the RCD. If they are connected to the input side, the RCD will malfunction because the power supply of the inverter is three phase and the R0 and T0 input is single phase. If it is required to connect terminals R0 and T0 are to the input side of the RCD, an isolation transformer is required as shown on the Fig. 2-3-2.

4. Connecting a DC link choke to terminals (P1 and P (+))
   a. Before connecting a DC link choke to these terminals, remove the factory-installed jumper. (Fig. 2-3-3)
   b. If a DC link choke is not used, *do not* remove the jumper.

*Note: For inverters of 100HP or more, the DC link choke is provided as separate standard component and should always be connected. For inverters less than 100 HP, the DC link choke is not provided and is optional.*

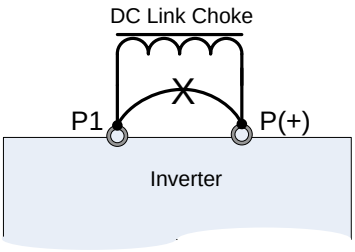



**Fig. 2-3-3 Remove Jumper**

4. Connecting an external braking-resistor to terminals (P (+) and DB) (10HP/CT, 15HP/VT or less) (Fig. 2-3-4). For inverters 10HP/CT, 15HP/VT or less, a built-in braking resistor is connected to terminals P (+) and DB. If this braking resistor does not provide sufficient thermal capacity (e.g. high operating duty cycle or high inertia loads), an optional external braking resistor must be installed to improve braking performance.

   a. Remove the internal braking resistor from terminals P(+) and DB and Insulate the terminals with adhesive insulation tape, etc.
   b. Connect terminals P(+) and DB of the external braking resistor to terminals P(+) and DB of the inverter.
   c. The wiring (cables twisted or otherwise) should not exceed 16ft (5m).

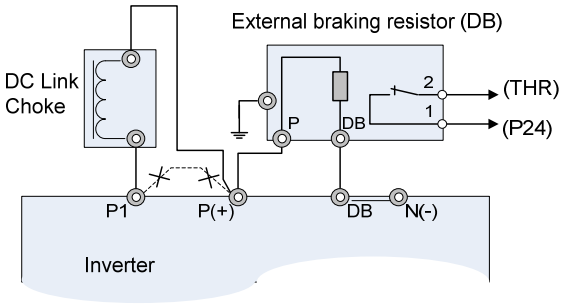



**Fig. 2-3-4 Connection (10HP/CT, 15HP/VT or less)**

6. DC link circuit terminals (P (+) and N (-)) (Fig.2-3-5).
The EQ5 inverter of 15HP/CT, 20HP/VT or more does not contain a drive circuit for the braking resistor. To improve braking performance, an optional external braking unit and external braking resistor must be installed.
   a. Connect terminals P and N of the braking unit to terminals P(+) and N(-) of the inverter. The wiring (cables twisted or otherwise) should not exceed 16ft(5m).
   b. Connect terminals P and DB of the braking resistor to terminals P and DB of the braking unit. The wiring (cables twisted or otherwise) should not exceed 33ft (10m).
   c. Connect terminals P and DB of the braking resistor to terminals P and DB of the braking unit. The wiring (cables twisted or otherwise) should not exceed 33ft (10m).

**DANGER-** *When terminals P (+) and N (-) of the inverter are not used, leave terminals open. If P(+) is connected to N (-) the bus voltage will be shorted, or if braking resistor is connected directly, the resistor can cause fire.*

d. Auxiliary contacts 1 and 2 of the braking unit are polarity sensitive. To connect the braking unit, refer to the "TECO Inverter Speecon Braking Unit Manual".

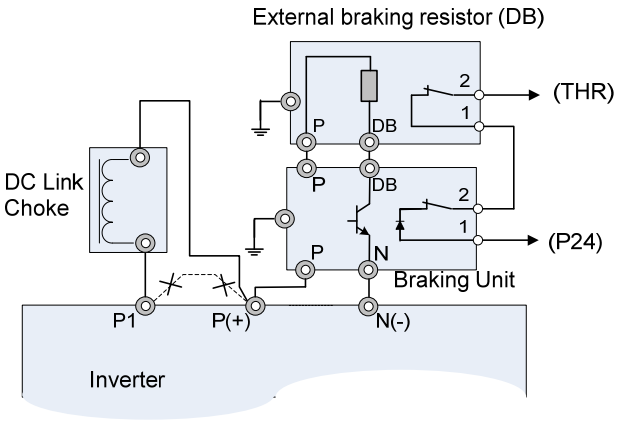



**Fig. 2-3-5 Connection (15HP or more)**

7. Inverter ground terminal
   To ensure safety and noise reduction, always bond the inverter ground terminal. Also, metal frames of electrical equipment must be grounded as specified in applicable codes
   The connection procedure is as follows:
   a. Ground all metal frames and chassis to a ground terminal (Ground resistance: ≤10Ω).
   b. In accordance with applicable codes, use a suitable ground cable to connect the inverter system to ground.

8. Placement of connector (CN UX) for inverters 40HP/CT, 50HP/VT and higher.
   When an inverter of 40HP or higher is connected to an input voltage listed in Table 2-3-2, disconnect the auxiliary power connector CN UX from U1 and connect to U2.
   (Refer to Fig. 2-3-7)

**Table 2-3-2 Main Input Voltage Requiring Auxiliary Power Connector Change**

| Frequency [Hz] | Input voltage range [VAC] |
|---|---|
| 50 | 380 - 398 |
| 60 | 380 - 430 |

9. Placement of fan power connector (CN RXTX) for inverters 40HP/CT, 50HP/VT or higher.
   An inverter of 40HP/CT, 50HP/VT or greater uses an AC cooling fan. When the inverter is being operated with DC Input power, the fan must still be energized from an AC power source. To do this, position the fan connector (CN RTXT) as shown in Fig. 2-3-9 and provide AC voltage to auxiliary input terminals R0 and T0. For the (CN RTXT) connector placement method, see Fig. 2-3-7.

*Note: When shipped, the fan connector (CN RXTX) is connected to L1/R-L3/T. Do not change the connector position unless DC power is being used.*

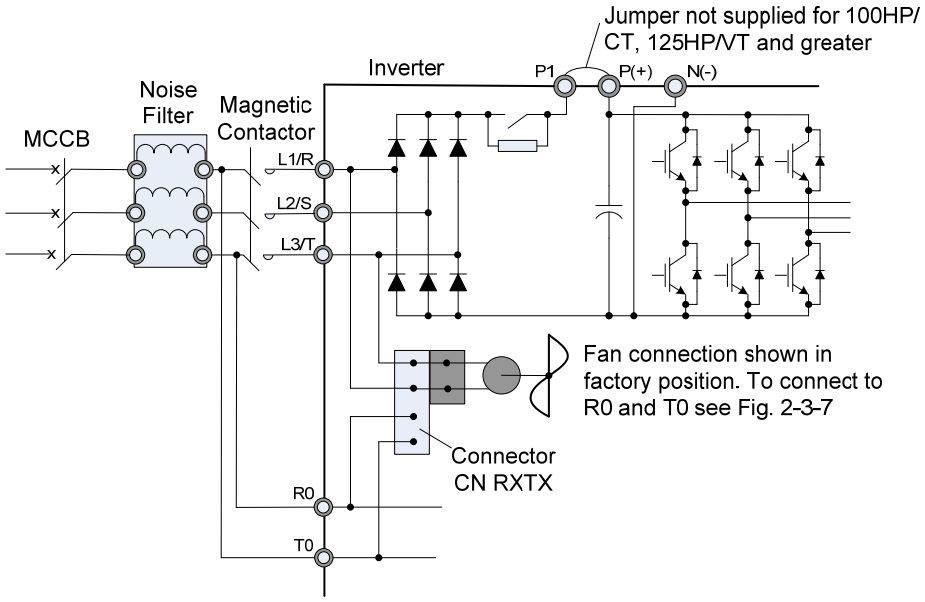
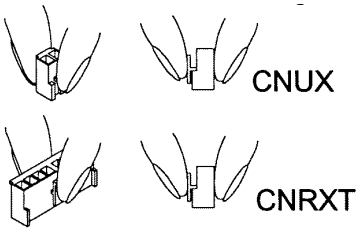


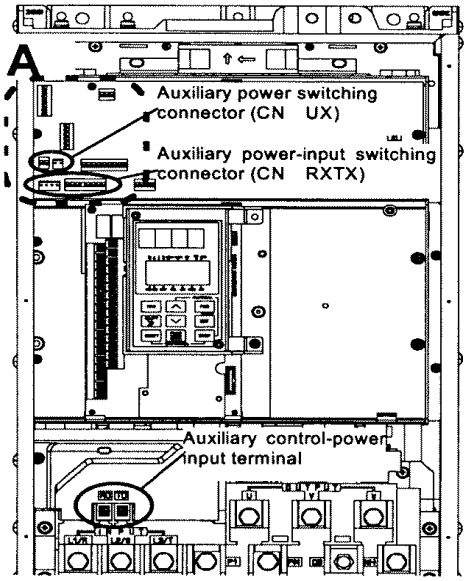

**Fig. 2-3-6 Fan Power Connection**

*NOTES*

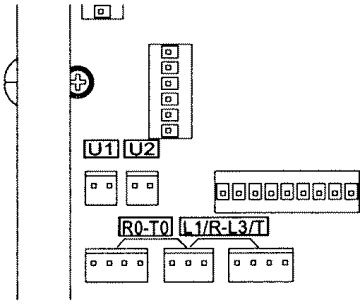
The connectors are mounted on the power PCB above the control PCB as shown on the right.



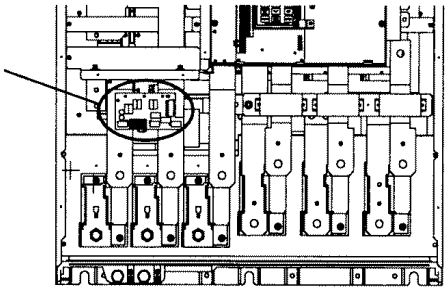

***Note:***
*To remove a connector, squeeze the locking mechanism and pull. To mount a connector, push the connector down until it locks (clicks).*




EQ5-4040-C to EQ5-4200-C
EQ5-2040-C to EQ5-14150-C




<Enlarged view of part A>




EQ5-4250-C to EQ5-4900-C

When shipped from the factory, CN UX is connected to U1 and CN RXTX is connected to L1/R-L3/T.

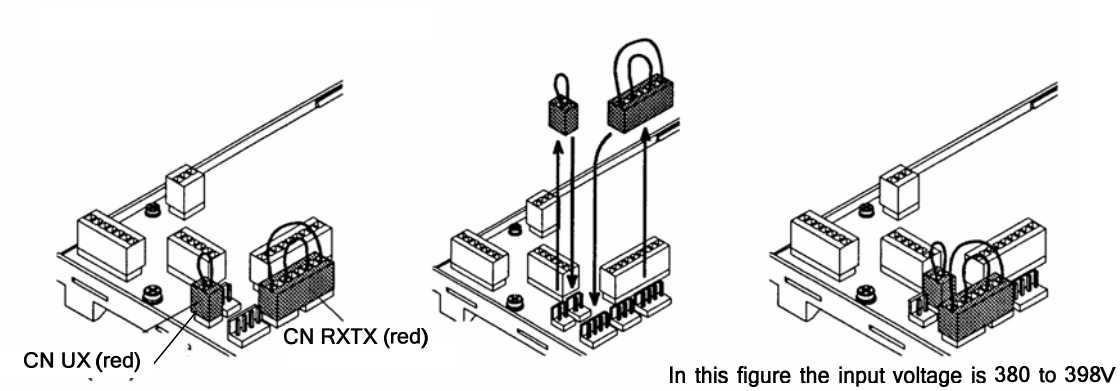



**Fig. 2-3-7 (CN UX) and (CN RXTX) Connector Locations and Orientation**

### 2-3-3 Connecting the Control Terminals

Table 2-3-3 lists the functions of the control circuit terminals. The connections to the control terminals will be in accordance with its function setting.

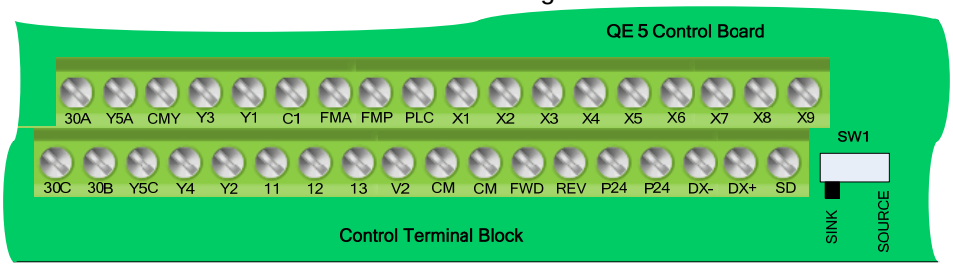
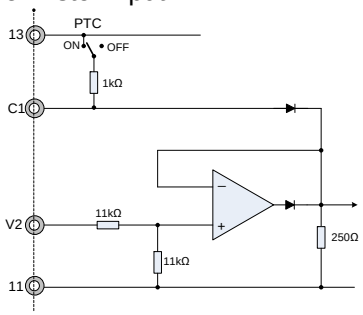
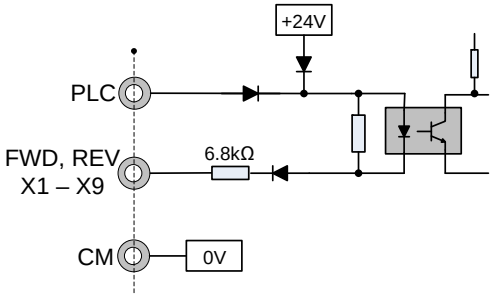
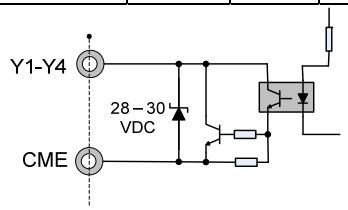



**Table 2-3-3 Control Terminal Functions**

| Classification | Terminal Symbol | Terminal Name | Function |
|---|---|---|---|
| Analog input | 13 | Potentiometer power supply | Supplies +10V DC to an externally connected frequency control potentiometer (1 to 5kΩ). |
| | 12 | Voltage input 1 | 1- Sets the output frequency in accordance with an analog input voltage applied from an external circuit.<br>- 0 to +10V DC / 0 to 100%<br>- Reversible operation using positive and negative signals: 0 to +/-10V DC / 0 to +/-100%<br>- Reverse operation: +10 to 0V DC / 0 to 100%<br>2- Feedback signal for PID control.<br>3- Output torque control.<br>* Terminal Input resistance: 22kΩ |
| | V2 | Voltage input 2 | Sets the output frequency in accordance with an analog input voltage applied from an external circuit.<br>- 0 to +10V DC / 0 to 100%<br>- Reverse operation:+10 to 0V DC / 0 to 100%<br>* Terminals "V2" and "C1" cannot be used at the same time.<br>* Terminal Input resistance: 22kΩ |
| | C1 | Current input | 1- Sets the output frequency in accordance with an analog input current applied from an external circuit.<br>- 4 to 20mA DC / 0 to 100%<br>- Reverse operation: 20 to 4mA DC / 0 to 100%<br>2- Feedback signal for PID control.<br>3- PTC thermistor input.<br>  <br>* Terminals "V2" and "C1" cannot be used at the same time.<br>* Terminal Input resistance: 250Ω<br>* PTC switch is off when function not used. |
| | 11 | Analog input common | Common terminal for analog input and output signals |

<table>
<tr><td rowspan="13">Digital input</td><td>FWD</td><td>Forward operation / stop command</td><td>Forward operation (when FWD-CM is on) or deceleration and stop (when FWD-CM is open).</td></tr>
<tr><td>REV</td><td>Reverse operation / stop command</td><td>Reverse operation (when REV-CM is on) or deceleration and stop (when REV-CM is open).</td></tr>
<tr><td>X1</td><td>Digital input 1</td><td rowspan="10">The coast-to-stop command, external alarm, alarm reset, multi-step frequency selection, and other functions (from an external circuit) can be assigned to terminals X1 to X9. For details, see "Setting the Terminal Functions E01 to E09" in Section 5.3 Function Explanation. <Specifications of digital input circuit><br>*<br><table><tr><th colspan="2">Item</th><th>min.</th><th>typ.</th><th>max.</th></tr><tr><td rowspan="2">Operating voltage</td><td>ON</td><td>2V</td><td>-</td><td>2V</td></tr><tr><td>OFF</td><td>22V</td><td>24V</td><td>27V</td></tr><tr><td>Operating current level</td><td>ON</td><td>-</td><td>3.2mA</td><td>4.5mA</td></tr><tr><td>Leakage current</td><td>OFF</td><td>-</td><td>-</td><td>0.5mA</td></tr></table>  </td></tr>
<tr><td>X2</td><td>Digital input 2</td></tr>
<tr><td>X3</td><td>Digital input 3</td></tr>
<tr><td>X4</td><td>Digital input 4</td></tr>
<tr><td>X5</td><td>Digital input 5</td></tr>
<tr><td>X6</td><td>Digital input 6</td></tr>
<tr><td>X7</td><td>Digital input 7</td></tr>
<tr><td>X8</td><td>Digital input 8</td></tr>
<tr><td>X9</td><td>Digital input 9</td></tr>
<tr><td></td><td></td></tr>
<tr><td>CM</td><td>Common terminal</td><td>Common terminal for digital inputs ,FMP and P24.</td></tr>
<tr><td>P24</td><td>Control Unit power Supply</td><td>+24VDC power supply for control input. Maximum output current 100mA</td></tr>
<tr><td>PLC</td><td>PLC signal power</td><td>Used to connect to a PLC power supply output 22 to 27 VDC, input signals set to sink logic operation.</td></tr>
<tr><td>Analog output</td><td>FMA<br>(11 Com)</td><td>Analog monitor</td><td>Analog output DC voltage 0 to +10V DC.<br>The signal is selected to indicate one of the following:<br>-Output frequency (before slip compensation)<br>-Power consumption<br>-Output frequency (after slip compensation)<br>-PID feedback value<br>-Output current<br>-PG feedback value<br>-Output voltage<br>-DC link circuit voltage<br>-Output torque<br>-Load factor<br>*Minimum load resistance: 5kΩ</td></tr>
</table>

<table>
<tr><td>Pulse output</td><td>FMP<br>(CM Com)</td><td>Frequency monitor<br>(pulse output)</td><td>Outputs a pulse frequency indicating the same as that of the analog FMA signal.</td></tr>
<tr><td rowspan="5">Transistor output</td><td>Y1</td><td>Transistor output1</td><td rowspan="4">A running signal, frequency equivalence signal, overload early warning signal, and other signals from the inverter are output (as a transistor output) to terminals Y1-Y4. For details, see "Setting the Terminal Functions E20 to E23" in Section 5.3 Function Explanation<br><br>Transistor output circuit specifications<br><table><tr><th colspan="2">Item</th><th>min.</th><th>typ.</th><th>max.</th></tr><tr><td rowspan="2">Operating voltage</td><td>ON</td><td>-</td><td>2V</td><td>3V</td></tr><tr><td>OFF</td><td>-</td><td>24V</td><td>27V</td></tr><tr><td>Maximum load current</td><td>ON</td><td>-</td><td>-</td><td>50mA</td></tr><tr><td>Leakage current</td><td>OFF</td><td>-</td><td>-</td><td>0.1mA</td></tr></table>  </td></tr>
<tr><td>Y2</td><td>Transistor output2</td></tr>
<tr><td>Y3</td><td>Transistor output3</td></tr>
<tr><td>Y4</td><td>Transistor output4</td></tr>
<tr><td>CME</td><td>Transistor output common</td><td>Common terminal for transistor output signals<br>This terminal is insolated from terminals [CM] and [11].</td></tr>
<tr><td rowspan="2">Relay outputs</td><td>30A,30B,<br>30C</td><td>Alarm output for any fault</td><td>If the inverter is stopped by an alarm (protective function), the relay (SPDT) will activate.<br>Contact rating: 250 VAC, .03A - 48V DC, 0.5A<br>The activation mode can be selected for normal or alarm operation.</td></tr>
<tr><td>Y5A,Y5C</td><td>Multipurpose-signal relay output</td><td>The activation signals can be the same as the Y1 -Y4 outputs above.<br>The contact ratings are the same as that of the alarm output above.</td></tr>
<tr><td rowspan="2">Communication</td><td>DX+, DX-</td><td>RS485<br>Modbus RTU<br>communication</td><td>Terminals for RS485 communication (Modbus RTU). UP to 31 inverters can be connected using the daisy chain method.</td></tr>
<tr><td>SD</td><td>Communication-cable shield connection terminal</td><td>Terminal for connecting the shield of the communication cable. The terminal is electrically floating.</td></tr>
</table>

(1) Analog input terminals (13,12,V2,C1,and 11)

a. These terminals receive analog signals that may be affected by external noise. The cables should be as short as possible (66ft /20m or less), be shielded twisted cable, and must be properly grounded. If the cables are affected by externally induced noise, the shielding effect may be improved by connecting the shield to terminal [11]. (see Fig. 2-3-8)

b. If contacts are used to connect to these circuits, twin (bifurcated type) contacts for handling low level signals must be used. A contact must not be connected to terminal [11].

c. If an external analog signal output device is connected to these terminals, it may malfunction as a result of inverter noise. To prevent malfunction, connect a ferrite core or capacitor to the external analog signal output device as shown in Fig. 2-3-9.

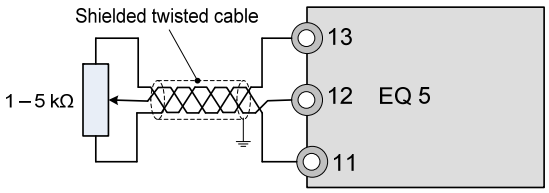



**Fig. 2-3-8 Shielding**

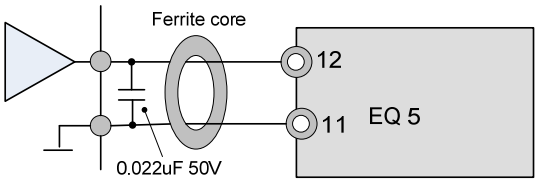



**Fig. 2-3-9 Noise Suppression Example**

(2) Digital input terminals (FWD, REV, X1 to X9, and CM)

a. Digital input terminals FWD, REV and X1 to X9 are generally turned on or off by switching the input to (P24) +24V (source logic) or to (CM) 0V (sink logic). If the digital input terminals are turned on or off by a PLC with open collector using an external power supply, a resulting bypass circuit may cause the inverter to malfunction. To prevent this, connect the PLC terminal as shown in Fig. 2-3-10.

b. When using a dry contact input such as a relay, highly reliable contacts capable of handling low level signals must be used.

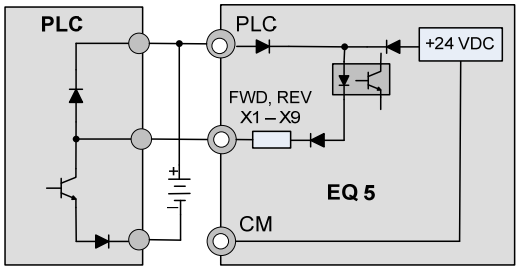



**Fig. 2-3-10 PLC Connection for External Power Supply**

(3) Transistor output terminals (Y1 to Y4, CME)

a. Refer to the circuit configuration in Table 2-3-3 Transistor Output and confirm the polarity of the external power supply.

b. When connecting a control relay to the transistor output, connect a transient absorbing diode to both ends of the relays' exciting coil.

(4) Sink or Source Logic selection

a. The slide switch SW1 located on the control board, sets the digital inputs for sink or source input logic. The factory default is the sink position and is most commonly used in the US while source logic is common in Europe.

b. For proper input digital connections, refer to the EQ 5 wiring diagram as well as other sections covering this subject. Ensure that the correct position is selected for a particular application.

(5) Others

a. To prevent faulty operation as a result of noise, the control terminal cables should be placed as far as possible from the main power cables.

b. The control cables inside the inverter must be secured to prevent direct contact with the main power section, such as the power terminal block.

(6) Wiring of the control circuit (40HP/CT, 50HP/VT or greater)

a. Pull out the control circuit wiring along the left panel as shown in Fig. 2-3-11.

b. Secure the cable binding hole A on the left wall of the power terminal block using a cable tie.
*Note: The cable tie should not exceed 0.14 "(3.5mm) in width and 0.06" (1.5mm) in thickness.*

c. When an optional PC card is mounted, the signal cables must be secured to cable binding hole B.

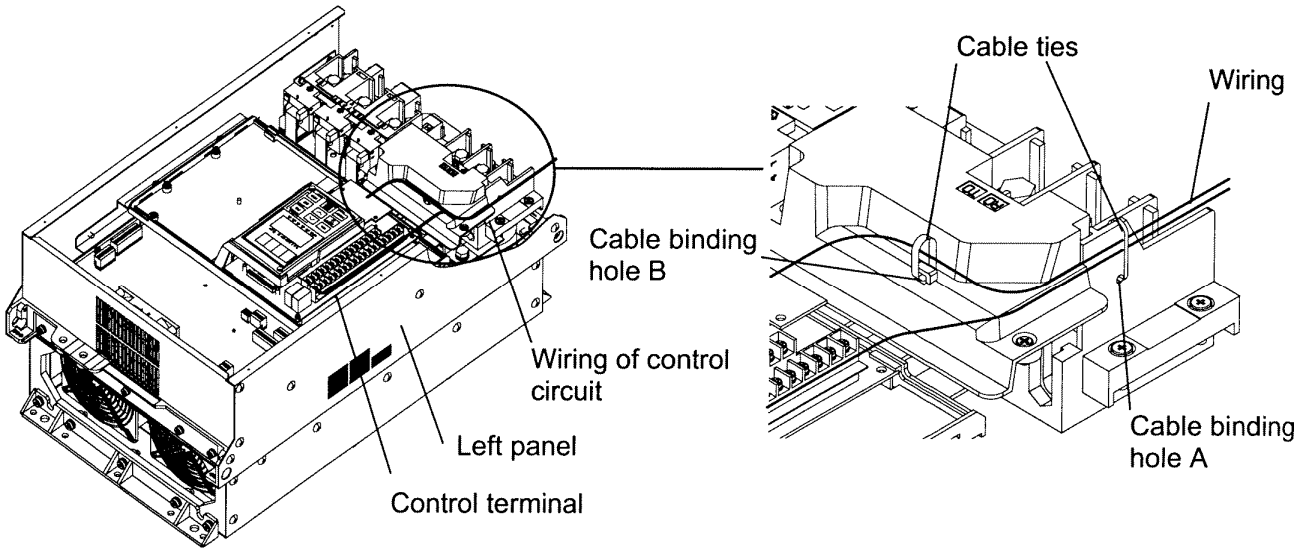



**Fig. 2-3-11 Control Cable Routing and Securing for 40HP/CT, 50HP/VT and Greater**

*NOTES*

**2-3-4 Input Protective Device Ratings.**

| Input Voltage | HP Rating (VT / CT) | Input Fuse (AMPS) | | | Input Circuit Breaker (AMPS) (*Note 1*) |
|---|---|---|---|---|---|
| | | L1/R, L2/S & L3/T (Nominal) | L1/R, L2/S & L3/T (Maximum) (*Note 1*) | Auxiliary Input R0 & T0 | |
| 230 VAC | 0.25 / 0.25 | 3 | 3 | 3 | 15 |
| | 0.5 / 0.5 | 5 | 6 | 3 | 15 |
| | 1 / 1 | 10 | 15 | 3 | 20 |
| | 2 / 2 | 15 | 20 | 3 | 30 |
| | 3 / 3 | 20 | 30 | 3 | 40 |
| | 5 / 5 | 35 | 50 | 3 | 60 |
| | 7.5 / 5 | 60 | 80 | 3 | 100 |
| | 10 / 7.5 | 70 | 125 | 3 | 125 |
| | 15 / 10 | 100 | 150 | 3 | 175 |
| | 20 / 15 | 125 | 200 | 3 | 225 |
| | 25 / 20 | 150 | 225 | 3 | 250 |
| | 30 / 25 | 175 | 250 | 3 | 300 |
| | 30 / 30 | 175 | 250 | 3 | 300 |
| | 40 / 30 | 200 | * | 5 | 200 |
| | 50 / 40 | 225 | * | 5 | 225 |
| | 60 / 50 | 300 | * | 5 | 300 |
| | 75 / 60 | 350 | * | 5 | 350 |
| | 100 / 75 | 300 | * | 5 | 300 |
| | 125 / 100 | 400 | * | 5 | 400 |
| | 150 / 125 | 450 | * | 5 | 450 |
| 460VAC | 0.5 / 0.5 | 3 | 3 | 3 | 15 |
| | 1 / 1 | 5 | 6 | 3 | 15 |
| | 2 / 2 | 10 | 10 | 3 | 15 |
| | 3 / 3 | 15 | 15 | 3 | 20 |
| | 5 / 5 | 20 | 25 | 3 | 35 |
| | 7.5 / 5 | 30 | 45 | 3 | 50 |
| | 10 / 7.5 | 40 | 60 | 3 | 70 |
| | 15 / 10 | 50 | 90 | 3 | 90 |
| | 20 / 15 | 70 | 110 | 3 | 110 |
| | 25 / 20 | 80 | 125 | 3 | 150 |
| | 30 / 25 | 100 | 125 | 3 | 175 |
| | 30 / 30 | 100 | 125 | 3 | 175 |
| | 40 / 30 | 100 | * | 10 | 100 |
| | 50 / 40 | 125 | * | 10 | 125 |
| | 60 / 50 | 175 | * | 10 | 175 |
| | 75 / 60 | 150 | * | 10 | 150 |
| | 100 / 75 | 175 | * | 10 | 175 |
| | 125 / 100 | 200 | * | 10 | 200 |
| | 150 / 125 | 225 | * | 10 | 225 |
| | 200 /150 | 300 | * | 10 | 300 |
| | 250 / 200 | 450 | * | 10 | 400 |
| | 300 / 250 | 500 | * | 10 | 450 |
| | 350 / 300 | 500 | * | 10 | 500 |
| | 400 / 350 | 600 | * | 10 | 600 |
| | 450 / 350 | 700 | * | 10 | 700 |
| | 500 / 400 | 700 | * | 10 | 700 |
| | 600 / 450 | 1000 | * | 10 | 1000 |
| | 700 / 500 | 1000 | * | 10 | 1000 |
| | 800 / 600 | 1200 | * | 10 | 1200 |

Note 1 - Class J fuse or circuit breaker rated 600V with the maximum current rating as shown in the above table to be connected to a drive 30HP/CT, 40HP/VT and less.

### 2-3-5 EQ5 Terminal Tightening Torque and Cable Size

| Input Voltage | HP Rating (CT / VT) | Terminal Tightening Torque lb – in (Nm) *(Note 4)* | | | Cable Size AWG *(Note 3)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L1/R, L2/S, L3/T, U, V, W, P1 & P(+) | E (G) | DB Circuit P(+), N(-) & DB *(Note 1)* | R0 & T0 | L1/R, L2/S & L3/T | U, V & W | DC Reactor, P1 & P(+) | DB Cir. P(+), N(-) & DB *(Note 1)* | R0 & T0 |
| 230 VAC | 0.25 / 0.25 | 10.6 (1.2) | | 10.6 (1.2) | - | 16 | | | 16 | - |
| | 0.5 / 0.5 | | | | | | | | | |
| | 1 / 1 | | | | | | | | | |
| | 2 / 2 | 20.8 (2.36) | | 20.8 (2.36) | 10.6 (1.2) | 14 | | | 14 | 14 |
| | 3 / 3 | | | | | 10 | | | | |
| | 5 / 5 | | | | | 8 | | | | |
| | 5 / 7.5 | 31.0 (3.5) | | 31.0 (3.5) | | 6 | | | | |
| | 7.5 / 10 | | | | | 4 | | | | |
| | 10 / 15 | 51.3 ( 5.8) | | | | 3 | | | | |
| | 15 / 20 | | | | | 2 | | | | |
| | 20 / 25 | | | | | 1 | | | | |
| | 25 / 30 | | | | | | | | | |
| | 30 / 30 | | | | | | | | | |
| | 30 / 40 | 119 (13.5) | | | | 4/0 | 1/0 | 2/0 | | 10 |
| | 40 / 50 | | | | | | | | | |
| | 50 / 60 | 239 (27) | 119 (13.5) | 119 (13.5) | | Qty 2-1 | 3/0 | 4/0 | 10 | |
| | 60 / 75 | | | | | Qty 2-2/0 | 4/0 | Qty 2-1 | | |
| | 75 / 100 | | | | | Qty 2-3/0 | Qty 2-1/0 | Qty 2-2/0 | 8 | |
| | 100 / 120 | 425 (48) | 239 (27) | | | Qty 2-2/0 | Qty 2-3/0 | Qty 2-4/0 | 6 | |
| | 125 / 150 | | | | | Qty 2-4/0 | Qty 2-4/0 | Qty 2-250 | 4 | |
| 460 VAC | 0.5 / 0.5 | 10.6 (1.2) | | 10.6 (1.2) | - | 16 | | | 16 | - |
| | 1 / 1 | | | | | | | | | |
| | 2 / 2 | 20.8 (2.36) | | 20.8 (2.36) | 10.6 (1.2) | | | | | 14 |
| | 3 / 3 | | | | | | | | | |
| | 5 / 5 | | | | | 14 | | | 14 | - |
| | 5 / 7.5 | 31.0 (3.5) | | 31.0 (3.5) | | 12 | | | | |
| | 7.5 / 10 | | | | | 10 | | | | |
| | 10 / 15 | 51.3 ( 5.8) | | | | | | | | |
| | 15 / 20 | | | | | 8 | | | | |
| | 20 / 25 | | | | | 6 | | | | |
| | 25 / 30 | | | | | 4 | | | | |
| | 30 / 30 | | | | | | | | | |
| | 30 / 40 | 119 (13.5) | | | | 2 | 3 | 3 | | 10 |
| | 40 / 50 | | | | | 1 | 2 | 2 | | |
| | 50 / 60 | | | 51.3 ( 5.8) | | 2/0 | 2 | 1 | | |
| | 60 / 75 | | | | | 3/0 | 2/0 | 2/0 | | |
| | 75 / 100 | 239 (27) | 119 (13.5) | | | 2/0 | 4/0 | 4/0 | | |
| | 100 / 125 | | 239 (27) | | | 3/0 | 4/0 | Qty 2-1 | 10 | |
| | 125 / 150 | | | 119 (13.5) | | Qty 2-1/0 | Qty 2-1/0 | Qty 2-1/0 | 8 | |
| | 150 / 200 | | | | | Qty 2-1/0 | Qty 2-2/0 | Qty 2-3/0 | | |
| | 200 / 250 | 425 (48) | | 239 (27) | | Qty 2-3/0 | Qty 2-3/0 | Qty 2-4/0 | 6 | |
| | 250 / 300 | | | | | Qty 2-4/0 | Qt y2-250 | Qty 2-300 | 4 | |
| | 300 / 350 | | | | | Qty 2-250 | Qty 2-300 | Qty 2-350 | | |
| | 350 / 400 | | | *(Note 2)* | | Qty 2-350 | Qty 2-400 | Qt y2-500 | *(Note 2)* | |
| | 350 / 450 | | | | | Qty 2-500 | Qty 2-500 | Qt y2-700 | | |
| | 400 / 500 | | | | | Qty 2-350 | Qty 2-400 | Qty 2-500 | | |
| | 450 / 600 | | | | | Qty 2-500 | Qty 2-500 | Qty 2-700 | | |
| | 500 / 700 | | | | | Qty 2-600 | Qty 2-600 | Qty 2-800 | | |
| | 600 / 800 | | | | | Qty 2-700 | Qty 2-750 | Qty 2-1000 | | |

Notes 1 - Based on TWMC standard DB unit and DB resistor designs.
2 - Consult Factory.
3 - Wire size from NEC tables 310-16. Copper wire rated 60°C for 100 Amps or less, 75°C for over 100 Amps in 30°C Ambient, and 1.25 x drive rated Amps.
4 - Control terminals tightening torque, 6.2 (0.7)

### 2-3-6 DC Link Choke Wattage Loss

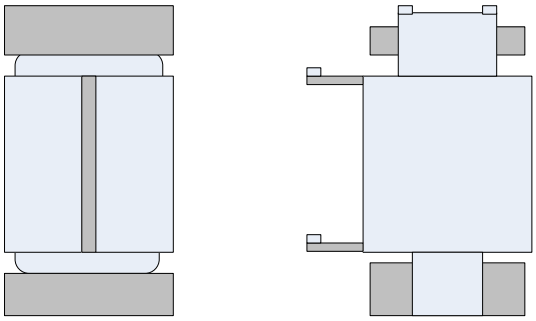


**Fig. 2-3-12 DC Link Choke**

*Note: Please refer to Sec. 8- 3- 4 for dimensions and weights.*

| Input Voltage | Hp | Model No. | Loss (Watts) |
|---|---|---|---|
| **230V** | 100/75 | DCR2-75B | 55 |
| | 125/100 | DCR2-90B | 57 |
| | 150/125 | DCR2-110B | 67 |
| **460V** | 100/75 | DCR4-75B | 58 |
| | 125/100 | DCR4-90B | 64 |
| | 150/125 | DCR4-110B | 73 |
| | 200/150 | DCR4-132B | 84 |
| | 250/200 | DCR4-160B | 90 |
| | 300/250 | DCR4-200B | 126 |
| | 350/300 | DCR4-220B | 131 |
| | 400/350 | DCR4-280B | 133 |
| | 450/350 | DCR4-280B | 150 |
| | 500/400 | DCR4-355B | 205 |
| | 600/450 | DCR4-400B | 215 |
| | 700/500 | DCR4-450B | 272 |
| | 800/600 | DCR4-500B | 292 |

*Notes:*

- *EQ5 Drives rated 100 Hp and above are furnished with a DC link choke. This choke must be installed between terminals P1 and P+ prior to applying power to the Drive.*
- *The weight of the DC Link Reactor is not included as part of weight referenced for the Drive.*
- *The DC Link choke is provided as open type and is separately mounted. Any enclosures are to be provided by the user.*

# 3. Initial Operation

## 3-1 Inspection and Preparation Before Operation

Check the following before operation:

1. Check that all the electrical connections are secure and correct. (Fig. 3-1-1)
   In particular, check that the input power supply is not connected to any of the U, V, and W output terminals to the motor and that the ground terminal is securely grounded.
2. Check for short-circuits and ground faults between the terminals and powered–up sections.
3. Check for loose terminals, connectors, or screws.
4. Check that the motor is disconnected from mechanical equipment.
5. Turn off all control switches before turning on power to ensure that the inverter will not start or operate abnormally at power-up.
6. Check the following after power-up:
   a. No alarm message is displayed on the digital operator (see Figure 3-1-2).
   b. The fan inside the inverter is rotating. (For drives 2HP or more)

**DANGER** Be sure that all protective covers are in place before turning on the power. Never remove the protective covers while the power is applied to the inverter. To ensure safety, do not operate switches with wet hands. **Electric shock may result**

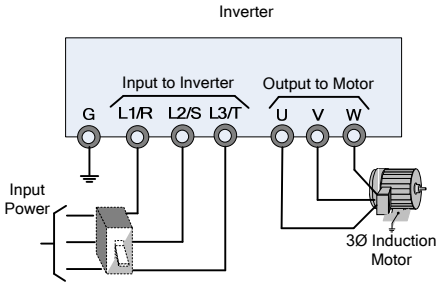



**Fig. 3-1-1 Inverter Connections**


**Fig. 3-1-2**
**Display on Digital Operator at Power-up**

## 3-2 Operation Method

There are various methods of operation. Select a method of operation according to the application requirements and specifications; referring to Section 4-2, Digital Operator LCD Screen Operating Structure, and Chapter 5, Explanation of Functions. Table 3-2-1 lists general methods of operation.

## 3-3 Trial Run

Upon confirming that the initial start-up is normal (see Section 3-1), proceed with a trial run. The initial operating mode (set at factory) is using the keypad panel with the motor disconnected from the mechanical load.

1. With power on and the motor disconnected, confirm that the digital operator is displaying 0.00Hz and is blinking.
2. Using ^, set the frequency to about 5 Hz.
3. To start, press FWD (for forward rotation or REV (for reverse rotation). To stop, press STOP.
4. Power down the inverter and following safety precautions, connect the motor. Power-up the drive and repeat steps 1-3 and check the following.
   a. Is the direction of rotation correct?
   b. Is the motor rotating smoothly with no buzzing or abnormal vibration ?
   c. Is the acceleration and deceleration smooth?
5. If no abnormalities are detected, increase the frequency and check the above items again. If the results of the trial run are normal, proceed to start a formal run.

**Table 3-2-1 General Methods of Operation**

| Operation mode | Frequency setting | Operation command |
|---|---|---|
| Operation using keypad | Keys on digital operator ^ v | FWD REV STOP |
| Operation using external signal terminals | ^ v Freq. setting Pot (VR), analog voltage, analog current. | Switch contact input Terminals: FWD-CM and REV-CM |

***Note*** - *If an error is detected in the above procedure immediately stop the operation and attempt to determine the cause by referring to Chapter 7, Troubleshooting.*

**DANGER**

Since voltage is still applied to the main circuit terminals (L1/R, L2/S, L3/T), and auxiliary control power terminals (R0, T0) even when the output from the inverter is terminated, do not touch the terminals. The large capacitor(s) in the inverter are still charged after the power is turned off and do not discharge immediately. Before touching any electric circuit, confirm that the charge lamp is *off* or a multimeter verifies that the voltage at the P-N terminals is below 25 VDC.

*NOTES*

## 4. Digital Operator

The Digital Operator has various functions for inputting, controlling, and displaying operations such as frequency setting, run/stop command, confirming and changing function data, confirming status, and copying.
Please review and become familiar with each function before attempting to operate the drive.
The Digital Operator can be removed or inserted during inverter operation, however, if it is removed during a keypad operation (e.g., run/stop, frequency setting), the inverter will stop and initiate an alarm.

### 4-1 Appearance of Digital Operator


**LED Monitor:**
4-digit 7-segment display used to display data such as setting frequency, output frequency and alarm code.

**Auxiliary Information Indication for LED Monitor:**
Indicates selected units or multiple of the monitored data shown on the LED monitor and is displayed on the top line of the LCD monitor. The ■ symbol indicates selected units or multiple number. The symbol ▲ indicates there is an upper screen not currently displayed.

**LCD Monitor:**
Used to display various items of information as operation status and function data. An operation guide message, which can be scrolled, is displayed at the bottom of the LCD monitor. This LCD monitor has a backlight feature which turns on when the control power is applied or any keypad key is pressed. It stays on approximately 5 minutes after the last key stroke.

**Indication on LCD Monitor:**
Displays one of the following operation status:

FWD: Forward operation
REV: Reverse operation
STOP: Stop
Displays the selected operation mode:
REM: Terminal block
LOC: Keypad panel
COMM: Communication terminal
JOG: Jogging mode
The symbol ▼ indicates there is a lower screen not currently displayed.

**Run LED :**
Indicates that an operation command was input by Pressing the FWD FWD or REV REV key.

**Control Keys**
(valid during digital operator operation):

Used for inverter run and stop

FWD Forward operation command
REV Reverse operation command
STOP Stop command

**Operation Keys:**
Used for switching screens, data change, frequency setting, etc. (Table 4-4-1)

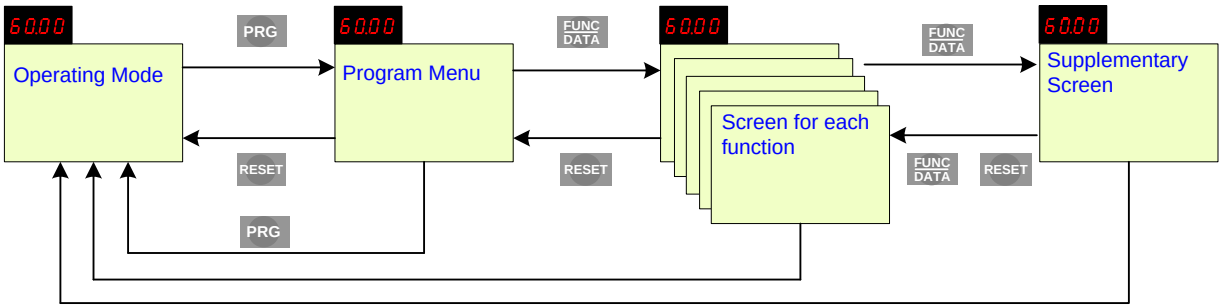
**Table 4-1-1 Functions of Operation Keys**

| Operation Key | Main Function |
|---|---|
| PRG | Used to switch the current screen display to the menu screen or switch to the initial display screen in the operation/trip mode. |
| FUNC DATA | Used to switch the LED monitor or to determine the entered frequency, function code, or data. |
| ^ v | Used to change data, move the cursor up or down, or scroll the display screen. |
| SHIFT >> | Used to move the cursor horizontally when changing data. When this key is pressed with the up or down key, the cursor moves to the next parameter function block. |
| RESET | Used to cancel the current input data and switch the display screen. If an alarm occurs, this key is used to reset the trip status (valid only when the alarm mode initial screen is displayed). |
| STOP + ^ | Used to switch normal operation mode to jogging operation mode or vice versa. The selected mode is displayed on the LCD screen. |
| STOP + RESET | Switches the operating mode from digital operator to terminal block operation (Local / Remote), and vice versa. When these keys are operated, function F01 data is automatically set to 3 if set at 0, or automatically set to 0 if set from 1 thru 4. The selected mode is displayed on the LCD screen. |

## 4-2 Digital Operator LCD Screen Operating Structure

### 4.2.1 Normal Operation

The Digital operator LCD operating structure.




### 4.2.2 Alarm modes

If an alarm is activated, operation is changed from normal digital operator function to alarm mode operation. The alarm mode screen appears and alarm information is displayed.

The program menu, function screens, and supplementary screens remain unchanged as during normal operation, though the switching method from program menu to alarm mode is limited to PRG .

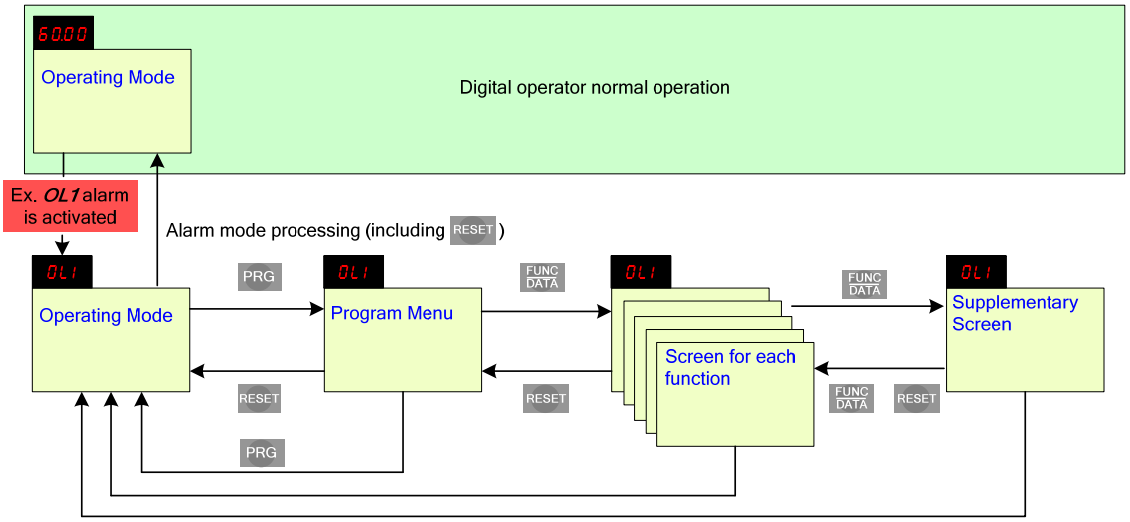



**Table 4-2-1 Overview of Contents Displayed for Each Level**

| No. | Level Name | Content |
|---|---|---|
| 1 | Operating mode | This screen is for normal operation. Frequency setting by keypad panel and the LED display switching are possible only when this screen is displayed. |
| 2 | Program menu | Each function of the digital operator is displayed in menu form and can be selected. By selecting the desired function from the list and pressing FUNC DATA the corresponding function screen is displayed. The following functions are available as digital operator functions (menus). |
| 3 | Screen for each function | The function screen selected on the program menu appears, hence completing the function. |
| 4 | Supplement screen | Functions not completed (e.g., modifying function data, displaying alarm factors) on individual function screens are displayed on the supplementary screen. |

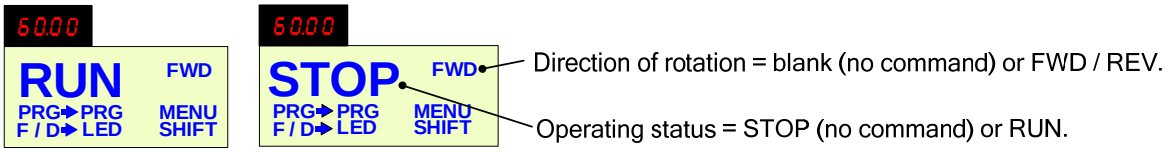
| No | Menu name | Outline |
|---|---|---|
| 1 | DATA SET | The code and name of the functions are displayed. Selecting a function displays a data setting screen for checking or modifying data. |
| 2 | DATA CHECK | The code and name of the function is displayed. Select a function to be displayed for checking data. Modifying data is possible by selecting the DATA SET screen above. |
| 3 | OPR MNTR | Can check the operating status of various data . |
| 4 | I/O CHECK | Can check the status of analog and digital inputs and outputs of the inverter and option cards. |
| 5 | MAINTENANCE | Can check inverter status, life expectancy, communication error status, and ROM version as maintenance information. |
| 6 | LOAD FCTR | Can measure maximum and average current and average breaking force in load rate measurement. |
| 7 | ALM INF | Can check the operating and input/output status for the last alarm occurrence. |
| 8 | ALM CAUSE | Can check the last alarm or simultaneously occurring alarms and alarm history. Selecting the alarm and pressing FUNC DATA, displays the contents of alarm for troubleshooting. |
| 9 | DATA COPY | Places the function of one inverter in memory for copying to another inverter. |

## 4-3 Digital Operator Keypad Navigation

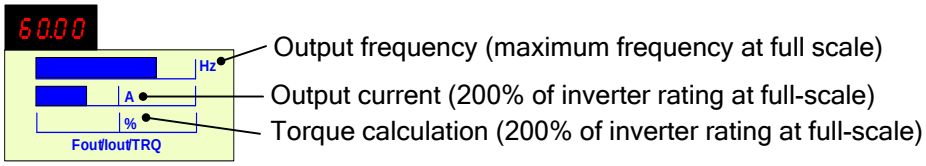
### 4-3-1 Operation Mode

The LCD screen for normal inverter operation displays the inverter operating status and an operation guide. A second screen is available which graphically displays the operating status in the form of a bar graph. Switching between screens is possible by setting the value of parameter E45 (=1 operation guide), (=2 bar graph).

1) Operation status (E45=0)




2) Bar graph (E45=1)




### 4-3-2 Setting the Output Frequency

Local mode: (F01=0 or C30=0)

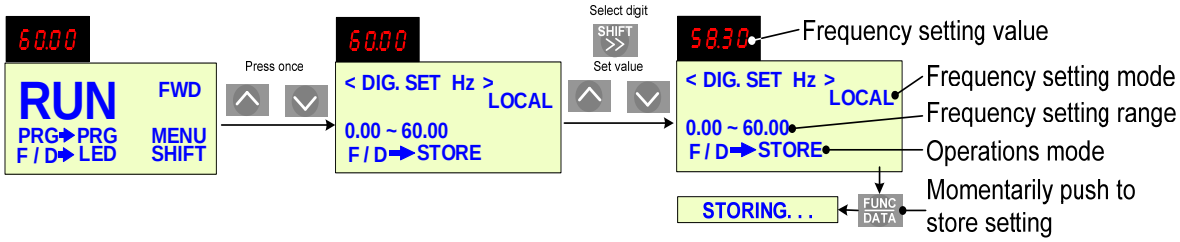
On the operation mode screen, press ^ or v to display the set frequency on the LED display. To change the setting, press SHIFT >> to select any one of the digits in the display and set the desired value with ^ or v (Note: By pressing and holding down ^ or v the value will change rapidly.) To save the setting press RESET and PRG at the same time to return to the operation mode.

Remote mode (F01≠0)

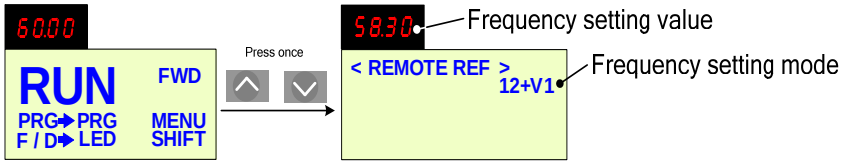
If the digital operator is not selected as the frequency reference source, then the remote frequency setting mode appears on the LCD and is changed according to the remote settings.

*Note:If the PID function is selected, the PID command or feedback can be displayed in engineering units such as PSI. (Refer to the engineering units list available in this manual).*

1) Output frequency control set by Digital operator (F01=0 or C30=0)




2) Output frequency set by external source (F01≠0)



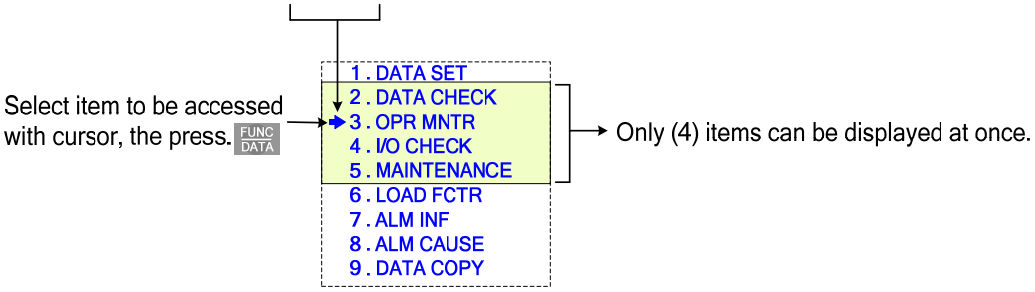
### 4-3-3 Switching to LED Monitor

During normal operation, press FUNC DATA to switch to the LED monitor display. When monitored data is switched, the LED monitor contents are displayed. When power is turned on, the monitor contents set by parameter (E43) are displayed. Parameter (E44) determines the display contents during run and stop.

| E43 | When stopped (E44 = 0) | When stopped (E44 = 1) | While running (E44 =0,1) | Units | Remarks |
|---|---|---|---|---|---|
| 0 | Setting frequency | Output frequency 1 (before slip compensation) | | Hz | |
| 1 | Setting frequency | Output frequency 2 (after slip compensation) | | | |
| 2 | Setting frequency | Setting frequency | | | |
| 3 | Output current | Output current | | A | |
| 4 | Output voltage (specified value) | Output voltage (specified value) | | V | |
| 5 | Synchronous speed setting value | Synchronous speed | | r/min. | For 4 digits or more, the last digits are cut, with x10, x100 marked on the indicator. |
| 6 | Line speed setting value | Line speed | | m/min. | |
| 7 | Load rotation speed setting value | Load rotation speed | | r/min. | |
| 8 | Torque calculation value | Torque calculation value | | % | ± indication |
| 9 | Power consumption | Power consumption | | kW | |
| 10 | PID setting value | PID setting value | | – | Displayed only when the PID function is selected. |
| 11 | PID remote setting value | PID remote setting value | | – | |
| 12 | PID feedback value | PID feedback value | | – | |

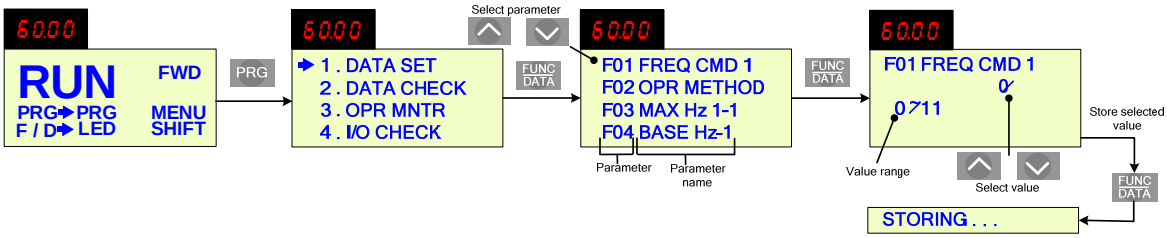
### 4-3-4 Program Menu Screen

By pressing PRG the menu program screen will be accessed and is shown below. Only four items can be displayed simultaneously. Move the cursor with ∧ or ∨ to select an item, then press FUNC DATA to display the next screen.



### 4-3-5 Setting the Parameter (function code) Value

On the program menu screen, select **1. DATA SET** as in para. 4-3-3. The parameter select screen appears. Select the desired parameter and set value as follows.

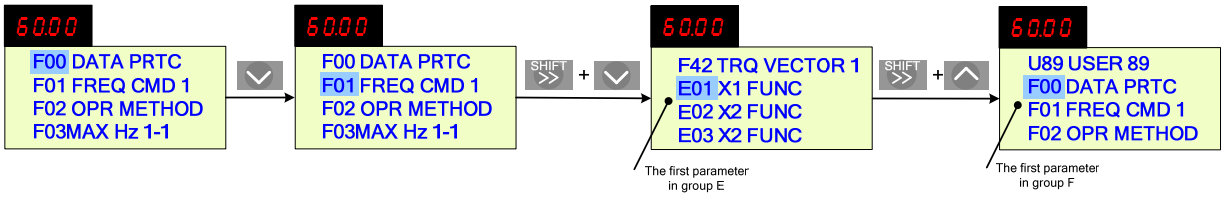



The parameter designations (function codes) consist of alphanumeric characters with unique alphabetical letters assigned to each parameter group as in table 4-3-1 below.

**Table 4-3-1 Parameter Designations and Corresponding Groups**

| Parameter | Group name | Remarks |
|---|---|---|
| F00 - F42 | Fundamental Functions | |
| E01 - E47 | Extension Terminal Functions | |
| C01 - C33 | Control Functions of Frequency | |
| P01 - P09 | Motor Parameters | |
| H03 - H39 | High Performance Functions | |
| A01 - A18 | Alternative Motor Parameters | |
| U01 - U61 | User Functions | |
| o01 - o55 | Optional Functions | Can be selected only with an option connected. |

To alphabetically scroll the parameter groups rapidly, use SHIFT >> + ^ or >> + v .



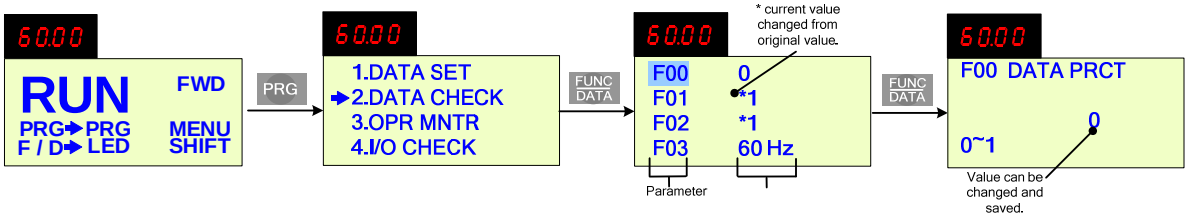

Using ^ or v, select the desired parameter within the group and press FUNC DATA to switch to the value setting screen. The data values on the LCD can be increased or decreased by pressing ^ or v. Holding down these keys will rapidly change the value. If there is more than one digit position in the parameter value SHIFT >> can be used to select a digit position and the value can then be set with ^ or v. When data is modified, the value before modification will be displayed at the same time for reference purposes. To save the data, press FUNC DATA. Pressing RESET cancels the changes made and returns to the value setting screen. The modified data will be effective in inverter operation after the data is saved by FUNC DATA. The inverter operation does not change if the data is not saved. When data setting is disabled in the case of "Data protected" or "Data setting invalid during inverter running," make necessary changes as shown in Table 4-3-2 .

**Table 4-3-2**

| Display | Reason for No Modification | To Enable Data Change |
|---|---|---|
| LINK ACTIVE | Currently writing from RS-485/RTU option to function is being made. | Send a cancel command to function writing from RS-485/RTU. Stops a "write" operation from the link. |
| NO SIGNAL(WE) | The edit enabling command function is selected using a general-purpose input terminal. | For functions E01 to E09, turn data terminal 19 (edit enabling command selection) ON. |
| DATA PRTCTD | Data protection is selected by parameter F00. | Change F00 to 0. |
| INV RUNNING | An attempt is made to change a function that cannot be changed during inverter operation. | Stop inverter operation. |
| FWD/REV ON | An attempt is made to change a function that cannot be changed with the FWD / REV command on. | Turn FWD / REV command off. |

### 4.3.6 Checking Parameter Values

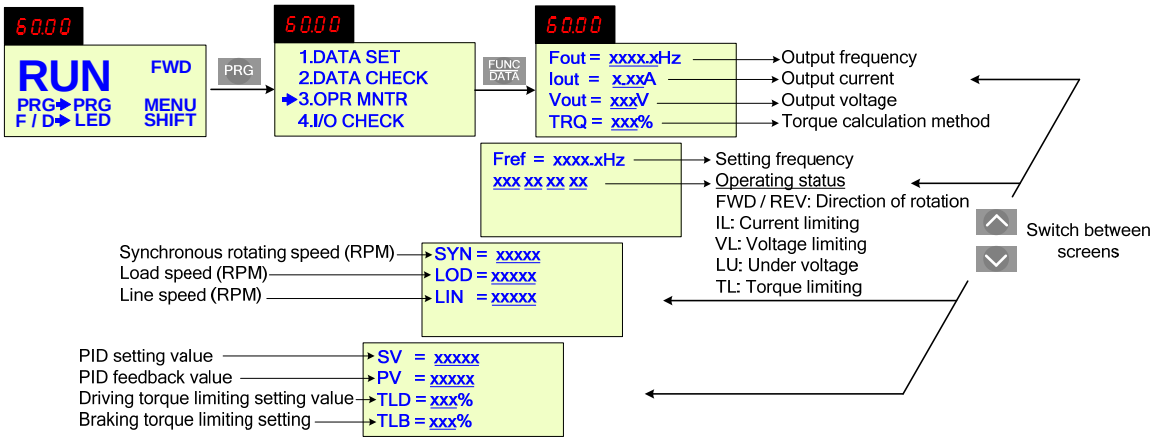
Select **2. DATA CHECK** on the program menu screen. The parameter select screen then appears with the parameters and current values. *(Note that an * will appear before the current value if it was changed from the original value.)*




At this point a parameter can be selected and by pressing FUNC DATA the value can be changed and saved.

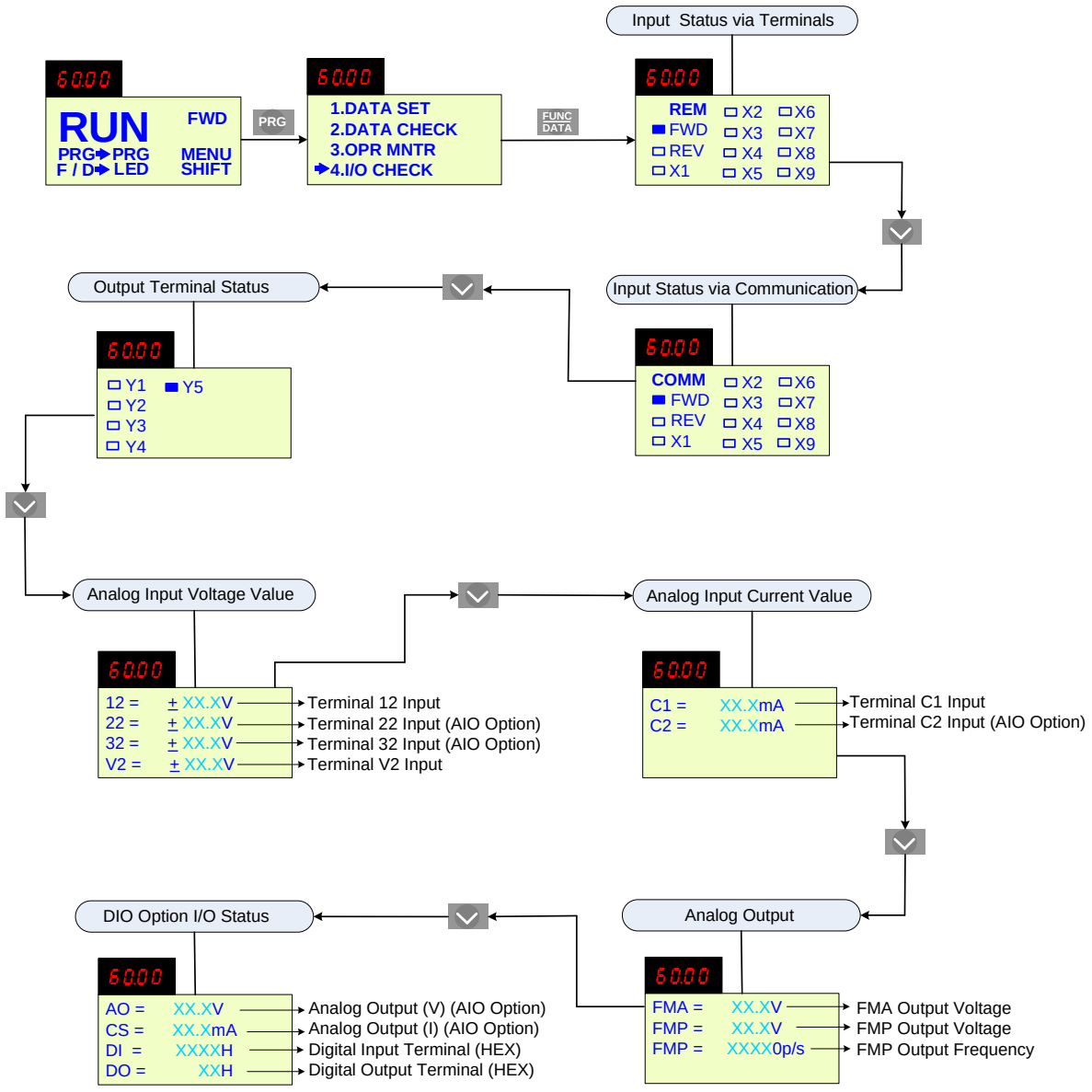
### 4.3.7 Monitoring Operating Status

Select **3. OPR MNTR** on the program menu screen to display the current inverter operating status.



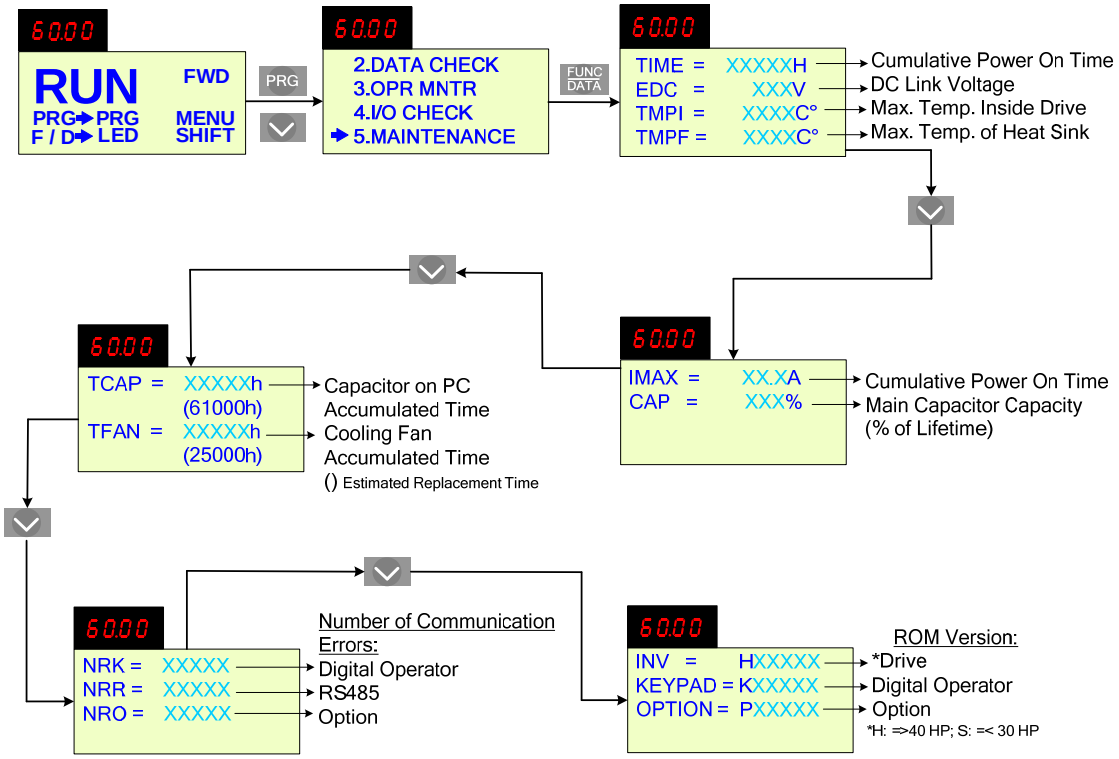
### 4-3-8 I/O Check

Select **4** on the program menu screen. Check to display analog and digital input / output signal status for the drive and options. Use ^ and v to switch between the seven screens of data.



### 4-3-9 Maintenance Information

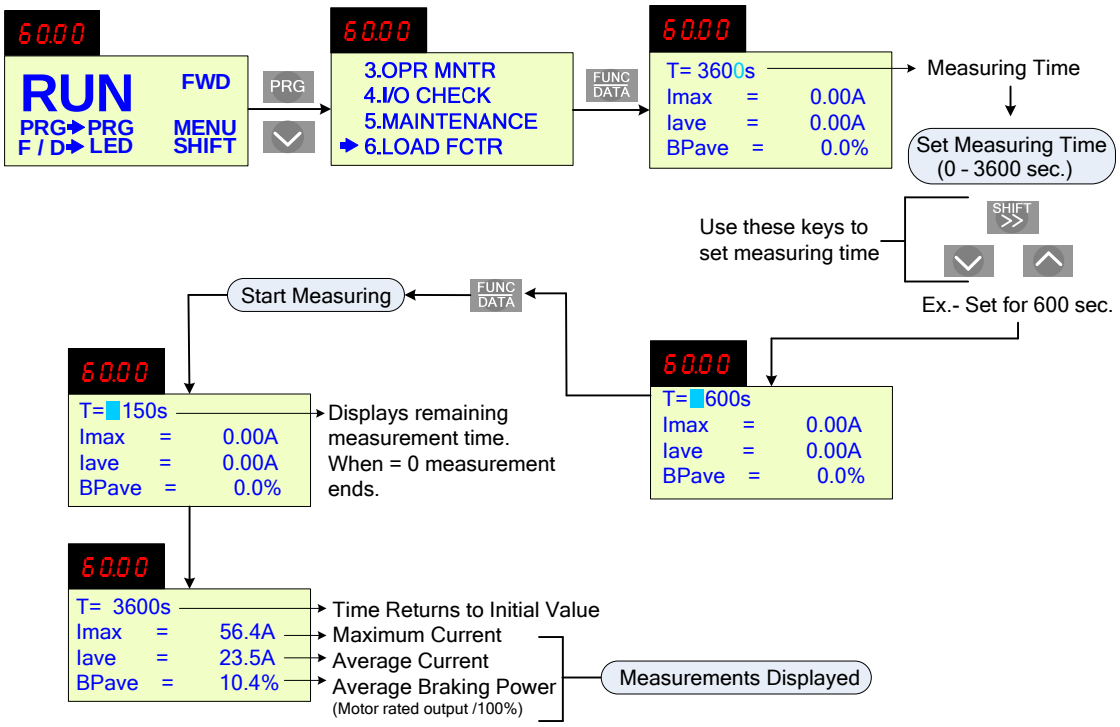
Select **5** on the program menu screen to display information necessary for maintenance and inspection. Use ^ and v to switch between the five screens of data.




*NOTES*

### 4-3-10 Load Rate Measurement

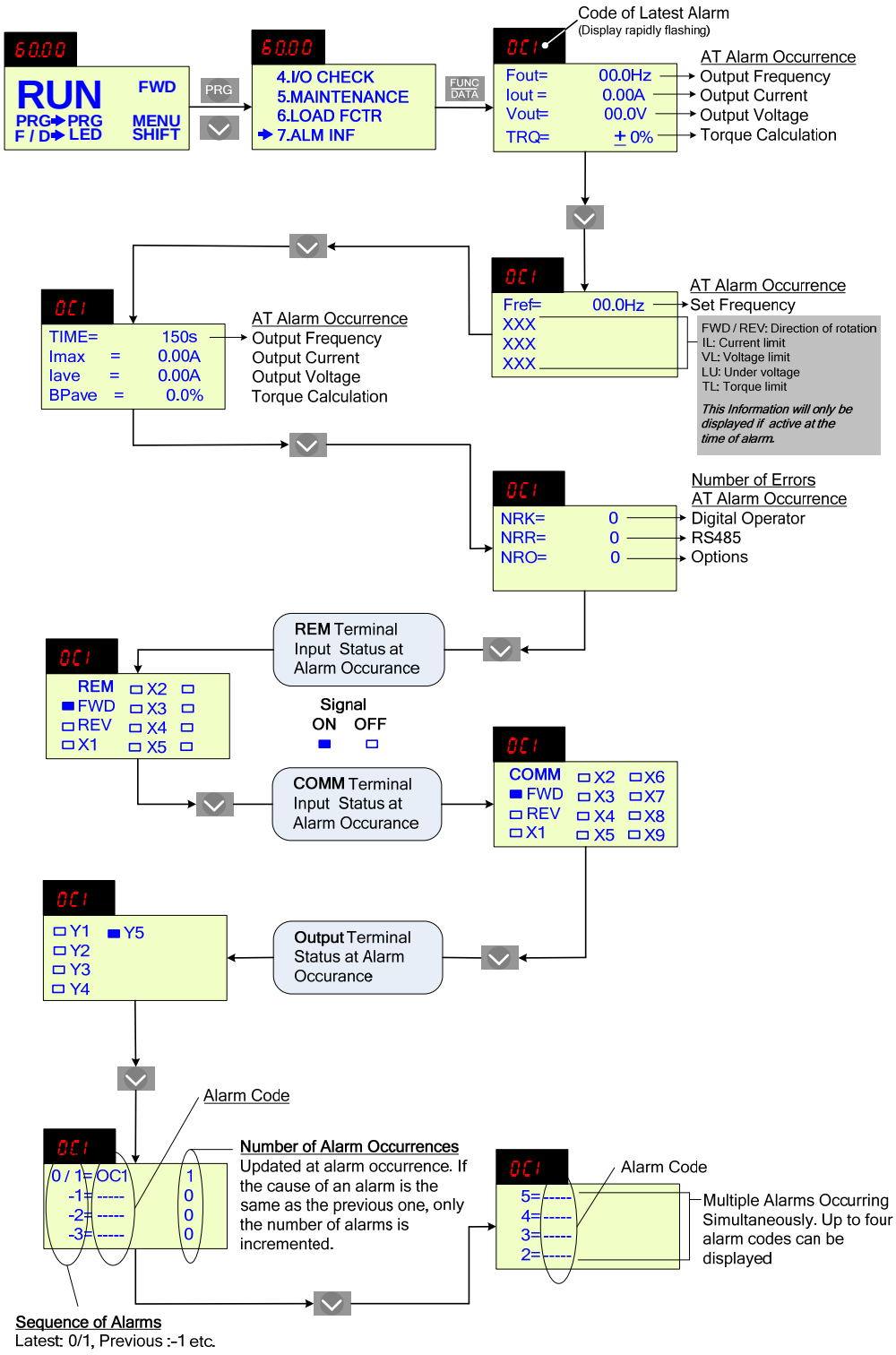
Select **6** Load Rate Measurement (LOAD FCTR) on the main menu screen. The maximum current, average current, and average braking power during the set measuring time are measured and displayed.




*NOTES*

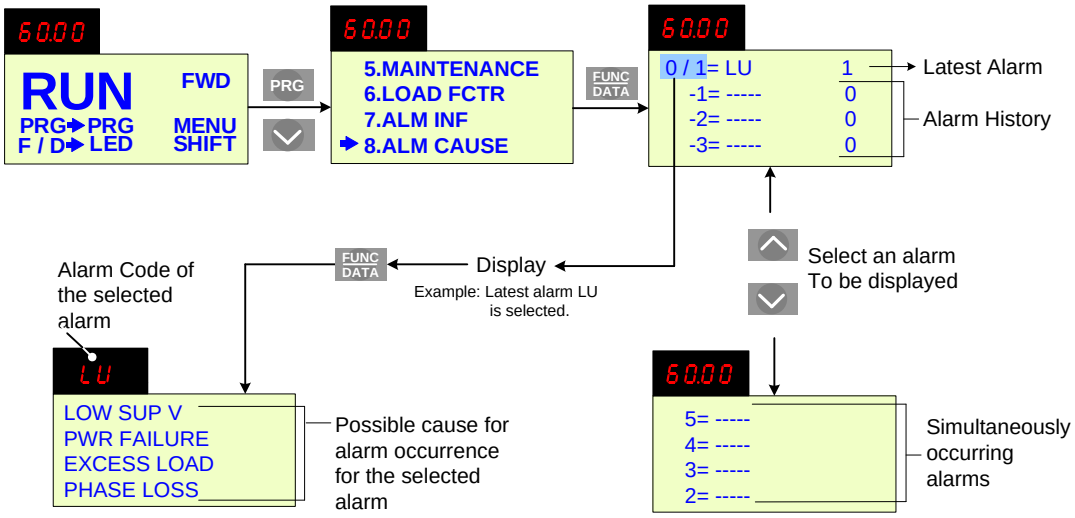
### 4-3-11 Alarm Information

Select **7** Alarm Information (ALM INF) on the main menu screen. A variety of operating data at the time of the latest alarm is displayed. Use ^ and ^ to switch between the nine screens of alarm information data.



### 4-3-12 Alarm History and Possible Reasons

Select **8** Alarm Cause (ALM CAUSE) on the main menu screen. The alarm history will be displayed. Select an alarm using ^ and ^, and then FUNC DATA to display that alarm and possible causes.

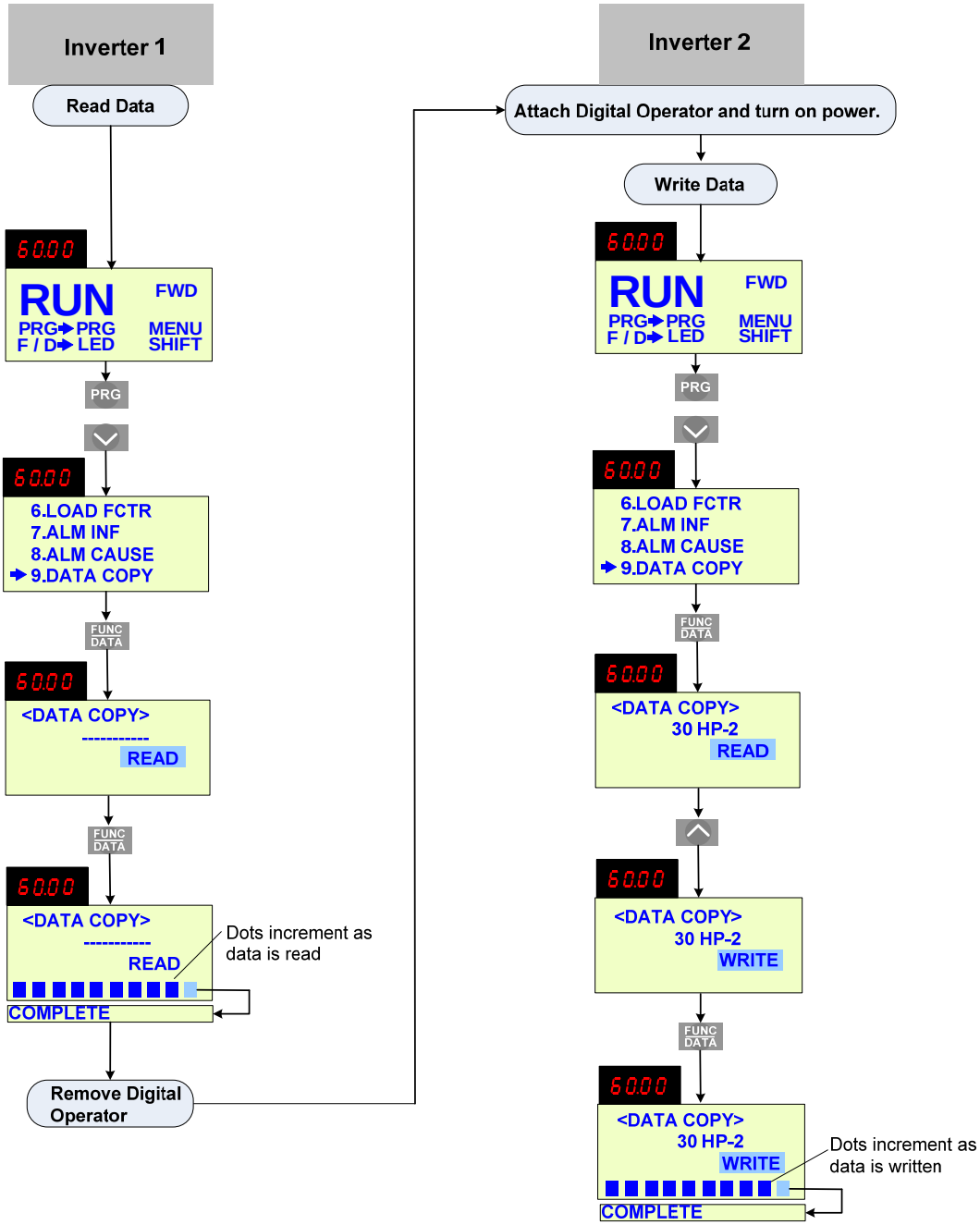


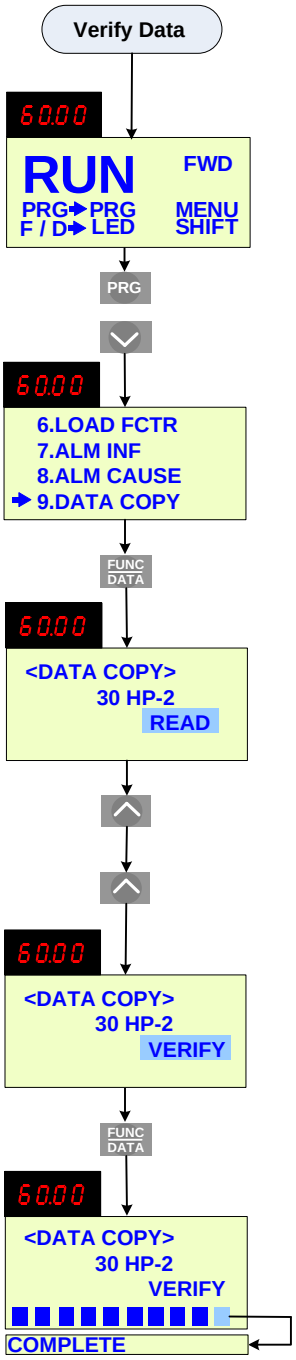

*NOTES*

### 4-3-13 Data Copy, Verify and Error Processing

Select **9** Data Copy (DATA COPY) on the main menu screen. Press FUNC DATA to access the Data Copy (READ) screen. Press FUNC DATA to read data from inverter 1. When complete, remove the Digital Operator and attach to inverter 2. Power up and again select 9. Press FUNC DATA. On the Data Copy screen press ^ to select (WRITE). Press FUNC DATA When complete the data transfer done.

The (VERIFY) feature which is covered on the next page also mkes it possible to compare and check differences in the data stored in the Digital Operator and the data stored in the inverter.

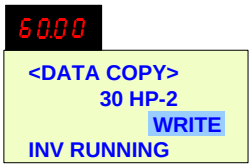





**Error Processing**

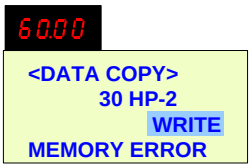
**1. Data Change Disabled During Operation**

If a write operation is attempted during a drive operation, or vice versa, the error message below will appear. After stopping the drive and pressing RESET retry the operation.



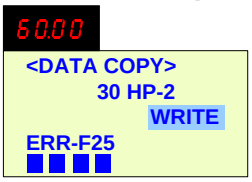

**2. Memory Error**

If a write operation is attempted while data has not been saved (i.e. no data) in the Digital Operator memory during the read mode or when the drive types do not match, the following error message will appear.



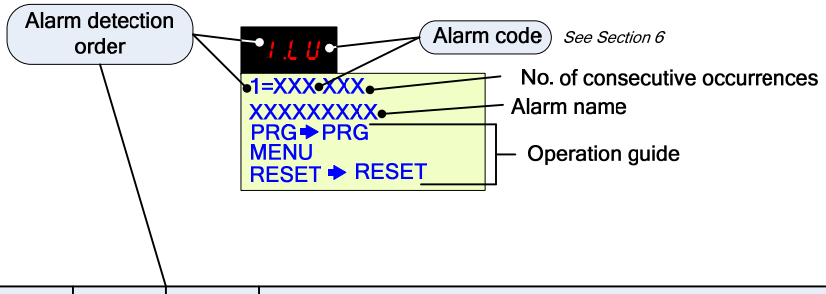

**3. Verify Error**

During a data check (Verify) operation, if the data stored in the Digital Operator differs from that stored in the drive, the following error message is displayed to indicate the function number. The data check stops at the first mismatch. To continue the data check press FUNC DATA until another mismatch is displayed or is complete. To stop the data check and switch to another operation, press RESET.



### 4-3-12 Alarm Mode

If an alarm occurs, the Alarm screen showing the alarm contents is displayed. Use ⌄ and ⌃ to display multiple alarms and alarm history.




| Operation Method | LED Display | LCD Display | Description |
|---|---|---|---|
| ⌄ ↕ ⌃ | 5. | 5 | No. 5 alarm |
| | 4. | 4 | No. 4 alarm |
| | 3. | 3 | No. 3 alarm |
| | 2. | 2 | No. 2 alarm |
| | 1. | 1 | No. 1 alarm (more than two alarms have occurred.) |
| | Blank | 0 | Latest alarm (only one alarm has occurred / alarm release) |
| | Blank | -1 | Previous alarm history |
| | Blank | -2 | Alarm history before previous alarm |
| | Blank | -3 | Alarm history two times before previous alarm |

*NOTES*

# 5. Parameters F,E,C,P,H, A and U

This section covers parameters F,E,C,P,H, A and U which can be set via the digital operator (see Sect. 4) to achieve a specific performance for a particular application. For most general purpose applications, the factory settings are sufficient and will not need to be changed. If the parameter values are to be changed, it is recommended that resulting overall drive performance be evaluated to avoid any unwanted performance issues.

## 5-1 Parameters Summary List

The following tables show the setting range, LCD readout, factory setting, and whether the value can be changed while the drive is operational.

### F Parameters

| Para. No. | NAME | LCD Display | | Setting range | Unit | Min. Unit | Factory setting 30HP/CT 40HP/VT | Factory setting 40HP/CT 50HP/VT | Change During Oper. | User Set value | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| F00 | Data protection | F00 | DATA PRTC | 0, 1 | - | - | 0 | | N | | |
| F01 | Frequency command 1 | F01 | FREQ CMD 1 | 0 to 11 | - | - | 0 | | N | | |
| F02 | Operation method | F02 | OPR METHOD | 0 to 4 | - | - | 0 | | N | | |
| F03 | Maximum frequency 1 | F03 | MAX Hz-1 | 50 to 120Hz | Hz | 1 | 60 | | N | | |
| F04 | Base frequency 1 | F04 | BASE Hz-1 | 25 to 120Hz | Hz | 1 | 60 | | N | | |
| F05 | Rated voltage 1 (at Base frequency 1) | F05 | RATED V-1 | 0V: (Output voltage proportional to source voltage)<br>80 to 240V: (230V class)<br>320 to 480V: (460V class) | V | 1 | 230:(230V class)<br>460:(460V class) | | N | | |
| F06 | Maximum voltage 1 (at Maximum frequency 1) | F06 | MAX V-1 | 80 to 240V: (230V class)<br>320 to 480V: (460V class) | V | 1 | 230:(230V class)<br>460:(460V class) | | N | | |
| F07 | Acceleration time 1 | F07 | ACC TIME1 | 0.01 to 3600s | s | 0.01 | 6.0 | 20.0 | Y | | |
| F08 | Deceleration time 1 | F08 | DEC TIME1 | | | | | | | | |
| F09 | Torque boost 1 | F09 | TRQ BOOST1 | 0.0, 0.1 to 20.0 | - | 0.1 | 0.1 | | Y | | |
| F10 | Electronic (Select) | F10 | ELCTRN OL1 | 0, 1, 2 | - | - | 1 | | Y | | |
| F11 | thermal 1( Level) | F11 | OL LEVEL1 | INV rated current 20 to 135% | A | 0.01 | Motor rated current | | Y | | |
| F12 | (Thermal time constant) | F12 | TIME CNST1 | 0.5 to 75.0 min | min | 0.1 | 5.0 | 10.0 | N | | |
| F13 | Electronic thermal overload relay (for braking resistor) | F13 | DBR OL | [Up to 10HP/CT, 15HP/VT]<br>0, 2<br>[15HP/CT, 20HP/VT and above ]<br>0 | - | - | 0<br>0 | | Y | | |
| F14 | Restart mode after momentary power failure | F14 | RESTART | 0 to 5 | - | - | 0 | | N | | |
| F15 | Frequency limiter (High) | F15 | H LIMITER | 0-120Hz | Hz | 1 | 70 | | Y | | |
| F16 | (Low) | F16 | L LIMITER | | | | | | N | | |
| F17 | Gain (for freq. set signal) | F17 | FREQ GAIN | 0.0 to 200.0% | % | 0.1 | 100.0 | | Y | | |
| F18 | Bias frequency | F18 | FREQ BIAS | -120.0 to +120.0Hz | Hz | 0.1 | 0.0 | | Y | | |
| F20 | DC brake (Starting freq.) | F20 | DC BRK Hz | 0.0 to 60.0Hz | Hz | 0.1 | 0.0 | | Y | | |
| F21 | (Braking level) | F21 | DC BRK LVL | 0 to 100% | % | 1 | 0 | | | | |
| F22 | (Braking time) | F22 | DC BRK t | 0.0s (Inactive) | s | 0.1 | 0.0 | | | | |
| F23 | Starting frequency (Freq.) | F23 | START Hz | 0.1 to 60.0Hz | Hz | 0.1 | 0.5 | | N | | |
| F24 | (Holding time) | F24 | HOLDING t | 0.0 to 10.0s | s | 0.1 | 0.0 | | | | |
| F25 | Stop frequency | F25 | STOP Hz | 0.1 to 60.0Hz | Hz | 0.1 | 0.2 | | N | | |
| F26 | Motor sound (Carrier freq.) | F26 | MTR SOUND | 0.75 to 15kHz (Vary by HP) | kHz | 1 | 2 | | Y | | |
| F27 | (Sound tone) | F27 | SOUND TONE | 0 to 3 | - | - | 0 | | | | |
| F30 | FMA (Voltage adjust) | F30 | FMA V-ADJ | 0 to 200% | % | 1 | 100 | | Y | | |
| F31 | (Function) | F31 | FMA FUNC | 0 to 11 | - | - | 0 | | | | |
| F33 | FMP (Pulse rate) | F33 | FMP PULSES | 300 to 6000p/s (full scale) | p/s | 1 | 1440 | | Y | | |
| F34 | (Voltage adjust) | F34 | FMP V-ADJ | 0%, 1 to 200% | % | 1 | 0 | | | | |
| F35 | (Function) | F35 | FMP FUNC | 0 to 10 | - | - | 0 | | | | |
| F36 | 30RY operation mode | F36 | 30RY MODE | 0, 1 | - | - | 0 | | Y | | |
| F40 | Torque limiter 1 (Driving) | F40 | DRV TRQ 1 | 20 to 150%, 999 | % | 1 | 999 | | Y | | |
| F41 | (Braking) | F41 | BRK TRQ 1 | 0%, 20 to 150%, 999 | | | 999 | | | | |
| F42 | Torque vector control 1 | F42 | TRQVECTOR1 | 0, 1 | - | - | 0 | | N | | |

## E Parameters

| Para. No. | NAME | LCD Display | Setting range | Unit | Min. Unit | Factory setting 30HP/CT 40HP/VT | Factory setting 40HP/CT 50HP/VT | Change During Oper. | User Set value | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| E01 | X1 terminal function | E01 X1 FUNC | 0 to 35 | - | - | 0 | | N | | |
| E02 | X2 terminal function | E02 X2 FUNC | | | | 1 | | N | | |
| E03 | X3 terminal function | E03 X3 FUNC | | | | 2 | | N | | |
| E04 | X4 terminal function | E04 X4 FUNC | | | | 3 | | N | | |
| E05 | X5 terminal function | E05 X5 FUNC | | | | 4 | | N | | |
| E06 | X6 terminal function | E06 X6 FUNC | | | | 5 | | N | | |
| E07 | X7 terminal function | E07 X7 FUNC | | | | 6 | | N | | |
| E08 | X8 terminal function | E08 X8 FUNC | | | | 7 | | N | | |
| E09 | X9 terminal function | E09 X9 FUNC | | | | 8 | | N | | |
| E10 | Acceleration time 2 | E10 ACC TIME2 | 0.01 to 3600s | s | 0.01 | 6.00 | 20.00 | Y | | |
| E11 | Deceleration time 2 | E11 DEC TIME2 | | | | 6.00 | 20.00 | Y | | |
| E12 | Acceleration time 3 | E12 ACC TIME3 | | | | 6.00 | 20.00 | Y | | |
| E13 | Deceleration time 3 | E13 DEC TIME3 | | | | 6.00 | 20.00 | Y | | |
| E14 | Acceleration time 4 | E14 ACC TIME4 | | | | 6.00 | 20.00 | Y | | |
| E15 | Deceleration time 4 | E15 DEC TIME4 | | | | 6.00 | 20.00 | Y | | |
| E16 | Torque limiter 2 (Driving) | E16 DRV TRQ 2 | 20 to 150%, 999 | % | 1 | 999 | | Y | | |
| E17 | (Braking) | E17 BRK TRQ 2 | 0%, 20 to 150%, 999 | % | 1 | 999 | | Y | | |
| E20 | Y1 terminal function | E20 Y1 FUNC | 0 to 37 | - | - | 0 | | N | | |
| E21 | Y2 terminal function | E21 Y2 FUNC | | | | 1 | | N | | |
| E22 | Y3 terminal function | E22 Y3 FUNC | | | | 2 | | N | | |
| E23 | Y4 terminal function | E23 Y4 FUNC | | | | 7 | | N | | |
| E24 | Y5A, Y5C terminal func. | E24 Y5 FUNC | | | | 10 | | N | | |
| E25 | Y5 RY operation mode | E25 Y5RY MODE | 0,1 | - | 1 | 0 | | N | | |
| E30 | FAR function (Hysteresis) | E30 FAR HYSTR | 0.0 to 10.0Hz | Hz | 0.1 | 2.5 | | Y | | |
| E31 | FDT function (Level) | E31 FDT1 LEVEL | 0 to 120Hz | Hz | 1 | 60 | | Y | | |
| E32 | Signal (Hysteresis) | E32 FDT1 HYSTR | 0.0 to 30.0Hz | Hz | 0.1 | 1.0 | | Y | | |
| E33 | OL1 function(Mode select) | E33 OL1 WARNING | 0: Thermal calculation<br>1: Output current | - | - | 0 | | Y | | |
| E34 | Signal (Level) | E34 OL1 LEVEL | 5 to 200% | A | 0.01 | Motor rated current | | Y | | |
| E35 | (Timer) | E35 OL1 TIMER | 0.0 to 60.0s | s | 0.1 | 10.0 | | | | |
| E36 | FDT2 function (Level) | E36 FDT2 LEVEL | 0 to120Hz | Hz | 1 | 60 | | Y | | |
| E37 | OL2 function (Level) | E37 OL2 LEVEL | 5 to 200% | A | 0.01 | Motor rated current | | Y | | |
| E40 | Display coefficient A | E40 COEF A | -999.00 to 999.00 | - | 0.01 | 0.01 | | Y | | |
| E41 | Display coefficient B | E41 COEF B | -999.00 to 999.00 | - | 0.01 | 0.00 | | Y | | |
| E42 | LED Display filter | E42 DISPLAY FL | 0.0 to 5.0s | s | 0.1 | 0.5 | | Y | | |
| E43 | LED Monitor (Function) | E43 LED MNTR | 0 to 12 | - | - | 0 | | Y | | |
| E44 | (Display at STOP mode) | E44 LED MNTR2 | 0, 1 | - | - | 0 | | Y | | |
| E45 | LCD Monitor (Function) | E45 LCD MNTR | 0, 1 | - | - | 0 | | Y | | |
| E46 | (Language) | E46 LANGUAGE | 0 to 5 | - | - | 1 | | Y | | |
| E47 | (Contrast) | E47 CONTRAST | 0 (soft) to 10 (hard) | - | - | 5 | | Y | | |

## C Parameters

| Para. No. | NAME | | LCD Display | Setting range | Unit | Min. Unit | Factory setting 30HP/CT 40HP/VT | Factory setting 40HP/CT 50HP/VT | Change During Oper. | User Set value | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | Jump frequency | (Jump freq. 1) | C01 JUMP Hz 1 | 0 to 120Hz | Hz | 1 | 0 | | Y | | |
| C02 | | (Jump freq. 2) | C02 JUMP Hz 2 | | | | 0 | | | | |
| C03 | | (Jump freq. 3) | C03 JUMP Hz 3 | | | | 0 | | | | |
| C04 | | (Hysteresis) | C04 JUMP HYSTR | 0 to 30Hz | Hz | 1 | 3 | | | | |
| C05 | Multistep frequency setting | (Freq. 1) | C05 MULTI Hz-1 | 0.00 to 120.00Hz | Hz | 0.01 | 0.00 | | | | |
| C06 | | (Freq. 2) | C06 MULTI Hz-2 | | | | 0.00 | | | | |
| C07 | | (Freq. 3) | C07 MULTI Hz-3 | | | | 0.00 | | | | |
| C08 | | (Freq. 4) | C08 MULTI Hz-4 | | | | 0.00 | | | | |
| C09 | | (Freq. 5) | C09 MULTI Hz-5 | | | | 0.00 | | | | |
| C10 | | (Freq. 6) | C10 MULTI Hz-6 | | | | 0.00 | | | | |
| C11 | | (Freq. 7) | C11 MULTI Hz-7 | | | | 0.00 | | | | |
| C12 | | (Freq. 8) | C12 MULTI Hz-8 | | | | 0.00 | | | | |
| C13 | | (Freq. 9) | C13 MULTI Hz-9 | | | | 0.00 | | | | |
| C14 | | (Freq. 10) | C14 MULTI Hz-10 | | | | 0.00 | | | | |
| C15 | | (Freq. 11) | C15 MULTI Hz-11 | | | | 0.00 | | | | |
| C16 | | (Freq. 12) | C16 MULTI Hz-12 | | | | 0.00 | | | | |
| C17 | | (Freq. 13) | C17 MULTI Hz-13 | | | | 0.00 | | | | |
| C18 | | (Freq. 14) | C18 MULTI Hz-14 | | | | 0.00 | | | | |
| C19 | | (Freq. 15) | C19 MULTI Hz-15 | | | | 0.00 | | | | |

*Cont.*

| Para. No. | NAME | LCD Display | | Setting range | Unit | Min. Unit | Factory setting 30HP/CT 40HP/VT \| 40HP/CT 50HP/VT | Change During Oper. | User Set value | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| C20 | JOG frequency | C20 | JOG Hz | 0.00 to 120.00Hz | Hz | 0.01 | 5.00 | N | | |
| C21 | PATTERN (Mode select) | C21 | PATTERN | 0,1,2 | - | - | 0 | N | | |
| C22 | (Stage 1) | C22 | STAGE 1 | Operation time:0.00 to 6000s F1 to F4 and R1 to R4 | s | 0.01 | 0.00 F1 | Y | | |
| C23 | (Stage 2) | C23 | STAGE 2 | | | | 0.00 F1 | | | |
| C24 | (Stage 3) | C24 | STAGE 3 | | | | 0.00 F1 | | | |
| C25 | (Stage 4) | C25 | STAGE 4 | | | | 0.00 F1 | | | |
| C26 | (Stage 5) | C26 | STAGE 5 | | | | 0.00 F1 | | | |
| C27 | (Stage 6) | C27 | STAGE 6 | | | | 0.00 F1 | | | |
| C28 | (Stage 7) | C28 | STAGE 7 | | | | 0.00 F1 | | | |
| C30 | Frequency command 2 | C30 | FREQ CMD 2 | 0 to 11 | - | - | 2 | N | | |
| C31 | Offset adjust (terminal [12]) | C31 | BIAS 12 | -100.0 to +100.0% | % | 0.1 | 0.0 | Y | | |
| C32 | | C32 | GAIN 12 | 0.0 to +200.0% | % | 0.1 | 100.0 | Y | | |
| C33 | Analog setting signal filter | C33 | REF FILTER | 0.00 to 5.00s | s | 0.01 | 0.05 | Y | | |

## P Parameters

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| P01 | Number of motor 1 poles | P01 | M1 POLES | 2 to 14 | - | 2 | 4 | N | | |
| P02 | Motor 1 (Capacity) | P02 | M1-CAP | Up to 30[HP]: 0.01 to 60HP<br>40[HP] and above: 0.01 to 800HP | HP | 0.01 | Motor Capacity | N | | |
| P03 | (Rated current) | P03 | M1-Ir | 0.00 to 2000A | A | 0.01 | Motor rated current | N | | |
| P04 | (Tuning) | P04 | M1 TUN1 | 0, 1, 2 | - | - | 0 | N | | |
| P05 | (On-line Tuning) | P05 | M1 TUN2 | 0, 1 | - | - | 0 | N | | |
| P06 | (No-load current) | P06 | M1-Io | 0.00 to 2000A | A | 0.01 | Standard Rated Value | N | | |
| P07 | (%R1 setting) | P07 | M1-%R1 | 0.00 to 50.00% | % | 0.01 | Standard Rated Value | Y | | |
| P08 | (%X setting) | P08 | M1-%X | 0.00 to 50.00% | % | 0.01 | Standard Rated Value | Y | | |
| P09 | Slip compensation control 1 | P09 | SLIP COMP1 | 0.00 to 15.00Hz | Hz | 0.01 | 0.00 | Y | | |

## H Parameters

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| H03 | Data initializing | H03 | DATA INIT | 0, 1 | - | - | 0 | N | | |
| H04 | Auto-reset (Times) | H04 | AUTO-RESET | 0, 1 to 10 times | - | 1 | 0 | Y | | |
| H05 | (Reset interval) | H05 | RESET INT | 2 to 20s | s | 1 | 5 | Y | | |
| H06 | Fan stop operation | H06 | FAN STOP | 0, 1 | - | - | 0 | Y | | |
| H07 | ACC/DEC pattern (Mode select) | H07 | ACC PTN | 0,1,2,3 | - | - | 0 | N | | |
| H08 | Rev. phase sequence lock | H08 | REV LOCK | 0, 1 | - | - | 0 | N | | |
| H09 | Start mode | H09 | START MODE | 0, 1, 2 | - | - | 0 | N | | |
| H10 | Energy-saving operation | H10 | ENERGY SAV | 0, 1 | - | - | 1 | Y | | |
| H11 | DEC mode | H11 | DEC MODE | 0, 1 | - | - | 0 | Y | | |
| H12 | Instantaneous OC limiting | H12 | INST CL | 0, 1 | - | - | 1 | N | | |
| H13 | Auto-restart (Restart time) | H13 | RESTART t | 0.1 to 10.0s | s | 0.1 | 0.1 | N | | |
| H14 | (Freq. fall rate) | H14 | FALL RATE | 0.00 to 100.00Hz/s | Hz/s | 0.01 | 10.00 | Y | | |
| H15 | (Holding DC voltage) | H15 | HOLD V | 3ph 230V class: 200 to 300V<br>3ph 460V class: 400 to 600V | V | 1 | 230V class:235V<br>460V class:470V | Y | | |
| H16 | (OPR command selfhold time) | H16 | SELFHOLD t | 0.0 to 30.0s, 999 | s | 0.1 | 999 | N | | |
| H19 | Active drive | H19 | AUT RED | 0, 1 | - | - | 0 | Y | | |
| H20 | PID control (Mode select) | H20 | PID MODE | 0, 1, 2 | - | - | 0 | N | | |
| H21 | (Feedback signal) | H21 | FB SIGNAL | 0, 1, 2, 3 | - | - | 1 | N | | |
| H22 | (P-gain) | H22 | P-GAIN | 0.01 to 10.00 times | - | 0.01 | 0.1 | Y | | |
| H23 | (I-gain) | H23 | I-GAIN | 0.0 , 0.1 to 3600s | s | 0.1 | 0.0 | Y | | |
| H24 | (D-gain) | H24 | D-GAIN | 0.00s , 0.01 to 10.0s | s | 0.01 | 0.00 | Y | | |
| H25 | (Feedback filter) | H25 | FB FILTER | 0.0 to 60.0s | s | 0.1 | 0.5 | Y | | |
| H26 | PTC thermistor (Mode select) | H26 | PTC MODE | 0, 1 | V | 0.01 | 0 | Y | | |
| H27 | (Level) | H27 | PTC LEVEL | 0.00 to 5.00V | | | 1.60 | Y | | |
| H30 | Serial link (Function select) | H30 | LINK FUNC | 0, 1, 2, 3 | - | - | 0 | Y | | |
| H31 | (Address) | H31 | ADDRESS | 0 (broadcast), 1 to 247 | - | 1 | 1 | N | | |
| H32 | (Mode select on no response error) | H32 | MODE ON ER | 0, 1, 2, 3 | - | - | 0 | Y | | |
| H33 | (Timer) | H33 | TIMER | 0.0 to 60.0s | s | 0.1 | 2.0 | Y | | |
| H34 | Modbus-RTU (Baud rate) | H34 | BAUD RATE | 0, 1, 2, 3 | - | - | 1 | Y | | |
| H35 | (Data length) | H35 | LENGTH | 0 (8-bit fixed) | - | - | 0 | Y | | |
| H36 | (Parity check) | H36 | PARITY | 0, 1, 2 | - | - | 0 | Y | | |
| H37 | (Stop bits) | H37 | STOP BITS | 0(2bit), 1(1bit) | - | - | 0 | Y | | |
| H38 | (No response error detection time) | H38 | NO RES t | 0 (No detection), 1 to 60s | s | 1 | 0 | Y | | |
| H39 | (Response interval) | H39 | INTERVAL | 0.00 to 1.00s | s | 0.01 | 0.01 | Y | | |

## A Parameters

| Para. No. | NAME | LCD Display | | Setting range | Unit | Min. Unit | Factory setting 30HP/CT 40HP/VT | Factory setting 40HP/CT 50HP/VT | Change During Oper. | User Set value | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **A01** | Maximum frequency 2 | **A01** | **MAX Hz-2** | 50 to 120Hz | Hz | 1 | 60 | | N | | |
| **A02** | Base frequency 2 | **A02** | **BASE Hz-2** | 25 to 120Hz | Hz | 1 | 60 | | N | | |
| **A03** | Rated voltage 2 (at Base frequency 2 ) | **A03** | **RATED V-2** | 0:<br>80 to 240V: (230V class)<br>320 to 480V: (460V class) | V | 1 | 220: (230V class)<br>380: (460V class) | | N | | |
| **A04** | Maximum voltage 2 (at Base frequency 2) | **A04** | **MAX V-2** | 80 to 240V: (230V class)<br>320 to 480V: (460V class) | V | 1 | 220:(230V class)<br>380:(460V class) | | N | | |
| **A05** | Torque boost2 | **A05** | **TRQ BOOST2** | 0.0, 0.1 to 20.0 | - | - | 0.1 | | Y | | |
| **A06** | Electronic thermal overload relay for motor 2 | **A06** | **ELCTRN OL2** | 0, 1, 2 | - | - | 1 | | Y | | |
| **A07** | (Level) | **A07** | **OL LEVEL2** | INV rated current 20%to135% | A | 0.01 | Motor rated current | | Y | | |
| **A08** | (Thermal time constant) | **A08** | **TIME CNST2** | 0.5 to 75.0 min | min | 0.1 | 5.0 | 10.0 | Y | | |
| **A09** | Torque vector control 2 | **A09** | **TRQVECTOR2** | 0, 1 | - | - | 0 | | N | | |
| **A10** | Number of motor-2 poles | **A10** | **M2 POLES** | 2 to 14 poles | poles | 2 | 4 | | N | | |
| **A11** | (Capacity) | **A11** | **M2-CAP** | Up to 30HP:0.01 to 60HP<br>40HP and above:0.01to800HP | HP | 0.01 | Motor capacity | | N | | |
| **A12** | (Rated current) | **A12** | **M2-Ir** | 0.00 to 2000A | A | 0.01 | Motor rated current | | N | | |
| **A13** | Motor 2 (Tuning) | **A13** | **M2 TUN1** | 0, 1, 2 | - | - | 0 | | N | | |
| **A14** | (On-line Tuning) | **A14** | **M2 TUN2** | 0, 1 | - | - | 0 | | N | | |
| **A15** | (No-load current) | **A15** | **M2-Io** | 0.00 to 2000A | A | 0.01 | TWMC standard rated value | | N | | |
| **A16** | (%R1 setting) | **A16** | **M2-%R1** | 0.00 to 50.00% | % | 0.01 | TWMC standard rated value | | Y | | |
| **A17** | (%X setting) | **A17** | **M2-%X** | 0.00 to 50.00% | % | 0.01 | TWMC standard rated value | | Y | | |
| **A18** | (Slip compensation control 2) | **A18** | **SLIP COMP2** | 0.00 to 15.00Hz | Hz | 0.01 | 0.00 | | Y | | |

## U Parameters

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U01 | Maximum compensation frequency during braking torque limit | **U01** | USER 01 | 0 to 65535 | - | 1 | 75 | | A | | |
| U02 | 1st S-shape level at acceleration | **U02** | USER 02 | 1 to 50% | % | 1 | 10 | | NA | | |
| U03 | 2nd S-shape level at acceleration | **U03** | USER 03 | 1 to 50% | % | 1 | 10 | | NA | | |
| U04 | 1st S-shape level at deceleration | **U04** | USER 04 | 1 to 50% | % | 1 | 10 | | NA | | |
| U05 | 2nd S-shape level at deceleration | **U05** | USER 05 | 1 to 50% | % | 1 | 10 | | NA | | |
| U08 | Main DC link capacitor (Initial value) | **U08** | USER 08 | 0 to 65535 | - | 1 | xxxx | | A | | |
| U09 | (Measured value) | **U09** | USER 09 | 0 to 65535 | - | 1 | 0 | | A | | |
| U10 | PC board capacitor powered on time | **U10** | USER 10 | 0 to 65535h | h | 1 | 0 | | A | | |
| U11 | Cooling fan operating time | **U11** | USER 11 | 0 to 65535h | h | 1 | 0 | | A | | |
| U13 | Magnetize current vibration damping gain | **U13** | USER 13 | 0 to 32767 | - | 1 | 819 | 410 | A | | |
| U15 | Slip compensation filter time constant | **U15** | USER 15 | 0 to 32767 | - | 1 | 556 | 546 | A | | |
| U23 | Integral gain of continuous operation at power failure | **U23** | USER 23 | 0 to 65535 | - | 1 | 1738 | 1000 | A | | |
| U24 | Proportional gain of continuous operation at power failure | **U24** | USER 24 | 0 to 65535 | - | 1 | 1024 | 1000 | A | | |
| U48 | Input phase loss protection | **U48** | USER 48 | 0, 1, 2 | - | - | -75HP<br>0 | 100HP-<br>1 | NA | | |
| U49 | RS-485 protocol selection | **U49** | USER 49 | 0, 1 | - | - | 1 | | NA | | |
| U59 | Braking-resistor function select(up to 30HP/CT, 40HP/VT)<br>Manufacturer's function(40HP/CT, 50HP/VT or more) | **U59** | USER 59 | 00 to A8(HEX) | - | 1 | 00 | | NA | | |
| U60 | Regeneration avoidance at deceleration | **U60** | USER 60 | 0, 1 | - | - | 0 | | NA | | |
| U61 | Voltage detect offset and gain adjustment | **U61** | USER 61 | --30HP/CT, 40HP/VT：0 (Fixed.)<br>40HP/CT, 50HP/CT--：0, 1, 2 | - | - | 0 | | A | | |
| U89 | Motor overload memory retention | **U89** | USER 89 | 0.1 | - | - | 1 | | A | | |

*NOTES*

## 5-2 Function Explanation

### *F:Fundamental function*

**F00** **Data protection**

◆Setting can be made so that a set value cannot be changed by keypad panel operation.

| F | 0 | 0 | D | A | T | A | | P | R | T | C |
|---|---|---|---|---|---|---|---|---|---|---|---|

Related functions **E01** to **E09** **(**Set values **19)**

Setting range 0 : The data can be changed.
1 : The data cannot be changed.

[Setting procedure ]

0 to 1: Press the STOP and ∧ keys simultaneously to change the value from 0 to 1, then press the FUNC DATA to validate the change.

1 to 0: Press the STOP and ∨ keys simultaneously to change the value from 1 to 0, then press the FUNC DATA key to validate the change.

**F01** **Frequency command 1**

◆This function selects the frequency setting method.

| F | 0 | 1 | F | R | E | Q | | C | M | D | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Related functions **E01** to **E09** (Set values **17, 18)** **C30**

0 : Setting by keypad panel operation ( ∧ ∨ key)
1 : Setting by voltage input (terminal [12 ](0 to +10V) + terminal [V2](0 to +10V) )
2: Setting by current input (terminal [C1] (4 to 20mA)).
3: Setting by voltage input + current input (terminal [12] + terminal [C1] ) (-10 to +10V + 4 to 20mA).
4: Reversible operation with polarity ( terminal [12] (-10 to +10V))
5: Reversible operation with polarity ( terminal [12] +[V2]+[V1](Option) (-10 to +10V))
6: Inverse mode operation (terminal [12] +[V2] (+10V to 0 ))
7: Inverse mode operation (terminal [C1] (20 to 4mA))

Related functions: **E01 to E09 (Set value 21)**

8: Setting by UP/DOWN control mode 1 (initial value = 0) (Terminals [UP] and [DOWN])
9: Setting by UP/DOWN control mode 2 (initial value =last final value) (terminals [UP] and [DOWN])
See the function explanation of E01 to E09 for details.

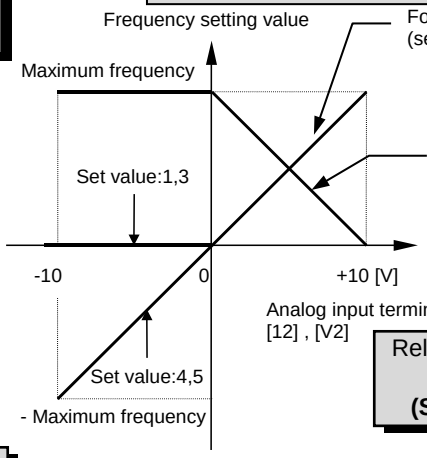
Related functions: **E01 to E09 (Set value 17,18)**

10: Setting by pattern operation
See the function explanation C21 to C28 for details.

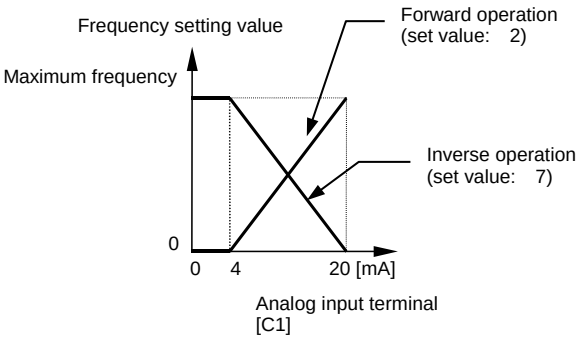
Related functions: **C21to C28**

11: Setting by digital input or pulse train
* Optional. For details, see the instruction manual on options.

**Forward / Inverse operation**




Related functions: **E01 to E09 (Set value 21)**

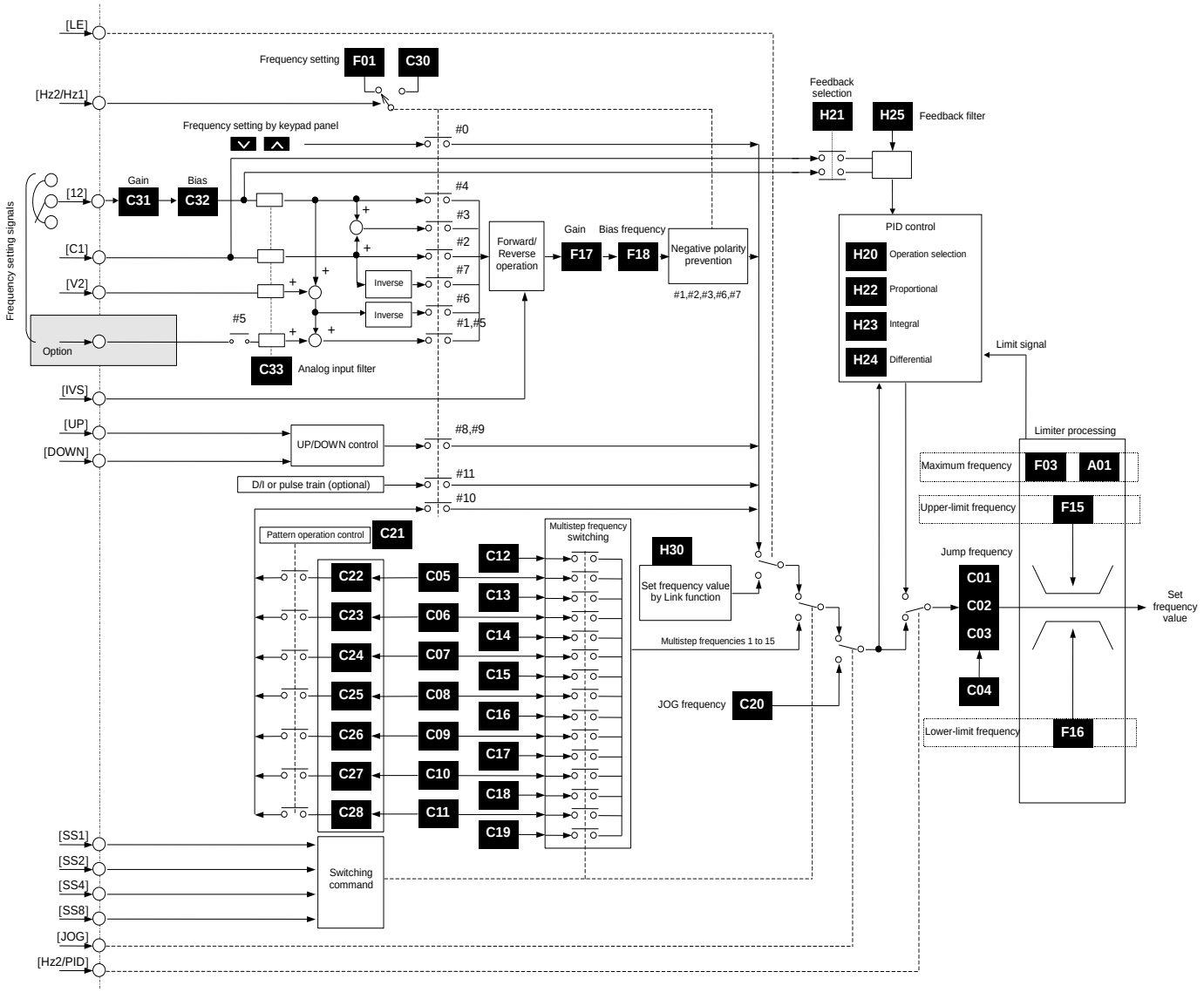



**F02** **Operation method**

◆This function sets the operation command input method.

| F | 0 | 2 | O | P | R | | M | E | T | H | O | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range 0: Key pad operation
( FWD REV STOP keys).
Press the FWD for forward operation.
Press the REV for reverse operation.
Press the STOP for deceleration to a stop.
Input from terminals [FWD] and [REV] is ignored.
(LOCAL)
1: Terminal operation( STOP key active)
2: Terminal operation( STOP key inactive)
3: Terminal operation( STOP key active) through software.
4: Terminal operation( STOP key inactive) through software.
* - This function can only be changed when terminals FWD and REV are open.
- REMOTE/LOCAL switching from the keypad panel automatically changes the set value of this function.
- REMOTE/LOCAL can be changed by pressing the STOP key and RESET key simultaneously.




Note: The numbers marked "#" means the setting value of each functions.

**Frequency setting block diagram**

## F03 Maximum frequency 1

◆This function sets the maximum output frequency for motor 1.
◆This is a function for motor 1.

| F | 0 | 3 | M | A | X | | H | z | - | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range EQ5: 50 to 120Hz

Setting a value higher than the rated value of the device to be driven may damage the motor or machine. Match the rating of the device.

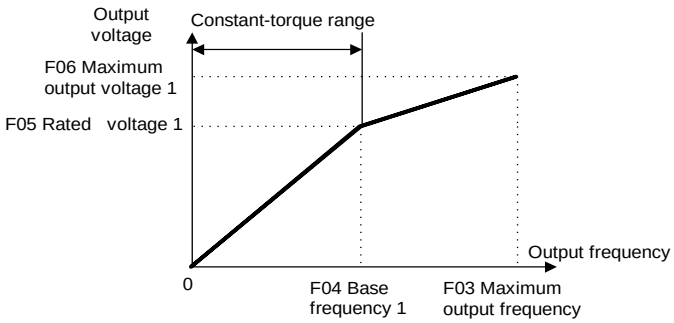
## F04 Base frequency 1

◆This function sets the maximum output frequency in the constant-torque range of motor 1 or the output frequency at the rated output voltage. Match the rating of the motor.
◆This is a function for motor 1.

| F | 0 | 4 | B | A | S | E | | H | z | - | 1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range EQ5: 25 to 120Hz

**Note:** When the set value of base frequency 1 is higher than that of maximum output frequency 1, the output voltage does not increase to the rated voltage because the maximum frequency limits the output frequency.




## F05 Rated voltage 1

◆This function sets the rated value of the voltage output to motor 1. Note that a voltage greater than the supply (input) voltage cannot be output.
◆This is a function for motor 1.

| F | 0 | 5 | R | A | T | E | D | | V | - | 1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range 230 V series: 0, 80 to 240V
460 V series: 0, 320 to 480V

Value 0 terminates operation of the voltage regulation function, thereby resulting in the output of a voltage proportional to the supply voltage.

**Note:** When the set value of rated voltage 1 exceeds maximum output voltage 1, the output voltage does not increase to the rated voltage because the maximum output voltage limits the output voltage.

## F06 Maximum voltage 1

◆This function sets the maximum value of the voltage output for motor 1. Note that a voltage higher than the supply (input) voltage cannot be output.
◆This is a function for motor 1.

| F | 0 | 6 | M | A | X | | V | - | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range 230 V series: 80 to 240V
460 V series: 320 to 480V

**Note:** When the set value of rated voltage 1 (F05) to "0", this function is invalid.

## F07 Acceleration time 1
## F08 Deceleration time 1

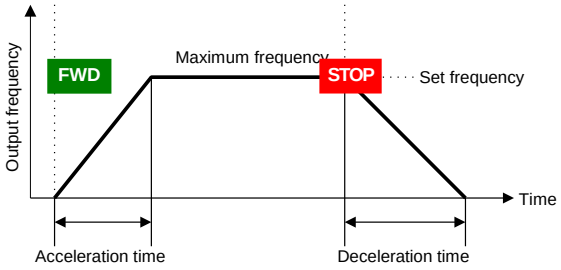
◆This function sets the acceleration time for the output frequency from startup to maximum frequency and the deceleration time from maximum frequency to operation stop.

| F | 0 | 7 | A | C | C | | T | I | M | E | 1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | 0 | 8 | D | E | C | | T | I | M | E | 1 | |

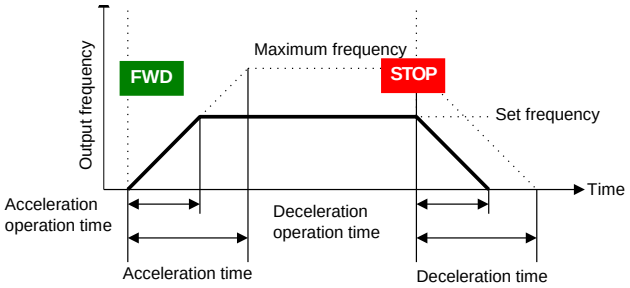
Setting range Acceleration time 1: 0.01 to 3,600 seconds
Deceleration time 1: 0.01 to 3,600 seconds

Set acceleration and deceleration times with respect to maximum frequency. The relationship between the set frequency value and acceleration/deceleration times is as follows:

<u>Set frequency = maximum frequency</u>
The actual operation time matches the set value.




<u>Set frequency < maximum frequency</u>
The actual operation time differs from the set value.
Acceleration(deceleration) operation time = set value x (set frequency/maximum frequency)




**Note:** If the set acceleration and deceleration times are too short even though the resistance torque and moment of inertia of the load are great, the torque limiting function or stall prevention function becomes activated, thereby prolonging the operation time beyond that stated above.

| F09 | Torque boost 1 |
|---|---|

◆This is a function for motor 1. The following can be selected:

| F | 0 | 9 | T | R | Q | | B | O | O | S | T | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

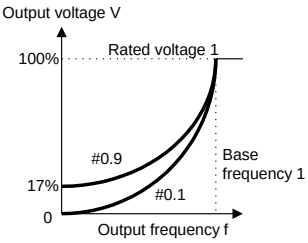
-- Selection of load characteristics such as automatic torque boost, square law reduction torque load, proportional torque load, constant torque load.

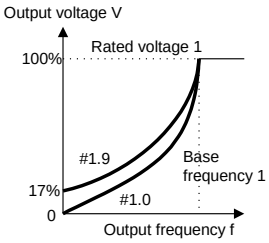
-- Enhancement of torque (V/f characteristics), which is lowered during low-speed operation. Insufficient magnetic flux of the motor due to a voltage drop in the low-frequency range can be compensated.

| Setting range | Characteristics selected |
|---|---|
| 0.0 | Automatic torque boost characteristic where the torque boost value of a constant torque load (a linear change) is automatically adjusted. The motor tuning (P04 / A13) should be set to "2" for this function is valid. |
| 0.1 to 0.9 | Square law reduction torque for fan and pump loads. |
| 1.0 to 1.9 | Proportional torque for middle class loads between square law reduction torque and constant torque (linear change) |
| 2.0 to 20.0 | Constant torque (linear change) |

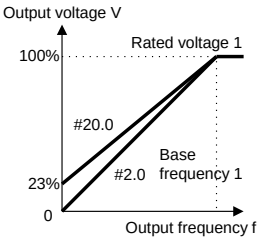
◆Torque characteristics(30HP/CT, 40HP/VT or less)

<Square law reduction torque> <Proportional torque>



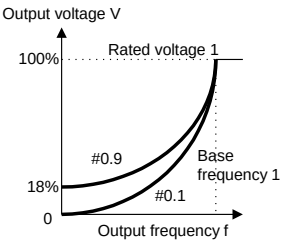



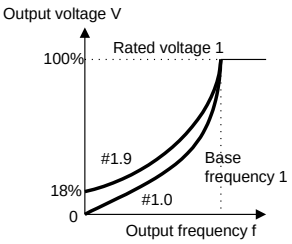

<Constant torque>



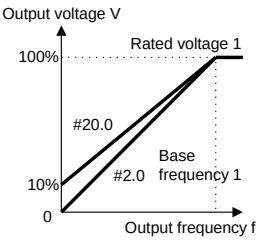

◆Torque characteristics(40HP or above)

<Square law reduction torque> <Proportional torque>




<Constant torque>




**Note:** As a large torque boost value creates overexcitation in the low-speed range, continued operation may cause motor to overheat. Check the characteristics of the driven motor.

| F10 | Electric thermal O/L relay ( select) |
|---|---|
| F11 | Electric thermal O/L relay (level) |
| F12 | Electric thermal O/L relay (Thermal time constant) |

The electronic thermal O/L relay manages the output frequency, output current, and operation time of the inverter to prevent the motor from overheating when 150% of the set current value flows for the time set by F12 (thermal time constant).

◆This is a function for motor 1.

◆This function specifies whether to operate the electronic thermal O/L relay and selects the target motor. When a general-purpose motor is selected, the operation level is lowered in the low speed range according to the cooling characteristics of the motor.

| F | 1 | 0 | E | L | C | T | R | N | | O | L | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

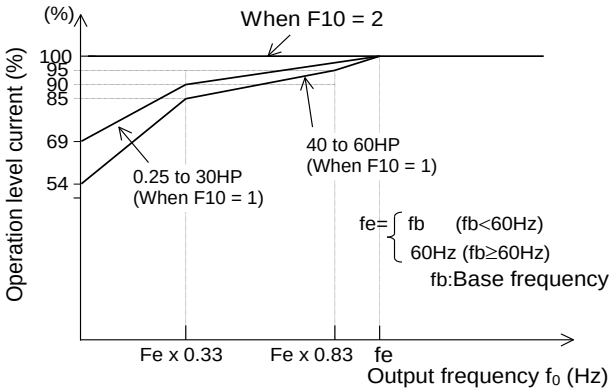
Set value 0: Inactive
1: Active (for general-purpose motor)
2: Active (for inverter motor)

◆This function sets the operation level (current value) of the electronic thermal. Enter a value from 1 to 1.1 times the current rating value of the motor.

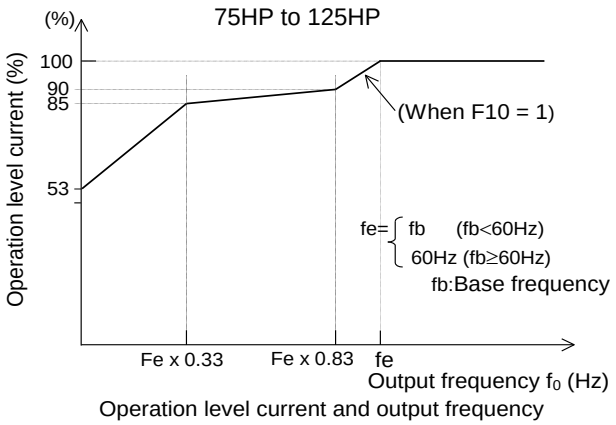
◆The set value "2" is set for the inverter motor because there is no cooling effect decrease by the rotational speed.

| F | 1 | 1 | O | L | | L | E | V | E | L | 1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

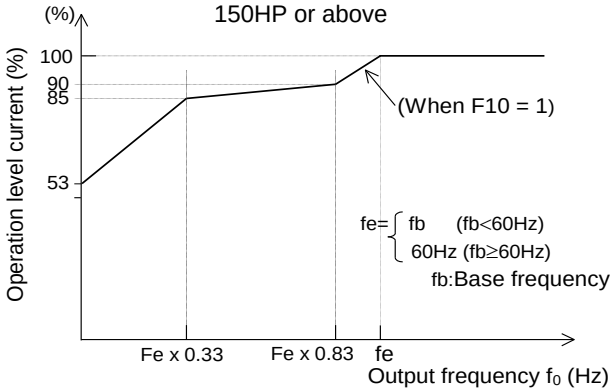
The setting range is 20 to 135% of the rated current of the inverter.




Operation level current and output frequency



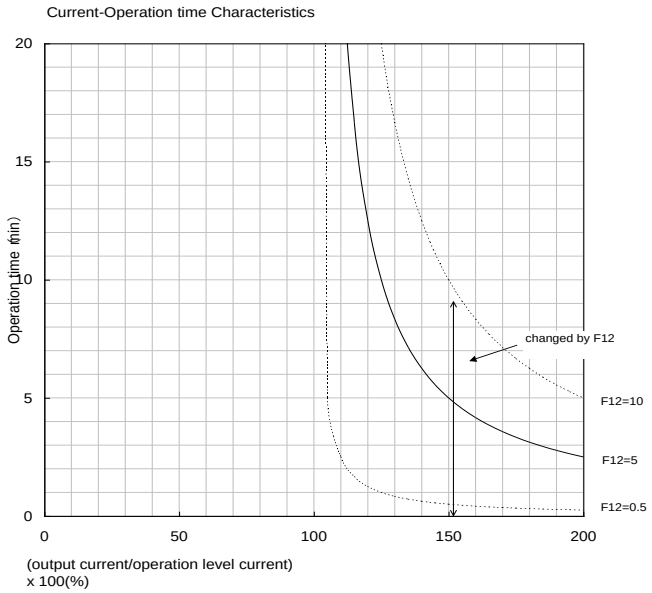
Operation level current and output frequency



Operation level current and output frequency

◆The time from when 150% of the operation level current flows continuously to when he electronic thermal O/L relay activates can be set.
The setting range is 0.5 to 75.0 minutes (in 0.1 minute steps).

| F | 1 | 2 | T | I | M | E | | C | N | S | T | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|




## F13 Electric thermal O/L relay (for breaking resistor)

This function controls the frequent use and continuous operating time of the braking resistor to prevent the resistor from overheating.

Related functions: **U59**

| F | 1 | 3 | D | B | R | | O | L | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Inverter capacity | Operation |
|---|---|
| EQ5:10HP/CT, 15HP/VT or less | 0: Inactive<br>2: Active<br>(DB***-2C/4C external braking resistor) |
| EQ5: 15HP/CT, 20HP/VT or more | 0: Inactive |

◆When the setting value is selected to "2", the type of braking resistor and connection circuit are set by U59.
The details are referred to the function : U59.

## F14 Restart mode after momentary power failure

◆This function selects operation if a momentary power failure occurs.
The function for detecting power failure and activating protective operation (i.e., alarm output, alarm display, inverter output cutoff) for undervoltage can be selected. The automatic restart function (for automatically restarting a coasting motor without stopping) when the supply voltage is recovered can also be selected.

◆When setting value is selected "2" or "3", both integration constant and the proportional constant during operation ride-though can be adjusted by the function code : U23 and U24. The details are referred to the function code : U23 and U24.

| F | 1 | 4 | R | E | S | T | A | R | T | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Related functions:
**U23, U24**

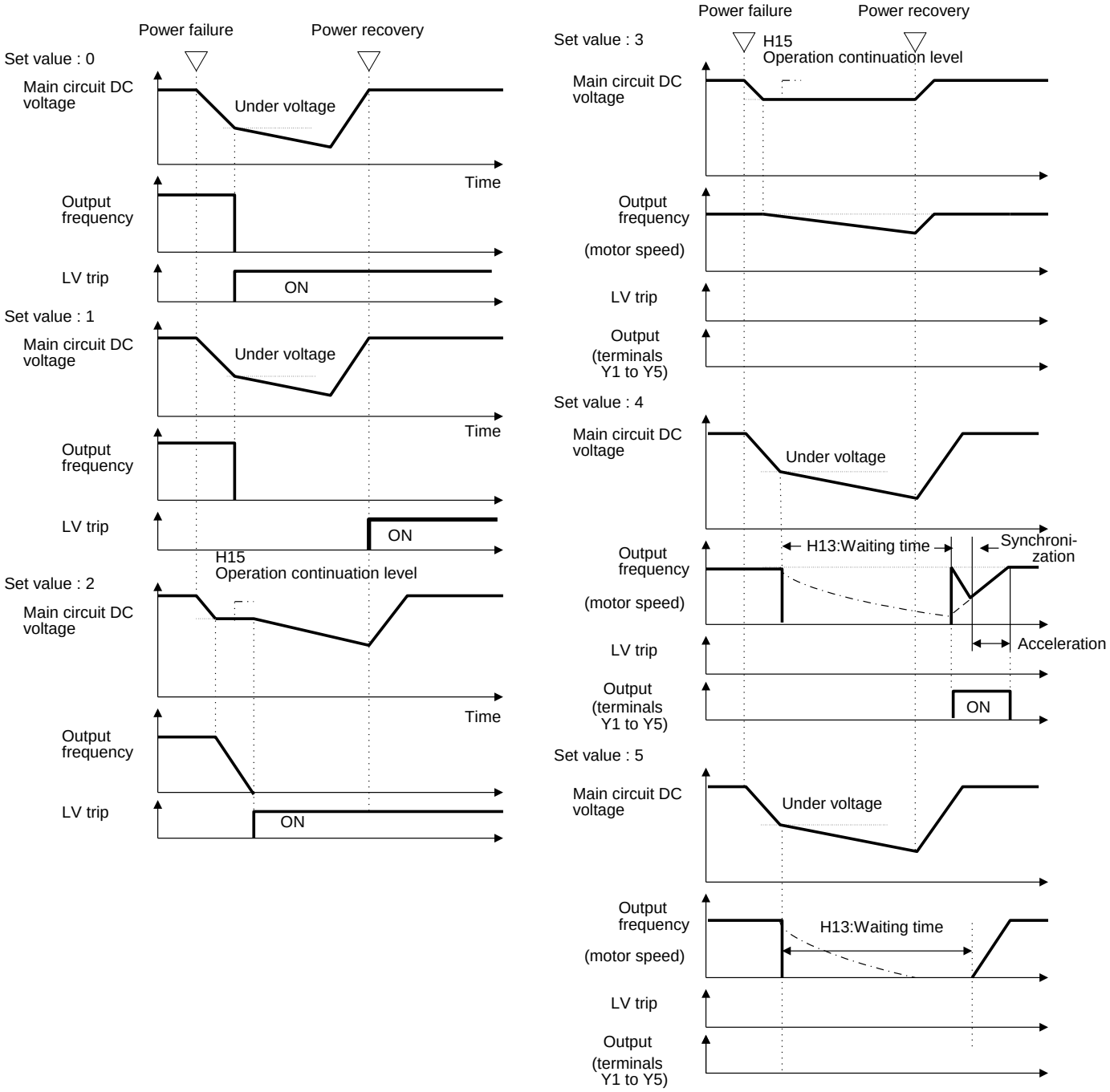
Setting range: 0 to 5
The following table lists the function details.

| Set value | Function name | Operation at power failure | Operation at power recovery |
|---|---|---|---|
| 0 | Inactive (immediate inverter trip) | If undervoltage is detected, the drive will immediately trip and an undervoltage fault (LU) is displayed. The drive output stops and the motor will coast to a stop. | The drive operation is not automatically restarted. Input a reset command and operation command to restart operation. |
| 1 | Inactive (inverter trip at recovery) | If undervoltage is detected, the drive output stops and the motor will immediately coast to a stop. A drive fault is not activated | An undervoltage fault (LU) is activated at power recovery. Drive operation is not automatically restarted. Input a reset command to restart operation. |
| 2 | Inactive (inverter trip after deceleration to a stop at power failure) Note1 | When the DC bus voltage reaches the continue operation voltage level (H15), a controlled deceleration to a stop occurs. The inverter collects the inertia energy of the load to maintain the DC bus voltage and controls the motor until it stops, then an undervoltage fault (LU) is activated. The drive will automatically decrease the deceleration time if necessary. If the amount of inertia energy from the load is small, and the undervoltage level is achieved before the motor stops, the undervoltage fault is immediately activated and the motor will coast to a stop. | The drive operation is not automatically restarted. Input a reset command and operation command to restart operation. |
| 3 | Active (operation ride through, for high-inertia loads) Note1 | When the DC bus voltage reaches the continue operation voltage level (H15), energy is collected from the inertia of the load to maintain the DC bus voltage and extend the ride through time. The drive will automatically adjust the deceleration rate to maintain DC bus voltage level. If undervoltage is detected, the protective function is not activated, but drive output stops and the motor coast to a stop. | Operation is automatically restarted. For power recovery during ride-through the drive will accelerate directly to the original frequency. If undervoltage is detected, operation automatically restarts with the frequency at the time that the undervoltage is detected. |
| 4 | Active (restart with the frequency at power failure) Note1 | If undervoltage is detected, the protective function is not activated. The drive output stops and the motor will coast to a stop. | Operation is automatically restarted with the frequency at power failure. |
| 5 | Active (restart with the start frequency, for low-inertia loads) Note1 | If undervoltage is detected, the protective function is not activated, but output stops. | Operation is automatically restarted with the frequency set by F23, "Starting frequency." |

Note1) When the function code H18(Torque control) is excluding "0" and Motor 1 is selected, the inverter will trip at power recovery if function code F14 is set to between "2" and "5". This operation is same as F14 is set to "1".

Function codes H13 to H16 are provided to control a restarting operation after momentary power failure. These functions should be understood and used. The pick-up (speed search) function can also be selected as a method of restarting when power is recovered following a momentary failure. (For setting details, see function code H09.)
The pick-up function searches for the speed of the coasting motor to restart the motor without subjecting it to excessive shock. In a high-inertia system, the reduction in motor speed is minimal even when the motor is coasting. A speed searching time is required when the pick-up function is active. In such a case, the original frequency may be recovered sooner when the function is inactive and the operation restarted with the frequency prior to the momentary power failure.
The pick-up function works in the range of 5 to 100 Hz. If the detected speed is outside this range, restart the motor using the regular restart function.

| | |
|---|---|
| ⚠**WARNING** | • Automatically restart could be provided at power recovered, if "Restart mode after momentary power failure" is valid.<br>• The machine should be designed to human safety when restarting.<br>**Otherwise accidents may result.** |



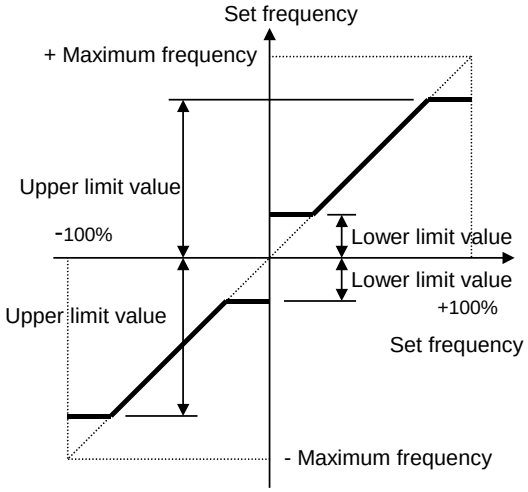

Note : Dotted-dashed lines indicate motor speed.

| F15 | Frequency limiter (High) |
|---|---|
| F16 | Frequency limiter (Low) |

◆This function sets the upper and lower limits for the setting frequency .

| F15 | H | | L | I | M | I | T | E | R | |
|---|---|---|---|---|---|---|---|---|---|---|
| F16 | L | | L | I | M | I | T | E | R | |

Setting range EQ5: 0 to 120Hz




※ The inverter output starts with the start frequency when operation begins, and stops with the stop frequency when operation ends.

※ If the upper limit value is less than the lower limit value, the upper limit value overrides the lower limit value.

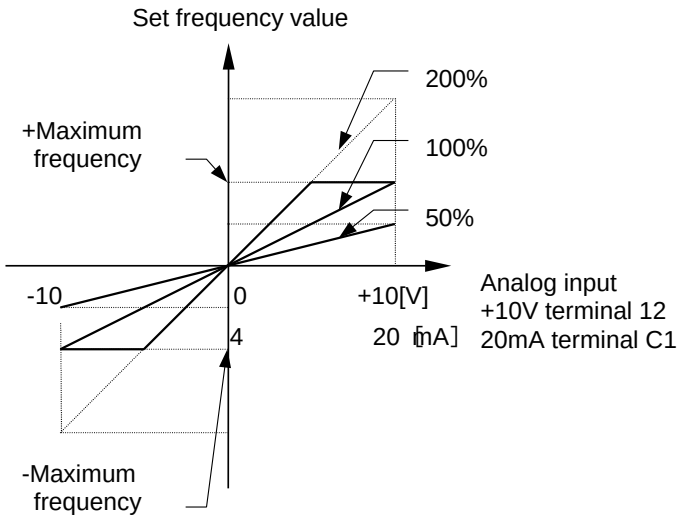
※ When lower limit value is set, the inverter operates with lower limit value at operation command is "ON" even frequency command is zero(0Hz).

| F17 | Gain |
|---|---|

◆This function sets the rate of the set frequency value to analog input.

| F17 | F | R | E | Q | | G | A | I | N | |
|---|---|---|---|---|---|---|---|---|---|---|

Operation follows the figure below.



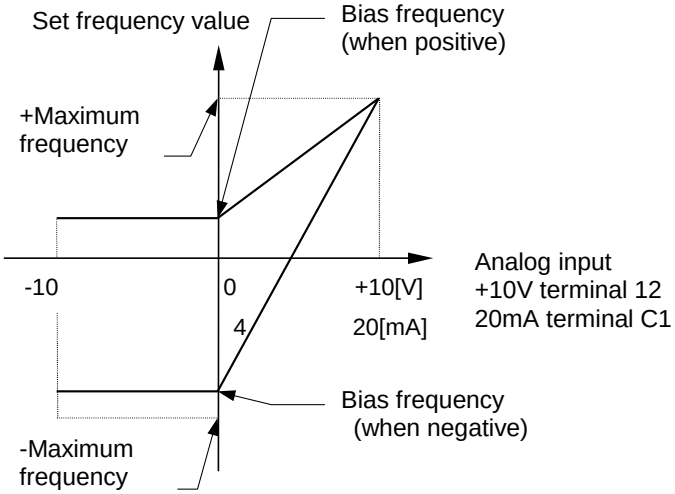

| F18 | Bias frequency |
|---|---|

◆This function adds a bias frequency to the set frequency value to analog input.

| F18 | F | R | E | Q | | B | I | A | S | |
|---|---|---|---|---|---|---|---|---|---|---|

Setting range EQ5: -120.0 to +120.0Hz

The operation follows the figure below.
When the bias frequency is higher than the maximum frequency or lower than the - maximum frequency, it is limited to the maximum or - maximum frequency.




※ Reversible operation is valid if the function code F01/C30 is set to "4" or "5" only.

※ This function is invalid if PID control is selected(H20 is "1" or "2").

| F20 | DC brake (starting frequency) |
|---|---|
| F21 | DC brake (Braking level) |
| F22 | DC brake (Braking time) |

◆Starting frequency: This function sets the frequency with which to start a DC injection brake to decelerate the motor to a stop.

| F20 | D | C | | B | R | K | | H | z | |
|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0 to 60Hz

◆Operation level: This function sets the output current level when a DC injection brake is applied. Set a percentage of inverter rated output current in 1% steps.

| F21 | D | C | | B | R | K | | L | V | L |
|---|---|---|---|---|---|---|---|---|---|---|

Setting range EQ5: 0 to 80%

◆Time: This function sets the time of a DC injection brake operation.

| F22 | D | C | | B | R | K | | t | | |
|---|---|---|---|---|---|---|---|---|---|---|

Setting range 0.0: Inactive
0.1 to 30.0 seconds

**⚠CAUTION**

Do not use the inverter brake function for mechanical holding.
**Injury may result.**

| F23 | Starting frequency (frequency) |
|---|---|
| F24 | Start frequency (Holding time) |
| F25 | Stop frequency |

The starting frequency can be set to reserve the torque at startup and can be sustained until the magnetic flux of the motor is being established.

◆Frequency: This function sets the frequency at startup.

F 2 3 S T A R T H z

Setting range: 0.1 to 60Hz

◆Holding time: This function sets the holding time during which the start frequency is sustained at startup.

F 2 4 H O L D I N G t

Set values: 0.1 to 10.0 seconds

∗The holding time does not apply at the time of switching between forward and reverse.

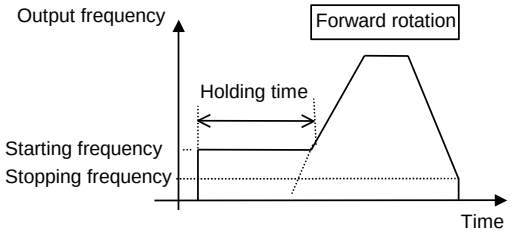
∗The holding time is not included in the acceleration time.

∗The holding time also applies when pattern operation (C21) is selected. The holding time is included in the timer value.

◆This function sets the frequency at stop.

F 2 5 S T O P H z

Setting range: 0.0 to 60.0Hz




The operation does not start when the starting frequency is less than the stopping frequency or when the setting frequency is less than the stopping frequency.

| F26 | Motor sound (carrier frequency) |
|---|---|

◆This function adjusts the carrier frequency, correct adjustment of which prevents resonance with the machine system, reduces motor and inverter noise, and also reduces leakage current from output circuit wiring.

F 2 6 M T R S O U N D

| | Nominal applied motor | Setting range |
|---|---|---|
| EQ5 | 30HP/CT or less<br>40HP/VT or less | 0.75 to 15kHz |
| | 40HP/CT to 100HP/CT<br>50HP/VT to 125HP/VT | 0.75 to 10kHz |
| | 125HP/CT or more<br>150HP/VT or more | 0.75 to 6kHz |

| Carrier frequency | Low | High |
|---|---|---|
| Motor noise | High | Low |
| Output current waveform | Bad | Good |
| Leakage current | Small amount | Large amount |
| Noise occurrence | Extremely low | High |

Notes:

1. Reducing the set value adversely affects the output current waveform (i.e., higher harmonics), increases motor loss, and raises motor temperature. For example, at 0.75 kHz, reduce the motor torque by about15%.
2. Increasing the set value increases inverter loss and increases the inverter temperature.

| F27 | Motor sound (sound tone) |
|---|---|

◆The tone of motor noise can be altered when the carrier frequency is 7kHz or lower. Use this function as required.

F 2 7 M T R T O N E

Setting range: 0 , 1, 2 , 3

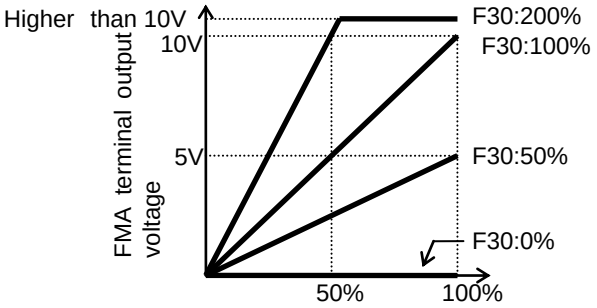
| F30 | FMA (voltage adjust) |
|---|---|
| F31 | FMA (function) |

Monitor data (e.g.,output frequency, output current) can be output to terminal FMA as a DC voltage. The amplitude of the output can also be adjusted.

◆This function adjusts the voltage value of the monitor item selected in F31 when the monitor amount is 100%. A value from 0 to 200 (%) can be set in 1% steps.

F 3 0 F M A V - A D J

Setting range: 0 to 200%




◆This function selects the monitor item to be output to terminal FMA.

F 3 1 F M A F U N C

| Set value | Monitor item | Definition of 100% monitor amount |
|---|---|---|
| 0 | Output frequency 1 (before slip compensation) | Maximum output frequency |
| 1 | Output frequency 2 (after slip compensation) | Maximum output frequency |
| 2 | Output current | Rated output current of inverter x 2 |
| 3 | Output voltage | 230V series: 250V<br>460V series: 500V |
| 4 | Output torque | Rated torque of motor x 2 |
| 5 | Load rate | Rated load of motor x 2 |
| 6 | Power consumption | Rated output of inverter x 2 |
| 7 | PID feedback amount | Feedback amount of 100% |
| 8 | PG feedback amount (only when option is installed) | Synchronous speed at maximum frequency |
| 9 | DC link circuit voltage | 230V series: 500V<br>460V series: 1,000V |
| 10 | Universal AO | 0 to 10V output through communication and not related to inverter operation. |

※The power consumption shows "0" during regenerative load.

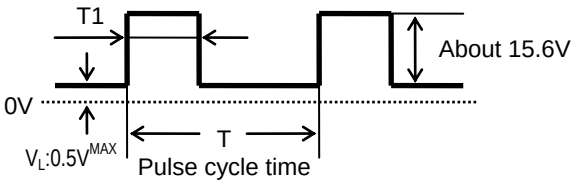
| F33 | FMP (pulse rate) |
|---|---|
| F34 | FMP (voltage adjust) |
| F35 | FMP terminal (function) |

Monitor data (e.g.,output frequency, output current) can be output to terminal FMP as pulse voltage. Monitor data can also be sent to an analog meter as average voltage.
When sending data to a digital counter or other instrument as pulse output, set the pulse rate in F33 to any value and the voltage in F34 to 0%.
When data is sent to an analog meter or other instrument as average voltage, the voltage value set in F34 determines the average voltage and the pulse rate in F33 is fixed to 2670 (p/s).

◆This function sets the pulse frequency of the monitor item selected in F35 within a range of 300 to 6000 (p/s) in 1 p/s steps.

| F | 3 | 3 | F | M | P | | P | U | L | S | E | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 300 to 6,000 p/s




Pulse frequency (p/s) = 1/T
Duty (%) = T1/T x 100
Average voltage (V) = 15.6 x T1/T

The output terminal of the FMP terminal is composed of the transistor, therefore there is a saturation voltage (0.5V$^{MAX}$). When using in the analogue by the filter processing the pulse voltage, it should be make a 0V adjustment by external equipment.

◆This function sets the average voltage of pulse output to terminal FMP.

| F | 3 | 4 | F | M | P | | V | - | A | D | J | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range
0%: The pulse rate varies depending on the monitor amount of the monitor item selected in F35. (The maximum value is the value set in F33. The pulse duty is fixed at 50%.)
1 to 200%: Pulse rate is fixed at 2,670 p/s. The average voltage of the monitor item selected in F35 when the monitor amount is 100% is adjusted in the 1 to 200% range (1% steps).
(The pulse duty varies.)

◆This function selects the monitor item to be output to terminal FMP.

| F | 3 | 5 | F | M | P | | F | U | N | C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

The set value and monitor items are the same as those of F31.

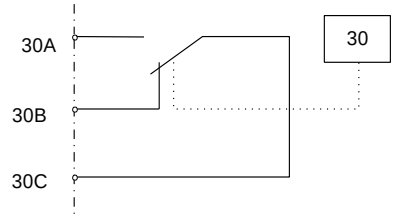
| F36 | 30Ry operation mode |
|---|---|

◆This function specifies whether to activate (excite) the alarm output relay (30Ry) for any fault at normal or alarm status.

| F | 3 | 6 | 3 | 0 | R | Y | | M | O | D | E | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Set value | Operation |
|---|---|
| 0 | At normal 30A - 30C: OFF, 30B - 30C: ON<br>At alarm condition 30A - 30C: ON, 30B - 30C:OFF |
| 1 | At normal 30A - 30C:ON, 30B - 30C: OFF<br>At alarm condition 30A - 30C: OFF, 30B - 30C: ON |

◆When the set value is 1, contacts 30A and 30C are connected when the inverter control voltage is established (about one second after power on).
◆When the power is off, contacts 30A and 30C are OFF; 30B and 30C are ON.




| F40 | Torque limiter 1 (driving) |
|---|---|
| F41 | Torque limiter 1 (braking) |

◆The torque limit operation calculates motor torque from the output voltage, current and the primary resistance value of the motor, and controls the frequency so the calculated value does not exceed the limit. This operation enables the inverter to continue operation under the limit even if a sudden change in load torque occurs.
◆Select limit values for the driving torque and braking torque.
◆When this function is activated, acceleration and deceleration operation times are longer than the set values.
◆The motor tuning (P04 / A13) should be set to "2" for this function is valid.
◆The increase frequency upper bound during torque limit operation is set by function code : U01.
◆When the setting value is selected "0" (prevent OU trip), the operation mode is selected by function code : U60.
The details are referred to the functions: U01, U60.

Related functions:
**U01, U60**

| F | 4 | 0 | D | R | V | | T | R | Q | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | 4 | 1 | B | R | K | | T | R | Q | 1 | | |

| Function | Setting range | Operation |
|---|---|---|
| Torque limit (driving) | EQ5:20% to 150% | The torque is limited to the set value. |
| | 999 | Torque limiting inactive |
| Torque limit (braking) | EQ5:20% to 150% | The torque is limited to the set value. |
| | 0 | Prevents OU trip due to power regeneration effect automatically. |
| | 999 | Torque limiting inactive |

## ⚠WARNING

When the torque limit function is selected, an operation may not match the set acceleration and deceleration time or set speed. The machine should be so designed that safety is ensured even when operation does not match set values.
**Otherwise accidents may result.**

## ⚠WARNING

The frequency may be stagnated / held constant when using the automatically OU trip prevention and set the frequency limit(Low) to the setting frequency or less.
**Otherwise accidents may result.**

### F42 Torque vector control 1

◆This is a function for motor 1.
◆To obtain the motor torque most efficiently, the torque vector control calculates torque according to load, to adjust the voltage and current vectors to optimum values based on the calculated value.

Related functions:
**P01, P09**

| F | 4 | 2 | T | R | Q | V | E | C | T | O | R | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Set value | Operation |
|---|---|
| 0 | Inactive |
| 1 | Active |

◆When 1 (Active) is set, the set values of the following functions differ from the written values:
① F09 Torque boost 1
Automatically set to 0.0 (automatic torque boosting).
② P09 Slip compensation amount Slip compensation is automatically activated.
When 0.0 is set, the amount of slip compensation for the TWMC standard 3-phase motor is applied. Otherwise, the written value is applied.
◆Use the torque vector control function under the following conditions:
① There must be only one motor.
Connection of two or more motors makes accurate control difficult.
②The function data (rated current P03, no-load current P06, %R1 P07, and %X P08) of motor 1 must be correct.
When the standard TWMC 3-phase motor is used, setting the capacity (function P02) ensures entry of the above data. An auto tuning operation should be performed for other motors.
③The rated current of the motor must not be significantly less than the rated current of the inverter. A motor two ratings lower in capacity than the nominal applied motor for the inverter should be used at the minimum (depending on the model).
④To prevent leakage current and ensure accurate control, the length of the cable between the inverter and motor should not exceed 164ft(50m).
⑤When a reactor is connected between the inverter and the motor and the impedance of the wiring cannot be disregarded, use P04, "Auto tuning," to rewrite data.

If these conditions are not satisfied, set 0 (Inactive).

# E: Extension Terminal Functions

| E01 | X1 Terminal function |
|---|---|
| ∫ | ∫ |
| E09 | X9 Terminal function |

◆Each function of digital input terminals X1 to X9 can be set as codes.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 0 | 1 | X | 1 | | F | U | N | C | | | |
| E | 0 | 2 | X | 2 | | F | U | N | C | | | |
| E | 0 | 3 | X | 3 | | F | U | N | C | | | |
| E | 0 | 4 | X | 4 | | F | U | N | C | | | |
| E | 0 | 5 | X | 5 | | F | U | N | C | | | |
| E | 0 | 6 | X | 6 | | F | U | N | C | | | |
| E | 0 | 7 | X | 7 | | F | U | N | C | | | |
| E | 0 | 8 | X | 8 | | F | U | N | C | | | |
| E | 0 | 9 | X | 9 | | F | U | N | C | | | |

| Set value | Function |
|---|---|
| 0,1,2,3 | Multistep frequency selection (1 to 15 steps) [SS1],[SS2],[SS4],[SS8] |
| 4,5 | Acceleration and deceleration time selection (3 steps) [RT1],[RT2] |
| 6 | Self-hold selection [HLD] |
| 7 | Coast-to-stop command [BX] |
| 8 | Alarm reset [RST] |
| 9 | External alarm [THR] |
| 10 | Jogging [JOG] |
| 11 | Frequency setting 2/frequency setting 1 [Hz2/Hz1] |
| 12 | Motor 2/motor 1 [M2/M1] |
| 13 | DC injection brake command [DCBRK] |
| 14 | Torque limit 2/torque limit 1 [TL2/TL1] |
| 15 | Switching operation from line to inverter (50Hz) [SW50] |
| 16 | Switching operation from line to inverter (60Hz) [SW60] |
| 17 | UP command [UP] |
| 18 | DOWN command [DOWN] |
| 19 | Edit permission command (data change permission) [WE-KP] |
| 20 | PID control cancellation [Hz/PID] |
| 21 | Forward/inverse switching (terminals 12 and C1) [IVS] |
| 22 | Interlock (52-2) [IL] |
| 24 | Link operation selection (Standard:RS-485, Option: BUS) [LE] |
| 25 | Universal DI [U-DI] |
| 26 | Start characteristics selection [STM] |
| 30 | Forced stop command [STOP1] |
| 31 | Forced stop command with Deceleration time 4 [STOP2] |
| 35 | Frequency setting 1 / Frequency setting 2 [Hz1/Hz2] |

Note: Data numbers which are not set in the functions from E01 to E09, are assumed to be inactive.

## Multistep frequency selection [SS1][SS2][SS4][SS8]

The frequency can be switched to a preset frequency in function codes C05 to C19 by switching the external digital input signal. Assign values 0 to 3 to the target digital input terminal. The combination of input signals determines the selected frequency.

| Combination of set value input signals | | | | Frequency selected | |
|---|---|---|---|---|---|
| 3 [SS8] | 2 [SS4] | 1 [SS2] | 0 [SS1] | | |
| off | off | off | off | Assigned by F01 or C30 | |
| off | off | off | on | C05 MULTI Hz-1 | Related function C05 to C19<br>Setting range<br>EQ5:0.00 to 120.00Hz |
| off | off | on | off | C06 MULTI Hz-2 | |
| off | off | on | on | C07 MULTI Hz-3 | |
| off | on | off | off | C08 MULTI Hz-4 | |
| off | on | off | on | C09 MULTI Hz-5 | |
| off | on | on | off | C10 MULTI Hz-6 | |
| off | on | on | on | C11 MULTI Hz-7 | |
| on | off | off | off | C12 MULTI Hz-8 | |
| on | off | off | on | C13 MULTI Hz-9 | |
| on | off | on | off | C14 MULTI Hz-10 | |
| on | off | on | on | C15 MULTI Hz-11 | |
| on | on | off | off | C16 MULTI Hz-12 | |
| on | on | off | on | C17 MULTI Hz-13 | |
| on | on | on | off | C18 MULTI Hz-14 | |
| on | on | on | on | C19 MULTI Hz-15 | |

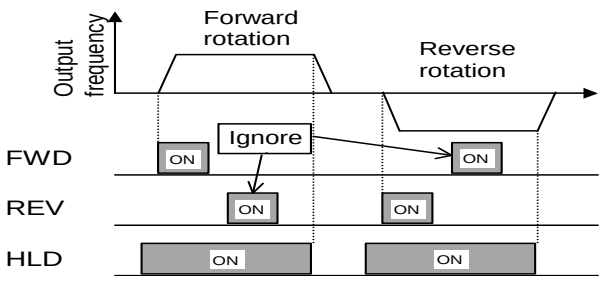
## Acceleration and deceleration time selection [RT1][RT2]

The acceleration and deceleration time can be switched to a preset time in function codes E10 to E15 by switching the external digital input signal. Assign values 4 and 5 to the target digital input terminal. The combination of input signals determines the acceleration and deceleration times.

| Combination of set value input signals | | Acceleration and deceleration times selected | |
|---|---|---|---|
| 5 [RT2] | 4 [RT1] | | |
| off | off | F07 ACC TIME1<br>F08 DEC TIME1 | Setting range<br>0.01 to 3600s<br>Related function<br>F07～F08<br>E10～E15 |
| off | on | E10 ACC TIME2<br>E11 DEC TIME2 | |
| on | off | E12 ACC TIME3<br>E13 DEC TIME3 | |
| on | on | E14 ACC TIME4<br>E15 DEC TIME4 | |

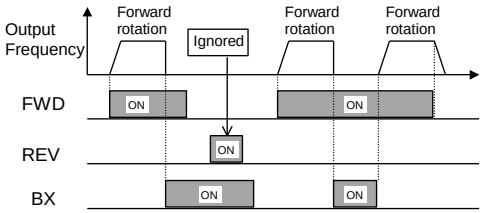
## 3-wire operation stop command [HLD]

This selection is used for 3-wire operation. The FWD or REV signal is self-held when [HLD] is on, and the self-hold is cleared when [HLD] is turned off. To use this [HLD] terminal function, assign 6 to the target digital input terminal.



## Coast-to-stop command [BX]

When BX and P24 are connected, inverter output is cut off immediately and the motor starts to coast-to-stop. An alarm signal is neither output nor self-held. If BX and P24 are disconnected when the operation command (FWD or REV) is on, operation starts at the start frequency. To use this BX terminal function, assign value "7" to the target digital input terminal.




## Alarm reset [RST]

When an inverter trip occurs, connecting RST and P24 clears the alarm output (for any fault) ; disconnecting them clears trip indication and restarts operation. To use this RST terminal function, assign value "8" to the target digital input terminal.

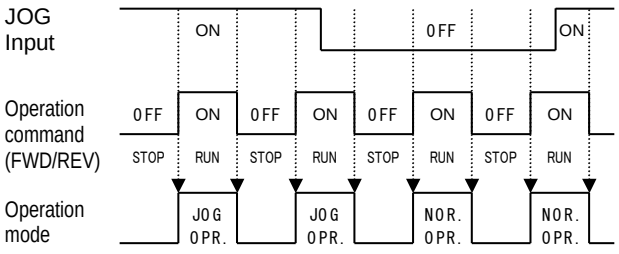
## External fault [THR]

Disconnecting THR and P24 during operation cuts off inverter output (i.e., motor starts to coast-to-stop) and outputs alarm OH2, which is self-held internally and cleared by RST input. This function is used to protect an external brake resistor and other components from overheating. To use this THR terminal function, assign value "9" to the target digital input terminal. ON input is assumed when this terminal function is not set.

## Jogging operation[JOG]

This function is used for jogging (inching) operation to position a work piece. When JOG and P24 are connected, the operation is performed with the jogging frequency set in function code C20 while the operation command (FWD-P24 or REV-P24) is on. To use this JOG terminal function, assign value "10" to the target digital input terminal.

Note: It is possible to change to the JOG operation by keypad panel when keypad panel operation.




## ⚠WARNING

- When the JOG command and operation command (FWD/REV) are input at the same time, the inverter can NOT be changed to the JOG operation and will operate at set frequency.
- When the JOG operation is used, the operation command should be input after the JOG command input while the inverter is STOPPED.
- When the JOG command and operation command are input at the same time, the JOG command is assigned to the "Multistep frequency selection (SS1 to SS8)".
- The inverter can NOT be stopped and JOG operation will continue even if JOG command is OFF during JOG operation. The inverter will decelerate to a stop if the operation command is switched OFF.

**Accidents may result.**

## Frequency setting 2/frequency setting 1 [Hz1/Hz2]

This function switches the frequency setting method set in function codes F01 and C30 by an external digital input signal.

| Set value input signal **11** | Frequency setting method selected |
|---|---|
| **off** | F01 FREQ CMD1 |
| **on** | C30 FREQ CMD2 |

Note: It can not be used with set value "35" simultaneously. When the set value "11" and "35" are selected, "Er6" is displayed.

## Motor 2/motor 1 [M1/M2]

This function switches motor constants using an external digital input signal.
This input is effective only when the operation command to the inverter is off, operation has stopped, and does not apply to the operation at 0Hz.

| Set value input signal **12** | Motor selected | **Related function A01～A18** |
|---|---|---|
| **off** | Motor 1 | |
| **on** | Motor 2 | |

## DC brake command [DCBRK]

When the external digital input signal is on, DC injection braking starts when the inverter's output frequency drops below the frequency preset in function code F20 after the operation command goes off. (The operation command goes off when the STOP key is pressed at keypad panel operation and when both terminals FWD and REV go on or off at terminal block operation.) The DC injection braking continues while the digital input signal is on. In this case, the longer time of the following is selected:

- The time set in function code F22.
- The time which the input signal is set on.

| Set value input signal **13** | Operation selected |
|---|---|
| **off** | No DC injection brake command is given. |
| **on** | A DC injection brake command is given. |

### Torque limit 2/torque limit 1 [TL2/TL1]

This function switches the torque limit value set in function codes F40 and F41, and E16 and E17 by an external digital input signal.

| Set value input signal | Torque limit value selected | Related function F40～F41 E16～E17 |
|---|---|---|
| **14** | | |
| **off** | F40 DRV TRQ1<br>F41 BRK TRQ1 | Setting range<br>DRV 20 to 200% ,999<br>BRK 0, 20 to 200% ,999 |
| **on** | E16 DRV TRQ2<br>E17 BRK TRQ2 | |

### Switching operation between line and inverter (50Hz) [SW50]

Motor operation can be switched from 50Hz commercial power operation to inverter operation without stopping the motor by switching the external digital input signal.

| Set value input signal | Function |
|---|---|
| **15** | |
| **off→on** | Inverter operation to line operation (50Hz) |
| **on→off** | Line operation to inverter operation (50Hz) |

### Switching operation between line and inverter (60Hz) [SW60]

Motor operation can be switched from 60Hz commercial power operation to inverter operation without stopping the motor by switching the external digital input signal.

| Set value input signal | Function |
|---|---|
| **16** | |
| **off→on** | Inverter operation to line operation (60Hz) |
| **on→off** | Line operation to inverter operation (60Hz) |

◆When the digital input signal goes off, 50 or 60 Hz is output according to the set value input signal after the restart waiting time following a momentary power failure (function code H13). The motor is then directed to inverter operation.

**⚠WARNING**

- After the LU(Low Voltage) trip is occurred and reset, the inverter will automatically restart because the operation command is kept by internal sequence.
**Accidents may result.**

### UP command [UP]/DOWN command [DOWN]

When an operation command is input (on), the output frequency can be increased or decreased by an external digital input signal.
The change ranges from 0 to maximum frequency. Operation in the opposite direction of the operation command is not allowed.

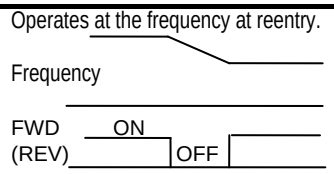
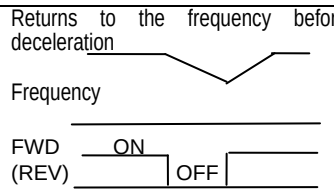
**Related function F01, C30**

**Related function E01～E09 (set value: 11, 35)**

| Combination of set value input signals | | Function selected (when operation command is on) |
|---|---|---|
| **18** | **17** | |
| **off** | **off** | Holds the output frequency. |
| **off** | **on** | Increases the output frequency according to the acceleration time. |
| **on** | **off** | Decreases the output frequency according to the deceleration time. |
| **on** | **on** | Holds the output frequency. |

There are the two types of UP/DOWN operations as shown below. Set the desired type by setting the frequency (F01 or C30).

◆The data "8: UP/DOWN 1" is valid only when the Motor 2 is selected.

| Frequency setting (F01 or C30) | Initial value at power input on | Operation command reentry during deceleration |
|---|---|---|
| **8** (UP/DOWN1) | 0Hz |  |
| **9** (UP/DOWN2) | Previous frequency |  |

### Write enable for KEYPAD [WE-KP]

This function allows the data to be changed only when an external signal is being input, thereby making it difficult to change the data.

| 19 | Function selected |
|---|---|
| **off** | Inhibit data changes. |
| **on** | Allow data changes. |

Note:
If a terminal is set to value 19, the data becomes unable to be changed. To change the data, turn on the terminal and change the terminal setting to another number.

### PID control cancel [Hz/PID]

The PID control can be disabled by an external digital input signal.

| Set value input signal | Function selected | Related function H20～H25 |
|---|---|---|
| **20** | | |
| **off** | Enable PID control. | |
| **on** | Disable PID control (frequency setting from keypad panel). | |

### Inverse mode changeover [IVS]

The analog input (terminals 12 and C1) can be switched between forward and inverse operations by an external digital input signal.

| Set value input signal | Function selected | Related function F01, C30 |
|---|---|---|
| **21** | | |
| **off** | Forward operation when forward operation is set and vice versa | |
| **on** | Inverse operation when forward operation is set and vice versa | |

◆This function is invalid when the PID control is selected(H20: 1 or 2).

### Interlock signal (52-2) [IL]

When a contactor is installed on the output side of the inverter, the contactor opens at the time of a momentary power failure, which hinders the reduction of the DC circuit voltage and may prevent the detection of a power failure and the correct restart operation when power is recovered. The restart operation at momentary power failure can be performed effectively with power failure information provided by an external digital input signal.

| Set value input signal | Function selected | Related function F14 |
|---|---|---|
| **22** | | |
| **off** | No momentary power failure detection operation by digital input | |
| **on** | Momentary power failure detection operation by digital input | |

Frequency and operation commands from the link can be enabled or disabled by switching the external digital input signal. Select the command source in H30, "Link function." Assign value "24" to the target digital input terminal and enable or disable commands in this input signal state.

| Set value input signal | Function selected | Related function H30 |
|---|---|---|
| **24** | | |
| **off** | Link command disabled. | |
| **on** | Link command enabled. | |

### Universal DI (U-DI)

Assigning value "25" to a digital input terminal renders the terminal a universal DI terminal. The ON/OFF state of signal input to this terminal can be checked through the RS-485 and BUS option.
This input terminal is only used to check for an incoming input signal through communication and does not affect inverter operation.

### Pick up start mode [STM]

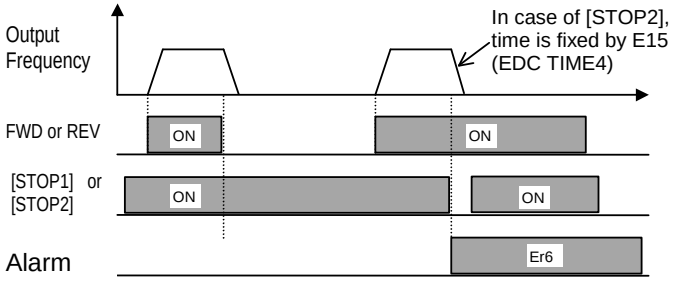
The start characteristics function (pick-up mode) in function code H09 can be enabled or disabled by switching the external digital input signal. Assign value "26" to the target digital input terminal and enable or disable the function in this input signal state.

| Set value input signal | Function selected | Related function H09 |
|---|---|---|
| **26** | | |
| **off** | Start characteristic function disabled | |
| **on** | Start characteristic function enabled | |

### Forced stop command with Deceleration [STOP1]

### Forced stop command with Deceleration time 4 [STOP2]

Normally this terminal should be “ON”, when this terminal goes off during motor running, the motor decelerates to stop, and outputs alarm “Er6 “. When the inverter is stop by STOP1/STOP2 signal, the signal should be kept on 4ms or longer.
In case of terminal [STOP2], the deceleration time is determined by E15( DEC TIME4).
This function is prioritized under any operation (Terminal. Keypad, Communication...operation). However when the torque limiter/regeneration avoidance at deceleration is selected, the time which is set by deceleration time may be longer.



Frequency setting 1 / Frequency setting 2 [Hz1/Hz2]

◆This function switches the frequency setting method set in function codes F01 and C30 by an external digital input signal.
This is the reverse-logic of setting value "11"(Frequency setting 2/Frequency setting 1 [Hz2/Hz1]).

| Set value input signal 35 | Frequency setting method selected |
|---|---|
| off | C30 FREQ CMD2 |
| on | F01 FREQ CMD1 |

Note: It can not be used with set value "11" simultaneously. When the set value "11" and "35" are selected, "Er6" is displayed.

**Settings when shipped from the factory**

| Digital input | Setting at factory shipment | |
|---|---|---|
| | Set value | Description |
| Terminal X1 | 0 | Multistep frequency selection [SS1] |
| Terminal X2 | 1 | Multistep frequency selection [SS2] |
| Terminal X3 | 2 | Multistep frequency selection [SS4] |
| Terminal X4 | 3 | Multistep frequency selection [SS8] |
| Terminal X5 | 4 | Acceleration and deceleration selection [RT1] |
| Terminal X6 | 5 | Acceleration and deceleration selection [RT2] |
| Terminal X7 | 6 | Self-hold selection [HLD] |
| Terminal X8 | 7 | Coast-to-stop command [BX] |
| Terminal X9 | 8 | Alarm reset [RST] |

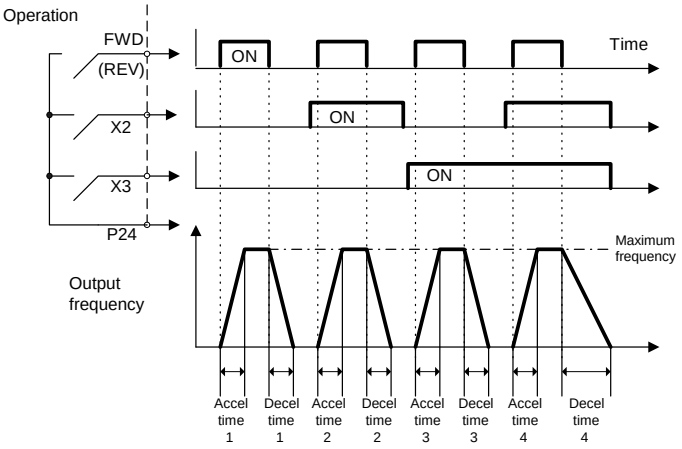
| | |
|---|---|
| **E10** | **Acceleration time 2** |
| **E11** | **Deceleration time 2** |
| **E12** | **Acceleration time 3** |
| **E13** | **Deceleration time 3** |
| **E14** | **Acceleration time 4** |
| **E15** | **Deceleration time 4** |

◆Acceleration time 1 (F07) and deceleration time 1 (F08) as well as three other types of acceleration and deceleration time can be selected.
◆The operation and setting ranges are the same as those of acceleration time 1 and deceleration time 1. See explanations for F07 and F08.
◆For switching acceleration and deceleration times, select any two terminals from terminal X1 (function selection) in E01 to terminal X9 (function selection) in E09 as switching signal input terminals. Set "4" (acceleration and deceleration time 1) and "5" (acceleration and deceleration time 2) to the selected terminals and input a signal to each terminal to switch acceleration and deceleration times. Switching is possible during acceleration, deceleration, or constant-speed operation.

**Related functions**
**E01 to E09**
**(Set values:14)**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 1 | 0 | A | C | C | | T | I | M | E | 2 | |
| E | 1 | 1 | D | E | C | | T | I | M | E | 2 | |
| E | 1 | 2 | A | C | C | | T | I | M | E | 3 | |
| E | 1 | 3 | D | E | C | | T | I | M | E | 3 | |
| E | 1 | 4 | A | C | C | | T | I | M | E | 4 | |
| E | 1 | 5 | D | E | C | | T | I | M | E | 4 | |

◆Example: When 4 and 5 are set to terminals X2 and X3:




| | |
|---|---|
| **E16** | **Torque limiter 2 (driving)** |
| **E17** | **Torque limiter 2 (braking)** |

◆This function is used to switch the torque limit level set in F40 and F41 by an external control signal. Input an external signal by selecting any of the control input terminals (X1 to X9) as torque limit 2/torque limit 1 (value 14) in E01 to E09.
◆The motor tuning (P04 / A13) should be set to "2" for this function is valid.
◆Maximum compensation frequency during braking torque limit is set by U01.

**Related functions**
**U01**
**U60**

◆The operation mode is set by U60 when the setting value is "0%: Regeneration avoidance at deceleration". The detail is referred to the U01, U60.

**Related functions**
**E01～E09**
**(Set value: 14)**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 1 | 6 | D | R | V | | T | R | Q | | 2 | |
| E | 1 | 7 | B | R | K | | T | R | Q | | 2 | |

| E20 | Y1 terminal function |
|---|---|
| ∫ | ∫ |
| E24 | Y5A and Y5C terminal function |

◆Some control and monitor signals can be selected and output from terminals [Y1] to [Y5]. Terminals [Y1] to [Y4] use transistor output; terminals[Y5A] and [Y5C] use relay contacts.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 2 | 0 | Y | 1 | | F | U | N | C | | | |
| E | 2 | 1 | Y | 2 | | F | U | N | C | | | |
| E | 2 | 2 | Y | 3 | | F | U | N | C | | | |
| E | 2 | 3 | Y | 4 | | F | U | N | C | | | |
| E | 2 | 4 | Y | 5 | | F | U | N | C | | | |

| Set value | Output signal |
|---|---|
| 0 | Operating [RUN] |
| 1 | Frequency arrival [FAR] |
| 2 | Frequency detection [FDT1] |
| 3 | Stopping due to undervoltage [LV] |
| 4 | Torque polarity detection [B/D] |
| 5 | Torque limiting [TL] |
| 6 | Restarting after momentary power failure [IPF] |
| 7 | Overload early warning [OL1] |
| 8 | During keypad panel operation [KP] |
| 9 | Inverter stopping [STP] |
| 10 | Ready for operation [RDY] |
| 11 | Operation switching between line and inverter [SW88] |
| 12 | Operation switching between line and inverter [SW52-2] |
| 13 | Operation switching between line and inverter [SW52-1] |
| 14 | Motor 2 switching [SWM2] |
| 15 | Terminal AX function [AX] |
| 16 | Pattern operation stage change [TU] |
| 17 | Pattern operation cycle operation completed [TO] |
| 18 | Pattern operation stage number [STG1] |
| 19 | Pattern operation stage number [STG2] |
| 20 | Pattern operation stage number [STG4] |
| 21 | Alarm detail [AL1] |
| 22 | Alarm detail [AL2] |
| 23 | Alarm detail [AL4] |
| 24 | Alarm detail [AL8] |
| 25 | Cooling fan operating [FAN] |
| 26 | Retry function operating [TRY] |
| 27 | Universal DO [U-DO] * |
| 28 | Heat sink overheat early warning [OH] |
| 29 | Not Used * |
| 30 | Life expectancy detection signal [LIFE] |
| 31 | 2nd Freq. level detection [FDT2] |
| 32 | 2nd OL level detection [OL2] |
| 33 | Terminal C1 off signal [C1OFF] |
| 37 | Torque limiting (Signal with delay) [TL2] |

Note: For output signals marked "*" are used for RS-485 communication.

**Inverter running [RUN]**

"Running" means that the inverter is outputting a frequency. “RUN” signal is output as when there is output speed (frequency). When the DC injection brake function is active, “RUN” signal is off.

**Frequency equivalence signal [FAR]**

See the explanation of function code E30 (frequency arrival [detection width]).

**Frequency level detection [FDT1]**

See the explanation of function codes E31 and E32 (frequency detection).

**Undervoltage detection signal [LV]**

If the undervoltage protective function activates, i.e. when the main circuit DC voltage falls below the undervoltage detection level, an ON signal is output. The signal goes off when the voltage recovers and increases above the detection level. The ON signal is retained while the undervoltage protective function is activating. Undervoltage detection level: 230V series: 200V, 460V series: 400V.

**Torque polarity [B/D]**

This function determines the torque polarity calculated in the inverter and outputs a signal indicating driving or braking torque. An OFF signal is output for driving torque; an ON signal is output for braking torque.

**Torque limiting [TL]**

When the torque limiting activates, the stall prevention function is automatically activated to change the output frequency. The torque limiting signal is output to lighten the load, and also used to display overload conditions on the monitor device. This ON signal is output during the current or torque is limited or power regeneration is prevented.

**Auto-restarting [IPF]**

Following a momentary power failure, this function reports the start of the restart mode, the occurrence of an automatic pull-in, and the completion of the recovery operation.
Following a momentary power failure, an ON signal is output when power is recovered and a synchronization (pull-in) operation is performed. The signal goes off when the frequency (before power failure) is recovered. For 0Hz restart at power recovery, no signal is output because synchronization ends when power is recovered. The frequency is not recovered to the frequency before the power failure occurrence.

**Overload early warning [OL1]**

Before the motor stops by the trip operation of an electronic thermal O/L relay, this function outputs an ON signal when the load reaches the overload early warning level. Either the electronic thermal O/L relay early warning or output current overload early warning can be selected.
For setting procedure, see “E33 Overload early warning (operation selection)”, and "E34 Overload early warning (operation level)."Note: This function is effective for motor 1 only.

**Keypad operation mode [KP]**

An ON signal is output when operation command keys ( FWD , REV and STOP ) on the keypad panel can be used (i.e., 0 set in "F02 Operation") to issue operation and stop commands. This signal is OFF when the function H30(Serial link) is set to communication side.

### Inverter stopping [STOP]

This function outputs an inverted signal to Running (RUN) to indicate zero speed. An ON signal is output when the DC injection brake function is operating.

### Ready output [RDY]

This function outputs an ON signal when the inverter is ready to operate. The inverter is ready to operate when the main circuit and control circuit power is established and the inverter protective function is not activating. About one second is required from power-on to ready for operation in normal condition.

### Line/Inv changeover [SW88] [SW52-2] [SW52-1]

To perform switching operation between the line and the inverter, the sequence prepared in the inverter can be used to select and output signals for opening and closing the magnetic contactors connected to the inverter. As the operation is complex, refer to technical documentation for the EQ5 series when using this function.
As the sequence will operate automatically when SW88 or SW52-2 is selected, do not select when not using the sequence.

### Motor 2 /Motor 1 [SWM2]

When a signal for switching to motor 2 is input from the terminal selected by terminals [X1] to [X9], this function selects and outputs the signal for switching the magnetic contactor for the motor. As this switching signal is not output during running including when the DC injection braking function is operating, a signal must be re-input after output stops.

### Auxiliary terminal [AX]

When an operation (forward or reverse) command is entered, this function outputs an ON signal. When a stop command is entered, the signal goes off after inverter output stops. When a coast-to-stop command is entered and the inverter protective function operates, the signal goes off immediately.

### Time-up signal for pattern operation [TU]

When the pattern operation stage changes, this function outputs a one-shot (100ms) ON signal to report a stage change.

### Cycle completion signal for pattern operation [TO]

When the seven stages of a pattern operation are completed, this function outputs a one-shot (100 ms) ON signal to report the completion of all stages.

### Stage No. indication for pattern operation [STG1] [STG2] [STG4]

During pattern operation, this function reports the stage (operation process) being operated.

| Pattern operation stage No. | Output terminal | | |
|---|---|---|---|
| | STG1 | STG2 | STG4 |
| Stage 1 | on | off | off |
| Stage 2 | off | on | off |
| Stage 3 | on | on | off |
| Stage 4 | off | off | on |
| Stage 5 | on | off | on |
| Stage 6 | off | on | on |
| Stage 7 | on | on | on |

When pattern operation is not activated (i.e., no stage is selected), the terminals do not output a signal.

### Alarm indication [AL1] [AL2] [AL4] [AL8]

This function reports the operating status of the inverter protective function.

| Alarm detail (inverter protective function) | Output terminal | | | |
|---|---|---|---|---|
| | AL1 | AL2 | AL4 | AL8 |
| Overcurrent, ground fault, fuse blown | on | off | off | off |
| Overvoltage | off | on | off | off |
| Undervoltage shortage, input phase failure | on | on | off | off |
| Motors 1 and 2 overload | off | off | on | off |
| Inverter overload | on | off | on | off |
| Heat sink overheating, inverter inside overheating | off | on | on | off |
| External alarm input, braking resistor overheating | on | on | on | off |
| Memory error, CPU error | off | off | off | on |
| Keypad panel communication error, option communication error | on | off | off | on |
| Option error | off | on | off | on |
| Output wiring error | off | off | on | on |
| RS-485 communication error | on | off | on | on |
| Not Used EQ5 | off | on | on | on |

In normal operation terminals do not output a signal.

### Fan operation signal [FAN]

When used with "H06 Cooling fan ON/OFF control," this function outputs a signal while the cooling fan is operating.

### Auto-resetting [TRY]

When a value of 1 or larger is set to "H04 Retry operating," the signal is output while retry operation is activating when the inverter protective function is activated.

### Universal DO [U-DO]

Assigning value "27" to a transistor output terminal renders the terminal a universal DO terminal.
This function enables ON/OFF through the RS-485 and BUS option.
This function serves only to turn on and off the transistor output through communication and is not related to inverter operation.

### Overheat early warning [OH]

This function outputs a early warning signal when heat sink temperature is (overheat detection level - 10℃) or higher.

### Life expectancy detection signal [LIFE]

◆When either of data for the Life expectancy judgment of the function code:U09 to U11 reaches at the Life expectancy judgment level, the ON signal is output. However, the inverter does not do alarm.
Moreover, the alarm output for any fault (30A, 30B, 30C ) does not operate.

| Function code | Parts of Life expectancy judgment | Life expectancy judgment level |
|---|---|---|
| U09 | Capacitor in main circuit | 85% or less of the initial value |
| U10 | Electrolytic capacitor on PCB | 61,000 hours |
| U11 | Cooling fan | 25,000 hours |
| U59 | DC fan broken for stir internal unit up ***[40HP/CT, 50HP/VT or more is annunciated.]*** | DC fan is broken |

In the following cases, normal life judgment of the capacitor in main circuit may not be able to be performed.

1. When a power is turned off during inverter operation.
2. When cooling fan ON/OFF control is operated. ( function code : H 06= 1)
3. When the power is supplied by the auxiliary input terminals (R0,T0).
4. When the option card is operated .
5. When RS-485 communication is operated .
6. When the power supply is turned off with digital input (FWD, REV, X1-X9) of a control terminal being ON.

In the case of "3", "4", "5" and "6", life judgment is enabled by adjusting the function both code:U08 and U09.

**Related functions**
**U08～U11, U59**

### 2nd Freq. level detection [FDT2]

This function is same as Frequency detection [FDT1], the detection level of the output frequency and hysteresis width are determined by E36 and E32.

### 2nd OL level early warning [OL2]

This function outputs an ON signal when the output current exceeds “E37 OL2 LEVEL” for longer than “E35 OL TIMER”.
NOTE) This function is valid for both of Motor 1 and Motor 2.

### Terminal C1 off signal [C1OFF]

This function outputs an ON signal when the input current of terminal C1 is less than 2mA.
(When AIO option is connected, it can be detected the disconnection of C2 terminal.)

### Torque limiting (Signal with delay) [TL2]

◆The turning on signal is output by continuing the limiting action(Torque limit operation, regeneration avoidance operation and overcurrent limiting operation) of 20ms or more.

Settings when shipped from the factory

| Digital input | Setting at factory shipment | |
|---|---|---|
| | Set value | Description |
| Terminal Y1 | **0** | Operating [RUN] |
| Terminal Y2 | **1** | Frequency arrival [FAR] |
| Terminal Y3 | **2** | Frequency detection [FDT] |
| Terminal Y4 | **7** | Overload early warning [OL1] |
| Terminal Y5 | **10** | Ready output [RDY] |

◆This function specifies whether to excite the Y5 relay at “ON signal mode” or “OFF signal mode”.

**E25 Y5RY MODE**

| Set value | Operation |
|---|---|
| 0 | At “OFF signal mode” Y5A - Y5C: OFF<br>At “ON signal mode” Y5A - Y5C: ON |
| 1 | At “OFF signal mode” Y5A - Y5C: ON<br>At “ON signal mode” Y5A - Y5C: OFF |

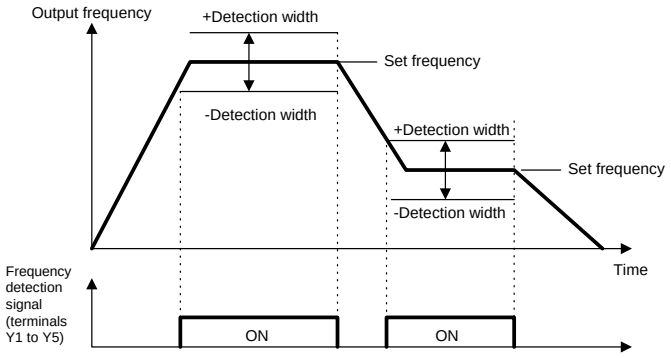
◆When the set value is "1", contacts Y5A and Y5C are connected when the inverter control voltage is established (about one second after power on).

### E30 FAR function signal (Hysteresis)

◆This function adjusts the detection width when the output frequency is the same as the set frequency (operating frequency). The detection width can be adjusted from 0 to ±10 Hz of the setting frequency.

**E30 FAR HYSTR**

Setting range: 0.0 to 10.0 Hz
When the frequency is within the detection width, an ON signal can be selected and output from terminals [Y1] to [Y5].



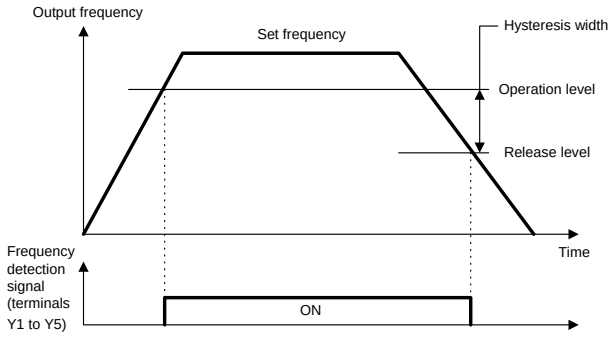

### E31 FDT1 function signal (Level)
### E32 FDT1 function signal (Hysteresis)

◆This function determines the operation (detection) level of the output frequency and hysteresis width for operation release. When the output frequency exceeds the set operation level, an ON signal can be selected and output from terminals [Y1] to [Y5].

**E31 FDT1 LEVEL**
**E32 FDT HYSTR**

Setting range(Operation level) : EQ5: 0 to 120 Hz

(Hysteresis width) : 0.0 to 30.0 Hz



## E33 OL function signal (mode select)

◆Select one of the following two types of overload early warning: early warning by electronic thermal O/L relay function or early warning by output current.

E33 OL WARNING

Set value 0: Electronic thermal O/L relay
1: Output current

| Set value | Function | Description |
|---|---|---|
| 0 | Electronic thermal O/L relay | Overload early warning by electronic thermal O/L relay (having inverse-time characteristics) to output current. The operation selection and thermal time constant for the inverse-time characteristics are the same as those of the electronic thermal O/L relay for motor protection (F10 and F12). |
| 1 | Output current | An overload early warning is issued when output current exceeds the set current value for the set time. The figure of OL2(E37) is referred. |

◆This function cannot be used when Motor 2 is selected.

## E34 OL function signal (Level)

◆This function determines the operation level of the electronic thermal O/L relay or output current.

E34 OL1 LEVEL

Setting range EQ5:Inverter rated output current x (5 to 150%)

The operation release level is 90% of the set value.

◆This function cannot be used when Motor 2 is selected.

## E35 OL function signal (Timer)

E35 OL1 TIMER

◆This function is used when 1 (output current) is set to "E33 Overload early warning (operation selection)."
Setting range: 0.1 to 60.0 seconds

◆Set the time from when the operation level is attained until the overload early warning function is activated.

## E36 FDT2 function (Level)

◆This function determines the operation (detection) level of output frequency for “2nd Freq. level detection [FDT2]”. The hysteresis width for operation release is set by the function E32: FDT1 function signal (Hysteresis).

E36 FDT2 LEVEL

Setting range(Operation level) : EQ5: 0 to 120 Hz

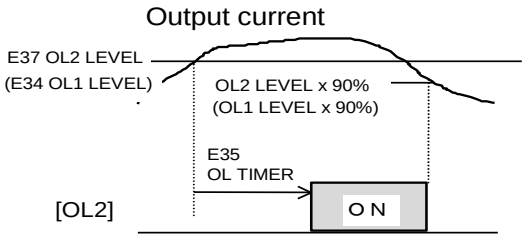
## E37 OL2 function (Level)

◆This function determines the operation level of the output current for “2nd OL level detection [OL2]”.

E37 OL2 LEVEL

Setting range EQ5: Inverter rated output current x (5 to 150%)

The operation release level is 90% of the set value.




## E40 Display coefficient A

## E41 Display coefficient B

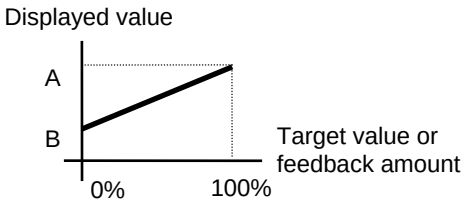
◆These coefficients are conversion coefficients which are used to determine the load and line speed and the target value and feedback amount (process amount) of the PID controller displayed on the LED monitor.

E40 COEF A
E41 COEF B

Setting range
Display coefficient A:-999.00 to 0.00 to +999.00
Display coefficient B:-999.00 to 0.00 to +999.00

◆Load and line speed
Use the display coefficient A.
Displayed value = output frequency x (0.01 to 200.00)
Although the setting range is ±999.00, the effective value range of display data is 0.01 to 200.00. Therefore, values smaller or larger than this range are limited to a minimum value of 0.01 or a maximum value of 200.00.

◆Target value and feedback amount of PID controller
Set the maximum value of display data in E40, "Display coefficient A," and the minimum value in E41, "Display coefficient B."
Displayed value = (target value or feedback amount) x (display coefficient A - B)+B



## E43 LED monitor (function)
## E44 LED monitor (display at stop mode)

◆The data during inverter operation, during stopping, at frequency setting, and at PID setting is displayed on the LED.

◆Display during running and stopping
During running, the items selected in "E43 LED monitor (display selection)," are displayed. In "E44 LED monitor (display at stopping)," specify whether to display some items out of the set values or whether to display the same items as during running.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E** | **4** | **3** | **L** | **E** | **D** | | **M** | **N** | **T** | **R** | | |
| **E** | **4** | **4** | **L** | **E** | **D** | | **M** | **N** | **T** | **R** | **2** | |

| Value set to E43 | E44=0 | | E44=1 | |
|---|---|---|---|---|
| | At stopping | During running | At stopping | During running |
| 0 | Set frequency value (Hz) | Output frequency (before slip compensation) (Hz) | | |
| 1 | Set frequency value (Hz) | Output frequency (after slip compensation) (Hz) | | |
| 2 | Set frequency value (Hz) | | | |
| 3 | Output current (A) | | | |
| 4 | Output voltage (command value) (V) | | | |
| 5 | Synchronous speed set value (r/min) | Synchronous speed (r/min) | | |
| 6 | Line speed set value (m/min.) | Line speed (m/min.) | | |
| 7 | Load speed set value (r/min) | Load speed (r/min) | | |
| 8 | Calculated torque value (%) | | | |
| 9 | Output power (HP) | | | |
| 10 | PID target value 1 (direct input from keypad panel) | | | |
| 11 | PID target value 2 (input from "F02 Frequency 1") | | | |
| 12 | PID feedback amount | | | |

Note: For the values 10 to 12 set to E43, the data is displayed only when selected in "H20 PID control (operation selection)."

◆Display at frequency setting
When a set frequency is checked or changed by the keypad panel, the set value shown below is displayed. Select the display item by using "E43 LED monitor (display selection)." This display is not affected by "E44 LED monitor (display at stopping)."

| Value set to E43 | Frequency setting |
|---|---|
| 0,1,2,3,4 | Set value of frequency (Hz) |
| 5 | Set value of synchronous speed (r/min) |
| 6 | Set value of line speed (m/min.) |
| 7 | Set value of load speed (r/min) |
| 8,9 | Set value of frequency (Hz) |
| 10,11,12 | Set value of frequency (Hz) |

Note: For the values 10 to 12 set to E43, the data is displayed only when selected in "H20 PID control (operation selection)."

## E45 LCD monitor (function)

◆This function selects the item to be displayed on the LCD monitor in the operation mode.

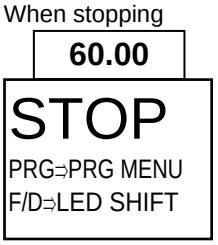
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E** | **4** | **5** | **L** | **C** | **D** | | **M** | **N** | **T** | **R** | | |

| Set value | Display item |
|---|---|
| 0 | Operation status, rotating direction, operation guide |
| 1 | Output frequency (before slip compensation), output current, calculated torque value in bar graph |

Set value: 0

During running


When stopping




Set value: 1


Full-scale value of bar graph

| Display item | Full-scale |
|---|---|
| Output frequency | Maximum frequency |
| Output current | 200% of inverter rated value |
| Calculated torque value | 200% of motor rated value |

Note: The scale cannot be adjusted.

## E46 Language

◆This function selects the language for data display on the LCD monitor.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E** | **4** | **6** | **L** | **A** | **N** | **G** | **U** | **A** | **G** | **E** | | |

| Set value | Language displayed | Set value | Language displayed |
|---|---|---|---|
| 0 | Japanese | 3 | French |
| 1 | English | 4 | Spanish |
| 2 | German | 5 | Italian |

Note: English language is used for all LCD screens in this manual. For other languages, refer to the relevant instruction manual.

## E47 LCD monitor (contrast)

◆This function adjusts the LCD contrast. Increase the set value to raise contrast and decrease to lower contrast.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E** | **4** | **7** | **C** | **O** | **N** | **T** | **R** | **A** | **S** | **T** | | |

| Set value | 0,1,2 • • • • • • 8,9,10 |
|---|---|
| Screen | Low ⟷ High |

| | |
|---|---|
| **C01** | **Jump frequency 1** |
| **C02** | **Jump frequency 2** |
| **C03** | **Jump frequency 3** |
| **C04** | **Jump frequency (Hysteresis)** |

◆This function makes the set frequency jump so that the inverter's output frequency does not match the mechanical resonance point of the load.
◆Up to three jump points can be set.
◆This function is ineffective when jump frequencies 1 to 3 are set to 0Hz.
◆A jump does not occur during acceleration or deceleration. When a jump frequency setting range overlaps another range, both ranges are added to determine the actual jump area.

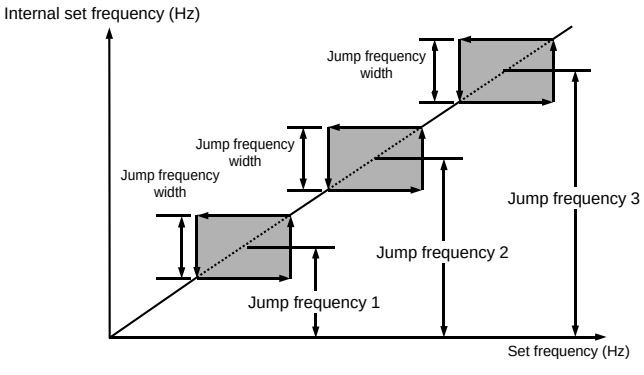
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 0 | 1 | J | U | M | P | | H | z | | 1 | |
| C | 0 | 2 | J | U | M | P | | H | z | | 2 | |
| C | 0 | 3 | J | U | M | P | | H | z | | 3 | |

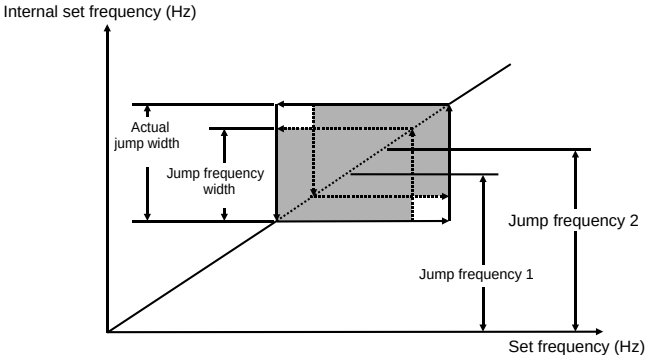
Setting range:
EQ5 : 0 to 120Hz
In 1Hz steps (min.)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 0 | 4 | J | U | M | P | | H | Y | S | T | R |

Setting range
0 to 30Hz
In 1Hz steps (min.)

To avoid the resonance of the motor driving frequency to the peculiar vibration frequency of the machine, the jump frequency band can be set to the output frequency up to three point.
◆During accelerating, an internal set frequency is kept constant by the lower frequency of the jump frequency band when a set frequency enters the jump frequency band. This means that the output frequency is kept constant according to an internal set frequency.
When a set frequency exceeds the upper bound of the jump frequency band, an internal set frequency reaches the value of a set frequency. The output frequency accelerates up to a set frequency while passing the jump frequency band according to the acceleration time at this time.
During decelerating, it has a relation opposite to accelerating. Refer to figure below.
◆When two jump frequency bands or more come in succession mutually, the lowest and highest frequency become the lower bound and the upper bound frequency of an actual jump frequency band respectively among them. Refer to upper right figure.



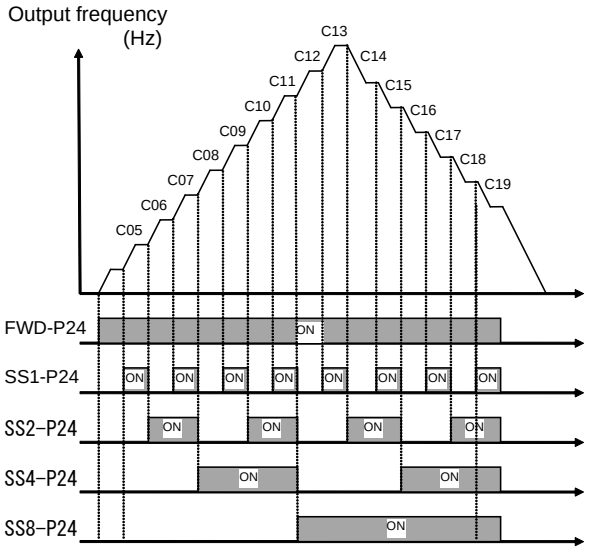

| | |
|---|---|
| **C05** | **Multistep frequency 1** |
| ⟆ | ⟆ |
| **C19** | **Multistep frequency 15** |

◆Multistep frequencies 1 to 15 can be switched by turning on and off terminal functions SS1, SS2, SS4, and SS8. (See E01 to E09 for terminal function definitions.)
◆OFF input is assumed for any undefined terminal of SS1, SS2, SS4, and SS8.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 0 | 5 | M | U | L | T | I | | H | z | - | 1 |
| C | 0 | 6 | M | U | L | T | I | | H | z | - | 2 |
| C | 0 | 7 | M | U | L | T | I | | H | z | - | 3 |
| C | 0 | 8 | M | U | L | T | I | | H | z | - | 4 |
| C | 0 | 9 | M | U | L | T | I | | H | z | - | 5 |
| C | 1 | 0 | M | U | L | T | I | | H | z | - | 6 |
| C | 1 | 1 | M | U | L | T | I | | H | z | - | 7 |
| C | 1 | 2 | M | U | L | T | I | | H | z | - | 8 |
| C | 1 | 3 | M | U | L | T | I | | H | z | - | 9 |
| C | 1 | 4 | M | U | L | T | I | | H | z | 1 | 0 |
| C | 1 | 5 | M | U | L | T | I | | H | z | 1 | 1 |
| C | 1 | 6 | M | U | L | T | I | | H | z | 1 | 2 |
| C | 1 | 7 | M | U | L | T | I | | H | z | 1 | 3 |
| C | 1 | 8 | M | U | L | T | I | | H | z | 1 | 4 |
| C | 1 | 9 | M | U | L | T | I | | H | z | 1 | 5 |

**Related functions E01 to E09 (Set value:0 to 3)**

Setting range
EQ5: 0.00 to 120.00Hz
In 0.01Hz steps (min



## C20 JOG frequency

◆This function sets the frequency for jogging operation of motor, which is different from the normal operation.

| C | 2 | 0 | J | O | G | | H | z | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range EQ5 : 0.00 to 120.00 Hz

◆Starting with the jogging frequency is combined with jogging select signal input from the keypad panel or control terminal. For details, see the explanations of "E01 Terminal X1" to "E09 Terminal X9."

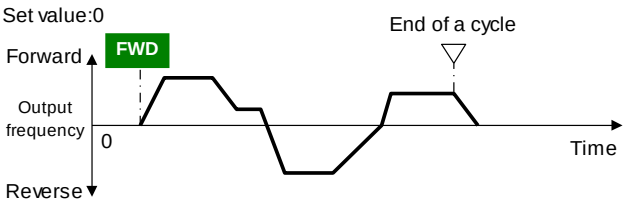
## C21 Pattern operation (mode select)

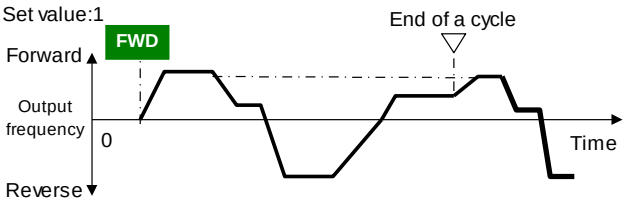
◆Pattern operation is an automatic operation according to preset operation time, direction of rotation, acceleration and deceleration time, and frequency.
When using this function, set 10 (pattern operation) to "F01 Frequency setting."
The following operation patterns can be selected.

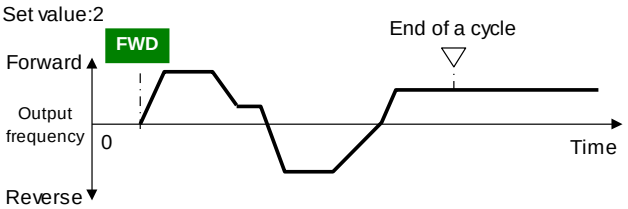
| C | 2 | 1 | P | A | T | T | E | R | N | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Related functions F01, C30 (Set value:10)**

| Set value | Operation pattern |
|---|---|
| 0 | Perform a pattern operation cycle, then stop operation. |
| 1 | Perform pattern operation repeatedly. Stop operation using a stop command. |
| 2 | Perform a pattern operation cycle, then continue operation with the last frequency set. |




## C22 Pattern operation (stage 1)
## ∫ ∫
## C28 Pattern operation (stage 7)

◆Seven stages are operated in order (of function codes) according to the values set in "C22 Pattern operation (stage 1)" to "C28 Pattern operation (stage 7)." Each function sets the operation time and the rotating direction for each stage and assigns set values of the acceleration

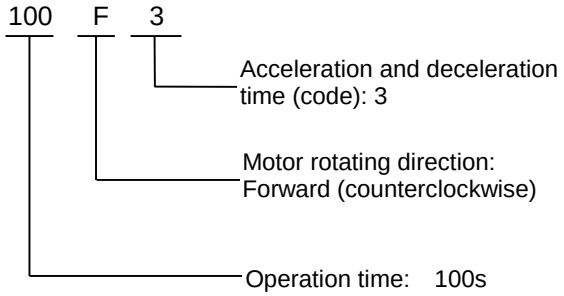
| C | 2 | 2 | S | T | A | G | E | | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 2 | 3 | S | T | A | G | E | | 2 | | | |
| C | 2 | 4 | S | T | A | G | E | | 3 | | | |
| C | 2 | 5 | S | T | A | G | E | | 4 | | | |
| C | 2 | 6 | S | T | A | G | E | | 5 | | | |
| C | 2 | 7 | S | T | A | G | E | | 6 | | | |
| C | 2 | 8 | S | T | A | G | E | | 7 | | | |

and deceleration time.

| Set or assign item | Value range |
|---|---|
| Operation time | 0. 00 to 6000s |
| Rotation direction | F: Forward (counterclockwise)<br>R: Reverse (clockwise) |
| Acceleration and deceleration time | 1: Acceleration time 1 (F07), deceleration time 1 (F08) |
| | 2: Acceleration time 2 (E10), deceleration time 2 (E11) |
| | 3: Acceleration time 3 (E12), deceleration time 3 (E13) |
| | 4: Acceleration time 4 (E14), deceleration time 4 (E15) |

Note: The operation time is represented by the three most significant digits, hence, can be set with only three high-order digits.

◆Setting example



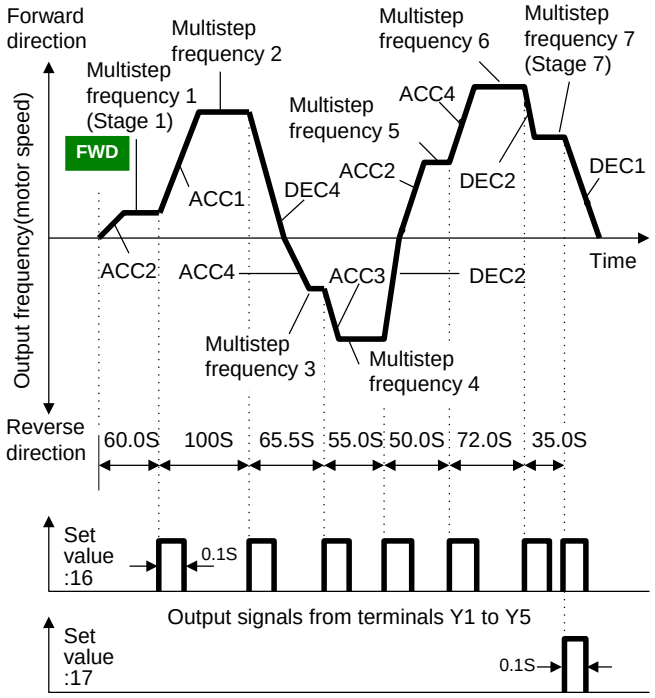

Set the operation time to 0.00 for stages not used, which are skipped in operation.
With regard to the set frequency value, the multistep frequency function is assigned as listed in the table below. Set frequencies to "C05 Multistep frequency 1," to "C11 Multistep frequency 7."

| Stage No. | Operation frequency to be set |
|---|---|
| Stage 1 | Multistep frequency 1 (C05) |
| Stage 2 | Multistep frequency 2 (C06) |
| Stage 3 | Multistep frequency 3 (C07) |
| Stage 4 | Multistep frequency 4 (C08) |
| Stage 5 | Multistep frequency 5 (C09) |
| Stage 6 | Multistep frequency 6 (C10) |
| Stage 7 | Multistep frequency 7 (C11) |

◆Pattern operation setting example

| Function | Set value | Operation frequency to be set |
|---|---|---|
| C21 (operation selection) | 1 | - |
| C22 (stage 1) | 60.0F2 | Multistep frequency 1 (C05) |
| C23 (stage 2) | 100F1 | Multistep frequency 2 (C06) |
| C24 (stage 3) | 65.5R4 | Multistep frequency 3 (C07) |
| C25 (stage 4) | 55.0R3 | Multistep frequency 4 (C08) |
| C26 (stage 5) | 50.0F2 | Multistep frequency 5 (C09) |
| C27 (stage 6) | 72.0F4 | Multistep frequency 6 (C10) |
| C28 (stage 7) | 35.0F2 | Multistep frequency 7 (C11) |

The following diagram shows this operation.




◆Running and stopping are controlled by pressing the FWD and STOP keys and by opening and closing the control terminals.
When using the keypad panel, pressing the FWD key starts operation. Pressing the STOP key pauses stage advance. Pressing the FWD key again restarts operation from the stop point according to the stages. If an alarm stop occurs, press the RESET key to release operation of the inverter protective function, then press the FWD key to restart stage advance.
If required to start operation from the first stage "C22 Pattern operation (stage 1)," enter a stop command and press the RESET key.
If an alarm stop occurs, press the RESET key to release the protective function, then press the key again.

Notes:
1. The direction of rotation cannot be reversed by a command issued from the REV key on the keypad panel or terminal [REV]. Any reverse rotation commands entered are canceled. Select forward or reverse rotation by the data in each stage. When the control terminals are used for operation, the self-hold function of operation command also does not work. Select an alternate type switch when using.
2. At the end of a cycle, the motor decelerates-to-stop according to the value set to "F08 Deceleration time 1."

## C30 Frequency command 2

◆This function selects the frequency setting method.

**Related functions**
**E01 to E09**
**(Set value:11)**
**F01**

| C | 3 | 0 | F | R | E | Q | | C | M | D | | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

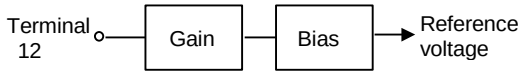
For the setting method, see the explanation for F01.

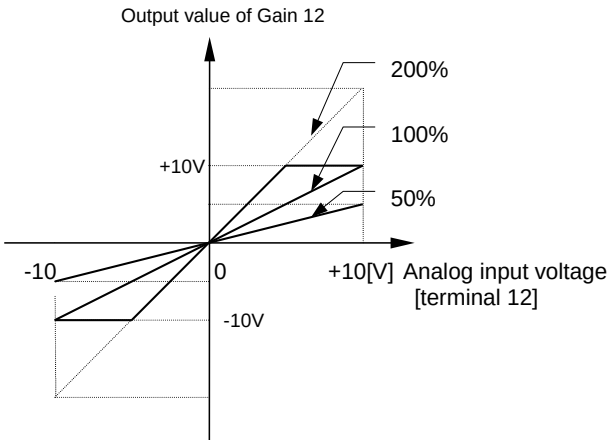
## C31 Bias (terminal[12])
## C32 Gain (terminal[12])

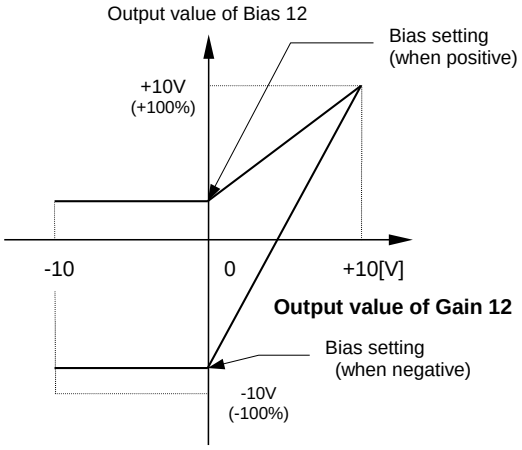
◆This function sets the Gain and Bias of the analog input (terminals [12] ).

| C | 3 | 1 | B | I | A | S | | 1 | 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 3 | 2 | G | A | I | N | | 1 | 2 | | | |

The setting range :
BIAS: -100 to +100%
GAIN:0.0 to 200%




## C33 Analog setting signal filter

◆Analog signals input from control terminal 12 or C1 may contain noise, which renders control unstable. This function adjusts the time constant of the input filter to remove the effects of noise.

| C | 3 | 3 | R | E | F | | F | I | L | T | E | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.00 to 5.00 seconds

◆An excessive setting delays control response though stabilizing control. A set value too small speeds up control response but renders control unstable.

If the optimum value is not known, adjust the setting when control is unstable or response is delayed.

Note:
The set value is commonly applied to terminals 12 and C1. For input of PID feedback amount, the PID control feedback filter (set in H25) is used.

## P01 Number of motor 1 poles

◆This function sets the number of poles of motor 1 to be driven. If this setting is not made, an incorrect motor speed (synchronous speed) is displayed on the LED.

| P | 0 | 1 | M | 1 | | P | O | L | E | S | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set values: 2, 4, 6, 8, 10, 12, 14

## P02 Motor 1 (capacity)

◆The nominal applied motor capacity is set at the factory. The setting should be changed when driving a motor with a different capacity.

| P | 0 | 2 | M | 1 | - | C | A | P | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value for models with nominal applied motor of 30HP or less
: 0.01 to 60HP
Models with nominal applied motor of 40HP or more
: 0.01 to 800HP

◆Set the nominal applied motor capacity listed in 9-1, "Standard Specifications." Also set a value in the range from two ranks lower to one rank higher than the nominal applied motor capacity. When a value outside this range is set, accurate control cannot be guaranteed. If a value between two nominal applied motor capacities is set, data for the lower capacity is automatically written for related function data.

◆ When the setting of this function is changed, the values of the following related functions are automatically set to data of the TWMC 3-phase standard motor.

-- P03 Motor 1 (rated current)
-- P06 Motor 1 (no-load current)
-- P07 Motor 1 (% R1)
-- P08 Motor 1 (% X1)

Note:
The set values for the TWMC 3-phase standard motor are 230V, 50Hz, 4 poles for the 230V series; 460V, 50Hz, 4 poles for the 460V series.

## P03 Motor 1 (rated current)

◆This function sets the rated current value of motor 1.

| P | 0 | 3 | M | 1 | - | I | r | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.00 to 2,000A

## P04 Motor 1 (Tuning)

◆This function measures and automatically writes motor data.

| P | 0 | 4 | M | 1 | | T | U | N | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Set value | Operation |
|---|---|
| 0 | Inactive |
| 1 | Measure the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping and automatically write both values in P07 and P08. |
| 2 | Measure the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping, measure the no-load current (Io) when the motor is running, and automatically write these values in P06, P07, and P08.<br>Put the motor into the state unit separating from the machine for the tuning of the no-load current.<br>In the state that the load is connected, cannot the tuning correctly. Execute the auto tuning of set value "1" after obtaining the test report etc. from the motor manufactures when not making it in the state of the motor unit, and setting P06 (no-load current) beforehand. |

◆Perform auto tuning when data in "P06 No-load current," "P07 %R1," and "P08 %X," differs from actual motor data. Typical cases are listed below. Auto tuning improves control and calculation accuracy.

- When a motor other than the TWMC standard 3-phase motor is used and accurate data is required for close control.
- When output-side impedance cannot be ignored as when cable between the inverter and the motor is too long or when a reactor is connected.
- When %R1 or %X is unknown as when a non-standard or special motor is used.

### Tuning procedure

1. Adjust the voltage and frequency according to motor characteristics. Adjust functions "F03 Maximum output frequency," "F04 Base frequency," "F05 Rated voltage," and "F06 Maximum output voltage."
2. Enter untunable motor constants first. Set functions "P02 Capacity," "P03 Rated current," and "P06 No-load current," (input of no-load current not required when P04=2, for running the motor at tuning, is selected).
3. When tuning the no-load current, beware of motor rotation.
4. Set 1 (motor stop) or 2 (motor rotation) to function "P04 Auto tuning." Press the FUNC DATA key to write the set value and press the FWD key or REV key then start tuning simultaneously.
5. Tuning takes several seconds to several tens of seconds (when 2 is set. As the motor accelerates up to half the base frequency according to acceleration time, is tuned for the no-load current, and decelerates according to the deceleration time, the total tuning time varies depending on set acceleration and deceleration times.)
6. Press the STOP key after the tuning is completed.
7. End of procedure.

Note1:
If REMOTE operation(F02: 1) is selected, operation signal is given from terminal [FWD] or [REV].
Note2:
Use function "A13 Motor 2 (auto tuning)," to tune motor 2. In this case, set values described in 1 and 2 above are for the function (A01 - ) of motor 2.

| ⚠WARNING | When the auto tuning value is set to 2, the motor rotates at a maximum of half the base frequency. Beware of motor rotation. **Otherwise injury may result**. |
|---|---|

**P05 Motor 1 (On-line Tuning)**

◆Long-time operation affects motor temperature and motor speed. Online tuning minimizes speed changes when motor temperature changes.
◆Auto tuning(P04/A13: 2) should be done to use this function.

**P 0 5 M 1 T U N 2**

| Set value | Operation |
|---|---|
| 0 | Inactive |
| 1 | Active |

**P06 Motor 1 (no-load current)**

◆This function sets the no-load current (exciting current) of motor 1.

**P 0 6 M 1 — I O**

Setting range: 0.00 to 2,000A

**P07 Motor 1 (%R1 setting)**
**P08 Motor 1 (%X setting)**

◆Write this data when using a motor other than the TWMC standard 3-phase motor and when the motor constant and the impedance between the inverter and motor are known.

**P 0 7 M 1 — % R 1**
**P 0 8 M 1 — % X**

◆Calculate %R1 using the following formula:

$$\%R1 = \frac{R1 + \text{Cable R}}{V/\left(\sqrt{3}\cdot I\right)} \times 100 \ [\%]$$

R1 : Primary coil resistance value of the motor [Ω]
Cable R : Output-side cable resistance value [Ω]
V : Rated voltage [V] I: Motor rated current [A]

◆Calculate %X using the following formula:

$$\%X = \frac{X1 + X2 \cdot XM/(X2 + XM) + \text{Cable X}}{V/\left(\sqrt{3}\cdot I\right)} \times 100 \ [\%]$$

X1 : Primary leakage reactance of the motor [Ω]
X2 : Secondary leakage reactance (converted to a primary value)of the motor [Ω]
XM : Exciting reactance of the motor [Ω]
Cable X : Output-side cable reactance [Ω]
V : Rated voltage [V] I : Motor rated current[A]

Note:
For reactance, use a value in the data written in "F04 Base frequency 1."

◆When connecting a reactor or filter to the output circuit, add its value. Use value 0 for cable values that can be ignored.

◆Changes in load torque affect motor slippage, thus causing

**P 0 9 S L I P C O M P 1**

variations in motor speed. The slip compensation control adds a frequency (proportional to motor torque) to the inverter output frequency to minimize variations in motor speed due to torque changes.
◆Auto tuning (P04/A13: 2) should be done to use this function.
Set value: 0.00 to 15.00Hz

◆Calculate the amount of slip compensation using the following formula:
Slip compensation amount

$$= \text{Base frequency} \times \frac{\text{Slippage [r/min]}}{\text{Synchronous speed [r/min]}} \ [\text{Hz}]$$

Slippage = Synchronous speed - Rated speed

## H03 Data initializing

◆This function returns all function data changed by the customer to the factory setting data. (initialization).

| H | 0 | 3 | D | A | T | A | | I | N | I | T | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Disabled.
1: Initializing data.

◆To perform initialization, press the STOP and ∧ keys together to set 1, then press the FUNC DATA key. The set values of all functions are initialized. The set value in H03 automatically returns to 0 following the end of initialization.

## H04 Auto-reset(Times)
## H05 Auto-reset (Reset interval)

◆When the inverter protective function which invokes the retry operation is activated, this function releases operation of the protective function and restarts operation without issuing an alarm or terminating output.

| H | 0 | 4 | A | U | T | O | - | R | E | S | E | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H | 0 | 5 | R | E | S | E | T | | I | N | T | |

Set the protective function release count and waiting time from its operation startup to release.
Setting range (Count) : 0, 1 to 10
(Waiting time) : 2 to 20 seconds

To disable the retry function, set 0 to "H04 Retry (count)."

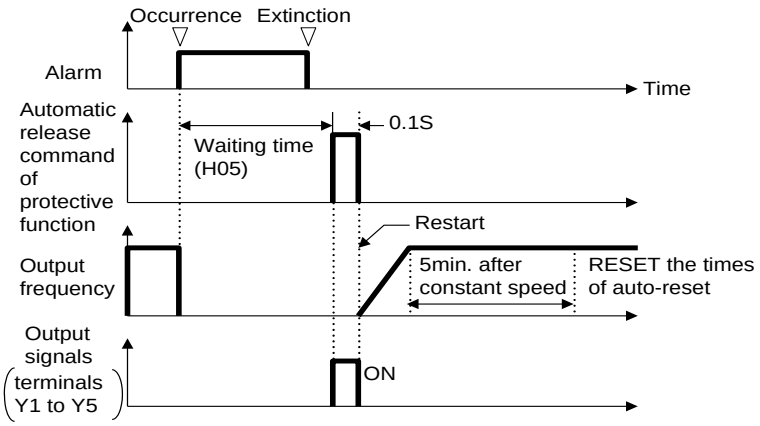
◆Inverter protective functions that can invoke retry function.

| | |
|---|---|
| OC1,OC2,OC3<br>: Overcurrent | dBH<br>: Braking resistor overheating |
| OV1,OV2,OV3<br>: Overvoltage | OL1<br>: Motor 1 overload |
| OH1<br>: Heat sink overheating | OL2<br>: Motor 2 overload |
| OH3<br>: Inverter inside overheating | OLU<br>: Inverter overload |

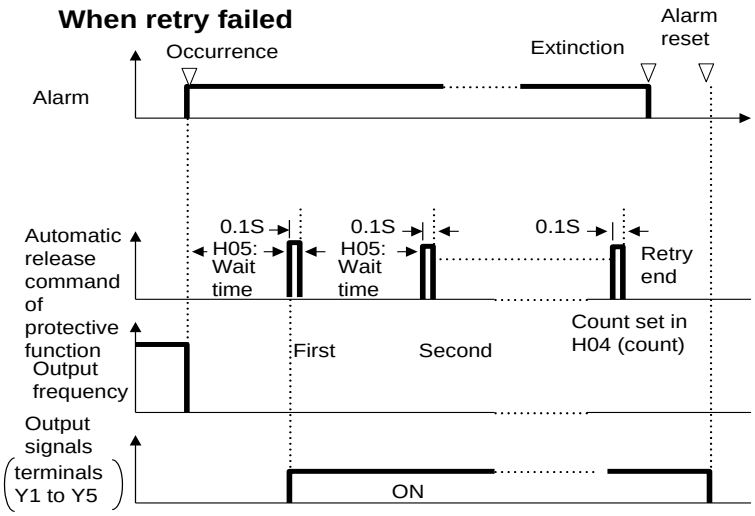
◆When the value of "H04 Retry (count)," is set from 1 to 10, an inverter run command is immediately entered following the wait time set in H05, "Retry (wait time)," and the startup of the retry operation. If the cause of the alarm has been removed at this time, the inverter starts without switching to alarm mode. If the cause of the alarm still remains, the protective function is reactivated according to the wait time set in "H05 Retry (waiting time)." This operation is repeated until the cause of the alarm is removed. The restart operation switches to alarm mode when the retry count exceeds the value set in "H04 Retry (count)."
The operation of the retry function can be monitored from terminals Y1 to Y5.

| | |
|---|---|
| ⚠WARNING | When the retry function is selected, operation automatically restarts depending on the cause of the trip stop. (The machine should be designed to ensure safety during a restart)<br>**Otherwise accidents may result**. |

**When retry is succesful**




**When retry failed**




## H06 Fan stop operation

◆This function specifies whether cooling fan ON/OFF control is automatic. While power is applied to the inverter, the automatic fan control detects the temperature of the cooling fan in the inverter and turns the fan on or off.
When this control is not selected, the cooling fan rotates continually.

| H | 0 | 6 | F | A | N | | S | T | O | P | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: ON/OFF control disabled.
1: ON/OFF control enabled.
The cooling fan operating status can be monitored from terminals Y1 to Y5.

## H07 ACC/DEC（Mode select）pattern

◆This function selects the acceleration and deceleration pattern.

| H | 0 | 7 | A | C | C | | P | T | N | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

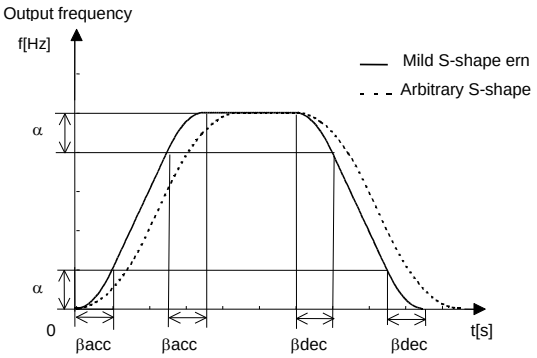
Set value 0: Inactive (linear acceleration and deceleration)
1: S-shape acceleration and deceleration (mild)
2: S-shape acceleration and deceleration (*)
3: Curvilinear acceleration and deceleration

**Related functions**
**U02 to U05**

* The S-shape range is set by the function: U02 to U05 when the set value "2" is selected. The detail is referred to the function: U02 to U05.

[S-shape acceleration and deceleration]

This pattern reduces shock by mitigating output frequency changes at the beginning/end of acceleration and deceleration.




<Pattern constants>

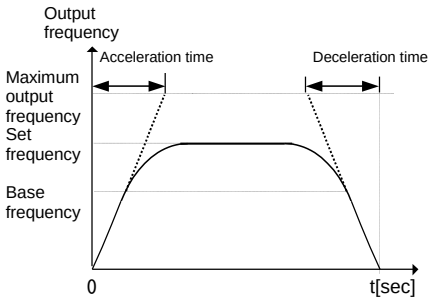
| | When 1 is selected in H07 (mild S-shape pattern) | When 2 is selected in H07 (arbitrary S-shape pattern) |
|---|---|---|
| Range of S-shape(α) | 0.05 x max. output freq. (Hz) | (U02 to U05) x max. output freq. (Hz) |
| Time for S-shape at acceleration (βacc) | 0.10 x acceleration time (s) | (U02, U03) x2 x acceleration time (s) |
| Time for S-shape at deceleration (βdec) | 0.10 x deceleration time (s) | U04, U05 x2 x deceleration time (s) |

* When acceleration and deceleration times are very long or short, acceleration and deceleration are rendered linear.
It may be switched the acceleration and deceleration time during constant speed or stopping by the function "acceleration and deceleration time selection"(E01 to E09: 4, 5).
The signal may be ignored switched during S-shape at acceleration.
The linear deceleration time is corresponded if switched during S-shape at deceleration.

It may be switched to the S-shape operation if output frequency is reached to the setting frequency or change to acceleration control.

[ Curvilinear acceleration and deceleration ]

This function is used to minimize motor acceleration and deceleration times in the range that includes a constant-output range.




## H08 Rev. phase sequence lock

◆When accidental reversing is expected to cause a malfunction, this function can be set to prevent reversal.

| H | 0 | 8 | R | E | V | | L | O | C | K | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Inactive
1: Active

When reversible operation with polarity(set value: "4" or "5") is selected in frequency command: F01, C30, the inverter operates as follows.

| Operation command | 0V to 10V input | -10V to 0V input |
|---|---|---|
| Short FWD-CM terminals or FWD : ON | The inverter operates. | The frequency display is "0.00" Hz. |
| Short REV-CM terminals or REV : ON | The frequency display is "0.00" Hz. | The inverter operates. |

This function prevents a reversing operation resulting from a connection between the REV and P24 terminals, inadvertent activation of the REV key, or negative analog input from terminal 12 or V1. During this function is operating, "0.00Hz" is displayed on the LED monitor.
This function cannot be prevented against H18: Torque control function. It may be reverse because of the torque signal and load.

## H09 Start mode

This function smoothly starts the motor which is coasting after a momentary power failure or after the motor has been subject to external force, without stopping motor.
At startup, this function detects the motor speed and outputs the corresponding frequency, thereby enabling a shock-free motor startup. Although the normal startup method is used, when the coasting speed of the motor is 120 Hz or more as an inverter frequency, when the value set to "F03 Maximum frequency," exceeds the value set to "F15 Frequency limiter (upper limit)." and when the coasting speed is less than 5 Hz as an inverter frequency.

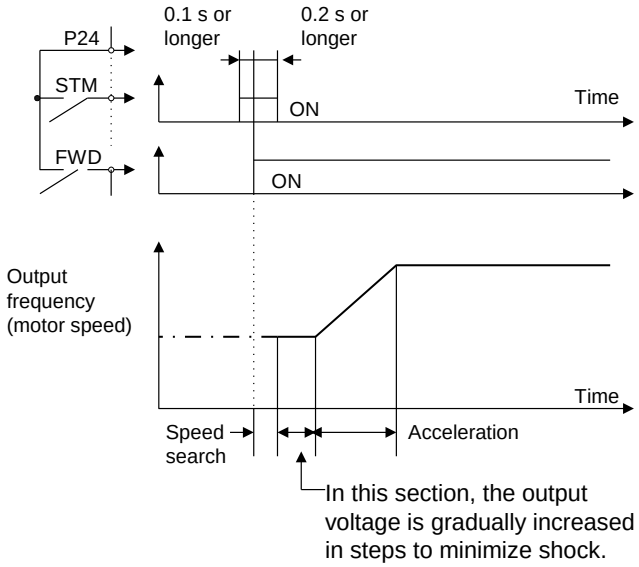
| H | 0 | 9 | S | T | A | R | T | | M | O | D | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0,1,2

| Set value | STM | Restart after a momentary power failure or Line-to-inverter switching | Other operation |
|---|---|---|---|
| 0 | OFF / not selected | Inactive (normal starting) | |
| 1 | | Active (smoothly starting) | Inactive |
| 2 | | Active | |
| any value | ON | Active | |

STM: Start characteristics selection signal(E01 to E09: 26)
NOTE:
-1: Automatically restart when overcurrent or overvoltage is detected during smoothly starts.
-2: The coasting speed is used 100 Hz or less as an inverter frequency.
-3: When H09:2 or STM:ON, it needs the time more than normal start even the motor is STOP because the motor speed is detected on ALL situation. And it may be rotated the motor when the load is too small.
-4: Auto tuning(P04/A13: 2) should be done to use this function.
-5: When the used motor slippage is different from TWMC motor, the "Slip compensation control (P09, A18)" should be set. The characteristics may not be satisfied.

◆When the operation above is problematic, this function is not used (inactive).
◆This function may not be satisfied due to the characteristics because of the load condition, motor constant, operating frequency, coasting speed, wire length, momentary power failure time or external factor.




Note: The dotted-dashed line indicates motor speed.

## H10 Energy-saving operation

◆When the output frequency is fixed (constant-speed operation) at light loads and except for"0.0" is set to F09, "Torque boost 1," this function automatically reduces the output voltage, while minimizing the product (power) of voltage and current.
◆Auto tuning (P04/A13: 2) should be done to use this function.
◆The energy-saving operation does not be operated when set below.
- Under Torque control
- Selected the Automatic torque boost
- Selected the Torque vector control

| H | 1 | 0 | E | N | E | R | G | Y | | S | A | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Inactive
1: Active

Note:
-Use this function for square law reduction torque loads (e.g., fans, pumps). When used for a constant-torque load or rapidly changing load, this function causes a delay in control response.
-The energy-saving operation automatically stops during acceleration and deceleration and when the torque limiting function is activated.

## H11 DEC mode

◆This function selects the inverter stopping method when a stop command is entered.

| H | 1 | 1 | D | E | C | | M | O | D | E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Deceleration-to-stop based on data set to "H07 Non-linear acceleration and deceleration"
1: Coasting-to-stop

Note:
This function is effective only when a stop command is entered and, therefore, is ineffective when the motor is stopped by lowering the set frequency.

## H12 Instantaneous overcurrent limiting

◆An overcurrent trip generally occurs when current flows above the inverter protective level following a rapid change in motor load. The instantaneous overcurrent limiting function controls inverter output and prohibits the flow of a current exceeding the protective level even when the load changes.
◆As the operation level of the instantaneous overcurrent limiting function cannot be adjusted, the torque limiting function must be used.

| | |
|---|---|
| ⚠**WARNING** | As motor generation torque may be reduced when instantaneous overcurrent limiting is applied, set this function to be inactive for equipment such as elevators, which are adversely affected by reduced motor generation torque, in which case an overcurrent trip occurs when the current flow exceeds the inverter protective level. A mechanical brake should be used to ensure safety. **Otherwise accidents may result**. |

| H | 1 | 2 | I | N | S | T | | C | L | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Inactive
1: Active

## H13 Auto-restart (Restart time)

◆Instantaneous switching to another power line (when the power of an operating motor is cut off or power failure occurs) creates a large phase difference between the line voltage and the voltage remaining in the motor, which may cause electrical or mechanical failure. To rapidly switch power lines, enter the remaining voltage attenuation time to wait for the voltage remaining in the motor to attenuate. This function operates at restart after a momentary power failure.

| H | 1 | 3 | R | E | S | T | A | R | T | | T | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.1 to 5.0 seconds

◆When the momentary power failure time is shorter than the wait time value, a restart occurs following the wait time. When the power failure time is longer than the wait time value, a restart occurs when the inverter is ready to operate (after about 0.2 to 0.5 second).

## H14 Auto-restart (Freq. fall rate)

◆This function determines the reduction rate of the output frequency for synchronizing the inverter output frequency and the motor speed. This function is also used to reduce the frequency and thereby prevent stalling under a heavy load during normal operation.

| H | 1 | 4 | F | A | L | L | | R | A | T | E | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.00, 0.01 to 100.00 Hz/s

◆When 0.00 is set, the frequency is reduced according to the set deceleration time.

Note:
A too large frequency reduction rate is may temporarily increase the regeneration energy from the load and invoke the overvoltage protective function. Conversely, a rate that is too small extends the operation time of the current limiting function and may invoke the inverter overload protective function.

## H15 Auto-restart (Holding DC voltage)

◆This function is for when 2 (deceleration-to-stop at power failure) or 3 (operation continuation) is set to "F14 Restart after momentary power failure (operation selection)." Either function starts a control operation if the main circuit DC voltage drops below the set operation continuation level.

| H | 1 | 5 | H | O | L | D | | V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range 230 V series: 200 to 300V
460 V series: 400 to 600V

◆When power supply voltage to the inverter is high, control can be stabilized even under an excessive load by raising the operation continuation level. However, when the level is too high, this function activates during normal operation and causes unexpected motion. Please contact TWMC electric when changing the initial value.

## H16 Auto-restart (OPR command selfhold time)

◆As the power to an external operation circuit (relay sequence) and the main power to the inverter is generally cut off at a power failure, the operation command issued to the inverter is also cut off. This function sets the time an operation command is to be held in the inverter. If a power failure lasts beyond the self-hold time, power-off is assumed, automatic restart mode is released, and the inverter starts operation at normal mode when power is applied again. (This time can be considered the allowable power failure time.)

| H | 1 | 6 | S | E | L | F | H | O | L | D | | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.0 to 30.0 seconds, 999

When "999" is set, an operation command is held (i.e., considered a momentary power failure) while control power in the inverter is being established or until the main circuit DC voltage is about 100Vdc.

◆This function controls motor torque according to a command value.

## H19 Active drive

◆This function automatically extends accelerating time against acceleration operation of 60 seconds or longer to prevent an inverter trip resulting from a temperature rise in inverter due to overcurrent.

| H | 1 | 9 | A | U | T | | R | E | D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Inactive
1: Active

(When the active drive function is activated, the acceleration time is three times the selected time.)

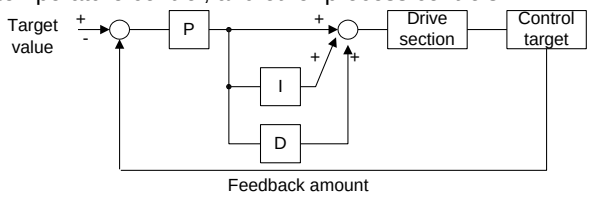
**H20** **PID control (Mode select)**

ʃ ʃ

**H25** **PID control (Feedback filter)**

◆PID control detects the amount of control (feedback amount) from a sensor of the control target, then compares it with the target value (e.g., reference temperature). If the values differ, this function performs a control to eliminate the deviation. In other words, this control matches the feedback amount with the target value.

This function can be used for flow control, pressure control, temperature control, and other process controls.

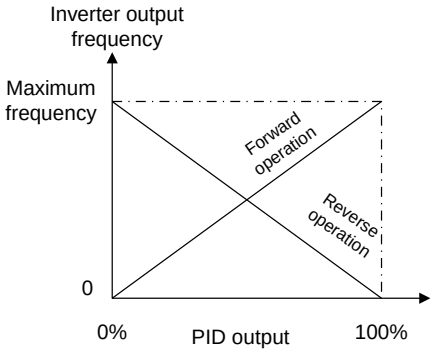



◆Forward or reverse operations can be selected for PID controller output. This enables motor revolutions to be faster or lower according to PID controller output

◆This function cannot be used when the motor 2 is selected.

| H | 2 | 0 | P | I | D | | M | O | D | E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

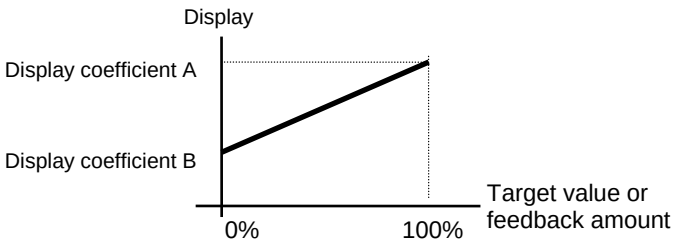
Set value 0: No operation
1: Forward operation
2: Reverse operation




◆The target value can be entered using F01, "Frequency setting 1," or directly from the keypad panel. Select any terminal of Terminals X1 (E01) to X9 (E09) and set value 11 (frequency setting switching).

For entry from F01, "Frequency setting 1," input an OFF signal to the selected terminal. For direct entry from the keypad panel, turn on the selected terminal.

◆For the target value and feedback amount, the process amount can be displayed according to the values set in E40, "Display coefficient A," and E41, "Display coefficient B."

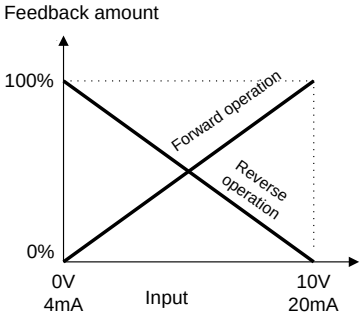



**H21** **PID control (Feedback signal)**

This function selects the feedback amount input terminal and electrical specifications of the terminal. Select a value from the table below according to sensor specifications.

| H | 2 | 1 | F | B | | S | I | G | N | A | L | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Set value | Descriptions |
|---|---|
| 0 | Control terminal 12, forward operation (0 to 10V voltage input) |
| 1 | Control terminal C1, forward operation (4 to 20mA current input) |
| 2 | Control terminal 12, reverse operation (10 to 0V voltage input) |
| 3 | Control terminal C1, reverse operation (20 to 4mA current input) |



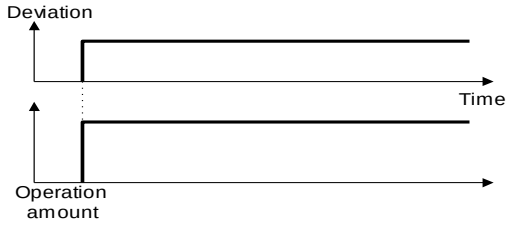

Only positive values can be input for this feedback amount of PID control. Negative values (e.g., 0 to -10V, -10 to 0V) cannot be input, thereby the function cannot be used for a reverse operation by an analog signal.

| | |
|---|---|
| **H22** | **PID control (P-gain)** |
| **H23** | **PID control (I-gain)** |
| **H24** | **PID control (D-gain)** |

◆These functions are not generally used alone but are combined like P control, PI control, PD control, and PID control.

◆P operation

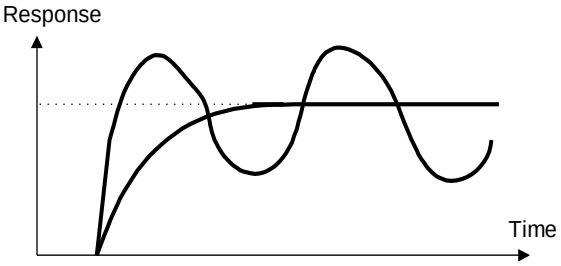
Operation using an operation amount (output frequency) proportional to deviation is called P operation, which outputs an operation amount proportional to deviation, though it cannot eliminate deviation alone.




**H 2 2 P - G A I N**

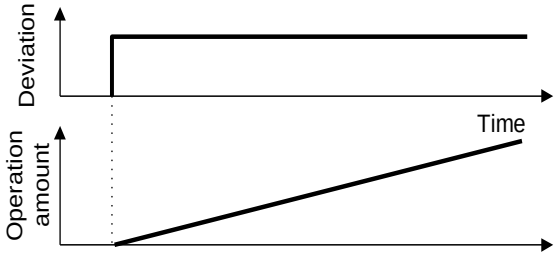
Setting range: 0.01 to 10.0 times

P (gain) is the parameter that determines the response level for the deviation of P operation. Although an increase in gain speeds up response, an excessive gain causes vibration, and a decrease in gain delays response. The value "1" is the P(gain) that is when the maximum frequency 100% at deviation 100%.




◆ I operation

An operation where the change speed of the operation amount (output frequency) is proportional to the deviation is called an I operation. An I operation outputs an operation amount as the integral of deviation and, therefore, has the effect of matching the control amount (feedback amount) to the target value (e.g., set frequency), though it deteriorates response for significant changes in deviation.



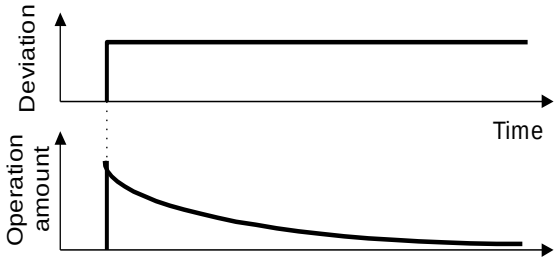

**H 2 3 I - G A I N**

Setting range: 0.0 (Inactive), 0.1 to 3600 seconds

"H23 I-gain" is used as a parameter to determine the effect of I operation. A longer integration time delays response and weakens resistance to external elements. A shorter integration time speeds up response, but an integration time that is too short causes vibration.

◆D operation

An operation where the operation amount (output frequency) is proportional to the deviation differential is called a D operation, which outputs an operation amount as the deviation differential and, therefore, is capable of responding to sudden changes.




**H 2 4 D - G A I N**

Setting range: 0.00 (Inactive), 0.01 to 10.0 seconds

"H24 D-gain" is used as a parameter to determine the effect of a D operation. A longer differentiation time causes vibration by P operation quickly attenuating at the occurrence of deviation. Excessive differentiation time could cause vibration. Shortening the differentiation time reduces attenuation at the occurrence of deviation.

◆PI control

P operation alone does not remove deviation completely. P + I control (where I operation is added to P operation) is normally used to remove the remaining deviation. PI control always operates to eliminate deviation even when the target value is changed or there is a constant disturbance. When I operation is strengthened, however, the response for rapidly changing deviation deteriorates. P operation can also be used individually for loads containing an integral element.

◆ PD control

If deviation occurs under PD control, an operation amount larger than that of D operation alone occurs rapidly and prevents deviation from expanding. For a small deviation, P operation is restricted. When the load contains an integral element, P operation alone may allow responses to vibrate due to the effect of the integral element, in which case PD control is used to attenuate the vibration of P operation and stabilize responses. In other words, this control is applied to loads in processes without a braking function.

◆PID control

PID control combines the P operation, the I operation which removes deviation, and the D operation which suppresses vibration. This control achieves deviation-free, accurate, and stable responses.

◆Adjusting PID set value

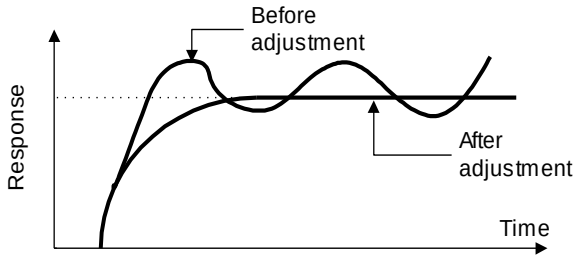
Adjust the PID value while monitoring the response waveform on an oscilloscope or other instrument if possible. Proceed as follows:

-Increase the value of "H22 P-gain" without generating vibration.

- Decrease the value of "H23 I-gain" without generating vibration.

- Increase the value of "H24 D-gain" without generating vibration.

-To suppress vibration with a frequency roughly equivalent to the value "H24 D-gain," decrease the value of H24. If there is residual vibration with 0.0, decrease the value of "H22 P-gain."




## H25 PID control (Feedback filter)

◆This filter is for feedback signal input from terminal [12] or [C1]. This filter stabilizes operation of the PID control system. A set value that is too large, however, deteriorates response.

| H | 2 | 5 | F | B | | F | I | L | T | E | R | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.0 to 60.0 seconds

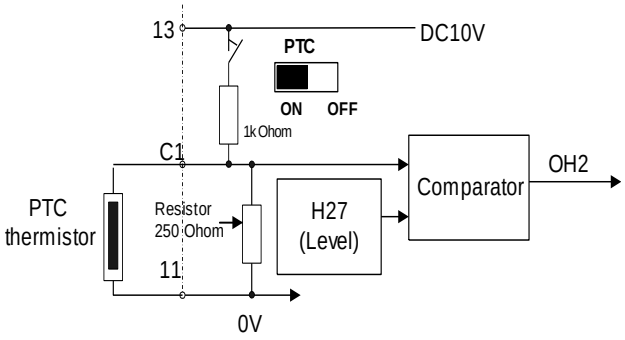
## H26 PTC thermistor (Mode select)

◆Set this function active when the motor has a PTC thermistor for overheat protection

| H | 2 | 6 | P | T | C | | M | O | D | E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value 0: Inactive
1: Active

◆Connect the PTC thermistor as shown in the figure below.
Turn on switch “PTC” on the control PCB.
The trip mode is activated by “OH2:External thermal relay tripped.”



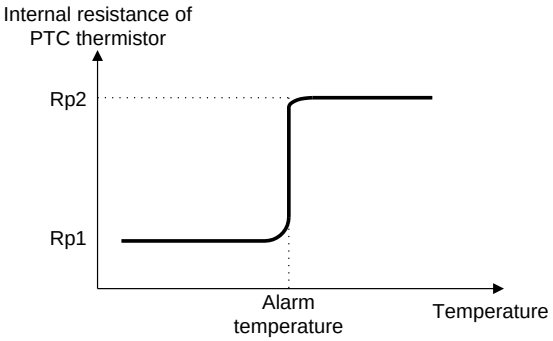

## H27 PTC thermistor (Level)

◆The voltage input to terminal [C1] is compared to the set voltage (Level). When the input voltage is equal to or greater than the set voltage (Level), "H26 PTC thermistor (Mode select)," starts.

| H | 2 | 7 | P | T | C | | L | E | V | E | L | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0.00 to 5.00V

◆The PTC thermistor has its own alarm temperature. The internal resistance value of the thermistor largely change at the alarm temperature. The operation (voltage) level is set using this change in the resistance value.




The figure in "H26 PTC thermistor (Mode select)," shows that resistor 250Ω and the thermistor (resistance value Rp) are connected in parallel. Hence, voltage $Vc_1$ (Level) at terminal [C1] can be calculated by using the following formula.

$$Vc_1 = \frac{\frac{250 \times Rp}{250 + Rp}}{1000 + \frac{250 \times Rp}{250 + Rp}} \times 10 \quad [V]$$

The operation level can be set by bringing Rp in the $Vc_1$ calculation formula into the following range.

$Rp_1 < Rp < Rp_2$

To obtain Rp easily, use the following formula.

$$Rp = \frac{Rp_1 + Rp_2}{2} \quad [\Omega]$$

## H30 Serial link (Function select)

◆The link function (communication function) provides RS-485 (provided as standard) and bus connections (optional).

The serial link function includes:

1) Monitoring (data monitoring, function data check)
2) Frequency setting
3) Operation command
   (FWD, REV, and other commands for digital input)
4) Write function data

**H30 LINK FUNC**

Setting range: 0 to 3

Communication can be enabled and disabled by a digital input. This function sets the serial link function when communication is enabled.

| Set value | Frequency command | Operation command |
|---|---|---|
| 0 | Disabled | Disabled |
| 1 | Enabled | Disabled |
| 2 | Disabled | Enabled |
| 3 | Enabled | Enabled |

The data monitoring and function data write functions are always enabled. Disabling communication using digital input brings about the same result as when "0" is set to this function. When the bus option is installed, this setting selects the function of the option and the RS-485 interface is restricted to monitoring and writing function data.

## H31 RS-485 (Address)

ʃ ʃ

## H39 RS-485 (Response interval)

These functions set the conditions of RS-485 Modbus-RTU communication. Set the conditions according to the upstream device. Refer to technical manual for the protocol.

◆This function sets the station address of RTU.

**H31 485ADRESS**

Setting range: 1 to 247

◆This function sets processing at communication error and sets the error processing timer value.

**H32 MODE ON ER**

Setting range: 0 to 3

| Set value | Processing at communication error |
|---|---|
| 0 | Immediate Er 8 trip (forced stop) |
| 1 | Continue operation within timer time, Er8 trip after timer time. |
| 2 | Continue operation and effect retry within timer time, then invoke an Er8 trip if a communication error occurs. If an error does not occur, continue operation. |
| 3 | Continue operation. |

**H33 TIMER**

Setting range: 0.0 to 60.0 seconds

◆This function sets the baud rate.

**H34 BAUD RATE**

Setting range: 0 to 3

| Set value | Baud rate |
|---|---|
| 0 | 19200 bit/s |
| 1 | 9600 bit/s |
| 2 | 4800 bit/s |
| 3 | 2400 bit/s |

◆This function sets data length.

**H35 LENGTH**

Setting range: 0

| Set value | Data length |
|---|---|
| 0 | 8 bit |

◆This function sets the parity bit.

**H36 PARITY**

Setting range: 0 to 2

| Set value | Parity bit |
|---|---|
| 0 | None |
| 1 | Even |
| 2 | Odd |

◆This function sets the stop bit.

**H37 STOP BITS**

Setting range: 0, 1

| Set value | Stop bit |
|---|---|
| 0 | 2 bit |
| 1 | 1 bit |

The stop bit is automatically configured by the value of the parity bit. For parity “NONE” the stop bit is 2bits. For parity “EVEN” or “ODD” the stop bit is 1 bit.

◆In a system where the local station is always accessed within a specific time, this function detects that access was stopped due to an open-circuit or other fault and invokes an Er 8 trip.

**H38 NO RES t**

Setting range: 0 (No detection)
1 to 60 seconds

◆This function sets the time from when a request is issued from the upstream device to when a response is returned.

**H39 INTERVAL**

Setting range: 0.00 to 1.00 second

## *Motor 2 (A: Alternative Motor Parameters)*

### A01 Maximum frequency2

◆This function sets the maximum frequency for motor 2 output by the inverter. This function operates the same as "F03 Maximum frequency 1." For details, see the explanation for F03.

| A | 0 | 1 | M | A | X | | H | z | - | 2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A02 Base frequency 2

◆This function sets the maximum output frequency in the constant-torque area of motor 2 (i.e., output frequency at rated output voltage). This function operates the same as "F04 Base frequency 1." For details, see the explanation for F04.

| A | 0 | 2 | B | A | S | E | | H | z | - | 2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A03 Rated voltage 2

◆This function sets the rated value of voltage output to motor 2. This function operates the same as "F05 Rated voltage 1." For details, see the explanation for F05.

| A | 0 | 3 | R | A | T | E | D | | V | 2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A04 Maximum voltage 2

◆This function sets the maximum value of the inverter output voltage of motor 2. This function operates the same as "F06 Maximum voltage 1." For details, see the explanation for F06.

| A | 0 | 4 | M | A | X | | V | - | 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A05 Torque boost 2

◆This function sets the torque boost function of motor 2. This function operates the same as "F09 Torque boost 1." For details, see the explanation for F09.

| A | 0 | 5 | T | R | Q | | B | O | O | S | T | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A06 Electronic thermal overload relay 2 (Select)

### A07 Electronic thermal overload relay 2 (Level)

### A08 Electronic thermal overload relay 2 (Thermal time constant)

◆This function sets the function of the electronic thermal overload relay for motor 2. This function operates the same as F10 to F12, "Electronic thermal overload relay 1." For details, see the explanations for F10 to F12.

| A | 0 | 6 | E | L | C | T | R | N | | O | L | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0 | 7 | O | L | | L | E | V | E | L | 2 | |
| A | 0 | 8 | T | I | M | E | | C | N | S | T | 2 |

### A09 Torque vector control 2

◆This function sets the torque vector function of motor 2. This function operates the same as "F42 Torque vector control 1." For details, see the explanation for F42.

| A | 0 | 9 | T | R | Q | V | E | C | T | O | R | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A10 Number of motor-2 poles

◆This function sets the number of poles of motor 2 to be driven. This function operates the same as "P01 Number of motor-1 poles." For details, see the explanation for P01.

| A | 1 | 0 | M | 2 | | P | O | L | E | S | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A11 Motor 2 (Capacity)

◆This function sets the capacity of motor 2. This function operates the same as "P02 Motor 1 (Capacity)." For details, see the explanation for P02. However, the related motor data functions change to "A12 Motor 2 (Rated current)," "A15 Motor 2 (No-load current)," "A16 Motor 2 (%R1 setting)," and "A17 Motor 2 (%X setting)."

| A | 1 | 1 | M | 2 | - | C | A | P | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A12 Motor 2 (Rated current)

◆This function sets the rated current of motor 2. This function operates the same as "P03 Motor 1 (Rated current)." For details, see the explanation for P03.

| A | 1 | 2 | M | 2 | - | I | r | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A13 Motor 2 (Tuning)

◆This function sets the auto tuning of motor 2. This function operates the same as "P04 Motor 1 (Tuning)." For details, see the explanation for P04.

| A | 1 | 3 | M | 2 | | T | U | N | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A14 Motor 2 (On-line tuning)

◆This function sets the online tuning of motor 2. This function operates the same as "P05 Motor 1 (On-line tuning)." For details, see the explanation for P05.

| A | 1 | 4 | M | 2 | | T | U | N | 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A15 Motor 2 (No-load current)

◆This function sets the no-load current of motor 2. This function operates the same as "P06 Motor 1 (No-load current)." For details, see the explanation for P06.

| A | 1 | 5 | M | 2 | - | I | o | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

### A16 Motor 2 (%R1 setting)

### A17 Motor 2 (%X setting)

◆This function sets %R1 and %X of motor 2. This function operates the same as "P07 Motor 1 (%R1 setting)," and "P08 Motor 1 (%X setting)." For details, see the explanations for P07 and P08.

| A | 1 | 6 | M | 2 | - | % | R | 1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 7 | M | 2 | - | % | X | | | | | |

### A18 Slip compensation control 2

◆This function sets the amount of slip compensation for motor 2. This function operates the same as "P09 Slip compensation control." For details, see the explanation for P09.

| A | 1 | 8 | S | L | I | P | | C | O | M | P | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value : 0.00Hz to 15.00Hz

◆Calculate the amount of slip compensation using the following formula:
Slip compensation amount

$$= \text{Base frequency} \times \frac{\text{Slippage}[\text{r/min}]}{\text{Synchronous speed}[\text{r/min}]} [\text{Hz}]$$

Slippage = Synchronous speed-Rated speed

**U01** **Maximum compensation frequency during braking torque limit**

◆This function becomes effective, when the torque limit (brake) is used. The inverter controls to increase the output frequency so that torque calculations do not exceed the torque limit (brake) setting ( F41 or E17). (When F41 or E17 is set to 999, it becomes invalid.)
This function sets the increment of upper limit for output frequency.
When the regeneration avoidance is selected, the resurrection ability can be improved by raising the increment of upper limit. However, the output frequency of the inverter is limited at the frequency limit(high): F15.

| U | 0 | 1 | U | S | E | R | | 0 | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to 65535

The set value "15" becomes 1Hz.
(The set value "1" becomes 1/15Hz)

**U02** **1st S-shape level at acceleration (start)**
**U03** **2nd S-shape level at acceleration (stop)**
**U04** **1st S-shape level at deceleration (start)**
**U05** **2nd S-shape level at deceleration (stop)**

◆When "2" is set in the function code: H07, both curvilinear acceleration and deceleration ranges of S-shape can be set up arbitrarily.
The range is the ratio for maximum output frequency 1 (F03) or 2 (A01) .

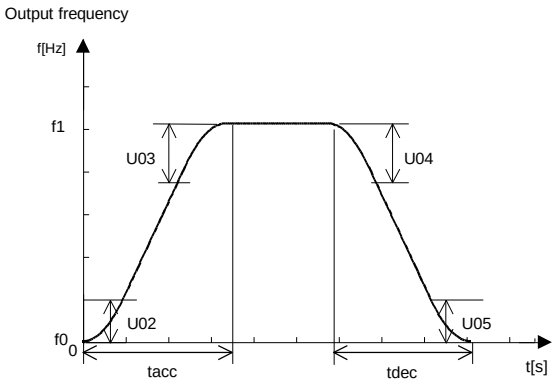
| U | 0 | 2 | U | S | E | R | | 0 | 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| U | 0 | 3 | U | S | E | R | | 0 | 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| U | 0 | 4 | U | S | E | R | | 0 | 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| U | 0 | 5 | U | S | E | R | | 0 | 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 1 to 50%




◆100% value of this function means maximum frequency (***fmax***) .
Acceleration time "***tacc***" and deceleration time "***tdec***" of upper figure become longer than the linear acceleration time and deceleration time. When the set acceleration time(F07, E10, E12, E14) is assumed to be "***Ta***" and deceleration time(F08, E11, E13, E15) is assumed to be "***Td***", "***tacc***" and "***tdec***" can be calculated by the following expressions.

- At acceleration,

$$|f1-f0| \geq fmax \times \frac{U02+U03}{100} \quad \text{or,}$$

- At deceleration,

$$|f1-f0| \geq fmax \times \frac{U04+U05}{100}$$

$$tacc = \left(\frac{f1-f0}{fmax} + \frac{U02+U03}{100}\right) \times Ta$$

$$tdec = \left(\frac{f1-f0}{fmax} + \frac{U04+U05}{100}\right) \times Td$$

linear Acceleration and deceleration clause — S-shape clause

- At acceleration,

$$|f1-f0| < fmax \times \frac{U02+U03}{100} \quad \text{or,}$$

- At deceleration,

$$|f1-f0| < fmax \times \frac{U04+U05}{100}$$

$$tacc = 2 \times \left\{\sqrt{\frac{f1-f0}{fmax} \times \frac{100}{U02+U03}}\right\} \times \left(\frac{U02+U03}{100}\right) \times Ta$$

$$tdec = 2 \times \left\{\sqrt{\frac{f1-f0}{fmax} \times \frac{100}{U04+U05}}\right\} \times \left(\frac{U04+U05}{100}\right) \times Td$$

**U08** **Initial value of main DC link capacitor**
**U09** **Measured value of main DC link capacitor**

◆Data for the life expectancy judgment of the capacitor in main circuit is stored in this function. The electrical discharge time of the capacitor can be measured automatically, and the time of part replacement can be confirmed according to the decrement rate from the factory shipment.

| U | 0 | 8 | U | S | E | R | | 0 | 8 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| U | 0 | 9 | U | S | E | R | | 0 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to 65535

◆The electrical discharge time which is measured in the factory shipment is set to function code U08 as a initial value. This value is different in each inverter.
◆The electrical discharge time of the capacitor is measured automatically, when the power supply is turned off. And, the result is stored in function code U09.
When the power supply is turned off under the conditions as follows, decrement rate (%) to the factory shipment can be measured.
Conditions: which has been described to "*Estimation of life expectancy based on maintenance information" of the instruction manual "8-2 periodical inspection".
The result of $\frac{U09}{U08} \times 100$ is displayed in CAP=xxx.x% of maintenance information. 85% becomes a standard at the part replacement time.

◆When you make measurement of capacity and life expectancy judgment of capacitor with an actual operating condition, set the value “30” to the function code “E20 to E24”. And write the measurement result U09 with an actual operating condition to the function code U08 as an initial value as early as possible since inverter operation starts.
However, life judgment by the measurement result cannot be performed in case of 1 and 2 as below.
1. During inverter operation, a power supply is turned off and it stops.
2. Cooling fan ON/OFF control is used.
(function code : H 06= 1)
Turn off the power supply of inverter, on the conditions at which the inverter has stopped, and a cooling fan is operated. It is not necessary to remove an option card and the connection with a control terminal.
As for this "measurement with an actual operating condition", carry out this measurement about 10 times to minimize the error of a measurement result, and make the average value into an initial value.
Moreover, when there is 10% or more of change from the last measured value, measurement is disregarded in order to prevent incorrect measurement. Renewal of a display is not carried out.

◆Set measured value U09 to the initial value U08 after exchanging capacitors.

**Related Functions**
**E20 to E24**
**(Set value:30)**

### U10 PC board capacitor powered on time

◆The accumulation time of the capacitor on PC board are displayed. The accumulation time of the control power supply multiplied by the life expectancy coefficient defined by the temperature inside the inverter are displayed. Hence, the hours displayed may not agree with the actual operating hours. Since the accumulation time are counted by unit hours, power input for less than one hour will be disregarded.
The accumulation time are displayed in TCAP=xxxxxh of maintenance information. The standard at the replacement time is 61,000h. Refer to the manual "8-2 regular check" for the maintenance.

| U | 1 | 0 | U | S | E | R | | 1 | 0 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0 to 65535 hours

◆Clear the accumulation time to 0 hour, after replacing the PC board on which capacitors are equipped with.
There is also PC Board without the capacitor (ex :Control circuit board) not to be cleared the accumulation time. For details, contact TWMC.

**Related Functions**
**E20 to E24**
**(Set value:30)**

### U11 Cooling fan operating time

◆The integrated operating hours of the cooling fan are displayed. Since the integrated hours are counted by unit hours, power input for less than one hour will be disregarded. The integrated hours are displayed in TFAN=xxxxxh of maintenance information.
The standard at the replacement time is 40,000h in the inverter of 5HP or less. The standard at the replacement time is 25,000h in the inverter of 7.5HP or more. (Estimated life expectancy of a cooling-fan at inverter ambient temperature of 40 degree.)
The displayed value should be considered as a rough estimate because the actual life of a cooling fan is influenced significantly by the temperature. Refer to the manual "8-2 regular check" for the maintenance.

| U | 1 | 1 | U | S | E | R | | 1 | 1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to 65535 hours
Clear integrated operating time to 0 hour after replacing the cooling fan.

**Related Functions**
**E20 to E24**
**(Set value:30)**

### U13 Magnetize current vibration damping gain

◆Adjust if Magnetizing current vibration occurred in the inverter output current .

| U | 1 | 3 | U | S | E | R | | 1 | 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0 to 32767

◆Adjust the value from 0 to 2048 as a standard value. Vibration damping gain becomes 100% in set value 4096.

### U15 Slip compensation filter time constant

◆The filter time constant of Slip compensation is set.

| U | 1 | 5 | U | S | E | R | | 1 | 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to 32767

◆Calculate the filter time constant using the following formula.

$$Filter\ time\ constant = \frac{2^{16}}{"U15"\ set\ value} \quad [ms]$$

◆The response time of the control slows because the filter time constant is enlarged when a value is set to smaller. However, system becomes steady.
◆The response time of the control quickens because the filter time constant becomes smaller, when a set value is enlarged.
Note : Response time quickens when a set value is enlarged. Therefore, there is a possibility that the output frequency becomes unstable. Please adjust a set value to smaller than factory setting value.

### U23 Integral gain of continuous operation at power failure
### U24 Proportional gain of continuous operation at power failure

◆This function becomes effective, when function code F14 (Restart mode after momentary power failure) set value is 2 or 3.

| U | 2 | 3 | U | S | E | R | | 2 | 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| U | 2 | 4 | U | S | E | R | | 2 | 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0～65535

◆In case of F14 set value : 2.
When the operation continuation level (H15) is reached, deceleration to a stop occurs. The DC voltage of the main circuit sharpens the deceleration slope, and the inverter collects the inertia energy of the load to maintain the DC bus voltage and controls the motor until it stops, so that the undervoltage protective function is not activated.
The deceleration slope is adjusted with U23 and U24.
However, the deceleration operation time never

becomes longer than the set deceleration time.

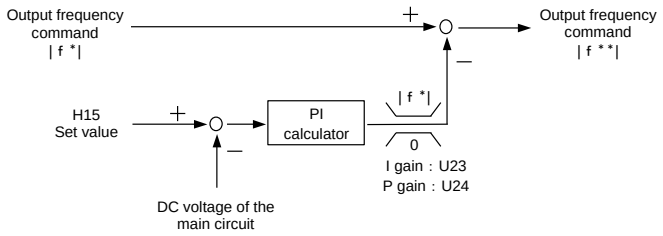
◆In case of F14 set value : 3.

The output frequency is lowered by the control by which the DC voltage of the main circuit is kept constant from the regeneration energy, so that the inverter may continue operation when momentary power failure occurs.

The response is adjusted with U23 and U24 at this time.

◆Calculate the integral gain using the following formula.

$$Integral\ gain = \frac{2^{16}}{"U23"\ set\ value} \quad [ms]$$




## U48 Input phase loss protection

◆This function selects operation of input phase loss or power supply unbalance protection.

| U | 4 | 8 | U | S | E | R | | 4 | 8 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to 2

| Set value | Operation |
|---|---|
| 0 | Active (without reactor (ACR/DCR)) |
| 1 | Active (with reactor (ACR/DCR)) |
| 2 | Inactive |

| ⚠ CAUTION | When "2" is set to U48, protection operation of the inverter to input phase loss or power supply voltage unbalance does not work. If you use it as it is, there is a possibility of damaging an inverter and **failure may result.** |
|---|---|

## U49 RS-485 protocol selection

◆The protocol of RS-485 communication is changed.

| U | 4 | 9 | U | S | E | R | | 4 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Set value : 0, 1

| Set value | Operation |
|---|---|
| 0 | FGI-bus |
| 1 | Modbus-RTU |

Instruction manual and specifications are prepared about communicative details. Contact TWMC.

◆When function code F13 (electronic thermal)is set to 2, both the type of the braking resistor and connection circuit are set. Factory setting is set to nominal applied resistor and the number of resistor is one. When the power load capacities of resistor are increased, set the factory setting properly

| U | 5 | 9 | U | S | E | R | | 5 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range : 0 to A8 (HEX)

Setting of ten's digit ( type selection )

| Set value | Resistance [Ω] | Capacity [W] | Duty cycle [%ED] |
|---|---|---|---|
| 0 | - | - | 10% |
| 1 | 100 | 200 | |
| 2 | 40 | 400 | |
| 3 | 33 | 400 | |
| 4 | 20 | 800 | |
| 5 | 15 | 900 | |
| 6 | 200 | 200 | |
| 7 | 160 | 400 | |
| 8 | 130 | 400 | |
| 9 | 80 | 800 | |
| A | 60 | 900 | |

Setting of unit's digit (connection circuit selection)

| Set value | Braking-resistor Use number | Braking-resistor Connection circuit | *1) Duty cycle [%ED] | Synthetic resistance [Ω] | Power consumption per resistance [comparatively] |
|---|---|---|---|---|---|
| 0 | 1 | P DB | 10% | R | 100% |
| 1 | 2 | P DB | 20% | 2R | 50% |
| 2 | 2 | P DB | 20% | (1/2)R | 50% |
| 3 | 4 | P DB | 40% | R | 25% |
| 4 | 3 | P DB | 30% | 3R | 33% |
| 5 | 6 | P DB | 50% | (3/2)R | 17% |
| 6 | 9 | P DB | 50% | R | 11% |
| 7 | 4 | P DB | 40% | 4R | 25% |
| 8 | 8 | P DB | 50% | 2R | 12.5% |

1) It is limited by the %ED value of the braking transistor inside the inverter.

## ⚠ CAUTION

◆Set the function code both " F13" and "U59 " before operating the inverter, and don't change the functions during operation. The integrated thermal data are cleared immediately, when function code " F13" or "U59 " are changed. The overheat protection of resistor becomes invalid. When the function code " F13" or "U59 " are changed in the state where temperature rose, the overheat protection of resistor becomes invalid, too.

◆As there is a possibility of damaging the inverter, the resistor value less than standard applied value should not be available.

◆Make into one kind the resistor used as combination conditions for a braking resistor, and connect it so that the electric power is consumed equally in each resistor.

◆When the resistor which is instead of DB***-2C/4C are used as External braking resistor, function code F13 should be set to "0".

◆ When resistor values less than Standard applied resistor value is set to the function code, regeneration operation is invalid. OU alarm will be occurred.

◆If connection of resistor and setting value of resistor is not corresponded, there is a possibility of damaging the resistor and the inverter.

**Caution or failure may result.**

### U59 *Function for manufacturer* *[40HP or more is corresponded]*

This function is available to release the overheating alarm (OH1) at the DC fan broken.

**U59USER 59**

Set value : 00, 01

| Set value | Operation |
|---|---|
| 00 | OH1 alarm at DC fan broken |
| 01 | No alarm at DC fan broken |

## ⚠ CAUTION

◆It causes overheating trip (OH1,OH3) in the inverter, and the life time decrease such as electrolytic capacitors on the PCB in the unit by a partial rise temperature, and there is a possibility to the worst unit damage when left with the DC fan for an internal stir stops.
Be sure that set it to the fan exchange and the factory setting value again promptly after the DC fan for an internal stir stops. (Contact the fan exchange procedure TWMC Electric.)

**Failure may result.**

### U60 Regeneration avoidance at deceleration

◆This function is available, when torque limit (brake) of F41( or E17) is set to "0%".

**U60USER 60**

Set value : 0, 1

| Set value | Operation |
|---|---|
| 0 | Torque limit operation (for high response use) |
| 1 | OU alarm avoidance operation (for only deceleration or Large inertia use ) |

◆If function code U60 is set to "0", braking torque is kept to about "0%" under acceleration, deceleration, constant speed state. Output frequency is controlled in correspond to the rapid change in motor load to prevent OU alarm. Deceleration time becomes longer than the set deceleration time (F08).

◆In case of setting value U60:1, Compared with setting value "0", it controls not to perform torque limit operation only at the deceleration time, but to prevent the rise of the DC voltage of the main circuit, and avoid OU alarm.
At this time, although deceleration time becomes longer than a setting value of F08, it becomes shorter than setting value"0" of U60. It may occur OU alarm, if load changes rapidly during deceleration.

### U61 Voltage detect offset and gain adjustment

◆40HP/CT, 50HP/VT or more :
It adjusts, only when a print board is replaced by maintenance, etc. If not necessary, do not use this function.

**U61USER 61**

Set value : 0, 1, 2

| Inverter capacity | Operation |
|---|---|
| 30HP/CT or 40HP/VT or less | 0 : Inactive(fixed) |
| 40HPCT 50HP/VT or more | 0 : Inactive<br>1 : Voltage detect offset adjustment<br>2 : Voltage detect gain adjustment |

◆Set the function code in the following procedure.
If the inverter are operated without this adjustment after replacing the PC board, normal operation may not be able to be performed.

(Offset adjustment)

1) Confirm that the main power supply is turned ON, the motor wiring are connected and the motor has stopped (inverter operation command is OFF).
2) When the data of U61 is changed to "1", and the FUNC/DATA key is ON, the offset self adjustment is started. The display of "storing" of the keypad panel disappears several seconds later. When the set value returns to "0", adjustment is completed.
If the main power supply is turned OFF, while outputting alarm, motor is driving, coast-to-stop command(BX) is ON and this adjustment is started, the inverter becomes "Er7:TUNING ERROR".
In this case, start the adjustment after removing the above-mentioned factor.

(Gain adjustment)

1) Drive the motor in an arbitrary frequency of about 10 to 60Hz (However, constant speed) after executing the above-mentioned offset adjustment. (U61:1)
   At this time, gain adjustment is available unrelated to the load state.
2) When the data of U61 is changed to "2", and the FUNC/DATA key is ON, the gain self adjustment is started. The display of "storing" of the keypad panel disappears several seconds to 30 seconds later. When the set value returns to "0", adjustment is completed.
   If inverter is not operated, this adjustment is not available.

## U89 Motor overload memory retention

◆This is Motor overload memory (Electrical thermal O/L relay) retention selection at power up.

| U | 8 | 9 | U | S | E | R | | 8 | 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Setting range: 0, 1

| Set value | Operation |
|---|---|
| 0 | Inactive<br>When power up the drive, Motor Overload data is reset. |
| 1 | Active.<br>When power is down, the drive stores Motor overload data and uses this data at next power up. |

# 6. Alarm Codes, Causes and Troubleshooting

The drive's built-in protective features protect the drive against operation outside its design limits.

## 6-1 Alarm Codes and Causes

Upon activation of an Alarm, the LED display shows the alarm code and the motor coasts to a stop. A list of alarm codes and causes are shown in the following table.

**Table 6-6-1 List of Alarms and Causes**

| Alarm Name | Keypad panel display | | Contents of operation | |
|---|---|---|---|---|
| | LED | LCD | | |
| Over current | OC1 | OC DURING ACC | During acceleration | Alarm activates when one of following conditions occur:<br>• Inverter output current momentarily exceeds the specified over-current detection level.<br>• Short-circuit or ground fault in the output circuit occurs.<br>**Note:** Ground Fault for inverters 40HP/CT, 50HP/VT and above is covered by a separate ground fault protection function (**EF**). |
| | OC2 | OC DURING DEC | During deceleration | |
| | OC3 | OC AT SET SPD | Running at constant speed | |
| Ground fault | EF | GROUND FAULT | Alarm activates when the following condition occurs:<br>• Ground fault in the in the inverter output circuit is detected.<br>It is recommended to install a separate ground-fault / ground leakage protection relay to protect against personal injury or property damage.<br>**Note:** For drives 30HP/CT, 40HP/VT and below Ground Fault Detection is covered by the over-current protection function. | |
| Overvoltage | OU1 | OV DURING ACC | During acceleration | Alarm activates when the following condition occurs:<br>• The DC link circuit voltage of the main circuit exceeds the overvoltage detection level (230V series: 400V DC, 460V series: 800V DC) due to an increase in the regenerating current from the motor.<br>**Note:** No protection is provided for a high voltage inadvertently applied to the inverter that exceeds the maximum overvoltage level (e.g. high voltage line. |
| | OU2 | OV DURING DEC | During deceleration | |
| | OU3 | OV AT SET SPD | Running at constant speed | |
| Undervoltage | LU | UNDERVOLTAGE | Alarm activates when the following condition occurs:<br>• The DC link voltage of the main circuit falls below the undervoltage detection level (230V series: 400V DC, 460V series: 800V DC) due to a low supply voltage.<br>**Note:** The undervoltage alarm is ***not*** displayed / activated when parameter F14 (Restart after momentary power failure) is selected or if the supply voltage falls below the level to maintain control power. | |
| Input open-phase | Lin | PHASE LOSS | Alarm activates when the following condition occurs:<br>• One of the input phases is lost (L1/R, L2/S, L3/T).<br>**Note:** Loss of an input phase may damage rectifying diodes and / or bus capacitors. | |

*Cont.*

| | | | |
|---|---|---|---|
| Overheating of heat sink | OH1 | FIN OVERHEAT | Alarm activates when the following condition occurs:<br>• Temperature of the heatsink rises above the maximum allowed heatsink temperature due to a cooling fan failure.<br>• Temperature falls below the minimum allowed heatsink temperature. |
| External alarm | OH2 | EXT ALARM | Alarm activates when one of following conditions occur:<br>• Control Circuit Terminal: THR input is closed (see user connection).<br>• PTC Thermal Protection is enabled (H26 = 1) and temperature level is reached. |
| Inverter internal overheating | OH3 | HIGH AMB TEMP | Alarm activates when one of following conditions occur:<br>• Temperature inside the inverter rises above the maximum allowed temperature. (E.g. due to poor ventilation)<br>Current draw of terminal 13 exceeds 20mA (e.g. due to a short circuit condition.) |
| Overheating of braking resistor | dbH | DBR OVERHEAT | Alarm activates when the following condition occurs:<br>Electronic thermal O/L relay is enabled (Parameter F13) and the external braking resistor is overheating. |
| Motor 1 overload | OL1 | MOTOR1 OL | Alarm activates when the following condition occurs:<br>Electronic thermal O/L relay 1 is enabled (Parameter F10) and the motor current exceeds the motor rated current level. |
| Motor 2 overload | OL2 | MOTOR2 OL | If the second motor current exceeds the preset level when the operation is switched to drive the second motor, the protective function is activated, provided that electronic thermal O/L relay 2 of function code A04 is selected. |
| Inverter overload | OLU | INVERTER OL | If the output current exceeds the rated overload current, the protective function is activated to provide thermal protection against semiconductor element overheating in the inverter main circuit. |
| Blown fuse | FUS | DC FUSE OPEN | If the fuse in the inverter is blown out following a short-circuit or damage to the internal circuit, the protective function is activated (for 40HP/CT, 50HP/VT or more only). |
| Memory error | Er1 | MEMORY ERROR | If a memory error occurs, such as missing or invalid data, the protective function is activated. |
| Digital Operator communication error | Er2 | KEYPD COM ERR | If a communication error or interrupt between the Digital operator and control circuit is detected, the protective function is activated. |
| CPU error | Er3 | CPU ERROR | If an CPU error occurs due to noise, etc., the protective function is activated. |
| Option error | Er4 | OPTN COM ERR | Error when using an optional unit |
| | Er5 | OPTION ERROR | |
| Forced stop | Er6 | OPR PROCD ERR | Error when using the forced stop command |
| Output wiring error | Er7 | TUNING ERROR | If there is an open circuit or a connection error in the inverter output wiring during auto-tuning, the protective function is activated. |
| RS-485 communication error | Er8 | RS-485 COM ERR | If an error occurs when using RS-485 communications, the protective function is activated. |

### 6-2 Alarm Reset

When the drive deactivates (trips) due to a fault, the cause must be determined and corrected before proceeding with the reset procedure. Once the fault is cleared, press the RESET key on the keypad or input a reset signal to the (RST) terminal of the control terminals. Since the reset command is a pulse edge operation, input a command such as OFF-ON-OFF shown in Fig. 6-2-1.

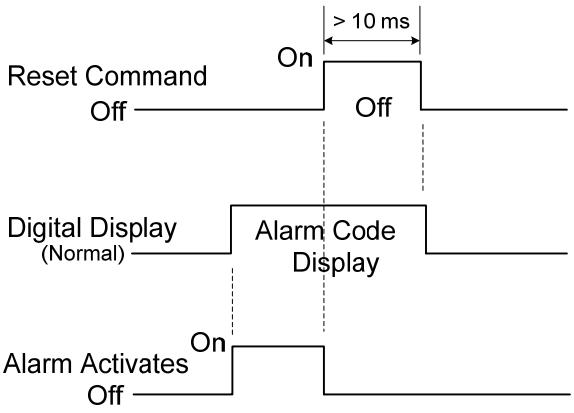



**Fig. 6-2-1 Alarm Diagram**

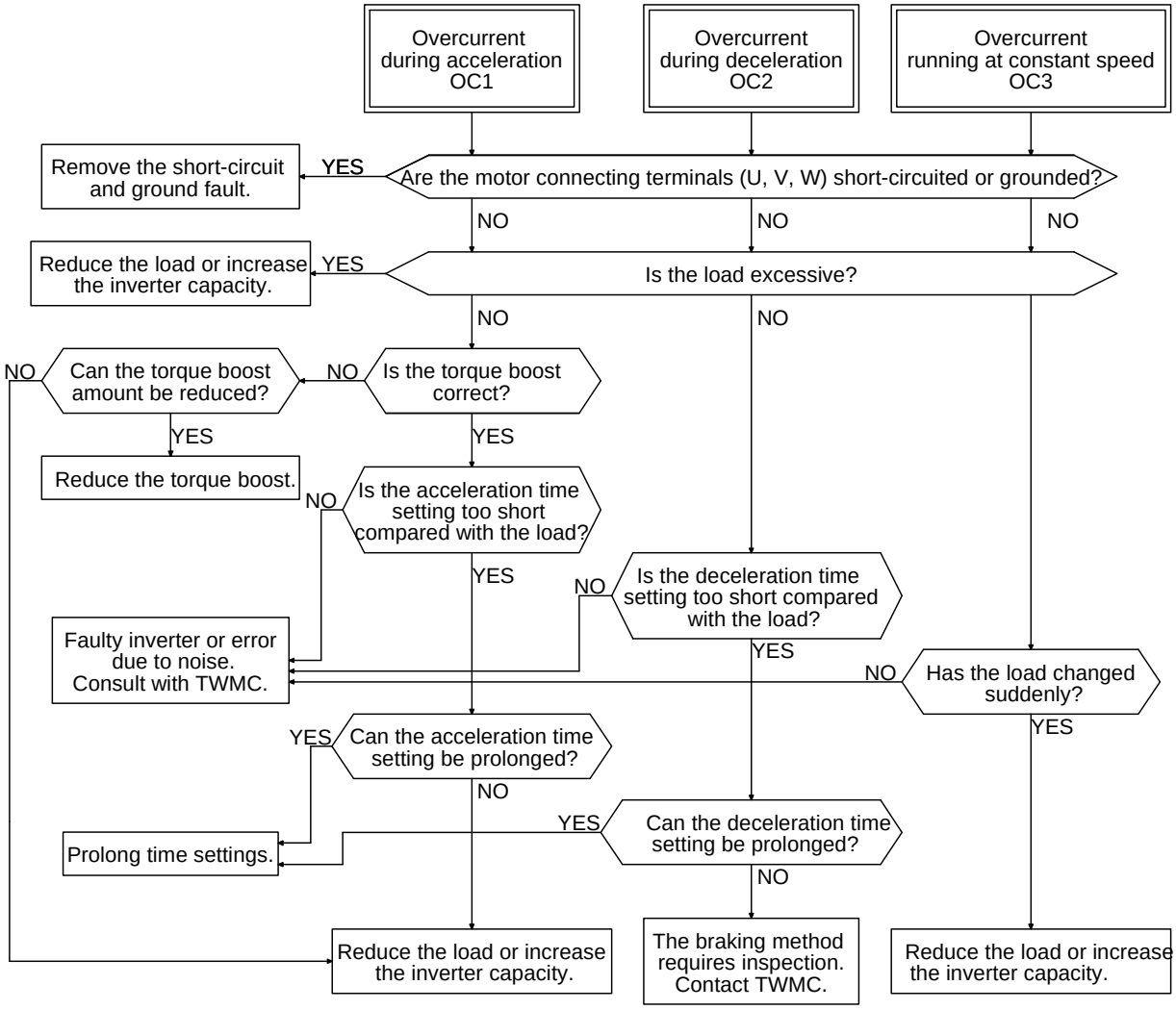
| | |
|---|---|
| **DANGER** | **If an alarm reset is activated when the operating signal is ON, the inverter can restart suddenly, which may be dangerous. To ensure safety to personnel, disable the operating signal before resetting the alarm.** |

*NOTES*

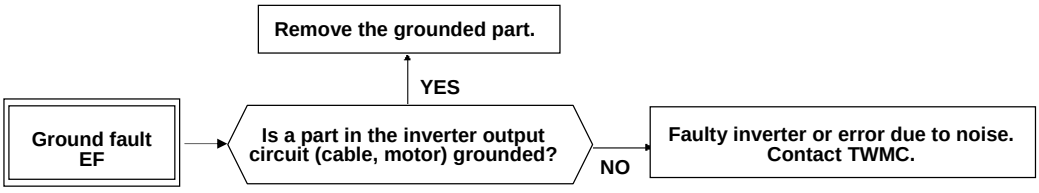
**6-3.Trouble shooting**

6-3-1 Protective function activation

(1) Overcurrent

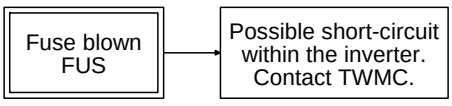



(2) Ground fault

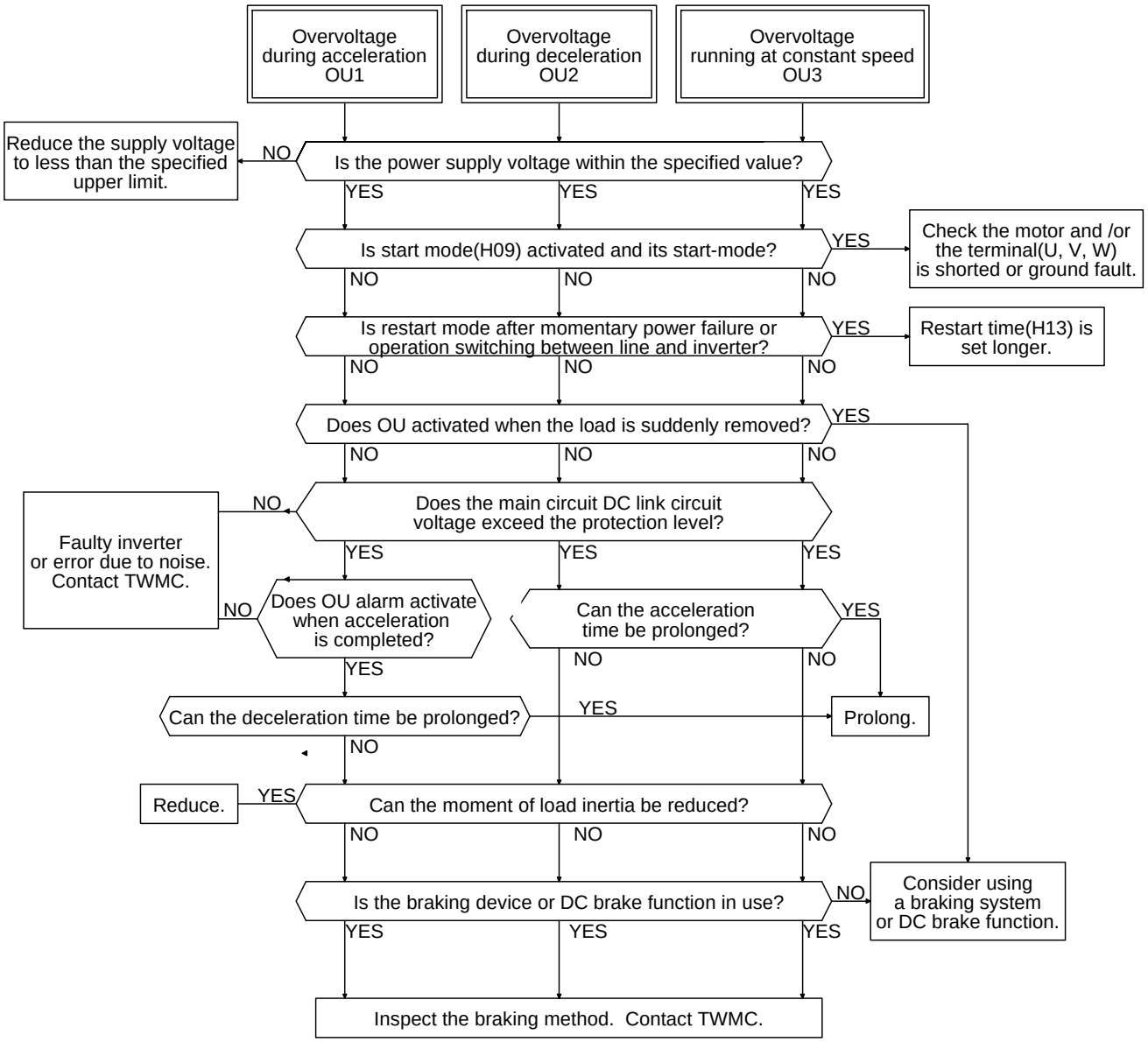



**Note: The ground fault protective function is only available for inverters rated 40HP/CT, 50HP/VT and above.**

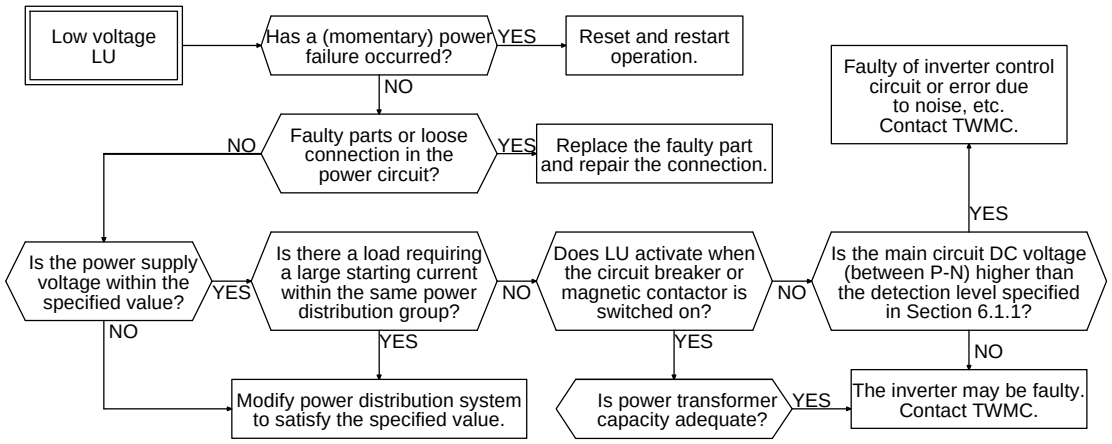
(3) Fuse brown



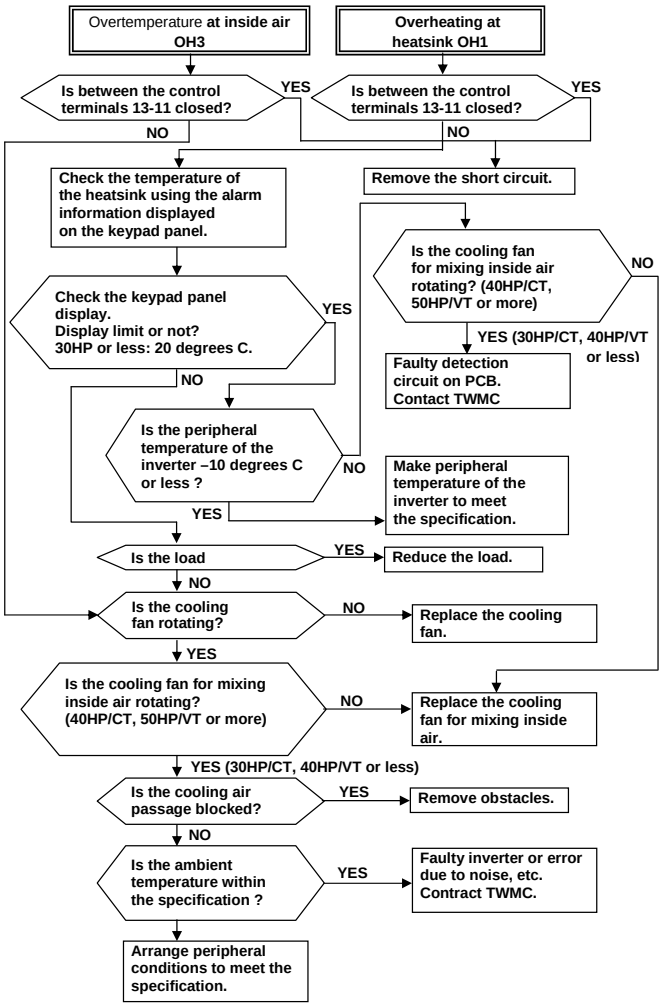
(4) Overvoltage



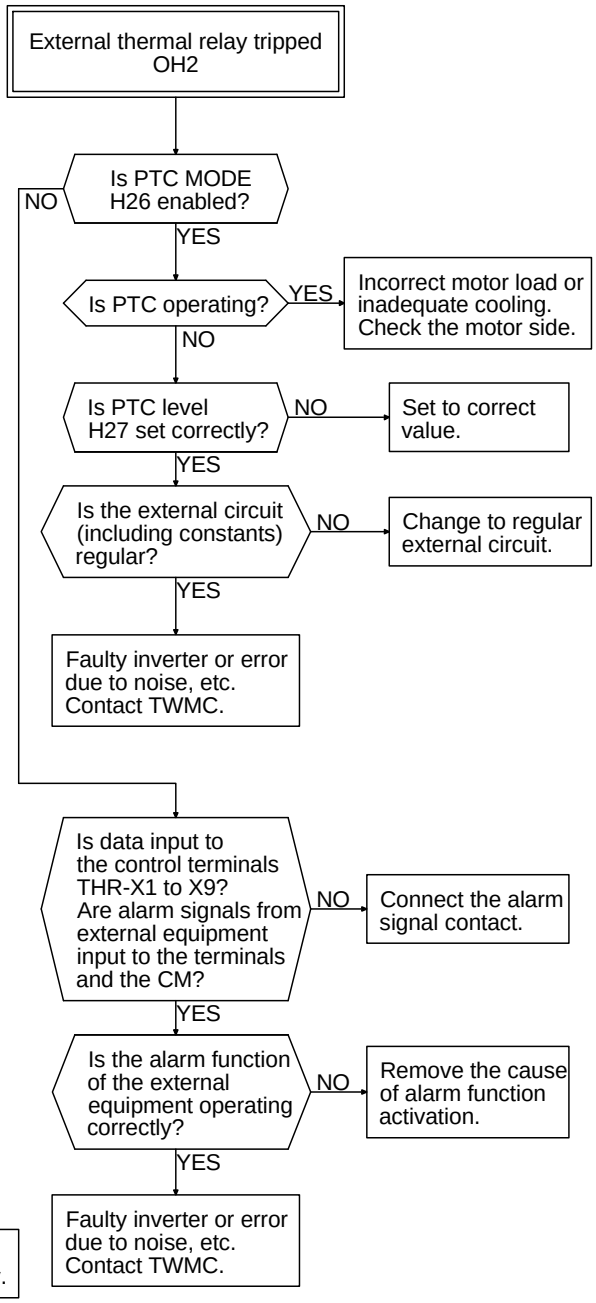

(5) Low voltage



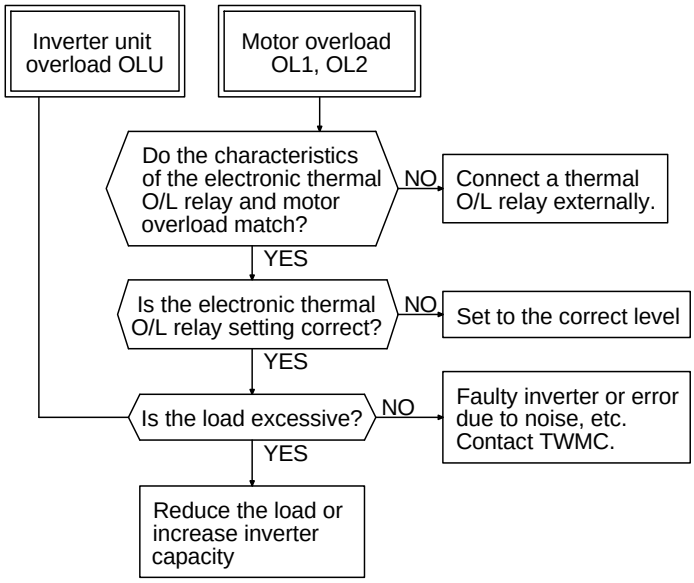
(6) Overtemperature at inside air and overheating at heatsink.



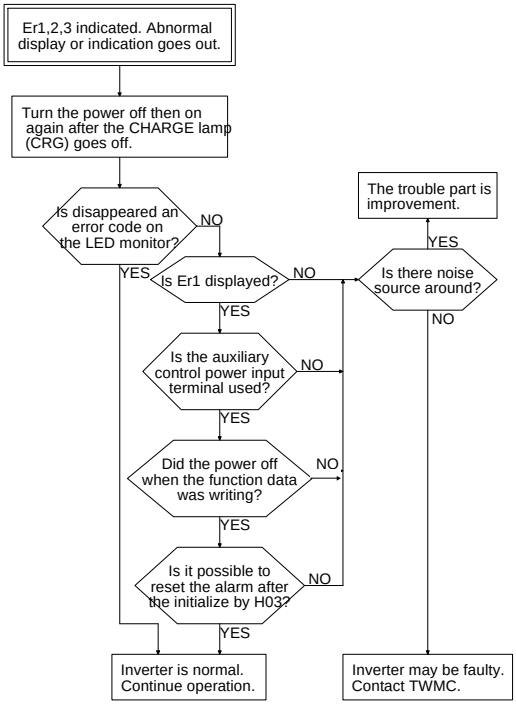

(7) External thermal relay tripped



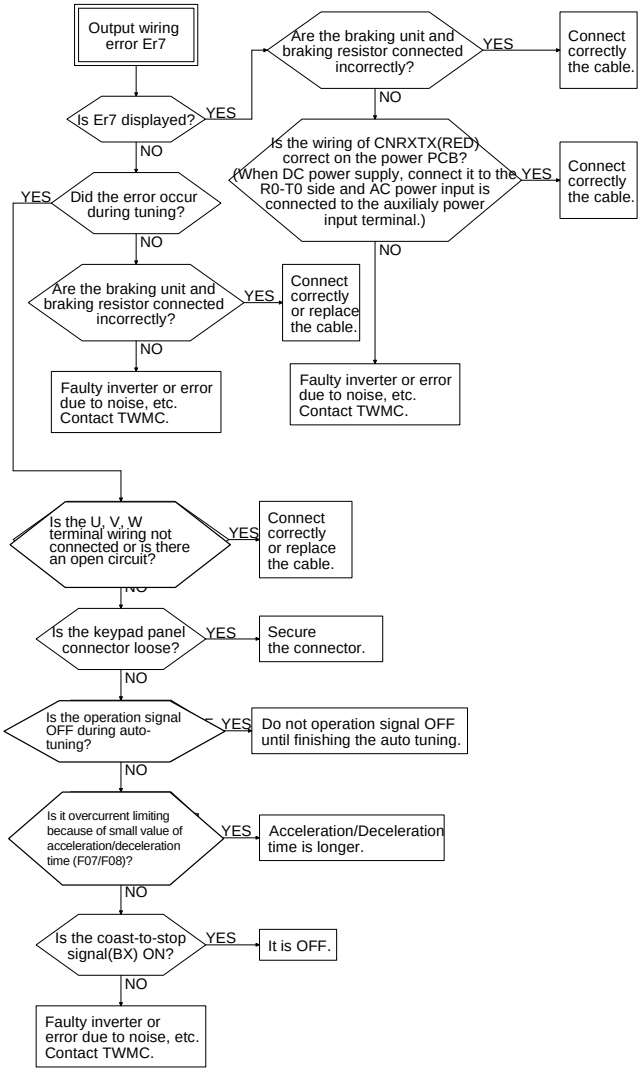

(8) Inverter unit overload and motor overload



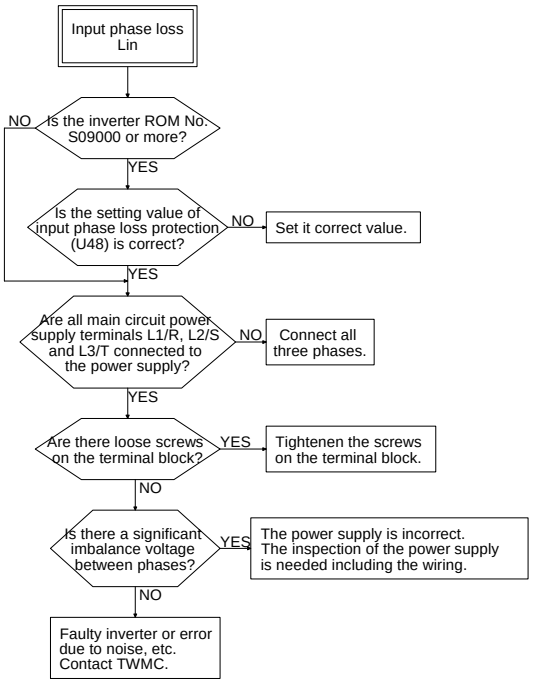
(9) Memory error Er1,
Keypad panel communication error Er2,CPU error Er3



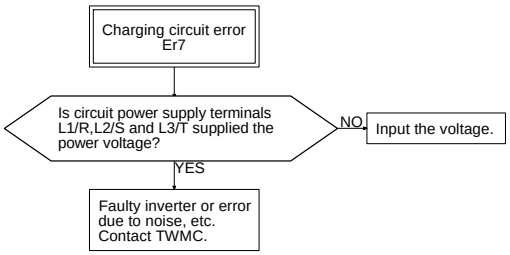

(10) Output wiring error




(11) Input phase loss

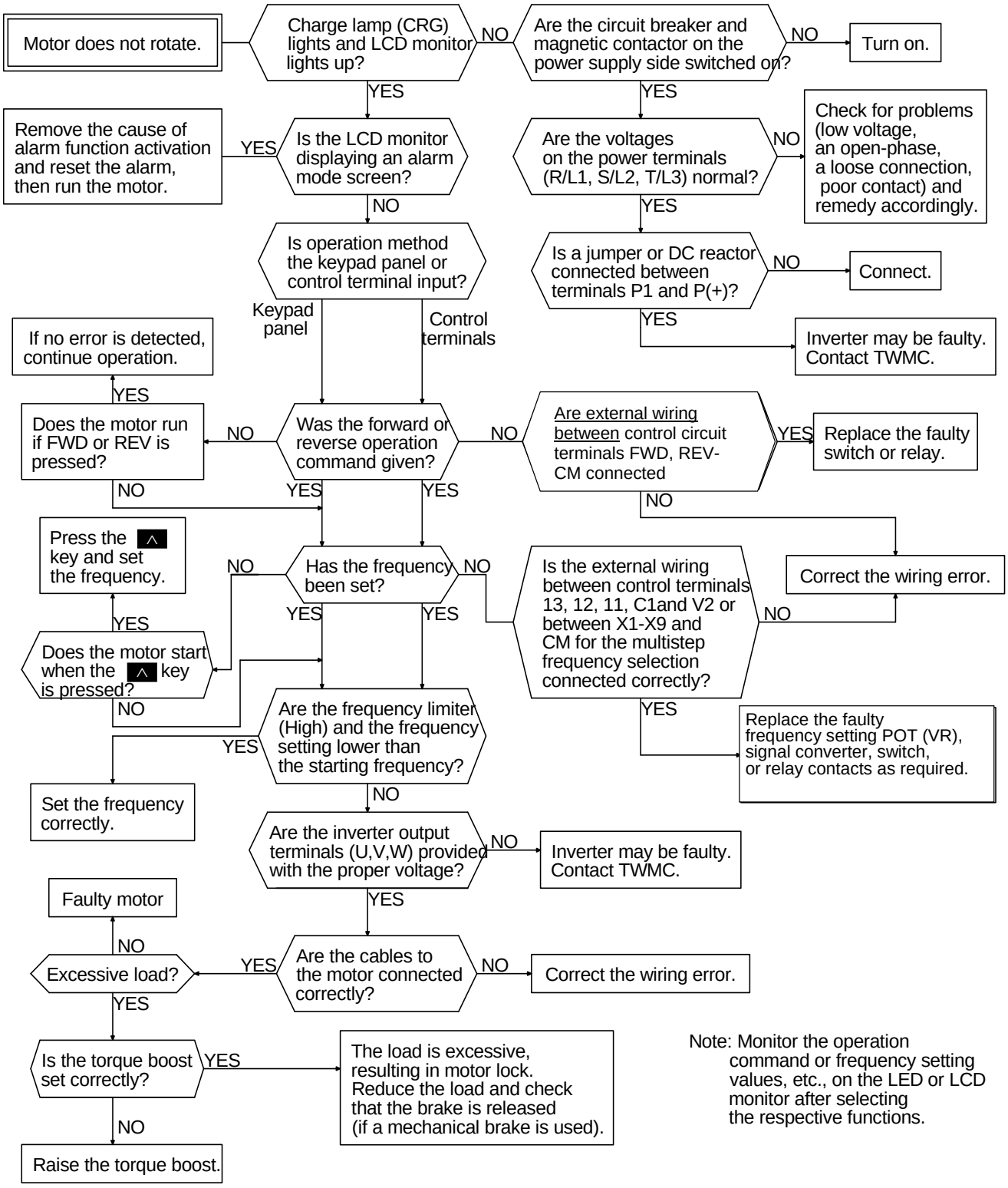



(12) Charging circuit error



**6-4 Abnormal motor rotation**

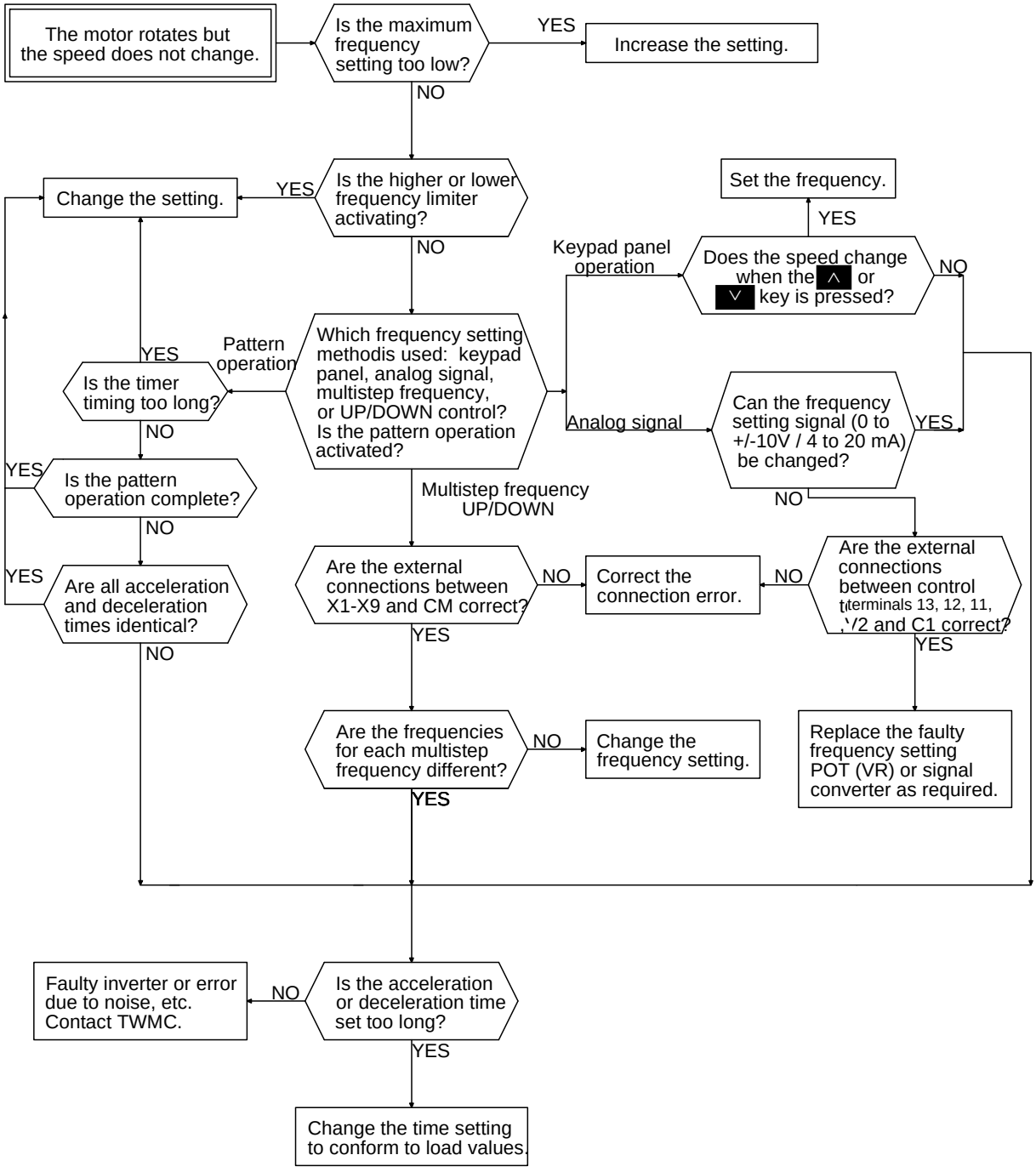
(1) If motor does not rotate




**The motor does not rotate if the following commands are issued.**

- **An operation command is issued while the coast-to-stop or DC braking command is output**
- **A reverse operation command is issued with the "H08 Rev. phase sequence lock" value set to 1.**

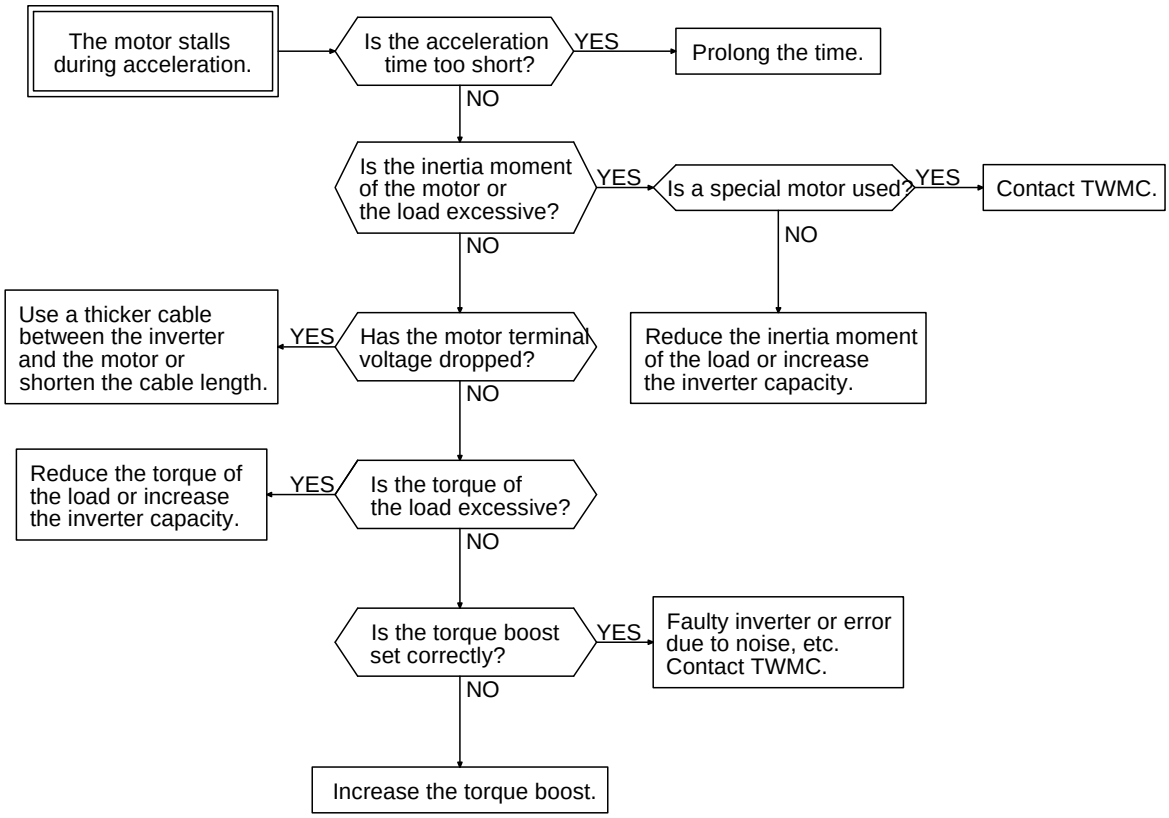
(2) If the motor rotates but the speed does not change



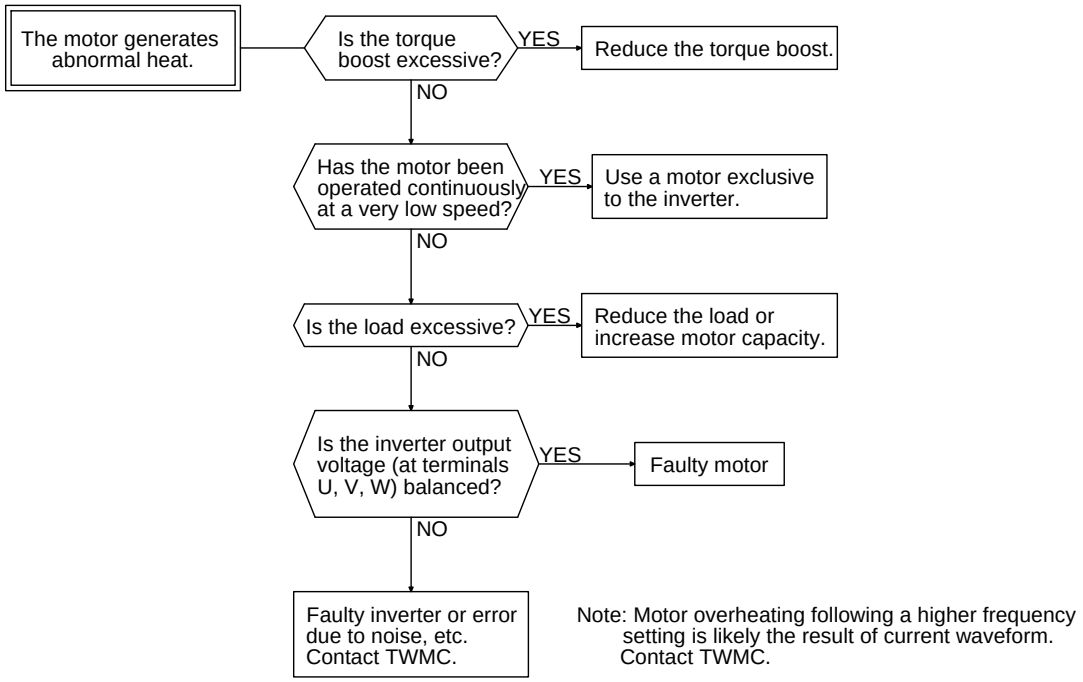

**In the following cases, changing the motor speed is also restricted:**

- **Signals are input from control terminals both 12 and C1 when "F01 Frequency command 1"and "C30 Frequency command 2" are set to 3, and there is no significant change in the added value**
- **The load is excessive, and the torque limiting and current limiting functions are activated**

(3) If the motor stalls during acceleration




(4) If the motor generates abnormal heat



## 7. Maintenance and Inspection

It is recommended that daily and periodic inspections be carried out to insure trouble-free operation and long-term reliability. The following are recommendations for conducting these inspections.

### 7-1 Daily Inspection

During operation, a visual inspection for abnormal operation can be completed externally without removing the covers.

The inspections should cover the following:

(1) The performance is as expected and is within specifications.
(2) The environment conforms to the drive specifications.
(3) The digital operator is functioning normally.
(4) There are no abnormal sounds, vibrations, or odors.
(5) There are no indications of overheating or discoloration.

### 7-2 Periodic Inspections

Periodic inspections are carried out after stopping drive operations, disconnecting the power source, and removing the protective cover(s).

| | |
|---|---|
| **DANGER** | • Because the large capacitors in the main DC circuit retain lethal voltage levels after power is disconnected and take time to discharge, wait at least five minutes after turning off the power supply for inverter rated at 30HP/CT, 40HP/VT or less, and ten minutes for inverter rated at 40HP/CT, 50HP/VT or more. (Check that the charge lamp (CRG) is off, and that the voltage is 25V DC or less between terminals P(+) and N(-). Otherwise, e**lectric shock or injury may result.**<br>• Only authorized personnel should carry out maintenance and component replacement operations. (Remove metal jewelry such as watches and rings and use insulated tools.)<br>• Never modify the inverter. Otherwise, **electric shock or injury may result.** |

**Table 7-2-1 Periodic Inspection List**

| Area to Check | | Items to Check | How to Inspect | Evaluation Criteria |
|---|---|---|---|---|
| Environment | | 1) Check the ambient temperature, humidity, Vibration and atmosphere (dust, gas, oil mist, water drops).<br>2) Is the area surrounding the equipment free of foreign objects? | 1) Conduct visual inspection and use the appropriate equipment.<br>2) Visual inspection. | 1)Results comply with specifications.<br>2) The area is clear. |
| Digital operator | | 1) Is the display hard to read?<br>2) Are the characters complete? | 1) Visual inspection.<br>2) Visual inspection. | 1) The display can be read.<br>2) Characters are complete. |
| Structure (frame & cover) | | 1) Is there abnormal sounds or vibration?<br>2) Are fasteners loose?<br>3) Is there deformation or damage?<br>4) Is there discoloration as a result of overheating?<br>5) Are there stains or accumulated dust? | 1) Visual and aural Inspection.<br>2) Tighten.<br>3) Visual inspection.<br>4) "<br>5) " | 1) No abnormalities<br>2) "<br>3) "<br>4) "<br>5) " |
| Main circuit | Common | 1) Are there loose or missing fasteners?<br>2) Is there deformation, cracks, damage, and discoloration due to overheating or deterioration in the equipment and insulation?<br>3) Are there stains and accumulated dust? | 1) Tighten.<br>2) Visual inspection.<br>3) " | 1) No abnormalities<br>2) No abnormalities *Note: Discoloration of the bus bar does*<br>3) *not indicate a problem.* |
| | Conductor and wire | 1) Is there discoloration or distortion of a conductor(s) due to overheating?<br>2) Are there cracks, crazing or discoloration of the cable sheath? | 1) Visual inspection.<br>2) " | 1) No abnormalities<br>2) " |

*Cont.*

| | | | | |
|---|---|---|---|---|
| Main circuit | Terminal block | Is there damage? | Visual inspection | No abnormalities |
| | Main DC Capacitor(s) | 1) Is there electrolyte leakage, discoloration, crazing, or swelling of the case?<br>2) Is the safety valve not protruding or are valves protruding too far?<br>3) Measure the capacitance if necessary. | 1) Visual inspection<br>2) Visual inspection<br>3) * Estimate life expectancy from maintenance information and from measurements using capacitance measuring equipment. | 1) No abnormalities<br>2) "<br>3) Capacitance $\geqq$ initial value x 0.85 |
| | Resistor | 1) Is there unusual odor or damage to the insulation by overheating?<br>2) Is there an open circuit? | 1) Visual and olfactory inspection.<br>2) Conduct a visual Inspection or use a multimeter by opening the connection on one side. | 1) No abnormalities<br>2) Less than $\pm$10% of the indicated resistance value. |
| | Transformer and reactor | Is there abnormal buzzing or an abnormal odor? | Auditory, olfactory, and visual inspection | No abnormalities |
| | Magnetic contactor and relay | 1) Is there chattering during operation?<br>2) Are the contacts pitted or burnt? | 1) Auditory inspection<br>2) Visual inspection | 1) No abnormalities<br>2) " |
| Control circuit | Control PC board and connector | 1) Are there any loose screws or connectors?<br>2) Is there an unusual odor or discoloration?<br>3) Are there cracks, damage, deformation, or rust?<br>4) Is there electrolyte leakage or damage to any of the capacitors? | 1) Tighten.<br>2) Visual and olfactory inspection<br>3) Visual inspection<br>4) * Estimate life expectancy by visual inspection and maintenance information. | 1) No abnormalities<br>2) "<br>3) "<br>4) " |
| Cooling system | Cooling fan | 1) Is there any abnormal sound or vibration?<br>2) Are any fasteners loose?<br>3) Is there discoloration due to overheating? | 1) Auditory and visual inspection.<br>2) Tighten.<br>3) Visual inspection<br>4) * Estimate life expectancy by maintenance information | 1) The fan must rotate smoothly.<br>2) No abnormalities<br>3) " |
| | Ventilation | Is there foreign matter on the heat sink or intake and exhaust ports? | Visual inspection | No abnormalities |

*Note: If equipment is stained, wipe with a clean cloth. Vacuum the dust.*

* The maintenance information is stored in the inverter digital operator and indicates the electrostatic capacitance of the main DC circuit capacitors and the life expectancy of the electrolytic capacitors on the control PC board and of the cooling fans. Use this data as the basis to estimate the life expectancy of parts.

**1) Determination of the capacitance of the main circuit capacitors.**

This inverter is equipped with a function to automatically indicate the capacitance of the capacitors in the main DC circuit when powering up the drive after disconnecting the power according to the prescribed conditions.

The initial capacitance values are set in the inverter when shipped from the factory, and the decrease ratio (%) to those values can be displayed.

Use the procedure as next described.

(a) Remove any option cards from the inverter. Also disconnect the DC bus connections to the main circuit P(+) and N(-) terminals from the braking unit or other inverters if connected. The existing power-factor correcting reactor (DC reactor) does not need to be disconnected.
A power supply connected to the auxiliary input terminals (R0, T0) that provides control power should be isolated.
(b) Disable all the digital inputs (FWD, REV, X1-X9) on the control terminals. Also disconnect RS485 serial communication if used.
Turn on the main power supply. Confirm that the cooling fan is rotating and that the inverter is not operating. (There is no problem if the "OH2 External thermal relay tripped" trip function is activated due to the digital input terminals being disabled.)
(c) Turn the main power off.
(d) Turn on the main power again after verifying that the charge lamp is completely off.
(e) Open the maintenance information on the digital operator and confirm the capacitance values of the capacitors.

**2) Life expectancy of the control PC board.**

The actual capacitance of a capacitors is not measured in this case. However, the integrated operating hours of the control power supply multiplied by the life expectancy coefficient defined by the temperature inside the inverter will be displayed. Hence, the hours displayed may not agree with the actual operating hours depending on the operational environment.

Since the integrated hours are counted by unit hours, power input for less than one hour will be disregarded.

**3) Life expectancy of cooling fan.**

The integrated operating hours of the cooling fan are displayed. Since the integrated hours are counted by unit hours, power input for less than one hour will be disregarded.

The displayed value should be considered as a rough estimate because the actual life of a cooling fan is influenced significantly by the temperature.

**Table 7-2-2 Estimate of Life Expectancy Using Maintenance Information**

| Parts | Level of Judgment |
|---|---|
| Capacitor in main DC circuit | 85% or less of the initial value |
| Electrolytic capacitor on control PC board | 61,000 hours |
| Cooling fan | 40,000 hours (5HP or less), 25,000 hours (Over 7.5HP/CT, 10HP/CT) (*1) |

*1 Estimated life expectancy of the cooling fan at inverter ambient temperature of 40°C (104°F)

## Inspection Notes and Records

| DATE | ITEM |
| --- | --- |
| | |

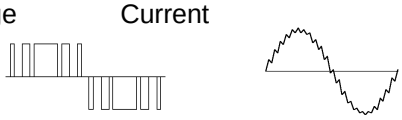
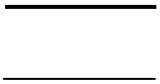
### 7-3 Main Circuit Voltage, Current, and Power Measurements.

When making main circuit voltage and current measurements, the resulting values depend on the type of meter used due to the harmonic component included in the voltage and current of the main circuit power (input) and the output (motor) side of the inverter. When measuring with a meter for commercial power frequency, use the meters shown in Table 7-3-1.

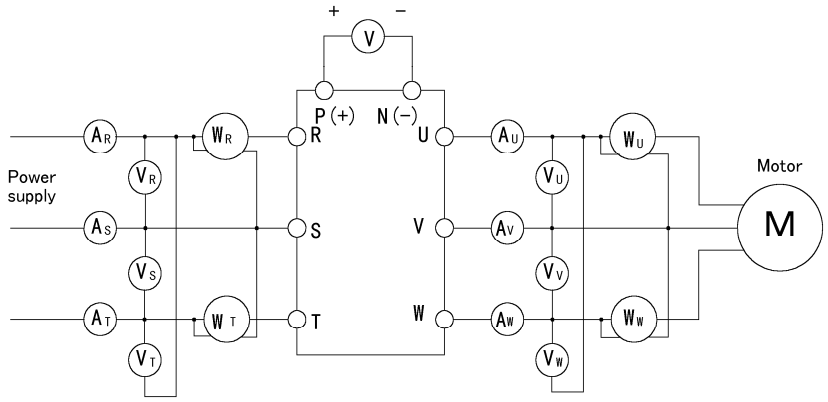
The power-factor cannot be measured directly using power-factor meters commercially available at present on the market, which measure the phase difference between voltage and current. When power-factors must be measured, measure the power, voltage, and current on both the input side and output side, then calculate the power-factor using the following formula:

$$\text{Power-factor} = \frac{\text{Power[W]}}{\sqrt{3} \times \text{Voltage[V]} \times \text{Current[A]}} \times 100[\%]$$

**Table 7-3-1 Meters Used for measuring Main Circuit Values**

| Item | Input (power supply) Side | | | Output (motor) Side | | | DC Link Circuit Voltage (P(+) - N(-)) |
|---|---|---|---|---|---|---|---|
| | Voltage / Current*  | | | Voltage / Current  | | |  |
| Meter name | Ammeter A R,S,T | Voltmeter V R,S,T | Powermeter W R,S,T | Ammeter A U,V,W | Voltmeter V U,V,W | Powermeter W U,V,W | DC voltmeter V |
| Meter type | Moving-iron type | Rectifier or moving-iron type | Digital power meter | Moving-iron type | Rectifier type | Digital power meter | Moving-coil type |
| Symbol |  |  | |  |  | |  |

*Note: When measuring the output voltage using a rectifier type meter, an error may occur. Use a digital AC power meter to ensure accuracy.*




**Meter Placement Diagram**

**7- 4 Insulation Test**

It is not necessary to do an insulation test on the inverter as this was completed at the factory. If an insulation test with a megger test must be completed, then proceed as described below as an incorrect testing method may result in product damage.
If a dielectric strength test must be completed, the specifications for the test must be followed as Improper testing may result in damage to the inverter. Please contact your local distributor or nearest TWMC sales office for further guidance.

**(1) Megger test for the main power circuit.**

a - Use a 500V DC type megger and isolate the main power before commencing measurement.
b - If the test voltage is connected to the control circuit, remove all connection cables to the control circuit.
c - Connect the main circuit terminals together using common cables as shown in Fig. 7-4-1.
d - Perform the megger test only between the common cables connected to the main circuit and the ground (terminal ⏚ G).
e - A megger indicating a reading of 5MΩ or more is normal. (This is the value measured with only the inverter connected.)

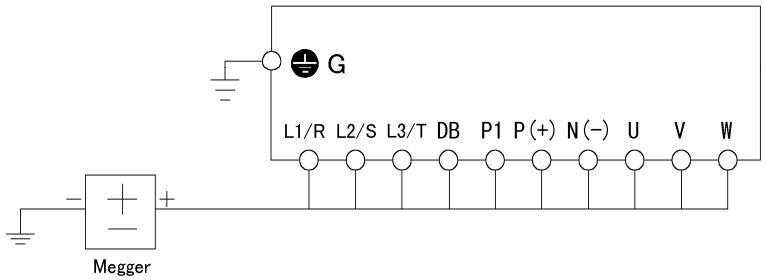



**Fig. 7-4-1 Main Circuit Insulation Test**

**(2) Insulation test in the control circuit.**

A megger test and a dielectric strength test must not be performed on the control circuit or damage will result. To test the control circuit, use a high resistance range multimeter and proceed as follows.
a - Remove all external cables from the control circuit terminals.
b - Conduct a continuity test between the isolated control circuit grounds. A result of 1MΩ or more is normal.

**(3) Exterior main circuit and sequence control circuit.**

Remove all cables from inverter terminals to ensure the test voltage is not applied to the inverter.

**7-5 Parts Replacement**

The life expectancy of a part depends on the type of part, the environment, and usage conditions. Parts should be replaced as shown in Table 7-5-1 Parts Replacement.

**Table 7-5-1 Parts Replacement**

| Part Name | Standard Period for Replacement | Comments |
|---|---|---|
| Cooling fan | 3 years | Exchange for a new part. |
| Smoothing capacitor | 5 years | Exchange for a new part (determine after checking). |
| Electrolytic capacitor on the PC board | 7 years | Exchange for a new PC board (determine after checking). |
| Fuse | 10 years | Exchange for a new part. |
| Other parts | — | Determine after checking. |

### 7-6 Inquiries About Damaged Products

If there is damage, a fault in the product, or questions concerning the product, contact your local distributor or nearest TWMC sales office with the following information:

a - Inverter type (Model No.)
b - Serial No. (equipment serial number)
c - Purchase date
d - Problem details (e.g., damaged part, extent of damage, questions, status of fault)

### 7-7 Warranty

All Low Voltage Motor Control Products, such as Solid State Starters and Inverters, ("products") sold by TECO-Westinghouse Motors Company ("TWMC"), are warranted to be free from defects in material and workmanship for a period of 36` months from the date of shipment. A warranty of 36 months from the date of manufacture is applicable when a TWMC Low Voltage Motor Control Product and a TWMC Inverter Duty motor (per NEMA MG1-31.4.2.2) are purchased together.

This warranty is conditioned upon the installation, operation, and maintenance of the products in accordance with TWMC's recommendations or standard industry practice, and that the products have at all times been operated or used under the normal operating conditions for which they were designed. This warranty will not be applicable to products that have been altered without prior written permission from TWMC.

TWMC shall, at its sole option and expense, repair or replace, F.O.B. warehouse or TWMC designated service center, any such products, which are defective within the warranty period. In the event of warranty claims, TWMC must be notified promptly following any product failure. The product shall be sent to a TWMC authorized service center for diagnosis of the cause of failure. TWMC will not be responsible for any repair that has been performed without prior written permission from TWMC.

The repair or replacement of defective material and workmanship shall constitute complete fulfillment of TWMC's warranty liability, whether the warranty claims are based on contract, tort (including negligence and strict liability), or otherwise. **THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL WARRANTIES ARISING FROM COURSE OF DEALING AND USAGE OF TRADE. UNDER NO CIRCUMSTANCES, SHALL TWMC BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING FREIGHT.**

**Warranty Return Procedure**

The Product must be returned prepaid to TECO-Westinghouse Motor Company factory. A completed Return Material Authorization (RMA) form with an assigned RMA number must be included in the shipment. Contact the nearest TECO-Westinghouse location or Factory directly for RMA forms.

*NOTES*

# 8. Specifications

## 8-1 Standard Specifications

### EQ5 CT (Constant Torque) – 230V Series

| Type | | NEMA 1 | | | | | | | | | | | | | OPEN CHASSIS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applied Motor Nominal (HP) | | 0.25 | 0.5 | 1 | 2 | 3 | 5 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 30 | 40 | 50 | 60 | 75 | 100 | 125 |
| | Model **EQ5-2XXX-XX** | 0P2 -N1 | 0P5 -N1 | 001 -N1 | 002 -N1 | 003 -N1 | 005 -N1 | 007 -N1 | 010 -N1 | 015 -N1 | 020 -N1 | 025 -N1 | 030 -N1 | 032 -N1 | 040 -C | 050 -C | 060 -C | 075 -C | 100 -C | 125 -C | 150 -C |
| | Rated output capacity [kVA] (*1) | 0.6 | 1.2 | 2.0 | 3.2 | 4.4 | 6.8 | 6.8 | 10 | 13 | 18 | 24 | 29 | 35 | 35 | 46 | 58 | 72 | 86 | 113 | 138 |
| | Rated output current [A] (*2) | 1.5 | 3.0 | 5.0 | 8.0 | 11 | 17 | 17 | 25 | 33 | 46 | 59 | 74 | 87 | 87 | 115 | 145 | 180 | 215 | 283 | 346 |
| | Overload capability | 150% of rated output current for 1 min.<br>200% of rated output current for 0.5 s | | | | | | | | | | | | | 150% of rated output current for 1 min.<br>180% of rated output current for 0.5 s | | | | | | |
| | Starting torque | 200% or more (under torque vector control) | | | | | | | | | | | | | 180% or more (under torque vector control) | | | | | | |
| Output ratings | Rated output voltage [V] (*3) | 3-phase, 200V/50Hz, 200V,220V,230V/60Hz | | | | | | | | | | | | | | | | | | | |
| | Rated output frequency [Hz] | 50,60Hz | | | | | | | | | | | | | | | | | | | |
| Input ratings | Phases, voltage, frequency | 3-phase, 200 to 230V, 50/60Hz | | | | | | | | | | | | | 3-phase, 200 to 220V, 220 to 230V/50Hz<br>3-phase, 200 to 230V/60Hz | | | | | | |
| | Voltage/frequency variations | Voltage: +10% to -15% (Imbalance rate between phases: 2% or less (*5) , Frequency: +5% to -5% | | | | | | | | | | | | | | | | | | | |
| | Momentary voltage dip capability (*6) | Operation will continue with 165V or more. If voltage drops below 165V, operation will continue for up to 15 ms.<br>If "Continuous operation" is selected, the output frequency will be lowered to withstand the load until normal voltage is resumed. | | | | | | | | | | | | | | | | | | | |
| | Required power supply capacity [kVA] (*7) | 0.4 | 0.7 | 1.3 | 2.2 | 3.1 | 5 | 5 | 7.2 | 9.7 | 15 | 20 | 24 | 29 | 29 | 38 | 47 | 56 | 69 | 93 | 111 |

### EQ5 VT (Variable Torque) – 230V Series

| Type | | NEMA 1 | | | | | | | | | | | | | OPEN CHASSIS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applied Motor Nominal (HP) | | 0.25 | 0.5 | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 |
| | Model **EQ5-2XXX-XX** | 0P2 -N1 | 0P5 -N1 | 001 -N1 | 002 -N1 | 003 -N1 | 005 -N1 | 007 -N1 | 010 -N1 | 015 -N1 | 020 -N1 | 025 -N1 | 030 -N1 | 032 -N1 | 040 -C | 050 -C | 060 -C | 075 -C | 100 -C | 125 -C | 150 -C |
| | Rated output capacity [kVA] (*1) | 0.6 | 1.2 | 2.0 | 3.2 | 4.4 | 6.8 | 8.8 | 12 | 17 | 22 | 27 | 31 | 35 | 46 | 58 | 72 | 86 | 113 | 138 | 165 |
| | Rated output current [A] (*2) | 1.5 | 3.0 | 5.0 | 8.0 | 11 | 17 | 22 | 29 | 42 | 55 | 68 | 80 | 87 | 115 | 145 | 180 | 215 | 283 | 346 | 415 |
| | Overload capability | 110% of rated output current for 1 min. | | | | | | | | | | | | | | | | | | | |
| | Starting torque | 50% or more | | | | | | | | | | | | | | | | | | | |
| Output ratings | Rated output voltage [V] (*3) | 3-phase, 200V/50Hz, 200V,220V,230V/60Hz | | | | | | | | | | | | | | | | | | | |
| | Rated output frequency [Hz] | 50,60Hz | | | | | | | | | | | | | | | | | | | |
| Input ratings | Phases, voltage, frequency | 3-phase, 200 to 230V, 50/60Hz | | | | | | | | | | | | | 3-phase, 200 to 220V, 220 to 230V/50Hz<br>3-phase, 200 to 230V/60Hz | | | | | | |
| | Voltage/frequency variations | Voltage: +10% to -15% (Imbalance rate between phases: 2% or less (*5) , Frequency: +5% to -5% | | | | | | | | | | | | | | | | | | | |
| | Momentary voltage dip capability (*6) | Operation will continue with 165V or more. If voltage drops below 165V, operation will continue for up to 15 ms.<br>If "Continuous operation" is selected, the output frequency will be lowered to withstand the load until normal voltage is resumed. | | | | | | | | | | | | | | | | | | | |
| | Required power supply capacity [kVA] (*7) | 0.4 | 0.7 | 1.3 | 2.2 | 3.1 | 5 | 7.2 | 9.7 | 15 | 20 | 24 | 29 | 29 | 38 | 47 | 56 | 69 | 93 | 111 | 139 |

*See notes 1 - 7 on the next pages.

## EQ5 CT (Constant Torque) – 460V Series

| Type | | Nema 1 | | | | | | | | | | | | Open Chassis | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applied Motor Nominal (HP) | | 0.5 | 1 | 2 | 3 | 5 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 350 | 400 | 450 | 500 | 600 |
| | Type **EQ5-4XXX-XX** | 0P5 -N1 | 001- -N1 | 002- -N1 | 003 -N1 | 005 -N1 | 005 -N1 | 010 -N1 | 015 -N1 | 020 -N1 | 025 -N1 | 030 -N1 | 032 -N1 | 040 -C | 050 -C | 060 -C | 075 -C | 100 -C | 125 -C | 150 -C | 200 -C | 250 -C | 300 -C | 350 -C | 400 -C | 450 -C | 500 -C | 600 -C | 700 -C | 800 -C |
| | Rated capacity [kVA] (*1) | 1.2 | 2.0 | 2.9 | 4.4 | 7.2 | 7.2 | 10 | 14 | 19 | 24 | 31 | 36 | 36 | 48 | 60 | 73 | 89 | 120 | 140 | 167 | 202 | 242 | 300 | 331 | 331 | 414 | 466 | 518 | 590 |
| | Rated output current [A] (*2) | 1.5 | 2.5 | 3.7 | 5.5 | 9 | 9 | 13 | 18 | 24 | 30 | 39 | 45 | 45 | 60 | 75 | 91 | 112 | 150 | 176 | 210 | 253 | 304 | 377 | 415 | 415 | 520 | 585 | 650 | 740 |
| | Overload capability | 150% of rated output current for 1 min.<br>200% of rated output current for 0.5 s | | | | | | | | | | | | 150% of rated output current for 1 min.<br>180% of rated output current for 0.5 s | | | | | | | | | | | | | | | | |
| | Starting torque | 200% or more (under torque vector control) | | | | | | | | | | | | 180% or more (under torque vector control) | | | | | | | | | | | | | | | | |
| Output ratings | Rated output Voltage [V] (*3) | 3-phase, 380V, 400V, 415V(440V)/50Hz, 380V, 400V, 440V, 460V/60Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Rated output frequency [Hz] | 50,60Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input ratings | Phases, voltage, frequency | 3-phase,380 to 480V,50/60Hz | | | | | | | | | | | | 3-phase, 380 to 440V/50Hz (*5)<br>3-phase, 380 to 480V/60Hz | | | | | | | | | | | | | | | | |
| | Voltage/frequency variations | Voltage: +10% to -15% (Imbalance rate between phases: 2% or less (*5) , Frequency: +5% to -5% | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Momentary voltage dip capability (*6) | Operation will continue with 310V or more. If voltage drops below 310V, operation will continue for up to 15 ms.<br>If "Continuous operation" is selected, the output frequency will be lowered to withstand the load until normal voltage is resumed. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Required power supply capacity [kVA] (*7) | 0.7 | 1.2 | 2.2 | 3.1 | 5.0 | 5.0 | 7.2 | 9.7 | 15 | 20 | 24 | 29 | 29 | 38 | 47 | 57 | 70 | 93 | 111 | 136 | 161 | 196 | 244 | 267 | 267 | 341 | 383 | 433 | 488 |

## EQ5 VT (Variable Torque) – 460V Series

| Type | | Nema 1 | | | | | | | | | | | | Open Chassis | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applied Motor Nominal (HP) | | 0.5 | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 | 700 | 800 |
| | Type **EQ5-4XXX-XX** | 0P5 -N1 | 001- -N1 | 002- -N1 | 003 -N1 | 005 -N1 | 005 -N1 | 010 -N1 | 015 -N1 | 020 -N1 | 025 -N1 | 030 -N1 | 032 -N1 | 040 -C | 050 -C | 060 -C | 075 -C | 100 -C | 125 -C | 150 -C | 200 -C | 250 -C | 300 -C | 350 -C | 400 -C | 450 -C | 500 -C | 600 -C | 700 -C | 800 -C |
| | Rated capacity [kVA] (*1) | 1.2 | 2.0 | 2.9 | 4.4 | 7.2 | 10 | 13 | 18 | 24 | 29 | 35 | 36 | 48 | 60 | 73 | 89 | 120 | 140 | 167 | 202 | 242 | 300 | 331 | 386 | 414 | 518 | 590 | 669 | 765 |
| | Rated output current [A] (*2) | 1.5 | 2.5 | 3.7 | 5.5 | 9 | 12.5 | 16.5 | 23 | 30 | 37 | 44 | 45 | 60 | 75 | 91 | 112 | 150 | 176 | 210 | 253 | 304 | 377 | 415 | 485 | 520 | 650 | 740 | 840 | 960 |
| | Overload capability | 110% of rated output current for 1 min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Starting torque | 50% or more | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Output ratings | Rated output voltage [V] (*3) | 3-phase, 380V, 400V, 415V(440V)/50Hz, 380V, 400V, 440V, 460V/60Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Rated output frequency [Hz] | 50,60Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input ratings | Phases, voltage, frequency | 3-phase,380 to 480V,50/60Hz | | | | | | | | | | | | 3-phase, 380 to 440V/50Hz (*4)<br>3-phase, 380 to 480V/60Hz | | | | | | | | | | | | | | | | |
| | Voltage/frequency variations | Voltage: +10% to -15% (Imbalance rate between phases: 2% or less (*5) , Frequency: +5% to -5% | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Momentary voltage dip capability (*6) | Operation will continue with 310V or more. If voltage drops below 310V, operation will continue for up to 15 ms.<br>If "Continuous operation" is selected, the output frequency will be lowered to withstand the load until normal voltage is resumed. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Required power Supply capacity [kVA] (*7) | 0.7 | 1.2 | 2.2 | 3.1 | 5.0 | 7.2 | 9.7 | 15 | 20 | 24 | 29 | 29 | 38 | 47 | 57 | 70 | 93 | 111 | 136 | 161 | 196 | 244 | 267 | 341 | 383 | 433 | 488 | 549 | 610 |

(*1) Indicated capacities are at the rated output voltage 230V for the 230V series and 460V for the 460V series. The rated capacity will be lowered if the supply voltage is lower.
(*2) In the case of a low impedance load, such as a high-frequency motor, the current may drop below the rated value.
(*3) The output voltage cannot exceed the input supply voltage.

*Cont.*

(*4) The taps within the inverter must be changed for an input power supply rated at 380 to 398V/50 Hz or 380 to 430V/60 Hz.

(*5) If the imbalance between phases exceeds 2%, use a power-factor correcting DC reactor (DCR).

$$\text{Imbalance rate between phases [\%]} = \frac{(\text{Max. Voltage [V]} - \text{Min. Voltage [V]})}{\text{3-phase average voltage [V]}} \times 67[\%]$$

(*6) The test was conducted under the standard load conditions stipulated by the JEMA committee (at the load equivalent to 85% of the nominal applied motor HP).

(*7) Indicates the values required when using a power-factor correcting DC reactor (DCR) with a loaded nominal applied motor. (optional for inverters of 75HP/CT, 100HP/VT or less)

## *NOTES*

## 8-2 Common Specifications

| Item | | | Explanation |
|---|---|---|---|
| Control | Control method | | Sinusoidal wave PWM control (with V/F control, torque vector control, PG feedback vector control (option)) |
| | Output frequency | Maximum frequency | 50-120Hz variable setting |
| | | Base frequency | 25-120Hz variable setting |
| | | Starting frequency | 0.1 to 60Hz variable setting Holding time: 0.0 to 10.0 s |
| | | Carrier frequency | 0.75 to 15kHz (30HP/CT, 40HP/VT or less) 0.75 to 10kHz (40 to 100HP/CT, 50 to 125HP/VT) 0.75 to 6kHz (125HP/CT, 150HP/VT or more) |
| | | Accuracy (stability) | Analog setting: +/- 0.2% or less of the max. frequency @ (25℃ (77°F) +/- 10℃ (50°F))<br>Digital setting: +/- 0.01% or less of the max. frequency @ (-10℃ (14°F) to +5℃ (122°F)) |
| | | Setting resolution | Analog setting: 1/1000 of max. frequency (30HP/CT, 40HP/VT or less) 1/3000 of max. frequency (40HP/CT, 50HP/VT or more)<br>Digital setting: 0.01Hz (99.99Hz or less), 0.1Hz (100.0Hz or more) |
| | Voltage/frequency characteristics | | Output voltage at base frequency can be adjusted separately, such as 80 to 240V (230V series) or 320 to 480V (460V series).<br>Output voltage at max. frequency can be adjusted separately, such as 80 to 240V (230V series) or 320 to 480V (460V series). |
| | Torque boost | | Auto: Optimum control corresponding to the load torque.<br>Manual: 0.1 to 20.0 code setting (energy saving reduced torque, constant torque, high starting torque, etc.) |
| | Accelerating/decelerating time | | 0.01 to 3600s<br>Four accelerating and decelerating time settings are available independent of each other by selecting a combination of digital input signals. In addition to linear acceleration and deceleration, either S-shaped acceleration/deceleration (weak/strong) or curve-linear acceleration/deceleration can be selected. |
| | DC injection braking | | Starting frequency: 0.0 to 60.0Hz, braking time: 0.0 to 30.0s,<br>Braking level: 0-80% |
| | Function equipped | | Frequency upper and lower limiter, bias frequency, frequency gain, jump frequency, pick-up operation, restart after momentary power failure, switching operation from line to inverter, slip compensation control, automatic energy saving operation, regeneration avoiding control, torque limiting (2-step), PID control, second motor switching, cooling fan ON/OFF control. |
| Operation | Operation method | | Keypad panel: Run by FWD REV keys, stop by STOP key.<br>Terminal input: Forward/stop command, reverse/stop command, coast-to-stop command, alarm reset, acceleration/deceleration selection, multistep frequency selection, etc. |
| | Frequency setting | | Keypad panel: Setting by ^ v keys.<br><br>External potentiometer: POT (VR) (1 to 5kΩ)<br>Analog input: 0 to +10V (0 to +5V), 4 to 20mA, 0 to +/- 10V (FWD/REV operation)<br>+10 V to 0 (reverse operation), 20 to 4mA (reverse operation)<br>Up/Down control: Frequency increases or decreases as long as the digital input signal is turned on.<br>Multistep frequency selection: Up to 16 steps are selectable by a combination of digital input signals.<br>Serial Communication operation: Operation by RS485 ModBus RTU.<br>Program operation: Pattern operation by programming.<br>Jogging operation: Jogging operation by FWD, REV key or digital input signals. |
| | Operation status output signals | | (4)Transistor outputs: Running, frequency arrival, frequency detection, overload early warning, etc.<br>(2) Relay outputs: Alarm output (for any fault), multi-purpose relay output signals, etc.<br>(1) Analog: Output frequency, output current, output voltage, output torque, power consumption, etc.<br>(1) Pulse output : Output frequency, output current, output power, output torque, power consumption, etc. |
| Indication | Digital display (LED) | | Output frequency, setting frequency, output current, output voltage, motor synchronous speed, line speed, load rotation speed, calculated torque value, power consumption, calculated PID value, PID command value, PID feedback value, and alarm code. |
| | Liquid crystal display (LCD) | | Operation information, operational guide, functional code/name/setting data, alarm information, tester function, motor load rate measuring function (Maximum/average current (rms) during measuring period, maintenance information (Integrated operation hours, capacitance measurement for main circuit capacitors, heat sink temperature, etc.)) |
| | Language | | Six languages (Japanese, English, German, French, Spanish, and Italian) |
| | Lamp display | | Charge indication (voltage residual). |
| Protective functions | | | Overcurrent, short-circuit, ground fault, overvoltage, undervoltage, overload, overheating, blown fuse, motor overload, external alarm, input open-phase, output open-phase (when tuning), braking resistor protection, CPU and memory error, keypad panel communication error, PTC thermistor protection, surge protection, stall prevention, etc. |
| Environment | Installation location | | Indoor, altitude less than 3300ft (1000m), free from corrosive gas, dust, and direct sunlight (Pollution degree 2) |
| | Ambient temperature | | -10℃ (14°F) to +50℃ (122°F) (ventilating cover must be removed under conditions exceeding +40℃ (104°F) for models at 30HP/CT, 40HP/VT or less) |
| | Humidity | | 5 to 95%RH (non-condenslng) |
| | Air pressure | | Operation/storage : 86 to 106 kPa<br>Transport : 70 to 106 kPa |
| | Vibration | | 0.12inch(3mm) from 2 to less than 9Hz, 9.8m/s$^2$ t from 9 to less than 20Hz,<br>2m/s$^2$ from 20 to less than 55Hz, 1m/s$^2$ from 55 to less than 200Hz, |
| | Storage | Ambient temperature | -25℃ (-13°F) to +65℃ (149°F) |
| | | Humidity | 5 to 95%RH (non-condensing) |

## 8-3 Dimensions and Weights

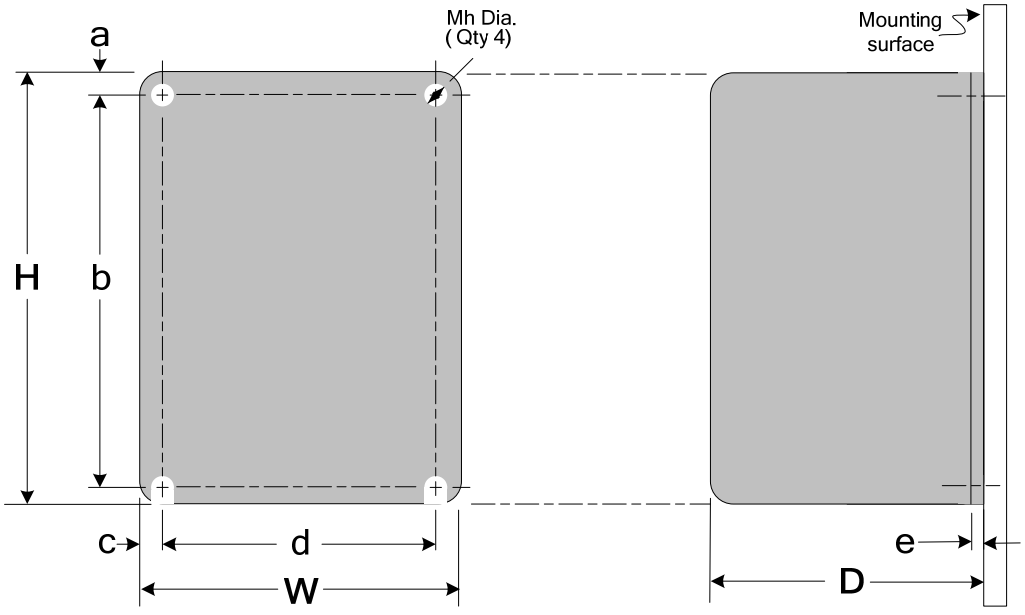
### 8-3-1 230V and 460V Series NEMA 1 (up to 30HP/CT, 40HP/VT )

**230 V Series NEMA 1**

| Model EQ5- 2XXX-N1 | Dimensions Inches / mm | | | | | | | | | Wt. Lbs. / kg |
|---|---|---|---|---|---|---|---|---|---|---|
| | H | W | D | a | b | c | d | e | Mh | |
| 0P2 & 0P5 | 10.2/260 | 4.33/110 | 5.12/130 | 0.28/7 | 9.69/246 | 0.28/7 | 3.78/96 | 0.24/6 | 0.24/6 | 4.9/2.2 |
| 001 | 10.2/260 | 4.33/110 | 5.71/145 | 0.28/7 | 9.69/246 | 0.28/7 | 3.78/96 | 0.24/6 | 0.24/6 | 5.5/2.5 |
| 002,003 & 005 | 10.2/260 | 5.90/150 | 5.71/145 | 0.28/7 | 9.69/246 | 0.28/7 | 5.35/136 | 0.24/6 | 0.24/6 | 8.4/3.8 |
| 007, 010 & 015 | 10.2/260 | 8.66/220 | 7.68/195 | 0.43/11 | 9.37/238 | 0.47/12 | 7.72/195 | 0.39/10 | 0.39/10 | 13/6.1 |
| 020, 025, &030 | 15.7/400 | 9.84/250 | 7.68/195 | 0.43/11 | 14.88/378 | 0.47/12 | 7.72/195 | 0.39/10 | 0.39/10 | 23/10.5 |

**460 V Series NEMA 1**

| Model EQ5- 4XXX-N1 | Dimensions Inches / mm | | | | | | | | | Wt. Lbs. / kg |
|---|---|---|---|---|---|---|---|---|---|---|
| | H | W | D | a | b | c | d | e | Mh | |
| 0P5 | 10.2/260 | 4.33/110 | 5.12/130 | 0.28/7 | 9.69/246 | 0.28/7 | 3.78/96 | 0.24/6 | 0.24/6 | 4.9/2.2 |
| 001 | 10.2/260 | 4.33/110 | 5.71/145 | 0.28/7 | 9.69/246 | 0.28/7 | 3.78/96 | 0.24/6 | 0.24/6 | 5.5/2.5 |
| 002,003 & 005 | 10.2/260 | 5.90/150 | 5.71/145 | 0.28/7 | 9.69/246 | 0.28/7 | 5.35/136 | 0.24/6 | 0.24/6 | 8.4/3.8 |
| 007, 010 & 015 | 10.2/260 | 8.66/220 | 7.68/195 | 0.43/11 | 9.37/238 | 0.47/12 | 7.72/195 | 0.39/10 | 0.39/10 | 13/6.1 |
| 020, 025, &030 | 15.7/400 | 9.84/250 | 7.68/195 | 0.43/11 | 14.88/378 | 0.47/12 | 7.72/195 | 0.39/10 | 0.39/10 | 23/10.5 |



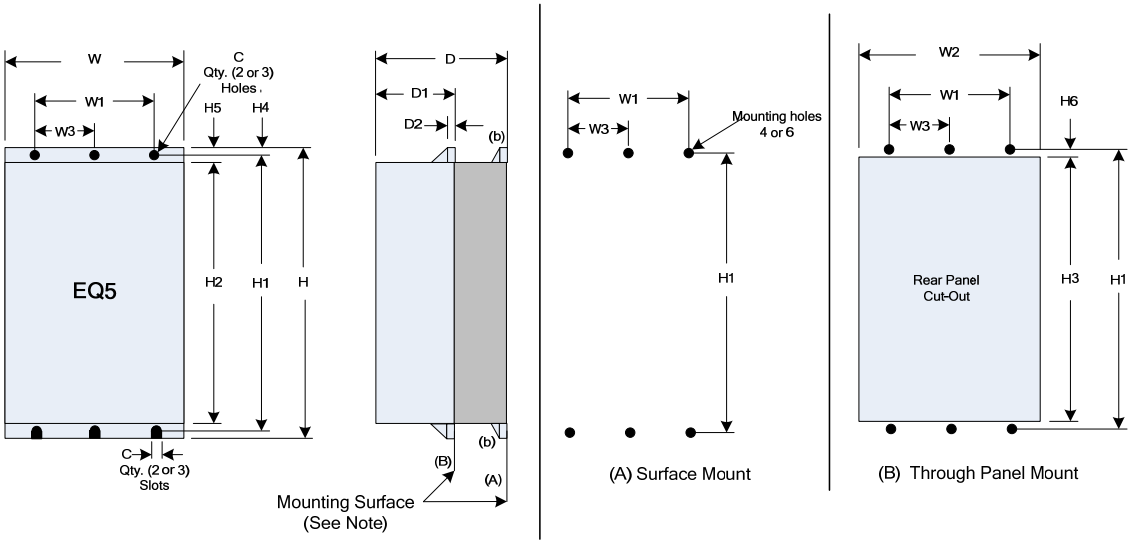
## 8-3-2 230V and 460V Series Open Chassis (30 – 350HP CT and 40 – 450HP VT)

**230 V Series Open Chassis**

| Model EQ5- 2XXX-C | Dimensions Inches (mm) | | | | | | | | | | | | | | | | Wt. Lb (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W | W1 | W2 | W3 | H | H1 | H2 | H3 | H4 | H5 | H6 | D | D1 | D2 | C | Bolt Size | |
| 40 & 50 | 13.4 (340) | 9.45 (240) | 12.8 (326) | N/A | 21.7 (550) | 20.9 (530) | 19.7 (500) | 20.2 (512) | 0.47 (12) | 0.98 (25) | 0.35 (9) | 10.0 (255) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 64 (29) |
| 60 | 14.8 (375) | 10.8 (275) | 14.2 (361) | | 24.2 (615) | 23.4 (595) | 22.2 (565) | 22.7 (577) | 0.47 (12) | 0.98 (25 | 0.35 (9) | 10.6 (270) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 79 (36) |
| 75 & 100 | 14.8 (375) | 10.8 (275) | 14.2 (361) | | 29.1 (740) | 28.3 (720) | 27.2 (690) | 27.6 (702) | 0.47 (12) | 0.98 (25 | 0.35 (9) | 10.6 (270) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 97 (44) |
| 125 | 20.9 (530) | 16.9 (430) | 20.1 (510) | | 29.5 (750) | 28.3 (720) | 27.0 (685) | 27.4 (695) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 11.2 (285) | 5.71 (145) | 0.16 (4) | 0.59 (15) | M12 | 154 (70) |
| 150 | 26.8 (680) | 22.8 (580) | 26.0 (660) | 11.4 (290) | 34.6 (880) | 33.5 (850) | 32.1 (815) | 32.5 (825) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 14.2 (360) | 8.66 (220) | 0.16 (4) | 0.59 (15) | M12 | 254 (115) |

**460 V Series Open Chassis**

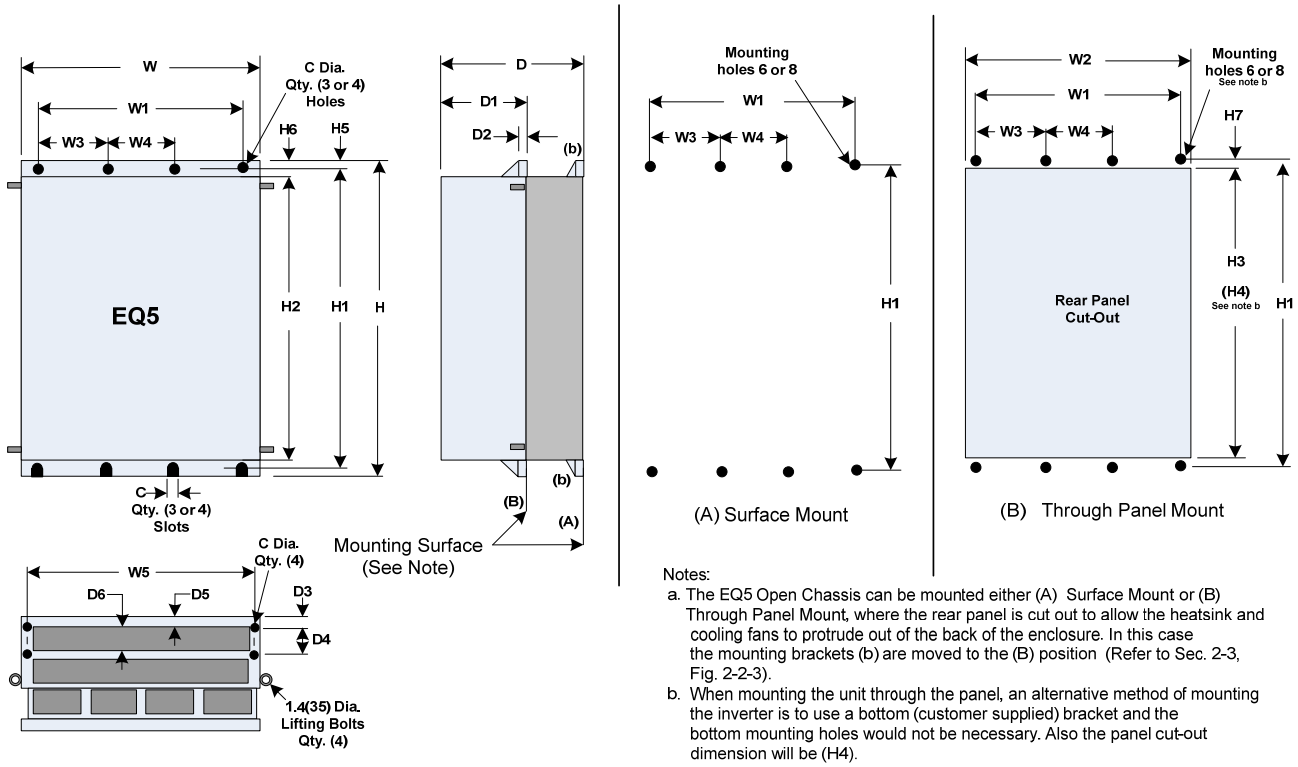
| Model EQ5- 4XXX-C | Dimensions Inches (mm) | | | | | | | | | | | | | | | | Wt. Lb (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W | W1 | W2 | W3 | H | H1 | H2 | H3 | H4 | H5 | H6 | D | D1 | D2 | C | Bolt Size | |
| 40 & 50 | 13.4 (340) | 9.45 (240) | 12.8 (326) | N/A | 21.7 (550) | 20.9 (530) | 19.7 (500) | 20.2 (512) | 0.47 (12) | 0.98 (25) | 0.35 (9) | 10.0 (255) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 64 (29) |
| 60 | 14.8 (375) | 10.8 (275) | 14.2 (361) | | 21.7 (550) | 23.4 (595) | 22.2 (565) | 22.7 (577) | 0.47 (12) | 0.98 (25 | 0.35 (9) | 10.6 (270) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 75 (34) |
| 75 & 100 | 14.8 (375) | 10.8 (275) | 14.2 (361) | | 26.6 (675) | 25.8 (655) | 24.6 (625) | 25.1 (637) | 0.47 (12) | 0.98 (25 | 0.35 (9) | 10.6 (270) | 5.71 (145) | 0.16 (4) | 0.39 (10) | M8 | 88 (39) |
| 125 | 14.8 (375) | 10.8 (275) | 14.2 (361) | | 29.1 (740) | 28.3 (720) | 27.2 (690) | 27.6 (702) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 12.4 (315) | 6.89 (175) | 0.16 (4) | 0.59 (15) | M12 | 106 (48) |
| 150 & 200 | 20.9 (530) | 16.9 (430) | 20.1 (510) | | 29.1 (740) | 28.0 (710) | 26.6 (675) | 27.0 (685) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 12.4 (315) | 6.89 (175) | 0.16 (4) | 0.59 (15) | M12 | 154 (70) |
| 250 & 300 | 20.9 (530) | 16.9 (430) | 20.1 (510) | | 39.4 (1000) | 38.2 (970) | 36.8 (935) | 37.2 (945) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 14.2 (360) | 8.66 (220) | 0.16 (4) | 0.59 (15) | M12 | 220 (100) |
| 350, 400 & 450 | 26.8 (680) | 22.8 (580) | 26.0 (660) | 11.4 (290) | 39.4 (1000) | 38.2 (970) | 36.8 (935) | 37.2 (945) | 0.61 (15.5) | 1.28 (32.5) | 0.49 (12.5) | 14.2 (360) | 8.66 (220) | 0.16 (4) | 0.59 (15) | M12 | 309 (140) |




Note: The EQ5 Open Chassis can be mounted either (A)Surface Mount or (B)Through Panel Mount, where the rear panel is cut out to allow the heatsink and cooling fans to protrude out of the back of the enclosure. In this case the mounting brackets (b) are moved to the (B) position (refer to Sec. 2-2, Fig. 2-2-3).

### 8-3-3 460V Series Open Chassis (400 – 600HP CT and 500 – 800HP VT)

| Model EQ5- 4XXX-C | Dimensions Inches (mm) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W | W1 | W2 | W3 | W4 | W5 | H | H1 | H2 | H3 | H4 | H5 | H6 | H7 |
| 500 & 600 | 26.8 (680) | 22.8 (580) | 26 (660) | 11.4 (290) | - | 24 (610) | 55.1 (1400) | 53.9 (1370) | 52.4 (1330) | 52.8 (1340) | 52.6 (1335) | 0.61 (15.5) | 1.38 (35) | 057 (14.5) |
| 700 & 800 | 34.6 (880) | 30.7 (780) | 33.9 (860) | 10.2 (260) | 10.2 (260) | 31.9 (810) | 55.1 (1400) | 53.9 (1370) | 52.4 (1330) | 52.8 (1340) | 52.6 (1335) | 0.61 (15.5) | 1.38 (35) | 057 (14.5) |
| ***Con't*** | **D** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **C** | **Bolt Size** | **Wt. Lb (kg)** | | | | |
| 500 & 600 | 17.7 (450) | 11.2 (285) | 0.25 (6.4) | 1.97 (50) | 3.94 (100) | 1.38 (35) | 4.53 (115) | 0.59 (15) | M12 | 551 (250) | | | | |
| 700 & 800 | 17.7 (450) | 11.2 (285) | 0.25 (6.4) | 1.97 (50) | 3.94 (100) | 1.38 (35) | 4.53 (115) | 0.59 (15) | M12 | 793 (360) | | | | |

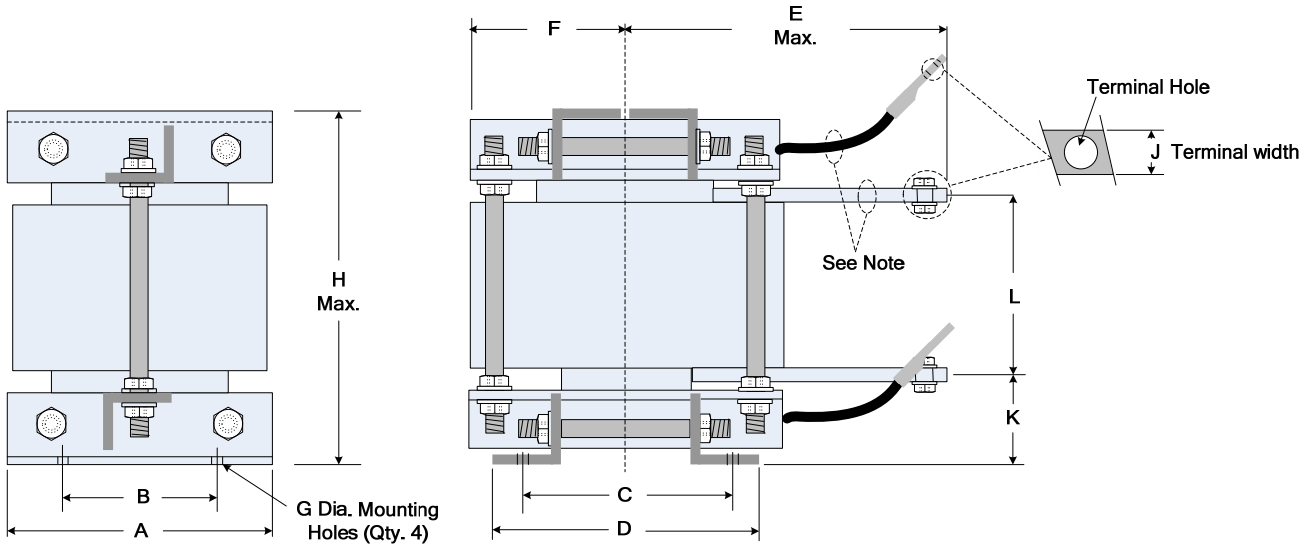



Notes:

a. The EQ5 Open Chassis can be mounted either (A) Surface Mount or (B) Through Panel Mount, where the rear panel is cut out to allow the heatsink and cooling fans to protrude out of the back of the enclosure. In this case the mounting brackets (b) are moved to the (B) position (Refer to Sec. 2-3, Fig. 2-2-3).

b. When mounting the unit through the panel, an alternative method of mounting the inverter is to use a bottom (customer supplied) bracket and the bottom mounting holes would not be necessary. Also the panel cut-out dimension will be (H4).

### 8-3-4 DC Link Choke for (75 –600HP CT and 100 – 800HP VT)




Note: Flexible leads are provided for chokes from DCR2-75B to DCR4-280B and bus type connections from DCR4-315B to DCR4-500B.

**230 V Series Open Chassis**

| Inverter Model EQ-2XXX-C | DC Choke Model | Dimensions Inches (mm) | | | | | | | | | | Wt. lbs (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | J | Terminal hole size | |
| 100 | DCR2-75B | 7.87 (200) | 6.69 (170) | 3.94 (100) | 5.55 (141) | 4.33 (110) | 2.76 (70) | 0.39 (10) | 8.27 (210) | N/A | M12 | 40 (18) |
| 125 | DCR2-90B | 7.09 (180) | 5.91 (150) | 4.33 (110) | 5.94 (151) | 5.51 (140) | 2.95 (75) | 0.39 (10) | 9.45 (240) | 0.98 (25) | φ15 | 44 (20) |
| 150 | DCR2-110B | 7.48 (190) | 6.30 (160) | 4.72 (120) | 6.34 (161) | 5.91 (150) | 3.15 (80) | 0.39 (10) | 10.6 (270) | 0.98 (25) | φ15 | 55 (25) |

**460 V Series Open Chassis**

| Inverter Model EQ-4XXX-C | DC Choke Model | Dimensions Inches (mm) | | | | | | | | | | | | Wt. lbs (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | J | K | L | Terminal hole size | |
| 100 | DCR4-75B | 7.48 (190) | 6.30 (160) | 4.53 (115) | 5.94 (151) | 3.94 (100) | 2.95 (75) | 0.39 (10) | 9.45 (240) | — | N/A | N/A | M10 | 44 (20) |
| 125 | DCR4-90B | 7.48 (190) | 6.30 (160) | 4.92 (125) | 6.34 (161) | 4.72 (120) | 3.15 (80) | 0.39 (10) | 9.84 (250) | 0.98 (25) | | | φ12 | 50 (23) |
| 150 | DCR4-110B | 7.48 (190) | 6.30 (160) | 4.92 (125) | 6.34 (161) | 4.72 (120) | 3.15 (80) | 0.39 (10) | 9.84 (250) | 0.98 (25) | | | φ12 | 55 (25) |
| 200 | DCR4-132B | 7.87 (200) | 6.69 (170) | 5.31 (135) | 6.73 (171) | 4.72 (120) | 3.35 (85) | 0.39 (10) | 10.2 (260) | 1.18 (30) | | | φ12 | 62 (28) |
| 250 | DCR4-160B | 8.27 (210) | 7.09 (180) | 5.31 (135) | 6.73 (171) | 4.72 (120) | 3.35 (85) | 0.47 (12) | 11.4 (290) | 1.18 (30) | | | φ12 | 71 (32) |
| 300 | DCR4-200B | 8.27 (210) | 7.09 (180) | 5.31 (135) | 6.73 (171) | 5.51 (140) | 3.54 (90) | 0.47 (12) | 11.6 (295) | 1.18 (30) | | | φ12 | 77 (35) |
| 350 | DCR4-220B | 8.66 (220) | 7.48 (190) | 5.31 (135) | 6.73 (171) | 5.51 (140) | 3.54 (90) | 0.47 (12) | 11.8 (300) | 1.57 (40) | | | φ15 | 88 (40) |
| 400 & 450 | DCR4-280B | 8.66 (220) | 7.48 (190) | 5.71 (145) | 7.13 (181) | 5.91 (150) | 3.74 (95) | 0.47 (12) | 12.6 (320) | 1.57 (40) | | | φ15 | 99 (45) |
| 500 | DCR4-355B | 8.66 (220) | 7.48 (190) | 5.71 (145) | 7.13 (181) | 6.30 (160) | 3.74 (95) | 0.47 (12) | 12.6 (320) | 1.57 (40) | | | φ15 | 121 (55) |
| 600 | DCR4-400B | 9.45 (240) | 8.27 (210) | 5.71 (145) | 7.13 (181) | 6.69 (170) | 3.74 (95) | 0.47 (12) | 13.4 (340) | 1.57 (40) | 1.77 (45) | 8.86 (225) | φ15 | 132 (60) |
| 700 | DCR4-450B | 10.2 (260) | 8.86 (225) | 5.71 (145) | 7.13 (181) | 6.69 (170) | 3.74 (95) | 0.47 (12) | 13.4 (340) | 1.97 (50) | 1.77 (45) | 8.86 (225) | φ15 | 148 (67) |
| 800 | DCR4-500B | 10.2 (260 | 8.86 (225) | 5.71 (145) | 7.13 (181) | 7.28 (185) | 3.94 (100) | 0.47 (12) | 13.4 (340) | 1.97 (50) | 1.77 (45) | 8.86 (225) | φ15 | 154 (70) |

## 8-4 RS-485 Modbus RTU Serial Communications

The serial communications interface supports operation, configuration and monitoring of inverter functions through an EIA/RS-485 connection. The serial interface is based on Modbus RTU protocol. This protocol allows the inverter to function as an RTU slave on an industrial network.

### 8- 4-1 Transmission Specifications

| Item | Specification |
|---|---|
| Physical level | EIA/RS-485 |
| Transmission distance | 1600 ft (500 m) |
| Number of nodes | 32 total |
| Transmission speed | 19200, 9600, 4800, 2400 [bits/s] |
| Transmission mode | Half duplex |
| Transmission protocol | Modbus RTU |
| Character code | Binary |
| Character length | 8 bits |
| Error check | CRC |

### 8- 4-2 Connection

Connection method:

Use shielded wire and connect to the control terminals (DX-, DX+ and SD). A terminating resistor should be added between the data lines on the each end of the network. The value of the terminating resistor depends on the characteristic impedance of the cable. A common value is 120 ohms.

Control terminals:

| Terminal Designation | Terminal Name | Function Description |
|---|---|---|
| DX+ | RS-485 communication data (+) | Input/output terminals for RS-485 communication. |
| DX- | RS-485 communication data (–) | |
| SD | Cable shield | Electrically floating |

### 8- 4-3 Serial Interface Configuration

Inverter function codes H30 to H39 are used to configure the serial interface parameters, such as device address, baud rate and error response.

### 8- 4- 4 Modbus RTU Functions

The following RTU functions are supported. The maximum number of consecutive parameters for function 03 and 16 messages is 16.

| Code | Description |
|---|---|
| 03 | Read Holding Registers (16 registers maximum) |
| 06 | Preset Single Register |
| 16 | Preset Multiple Registers (16 registers maximum) |

### 8-4-5 Inverter Function Code Access

All of the inverter function codes are accessible through the RS-485 serial interface. Inverter function codes are mapped to RTU holding registers. An inverter function code RTU address is 2 bytes in length. The high byte corresponds to a code that represents the inverter parameter sort (F–M). The low byte corresponds to the inverter parameter number within the sort (0 -99).

| high byte | low byte |
|---|---|
| inverter parameter sort code | inverter parameter number |

| Code | Sort | Name | Code | Sort | Name |
|---|---|---|---|---|---|
| 0 | F | Basic function | 5 | A | Motor 2 function |
| 1 | E | Terminal function | 6 | o | Option function |
| 2 | C | Control function | 7 | S | Command/function data |
| 3 | P | Motor 1 function | 8 | M | Monitor data |
| 4 | H | High level function | | | |

For example, inverter function code M11 the output current, is addressed as RTU parameter number 080B hexadecimal or 2059 decimal.

### 8-4-6 Command and Monitor Data Registers

The command and monitor function codes are used to control the operation of the inverter and monitor the status variables through the serial interface. The command and monitor function codes are not accessible from the inverter keypad interface. Inverter parameter H30 and digital input signal LE must be enabled to operate the inverter from the Modbus interface. If LE is not assigned to a digital input (X1-X9), the signal will default to ON.

Frequency Setting Registers:

| Address | Code | Name | Unit | Variable Range | Min. Unit | Read/ Write | Data Format |
|---|---|---|---|---|---|---|---|
| 1793 | S01 | Frequency command | - | -20000–20000 (max. frequency at ± 20000) | 1 | R/W | 2 |
| 1797 | S05 | Frequency command | Hz | 0.00–120.00 | 0.01 | R/W | 5 |

*Notes: 1) If both S01 and S05 are set, the inverter will ignore the setting of S05.*
*2) A data setting that exceeds the setting range is possible, but the actual action will be limited by the inverter configuration.*

Operation command data Registers:

| Address | Code | Name | Unit | Variable Range | Min. Unit | Read/ Write | Data Format |
|---|---|---|---|---|---|---|---|
| 1798 | S06 | Operation command | - | Refer to the data format [14] | - | R/W | 14 |
| 1799 | S07 | Universal Do | - | Refer to the data format [15] | - | R/W | 15 |
| 1804 | S12 | Universal Ao | - | -20000–20000 (100% output at ± 20000 ) | 1 | R/W | 2 |

*Notes: 1) Since X1–X9 are configurable input commands, it is necessary to set the functions by E01–E09.*
*2)The alarm reset is executed, when RST signal changes from ON to OFF even if there are no alarms.*
*3) Universal Do is a function that utilizes the inverter's digital outputs via communication.*

Function data Registers

| Address | Code | Name | Unit | Variable Range | Min. Unit | Read/ Write | Data Format |
|---|---|---|---|---|---|---|---|
| 1800 | S08 | Acceleration time F07 | s | 0.1–3600.0 | 0.1 | R/W | 3 |
| 1801 | S09 | Deceleration time F08 | s | 0.1–3600.0 | 0.1 | R/W | 3 |
| 1802 | S10 | Torque limit level 1 (driving) F40 | % | 20.00 –200.00, 999 (EQ5:20.00-150.00) | 1.00 | R/W | 5 |
| 1803 | S11 | Torque limit level 2 (braking) F41 | % | 0.00, 20.00–200.00, 999 (EQ5:20.00-150.00) | 1.00 | R/W | 5 |

*Notes: 1) The writing of data out of range is treated as out of range error.*
*2) Use a value of $7FFF_H$ to enter 999 for torque limit functions.*

Monitoring parameter registers

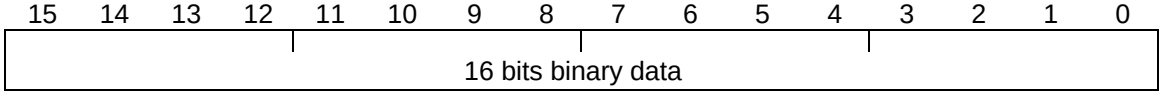
| Address | Code | Description | Unit | Range | Min. Unit | Read/Write | Data Format |
|---|---|---|---|---|---|---|---|
| 2049 | M01 | Frequency command (final command) | - | - 20000–20000 (max. frequency at ± 20000) | 1 | R | [2] |
| 2053 | M05 | Frequency command (final command) | Hz | 0.00-120.00) | 0.01 | R | [5] |
| 2054 | M06 | Actual frequency | - | - 20000–20000 (max. frequency at ± 20000) | 1 | R | [2] |
| 2055 | M07 | Actual torque value | % | - 200.00–200.00 | 0.01 | R | [6] |
| 2056 | M08 | Torque current | % | - 200.00–200.00 | 0.01 | R | [6] |
| 2057 | M09 | Output frequency | Hz | 0.00-120.00) | 0.01 | R | [5] |
| 2058 | M10 | Motor output (input electric power) | % | 0.00–200.00 | 0.01 | R | [5] |
| 2059 | M11 | Output current r. m. s. | % | 0.00–200.00 (inverter rating at 100.00) | 0.01 | R | [5] |
| 2060 | M12 | Output voltage r. m. s. | V | 0.0–600.0 | 1.0 | R | [3] |
| 2061 | M13 | Operation command (final command) | - | Refer to data format [14] | - | R | [14] |
| 2062 | M14 | Operating state | - | Refer to data format [16] | - | R | [16] |
| 2063 | M15 | Universal output terminal data | - | Refer to data format [15] | - | R | [15] |
| 2064 | M16 | Fault memory 0 | - | Refer to data format [10] | - | R | [10] |
| 2065 | M17 | Fault memory 1 | | | | | |
| 2066 | M18 | Fault memory 2 | | | | | |
| 2067 | M19 | Fault memory 3 | | | | | |
| 2068 | M20 | Integrated operating time | h | 0–65535 | 1 | R | [1] |
| 2069 | M21 | DC link voltage | V | 0–1000 | 1 | R | [1] |
| 2071 | M23 | Type code | - | Refer to data format [17] | - | R | [17] |
| 2072 | M24 | Inverter capacity code | - | Refer to data format [11] | - | R | [11] |

*Cont.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2073 | M25 | ROM version | - | 0–64999 | 1 | R | [1] |
| 2074 | M26 | Transmission error processing code | - | Refer to data format [20] | - | R | [20] |
| 2075 | M27 | Frequency command at alarm (final command) | - | - 20000–20000 (max. frequency at ±20000 ) | 1 | R | [2] |
| 2079 | M31 | Frequency command at alarm (final command) | Hz | 0.00-120.00) | 0.01 | R | [5] |
| 2080 | M32 | Actual frequency at alarm | - | - 20000–20000 (max. frequency at ± 20000) | 1 | R | [2] |
| 2081 | M33 | Actual torque at alarm | % | - 200.00 – 200.00 | 0.01 | R | [6] |
| 2082 | M34 | Torque current at alarm | % | - 200.00 – 200.00 | 0.01 | R | [6] |
| 2083 | M35 | Output frequency at alarm | Hz | 0.00 – 120.00 | 0.01 | R | [5] |
| 2084 | M36 | Motor output at alarm (input power) | % | 0.00–200.00 | 0.01 | R | [5] |
| 2085 | M37 | Output current rms. at alarm | % | 0.00 – 200.00 (inverter rating at 100.00) | 0.01 | R | [5] |
| 2086 | M38 | Output voltage effective value at alarm | V | 0.0 – 600.0 | 1.0 | R | [3] |
| 2087 | M39 | Operation command at alarm | - | Refer to data format [14] | - | R | [14] |
| 2088 | M40 | Operating state at alarm | - | Refer to data format [16] | - | R | [16] |
| 2089 | M41 | Universal output terminal data at alarm | - | Refer to data format [15] | - | R | [15] |
| 2090 | M42 | Integrated operation time at alarm | h | 0–65535 | 1 | R | [1] |
| 2091 | M43 | DC link voltage at alarm | V | 0–1000 | 1 | R | [1] |
| 2092 | M44 | Inverter internal air temp.at alarm | °C | 0–120 | 1 | R | [1] |
| 2093 | M45 | Cooling fin temp. at alarm | °C | 0–120 | 1 | R | [1] |
| 2094 | M46 | Life of main circuit capacitor. | % | 0.0–100.0 | 0.1 | R | [3] |
| 2095 | M47 | Life of printed circuit board capacitor. | h | 0–65535 | 1 | R | [1] |
| 2096 | M48 | Life of cooling fan. | h | 0–65535 | 1 | R | [1] |

### 8-4-7 Data Format Specification

All data in the data field of communication frame shall be represented by a 16 bit length word.




Data format [1] Unsigned Integer data (Positive): Min. unit 1
Example: F15 (Frequency limit, upper)= 60Hz ***60 = 003C$_H$***

Data format [2] Integer data (Positive, negative): Min. unit 1
Example: data = -20 ***-20 = FFEC$_H$***

Data format [3] Unsigned Decimal data (Positive): Min. unit 0.1
Example: F17 (frequency gain setting signal) = 100.0% ***100.0 X 10 = 1000 = 03E8$_H$***

Data format [4] Decimal data (Positive, negative): Min. unit 0.1
Example: C31 (Analog input offset adjust, term.12) = - 5.0% ***- 5.0 X 10= - 50 = FFCE$_H$***

Data format [5] Unsigned Decimal data (Positive): Min. unit 0.01
Example: C05 (multi-step frequency 1) = 50.25Hz ***50.25 X 100 = 5025 = 13A1$_H$***

Data format [6] Decimal data (Positive, negative): Min. unit 0.01
Example: M07 (actual torque value)= - 85.38% ***- 85.38 X 100= - 8538=DEA6$_H$***

Data format [7] Unsigned Decimal data (Positive): Min. unit 0.001
Example: If o05 (follow - up side ASR 1 constant) = 0.105s ***0.105 X 1000 = 105 = 0069$_H$***

Data format [8] Decimal data (Positive, negative): Min. unit 0.001
Example: Data = -1.234 ***- 1.234 X 1000 = - 1234 = FB2E$_H$***

Data format [9] Unsigned Integer data (Positive): Min. unit 2
Example If P01 (Motor 1 number of poles) =2pole ***2 = 0002$_H$***

Data format [10] Alarm code:

| Code | Description | | Code | Description | |
|---|---|---|---|---|---|
| 0 | No alarm | - | 22 | Overheat, DB resistor | dbH |
| 1 | Overcurrent, during acceleration (INV output ) | OC1 | 23 | Overload, motor 1 | OL1 |
| 2 | Overcurrent, during deceleration (INV output ) | OC2 | 24 | Overload, motor 2 | OL2 |
| 3 | Overcurrent, during steady state operation (INV output ) | OC3 | 25 | Overload, inverter | OLU |
| 5 | Ground fault | EF | 27 | Overspeed | OS |
| 6 | Overvoltage, during acceleration | OU1 | 28 | PG wire break | Pg |
| 7 | Over voltage, during deceleration | OU2 | 31 | Memory error | Er1 |
| 8 | Overvoltage, during steady state operation | OU3 | 32 | Keypad error | Er2 |
| 10 | DC undervoltage | LU | 33 | CPU error | Er3 |
| 11 | Power supply open phase | Lin | 34 | Option comm. error | Er4 |
| 14 | Blown DC fuse | FUS | 35 | Option error | Er5 |
| 16 | Output wiring error | Er7 | 36 | PL error | Er6 |
| 17 | Overheat, heat sink, inverter | OH1 | 37 | Output wiring error | Er7 |
| 18 | Overheat, outside thermal | OH2 | 38 | RS-485 comm. error | Er8 |
| 19 | Overheat, unit inside temp. | OH3 | | | |

Data format [11] Capacity code:

| Code | Capacity (HP) | Code | Capacity (HP) | Code | Capacity (HP) |
|---|---|---|---|---|---|
| 7 | 0.07(spare) | 2000 | 20 | 20000 | 200 |
| 15 | 0.15(spare) | 2500 | 25 | 25000 | 250 |
| 25 | 0.25 | 3000 | 30 | 30000 | 300 |
| 50 | 0.5 | 4000 | 40 | 35000 | 350 |
| 100 | 1 | 5000 | 50 | 40000 | 400 |
| 200 | 2 | 6000 | 60 | 45000 | 450 |
| 300 | 3 | 7500 | 75 | 50000 | 500 |
| 500 | 5 | 10000 | 100 | 60600 | 600 |
| 750 | 7.5 | 12500 | 125 | 60700 | 700 |
| 1000 | 10 | 15000 | 150 | 60800 | 800 |
| 1500 | 15 | 17500 | 175 | | |

Data format [12] Index data (ACC/DEC time, display coefficient):

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Polarity | 0 | 0 | 0 | Index portion | | Data portion | | | | | | | | | |

| | | | | |
|---|---|---|---|---|
| 0: Positive (+), | 0: 0.01 | X | 001–999 | (0.00–9.99) |
| | 1: 0.1 | X | 100–999 | (10.0–99.9) |
| 1: Negative ( - ) | 2: 1 | X | 100–999 | (100–999) |
| | 3: 10 | X | 100–999 | (1000–9990) |

Example: F07 (acceleration time 1) = 20.0 s
10.0 < 20< 99.9 → index =1
20.0 = 0.1 X 200 → $0400_H + 00C8_H = 04C8_H$

Data format [13] Pattern operation:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction of rotation | 0 | Time | | Index portion | | Data portion | | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | 0: 1st ACC/DEC time | 0: 0.01 | X | 001–999 | (0.00–9.99) |
| 0: FWD | 1: 2nd ACC/DEC time | 1: 0.1 | X | 100–999 | (10.0–99.9) |
| 1: REV | 2: 3rd ACC/DEC time | 2: 1 | X | 100–999 | (100–999) |
| | 3: 4th ACC/DEC time | 3: 10 | X | 100–999 | (1000–9990) |

Example: C22 (Stage1) = 10.0s R2 (10s, reverse rotation, acceleration time 2/deceleration time 2)
Since 10.0 = 0.1 X 100 > $9000_H + 0400_H + 0064_H = 9464_H$

Data format [14] Operation command:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RST | 0 | 0 | 0 | 0 | X9 | X8 | X7 | X6 | X5 | X4 | X3 | X2 | X1 | REV | FWD |

(All bit are ON by 1)
Example: S06 (operation command) = FWD, X1 and X5 = ON
$0000\ 0000\ 0100\ 0101_b = 0045_H$

Data format [15] Universal output terminal:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Y5 | Y4 | Y3 | Y2 | Y1 |

(All bit are ON by 1)
Example: M15 (Universal output terminal)=Y1 and Y5 = ON
$0000\ 0000\ 0001\ 0001_b = 0011_H$

Data format [16] Operating state:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUSY | WR | | RL | ALM | DEC | ACC | IL | VL | TL | NUV | BRK | INT | EXT | REV | FWD |

(All bit are ON or active by 1)

FWD: Forward operation
REV: Reverse operation
EXT: DC braking active (or pre-excitation)
INT: No Output
BRK: Braking active
NUV: DC link voltage is established (undervoltage at 0)
TL: Torque limiting
VL: Voltage limiting
IL: Current limiting
ACC: Under acceleration
DEC: Under deceleration
ALM: Inverter fault
RL: Transmission valid
WR: Function writing privilege
0: Keypad panel
1: RS-485
2: Fieldbus (option)
BUSY: Processing data write

Data format [17] Type code:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | | | | Generation | | | | Series | | | | Voltage series | | | |

| Code | Type | Generation | Series | Voltage series |
|---|---|---|---|---|
| 1 | - | EQ5 | - | - |
| 2 | - | - | - | - |
| 3 | EQ5 | - | - | 230V three phase |
| 4 | - | - | - | 460V three phase |
| 5 | - | - | USA | 575V three phase |
| 6 | - | - | - | - |

Data format [18] Code setting (1–4 figures):

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Data 4 | | | | Data 3 | | | | Data 2 | | | | Data 1 | | | |

Data format [19] Amperage value Decimal data (positive ):
Min. unit 0.01 inverter capacity is not more than 30HP/CT, 40HP/VT.
Min unit 0.01 for not less than 40HP/CT, 50HP/CT.

Example: F11 (electronics thermal overload relay 1 level) 107.0A (40HP) ***107.0 X 10=1070=042E$_H$***
F11 (electronics thermal overload relay 1 level) =3.60A (1HP) ***3.60 X 100=360=0168$_H$***

Data format [20] Transmission error code:

| Code | Description | Code | Description |
|---|---|---|---|
| 1 | FC (function code) error | 71 | CRC error (no response) |
| 2 | Illegal address | 72 | Parity error (no response) |
| 3 | Illegal address (Data range error) | 73 | Other errors (no response)<br>-Framing error<br>-Overrun error<br>-Buffer full error |
| 7 | NAK<br>-Priority for comm.<br>-No privilege for writing error<br>-Forbidden writing error | | |

Data format [21] Auto tuning:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | REV | FWD | Data portion | | | | | | | |

0: Without forward rotation command
1: With forward rotation command.
0: Without reverse rotation command.
1: With reverse rotation command.

Example: P04 (motor 1 auto - tuning)=1: Forward rotation
0000 0001 0000 $0001_b$=$0101_H$

**8-4-8 Communication Errors (**Exception Response)

When the inverter receives a message that does not contain communication errors but the message can not be processed, the inverter will return an exception response. The exception response contains an error sub-code in the data field that represents the problem.

Exception Response Errors:

| Sub-Code | Name | Causes |
|---|---|---|
| 1 | Illegal Function | Received RTU Function other than 03, 06 or 16 |
| 2 | Illegal Data Address | • The starting parameter address is an unused inverter parameter.<br>• The starting parameter address plus the offset refers to inverter parameter greater than the last parameter in a Function Code sort.<br>• The number of registers is greater than 16. |
| 3 | Illegal Data Value | Data contains an out of range value for an inverter parameter |
| 7 | Negative Acknowledge | • Requested data cannot be changed while the inverter is running.<br>• The inverter parameter function is owned by the network interface option card and cannot be changed. |

Communication errors:
Communication errors occur when the inverter receives an invalid message. The inverter will not return a response to a communication error. A code that represents the last communication error is stored in inverter parameter M26. Typical communication message errors include parity, framing, and CRC errors.

## 9. Options

The inverter supports two internally mounted cards. One option card is mounted under the main cover (Location A) and the other option card is mounted in a special adapter under the keypad (Location B). Only one card can be mounted in these locations. There are two different types of option cards, Type 1 and Type 2. You cannot use two Type 1 or Two Type 2 cards but you can mix any combination of Type 1 and Type 2 provided you only have one option per mounting location. Each option card must be mounted in the designated location. The chart below lists the option card, their types, and their mounting locations.

| Name | Type | Loc. | 2nd Option Type/Loc | Function |
|---|---|---|---|---|
| OPC-G11S-RY (Relay output card) | 1 | A | 2/B | • Relay output card<br>The transistor output from the inverter control output terminals Y1 and Y4 are converted to the relay output (1SPDT). |
| OPC-G11S-DIO (Digital interface card) | 2 | A | None | • Frequency setting by binary code (max. 16 bits)<br>• Monitoring (8 bits) of frequency, output current, and output voltage |
| OPC-G11S-AIO (Analog interface card) | 2 | A | None | • Auxiliary input for analog frequency setting (0 to +/-10 V)<br>• Monitoring of inverter output frequency, current, and torque in analog voltage, analog output 0-10 VDC and 4-20mA |
| OPC-G11S-PDP (Communication card) | 2 | B | 1/A | • Serial communication card for Profibus-DP |
| OPC-G11S-DEV (Communication card) | 2 | B | 1/A | • Serial communication card for Device Net |
| OPC-G11S-COP (Communication card) | 2 | B | 1/A | • Serial communication card for CAN |
| OPC-G11S-MBP (Communication card) | 2 | B | 1/A | • Serial communication card for Modbus plus |
| OPC-G11S-IBS (Communication card) | 2 | B | 1/A | • Serial communication card for Interbus-S |

# 10. Electromagnetic Compatibility (EMC)

## 10-1 General

In accordance with the provisions described in the European Commission Guidelines Document on Council Directive 89/336/EEC, the EQ5 series of inverters is chosen to be classified as "Complex Components". Classification as a "Complex Components" allows a product to be treated as an "apparatus", and thus permits compliance with the essential requirements of the EMC Directive to be demonstrated to both an integrator of EQ5 Inverters and to his customer or the installer and the user.

EQ5 Inverters are supplied `CE-marked', signifying compliance with EC Directive 89/336/EEC when used with a specified filter installed and grounded in accordance with this sheet. This Specification requires the following performance criteria to be met.

EMC product standard **EN61800-3/1997 +A11/2000**

Immunity : **Second environment** ( Industrial environment )
Emission : **First environment** ( Domestic environment )

**Distribution class of Emission:**

| Unrestricted Distribution | Restricted Distribution |
|---|---|
| EQ5-4025-C or less.<br>**Without** Options installed (See Sec. 9) | **Without** Options installed (See Sec. 9)<br>EQ5-4025-C or more.<br>EQ5-2XXX-C |
| | **With** Options installed (See Sec. 9)<br>EQ5-2XXX-C / EQ5-4XXX-C all models with any of the following options.<br>Card option :OPC-G11S-AIO, DIO, RY, PGDIO, PGRY, TL<br>Bus option :OPC-G11S-PDP, DEV, MBP, IBS, COP |
| | WARNING<br>This is a product of the restricted sales distribution class according to IEC61800-3.<br>In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures. |

*Note: It is customer's responsibility to check whether the equipment conforms to EMC directive.*

## 10-2 Recommended Installation Instructions

It order to conform to the EMC Directive, these instructions must be followed. Please follow all safety procedures when working with electrical equipment. All electrical connections to the filter, Inverter and motor must be made by a qualified electrical technician.

1) Use the correct filter according to Table 10-2-1.
2) Install the Inverter and filter in an electrically shielded metal enclosure.
3) The back panel of the enclosure should be prepared for the mounting of the filter. Care should be taken to remove any paint etc. from the mounting holes and surface area of the panel to ensure the best possible grounding of the filter and other components.
4) Use shielded cable for the control, motor and other wiring connected to the Inverter, and properly ground the shields. (See Fig. 10-2-5)
5) It is important that all wire lengths are kept as short as possible and that incoming power and outgoing motor cables are kept well separated.

*Note: To minimize the conducted radio disturbance in the power distribution system, the length of the motor-cable should be as short as possible.*

**Table 10-2-1 RFI filters**

| Inverter Model No. | Filter Type | Rated Current | Max. Rated Voltage | RFI Filter | | |
|---|---|---|---|---|---|---|
| | | | | Dimensions L x W x H [inch (mm)] | Mount. Dims. Y x X [inch (mm)] | Fig. |
| EQ5 – 40P5 – N1<br>EQ5 – 4001 – N1 | FS5536-5-07<br>(EFL-0.75G11-4) | 5A | 3ph 460Vac | 12.6(320)×4.57(116)×1.65(42) | 11.5(293)×3.54(90) | 10 -1 |
| EQ5 – 4002 – N1<br>EQ5 – 4003 – N1<br>EQ5 – 4005 – N1 | FS5536-12-07<br>(EFL-4.0G11-4) | 12A | | 12.6(320)×6.10(155)×1.77(45) | 11.5(293)×4.13(105) | |
| EQ5 – 4007 – N1<br>EQ5 – 4010 – N1 | FS5536-35-07<br>(EFL-7.5G11-4) | 35A | | 13.4(341)×8.86(225)×1.87(47.5) | 12.2(311)×6.57(167) | |
| EQ5 – 4015 – N1<br>EQ5 – 4020 – N1 | FS5536-50-07<br>(EFL-15G11-4) | 50A | | 19.7(500)×9.84(250)×2.76(70) | 17.7(449)×7.28(185) | |
| EQ5 – 4025 – N1<br>EQ5 – 4030 – N1<br>EQ 5 - 4032 –N1 | FS5536-72-07<br>(EFL-22G11-4) | 72A | | 19.7(500)×9.84(250)×2.76(70) | 17.7(449)×7.28(185) | |
| EQ 5 - 4040 –N1 | RF 3100-F11 | 100A | 3ph 460Vac | 17.1(435)×7.87(200)×5.12(130) | 16.0(408)×6.54(166) | 10 -2 |
| EQ 5 - 4050 –N1<br>EQ 5 - 4060 –N1<br>EQ 5 - 4075 –N1<br>EQ 5 - 4100 –N1<br>EQ 5 - 4125–N1 | RF 3180-F11 | 180A | | 19.5(495)×7.87(200)×6.30(160) | 18.4(468)×6.54(166) | |
| EQ 5 - 4150 –N1<br>EQ 5 - 4200–N1 | RF 3280-F11 | 280A | | 9.84(250)×23.11(587)×8.07(205) | 22.1(560)×3.35(85) | 10 -3 |
| EQ 5 - 4250 –N1<br>EQ 5 - 4300–N1<br>EQ 5 - 4350 –N1 | RF 3400-F11 | 400A | | 9.84(250)×23.11(587)×8.07(205) | 22.1(560)×3.35(85) | |
| EQ 5 - 4400–N1<br>EQ 5 - 4450–N1 | RF 3880-F11 | 880A | | 27.1(688)×14.33(364)×7.09(180) | 25.5(648)×5.91(150) | 10 -4 |

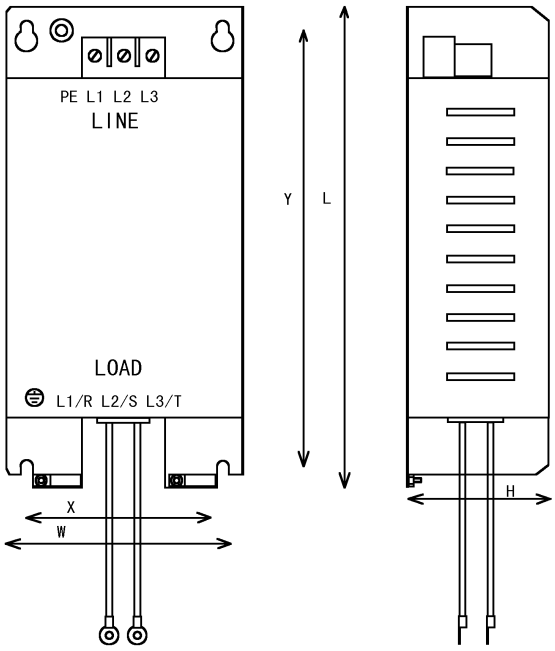
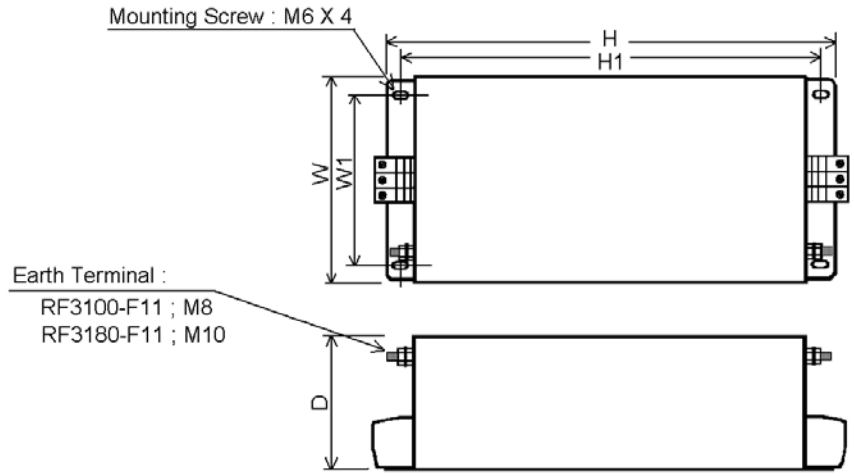



**Fig.10-2-1 Outline Dimensions**




| Filter Type | Dimensions [inch(mm)] | | | | |
|---|---|---|---|---|---|
| | W | W1 | H | H1 | D |
| RF3100-F11 | 7.87 (200) | 6.54 (166) | 17.1 (435) | 16.1 (408) | 5.12 (130) |
| RF3180-F11 | 7.87 (200) | 6.54 (166) | 19.5 (495) | 18.4 (468) | 6.30 (160) |

**Fig.10-2-2 Outline Dimensions**

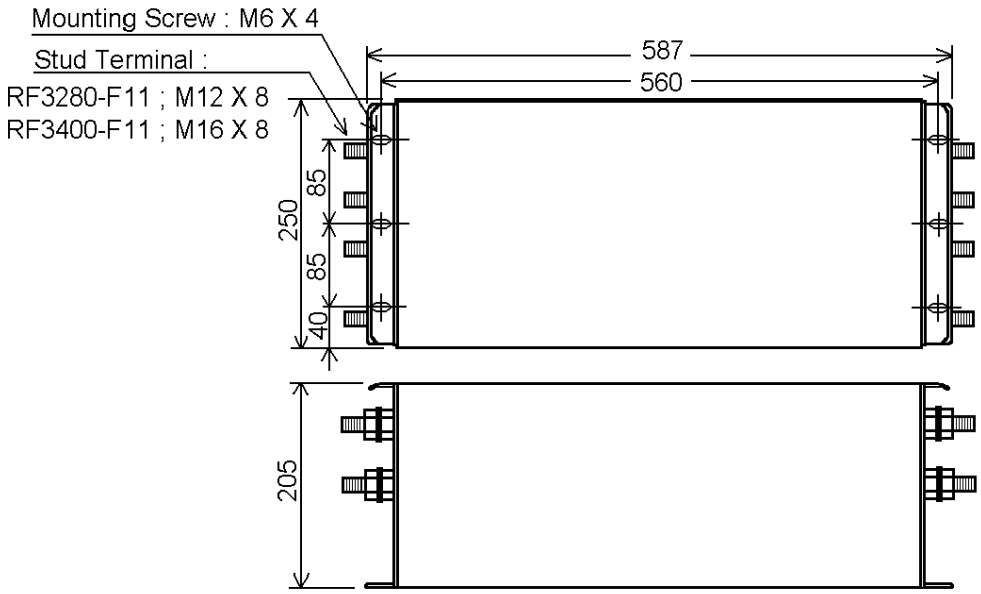


**Fig.10-2-3 Outline Dimensions**

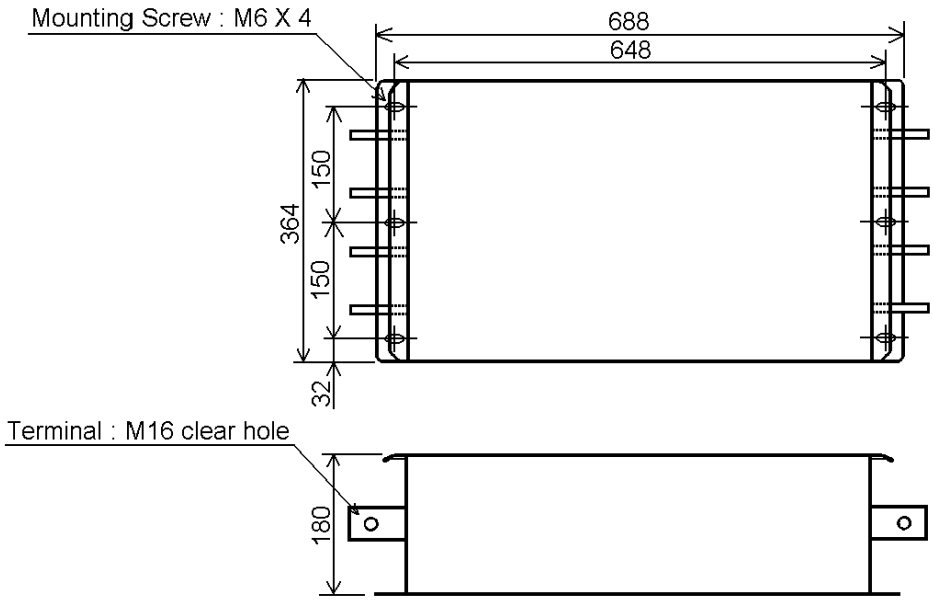



**Fig.10-2-4 Outline Dimensions**

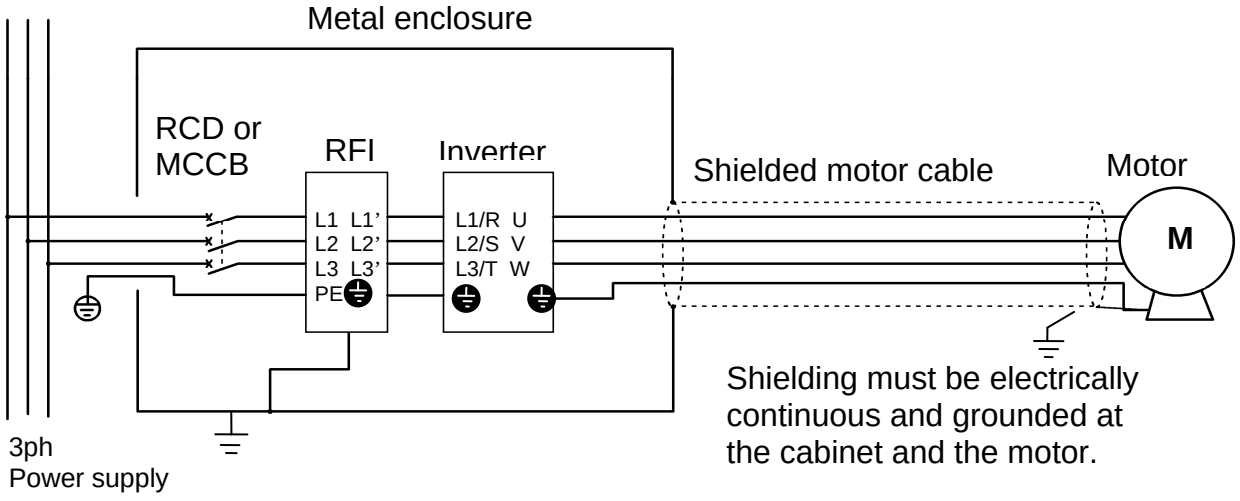



**Fig.10-2-5 Enclosure and Shielding**

## TECO-Westinghouse Motor Company

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