

INVERTER



F510

INSTRUCTION MANUAL

230V Class 3~

Open Chassis / NEMA 1

3.7 - 132 kW

5 - 175 HP

460V Class 3~

Open Chassis / NEMA 1

3.7 - 600 kW

5 - 800 HP

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

**** STATEMENT ****

Si Desea descargar el manual en español diríjase a este Link: www.tecowestinghouse.com

Table of Contents

| | |
|--|------------|
| Preface | 0-1 |
| 1 Safety Precautions | 1-1 |
| 1.1 Before Supplying Power to the Inverter..... | 1-1 |
| 1.2 Wiring..... | 1-2 |
| 1.3 Before Operation | 1-3 |
| 1.4 Parameters Setting..... | 1-3 |
| 1.5 Operation | 1-4 |
| 1.6 Maintenance, Inspection and Replacement | 1-5 |
| 1.7 Disposal of the Inverter..... | 1-5 |
| 2 Model Description | 2-1 |
| 2.1 Nameplate Data..... | 2-1 |
| 2.2 Inverter Models – Motor Power Rating..... | 2-2 |
| 3 Environment and Installation | 3-1 |
| 3.1 Environment..... | 3-1 |
| 3.2 Installation..... | 3-2 |
| 3.3 External View..... | 3-3 |
| 3.4 Warning Labels..... | 3-4 |
| 3.5 Removing the Front Cover and Keypad | 3-5 |
| 3.5.1 Standard type (IP00/IP20) | 3-8 |
| 3.6 Wire Gauges and Tightening Torque | 3-15 |
| 3.7 Wiring Peripheral Power Devices..... | 3-16 |
| 3.8 General Wiring Diagram | 3-18 |
| 3.9 User Terminals | 3-19 |
| 3.10 Power Terminals..... | 3-22 |
| 3.11 Input / Output Section Block Diagram | 3-26 |
| 3.11.1 Cooling Fan Supply Voltage Selection (400V class) | 3-30 |
| 3.12 Inverter Wiring | 3-31 |
| 3.13 Input Power and Motor Cable Length..... | 3-32 |
| 3.14 Cable Length vs, Carrier Frequency | 3-32 |
| 3.15 Installing an AC Line Reactor | 3-32 |
| 3.16 Power Input Wire Size, NFB and MCB Part Numbers | 3-33 |
| 3.17 Control Circuit Wiring..... | 3-35 |
| 3.18 Inverter Specifications | 3-37 |
| 3.19 General Specifications..... | 3-39 |
| 3.20 Inverter Derating Based on Carrier Frequency | 3-41 |
| 3.21 Inverter Derating Based on Temperature..... | 3-45 |
| 3.22 Inverter Dimensions..... | 3-46 |

| | |
|---|-------------|
| 4. Keypad and Programming Functions | 4-1 |
| 4.1 LCD Keypad | 4-1 |
| 4.1.1 Keypad Display and Keys | 4-1 |
| 4.1.2 Keypad Menu Structure | 4-3 |
| 4.2 Parameters | 4-8 |
| 4.3 Description of Parameters | 4-64 |
| | |
| 5. Check Motor Rotation and Direction | 5-1 |
| | |
| 6. Speed Reference Command Configuration | 6-1 |
| 6.1 Reference from the Keypad..... | 6-1 |
| 6.2 Reference from an Analog Signal (0-10V / 4-20mA) / Speed Pot..... | 6-2 |
| 6.3 Reference from Serial Communication RS485 | 6-4 |
| 6.4 Reference from two Analog Inputs | 6-6 |
| 6.5 Change Frequency Unit from Hz to rpm..... | 6-6 |
| | |
| 7. Operation Method Configuration (Run / Stop)..... | 7-1 |
| 7.1 Run / Stop from the Keypad | 7-1 |
| 7.2 Run / Stop from External Switch / Contact or Pushbutton | 7-2 |
| 7.3 Run / Stop from Serial Communication RS485 | 7-4 |
| | |
| 8. Motor and Application Specific Settings | 8-1 |
| 8.1 Set Motor Nameplate Data | 8-1 |
| 8.2 Acceleration and Deceleration Time | 8-2 |
| 8.3 Automatic Energy Savings Functions..... | 8-3 |
| 8.4 Emergency Stop | 8-5 |
| 8.5 Direct / Unattended Startup | 8-6 |
| 8.6 Analog Output Setup | 8-7 |
| | |
| 9. Using PID Control for Constant Flow / Pressure Applications | 9-1 |
| 9.1 What is PID Control | 9-1 |
| 9.2 Connect Transducer Feedback Signal | 9-3 |
| 9.3 Engineering Units | 9-4 |
| 9.4 Sleep / Wakeup Function | 9-5 |
| | |
| 10 Troubleshooting and Fault Diagnostics..... | 10-1 |
| 10.1 General | 10-1 |
| 10.2 Fault Detection Function..... | 10-1 |
| 10.3 Warning / Self-diagnosis Detection Function | 10-6 |
| 10.4 Auto-tuning Error | 10-13 |
| 10.5 PM Motor Auto-tuning Error..... | 10-14 |

| | |
|--|-------------|
| 11 Inverter Peripheral Devices and Option | 11-1 |
| 11.1 Braking Resistors and Braking Units | 11-1 |
| 11.2 AC Line Reactors | 11-3 |
| 11.3 Output Filters | 11-4 |
| 11.4 Input Current and Fuse Specifications | 11-5 |
| 11.5 Other options | 11-6 |
| 11.6 Communication options | 11-10 |
| | |
| Appendix A: Single and Multi-Pump Wiring | A1 |
| Appendix B: UL Instructions | B1 |

Preface

The F510 product is an inverter designed to control a three-phase induction motor. Please read this manual carefully to ensure correct operation and safety aspects to become familiar with the inverter functions.



The F510 inverter is an electrical / electronic product and must be installed and handled by qualified service personnel.



Improper handling may result in incorrect operation, shorter life cycle, or failure of this product as well as the motor.

All F510 documentation is subject to change without notice. Be sure to obtain the latest editions for use or visit our website at www.tecowestinghouse.com , for documentation in Spanish visit www.tecowestinghouse.com.mx

Read this Instruction Manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection.

Ensure you have thorough knowledge of the inverter and familiarize yourself with all safety information and precautions before proceeding to operate the inverter. Read the this Instruction Manual for detailed description on parameters.

Please pay close attention to the safety precautions indicated by the warning  and caution  symbol.

| | |
|--|--|
|  Warning | Failure to ignore the information indicated by the warning symbol may result in death or serious injury. |
|  Caution | Failure to ignore the information indicated by the caution symbol may result in minor or moderate injury and/or substantial property damage. |

1. Safety Precautions

1.1 Before supplying Power to the Inverter



Warning

The main circuit must be correctly wired. For single phase supply use input terminals (R/L1, T/L3) and for three phase supply use input terminals (R/L1, S/L2, T/L3). Terminals U/T1, V/T2, W/T3 must only be used to connect the motor. Connecting the input supply to any of the U/T1, V/T2 or W/T3 terminals will cause damage to the inverter.



Caution

- To avoid the front cover from disengaging or other physical damage, do not carry the inverter by its cover. Support the unit by its heat sink when transporting. Improper handling can damage the inverter or injure personnel, and should be avoided.
- To avoid the risk of fire, do not install the inverter on or near flammable objects. Install on nonflammable objects such as metal surfaces.
- If several inverters are placed inside the same control enclosure, provide adequate ventilation to maintain the temperature below 40°C/104°F (50°C/122°F without a dust cover) to avoid overheating or fire.
- When removing or installing the digital operator, turn off the power first, and then follow the instructions in this manual to avoid operator error or loss of display caused by faulty connections.



Warning

This product is sold subject to IEC 61800-3. In a domestic environment this product may cause radio interference in which case the user may need to apply corrective measures.

1.2 Wiring



Warning

- Always turn OFF the power supply before attempting inverter installation and wiring of the user terminals.
- Wiring must be performed by a qualified personnel / certified electrician.
- Make sure the inverter is properly grounded. (230V Class: Grounding impedance shall be less than 100Ω. 460V Class: Grounding impedance shall be less than 10Ω.)
- Please check and test emergency stop circuits after wiring. (Installer is responsible for the correct wiring.)
- Never touch any of the input or output power lines directly or allow any input or output power lines to come in contact with the inverter case.
- Do not perform a dielectric voltage withstand test (megger) on the inverter this will result in inverter damage to the semiconductor components.



Caution

- The line voltage applied must comply with the inverter's specified input voltage. (See product nameplate section 2.1)
- Connect braking resistor and braking unit to the designated terminals. (See section 3.10)
- Do not connect a braking resistor directly to the DC terminals P(+) and N(-), otherwise fire may result.
- Use wire gauge recommendations and torque specifications. (See Wire Gauge and Torque Specification section 3.6)
- Never connect input power to the inverter output terminals U/T1, V/T2, W/T3.
- Do not connect a contactor or switch in series with the inverter and the motor.
- Do not connect a power factor correction capacitor or surge suppressor to the inverter output.
- Ensure the interference generated by the inverter and motor does not affect peripheral devices.

1.3 Before Operation



Warning

- Make sure the inverter capacity matches the parameters 13-00.
- Reduce the carrier frequency (parameter 11-01) if the cable from the inverter to the motor is greater than 80 ft (25m), refer to table 3.14.1. 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 an inaccurate current readout.
- Be sure to install all covers before turning on power. Do not remove any of the covers while power to the inverter is on, otherwise electric shock may occur.
- Do not operate switches with wet hands, otherwise electric shock may result.
- Do not touch inverter terminals when energized even if inverter has stopped, otherwise electric shock may result.

1.4 Parameter Setting



Caution

- Do not connect a load to the motor while performing a rotational auto-tune.
- Make sure the motor can freely run and there is sufficient space around the motor when performing a rotational auto-tune.

1.5 Operation



Warning

- Be sure to install all covers before turning on power. Do not remove any of the covers while power to the inverter is on, otherwise electric shock may occur.
- Do not connect or disconnect the motor during operation. This will cause the inverter to trip and may cause damage to the inverter.
- Operations may start suddenly if an alarm or fault is reset with a run command active. Confirm that no run command is active upon resetting the alarm or fault, otherwise accidents may occur.
- Do not operate switches with wet hands, otherwise electric shock may result.
- All F510 inverters have an independent external hardware emergency switch, which immediately shuts down the inverter output in the case of danger.
- If automatic restart after power recovery (parameter 07-00) is enabled, the inverter will start automatically after power is restored.
- Make sure it is safe to operate the inverter and motor before performing a rotational auto-tune.
- Do not touch inverter terminals when energized even if inverter has stopped, otherwise electric shock may result.
- Do not check signals on circuit boards while the inverter is running.
- After the power is turned off, the cooling fan may continue to run for some time.



Caution

- Do not touch heat-generating components such as heat sinks and braking resistors.
- Carefully check the performance of motor or machine before operating at high speed, otherwise Injury may result.
- Note the parameter settings related to the braking unit when applicable.
- Do not use the inverter braking function for mechanical holding, otherwise injury may result.
- Do not check signals on circuit boards while the inverter is running.

1.6 Maintenance, Inspection and Replacement



Warning

- Wait a minimum of five minutes after power has been turned OFF before starting an inspection. Also confirm that the charge light is OFF and that the DC bus voltage has dropped below 25Vdc.
- Never touch high voltage terminals in the inverter.
- Make sure power to the inverter is disconnected before disassembling the inverter.
- Only authorized personnel should perform maintenance, inspection, and replacement operations. (Remove any metal jewelry such as watches and rings and use insulated tools.)



Caution

- The Inverter can be used in an environment with a temperature range from 14° -104°F (-10-40°C) and relative humidity of 95% non-condensing.
- The inverter must be operated in a dust, gas, mist and moisture free environment.

1.7 Disposal of the Inverter



Caution

- Please dispose of this unit with care as an industrial waste and according to your any local regulations.
- The capacitors of inverter main circuit and printed circuit board are considered as hazardous waste and must not be burned.
- The Plastic enclosure and parts of the inverter such as the top cover board will release harmful gases if burned.

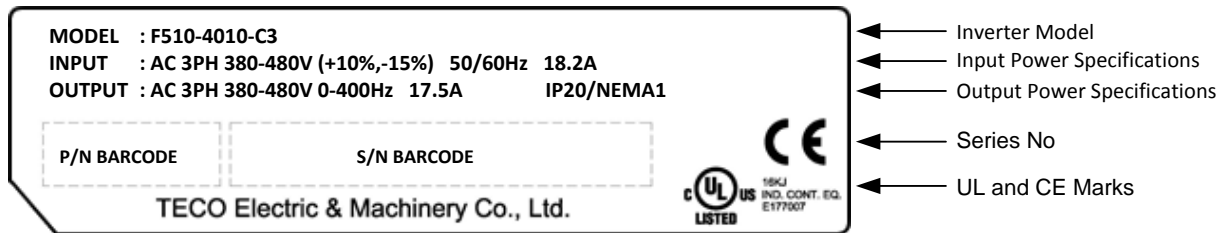
2. Model Description

2.1 Nameplate Data

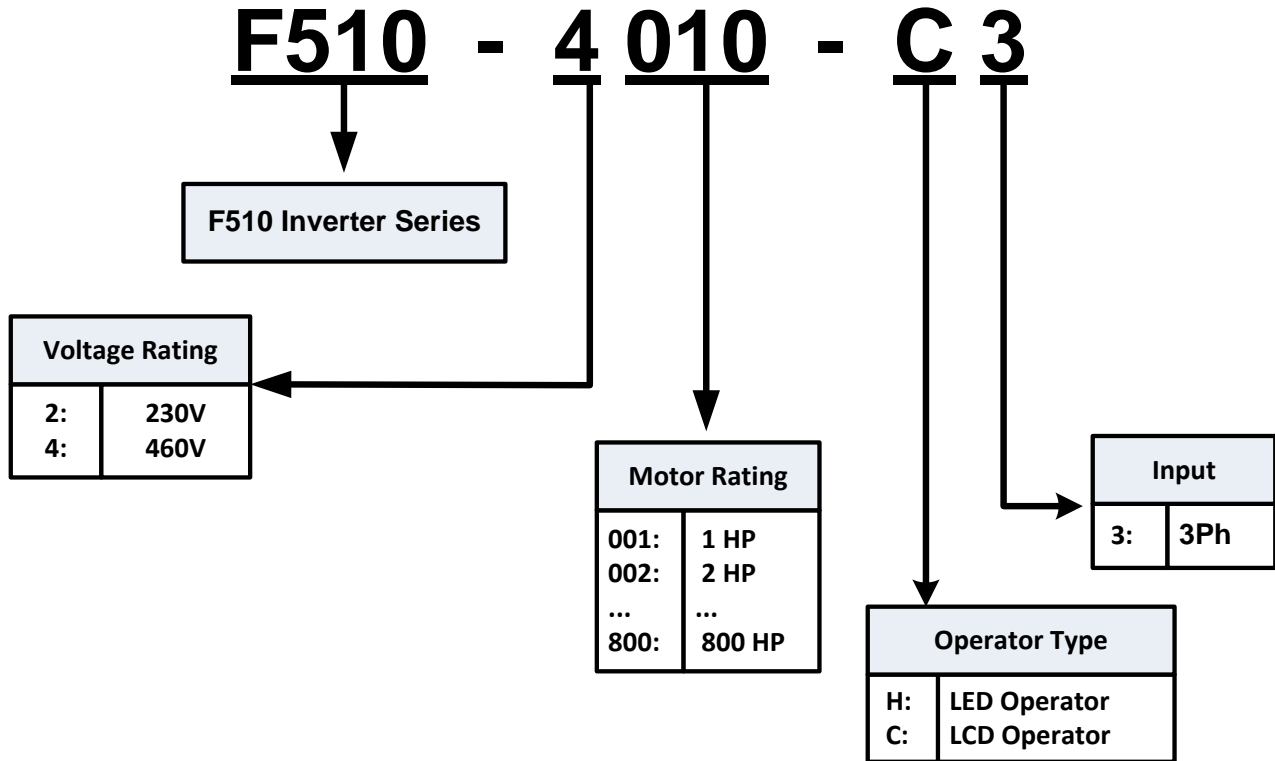
It is essential to verify the F510 inverter nameplate and make sure that the F510 inverter has the correct rating so it can be applied with the proper sized AC motor.

Unpack the F510 inverter and check the following:

- (1) The F510 inverter and instruction manual (this document) are contained in the package.
- (2) The F510 inverter has not been damaged during transportation there should be no dents or parts missing.
- (3) The F510 inverter is the correct ratings as ordered. Check the type and specifications on the main nameplate.
- (4) Check that the input voltage range meets the input power requirements.
- (5) Ensure that the motor full load amp rating matches the output rating of the inverter.



Model Identification



2.2 Inverter Models – Motor Power Rating (ND – Normal Duty / Variable Torque)

230V Class

| Voltage (Vac) / Frequency (Hz) | F510 Model | Motor Power (HP) | Applied Motor (kW) | Operator | |
|---|----------------|---------------------|-----------------------|----------|-----|
| | | | | LED | LCD |
| 3ph 200~240V +10%/-15% 50/60Hz | F510-2001-H-U | 1 | 0.75 | ⊙ | |
| | F510-2001-C-U | 1 | 0.75 | | ⊙ |
| | F510-2002-H-U | 2 | 1.5 | ⊙ | |
| | F510-2002-C-U | 2 | 1.5 | | ⊙ |
| | F510-2003-H-U | 3 | 2.2 | ⊙ | |
| | F510-2003-C-U | 3 | 2.2 | | ⊙ |
| | F510-2005-H3-U | 5 | 3.7 | ⊙ | |
| | F510-2005-C3-U | 5 | 3.7 | | ⊙ |
| | F510-2008-H3-U | 7.5 | 5.5 | ⊙ | |
| | F510-2008-C3-U | 7.5 | 5.5 | | ⊙ |
| | F510-2010-H3-U | 10 | 7.5 | ⊙ | |
| | F510-2010-C3-U | 10 | 7.5 | | ⊙ |
| | F510-2015-H3-U | 15 | 11 | ⊙ | |
| | F510-2015-C3-U | 15 | 11 | | ⊙ |
| | F510-2020-H3-U | 20 | 15 | ⊙ | |
| | F510-2020-C3-U | 20 | 15 | | ⊙ |
| | F510-2025-H3-U | 25 | 18.5 | ⊙ | |
| | F510-2025-C3-U | 25 | 18.5 | | ⊙ |
| | F510-2030-H3-U | 30 | 22 | ⊙ | |
| | F510-2030-C3-U | 30 | 22 | | ⊙ |
| | F510-2040-H3-U | 40 | 30 | ⊙ | |
| | F510-2040-C3-U | 40 | 30 | | ⊙ |
| | F510-2050-H3-U | 50 | 37 | ⊙ | |
| | F510-2050-C3-U | 50 | 37 | | ⊙ |
| | F510-2060-H3-U | 60 | 45 | ⊙ | |
| | F510-2060-C3-U | 60 | 45 | | ⊙ |
| | F510-2075-H3-U | 75 | 55 | ⊙ | |
| | F510-2075-C3-U | 75 | 55 | | ⊙ |
| | F510-2100-H3-U | 100 | 75 | ⊙ | |
| | F510-2100-C3-U | 100 | 75 | | ⊙ |
| F510-2125-H3-U | 125 | 94 | ⊙ | | |
| F510-2125-C3-U | 125 | 94 | | ⊙ | |
| F510-2150-H3-U | 150 | 112 | ⊙ | | |
| F510-2150-C3-U | 150 | 112 | | ⊙ | |
| F510-2175-H3-U | 175 | 130 | ⊙ | | |
| F510-2175-C3-U | 175 | 130 | | ⊙ | |

Note: Short Circuit Rating: 200V Class: 5KA.

460V Class

| Voltage (Vac) / Frequency (Hz) | F510 Model | Motor Power (HP) | Applied Motor (kW) | Operator | |
|---|----------------|---------------------|-----------------------|----------|-----|
| | | | | LED | LCD |
| 3ph 380~480V +10%/-15% 50/60Hz | F510-4005-H3-U | 5 | 3.7 | ☉ | |
| | F510-4005-C3-U | 5 | 3.7 | | ☉ |
| | F510-4008-C3-U | 7.5 | 5.5 | | ☉ |
| | F510-4010-C3-U | 10 | 7.5 | | ☉ |
| | F510-4015-C3-U | 15 | 11 | | ☉ |
| | F510-4020-C3-U | 20 | 15 | | ☉ |
| | F510-4025-C3-U | 25 | 18.5 | | ☉ |
| | F510-4030-C3-U | 30 | 22 | | ☉ |
| | F510-4040-C3-U | 40 | 30 | | ☉ |
| | F510-4050-H3-U | 50 | 37 | ☉ | |
| | F510-4050-C3-U | 50 | 37 | | ☉ |
| | F510-4060-H3-U | 60 | 45 | ☉ | |
| | F510-4060-C3-U | 60 | 45 | | ☉ |
| | F510-4075-H3-U | 75 | 55 | ☉ | |
| | F510-4075-C3-U | 75 | 55 | | ☉ |
| | F510-4100-H3-U | 100 | 75 | ☉ | |
| | F510-4100-C3-U | 100 | 75 | | ☉ |
| | F510-4125-H3-U | 125 | 94 | ☉ | |
| | F510-4125-C3-U | 125 | 94 | | ☉ |
| | F510-4150-H3-U | 150 | 112 | ☉ | |
| | F510-4150-C3-U | 150 | 112 | | ☉ |
| | F510-4175-H3-U | 175 | 130 | ☉ | |
| | F510-4175-C3-U | 175 | 130 | | ☉ |
| | F510-4215-H3-U | 215 | 160 | ☉ | |
| F510-4215-C3-U | 215 | 160 | | ☉ | |
| F510-4250-H3-U | 250 | 185 | ☉ | | |
| F510-4250-C3-U | 250 | 185 | | ☉ | |

Note: Short Circuit Rating: 460V Class: 5KA.

460V Class (Continued)

| Voltage (Vac) / Frequency (Hz) | F510 Model | Motor Power (HP) | Applied Motor (kW) | Operator | |
|---|----------------|---------------------|-----------------------|----------|-----|
| | | | | LED | LCD |
| 3ph 380~480V +10%/-15% 50/60Hz | F510-4300-H3-U | 300 | 220 | ⊙ | |
| | F510-4300-C3-U | 300 | 220 | | ⊙ |
| | F510-4375-H3-U | 375 | 280 | ⊙ | |
| | F510-4375-C3-U | 375 | 280 | | ⊙ |
| | F510-4425-H3-U | 425 | 317 | ⊙ | |
| | F510-4425-C3-U | 425 | 317 | | ⊙ |
| | F510-4535-H3-U | 535 | 400 | ⊙ | |
| | F510-4535-C3-U | 535 | 400 | | ⊙ |
| | F510-4670-H3-U | 670 | 500 | ⊙ | |
| | F510-4670-C3-U | 670 | 500 | | ⊙ |
| | F510-4800-H3-U | 800 | 600 | ⊙ | |
| | F510-4800-C3-U | 800 | 600 | | ⊙ |

Note: Short Circuit Rating: 400V Class: 5KA.

3. Environment and Installation

3.1 Environment

The environment will directly affect the proper operation and the life span of the inverter. To ensure that the inverter will give maximum service life, please comply with the following environmental conditions:

| | |
|------------------------------|--|
| Protection | |
| Protection Class | IP20 / NEMA 1 or IP00 |
| | NEMA 12 |
| Operating Temperature | Ambient Temperature: (-10°C to +40°C (14 to 104 °F) Without Cover: -10°C to +50°C (14 to 122 °F) If several inverters are placed in the same control panel, provide additional cooling to maintain ambient temperatures below 40°C |
| Storage Temperature | -20°C - +70°C (-4 to 158 °F) |
| Humidity: | 95% non-condensing Relative humidity 5% to 95%, free of moisture. (Follow IEC60068-2-78 standard) |
| Altitude: | < 3,281 ft. (1000m) |
| Installation Site: | Avoid exposure to rain or moisture. |
| | Avoid direct sunlight. |
| | Avoid oil mist and salinity. |
| | Avoid corrosive liquid and gas. |
| | Avoid dust, lint fibers, and metal filings. |
| | Keep away from radioactive and flammable materials. |
| | Avoid electromagnetic interference (soldering machines, power machines). |
| | Avoid vibration (stamping, punching machines etc.). Add a vibration-proof pad if vibration cannot be avoided. |
| Shock | Maximum acceleration: 1.2G (12m/s ²), from 49.84 to 150 Hz Displacement amplitude : 0.3mm (peak value), from 10 to 49.84 Hz (Follow IEC60068-2-6 standard) |

3.2 Installation

When installing the inverter, ensure that inverter is installed in upright position (vertical direction) and there is adequate space around the unit to allow normal heat dissipation as per the following Fig. 3.2.1

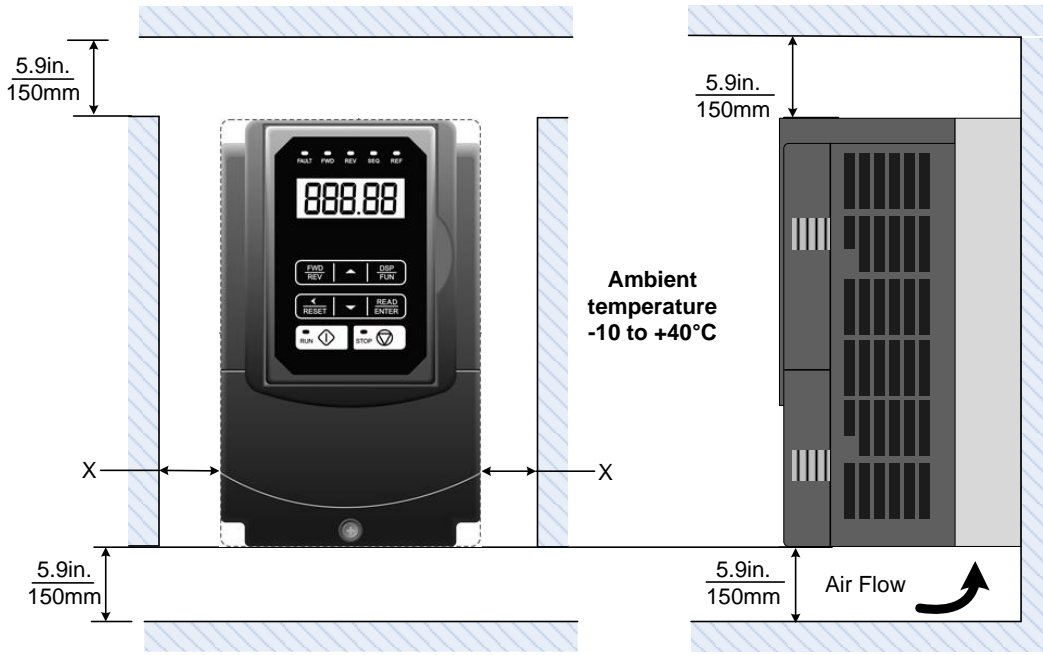


Fig 3.2.1: F510 Installation space

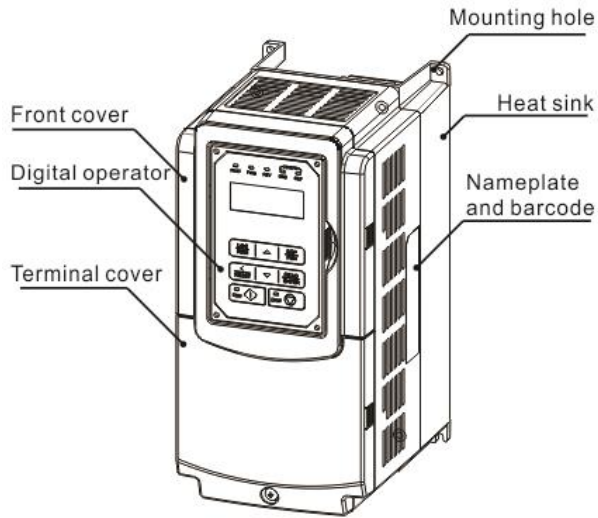
X = 1.18" (30mm) for inverter ratings up to 25HP

X = 1.96" (50mm) for inverter ratings 30HP or higher

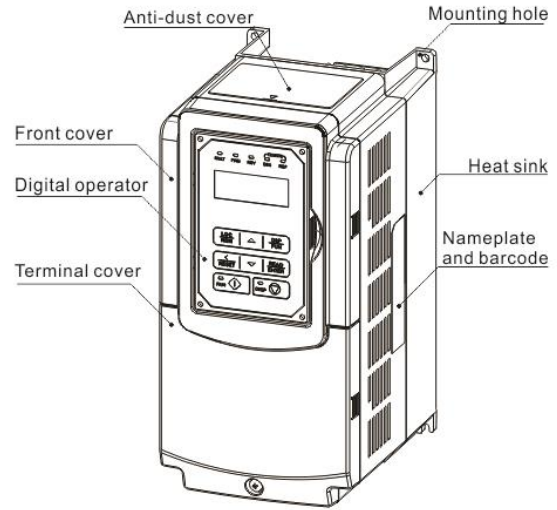
Important Note: The inverter heatsink temperature can reach up to 194°F / 90°C during operation; Use insulation material rated for this temperature.

3.3 External View

(a) 200V 1-7.5HP/ 400V 1-10HP

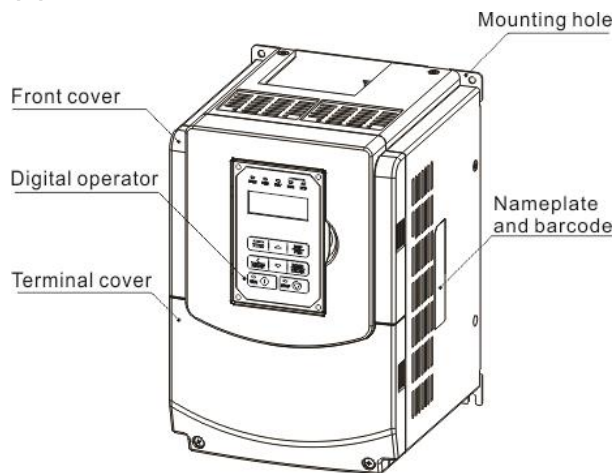


(Wall-mounted type, IEC IP00)

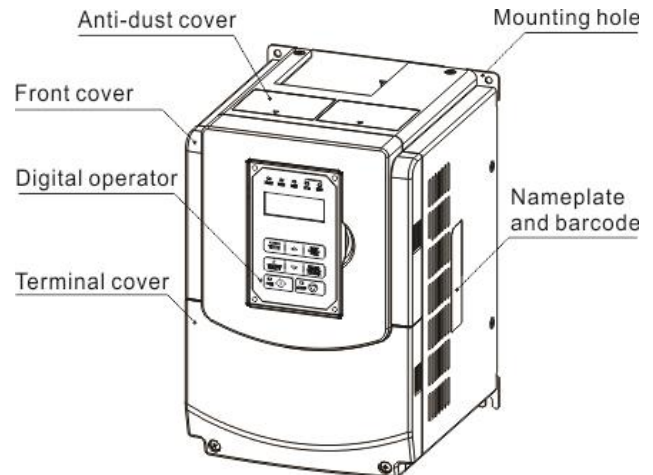


(Wall-mounted type, IEC IP20, NEMA1)

(b) 200V 10-30HP/ 400V 15-40HP

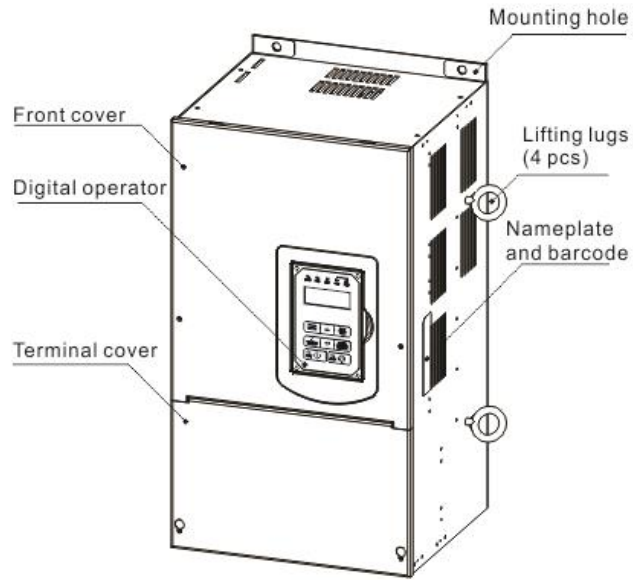


(Wall-mounted type, IEC IP00)



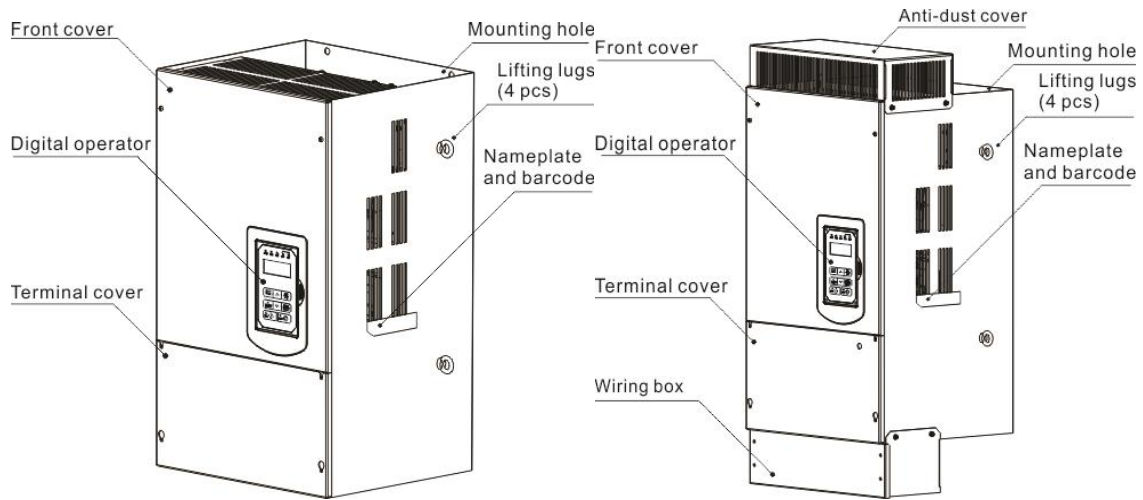
(Wall-mounted type, IEC IP20, NEMA1)

(c) 200V 40-50HP/ 400V 50-75HP



(Wall-mounted type, IEC IP20, NEMA1)

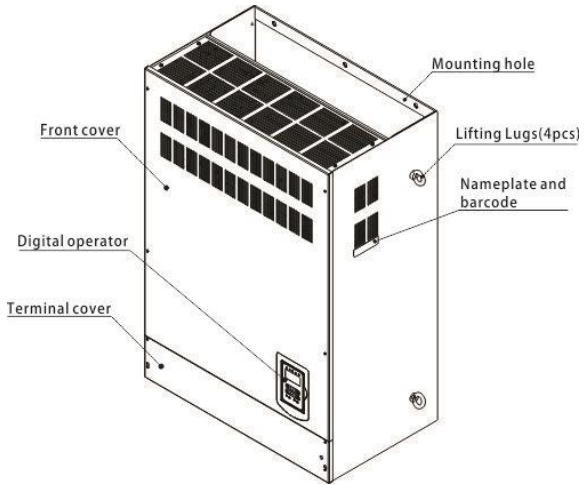
(d) 200V 60-125HP/ 400V 100-250HP



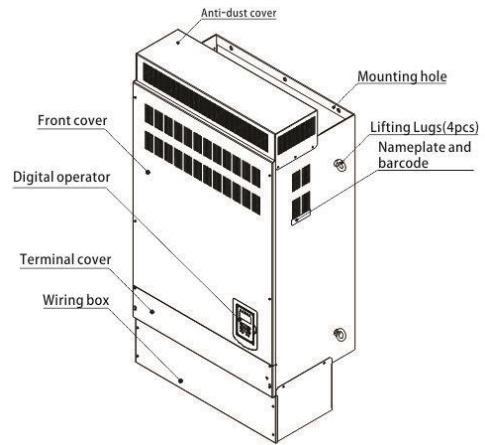
(Wall-mounted type, IEC IP00)

(Wall-mounted type, IEC IP20, NEMA1)

(e) 200V 150-175HP/ 400V 300-425HP

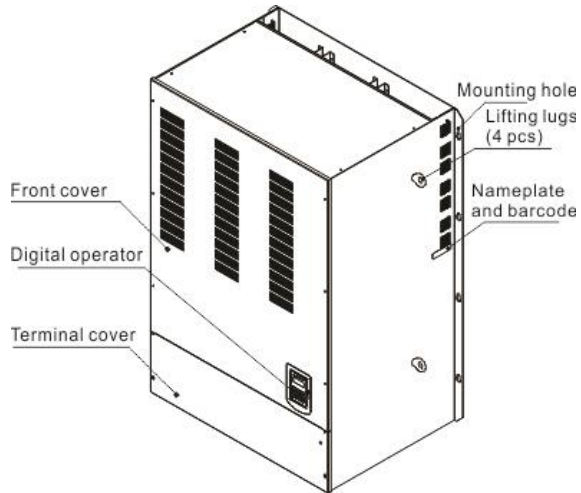


(Wall-mounted type, IEC IP00)

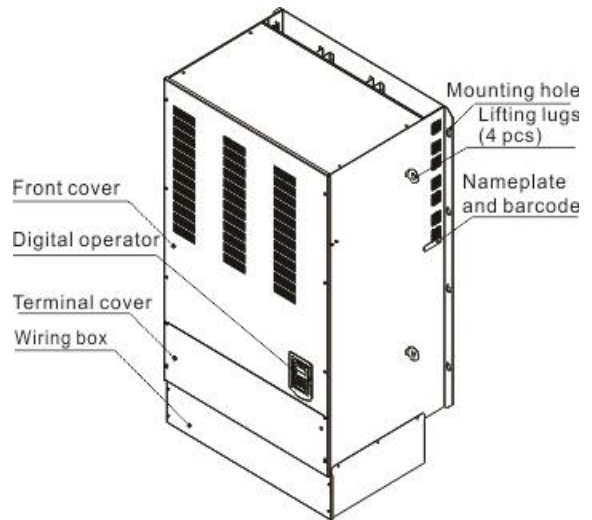


(Wall-mounted type, IEC IP20)

(f) 400V 535-800HP



(Wall-mounted type, IEC IP00)



(Wall-mounted type, IEC IP20)

3.4 Warning Labels

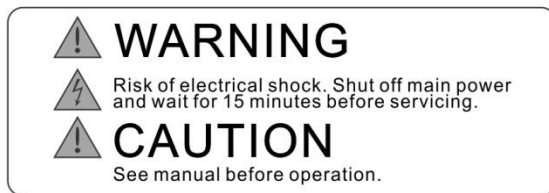
Important: Warning information located on the front cover must be read upon installation of the inverter.



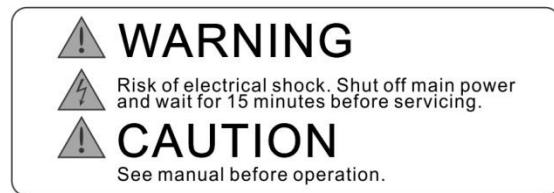
(a) 200V: 5 ~ 7.5HP / 400V: 5 ~ 10HP (IP20)



(b) 200V: 10 ~ 15HP / 400V: 15 ~ 20HP



(c) 200V: 20 ~ 125HP / 400V: 20 ~ 250HP



(d) 400V: 5 ~ 100HP / 400V: 5 ~ 100HP

3.5 Removing the Front Cover and Keypad

IP00 / IP20

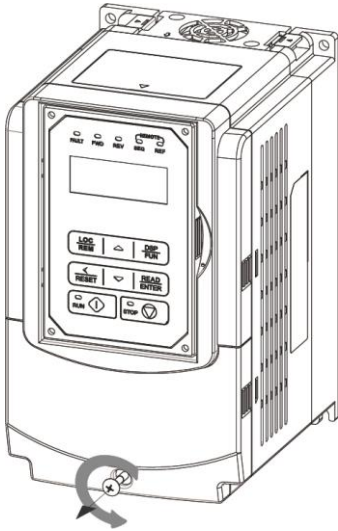


Caution

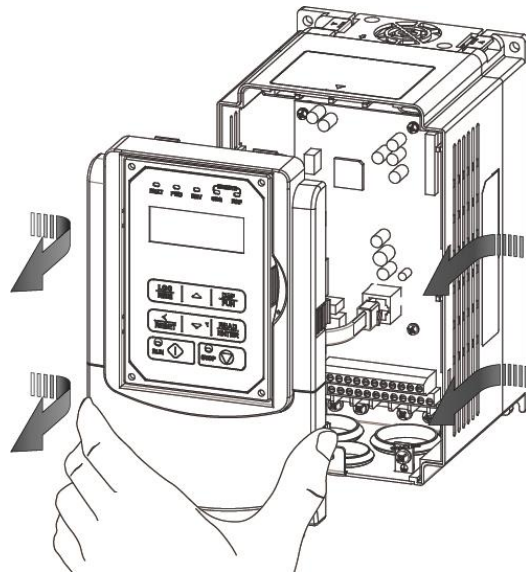
- Before making any wiring connections to the inverter the front cover needs to be removed.
- It is not required to remove the digital operator before making any wiring connections.
- Models 200V, 1 – 30 HP and 400V, 1 – 40 HP have a plastic cover. Loosen the screws and remove the cover to gain access to the terminals and make wiring connections. Place the plastic cover back and fasten screws when wiring connections have been made.
- Models 200V, 40 -175 HP and 400V, 50 – 800 HP have a metal cover. Loosen the screws and remove the cover to gain access to the terminals and make wiring connections. Place the metal cover back and fasten screws when wiring connections have been made.

3.5.1 Standard Type

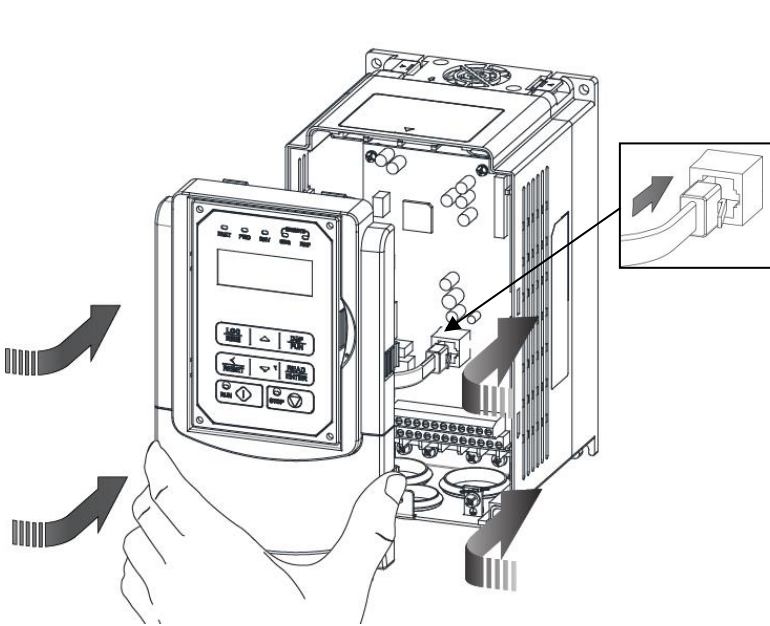
(a) 200V 1-3HP/ 400V 1-3HP



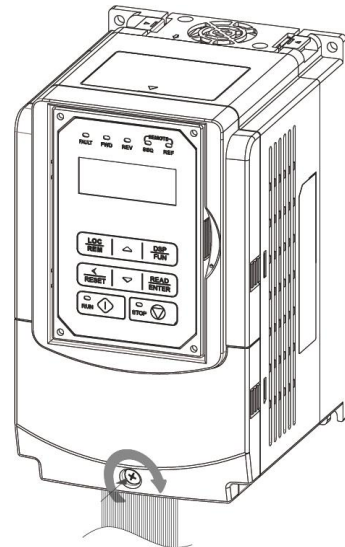
Step 1: Unscrew cover



Step 2: Remove cover and unplug RJ45connector

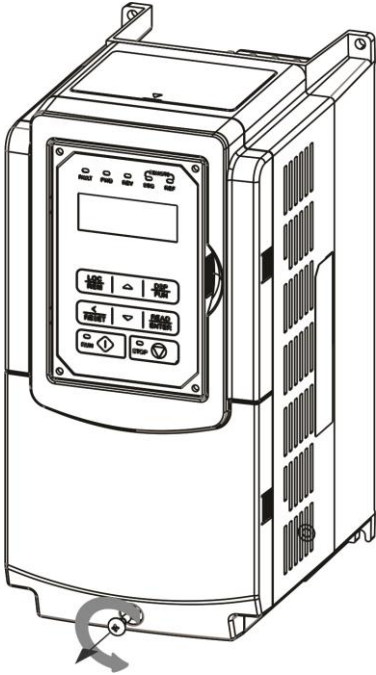


Step 3: Make wire connections, insert RJ45 connector and reinstall cover

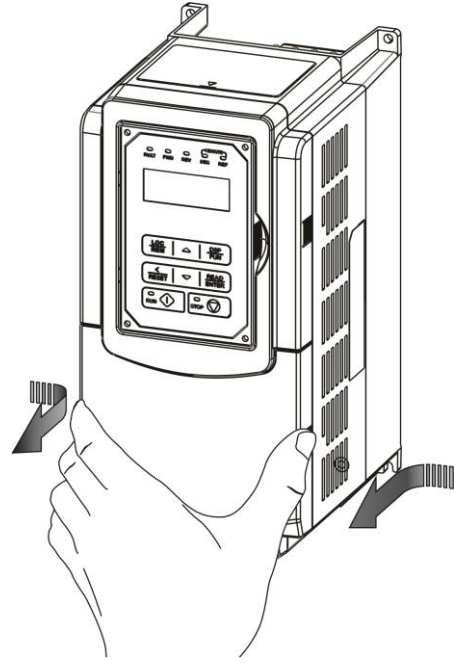


Step 4: Fasten screw

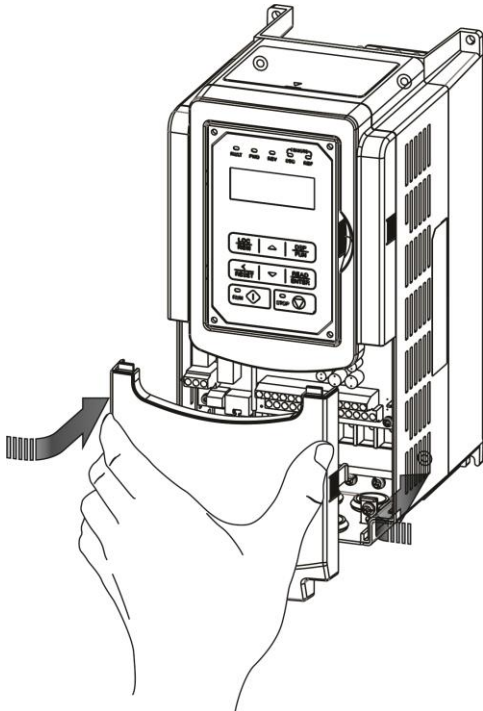
(b) 200V: 5 ~ 7.5 HP / 400V: 5 ~ 10 HP



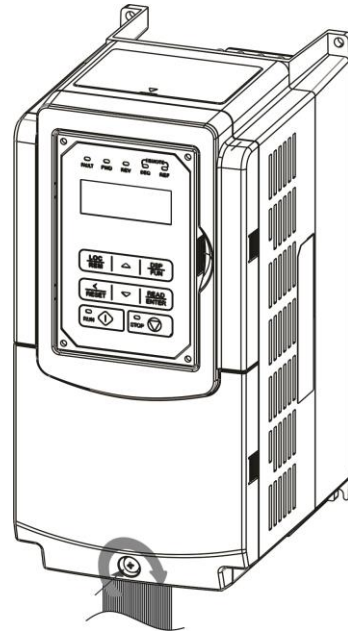
Step 1: Unscrew cover



Step 2: Remove cover

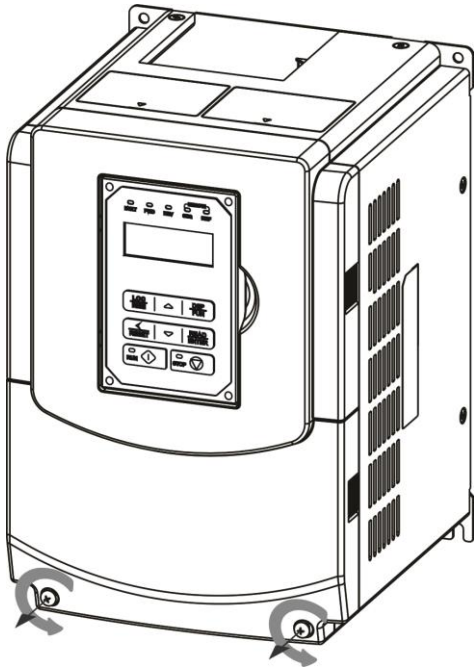


Step 3: Make wire connections and reinstall cover

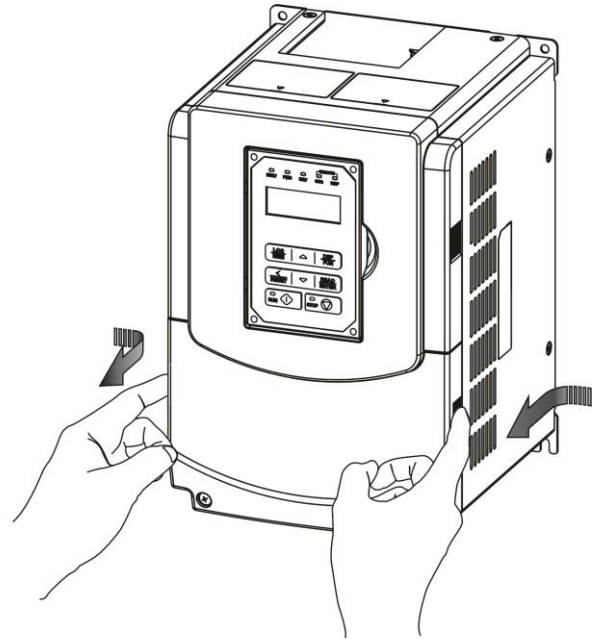


Step 4: Fasten screw

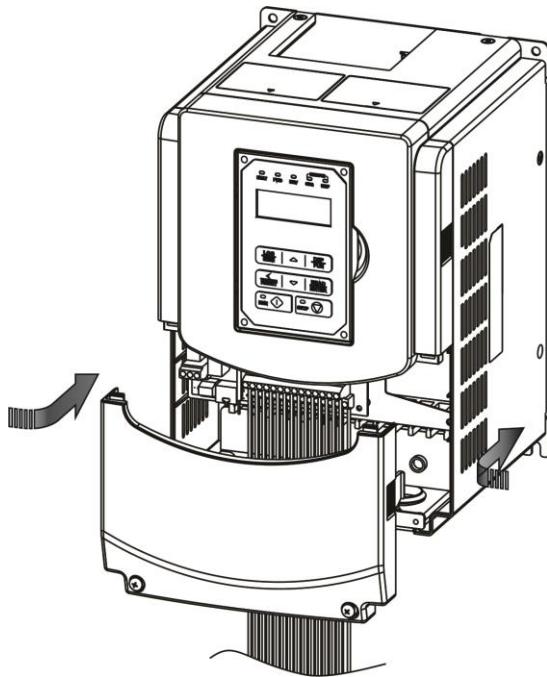
(c) 200V: 5 ~ 7.5 HP / 400V: 5 ~ 10 HP



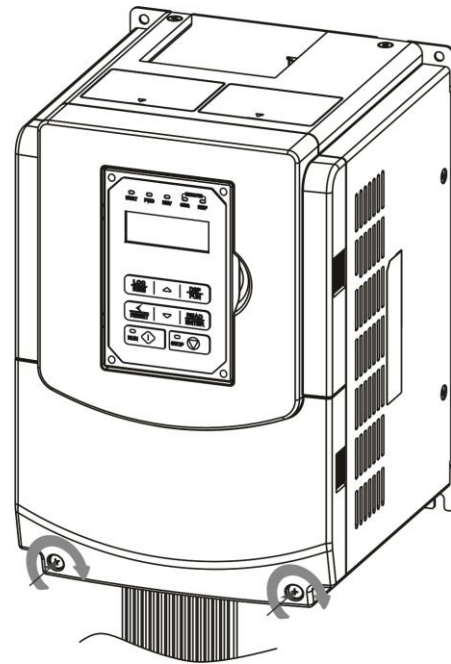
Step 1: Unscrew cover



Step 2: Remove cover

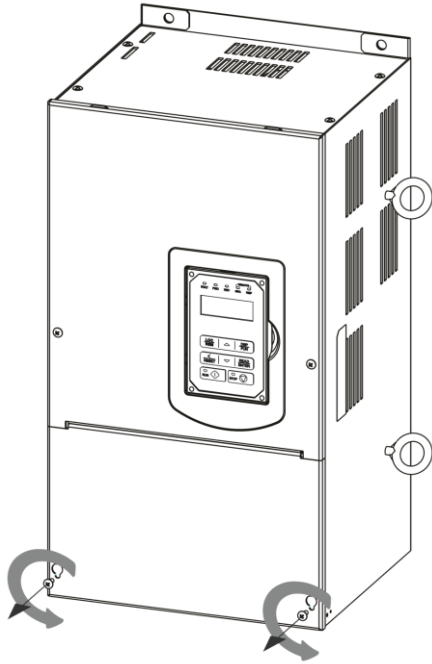


Step 3: Make wire connections and reinstall cover

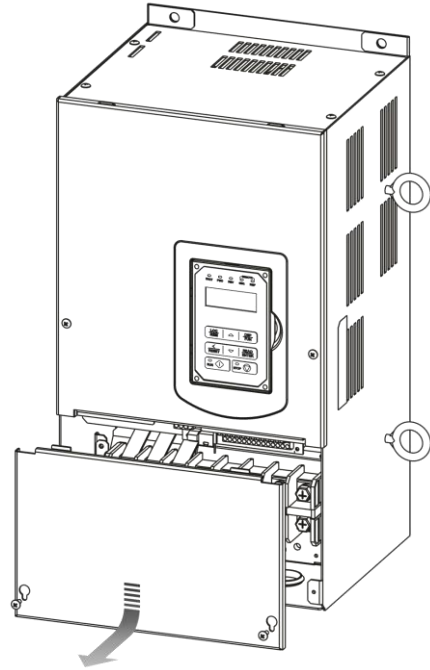


Step 4: Fasten screws

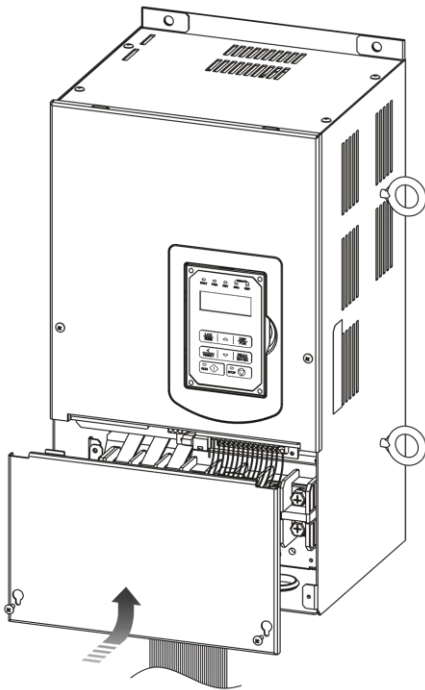
(d) 200V: 40 ~ 50 HP / 400V: 50 ~ 75 HP



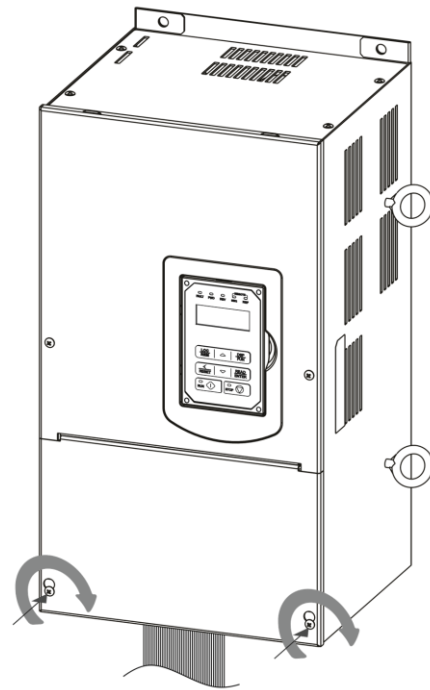
Step 1: Unfasten screw on cover



Step 2: Remove cover

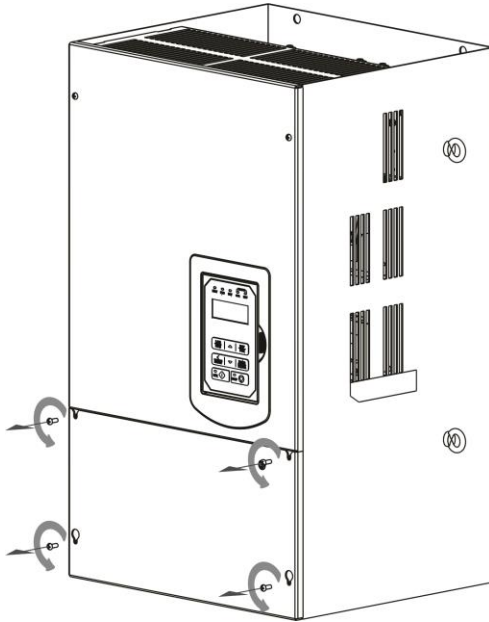


Step 3: Make wire connections and reinstall cover

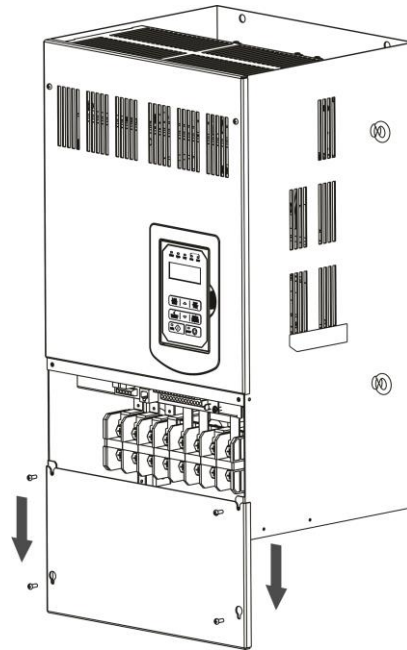


Step 4: Fasten screws

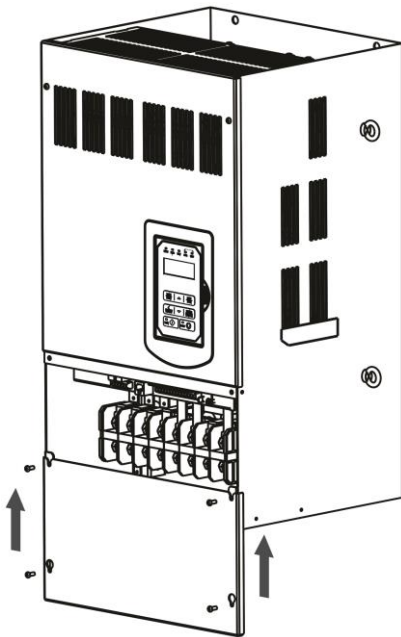
(e) 200V: 60 ~ 125 HP / 400V: 100 ~ 250 HP



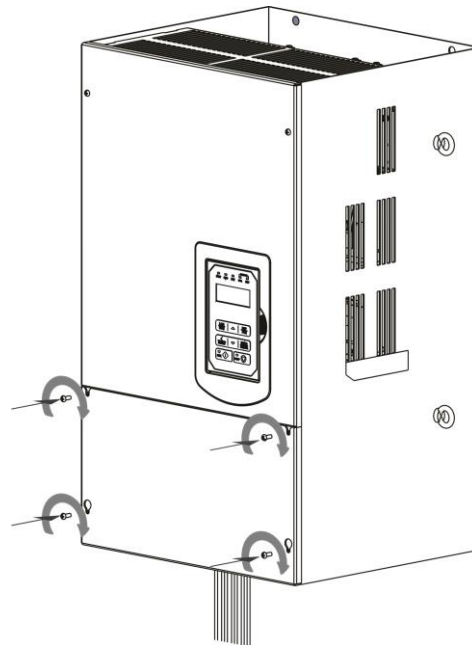
Step 1: Unfasten screw on cover



Step 2: Remove cover

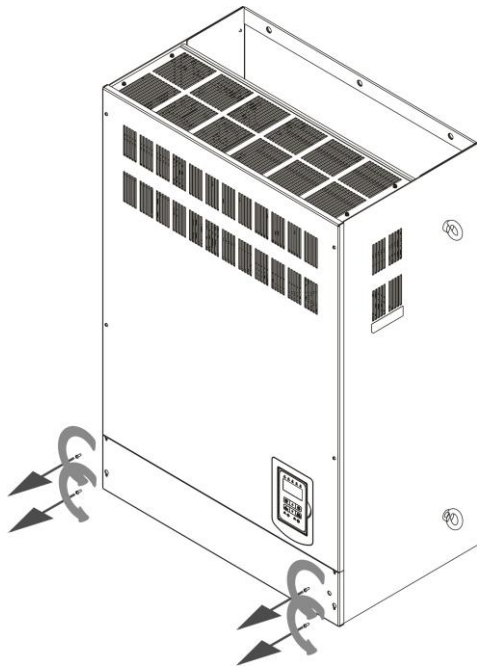


Step 3: Make wire connections and reinstall cover

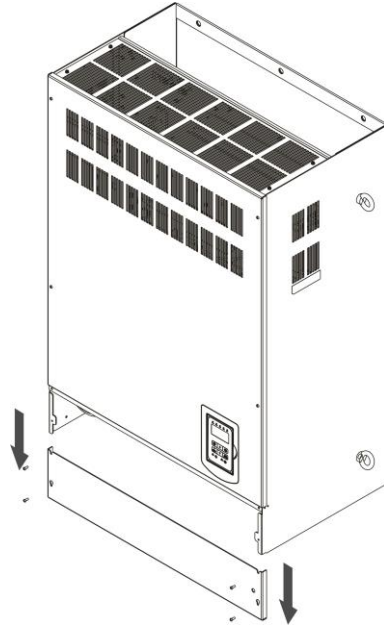


Step 4: Fasten screws

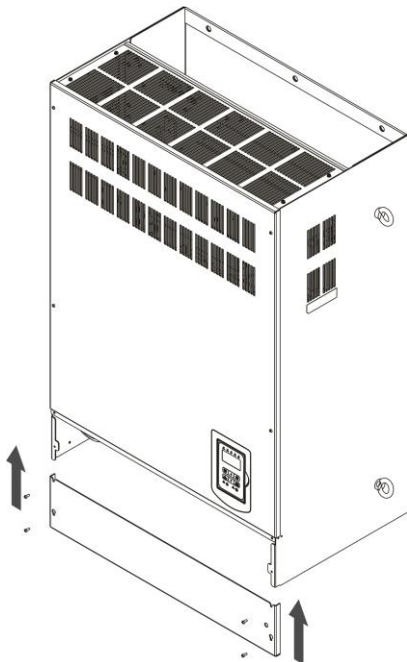
(f) 200V 150-175HP/ 400V 300-425HP



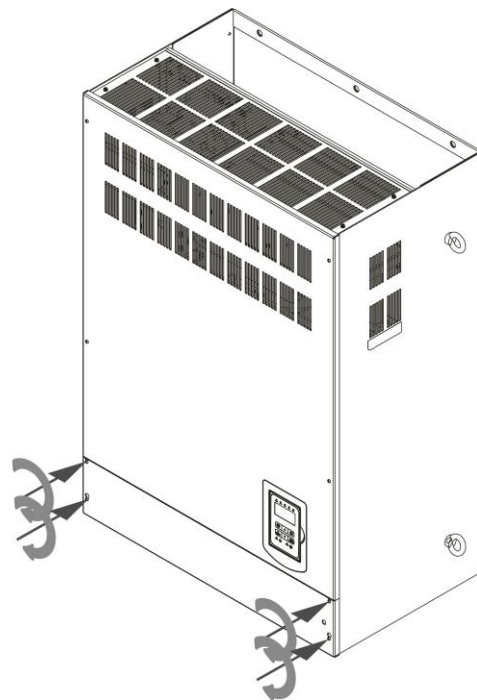
Step 1: Unscrew cover



Step 2: Remove cover

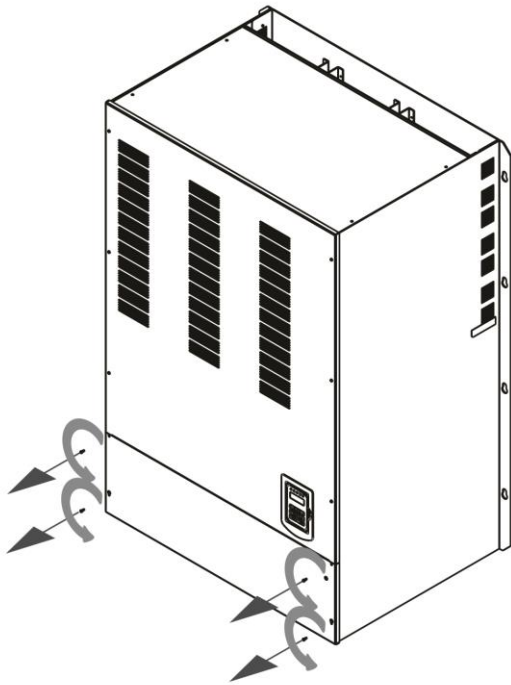


Step 3: Make wire connections and place cover back

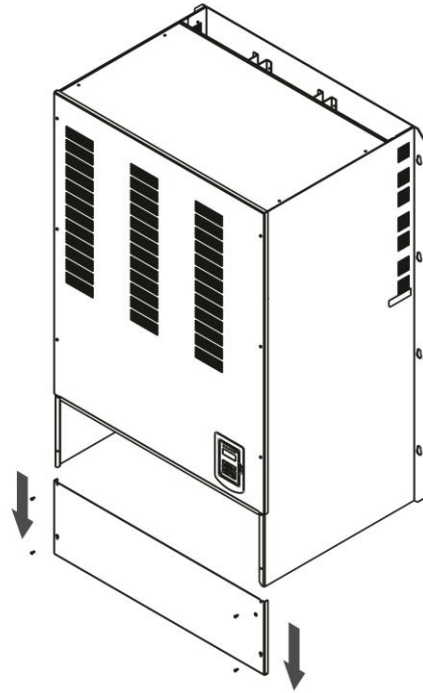


Step 4: Fasten screws

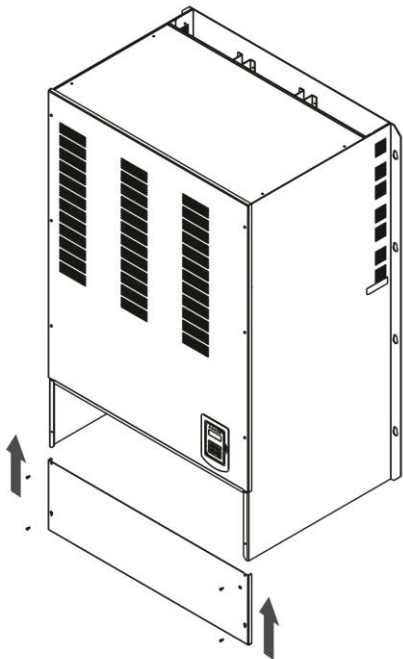
(g) 400V 535-800HP



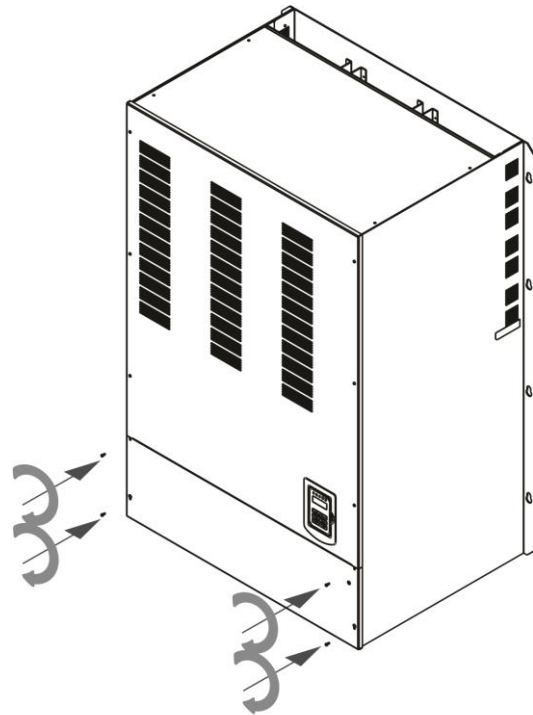
Step 1: Unscrew cover



Step 2: Remove cover



Step 3: Make wire connections and place cover back



Step 4: Fasten screws

3.6 Wire Gauges and Tightening Torque

To comply with UL standards, use UL approved copper wires (rated 75° C) and round crimp terminals (UL Listed products) as shown in table below when connecting to the main circuit terminals. TECO recommends using crimp terminals manufactured by NICHIFU Terminal Industry Co., Ltd and the terminal crimping tool recommended by the manufacturer for crimping terminals and the insulating sleeve.

| Wire size mm ² (AWG) | Terminal Screw size | Round crimp terminal PN | Tightening torque kgf.cm (in.lbs) | Insulating sleeve PN | Crimp tool PN |
|------------------------------------|------------------------|----------------------------|--------------------------------------|-------------------------|---------------|
| 0.75 (18) | M3.5 | R1.25-3.5 | 8.2 to 10 (7.1 to 8.7) | TIC 1.25 | NH 1 |
| | M4 | R1.25-4 | 12.2 to 14 (10.4 to 12.1) | TIC 1.25 | NH 1 |
| 1.25 (16) | M3.5 | R1.25-3.5 | 8.2 to 10 (7.1 to 8.7) | TIC 1.25 | NH 1 |
| | M4 | R1.25-4 | 12.2 to 14 (10.4 to 12.1) | TIC 1.25 | NH 1 |
| 2 (14) | M3.5 | R2-3.5 | 8.2 to 10 (7.1 to 8.7) | TIC 2 | NH 1 / 9 |
| | M4 | R2-4 | 12.2 to 14 (10.4 to 12.1) | TIC 2 | NH 1 / 9 |
| | M5 | R2-5 | 22.1 to 24 (17.7 to 20.8) | TIC 2 | NH 1 / 9 |
| | M6 | R2-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 2 | NH 1 / 9 |
| 3.5/5.5 (12/10) | M4 | R5.5-4 | 12.2 to 14 (10.4 to 12.1) | TIC 3.5/5.5 | NH 1 / 9 |
| | M5 | R5.5-5 | 20.4 to 24 (17.7 to 20.8) | TIC 3.5/5.5 | NH 1 / 9 |
| | M6 | R5.5-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 3.5/5.5 | NH 1 / 9 |
| | M8 | R5.5-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 3.5/5.5 | NH 1 / 9 |
| 8 (8) | M4 | R8-4 | 12.2 to 14 (10.4 to 12.1) | TIC 8 | NOP 60 |
| | M5 | R8-5 | 20.4 to 24 (17.7 to 20.8) | TIC 8 | NOP 60 |
| | M6 | R8-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 8 | NOP 60 |
| | M8 | R8-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 8 | NOP 60 |
| 14 (6) | M4 | R14-4 | 12.2 to 14 (10.4 to 12.1) | TIC 14 | NH 1 / 9 |
| | M5 | R14-5 | 20.4 to 24 (17.7 to 20.8) | TIC 14 | NH 1 / 9 |
| | M6 | R14-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 14 | NH 1 / 9 |
| | M8 | R14-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 14 | NH 1 / 9 |
| 22 (4) | M6 | R22-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 22 | NOP 60/ 150H |
| | M8 | R22-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 22 | NOP 60/ 150H |
| 30/38 (3 / 2) | M6 | R38-6 | 25.5 to 30.0 (22.1 to 26.0) | TIC 38 | NOP 60/ 150H |
| | M8 | R38-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 38 | NOP 60/ 150H |
| 50/ 60 (1/ 1/ 0) | M8 | R60-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 60 | NOP 60/ 150H |
| | M10 | R60-10 | 102 to 120 (88.5 to 104) | TIC 60 | NOP 150H |
| 70 (2/0) | M8 | R70-8 | 61.2 to 66.0 (53.0 to 57.2) | TIC 60 | NOP 150H |
| | M10 | R70-10 | 102 to 120 (88.5 to 104) | TIC 60 | NOP 150H |
| 80 (3/0) | M10 | R80-10 | 102 to 120 (88.5 to 104) | TIC 80 | NOP 150H |
| | M16 | R80-16 | 255 to 280 (221 to 243) | TIC 80 | NOP 150H |
| 100 (4/0) | M10 | R100-10 | 102 to 120 (88.5 to 104) | TIC 100 | NOP 150H |
| | M12 | R100-12 | 143 to 157 (124 to 136) | TIC 100 | NOP 150H |
| | M16 | R80-16 | 255 to 280 (221 to 243) | TIC 80 | NOP 150H |

3.7 Wiring Peripheral Power Devices



Caution

- After power is shut off to the inverter the capacitors will slowly discharge. Do NOT touch and of the inverter circuitry or replace any components until the “CHARGE” indicator is off.
- Do NOT wire or connect/disconnect internal connectors of the inverter when the inverter is powered up or when powered off and the “CHARGE” indicator is on.
- Do NOT connect inverter output U, V and W to the supply power. This will result in damage to the inverter.
- The inverter must be properly grounded. Use terminal E to connect earth ground and comply with local standards.
- Do NOT perform a dielectric voltage withstand test (Megger) on the inverter this will result in inverter damage to the semiconductor components.
- Do NOT touch any of the components on the inverter control board to prevent damage to the inverter by static electricity.



Caution

- Refer to the recommended wire size table for the appropriate wire to use. The voltage between the power supply and the input of the inverter may not exceed 2%.

$$\text{Phase-to-phase voltage drop (V)} = \sqrt{3} \times \text{resistance of wire } (\Omega/\text{km}) \times \text{length of line (m)} \times \text{current} \times 10^{-3}.$$


(km=3280 x feet) / (m=3.28 x feet)

- Reduce the carrier frequency (parameter 11-01) If the cable from the inverter to the motor is greater than 25m (82ft). 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 an inaccurate current readout.
- To protect peripheral equipment, install fast acting fuses on the input side of the inverter. Refer to section 11.4 for additional information.



Power Supply

Power supply:

-  Make sure the correct voltage is applied to avoid damaging the inverter.




Molded Circuit Breaker

Molded-case circuit breaker (MCCB) or fused disconnect:


- A molded-case circuit breaker or fused disconnect must be installed between the AC source and the inverter that conforms to the rated voltage and current of the inverter to control the power and protect the inverter.



Magnetic Contactor

-  Do not use the circuit breaker as the run/stop switch for the inverter.


Ground fault detector / breaker:

-  Install a ground fault breaker to prevent problems caused by current leakage and to protect personnel. Select current range up to 200mA, and action time up to 0.1 second to prevent high frequency failure.



AC Reactor

Magnetic contactor:

- Normal operations do not need a magnetic contactor. When performing functions such as external control and auto restart after power failure, or when using a brake controller, install a magnetic contactor.
-  Do not use the magnetic contactor as the run/stop switch for the inverter.



Fast Acting Fuse

AC line reactor for power quality:

- When inverters are supplied by a high capacity power source (> 600KVA), an AC reactor can be connected to improve the power factor.



Input Noise Filter

Install Fast Acting Fuse:

- To protect peripheral equipment, install fast acting fuses in accordance with the specifications in section 11 for peripheral devices.





F510 Inverter

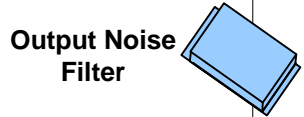
Input Noise filter:

- A filter must be installed when there are inductive loads affecting the inverter. The inverter meets EN55011 Class A, category C3 when the TECO special filter is used. See section 11 for peripheral devices.

Ground

Inverter:

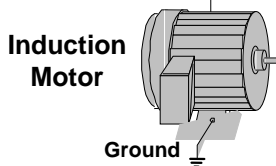
- Output terminals T1, T2, and T3 are connected to U, V, and W terminals of the motor. If the motor runs in reverse while the inverter is set to run forward, swap any two terminals connections for T1, T2, and T3.
-  To avoid damaging the inverter, do not connect the output terminals T1, T2, and T3 to AC input power.
-  Connect the ground terminal properly. (200V series: $R_g < 100\Omega$; 400V series: $R_g < 10\Omega$.)



Output Noise Filter

Output Noise filter:

- An output noise filter may reduce system interference and induced noise. See section 11 for peripheral devices.



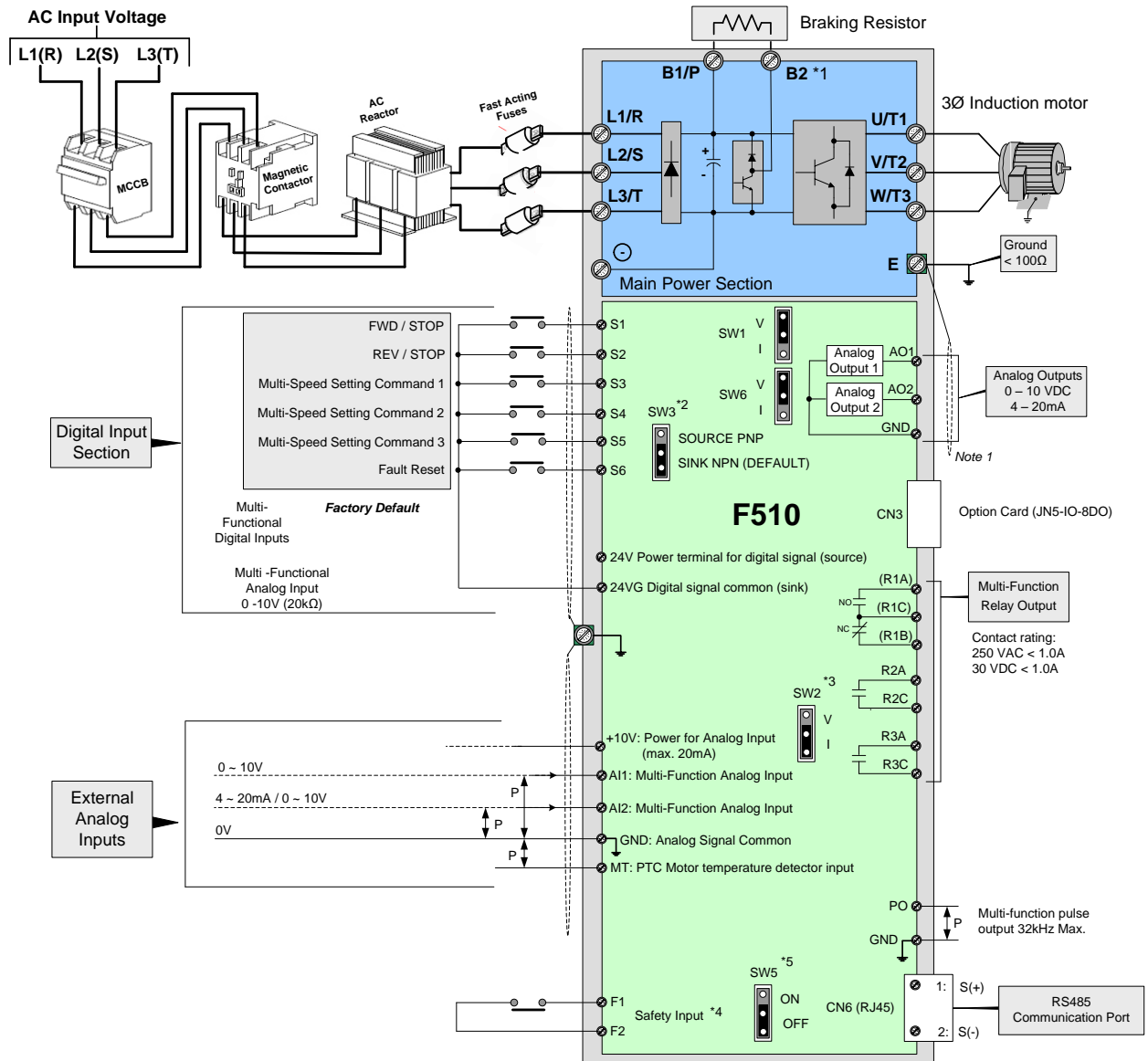
Induction Motor

Motor:

- If the inverter drives multiple motors the output rated current of the inverter must be greater than the total current of all the motors.

Ground

3.8 General Wiring Diagram



Notes:

- *1: Models IP20 200V 1 ~ 30HP, 400V 1 ~ 40HP have a built-in braking transistor. To use this braking transistor a braking resistor can be connected between B1 and B2.
- *2: Use SW3 to select between Sink (NPN, with 24VG common) or Source (PNP, with +24V common) for multi-function digital input terminals S1~S6.
- *3: Use SW2 to switch between voltage and current input for Multi-function analog input 2 (AI2). See parameter 04-00.
- *4: Safety input F1 and F2 is a normally closed input. This input should be closed to enable the inverter output. To activate this input remove the jumper wire between F1 and F2.
- *5: Terminating resistor can be set to ON or bypass (Off). This is used when connecting multiple drives in an RS485 network.
- *6: Models IP20 1 ~ 3HP do not support an option card.

3.9 User Terminals (Control Circuit Terminals)

IP20 Type:

200V: 1 ~ 3 HP, 400V: 1~ 3HP

| | |
|-----|-----|
| R2A | R2C |
|-----|-----|

| | |
|-----|-----|
| R3A | R3C |
|-----|-----|

| | | |
|-----|-----|-----|
| R1A | R1B | R1C |
|-----|-----|-----|

| | | | | | | | | | | | |
|------|------|----|----|----|-----|------|----|-----|-----|-----|-----|
| S(+) | S(-) | S1 | S3 | S5 | 24V | +10V | MT | GND | GND | A11 | A12 |
| E | 24VG | S2 | S4 | S6 | F1 | F2 | PO | PI | AO1 | AO2 | E |

200V: 5 ~ 50 HP, 400V: 5~ 75HP

| | | | | | | | | | | | |
|------|------|----|----|----|-----|------|----|-----|-----|-----|-----|
| S(+) | S(-) | S1 | S3 | S5 | 24V | +10V | MT | GND | GND | A11 | A12 |
| E | 24VG | S2 | S4 | S6 | F1 | F2 | PO | PI | AO1 | AO2 | E |

| | | | |
|-----|-----|-----|-----|
| R1A | R1B | R1C | |
| R2A | R2C | R3A | R3C |

200V: 60 ~ 175 HP, 400V: 100 ~ 800HP

| | | | | | | | | | | | |
|------|------|----|----|----|-----|------|----|-----|-----|-----|-----|
| S(+) | S(-) | S1 | S3 | S5 | 24V | +10V | MT | GND | GND | A11 | A12 |
| E | 24VG | S2 | S4 | S6 | F1 | F2 | PO | PI | AO1 | AO2 | E |

| | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|
| R1A | R1B | R1C | R2A | R2C | R3A | R3C |
|-----|-----|-----|-----|-----|-----|-----|

Description of User Terminals

| Type | Terminal | terminal function | Signal level / Information |
|----------------------|-------------|--|--|
| Digital input signal | S1 | 2-Wire Forward Run - stop command (default), multi-function input terminals * 1 | Signal Level 24 VDC (opto isolated) Maximum current: 8mA Maximum voltage: 30 Vdc Input impedance: 9.03k Ω |
| | S2 | 2-Wire Reverse Run - stop command (default), multi-function input terminals * 1 | |
| | S3 | Multi-speed/ position setting command 1 (default), multi-function input terminals * 1 | |
| | S4 | Multi-speed/ position setting command 2 (default), multi-function input terminals * 1 | |
| | S5 | Multi-speed/ position setting command 3 (default), multi-function input terminal* 1 | |
| | S6 | Fault reset input, multi-function input terminal * 1 | |
| 24V Power supply | 24V | Digital signal SOURCE (SW3 switched to mode) | $\pm 15\%$, Max. output current: 250mA (The sum of all loads connected) |
| | 24VG | Common terminal for Digital signals Common point for digital signal SINK (SW3 switched to SINK) | |
| Analog input signal | +10V | Power for external speed potentiometer | $\pm 5\%$ (Max. current: 20mA) |
| | MT | Motor temperature detector for eccternally connected PTC | 1330 Ω Range, 550 Ω return |
| | AI1 | Multi-function analog input for speed reference (0-10V input) | Range 0 to +10V Input impedance: 20K Ω Resolution: 12bit |
| | AI2 | Multi-function analog input terminals *2, SW2 switched between voltage or current input (0~10V)/(4-20mA) | Range 0 to +10V Input impedance: 20K Ω Range 4 to 20 mA Input impedance: 250 Ω Resolution: 12bit |
| | GND | Analog signal ground terminal | ---- |
| | E | Shielding wire connecting terminal (Ground) | ---- |
| Analog output signal | AO1 | Multi-function analog output terminals *3 (0~10V/ 4-20mA output) | Range 0 to 10V Max. current: 2mA From 4 to 20 mA |
| | AO2 | Multi-function analog output terminals *3 (0~10V/ 4-20mA output) | |
| | GND | Analog signals ground terminal | |
| Type | Terminal | terminal function | Signal level / Information |
| Pulse output signal | PO | Pulse output, Bandwidth 32KHz | Max. Frequency: 32KHz Open Collector output (Load: 2.2k Ω) |
| | GND | Analog signals ground terminal | ---- |

| | | | |
|----------------------|-------------------------------|--|--|
| Pulse input signal | PI | Pulse command input, bandwidth is 32KHz | L: from 0.0 to 0.5V H: from 4.0 to 13.2V Max. Frequency: 0 - 32KHz Impedance: 3.89 K Ω |
| | GND | Analog signals ground terminal | ---- |
| Relay output | R1A- R1B- R1C- | Relay A contact (multi-function output terminal) Relay B contact (multi-function output terminal) Relay contact common terminal, please refer to parameter group 03 in this manual for function description. | Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A |
| | R2A-R2C | Same functions as R1A/R1B/R1C | Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A |
| | R3A-R3C | Same functions as R1A/R1B/R1C | Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A |
| Run Permissive Input | F1 | On: normal operation. Off: stop. (Jumper wired between F1 and F2 has to be removed by using external contact to stop.) | 24Vdc, 8mA, pull-up |
| | F2 | Safety command common terminal | 24V Ground |
| RS-485 port | S (+) | RS485/MODBUS | Differential input and output |
| | S (-) | | |
| Grounding | E (G) | Grounding to earth Shield the connecting terminal | ---- |

Notes:

*1:Refer to:


- Group 03: External Terminals Digital Input / Output Function Group.

*2:Refer to:

- Group 04 - External Terminal Analog Signal Input (Output) Function Group.

*3:Refer to:

- Group 04 - External Terminal Analog Signal Input (Output) Function Group.

| |
|---|
|  Caution |
| <ul style="list-style-type: none"> • Maximum output current capacity for terminal 10V is 20mA. • Multi-function analog output AO1 and AO2 are intended as analog output meter signals. Do not use them for feedback control. • Control board's 24V and 10V are to be used for internal control only, Do not use the internal power-supply to power external devices. |

3.10 Power Terminals

IP00 / IP20 Type

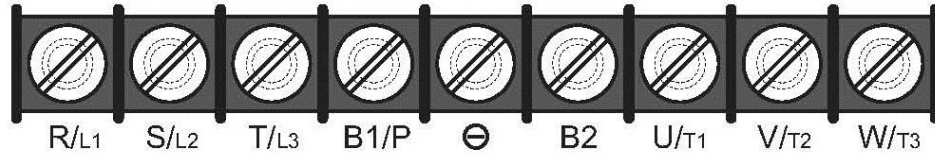
| Terminal | 200V: 1 ~ 30HP 400V: 1 ~ 40HP | 200V: 40 ~ 175HP 400V: 50 ~ 800HP |
|----------|---|---|
| R/L1 | Input Power Supply (For single phase use terminals R/L1 and S/L3) | |
| S/L2 | | |
| T/L3 | | |
| B1 / P | <ul style="list-style-type: none"> • B1 / P-⊖: DC power supply • B1 / P-B2: external braking resistor | - |
| B2 | | <ul style="list-style-type: none"> • ⊕ -⊖: DC power supply or connect braking module |
| ⊖ | - | |
| ⊕ | - | - |
| U/T1 | Inverter output | |
| V/T2 | | |
| W/T3 | | |
| E | Ground terminal | |

*1. All models 400V 25HP (18.5KW) and below have a built-in braking transistor.

*2. Before connecting DC reactor, please remove factory supplied jumper between terminal ⊕1 and ⊕2.

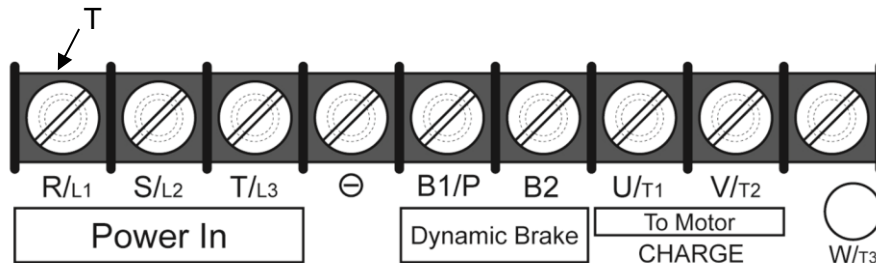
IP20 Type

200V: 1-3HP/ 400V: 1-3HP



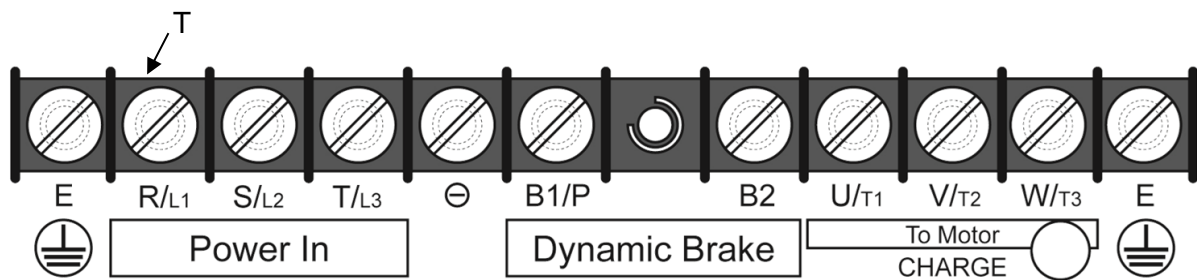
| Terminal screw size | |
|---------------------|----|
| T | ⊕ |
| M4 | M4 |

200V: 5-7.5HP/ 400V: 5-10HP



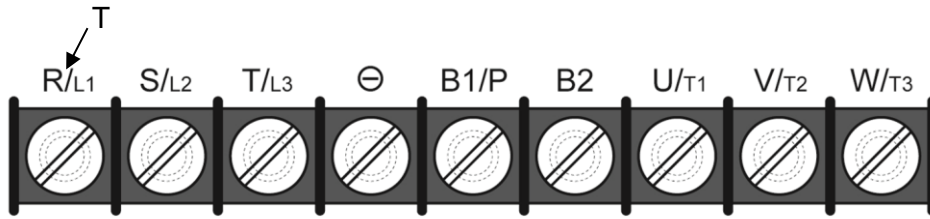
| Terminal screw size | |
|---------------------|----|
| T | ⊕ |
| M4 | M4 |

200V: 10-15HP/ 400V: 15- 20HP



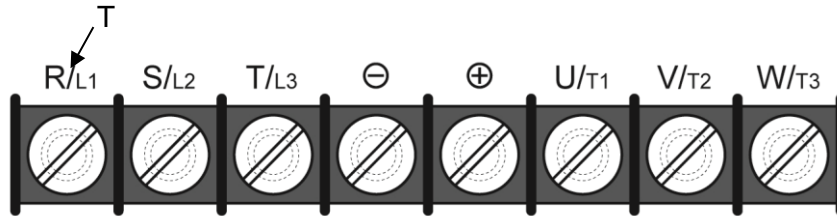
| Terminal screw size | |
|---------------------|----|
| T | ⊕ |
| M4 | M4 |

200V: 20-30HP/ 400V: 25-40HP



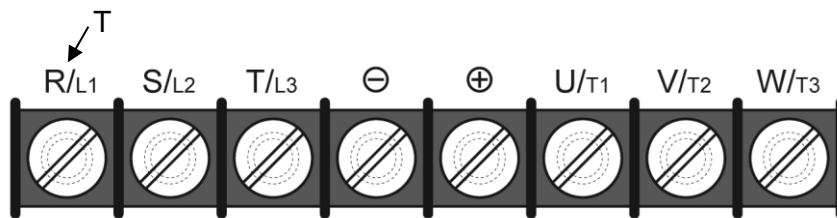
| Terminal screw size | |
|---------------------|----|
| T | ⊖ |
| M6 | M6 |

200V: 40-50HP/ 400V: 50-75HP



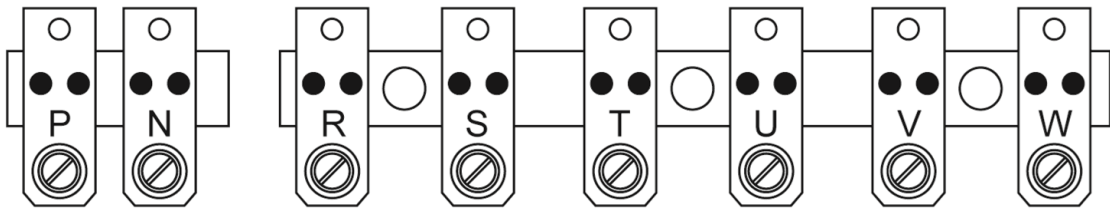
| Terminal screw size | |
|---------------------|----|
| T | ⊖ |
| M8 | M8 |

200V: 60-75HP/ 400V: 100-125HP



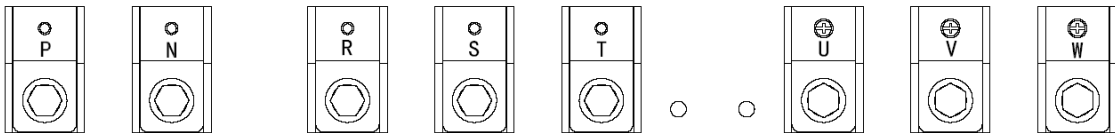
| Terminal screw size | | |
|-----------------------------|-----|-----|
| Power supply | T | ⊖ |
| 400V 100HP | M8 | M10 |
| 200V 60-75HP/ 400V 125HP | M10 | M10 |

200V: 100-125HP/ 400V: 150-250HP



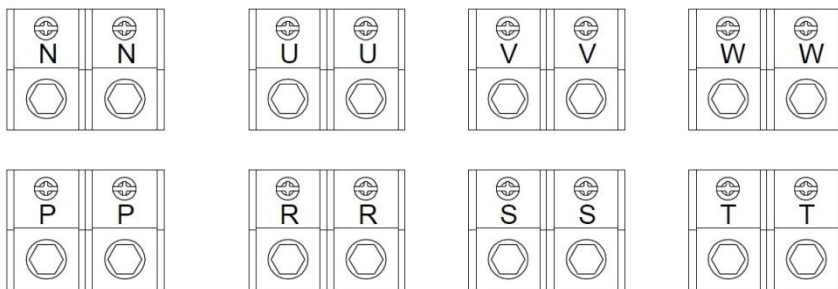
| Terminal screw size | |
|---------------------|-----|
| T | ⊕ |
| M10 | M10 |

200V: 150-175HP/ 400V: 300-425HP



| Terminal screw size | |
|---------------------|-----|
| T | ⊕ |
| M12 | M10 |

400V: 530-800HP



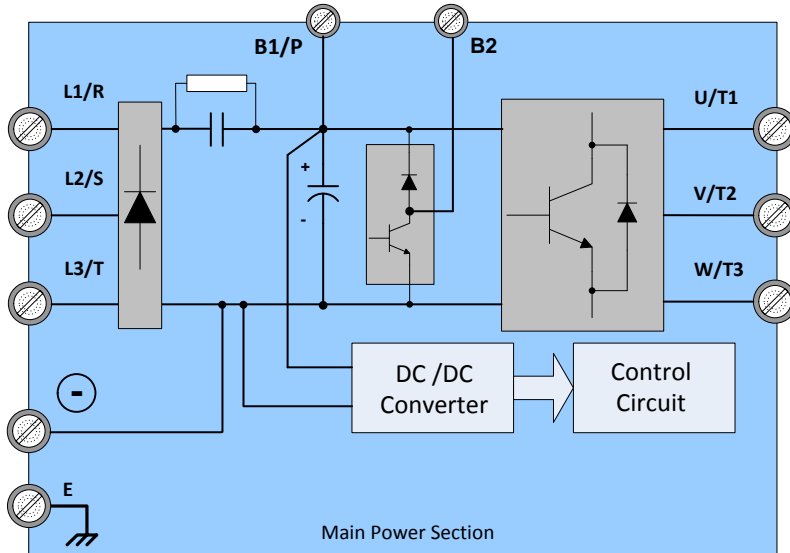
| Terminal screw size | |
|---------------------|-----|
| T | ⊕ |
| M10 | M10 |

3.11 Input / Output Power Section Block Diagram

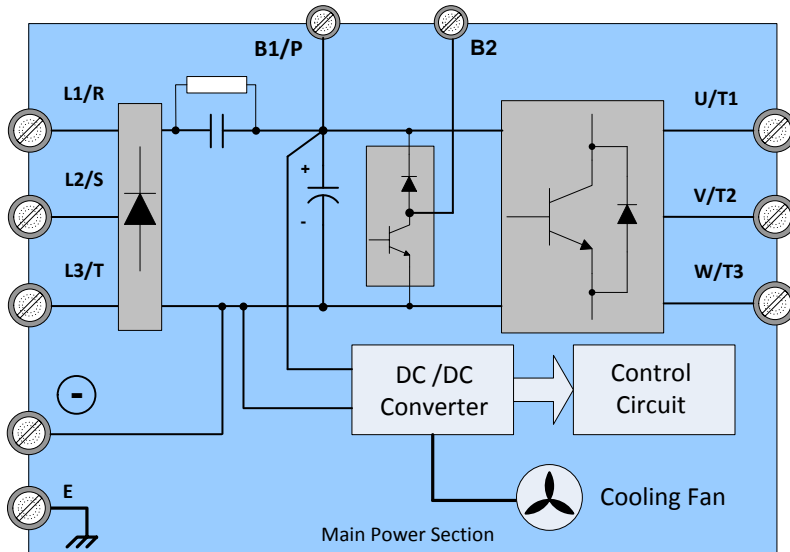
The following diagrams show the basic configuration for IP00/IP20 power sections for the range of horsepower and input voltages. This is shown for reference only and is not a detailed depiction.

IP00/IP20 Type

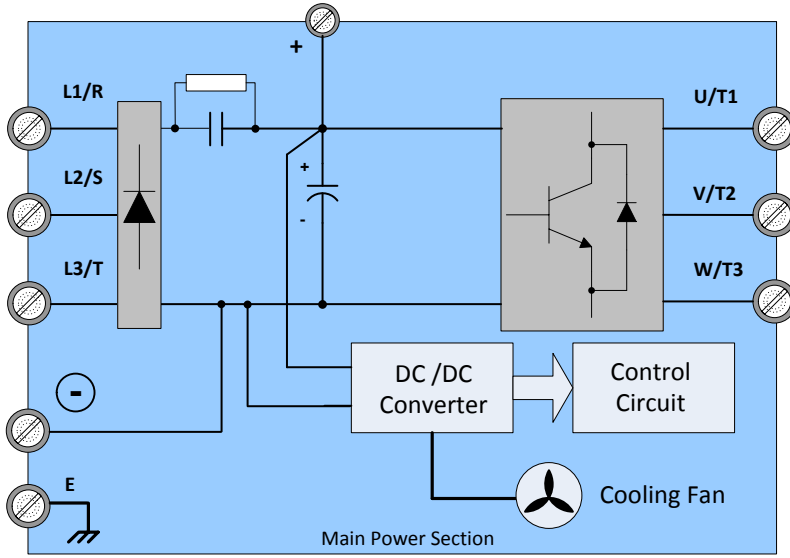
1: 200V: 1 HP / 400V: 1 ~ 2 HP



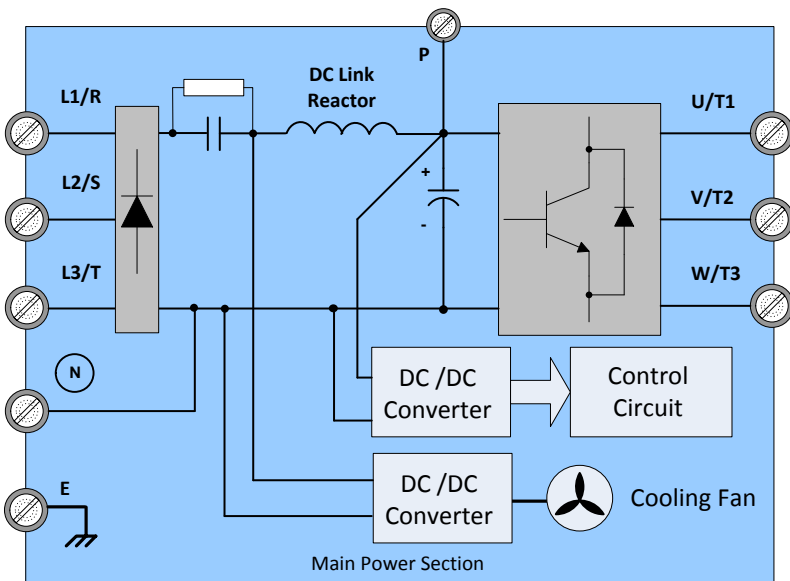
2: 200V: 2 ~ 30 HP / 400V: 3 ~ 40 HP



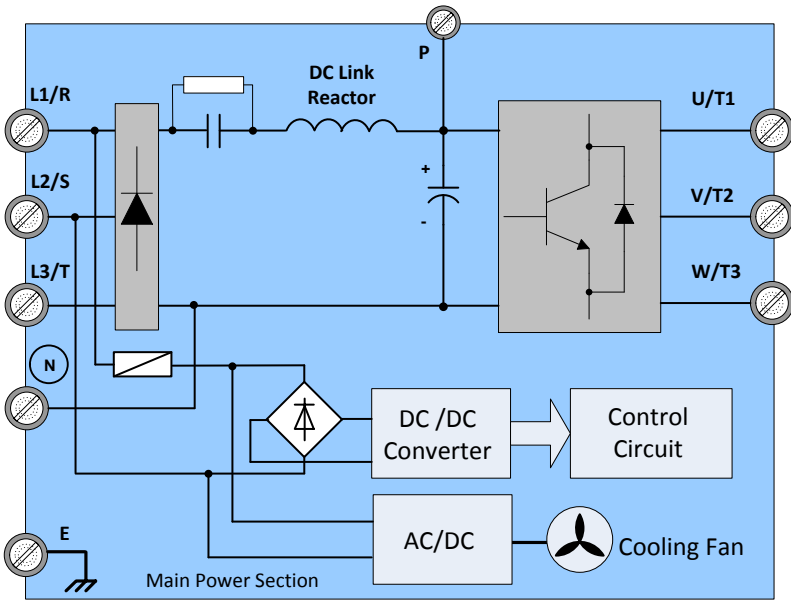
3: 200V: 40 ~ 50 HP / 400V: 50 ~ 75 HP



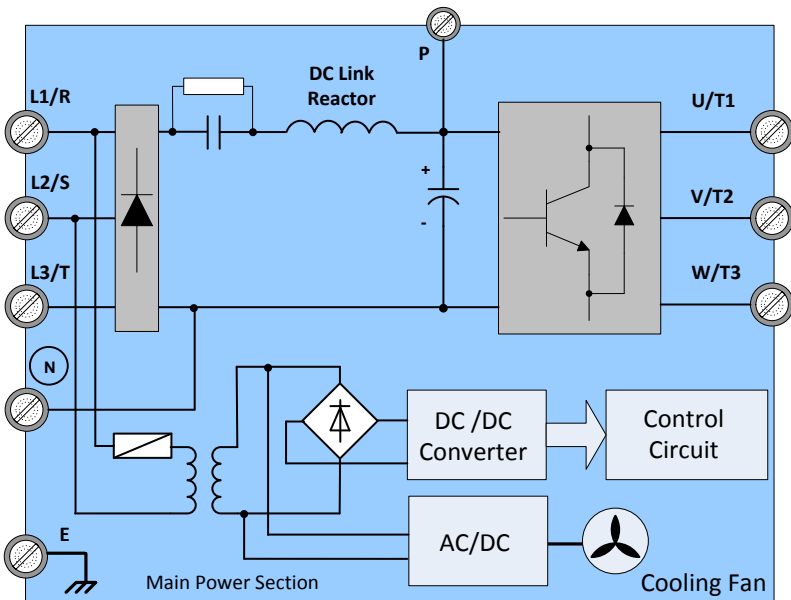
4: 200V: 60 ~ 75 HP / 400V: 100 ~ 125 HP



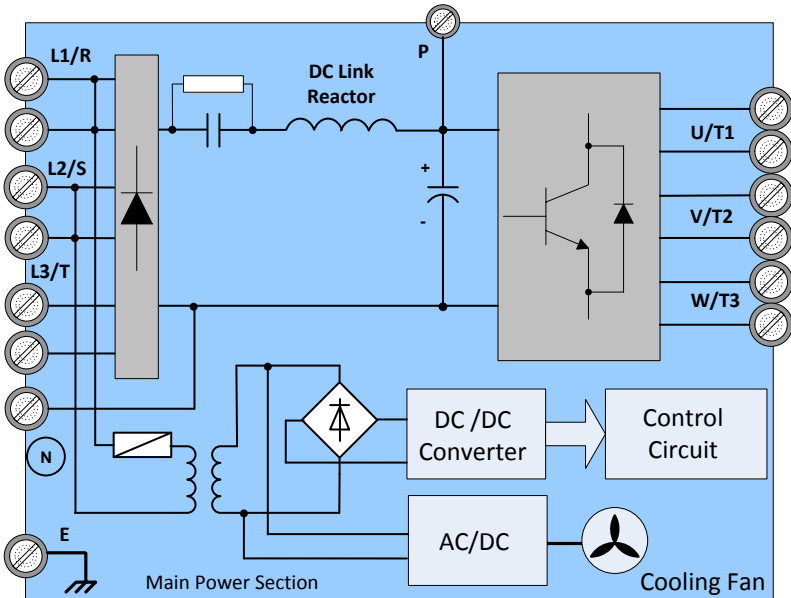
5: 200V: 100 ~ 175 HP



6: 400V: 150 ~ 425 HP



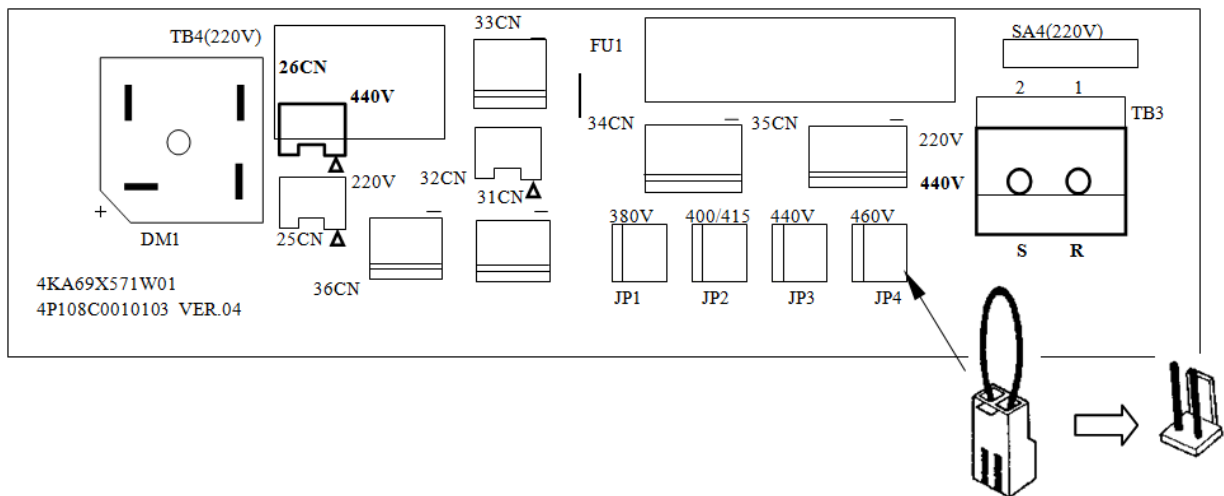
7: 400V: 535 ~ 800 HP



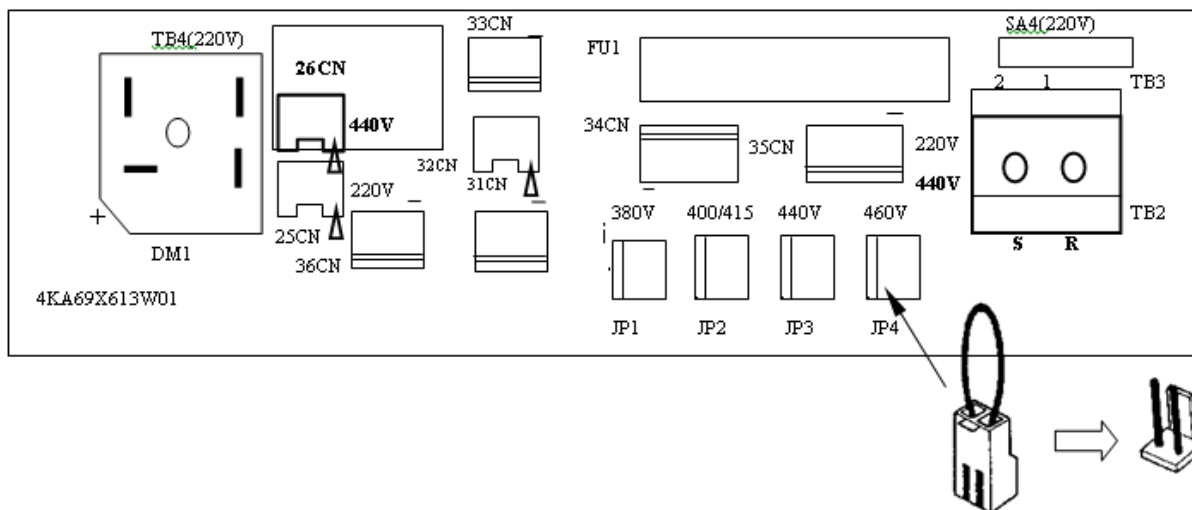
3.11.1 Cooling Fan Supply Voltage Selection (400V class)

The inverter input voltage range of the F510 400V class models ranges from 380 to 480Vac. In these models the cooling fan is directly powered from the power supply. Inverter models F510-4125/ 4150/ 4175/ 4215/ 4250 requires the user to select the correct jumper position based on the inverter input voltage ("400V" is the default position for these models). Please select the correct position according to the input voltage. If the voltage setting is too low, the cooling fan will not provide adequate cooling for the inverter resulting in an over-heat error. If the input voltage is greater than 400Vac, select the "400V" position.

400V: 150 – 250 HP




400V: 300 – 800 HP



3.12 Inverter Wiring

Wiring Precautions

| | |
|---|---|
|  Danger | <ul style="list-style-type: none">• Do NOT remove any protective covers or attempt any wiring while input power is applied. Connect all wiring before applying input power. When making wiring changes after power up, remove input power and wait a minimum of five minutes after power has been turned off before starting. Also confirm that the charge lamp is off and that DC voltage between terminals B1/P or (+) and (-) does not exceed 25V, otherwise electric shock may result.• Only authorized personnel should work on the equipment. (Remove any metal jewelry such as watches and rings and use insulated tools.), otherwise electric shock or injury may result. |
|---|---|

(A) Power input terminals

1. The Input power supply voltage can be connected in any phase sequence to power input terminals R/L1, S/L2, or T/L3 on the terminal block.
2. DO NOT connect the AC input power source to the output terminals U/T1, V/T2 and. W/T3.
3. Connect the output terminals U/T1, V/T2, W/T3 to motor lead wires U/T1, V/T2, and W/T3, respectively.
4. Check that the motor rotates forward with the forward run source. If it does not, swap any 2 of the output cables to change motor direction.
5. DO NOT connect phase correcting capacitors or LC/RC noise filter to the output circuit.

(B) Grounding

1. Connect the ground terminal (E) to ground having a resistance of less than 100Ω.
2. Do not share the ground wire with other devices, such as welding machines or power tools.
3. Always use a ground wire that complies with the local codes and standards for electrical equipment and minimize the length of ground wire.
4. When using more than one inverter, be careful not to loop the ground wire. See examples below in Fig. 3.12.1.

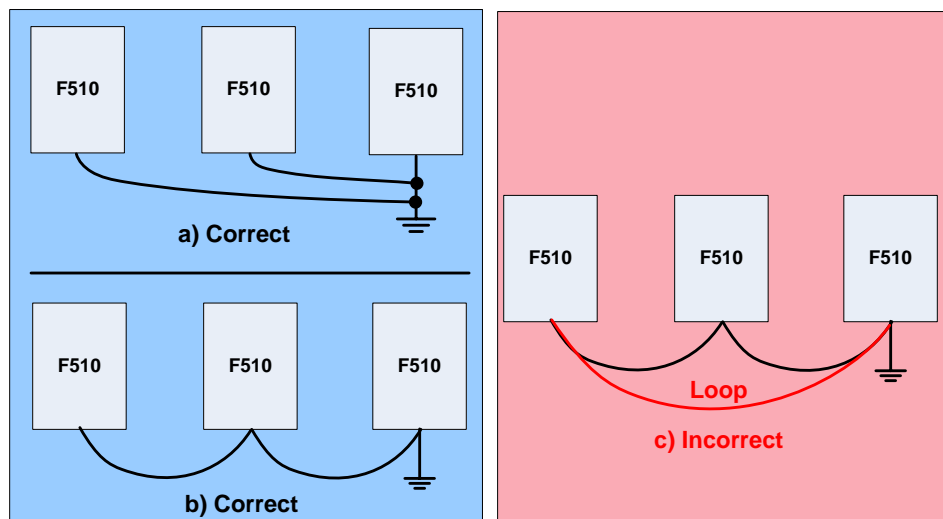


Fig. 3.12.1 Inverter Grounding

3.13 Input Power and Motor Cable Length

The length of the cables between the input power source and /or the motor and inverter can cause a significant phase to phase voltage reduction due to the voltage drop across the cables. The wire size shown in Tables 3.16.1 is based on a maximum voltage drop of 2%. If this value is exceeded, a wire size having larger diameter may be needed. To calculate phase to phase voltage drop, apply the following formula:

$$\text{Phase-to-phase voltage drop (V)} = \sqrt{3} \times \text{resistance of wire } (\Omega/\text{km}) \times \text{length of line (m)} \times \text{current} \times 10^{-3}.$$

(km=3280 x feet)

(m=3.28 x feet)

3.14 Cable Length vs. Carrier Frequency

The allowable setting of the PWM carrier frequency is also determined by motor cable length and is specified in the following Table 3.14.1.

Table 3.14.1 Cable Length vs. Carrier Frequency

| | | | | |
|--|-----------------|------------------------|-------------------------|-------------------|
| Cable length between the inverter and Motor in ft. (m) | <100 (< 30) | 100 – 165 (30 – 50) | 166 - 328 (50 – 100) | ≥ 329 (≥ 100) |
| Recommended carrier frequency allowed Parameter 11-01 | 16kHz (max) | 10 kHz (max) | 5 kHz (max) | 2 kHz (max) |

3.15 Installing an AC Line Reactor

If the inverter is connected to a large-capacity power source (600kVA or more), install an AC reactor on the input side of the inverter. This also improves the power factor on the power supply side.

3.16 Power Input Wire Size, NFB and MCB Part Numbers

The following table shows the recommended wire size, molded case circuit breakers and magnetic contactors for each of the F510 models. It depends on the application whether or not to install a circuit breaker. The NFB must be installed between the input power supply and the inverter input (R/L1, S/L2, T/L3).

Note: When using ground protection make sure the current setting is above 200mA and trip delay time is 0.1 sec of higher.

Table 3.16.1 Wiring Information for 200V/400V class (IP00/IP20)

| Power supply | F510 Model | | | Wire size (mm ²) | | | NFB ³ | MC ³ |
|------------------|------------------|-----------|-------------------|------------------------------|----------------|----------------------------|------------------|-----------------|
| | Horse power (HP) | Rated KVA | Rated current (A) | Main circuit ^{*1} | Grounding E(G) | Control line ^{*2} | | |
| 200V 1 Ø / 3Ø | 1HP | 1.9 | 5 | 2~5.5 | 2~5.5 | 0.5~2 | TO-50EC(15A) | CU-11 |
| | 2HP | 2.9 | 7.5 | 2~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(20A) | CU-11 |
| | 3HP | 4.0 | 10.6 | 3.5~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(30A) | CU-11 |
| 200V 3 Ø | 5HP | 5.5 | 14.5 | 3.5~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(30A) | CU-16 |
| | 7.5HP | 8.0 | 22 | 5.5 | 5.5 | 0.5~2 | TO-50EC(30A) | CU-16 |
| | 10HP | 11.4 | 30 | 8 | 5.5~8 | 0.5~2 | TO-100EC(50A) | CU-18 |
| | 15HP | 15 | 42 | 8 | 5.5~8 | 0.5~2 | TO-100EC(50A) | CU-27 |
| | 20HP | 21 | 56 | 14 | 8 | 0.5~2 | TO-100EC(100A) | CU-50 |
| | 25HP | 26 | 69 | 22 | 8 | 0.5~2 | TO-100EC(100A) | CU-65 |
| | 30HP | 30 | 80 | 22 | 14 | 0.5~2 | TO-225E(125A) | CU-80 |
| | 40HP | 42 | 110 | 38 | 14 | 0.5~2 | TO-225E(150A) | CN-100R |
| | 50HP | 53 | 138 | 60 | 22 | 0.5~2 | TO-225E(175A) | CN-125R |
| | 60HP | 64 | 169 | 80 | 22 | 0.5~2 | TO-225E(200A) | CN-150 |
| | 75HP | 76 | 200 | 100 | 22 | 0.5~2 | TO-225E(225A) | CN-180 |
| | 100HP | 95 | 250 | 150 | 22 | 0.5~2 | TO-400S(300A) | CN-300 |
| | 125HP | 119 | 312 | 200 | 38 | 0.5~2 | TO-400S(400A) | CN-300 |
| | 150HP | 137 | 400 | 300 | 38 | 0.5~2 | TO-600S(600A) | CN-400 |
| | 175HP | 172 | 450 | 250*2P | 50 | 0.5~2 | TO-800S(800A) | CN-630 |
| 400V 3 Ø | 1HP | 2.6 | 3.4 | 2~5.5 | 2~5.5 | 0.5~2 | TO-50EC(15A) | CU-11 |
| | 2HP | 3.1 | 4.1 | 2~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(15A) | CU-11 |
| | 3HP | 4.1 | 5.4 | 2~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(15A) | CU-11 |
| | 5HP | 7.0 | 9.2 | 2~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(15A) | CU-18 |
| | 7.5HP | 8.5 | 12.1 | 2~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(15A) | CU-18 |
| | 10HP | 13.3 | 17.5 | 3~5.5 | 3.5~5.5 | 0.5~2 | TO-50EC(20A) | CU-18 |
| | 15HP | 18 | 23 | 5.5 | 5.5 | 0.5~2 | TO-50EC(30A) | CU-25 |
| | 20HP | 24 | 31 | 8 | 8 | 0.5~2 | TO-100EC(50A) | CU-25 |
| | 25HP | 29 | 38 | 8 | 8 | 0.5~2 | TO-100EC(50A) | CU-35 |
| | 30HP | 34 | 44 | 8 | 8 | 0.5~2 | TO-100EC(50A) | CU-50 |
| | 40HP | 41 | 58 | 14 | 8 | 0.5~2 | TO-100EC(75A) | CU-50 |
| | 50HP | 55 | 73 | 22 | 8 | 0.5~2 | TO-100EC(100A) | CU-65 |
| | 60HP | 67 | 88 | 22 | 14 | 0.5~2 | TO-100EC(100A) | CN-80 |
| | 75HP | 79 | 103 | 38 | 14 | 0.5~2 | TO-225E(150A) | CN-100R |
| 100HP | 111 | 145 | 60 | 22 | 0.5~2 | TO-225E(175A) | CN-150 | |

| F510 Model | | | | Wire size (mm ²) | | | NFB ^{*3} | MC ^{*3} |
|--------------|------------------|-----------|-------------------|------------------------------|----------------|----------------------------|-------------------|------------------|
| Power supply | Horse power (HP) | Rated KVA | Rated current (A) | Main circuit ^{*1} | Grounding E(G) | Control line ^{*2} | | |
| | 125HP | 126 | 168 | 80 | 22 | 0.5~2 | TO-225E(225A) | CN-150 |
| | 150HP | 159 | 208 | 150 | 22 | 0.5~2 | TO-400S(300A) | CN-300 |
| | 175HP | 191 | 250 | 150 | 22 | 0.5~2 | TO-400S(300A) | CN-300 |
| | 215HP | 226 | 296 | 200 | 30 | 0.5~2 | TO-400S(400A) | CN-300 |
| | 250HP | 250 | 328 | 250 | 30 | 0.5~2 | TO-400S(400A) | CN-400 |
| | 300HP | 332 | 435 | 300 | 38 | 0.5~2 | TO-600S(600A) | CN-630 |
| | 375HP | 393 | 515 | 250*2P | 50 | 0.5~2 | TO-800S(800A) | CN-630 |
| | 425HP | 457 | 585 | 250*2P | 50 | 0.5~2 | TE-1000(1000A) | CN-630 |
| | 535HP | 526 | 700 | 300*2P | 50 | 0.5~2 | TE-1000(1000A) | 800 |
| | 670HP | 640 | 875 | 300*2P | 50 | 0.5~2 | TE-1200(1200A) | 1000 |
| | 800HP | 732 | 960 | 300*2P | 50 | 0.5~2 | TE-1200(1200A) | 1000 |

*1. The main circuit terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1/P, B2, ⊖, ⊕.

*2. Control line is the terminal wire on the control board.

*3. The NFB and MCB listed in the table are of TECO product numbers. Products with same rating from other manufacturers may be used. To reduce electrical noise interference, ensure that an RC surge absorber (R: 10Ω/ 5W, C: 0.1μf/1000VDC) is added to both sides of MCB coil.

3.17 Control Circuit Wiring

- (1) Separate the wiring for control circuit terminals from main circuit wiring for terminals (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3).
- (2) Separate the wiring for control circuit terminals R1A-R1B-R1C (or R2A, R2C) (Relay outputs) from wiring for terminals ① - ⑥, A01, A02, GND, DO1, DO2, DOG, +12V, (-12V), AI1, AI2 and GND wiring.
- (3) Use shielded twisted-pair cables (#24 - #14 AWG / 0.5 - 2 mm²) shown in Fig. 3.17.1 for control circuits to minimize noise problems. The maximum wiring distance should not exceed 50m (165 ft).

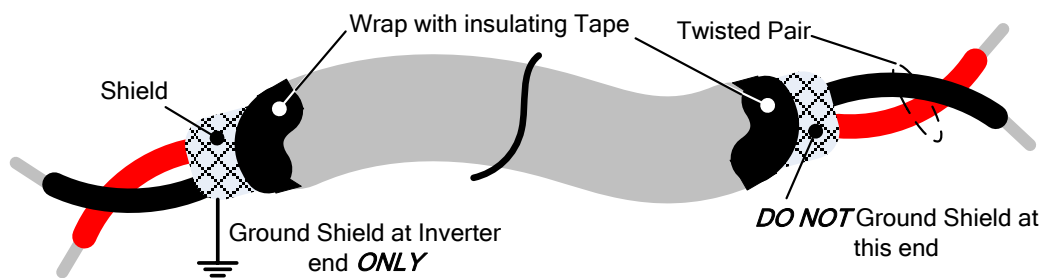


Fig. 3.17.1 Shielded Twisted-Pair

- (4) In Section 3.8 the control boards referenced have a jumper SW3 that can select the digital input to terminals ① - ③ to be set for SINK or SOURCE. The following Fig. 3.17.2 (a.) – (d.) shows examples for the various SINK / Source interfaces.

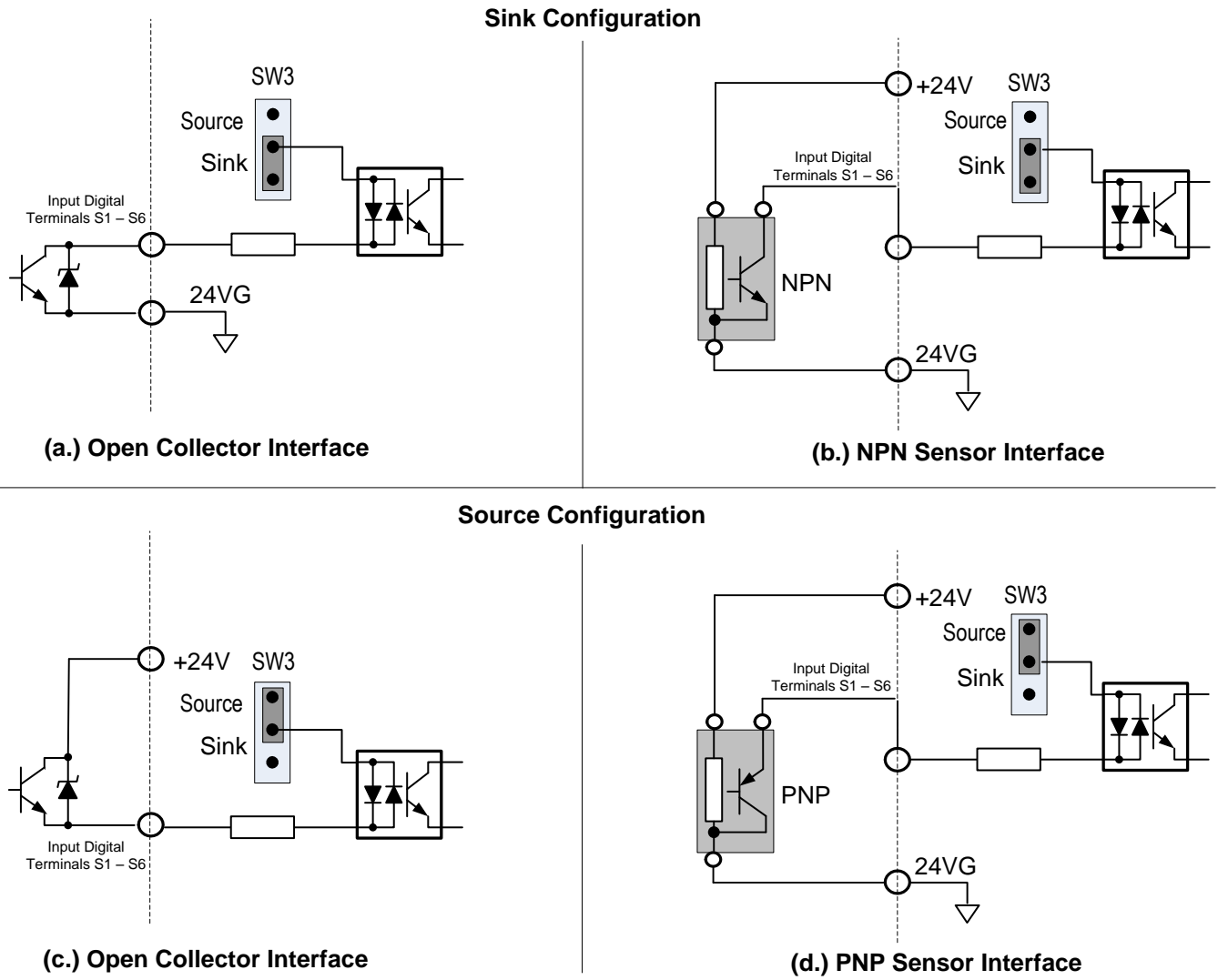


Fig. 3.17.2 Sink / Source Configurations

3.18 Inverter Specification

Basic Specifications 200V class

| Inverter capacity (HP) | | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 175 | |
|------------------------|--|---|------------|------------|----------------------------|--------------|-------------|------------|------------|--------------|------------|------------|------------|------------|------------|-------------|-------------|--------------|--------------|--|
| Output Rated | Rated Output Capacity (KVA) | 1.9 | 2.9 | 4.0 | 5.5 | 8 | 11.4 | 15.2 | 21.3 | 26.2 | 30 | 41.9 | 52.5 | 64.3 | 76.2 | 95.2 | 118.8 | 152.4 | 171.4 | |
| | Rated Output Current (A) | 5.0 | 7.5 | 10.6 | 14.5 | 22 | 30 | 42 | 56 | 69 | 80 | 110 | 138 | 169 | 200 | 250 | 312 | 400 | 450 | |
| | Maximum Applicable Motor ^{*1} HP (KW) | 1 (0.75) | 2 (1.5) | 3 (2.2) | 5 (3.7) | 7.5 (5.5) | 10 (7.5) | 15 (11) | 20 (15) | 25 (18.5) | 30 (22) | 40 (30) | 50 (37) | 60 (45) | 75 (55) | 100 (75) | 125 (90) | 150 (110) | 175 (130) | |
| | Maximum Output Voltage (V) | 3-phase 200V~240V | | | | | | | | | | | | | | | | | | |
| | Maximum Output Frequency (Hz) | Based on parameter setting 0.1~400.0 Hz | | | | | | | | | | | | | | | | | | |
| Power supply | Rated Voltage, Frequency | 1-phase/ 3-phase | | | 3-phase 200V~240V, 50/60Hz | | | | | | | | | | | | | | | |
| | Allowable Voltage Fluctuation | -15% ~ +10% | | | | | | | | | | | | | | | | | | |
| | Allowable Frequency Fluctuation | ±5% | | | | | | | | | | | | | | | | | | |

Basic Specifications 400V class

| Inverter capacity (HP) | | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 175 | 215 | 250 | 300 | 375 | |
|------------------------|--|---|------------|------------|------------|--------------|-------------|------------|------------|--------------|------------|------------|------------|------------|------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--|
| Output Rated | Rated Output Capacity (KVA) | 2.6 | 3.1 | 4.1 | 7.0 | 8.4 | 13.3 | 17.5 | 23.6 | 28.9 | 33.5 | 41.1 | 54.8 | 67 | 78.4 | 110 | 125 | 158 | 190 | 225 | 250 | 331 | 392 | |
| | Rated Output Current (A) | 3.4 | 4.1 | 5.4 | 9.2 | 12.1 | 17.5 | 23 | 31 | 38 | 44 | 58 | 73 | 88 | 103 | 145 | 168 | 208 | 250 | 296 | 328 | 435 | 515 | |
| | Maximum Applicable Motor ^{*1} HP (KW) | 1 (0.75) | 2 (1.5) | 3 (2.2) | 5 (3.7) | 7.5 (5.5) | 10 (7.5) | 15 (11) | 20 (15) | 25 (18.5) | 30 (22) | 40 (30) | 50 (37) | 60 (45) | 75 (55) | 100 (75) | 125 (90) | 150 (110) | 175 (132) | 215 (160) | 250 (185) | 300 (220) | 375 (280) | |
| | Maximum Output Voltage (V) | 3-phase 380V~480V | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum Output Frequency (Hz) | Based on parameter setting 0.1~400.0 Hz | | | | | | | | | | | | | | | | | | | | | | |
| Power supply | Rated Voltage, Frequency | 3-phase 380V ~ 480V, 50/60Hz | | | | | | | | | | | | | | | | | | | | | | |
| | Allowable Voltage Fluctuation | -15% ~ +10% | | | | | | | | | | | | | | | | | | | | | | |
| | Allowable Frequency Fluctuation | ±5% | | | | | | | | | | | | | | | | | | | | | | |

| Inverter capacity (HP) | | 425 | 535 | 670 | 800 |
|------------------------|--|---|--------------|--------------|--------------|
| Output Rated | Rated Output Capacity (KVA) | 445 | 525 | 640 | 731 |
| | Rated Output Current (A) | 585 | 700 | 875 | 960 |
| | Maximum Applicable Motor *1 HP (KW) | 425 (315) | 535 (400) | 670 (500) | 800 (600) |
| | Maximum Output Voltage (V) | 3-phase 380V~480V | | | |
| | Maximum Output Frequency (Hz) | Based on parameter setting 0.1~400.0 Hz | | | |
| Power supply | Rated Voltage, Frequency | 3-phase 380V ~ 480V, 50/60Hz | | | |
| | Allowable Voltage Fluctuation | -15% ~ +10% | | | |
| | Allowable Frequency Fluctuation | ±5% | | | |

*1: Take standard 4-pole induction motor as the base.

*2: F510 model is designed to be used for normal duty (ND), with overload capability is 120% for 1 min.

*3: If greater than the default carrier frequency, adjust the load current based on the de-rating curve.

| 200V class | Carrier freq. default setting | Carrier freq. range | 400V class | Carrier freq. default setting | Carrier freq. range |
|------------|-------------------------------|---------------------|------------|-------------------------------|---------------------|
| 1~25HP | 2KHz | 2~16KHz | 1~30HP | 4KHz | 2~16KHz |
| 30HP | 2KHz | 2~12KHz | 40HP | 2KHz | 2~16KHz |
| 40~50HP | 2KHz | 2~12KHz (*4) | 50~60HP | 4KHz | 2~12KHz (*4) |
| 60~125HP | 2KHz | 2~10KHz (*4) | 75~215HP | 4KHz | 2~10KHz (*4) |
| - | - | - | 250HP | 2KHz | 2~8KHz |
| 150~175HP | 2KHz | 2~5KHz | 300~375HP | 4KHz | 2~5KHz |
| - | - | - | 425HP | 2KHz | 2~5KHz |
| - | - | - | 535~800HP | 4KHz | 2~5KHz |

*4: If control mode is set to SLV mode and maximum frequency (01-02) is greater than 80Hz, the carrier frequency range is 2~8 kHz.

The following table shows the maximum output frequency for each control mode.

| Control mode | Other settings | Maximum output frequency |
|--------------|---|--------------------------|
| V/F | Unlimited | 400Hz |
| SLV | 200V 1~15HP, 400V 1~20HP | 150Hz |
| | 200V 20~30HP, 400V 25HP | 110Hz |
| | 400V 30~40HP | 100Hz |
| | 200V 40~125HP, 400V 50~215HP, carrier (11-01) is set as 8K or below 8K. | 100Hz |
| | 200V 40~125HP, 400V 50~215HP, carrier (11-01) is set as above 8K. | 80Hz |
| | 200V 150~175HP, 400V 250~800HP | 100Hz |
| PMSLV | Unlimited | 400Hz |

3.19 General Specifications

| | | |
|-------------------------|---|--|
| Control Characteristics | Operation Modes | LED keypad with seven-segment display *5 and LCD keypad (Optional HOA LCD keypad); all LCD keypad with parameter copy function |
| | Control Modes | V/F, SLV, PMSLV with space vector PWM mode |
| | Frequency Control Range | 0.1Hz~400.0Hz |
| | Frequency Accuracy (Temperature change) | Digital references: $\pm 0.01\%$ (-10 to +40°C), Analog references: $\pm 0.1\%$ (25°C $\pm 10^\circ\text{C}$) |
| | Speed Control Accuracy | $\pm 0.5\%$ (Sensorless Vector Control Mode)* ¹ |
| | Frequency Setting Resolution | Digital references: 0.01Hz , Analog references: 0.06Hz/60Hz |
| | Output Frequency Resolution | 0.01Hz |
| | Inverter Overload | 120%/1 min |
| | Frequency Setting Signal | DC 0~+10V / 0~20mA or 4~20mA |
| | Acceleration/Deceleration Time | 0.0~6000.0 seconds (separately set acceleration and deceleration time) |
| | Voltage, Frequency Characteristics | Custom V/F curve based on parameters |
| | Braking Torque | About 20% |
| | Main Control Functions | Auto tuning, Soft-PWM, Over voltage protection, Dynamic braking, Speed search, Restart upon momentary power loss, 2 sets of PID control, Slip Compensation, RS-485 communication standard, Simple PLC function, 2 sets of analog outputs, Safety switch |
| | Other Functions | Accumulated power-on/ run time, 4 sets of fault history records and latest fault record state, Energy-saving function setting, Phase loss protection, Smart braking, DC braking, Dwell · S curve acceleration and deceleration, Up/Down operation, Modbus, BACnet MS/TP and Metasys N2 communication protocol, Display of multi-engineering unit, Local/ Remote switch, SINK/SOURCE input interface selection, User parameter settings |
| Protection Function | Stall Prevention | Current level can be setting (It can be set separately in acceleration or constant speed; it can be set with or without protection in deceleration) |
| | Instantaneous Over Current (OC) and Output Short-Circuit (SC) Protection | Inverter stops when the output current exceeds 160% of the inverter rated current |
| | Inverter Overload Protection (OL2) | If inverter rated current 120%/1min is exceeded, inverter stops. The factory default carrier frequency is 2~4KHZ ² |
| | Motor Overload Protection (OL1) | Electrical overload protection curve |
| | Over voltage (OV) Protection | If the main circuit DC voltage rises over 410V (200V class)/ 820V (400V class), the motor stops running. |
| | Under voltage (UV) Protection | If the main circuit DC voltage falls below 190V (200V class) /380V (400V class), the motor stops running. |
| | Auto-Restart after Momentary Power Loss | Power loss exceeds 15ms. Auto-restart function available after momentary power loss in 2 sec. |
| | Overheat(OH) Protection | Use temperature sensor for protection. |
| | Ground Fault (GF) Protection | Use current sensor for protection. |
| | DC Bus Charge Indicator | When main circuit DC voltage $\geq 50\text{V}$, the CHARGE LED turns on. |
| | Output Phase Loss (OPL) Protection | If the OPL is detected, the motor stops automatically. |

| | | |
|-----------------------------------|-------------------------------|---|
| Environment Specifications | Installation Location | Indoor (protected from corrosive gases and dust) |
| | Ambient Temperature | -10~+40°C(14°F~104°F) (IP20/NEMA1 or NEMA12), -10~+50°C(14°F~122°F) (IP00) without de-rating; with de-rating, its maximum operation temperature is 60°C(140°F). |
| | Storage Temperature | -20~+70°C(-4°F~+158°F) |
| | Humidity | 95%RH or less (no condensation) |
| | Altitude and Vibration | Altitude of 1000m (3181ft) or below, below 5.9m/s2(0.6G) |
| Communication Function | | Built-in RS-485 as standard (Modbus protocol with RJ45/ BACnet/ Metasys N2) |
| PLC Function | | Built-in |
| EMI Protection | | The built-in noise filter complies with EN61800-3 available for inverters 400V 75HP or below (IP20) / 400V 60HP or below |
| EMS Protection | | in compliance with EN61800-3 |
| Safety Certification | CE Declaration | in compliance with EN61800-3 (CE & RE) and EN61800-5-1 (LVD, Low-Voltage Directive) |
| | UL Certification | UL508C |
| Accessories | | 1 to 8 Pump card, HOA keypad, Profibus card |

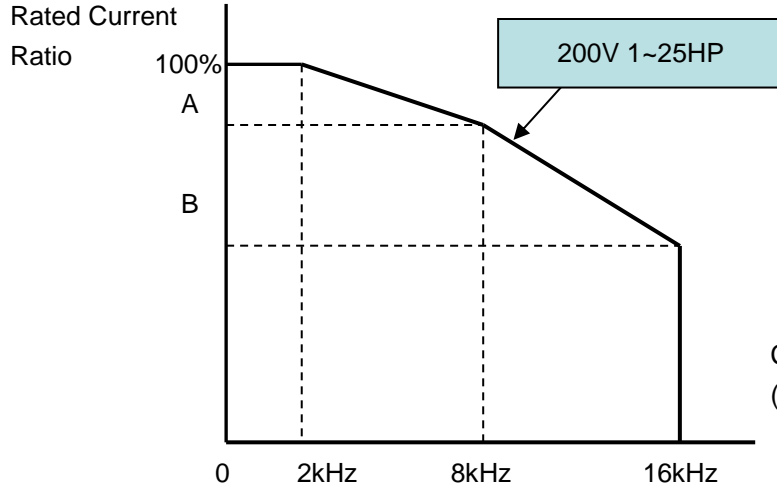
*1: Speed control accuracy is different for each system and motor type.

*2: The factory default for carrier frequency varies with KVA rating.

3.20 Inverter Derating Based on Carrier Frequency

200V Models

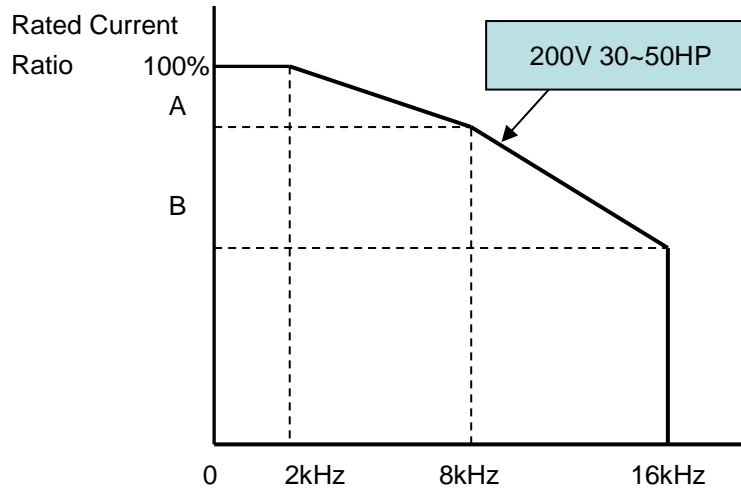
Note: Derating curve current of carrier frequency means inverter rated current.



| Model | 2001 | 2002 | 2003 | 2005 | 2008 |
|-------|------|------|------|------|------|
| A | 100% | 67% | 76% | 76% | 83% |
| B | 80% | 53% | 60% | 61% | 67% |

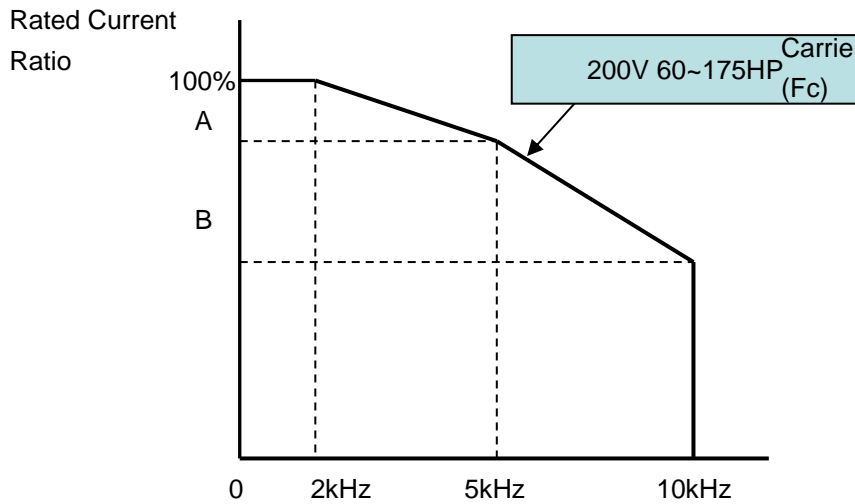
| Model | 2010 | 2015 | 2020 | 2025 |
|-------|------|------|------|------|
| A | 83% | 83% | 84% | 87% |
| B | 67% | 66% | 67% | 70% |

Carrier Frequency
(Fc)



| Model | 2030 | 2040 | 2050 |
|-------|------|------|------|
| A | 92% | 77% | 83% |
| B | 74% | 62% | 67% |

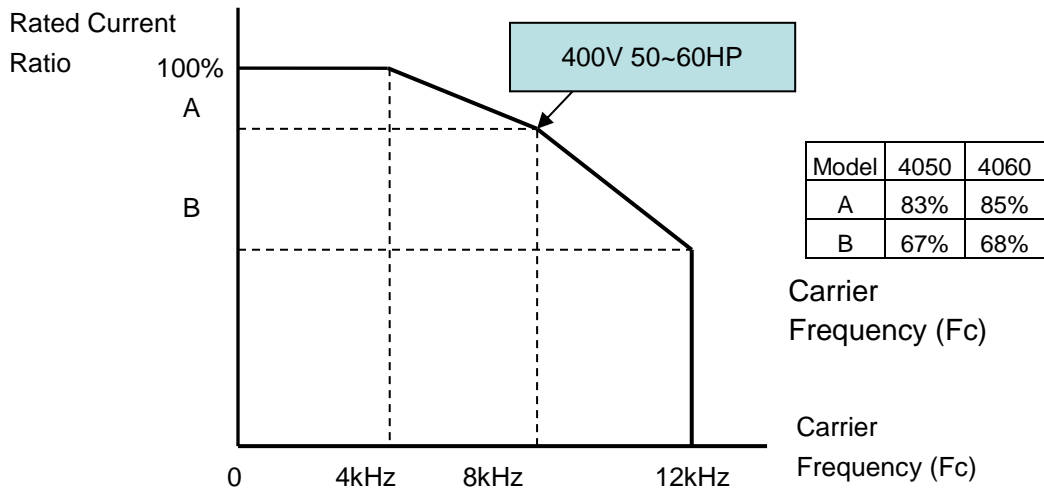
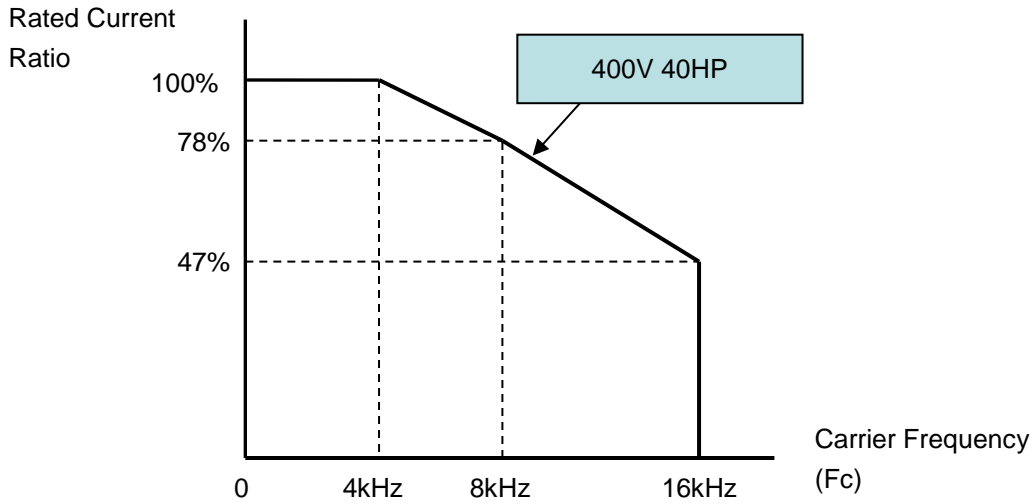
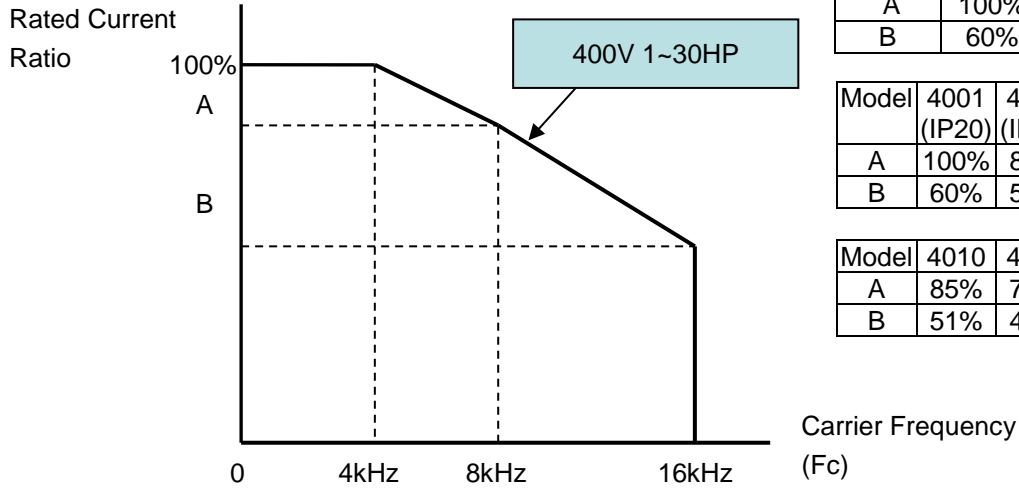
Carrier Frequency
(Fc)

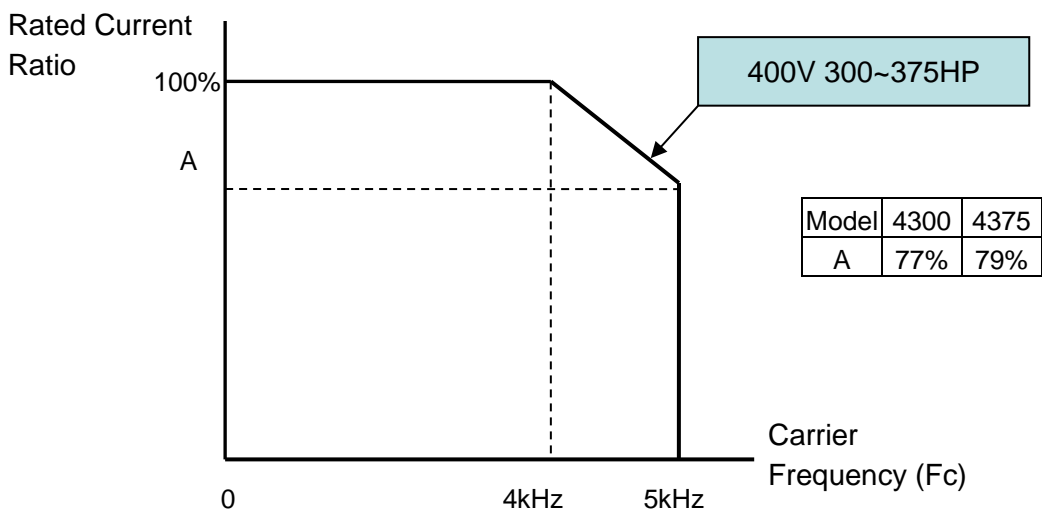
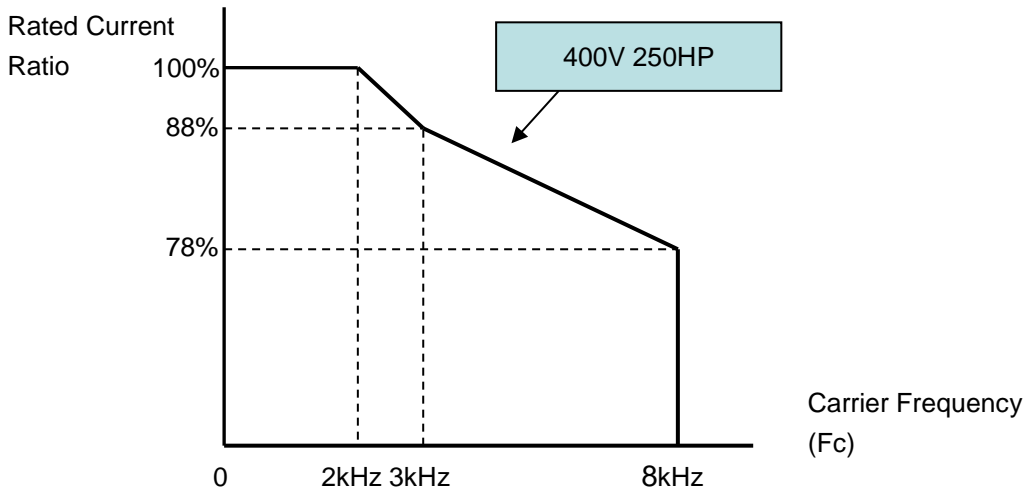
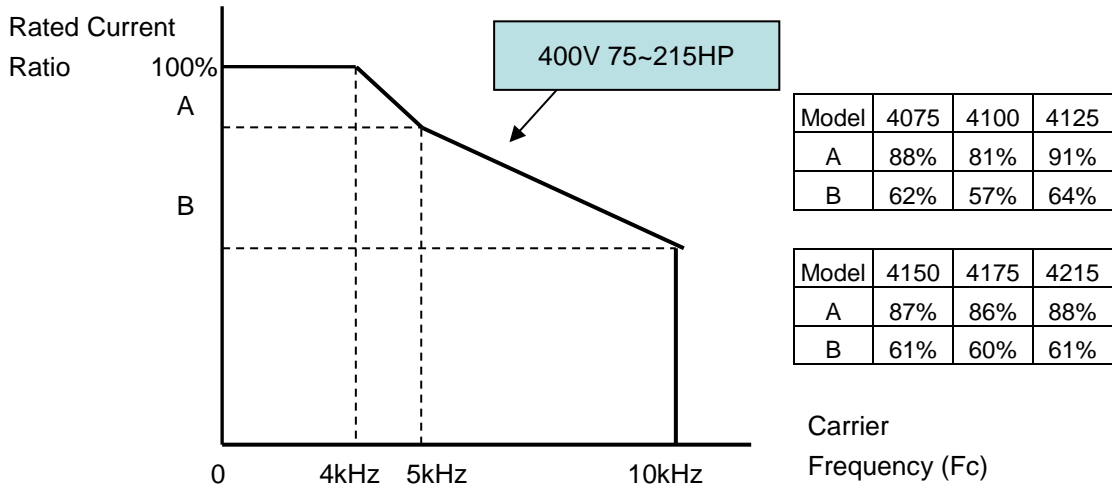


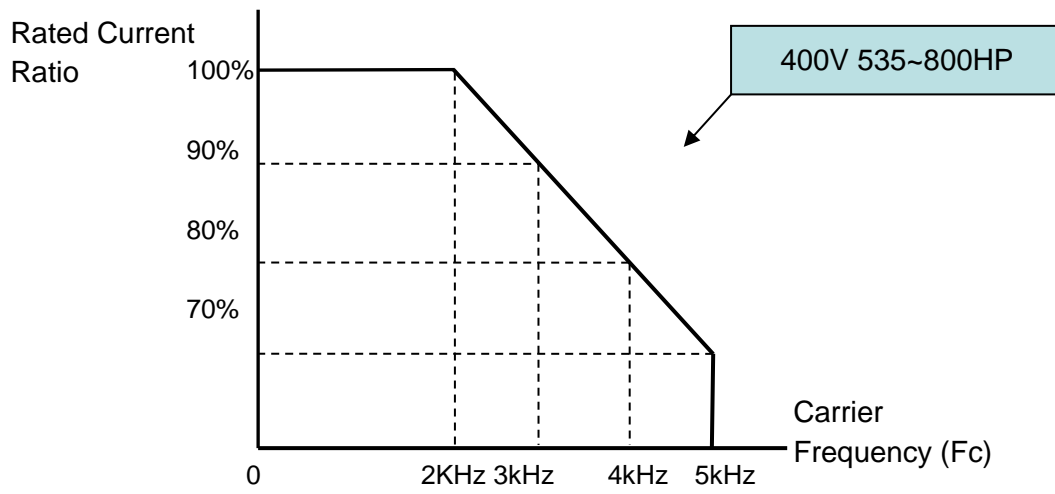
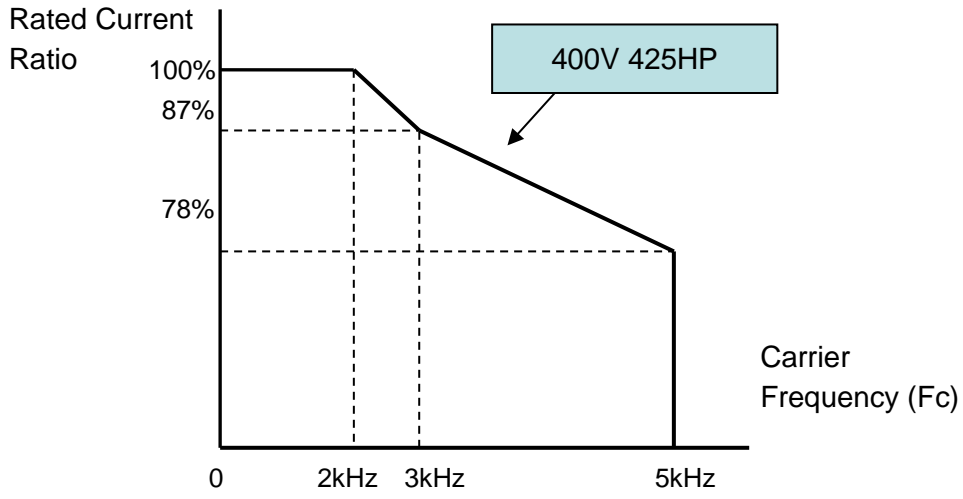
| Model | 2060 | 2075 | 2100 |
|-------|------|------|------|
| A | 85% | 90% | 86% |
| B | 68% | 72% | 69% |

| Model | 2125 | 2150 | 2175 |
|-------|------|------|------|
| A | 91% | 87% | 92% |
| B | 73% | 78% | 83% |

400V Models

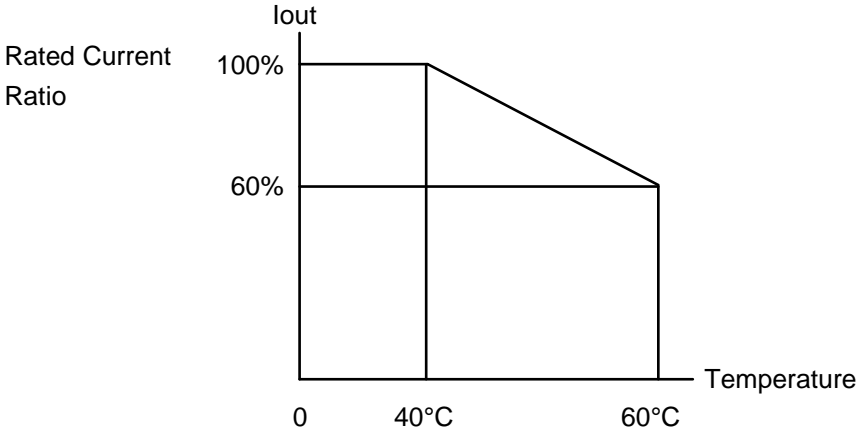






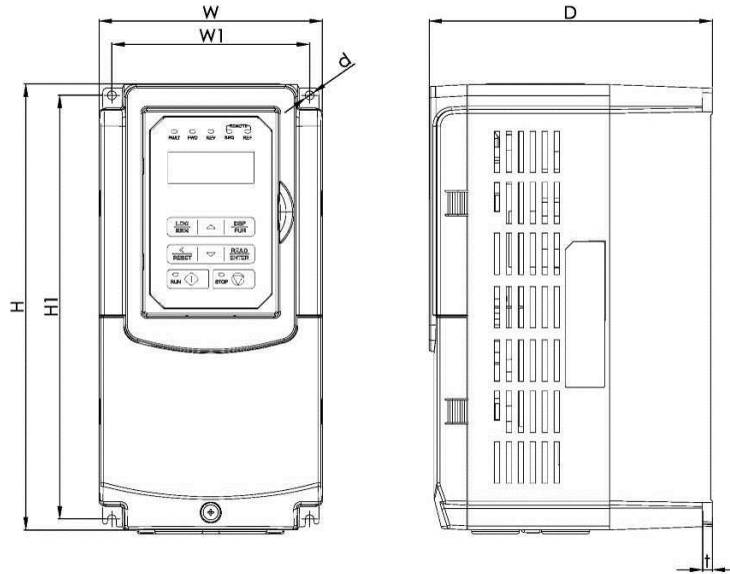
3.21 Inverter Derating Based on Temperature

Note: Adjust the inverter rated current for ambient temperature to ensure the appropriate application.



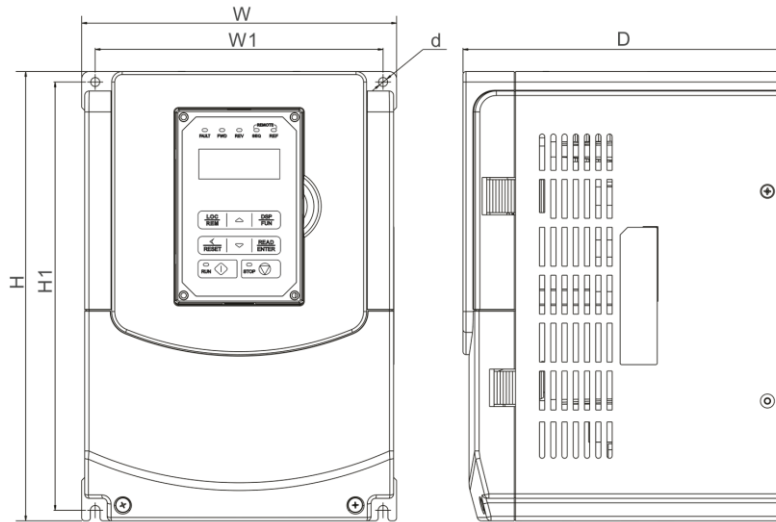
3.22 Inverter Dimensions (IP00 / IP20)

(a) 200V: 1-7.5HP/ 400V: 1-10HP



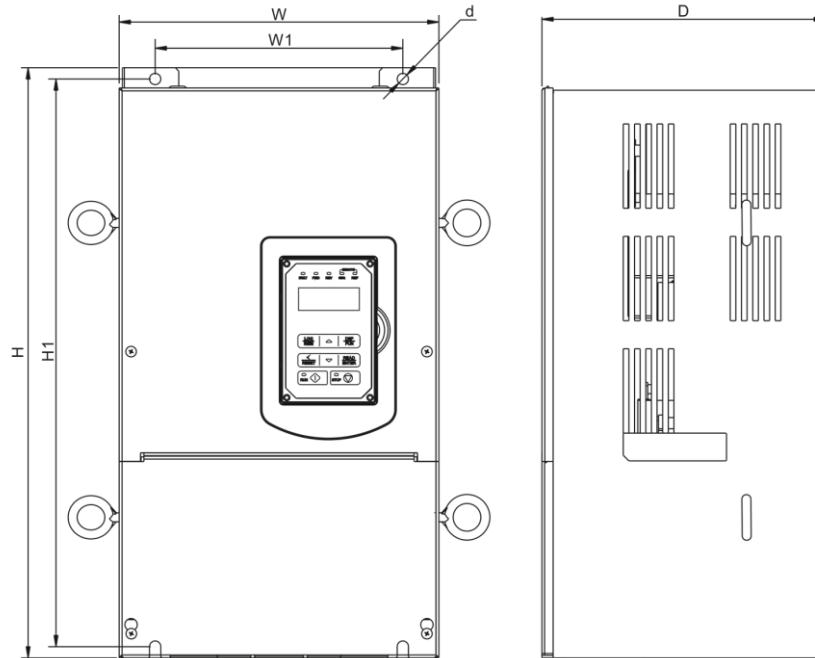
| Inverter Model | Dimensions in inch (mm) | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|----------------|---------------|---------------|----------------|-------------|----|---------------|
| | W | H | D | W1 | H1 | t | | |
| F510-2001-C | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |
| F510-2002-C | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |
| F510-2003-C | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |
| F510-2005-C3 | 140 (5.51) | 279 (10.98) | 177 (6.97) | 122 (4.80) | 267 (10.51) | 7 (0.28) | M6 | 3.8 (8.38) |
| F510-2008-C3 | 140 (5.51) | 279 (10.98) | 177 (6.97) | 122 (4.80) | 267 (10.51) | 7 (0.28) | M6 | 3.8 (8.38) |
| F510-4001-C3 | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |
| F510-4002-C3 | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |
| F510-4003-C3 | 130 (5.12) | 215 (8.46) | 150 (5.91) | 118 (4.65) | 203 (7.99) | 5 (0.20) | M5 | 2.5 (5.5) |

(b) 200V: 10-30HP/ 400V: 15-40HP (IP20)



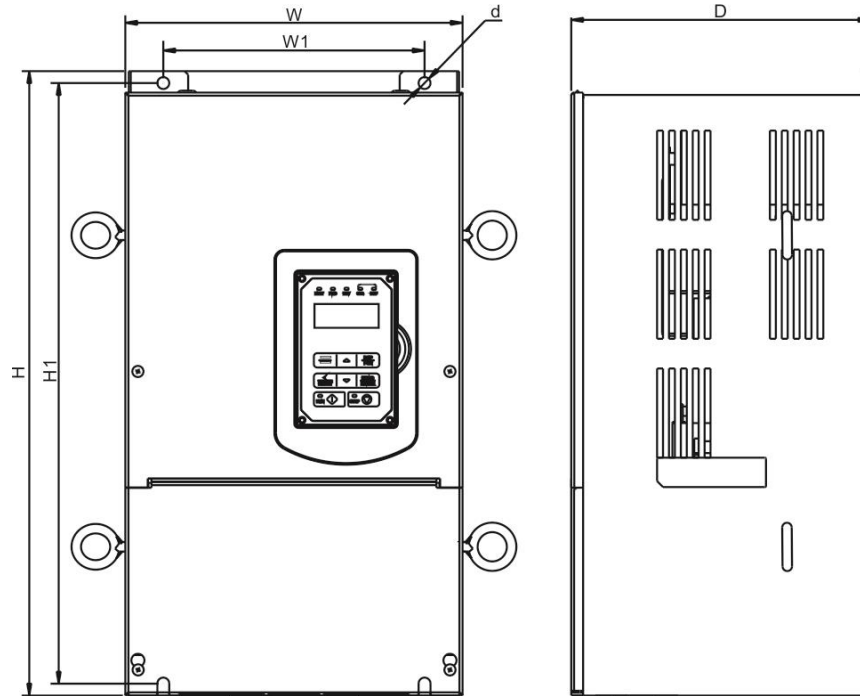
| Inverter Model | Dimensions in inch (mm) | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|----------------|---------------|---------------|----------------|---------------|----|----------------|
| | W | H | D | W1 | H1 | t | | |
| F510-2010-C3 | 210 (8.27) | 300 (11.81) | 215 (8.46) | 192 (7.56) | 286 (11.26) | 1.6 (0.06) | M6 | 6.2 (13.67) |
| F510-2015-C3 | 210 (8.27) | 300 (11.81) | 215 (8.46) | 192 (7.56) | 286 (11.26) | 1.6 (0.06) | M6 | 6.2 (13.67) |
| F510-2020-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |
| F510-2025-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |
| F510-2030-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |
| F510-4015-C3 | 210 (8.27) | 300 (11.81) | 215 (8.46) | 192 (7.56) | 286 (11.26) | 1.6 (0.06) | M6 | 6.2 (13.67) |
| F510-4020-C3 | 210 (8.27) | 300 (11.81) | 215 (8.46) | 192 (7.56) | 286 (11.26) | 1.6 (0.06) | M6 | 6.2 (13.67) |
| F510-4025-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |
| F510-4030-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |
| F510-4040-C3 | 265 (10.43) | 360 (14.17) | 225 (8.86) | 245 (9.65) | 340 (13.39) | 1.6 (0.06) | M8 | 10 (22.05) |

(c) 200V: 40-50HP/ 400V: 50-75HP (IP00)



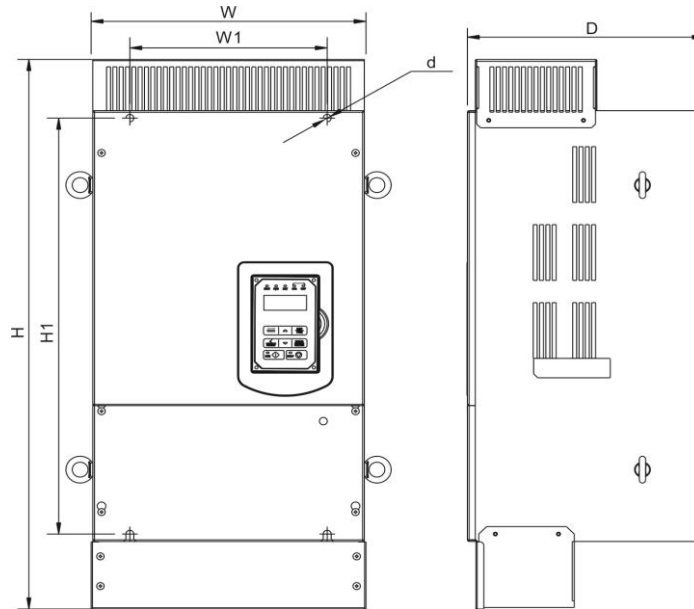
| Inverter Model | Dimensions in inch (mm) | | | | | | d | NW in kg(lbs)) |
|----------------|-------------------------|----------------|---------------|---------------|----------------|---------------|----|----------------|
| | W | H | D | W1 | H1 | t | | |
| F510-2040-C3 | 284 (11.18) | 525 (20.67) | 252 (9.92) | 220 (8.66) | 505 (19.88) | 1.6 (0.06) | M8 | 30 (66.14) |
| F510-2050-C3 | 284 (11.18) | 525 (20.67) | 252 (9.92) | 220 (8.66) | 505 (19.88) | 1.6 (0.06) | M8 | 30 (66.14) |
| F510-4050-C3 | 284 (11.18) | 525 (20.67) | 252 (9.92) | 220 (8.66) | 505 (19.88) | 1.6 (0.06) | M8 | 30 (66.14) |
| F510-4060-C3 | 284 (11.18) | 525 (20.67) | 252 (9.92) | 220 (8.66) | 505 (19.88) | 1.6 (0.06) | M8 | 30 (66.14) |
| F510-4075-C3 | 284 (11.18) | 525 (20.67) | 252 (9.92) | 220 (8.66) | 505 (19.88) | 1.6 (0.06) | M8 | 30 (66.14) |

(d) 200V: 60-125HP/ 400V: 100-250HP (IP00)



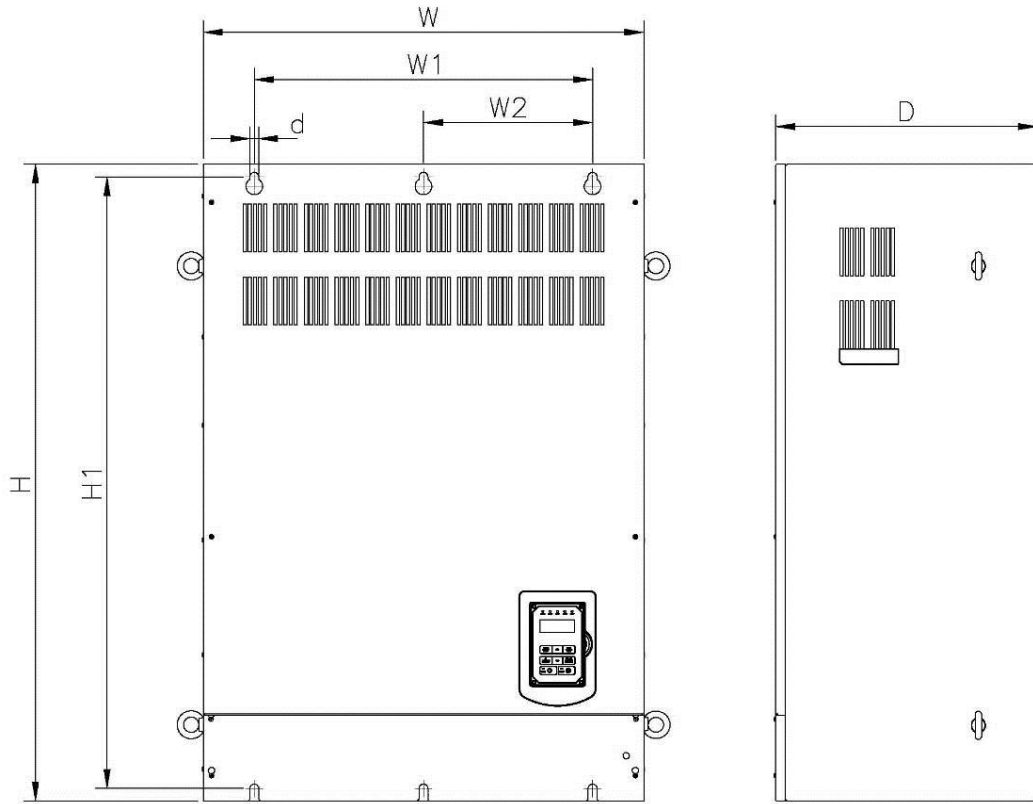
| Inverter Model | Dimensions in inch (mm) | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|----------------|------------------|----------------|----------------|---------------|-----|-----------------|
| | W | H | D | W1 | H1 | t | | |
| F510-2060-C3 | 344 (13.54) | 580 (22.83) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 40.5 (89.29) |
| F510-2075-C3 | 344 (13.54) | 580 (22.83) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 40.5 (89.29) |
| F510-2100-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |
| F510-2125-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |
| F510-4100-C3 | 344 (13.54) | 580 (22.83) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 40.5 (89.29) |
| F510-4125-C3 | 344 (13.54) | 580 (22.83) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 40.5 (89.29) |
| F510-4150-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |
| F510-4175-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |
| F510-4215-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |
| F510-4250-C3 | 459 (18.07) | 790 (31.10) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 74 (163.14) |

(e) 200V: 60-125HP/ 400V: 100-250HP (IP20)



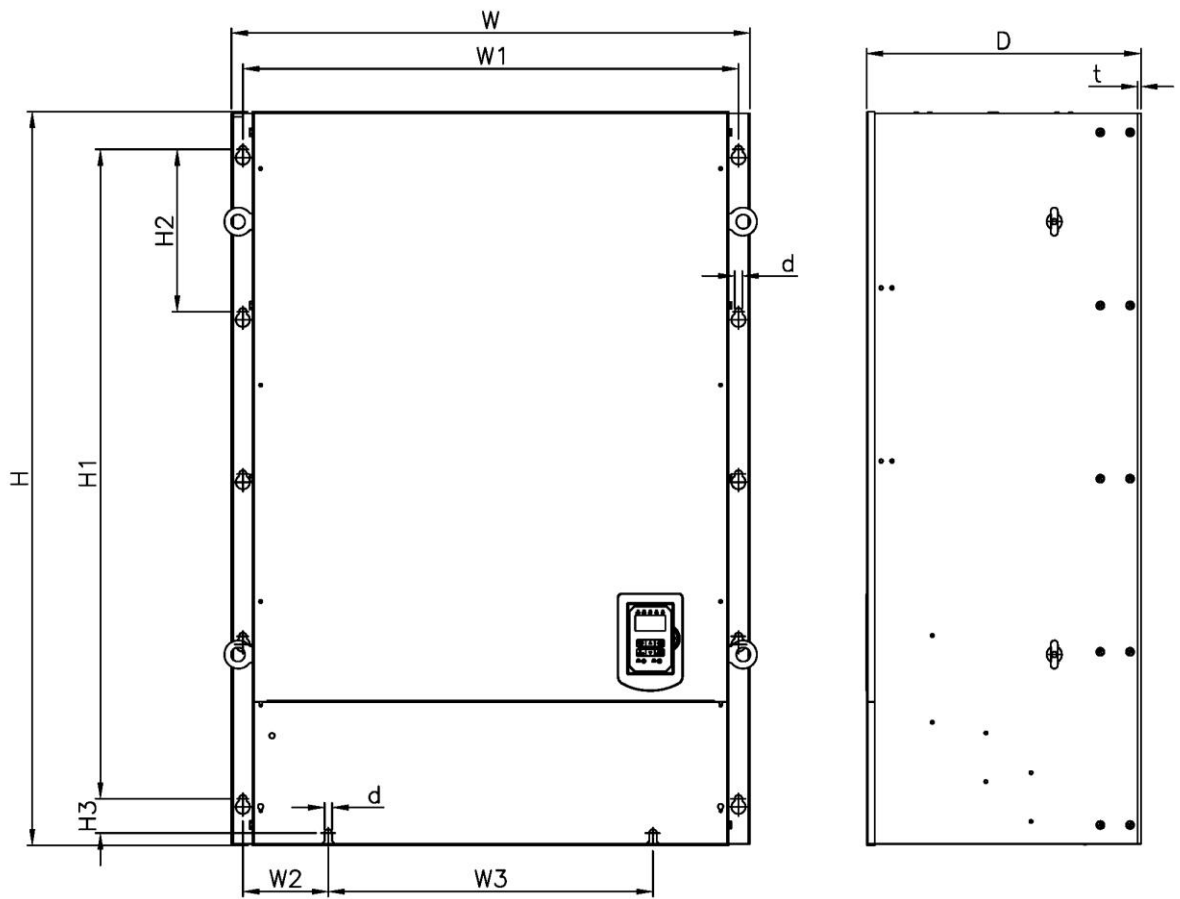
| Inverter Model | Dimensions in inch (mm) | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|-----------------|------------------|----------------|----------------|---------------|-----|----------------|
| | W | H | D | W1 | H1 | t | | |
| F510-2060-C3 | 348.5 (13.72) | 740 (29.13) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 44 (97.00) |
| F510-2075-C3 | 348.5 (13.72) | 740 (29.13) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 44 (97.00) |
| F510-2100-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-2125-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-4100-C3 | 348.5 (13.72) | 740 (29.13) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 44 (97.00) |
| F510-4125-C3 | 348.5 (13.72) | 740 (29.13) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 44 (97.00) |
| F510-4150-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-4175-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-4215-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-4250-C3 | 463.5 (18.25) | 1105 (43.50) | 324.5 (12.78) | 320 (12.60) | 760 (29.92) | 1.6 (0.06) | M10 | 81 (178.57) |
| F510-2060-C3 | 348.5 (13.72) | 740 (29.13) | 300 (11.81) | 250 (9.84) | 560 (22.05) | 1.6 (0.06) | M10 | 44 (97.00) |

(f) 200V: 150-175HP/ 400V: 300-425HP (IP20)



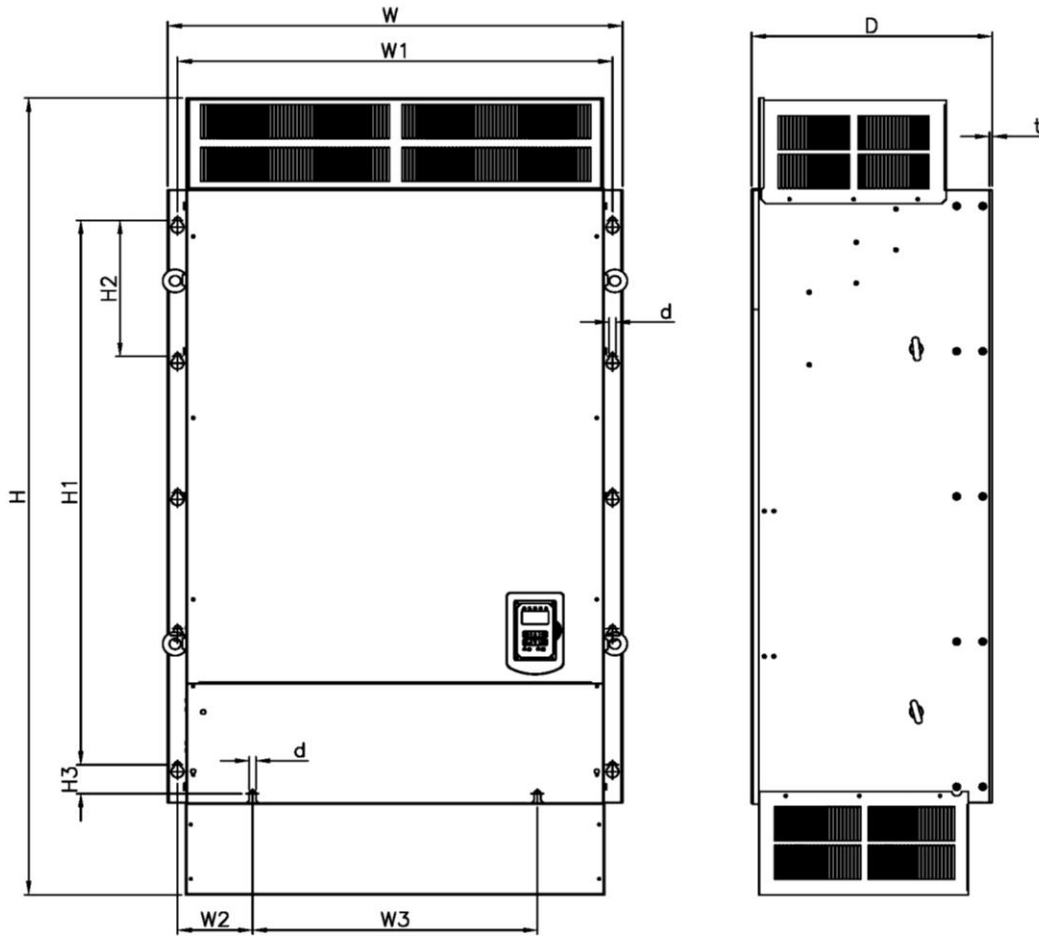
| Inverter Model | Dimensions in inch (mm) | | | | | | NW in kg(lbs) | |
|----------------|-------------------------|-----------------|----------------|----------------|----------------|----------------|---------------|-----|
| | W | H | D | W1 | H1 | t | | |
| F510-2150-C3 | 690 (27.17) | 1000 (39.37) | 410 (16.14) | 530 (20.87) | 265 (10.43) | 960 (37.80) | 1.6 (0.06) | M12 |
| F510-2175-C3 | 690 (27.17) | 1000 (39.37) | 410 (16.14) | 530 (20.87) | 265 (10.43) | 960 (37.80) | 1.6 (0.06) | M12 |
| F510-4300-C3 | 690 (27.17) | 1000 (39.37) | 410 (16.14) | 530 (20.87) | 265 (10.43) | 960 (37.80) | 1.6 (0.06) | M12 |
| F510-4375-C3 | 690 (27.17) | 1000 (39.37) | 410 (16.14) | 530 (20.87) | 265 (10.43) | 960 (37.80) | 1.6 (0.06) | M12 |
| F510-4425-C3 | 690 (27.17) | 1000 (39.37) | 410 (16.14) | 530 (20.87) | 265 (10.43) | 960 (37.80) | 1.6 (0.06) | M12 |

(g) 400V: 535-800HP (IP00)



| Inverter Model | Dimensions in mm (inch) | | | | | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|-----------------|----------------|----------------|---------------|----------------|-----------------|----------------|----------------|---------------|-----|---------------|
| | W | H | D | W1 | W2 | W3 | H1 | H2 | H3 | t | | |
| F510-4535-C3 | 958 (37.72) | 1356 (53.38) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 335 (739) |
| F510-4670-C3 | 958 (37.72) | 1356 (53.38) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 335 (739) |
| F510-4800-C3 | 958 (37.72) | 1356 (53.38) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 335 (739) |

(h) 400V: 535-800HP (IP20)



| Inverter Model | Dimensions in mm (inch) | | | | | | | | | | d | NW in kg(lbs) |
|----------------|-------------------------|-----------------|----------------|----------------|---------------|----------------|-----------------|----------------|----------------|---------------|-----|---------------|
| | W | H | D | W1 | W2 | W3 | H1 | H2 | H3 | t | | |
| F510-4535-C3 | 958 (37.72) | 1756 (69.13) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 350 (772) |
| F510-4670-C3 | 958 (37.72) | 1756 (69.13) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 350 (772) |
| F510-4800-C3 | 958 (37.72) | 1756 (69.13) | 507 (19.96) | 916 (36.06) | 158 (6.22) | 600 (23.62) | 1200 (47.24) | 300 (11.81) | 63.5 (2.50) | 6.2 (0.24) | M12 | 350 (772) |

4. Keypad and Programming Functions

4.1 LCD Keypad

4.1.1 Keypad Display and Keys



| DISPLAY | Description |
|-----------------------|---|
| LCD Display | Monitor inverter signals, view / edit parameters, fault / alarm display. |
| LED INDICATORS | |
| FAULT | LED ON when a fault or alarm is active. |
| FWD | LED ON when inverter is running in forward direction, flashing when stopping. |
| REV | On when inverter is running in reverse direction, flashing when stopping. |
| SEQ | LED ON when RUN command is from the external control terminals or from serial communication |
| REF | LED ON when Frequency Reference command is from the external control terminals or from serial communication |

| KEYS (8) | Description |
|---------------------|--|
| RUN | RUN Inverter in Local Mode |
| STOP | STOP Inverter |
| ▲ | Parameter navigation Up, Increase parameter or reference value |
| ▼ | Parameter navigation Down, Decrease parameter or reference value |
| FWD/REV | Used to switch between Forward and Reverse direction |
| DSP/FUN | Used to scroll to next screen Frequency screen →Function selection→Monitor parameter |
| ◀ / RESET | Selects active seven segment digit for editing with the ▲ ▼ keys Used to reset fault condition. |
| READ / ENTER | Used to read and save the value of the active parameter |

Auto-Repeat Keys

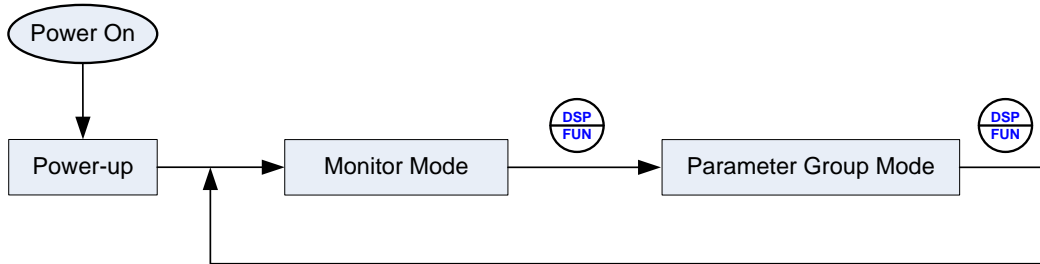
Holding the ▲UP or ▼DOWN key for a longer period of time will initiate the auto-repeat function resulting in the value of the selected digit to automatically increase or decrease.

Note: HOA LCD keypad is available as an option.

4.1.2 Keypad Menu Structure

Main Menu

The A510 inverter main menu consists of two main groups (modes). The DSP/FUN key is used to switch between the monitor mode and the parameter group mode.



| Mode | Description |
|----------------------|---|
| Monitor Mode | View inverter status, signals and fault data. |
| Parameter Group Mode | Access to available parameter groups. |

All the available parameter groups are listed in the Parameter Group Mode use the up and down keys to select a group and press Read/Enter key to access its parameters.

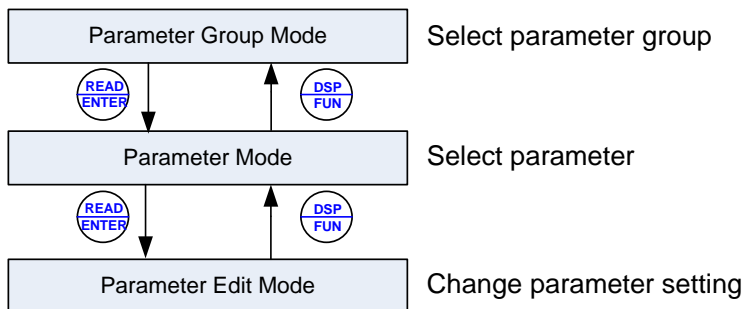


Fig. 4.1.2.1 Parameter Group Structure

Notes:

- Always perform an auto-tune on the motor before operating the inverter in vector control (sensorless vector). Auto-tuning mode will not be displayed when the inverter is running or when a fault is active.
- To scroll through the available modes, parameter groups or parameter list press and hold the up or down key.

Monitor Mode

In monitor mode inverter signals can be monitored such as output frequency, output current and output voltage, etc...) as well as fault information and fault trace. See Fig 4.1.2.2 for keypad navigation.

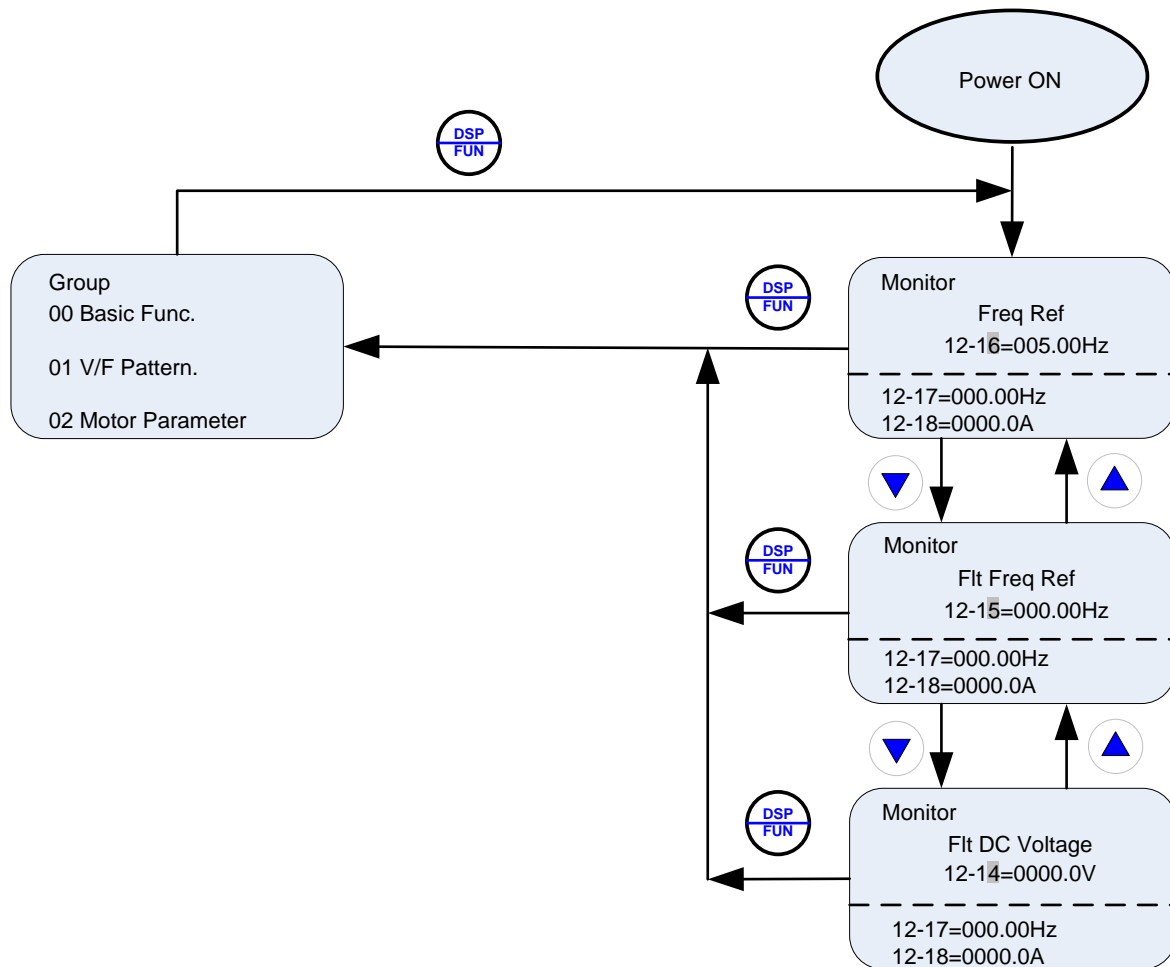


Fig 4.1.2.2 Monitor Mode

Notes:

- To scroll through the available monitor parameter list, press and hold the ▲ (up) or ▼ (down) key.

Programming Mode

In programming mode inverter parameters can be read or changed. See Fig 4.1.2.3 for keypad navigation.

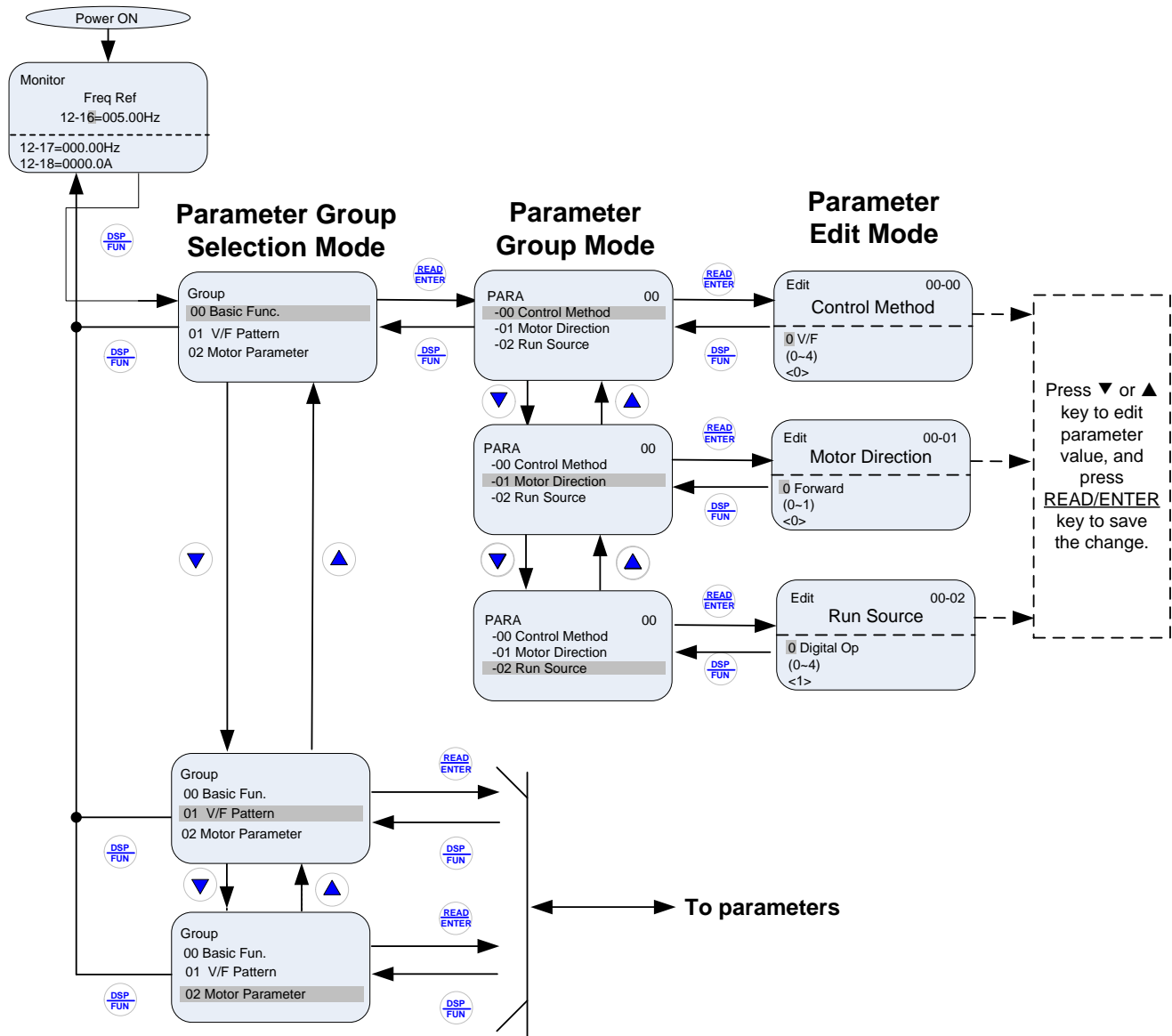
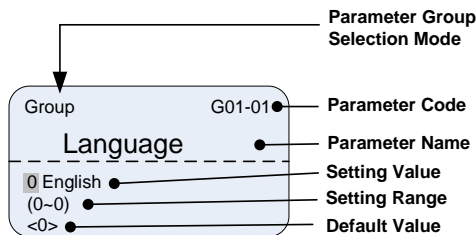


Fig 4.1.2.3 Programming Mode



Notes:

- The parameters values can be changed from the Edit screen with the up, down and < / RESET shift key.
- To save a parameter press the READ/ENTER key.
- Refer to section 4.3 for parameter details.
- Press the ▲ (up) or ▼ (down) key to scroll parameter groups or parameter list.

Auto-tuning Mode (Sensorless Vector Only)

In the auto-tuning mode motor parameters can be calculated and set automatically based on the selected control mode. See Fig 4.1.2.4 for keypad navigation.

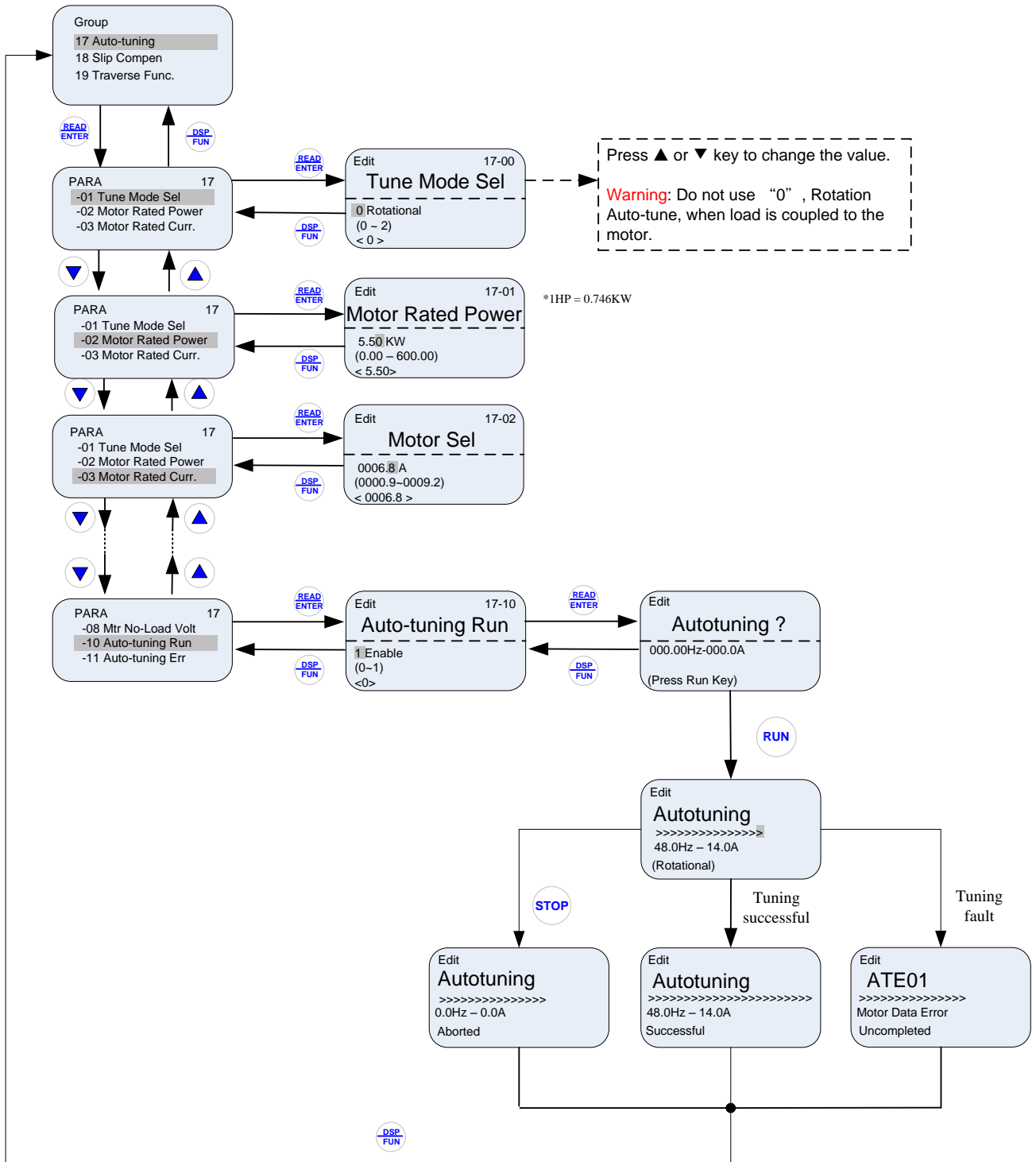


Fig 4.1.2.4 Auto-tuning Mode

Notes:

- Set correct motor parameters by referring to motor nameplate.
- Refer to section 4.3 for parameter details.

Notes:

1. Use the up and down keys to scroll through the auto-tuning parameter list. Depending on the selected control mode in parameter 00-00, some of the auto-tuning parameters will not be accessible. (Refer to the Auto-tuning Group 17 parameters).
2. After entering the motor nameplate rated output power (17-01), rated current (17-02), rated voltage (17-03), rated frequency (17-04), rated speed (17-05) and number of motor poles (17-06), select the automatic tuning mode and press the RUN key to perform the auto-tuning operation. When auto-tuning is successful the calculated motor parameters will be saved into parameter group 02 (motor parameters).
3. (a) "Rotational" will be displayed during rotational auto-tuning (17-00=0) and the motor will rotate during auto-tuning. Ensure that it is safe to operate the motor before pressing the RUN key.
(b) "Stationary" will be displayed during stationary auto-tuning (17-00=1); the motor shaft does not rotate.
(c) The RUN LED (in the upper left corner of the RUN key) will be lit during auto-tuning.
(d) The LCD display shows ">>>" or "Atund" during the auto-tuning process.
4. Press the STOP key on the keypad to abort the auto-tuning operation.
5. In case of an auto-tuning fault, a fault message and the uncompleted message are displayed on the keypad. The RUN LED will be flashing and the motor will coast to stop. (Refer to section 10.4 for the Auto-tuning Faults.) The auto-tuning fault can be cleared by pressing the RESET key after which the keypad displays the auto-tuning mode again.

All motor parameters (group 02 and group 17 parameters) will revert back to their factory settings if a fault occurs. The motor data must be re-entered before starting the auto-tuning function again. The keypad shows ">>>" during an auto-tuning fault.
6. Upon successful completion of an auto-tune, the RUN LED will turn off. Press the DSP/FUN key to return to the main menu to select the next operation. The auto-tuning procedure takes approximately 50 seconds.

4.2 Parameters

| Parameter group | Name |
|-----------------|--|
| Group 00 | Basic Parameters |
| Group 01 | V/F Control Parameters |
| Group 02 | IM Motor Parameters |
| Group 03 | External Digital Input and Output Parameters |
| Group 04 | External Analog Input and Output Parameters |
| Group 05 | Multi-Speed Parameters |
| Group 06 | Automatic Program Operation Parameters |
| Group 07 | Start/ Stop Parameters |
| Group 08 | Protection Parameters |
| Group 09 | Communication Parameters |
| Group 10 | PID Parameters |
| Group 11 | Auxiliary Parameters |
| Group 12 | Monitoring Parameters |
| Group 13 | Maintenance Parameters |
| Group 14 | PLC Setting Parameters |
| Group 15 | PLC Monitoring Parameters |
| Group 16 | LCD Parameters |
| Group 17 | IM Motor Automatic Tuning Parameters |
| Group 18 | Slip Compensation Parameters |
| Group 19 | Reserved |
| Group 20 | Speed Control Parameters |
| Group 21 | Torque Control Parameters |
| Group 22 | PM Motor Parameters |
| Group 23 | Pump & HVAC |
| Group 24 | 1 to 8 Pump Card Function Group |

| Group 00 Basic Parameters | | | | | | | | |
|---------------------------|--|---|---------------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 00-00 | Control Mode Selection | 0: V/F | 0 | - | 0 | 0 | 0 | *3 |
| | | 1: Reserved | | | | | | |
| | | 2: SLV | | | | | | |
| | | 3~4: Reserved | | | | | | |
| | | 5: PM SLV | | | | | | |
| 00-01 | Motor's Rotation Direction | 0: Forward | 0 | - | 0 | 0 | 0 | *1 |
| | | 1: Reverse | | | | | | |
| 00-02 | Main Run Command Source Selection | 0: Keypad | 1 ^{*note1} | - | 0 | 0 | 0 | |
| | | 1: External Terminal (Control Circuit) | | | | | | |
| | | 2: Communication Control (RS-485) | | | | | | |
| | | 3: PLC | | | | | | |
| | | 4: RTC | | | | | | |
| 00-03 | Alternative Run Command Source Selection | 0: Keypad | 0 | - | 0 | 0 | 0 | |
| | | 1: External Terminal (Control Circuit) | | | | | | |
| | | 2: Communication Control (RS-485) | | | | | | |
| | | 3: PLC | | | | | | |
| | | 4: RTC | | | | | | |
| 00-04 | Language Selection (for LCD only) | 0: English | 0 | - | 0 | 0 | 0 | |
| | | 1: Simple Chinese | | | | | | |
| | | 2: Traditional Chinese | | | | | | |
| | | 3: Turkish | | | | | | |
| 00-05 | Main Frequency Command Source Selection | 0: Keypad | 1 ^{*note1} | - | 0 | 0 | 0 | |
| | | 1: External Terminal (Analog AI1) | | | | | | |
| | | 2: Terminal Command UP/ DOWN | | | | | | |
| | | 3: Communication Control (RS-485) | | | | | | |
| | | 4: Reserved | | | | | | |
| | | 5: Reserved | | | | | | |
| | | 6: RTC | | | | | | |
| | | 7. AI2 Auxiliary Frequency ^{*7} | | | | | | |
| 00-06 | Alternative Frequency Command Source Selection | 0: Keypad | 0 | - | 0 | 0 | 0 | |
| | | 1: External Terminal (Analog) | | | | | | |
| | | 2: Terminal Command UP/ DOWN | | | | | | |
| | | 3: Communication Control (RS-485) | | | | | | |
| | | 4: Reserved | | | | | | |
| | | 5: Reserved | | | | | | |
| | | 6: RTC | | | | | | |
| | | 7. AI2 Auxiliary Frequency ^{*7} | | | | | | |
| 00-07 | Main and Alternative Frequency Command Modes | 0: Main Frequency | 0 | - | 0 | 0 | 0 | |
| | | 1: Main Frequency + Alternative Frequency | | | | | | |
| 00-08 | Communication Frequency Command Range | 0.00-400.00 | 0.00 | Hz | 0 | 0 | 0 | |
| 00-09 | Communication Frequency Command Memory Selection | 0: Do not save when power is off. | 0 | - | 0 | 0 | 0 | |
| | | 1: Save when power is off. | | | | | | |

| Group 00 Basic Parameters | | | | | | | | |
|---------------------------|--|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 00-10 | Minimum frequency detection | 0: Show warning if lower than minimum frequency 1: Run as minimum frequency if lower than minimum frequency | 0 | - | ○ | ○ | ○ | |
| 00-11 | Selection of PID Lower Limit Frequency | 0: PID is bound to lower limit frequency when inverter sleeps. | 0 | - | ○ | ○ | ○ | |
| | | 1: PID is bound to 0Hz when inverter sleeps. | | | | | | |
| 00-12 | Upper Limit Frequency | 0.1~109.0 | 100.0 | % | ○ | ○ | ○ | |
| 00-13 | Lower Limit Frequency | 0.0~109.0 | 0.0 | % | ○ | ○ | ○ | |
| 00-14 | Acceleration Time 1 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-15 | Deceleration Time 1 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-16 | Acceleration Time 2 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-17 | Deceleration Time 2 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-18 | Jog Frequency | 0.00~400.00 | 6.00 | Hz | ○ | ○ | ○ | *1 |
| 00-19 | Jog Acceleration Time | 0.1~0600.0 | - | s | ○ | ○ | ○ | *1 |
| 00-20 | Jog Deceleration Time | 0.1~0600.0 | - | s | ○ | ○ | ○ | *1 |
| 00-21 | Acceleration Time 3 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-22 | Deceleration Time 3 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-23 | Acceleration Time 4 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-24 | Deceleration Time 4 | 0.1~6000.0 | - | s | ○ | ○ | ○ | *1 |
| 00-25 | Switch-Over Frequency of Acc/Dec Time 1 and Time 4 | 0.0~400.0 | 0.0 | Hz | ○ | ○ | ○ | |
| 00-26 | Emergency Stop Time | 0.1~6000.0 | 5.0 | s | ○ | ○ | ○ | |
| 00-27 | Reserved | | | | | | | |
| 00-28 | Main Frequency Command Characteristic Selection | 0: Positive Characteristic (0~10V/4~20mA is corresponding to 0~100%) | 0 | - | ○ | ○ | ○ | |
| | | 1: Negative Characteristic (0~10V/4~20mA is corresponding to 100~0%) | | | | | | |
| 00-29 ~ 00-31 | Reserved | | | | | | | |
| 00-32 | Application Selection Presets | 0: General | 0 | - | ○ | ○ | ○ | |
| | | 1: Water Supply Pump | | | | | | |
| | | 2: Conveyor *7 | | | | | | |
| | | 3: Exhaust fan | | | | | | |
| | | 4: HVAC | | | | | | |
| | | 5: Compressor *7 | | | | | | |
| | | 6: Reserved | | | | | | |
| 7: Reserved | | | | | | | | |
| 00-33 | Modified Parameters (only for LCD) | 0: Enable | 0 | - | ○ | ○ | ○ | |
| | | 1: Disable | | | | | | |
| 00-34 | Reserved | | | | | | | |
| 00-35 | Reserved | | | | | | | |
| 00-36 | Reserved | | | | | | | |
| 00-37 | Reserved | | | | | | | |

| Group 00 Basic Parameters | | | | | | | | |
|---------------------------|-------------------|---|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| ~ 00-40 | | | | | | | | |
| Group 00 Basic Parameters | | | | | | | | |
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 00-41 | User Parameter 0 | Set 13-06 = 1, and enable user parameter. Setting Range: 01-00 ~24-06 (only used in LCD keypad) | - | | 0 | 0 | 0 | |
| 00-42 | User Parameter 1 | | - | | 0 | 0 | 0 | |
| 00-43 | User Parameter 2 | | - | | 0 | 0 | 0 | |
| 00-44 | User Parameter 3 | | - | | 0 | 0 | 0 | |
| 00-45 | User Parameter 4 | | - | | 0 | 0 | 0 | |
| 00-46 | User Parameter 5 | | - | | 0 | 0 | 0 | |
| 00-47 | User Parameter 6 | | - | | 0 | 0 | 0 | |
| 00-48 | User Parameter 7 | | - | | 0 | 0 | 0 | |
| 00-49 | User Parameter 8 | | - | | 0 | 0 | 0 | |
| 00-50 | User Parameter 9 | | - | | 0 | 0 | 0 | |
| 00-51 | User Parameter 10 | | - | | 0 | 0 | 0 | |
| 00-52 | User Parameter 11 | | - | | 0 | 0 | 0 | |
| 00-53 | User Parameter 12 | | - | | 0 | 0 | 0 | |
| 00-54 | User Parameter 13 | | - | | 0 | 0 | 0 | |
| 00-55 | User Parameter 14 | | - | | 0 | 0 | 0 | |
| 00-56 | User Parameter 15 | - | | 0 | 0 | 0 | | |

| Group 01 V/F Control Parameters | | | | | | | | |
|---------------------------------|---------------------------------------|-------------------------------|---------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 01-00 | V/F Curve Selection | 0~FF | F | - | O | X | X | *3 |
| 01-01 | Reserved | | | | | | | |
| 01-02 | Maximum Output Frequency | 4.8~400.0 | 50.0/ 60.0 | Hz | O | O | O | *6*8 |
| 01-03 | Maximum Output Voltage | 200V: 0.1~255.0 | 230.0 | V | O | X | X | *8 |
| | | 400V: 0.2~510.0 | 400.0 | | | | | |
| 01-04 | Middle Output Frequency 2 | 0.0~400.0 | 0.0 | Hz | O | X | X | |
| 01-05 | Middle Output Voltage 2 | 200V: 0.0~255.0 | 0.0 | V | O | X | X | *8 |
| | | 400V: 0.0~510.0 | | | | | | |
| 01-06 | Middle Output Frequency 1 | 0.0~400.0 | 30.0 | Hz | O | X | X | |
| 01-07 | Middle Output Voltage 1 | 200V: 0.0~255.0 | 38.5 | V | O | X | X | *8 |
| | | 400V: 0.0~510.0 | 77.0 | | | | | |
| 01-08 | Minimum Output Frequency | 0.0~400.0 | 1.5 | Hz | O | O | O | |
| 01-09 | Minimum Output Voltage | 200V: 0.0~255.0 | 6.6 | V | O | X | X | *8 |
| | | 400V: 0.0~510.0 | 13.2 | | | | | |
| 01-10 | Torque Compensation Gain | 0.0~2.0 | 0.5 | - | O | X | X | *1 |
| 01-11 | Selection of Torque Compensation Mode | 0: Torque Compensation Mode 0 | 0 | - | O | X | X | |
| | | 1: Torque Compensation Mode 1 | | | | | | |
| 01-12 | Base Frequency | 4.8~400.0 | 50.0/ 60.0 | Hz | O | O | O | *8 |
| 01-13 | Base Output Voltage | 200V: 0.0~255.0 | 230.0 | V | O | X | X | *8 |
| | | 400V: 0.0~510.0 | 400.0 | | | | | |
| 01-14 | Input Voltage Setting | 200V: 155.0~255.0 | 230.0 | V | O | O | O | *8 |
| | | 400V: 310.0~510.0 | 400.0 | | | | | |
| 01-15 | Torque Compensation Time | 0~10000 | 200 | ms | O | X | X | |

| Group 02 IM Motor Parameters | | | | | | | | |
|------------------------------|-------------------------------|--|---------------|-------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 02-00 | No-Load Current | 0.01~600.00 | KVA | A | O | X | X | |
| 02-01 | Rated Current | V/F mode is 10%~200% of inverter's rated current; SLV mode is 25%~200% of inverter's rated current. | KVA | A | O | O | X | |
| 02-02 | Reserved | | | | | | | |
| 02-03 | Rated Rotation Speed | 0~60000 | KVA | Rpm | O | O | X | |
| 02-04 | Rated Voltage | 200V: 50.0~240.0 | 230.0 | V | O | O | X | *8 |
| | | 400V: 100.0~480.0 | 400.0 | | | | | |
| 02-05 | Rated Power | 0.01~600.00 | KVA | kW | O | O | X | |
| 02-06 | Rated Frequency | 4.8~400.0 | 50.0/ 60.0 | Hz | O | O | X | *8 |
| 02-07 | Poles | 2~16 (Even) | 4 | pole- | O | O | X | *6 |
| 02-08 | Reserved | | | | | | | |
| 02-09 | Excitation Current | 15.0~70.0 | KVA | % | X | O | X | |
| 02-10 | Core Saturation Coefficient 1 | 1~100 | KVA | % | X | O | X | |
| 02-11 | Core Saturation Coefficient 2 | 1~100 | KVA | % | X | O | X | |
| 02-12 | Core Saturation Coefficient 3 | 80~300 | KVA | % | X | O | X | |

| Group 02 IM Motor Parameters | | | | | | | | |
|------------------------------|--------------------------|---------------|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 02-13 | Core Loss | 0.0~15.0 | KVA | % | O | X | X | |
| 02-14 | Reserved | | | | | | | |
| 02-15 | Resistance between Wires | 0.001~60.000 | KVA | Ω | O | O | X | |
| 02-19 | No-Load Voltage | 200V: 50~240 | KVA | V | X | O | X | |
| | | 400V: 100~480 | | | | | | |
| 02-20 ~ 02-32 | Reserved | | | | | | | |
| 02-33 | Leakage Inductance Ratio | 0.1~15.0 | KVA | % | X | O | X | |
| 02-34 | Slip Frequency | 0.10~20.00 | KVA | Hz | X | O | X | |

Group 03 External Digital Input and Output Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute | |
|---|---|---|---------|------|--------------|-----|--------|-----------|----|
| | | | | | V/F | SLV | PM SLV | | |
| 03-00 | Multi-function Terminal Function Setting-S1 | 0: 2-Wire Sequence (ON: Forward Run Command) | 0 | | | O | O | O | |
| | | 1: 2-Wire Sequence (ON: Reverse Run Command) | | | | | | | |
| 03-01 | Multi-function Terminal Function Setting-S2 | 2: Multi-Speed Setting Command 1 | 1 | | | O | O | O | |
| | | 3: Multi-Speed Setting Command 2 | | | | | | | |
| | | 4: Multi-Speed Setting Command 3 | | | | | | | |
| 03-02 | Multi-function Terminal Function Setting-S3 | 5: Multi-Speed Setting Command 4 | 2 | | - | O | O | O | *6 |
| | | 6: Forward Jog Run Command | | | | | | | |
| 03-03 | Multi-function Terminal Function Setting-S4 | 7: Reverse Jog Run Command | 3 | | | O | O | O | *6 |
| | | 8: UP Frequency Increasing Command | | | | | | | |
| 03-04 | Multi-function Terminal Function Setting-S5 | 9: DOWN Frequency Decreasing Command | 4 | | | O | O | O | *6 |
| | | 10: Acceleration/ Deceleration Setting Command 1 | | | | | | | |
| | | 11: Acceleration/ Deceleration Inhibition Command | | | | | | | |
| 03-05 | Multi-function Terminal Function Setting-S6 | 12: Main/Alternative Run command Switching | 17 | | - | O | O | O | |
| | | 13: Main/Alternative Frequency Command Switching | | | | | | | |
| | | 14: Emergency Stop (Decelerate to Zero and Stop) | | | | | | | |
| | | 15: External Base block Command (Rotation freely to Stop) | | | | | | | |
| | | 16: PID Control Disable | | | | | | | |
| | | 17: Fault Reset (RESET) | | | | | | | |
| | | 18: Reserved | | | | | | | |
| | | 19: Speed Search 1(from the maximum frequency) | - | O | O | X | | | |
| | | 20: Manual Energy Saving Function | - | O | X | X | | | |
| | | 21: PID Integral Reset | - | O | O | O | | | |
| | | 22~23: Reserved | - | - | - | - | | | |
| | | 24: PLC Input | 17 | | - | O | O | O | |
| | | 25: External Fault | | | | | | | |
| | | 26: 3-Wire Sequence (Forward/ Reverse Command) | | | | | | | |
| | | 27: Local/ Remote Selection | | | | | | | |
| | | 28: Remote Mode Selection | | | | | | | |
| | | 29: Jog Frequency Selection | | | | | | | |
| | | 30: Acceleration/ Deceleration Setting Command 2 | | | | | | | |
| | | 31: Inverter Overheating Warning | - | - | - | - | | | |
| 32: Reserved | - | O | X | X | | | | | |
| 33: DC Braking | - | O | X | O | | | | | |
| 34: Speed Search 2 (from Frequency Command) | - | O | O | O | | | | | |
| 35: Timing Function Input | - | O | O | O | | | | | |
| 36: PID Soft Start Disable | - | O | O | O | | | | | |

Group 03 External Digital Input and Output Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute | | | |
|---------------------------|---|--|---------|------|--------------|-----|--------|-----------|--|--|--|
| | | | | | V/F | SLV | PM SLV | | | | |
| | | 37~40: Reserved | | - | - | - | - | | | | |
| | | 41: PID Sleep | | - | O | O | O | | | | |
| | | 42~46: Reserved | | - | - | - | - | | | | |
| | | 47: Fire Mode (Forced to Run Mode) | | - | O | O | O | | | | |
| | | 48: KEB Acceleration | | - | O | X | X | | | | |
| | | 49: Parameters Writing Allowable | | - | O | O | O | | | | |
| | | 50: Unattended Start Protection (USP) | | - | O | O | O | | | | |
| | | 51~52: Reserved | | - | - | - | - | | | | |
| | | 53: 2-Wire Self Holding Mode (Stop Command) | | | | | | | | | |
| | | 54: Switch PID1 and PID2 | | | | | | | | | |
| | | 55: RTC Time Enable | | | | | | | | | |
| | | 56: RTC Offset Enable | | | | | | | | | |
| | | 57: Forced Frequency Run | | | | | | | | | |
| | | 58: Run Permissive Function | | | | | | | | | |
| | | 63: switch to Tolerance Range of Constant Pressure 2 | | | | | | | | | |
| | | 64: Reserved | | | | | | | | | |
| 65: Short-circuit braking | - | X | X | O | | | | | | | |
| 03-06 ~ 03-07 | Reserved | | | | | | | | | | |
| 03-08 | (S1~S6) DI Scan Time | 0: Scan Time 4ms 1: Scan Time 8ms | 1 | - | O | O | O | | | | |
| 03-09 | Multi-Function Terminal (S1-S4 Selection) | xxx0b:S1 A Contact xxx1b:S1 B Contact | 0000b | | O | O | O | | | | |
| | | xx0xb:S2 A Contact xx1xb:S2 B Contact | | | | | | | | | |
| | | x0xxb:S3 A Contact x1xxb:S3 B Contact | | | | | | | | | |
| | | 0xxxb:S4 A Contact 1xxxb:S4 B Contact | | | | | | | | | |
| 03-10 | Multi-Function Terminal (S5-S6 Selection) | xxx0b:S5 A Contact xxx1b:S5 B Contact | 0000b | | O | O | O | | | | |
| | | xx0xb:S6 A Contact xx1xb:S6 B Contact | | | | | | | | | |
| | | x0xxb: Reserved x1xxb: Reserved | | | | | | | | | |
| | | 0xxxb: Reserved 1xxxb: Reserved | | | | | | | | | |
| 03-11 | Relay (R1A-R1C) Output | 0: During Running | 1 | | O | O | O | *6 | | | |
| | | 1: Fault Contact Output | | | | | | | | | |
| | | 2: Frequency Agree | | | | | | | | | |
| 03-12 | Relay (R2A-R2C) Output | 3: Setting Frequency Agree (03-13 ± 03-14) | 0 | | O | O | O | *6 | | | |
| | | 4: Frequency Detection 1 (≥03-13+03-14) | | | | | | | | | |
| | | 5: Frequency Detection 2 (<03-13+03-14) | | | | | | | | | |

Group 03 External Digital Input and Output Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|-----------------------------|--|---------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| | | 6: Automatic Restart | | | O | O | O | |
| | | 7~8: Reserved | | | - | - | - | |
| | | 9: Baseblock | | | O | O | O | |
| | | 10~11: Reserved | | | - | - | - | |
| | | 12: Over-Torque Detection | | | O | O | O | |
| | | 13: Current Agree *7 | | | O | O | O | |
| | | 14: Mechanical Brake Control (03-17~18) ^{Note1} | | | O | O | O | |
| | | 15~17: Reserved | | | - | - | - | |
| | | 18: PLC Status | | | | | | |
| | | 19: PLC Control | | | | | | |
| | | 20: Zero Speed | | | | | | |
| | | 21: Inverter Ready | | | | | | |
| | | 22: Undervoltage Detection | | | | | | |
| | | 23: Source of Operation Command | | | O | O | O | |
| | | 24: Source of Frequency Command | | | | | | |
| | | 25: Low Torque Detection | | | | | | |
| | | 26: Frequency Reference Missing | | | | | | |
| | | 27: Timing Function Output | | | | | | |
| | | 28~31: Reserved | | | - | - | - | |
| | | 32: Communication Control Contacts | | | | | | |
| | | 33: RTC Timer 1 | | | | | | |
| | | 34: RTC Timer 2 | | | | | | |
| | | 35: RTC Timer 3 | | | O | O | O | |
| | | 36: RTC Timer 4 | | | | | | |
| | | 37: Detection Output of PID Feedback Loss *7 | | | | | | |
| | | 38: Brake Release *7 | | | X | O | X | |
| | | 42: Over-High Pressure ^{Note1} | | | O | X | X | |
| | | 43: Over-Low Pressure ^{Note1} | | | O | X | X | |
| | | 44: Loss of Pressure Detection ^{Note1} | | | O | X | X | |
| | | 45: PID Sleep ^{Note1} | | | O | O | O | |
| | | 46: Over-High Flow ^{Note1} | | | O | O | O | |
| | | 47: Over-Low Flow ^{Note1} | | | O | O | O | |
| | | 48: Shortage of Low Suction ^{Note1} | | | O | O | O | |
| | | 49: Communication Error ^{Note2} | | | O | O | O | |
| | | 50: Frequency Detection 3 ^{Note2} | | | O | O | O | |
| | | 51: Frequency Detection 4 ^{Note2} | | | O | O | O | |
| | | 52: Frequency Detection 5 ^{Note2} | | | O | O | O | |
| | | 53: Frequency Detection 6 ^{Note2} | | | O | O | O | |
| | | 54: Turn on short-circuit braking ^{Note2} | | | X | X | O | |
| | | 57: Low Current Detection ^{Note3} | | | O | O | O | |
| 03-13 | Frequency Detection Level | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 03-14 | Frequency Detection Width | 0.1~25.5 | 2.0 | Hz | O | O | O | |
| 03-15 | Current Agree Level | 0.1~999.9 | 0.1 | A | O | O | O | *7 |
| 03-16 | Delay Time of Current Agree | 0.1~10.0 | 0.1 | s | X | O | X | *7 |

| Group 03 External Digital Input and Output Parameters | | | | | | | | |
|---|--|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | Detection | | | | | | | |
| 03-17 | Setting of Mechanical Brake Release Level ^{Note1} | 0.00~400.00 | 0.00 | Hz | O | O | O | |
| 03-18 | Setting of Mechanical Brake Operation Level ^{Note1} | 0.00~400.00 | 0.00 | Hz | O | O | O | |
| 03-19 | Relay(R1A-R3C)Type | xxx0b: R1 A Contact | 0000b | - | O | O | O | |
| | | xxx1b: R1 B Contact | | | | | | |
| | | xx0xb: R2 A Contact xx1xb: R2 B Contact | | | | | | |
| | | x0xxb: R3 A Contact x1xxb: R3 B Contact | | | | | | |
| 03-20 ~ 03-26 | Reserved | | | | | | | |
| 03-27 | UP/DOWN Frequency Hold/ Adjust Selection | 0: Keep UP/DOWN frequency when stopping. | 0 | - | O | O | O | |
| | | 1: Clear UP/DOWN frequency when stopping. | | | | | | |
| | | 2: Allow frequency UP/DOWN when stopping. | | | | | | |
| | | 3: Refresh frequency at acceleration. | | | | | | |
| 03-28 ~ 03-29 | Reserved | | | | | | | |
| 03-30 | Pulse Input Selection | 0: Common Pulse Input | 0 | - | O | O | O | *7 |
| | | 1: PWM (Pulse Width Modulation) | | | | | | |
| 03-31 | Pulse Input Scaling | 50~32000 | 1000 | Hz | O | O | O | *1 |
| 03-32 | Pulse input gain | 0.0~1000.0 | 100 | % | O | O | O | *1 |
| 03-33 | Pulse input bias | -100.0~100.0 | 0.0 | % | O | O | O | *1 |
| 03-34 | Pulse input filter time | 0.00~2.00 | 0.1 | Sec | O | O | O | *1 |
| 03-35 ~ 03-36 | Reserved | | | | | | | |
| 03-37 | Timer ON Delay (DI/DO) | 0.0~6000.0 | 0.0 | s | O | O | O | |
| 03-38 | Timer OFF Delay (DI/DO) | 0.0~6000.0 | 0.0 | s | O | O | O | |
| 03-39 | Relay (R3A-R3C) Output | Setting range and definition are the same as those of 03-11 and 03-12. | 20 | - | O | O | O | |
| 03-40 | Up/down Frequency Width Setting | 0.00~5.00 | 0.00 | Hz | O | O | O | *7 |
| 03-41 | Torque Detection Level | 0~150 | 10 | % | X | O | X | *7 |
| 03-42 | Delay Time of Braking Action | 0.00~65.00 | 0.00 | s | X | O | X | *7 |
| 03-43 | UP/DOWN Acceleration/ Deceleration Selection | 0: Acceleration/ Deceleration Time 1 | 0 | - | O | O | O | |
| | | 1: Acceleration/ Deceleration Time 2 | | | | | | |
| 03-44 | Frequency Detection Level 2 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 03-45 | Frequency Detection Width 2 | 0.1~25.5 | 2.0 | Hz | O | O | O | |
| 03-46 | Frequency Detection Level 3 | 0.0~400.0 | 0.0 | Hz | O | O | O | |

| Group 03 External Digital Input and Output Parameters | | | | | | | | |
|---|----------------------------------|---------------|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 03-47 | Frequency Detection Width 3 | 0.1~25.5 | 2.0 | Hz | O | O | O | |
| 03-48 | Low Current Detection Level | 0.0~999.9 | 0.1 | A | O | O | O | |
| 03-49 | Low Current Detection Delay Time | 0.00~655.35 | 0.01 | Sec | O | O | O | |
| 03-50 | Frequency Detection Level 4 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 03-51 | Frequency Detection Level 5 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 03-52 | Frequency Detection Level 6 | 0.0~400.0 | 0.0 | Hz | O | O | O | |

Group 04 External Analog Input and Output Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|---------------------|--|---|---------|------|----------------------------------|----------------------------------|----------------------------------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| 04-00 | AI Input Signal Type | 0: AI2: 0~10V/0~20mA 1: AI2: 4~20mA/ 2~10V | 1 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 04-01 | AI1 Signal Scanning and Filtering Time | 0.00~2.00 | 0.03 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 04-02 | AI1 Gain | 0.0~1000.0 | 100.0 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 04-03 | AI1 Bias | -100.0~100.0 | 0 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 04-04 | Reserved | | | | | | | |
| 04-05 | AI2 Function Setting | 0: Auxiliary Frequency | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Frequency Reference Gain | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 2: Frequency Reference Bias | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 3: Output Voltage Bias | | | <input type="radio"/> | <input checked="" type="radio"/> | <input type="radio"/> | |
| | | 4: Coefficient of Acceleration and Deceleration Reduction | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 5: DC Braking Current | | | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> | |
| | | 6: Over-Torque Detection Level | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 7: Stall Prevention Level During Running | | | <input type="radio"/> | <input checked="" type="radio"/> | <input checked="" type="radio"/> | |
| | | 8: Frequency Lower Limit | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 9: Jump Frequency 4 | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 10: Added to AI1 | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 11: Positive Torque Limit | | | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 12: Negative Torque Limit | | | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 13: Regenerative Torque Limit | | | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 14: Positive / Negative Torque Limit | | | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 15: Reserved | | | - | - | - | |
| | | 16: Torque Compensation | | | <input checked="" type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> | |
| 17: Reserved | - | - | - | | | | | |
| 04-06 | AI2 Signal Scanning and Filtering Time | 0.00~2.00 | 0.03 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 04-07 | AI2 Gain | 0.0~1000.0 | 100.0 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 04-08 | AI2 Bias | -100.0~100.0 | 0 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 04-09 ~ 04-10 | Reserved | | | | | | | |
| 04-11 | AO1 Function Setting | 0: Output Frequency | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Frequency Command | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 2: Output Voltage | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 3: DC Voltage | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 4: Output Current | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 5: Output Power | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 6: Motor Speed | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 7: Output Power Factor | | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

Group 04 External Analog Input and Output Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|---------------------|-------------------------------|---|---------|------|--------------|-----|-----------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| | | 8: AI1 Input | | | O | O | O | |
| | | 9: AI2 Input | | | O | O | O | |
| | | 10: Torque Command | | | X | O | O | |
| | | 11: q-axis Current | | | X | O | O | |
| | | 12: d-axis Current | | | X | O | O | |
| | | 13: Speed deviation | | | X | X | O | |
| | | 14: Reserved | | | - | - | - | |
| | | 15: ASR Output | | | X | X | O | |
| | | 16: Reserved | | | - | - | - | |
| | | 17: q-axis Voltage | | | X | O | O | |
| | | 18: d-axis Voltage | | | X | O | O | |
| | | 19~20: Reserved | | | - | - | - | |
| | | 21: PID Input | | | O | O | O | |
| | | 22: PID Output | | | O | O | O | |
| | | 23: PID Target Value | | | O | O | O | |
| | | 24: PID Feedback Value | | | O | O | O | |
| | | 25: Output Frequency of the Soft Starter | | | O | O | O | |
| | | 26: Reserved | | | - | - | - | |
| | | 27: Reserved | | | - | - | - | |
| | | 28: Communication Control *6 | | | O | O | O | |
| 04-12 | AO1 Gain | 0.0~1000.0 | 100.0 | % | O | O | O | *1 |
| 04-13 | AO1 Bias | -100.0~100.0 | 0 | % | O | O | O | *1 |
| 04-14 ~ 04-15 | Reserved | | | | | | | |
| 04-16 | AO2 Function Setting | Setting range and definition are the same as 04-11 | 3 | - | O | O | O | |
| 04-17 | AO2 Gain | 0.0~1000.0 | 100.0 | % | O | O | O | *1 |
| 04-18 | AO2 Bias | -100.0~100.0 | 0 | % | O | O | O | *1 |
| 04-19 | AO Output Signal Type | 0: AO1:0~10V AO2:0~10V 1: AO1:0~10V AO2:4~20mA 2: AO1:4~20mA AO2:0~10V 3: AO1:4~20mA AO2: 4~20mA | 0 | | O | O | O | |
| 04-20 | Filter Time of AO Signal Scan | 0.00~0.50 | 0.00 | s | O | O | O | *1 *7 |

| Group 05 Multi-Speed Function Group | | | | | | | | |
|-------------------------------------|--|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 05-00 | Acceleration and Deceleration Selection of Multi-Speed | 0: Acceleration and deceleration time are set by 00-14 ~ 00-24 | 0 | - | ○ | ○ | ○ | |
| | | 1: Acceleration and Deceleration Time are set by 05-17 ~ 05-48 | | | | | | |
| 05-01 | Frequency Setting of Speed-Stage 0 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *1 |
| 05-02 | Frequency Setting of Speed-Stage 1 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-03 | Frequency Setting of Speed-Stage 2 | 0.00~400.00 | 10.00 | Hz | ○ | ○ | ○ | *7 |
| 05-04 | Frequency Setting of Speed-Stage 3 | 0.00~400.00 | 20.00 | Hz | ○ | ○ | ○ | *7 |
| 05-05 | Frequency Setting of Speed-Stage 4 | 0.00~400.00 | 30.00 | Hz | ○ | ○ | ○ | *7 |
| 05-06 | Frequency Setting of Speed-Stage 5 | 0.00~400.00 | 40.00 | Hz | ○ | ○ | ○ | *7 |
| 05-07 | Frequency Setting of Speed-Stage 6 | 0.00~400.00 | 50.00 | Hz | ○ | ○ | ○ | *7 |
| 05-08 | Frequency Setting of Speed-Stage 7 | 0.00~400.00 | 50.00 | Hz | ○ | ○ | ○ | *7 |
| 05-09 | Frequency Setting of Speed-Stage 8 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-10 | Frequency Setting of Speed-Stage 9 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-11 | Frequency Setting of Speed-Stage 10 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-12 | Frequency Setting of Speed-Stage 11 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-13 | Frequency Setting of Speed-Stage 12 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-14 | Frequency Setting of Speed-Stage 13 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-15 | Frequency Setting of Speed-Stage 14 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-16 | Frequency Setting of Speed-Stage 15 | 0.00~400.00 | 5.00 | Hz | ○ | ○ | ○ | *7 |
| 05-17 | Acceleration Time Setting of Multi Speed 0 | 0.1~6000.0 | 10.0 | s | ○ | ○ | ○ | |
| 05-18 | Deceleration Time Setting of Multi Speed 0 | 0.1~6000.0 | 10.0 | s | ○ | ○ | ○ | |
| 05-19 | Acceleration Time Setting of Multi Speed 1 | 0.1~6000.0 | 10.0 | s | ○ | ○ | ○ | |
| 05-20 | Deceleration Time Setting of Multi Speed 1 | 0.1~6000.0 | 10.0 | s | ○ | ○ | ○ | |

| Group 05 Multi-Speed Function Group | | | | | | | | |
|-------------------------------------|---|---------------|---------|------|-----------------------|-----------------------|-----------------------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 05-21 | Acceleration Time Setting of Multi Speed 2 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-22 | Deceleration Time Setting of Multi Speed 2 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-23 | Acceleration Time Setting of Multi Speed 3 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-24 | Deceleration Time Setting of Multi Speed 3 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-25 | Acceleration Time Setting of Multi Speed 4 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-26 | Deceleration Time Setting of Multi Speed 4 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-27 | Acceleration Time Setting of Multi Speed 5 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-28 | Deceleration Time Setting of Multi Speed 5 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-29 | Acceleration Time Setting of Multi Speed 6 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-30 | Deceleration Time Setting of Multi Speed 6 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-31 | Acceleration Time Setting of Multi Speed 7 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-32 | Deceleration Time Setting of Multi Speed 7 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-33 | Acceleration Time Setting of Multi Speed 8 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-34 | Deceleration Time Setting of Multi Speed 8 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-35 | Acceleration Time Setting of Multi Speed 9 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-36 | Deceleration Time Setting of Multi Speed 9 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-37 | Acceleration Time Setting of Multi Speed 10 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-38 | Deceleration Time Setting of Multi Speed 10 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-39 | Acceleration Time Setting of Multi Speed 11 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-40 | Deceleration Time Setting of Multi Speed 11 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-41 | Acceleration Time Setting of Multi Speed 12 | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 05-42 | Deceleration Time Setting of | 0.1~6000.0 | 10.0 | s | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

| Group 05 Multi-Speed Function Group | | | | | | | | |
|-------------------------------------|---|---------------|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | Multi Speed 12 | | | | | | | |
| 05-43 | Acceleration Time Setting of Multi Speed 13 | 0.1~6000.0 | 10.0 | s | O | O | O | |
| 05-44 | Deceleration Time Setting of Multi Speed 13 | 0.1~6000.0 | 10.0 | s | O | O | O | |
| 05-45 | Acceleration Time Setting of Multi Speed 14 | 0.1~6000.0 | 10.0 | s | O | O | O | |
| 05-46 | Deceleration Time Setting of Multi Speed 14 | 0.1~6000.0 | 10.0 | s | O | O | O | |
| 05-47 | Acceleration Time Setting of Multi Speed 15 | 0.1~6000.0 | 10.0 | s | O | O | O | |
| 05-48 | Deceleration Time Setting of Multi Speed 15 | 0.1~6000.0 | 10.0 | s | O | O | O | |

Group 06 Automatic Program Operation Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|---|--|---------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| 06-00 | Automatic Operation Mode Selection | 0: Disable | 0 | - | O | O | X | |
| | | 1: Execute a single cycle operation mode. Restart speed is based on the previous stopped speed. | | | | | | |
| | | 2: Execute continuous cycle operation mode. Restart speed is based on the previous stopped speed. | | | | | | |
| | | 3: After the completion of a single cycle, the on-going operation speed is based on the speed of the last stage. Restart speed is based on the previous stopped speed. | | | | | | |
| | | 4: Execute a single cycle operation mode. Restart speed will be based on the speed of stage 1. | | | | | | |
| | | 5: Execute continuous cycle operation mode. Restart speed will be based on the speed of stage 1. | | | | | | |
| | | 6: After the completion of a single cycle, the on-going operation speed is based on the speed of the last stage. Restart speed is based on the previous stopped speed. | | | | | | |
| 06-01 | Frequency Setting of Operation-Stage 1 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-02 | Frequency Setting of Operation -Stage 2 | 0.00~400.00 | 10.00 | Hz | O | O | X | *1 |
| 06-03 | Frequency Setting of Operation -Stage 3 | 0.00~400.00 | 20.00 | Hz | O | O | X | *1 |
| 06-04 | Frequency Setting of Operation -Stage 4 | 0.00~400.00 | 30.00 | Hz | O | O | X | *1 |
| 06-05 | Frequency Setting of Operation -Stage 5 | 0.00~400.00 | 40.00 | Hz | O | O | X | *1 |
| 06-06 | Frequency Setting of Operation -Stage 6 | 0.00~400.00 | 50.00 | Hz | O | O | X | *1 |
| 06-07 | Frequency Setting of Operation -Stage 7 | 0.00~400.00 | 50.00 | Hz | O | O | X | *1 |
| 06-08 | Frequency Setting of Operation -Stage 8 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-09 | Frequency Setting of Operation -Stage 9 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |

Group 06 Automatic Program Operation Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|--|---------------|---------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| 06-10 | Frequency Setting of Operation -Stage 10 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-11 | Frequency Setting of Operation -Stage 11 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-12 | Frequency Setting of Operation -Stage 12 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-13 | Frequency Setting of Operation -Stage 13 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-14 | Frequency Setting of Operation -Stage 14 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-15 | Frequency Setting of Operation -Stage 15 | 0.00~400.00 | 5.00 | Hz | O | O | X | *1 |
| 06-16 | Time Setting of Operation -Stage 0 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-17 | Time Setting of Operation -Stage 1 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-18 | Time Setting of Operation -Stage 2 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-19 | Time Setting of Operation -Stage 3 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-20 | Time Setting of Operation -Stage 4 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-21 | Time Setting of Operation -Stage 5 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-22 | Time Setting of Operation -Stage 6 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-23 | Time Setting of Operation -Stage 7 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-24 | Time Setting of Operation -Stage 8 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-25 | Time Setting of Operation -Stage 9 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-26 | Time Setting of Operation -Stage 10 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-27 | Time Setting of Operation -Stage 11 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-28 | Time Setting of Operation -Stage 12 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-29 | Time Setting of Operation -Stage 13 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-30 | Time Setting of Operation -Stage 14 | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |
| 06-31 | Time Setting of Operation | 0.0~6000.0 | 0.0 | s | O | O | X | *1 |

Group 06 Automatic Program Operation Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|--|-------------------------------|---------|------|--------------|-----|-----------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| | -Stage 15 | | | | | | | |
| 06-32 | Direction Selection of Operation -Stage 0 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-33 | Direction Selection of Operation -Stage 1 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-34 | Direction Selection of Operation -Stage 2 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-35 | Direction Selection of Operation -Stage 3 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-36 | Direction Selection of Operation -Stage 4 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-37 | Direction Selection of Operation -Stage 5 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-38 | Direction Selection of Operation -Stage 6 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-39 | Direction Selection of Operation -Stage 7 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-40 | Direction Selection of Operation -Stage 8 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-41 | Direction Selection of Operation -Stage 9 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-42 | Direction Selection of Operation -Stage 10 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-43 | Direction Selection of Operation -Stage 11 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-44 | Direction Selection of Operation -Stage 12 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-45 | Direction Selection of Operation -Stage 13 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-46 | Direction Selection of Operation -Stage 14 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |
| 06-47 | Direction Selection of Operation -Stage 15 | 0: Stop 1: Forward 2: Reverse | 0 | - | O | O | X | |

| Group 07: Start /Stop Parameters | | | | | | | | |
|----------------------------------|--|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 07-00 | Momentary Power Loss/ Fault Restart Selection | 0: Disable | 0 | - | O | O | O | |
| | | 1: Enable | | | | | | |
| 07-01 | Fault Auto-Restart Time | 0~7200 | 0 | s | O | O | O | |
| 07-02 | Number of Fault Auto-Restart Attempts | 0~10 | 0 | - | O | O | O | |
| 07-03 | Reserved | | | | | | | |
| 07-04 | Direct Start at Power on | 0: When the external run command is enabled, direct start at power up | 1 | - | O | O | O | |
| | | 1: When the external run command is enabled, unable to direct start at power-up. | | | | | | |
| 07-05 | Automatic start delay at power up | 1.0~300.0 | 3.5 | Sec | O | O | O | |
| 07-06 | DC Injection Braking Start Frequency | 0.0~10.0 | 0.5 | Hz | O | O | O | |
| 07-07 | DC Injection Braking Current | 0~100 | 50 | % | O | O | O | |
| 07-08 | DC Injection Braking Time at Stop | 0.00~10.00 | 0.50 | s | O | O | O | |
| 07-09 | Stop Mode Selection | 0: Deceleration to Stop | 0 | - | O | O | O | |
| | | 1: Coast to Stop | | | | | | |
| | | 2: DC Braking Stop | | | | | | |
| | | 3: Coast to Stop with Timer | | | | | | |
| 07-10 ~ 07-12 | Reserved | | | | | | | |
| 07-13 | Low Voltage Detection Level | 200V: 150~300 | 190 | V | O | O | O | |
| | | 400V: 300~600 | 380 | | | | | |
| 07-14 | Pre-excitation Time | 0.00~10.00 | 2.00 | s | X | O | X | |
| 07-15 | Pre-excitation Level | 50~200 | 100 | % | X | O | X | *6 |
| 07-16 | DC Injection Braking Time at Start | 0.00~100.00 | 0.00 | s | O | O | O | |
| 07-17 | Reserved | | | | | | | |
| 07-18 | Minimum Base block Time | 0.1~5.0 | - | Sec | O | O | O | |
| 07-19 | Direction-Detection Speed Search Operating Current | 0~100 | 50 | % | O | O | X | |
| 07-20 | Speed Search Operating Current | 0~100 | 20 | % | O | O | X | |
| 07-21 | Integral Time of Speed Searching | 0.1~10.0 | 2.0 | Sec | O | O | X | |
| 07-22 | Delay Time of Speed Searching | 0.0~20.0 | 0.2 | Sec | O | O | X | |
| 07-23 | Voltage Recovery Time | 0.1~5.0 | 2.0 | Sec | O | O | X | |
| 07-24 | Direction-Detection Speed | 0: Disable | 1 | - | O | O | X | |

| Group 07: Start /Stop Parameters | | | | | | | | |
|----------------------------------|---|--|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | Search Selection | 1: Enable | | | | | | |
| 07-25 | Low voltage Detection Time | 0.00~1.00 | 0.02 | Sec | O | O | O | |
| 07-26 | SLV Speed Search Function | 0: Enable | 0 | - | X | O | X | |
| | | 1: Disable | | | | | | |
| 07-27 | Start Selection after Fault during SLV Mode | 0: Speed search start | 0 | - | X | O | X | |
| | | 1: Normal Start | | | | | | |
| 07-28 | Start Selection after External Base Block | 0: Speed search start | 0 | - | X | O | X | |
| | | 1: Normal Start | | | | | | |
| 07-29 | Run Command Available during DC Braking | 0: Disable (Run command isn't available until the DC braking is completely done) | 0 | - | O | X | X | |
| | | 1: Enable | | | | | | |
| 07-30 | Reserved | | | | | | | |
| 07-31 | Reserved | | | | | | | |
| 07-32 | Speed Search Mode Selection | 0: Disable | 0 | | O | O | O | |
| | | 1: Mode1: Start a Speed Search at Power on | | | | | | |
| | | 2: Mode 2: Start Speed Search upon the Motor Run | | | | | | |
| 07-33 | Start Frequency of Speed Search Selection | 0: Maximum Output Frequency of Motor 1: Frequency Command | 0 | | O | O | X | |
| 07-34 | Short-circuit Braking Time at Start | 0.00~100.00 | 0 | Sec | X | X | O | |
| 07-35 | Short-circuit Braking Time at Stop | 0.00~100.00 | 0.5 | Sec | X | X | O | |
| 07-36 | Short-circuit Braking Current Limited Level | 0.0~200.0 | 100 | % | X | X | O | |
| 07-42 | Voltage limit gain | 0.0~50.0 | 0 | % | X | O | X | |
| 07-43 | Short-circuit Braking Time of PM Motor Speed Search | 0.00~100.00 | 0.00 | Sec | X | X | O | |
| 07-44 | DC Braking Time of PM Motor Speed Search | 0.00~100.00 | 0.00 | Sec | X | X | O | |

| Group 08 Protection Parameters | | | | | | | | |
|--------------------------------|--|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 08-00 | Stall Prevention Function | xxx0b: Stall prevention is enabled in acceleration. | 0000b | - | O | O | O | |
| | | xxx1b: Stall prevention is disabled in acceleration. | | | | | | |
| | | xx0xb: Stall prevention is enabled in deceleration. | | | | | | |
| | | xx1xb: Stall prevention is disabled in deceleration. | | | | | | |
| | | x0xxb: Stall prevention is enabled in operation | | | | | | |
| | | x1xxb: Stall prevention is disabled in operation | | | | | | |
| | | 0xxxb: Stall prevention in operation decelerates based on deceleration time 1 | | | | | | |
| | | 1xxxb: Stall prevention in operation decelerates based on deceleration time 2 | | | | | | |
| 08-01 | Stall Prevention Level in Acceleration | 20~200 | 120 | % | O | O | O | |
| 08-02 | Stall Prevention Level in Deceleration | 200V: 330~410 | 385 | V | O | O | O | |
| | | 400V: 660~820 | 770 | | | | | |
| 08-03 | Stall Prevention Level in Operation | 30~200 | 120 | % | O | X | X | |
| 08-04 | Reserved | | | | | | | |
| 08-05 | Selection for Motor Overload Protection (OL1) | xxx0b: Motor Overload Protection is disabled | 0001b | - | O | O | O | |
| | | xxx1b: Motor Overload Protection is enabled | | | | | | |
| | | xx0xb: Cold Start of Motor Overload | | | | | | |
| | | xx1xb: Hot Start of Motor Overload | | | | | | |
| | | x0xxb: Standard Motor | | | | | | |
| | | x1xxb: Special motor | | | | | | |
| | | 0xxxb: Reserved | | | | | | |
| | | 1xxxb: Reserved | | | | | | |
| 08-06 | Start-up Mode of Overload Protection Operation (OL1) | 0: Stop Output after Overload Protection | 0 | - | O | O | O | |
| | | 1: Continuous Operation after Overload Protection. | | | | | | |
| 08-07 | Motor Overload (OL1) Protection Level | 0: Motor overload (OL1) Protection 0 | 0 | - | O | O | O | Note3 |
| | | 1: Motor overload (OL1) Protection 1 | | | | | | |

| Group 08 Protection Parameters | | | | | | | | |
|--------------------------------|---|---|---------|------|-----------------------|-----------------------|-----------------------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | 2: Motor overload (OL1) Protection 2 | | | | | | |
| 08-08 | Automatic Voltage Regulation (AVR) | 0: Enable 1: Disable | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-09 | Selection of Input Phase Loss Protection | 0: Disable 1: Enable | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-10 | Selection of Output Phase Loss Protection | 0: Disable 1: Enable | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-11 ~ 08-12 | Reserved | | | | | | | |
| 08-13 | Selection of Over-Torque Detection | 0: Over-Torque Detection is Disabled. | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Start to Detect when Reaching the Set Frequency. | | | | | | |
| | | 2: Start to Detect when the Operation is Begun. | | | | | | |
| 08-14 | Selection of Over-Torque Operation | 0: Deceleration to Stop when Over-Torque is Detected. | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Display Warning when Over-Torque is Detected. Go on Operation. | | | | | | |
| | | 2: Coast to Stop when Over Torque is Detected | | | | | | |
| 08-15 | Level of Over-Torque Detection | 0~300 | 150 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-16 | Time of Over-Torque Detection | 0.0~10.0 | 0.1 | Sec | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-17 | Selection of Low-Torque Detection | 0: Low-Torque Detection is Disabled. | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Start to Detect when Reaching the Set Frequency. | | | | | | |
| | | 2: Start to Detect when the Operation is Begun. | | | | | | |
| 08-18 | Selection of Low-Torque Operation | 0: Deceleration to Stop when Low-Torque is Detected. | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Display Warning when Low-Torque is Detected. Go on Operation. | | | | | | |
| | | 2: Coast to Stop when Low-Torque is Detected | | | | | | |
| 08-19 | Level of Low-Torque Detection | 0~300 | 30 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-20 | Time of Low-Torque Detection | 0.0~10.0 | 0.1 | Sec | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 08-21 | Limit of Stall Prevention in Acc | 1~100 | 50 | % | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

| Group 08 Protection Parameters | | | | | | | | |
|--------------------------------|--|---|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | over Base Speed | | | | | | | |
| 08-22 | Stall Prevention Detection Time in Operation | 2~100 | 100 | ms | O | O | O | |
| 08-23 | Ground Fault (GF) Selection | 0: Disable | 0 | - | O | O | O | |
| | | 1: Enable | | | | | | |
| 08-24 | Operation Selection of External Fault | 0: Deceleration to Stop | 0 | - | O | O | O | |
| | | 1: Coast to Stop | | | | | | |
| | | 2: Continuous Operation | | | | | | |
| 08-25 | Detection selection of External Fault | 0: Immediately Detect when the Power is Supplied. | 0 | - | O | O | O | |
| | | 1: Start to Detect during Operation | | | | | | |
| 08-26 ~ 08-29 | Reserved | | | | | | | |
| 08-30 | Selection of Run Permissive Function | 0: Deceleration to Stop | 0 | - | O | O | O | |
| | | 1: Coast to Stop | | | | | | |
| 08-31 ~ 08-34 | Reserved | | | | | | | |
| 08-35 | Fault Selection of Motor Overheat | 0: Disable | 0 | - | O | O | O | |
| | | 1: Deceleration to Stop | | | | | | |
| | | 2: Coast to Stop | | | | | | |
| 08-36 | Time Coefficient of PTC Input Filter | 0.00 ~ 5.00 | 2 | Sec | O | O | O | |
| 08-37 | Fan Control Function (Note) | 0: Start at Operation | 0 | - | O | O | O | |
| | | 1: Permanent Start | | | | | | |
| | | 2: Start at High Temperature (Note) | | | | | | |
| 08-38 | Delay Time of Fan Off | 0~600 | 60 | Sec | O | O | O | |
| 08-39 | Delay Time of Motor Overheat Protection | 1~300 | 60 | Sec | O | O | O | |
| 08-42 | PTC Trip Level | 0.1~10.0 | 0.7 | V | O | O | O | |
| 08-43 | PTC Reset Level | 0.1~10.0 | 0.3 | V | O | O | O | |
| 08-45 | PTC Disconnection Detection | 0: Disable | 0 | - | O | O | O | |
| | | 1: Warning | | | | | | |
| | | 2: Fault | | | | | | |

Note: Inverter models 2060 and 4100 and above (IP20) do not have this function.

| Group 09: Communication Parameters | | | | | | | | |
|------------------------------------|------------------------------------|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 09-00 | INV Communication Station Address | 1~31 | 1 | - | O | O | O | *2 |
| 09-01 | Communication Mode Selection | 0: MODBUS | 0 | - | O | O | O | |
| | | 1: BACNET | | | | | | |
| | | 2: METASYS | | | | | | |
| | | 3: PUMP in Parallel Connection | | | | | | |
| | | 4: PROFIBUS | | | | | | |
| 09-02 | Baud Rate Setting (bps) | 0:1200 | 4 | - | O | O | O | *2 *6 |
| | | 1:2400 | | | | | | |
| | | 2:4800 | | | | | | |
| | | 3:9600 | | | | | | |
| | | 4:19200 | | | | | | |
| | | 5:38400 | | | | | | |
| 09-03 | Stop Bit Selection | 0:1 Stop Bit | 0 | - | O | O | O | *2 |
| | | 1: 2 Stop Bit | | | | | | |
| 09-04 | Parity Selection | 0: No Parity | 0 | - | O | O | O | *2 |
| | | 1: Even Bit | | | | | | |
| | | 2: Odd Bit | | | | | | |
| 09-05 | Communications Data Bits Selection | 0: 8 bits data | 0 | - | O | O | O | |
| | | 1: 7 bits data | | | | | | |
| 09-06 | Communication Error Detection Time | 0.0~25.5 | 0.0 | S | O | O | O | |
| 09-07 | Fault Stop Selection | 0: Deceleration to Stop Based on Deceleration Time 1 when Communication Fault Occurs. | 3 | - | O | O | O | |
| | | 1: Coast to Stop when Communication Fault Occurs. | | | | | | |
| | | 2: Deceleration to Stop Based on Deceleration Time 2 when Communication Fault Occurs. | | | | | | |
| | | 3: Keep Operating when Communication Fault Occurs. | | | | | | |
| | | 4. Run the Frequency Command given by AI2 | | | | | | |
| 09-08 | Comm. Fault Tolerance Count | 1~20 | 1 | - | O | O | O | |
| 09-09 | Waiting Time | 5~65 | 5 | ms | O | O | O | |
| 09-10 | Device Instance Number | 1 ~ 254 | 1 | - | O | O | O | |

Note: Parameters in group 09 are not affected by a parameter initialization (13-08)

| Group 10: PID Parameters | | | | | | | | |
|---|---------------------------------------|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 10-00 | PID Target Value Source Setting | 0: PUMP or HVAC function given (refer to group 23) | 1 | - | O | O | O | |
| | | 1: AI1 Given | | | | | | |
| | | 2: AI2 Given | | | | | | |
| | | 3: Reserved | | | | | | |
| | | 4: 10-02 Given | | | | | | |
| | | 5: Reserved ^{Note} | | | | | | |
| | | 6: Frequency Command (00-05) <small>Note</small> | | | | | | |
| 7: Multi-speed Frequency Command ^{Note4} | | | | | | | | |
| 10-01 | PID Feedback Value Source Setting | 1: AI1 Given | 2 | - | O | O | O | |
| | | 2: AI2 Given | | | | | | |
| | | 3: Reserved | | | | | | |
| | | 4: AI1 - AI2 Given | | | | | | |
| 10-02 | PID Target Value | 0.0~100.0 | 0.0 | % | O | O | O | |
| 10-03 | PID Control Mode | xxx0b: PID Disable | 0000b | - | O | O | O | |
| | | xxx1b: PID Enable | | | | | | |
| | | xx0xb: PID Positive Characteristic | | | | | | |
| | | xx1xb: PID Negative Characteristic | | | | | | |
| | | x0xxb: PID Error Value of D Control | | | | | | |
| | | x1xxb: PID Feedback Value of D Control | | | | | | |
| | | 0xxxb: PID Output | | | | | | |
| | | 1xxxb: PID Output + Frequency Command | | | | | | |
| 10-04 | Feedback Gain | 0.01~10.00 | 1.00 | - | O | O | O | *1 |
| 10-05 | Proportional Gain (P) | 0.00~10.00 | 3.00 | - | O | O | O | *1 |
| 10-06 | Integral Time (I) | 0.00~100.00 | 0.50 | s | O | O | O | *1 |
| 10-07 | Differential Time (D) | 0.00~10.00 | 0.00 | s | O | O | O | *1 |
| 10-08 | Reserved | | | | | | | |
| 10-09 | PID Bias | -100.0~100.0 | 0 | % | O | O | O | *1 |
| 10-10 | PID Primary Delay Time | 0.00~10.00 | 0.00 | s | O | O | O | *1 |
| 10-11 | PID Feedback Loss Detection Selection | 0: Disable | 0 | - | O | O | O | |
| | | 1: Warning | | | | | | |
| | | 2: Fault | | | | | | |
| 10-12 | PID Feedback Loss Detection Level | 0~100 | 0 | % | O | O | O | |
| 10-13 | PID Feedback Loss Detection Time | 0.0~10.0 | 1.0 | s | O | O | O | |
| 10-14 | PID Integral Limit | 0.0~100.0 | 100.0 | % | O | O | O | *1 |
| 10-15 ~ 10-16 | Reserved | | | | | | | |

| Group 10: PID Parameters | | | | | | | | |
|--------------------------|---|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 10-17 | Start Frequency of PID Sleep | 0.00~400.00 | 30.00 | Hz | O | O | O | |
| 10-18 | Delay Time of PID Sleep | 0.0~255.5 | 0.0 | s | O | O | O | |
| 10-19 | Frequency of PID Waking up | 0.00~400.00 | 0.00 | Hz | O | O | O | |
| 10-20 | Delay Time of PID Waking up | 0.0~255.5 | 0.0 | s | O | O | O | |
| 10-21 | Reserved | | | | | | | |
| 10-22 | Start Level of PID Enable | 0.00~400.00 | 0.00 | Hz | O | O | O | |
| 10-23 | PID Limit | 0.00~100.0 | 100.0 | % | O | O | O | *1 |
| 10-24 | PID Output Gain | 0.0~25.0 | 1.0 | - | O | O | O | |
| 10-25 | PID Reversal Output Selection | 0: Do not Allow Reversal Output | 0 | - | O | O | O | |
| | | 1: Allow Reversal Output | | | | | | |
| 10-26 | PID Target Acceleration/Deceleration Time | 0.0~25.5 | 0.0 | s | O | O | O | |
| 10-27 | PID Feedback Display Bias | 0~9999 | 0 | - | O | O | O | |
| 10-28 | Reserved | | | | | | | |
| 10-29 | PID Sleep Selection | 0: Disable | 1 | - | O | O | O | |
| | | 1: Enable | | | | | | |
| | | 2: Set by DI | | | | | | |
| 10-30 | Upper Limit of PID Target | 0.0 ~ 100.0 | 100.0 | % | O | O | O | |
| 10-31 | Lower Limit of PID Target | 0.0 ~ 100.0 | 0.0 | % | O | O | O | |
| 10-32 | PID Switching Function | 0: PID1 | 0 | | O | O | O | |
| | | 1: PID2 | | | | | | |
| | | 2: Set by DI | | | | | | |
| | | 3: Switch to PID2 when RTC Timer Enables | | | | | | |
| 10-33 | PID Maximum Feedback Value | 1~10000 | 999 | - | O | O | O | |
| 10-34 | PID Decimal Width | 0~4 | 1 | - | O | O | O | |
| 10-35 | PID Unit | 0: % | 0 | - | O | O | O | *6 |
| | | 1: FPM | | | | | | |
| | | 2: CFM | | | | | | |
| | | 3: PSI | | | | | | |
| | | 4: GPH | | | | | | |
| | | 5: GPM | | | | | | |
| | | 6: IN | | | | | | |
| | | 7: FT | | | | | | |
| | | 8: /s | | | | | | |
| | | 9: /m | | | | | | |
| | | 10: /h | | | | | | |
| | | 11: °F | | | | | | |
| | | 12: inW | | | | | | |
| | | 13: HP | | | | | | |
| | | 14: m/s | | | | | | |
| 15: MPM | | | | | | | | |

| Group 10: PID Parameters | | | | | | | | |
|--------------------------|---|--------------------------|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | 16: CMM | | | | | | |
| | | 17: W | | | | | | |
| | | 18: KW | | | | | | |
| | | 19: m | | | | | | |
| | | 20: °C | | | | | | |
| | | 21: RPM | | | | | | |
| | | 22: Bar | | | | | | |
| | | 23: Pa | | | | | | |
| | | 24: KPa ^{Note4} | | | | | | |
| 10-36 | PID2 Proportional Gain (P) | 0.00~10.00 | 3.00 | - | O | O | O | *1 |
| 10-37 | PID2 Integral Time (I) | 0.0~100.0 | 0.50 | s | O | O | O | *1 |
| 10-38 | PID2 Differential Time (D) | 0.00~10.00 | 0.00 | s | O | O | O | *1 |
| 10-39 | PID Output Frequency Setting during disconnection | 00.00~400.00 | 30.00 | Hz | O | O | O | *6 |
| 10-40 | Compensation Frequency Selection of PID Sleep | 0: Disable | 0 | - | O | O | O | |
| | | 1: Enable | | | | | | |
| 10-41 | Reserved | | | | | | | |
| 10-42 | Reserved | | | | | | | |
| 10-43 | Reserved | | | | | | | |
| 10-44 | Precharge Frequency | 0.0~120.0 | 0 | Hz | O | O | O | |
| 10-45 | Precharge Time | 0~250 | 0 | Sec | O | O | O | |
| 10-46 | Precharge Target Level | 0~10000 | 0 | - | O | O | O | |

| Group 11: Auxiliary Parameters | | | | | | | | |
|--------------------------------|---|---------------------------------------|---------------------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 11-00 | Direction Lock Selection | 0: Allow Forward and Reverse Rotation | 1 | - | O | O | O | |
| | | 1: Only Allow Forward Rotation | | | | | | |
| | | 2: Only Allow Reverse Rotation | | | | | | |
| 11-01 | Carrier Frequency | 0: Carrier Output Frequency Tuning | Inverter KVA ^a | - | O | O | O | |
| | | 1: 1~16: 1~16KHz | | | | | | |
| 11-02 | Soft PWM Function Selection | 0: Disable | 1 ^b | - | O | O | O | |
| | | 1: Soft PWM Function 1 | | | | | | |
| | | 2: Soft PWM Function 2 | | | | | | |
| 11-03 | Automatic carrier lowering selection | 0: Disable | 0 | - | O | X | X | |
| | | 1: Enable | | | | | | |
| 11-04 | S-curve Time Setting at the Start of Acceleration | 0.00~2.50 | 0.20 | s | O | O | O | |
| 11-05 | S-curve Time Setting at the | 0.00~2.50 | 0.20 | s | O | O | O | |

| Group 11: Auxiliary Parameters | | | | | | | | |
|--------------------------------|---|---------------|------------------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | End of Acceleration | | | | | | | |
| 11-06 | S-curve Time Setting at the Start of Deceleration | 0.00~2.50 | 0.20 | s | O | O | O | |
| 11-07 | S-curve Time Setting at the End of Deceleration | 0.00~2.50 | 0.20 | s | O | O | O | |
| 11-08 | Jump Frequency 1 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 11-09 | Jump Frequency 2 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 11-10 | Jump Frequency 3 | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 11-11 | Jump Frequency Width | 0.0~25.5 | 1.0 | Hz | O | O | O | |
| 11-12 | Manual Energy Saving Gain | 0~100 | 80 | % | O | X | X | |
| 11-13 | Automatic Return Time | 0~120 | 60 | Sec | O | O | O | *6 |
| 11-14 ~ 11-17 | Reserved | | | | | | | |
| 11-18 | Manual Energy Saving Frequency | 0.00~400.00 | 0.00 | Hz | O | X | X | |
| 11-19 | Automatic Energy Saving Function | 0: Disabled | 0 | - | O | X | X | |
| | | 1: Enabled | | | | | | |
| 11-20 | Filter Time of Automatic Energy Saving | 0~200 | 140 | ms | O | X | X | |
| 11-21 | Voltage Upper Limit of Energy Saving Tuning | 0~100 | 100 | % | O | X | X | |
| 11-22 | Adjustment Time of Automatic Energy Saving | 0~5000 | 20 | ms | O | X | X | *1 |
| 11-23 | Detection Level of Automatic Energy Saving | 0~100 | 10 | % | O | X | X | |
| 11-24 | Coefficient of Automatic Energy Saving | 0.00~655.34 | KVA ^a | - | O | X | X | |
| 11-25 ~ 11-27 | Reserved | | | | | | | |
| 11-28 | Frequency Gain of Overvoltage Prevention 2 | 1~200 | 100 | % | O | X | X | |
| 11-29 | Auto De-rating Selection | 0: Disable | 0 | - | O | X | X | |
| | | 1: Enable | | | | | | |
| 11-30 | Variable Carrier Frequency Max. Limit | 2~16 | KVA ^a | KHz | O | X | X | |
| 11-31 | Variable Carrier Frequency Min. Limit | 1~16 | KVA ^a | KHz | O | X | X | |
| 11-32 | Variable Carrier Frequency Proportional Gain | 00~99 | 00 | - | O | X | X | |
| 11-33 | Rise Amount of DC Voltage Filter | 0.1~10.0 | 0.1 | Vdc | O | X | X | *1 |
| 11-34 | Fall Amount of DC Voltage Filter | 0.1~10.0 | 5.0 | Vdc | O | X | X | *1 |

| Group 11: Auxiliary Parameters | | | | | | | | |
|--------------------------------|---|---|------------------------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 11-35 | Dead band Level of DC Voltage Filter | 0.0~99.0 | 10.0 | Vdc | O | X | X | *1 |
| 11-36 | Frequency Gain of OV Prevention | 0.000~1.000 | 0.050 | - | O | X | X | *1 |
| 11-37 | Frequency Limit of OV Prevention | 0.00~400.00 | 5.00 | Hz | O | X | X | |
| 11-38 | Deceleration Start Voltage of OV Prevention | 200V: 200~400V 400V: 400~800V | 200V: 300 400V: 700 | V | O | X | X | |
| 11-39 | Deceleration Stop Voltage of OV Prevention | 200V: 300~400V 400V: 600~800V | 220V: 350 440V: 750 | V | O | X | X | |
| 11-40 | OV Prevention Selection | 0: Disable 1: OV Prevention Mode 1 2: OV Prevention Mode 2 3: OV Prevention Mode 3 | 0 | - | O | X | X | |
| 11-41 | Reference Frequency Loss Detection | 0: Deceleration to Stop when Reference Frequency Disappears | 0 | - | O | O | O | |
| | | 1: Operation is Set by 11-42 when Reference Frequency Disappears | | | | | | |
| 11-42 | Reference Frequency Loss Level | 0.0~100.0 | 80.0 | % | O | O | O | |
| 11-43 | Hold Frequency at Start | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 11-44 | Frequency Hold Time at Start | 0.0~10.0 | 0.0 | s | O | O | O | |
| 11-45 | Hold Frequency at Stop | 0.0~400.0 | 0.0 | Hz | O | O | O | |
| 11-46 | Frequency Hold Time at Stop | 0.0~10.0 | 0.0 | s | O | O | O | |
| 11-47 | EB Deceleration Time | 0.0~25.5 | 0.0 | s | O | X | X | *1 |
| 11-48 | KEB Detection Level | 200V: 190~210 | 200 | V | O | X | X | |
| | | 400V: 380~420 | 400 | | | | | |
| 11-49 ~ 11-50 | Reserved | | | | | | | |
| 11-51 | Braking Selection of Zero Speed | 0: Disable | 0 | - | O | X | X | |
| | | 1: Enable | | | | | | |
| 11-52 ~ 11-53 | Reserved | | | | | | | |
| 11-54 | Initialization of Cumulative Energy | 0: Do not Clear Cumulative Energy | 0 | - | O | O | O | *1 |
| | | 1: Clear Cumulative Energy | | | | | | |
| 11-55 | STOP Key Selection | 0: Stop Key is Disabled when the | 1 | - | O | O | O | |

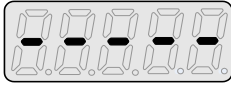
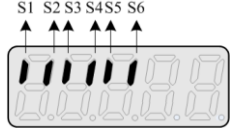
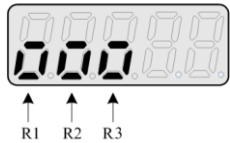
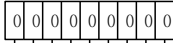
| Group 11: Auxiliary Parameters | | | | | | | | |
|--------------------------------|--|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | Operation Command is not Provided by Keypad. | | | | | | |
| | | 1: Stop Key is Enabled when the Operation Command is not Provided by Keypad. | | | | | | |
| 11-56 | UP/DOWN Selection | 0: When UP/DOWN in Keypad is Disabled, it will be Enabled if Pressing ENTER after Frequency Modification. | 0 | - | O | O | O | |
| | | 1: When UP/DOWN in Keypad is Enabled, it will be Enabled upon Frequency Modification. | | | | | | |
| 11-57 | Reserved | | | | | | | |
| 11-58 | Record Reference Frequency | 0: Disable | 0 | - | O | O | O | *1 |
| | | 1: Enable | | | | | | |
| 11-59 | Gain of Preventing Oscillation | 0.00~2.50 | 0.01 | | O | X | X | *7 |
| 11-60 | Upper Limit of Preventing Oscillation | 0~100 | 30 | % | O | X | X | *7 |
| 11-61 | Time Parameter of Preventing Oscillation | 0~100 | 0 | | O | X | X | *7 |
| 11-62 | Prevention of Oscillation Selection | 0: Mode 1 1: Mode 2 2: Mode 3 | 1 | | O | X | X | *7 |
| 11-63 | Flux-Strengthening Selection | 0: Disable | 1 | | X | O | X | |
| | | 1: Enable | | | | | | |
| 11-64 | Acceleration Speed Gain Adjustment | 0.1~10.0 | 1.0 | - | O | X | X | |
| 11-65 | Target Main Circuit Voltage | 200V: 200V~400V | 370 | | | | | |
| | | 400V: 400V~800V | 740 | - | O | X | X | |
| 11-66 | 2 Phase/ 3 Phase PWM Switch Frequency | 6.00~60.00 | 20 | Hz | O | O | X | |
| 11-67 | Detection Range at Soft PWM Function 2 | 0~12000 | 0 | Hz | X | O | O | |
| 11-68 | Detecting Start Frequency at Soft PWM Function 2 | 6.00~60.00 | 20 | Hz | X | O | O | |
| 11-69 | Gain of Preventing Oscillation 3 | 0.00~200.00 | 5.00 | % | O | X | X | |
| 11-70 | Upper Limit of Preventing Oscillation 3 | 0.01~100.00 | 5.00 | % | O | X | X | |
| 11-71 | Time Parameter of Preventing Oscillation 3 | 0~30000 | 100 | ms | O | X | X | |
| 11-72 | Switch Frequency 1 for Preventing Oscillation Gain | 0.01~300.00 | 30.00 | Hz | O | X | X | |
| 11-73 | Switch Frequency 2 for Preventing Oscillation Gain | 0.01~300.00 | 50.00 | Hz | O | X | X | |

*a: KVA means the default value of this parameter is changed based on the inverter rating.

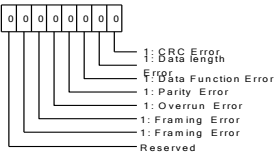
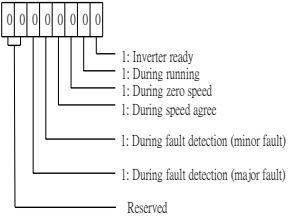
*b: Default value is 1 in V/F mode.

| Group 12: Monitoring Parameters | | | | | | | | |
|---------------------------------|---|---|---------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 12-00 | Display Screen Selection (LED) | 00000~77777 From the leftmost bit, it displays the screen when press DSP key in order. 0: No display 1: Output Current 2: Output Voltage 3: DC Bus Voltage 4: Heatsink Temperature 5: PID Feedback 6: AI1 Value 7: AI2 Value | 00321 | - | ○ | ○ | ○ | *1 *5 |
| 12-01 | PID Feedback Display Mode (LED) | 0: Display the Feedback Value by Integer (xxx) | 0 | | ○ | ○ | ○ | *5 |
| | | 1: Display the Feedback Value by the Value with First Decimal Place (xx.x) | | | | | | |
| | | 2: Display the Feedback Value by the Value with Second Decimal Place (x.xx) | | | | | | |
| 12-02 | PID Feedback Display Unit Setting (LED) | 0: xxxxx (no unit) | 0 | | ○ | ○ | ○ | *5 |
| | | 1: xxxPb (pressure) | | | | | | |
| | | 2: xxxFL (flow) | | | | | | |
| 12-03 | Line Speed Display (LED) | 0~60000 | 1500/ 1800 | RPM | ○ | ○ | ○ | *5 |
| 12-04 | Line Speed Display Mode (LED) | 0: Display Inverter Output Frequency | 0 | | ○ | ○ | ○ | *1 *5 |
| | | 1: Line Speed Display at Integer.(xxxx) | | | | | | |
| | | 2: Line Speed Display at One Decimal Place. (xxxx.x) | | | | | | |
| | | 3: Line Speed Display at Two Decimal Places. (xxx.xx) | | | | | | |
| | | 4: Line Speed Display at Three Decimal Places. (xx.xxx) | | | | | | |

Group 12: Monitoring Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|---------------------|--|---|---------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| 12-05 | Status display of digital input terminal (LED / LCD) | <p>LED display is shown as below no input</p>  <p>correspondences to input and output</p>   <p>LCD display is shown as below</p>  <p>0 : OPEN 1 : CLOSE</p> <ul style="list-style-type: none"> Input Terminal(S6) Input Terminal(S5) Input Terminal(S4) Input Terminal(S3) Input Terminal(S2) Input Terminal(S1) Output Terminal(R3) Output Terminal(R2) Output Terminal(R1) | - | - | O | O | O | |
| 12-06 ~ 12-10 | Reserved | | | | | | | |
| 12-11 | Output Current of Current Fault | Display the output current of current fault | - | A | O | O | O | |
| 12-12 | Output Voltage of Current Fault | Display the output voltage of current fault | - | V | O | O | O | |
| 12-13 | Output Frequency of Current Fault | Display the output frequency of current fault | - | Hz | O | O | O | |
| 12-14 | DC Voltage of Current Fault | Display the DC voltage of current fault | - | V | O | O | O | |
| 12-15 | Frequency Command of Current Fault | Display the frequency command of current fault | - | Hz | O | O | O | |
| 12-16 | Frequency Command | If LED enters this parameter, it only allows monitoring frequency command. | - | Hz | O | O | O | |
| 12-17 | Output Frequency | Display the current output frequency | - | Hz | O | O | O | |
| 12-18 | Output Current | Display the current output current | - | A | O | O | O | |
| 12-19 | Output Voltage | Display the current output voltage | - | V | O | O | O | |
| 12-20 | DC Voltage | Display the current DC voltage | - | V | O | O | O | |
| 12-21 | Output Power | Display the current output power | - | kW | O | O | O | |

| Group 12: Monitoring Parameters | | | | | | | | |
|---------------------------------|-------------------------------|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 12-22 | Motor's Rotation Speed | Display motor's current rotation speed in VF/SLV mode Motor's rotation speed = output power x(120/motor's pole number) In PG/SV mode, motor's rotation speed is calculated by feedback frequency. Max limit is 65535 | - | rpm | O | O | O | |
| 12-23 | Output Power Factor | Display the current output power factor | - | - | O | O | O | |
| 12-24 | Control Mode | Display control mode 0 : VF 2 : SLV 5 : PM SLV | - | - | O | O | O | |
| 12-25 | AI1 Input | Display the current AI1 input (0V corresponds to 0%, 10V corresponds to 100%,) | - | % | O | O | O | |
| 12-26 | AI2 Input | Display the current AI2 input (0V or 4mA corresponds to 0%, 10V or 20mA corresponds to 100%) | - | % | O | O | O | |
| 12-27 | Motor Torque | Display the current torque command (100% corresponds to motor torque) | - | % | X | O | O | |
| 12-28 | Motor Torque Current (Iq) | Display the current q-axis current | - | % | X | O | O | |
| 12-29 | Motor Excitation Current (Id) | Display the current d-axis current | - | % | X | O | O | |
| 12-30 ~ 12-35 | Reserved | | | | | | | |
| 12-36 | PID Input | Display input error of the PID controller (PID target value - PID feedback) (100% corresponds to the maximum frequency set by 01-02 or 01-16) | - | % | O | O | O | |
| 12-37 | PID Output | Display output of the PID controller (100% corresponds to the maximum frequency set by 01-02 or 01-16) | - | % | O | O | O | |

| Group 12: Monitoring Parameters | | | | | | | | |
|---------------------------------|-------------------------------------|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 12-38 | PID Setting | Display the target value of the PID controller (100% corresponds to the maximum frequency set by 01-02 or 01-16) | - | % | O | O | O | |
| 12-39 | PID Feedback | Display the feedback value of the PID controller (100% corresponds to the maximum frequency set by 01-02 or 01-16) | - | % | O | O | O | |
| 12-40 | Reserved | | | | | | | |
| 12-41 | Heatsink Temperature | Display the heatsink temperature of IGBT temperature. | - | °C | O | O | O | |
| 12-42 | RS-485 Error Code |  | - | - | O | O | O | *7 |
| 12-43 | Inverter Status |  | 101B | - | O | O | O | |
| 12-44 | Reserved | | | | | | | |
| 12-45 | Recent Fault Message | Display current fault message | - | - | O | O | O | |
| 12-46 | Previous Fault Message | Display previous fault message | - | - | O | O | O | |
| 12-47 | Previous Two Fault Messages | Display previous two fault messages | - | - | O | O | O | |
| 12-48 | Previous Three Fault Messages | Display previous three fault messages | - | - | O | O | O | |
| 12-49 | Previous Four Fault Messages | Display previous four fault messages | - | - | O | O | O | |
| 12-50 | DIO Status of Current Fault | Display the DI/DO status of current fault Description is similar to 12-05 | - | - | O | O | O | |
| 12-51 | Inverter Status of Current Fault | Display the inverter status of current fault Description is similar to 12-43 | - | - | O | O | O | |
| 12-52 | Trip Time 1 of Current Fault | Display the operation time of current fault, 12-53 is the days, while 12-52 is the remaining hours. | - | Hr | O | O | O | |
| 12-53 | Trip Time 2 of Current Fault | | - | day | O | O | O | |
| 12-54 | Frequency Command of Previous Fault | Display frequency command of previous fault | - | Hz | O | O | O | |

| Group 12: Monitoring Parameters | | | | | | | | |
|---------------------------------|--|---|----------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 12-55 | Output Frequency of Previous Fault | Display output frequency of previous fault | - | Hz | O | O | O | |
| 12-56 | Output Current of Previous Fault | Display output current of previous fault | - | A | O | O | O | |
| 12-57 | Output Voltage of Previous Fault | Display output voltage of previous fault | - | V | O | O | O | |
| 12-58 | DC Voltage of Previous Fault | Display DC voltage of previous fault | - | V | O | O | O | |
| 12-59 | DIO Status of Previous Fault | Display DI/DO status of previous fault Description is similar to 12-05 | - | - | O | O | O | |
| 12-60 | Inverter Status of Previous Fault | Display inverter status of previous fault Description is similar to 12-43 | - | - | O | O | O | |
| 12-61 | Trip time 1 of last fault | Display the operation time of last time's fault, 12-62 is the days, while 12-61 is the remaining hours. | - | Hr | O | O | O | |
| 12-62 | Trip time 2 of last fault | | - | day | O | O | O | |
| 12-63 | Recent warning messages | Display the recent warning messages | - | - | O | O | O | |
| 12-64 | Previous warning message | Display the previous warning messages | - | - | O | O | O | |
| 12-65 ~ 12-66 | Reserved | | | | | | | |
| 12-67 | Accumulative Energy (kWHr) | 0.0 ~ 999.9 | | kWHr | O | O | O | |
| 12-68 | Accumulative Energy (MWHr) | 0 ~ 60000 | | MWHr | O | O | O | |
| 12-69 | Accumulative Electricity Price (\$) | 0 ~ 9999 | | \$ | O | O | O | |
| 12-70 | Accumulative Electricity Price (10000\$) | 0 ~ 60000 | | \$ | O | O | O | |
| 12-71 | Flow Meter Feedback | 1 ~ 50000 | | GP M | O | O | O | |
| 12-72 | RTC Date | 12.01.01 ~ 99.12.31 | 12.01.01 | | O | O | O | |
| 12-73 | RTC Time | 00:00 ~ 23:59 | 00:00 | | O | O | O | |
| 12-74 | Operating Pressure Setting | 0.01 ~ 25.50 | 2.00 | PSI | O | X | X | |
| 12-75 | Pressure Feedback Value | 0.01 ~ 25.50 | - | PSI | O | X | X | |
| 12-76 | Non-Load Voltage | 0.0 ~ 600.0 | - | V | X | O | X | |
| 12-77 | Flow Meter Target Setting | 1 ~ 50000 | - | GP M | O | O | O | *7 |
| 12-78 | Reserved | | | | | | | |
| 12-79 | Pulse Input Percentage | 0.0~100.0 | - | % | O | O | O | *7 |

Note: Inverter models 2060 and 4100 and above (IP20) do not have the heatsink monitoring function.

| Group 13 Maintenance Function Group | | | | | | | | |
|-------------------------------------|---|---|---------|------|-----------------------|-----------------------|-----------------------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 13-00 | Inverter Rating Selection | 00H~FFH | - | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *4 |
| 13-01 | Software Version | 0.00-9.99 | - | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *4 |
| 13-02 | Clear Cumulative Operation Hours Function | 0: Disable to Clear Cumulative Operation Hours 1: Clear Cumulative Operation Hours | 0 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 13-03 | Cumulative Operation Hours 1 | 0~23 | - | hr | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *4 |
| 13-04 | Cumulative Operation Hours 2 | 0~65534 | - | day | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *4 |
| 13-05 | Selection of Accumulative Operation Time | 0: Accumulative time in power on 1: Accumulative time in operation | 0 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 13-06 | Parameters Locked | 0: Parameters out of 13-06 and main frequency 05-01 are read-only. 1: Only user parameter is enabled. 2: All parameters are writable. | 2 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 |
| 13-07 | Parameter Password Function | 00000~65534 | 00000 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 13-08 | Restore Factory Setting | 0: No Initialization 2: 2 wire Initialization (220/440V, 60Hz) 3: 3 wire Initialization (220/440V, 60Hz) 4: 2 wire Initialization (230/415V, 50Hz) 5: 3 wire Initialization (230/415V, 50Hz) 6: 2 wire Initialization (200/380V, 50Hz) 7: 3 wire Initialization (200/380V, 50Hz) 8: PLC Initialization 9: 2 Wire Initialization (230V/460V, 60Hz) 10: 3 Wire Initialization (230V/460V, 60Hz) 11: 2 wire Initialization, 230V/400V, 60Hz 12: 3 wire Initialization, 230V/400V, 60Hz 13: 2 wire Initialization, 230V/400V, 50Hz 14: 3 wire Initialization, 230V/400V, 50Hz 15: 2 wire Initialization, (220/380V, 50Hz) ^{Note4} 16: 3 wire Initialization | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

| Group 13 Maintenance Function Group | | | | | | | | |
|-------------------------------------|----------------------------------|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | (220/380V, 50Hz) ^{Note4} | | | | | | |
| 13-09 | Fault History Clearance Function | 0: Do not Clear Fault History 1: Clear Fault History | 0 | - | ○ | ○ | ○ | *1 |
| 13-10 | Situation | 0 ~ 9999 | 0 | | ○ | ○ | ○ | |
| 13-11 | C/B CPLD Ver. | 0.00~9.99 | - | | ○ | ○ | ○ | *7 |
| 13-12 | Option Card Id | 0~255 | 0 | | ○ | ○ | ○ | *7 |
| 13-13 | Option Card CPLD Ver. | 0.00~9.99 | - | | ○ | ○ | ○ | *7 |
| 13-14 | Fault Storage Selection | 0: Auto Restart Fault Messages are not saved in fault history. 1: Auto Restart Fault Messages are saved in fault history. | 1 | | ○ | ○ | ○ | |
| 13-15 ~ 13-20 | Reserved | | | | | | | |
| 13-21 | Previous Fault Message | Display Previous Fault Message | - | - | ○ | ○ | ○ | |
| 13-22 | Previous Two Fault Message | Display Previous Two Fault Message | - | - | ○ | ○ | ○ | |
| 13-23 | Previous Three Fault Message | Display Previous Three Fault Message | - | - | ○ | ○ | ○ | |
| 13-24 | Previous Four Fault Message | Display Previous Four Fault Message | - | - | ○ | ○ | ○ | |
| 13-25 | Previous Five Fault Message | Display Previous Five Fault Message | - | - | ○ | ○ | ○ | |
| 13-26 | Previous Six Fault Message | Display Previous Six Fault Message | - | - | ○ | ○ | ○ | |
| 13-27 | Previous Seven Fault Message | Display Previous Seven Fault Message | - | - | ○ | ○ | ○ | |
| 13-28 | Previous Eight Fault Message | Display Previous Eight Fault Message | - | - | ○ | ○ | ○ | |
| 13-29 | Previous Night Fault Message | Display Previous Night Fault Message | - | - | ○ | ○ | ○ | |
| 13-30 | Previous Ten Fault Message | Display Previous Ten Fault Message | - | - | ○ | ○ | ○ | |
| 13-31 | Previous Eleven Fault Message | Display Previous Eleven Fault Message | - | - | ○ | ○ | ○ | |
| 13-32 | Previous Twelve Fault Message | Display Previous Twelve Fault Message | - | - | ○ | ○ | ○ | |
| 13-33 | Previous Thirteen Fault Message | Display Previous Thirteen Fault Message | - | - | ○ | ○ | ○ | |
| 13-34 | Previous Fourteen Fault Message | Display Previous Fourteen Fault Message | - | - | ○ | ○ | ○ | |
| 13-35 | Previous Fifteen Fault Message | Display Previous Fifteen Fault Message | - | - | ○ | ○ | ○ | |
| 13-36 | Previous Sixteen Fault | Display Previous Sixteen Fault | - | - | ○ | ○ | ○ | |

Group 13 Maintenance Function Group

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|-------------------------------------|---|---------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| | Message | Message | | | | | | |
| 13-37 | Previous Seventeen Fault Message | Display Previous Seventeen Fault Message | - | - | ○ | ○ | ○ | |
| 13-38 | Previous Eighteen Fault Message | Display Previous Eighteen Fault Message | - | - | ○ | ○ | ○ | |
| 13-39 | Previous Nineteen Fault Message | Display Previous Nineteen Fault Message | - | - | ○ | ○ | ○ | |
| 13-40 | Previous Twenty Fault Message | Display Previous Twenty Fault Message | - | - | ○ | ○ | ○ | |
| 13-41 | Previous Twenty One Fault Message | Display Previous Twenty One Fault Message | - | - | ○ | ○ | ○ | |
| 13-42 | Previous Twenty Two Fault Message | Display Previous Twenty Two Fault Message | - | - | ○ | ○ | ○ | |
| 13-43 | Previous Twenty Three Fault Message | Display Previous Twenty Three Fault Message | - | - | ○ | ○ | ○ | |
| 13-44 | Previous Twenty Four Fault Message | Display Previous Twenty Four Fault Message | - | - | ○ | ○ | ○ | |
| 13-45 | Previous Twenty Five Fault Message | Display Previous Twenty Five Fault Message | - | - | ○ | ○ | ○ | |
| 13-46 | Previous Twenty Six Fault Message | Display Previous Twenty Six Fault Message | - | - | ○ | ○ | ○ | |
| 13-47 | Previous Twenty Seven Fault Message | Display Previous Twenty Seven Fault Message | - | - | ○ | ○ | ○ | |
| 13-48 | Previous Twenty Eight Fault Message | Display Previous Twenty Eight Fault Message | - | - | ○ | ○ | ○ | Nte2 |
| 13-49 | Previous Twenty Nine Fault Message | Display Previous Twenty Nine Fault Message | - | - | ○ | ○ | ○ | |
| 13-50 | Previous Thirty Fault Message | Display Previous Thirty Fault Message | - | - | ○ | ○ | ○ | |

| Group 14: PLC Setting Parameters | | | | | | | | |
|----------------------------------|-------------------------|---------------|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 14-00 | T1 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-01 | T1 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-02 | T2 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-03 | T2 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-04 | T3 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-05 | T3 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-06 | T4 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-07 | T4 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-08 | T5 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-09 | T5 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-10 | T6 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-11 | T6 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-12 | T7 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-13 | T7 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-14 | T8 Set Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-15 | T8 Set Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 14-16 | C1 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-17 | C2 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-18 | C3 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-19 | C4 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-20 | C5 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-21 | C6 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-22 | C7 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-23 | C8 Set Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-24 | AS1 Set Value 1 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-25 | AS1 Set Value 2 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-26 | AS1 Set Value 3 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-27 | AS2 Set Value 1 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-28 | AS2 Set Value 2 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-29 | AS2 Set Value 3 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-30 | AS3 Set Value 1 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-31 | AS3 Set Value 2 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-32 | AS3 Set Value 3 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-33 | AS4 Set Value 1 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-34 | AS4 Set Value 2 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-35 | AS4 Set Value 3 | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 14-36 | MD1 Set Value 1 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-37 | MD1 Set Value 2 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-38 | MD1 Set Value 3 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-39 | MD2 Set Value 1 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-40 | MD2 Set Value 2 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-41 | MD2 Set Value 3 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-42 | MD3 Set Value 1 | 0~65534 | 1 | - | ○ | ○ | ○ | |

| Group 14: PLC Setting Parameters | | | | | | | | |
|----------------------------------|-----------------|---------------|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 14-43 | MD3 Set Value 2 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-44 | MD3 Set Value 3 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-45 | MD4 Set Value 1 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-46 | MD4 Set Value 2 | 0~65534 | 1 | - | ○ | ○ | ○ | |
| 14-47 | MD4 Set Value 3 | 0~65534 | 1 | - | ○ | ○ | ○ | |

| Group 15: PLC Monitoring Parameters | | | | | | | | |
|-------------------------------------|-----------------------------|---------------|---------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 15-00 | T1 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-01 | T1 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-02 | T2 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-03 | T2 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-04 | T3 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-05 | T3 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-06 | T4 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-07 | T4 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-08 | T5 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-09 | T5 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-10 | T6 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-11 | T6 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-12 | T7 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-13 | T7 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-14 | T8 Current Value 1 | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-15 | T8 Current Value 2 (Mode 7) | 0~9999 | 0 | - | ○ | ○ | ○ | |
| 15-16 | C1 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-17 | C2 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-18 | C3 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-19 | C4 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-20 | C5 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-21 | C6 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-22 | C7 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-23 | C8 Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-24 | AS1 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-25 | AS2 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-26 | AS3 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-27 | AS4 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-28 | MD1 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-29 | MD2 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-30 | MD3 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-31 | MD4 Results | 0~65534 | 0 | - | ○ | ○ | ○ | |
| 15-32 | TD Current Value | 0~65534 | 0 | - | ○ | ○ | ○ | |

| Group 16: LCD Function Parameters | | | | | | | | |
|--|-------------------------------|--|---------|------|-----------------------|-----------------------|-----------------------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 16-00 | Main Screen Monitoring | 5~79 When using LCD to operate, the monitored item displays in the first line. (default is frequency command) | 16 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 *6 |
| 16-01 | Sub-Screen Monitoring 1 | 5~79 (Parameter 12-05~12-79) When using LCD to operate, the monitored item displays in the second line. (default is output frequency) | 17 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 *6 |
| 16-02 | Sub-Screen Monitoring 2 | 5~76(Parameter 12-05~12-79) when using LCD to operate, the monitored item displays in the third line. (default is output current) | 18 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *1 *6 |
| 16-03 | Selection of Display Unit | 0~39999: Determine the display way and unit of frequency command | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 0: Frequency display unit is 0.01Hz | | | | | | |
| | | 1: Frequency display unit 0.01% | | | | | | |
| | | 2: Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate. | | | | | | |
| | | 3~39: Reserved | | | | | | |
| | | 40~9999: Users specify the format, Input 0XXXX represents the display of XXXX at 100%. | | | | | | |
| | | 10001~19999: Users specify the format; Input 1XXXX represents the display of XXX.X at 100%. | | | | | | |
| | | 20001~29999: Users specify the format, Input 2XXXX represents the display of XX.XX at 100%. | | | | | | |
| 30001~39999: Users specify the format, Input 3XXXX represents the display of X.XXX at 100%. | | | | | | | | |
| 16-04 | Selection of Engineering Unit | 0: No Unit | 0 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | *6 |
| | | 1: FPM | | | | | | |
| | | 2: CFM | | | | | | |
| | | 3: PSI | | | | | | |
| | | 4: GPH | | | | | | |
| | | 5: GPM | | | | | | |
| | | 6: IN | | | | | | |
| | | 7: FT | | | | | | |

Group 16: LCD Function Parameters

| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
|-------|-------------------------------------|--|----------|------|--------------|-----|--------|-----------|
| | | | | | V/F | SLV | PM SLV | |
| | | 8: /s | | | | | | |
| | | 9: /m | | | | | | |
| | | 10: /h | | | | | | |
| | | 11: °F | | | | | | |
| | | 12: inW | | | | | | |
| | | 13: HP | | | | | | |
| | | 14: m/s | | | | | | |
| | | 15: MPM | | | | | | |
| | | 16: CMM | | | | | | |
| | | 17: W | | | | | | |
| | | 18: KW | | | | | | |
| | | 19: m | | | | | | |
| | | 20: °C | | | | | | |
| | | 21: RPM | | | | | | |
| | | 22: Bar | | | | | | |
| | | 23: Pa | | | | | | |
| | | 24: KPa ^{Note4} | | | | | | |
| 16-05 | LCD Backlight | 0~7 | 5 | - | 0 | 0 | 0 | *1 |
| 16-06 | Reserved | | | | | | | |
| 16-07 | Copy Function Selection | 0: Do not copy parameters | 0 | - | 0 | 0 | 0 | |
| | | 1: Read inverter parameters and save to the operator. | | | | | | |
| | | 2: Write the operator parameters to inverter. | | | | | | |
| | | 3: Compare parameters of inverter and operator. | | | | | | |
| 16-08 | Selection of Allowing Reading | 0: Do not allow to read inverter parameters and save it to the operator. | 0 | - | 0 | 0 | 0 | |
| | | 1: Allow to read inverter parameters and save it to the operator. | | | | | | |
| 16-09 | Selection of Operator Removed (LCD) | 0: Keep operating when LCD operator is removed. | 0 | - | 0 | 0 | 0 | *1 |
| | | 1: Display fault to stop when LCD operator is removed | | | | | | |
| 16-10 | RTC Time Display Setting | 0: Hide | 0 | | 0 | 0 | 0 | |
| | | 1: Display | | | | | | |
| 16-11 | RTC Date Setting | 12.01.01 ~ 99.12.31 | 12.01.01 | | 0 | 0 | 0 | |
| 16-12 | RTC Time Setting | 00:00 ~ 23:59 | 00:00 | | 0 | 0 | 0 | |
| 16-13 | RTC Timer Function | 0: Disable | 0 | | 0 | 0 | 0 | |
| | | 1: Enable | | | | | | |
| | | 2: Set by DI | | | | | | |

| Group 16: LCD Function Parameters | | | | | | | | |
|-----------------------------------|-------------------------|---|---------|------|-----------------------|-----------------------|-----------------------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 16-14 | P1 Start Time | 00:00 ~ 23:59 | 08:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-15 | P1 Stop Time | 00:00 ~ 23:59 | 18:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-16 | P1 Start Date | 1:Mon, 2:Tue, 3:Wed, | 1 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-17 | P1 Stop Date | 4:Thu, 5:Fri, 6:Sat, 7:Sun | 5 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-18 | P2 Start Time | 00:00 ~ 23:59 | 08:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-19 | P2 Stop Time | 00:00 ~ 23:59 | 18:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-20 | P2 Start Date | 1:Mon, 2:Tue, 3:Wed, | 1 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-21 | P2 Stop Date | 4:Thu, 5:Fri, 6:Sat, 7:Sun | 5 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-22 | P3 Start Time | 00:00 ~ 23:59 | 08:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-23 | P3 Stop Time | 00:00 ~ 23:59 | 18:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-24 | P3 Start Date | 1:Mon, 2:Tue, 3:Wed, | 1 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-25 | P3 Stop Date | 4:Thu, 5:Fri, 6:Sat, 7:Sun | 5 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-26 | P4 Start Time | 00:00 ~ 23:59 | 08:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-27 | P4 Stop Time | 00:00 ~ 23:59 | 18:00 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-28 | P4 Start Date | 1:Mon, 2:Tue, 3:Wed, | 1 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-29 | P4 Stop Date | 4:Thu, 5:Fri, 6:Sat, 7:Sun | 5 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-30 | Selection of RTC Offset | 0: Disable | 0 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| | | 1: Enable | | | | | | |
| | | 2: Set by DI | | | | | | |
| 16-31 | RTC Offset Time Setting | 00:00 ~ 23:59 | 00:00 | - | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-32 | Source of Timer 1 | 0: None, 1:P1, | 1 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-33 | Source of Timer 2 | 2:P2, 3:P1+P2 | 2 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-34 | Source of Timer 3 | 4:P3, 5:P1+P3, | 4 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| 16-35 | Source of Timer 4 | 6:P2+P3, 7:P1+P2+P3, 8:P4, 9:P1+P4, 10:P2+P4, 11:P1+P2+P4 12:P3+P4 13:P1+P3+P4, 14:P2+P3+P4 15:P1+P2+P3+P4, 16:Off, 17:Off+P1 18:Off+P2, 19:Off+P1+P2 20:Off+P3, 21:Off+P1+P3 22:Off+P2+P3 23:Off+P1+P2+P3 24:Off+P4 25:Off+P1+P4 26:Off+P2+P4 | 8 | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

| Group 16: LCD Function Parameters | | | | | | | | |
|-----------------------------------|-------------------------------------|---|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | 27:Off+P1+P2+P4 28:Off+P3+P4 29:Off+P1+P3+P4 30:Off+P2+P3+P4 31:Off+P1+P2+P3+P4 | | | | | | |
| 16-36 | Selection of RTC Speed | 0: Off | 0 | | ○ | ○ | ○ | |
| | | 1: By Timer 1 | | | | | | |
| | | 2: By Timer 2 | | | | | | |
| | | 3: By Timer 3 | | | | | | |
| | | 4: By Timer 4 | | | | | | |
| 5: By Timer 1+2 | | | | | | | | |
| 16-37 | Selection of RTC Rotation Direction | xxx0b: RTC Run1 Forward Rotation | 0000b | | ○ | ○ | ○ | |
| | | xxx1b: RTC Run1 Reverse Rotation | | | | | | |
| | | xx0xb: RTC Run2 Forward Rotation | | | | | | |
| | | xx1xb: RTC Run2 Reverse Rotation | | | | | | |
| | | x0xxb: RTC Run3 Forward Rotation | | | | | | |
| | | x1xxb: RTC Run3 Reverse Rotation | | | | | | |
| | | 0xxxb: RTC Run4 Forward Rotation | | | | | | |
| | | 1xxxb: RTC Run4 Reverse Rotation | | | | | | |

| Group 17: IM Motor Automatic Tuning Parameters | | | | | | | | |
|---|------------------------------------|---|------------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 17-00 | Mode Selection of Automatic Tuning | 0: Rotational Auto-tuning | VF:2 SLV:6 | - | O | O | X | |
| | | 1: Static Auto-tuning | | | | | | |
| | | 2: Stator Resistance Measurement | | | | | | |
| | | 3: Reserved | | | | | | |
| | | 4: Loop Tuning | | | | | | |
| | | 5: Rotational Auto-tuning Combination (Item: 4+2+0) ^{Note} | | | | | | |
| 6: Static Auto-tuning Combination (Item: 4+2+1) ^{Note} | | | | | | | | |
| 17-01 | Motor Rated Output Power | 0.00~600.00 | - | KW | O | O | X | |
| 17-02 | Motor Rated Current | 0.1~1200.0 | - | A | O | O | X | |
| 17-03 | Motor Rated Voltage | 200V: 50.0~240.0 | 220 | V | O | O | X | |
| | | 400V:100.0~480.0 | 440 | | | | | |
| 17-04 | Motor Rated Frequency | 4.8~400.0 | 60.0 | Hz | O | O | X | |
| 17-05 | Motor Rated Speed | 0~24000 | KVA ^a | rpm | O | O | X | |
| 17-06 | Pole Number of Motor | 2~16 (Even) | 4 | Pole | O | O | X | *6 |
| 17-07 | Reserved | | | | | | | |
| 17-08 | Motor No-load Voltage | 200V: 50~240 | KVA ^a | V | O | O | X | |
| | | 400V: 100~480 | | | | | | |
| 17-09 | Motor Excitation Current | 0.01~600.00 (15%~70% motor rated current) | KVA ^a | A | O | O | X | ■1 |
| 17-10 | Automatic Tuning Start | 0: Disable | 0 | - | O | O | X | |
| | | 1: Enable | | | | | | |
| 17-11 | Error History of Automatic Tuning | 0: No Error | 0 | - | O | O | X | |
| | | 1: Motor Data Error | | | | | | |
| | | 2: Stator Resistance Tuning Error | | | | | | |
| | | 3: Leakage Induction Tuning Error | | | | | | |
| | | 4: Rotor Resistance Tuning Error | | | | | | |
| | | 5: Mutual Induction Tuning Error | | | | | | |
| | | 6: Reserved | | | | | | |
| | | 7: DT Error | | | | | | |
| | | 8: Motor Acceleration Error | | | | | | |
| 9: Warning | | | | | | | | |
| 17-12 | Leakage Inductance Ratio | 0.1 ~ 15.0 | 3.4 | % | X | O | X | |
| 17-13 | Slip Frequency | 0.10 ~ 20.00 | 1.00 | Hz | X | O | X | |
| 17-14 | Rotational Tuning Mode Selection | 0: VF Mode | 0 | - | O | O | X | |
| | | 1: Vector Mode | | | | | | |

*a: KVA means the default value of this parameter is changed based on the inverter rating.

Note: New added parameters in software V1.41

■1: Enabled when 17-00=1, 2, 6.

| Group 18: Slip Compensation Parameters | | | | | | | | |
|--|--|---------------|--------------------|------|--------------|-----|-----------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 18-00 | Slip Compensation Gain at Low Speed | 0.00~2.50 | 0.00 ^{*d} | - | O | O | X | *1 |
| 18-01 | Slip Compensation Gain at High Speed | -1.00~1.00 | 0.0 | - | O | O | X | *1 |
| 18-02 | Slip Compensation Limit | 0~250 | 200 | % | O | X | X | |
| 18-03 | Slip Compensation Filter Time | 0.0~10.0 | 1.0 | Sec | O | X | X | |
| 18-04 | Regenerative Slip Compensation Selection | 0: Disable | 0 | - | O | X | X | |
| | | 1: Enable | | | | | | |
| 18-05 | FOC Delay Time | 1~1000 | 100 | ms | X | O | X | |
| 18-06 | FOC Gain | 0.00~2.00 | 0.1 | - | X | O | X | |

*d: Default value is 0.00 in V/F mode and 1.0 in SLV mode.

| Group 20 Speed Control Parameters* | | | | | | | | |
|------------------------------------|--|---|----------------------------------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 20-00 | ASR Gain 1 | 0.00~250.00 | 3.00 | - | X | O | O | *1 |
| 20-01 | ASR Integral Time 1 | 0.001~10.000 | SLV: 0.500 PMSLV :0.08, | Sec | X | O | O | *1 |
| 20-02 | ASR Gain 2 | 0.00~250.00 | 3.00 | - | X | O | O | *1 |
| 20-03 | ASR Integral Time 2 | 0.001~10.000 | SLV: 0.500 PMSLV :0.08, | Sec | X | O | O | *1 |
| 20-04 | ASR Integral Time Limit | 0~300 | 200 | % | X | O | O | |
| 20-05 ~ 20-06 | Reserved | | | | | | | |
| 20-07 | Selection of Acceleration and Deceleration of P/PI | 0: PI speed control will be enabled only in constant speed. For accel/ decel, only use P control. | 1 | - | X | O | X | |
| | | 1: Speed control is enabled either in constant speed or accel/ decel. | | | | | | |
| 20-08 | ASR Delay Time | 0.000~0.500 | 0.004 | Sec | X | O | O | |
| 20-09 | Speed Observer Proportional (P) Gain 1 | 0.00~2.55 | 0.61 | - | X | O | X | *1 |
| 20-10 | Speed Observer Integral(I) Time 1 | 0.01~10.00 | 0.05 | Sec | X | O | X | *1 |
| 20-11 | Speed Observer Proportional (P) Gain 2 | 0.00~2.55 | 0.61 | - | X | O | X | *1 |
| 20-12 | Speed Observer Integral(I) Time 2 | 0.01~10.00 | 0.06 | Sec | X | O | X | *1 |
| 20-13 | Low-pass Filter Time Constant of Speed Feedback 1 | 1~1000 | 4 | ms | X | O | X | |
| 20-14 | Low-pass Filter Time Constant of Speed Feedback 2 | 1~1000 | 30 | ms | X | O | X | |
| 20-15 | ASR Gain Change Frequency 1 | 0.0~400.0 | 4.0 | Hz | X | O | O | |
| 20-16 | ASR Gain Change Frequency 2 | 0.0~400.0 | 8.0 | Hz | X | O | O | |
| 20-17 | Torque Compensation Gain at Low Speed | 0.00~2.50 | 1.00 | - | X | O | X | *1 |
| 20-18 | Torque Compensation Gain at High Speed | -10~10 | 0 | % | X | O | X | *1 |
| 20-19 ~ 20-32 | Reserved | | | | | | | |
| 20-33 | Constant Speed Detection Level | 0.1~5.0 | 1.0 | | X | O | O | *7 |
| 20-34 | Derating of Compensation Gain | 0~25600 | 0 | % | X | O | X | *7 |
| 20-35 | Derating of Compensation Time | 0~30000 | 100 | ms | X | O | X | *7 |

*: This parameter group enabled in SLV and PMSLV mode only.

| Group 21 Torque Control Parameters | | | | | | | | |
|------------------------------------|------------------------------------|---------------|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 21-00 ~ 21-04 | Reserved | | | | | | | |
| 21-05 | Positive Torque Limit | 0~160 | 160 | % | X | O | O | |
| 21-06 | Negative Torque Limit | 0~160 | 160 | % | X | O | O | |
| 21-07 | Forward Regenerative Torque Limit | 0~160 | 160 | % | X | O | O | |
| 21-08 | Reversal Regenerative Torque Limit | 0~160 | 160 | % | X | O | O | |

| Group 22: PM Motor Parameters | | | | | | | | |
|-------------------------------|--|--|---------|-------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 22-00 | Rated Power of PM Motor | 0.00~600.00 | KVA | kW | X | X | O | |
| 22-01 | Reserved | | | | | | | |
| 22-02 | Rated Current of PM Motor | 0.1~999.9 | KVA | A | X | X | O | |
| 22-03 | Pole Number of PM Motor | 2~96 | 6 | poles | X | X | O | |
| 22-04 | Rated Rotation Speed of PM Motor | 6~60000 (22-04, 22-06, only need to set one of them, the program will calculate the other.) | 1500 | rpm | X | X | O | |
| 22-05 | Maximum Rotation Speed of PM Motor | 6~60000 | 1500 | rpm | X | X | O | |
| 22-06 | PM Motor Rated Frequency | 4.8~400.0 | 75.0 | Hz | X | X | O | |
| 22-07 ~ 22-09 | Reserved | | | | | | | |
| 22-10 | PM SLV Start Current | 20 ~ 200% Motor Rated Current | 80 | % | X | X | O | |
| 22-11 | I/F Mode Start Frequency Switching Point | 1.0 ~ 20.0% Motor Rated Current | 10.0 | % | X | X | O | |
| 22-12 | Speed Estimation kp Value | 1~10000 | 3000 | - | X | X | O | *7 |
| 22-13 | Speed Estimation kl Value | 1~1024 | 40 | - | X | X | O | *6 |
| 22-14 | PM Motor Armature Resistance | 0.001 ~ 30.000 | 1.000 | Ω | X | X | O | |
| 22-15 | PM Motor D-axis Inductance | 0.01 ~ 300.00 | 10.00 | mH | X | X | O | |
| 22-16 | PM Motor Q-axis Inductance | 0.01 ~ 300.00 | 10.00 | mH | X | X | O | |
| 22-17 | Reserved | | | | | | | |
| 22-18 | Flux-Weakening Control | 0~100 | 0 | % | X | X | O | |
| 22-19 ~ 22-20 | Reserved | | | | | | | |
| 22-21 | SLV PM Motor Tuning | 0: Disable 1: Enable | 0 | - | X | X | O | |

| Group 22: PM Motor Parameters | | | | | | | | |
|-------------------------------|---|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 22-22 | Fault History of SLV PM Motor Tuning | 0: No Error | 0 | -- | X | X | O | *4 |
| | | 1~4: Reserved | | | | | | |
| | | 5: Circuit tuning time out. | | | | | | |
| | | 6: Reserved | | | | | | |
| | | 7: Other motor tuning errors | | | | | | |
| | | 8: Reserved | | | | | | |
| | | 9: Current Abnormity Occurs while Loop Adjustment. | | | | | | |
| | | 10: Reserved | | | | | | |
| | | 11: Stator Resistance Measurement Timeout | | | | | | |
| | | 12: Reserved | | | | | | |
| 22-25 | Detection Mode Selection of Default Magnetic Pole | 0: Angle before Stop | 1 | -- | X | X | O | |
| | | 1: Mode 1 | | | | | | |
| | | 2: Mode 2 | | | | | | |
| | | 3: Mode 3 | | | | | | |
| 22-27 | Mode 2 Voltage Command | 5~100 (22-25=2 is enabled) | 50 | % | X | X | O | |
| 22-28 | Mode 2 Frequency Division Ratio | 0~4 (22-25=2 is enabled) | 2 | | X | X | O | |
| 22-29 | Field-Weakening Voltage Control | 80~100 | 95 | % | X | X | O | |

| Group 23 Pump & HVAC Function Parameters | | | | | | | | |
|--|--|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 23-00 | Function Selection | 0: Disable | 0 | - | O | O | O | *7 |
| | | 1: Pump | | | | | | |
| | | 2: HVAC | | | | | | |
| | | 3: Compressor *7 | | | | | | |
| 23-01 | Setting of Single & Multiple Pumps and Master & Slave Machines | 0: Single Pump | 0 | | O | O | O | |
| | | 1: Master | | | | | | |
| | | 2: Slave 1 | | | | | | |
| | | 3: Slave 2 | | | | | | |
| | | 4: Slave 3 | | | | | | |
| 23-02 | Operation Pressure Setting | 0.10 ~ 650.00 | 4.00 | PSI | O | O | O | *6 |
| 23-03 | Maximum Pressure of Pressure Transmitter | 0.10 ~ 650.00 | 10.00 | PSI | O | O | O | *6 |
| 23-04 | Pump Pressure Command Source | 0: Set by 23-02 | 0 | | O | O | O | |
| | | 1: Set by AI | | | | | | |
| 23-05 | Display Mode Selection | 0: Display of Target and Pressure Feedback * | 0 | % | O | O | O | |
| | | 1: Only Display Target Pressure | | | | | | |
| | | 2: Only Display Feedback Pressure | | | | | | |
| 23-06 | Proportion Gain (P) | 0.00~10.00 | 3.00 | - | O | O | O | |

| Group 23 Pump & HVAC Function Parameters | | | | | | | | |
|--|--|--|---------|------------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 23-07 | Integral Time (I) | 0.0~100.0 | 0.5 | Sec | O | O | O | |
| 23-08 | Differential Time (D) | 0.00~10.00 | 0.00 | Sec | O | O | O | |
| 23-09 | Tolerance Range of Constant Pressure | 23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100 | 5 | %/ PSI | O | O | O | *6 |
| 23-10 | Sleep Frequency of Constant Pressure | 0.00 ~ 400.00 | 30.00 | Hz | O | O | O | |
| 23-11 | Sleep Time of Constant Pressure | 0.0 ~ 255.5 | 0.0 | Sec | O | O | O | |
| 23-12 | Maximum Pressure Limit | 23-20=0 : 0.00 ~ 650.00 23-20=1 : 0~100 | 50 | %/ PSI | O | O | O | *6 |
| 23-13 | Warning Time of High Pressure | 0.0 ~ 600.0 | 10.0 | Sec | O | O | O | |
| 23-14 | Stop Time of High Pressure | 0.0 ~ 600.0 | 20.0 | Sec | O | O | O | |
| 23-15 | Minimum Pressure Limit | 23-20=0 : 0.00 ~ 650.00 23-20=1 : 0~100 | 5 | %/ PSI | O | O | O | *6 |
| 23-16 | Warning Time of Low Pressure | 0.0 ~ 600.0 | 0.0 | Sec | O | O | O | |
| 23-17 | Fault Stop Time of Low Pressure | 0.0 ~ 600.0 | 0.0 | Sec | O | O | O | |
| 23-18 | Detection Time of Loss Pressure | 0.0 ~ 600.0 | 0.0 | Sec | O | O | O | |
| 23-19 | Detection Proportion of Loss Pressure | 0 ~ 100 | 0 | % | O | O | O | |
| 23-20 | Switching of Pressure and Percentage | 0:Pressure 1:Percentage | 1 | - | O | O | O | |
| 23-21 | Reserved | | | | | | | |
| 23-22 | Slave Trip Frequency | 0.00 ~ 400.00 | 45.00 | Hz | O | O | O | |
| 23-23 | Direction of Water Pressure Detection | 0: Upward Detection 1: Downward Detection | 1 | - | O | O | O | |
| 23-24 | Range of Water Pressure Detection | 23-20=0 : 0.00 ~ 65.00 23-20=1 : 0~10 | 1 | %/ PSI | O | O | O | *6 |
| 23-25 | Period of Water Pressure Detection | 0.0 ~ 200.0 | 30.0 | Sec | O | O | O | |
| 23-26 | Acceleration Time of Water Pressure Detection | 0.1 ~ 6000.0 | KVA | Sec | O | O | O | |
| 23-27 | Deceleration Time of Water Pressure Detection | 0.1 ~ 6000.0 | KVA | Sec | O | O | O | |
| 23-28 | Forced Run Command | 0.00 ~ 400.00 | 0.00 | Hz | O | O | O | |
| 23-29 | Switching Time of Multiple Pumps in Parallel | 0 ~ 240 | 3 | Hr/ min | O | O | O | |
| 23-30 | Detection Time of Multiple Pumps in Parallel Running Start | 0.0 ~ 30.0 | 0.0 | Sec | O | O | O | |
| 23-31 | Synchronous Selection of | 0: Disable | 1 | | O | O | O | |

| Group 23 Pump & HVAC Function Parameters | | | | | | | | |
|--|---|---|---------|-----------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | Multiple Pumps in Parallel | 1: Pressure Setting and Run/Stop | | | | | | |
| | | 2: Pressure Setting | | | | | | |
| | | 3: Run/Stop | | | | | | |
| 23-32 | Reserved | | | | | | | |
| 23-33 | Reserved | | | | | | | |
| 23-34 | Tolerance Range of Constant Pressure 2 | 23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100 | 5 | %/ PSI | 0 | 0 | 0 | |
| 23-35 | Selection of Multiple Pumps Shift Operation | 0: No function 1: Timer Alternately Selection 2: Sleep Stop Alternately Selection 3: Timer and Sleep Stop Alternately Selection 4: Multiple Pumps Test Mode | 1 | | 0 | 0 | 0 | |
| 23-36 | PUMP Unit Display | 0:PSI | 0 | | 0 | 0 | 0 | |
| | | 1:inW | | | | | | |
| | | 2:Bar | | | | | | |
| | | 3:Pa | | | | | | |
| 23-37 | Leakage Detection Time | 0.0~100.0 | 0.0 | Sec | 0 | 0 | 0 | *7 |
| 23-38 | Pressure Variation of Leakage Detection Restart | 23-20=0 : 0.01 ~ 65.00 23-20=1 : 1~10 | 1 | %/ PSI | 0 | 0 | 0 | *7 |
| 23-39 | Pressure Tolerance Range of Leakage Detection Restart | 23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100 | 5 | %/ PSI | 0 | 0 | 0 | *7 |
| 23-40 | Reserved | | | | | | | |
| 23-41 | Local/ Remote Key | 0: Disable | 1 | | 0 | 0 | 0 | |
| | | 1: Enable | | | | | | |
| 23-42 | Energy Recalculating | 0: Disable (Energy Accumulating) | 0 | | 0 | 0 | 0 | |
| | | 1: Enable | | | | | | |
| 23-43 | Electricity Price per kWh | 0.000 ~ 5.000 | 0.000 | \$ | 0 | 0 | 0 | |
| 23-44 | Selection of Accumulative Electricity Pulse Output Unit | 0: Disable | 0 | | 0 | 0 | 0 | |
| | | 1: Unit for 0.1kWh | | | | | | |
| | | 2: Unit for 1kWh | | | | | | |
| | | 3: Unit for 10kWh | | | | | | |
| | | 4: Unit for 100kWh | | | | | | |
| | 5: Unit for 1000kWh | | | | | | | |
| 23-45 | Given Modes of Flow Meters Feedback | 0: Disable | 1 | | 0 | 0 | 0 | |
| | | 1: Analog Input | | | | | | |
| | | 2: Pulse Input | | | | | | |
| 23-46 | Maximum Value of Flow Meters | 1 ~ 50000 | 10000 | GPM | 0 | 0 | 0 | |
| 23-47 | Target Value of Flow Meters | 1 ~ 50000 | 5000 | GPM | 0 | 0 | 0 | |
| 23-48 | Maximum Flow Value of Feedback | 0.01 ~ 99.00 | 80.00 | % | 0 | 0 | 0 | |
| 23-49 | Maximum Flow Warning Time of Feedback | 0.0 ~ 255.0 | 3.0 | Sec | 0 | 0 | 0 | |

| Group 23 Pump & HVAC Function Parameters | | | | | | | | |
|--|---|--------------------------------|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 23-50 | Maximum Flow Stop Time of Feedback | 0.0 ~ 255.0 | 6.0 | Sec | O | O | O | |
| 23-51 | Minimum Flow Value of Feedback | 0.01 ~ 99.00 | 10.00 | % | O | O | O | |
| 23-52 | Minimum Flow Warning Time of Feedback | 0.0 ~ 255.0 | 3.0 | Sec | O | O | O | |
| 23-53 | Minimum Flow Stop Time of Feedback | 0.0 ~ 255.0 | 6.0 | Sec | O | O | O | |
| 23-54 | Detection Function of Low Suction | 0: Disable | 0 | | O | O | O | |
| | | 1: PID Error Value | | | | | | |
| | | 2: Current | | | | | | |
| | | 3: Current and PID Error Value | | | | | | |
| 23-55 | Detection Time of Low Suction | 0 ~ 30.0 | 10.0 | Sec | O | O | O | |
| 23-56 | PID Error Level of Low Suction | 0 ~ 30 | 10 | % | O | O | O | |
| 23-57 | Current Level of Low Suction(Motor Rated Current) | 0 ~ 100 | 10 | % | O | O | O | |
| 23-58 | Reaction of Low Suction | 0: Disable | 0 | | O | O | O | |
| | | 1: Warning | | | | | | |
| | | 2: Fault | | | | | | |
| | | 3: Fault & Restart | | | | | | |
| 23-59 | Source of HVAC Pressure Command | 0: Set by 23-47 | 0 | | O | O | O | |
| | | 1: Set by AI | | | | | | |
| 23-60 | HVAC Unit Display | 0: GPM | 0 | | O | O | O | |
| | | 1: FPM | | | | | | |
| | | 2: CFM | | | | | | |
| | | 3: GPH | | | | | | |
| 23-66 | Derating of Current Level | 10~200 | 110 | % | O | X | X | |
| 23-67 | Derating of Delay Time | 1.0~20.0 | 10.0 | Sec | O | X | X | |
| 23-68 | Derating of Frequency Gain | 1~100 | 90 | % | O | X | X | |
| 23-69 | OL4 Current Level | 10~200 | 120 | % | O | X | X | |
| 23-70 | OL4 Delay Time | 0~20.0 | 5.0 | Sec | O | X | X | |
| 23-71 | Maximum Pressure Setting | 0.10~650.00 | 10.00 | PSI | O | O | O | |
| 23-72 | Switching Time of Alternation in Parallel | 0: Hour | 0 | | O | O | O | |
| | | 1: Minute | | | | | | |
| 23-73 | Slave Wake-up Selection | 0: Disable | 0 | | O | O | O | |
| | | 1: Enable | | | | | | |

| Group 24 Pump Control Function Parameters | | | | | | | | |
|---|------------------------------------|--|---------|------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| 24-00 | Selection of Pump Control Function | 0: Function of 1 to 8 Pump Card is Disabled | 0 | - | ○ | ○ | ○ | |
| | | 1: Fixed Modes of Inverter Pump: First on and Last off; then Stop All. | | | | | | |
| | | 2: Fixed Modes of Inverter Pump: Only Stop Inverter Pump. | | | | | | |
| | | 3: Fixed Modes of Inverter Pump: First on and First Off; then Stop All. | | | | | | |
| | | 4: Cycle Modes of Inverter Pump: First on and First Off; then Stop All. | | | | | | |
| | | 5: Cycle Modes of Inverter Pump: Only Stop Inverter Pump. | | | | | | |
| | | 6: 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First off; then Stop All | | | | | | |
| | | 7: Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling. ^{Note1} | | | | | | |
| | | 8: Cycle Modes of Inverter Pump 1 to 3 Relay: First on and First Off; then Stop All. And First Boot Relay in Cycling. ^{Note1} | | | | | | |
| | | 9: Cycle Modes of Inverter Pump 1 to 3 Relay: Only Stop Inverter Pump. And First Boot Relay in Cycling. ^{Note3} | | | | | | |
| 24-01 | Selection of Relay 2-4 Function | xxx0b: Reserved | 0000b | | ○ | ○ | ○ | |
| | | xxx1b: Reserved | | | | | | |
| | | xx0xb: Relay 2 Disable | | | | | | |
| | | xx1xb: Relay 2 Enable | | | | | | |
| | | x0xxb: Relay 3 Disable | | | | | | |
| | | x1xxb: Relay 3 Enable | | | | | | |
| | | 0xxxb: Relay 4 Disable | | | | | | |
| | | 1xxxb: Relay 4 Enable | | | | | | |
| 24-02 | Selection of Relay 5-8 Function | xxx0b: Relay 5 Disable | 0000b | | ○ | ○ | ○ | |
| | | xxx1b: Relay 5 Enable | | | | | | |
| | | xx0xb: Relay 6 Disable | | | | | | |
| | | xx1xb: Relay 6 Enable | | | | | | |
| | | x0xxb: Relay 7 Disable | | | | | | |
| | | x1xxb: Relay 7 Enable | | | | | | |

| Group 24 Pump Control Function Parameters | | | | | | | | |
|---|--------------------------------------|--|---------|------------|--------------|-----|--------|-----------|
| Code | Parameter Name | Setting Range | Default | Unit | Control Mode | | | Attribute |
| | | | | | V/F | SLV | PM SLV | |
| | | 0xxxb: Relay 8 Disable 1xxxb: Relay 8 Enable | | | | | | |
| 24-03 | Duration of Upper Limit Frequency | 1.0 ~ 600.0 | 300.0 | Sec | O | O | O | *1 |
| 24-04 | Duration of Lower Limit Frequency | 1.0 ~ 600.0 | 300.0 | Sec | O | O | O | *1 |
| 24-05 | Switching Time of Magnetic Contactor | 0.1 ~ 20.0 | 1.00 | Sec | O | O | O | *1 |
| 24-06 | Allowable Bias of Pump Switch | 0.0 ~ 20.0 | 0.0 | % | O | O | O | *1 |
| 24-07 | Pump Control Source Selection | 0: 1 to 8 pump card 1: Built-in 1 to 3 control mode | 0 | | O | O | O | |
| 24-08 | Relay Switching Time | 0~240 | 1 | Hr/ min | O | O | O | |
| 24-09 | Frequency/ Target Switch | 0: Disable 1: Enable | 0 | | O | O | O | |
| 24-10 | Stop Mode Selection on Mode 6/7/9 | 0: Disable 1: Enable | 0 | | O | O | O | |
| 24-11 | High Voltage Limit Level | 0~10000 | 500 | - | O | O | O | |
| 24-12 | Delay Time of High Voltage Warning | 0.0 ~ 600.0 | 10.0 | Sec | O | O | O | |
| 24-13 | Delay Time of High Voltage Error | 0.0 ~ 600.0 | 20.0 | Sec | O | O | O | |
| 24-14 | Low Voltage Limit Level | 0~10000 | 0 | - | O | O | O | |
| 24-15 | Delay Time of Low Voltage Warning | 0.0 ~ 600.0 | 0.0 | Sec | O | O | O | |
| 24-16 | Delay Time of Low Voltage Error | 0.0 ~ 600.0 | 0.0 | Sec | O | O | O | |

4.3 Description of Parameters

| |
|-----------------------------------|
| Group 00: Basic Parameters |
|-----------------------------------|

| 00- 00 | Control Mode Selection |
|--------|---|
| Range | 【0】 : V/F 【1】 : Reserved 【2】 : SLV 【3】 : Reserved 【4】 : Reserved 【5】 : PMSLV |

The inverter offers the following control modes:

00-00=0: V/F Mode

Select the required V/F curve (01-00) based on your motor and application.

Perform a stationary auto-tune (17-00=2). If the motor cable length is longer than 50m (165ft), see parameter 17-00 for details.

00-00=2: Sensorless Vector Control

Verify the inverter rating matches the motor rating. Perform rotational auto-tune to measure and store motor parameters for higher performance operation. Perform non-rotational auto-tune if it's not possible to rotate the motor during auto-tune. Refer to parameter group 17 for details on auto-tuning.

00-00=5: PM Sensorless Vector Control

Verify the inverter rating matches the motor rating. Set PM motor data in parameters 22-00 to 22-06. Refer to parameter 22-17 for details on PM Motor tuning. Stall prevention during deceleration will automatically be disabled (08-00=xx1xb) after control mode changes to PMSLV. A braking resistor is recommended to be used to prevent drive from getting regenerative energy. A braking module is required for Inverters ratings 230V 30HP, 460V/40HP or greater.

Note: Parameter 00-00 is excluded from initialization.

| 00- 01 | Motor's Rotation Direction |
|--------|--|
| Range | 【0】 : Forward 【1】 : Reverse |

Use the FWD/REV key to change motor direction when Run Command Selection (00-02 = 0) is set to keypad control. In keypad control operation the direction is stored in 00-01. Direction of this function will be limited to the motor direction lock selection of parameter 11-00.

| 00- 02 | Main Run Command Source Selection |
|--------|---|
| Range | 【0】 : Keypad control 【1】 : External terminal control 【2】 : Communication control 【3】 : PLC 【4】 : RTC |

00-02=0: Keypad Control

Use the keypad to start and stop the inverter and set direction with the forward / reverse key. Refer to section 4-1 for details on the keypad.

00-02=1: External Terminal Control

External terminals are used to start and stop the inverter and select motor direction.

The inverter can be operated in 2-wire and 3-wire mode.

| 00- 03 | Alternative Run Command Source Selection |
|--------|---|
| Range | 【0】 : Keypad control 【1】 : External terminal control 【2】 : Communication control 【3】 : PLC 【4】 : RTC |

00-03=0: Keypad Control

Use the keys (Stop/ Run or FWD/ REV) in the keypad via the setting of 00-03=0 to run the inverter (please refer to section 4.1 for details on the keypad).

00-03=1: External Terminal Control

External terminals are used to start and stop the inverter and select motor direction via the setting of 00-03=1.

Note: Assign the function of one of DI (S1 to S6) to be “Run Command Switch Over” (03-00~03-05=12), then the run command source can be switched over between the setting of main (00-02) and alternative (00-03).

■ **2-wire operation**

For 2-wire operation, set 03-00 (S1 terminal selection) to 0 and 03-01 (S2 terminal selection) to 1.

| Terminal S1 | Terminal S2 | Operation |
|-------------|-------------|--|
| Open | Open | Stop Inverter |
| Closed | Open | Run Forward |
| Open | Closed | Run Reverse (Only at 11-00=0) |
| Closed | Closed | Stop Inverter, Display EF9 Alarm after 500ms |

Parameter 13-08 to 2, 4 or 6 for 2-wire program initialization, multi-function input terminal S1 is set to forward , operation/ stop, and S2 is set for reverse, operation / stop.

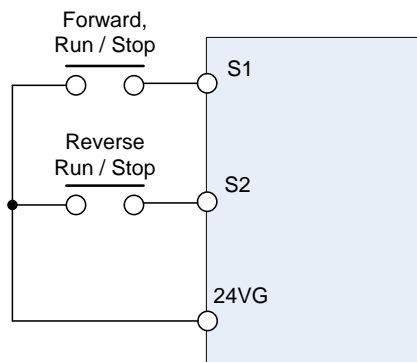


Figure 4.3.1 Wiring example of 2-wire

■ 3-wire operation

For 3-wire operation set any of parameters 03-02 to 03-05 (terminal S3 ~ S6) to 26 to enable 3-wire operation in combination with S1 and S2 terminals set to operation command and stop command.

Parameter 13-08 for 3-wire program initialization, multi-function input terminal S1 is set to run operation, S2 for stop operation and S5 for forward/reverse command. (Additionally must be 00-02=1, 11-00=0)

Note: Terminal S1 must be closed for a minimum of 50ms to activate operation.

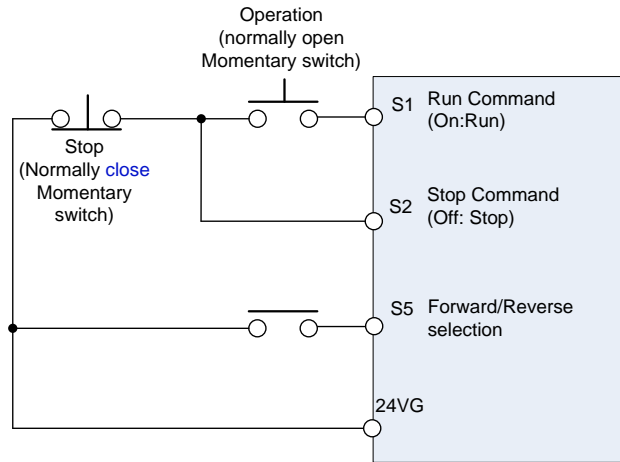


Figure 4.3.2 Wiring example of 3-wire

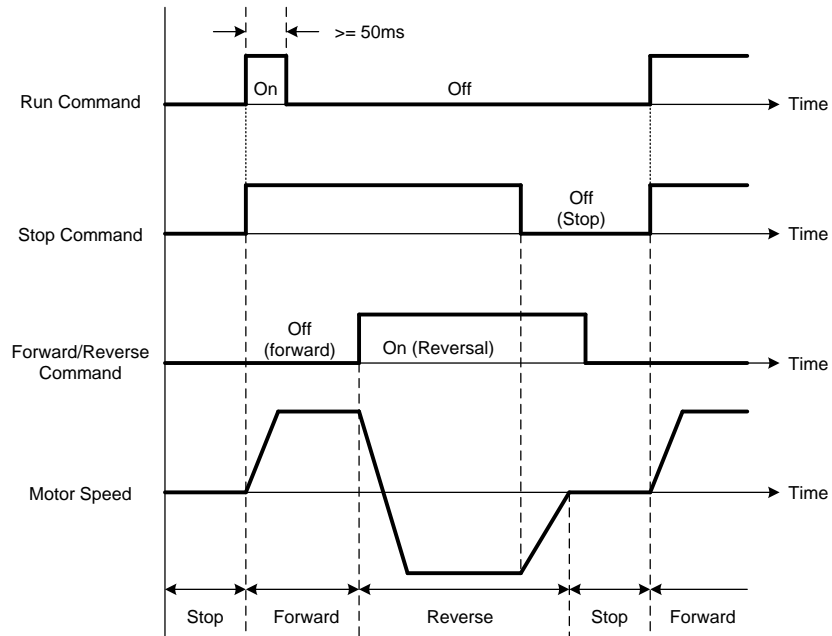
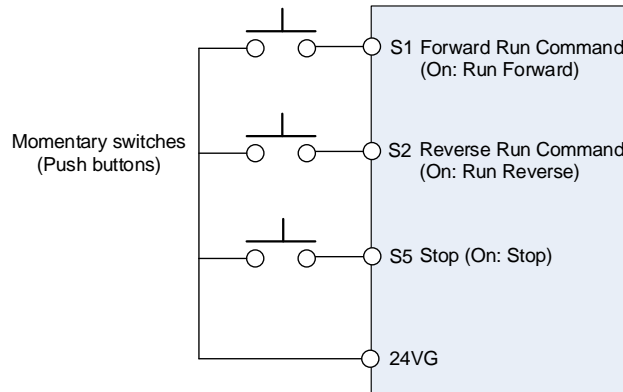


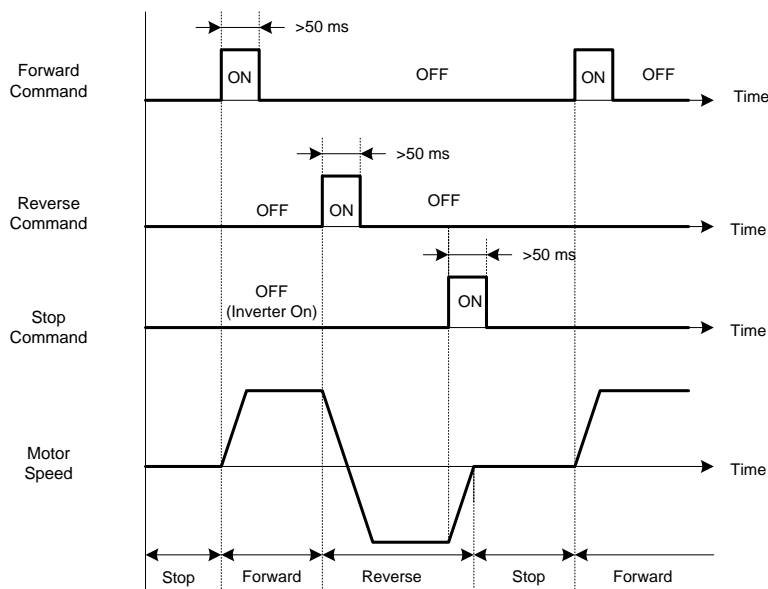
Figure 4.3.3 Timing chart of 3-wire operation

■ 2-wire self holding (latching) operation

Set one of parameters, 03-00 to 03-05 (terminal S1 ~ S6), to 53 in order to enable 2-wire self holding operation. After this mode is enabled, set terminal S1 (03-00=0) to forward and S2 (03-01=1) to reverse run command.



Note: Terminal S1, S2 and S5 must be closed for a minimum of 50ms to activate operation. The inverter will display SE2 error when input terminals S1-S6 is set to 53 and 26 simultaneously.



00-03=2: Communication control

The inverter is controlled by the RS-485 port. Refer to parameter group 9 for communication setup.

00-03=3: PLC control

The inverter is controlled by the inverter built-in PLC logic. Refer to section 4.3.

00-03=4: RTC control

The inverter is controlled by RTC timer when run command is set to RTC. Refer to function group 16.

| | |
|---------------|---|
| 00- 04 | Language Selection (for LCD only) |
| Range | 【0】 : English 【1】 : Simple Chinese 【2】 : Traditional Chinese 【3】 : Turkish |

It is only for LCD keypad to select. This parameter is not allowed to be modified when 13-08 (restore factory setting) is active but it is still initialized in inverter software V1.3).

00-04 = 0: English Display

00-04 = 1: Simple Chinese Display

00-04 = 2: Traditional Chinese Display

00-04 = 3: Turkish Display

| | |
|---------------|--|
| 00- 05 | Main Frequency Command Source Selection |
| 00- 06 | Alternative Frequency Source Selection |
| Range | 【0】 : Keypad 【1】 : External control (analog AI1) 【2】 : Terminal UP / DOWN 【3】 : Communication control 【4】 : Reserved 【5】 : Reserved 【6】 : RTC 【7】 : AI2 Auxiliary frequency |

*1

***1: It is new added in inverter software V1.4.**

00-05/00-06= 0: Keypad

Use the keypad to enter the frequency reference or by setting parameter 05-01 (frequency reference 1). Note that once the frequency command is switched to alternative one, and 00-06=0, the frequency just can be adjusted via parameter 05-01. Refer to section 4.1.4 for details.

00-05/00-06= 1: External control (Analog Input)

When 04-05=0, give frequency reference command from control circuit terminal AI1 (voltage input). If auxiliary frequency is used, refer to the descriptions of multi-speed functions in parameter 03-00~05.

When frequency reference command is control by either AI1 or AI2, please regard the following setting:

- ① 00-05/ 00-06 are set individually to be 1 and 7.
- ② Set AI2 signal type in 04-00 (AI1 is always 0~10V).
- ③ Set 04-05=0 (Auxiliary frequency setting).
- ④ Set multi-function terminal function of 03-00~05 to be 13, then frequency reference command can be switched to AI1 control or AI2 control.

When 04-05=1, give frequency reference command from control circuit terminal AI1 (voltage input) or AI2 (current input, set by 04-00).

Use AI1 terminal when voltage input signal is the main frequency reference command.

Use AI2 terminal when current input signal (4-20mA) is the main frequency reference command.

Use analog reference from analog input AI1 or AI2 to set the frequency reference (as shown in Figure 4.3.4). Refer to parameter 04-00 to select the signal type.

| | Voltage input | Current input | 04-00 Setting (Default = 1) | Dipswitch SW2 (Default 'V') | Remark Default 04-05="10" |
|-----------------------------|---------------|---------------|-----------------------------|-----------------------------|------------------------------|
| AI1 – Analog Input 1 | 0 ~ 10V | ----- | ----- | ----- | ----- |
| AI2 – Analog Input 2 | 0 ~ 10V | ----- | 0: AI2 0~10V | Set to 'V' | Set 04-05="10" (Note) |
| | ----- | 4 ~ 20mA | 1: AI2 4~20mA | Set to "I" | |

Note: Set parameter 04-05 to 10 to add frequency reference AI2 to AI1.

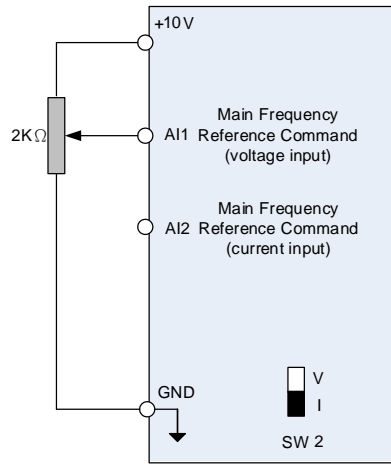


Figure 4.3.4 Analog input as main frequency reference command

00-05/00-06= 2: Terminal UP / DOWN

The inverter accelerates with the UP command closed and decelerates with the DOWN command closed. Please refer to parameter 03-00 ~ 03-05 for additional information.

Note: To use this function both the UP and DOWN command have to be selected to any of the input terminals.

00-05/00-06= 3: Communication Control

The frequency reference command is set via the RS-485 communication port using the MODBUS RTU/ BacNet/ MetaSys protocol.

Refer to parameter group 9 for additional information.

00-05/00-06= 6: RTC

Enables RTC control, reference frequency is controlled by the RTC function, Refer to parameter group 16 for RTC setup.

00-05/00-06=7: AI2 Auxiliary frequency^{*1}

When 04-05 is set to 0 (auxiliary frequency), frequency command is set by multi-function analog input AI2. Maximum output frequency (01-02, Fmax) =100%; if 04-05 is not set to 0, the frequency is 0. Refer to p4-94 for descriptions of multi-speed functions.

| | |
|---------------|--|
| 00- 07 | Main and Alternative Frequency Command Modes |
| Range | 【0】 : Main reference frequency 【1】 : Main frequency + alternative frequency |

When set to 0 the reference frequency is set by the main reference frequency selection of parameter 00-05.
When set to 1 the reference frequency is sum of the main reference frequency (00-05) and alternative frequency (00-06).

Note: The inverter will display the SE1 error when 00-07 = 1 and parameter 00-05 and 00-06 are set to the same selection.

When parameter 00-06 is set to 0 (Keypad) the alternative frequency reference is set by parameter 05-01 (Frequency setting of speed-stage 0).

| | |
|---------------|--|
| 00- 08 | Communication Frequency Command – READ ONLY |
| Range | 【0.00~400.00】 Hz |

Display the frequency reference when 00-05 or 00-06 is set to communication control (3).

| | |
|---------------|---|
| 00- 09 | Communication Frequency Command Memory |
| Range | 【0】 : Do not store the communication frequency command at power down 【1】 : Store communication frequency reference at power down |

Note: This parameter is only active when frequency reference is set through communication.

| | |
|--------------|---|
| 00-10 | Minimum frequency detection |
| Range | 【0】 : Show warning if frequency falls below minimum frequency 【1】 : Run at minimum frequency if output frequency falls below minimum frequency |

00-10=0:

When frequency command is falls below 01-08 (Minimum Output Frequency of Motor 1), display shows STP0 warning.

00-10=1:

When frequency command falls below 01-08 (Minimum Output Frequency of Motor 1), inverter runs as minimum output frequency of motor 1.

| | |
|---------------|--|
| 00- 11 | Selection of PID Lower Limit Frequency |
| Range | 【0】 : PID is bound to lower limit frequency when inverter sleeps. 【1】 : PID is bound to 0Hz when inverter sleeps. |

When inverter gets to sleep,

00-11=0: PID is bound to lower limit frequency (00-13).

00-11=1: PID is bound to 0 Hz.

Note: Refer to descriptions of parameters 10-17~10-20 for details when inverter gets to sleep.

| | |
|--------------|------------------------------|
| 00-12 | Upper Limit Frequency |
| Range | 【0.1~109.0】 % |

Set the maximum frequency reference as a percentage of the maximum output frequency. Maximum output frequency depends on motor selection.

Motor 1: Maximum frequency parameter 01-02.

Motor 2: Maximum frequency parameter 01-16.

| | |
|--------------|------------------------------|
| 00-13 | Lower Limit Frequency |
| Range | 【0.0~109.0】 % |

Set the minimum frequency reference as a percentage of the maximum output frequency. Maximum output frequency depends on motor selection. Motor 1: Maximum frequency is set by parameter 01-02 and Motor 2 Maximum frequency is set by parameter 01-16.

Notes:

- When the frequency lower limit is set to a value greater than 0 and the inverter is started the output frequency will accelerate to the frequency lower limit with a minimum frequency defined by parameter 01-08 for motor 1 and parameter 01-22 for motor 2.
- Frequency upper limit has to greater or equal to the frequency lower limit otherwise the inverter will display a SE01 (Set range error).
- Frequency upper and lower limit is active for all frequency reference modes.

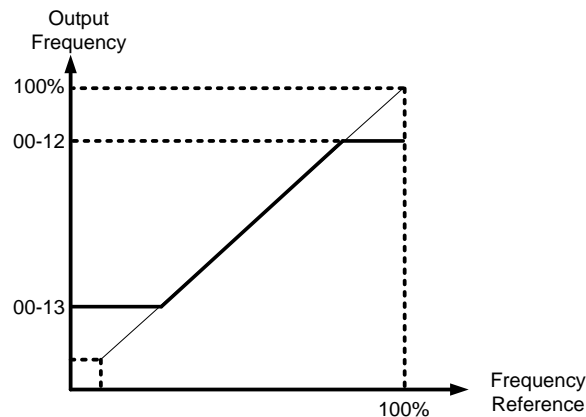


Figure 4.3.5 Frequency reference upper and lower limits

Note: The maximum output frequency is based on parameter 01-02 (Maximum Output Frequency) and 00-12 (Upper Frequency limit). The upper frequency maximum is limited to 400Hz for 100% frequency reference.

| | |
|--------------|----------------------------|
| 00-14 | Acceleration Time 1 |
| Range | 【0.1~6000.0】 Sec |
| 00-15 | Deceleration Time 1 |
| Range | 【0.1~6000.0】 Sec |
| 00-16 | Acceleration Time 2 |
| Range | 【0.1~6000.0】 Sec |
| 00-17 | Deceleration Time 2 |

| | |
|-------|--|
| Range | 【0.1~6000.0】 Sec |
| 00-21 | Acceleration Time 3 |
| Range | 【0.1~6000.0】 Sec |
| 00-22 | Deceleration Time 3 |
| Range | 【0.1~6000.0】 Sec |
| 00-23 | Acceleration Time 4 |
| Range | 【0.1~6000.0】 Sec |
| 00-24 | Deceleration Time 4 |
| Range | 【0.1~6000.0】 Sec |
| 00-25 | Switching Frequency of Acceleration and Deceleration |
| Range | 【0.00~400.00】 Hz |

Acceleration time is the time required to accelerate from 0 to 100% of maximum output frequency.

Deceleration time is the time required to decelerate from 100 to 0% of maximum output frequency.

Motor 1: Maximum frequency is set by parameter 01-02 and Motor 2 Maximum frequency is set by parameter 01-16.

Note: Actual acceleration and deceleration times can be affected by the inverter driven load.

The default values for the acceleration, deceleration times are dependent on the inverter size.

| Size | | Acceleration / Deceleration Default Value |
|------------|------------|--|
| 200V Class | 400V Class | |
| 1~15HP | 1~20HP | 10s |
| 20~30HP | 25~40HP | 15s |
| 40~175HP | 50~800HP | 20s |

A: Select acceleration and deceleration time via the digital input terminals

The following table shows the acceleration / deceleration selected when the digital input function Accel/Decel time 1 (#10) and Accel/Decel time 2 1(#30) are used.

Table 4.3.1 Acceleration / deceleration time selection

| Accel/dec time 2 (Set 03-00 ~ 03-05 = 30) | Accel/dec time 1 (Set 03-00 to 03-05 = 10) | Acceleration time | Deceleration time |
|--|---|----------------------|----------------------|
| 0 | 0 | Tacc1 (00-14) | Tdec1 (00-15) |
| 0 | 1 | Tacc2 (00-16) | Tdec2 (00-17) |
| 1 | 0 | Tacc3 (00-21) | Tdec3 (00-22) |
| 1 | 1 | Tacc4 (00-23) | Tdec4 (00-24) |

0: OFF, 1: ON

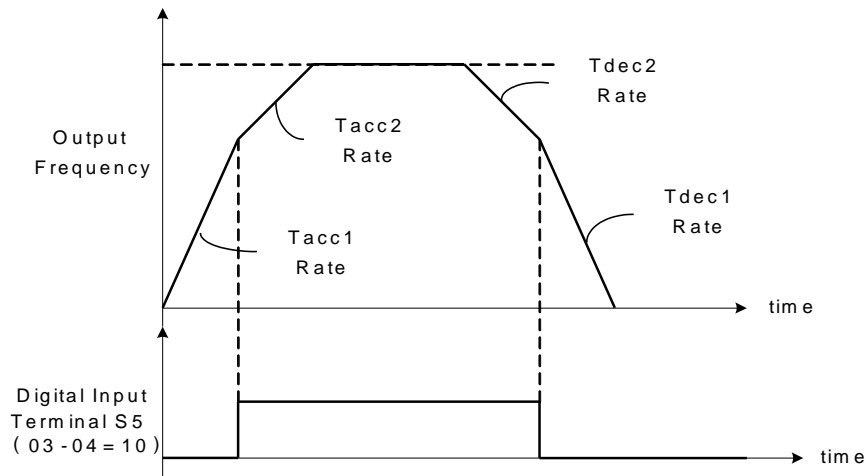


Figure 4.3.6: Terminal S5 switch between Tacc1/Tacc2 and Tdec1/Tdec2

B. Automatically acceleration / deceleration time switch-over based on output frequency

Set acceleration / deceleration switch over frequency parameter 00-25 to a value greater than 0 to automatically switch between Tacc1 (00-14) / Tdec1 (00-23) and Tacc4 (00-24) / Tdec4 (00-15).

Tacc1 (00-14) / Tdec1 (00-23) are active when the output frequency < 00-25 and Tacc4 (00-24) / Tdec4 (00-15) are active when the output frequency >= 00-25. Refer to the Figure 4.3.7 for details.

Note: Multi-function input function #10 (Accel/Decel time 1) and #30 (Accel/Decel time 2) have a higher priority than switch over frequency parameter 00-25.

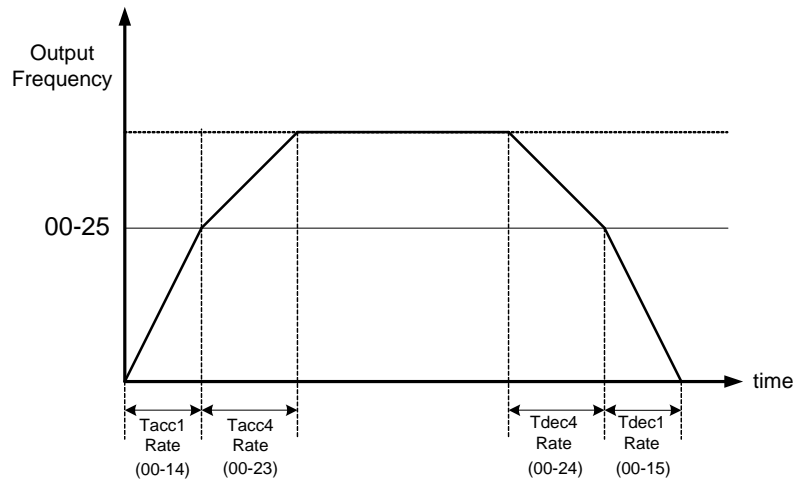


Figure 4.3.7 Automatic acceleration / deceleration time switch-over based on output frequency

| | |
|--------------|------------------------------|
| 00-18 | Jog Frequency |
| Range | 【0.00~400.00】 Hz |
| 00-19 | Jog Acceleration Time |
| Range | 【0.1~0600.0】 Sec |
| 00-20 | Jog Deceleration Time |
| Range | 【0.1~0600.0】 Sec |

Jog acceleration time (00-19) is the time required to accelerate from 0 to 100% of maximum output frequency. Jog deceleration time (00-20) is the time required to decelerate from 100 to 0% of maximum output frequency. Motor 1: Maximum frequency is set by parameter 01-02 and Motor 2 Maximum frequency is set by parameter 01-16.

When run command selection is set to external terminal control (00-02=1) and the inverter uses the jog frequency (00-18, default 6.0 Hz) as its frequency reference with 03-00~03-07=6 or 7(6: Forward jog run command 7: Reverse jog run command).The motor will run by the setting.

| | |
|---------------|----------------------------|
| 00- 26 | Emergency Stop Time |
| Range | 【0.0~6000.0】 Sec |

The emergency stop time is used in combination with multi-function digital input function #14 (Emergency stop). When emergency stop input is activated the inverter will decelerate to a stop using the Emergency stop time (00-26) and display the [EM STOP] condition on the keypad.

Note: To cancel the emergency stop condition the run command has to be removed and emergency stop input deactivated.

Multi-function digital input terminals (03-00 ~ 03-05) are set to 14: When the emergency stop input is activated the inverter will decelerate to a stop using the time set in parameter 00-26.

Note: After an emergency stop command the run command and emergency stop command have to be removed before the inverter can be restarted. Please refer to Figure 4.3.8. The emergency stop function can be used to stop inverter in case of an external event.

Multi-function digital input terminals (03-00 ~ 03-05) set to 15: When the base block input is activated the inverter output will turn off and the motor will coast to a stop.

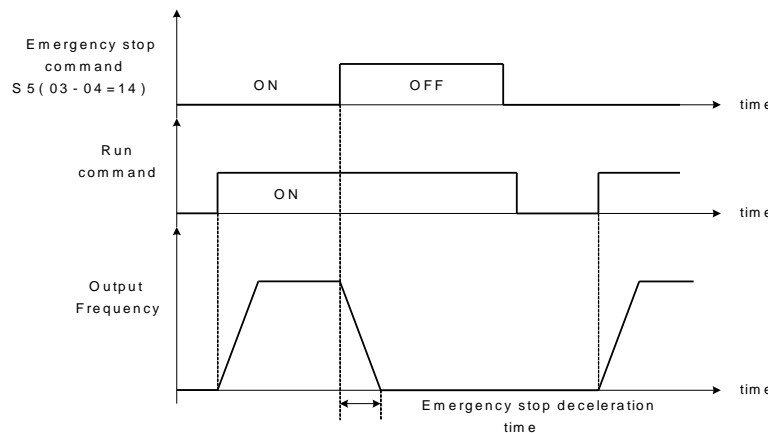


Figure 4.3.8 Emergency stop example

| | |
|---------------|--|
| 00- 28 | Selection of Main Frequency Command Characteristic |
| Range | 【0】 : Positive characteristic (0~10V/4~20mA = 0~100%) 【1】 : Negative / inverse characteristic (0~10V/4~20mA = 100~0%) |

00-28= 0: Positive reference curve, 0 – 10V / 4 – 20mA = 0 – 100% main frequency reference.

00-28= 1: Negative reference curve, 0 – 10V / 4 – 20mA = 100 – 0% main frequency reference.

Note: Selection applies to analog input AI1 and AI2.

Note: AI2 will be useful for analog input frequency command when 04-05=0.

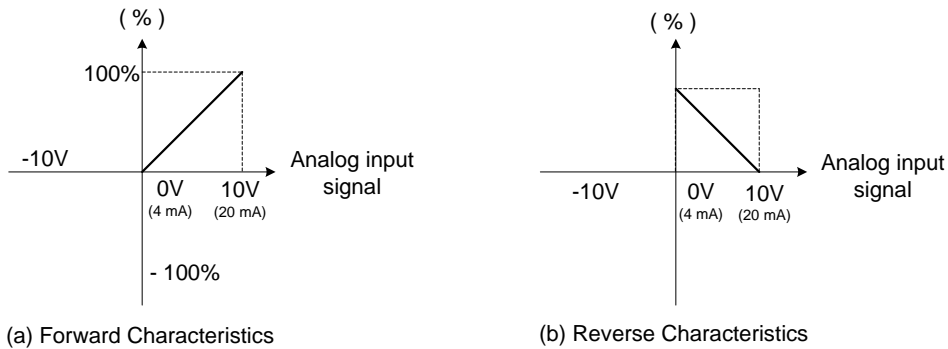


Figure 4.3.9 Positive/negative analog input as main frequency reference command.

| 00- 32 | Application |
|--------|---|
| Range | 【0】 : General |
| | 【1】 : Water supply pump |
| | 【2】 : Conveyor *1 |
| | 【3】 : Exhaust fan |
| | 【4】 : HVAC |
| | 【5】 : Compressor *1 |
| | 【6】 : Reserved |
| | 【7】 : Reserved |

***1: It is new added in inverter software V1.4.**

Note: Before setting up 00-32 Application, initialize the inverter (parameter 13-08) first. I/O configuration changes automatically when the application setting in 00-32 is changed, the I/O port function. Check all I/O settings before running the inverter.

(1) Water supply pump

| Parameter | Name | Value |
|-----------|---|---|
| 00-00 | Control mode selection | 0 : V/F |
| 00-14 | Acceleration Time 1 | 2.0 sec |
| 00-15 | Deceleration Time 1 | 15.0 sec |
| 11-00 | Direction lock selection | 1 : Forward direction only |
| 01-00 | V/F curve selection | F |
| 07-00 | Momentary power loss/ fault restart selection | 1 : Enable |
| 07-32 | Speed Search Mode Selection | 0 : Disable |
| 08-00 | Stall prevention function | xx0xb : Stall prevention is enabled in deceleration |
| 23-00 | Function Selection | 1: Pump |
| 23-06 | Proportion Gain (P) | 2.00 |
| 23-07 | Integral Time (I) | 3.00 sec |
| 23-26 | Acceleration Time of Water Pressure Detection | 3.0 sec |
| 23-27 | Deceleration Time of Water Pressure Detection | 3.0 sec |
| 10-03 | PID Control Mode | xxx1b: PID Enable |

(2) Conveyor

| Parameter | Name | Value |
|-----------|-----------------------------|--|
| 00-00 | Control mode selection | 0: V/F |
| 00-14 | Acceleration time 1 | 3.0 sec |
| 00-15 | Deceleration time 1 | 3.0 sec |
| 07-32 | Speed Search Mode Selection | 0 : Disable |
| 08-00 | Stall prevention function | xx0xb: Stall prevention is enabled in deceleration |

(3) Exhaust fan

| Parameter | Name | Value |
|-----------|---|---|
| 00-00 | Control mode selection | 0 : V/F |
| 11-00 | Direction lock selection | 1 : Forward direction only |
| 01-00 | V/F curve selection | F |
| 07-00 | Momentary power loss/ fault restart selection | 1 : Enable |
| 07-32 | Speed Search Mode Selection | 1 : Enable |
| 08-00 | Stall prevention function | xx0xb : Stall prevention is enabled in deceleration |

(4) HVAC

| Parameter | Name | Value |
|-----------|---|----------------------------|
| 00-00 | Control mode selection | 0 : V/F |
| 11-00 | Direction lock selection | 1 : Forward direction only |
| 11-01 | Carrier frequency | 8.0kHz |
| 07-00 | Momentary power loss/ fault restart selection | 1 : Enable |
| 07-32 | Speed Search Mode Selection | 0 : Disable |
| 10-03 | PID Control Mode | xxx1b: PID Enable |
| 11-03 | Automatic carrier frequency reduction | 1 : Enable |
| 01-00 | V/F curve selection | F |
| 23-00 | Function Selection | 2: HVAC |

(5) Compressor

| Parameter | Name | Value |
|-----------|---|--|
| 00-00 | Control mode selection | 0: V/F |
| 00-02 | Main Run Command Source Selection | 1: External Terminal (Control Circuit) |
| 00-05 | Main Frequency Command Source Selection | 1: External Terminal (Analog AI1) |
| 11-00 | Direction lock selection | 1: Forward direction only |
| 00-14 | Acceleration time 1 | 5.0 sec |
| 00-15 | Deceleration time 1 | 5.0 sec |
| 01-06 | Middle Output Frequency 1 | Half of the maximum frequency |
| 01-07 | Middle Output Voltage 1 | Half of the maximum voltage |
| 07-00 | Momentary power loss/ fault restart selection | 1: Enable |
| 07-32 | Speed Search Mode Selection | 0: Disable |
| 08-00 | Stall prevention function | xx0xb: Stall prevention is enabled in deceleration |
| 23-00 | Function Selection | 3: Compressor |

Note: 01-00 (V/F pattern) will hidden automatically.

(6) Reserved**(7) Reserved**

| | |
|---------------|---|
| 00- 33 | Modified Parameters |
| Range | 【0】 : Disable 【1】 : Enable |

Note: only for LCD.

This parameter automatically lists all the adjusted parameters. When the default value is adjusted and 00-33=1, it will list all the parameters different from default values in the advanced modes and these parameters can be edited directly. The adjusted parameters list displays only when 00-33 is set from 0 to 1 or 00-33=1 at start up.

If user wants to restore to the original editing interface, it is only required to set parameter 00-33=0.

This function can display 250 adjusted parameters. If they are more than 250 parameters, it will list the adjusted parameters before 250.

Example: set 00-03 (Alternative Run Command Source Selection) to be different default value.

| Steps | LCD Display | Descriptions |
|-------|--|--|
| 1 | Group 00 Basic Func. 01 V/F Pattern 02 Motor Parameter | The starting parameter group (00) in the setting modes of ▲ (Up)/ ▼ (Down) selection groups. |
| 2 | PARA 00 -01. Motor Direction -02. RUN Source -03. Sub RUN Source | Press READ/ ENTER key and ▲ (Up)/ ▼ (Down) to select alternative run command source (00-03). |
| 3 | Edit 00-00 Sub RUN Source 1 Terminal (0 ~4) <2> | Press READ/ ENTER key and adjust the value. The selected setting value will flash. |
| 4 | PARA 00 -33. Modify parameter -41. User P1 -42. User P2 | Press DSP/ FUN to the menu of modified parameters (00-33). |
| 5 | Edit 00-33 Modify parameter 1 Enable (0 ~1) <0> | Press READ/ ENTER key to adjust the value to 1 (The modified parameter is enabled.) The selected setting value will flash. |
| 6 | Modify 00 00-03. Sub RUN Source 00-33. Modify parameter | Press DSP/ FUN back to the advanced modes. |

■ **User Parameter Setting (00-41 ~ 00-56) (only for LCD)**

| | |
|---------------|---|
| 00- 41 | User Parameter 0 Function Setting |
| 00- 42 | User Parameter 1 Function Setting |
| 00- 43 | User Parameter 2 Function Setting |
| 00- 44 | User Parameter 3 Function Setting |
| 00- 45 | User Parameter 4 Function Setting |
| 00- 46 | User Parameter 5 Function Setting |
| 00- 47 | User Parameter 6 Function Setting |
| 00- 48 | User Parameter 7 Function Setting |
| 00- 48 | User Parameter 8 Function Setting |
| 00- 50 | User Parameter 9 Function Setting |
| 00- 51 | User Parameter 10 Function Setting |
| 00- 52 | User Parameter 11 Function Setting |
| 00- 53 | User Parameter 12 Function Setting |
| 00- 54 | User Parameter 13 Function Setting |
| 00- 55 | User Parameter 14 Function Setting |
| 00- 56 | User Parameter 15 Function Setting |

- User parameter (00-41 ~ 00-56) can select 16 sets of parameters (01-00 group ~ 24-06 group) and put them into the list to do the fast access setting.
- When the access setting of parameter 13-06 is set to 1, user parameter 00-41 ~ 00-56 can be displayed and changed.
- User parameter 00-41 ~ 00-56 can be changed in the advanced modes, exclusive of being in operation.
- Set value in the parameter of 00-41 ~ 00-56 and set 13-06 to 1.
- When 13-06=1, only parameter of 00-00 ~ 00-56 can be set or read in the advanced modes. 13-06=1 is enabled in the parameter setting of 00-41~00-56.
- When user would like to leave the screen of user parameters, press RESET key and then DSP/FUN key to select parameter Group 13.
-

Example 1: Set 03-00 (Multi-function terminal Function Setting-S1) to user parameter 0 (00-41)

| Steps | LCD Display | Descriptions |
|-------|---|--|
| 1 | Group 00 Basic Func. 01 V/F Pattern 02 Motor Parameter | Select the start parameter group (00) in the advanced modes. |
| 2 | PARA 00 -41. User P0 -42. User P1 -43. User P2 | Press (READ/ ENTER) key and ▲ (Up) / ▼ (Down) to select user parameter 0 (00-41). |
| 3 | Edit 00-41 User P0=00-41 00-41 User P0 <00-01 - 24-07> | Press (READ/ ENTER) key to the screen of data setting/ read. * The selected setting value will flash. |
| 4 | Edit 00-41 User P0=00-41 03-00 S1 Function Sel <00-01 - 24-07> | Press ◀ (Left) / ▶ (Right) and ▲ (Up) / ▼ (Down) key to set the value to 03-00 (Multi-function terminal Function Setting-S1) |
| 5 | Edit 00-41 User P0= 03-00 03-00 S1 Function Sel <00-01 - 24-07> | Press (READ/ ENTER) key to save 03-00 and the digit stops flashing and the screen displays User P0 = 03-00 ; 03-00 (Multi-function terminal Function Setting-S1) has been defined as 00-41. Few seconds later, the selected digit will flash again. |
| 6 | Monitor Freq Ref 12-16=000.00Hz ----- 12-17=000.00Hz 12-18=0000.0A | Press (DSP/ FUN) key to the display of main screen. * If users do not press BACK key in one minute, the screen will automatically display the monitor mode shown as the left figure. The automatically return time can be set via 16-06. |

Example 2: After one or more parameters in 00-41 ~ 00-56 are set, user parameters settings are as follows.

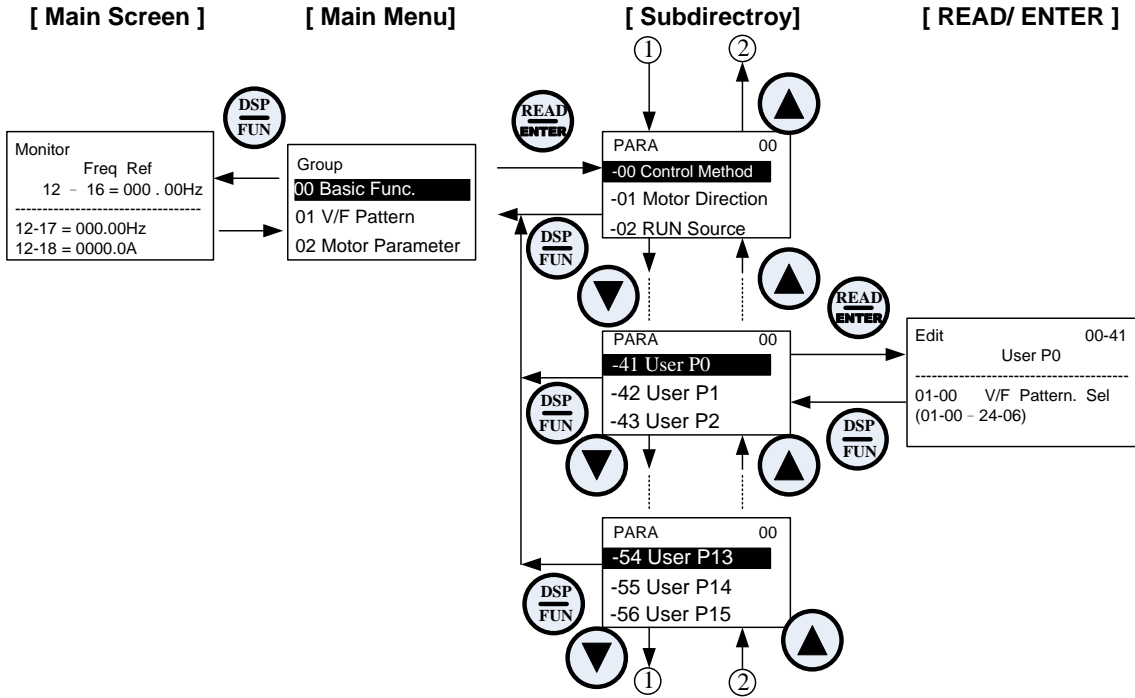
| Step | LCD Display | Descriptions |
|------|--|---|
| 1 | Group 13 Driver Status 14 PLC Setting 15 PLC Monitor | Select the start parameter group (03) in the advanced modes. |
| 2 | PARA 13 -06. Access Level -07. Password 1 -08. Initialize | Press (READ/ ENTER) and ▲ (Up) / ▼ (Down) key to enter the access level of parameter (13-06). |
| 3 | Edit 13-06 Access Level ----- 1 User Level (0~2) < 2 > | Press (READ/ ENTER) key to enter the screen of the data setting/read. * The selected setting value will flash. |
| 4 | —ADV— G01-02 Access Level 1 User Level (0-2) < 2 > | Press ▲ (Up) / ▼ (Down) key to change setting value to 1 (13-06=1, user level) and Press (READ/ ENTER) key to save the setting value (03-00). Then, the digit stops flashing and the screen displays the setting value. Few seconds later, the selected digit will flash again. User level (13-06=1) can be set by one or more parameters in the user parameters of 00-41 ~ 00-56. If users do not set user parameters, 13-06 will not be set in the user level (setting value=1). |
| 5 | PARA 13 -06. Access Level | Press (DSP/FUN) key to the display of subdirectory. |
| 6 | Group 00.User Function | Press (DSP/FUN) key to the display of group directory. It is required to press ▲ (Up) key to select Group 00 User Function. |
| 7 | Monitor Freq Ref 12-16=000.00Hz ----- 12-17=000.00Hz ----- 12-18=0000.0A | Press (DSP/ FUN) key to enter the main screen. If user would like to leave the screen of user parameters, press RESET key and then DSP/FUN key to select parameter Group 13. Hotkeys are only enabled in inverter software V1.4. |
| 8 | Group 00. User Function00 User 13.Driver Status | 13-06 can be selected to be adjusted so leave parameters or enter parameter group 00 to edit user parameters is allowable. |

| | | |
|----|---|--|
| 9 | PARA -41. S1 Function Sel 00 | Press (READ/ ENTER) key and ▲ (Up) / ▼ (Down) key to select user parameter 0 (00-41) display. |
| 10 | Edit 00-41 S1 Function Sel 00 2-Wire (FWD-RUN) (00~57) < 00 > < 03-00 > | Press (READ/ ENTER) key to enter the screen of data setting/read. *The selected setting value will flash. In this example, 03-00 (Multi-function terminal Function Setting-S1) has been defined as user parameters (00-41). The right bottom location displays the original parameter group. |

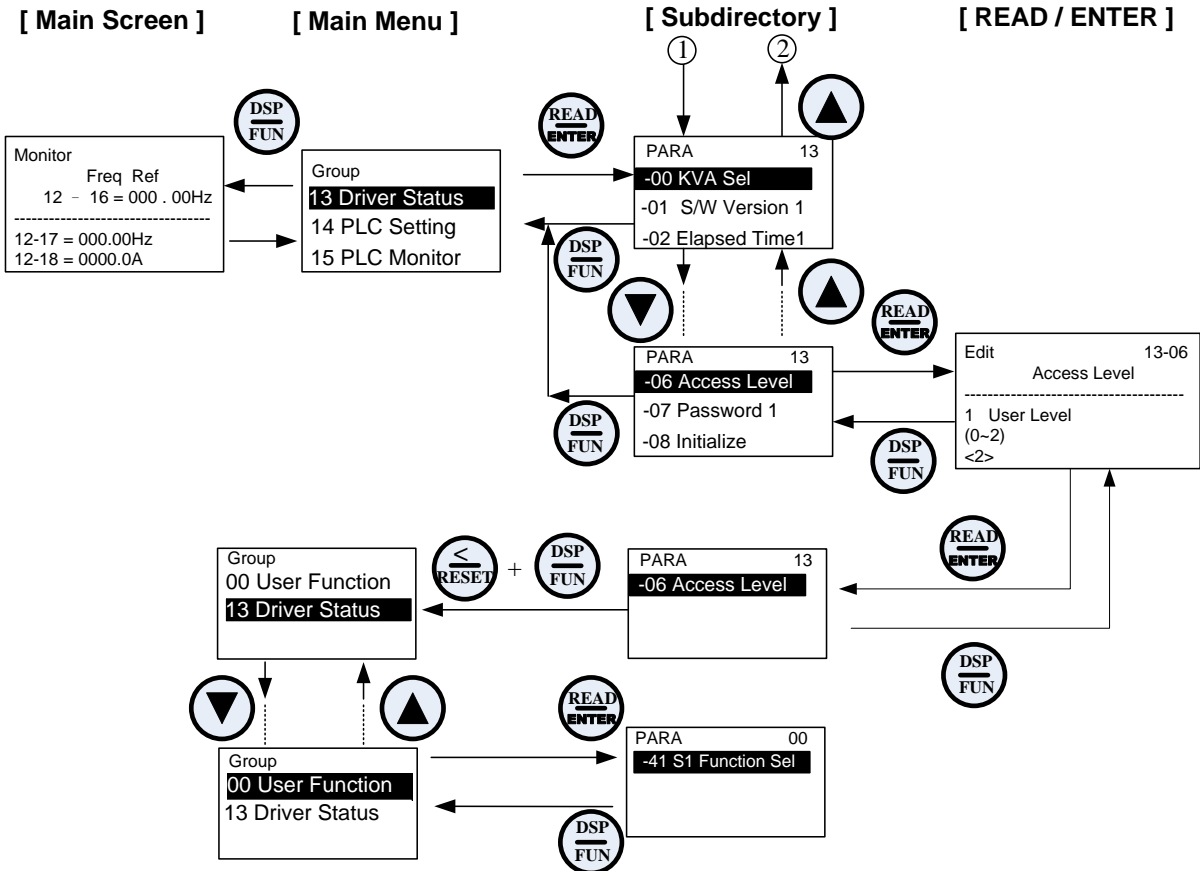
| Step | LCD Display | Descriptions |
|------|---|--|
| 11 | Edit 00-41 S1 Function Sel 06 FJOG (00~57) < 00 > < 03-00 > | Press ▲ (Up) / ▼ (Down) key to change the setting value to 2. Use (READ/ ENTER) key to save the setting value. When the selected setting value does not flash again, the setting value will be saved to 00-41 and 03-00 simultaneously. |
| 12 | Monitor Freq Ref 12-16=000.00Hz ----- 12-17=000.00Hz 12-18=0000.0A | Press (DSP/FUN) key to the display of main screen. * If users do not press (DSP/ FUN) key in one minute, the screen will automatically display the monitor mode shown as the left figure. The automatically return time can be set via 16-06. |

User Parameter Run Mode Structures

A. Define Parameter Group 0~24 as user parameters except parameter 00-00 and 00-41~00-56.



Note: User level (13-06=1) can be set by one or more parameters in the user parameters of 00-41 ~ 00-56.



| |
|--|
| Group 01-V/F Control Parameters |
|--|

| | |
|---------------|----------------------------|
| 01- 00 | V/F Curve Selection |
| Range | 【0~FF】 |

* When restore factory setting (13-08), this parameter will not be changed.

The V/F curve selection is enabled for V/F mode. Make sure to set the inverter input voltage parameter 01-14.

There are three ways to set V/F curve:

- (1) 01-00 = 0 to E: choose any of the 15 predefined curves (0 to E).
- (2) 01-00 = 0F, use 01-02~01-09 and 01-12 ~ 01-13, with voltage limit.
- (3) 01-00 = FF: use 01-02~01-09 and 01-12 ~ 01-13, without voltage limit.

The default parameters (01-02 ~ 01-09 and 01-12 ~ 01-13) are the same when 01-00 is set to F (default) and 01-00 is set to 1.

Parameters 01-02 ~ 01-13 are automatically set when any of the predefined V/F curves are selected.

This parameter will be affected to reset by the initialization parameter (13-08).

Consider the following items as the conditions for selecting a V/F pattern.

- (1) The voltage and frequency characteristic of motor.
- (2) The maximum speed of motor.

Table 4.3.2 1 - 30HP V/F curve selection

| Type | Specification | 01-00 | V/F curve ^{*1} | Type | Specification | 01-00 | V/F ^{*1} | |
|--------------------------------|------------------------|----------------------------|----------------------------|-----------------------------------|---------------|----------------------|-------------------|---|
| General purpose | 50Hz | 0 | | High Starting Torque [‡] | 50Hz | 8 | | |
| | | F | | | | 9 | | |
| | 60Hz | 1 F (Def. Value) | | | 60Hz | Low Starting Torque | A | |
| | | 2 50Hz Saturation | | | | High Starting Torque | B | |
| Variable Torque Characteristic | 72Hz | 3 | | Constant-power torque(Reducer) | 90Hz | C | | |
| | | 50Hz | 4 (Def. Value for 50Hz) | | | | 120Hz | D |
| | 5 Variable Torque 2 | | | | 180Hz | E | | |
| | 60Hz | 6 (Def. Value for 60Hz) | | | | 60Hz | Variable Torque 3 | 7 |
| | | 7 Variable Torque 4 | | | | | | |

| Type | Specification | 01-00 | V/F curve ^{*1} |
|-----------------------------------|---------------|-------|-------------------------|
| Rated Horsepower Torque (Reducer) | 180Hz | F | |

*1. Values shown are for 200V class inverters; double values for 400V class inverters.

‡ Select high starting torque only for the following conditions.

- (1) The power cable length is > 50m (492ft).
- (2) Voltage drop at startup is high.
- (3) An AC reactor is used on the input side or output side of the inverter.
- (4) Motor power is lower than the inverter rated power.

Table 4.3.3 40HP and above V/F curve selection

| Type | Specification | 01-00 | V/F curve ^{*1} | Type | Specification | 01-00 | V/F curve ^{*1} | |
|--------------------------------|-------------------|-------------------------|-------------------------|-----------------------------------|----------------------|----------------------|-------------------------|--|
| General purpose | 50Hz | 0 | | High Starting Torque [‡] | Low Starting Torque | 8 | | |
| | | F | | | High Starting Torque | 9 | | |
| | 60Hz | 60Hz Saturation | 1 F (Def. Value) | | | Low Starting Torque | A | |
| | | 50Hz Saturation | 2 | | | High Starting Torque | B | |
| Variable Torque Characteristic | 72Hz | 3 | | Constant-power torque(Reducer) | 90Hz | C | | |
| | | 50Hz | 4 (Def. Value for 50Hz) | | | | | |
| | Variable Torque 2 | | 5 | | | | | |
| | 60Hz | 6 (Def. Value for 60Hz) | | | 180Hz | E | | |
| | | Variable Torque 4 | 7 | | | | | |

*1. Values shown are for 200V class inverters; double values for 400V class inverters.

‡ Select high starting torque only for the following conditions.

- (1) The power cable length is > 50m (492ft).
- (2) Voltage drop at startup is high.
- (3) An AC reactor is used on the input side or output side of the inverter.
- (4) Motor power lower than the inverter rated power.

| | |
|--------|--|
| 01- 02 | Maximum Output Frequency |
| Range | 【4.8~400.0】 Hz ^{*1} |
| 01- 03 | Maximum Output Voltage |
| Range | 200V: 【0.1~255.0】 V 400V: 【0.2~510.0】 V |
| 01- 04 | Middle output frequency 2 |
| Range | 【0.0~400.0】 Hz |
| 01- 05 | Middle Output Voltage 2 |
| Range | 200V: 【0.0~255.0】 V 400V: 【0.0~510.0】 V |
| 01- 06 | Middle Output Frequency 1 |
| Range | 【0.0~400.0】 Hz |
| 01- 07 | Middle Output Voltage 1 |
| Range | 200V: 【0.0~255.0】 V 400V: 【0.0~510.0】 V |
| 01- 08 | Minimum Output Frequency |
| Range | 【0.0~400.0】 Hz |
| 01- 09 | Minimum Output Voltage |
| Range | 200V: 【0.0~255.0】 V 400V: 【0.0~510.0】 V |
| 01- 12 | Base Frequency |
| Range | 【4.8~400.0】 Hz |
| 01- 13 | Base Output Voltage |
| Range | 200V: 【0.0~255.0】 V 400V: 【0.0~510.0】 V |

*1: The setting range of 01-02 in inverter software V1.3 is 【40.0~400.0】

V/F curve setting (01-02 ~ 01-09 and 01-12 ~ 01-13)

Select any of the predefined V/F curves setting '0' to 'E' that best matches your application and the load characteristic of your motor, choose a custom curve setting 'F' or 'FF' to set a custom curve.

Important:

Improper V/F curve selection can result in low motor torque or increased current due to excitation.

For low torque or high speed applications, the motor may overheat. Make sure to provide adequate cooling when operating the motor under these conditions for a longer period of time.

If the automatic torque boost function is enabled (parameter 01-10), the applied motor voltage will automatically change to provide adequate motor torque during start or operating at low frequency.

Custom V/F Curve Setting:

A custom curve selection allows users to set parameters 01-02 ~ 01-13 whereas a predefined curve selection does not.

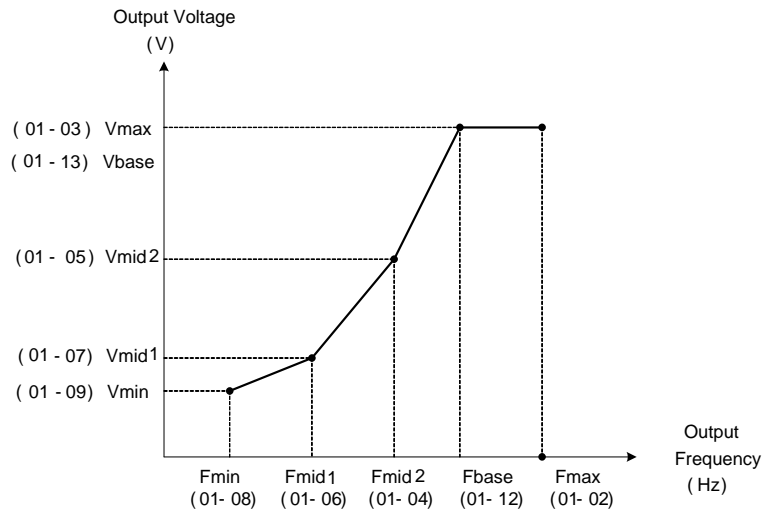


Figure 4.3.10 Custom V/F curve

When setting the frequency related parameters for a custom V/F curve values make sure that:

$$F_{\max} > F_{\text{base}} > F_{\text{mid2}} > F_{\text{mid1}} > F_{\min}$$

(01-02) (01-12) (01-04) (01-06) (01-08)

The 'SE03' V/F curve tuning error is displayed when the frequency values are set incorrectly.

When 01-04 and 01-05 (or 01-18 and 01-09) are set to 0, the inverter ignores the set values of Fmid2 and Vmid2.

When the control mode is changed parameter 00-00, 01-08 (F_{\min}) and 01-09 (V_{\min}) will automatically be changed to the default setting of the selected control mode.

SLV (Sensorless vector control)

Enter the motor data in parameter group 17 for SV and SLV control mode (00-00) and perform auto-tuning.

In the SLV mode the V/F curve normally does not have to be re-adjusted after a successful auto-tune.

The maximum output frequency setting 01-02 (F_{\max}), base frequency 01-12 (F_{base}) or minimum output frequency 01-08 (F_{\min}) can be adjusted but the voltage is automatically adjusted by the internal current controller.

Set the base frequency (01-12, F_{base}) to the motor rated frequency on the motor nameplate.

Perform the auto-tuning procedure after adjusting parameters 02-19 or 17-04 to reduce the voltage at no-load operation.

Motor jitter can be reduced by lowering the no-load voltage. Please note that lowering the no-load voltage increases the current at no-load.

| | |
|--------------|---------------------------------|
| 01-10 | Torque Compensation Gain |
| Range | 【0.0~2.0】 |

In V/F mode the inverter automatically adjusts the output voltage to adjust the output torque during start or during load changes based on the calculated loss of motor voltage.

The rate of adjustment can be changed with the torque compensation gain parameter.

Refer to the torque compensation gain adjustment shown in Figure 4.3.11.

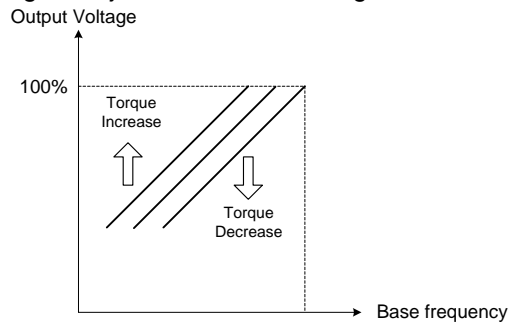


Figure 4.3.11 Torque compensation gain to increase/decrease output torque

Increase value when:

- The wiring between the inverter and the motor is too long
- The motor size is smaller than the inverter size

Note: Gradually increase the torque compensation value and make sure the output current does not exceed inverter rated current.

Reduce value when:

- When experiencing motor vibration

Important:

Confirm that the output current at low speed does not exceed the rated output current of the inverter.

| | |
|--------------|--|
| 01-11 | Selection of Torque Compensation Mode |
| Range | 0: Torque Compensation Mode 0 1: Torque Compensation Mode 1 |

01-11=0: General torque compensation mode.

01-11=1: High-speed torque compensation mode (120~160Hz).

Compensation amount decreases as the frequency increases. Compensation in 0~120Hz is the same as that in torque compensation mode 0.

| | |
|--------------|--|
| 01-14 | Input Voltage Setting |
| Range | 200V: 【155.0~255.0】 V 400V: 【310.0~510.0】 V |

The minimum input voltage of inverter is 0.1V.

Set the inverter input voltage (E.g. 200V / 208V / 230V / 240V or 380V / 415V / 440V / 460V / 480V).

This parameter is used as a reference for predefined V/F curve calculation (01-00 = 0 to E), over-voltage protection level, stall prevention, etc...

Note: It will depend on restore factory setting (13-08) to set the value of voltage

| | |
|--------------|---------------------------------|
| 01-15 | Torque Compensation Time |
| Range | 【0~10000】 ms |

Set the torque compensation delay time in milliseconds.

Only adjust in the following situations:

Increase value when:

- When experiencing motor vibration

Decrease value when:

- When motor torque response is too slow

| | |
|------------------------------------|--|
| Group 02-IM Motor Parameter | |
|------------------------------------|--|

| | |
|---------------|--|
| 02- 00 | No-load Current |
| Range | 【0.01~600.00】 A |
| 02- 01 | Rated Current |
| Range | V/F mode is 10%~200% of inverter's rated current. SLV mode is 25%~200% of inverter's rated current. |
| 02-03 | Rated Rotation Speed |
| Range | 【0~60000】 rpm |
| 02- 04 | Rated Voltage |
| Range | 200V: 【50.0~240.0】 V 400V: 【100.0~480.0】 V |
| 02- 05 | Rated Power |
| Range | 【0.01~600.00】 KW |
| 02-06 | Rated Frequency |
| Range | 【4.8~400.0】 Hz |
| 02-07 | Poles |
| Range | 【2~16】 (Even)^{*1} |
| 02-09 | Excitation Current <1> |
| Range | 【15.0~70.0】 % |
| 02-10 | Core Saturation Coefficient 1 <1> |
| Range | 【0~100】 % |
| 02-11 | Core Saturation Coefficient 2 <1> |
| Range | 【0~100】 % |
| 02-12 | Core Saturation Coefficient 3 <1> |
| Range | 【80~300】 % |
| 02-13 | Core Loss |
| Range | 【0.0~15.0】 % |
| 02-15 | Resistance between Wires |
| Range | 【0.001~60.000】 Ω |
| 02-19 | No-Load Voltage |
| Range | 200V: 【50~240】 V 400V: 【100~480】 V |
| 02-33 | Leakage Inductance Ratio <1> |
| Range | 【0.1~15.0】 % |
| 02-34 | Slip Frequency <1> |
| Range | 【0.1~20.0】 Hz |

*1: The setting range of 02-07 in inverter software V1.3 is **【2~8】 (Even)**.

In most case no adjustment is required after performing an auto-tune except when using the inverter in special applications (e.g. machine tool, positioning, etc...).

Please refer to parameter group 22 for permanent magnet motor parameters.

(1) Number of motor poles (02-07)

Set the number of motor pole according to the motor nameplate.

(2) Motor rated power (02-05)

Set the motor power according to the motor nameplate.

(3) Motor rated current (02-01)

Set the motor rated current according to the motor nameplate.

(4) Motor rated voltage (02-04)

Set the motor rated voltage according to the motor nameplate.

(5) Rated frequency of motor (02-06)

Set the motor rated frequency according to the motor nameplate.

(6) Rated rotation speed of motor (02-03)

Set the motor rpm according to the motor nameplate.

(7) No-load motor voltage (02-19)

Parameter determines the rated flux during motor's rated rotation in SLV control mode. Set the value of this parameter to the same value as parameter 17-08 (02-19 for motor 2). A value of 10~50V below the input voltage level ensures that the motor is capable of providing adequate torque performance when operating at nominal speed (or higher speed). Setting the value to small can result in a reduction in no-load current, weakened motor flux and an increase in motor current while the motor is loaded.

(8) Motor excitation current (02-09)

- This parameter is automatically set via auto-tuning. It required manual adjustment without auto-tuning.
- Start tunig from 33% when doing manual adjustment. If the output value of no-load voltage (12-67) is higher than the setting value of no-load voltage (17-08), the motor excitation current is adjusted downward; if the value (12-67) is lower than the value (17-08), the motor excitation current is adjusted upward.
- Adjust the value of motor excitation current (02-09) will change the value of the motor leakage inductance (02-17) and motor mutual inductance (02-18).

(9) Setting of motor core saturation coefficients 1, 2 and 3 (02-10, 02-11, 02-12)

These parameters are automatically set during auto-tune. No adjustment required. Parameters are set to 50% for 02-10, 75% for 02-11 and 137.5% for 02-12 to reduce the impact of core saturation. The motor core's saturation coefficient is defined as a percentage of the motor excitation current. When the motor flux reaches 137.5% level, the core's saturation coefficient shall be greater than 137.5%. When the motor flux is 50% or 75%, the core's saturation coefficient is required to be less than 50% and 75%.

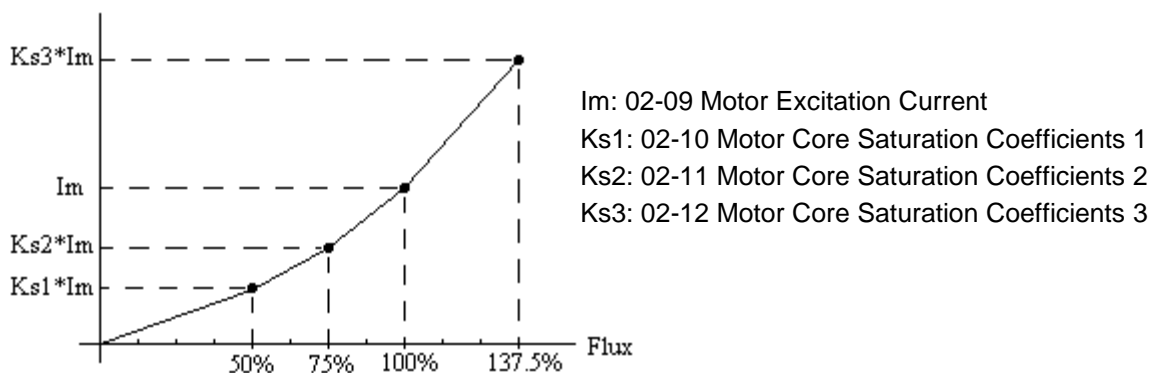


Figure 4.3.12-a Y-equivalent model of an induction motor

(10) Motor core loss (02-13)

Set motor core loss as the percentage of the motor rated power.

$$\% W_{\text{core}} (02-13) = \frac{3 \times \text{Motor core loss (watt)}}{\text{Motor rated power (watts, 02-05)}} \times 100\%$$

Note: In V/F mode motor core loss (02-13) is used to for torque compensation.

(11) Motor line to line resistance (02-15)

(12) Motor no-load current (02-00).

Value is calculated based on the motor rated frequency (17-05) and motor rated current (17-03).

In V / F control mode, the output current is greater than the no-load current with slip compensation is enabled.

Note: The value of 02-01 needs to be greater than the value set in parameter 02-00, otherwise warning message "SE01" out of range error will be displayed.

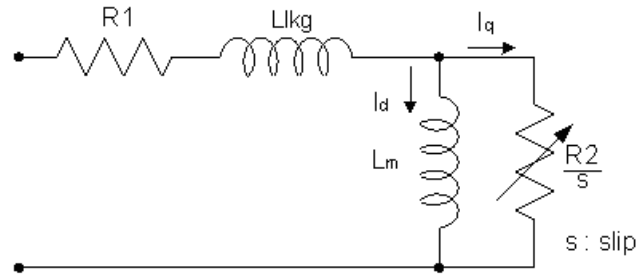


Figure 4.3.12-b Y-equivalent model of an induction motor

(13) Motor Leakage Inductance Ratio (02-33)

- This parameter is set by the conversion of manual adjustment function. This adjustment does not have the magnetic function. Normally, it does not require adjustment.
- Definition of leakage inductance ratio is the ratio of leakage inductance to rotor inductance. If default setting is 3.4%, adjust this ratio changes the parameter of motor leakage inductance. The formula of this ratio is as follows:

$$\xi = \frac{LkG}{Lr}$$

- When the ratio of leakage inductance is too high or too low, it may cause the motor jittering with different sound and without operation. The general setting range is 3.0%~5.0% and 4.0% is the relatively common value for motor operation normally. The ratio of leakage inductance is adjusted depending on different motor types.

(14) Motor Slip Frequency (02-34)

- This parameter is set by the conversion of manual adjustment function. This adjustment does not have the magnetic function. Normally, it does not require adjustment.
- The default setting is 1Hz and the value of motor slip frequency is obtained from motor nameplate. Take 4-pole motor with 60Hz for example,

Synchronous speed is $N = \frac{120 \times \text{Frequency}}{\text{Pole}} = \frac{120 \times 60}{4} = 1800$ rpm and the rated speed in the motor

nameplate is 1700 rpm, then $\text{Slip} = \frac{1800 - 1700}{60} = 1.67$ Hz .

Note: Adjusting the motor slip frequency changes the parameter of rotor resistance and the value of slip frequency is adjusted depending on different motor types.

Note: After executing auto-tuning, parameters marked with <1> will have updated values. Please refer Group 17: Automatic Tuning Parameters for more detail.

Group 03- External Digital Input and Output Parameters

| | |
|---------------|---|
| 03- 00 | Multi-function terminal function setting – S1 |
| 03- 01 | Multi-function terminal function setting – S2 |
| 03- 02 | Multi-function terminal function setting – S3 |
| 03- 03 | Multi-function terminal function setting – S4 |
| 03- 04 | Multi-function terminal function setting – S5 |
| 03- 05 | Multi-function terminal function setting – S6 |
| Range | <p>【0】 : 2-Wire Sequence (ON: Forward Run Command) 【1】 : 2-Wire Sequence (ON: Reverse Run Command) 【2】 : Multi-Speed Setting Command 1 【3】 : Multi-Speed Setting Command 2 【4】 : Multi-Speed Setting Command 3 【5】 : Multi-Speed Setting Command 4 【6】 : Forward Jog Run Command 【7】 : Reverse Jog Run Command 【8】 : UP Frequency Increasing Command 【9】 : DOWN Frequency Decreasing Command 【10】 : Acceleration/ Deceleration Setting Command 1 【11】 : Acceleration/ Deceleration Inhibition Command 【12】 : Main/Alternative Run command Switching 【13】 : Main/Alternative Frequency Command Switching 【14】 : Emergency Stop (Decelerate to Zero and Stop) 【15】 : External Baseblock Command (Rotation freely to Stop)^{*1} 【16】 : PID Control Disable 【17】 : Fault Reset (RESET) 【18】 : Reserved 【19】 : Speed Search 1(from the maximum frequency)^{*1} 【20】 : Manual Energy Saving Function 【21】 : PID Integral Reset 【22】 ~ 【23】 : Reserved 【24】 : PLC Input 【25】 : External Fault 【26】 : 3-Wire Sequence (Forward/ Reverse Command) 【27】 : Local/ Remote Selection 【28】 : Remote Mode Selection 【29】 : Jog Frequency Selection 【30】 : Acceleration/ Deceleration Setting Command 2 【31】 : Inverter Overheating Warning 【32】 : Reserved 【33】 : DC Braking^{*1} 【34】 : Speed Search 2 (from Frequency Command)^{*1} 【35】 : Timing Function Input 【36】 : PID Soft Start Disable 【37】 ~ 【40】 : Reserved 【41】 : PID Sleep 【42】 ~ 【46】 : Reserved 【47】 : Fire Mode (Forced to Run Mode) 【48】 : KEB Acceleration</p> |

- 【49】 : Parameters Writing Allowable**
- 【50】 : Unattended Start Protection (USP)**
- 【51】 ~ 【52】 : Reserved**
- 【53】 : 2-Wire Self Holding Mode (Stop Command)**
- 【54】 : Switch PID1 and PID2**
- 【55】 : RTC Time Enable**
- 【56】 : RTC Offset Enable**
- 【57】 : Forcing Frequency Run**
- 【58】 : Run Permissive Function**
- 【63】 : Switch to Tolerance Range of Constant Pressure 2**
- 【64】 : Reserved**
- 【65】 : Short-circuit braking**

*1: Selection 15, 19, 33, and 34 cannot be used when using a permanent magnetic (PM) motor.

Refer to the multi-function digital input and related parameters in the following Fig. 4.3.13

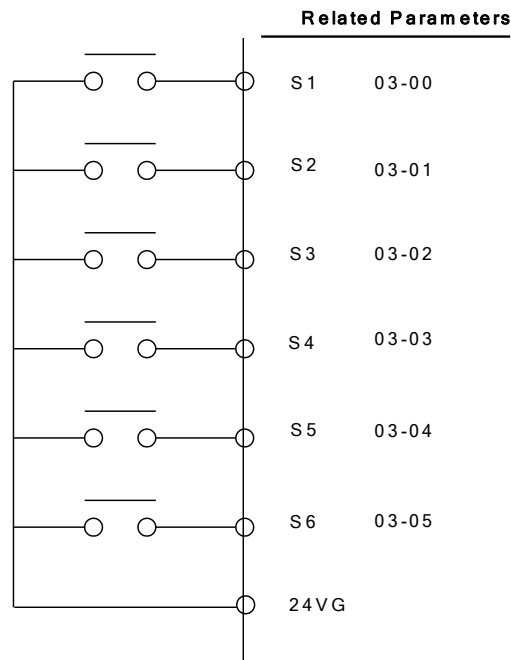


Figure 4.3.13 Multi-function digital input and related parameters

Table 4.3.4 Multi-function digital input setting (03-00 ~ 03-05) (“O”: Enable, “X”: Disable)

| Value | Function | | Description | Control mode | | |
|-------|--|----------------------------|--|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 0 | 2-wire type (Forward operation) | 2-Wire (FWD-RUN) | 2- wire (ON : Forward operation command). | O | O | O |
| 1 | 2-wire type (Reverse operation) | 2-Wire (REV-RUN) | 2- wire (ON : Reverse operation command). | O | O | O |
| 2 | Multi-Speed Setting Command 1 | Muti-Spd Ref 1 | Multi-Speed Reference 1 | O | O | O |
| 3 | Multi-Speed Setting Command 2 | Muti-Spd Ref 2 | Multi-Speed Reference 2 | O | O | O |
| 4 | Multi-Speed Setting Command 3 | Muti-Spd Ref 3 | Multi-speed Reference 3 | O | O | O |
| 5 | Multi-Speed Setting Command 4 | Muti-Spd Ref 4 | Multi-speed Reference 4 | O | O | O |
| 6 | Forward Jog Run Command | FJOG | ON: Forward operation in jog mode (00-18) | O | O | O |
| 7 | Reverse Jog Run Command | RJOG | ON: Reverse operation in jog mode (00-18) | O | O | O |
| 8 | UP Frequency Increasing Command | UP command | ON: Command of output frequency increasing (only used by support of DOWN command). | O | O | O |
| 9 | DOWN Frequency Decreasing Command | DOWN command | ON: Command of output frequency decreasing (only used by support of UP command). | O | O | O |
| 10 | Acceleration/Deceleration Setting Command 1 | Acc/Decel Time Selection 1 | Acceleration/deceleration time selection command1 | O | O | O |
| 11 | Acceleration/Deceleration Inhibition Command | ACC/DEC Inhibit | ON: Acceleration/deceleration prohibition | O | O | O |
| 12 | Main/Alternative Run command Switching | Run Change Sel | Run command source is set by alternative run command (00-03). | O | O | O |
| 13 | Main/Alternative Frequency Command Switching | Freq Change Sel | Frequency command source is set by alternative frequency command (00- 06). | O | O | O |
| 14 | Emergency Stop (Decelerate to Zero and Stop) | E-Stop | ON: Emergency stop input | O | O | O |
| 15 | External Baseblock Command (Rotation freely to Stop) | Ext. BB | ON: Inverter base interdiction | O | O | O |
| 16 | PID Control Disable | PID Disable | ON: PID control disable | O | O | O |
| 17 | Fault Reset | Fault Reset | Fault reset | O | O | O |

| Value | Function | | Description | Control mode | | |
|-------|--|----------------------------|---|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 18 | Reserved | Reserved | Reserved | - | - | - |
| 19 | Speed Search 1 (from the maximum frequency) | Speed Search 1 | ON: Search the speed from the maximum output frequency | ○ | ○ | × |
| 20 | Manual Energy Saving Function | Energy saving | ON: Manual energy saving control is based on the settings of 11-12 and 11-18. | ○ | × | × |
| 21 | PID Integral Reset | PID I-Reset | ON: PID integral value reset | ○ | ○ | ○ |
| 22~23 | Reserved | Reserved | Reserved | - | - | - |
| 24 | PLC input | PLC Input | ON: Digital PLC input | ○ | ○ | ○ |
| 25 | External fault | Ext. Fault | ON: External fault alarm | ○ | ○ | ○ |
| 26 | 3-Wire Sequence (Forward/ Reverse Command) | 3-Wire (FWD/REV) | 3-wire control (forward/reverse command). ON: Reverse; OFF: Forward. When the parameter is set to 26, terminal S1 and terminal will become operation command and stop command respectively, and their original functions will be closed. | ○ | ○ | ○ |
| 27 | Local/ Remote Selection | Local/Remote | ON: Local mode (via the digital operator) OFF: Frequency command and operation command will be determined according to the setting of parameter (00-02 and 00-05) | ○ | ○ | ○ |
| 28 | Remote Mode Selection | Remote Mode Sel | ON: RS-485 communication OFF: Control circuit terminal | ○ | ○ | ○ |
| 29 | Jog Frequency Selection | JOG Freq Ref | ON: Selection jog frequency command | ○ | ○ | ○ |
| 30 | Acceleration/ Deceleration Setting Command 2 | Acc/Decel Time Selection 2 | Acceleration/deceleration time selection command2 | ○ | ○ | ○ |
| 31 | Inverter Overheating Warning (OH2) | Overheat Alarm | ON: Inverter overheat alarm (OH2) input(will display OH2) | ○ | ○ | ○ |
| 32 | Reserved | Reserved | Reserved | - | - | - |
| 33 | DC Braking | DC Brake Command | ON: Perform DC braking | ○ | × | × |
| 34 | Speed Search 2 (from Frequency Command) | Speed Search 2 | ON: Search speed from set frequency | ○ | × | ○ |
| 35 | Timing Function Input | Timer Input | .Set the time function at 03-37, 03-38 .Set the time function output at 03-11, 03-12 | ○ | ○ | ○ |
| 36 | PID Soft Start Disable | PID SFS Disable | ON: PID slow-start off | ○ | ○ | ○ |
| 37~40 | Reserved | Reserved | Reserved | - | - | - |
| 41 | PID Sleep | PID Sleep | ON: PID Sleep | ○ | ○ | ○ |
| 42~46 | Reserved | Reserved | Reserved | - | - | - |

| Value | Function | | Description | Control mode | | |
|-------|--|-------------------------|---|--------------|-----|-----------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 47 | Fire Mode (Forced to Run Mode) | Fire Mode | ON: Inverter runs in the max. frequency of motor 1 (parameter 01-02). Note: If fault message of OC, SC, CUV, FUL, STO occur, function of fire mode will stop. | ○ | ○ | ○ |
| 48 | KEB Acceleration | KEB Accel. | ON: KEB acceleration start | ○ | × | × |
| 49 | Parameters Write-in Allowed | Write Enabled | ON: All parameters are writable. OFF: Except reference frequency (00-05) all parameters are write-protected. | ○ | ○ | ○ |
| 50 | Unattended Start Protection (USP) | USP | ON: After power is input, the inverter ignores the operation command OFF: After power is input, the inverter will return the operation status before power is cut off. | ○ | ○ | ○ |
| 51~52 | Reserved | Reserved | Reserved | - | - | - |
| 53 | 2-Wire Self Holding Mode (Stop Command) | 2-Wire (STOP) | 2-Wire Self Holding Mode (ON: Stop Command). | ○ | ○ | ○ |
| 54 | Switch PID1 and PID2 | PID 2 Enable | ON: PID1 enabled OFF: PID2 enabled | ○ | ○ | ○ |
| 55 | RTC Time Enable | RTC Timer Switch | ON:RTC Time Function Enabled | ○ | ○ | ○ |
| 56 | RTC Offset Enable | Offset Time Switch | ON:RTC Offset Enabled | ○ | ○ | ○ |
| 57 | Forcing Frequency Run | Force Freq Cmd | ON: Run on Forcing Frequency (23-28) OFF: Determine frequency reference and run command depending on the setting of parameter (00-02 and 00-05) | ○ | ○ | ○ |
| 58 | Run Permissive Function | Safety Function | ON: Stop on the setting of 08-30 | ○ | ○ | ○ |
| 63 | Switch to Tolerance Range of Constant Pressure 2 | Switch Const.P. Range 2 | ON: Use tolerance range of constant pressure 2 (23-34) for PUMP mode OFF: Use tolerance range of constant pressure 1 (23-09) for PUMP mode | ○ | ○ | ○ |
| 64 | Reserved | Reserved | Reserved | - | - | - |
| 65 | Short-circuit braking | SC Brk | ON: Execute short-circuit braking | × | × | ○ |

03-0X =00: 2-wire control: forward operation

03-0X =01: 2-wire control: reverse operation. Refer to the 2-wire operation mode in Figure 4.3.1.

03-0X =02: Multi-speed setting command 1.

03-0X =03: Multi-speed setting command 2.

03-0X =04: Multi-speed setting command 3.

03-0X =05: Multi-speed setting command 4.

03-0X =29: Jog frequency selection (setting =29).

Select frequency reference using the multi-function digital input.

Table 4.3.5 Multi-speed operation selection

| Speed | Multi-function digital input (S1 ~ S6) ^{*3} | | | | | Frequency selection |
|-------|--|-------------------------|-------------------------|-------------------------|-------------------------|--|
| | Jog frequency reference | Multi-speed frequency 4 | Multi-speed frequency 3 | Multi-speed frequency 2 | Multi-speed frequency 1 | |
| 1 | 0 | 0 | 0 | 0 | 0 | Frequency command 0 (05-01) or main speed frequency ^{*2} |
| 2 | 0 | 0 | 0 | 0 | 1 | (04-05=0) Auxiliary speed frequency or (04-05≠0) Frequency command 1 (05-02) |
| 3 | 0 | 0 | 0 | 1 | 0 | Frequency command 2 (05-03) |
| 4 | 0 | 0 | 0 | 1 | 1 | Frequency command 3 (05-04) |
| 5 | 0 | 0 | 1 | 0 | 0 | Frequency command 4 (05-05) |
| 6 | 0 | 0 | 1 | 0 | 1 | Frequency command 5 (05-06) |
| 7 | 0 | 0 | 1 | 1 | 0 | Frequency command 6 (05-07) |
| 8 | 0 | 0 | 1 | 1 | 1 | Frequency command 7 (05-08) |
| 9 | 0 | 1 | 0 | 0 | 0 | Frequency command 8 (05-09) |
| 10 | 0 | 1 | 0 | 0 | 1 | Frequency command 9 (05-10) |
| 11 | 0 | 1 | 0 | 1 | 0 | Frequency command 10 (05-11) |
| 12 | 0 | 1 | 0 | 1 | 1 | Frequency command 11 (05-12) |
| 13 | 0 | 1 | 1 | 0 | 0 | Frequency command 12 (05-13) |
| 14 | 0 | 1 | 1 | 0 | 1 | Frequency command 13 (05-14) |
| 15 | 0 | 1 | 1 | 1 | 0 | Frequency command 14 (05-15) |
| 16 | 0 | 1 | 1 | 1 | 1 | Frequency command 15 (05-16) |
| 17 | 1 ^{*1} | — | — | — | — | Jog frequency command (00-18) |

0: OFF, 1: ON, —: Ignore

*1. Jog frequency terminal has a higher priority than multi-speed reference 1 to 4.

*2. When parameter 00-05=0 (frequency reference input = digital operator), multi-speed frequency 1 will be set by 05-01 frequency reference setting1). When parameter 00-05=1 (frequency reference input=control circuit terminal), multi-speed frequency command 1 is input through analog command terminal AI1 or AI2.

*3. 05-02 is used for auxiliary speed frequency of AI2 (default setting). Set 04-05≠0 to switch 05-02 to be Frequency command 1. When PID control mode is enabled (10-03= xxx1b), Frequency reference - Stage 1 cannot switch to auxiliary speed frequency even when Multi-function Terminal Function Setting (03-00~03-05) =16 (PID control disable).

Wiring Example: Fig. 4.3.14 and 4.3.15 show an example of a 9-speed operation selection.

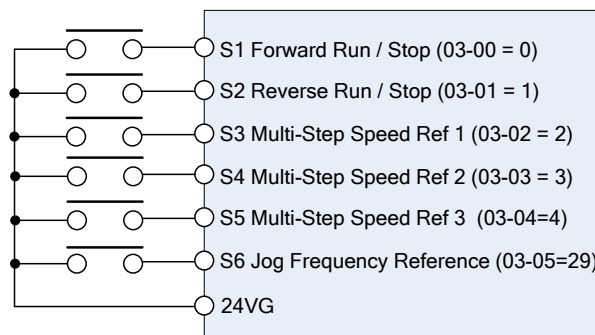


Figure 4.3.14 Control Terminal Wiring Example

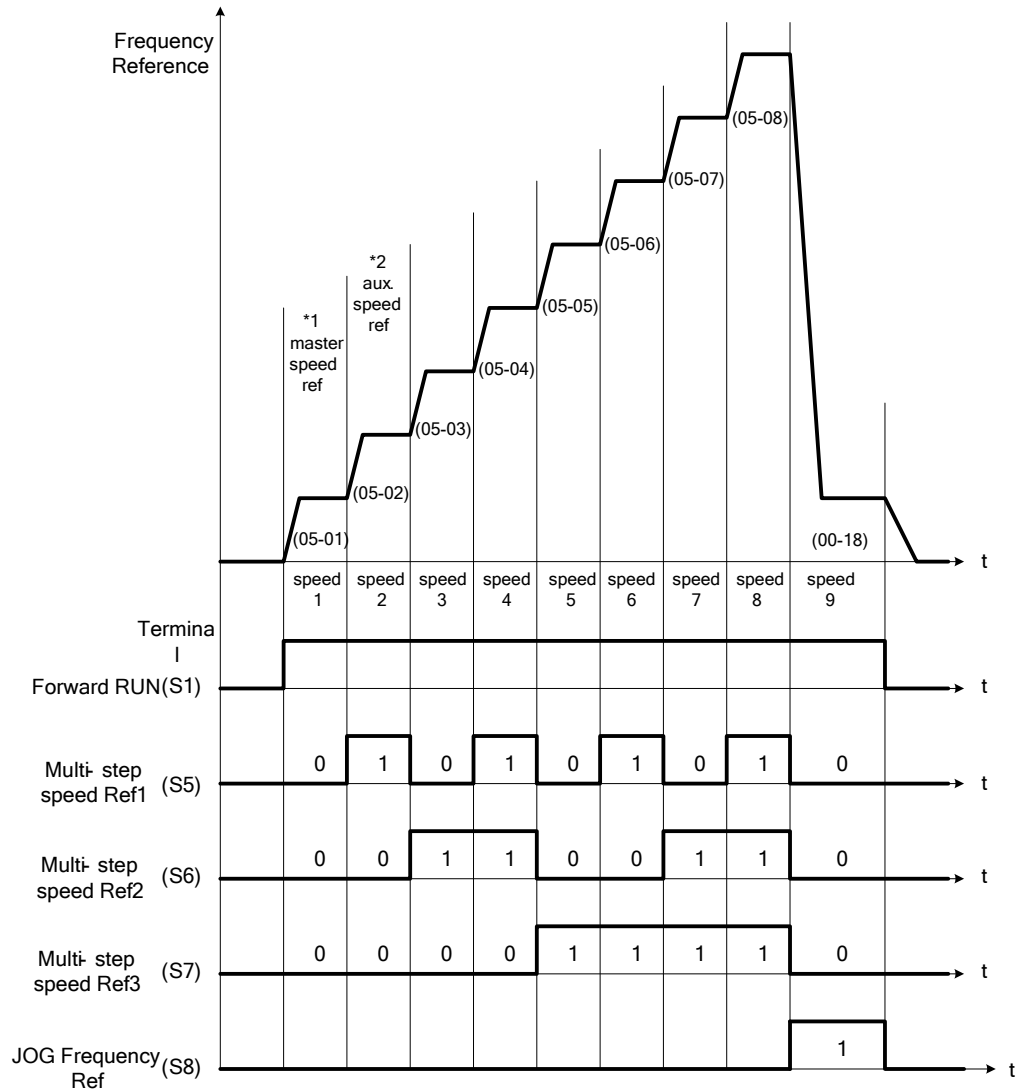


Figure 4.3.15 9-speed timing diagram

*1. When 00-05=1, multi-speed frequency reference is set by analog input AI1 or AI2.

03-0X =06: Forward jog run command, uses jog frequency parameter 00-18.

03-0X =07: Reverse jog run command, uses jog frequency parameter 00-18.

Notes:

- To use Forward jog or Reverse jog command set 00-02=1.
- Jog command has a higher priority than other frequency reference commands.
- Jog command uses stop mode set in parameter 07-09 when Jog command is active > 500ms.
- When 11-00 (Direction Lock Selection) set to 1 (Only Allow Forward Rotation), if there is a motor reverse command, the "RUNER" warning will display.
- When 11-00 (Direction Lock Selection) set to 2 (Only Allow Reverse Rotation), if there is a motor forward command, the "RUNER" warning will display.

03-0X =08: UP frequency accelerating command; set parameter 00-05 Frequency command to 2 to activate.

03-0X =09: Down frequency decelerating command; set parameter 00-05 Frequency command to 2 to activate.

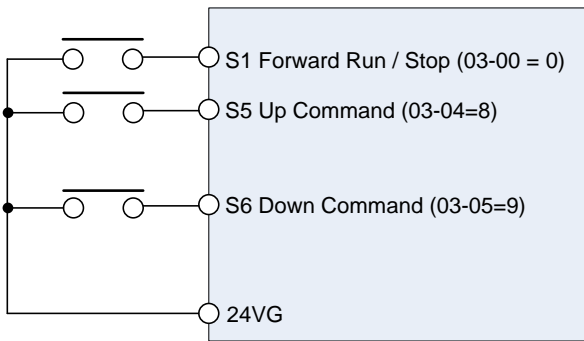
Note:

- In this mode the output frequency can be adjusted using the keypad (refer to parameter 11-56) or external multi-function digital input (terminal S1to S6).
- UP/DOWN control requires two digital input terminals one for UP and the other for DOWN command. Set 00-02=1 (external terminals) & 00-05=2 (terminal command UP/DOWN) & 03-00~03-05=8 (UP command)/ 9 (DOWN command).
- In UP/DOWN control the inverter uses the standard acceleration/ deceleration times.

Note: SE02 DI terminal Error is displayed when:

- Only the UP or DOWN command function is set.
- Both UP command and Inhibit Acceleration/deceleration command are activated simultaneously.
- Both DOWN command and Inhibit Acceleration/deceleration command are activated simultaneously.

For the examples of UP/DOWN control wiring and operation, please refer to Figure 4.3.16 and 4.3.17.



| | | | | |
|--------------------------------------|---------------|----------------|------|------|
| UP Command (Terminal S5) | 1 | 0 | 0 | 1 |
| Down Command (Terminal S6) | 0 | 1 | 0 | 1 |
| Operation | Accel (UP) | Decel (DWN) | Hold | Hold |

Figure 4.3.16 UP/DOWN wiring and operation example

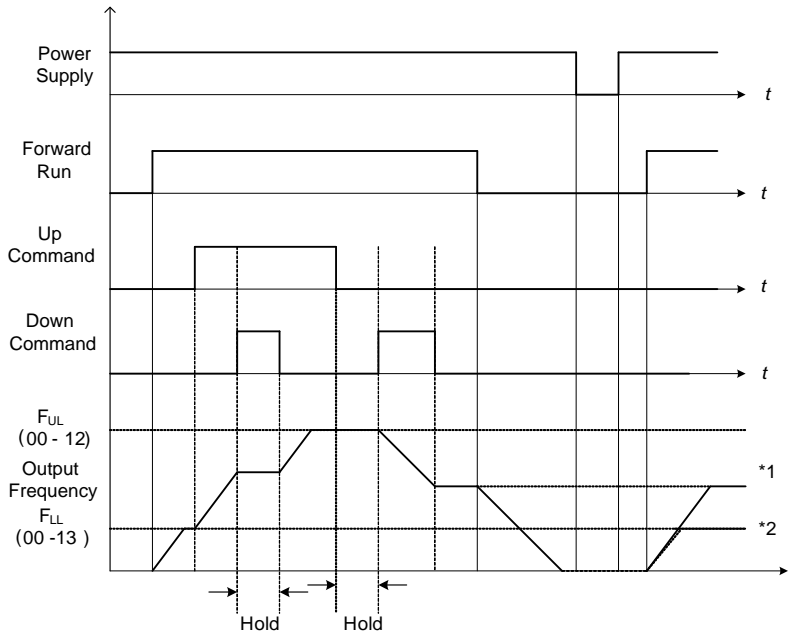


Figure 4.3.17 Up / Down command timing diagram

UP / DOWN Command Operation

When the Forward Run command is active and the UP or Down command is momentarily activated the inverter will accelerate the motor up to the lower limit of the frequency reference (00-13).

When using the UP / Down command, the output frequency is limited to the upper limit of frequency reference (00-12) and the lower limit of frequency reference (00-13).

The UP / DOWN command uses acceleration 1 or 2 / deceleration time 1 or 2 for normal operation Tacc1 / Tdec1 (00-14, 00-15) or Tacc2 / Tdec 2 (00-16, 00-17).

Refer to 03-40 UP/ DOWN frequency width setting for using other functions of UP/ DOWN. (It is enabled in inverter software V1.4)

Frequency reference retention is active when parameter 11-58 is set to 1 and the frequency reference is saved when power is lost and retrieved when power is restored.

*1: When 11-58 = 1 and the operation command is active, the output frequency will accelerate to the previously stored frequency command.

*2: When 11-58 = 0 and the operation command is active, the output frequency will accelerate to the lower limit of frequency reference (00-13).

03-0X =10: Acceleration/deceleration 1 selection

03-0X =30: Acceleration/deceleration 2 selection

Refer to the "multi-function digital input terminals select acceleration/ deceleration time" in Table 4.3.1 and Figure 4.3.6.

03-0X =11: Acceleration/deceleration inhibition command (hold command)

When activated suspends the acceleration / deceleration operation and maintains the output frequency at current level.

If 11-58 = 1, the frequency reference value is saved when the acceleration/deceleration inhibition command is active. Deactivating the acceleration / deceleration inhibition command resumes acceleration / deceleration.

If 11-58 = 0, the frequency reference value is saved when the acceleration/deceleration inhibition command is active and even when powering down the inverter.

Refer to Fig.4.3.18.

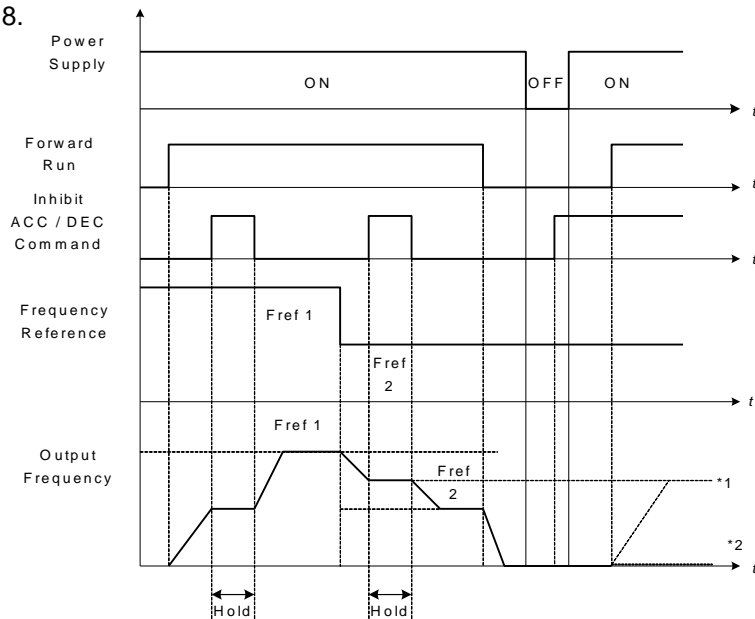


Figure 4.3.18 Acceleration / deceleration inhibition command operation

*1. When 11-58 = 1, and acceleration / deceleration inhibit command is activated, the frequency reference is stored even when powering down the inverter. When a run command is given (e.g. run forward) and the acceleration / deceleration inhibit command is active, the inverter will accelerate to the previously stored frequency reference.

*2. When 11-58 = 0, and a run command is given and the acceleration / deceleration inhibit command is active, the frequency reference and output frequency will remain at zero.

03-0X =12: Main/Alternative Run command Switching

Run command source is set by alternative run command (00-03) when function terminal is active. When function terminal is set to 27 (Local/ Remote control selection), the priority will higher than the switch of main/ alternative run command.

03-0X =13: Main/Alternative Frequency Command Switching

Frequency command source is set by alternative frequency command (00- 06) when function terminal is active. When function terminal is set to 27 (Local/ Remote control selection), the priority will higher than the switch of main/ alternative frequency command.

03-0X =14: Emergency stop (decelerate to zero and stop)

Refer to the "emergency stop time" parameter 00-26.

03-0X =15: External Baseblock Command (coast to stop)

Execute the base block command by the use of ON / OFF way of multi-function digital input terminal, and prohibit the inverter output.

During run: When an external base block command is activated, the keypad displays "BBn BaseBlock (Sn)", indicating the inverter output is turned off (n indicates the digital input number 1 – 6). Upon removing the base block signal, the motor will run at the frequency reference. If speed search from frequency reference is active the inverter output frequency starts from the frequency reference and searches for the coasting motor speed and continue to operate. If speed search is not active the output frequency starts at 0Hz.

During deceleration: When an external base block command is activated, the keypad displays "BBn BaseBlock (Sn)", indicating the inverter output is turned off (n indicates the digital input number 1 – 6). Upon removing the base block signal, the motor is stopped or will coast to a stop and the inverter will remains in the stop condition.

During acceleration: When an external base block command is activated, the keypad displays "BBn BaseBlock (Sn)", indicating the inverter output is turned off (n indicates the digital input number 1 – 6). Upon removing the base block signal, the motor will run at the frequency reference. If speed search from frequency reference is active the inverter output frequency starts from the frequency reference and searches for the coasting motor speed and continue to operate. If speed search is not active the output frequency starts at 0Hz.

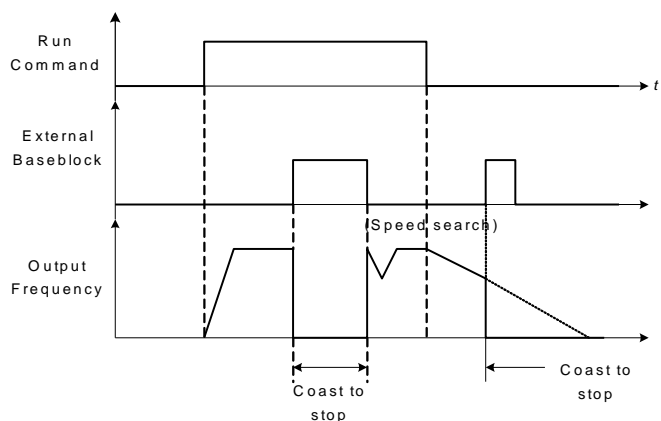


Figure 4.3.19 External base block operation

03-0X =16: PID control disable.

Note: The frequency will depend on parameter 00-05 (reference frequency) to determine the source of frequency input. Refer to the descriptions of parameter 00-05 and 00-06 for details.

03-0X =17: Fault reset

The output becomes active when the inverter trips on a fault. Upon an inverter fault the inverter output will turn off (base block) and the keypad displays the dedicated fault message.

When fault occurs, the following actions can be used to reset the fault:

1. Program one of the multi-function digital inputs (03-00 to 03-05) to 17 (reset fault) and active input.*
2. Press the reset key of the digital operator (RESET).*
3. Recycle power to the inverter. **Important Note:** If a run command is active during power-up, the inverter will start running automatically.

* To reset an active fault the run command has to be removed.

03-0X =19: Speed Search 1 (from the maximum frequency).

03-0X =34: Speed Search 2 (from the frequency command).

Refer to the "speed search" function in the parameter group 7 (start/ stop control function).

03-0X =20: Energy saving enabled

Manual energy savings function is set with parameters 11-12 and 11-18.

For the manual energy saving operation refer to Figure 4.3.78.

03-0X =21: PID integral reset

03-0X =25: External fault

Activating the external fault input will turn off the inverter output and the motor will coast to a stop. The keypad displays the external fault message "EFn Ext. Fault (Sn)", where n is the input terminal number.

03-0X =27: Local / Remote selection.

Switch the inverter frequency reference source between Local (keypad) or Remote (control circuit terminals or RS485). Use parameter 00-05 (Main frequency command source selection) and 00-02 (Run command selection) to select the input source. When PID is enabled (10-03=XXX1), parameter 10-00 (target value source) is performed. If 23-00=1, make sure the setting value of parameter 23-04. If 23-00=2, make sure the setting value of parameter 23-59 and 00-02.

Note: In 3-wire operation terminal S1 and S2 are reserved for run/stop operation and the Local / Remote function can only be set to digital input terminals S3 to S6 (03-02 to 03-05).

Note: To switch between local and remote the inverter has to be stopped.

| Input | Mode | Frequency Reference / Run/Stop Command Source |
|-------|--------|--|
| ON | Local | - Frequency reference and Run-Stop from keypad. - LEDs SEQ and REF are off. - When PID is enabled, REF indicator OFF presents PID target value is set by the keypad. |
| OFF | Remote | - Frequency reference source selected by parameter 00-05 and Run-Stop source selected by parameter 00-02. - LEDs SEQ and REF are on. - When PID is enabled, REF indicator ON presents PID target value is set by the control terminal AI1. |

03-0X =28: Remote mode selection

Switch between terminal source and communication (RS-422/RS-485) source for frequency reference and operation command.

In Remote mode, indicators of SEQ and REF are on; you can use terminals AI1 and AI2 to control the frequency command, and use terminals S1, S2 or communication terminal RS-485 to control the operation command.

| Input | Mode | Frequency Reference / Run/Stop Command Source |
|-------|---------------|--|
| ON | Communication | - Frequency reference and run/stop command control via communication (RS-422/RS-485). |
| OFF | Terminal | - Frequency reference source from AI1 / AI2 input (00-05=1) and Run-Stop command from terminals S1 / S2 (00-02=1). |

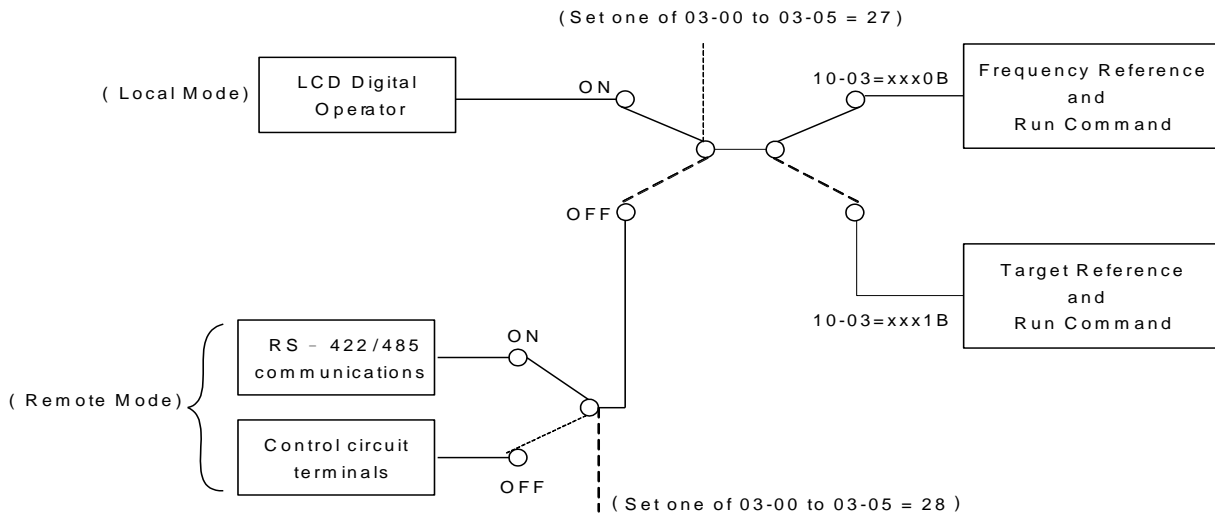


Figure 4.3.20 Remote mode operation selection

To switch the frequency reference and operation command input between communication RS-485 and control terminals the following parameters have to be set:

1. 00-05=1 (use control terminal AI1 or AI2 as reference frequency source)

2. 00-02=1 (use control terminal S1 or S2 for operation command)
3. Set one of the digital input terminals (03-02 to 03-05) to 28 (Operation selection of remote mode)

03-0X =24: PLC Input

It is required to match Drive Link program. Ladder diagram is edited in the PLC program. When the message output is conducted, this message will be sent to the inverter.

03-0X =26: 3-Wire Sequence (Forward/ Reverse Command)

When the digital input terminals (S3~S6) is set to 26, terminal S1 and S2 will become the run command and stop command. Refer to Fig.4.3.2.

03-0X =29: Jog Frequency Selection

When 00-18 (Jog Frequency) is set up, the inverter depends on this frequency for command when it is ON.

03-0X =30: Acceleration/ Deceleration Setting Command 2

When it is ON, the inverter will be active depends on the acceleration time 2 of 00-16 and deceleration time 2 of 00-17.

03-0X =31: Inverter overheat warning

When input is active the inverter displays warning message "OH2" and continues operation. Deactivating the input reverts back to the original display. Warning message does not require resetting the inverter.

03-0X =33: DC braking

When input is active DC-Injection braking is enabled during start and stopping of the inverter. DC Injection braking is disabled when a run or jog command is active.

Note: When short-circuit braking and DC braking commands are selected at the same time a SE02 error (DI Terminal Error) will be displayed.

Refer to the DC braking time diagram in Fig.4.3.21.

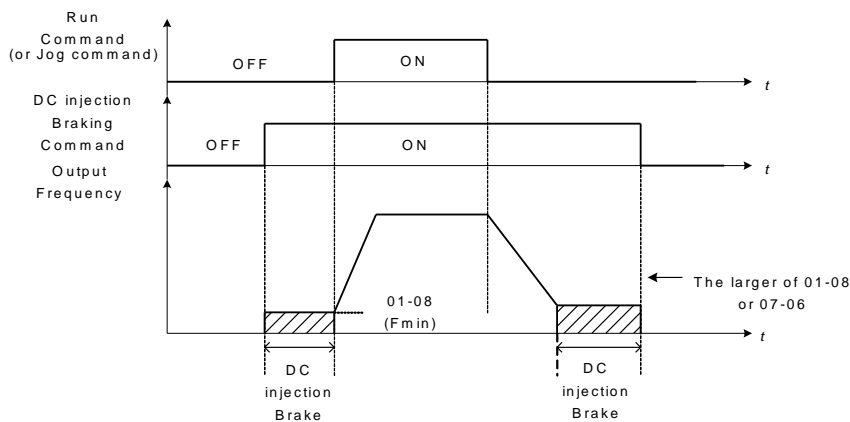


Figure 4.3.21 DC braking timing diagram

03-0X =35: Timing function

Refer to the "time function" parameter 03-37 and 03-38.

03-0X =36: PID Soft start disable

Refer to the "PID Control" function of PID function parameter group 10.

03-0X =47: Fire mode (Forced to operation mode)

When input is active disables all inverter warning and hardware (exclusive of SC) protections. This function is commonly used in commercial applications where the inverter controls an exhaust fan and needs run to destruction in case of a fire.

03-0X =48: KEB acceleration

When input is active enables KEB (Kinetic Energy Braking) during acceleration. Refer to the parameter description of 11-47 and 11-48. Note: To enable set parameter 11-47 to a value greater than 0.

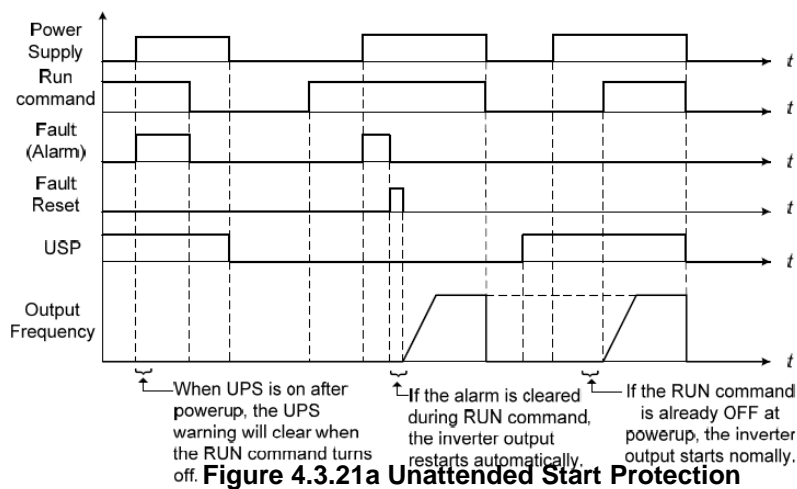
03-0X =49: Parameters write-in allowed
 When input is active allows parameter to be changed.

Note: When none of the digital input terminals are set to function 49, parameter write-in protection is controlled by parameter 13-06.

| Input | Parameter Save |
|-------|----------------------------|
| ON | Parameters Write Enabled |
| OFF | Parameters Write Protected |

03-0X =50: Unattended Start Protection (USP)

When input is active prevents inverter from starting automatically when a run command is present at time of power-up. Please refer to Fig.4.3.21a for more details.



03-0X =53: 2-Wire Self Holding Mode (Stop Command).

Refer to the “2-wire operation with hold function” of parameter 00-02.

03-0X =54: Switch PID1 and PID2

It will switch PID1 to PID2 when PID2 is ON.

03-0X =55: RTC Time Enable

When 16-13 (RTC timer function) = 2 (DI setting) and RTC Time Enable is ON, RTC timer function is enabled.

03-0X =56: RTC Offset Enable

When 16-30 (Selection of RTC Offset) = 2 (DI setting) and RTC Offset Enable is ON, the inverter will run depending on RTC offset time setting (16-31).

03-0X =57: Forced Frequency Run

This function enables with the corresponding of parameter of 23-28 and the source of frequency command of parameter 00-05 set to the value of 5 (PID given, namely the parameter of 10-03 needs to be active).

When any one of the multi-function digital input terminal (S1~S6) is set to the value of 16 (the interdiction of PID function), pump will not depend on feedback to do any PID output adjustment; simultaneously another one is set to the value of 57 (forced frequency run) and inverter will have the frequency run setting depending on the parameter of 23-28. Inverter will stop output when digital input terminals (S1~S6) are removed.

This function is applied to inverter output being controlled by external pressure sensor (eg. differential pressure switch) when pressure sensor disconnects.

03-0X =58: Run Permissive Function

When active the inverter will stop based on the setting of parameter 08-30.

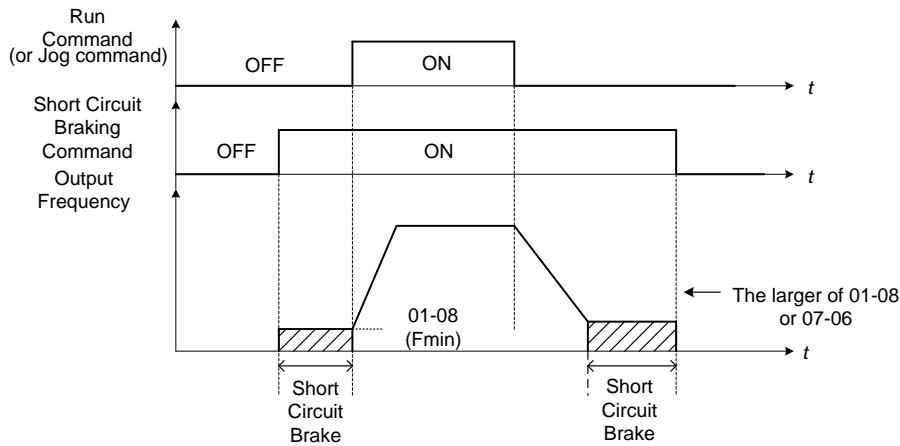
03-0X =63: Switch to Tolerance Range of Constant Pressure 2

When PUMP mode is active (23-00=1), the constant pressure bandwidth (23-09) will be used for waking up the inverter. When digital input terminal is active, constant pressure bandwidth 2 (23-34) will be used.

03-0X =65: Short-circuit braking

Stops inverter when short-circuit braking is active. Applying a run command or jog command, during short-circuit braking, will deactivate short-circuit braking and run command becomes active. See timing diagram below for short-circuit braking operation.

Note: When short-circuit braking and DC braking commands are set simultaneously a SE02 error (DI Terminal Error) will be displayed.



| | |
|---------------|--|
| 03- 08 | (S1~S6) DI Scan Time |
| Range | 【0】 Scan Time 4ms 【1】 Scan Time 8ms |

Set the digital input CPU scan time. The digital input signal needs to be present for the minimum scan time to qualify as an enabled command.

Note: For noisy environments select scan time of 8ms (results in a slower response time).

| | |
|---------------|--|
| 03- 09 | Multi-function Terminal S1-S4 Type Selection |
| Range | 【xxx0b】 : S1 A contact 【xxx1b】 : S1 B contact 【xx0xb】 : S2 A contact 【xx1xb】 : S2 B contact 【x0xxb】 : S3 A contact 【x1xxb】 : S3 B contact 【0xxx b】 : S4 A contact 【1xxx b】 : S4 B contact |

| | |
|---------------|--|
| 03- 10 | Multi-function Terminal S5-S6 Type Selection |
| Range | 【xxx0b】 : S5 A contact 【xxx1b】 : S5 B contact 【xx0xb】 : S6 A contact 【xx1xb】 : S6 B contact |

Parameter 03-09 and 03-10 selects the digital input type between a normally open and a normally closed switch/contact.

Each bit of 03-09/03-10 presents an input:

03-09= 0 0 0 0 0: normally open switch
 s4 s3 s2 s1 1: normally closed switch

03-10= x x 0 0 0: normally open switch
 s6 s5 1: normally closed switch

Example: S1 and S2 wired to a normally closed contact / switch set 03-09=0011.



Do not set the operation command parameter 00-02 to terminal control before setting the digital input type. Failure to comply may cause death or serious injury.

| 03-11 | Relay (R1A-R1C) Output |
|-------|--|
| 03-12 | Relay (R2A-R2C) Output |
| 03-39 | Relay (R3A-R3C) Output |
| Range | <p> 【0】 : During Running 【1】 : Fault Contact Output 【2】 : Frequency Agree 【3】 : Setting Frequency Agree (03-13±03-14) 【4】 : Frequency Detection 1 (\geq 03-13 + 03-14) 【5】 : Frequency Detection 2 ($<$ 03-13) 【6】 : Automatic Restart 【7】 ~ 【8】 : Reserved 【9】 : Baseblock 【10】 ~ 【11】 : Reserved 【12】 : Over-Torque Detection 【13】 : Current Agree *1 【14】 : Mechanical Brake Control (03-17~18) 【15】 ~ 【17】 : Reserved 【18】 : PLC Status 【19】 : PLC Control 【20】 : Zero Speed 【21】 : Inverter Ready 【22】 : Undervoltage Detection 【23】 : Source of Operation Command 【24】 : Source of Frequency Command 【25】 : Low Torque Detection 【26】 : Frequency Reference Missing 【27】 : Timing Function Output 【28】 ~ 【31】 : Reserved 【32】 : Communication Control Contacts 【33】 : RTC Timer 1 【34】 : RTC Timer 2 【35】 : RTC Timer 3 【36】 : RTC Timer 4 【37】 : Detection Output of PID Feedback Loss 【38】 : Brake Release 【42】 : Over-High Pressure </p> |

- 【43】 : Over-Low Pressure
- 【44】 : Loss of Pressure Detection
- 【45】 : PID Sleep
- 【46】 : Over-High Flow
- 【47】 : Over-Low Flow
- 【48】 : Shortage of Low Suction
- 【49】 : Communication Error
- 【50】 : Frequency Detection 3 ($\geq 03-44+03-45$)
- 【51】 : Frequency Detection 4 ($< 03-44$)
- 【52】 : Frequency Detection 5 ($\geq 03-46+03-47$)
- 【53】 : Frequency Detection 6 ($< 03-46$)
- 【54】 : Turn on short-circuit braking
- 【57】 : Low Current Detection

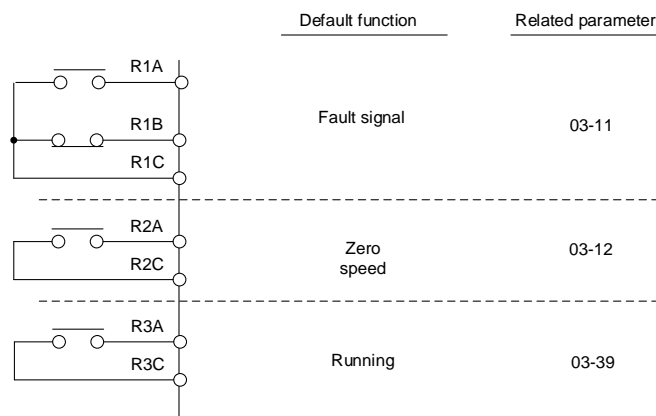


Figure 4.3.22 Multi-function digital output and related parameters

Table 4.3.6 Description of multi-function digital output

| Value | Function | | Description | Control Mode | | |
|-------|-------------------------|--------------------|--|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 0 | During Running | Running | ON: During running (Run Command is ON) | ○ | ○ | ○ |
| 1 | Fault Contact Output | Fault | ON: Fault contact output (except CF00 and CF01) | ○ | ○ | ○ |
| 2 | Frequency Agree | Freq. Agree | ON: Frequency agree (frequency agree width detection is set by 03-14) | ○ | ○ | ○ |
| 3 | Setting Frequency Agree | Setting Freq Agree | ON: Output frequency = allowed frequency detection level (03-13) \pm frequency bandwidth (03-14) | ○ | ○ | ○ |
| 4 | Frequency Detection 1 | Freq. Detect 1 | ON: Output frequency $\geq 03-13 + 03-14$ | ○ | ○ | ○ |
| 5 | Frequency Detection 2 | Freq. Detect 2 | OFF: Output frequency $\geq 03-13 + 03-14$ | ○ | ○ | ○ |
| 6 | Automatic Restart | Auto Restart | ON: the period of automatic restart | ○ | ○ | ○ |
| 7~8 | Reserved | Reserved | Reserved | - | - | - |
| 9 | Baseblock | Baseblock | ON: During baseblock | ○ | ○ | ○ |
| 10~11 | Reserved | Reserved | Reserved | - | - | - |
| 12 | Over-Torque Detection | Over Torque | ON: Over torque detection is ON | ○ | ○ | ○ |

| Value | Function | | Description | Control Mode | | |
|-------|--|-------------------|--|--------------|-----|-----------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 13 | Current Agree | Current Agree | ON: Output current > 03-15 | ○ | ○ | ○ |
| 14 | Mechanical Brake Control (03-17~03-18) | Brake Release | ON: Mechanical brake release frequency OFF: Mechanical brake operation frequency | ○ | ○ | ○ |
| 15~17 | Reserved | Reserved | Reserved | - | - | - |
| 18 | PLC Status | PLC statement | ON: when 00-02 is set to 3 (PLC operation command source) | ○ | ○ | ○ |
| 19 | PLC Control | Control From PLC | ON: Control from PLC | ○ | ○ | ○ |
| 20 | Zero Speed | Zero Speed | ON: Output frequency < Minimum output frequency (Fmin) | ○ | ○ | ○ |
| 21 | Inverter Ready | Ready | ON: Inverter ready (after power on, no faults) | ○ | ○ | ○ |
| 22 | Undervoltage Detection | Low Volt Detected | ON: DC bus voltage = < Low-voltage warning detection level (07-13) | ○ | ○ | ○ |
| 23 | Source of Operation Command | Run Cmd Status | ON: Operation command from LED digital operator (local mode) | ○ | ○ | ○ |
| 24 | Source of Frequency Command | Freq Ref Status | ON: Reference frequency from LED digital operator (local mode) | ○ | ○ | ○ |
| 25 | Low Torque Detection | Under Torque | ON: Low-torque detection is ON | ○ | ○ | ○ |
| 26 | Frequency Reference Missing | Ref. Loss. | ON: Reference frequency loss | ○ | ○ | ○ |
| 27 | Timing Function Output | Timer Output | Set time function parameter to 03-37 and 03-38, and the time function input is set by parameter from 03-00 and 03-05 | ○ | ○ | ○ |
| 28~31 | Reserved | Reserved | Reserved | - | - | - |
| 32 | Communication Control Contacts | Control From Comm | ON: DO is set by communication control. | ○ | ○ | ○ |
| 33 | RTC Timer 1 | RTC Timer 1 | ON: 16-36 (RTC Speed Selection) selects Timer 1 and 16-32 (Source of Timer 1) is active in the set time. | ○ | ○ | ○ |
| 34 | RTC Timer 2 | RTC Timer 2 | ON: 16-36 (RTC Speed Selection) selects Timer 2 and 16-33 (Source of Timer 2) is active in the set time. | ○ | ○ | ○ |
| 35 | RTC Timer 3 | RTC Timer 3 | ON: 16-36 (RTC Speed Selection) selects Timer 3 and 16-34 (Source of Timer 3) is active in the set time. | ○ | ○ | ○ |
| 36 | RTC Timer 4 | RTC Timer 4 | ON: 16-36 (RTC Speed Selection) selects Timer 4 and 16-35 (Source of Timer 4) is active in the set time. | ○ | ○ | ○ |
| 37 | Detection Output of PID Feedback Loss | PID Fbk Loss | ON: PID Feedback Loss | ○ | ○ | ○ |
| 38 | Brake Release | Brake Release | ON: Brake Release | X | ○ | X |
| 42 | Over-High Pressure | High PSI | ON: High PSI Warning/Fault | ○ | X | X |

| Value | Function | | Description | Control Mode | | |
|-------|-------------------------------|--------------------|---|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 43 | Over-Low Pressure | Low PSI | ON: Low PSI Warning/Fault | O | X | X |
| 44 | Loss of Pressure Detection | Fb PSI | ON: Fb PSI Fault | O | X | X |
| 45 | PID Sleep | PID Sleep | ON: During PID Sleep | O | O | O |
| 46 | Over-High Flow | Over GPM | ON: Over GPM Warning/Fault | O | O | O |
| 47 | Over-Low Flow | Low GPM | ON: Low GPM Warning/Fault | O | O | O |
| 48 | Shortage of Low Suction | Low Suction | ON: Low Suction Warning/Fault | O | O | O |
| 49 | Communication Error | RS-485 Err. | ON: Communication Error Warning | O | O | O |
| 50 | Frequency Detection 3 | Freq. Detect 3 | ON: Output frequency \geq 03-44 + 03-45 | O | O | O |
| 51 | Frequency Detection 4 | Freq. Detect 4 | OFF: Output frequency \geq 03-44+ 03-45 | O | O | O |
| 52 | Frequency Detection 5 | Freq. Detect 5 | ON: Output frequency \geq 03-46 + 03-47 | O | O | O |
| 53 | Frequency Detection 6 | Freq. Detect 6 | OFF: Output frequency \geq 03-46+ 03-47 | O | O | O |
| 54 | Turn on short-circuit braking | SC Brk | ON: Turn on short-circuit braking | X | X | O |
| 57 | Low Current Detection | Low Current Detect | ON: Output Current \leq 03-48 Low current detection level | O | O | O |

03-1X=0: During Running

| | |
|-----|--|
| OFF | Run command is OFF and the inverter is stopped. |
| ON | Run command is ON or output frequency is greater than 0. |

03-1X=1: Fault contact output

Output is active during fault condition.

Note: Communication error (CF00, CF01) do not activate the fault contact.

03-1X=2: Frequency Agree

Output is active when the output frequency falls within the frequency reference minus the frequency detection width (03-14).

03-1X=3: Setting Frequency Agree

Output is active when the output frequency falls within the frequency detection width (03-14) of the set frequency detection level (03-13).

03-1X=4: Frequency detected 1

Output is active when the output frequency rises above the frequency detection level (03-13) + frequency detection width (03-14) and deactivates when the output frequency falls below frequency detection level (03-13).

03-1X=5: Frequency detected 2

Output is active when the output frequency is below the frequency detection level (03-13) + frequency detection width (03-14) and turns off when the output frequency falls below frequency detection level.

Refer to parameter group 03 for frequency detection function.

03-1X=6: Automatic restart.

Output is active during an auto-restart operation.

03-1X=9: Baseblock (B.B.)

Output is active when the inverter output is turned off during a Baseblock command.

03-1X=12: Over torque detected (Normally Open)

Output is active during an over torque detection see parameters 08-13 ~ 08-16.

03-1X=25: Low torque detected (Normally Open)

Output is active during low torque detection see parameters 08-17 ~ 08-20.

03-1X=13: Current Agree

When the output current is larger than that in 03-15 and its duration is higher than that in 03-16, this function will be ON.

03-1X=18: PLC status (setting =18)

Output is active when operation command parameter (00-02) is set to 3: PLC Control.

03-1X=19: PLC control contact

Output is controlled by the PLC logic

03-1X=20: Zero-speed

Output is active during zero-speed

| | |
|--------|--|
| Active | Output frequency \geq minimum output frequency (01-08, Fmin) |
| Off | Output frequency is \leq the minimum output frequency |

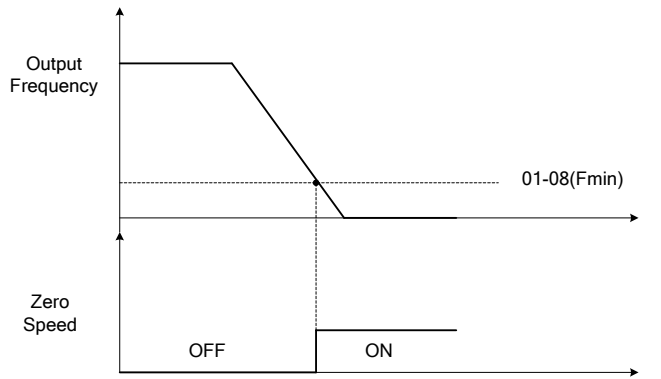


Figure 4.3.23 Zero-speed operation

03-1X=21: Inverter Ready

Output is active when no faults are active and the inverter is ready for operation.

03-1X=22: Undervoltage Detection

Output is active when the DC bus voltage falls below the low voltage detection level (07-13).

03-1X=23: Source of operation command

Output is active in local operation command.

| | |
|------------|--|
| OFF | Remote mode: 00-02 = 1 or 2, or any one of the multi-function digital input terminals (S1 to S6) set to function 5 (LOCAL / REMOTE control) is OFF. SEQ LED of the keypad is ON. |
| ON | Local mode: 00-02 = 0, or any one of the multi-function digital input terminals (S1 to S6) set to function 5 (LOCAL / REMOTE control) is active. SEQ LED of the keypad is OFF. |

03-1X=24: Source of frequency command

Output is active in local frequency command.

| | |
|------------|--|
| OFF | Remote mode: 00-05 = 1 or 2, or any one of the multi-function digital input terminals (S1 to S6) set to function 5 (LOCAL / REMOTE control) is OFF. REF LED of the keypad is ON. |
| ON | Local mode: 00-05 = 0, or any one of the multi-function digital input terminals (S1 to S6) set to function 5 (LOCAL / REMOTE control) is active. REF LED of the keypad is OFF. |

03-1X=26: Frequency reference missing

Output is active when the frequency reference is lost. When parameter 11-41 is set to 0 the inverter will decelerate to a stop. When parameter 11-41 is set to 1 operation will continue at the value of parameter 11-42 times the last know frequency reference.

03-1X=27: Time function output

Output is controlled by timer function see parameter 03-37 and 03-38.

03-1X=32: Communication control contacts

Output is active when communication control is active.

03-1X=37: Detection Output of PID Feedback Loss

When PID feedback loss occurs (refer to parameters setting 10-11~10-13), this function will be ON.

03-1X=38: Brake Release

When this function is ON, Break release is enabled. Refer to parameters descriptions of 03-41~03-42.

03-1X=42: Over-High Pressure

Refer to the setting of parameters 23-12~23-14 for the warning / fault.

03-1X=43: Over-Low Pressure

Refer to the setting of parameters 23-15~23-17 for the warning / fault.

03-1X=44: Loss of Pressure Detection

Refer to the setting of parameters 23-18~23-19 for the warning / fault.

03-1X=45: PID Sleep

PID sleep will be informed.

03-1X=46: Over-High Flow

Refer to the setting of parameters 23-48~23-50 for the warning / fault.

03-1X=47: Over-Low Flow

Refer to the setting of parameters 23-51~23-53 for the warning / fault.

03-1X=48: Shortage of Low Suction

Refer to the setting of parameters 23-54~23-58 for the warning / fault.

03-1X=49: RS-485 communication error

When RS-485 communication error, the output terminal is closed, please refer to the description of 09-06~09-07.

03-1X=54: Turn on short-circuit braking

Output terminal is closed when Turning on short-circuit braking

03-1X=57: Low Current Detection

Output terminal is closed when output current \leq 03-48.

| | |
|--------------|------------------------------------|
| 03-13 | Frequency Detection Level |
| Range | 【0.0~400.0】 Hz |
| 03-14 | Frequency Detection Width |
| Range | 【0.1~25.5】 Hz |
| 03-44 | Frequency Detection Level 2 |
| Range | 【0.0~400.0】 Hz |
| 03-45 | Frequency Detection Width 2 |
| Range | 【0.1~25.5】 Hz |
| 03-46 | Frequency Detection Level 3 |
| Range | 【0.0~400.0】 Hz |
| 03-47 | Frequency Detection Width 3 |
| Range | 【0.1~25.5】 Hz |
| 03-50 | Frequency Detection Level 4 |
| Range | 【0.0~400.0】 Hz |
| 03-51 | Frequency Detection Level 5 |
| Range | 【0.0~400.0】 Hz |
| 03-52 | Frequency Detection Level 6 |
| Range | 【0.0~400.0】 Hz |

Frequency Detection Level: set the multi-function output terminals R1A-R1C, R2A-R2C or R3A-R3C (03-11, 03-12 or 03-39) to the output frequency detection signal. Set frequency and output frequency detection 1 and 2.

The time charts for the Frequency Agree Detection operation are shown in the following Table 4.3.7.

Table 4.3.7 Frequency Detection Operation

| Function | Detection operation of frequency confirmation | Description |
|--|---|--|
| <p>Frequency agree</p> | | <ul style="list-style-type: none"> • Output is active when the output frequency falls within the frequency reference minus the frequency detection width (03-14). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 2 (Frequency agree). |
| <p>Set frequency agree</p> | | <ul style="list-style-type: none"> • Output is active the output frequency falls within the frequency detection width (03-14) of the set frequency detection level (03-13). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 3 (Set frequency agree) |
| <p>Output frequency detection 1</p> | | <ul style="list-style-type: none"> • Output frequency detection 1 signal is ON in acceleration when the output frequency rises above the frequency detection level (03-13) + frequency detection width (03-14). • Output frequency detection 1 signal is OFF in deceleration when the output frequency declines to the frequency detection level 4 (03-50). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 4 (Output frequency detection 1). |
| <p>Output frequency detection 2</p> | | <ul style="list-style-type: none"> • Output frequency detection 2 signal is OFF in acceleration when the output frequency rises above the frequency detection level (03-13) + frequency detection width (03-14). • Output frequency detection 2 signal is ON in deceleration when the output frequency declines to the frequency detection level 4 (03-50). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 5 (Output frequency detection 2). |

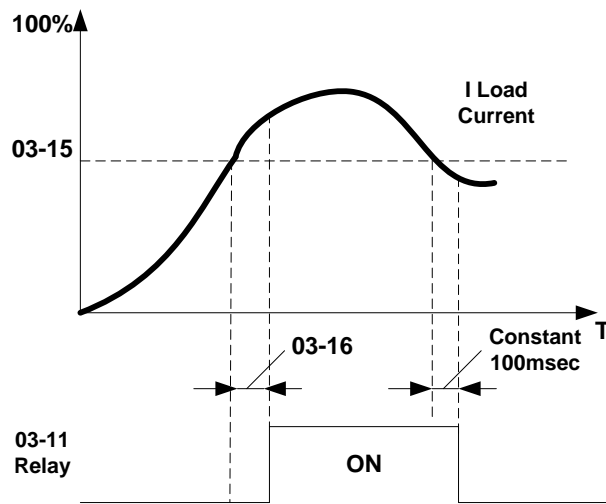
| Function | Detection operation of frequency confirmation | Description |
|------------------------------|---|---|
| Output frequency detection 3 | | <ul style="list-style-type: none"> • Output frequency detection 3 signal is ON in acceleration when the output frequency rises above the frequency detection level 2 (03-44) + frequency detection width 2 (03-45). • Output frequency detection 3 signal is OFF in deceleration when the output frequency declines to the frequency detection level 5 (03-51). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 50 (Output frequency detection 3). |
| Output frequency detection 4 | | <ul style="list-style-type: none"> • Output frequency detection 4 signal is OFF in acceleration when the output frequency rises above the frequency detection level 2 (03-44) + frequency detection width 2 (03-45). • Output frequency detection 4 signal is ON in deceleration when the output frequency declines to the frequency detection level 5 (03-51). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 51 (Output frequency detection 4). |
| Output frequency detection 5 | | <ul style="list-style-type: none"> • Output frequency detection 5 signal is ON in acceleration when the output frequency rises above the frequency detection level 3 (03-46) + frequency detection width 3 (03-47). • Output frequency detection 5 signal is OFF in deceleration when the output frequency declines to the frequency detection level 6 (03-52). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 52 (Output frequency detection 5). |
| Output frequency detection 6 | | <ul style="list-style-type: none"> • Output frequency detection 6 signal is OFF in acceleration when the output frequency rises above the frequency detection level 3 (03-46) + frequency detection width 3 (03-47). • Output frequency detection 6 signal is ON in deceleration when the output frequency declines to the frequency detection level 6 (03-52). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 53 (Output frequency detection 6). |

| | | |
|--------------|--|-----------|
| 03-15 | Current Agree Level | *1 |
| Range | 【0.1~999.9】 A | |
| 03-16 | Delay Time of Current Agree Detection | *1 |
| Range | 【0.1~10.0】 Sec | |

*1: It is new added in inverter software V1.4.

- 03-11=13: Relay is active when output current is larger than that in 03-15.
- 03-15: The suggested setting value is 0.1~ the motor rated current.
- 03-16: The unit of the setting value (0.1~10.0) is second. The delay time of relay signal from ON to OFF is 100ms (constant).

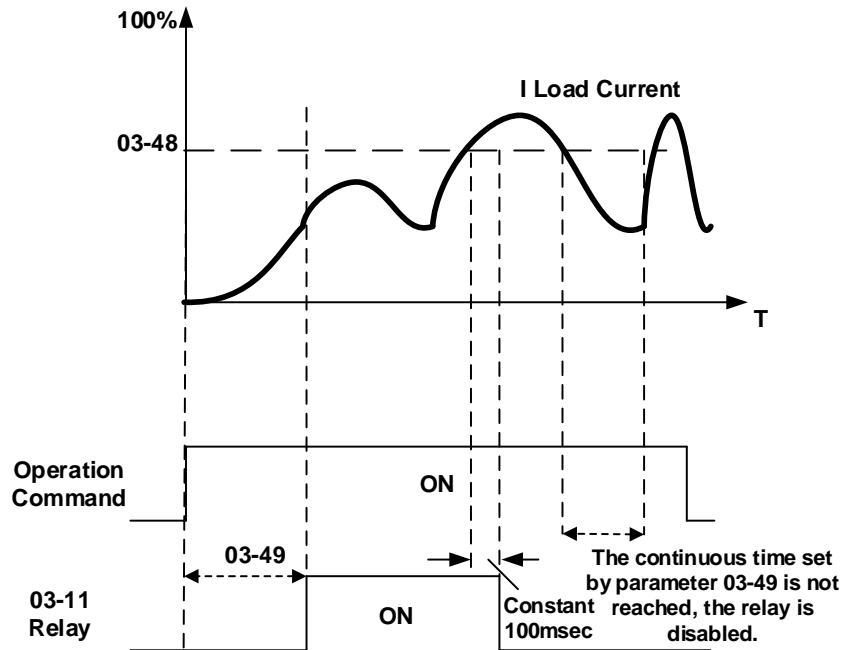
Timing Diagram:



| | | |
|--------------|---|--|
| 03-48 | Low Current Detection Level | |
| Range | 【0.1~999.9】 A | |
| 03-49 | Low current Detection Delay Time | |
| Range | 【0.00~655.35】 Sec | |

- 03-11 =57: Output becomes active when the output current falls below 03-48 level for time specified in 03-49.
- 03-48: Setting value: 0.1~999.9; 0.0 disables the low current detection function.
- 03-49: Setting value: 0.00~655.35 (unit: sec); when the output current falls below 03-48 level for time specified in 03-49. The delay time for the output relay signal to from ON to OFF is 100ms.

Timing Diagram:

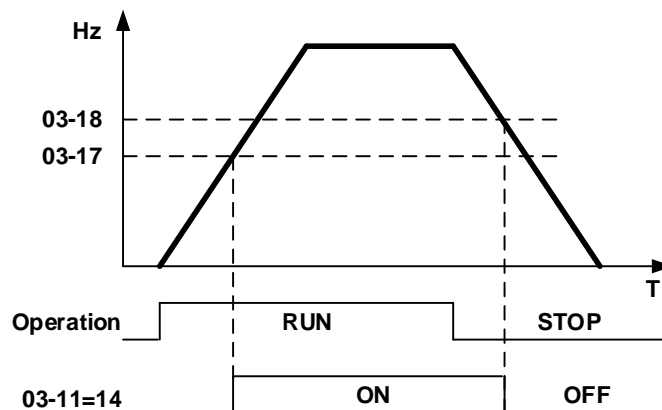


| | |
|--------------|--|
| 03-17 | Setting of Mechanical Brake Release Level |
| Range | 0.00~400.00 Hz |
| 03-18 | Setting of Mechanical Brake Operation Level |
| Range | 0.00~400.00 Hz |

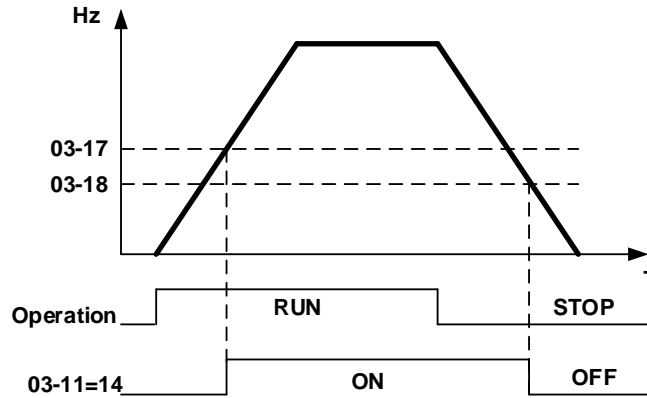
When 03-11=14,

Relay output starts at acceleration if the output frequency reaches the mechanical brake release level (03-17).
Relay output stops at deceleration if the output frequency reaches the mechanical brake operation level (03-18).

When **03-17 ≤ 03-18**, timing diagram is as follows:



When **03-17**≥**03-18**, timing diagram is as follows:



| 03- 19 | Relay (R1A-R3C) Type | |
|--------|--|---|
| Range | 【xx0xb】 : R1A normally open 【xx0xb】 : R2A normally open 【x0xxb】 : R3A normally open | 【xxx1b】 : R1A normally close 【xx1xb】 : R2A normally close 【x1xxb】 : R3A normally close |

Parameter 03-19 selects the digital output type between a normally open and a normally closed contact.
Each bit of 03-19 presents an output:

03-19= 0 0 0 0 0: normally open contact
 R3 R2 R1 1: normally close contact

Example: R1 normally closed and R2 normally open contact set 03-19=x001b.

| 03- 27 | UP/DOWN Frequency Hold/ Adjust Selection |
|--------|---|
| Range | 【0】 : Keep UP/DOWN frequency when stopping. 【1】 : Clear UP/DOWN frequency when stopping. 【2】 : Allow frequency UP/DOWN when stopping. 【3】 : Refresh frequency at acceleration. |

03-27=0: When the run command is removed the UP/DOWN frequency reference before deceleration is stored. The next time the run command is applied the output frequency will ramp up to the previously stored frequency reference.

03-27=1: When the run command is removed the UP/DOWN frequency reference command is cleared (set to 0). The next time the run command is applied the output frequency will start at 0.

03-27=2: UP/DOWN command is active when run command is not active.

03-27=3: Keep the state of frequency command not to be cleared. When Run Command re-sends, press UP/DOWN key before the run frequency reaches the frequency command, press UP/ DOWN key, then:

- When 03-40 = 0, Frequency Command is set by Run Frequency.
- When 03-40≠0, Frequency Command is set by the values of Run Frequency plus the setting frequency of 03-40.

| | | |
|---------------|--|-----------|
| 03- 30 | Pulse Input Selection | *1 |
| Range | 【0】 : Common Pulse Input 【1】 : PWM (Pulse Width Modulation) | |

***1: It is new added in inverter software V1.4.**

There are two modes in pulse input selection:

03-30=0: Common Pulse Input

Pulse Input (PI) = the selected frequency divided by pulse input scaling (set by 03-31), corresponding to the maximum output frequency of motor 1 (01-02).

Note: Monitor parameter 12-79 (pulse input percentage) displays the proportional relationship between input signal and 03-31 (pulse input scaling).

03-30=1: PWM (Pulse Width Modulation)

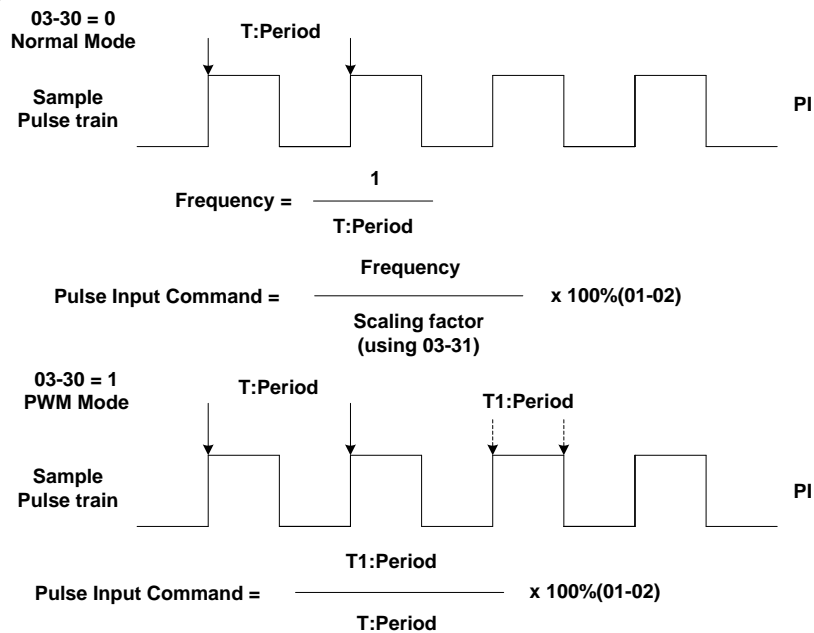
It is required to input the correct frequency.

PWM= posedge pulse time divided by previous pulse time period, corresponding to the maximum output frequency of motor 1 (01-02).

Note: Monitor parameter 12-79 (pulse input percentage) displays the proportional relationship between the positive edge of input signal and time period.

Note: Tolerance range of pulse time period in PWM modes is $\pm 12.5\%$. If it is over than the range, it is inactive.

Diagram of pulse input selection:



| | |
|--------------|----------------------------|
| 03-31 | Pulse Input Scaling |
| Range | 【50~32000】 Hz |

Pulse input scaling, 100% = Maximum pulse frequency.

| | |
|--------------|-------------------------|
| 03-32 | Pulse Input Gain |
| Range | 【0.0~1000.0】 % |

Target value (03-03) in % = Pulse input frequency scaled to 100% based on maximum pulse frequency (03-31) times the gain (03-32) + bias (03-33).

| | |
|--------------|-------------------------|
| 03-33 | Pulse Input Bias |
| Range | 【-100.0~100.0】 % |

Target value (03-03) in % = Pulse input frequency scaled to 100% based on maximum pulse frequency (03-31) times the gain (03-32) + bias (03-33).

| | |
|--------------|--------------------------------|
| 03-34 | Pulse Input Filter Time |
| Range | 【0.00~2.00】 Sec |

* Refer to Fig.4.3.24 for the pulse input specification.

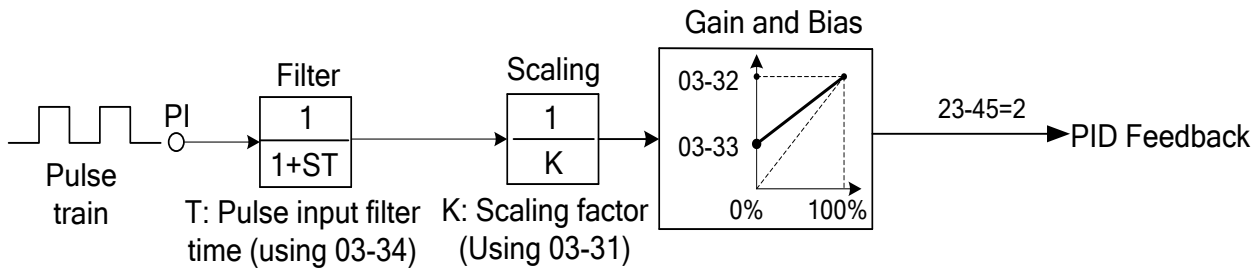


Figure 4.3.24 Pulse input adjustment

Set Pulse Input Setup as Flow Meters Input

Set parameter 23-45 (Given Modes of Flow Meters Feedback) to 2 (Pulse Input) to use the pulse input terminal PI as the flow meters input. Refer to the description of parameter group 23 for details. Next set the pulse input scaling (03-31), enter the pulse input frequency to match the maximum output frequency. Adjust the pulse input filter time (03-34) in case interference or noise is encountered.

| | |
|---------------|--------------------------------|
| 03- 37 | Timer ON Delay (DI/DO) |
| Range | 【0.0~6000.0】 Sec |
| 03-38 | Timer OFF Delay (DI/DO) |
| Range | 【0.0~6000.0】 Sec |

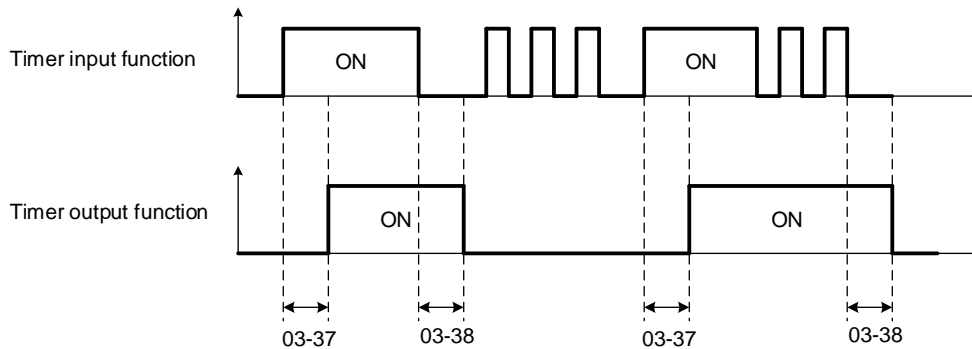
Enable the timer function by setting one of multi-function input parameters 03-00~03-05 (S1 to S6) to 35 (timer function input) and one of multi-function output parameters 03-11, 03-12, 03-39 (R1A-R1C to R3A- R3C) to 27 (timer function output).

The timer function can be used to implement a timer relay. Use timing parameter 03-37 and 03-38 to set the timer ON / OFF delay.

Timer output is turned ON when the multi-function timer input is ON for the time specified in parameter 03-37.

Timer output is turned OFF after the multi-function timer input is OFF for the time specified in parameter 03-38.

Timing example:



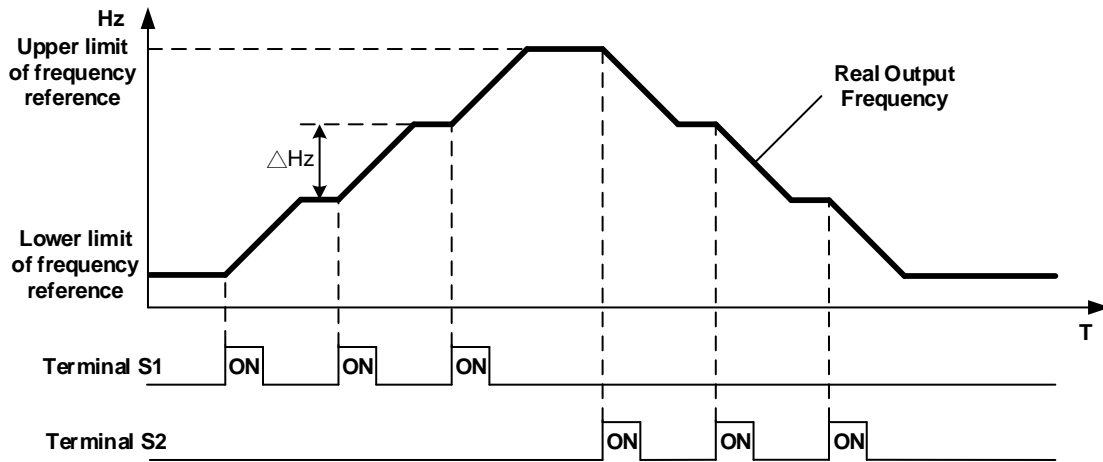
| | | |
|---------------|--|-----------|
| 03- 40 | Up/down Frequency Width Setting | *1 |
| Range | 【0.00~5.00】 Hz | |

*1: It is new added in inverter software V1.4.

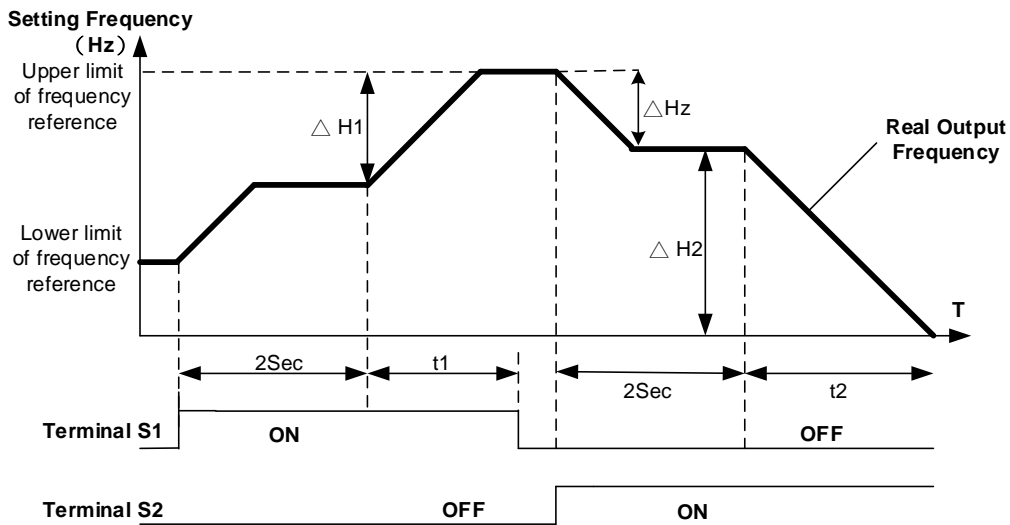
For example: Set terminal **S1: 03- 00= 【8】 (Up Frequency Increasing Command)**, **S2: 03- 01= 【9】 (DOWN Frequency Decreasing Command)** and **03- 40= 【Δ】 Hz**.

Mode1: When 03-40 is set to 0Hz, it will maintain the original **up/down** function, shown as Fig. 4.3.20.

Mode2: When 03-40 is not set to 0Hz and terminal conduction time is lower than 2 sec, conducting one time leading to frequency variation **ΔHz** (setting frequency by 03-40).



Mode3: When 03-40 is not set to 0Hz and terminal conduction time is larger than 2 sec, frequency variation depends on acceleration/ deceleration.



Notes:

ΔH1: setting frequency increment in acceleration, t1: terminal conduction time in acceleration,
 ΔH2: setting frequency increment in deceleration, t2: terminal conduction time in deceleration.

$$\Delta H1 = \frac{\text{Upper Limit Frequency}}{\text{Acceleration Time } 2} \times \text{Terminal Conduction Time } (t1)$$

$$\Delta H2 = \frac{\text{Upper Limit Frequency}}{\text{Deceleration Time } 2} \times \text{Terminal Conduction Time } (t2)$$

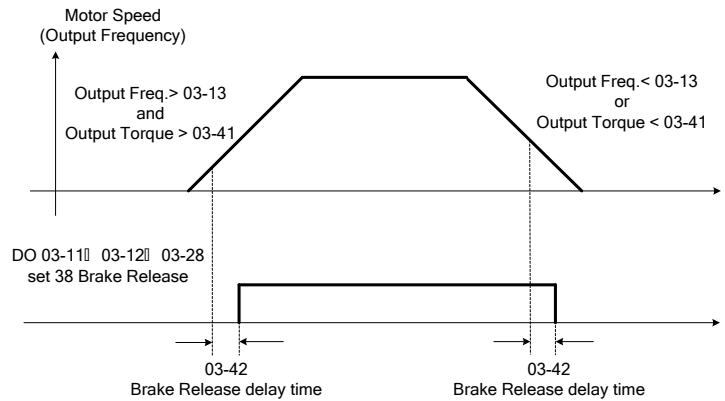
| | | |
|---------------|-------------------------------------|-----------|
| 03- 41 | Torque Detection Level | *1 |
| Range | 【0~150】 % | |
| 03-42 | Delay Time of Braking Action | *1 |
| Range | 【0.00~65.00】 Sec | |

*1: It is new added in inverter software V1.4.

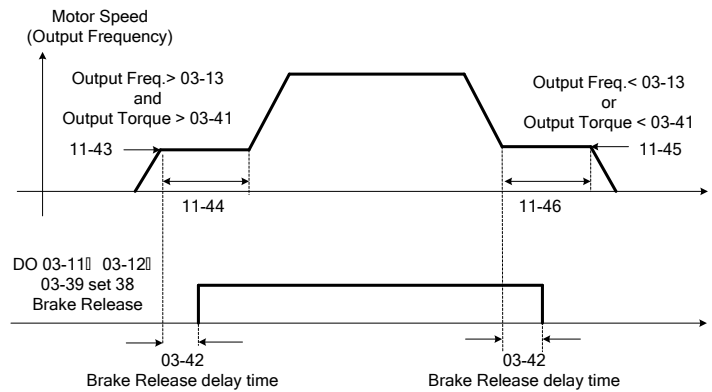
Function of Brake Release:

It requires function of frequency agree to use, shown as the following figure.

When output frequency is larger than frequency detection level (03-13) and output torque is larger than torque detection level (03-41) during Inverter operation, it will delay braking action delay time (03-42) and then release brake.



It is also recommended to be with the use of start and stop frequency locked function (11-43~11-46), shown as the following figure:



| | |
|--------------|--|
| 03-43 | UP/DOWN Acceleration/ Deceleration Selection |
| Range | 【0】 : Acceleration/Deceleration Time 1 【1】 : Acceleration/Deceleration Time 2 |

Calculate the acceleration/ deceleration time of frequency command by switch the function of UP/DOWN from parameter 03-43. Ex: $\Delta H1$ (set frequency increment at acceleration) and $\Delta H2$ (set frequency increment at deceleration).

| |
|---|
| Group 04 External Analog Input and Output Parameters |
|---|

| | |
|---------------|--|
| 04- 00 | AI Input Signal Type |
| Range | 【0】 : AI2 0~10V/0~20mA 【1】 : AI2 4~20mA/ 2~10V |
| 04- 01 | AI1 Signal Scanning and Filtering Time |
| Range | 【0.00~2.00】 Sec |
| 04- 02 | AI1 Gain |
| Range | 【0.0~1000.0】 % |
| 04- 03 | AI1 Bias |
| Range | 【-100~100.0】 % |
| 04- 05 | AI2 Function Setting |
| Range | 【0】 : Auxiliary Frequency 【1】 : Frequency Reference Gain 【2】 : Frequency Reference Bias 【3】 : Output Voltage Bias 【4】 : Coefficient of Acceleration and Deceleration Reduction 【5】 : DC Braking Current* 【6】 : Over-Torque Detection Level 【7】 : Stall Prevention Level During Running 【8】 : Frequency Lower Limit 【9】 : Jump Frequency 4 【10】 : Added to AI1 【11】 : Positive Torque Limit 【12】 : Negative Torque Limit 【13】 : Regenerative Torque Limit 【14】 : Positive / Negative Torque Limit 【15】 : Reserved 【16】 : Torque Compensation 【17】 : Reserved |
| 04- 06 | AI2 Signal Scanning and Filtering Time |
| Range | 【0.00~2.00】 Sec |
| 04- 07 | AI2 Gain |
| Range | 【0.0~1000.0】 % |
| 04- 08 | AI2 Bias |
| Range | 【-100.0~100.0】 % |

Refer to the followings for the details of parameter 04-00 (AI input signal type)

- ① AI2=0~10V, Set 04-00=0, tune SW2 on the control board to V.
- ② AI2=0~20mA, Set 04-00=0, tune SW2 on the control board to I.
- ③ AI2=4~20mA, Set 04-00=1, tune SW2 on the control board to I.
- ④ AI2=2~10V, Set 04-00=1, tune SW2 on the control board to V.

(1) Analog Input Level Adjustment AI1, AI2 (04-02, 04-03, 04-07, 04-08)

Each analog input AI1 and AI2 has a separate gain and bias parameter associated with it.

Analog input signal AI1 can be adjusted with parameter 04-02 and 04-03; Analog input signal AI2 can be adjusted with parameter 04-07 and 04-08. Refer to Fig.4.3.25.

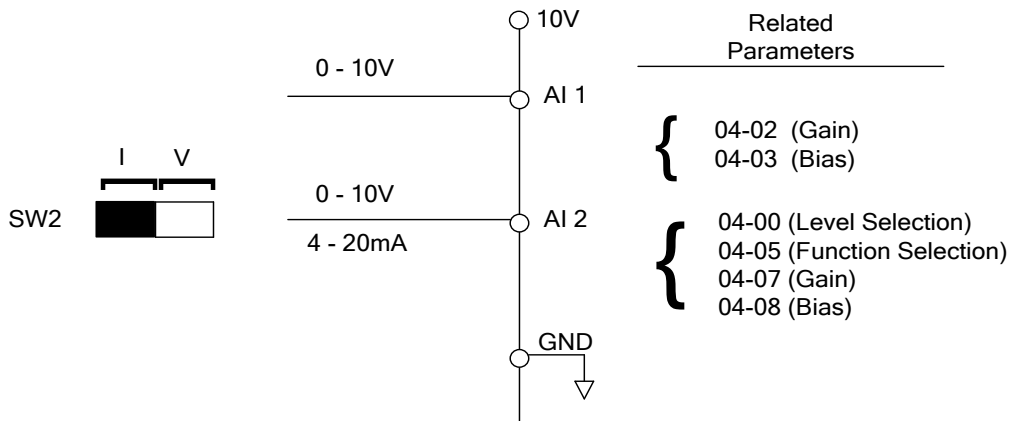


Figure 4.3.25 Analog inputs and related parameters

Gain setting: Sets the level in % that corresponds to a 10V or 20mA signal at the analog input.

Bias setting: Sets the level in % that corresponds to a 0V or 4mA signal at the analog input.

Use both gain and bias setting to scale the input signal.

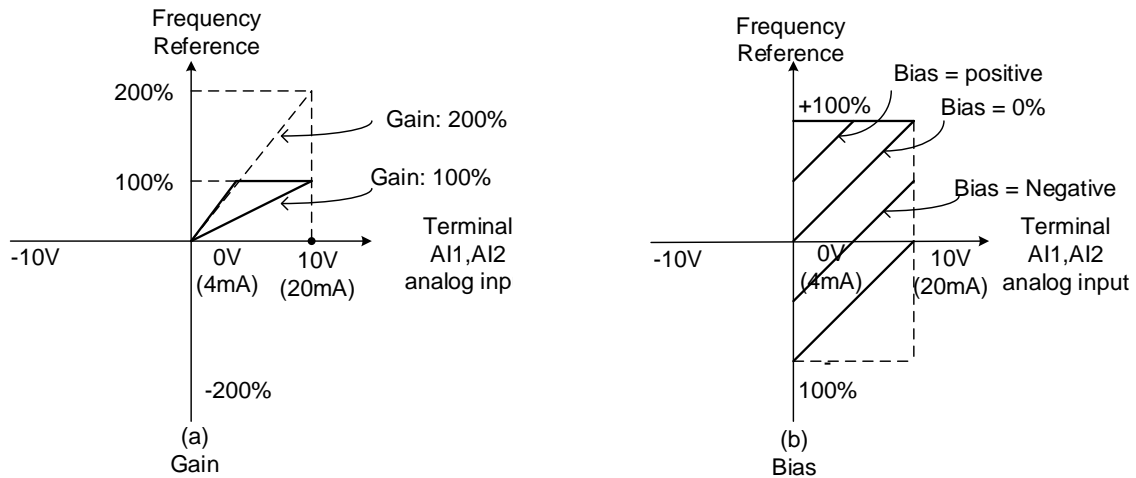


Figure 4.3.26 Gain and bias operations (for frequency reference signal)

(2) AI1 signal filtering time (04-01)

(3) AI2 signal filtering time (04-06)

All analog inputs (AI1, AI2) have a 1st order programmable input filter that can be adjusted when noise is present on each of the incoming analog signal to prevent erratic drive control.

The filter time constant (range: 0.00 to 2.00 seconds) is defined as the time that the input step signal reaches 63% of its final value.

Note: Increasing the filter time causes the drive operation to become more stable but less responsive to change to the analog input.

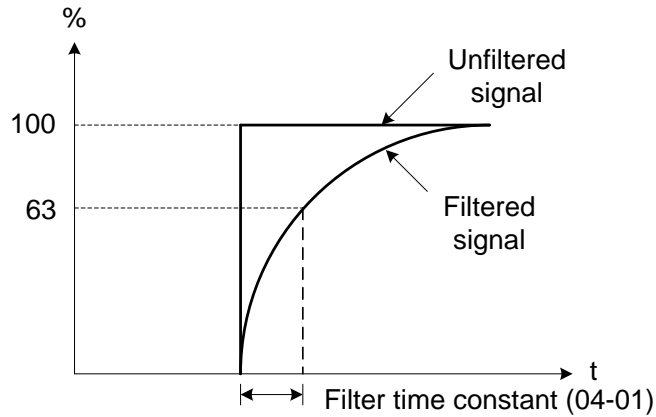


Figure 4.3.27 Filter time constant

(4) AI2 function setting (04-05)

AI2 is multi-function analog input terminal function selection. Refer to Table 4.3.8 for function overview

Table 4.3.8 Multi-function analog input list (04-05 setting)

| Value | Function | | Description | Control mode | | |
|-------|--|-------------------|--|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 0 | Auxiliary Frequency | AUX.Freq Ref | Max Output Frequency (01-02, Fmax) =100% | ○ | ○ | ○ |
| 1 | Frequency Reference Gain (FGAIN) | Freq Ref Gain | Aggregated gain = AI1 = 04-02 * FGAIN | ○ | ○ | ○ |
| 2 | Frequency Reference Bias (FBIAS) | Freq Ref Bias | Aggregated bias = AI1 = 04-03 * FBIAS | ○ | ○ | ○ |
| 3 | Output Voltage Bias (VBIAS) | Output Volt Bias | Aggregate output voltage = V/F curve voltage + VBIAS | ○ | X | ○ |
| 4 | Coefficient of Acceleration and Deceleration Reduction (K) | Tacc/Tdec Scaling | Actual acceleration and deceleration time = accel. and decal. time / K | ○ | ○ | ○ |
| 5 | DC Braking Current | DC Inj Current | Adjust the DC braking current (0 ~ 100%) based on analog input. When the inverter rated current = 100%, DC braking current 07-07 is disabled. | ○ | ○ | ○ |
| 6 | Over-Torque Detection Level | Over Tq Level | Change over-torque detection level based on over-torque detection level, at this time, 08-15 is disabled. | ○ | ○ | ○ |
| 7 | Stall Prevention Level During Running | Run Stall Level | Adjust the action level (30% ~ 200%) of stall prevention in operation based on analog input. The inverter rated current = 100% | ○ | X | ○ |
| 8 | Frequency Lower Limit | Ref. Low Bound | Adjust the lower limit (0 ~ 100%) of frequency command based on analog input, the maximum output = 100%. The lower limit of frequency command is the greater one of the actual frequency command's lower limit 00-13 or the multi-function analog input. | ○ | ○ | ○ |
| 9 | Jump Frequency 4 | Jump Freq 4 | Jump frequency 4. 100% = maximum output frequency | ○ | ○ | ○ |

| Value | Function | | Description | Control mode | | |
|-------|----------------------------------|-------------------|--|--------------|-----|--------|
| | Name | LCD Display | | V/F | SLV | PM SLV |
| 10 | Added to AI1 | Add to AI1 | Added to AI1. 100% = maximum output frequency | 0 | 0 | 0 |
| 11 | Positive Torque Limit | Positive Tq Limit | 100% = Motor's rated torque | X | 0 | 0 |
| 12 | Negative Torque Limit | Negative Tq Limit | 100% = Motor's rated torque | X | 0 | 0 |
| 13 | Regenerative Torque Limit | Regen. Tq Limit | 100% = Motor's rated torque | X | 0 | 0 |
| 14 | Positive / Negative Torque Limit | +/- Tq Limit | 100% = Motor's rated torque | X | 0 | 0 |
| 15 | Torque Limit | Tq Limit | 100% = Motor's rated torque | X | X | X |
| 16 | Torque Compensation | Tq Compensation | 100% = Motor's rated torque | X | 0 | X |
| 17 | Reserved | No Function | Reserved | 0 | 0 | 0 |

04-05=0: Auxiliary frequency

When parameter 00-05 = 1 (main frequency from external control) auxiliary speed reference frequency can be activated via a multi-speed input commands (see table 4.3.5). The auxiliary frequency command uses analog input AI2 and the maximum output frequency is set by 01-02, $F_{max} = 100\%$.

04-05=1: Frequency Reference Gain (FGAIN)

Multi-function analog input AI2 can be used to adjust the frequency reference gain of analog input AI1.

The total frequency reference gain of terminal AI1 is the internal gain set by parameter 04-02 times FGAIN.

The maximum frequency reference for AI1 is 100%.

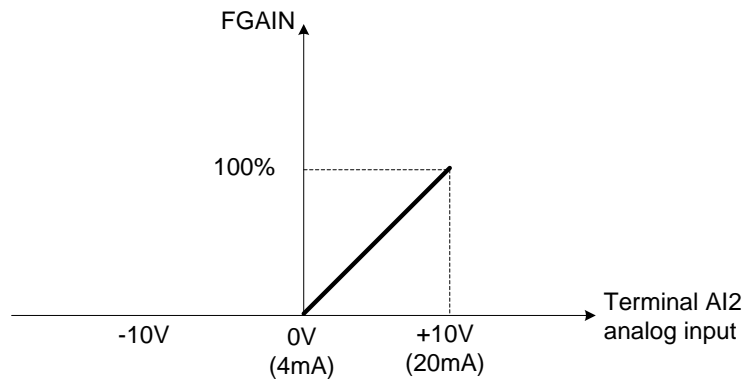


Figure 4.3.28 Frequency gain adjustment

Example:

When the internal gain of AI1 (04-02) is set to 100% and AI2 to 5V (for example FGAIN = 50%), the reference frequency of terminal AI1 will be 50%, as shown in Fig. 4.3.29.

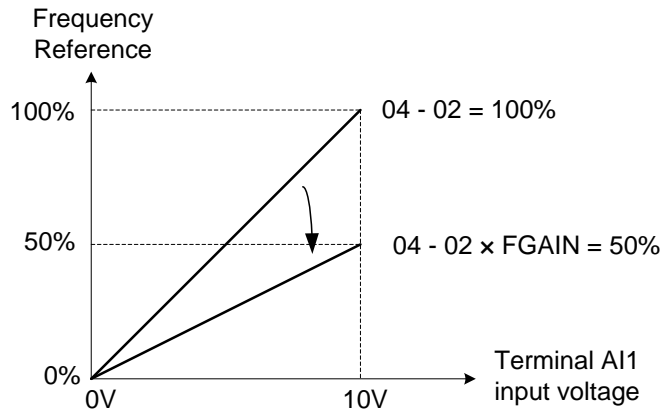


Figure 4.3.29 Frequency reference gain adjustment (example)

04-05=2: Frequency Reference bias (FBIAS)

Multi-function analog input terminal AI2 can be used to adjust the frequency reference bias of AI1. The total frequency reference bias of terminal AI1 is the sum of internal bias set by parameter 04-03 and FBIAS. The maximum frequency reference for AI1 is 100%.

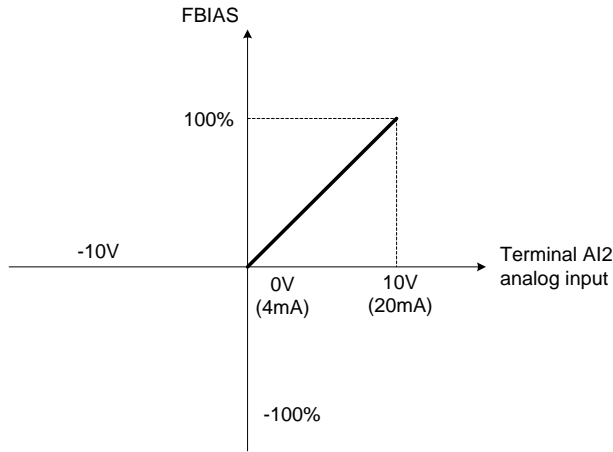


Figure 4.3.30 Bias adjustment

Example:

Terminal AI1 input is 0V, 04-02 = 100% (AI1 gain), 04-03 = 0% (AI1 bias) and terminal AI2 input is 3V. The reference frequency will be 30% as shown in Fig.4.3.31.

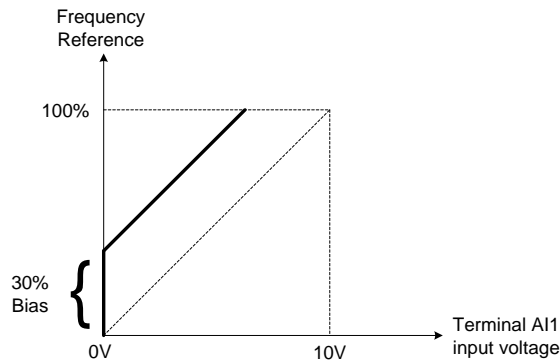


Figure 4.3.31 Frequency Reference bias adjustment (example)

04-05=3: Output Voltage Bias (VBIAS)

Multi-function analog input AI2 can be used to adjust the output voltage. The total output voltage of inverter is the sum of output voltage based on the selected V/F curve (01-00=F) and VBIAS.

The maximum output voltage will be limited by 01-03, $V_{max} = 100\%$

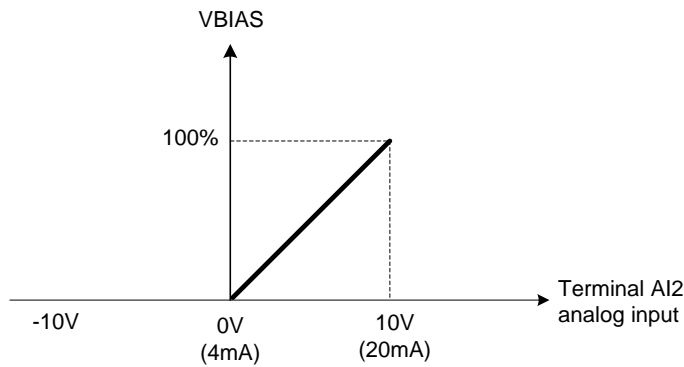


Figure 4.3.32 Bias adjustment

04-05=4: Acceleration and deceleration coefficient (K)

Multi-function analog input AI2 can be used to adjust the acceleration and deceleration time coefficient. The actual acceleration and deceleration time is calculated as follows:

$$\text{Actual accel / decel time} = \frac{\text{Acceleration / Deceleration time (00-14 ~ 00-17, 00-21 ~ 00-24)}}{K}$$

Acceleration/ Deceleration time setting is 100% (00-14~00-17, 00-21~00-24).

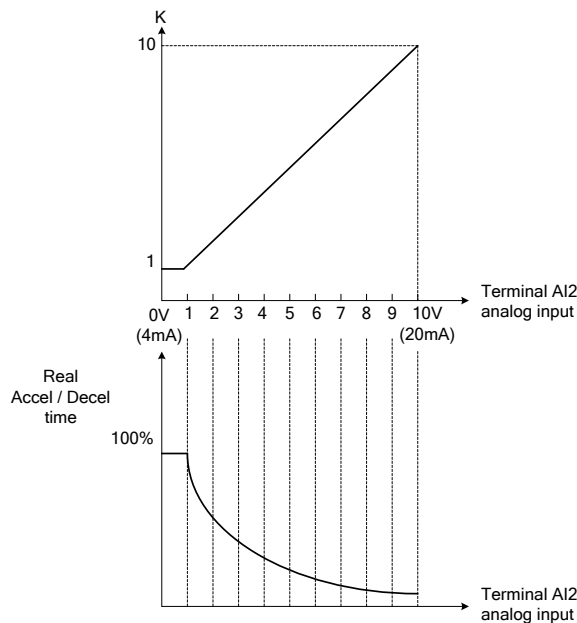


Figure 4.3.33 Acceleration / deceleration time reduction coefficient

04-05=5: DC braking current

Multi-function analog input AI2 can be used to adjust the DC Injection braking current.

DC braking current parameter 07-07 setting should be set to 0% to use this function.

The inverter rated current = 100%

Note: When using the permanent magnet (PM) motor, there will be no options of setting 5.

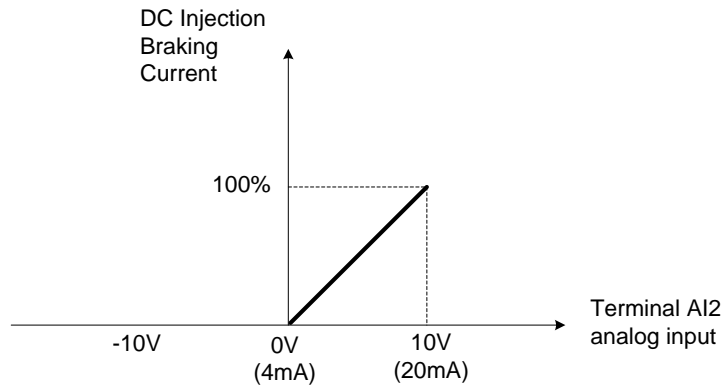


Figure 4.3.34 DC braking current adjustment

04-05=6: Over-torque detection level

Multi-function analog input AI2 can be used to adjust the over-torque detection level.

100% of inverter rated current (V/F control mode)

100% motor rated torque (SLV control mode)

If the multi-function analog input is used to adjust the over-torque level, the internal over-torque detection level (08-15) is disabled.

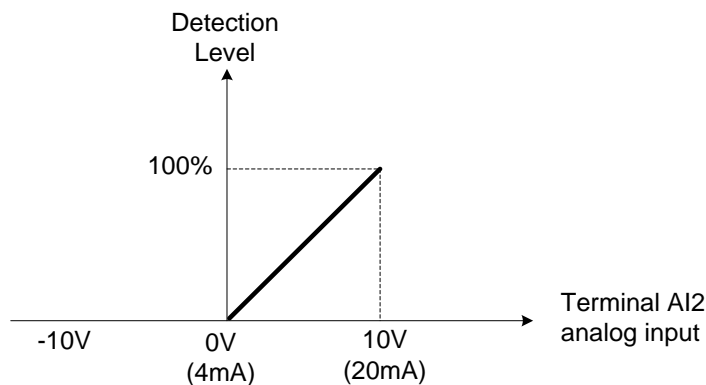


Figure 4.3.35 Over-torque/less torque detection level adjustment

4-05=7: Stall prevention level during running

Multi-function analog input AI2 can be used to adjust the stall prevention level during operation.

Inverter rated current = 100%. When AI2 is set to control stall prevention level (04-05 = 7) and parameter 08-03 (Stall prevention level during operation) is used, then the lesser of the two value becomes the active stall prevention level during operation.

Example: If the motor power is less than that of the inverter, the operation and the stall prevention of the motor will be based on the factory settings, multi-function analog input AI2 can be used to reduce the stall prevention level during operation.

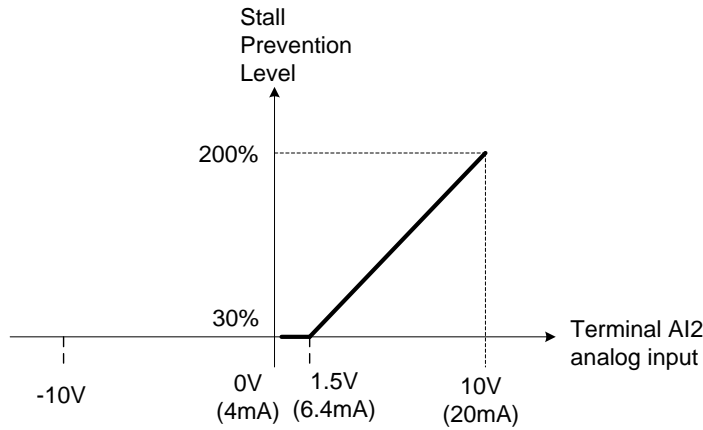


Figure 4.3.36 Stall prevention level adjustment during operation

04-05=8: Frequency lower limit

Multi-function analog input AI2 can be used to adjust the lower limit of frequency reference. Maximum output frequency (F_{max} , 01-02) = 100%. The actual lower limit is determined by the maximum value of 00-13 (frequency lower limit) and level of the multi-function analog input AI2.

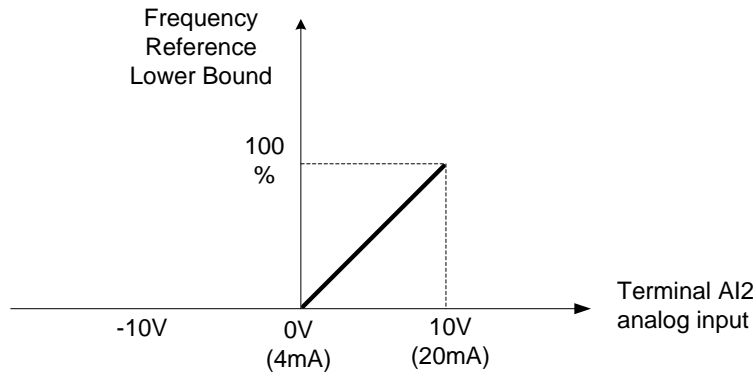


Figure 4.3.37 Adjustment of lower limit of frequency reference

04-05=9: Jump frequency 4

Multi-function analog input AI2 can be used to adjust Jump frequency 4. Maximum output frequency (01-02, F_{max}) = 100%. Setting 11-08 ~ 11-10 to 0.0Hz turns off the Jump frequency function.

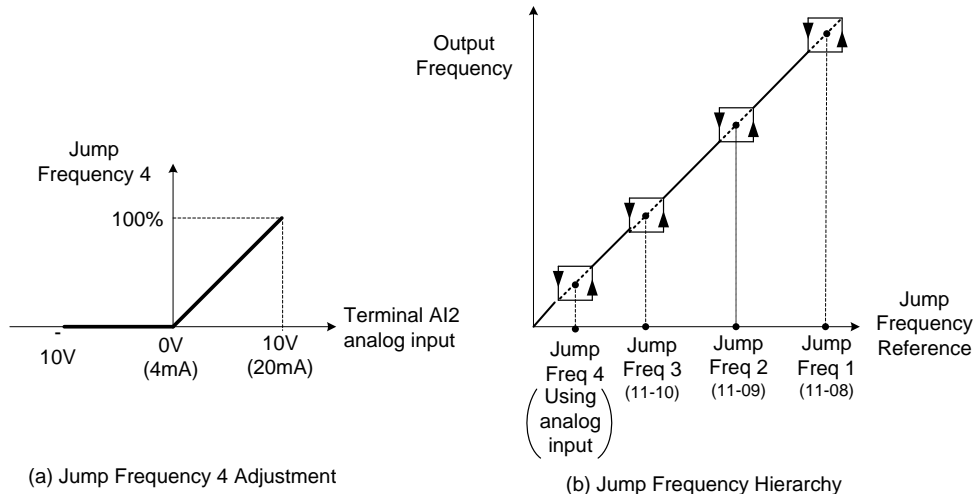


Figure 4.3.38 Jump frequency 4 setting operation

04-05=10: Added to AI1

Multi-function analog input AI2 can be used as a bias level for analog input AI1.

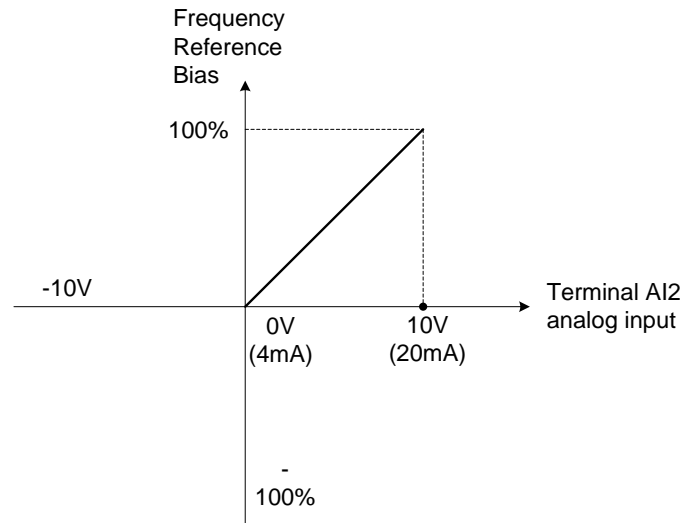


Figure 4.3.39 Added to AI1 as a bias operation

Example:

04-02 (AI1 gain) = 100%, 04-03 (AI2 gain) = 0%, and terminal AI2 level is 2V. If input terminal AI1 is 0V, the internal reference frequency of terminal AI1 will be 20 %

04-05=11: Positive torque limit

Multi-function analog input AI2 can be used to adjust the positive torque limit.

04-05=12: Negative torque limit

Multi-function analog input AI2 can be used to adjust the negative torque limit.

04-05=13: Regenerative torque limit

Multi-function analog input AI2 can be used to adjust the regenerative torque limit.

04-05=14: Positive / negative torque limits

Multi-function analog input AI2 can be used to adjust both the positive and negative torque limit.

For more details on torque limits, please refer to parameter group 21 - torque control group.

04-05=15: Reserved

04-05=16: Torque compensation of speed control

Multi-function analog input AI2 can be used to adjust the torque compensation in closed loop vector mode.

For more details on the torque control functions, please refer to parameter group 21 - torque control group.

| | | |
|--------------|---|--|
| 04-11 | AO1 Function Setting | |
| Range | 【0】 : Output Frequency 【1】 : Frequency Command 【2】 : Output Voltage 【3】 : DC Voltage 【4】 : Output Current 【5】 : Output Power 【6】 : Motor Speed 【7】 : Output Power Factor 【8】 : AI1 Input 【9】 : AI2 Input 【10】 : Torque Command 【11】 : q-axis Current 【12】 : d-axis Current 【13】 : Speed Deviation 【14】 : Reserved 【15】 : ASR Output 【16】 : Reserved 【17】 : q-axis Voltage 【18】 : d-axis Voltage 【19】 ~ 【20】 : Reserved 【21】 : PID Input 【22】 : PID Output 【23】 : PID Target Value 【24】 : PID Feedback Value 【25】 : Output Frequency of the Soft Starter 【26】 : Reserved 【27】 : Reserved 【28】 : Communication Control | |
| 04-12 | AO1 Gain | |
| Range | 【0.0~1000.0】 % | |
| 04-13 | AO1 Bias | |
| Range | 【-100.0~100.0】 % | |
| 04-16 | AO2 Function Setting | |
| Range | Setting range and definition are the same as those of 04-11. | |
| 04-17 | AO2 Gain | |
| Range | 【0.0~1000.0】 % | |
| 04-18 | AO2 Bias | |
| Range | 【-100.0~100.0】 % | |
| 04-19 | AO Output Signal Type | |
| Range | 【0】 : AO1 0~10V 【1】 : AO1 0~10V 【2】 : AO1 4~20mA 【3】 : AO1 4~20mA | AO2 0~10V AO2 4~20mA AO2 0~10V AO2 4~20mA |

For the analog output and related parameters, refer to Fig.4.3.40.

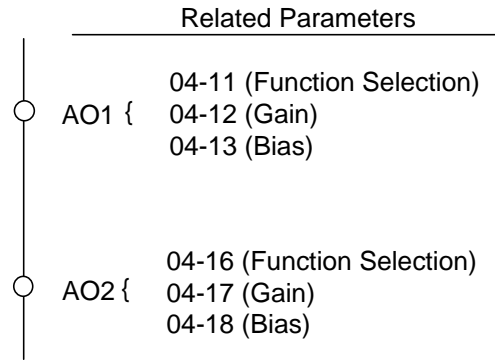


Figure 4.3.40 Analog outputs and related parameters

Analog output AO1 and AO2 adjustment (04-12, 04-13 and 04-17, 04-18)

Signal: Use parameter 04-11 to select the analog output signal for AO1 and parameter 04-16 to select the analog output signal for AO2.

Gain: Use parameter 04-12 to adjust the gain for AO1 and parameter 04-17 to adjust the gain for AO2. Adjust the gain so that the analog output (10V/20mA) matches 100% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

Bias: Use parameter 04-13 to adjust the bias for AO1 and parameter 04-18 to adjust the bias for AO2. Adjust the bias so that the analog output (0V/4mA) matches 0% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

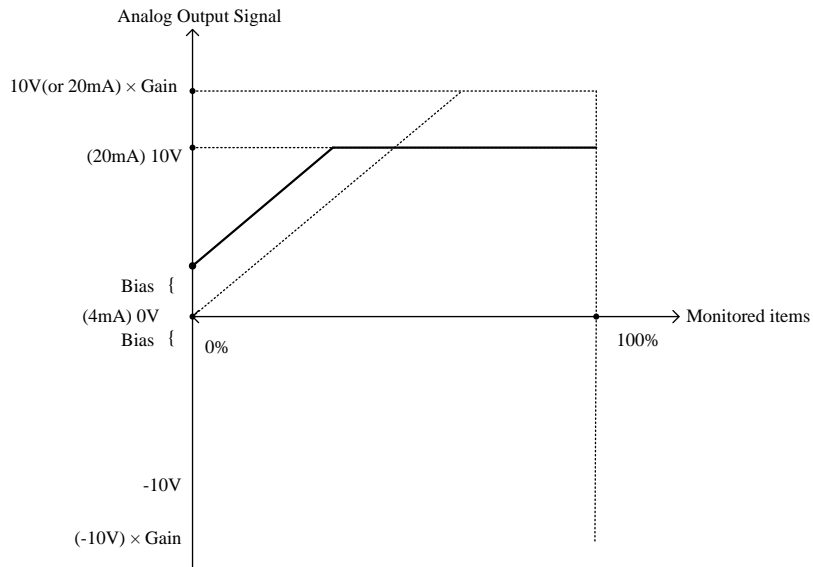


Figure 4.3.41 Analog output level adjustment

Table 4.3.9 Selection of analog output terminals function (04-11 and 04-16)

| 04-11, 04-16 Parameter setting | Function (Keypad display) | Monitoring Parameters Group 12 | Control Mode | | |
|-----------------------------------|------------------------------|-----------------------------------|--------------|-----|-----------|
| | | | VF | SLV | PM SLV |
| 0 | Output Freq | 12-17 | O | O | O |
| 1 | Freq Ref | 12-16 | O | O | O |
| 2 | Output Voltage | 12-19 | O | O | O |
| 3 | DC Voltage | 12-20 | O | O | O |
| 4 | Output Current | 12-18 | O | O | O |
| 5 | Output KW | 12-21 | O | O | O |
| 6 | Motor Speed | 12-22 | O | O | O |
| 7 | Output PF | 12-23 | O | O | O |
| 8 | AI1 Input | 12-25 | O | O | O |
| 9 | AI2 Input | 12-26 | O | O | O |
| 10 | Torque Ref | 12-27 | X | O | O |
| 11 | Current Iq | 12-28 | X | O | O |
| 12 | Current Id | 12-29 | X | O | O |
| 13 | Speed Deviation | 12-30 | X | O | O |
| 14 | Reserved | - | X | X | X |
| 15 | ASR Output | 12-32 | X | X | X |
| 16 | Reserved | - | X | X | X |
| 17 | Voltage Ref Vq | - | X | O | O |
| 18 | Voltage Ref Vd | - | X | O | O |
| 19~20 | Reserved | - | X | X | X |
| 21 | PID Input | 12-36 | O | O | O |
| 22 | PID Output | 12-37 | O | O | O |
| 23 | PID Setpoint | 12-38 | O | O | O |
| 24 | PID Feedback | 12-39 | O | O | O |
| 25 | Output Freq (SFS) | - | O | O | O |
| 26~27 | Reserved | - | X | X | X |
| 28 | Comm Control | - | O | O | O |

| | | |
|--------------|--------------------------------------|-----------|
| 04-20 | Filter Time of AO Signal Scan | *1 |
| Range | 【0.00~0.50】 Sec | |

***1: It is new added in inverter software V1.4.**

This function is used for filtering out momentary changes in the analog output signal.

Note: Increasing the filter time results in a slower system response, decreasing the filter time may cause instability of the analog output signal.

| |
|--|
| Group 05 Multi-Speed Parameters |
|--|

| | |
|---------------|--|
| 05- 00 | Acceleration and Deceleration Selection of Multi-Speed |
| Range | 【0】 : Acceleration and deceleration time are set by 00-14 ~ 00-24 【1】 : Acceleration and Deceleration Time are set by 05-17 ~ 05-48 |

05-00=0: Standard Acceleration and deceleration times parameters 00-14 ~ 00-17 / 00-21 ~ 00-24 are used for multi-speed 0 ~ 15.

05-00=1: Each multi-speed uses a dedicated acceleration and deceleration time parameters 05-17 ~ 05-48. There are two different modes for acceleration / deceleration timing when 05-00 is set to 1, see time example on the next page.

Acceleration time calculation formula

$$\text{Time it takes to reach set frequency} = \frac{\text{Acceleration time} \times (\text{set frequency} - \text{output frequency})}{\text{Maximum output frequency}}$$

Deceleration time calculation formula

$$\text{Time it takes to reach set frequency} = \frac{\text{Deceleration time} \times (\text{output frequency} - \text{set frequency})}{\text{Maximum output frequency}}$$

Maximum output frequency: Parameter 01-00=F, maximum output frequency set by 01-02, 01-00 ≠ F, maximum output frequency determined by V/F curve selected (50.0 / 60.0 / 90.0 / 120.0 / 180.0).

Example: 01-00=01 (50Hz (maximum output frequency)), 05-02=10 Hz (multi-step speed 0), 05-17=5.0s (Acceleration time), 05-18=20.0 sec. (Deceleration time).

Acceleration time calculation formula

$$\text{Time it takes to reach set frequency} = \frac{5.0 \times 10 \text{ Hz}}{50 \text{ Hz}} = 1.0 \text{ sec.}$$

Deceleration time calculation formula

$$\text{Time it takes to reach set frequency} = \frac{20.0 \times 10 \text{ Hz}}{50 \text{ Hz}} = 4.0 \text{ sec.}$$

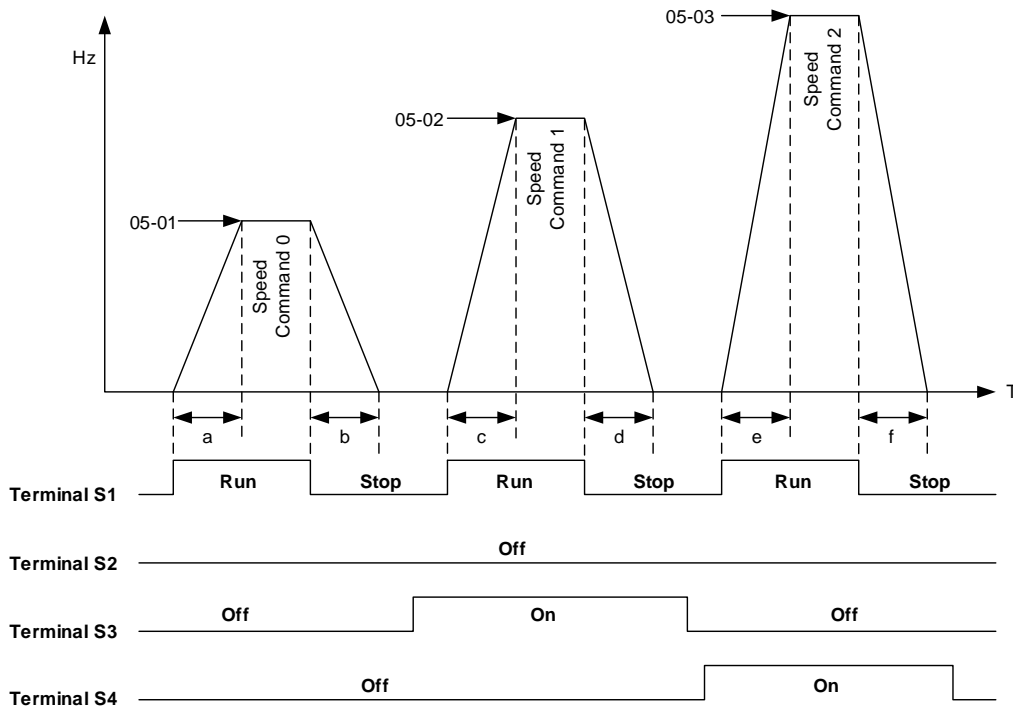
Example: Acceleration / deceleration timing when 05-00 is set to 1. In this example the following parameters are set:

- 00-02=1** (External Terminal Operation)
- 03-00=0** (Terminal S1: Forward /Stop)
- 03-01=1** (Terminal S2: Reversal /Stop)
- 03-02=2** (Terminal S3: Speed 1)
- 03-03=3** (Terminal S4: Speed 2)
- 03-03=4** (Terminal S5: Speed 3)

*Speed 1 is required to confirm if AI2 function setting (04-05) is set to 0 (Auxiliary frequency). If 04-05=0, it will make the frequency of speed 1 set to AI2 auxiliary frequency and the value is determined by AI2. If function of speed 1 is generally used, set AI2 to other functions except 0 (the recommended value: set 10 ADD to AI1.)

Acceleration / Deceleration Calculation Mode 1:

If the run command is cycled on and off, acceleration and deceleration time (a ~ f) is calculated based on the active speed command as follows:

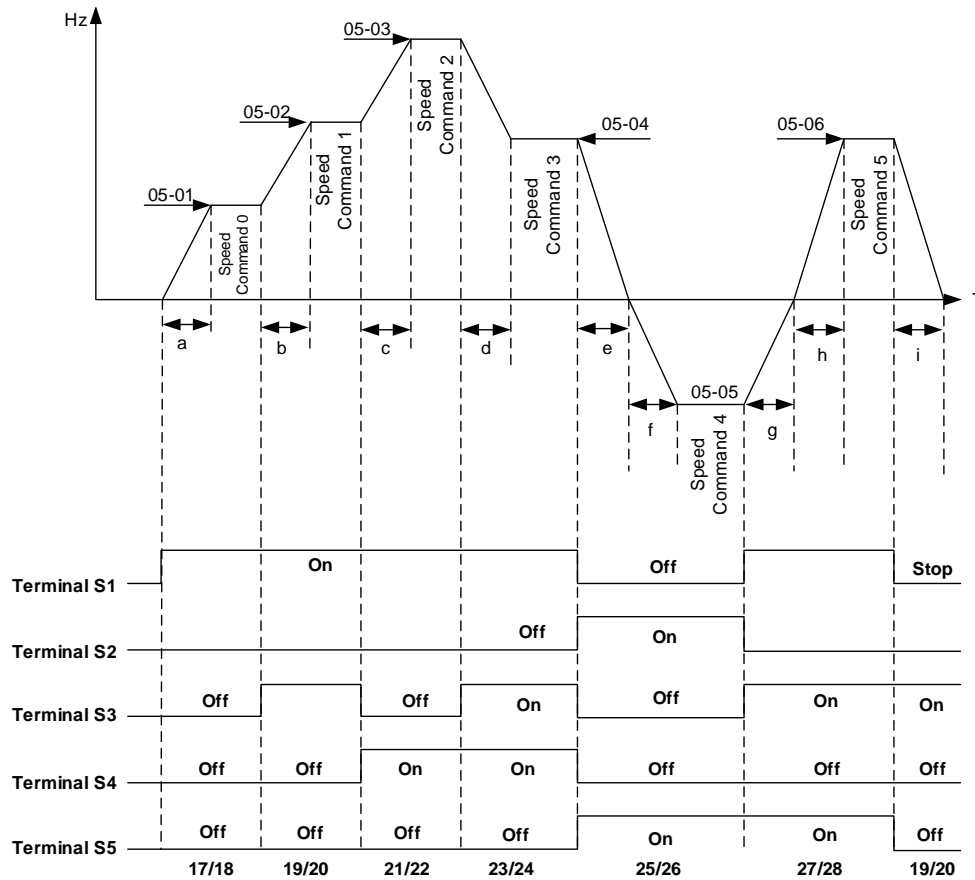


$$a = \frac{(05-17) \times (05-01)}{(01-02)} \quad b = \frac{(05-18) \times (05-01)}{(01-02)} \quad c = \frac{(05-19) \times (05-02)}{(01-02)} \quad \text{in sec.}$$

$$d = \frac{(05-20) \times (05-02)}{(01-02)} \quad e = \frac{(05-21) \times (05-03)}{(01-02)} \quad f = \frac{(05-22) \times (05-03)}{(01-02)} \quad \text{in sec.}$$

Acceleration / Deceleration Calculation Mode 2:

If the run command remains active, acceleration and deceleration time (a ~ f) is calculated based on the active speed command as follows:



$$a = \frac{(05-17) \times (05-01)}{(01-02)} \quad b = \frac{(05-19) \times [(05-02) - (05-01)]}{(01-02)} \quad c = \frac{(05-21) \times [(05-03) - (05-02)]}{(01-02)} \quad \text{in sec.}$$

$$d = \frac{(05-24) \times [(05-03) - (05-04)]}{(01-02)} \quad e = \frac{(05-26) \times (05-04)}{(01-02)} \quad f = \frac{(05-25) \times (05-05)}{(01-02)} \quad \text{in sec.}$$

$$g = \frac{(05-27) \times (05-05)}{(01-02)} \quad h = \frac{(05-27) \times (05-06)}{(01-02)} \quad i = \frac{(05-19) \times (05-06)}{(01-02)} \quad \text{in sec.}$$

| | |
|---------------|--|
| 05- 01 | Frequency Setting of Speed-Stage 0* |
| Range | 【0.0~400.00】 Hz |

| | |
|--------------|---|
| 05-02 | Frequency Setting of Speed- Stage 1* |
| Range | 【0.0~400.00】 Hz |

| | |
|--------------|---|
| 05-03 | Frequency Setting of Speed- Stage 2* |
| Range | 【0.0~400.00】 Hz |

| | |
|-------|---------------------------------------|
| 05-04 | Frequency Setting of Speed- Stage 3* |
| Range | 【0.0~400.00】 Hz |
| 05-05 | Frequency Setting of Speed- Stage 4* |
| Range | 【0.0~400.00】 Hz |
| 05-06 | Frequency Setting of Speed- Stage 5* |
| Range | 【0.0~400.00】 Hz |
| 05-07 | Frequency Setting of Speed- Stage 6* |
| Range | 【0.0~400.00】 Hz |
| 05-08 | Frequency Setting of Speed- Stage 7* |
| Range | 【0.0~400.00】 Hz |
| 05-09 | Frequency Setting of Speed- Stage 8* |
| Range | 【0.0~400.00】 Hz |
| 05-10 | Frequency Setting of Speed- Stage 9* |
| Range | 【0.0~400.00】 Hz |
| 05-11 | Frequency Setting of Speed- Stage 10* |
| Range | 【0.0~400.00】 Hz |
| 05-12 | Frequency Setting of Speed- Stage 11* |
| Range | 【0.0~400.00】 Hz |
| 05-13 | Frequency Setting of Speed- Stage 12* |
| Range | 【0.0~400.00】 Hz |
| 05-14 | Frequency Setting of Speed- Stage 13* |
| Range | 【0.0~400.00】 Hz |
| 05-15 | Frequency Setting of Speed- Stage 14* |
| Range | 【0.0~400.00】 Hz |
| 05-16 | Frequency Setting of Speed- Stage 15* |
| Range | 【0.0~400.00】 Hz |
| | 【0.1~6000.0】 Sec |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

| | |
|-------|---|
| 05-17 | Acceleration time setting for multi speed 0 |
| Range | 【0.1~6000.0】 Sec |
| 05-18 | Deceleration time setting for multi speed 0 |
| Range | 【0.1~6000.0】 Sec |
| 05-19 | Acceleration time setting for multi speed 1 |
| Range | 【0.1~6000.0】 Sec |
| 05-20 | Deceleration time setting for multi speed 1 |
| Range | 【0.1~6000.0】 Sec |
| 05-21 | Acceleration time setting for multi speed 2 |
| Range | 【0.1~6000.0】 Sec |
| 05-22 | Deceleration time setting for multi speed 2 |
| Range | 【0.1~6000.0】 Sec |
| 05-23 | Acceleration time setting for multi speed 3 |
| Range | 【0.1~6000.0】 Sec |
| 05-24 | Deceleration time setting for multi speed 3 |
| Range | 【0.1~6000.0】 Sec |
| 05-25 | Acceleration time setting for multi speed 4 |
| Range | 【0.1~6000.0】 Sec |
| 05-26 | Deceleration time setting for multi speed 4 |
| Range | 【0.1~6000.0】 Sec |
| 05-27 | Acceleration time setting for multi speed 5 |
| Range | 【0.1~6000.0】 Sec |
| 05-28 | Deceleration time setting for multi speed 5 |
| Range | 【0.1~6000.0】 Sec |
| 05-29 | Acceleration time setting for multi speed 6 |
| Range | 【0.1~6000.0】 Sec |
| 05-30 | Deceleration time setting for multi speed 6 |
| Range | 【0.1~6000.0】 Sec |
| 05-31 | Acceleration time setting for multi speed 7 |
| Range | 【0.1~6000.0】 Sec |
| 05-32 | Deceleration time setting for multi speed 7 |
| Range | 【0.1~6000.0】 Sec |

| | |
|--------------|---|
| 05-33 | Acceleration time setting for multi speed 8 |
| Range | 【0.1~6000.0】 Sec |
| 05-34 | Deceleration time setting for multi speed 8 |
| Range | 【0.1~6000.0】 Sec |
| 05-35 | Acceleration time setting for multi speed 9 |
| Range | 【0.1~6000.0】 Sec |
| 05-36 | Deceleration time setting for multi speed 9 |
| Range | 【0.1~6000.0】 Sec |
| 05-37 | Acceleration time setting for multi speed 10 |
| Range | 【0.1~6000.0】 Sec |
| 05-38 | Deceleration time setting for multi speed 10 |
| Range | 【0.1~6000.0】 Sec |
| 05-39 | Acceleration time setting for multi speed 11 |
| Range | 【0.1~6000.0】 Sec |
| 05-40 | Deceleration time setting for multi speed 11 |
| Range | 【0.1~6000.0】 Sec |
| 05-41 | Acceleration time setting for multi speed 12 |
| Range | 【0.1~6000.0】 Sec |
| 05-42 | Deceleration time setting for multi speed 12 |
| Range | 【0.1~6000.0】 Sec |
| 05-43 | Acceleration time setting for multi speed 13 |
| Range | 【0.1~6000.0】 Sec |
| 05-44 | Deceleration time setting for multi speed 13 |
| Range | 【0.1~6000.0】 Sec |
| 05-45 | Acceleration time setting for multi speed 14 |
| Range | 【0.1~6000.0】 Sec |
| 05-46 | Deceleration time setting for multi speed 14 |
| Range | 【0.1~6000.0】 Sec |
| 05-47 | Acceleration time setting for multi speed 15 |
| Range | 【0.1~6000.0】 Sec |
| 05-48 | Deceleration time setting for multi speed 15 |
| Range | 【0.1~6000.0】 Sec |

Group 06 Automatic Program Operation Parameters

| 06- 00 | Automatic Operation Mode Selection |
|--------|--|
| Range | <p>【0】 : Disable</p> <p>【1, 4】 : Execute a single cycle operation. Restart speed is based on the previous stopped speed.</p> <p>【2, 5】 : Execute continuous cycle operation. Restart speed is based on the previous cycle stop speed.</p> <p>【3, 6】 : After completion of a single cycle, the on-going operation speed is based on the speed of the last stage. Restart speed is based on the previous stopped speed</p> <p>1 to 3: After a stop the inverter will start with the incomplete step when the run command is re-applied.</p> <p>4 to 6: After a stop the inverter will start with the first step of the cycle when the run command is re-applied.</p> |

Automatic operation mode uses frequency reference parameters 05-01, 06-01~06-15, operation time parameters 06-16 ~ 06-31 and direction of operation parameters 06-32~06-47.

Note: The automatic operation mode is disabled when any of the following functions are enabled:

- Frequency wobbling function
- PID function
- Parameters 06-16 to 06-31 are set to 0.

Notes:

- When automatic operation mode is enabled multi-step speed reference command 1~4 (03-00~03-07=2~5) is disabled.
- Frequency of multi-step speed 0 is set by 05-01.
- Acceleration/deceleration time is set by parameter 00-14 and 00-15 in automatic operation mode.

| Automatic operation frequency reference settings | |
|--|---|
| 06-01 | Frequency Setting of Operation -Stage 1* |
| 06-02 | Frequency Setting of Operation -Stage 2* |
| 06-03 | Frequency Setting of Operation -Stage 3* |
| 06-04 | Frequency Setting of Operation -Stage 4* |
| 06-05 | Frequency Setting of Operation -Stage 5* |
| 06-06 | Frequency Setting of Operation -Stage 6* |
| 06-07 | Frequency Setting of Operation -Stage 7* |
| 06-08 | Frequency Setting of Operation -Stage 8* |
| 06-09 | Frequency Setting of Operation -Stage 9* |
| 06-10 | Frequency Setting of Operation -Stage 10* |
| 06-11 | Frequency Setting of Operation -Stage 11* |
| 06-12 | Frequency Setting of Operation -Stage 12* |
| 06-13 | Frequency Setting of Operation -Stage 13* |
| 06-14 | Frequency Setting of Operation -Stage 14* |
| 06-15 | Frequency Setting of Operation -Stage 15* |
| Range | 0.00~400.00 Hz |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

| Automatic operation time settings | |
|-----------------------------------|-------------------------------------|
| 06-16 | Time Setting of Operation -Stage 0 |
| 06-17 | Time Setting of Operation -Stage 1 |
| 06-18 | Time Setting of Operation -Stage 2 |
| 06-19 | Time Setting of Operation -Stage 3 |
| 06-20 | Time Setting of Operation -Stage 4 |
| 06-21 | Time Setting of Operation -Stage 5 |
| 06-22 | Time Setting of Operation -Stage 6 |
| 06-23 | Time Setting of Operation -Stage 7 |
| 06-24 | Time Setting of Operation -Stage 8 |
| 06-25 | Time Setting of Operation -Stage 9 |
| 06-26 | Time Setting of Operation -Stage 10 |
| 06-27 | Time Setting of Operation -Stage 11 |
| 06-28 | Time Setting of Operation -Stage 12 |
| 06-29 | Time Setting of Operation -Stage 13 |
| 06-30 | Time Setting of Operation -Stage 14 |
| 06-31 | Time Setting of Operation -Stage 15 |
| Range | 0.0~6000.0 Sec |

| Automatic operation direction settings | |
|--|--|
| 06-32 | Direction Selection of Operation -Stage 0 |
| 06-33 | Direction Selection of Operation -Stage 1 |
| 06-34 | Direction Selection of Operation -Stage 2 |
| 06-35 | Direction Selection of Operation -Stage 3 |
| 06-36 | Direction Selection of Operation -Stage 4 |
| 06-37 | Direction Selection of Operation -Stage 5 |
| 06-38 | Direction Selection of Operation -Stage 6 |
| 06-39 | Direction Selection of Operation -Stage 7 |
| 06-40 | Direction Selection of Operation -Stage 8 |
| 06-41 | Direction Selection of Operation -Stage 9 |
| 06-42 | Direction Selection of Operation -Stage 10 |
| 06-43 | Direction Selection of Operation -Stage 11 |
| 06-44 | Direction Selection of Operation -Stage 12 |
| 06-45 | Direction Selection of Operation -Stage 13 |
| 06-46 | Direction Selection of Operation -Stage 14 |
| 06-47 | Direction Selection of Operation -Stage 15 |
| Range | 0: Stop, 1: Forward, 2: Reversal |

Example 1: Automatic operation mode – Single cycle

In this example the inverter executes a single cycle and then stops.

Parameter Settings:

- 06-00 = 1 (Single cycle operation)
- 06-32~06-34 = 1 (Forward for operation stage 0 - 2)
- 06-47 = 2 (Reversal for operation stage 15)
- 06-35~06-46 = 0 (Stop for operation frequency stage 3 - 14)
- 05-01 = 15 Hz (Operation frequency stage 0: 15 Hz)
- 06-01 = 30 Hz (Operation frequency stage 1: 30 Hz)
- 06-02 = 50 Hz (Operation frequency stage 2: 50 Hz)
- 06-15 = 20 Hz (Operation frequency stage 15: 20 Hz)
- 06-16 = 20 sec (Operation time stage 0: 20 sec)
- 06-17 = 25 sec (Operation time stage 1: 25 sec)
- 06-18 = 30 sec (Operation time stage 2: 30 sec)
- 06-31 = 40 sec (Operation time stage 15 :40 sec)

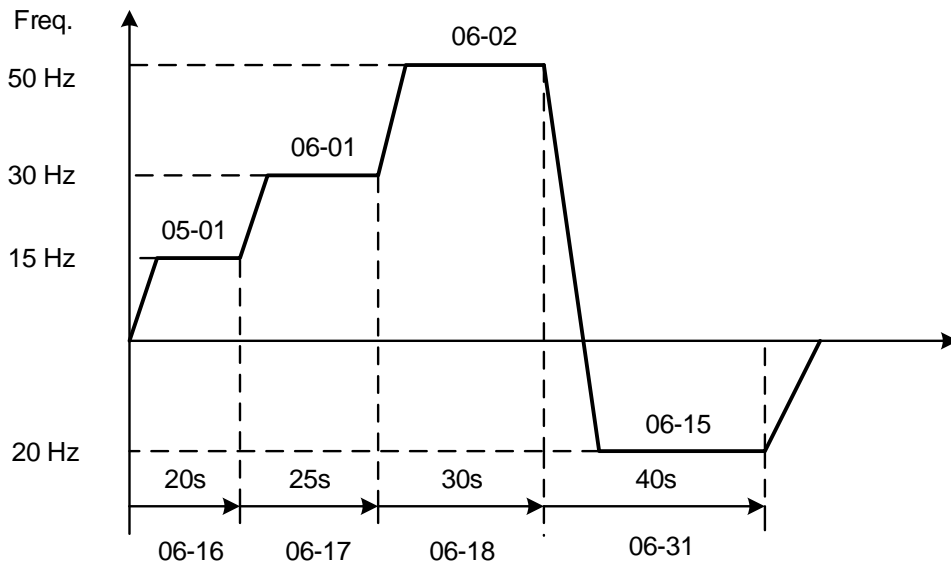


Figure 4.3.42 Single cycle automatic operation (stop)

Example 2: Automatic operation mode – Continuous cycle

In this example the inverter repeats the same cycle.

Parameter Settings:

- 06-00 = 2 or 5 (Continuous cycle operation)
- 06-01~06-47= Enter same setting as that of Example 1.

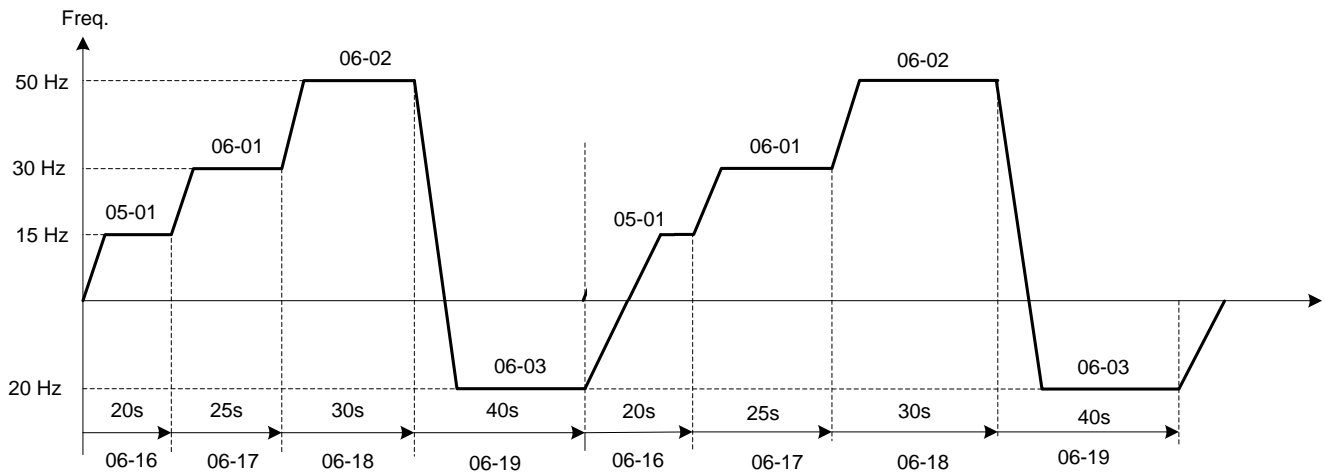


Figure 4.3.43 Periodic automatic operation

Example 3: Automatic operation mode – Single cycle and continue running at last speed of the cycle

In this example the inverter executes a single cycle and continue running at last speed of the cycle.

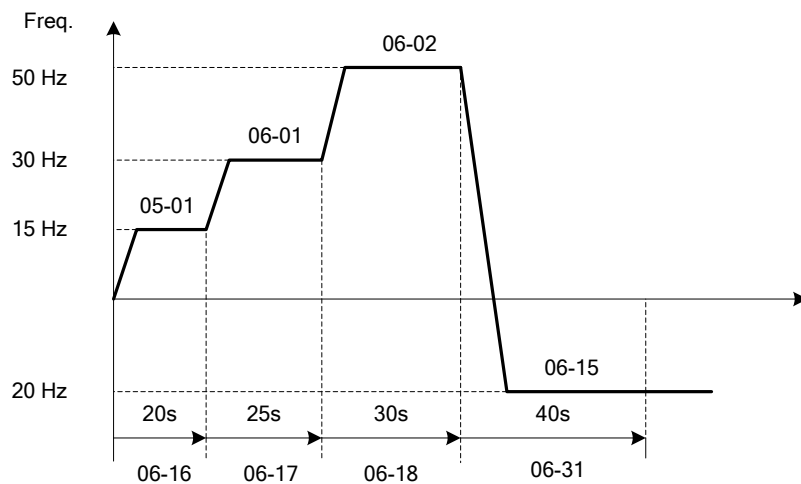


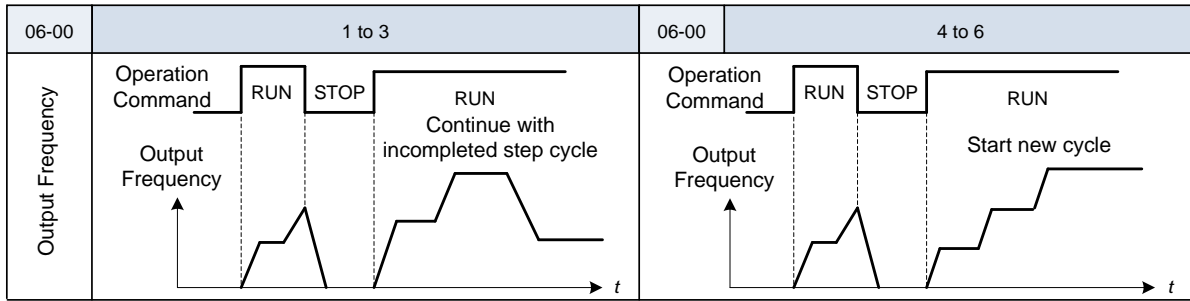
Figure 4.3.44 Single cycle automatic operation (continuous)

06-00= 1 to 3:

After a stop the inverter will start with the incomplete step when the run command is re-applied.

06-00= 4 to 6:

After a stop the inverter will start with the first step of the cycle when the run command is re-applied.



Notes:

- Acceleration/ deceleration time is set with parameters 00-14 and 00-15 in automatic operation mode.
- Automatic operation mode is disabled when parameter 06-16 ~ 06-31 are set to 0.

| |
|---|
| Group 07: Start /Stop Parameters |
|---|

| | |
|---------------|---|
| 07- 00 | Momentary Power Loss/Fault Restart Selection |
| Range | 【0】 : Disable 【1】 : Enable |

07-00=0: Inverter trips on “UV” fault if power is lost for more than 8ms.
07-00=1: Inverter restarts after power to the inverter is restored.

Note: When 07-00=1, inverter restore automatically the motor rotation after restarting the power even if momentary power loss occurs.

| | |
|---------------|--------------------------------|
| 07- 01 | Fault Auto-Restart Time |
| Range | 【0~7200】 Sec |

07-01 = 0 sec.: Automatic restart time interval is set by minimum baseblock time (07-18).
 07-01 <07-18: Automatic restart time interval is set by minimum baseblock time (07-18).
 07-01 > 07-18: Automatic restart time interval is set by fault reset time (07-01).

Note:
 Automatic restart time interval is time specified in 07-18 plus 07-01 and speed search delay time (07-22).

Refer to Fig.4.3.45 for setting automatic restart interval.

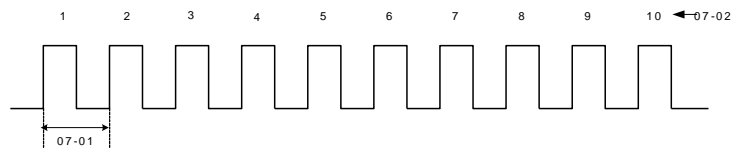


Figure 4.3.45 Automatic restart operation

| | |
|---------------|--|
| 07- 02 | Number of Fault Auto-Restart Attempts |
| Range | 【0~10】 |

When the total number of restart attempts has exceeded the number of automatic restart attempts set in parameter 07-02, the inverter will turn off the output and the fault contact is activated. Manually resetting the inverter is required at this time.

When the automatic restart function is enabled the internal automatic restart attempt counter is reset based on the following actions:

1. No fault occurs in 10 minutes or longer after the automatic restart
2. Reset command to clear fault via input terminal or using the keypad (press reset/◀ key)
3. Power to the inverter is turned off and back on again

Note:
 Multi-function digital output R1A-R1C, R2A-R2C, R3A-R3C can be programmed to activate during an automatic reset attempt, refer to parameter 03-11, 03-12 and 03-39.

Automatic restart operation:

Inverter trips and inverter output is turned off, keypad shows the active fault. Next inverter waits for the minimum baseblock time parameter 07-18 to expire before accepting an automatic restart command.

After the minimum baseblock time (07-18) and speed search delay time have expired, the active fault is reset and a speed search operation is performed. The time between each fault restart attempt is set by parameter 07-01.

When the total number of restart attempts has exceeded the number of automatic restart attempts set in parameter 07-02, the inverter will turn off the output and the fault contact is activated. Manually resetting the inverter is required at this time.

Please refer to Figure 4.3.46 for the automatic restart operation.

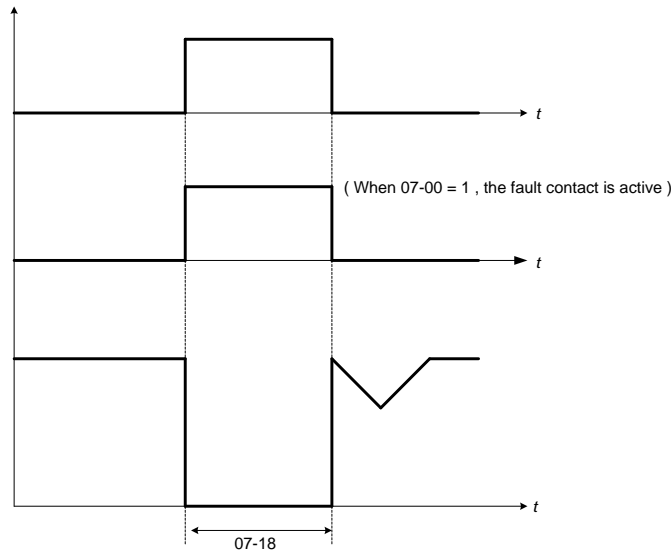


Figure 4.3.46 Auto-restart operation

The automatic restart function is active for the following faults. Please note that when the fault is not listed in the table the inverter will not attempt an automatic restart.

| Parameter Name | Faults | | Numbers of Restart |
|----------------|--|--|----------------------------------|
| 07-00 | UV (under voltage) | | Unlimited |
| 07-01 | OC (over current) OCA (over current in ACC.) OCC (over current in constant speed) | GF (ground failure) OV (overvoltage) OL2 (Inverter overload) OT (Over-torque detection) | Depend on parameter 07-02 |
| 07-02 | OCd (over current in DEC) OL1 (motor overload) UT (Under torque detection) IPL (input phase loss) | OPL (Output phase loss) CF07 (SLV motor control setting fault) CF08 (PMSLV motor control setting fault) | |

Notes:

1. Fault restart function performs a momentary power loss restart and auto reset restart.
2. Refer to chapter 10 for the details for troubleshooting and fault diagnostics of the inverter.
3. Refer to speed search function (07-19~07-24) for the selection of speed search modes.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including adding and posting warning labels.

Warning - Excessively use of the automatic restart function will damage the inverter.

| | |
|---------------|--|
| 07- 04 | Automatic start at power up |
| Range | 【0】 : Automatic start at power up when external run command is enabled 【1】 : Without automatic start at power up when external run command is enabled |

When direct run on power up is enabled (07-04=0) and the inverter is set to accept an external run command (00-02/00-03=1), the inverter will automatically start when power is applied and the run switch is ON.

It is recommend turning off the run switch when power to the inverter is turned off to avoid possibility of injury to operators and damage to machines when power is applied to the inverter.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including adding and posting warning labels.

When direct run is disabled (07-04 =1) and the inverter is set to accept an external run command (00-02/00-03=1), the inverter will not start when power is applied. In this condition the display will flash with STP1. To start the inverter turn the run switch to OFF and back ON again.

| | |
|---------------|--|
| 07- 05 | Automatic start delay at power up |
| Range | 【1.0~300.0】 Sec |

When 07-04=0 the inverter will wait for the time specified in 07-05 to start after power is applied.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including warning labels.

| | |
|--------------|--|
| 07-06 | DC injection braking starting frequency |
| Range | 0.0~10.0 Hz |

DC Injection braking functionality depends on the selected control mode (00-00), please refer to the description below for each control mode.

V/f or SLV Control mode (00-00 = 0, 2):

DC Injection Brake Start Frequency parameter (07-06) is the level the output frequency has to reach before DC braking injection function is de-activated at start and activated at stop.

DC Injection Brake Level (07-07) is set as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

DC Injection Brake Time at Start (07-16) specifies the time DC injection braking time is active at start. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

DC Injection Brake Time at Stop (07-08) specifies the time DC injection braking is active during a stop operation. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

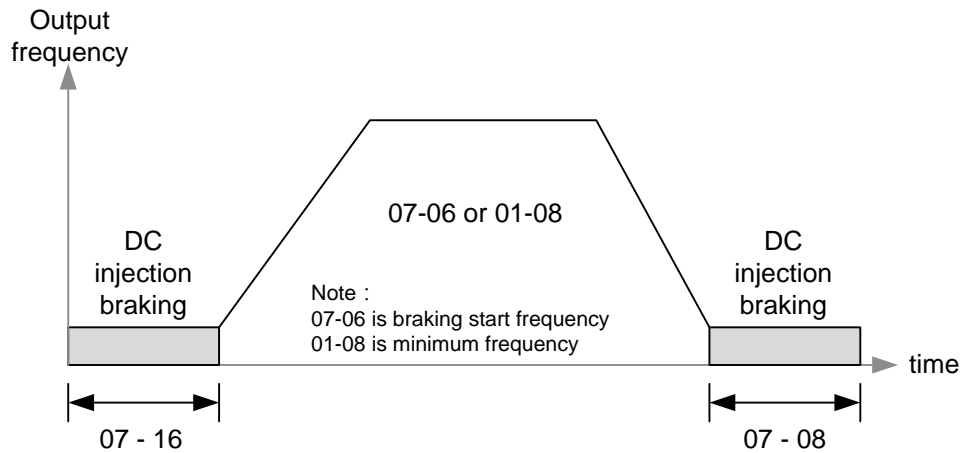


Figure 4.3.47a VF and SLV DC injection braking

Note: When 07-06 < 01-08, DC injection braking starting frequency becomes frequency set in parameter 01-08.

PMSLV Control Mode (00-00=5):

In this control mode short-circuit braking is used.

Short Circuit Braking Start Frequency parameter (07-06) is the level the output frequency has to reach before Short Circuit Braking function is de-activated at start. The same level is used to activate Short Circuit Braking when the output frequency falls below this level.

DC Injection Brake Level (07-07) is set as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

Start Short-circuit Braking Time (07-34) specifies the time short-circuit braking is active at start. Short Circuit Braking at stop is disabled when parameter 07-34 is set to 0 sec.

Stop Short-circuit Braking Time (07-35) specifies the time short-circuit braking is active during a stop operation. Start Short-circuit Braking Time at stop is disabled when parameter 07-35 is set to 0 sec.

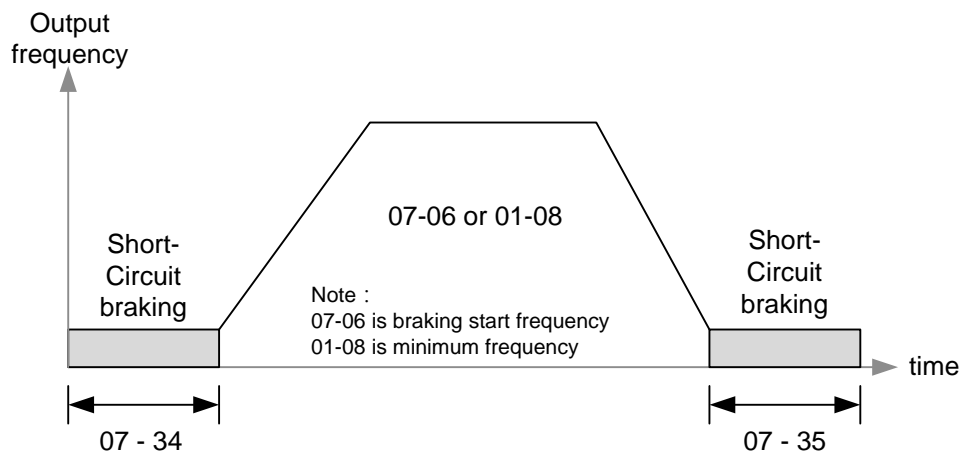


Figure 4.3.47b PMSLV short-circuit braking

Note: When 07-06 < 01-08, DC injection braking starting frequency becomes frequency set in parameter 01-08.

| | |
|---------------|-------------------------------------|
| 07- 07 | DC Injection Braking Current |
| Range | 【0~100】 % |

DC Injection braking current as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

| | |
|---------------|--|
| 07- 08 | DC Injection Braking Time at Stop |
| Range | 【0.00~10.00】 Sec |

Duration of DC injection braking is during a stop operation. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

| | |
|---------------|---|
| 07- 16 | DC Injection Braking Time at Start |
| Range | 【0.00~100.00】 Sec |

Duration of DC injection braking is during a start operation. DC injection braking at start is disabled when parameter 07-16 is set to 0 sec.

DC Injection Braking Operation

When DC Injection braking is active DC voltage is applied to the motor, increasing the braking current and resulting in an increase in the strength of the magnetic field trying to lock the motor shaft.

To enable DC injection braking during a start operation set the DC injection braking current (07-07) and the DC injection braking time (07-16) at start to a value greater than 0. DC injection braking at start can be used to prevent “wind milling effect” in fan applications.

To enable DC injection braking during a stop operation set the DC injection braking current (07-07) and the DC injection braking time at stop (07-08) to a value greater than 0.

Notes:

- When parameter 07-16 is set to 0 sec (DC injection braking off). the inverter will start from the minimum output frequency.
- Increasing the DC braking time (07-08, 07-16) can reduce the motor stop time.
- Increasing the DC braking current (07-07) can reduce the motor stop time.
- During stop operation: If the DC braking start frequency < minimum output frequency (01-08), DC braking is activated when the output frequency reaches the minimum output frequency level.

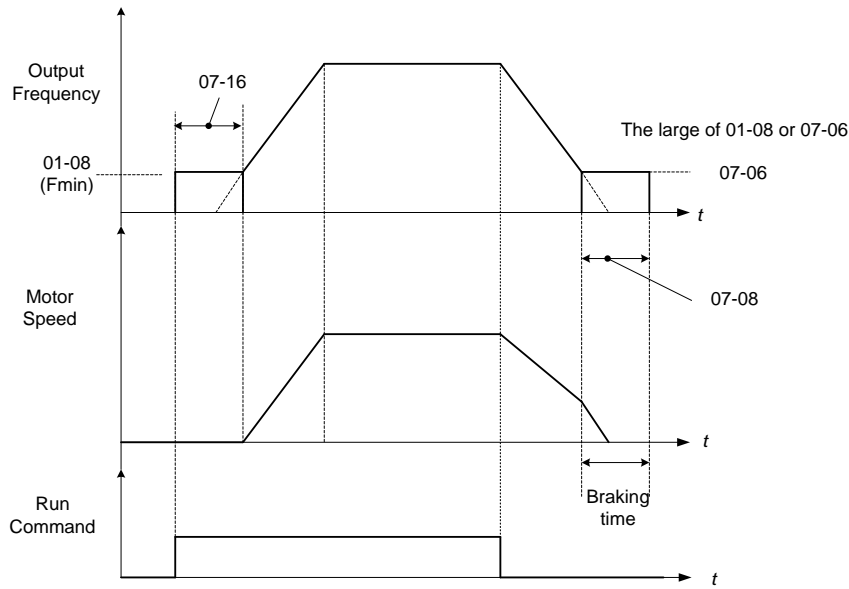


Figure 4.3.47c DC braking operation

DC braking operation can be controlled via any one of the multi-function input terminals (03-00 to 05) function 33. Refer to Fig. 4.3.47 for DC braking operation.

DC braking current can be controlled via the multi-function analog input (04-05) function 5. Refer to Fig. 4.3.34.

| | |
|--------------|--|
| 07-34 | Start short-circuit braking time |
| Range | 【0.00~100.00】 Sec |
| 07-35 | Stop Short-circuit braking time |
| Range | 【0.00~100.00】 Sec |
| 07-36 | Short-circuit braking current limit |
| Range | 【0.0~200.0】 % |

Short-circuit braking is available only in PMSLV control mode (00-00 = 5) and functions switching the IGBTs to producing braking torque. Use parameters 07-06, 07-34 and 07-36 to adjust braking settings. The value of 07-36 is set as a percentage of the inverter rated current.

When 07-35 is set to 0 short-circuit braking during stop is disabled.

Short-circuit Braking can be controlled via any one of the multi-function input terminals (03-00 to 05) set to function 65.

| | |
|---------------|--|
| 07- 09 | Stop Mode Selection |
| Range | 【0】 : Deceleration to Stop 【1】 : Coast to Stop 【2】 : DC Braking Stop 【3】 : Coast to Stop with Timer |

When a stop command is issued the inverter stops according to the stop mode selected. There are four types of stop modes,

Note: When using the permanent magnet motor, only the option of deceleration to stop mode is available.

07-09=0: Deceleration to stop

When a stop command is issued, the motor will decelerate to the minimum output frequency (01-08) F_{min} and then stop. Deceleration rate depends on the deceleration time (factory default: 00-15).

When the output frequency reaches the DC braking stop frequency (07-06) or the minimum output frequency (01-08), DC injection braking is activated and the motor stops.

$$\text{Deceleration time} = \frac{\text{Output frequency when stop command is issued}}{\text{Maximum output frequency } F_{max} \text{ (01-02)}} \times \text{deceleration time setting}$$

Note: S curve setting will add to the overall stop time

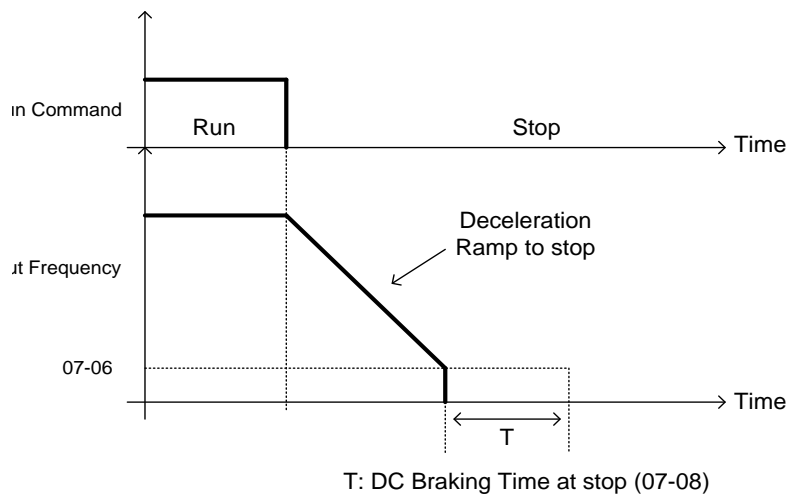


Figure 4.3.48 Deceleration to stop

07-09=1: Coast to stop

When a stop command is issued, the motor will coast to a stop. Stop time depends on motor load and friction of the system.

The inverter waits for the time set in the minimum baseblock time (07-18) before accepting the next run command.

In SLV mode (00-00=2) the speed search function is automatically enabled upon the next run command.

Note: When using a mechanical brake set parameter 07-26 to 1.

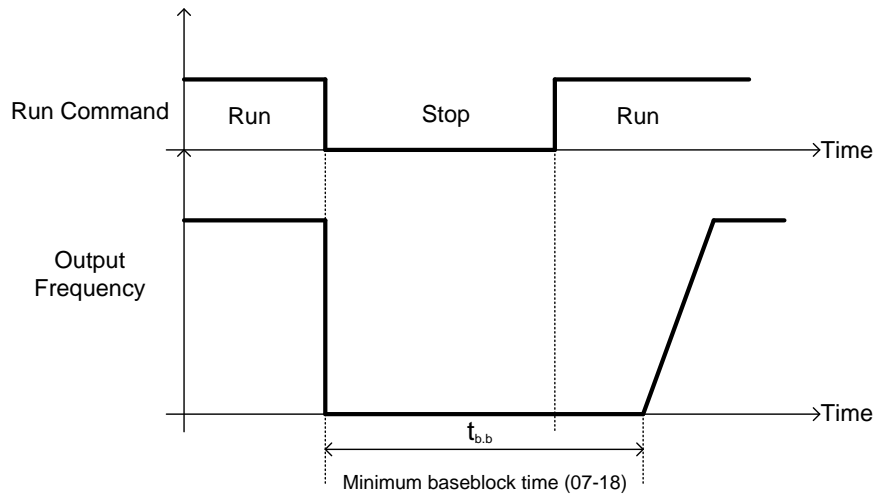


Figure 4.3.49 Coast to stop

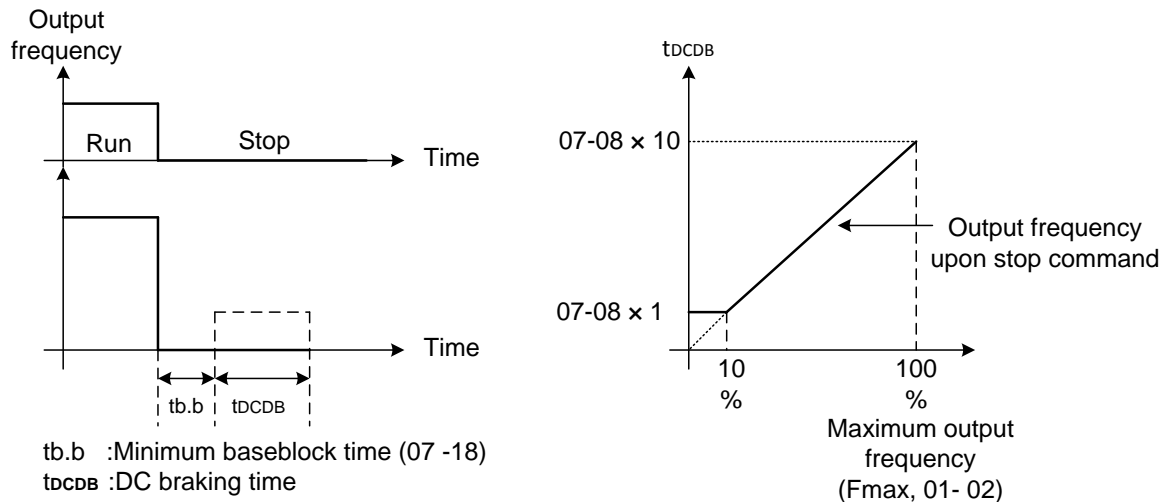
07-09=2: DC braking to stop

When a stop command is issued, the inverter will turn off the output (Baseblock) and after the minimum Baseblock time (07-18) has expired activate DC braking (07-07). Refer to Fig.4.3.50.

The DC braking time (tDCDB) of Figure 4.3.50 is determined by the value of 07-08 (DC Braking start time) and the output frequency at the time the stop command was issued.

$$t_{DCDB} = \frac{(07-08) \times 10 \times \text{output frequency}}{F_{max} (01-02)}$$

Note: Increase the minimum Baseblock time (07-18) in case an Overcurrent trip occurs during the DC braking.



tb.b :Minimum baseblock time (07 -18)
tDCDB :DC braking time

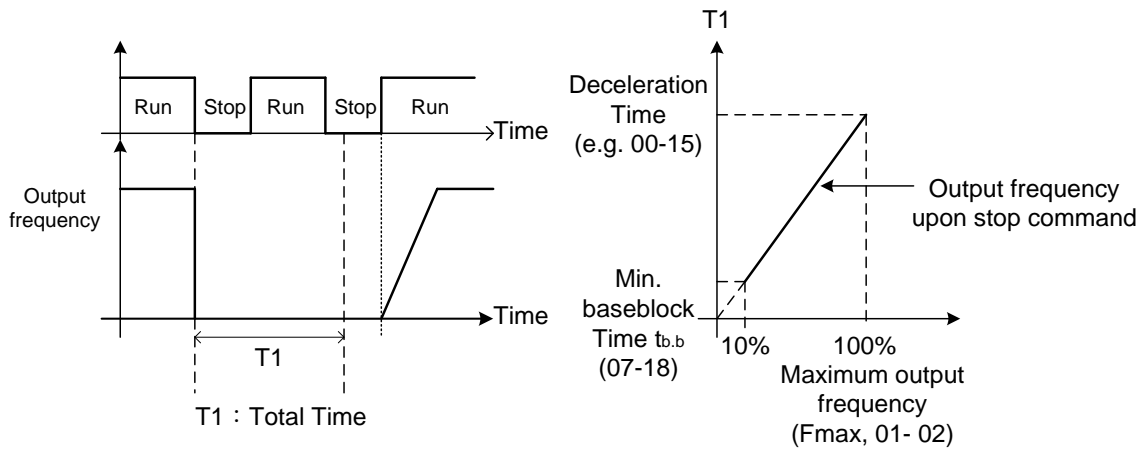
4.3.50 DC braking to stop

Figure

07-09=3: Coast to stop with timer

When a stop command is issued the motor will coast to a stop after the minimum Baseblock time (07-18) has expired. The inverter ignores the run command until the total time of the timer has expired.

The total time of the timer is determined by the deceleration time (00-15, 17, 22 or 24) and the output frequency upon stop. Refer to Fig.4.3.51



Figure

4.3.51 Coast to stop with timer

| | |
|---------------|--|
| 07- 13 | Low Voltage Detection Level |
| Range | 【200V】 : 150~300V 【400V】 : 300~600V |
| 07- 25 | Low voltage Detection Time |
| Range | 【0.00~1.00】 Sec |

Adjust the 07-13 voltage level from 150 to 300 Vdc (200V class) or from 300 to 600 Vdc (400V class).

When the AC input voltage is lower than the 07-13 value ($07-13 / 1.414 =$ AC voltage detection level) for the time specified in 07-25 the low-voltage error "UV" will displayed. If 07-25 = 0.00 sec., the UV error will be displayed immediately.

Set preventive measures:

- The inverter input voltage will limit the output voltage. If the input voltage drops excessively, or if the load is too big, the motor may stall.
- If the input voltage drops below the value set in 07-13 then the output is turned off momentarily. The inverter will not automatically start when power is restored.

| | |
|---------------|-----------------------------|
| 07- 14 | Pre-excitation Time |
| Range | 【0.00~10.00】 Sec |
| 07- 15 | Pre-excitation Level |
| Range | 【50~200】 % |

If a high starting torque is required for the application, especially for a large horsepower motors, the pre-excitation operation can be used to pre-flux (magnetize) the motor.

07-14: Pre-excitation time

When an operation command (forward or reverse) is activated, the inverter will automatically start pre-excitation based on the time set in parameter 07-14.

The time for the flux to reach 100% is a function value of motor's electrical time constant (See figure 4.3.52).

Electrical time constant (quadratic by-pass circuit time constant) is suggested to set 2.00~4.00 Sec.

07-15: Pre-excitation initial level

Use the pre-excitation initial level (07-15) to provide a higher excitation current during the pre-excitation time (07-14), which will increase the speed and stability for motors.

In order to quickly magnetize the motor, reduce the pre-excitation time (07-14) and set the pre-excitation level (07-15) to a high level.

If 07-15 is set greater than 100%, providing a high excitation current during the pre-excitation time (07-14), motor's magnetization time is shortened. When the setting reaches 200%, magnetization is reduced by roughly half.

A high pre-excitation level (07-15) might result in excessive motor sound during pre-excitation.

When the flux reaches 100%, pre-excitation current reverts back to 100% and pre-excitation is completed.

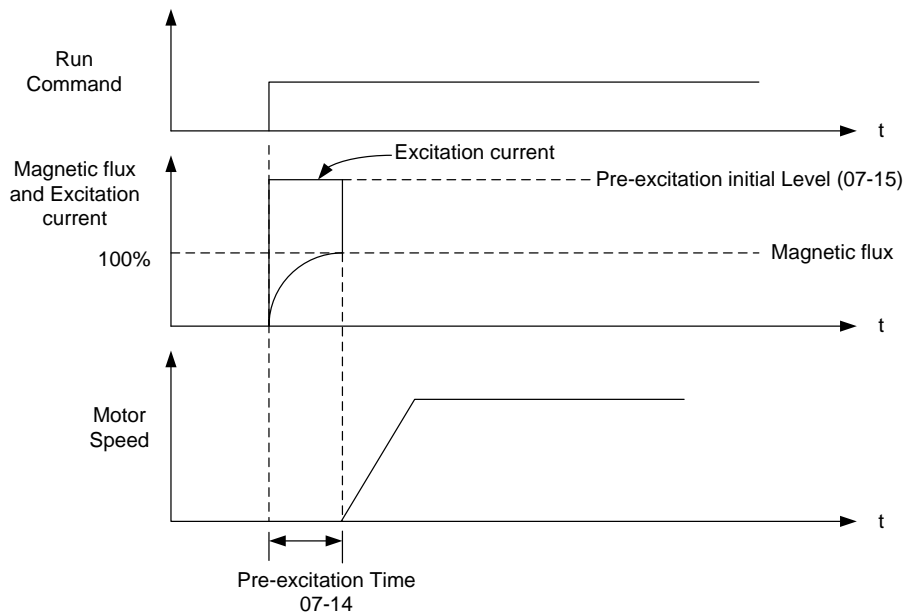


Figure 4.3.52 Pre-excitation operation

| | |
|---------------|--------------------------------|
| 07- 18 | Minimum Base block Time |
| Range | 【0.1~5.0】 Sec |

In case of a momentary power failure, the inverter continues to operate after the power has been restored when parameter 07-00 is set to 1. Once the momentary power failure is detected; the inverter will automatically shut down the output and maintain B.B for a set time (07-18).

It is expected that after the minimum base block time has expired the residual voltage to be almost zero.

When the momentary power failure time exceeds the minimum base block time (07-18), the inverter will automatically perform a speed search upon return of power. Refer to the following figure 4.3.53.

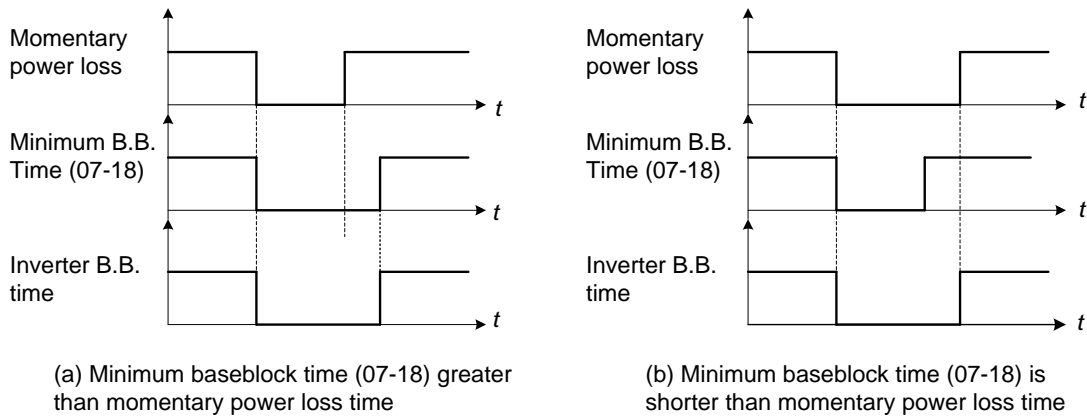


Figure 4.3.53 Minimum B.B time and momentary power loss time

Minimum base block time (07-18) is also used for the DC braking function in combination with speed search as follows:

- Set the minimum base block time required (07-18).
- Execute speed search or DC braking function.
- Increase minimum Baseblock time if over-current "OC" condition occurs.
- After speed search is completed, normal operation continues.

| | |
|---------------|---|
| 07- 19 | Direction-Detection Speed Search Operating Current |
| Range | 【0~100】 % |
| 07- 20 | Speed Search Operating Current |
| Range | 【0~100】 % |
| 07- 21 | Integral Time of Speed Searching |
| Range | 【0.1~10.0】 Sec |
| 07- 22 | Delay Time of Speed Search |
| Range | 【0.0~20.0】 Sec |
| 07-23 | Voltage Recovery Time |
| Range | 【0.1~5.0】 Sec |
| 07- 24 | Direction-Detection Speed Search Selection |
| Range | 【0】 : Disable 【1】 : Enable |
| 07- 26 | SLV Speed Search Function |
| Range | 【0】 : Enable 【1】 : Disable |
| 07- 27 | Start Selection after Fault during SLV Mode |
| Range | 【0】 : Speed search start 【1】 : Normal Start |
| 07- 28 | Start after External Base Block |
| Range | 【0】 : Speed search start 【1】 : Normal Start |
| 07- 32 | Speed Search Mode Selection |
| Range | 【0】 : Disable 【1】 : Mode1: Start a Speed Search at Power on 【2】 : Mode2: Start Speed Search upon the Motor Run |

| | |
|---------------|--|
| 07- 33 | Start Frequency of Speed Search Selection |
| Range | 【0】 : Maximum Output Frequency of Motor 【1】 : Frequency Command |

Speed search function is used to find the speed of a coasting motor and continue operation from that point. The speed search function is active after a momentary power loss.

Speed Search from Multi-function digital inputs

Set the multi-function digital input to external speed search command 1 or 2. External speed search command 1 (value = 19) and 2 (value = 34) cannot be set at the same time, otherwise "SE02" (digital input terminal error) warning occurs.

Speed search function must be enabled before applying the run command to ensure proper operation. See relay logic in Fig. 4.3.54.

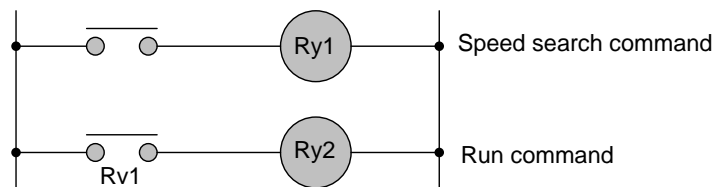


Figure 4.3.54 Speed search and operation commands

Notes: Speed Search Operation

- The speed search cannot be used when the motor rated power is greater than the inverter rated power.
- The speed search cannot be used when the motor rated power is two inverter sizes smaller than the inverter currently used.
- The speed search cannot be used in combination with a high-speed motor.
- In V/F mode, it is necessary to perform a static auto-tune.
- In SLV mode, it is necessary to perform a rotational auto-tune. Perform a static auto-tune when using long motor leads.

Speed search uses current detecting. Use parameter 07-24 to select detection direction.

07-19: Speed Direction Search Operating Current

- Used in bidirectional speed search only (07-24 = 1).
- Set bidirectional current level.
- Increase value if speed search is not successful at low speeds (above 5Hz)

Note: If value is too high may cause DC braking effect.

07-20: Speed Search Operating Current

- Can be used for bidirectional (07-24 = 1) or unidirectional (07-24 = 0) speed search.
- Sets speed search current Level.
- The set value must be lower than the excitation current (02-09) and must equal to the no-load current. If the no-load current is unknown it is recommended to set value at 20%.

- Excessive speed search current will cause inverter output to saturate.
- It is recommended to use speed search in case of a momentary power loss. Increase the minimum base block time (07-18) in case of an over-current condition.

07-21: Integral time of speed searching

- Can be used for bidirectional (07-24 = 1) or unidirectional (07-24 = 0) speed search.
- Set the integral time during speed search.
- If OV occurs, increase the set value to increase the speed search time. Decrease the value if a quick start is required

07-22: Delay time of speed search

- Use delay time when using a contactor on the inverter output side.
- The inverter speed search starts after the delay time expires.
- Speed search delay time is disabled when set to 0.0 sec. (07-22 = 0.0)

07-23: Voltage recovery time

- Sets the voltage recovery time.
- Sets the time for the inverter to restore the output voltage from 0V to the specified V/f level after speed search function is completed.

07-24: Direction-Detection Speed Search Selection

07-24=0: Disable Direction-Detection Speed Search

Speed search is executed using speed search operating current defined in parameter 07-20. In case speed search is not successful (e.g. motor speed is too low) a speed search time-out warning is displayed. Set 07-19 to value greater than 0 to enable DC braking at speed search if a time-out occurs frequently.

07-24=1: Enable Direction-Detection Speed Search

At start the current controller will send a step current to the motor (07-19) to determine the motor direction. Once direction is determined the current controller will perform a speed search using speed search operating current defined in parameter 07-20. Speed search is executed after a momentary power loss (external speed search command 2, 03-00 to 03-05 = 34) or from max. frequency (external speed search command 1, 03-00 to 03-05 = 19). Speed search direction will follow the speed command.

07-26: SLV Speed Search Function

- In SLV mode (00-00 = 2) set the stop mode to the coast stop (07-09 = 1) or to the coast to stop with timer (07-09 = 3). After a stop command is issued (coast to stop or coast to stop with times) the speed search function is automatically activated for the next start.

07-26=0: Enable (No mechanical brake is installed)

07-26=1: Disable (Mechanical brake is installed)

07-27: Start Selection after fault during SLV mode

07-27=0: Speed search start: Speed search is executed after a fault in SLV mode.

07-27=1: Normal start: Speed search is not enabled.

Note: Set the parameter to 1 (normal start) after a fault has occurred and a mechanical brake is used to stop the motor.

07-28: Start after external Baseblock

07-28=0: Speed search start: Speed search is executed after base block is removed.

07-28=1: Normal start: Speed search is not enabled.

07-32: Speed Search Mode Selection

0: Disable: Speed search is disabled and inverter start from minimum output frequency.

1: Execute a Speed Search at Power On: Speed search is executed after first run command at power up from motor rotation speed.

2: The inverter will execute speed search at each run command.

07-33: Start Frequency of Speed Search Selection

07-33=0: The speed search starts from the maximum output frequency of motor.

07-33=1: The speed search starts from frequency command.

Notes:

- Set parameter to 1 for the control mode of SLV mode (00-00 = 2) when the external base block active time is longer than the time the motor needs to come to a complete stop. After the external base block command is removed the inverter will accelerate from min. frequency.
- In PM mode the inverter performs a normal start.

■ Speed search based on current detection

(a) Speed search at starting

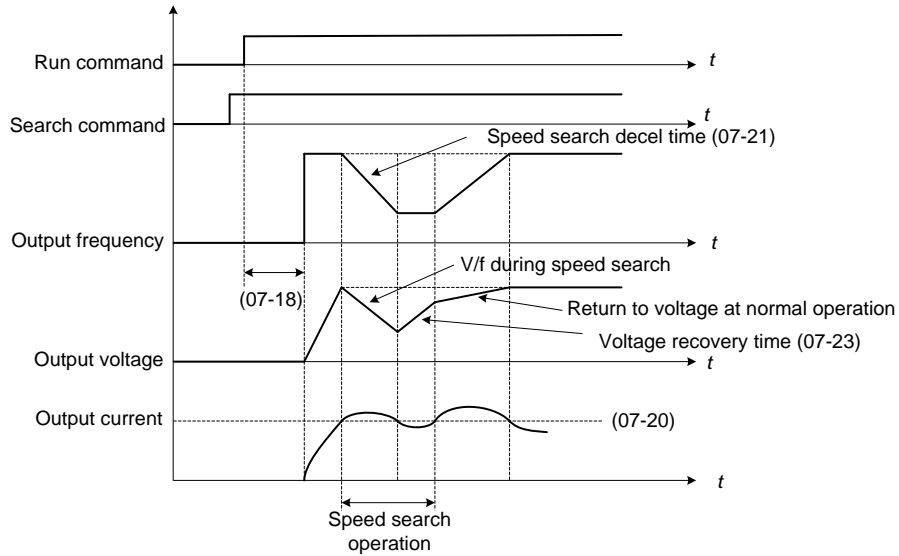


Figure 4.3.55 Speed search at starting

(b) Speed search in recovery period of momentary power failure

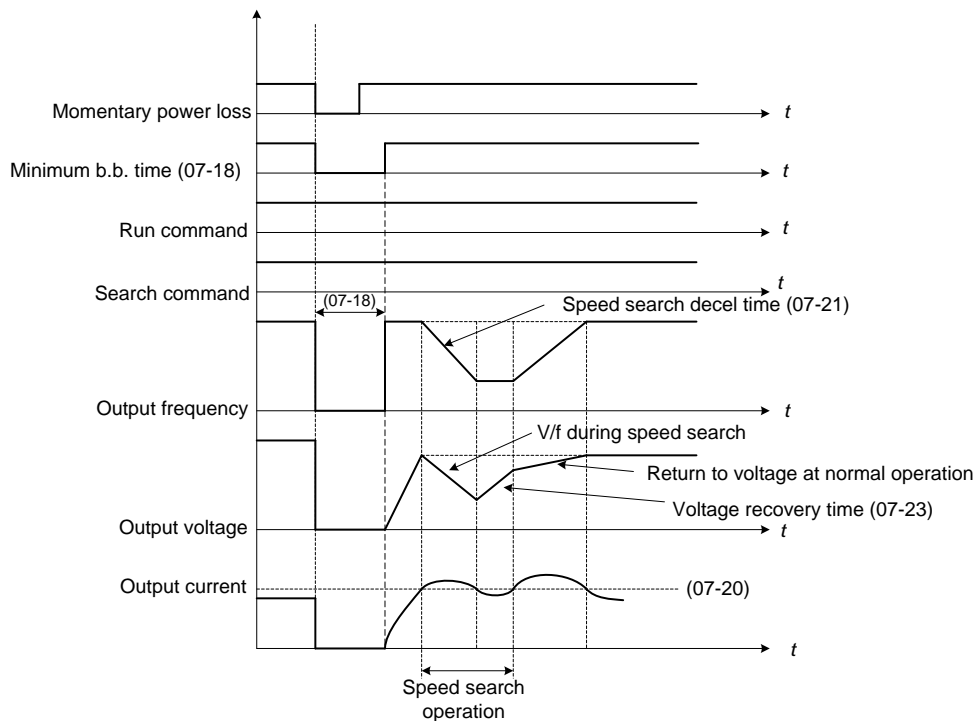


Figure 4.3.56 Speed search in recovery period of momentary power failure

Notes:

- If the minimum base block time (07-18) is longer than the momentary power failure time, the speed search starts operation after the minimum base block time (07-18).
- If the minimum base block time (07-18) is too short, the speed search operation begins immediately after power has been restored.

| | |
|---------------|---|
| 07- 29 | Run Command Available during DC Braking |
| Range | 【0】 : Disable (Run command isn't available until the DC braking is completely done) 【1】 : Enable |

After DC braking action starts, if run command selection is set to 0, it will not run until DC braking action ends.

If run command selection is set to 1, it is not required to wait for the ending of DC braking action. It can run during DC braking action process.

| | |
|---------------|---------------------------|
| 07- 42 | Voltage Limit Gain |
| Range | 【0.0~ 50.0】 % |

In case of motor saturation increase this parameter to limit the output voltage.

Setting this value to high may result in lower than required output torque.

| | |
|---------------|--|
| 07- 43 | Short-circuit Braking Time of PM Motor Speed Search |
| Range | 【0.00~100.00】 Sec |
| 07- 44 | DC Braking Time of PM Motor Speed Search |
| Range | 【0.00~100.00】 Sec |

If the motor is rotating due to inertia and rotation speed is below the minimum speed control range, parameters 07-43 and 07-44 are available to perform braking action to have the motor stop and then restart.

If the motor is rotating due to inertia and the rotation speed is greater than the minimum speed control range, the motor will start at the found rotational frequency regardless of the setting value of parameter 07-43 or 07-44.

If parameters 07-43 and 07-44 are set to 0, the motor starts at the found rotational frequency.

| |
|---------------------------------------|
| Group 08 Protection Parameters |
|---------------------------------------|

| | |
|---------------|---|
| 08- 00 | Stall Prevention Function |
| Range | 【xxx0b】 : Stall prevention is enabled in acceleration. 【xxx1b】 : Stall prevention is disabled in acceleration. 【xx0xb】 : Stall prevention is enabled in deceleration. 【xx1xb】 : Stall prevention is disabled in deceleration. 【x0xxb】 : Stall prevention is enabled in operation. 【x1xxb】 : Stall prevention is disabled in operation. 【0xxxb】 : Stall prevention in operation decelerates based on deceleration time 1 【1xxxb】 : Stall prevention in operation decelerates based on deceleration time 2 |
| 08- 01 | Stall Prevention Level in Acceleration |
| Range | 【20~200】 % |
| 08- 02 | Stall Prevention Level in Deceleration |
| Range | 【330~410】 V : 200V 【660~820】 V : 400V |
| 08- 03 | Stall Prevention Level in Operation |
| Range | 【30~200】 % |
| 08-21 | Limit of Stall Prevention in Acc over Base Speed |
| Range | 【1~100】 % |
| 08-22 | Stall Prevention Detection Time in Operation |
| Range | 【2~100】 msec |

Stall prevention during acceleration (08-00=xxx0b)

Prevents the inverter from faulting (Overcurrent, Motor overload, Inverter overload) when accelerating with heavy loads.

When the inverter output current reaches the level set in parameter 08-01 minus 15% the acceleration rate starts to decrease. When the inverter output current reaches the level set in parameter 08-01 the motor stops accelerating. Refer to Fig.4.3.57 for more information.

Notes:

- Reduce stall prevention level during acceleration (08-01) in case the motor stalls (when the motor power is smaller than the inverter rating).
- The inverter rated output current should be set to 100%.

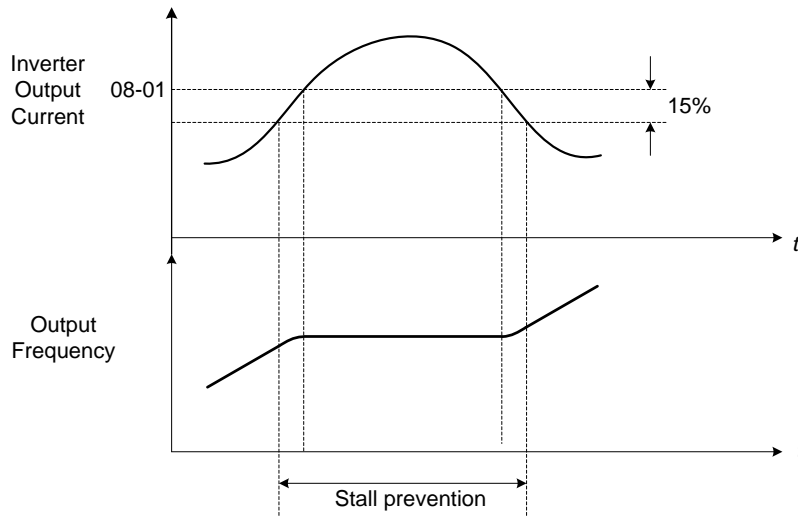


Figure 4.3.57 Stall prevention during acceleration

If the motor is used in the constant power (CH) region, the stall prevention level (08-01) is automatically reduced to prevent the stall.

Stall prevention level during acceleration (Constant horsepower)

$$\text{Stall Prev. Lev. Acceleration (CH)} = \frac{\text{Stall prevention level in acceleration (08-01)} \times \text{Fbase (01-12)}}{\text{Output frequency}}$$

Parameter 08-21 is the stall prevention limit value in Constant Horsepower region. Refer to Fig.4.3.58.

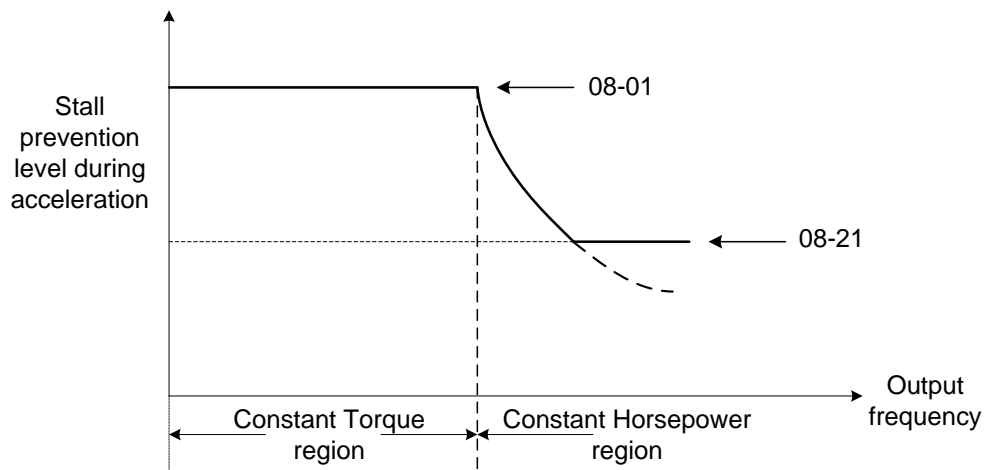


Figure 4.3.58 Stall prevention level and limit in acceleration

Stall prevention selection during deceleration (08-00=xx0xb)

Stall prevention during deceleration automatically increases the deceleration time according based on the DC-bus voltage to prevent over-voltage during deceleration. Refer to Fig.4.3.59 for stall prevention during deceleration

When the DC-bus voltage exceeds the stall prevention level deceleration will stop and the inverter will wait for the DC-bus voltage to fall below the stall prevention level before continuing deceleration. Stall prevention level can be

set by 08-02, see Table 4.3.10.

Table 4.3.10 Stall prevention level

| Inverter model | 08-02 default value |
|----------------|---------------------|
| 200V class | 385VDC |
| 400V class | 770VDC |

Note: When using external braking (braking resistor or braking module) disable stall prevention during deceleration (08-00 to xx1xb).

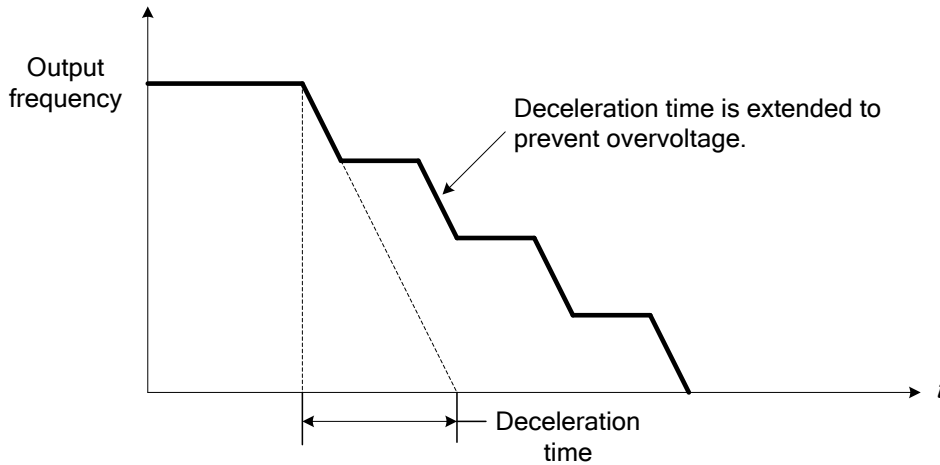


Figure 4.3.59 Stall prevention selection in deceleration

Stall prevention selection during run (08-00=x0xxb)

Stall prevention during run can only be used in V/F control mode for induction motor.

This function prevents the motor from stalling by automatically reducing the output frequency during run.

If the inverter output current rises above the level set in parameter 08-03 for the time specified in parameter 08-22, the inverter output frequency is automatically decreased following deceleration time 1 (00-15) or deceleration time 2 (00-17).

When the inverter output current falls below the level set in parameter (08-03) minus 2%, normal operation continues and the output frequency increases to the frequency reference using the acceleration time 1 or acceleration time 2. Refer to the following Fig.4.3.60.

Note: The stall prevention level during run can be set by using multi-function analog input AI2 (04-05=7).

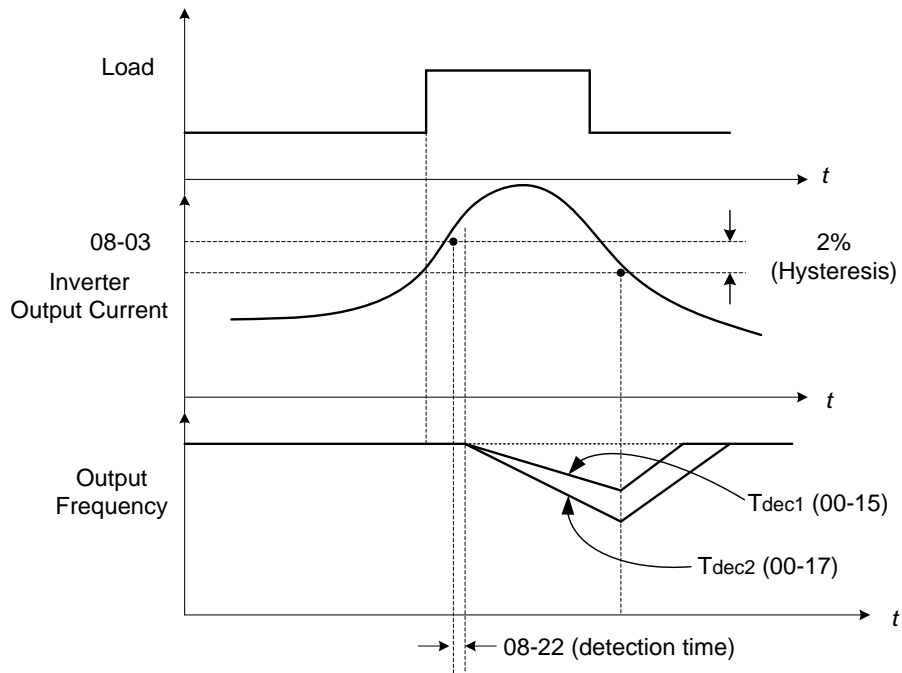


Figure 4.3.60 Stall prevention selection in operation

| | |
|--------------|---|
| 08-05 | Selection for Motor Overload Protection (OL1) |
| Range | 【xxx0b】 : Motor Overload Protection is disabled. 【xxx1b】 : Motor Overload Protection is enabled. 【xx0xb】 : Cold Start of Motor Overload 【xx1xb】 : Hot Start of Motor Overload 【x0xxb】 : Standard Motor 【x1xxb】 : Special motor 【0xxxb】 : Reserved 【1xxxb】 : Reserved |
| 08-07 | Motor Overload (OL1) Protection Level |
| Range | 【0】 : Motor Overload (OL1) Protection 0 【1】 : Motor Overload (OL1) Protection 1 【2】 : Motor Overload (OL1) Protection 2 |

The motor overload protection function estimates the motor overload level based on the output current, output frequency, motor characteristics and time. The motor overload trip time depends on the motor rated current when the output frequency is higher than 60Hz.

At power-up the motor overload protection internal thermal accumulation register is automatically reset.

To use the built-in motor overload protection function parameter 02-01 (motor rated current) has to match the motor rated current on the motor nameplate.

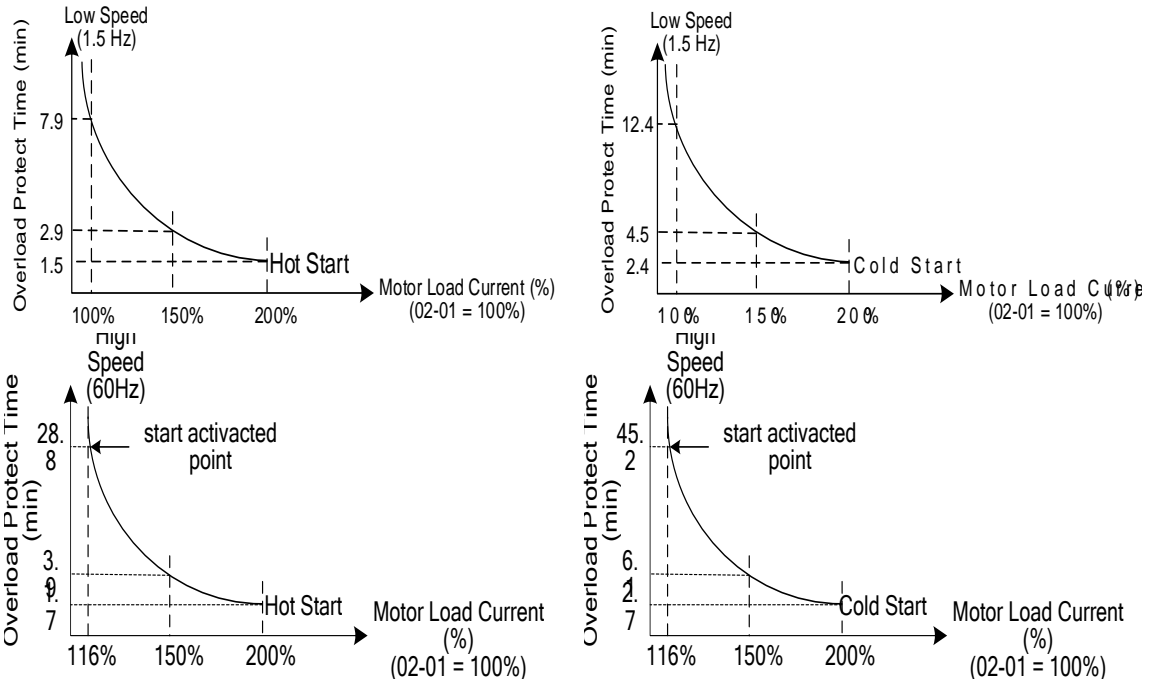
Turn off the motor overload protection when using two or more motors connected to the inverter (set 08-05 = xxx0b), and provide external overload protection for each motor (e.g. thermal overload switch).

With cold start enabled (08-05 = xx0xb), motor overload protection activates in 5 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

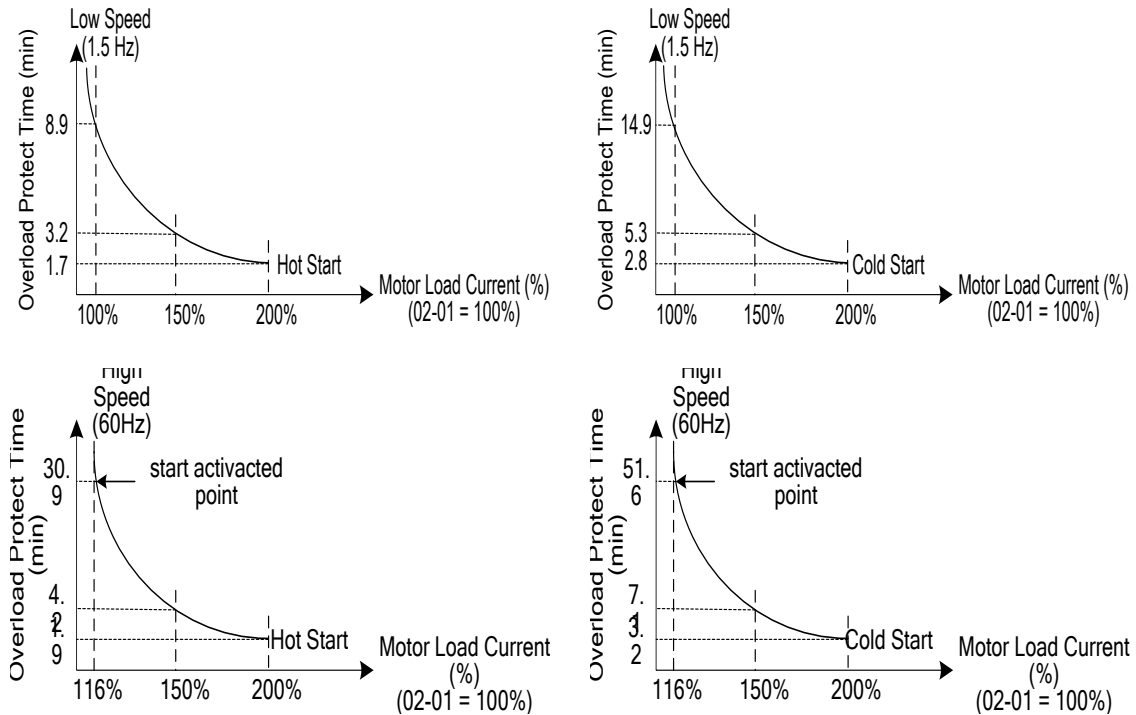
With hot start enabled (08-05 = xx1xb), motor overload protection activates in 3 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

Refer to the following Fig.4.3.61 for motor overload protection curves based on parameter 08-07 selection.

08-07=0:



08-07=1:



08-07=2:

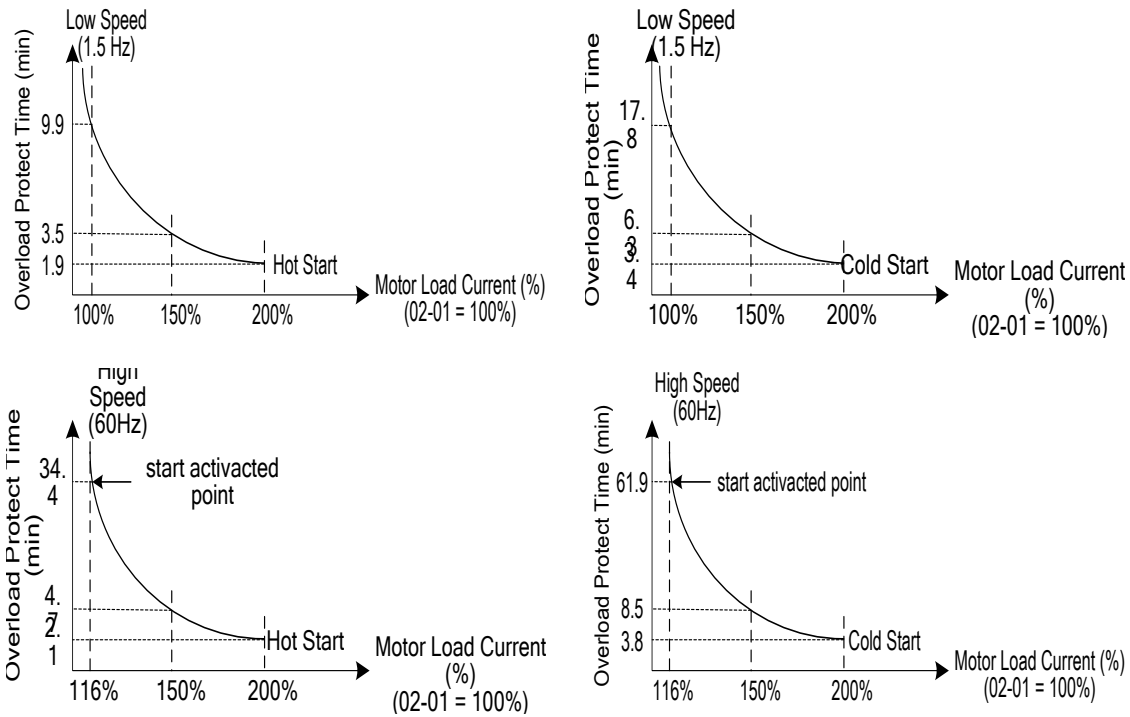


Figure 4.3.61 Motor overload protection curve (example: standard motor)

When using force cooled motors (Special inverter motor), thermal characteristics are independent of the motor speed, set 08-05 = x1xxb.

When 08-05 = x1xxb, overload protection function is based on motor rated current for output frequencies between 6 and 60Hz. If the output frequency is lower than 1Hz, the overload protection function uses 83% of the motor rated current to determine an overload condition.

When 08-05 = x0xxb, overload protection function is based on 70% of the motor rated current for an output frequency of 20Hz. If the output frequency is lower than 1Hz, the overload protection function uses 40% of the motor rated current to determine an overload condition.

Refer to Fig.4.3.62 for motor overload rating at different output frequencies.

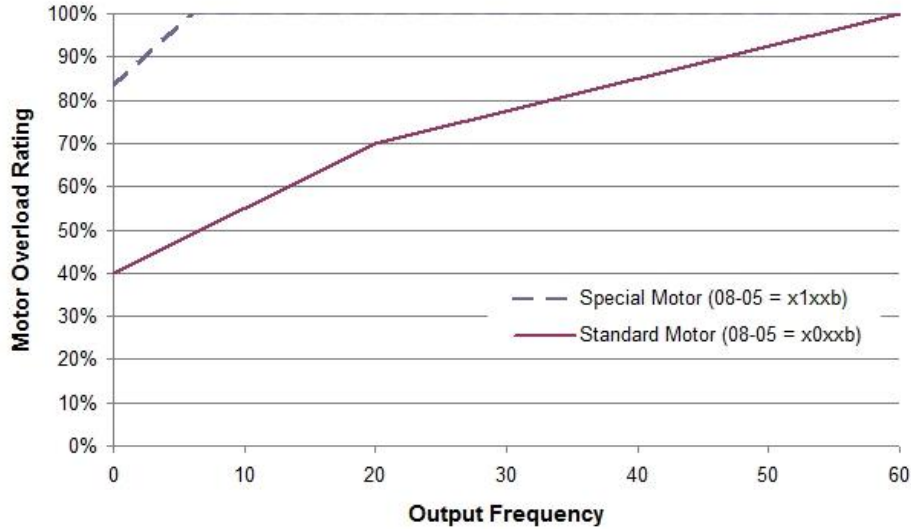


Figure 4.3.62 Motor overload rating at different output frequencies

| | |
|---------------|--|
| 08- 06 | Start-up mode of overload protection operation (OL1) |
| Range | 【0】 : Stop Output after Overload Protection 【1】 : Continuous Operation after Overload Protection. |

08-06=0: When the inverter detects a motor overload the inverter output is turned off and the OL1 fault message will flash on the keypad. Press RESET button on the keypad or activate the reset function through the multi-function inputs to reset the OL1 fault.

08-06=1: When the inverter detects a motor overload the inverter will continue running and the OL1 alarm message will flash on the keypad until the motor current falls within the normal operating range.

| | |
|---------------|---|
| 08- 08 | Automatic Voltage Regulation (AVR) |
| Range | 【0】 : AVR is enabled 【1】 : AVR is disabled |

Automatic voltage regulation stabilizes the motor voltage independent of fluctuation to the input voltage.

08-08=0: Automatic voltage regulation is active. It will limit the maximum output voltage. When the inverter three-phase input voltage fluctuates and the voltage level is smaller than the value of 01-14, the output voltage will fluctuate with the fluctuation of input voltage.

08-08=1: Automatic voltage regulation is not active, motor voltage follows the input voltage fluctuation. When the inverter three-phase input voltage fluctuates, the output voltage will fluctuate based on the input voltage.

| | |
|---------------|---|
| 08- 09 | Selection of Input Phase Loss Protection |
| Range | 【0】 : Disable 【1】 : Enable |

08-09=0: Input phase loss detection is disabled.

08-09=1: Input phase loss detection is enabled. Keypad shows "IPL input Phase Loss" (IPL), when an input phase loss is detected and the inverter output is turned off and the fault contact is activated.

Note: Input phase loss detection is disabled when the output current is less than 30% of the inverter rated current.

| | |
|---------------|--|
| 08- 10 | Selection of Output Phase Loss Protection |
| Range | 【0】 : Disable 【1】 : Enable |

08-10=0: Output phase loss detection is disabled.

08-10=1: Output phase loss detection is enabled. Keypad shows "OPL Output Phase Loss" (OPL), when an output phase loss is detected and the inverter output is turned off and the fault contact is activated.

Note: Output phase loss detection is disabled when the output current is less than 10% of the inverter rated current.

| | |
|---------------|--|
| 08- 13 | Selection of Over-Torque Detection |
| Range | 【0】 : Over-Torque Detection is Disabled. 【1】 : Start to Detect when Reaching the Set Frequency. 【2】 : Start to Detect when the Operation is Begun. |
| 08- 14 | Selection of Over-Torque Operation |
| Range | 【0】 : Deceleration to Stop when Over- Torque is Detected. 【1】 : Display Warning when Over- Torque is Detected. Go on Operation. 【2】 : Coast to Stop when Over Torque is Detected. |
| 08- 15 | Level of Over-Torque Detection |
| Range | 【0~300】 % |
| 08- 16 | Time of Over-Torque Detection |
| Range | 【0.0~10.0】 Sec |
| 08- 17 | Selection of Low-Torque Detection |
| Range | 【0】 : Low-Torque Detection is Disabled. 【1】 : Start to Detect when Reaching the Set Frequency. 【2】 : Start to Detect when the Operation is Begun. |
| 08- 18 | Selection of Low-Torque Operation |
| Range | 【0】 : Deceleration to Stop when Low- Torque is Detected. 【1】 : Display Warning when Low- Torque is Detected. Go on Operation. 【2】 : Coast to Stop when Low-Torque is Detected. |
| 08- 19 | Level of Low-Torque Detection |
| Range | 【0~300】 % |
| 08- 20 | Time of Low-Torque Detection |
| Range | 【0.0~10.0】 Sec |

The over torque detection function monitors the inverter output current or motor torque and can be used to detect increases in inverter current or motor torque (e.g. heavy load).

The low torque detection function monitor the inverter output current or motor torque and can be used to detect a decrease in inverter current or motor torque (e.g. belt break).

The torque detection levels (08-15, 08-19) are based on the inverter rated output current (100% = inverter rated output current) when operating the inverter in V/F control mode and motor output torque (100% = motor rated torque) when operating the inverter in SLV control mode.

Over-torque detection

Parameter 08-13 selects over-torque detection function. An over-torque condition is detected when the output current / torque rises above the level set in parameter 08-15 (Over-torque detection level) for the time specified in parameter 08-06 (Over-torque detection time).

08-13=0: Over-torque detection is disabled.

08-13=1: Over-torque detection is enabled when the output frequency reaches the set frequency.

08-13=2: Over-torque detection is enabled during running.

Parameter 08-14 selects the way the inverter acts when an over-torque condition is detected.

08-14=0: When an over-torque condition is detected the inverter displays an over-torque detection fault and the motor decelerates to a stop.

08-14=1: When an over-torque condition is detected the inverter displays an over-torque detection alarm and continues to run.

08-14=2: When an over-torque condition is detected the inverter displays an over-torque detection fault and the motor coasts to a stop.

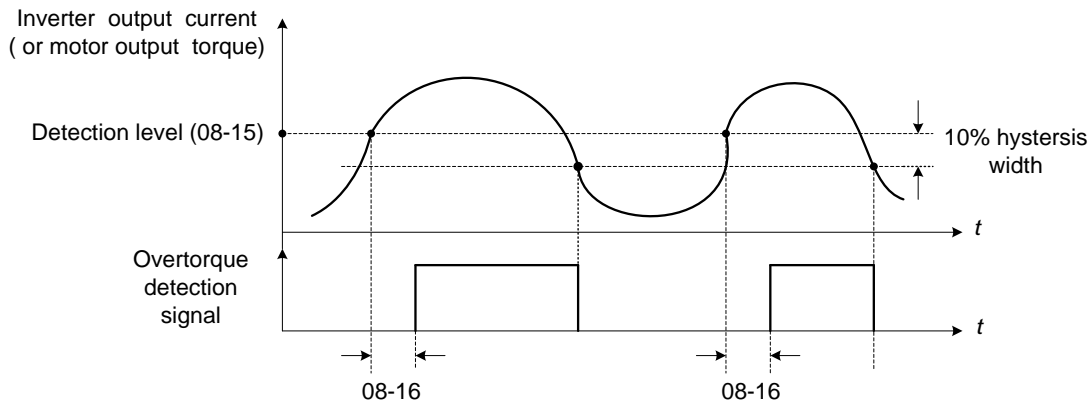


Figure 4.3.63 Over-torque detection operation

Low-torque detection

Parameter 08-18 selects low-torque detection function. A low-torque condition is detected when the output current / torque falls below the level set in parameter 08-19 (low-torque detection level) for the time specified in parameter 08-20 (Low-torque detection time).

08-17=0: Low-torque detection is disabled.

08-17=1: Low-torque detection is enabled when the output frequency reaches the set frequency.

08-17=2: Low-torque detection is enabled during running.

Parameter 08-18 selects the way the inverter acts when an over-torque condition is detected.

08-18=0: When a low-torque condition is detected the inverter displays a low-torque detection fault and the motor decelerates to a stop.

08-18=1: When a low-torque condition is detected the inverter displays a low-torque detection alarm and continues to run.

08-18=2: When a low-torque condition is detected the inverter displays and low-torque detection fault and the motor coasts to a stop.

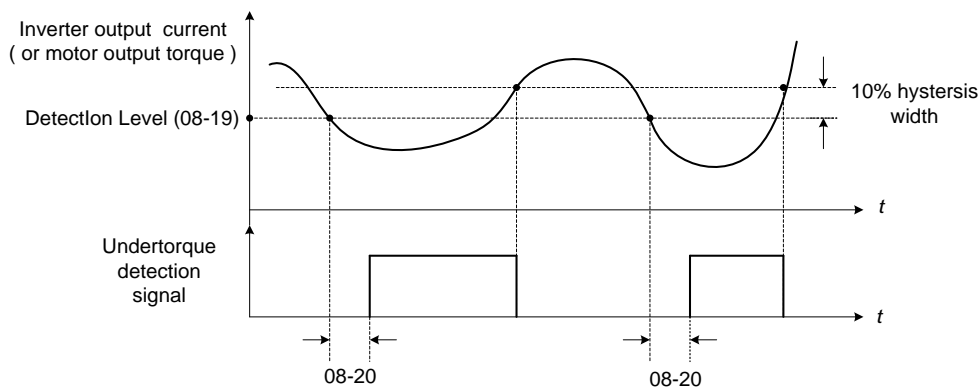


Figure 4.3.64 Low torque detection operation

The multi-function digital outputs (R1A-R1C, R2A-R2C, R3A-R3C) can be used to indicate an over and low torque detection condition by setting parameters 03-11, 03-12 and 03-39 to 12 or 25. Refer to Fig. 4.3.65 for more information.

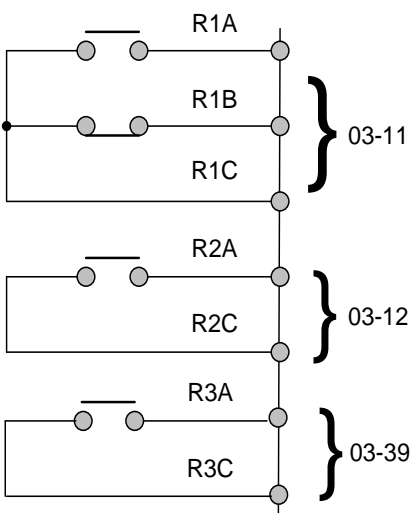


Figure 4.3.65 Over-torque / low torque detection multi-function digital output terminal

| | |
|---------------|---|
| 08- 23 | Ground Fault (GF) Selection |
| Range | 【0】 : Disable 【1】 : Enable |

If the inverter leakage current is greater than 50% of inverter rated current and the ground fault function is enabled (08-23), the keypad will display a "GF Ground Fault" (GF), motor will coast to a stop and fault contact is activated.

| | |
|---------------|--|
| 08- 24 | Operation Selection of External Fault |
| Range | 【0】 : Deceleration to Stop 【1】 : Coast to Stop 【2】 : Continuous Operation |

When multi-function digital input terminal is set to 25 (the external fault) and this terminal signal is triggered off, parameter 08-24 (Operation Selection of External Fault) can be selected to stop it. The selection of stop modes is the same as 07-09.

| | |
|---------------|---|
| 08- 25 | Detection selection of External Fault |
| Range | 【0】 : Immediately Detect when the Power is Supplied 【1】 : Start to Detect during Operation |

External fault detection selection:

08-25=0: External fault detection active at power up.

08-25=1: External fault detection active during running.

| | |
|---------------|---|
| 08- 30 | Selection of Safety Function |
| Range | 【0】 : Deceleration to Stop 【1】 : Coast to Stop |

If multi-function digital input terminal is set to 58 (Safety Function), inverter will stop based on value set in parameters 08-30 when safety function is activated.

| | |
|---------------|---|
| 08- 37 | Fan Control Function |
| Range | 【0】 : Start at Operation 【1】 : Permanent Start 【2】 : Start at High Temperature |
| 08- 38 | Delay Time of Fan Off |
| Range | 【0~600】 Sec |

08-37=0: Start at Operation

Fan starts when the inverter starts running.

If the inverter stops the fan will turn off after the delay time (08-38).

08-37=1: Permanent Start

Fan starts running when the inverter is at powered on and will run permanently.

08-37=2: Start at High Temperature

When the heatsink temperature rises above maximum allowed heatsink temperature the fan turns on.

If the temperature falls below maximum allowed heatsink temperature the fan will turn off after the delay time of fan off (08-38) timer has expired.

Note: The fan control function is not available for IP20 models of 60HP and above (200V) and 100HP and above (400V).

| | |
|---------------|---|
| 08- 35 | Fault Selection of Motor Overheat |
| Range | 【0】 : Disable 【1】 : Deceleration to Stop 【2】 : Coast to Stop |

| | |
|----------------|--|
| 08- 36 | Time Coefficient of PTC Input Filter |
| Range | 【0.00 ~ 5.00】 |
| 08- 39 | Delay Time of Motor Overheat Protection |
| Range | 【1 ~ 300】 Sec |
| 08 - 42 | PTC Trip Level |
| Range | 【0.1~10】 V |
| 08 - 43 | PTC Reset Level |
| Range | 【0.1~10】 V |
| 08-45 | PTC Disconnection Detection |
| Range | 【0】 : Disable 【1】 : Warning 【2】 : Fault |

Enable the motor overheat protection by using the motor's built in PTC resistor. Connect the PTC resistor between MT and GND. If the motor overheats the keypad will display the OH4 error code.

08-35=0: Motor overheating fault is disabled.

08-35=1, 2: Motor stops running inverter displays a warning.

08-35=1, 2: Motor stops running inverter displays a fault.

A motor overheating condition occurs when 08-45 is enabled and the motor temperature rises where the MT voltage level is rises above the 08-42 PTC trip level for the time specified in 08-39. The keypad will display "OH4 Motor overheat" and fault output is activated.

When the motor temperature drops, and the MT voltage level falls below the 08-43 PTC reset level, the "OH4 Motor overheat" fault can be reset'.

Note: The stop mode of the inverter when a fault occurs is set by 08-35.

08-35=1: Deceleration to stop when the inverter fault occurs.

08-35=2: Coast to stop when the inverter fault occurs

Note: The resistor (PTC) according to the British Standards Institution:

Tr is 150°C for Class F and is 180°C for Class H

Tr - 5°C : $RT \leq 550\Omega$, insert value of RT into formula (1) and set 08-43 to the calculated value.

Tr+ 5°C: $RT \geq 1330\Omega$, put the value of RT in formula (1), and set 08-42 to the calculated value..

Formula (1) can also be used for different values of PTC resistors.

Notes:

1. Use formula 1 to calculate the value of 8-42 and 8-43 if the specification of the PTC is different..

$$V = \frac{1}{2} \times 10 V \times \frac{R_{PTC} // 20 K}{10 K + (R_{PTC} // 20 K)} \quad \text{Formula (1)}$$

2. Use formula (1) to calculate level when PTC is not connected and the voltage value is between 3.3~4V. If PTC is disconnected, the inverter trips and a PTCLS warning or fault signal occur. Select fault selection using parameter 08-45. There will be a ten second delay for disconnect detection. If the PTC is reconnected within this time the inverter will not trip and the delay timer is reset.
3. When measuring the voltage-across from MT and GND terminals and the measured voltage is not equal to the input level one use formula (1) to calculate the new value.

Refer to Fig. 4.3.66 shows PTC connection and PTC Characteristics.

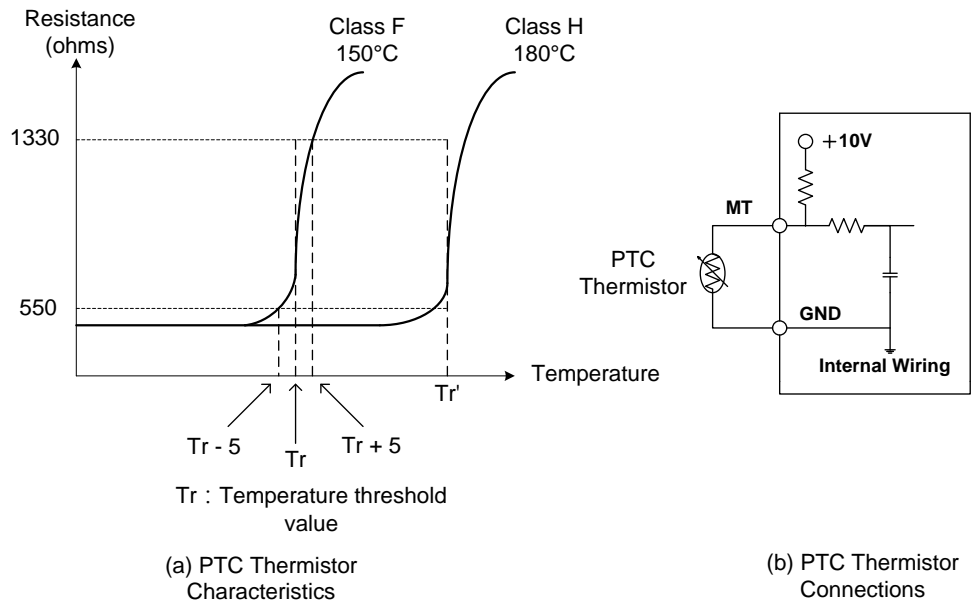


Figure 4.3.66 (a) PTC Thermistor Characteristics

(b) PTC Thermistor Connections

Group 09: Communication Parameters

| | |
|---------------|---|
| 09- 00 | INV Communication Station Address |
| Range | 【1~31】 |
| 09- 01 | Communication Mode Selection |
| Range | 【0】 : MODBUS 【1】 : BacNET 【2】 : MetaSys 【3】 : PUMP in Parallel Connection 【4】 : PROFIBUS |
| 09- 02 | Baud Rate Setting (bps) |
| Range | 【0】 : 1200 【1】 : 2400 【2】 : 4800 【3】 : 9600 【4】 : 19200 【5】 : 38400 |
| 09- 03 | Stop Bit Selection |
| Range | 【0】 : 1 Stop Bit 【1】 : 2 Stop Bits |
| 09- 04 | Parity Selection |
| Range | 【0】 : No Parity 【1】 : Even Bit 【2】 : Odd Bit |
| 09-05 | Communications Data Bits Selection |
| Range | 【0】 : 8 bits data 【1】 : 7 bits data |
| 09- 06 | Communication Error Detection Time |
| Range | 【0.0~25.5】 Sec |
| 09- 07 | Fault Stop Selection |
| Range | 【0】 : Deceleration to Stop Based on Deceleration Time 1 【1】 : Coast to Stop when Communication Fault Occurs. 【2】 : Deceleration to Stop Based on Deceleration Time 2 【3】 : Keep Operating when Communication Fault Occurs. 【4】 : Run at the Frequency Command given by AI2 |
| 09- 08 | Comm. Fault Tolerance Count |
| Range | 【1~20】 |
| 09- 09 | Waiting Time |
| Range | 【5~65】 msec |
| 09- 10 | Device Instance Number |
| Range | 1~254 |

The Modbus communication port RJ45 (S+, S-) can be used to monitor, control, program and trouble-shoot the inverter. The built-in RS-485 can support the following communication protocols:

- Modbus communication protocol
- BacNet communication protocol (Refer to section 4.7 for more details)
- MetaSys communication protocol (Refer to section 4.8 for more details)
- Profibus communication protocol (Refer to section 11.9 Profibus communication option card for more details and this function is required to install Profibus card to be enabled).

Modbus communication can perform the following operations, independent of the frequency command selection (00-05) setting and operation command selection (00-02) setting:

- Monitor inverter signals
- Read and write parameters.
- Reset fault
- Control multi-function inputs

Modbus (RS-485) communication specification:

| Items | Specification |
|--------------------------|---|
| Interface | RS-485 |
| Communication type | Asynchronous (start - stop synchronization) |
| Communication parameters | Baud rate: 1200, 2400, 4800, 9600, 19200 and 38400 bps Data Length: 8 bits (Fixed) Parity: options of none, even and odd bit. For even and odd selection stop bit is fixed at 1 bit. |
| Communication protocol | Modbus RTU / ASCII |
| Number of inverters | Maximum 31 units |

Communication wiring and setup

- (1) Turn off power to the inverter.
- (2) Connect communication lines of the controller to the inverter (RJ45).
- (3) Turn power on.
- (4) Set the required communication parameters (09-00) via the keypad.
- (5) Turn off power to the inverter and wait until keypad is completely off.
- (6) Turn power on
- (7) Start communication between controller and inverter.

Modbus (485) communication architecture

- (1) Modbus communication configuration uses a master controller (PC, PLC), communicating to a maximum of 31 inverters.
- (2) The master controller is directly connected to the inverter via the RS-485 interface. If the master controller has a RS-232 port, a converter must be used to convert the signals to RS-485 to connect the master controller to the inverter.
- (3) A maximum 31 inverters can be connected to a network, following the Modbus communication standard.

Communication Parameters:

09-00: Inverter station addresses: Range 1-31

09-02: RS-485 communication baud rate setting

- = 0: 1200 bps (bits / second)
- = 1: 2400 bps
- = 2: 4800 bps
- = 3: 9600 bps
- = 4: 19200 bps
- = 5: 38400 bps

09-03: Stop bit selection

- = 0: 1 stop bit
- = 1: 2 stop bits

09-04: Parity selection

- = 0: No parity.
- = 1: even parity.
- = 2: odd parity.

09-05: Communications Data Bits Selection

- = 0: 8 bits data
- = 1: 7 bits data

09-06: RS-485 communication error detection time

09-07: Stop selection of RS-485 communication failure

- = 0: Deceleration to stop by deceleration time set by 00-15
- = 1: Coast to stop
- = 2: Deceleration to stop using the deceleration time set by 00-26 (emergency stop time)
- = 3: Continue to operate (only shows a warning message, press the stop button to stop operation)
- = 4: Run at the frequency command given by AI2 after delay time set by Communication Error Detection Time (09-06). When an RS-485 communication error occurs a warning message will be display and AI2 will be used for frequency command. When the stop key is pressed, the inverter stops.

09-08: Comm. fault tolerance count

When the number of communication errors exceeds the value set in parameter 09-08 the inverter will display the comm. Fault alarm "ERR6".

09-09: Wait time of inverter transmission (09-09).

Sets the inverter response delay time. This is the time between the controller message and the start of the inverter response message. Refer to Figure 4.3.76. Set the controller receive time-out to a greater value than the wait time parameter (09-09).

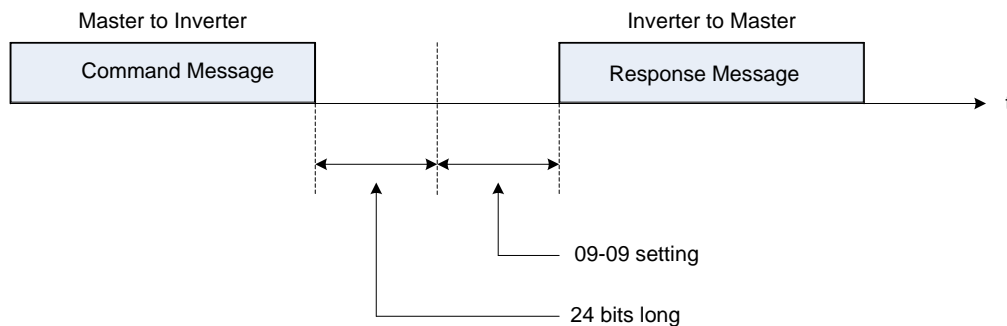


Figure 4.3.67 Communication Message Timing

| |
|---------------------------------|
| Group 10: PID Parameters |
|---------------------------------|

| 10- 00 | PID Target Value Source Setting |
|--------|---|
| Range | 【0】 : Keypad (for PUMP or HVAC mode) 【1】 : AI1 (Analog Input 1) 【2】 : AI2 (Analog Input 2) 【3】 : Reserved 【4】 : 10-02 Parameter 【5】 : Reserved 【6】 : Frequency Command (00-05) 【7】 : Multi-speed Frequency Command |

Operation Pressure Setting (23-02) or Target Value of Flow Meters (PUMP or HVAC function selection) can be used as PID's target value (setpoint) only when 10-00=0 and 23-00=1 or 2.

10-00=1 or 2,

PID Target Value (Setpoint) is set via analog input terminal AI1 or AI2.

For example:

0~10V is corresponding to 0~100% target value. Analog input level set to 2V, corresponds to a 20% target value.

10-00=4

10-02 (PID target value) is set as percentage and PID setting is at main screen monitor (12-38).

Maximum target value is set by parameter 10-33 (PID feedback maximum value), the number of decimals are determined by parameter 10-34 (PID decimal width), and the unit is set by parameter 10-35 (PID unit).

Example:

Set 10-33 = 999, 10-34 = 1, 10-35 = 3, and set 10-02 to 10%

Main monitor 12-38 shows 9.9 PSI. Maximum value is 99.9 PSI (limited by value of parameter 10-33).

10-00=6

The PID target value (setpoint) is the percentage of frequency reference corresponding to the rated frequency.

(Example: setpoint = 50 %, if the frequency reference is 30Hz and the rated frequency is 60Hz). Frequency command refers to the setting of 00-05.

10-00=7

The PID target value (setpoint) is set by the multi-speed frequency commands (refer to parameter group 3).

(Example: setpoint = 50 %, if one of the multi-speed frequencies is set for 30Hz and is active based on a rated frequency is 60Hz). Multi-speed stage frequency setting can be set using parameters 05-01~05-16.

Note: Speed-stage 1 cannot be set as PID target value by switching auxiliary frequency via 04-05=0.

| 10- 01 | PID Feedback Value Source Setting |
|--------|--|
| Range | 【1】 : AI1 (Analog Input 1) 【2】 : AI2 (Analog Input 2) 【3】 : Reserved 【4】 : AI1 - AI2 Analog Input |

Note: Parameter 10-00 and 10-01 cannot be set to the same source. If both parameters are set to the same source the keypad will show a SE05 alarm.

Note: When AI1 - AI2 is negative minus, PID feedback value will be 0.

| | |
|---------------|--|
| 10- 02 | PID Target Value |
| Range | 【0.0~100.0】 % |
| 10- 03 | PID Control Mode |
| Range | 【xxx0b】 : PID Disable 【xxx1b】 : PID Enable 【xx0xb】 : PID Positive Characteristic 【xx1xb】 : PID Negative Characteristic 【x0xxb】 : PID Error Value of D Control 【x1xxb】 : PID Feedback Value of D Control 【0xxxb】 : PID Output 【1xxxb】 : PID Output + Frequency Command |

PID target value source (setpoint) is selected by parameter 10-00 and PID feedback value source setting (10-01).

Please check parameter 04-00 for the correct input level (0V~10 V or 4mA~20mA) if AI2 is used as PID target or PID feedback use switch SW2 on the control board to selected between (V and I), please refer to wiring diagram for more details.

When 10-03 is set to xxx0b, PID mode is disabled; if set to xxx1b, PID mode is enabled.

Note: PID Mode Enabled

- LCD keypad is automatically switched to show PID Target / Feedback (16-00).
- Main Screen Monitoring will be changed to PID Target (Setpoint) (12-38).
- Sub-Screen Monitoring 1 will be changed to PID Feedback (12-39).
- Sub-Screen Monitoring 2 will be changed to Output Frequency (12-17).

When PID is disabled the display automatically switches back to frequency command. When enabling PID mode using an LED keypad the information displayed is set by parameter 23-05.

Note: when 23-05=0, set 10-33 to a value smaller than 1000 and 10-34=1, otherwise the inverter will display PID setting error (SE05).

10-03= xx0xb: PID output is set to forward; If PID input is negative the output frequency of PID will decrease and increase when PID input is positive.

10-03= xx1xb: PID output is reverse. If PID input is negative the output frequency of PID will increase and decrease when PID input is positive.

10-03=x1xxb: PID control with feedback differential control.

10-03=x0xxb: Basic PID control. Refer to Fig.4.3.69 and Fig.4.3.70.

10-03 =0xxxb: PID output is enabled and corresponds to the frequency of 01-02 at 100%.

When 10-03 is set to 1xxxb, PID output and frequency command are both enabled. The output percentage of frequency command (corresponding to the selected main frequency command of 00-05/ 00-06) will accumulate when the inverter starts to run and PID control starts.

| | |
|--------|---|
| 10- 04 | Feedback Gain |
| Range | 【0.01~10.00】 |
| 10- 05 | Proportional Gain (P) |
| Range | 【0.00~10.00】 |
| 10- 06 | Integral Time (I) |
| Range | 【0.0~100.0】 Sec |
| 10- 07 | Differential Time (D) |
| Range | 【0.00~10.00】 Sec |
| 10- 09 | PID Bias |
| Range | 【-100~100】 % |
| 10- 10 | PID Primary Delay Time |
| Range | 【0.00~10.00】 % |
| 10-14 | PID Integral Limit |
| Range | 【0.0~100.0】 % |
| 10-23 | PID Limit |
| Range | 【0.00~100.0】 % |
| 10-24 | PID Output Gain |
| Range | 【0.0~25.0】 |
| 10-25 | PID Reversal Output Selection |
| Range | 【0】 : Do not Allow Reversal Output 【1】 : Allow Reversal Output |
| 10-26 | PID Target Acceleration/ Deceleration Time |
| Range | 【0.0~25.5】 Sec |

PID Adjustments

10-05 Proportional Gain: The error signal (deviation) between the input command (PID target value) and the actual control value (PID feedback). This error signal or deviation is amplified by the proportional gain (P) to control the offset between the set value and the feedback value.

10-06 Integral Time: The output of this control is the integral of the error signal (difference between PID target value and feedback value) and is used to minimize the offset signal that is left over from the gain control. When the integral time (I) is increased, the system response becomes slower.

10-07 Differential Time: This control is the inverse from integral control and tries to guess the behavior of the error signal by multiplying the error with the differential time. The result is added to the PID input. Differential control slows down the PID controller response and may reduce system oscillation. **Note:** Most applications that use PID control (fan and pump) do not require differential control.

Refer to Fig. 4.3.68 for PID control operation

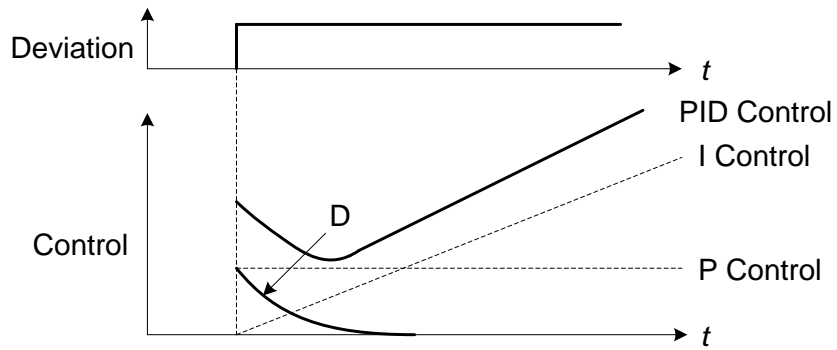


Figure 4.3.68 PID Control

PID Control Type

The inverter offers two types of PID control:

(a) PID control with differential feedback: (10-03 = x1xxb)

Make sure to adjust the PID parameters without causing system instability. Refer to Fig. 4.3.69 for PID control for feedback value differential.

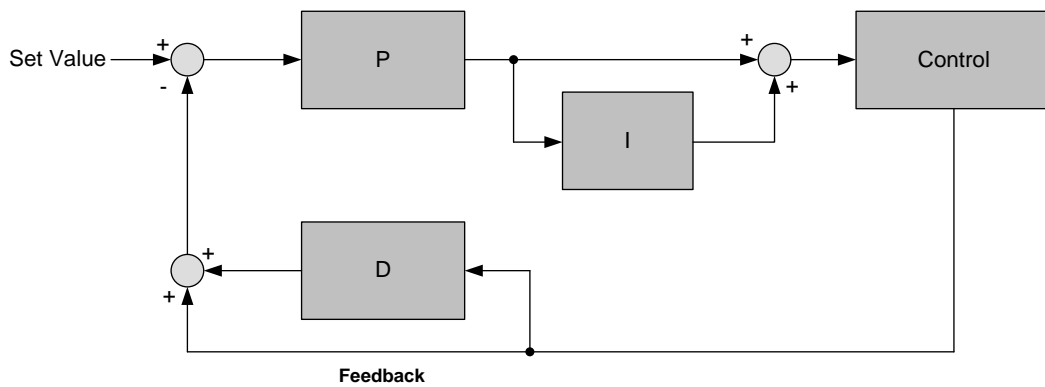


Figure 4.3.69 PID control for feedback differential value

(b) Basic PID control: (10-03 = x0xxb)

This is the basic type of PID control. Refer to the Fig. 4.3.70.

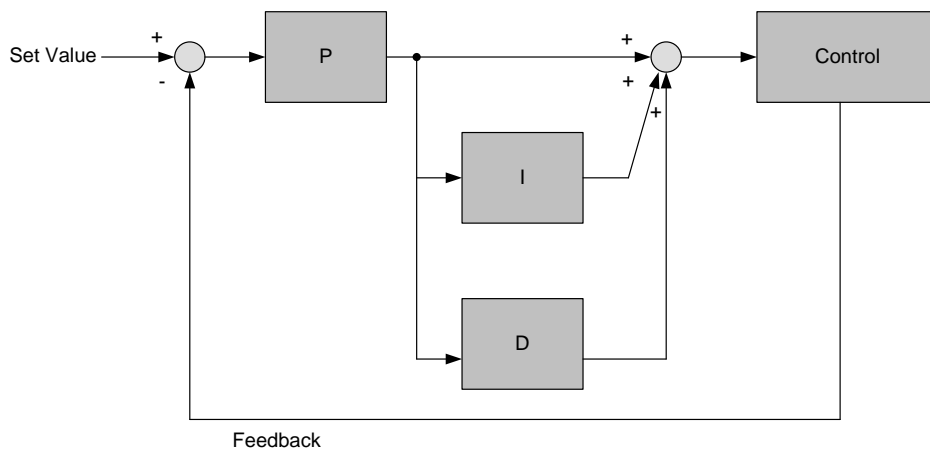


Figure 4.3.70 Basic PID control

PID Setup

Enable PID control by setting parameter 10-03, PID target value (10-00) and PID feedback value (10-01).

10-00: PID target (setpoint) value

- = 0: keypad given
- = 1: AI1 Analog Input (default)
- = 2: AI2 Analog Input
- = 3: Reserved
- = 4: 10-02

10-01: PID feedback value

- = 1: AI1 Analog Input
- = 2: AI2 Analog Input
- = 3: Reserved

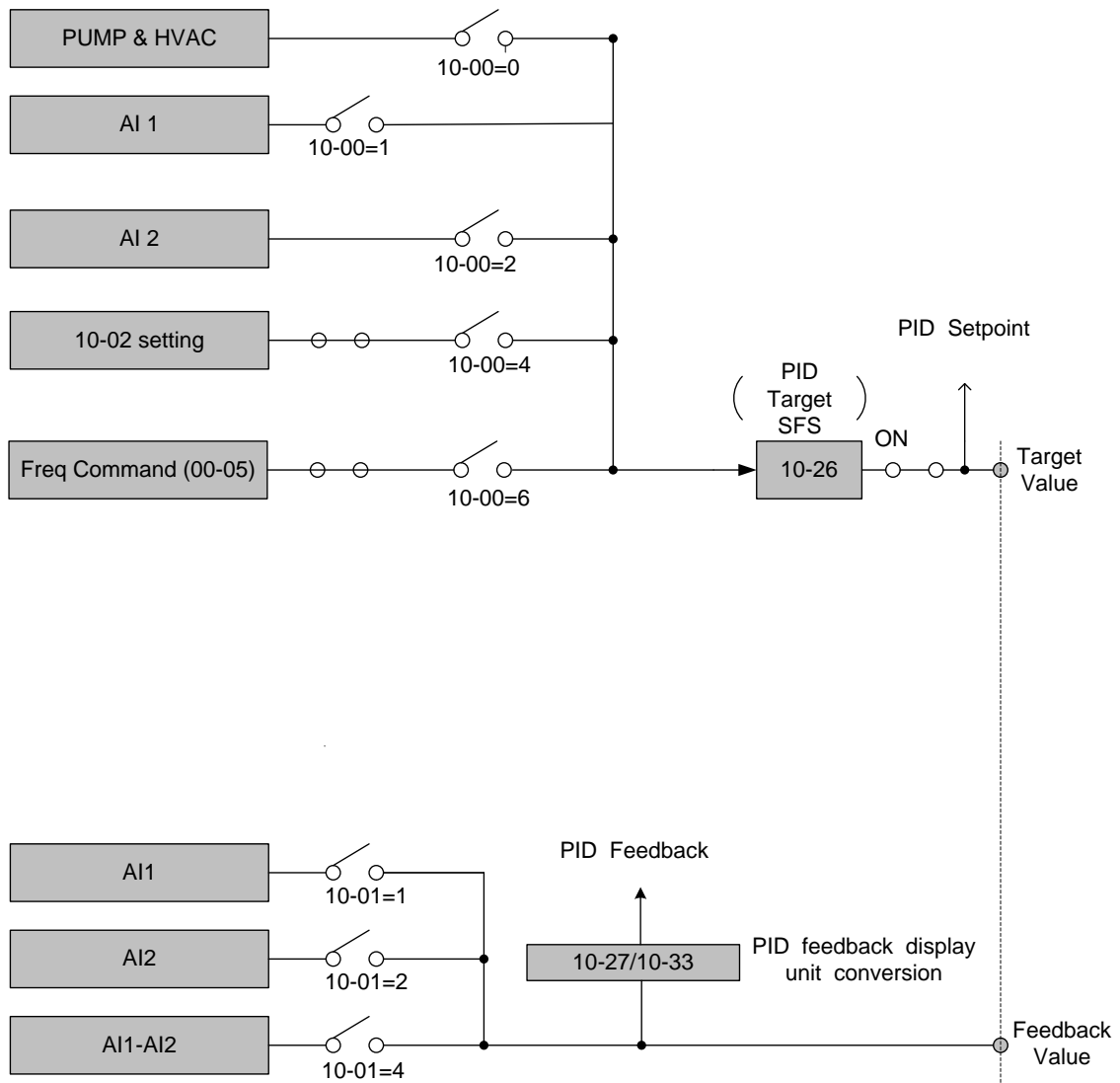


Figure 4.3.71 PID input selection

PID Control Setting

PID control block diagram.

The following diagram shows the PID control block diagram.

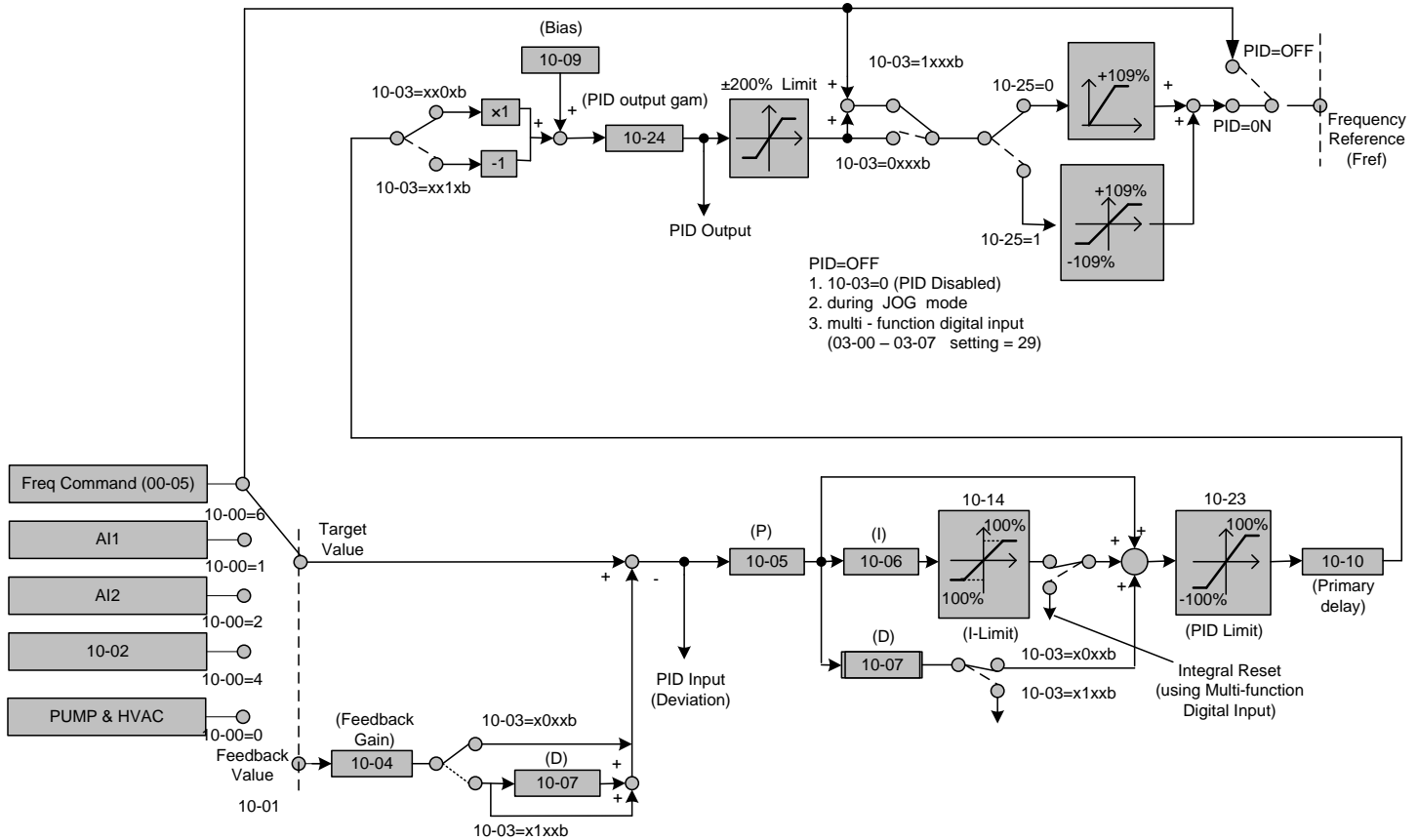


Figure 4.3.72 PID control block diagram

PID Tuning

Use the following procedures to start PID control,

- (1) Enable PID control (set 10-03 to a value greater than "xx0b").
- (2) Increase the proportional gain (10-05) to the highest value possible without causing the system to become unstable.
- (3) Decrease the integral time (10-06) to the lowest value possible without causing the system to become unstable.
- (4) Increase the differential time (10-07) to the highest value possible without causing the system to become unstable.

The PID control serves to maintain a given process within certain limits whether it is pressure, flow etc. To do this the **feedback** signal is compared to the **set value** and the difference becomes the error signal for the PID control.

The PID control then responds by trying to minimize this error. The error is multiplied times the value of the **Proportional gain** set by parameter **10-05**. An increased gain value results in a larger error. However, in any system as the gain is increased there is a point that the system will become unstable (oscillate).

To correct this instability, the response time of the system may be **slowed** down by increasing the **Integral time**

set by parameter **10-06**. However slowing the system down too much may be unsatisfactory for the process.

The end result is that these two parameters in conjunction with the acceleration time (01-14) and deceleration (**01-15**) times require to be adjusted to achieve optimum performance for a particular application.

PID output polarity can be selected with parameter 10-03 (setting = xx0xb: PID output forward, setting = xx1xb: PID output reversal). When PID output is set to reverse operation, and PID input is negative, the output frequency of PID will increase. When the PID output is set for forward (normal) operation and the PID input goes negative, the output frequency of PID will decrease.

PID feedback value can be adjusted using parameter 10-04 (PID feedback gain) as well as with the analog input gain and bias for terminal AI1 or AI2.

10-14: PID integral limit: Used to limit the integral output to prevent motor from stalling or damage to the system in case of a rapid change in the feedback signal. Reduce the value of 10-14 to increase the inverter response.

10-23: PID limit: Used to limit the output of the PID control. Maximum output frequency is 100%.

10-10: Primary delay time: Low pass filter located after the PID limit block that can be used to prevent PID output resonance. Increase the time constant to a value greater than the resonance frequency cycle and reduce time constant to increase the inverter response.

10-09: PID bias: Used to adjust the offset of the PID control. The offset value is added to the frequency reference as compensation. Use parameter 10-24 (PID output gain) to control the amount of compensation.

In case the PID control output value goes negative, parameter 10-25 (PID reversal output selection) can be used to reverse the motor direction.

Note: The PID output remains at zero when reverse operation is disabled.

10-26: PID target SFS: Sets the PID target value acceleration and deceleration ramp time. The PID target SFS can be disabled by setting the multi-function digital inputs 03-00 ~ 03-05 to 36 (PID target SFS is off). Reduce the acceleration / deceleration time when experiencing load resonance or system instability.

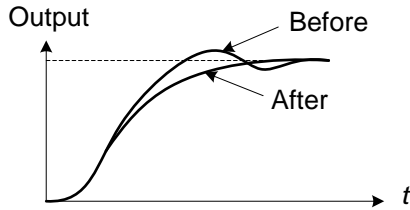
PID Fine Tuning

All PID control parameters are related to each other and require to be adjusted to its proper values. When the PID loop is operating within range the instructions can be used to fine tune PID operation.

- (1) Increase or decrease the proportion (P) gain until the system is stable using the smallest possible control change.
- (2) The integral (I) reduces the system stability which is similar to increasing the gain. Adjust the integral time so that the highest possible proportional gain value can be used without affecting the system stability. An increase in the integral time reduces system response.
- (3) Adjust the differential time if necessary to reduce overshoot on startup. The acceleration / deceleration time can also be used for the same purpose.

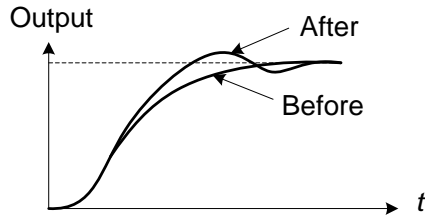
Fine-tuning PID control parameters:

(1) Reduce overshoot



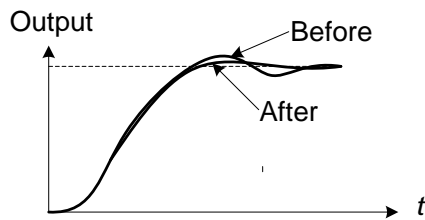
In case overshoot occurs, reduce the derivative time (D) and increase the integral time (I).

(2) Stabilize PID control



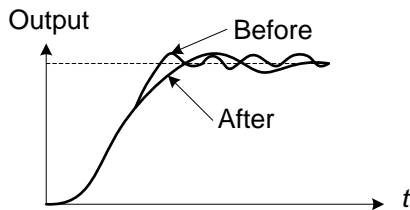
To quickly stabilize the PID control, reduce the integral time (I) and increase the differential time (D) in case overshoot occurs.

(3) Reduce long-period oscillation



Adjust the integral time (I) in case of long-periodical system oscillation.

(4) Reduce short-period oscillation



Adjusting the differential time (D) and proportional (P) gain when experiencing short-periodical oscillation.

| | |
|--------------|--|
| 10-11 | PID Feedback Loss Detection Selection |
| Range | 【0】 : Disable 【1】 : Warning 【2】 : Fault |
| 10-12 | PID Feedback Loss Detection Level |
| Range | 【0~100】 % |
| 10-13 | PID Feedback Loss Detection Time |
| Range | 【0.0~10.0】 Sec |

The PID control function provides closed-loop system control. In case PID feedback is lost, the inverter output frequency may be increase to the maximum output frequency.

It is recommended to enable to the PID feedback loss when the PID function is used.

PID feedback loss detection

10-11=0: Disable

10-11=1: Warning

A feedback loss condition is detected when the PID feedback value falls below the value set in parameter 10-12 (PID feedback loss detection level) for the time set in parameter 10-13 (PID feedback loss detection time). PID feedback loss warning message "Fb" will be displayed on the keypad and the inverter will continue to operate.

10-11=2: Fault

A feedback loss condition is detected when the PID feedback value falls below the value set in parameter 10-12 (PID feedback loss detection level) for the time set in parameter 10-13 (PID feedback loss detection time). PID feedback loss fault message "Fb" will be displayed on the keypad, the inverter stops and the fault contact is activated.

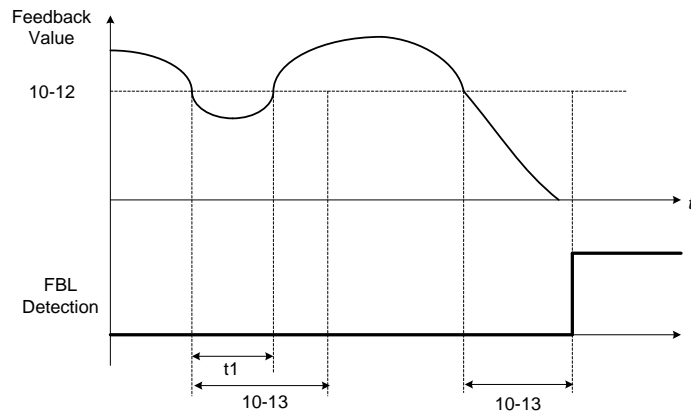


Figure 4.3.73 PID feedback loss detection

| | |
|-------|---|
| 10-17 | *Start Frequency of PID Sleep |
| Range | 【0.00~400.00】 Hz |
| 10-18 | Delay Time of PID Sleep |
| Range | 【0.0~255.5】 Sec |
| 10-19 | *Frequency of PID Waking up |
| Range | 【0.00~400.00】 Hz |
| 10-20 | Delay Time of PID Waking up |
| Range | 【0.0~255.5】 Sec |
| 10-29 | PID Sleep Selection |
| Range | 【0】 : Disable 【1】 : Enable 【2】 : Set by DI |
| 10-40 | Compensation Frequency Selection of PID Sleep |
| Range | 【0】 : Disable 【1】 : Enable |

The PID Sleep function is used to stop the inverter when the PID output falls below the PID sleep level (10-17) for the time specified in the PID sleep delay time parameter (10-18).

The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID

wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

Use parameter 10-29 to enable / disable PID sleep function.

10-29 =0: PID Sleep function is disabled.

10-29 =1: PID sleep operation is based on parameters of 10-17 and 10-18.

10-29 =2: PID sleep mode is enabled by multi-function digital input

Refer to Fig.4.3.74 (a), (b) and (c) for PID sleep / wakeup operation.

Note: Parameter 10-17 PID sleep start frequency does not apply to constant pressure operation (parameter 23-10).

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

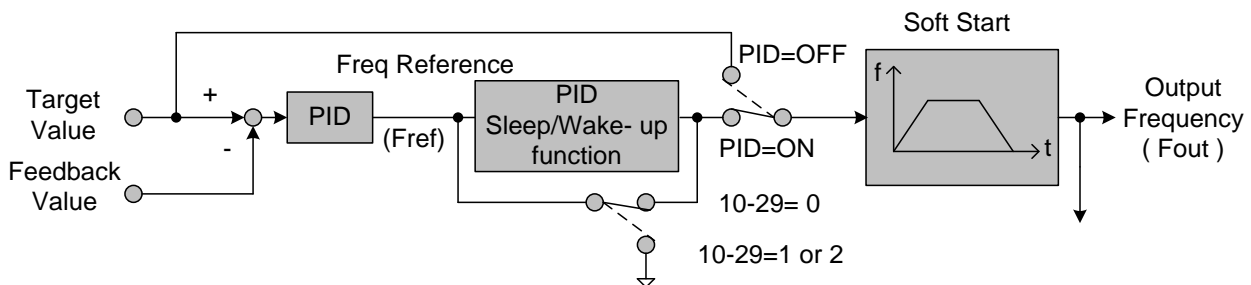


Figure 4.3.74: (a) PID control block diagram

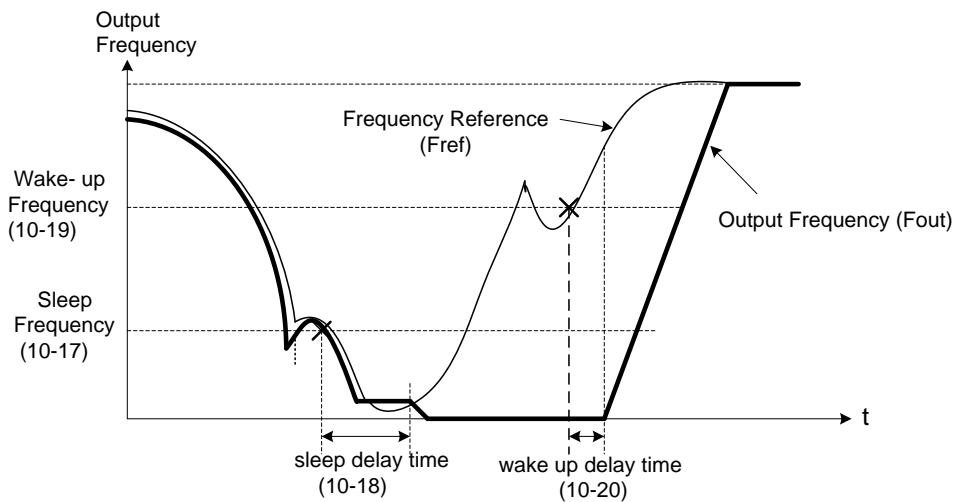


Figure 4.3.74: (b) Timing diagram PID sleep / wakeup

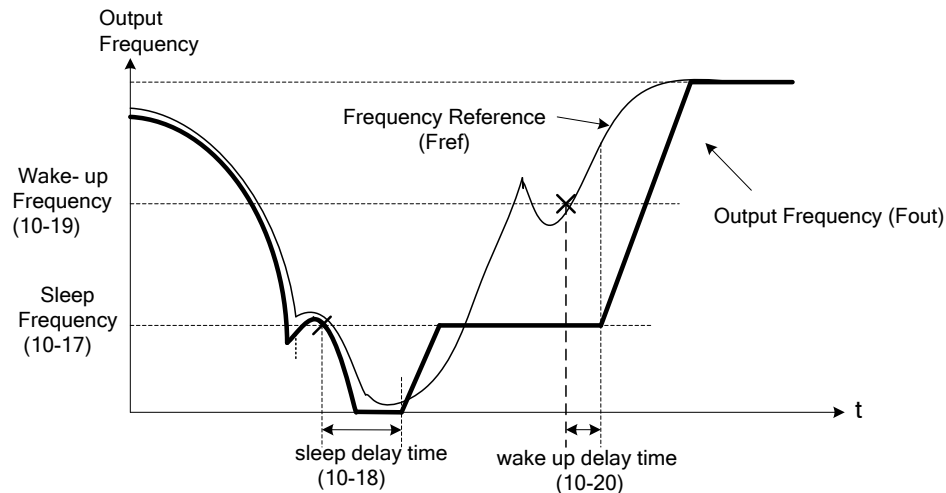


Figure 4.3.74: (c) Timing diagram of PID sleep compensation frequency/wakeup

10-40: Selection of PID Sleep Compensation Frequency

10-40=0, refer to Figure 4.3.83(b)

When the output frequency (Fout) falls below the PID sleep frequency (10-17) for the time specified in the PID sleep delay time (10-18) the inverter will decelerate to a stop and enter sleep mode.

10-40=1, refer to Figure 4.3.83(c)

When the output frequency (Fout) falls below the PID sleep frequency (10-17), the PID sleep timer starts and the inverter decelerates to the minimum output frequency (Fmin) set by 01-08. When the sleep timer expires the inverter will enter sleep mode and run at the sleep frequency set by 10-17.

While sleep mode is active and the motor has stopped, the internal PID control is still operating. When the reference frequency increases and exceeds the wakeup frequency parameter 10-19 for the time specified in the wakeup delay time parameter 10-20, the inverter will restart and the output frequency will ramp up to the reference frequency.

Notes:

- If the wakeup frequency < sleep frequency, sleep mode is activated when the output frequency reaches the wakeup frequency. If the wakeup frequency > sleep frequency, sleep mode is activated when the output frequency reaches the sleep frequency.
- Sleep mode is only active in positive direction. When 10-25=1 (Reverse Output), sleep mode has to be disabled.
- Parameter 10-00 and 10-01 cannot be set to the same source otherwise "SE05" (PID selection error message) will be displayed on the keypad.
- When PID sleep selection is enabled or activated by digital input (10-29= 1 or 2) and PID reverse output selection 10-25=1 is selected "SE05" (PID selection error message) will be displayed on the keypad.
- When PID sleep selection is enabled or activated by digital input (10-29= 1 or 2) and PID control mode (10-03) = 1xxx, "SE05" (PID selection error message) will be displayed on the keypad.

| | |
|--------------|----------------------------------|
| 10-22 | Start Level of PID Enable |
| Range | 【0~400.00】 |

Parameter 10-22 is active when 23-00=1 (PUMP) and 10-03=xxx1b (PID enabled).

When the output frequency \geq 10-22, PID Group 1 is used to setup the PID to reduce the error between setpoint and feedback value, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are set with 10-05 / 10-06 and 10-07.

When the output frequency $<$ 10-22, PID Group 2 is used to setup the PID to reduce the error between setpoint and feedback value, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are set with 10-36 / 10-37 and 10-38.

| | |
|--------------|----------------------------------|
| 10-27 | PID Feedback Display Bias |
| Range | 【0~9999】 |

PID Feedback Display Scaling

The PID feedback signal can be scaled to represent actual engineering units. Use parameter 10-33 to set the feedback signal gain for the feedback signal range maximum and parameter 10-27 to the feedback signal minimum.

Example: 0-10V or 4-20mA feedback scaled in PSI for to display pressure feedback, use 10-27 to set the pressure at 0V or 4mA feedback signal and use 10-33 to set the pressure at 10V or 20mA.

Refer to the Fig.4.3.75 for displaying the unit conversion.

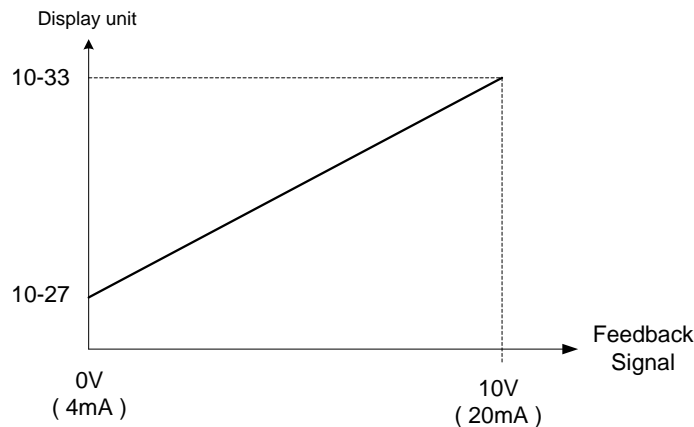


Figure 4.3.75 Feedback signal scaling

Example: Feedback signal: 0V = 0% = 1.0 PSI
 10V = 100% = 20.0 PSI
 Parameter setting: 10-27 = 10 (0% feedback)
 10-33 = 200 (100% feedback)

| | |
|--------------|----------------------------------|
| 10-30 | Upper Limit of PID Target |
| Range | 【0 ~ 100】 % |
| 10-31 | Lower Limit of PID Target |
| Range | 【0 ~ 100】 % |

Note: PID target value will be limited to the upper and lower limit range of PID target.

| 10- 32 | PID Switching Function |
|--------|---|
| Range | 【0】 : PID1 【1】 : PID2 【2】 : Set by DI 【3】 : Set by RTC |

10-32=0: PID 1 function is enabled.

PID target value (setpoint) is set by 10-02 and proportional gain, integral time and differential time are set by 10-05, 10-06 and 10-07.

10-32=1: PID 2 function is enabled.

PID target value (setpoint) is set by 10-02 and proportional gain, integral time and differential time are set by 10-36, 10-37 and 10-38.

10-32=2: Set by Digital Input

If the digital input terminal is active (digital multi-function terminal set to 54), PID2 is selected. If the digital input terminal is not active PID1 is selected.

10-32=3: Set by RTC

When RTC timer is enabled, PID1 switches to PID2.

| 10- 33 | PID Maximum Feedback Value |
|--------|----------------------------|
| Range | 【1~10000】 |

Set the PID feedback scaling, 100% of the PID feedback equals value set in 10-33.

| 10- 34 | PID Decimal Width |
|--------|-------------------|
| Range | 【0~4】 |

Set PID target and feedback value decimal point.

Example: 10-34=1, keypad displays shows XXX.X; 10-34=2, keypad displays XX.XX.

| 10- 35 | PID Unit (Only display in LCD Keypad) |
|--------|---------------------------------------|
| Range | 【0~24】 |

Select PID engineering unit (e.g. PSI) depending on the application.

When 10-35=0, parameter of 12-38 will be used and unit will be in %.

| 10- 36 | PID2 Proportional Gain (P) |
|--------|----------------------------|
| Range | 【0.00~10.00】 |
| 10- 37 | PID2 Integral Time (I) |
| Range | 【0.0~100.0】 Sec |
| 10- 38 | PID2 Differential Time (D) |
| Range | 【0.00~10.00】 Sec |

Refer to the PID function for additional information on PID2.

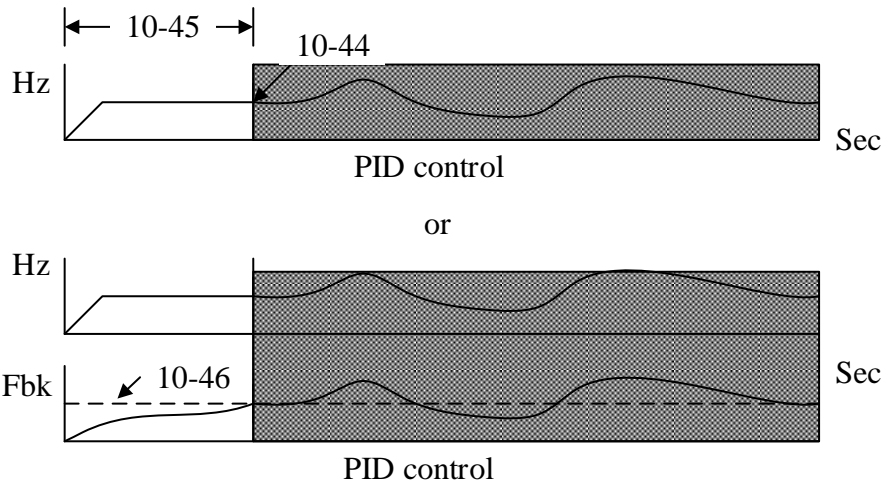
| | | |
|--------------|--|---|
| 10-39 | PID Output Frequency Setting during disconnection | * |
| Range | 【0~400】 Hz | |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

During a PID feedback loss condition (10-11=1) the inverter will run at a fixed output frequency set by parameter 10-39. PID operation continues when feedback loss condition is no longer active.

| | |
|--------------|-------------------------------|
| 10-44 | Precharge Frequency |
| Range | 【0~120.0】 Hz |
| 10-45 | Precharge Time |
| Range | 【0~250】 Sec |
| 10-46 | Precharge Target Level |
| Range | 【0~10000】 |

When parameter 10-44 is set to a value greater than 0 and PID control mode is set to be 10-03=XXX1B (PID enable) precharge is enabled. Upon start the inverter will run at the precharge frequency and stops precharge operation when the precharge time set by parameter 10-45 has expired or the PID feedback signal is equal or higher than the precharge target level (parameter 10-46). Once precharge function is completed the inverter will operate in PID control.



Parameter 10-46 decimal places are set by parameter 10-34 and engineering units by 10-35. Upper limit is determined by parameter 10-33 when 10-00 (PID target value source0 is set to 4).

Group 11: Auxiliary Parameters

| | |
|---------------|---|
| 11- 00 | Direction Lock Selection |
| Range | 【0】 : Allow Forward and Reverse Rotation 【1】 : Only Allow Forward Rotation 【2】 : Only Allow Reverse Rotation |

If Direction Lock Selection parameter 11-01 is set to 1 or 2, the motor only operates in that specific direction. A run command for the opposite direction will run in the selected direction. Forward or reverse commands can be issued via the control terminals, keypad or communication.

Note: This parameter can be used in fan and pump application where reverse rotation is prohibited.

| | |
|---------------|---|
| 11- 01 | Carrier Frequency |
| Range | 【0】 : Carrier Output Frequency Tuning 【1~16】 KHz |

Notes:

- (1) Value 1 to 16 represents KHz.
- (2) When 11-01=0, variable carrier frequency is used see parameter 11-30~11-32.
- (3) For SLV mode, the minimum value of 11-01 is 2 kHz, due to the sample rate; It is suggested to use 4 KHz, with a motor cable length of maximum 300ft (100m).
- (4) Setting range is determined by the inverter rating (13-00).
- (5) Refer to section 3 inverter derating based on carrier frequency.
- (6) A low carrier frequency increases motor noise but reduces motor losses and temperature.
- (7) A low carrier frequency decreases RFI, EMI interference and motor leakage current.

Refer to the carrier frequency Table 4.3.11.

| Carrier Frequency | 1KHz | 6KHz | 10KHz | 16KHz |
|---|-------------|-------------|--------------|-----------------|
| Motor noise | High | ----- | | Low |
| Output current waveform (similar to sinusoidal wave) | Fair | ----- | Good | ----- Better |
| Noise interference | Low | ----- | | High |
| Leakage current | Low | ----- | | High |
| Heat loss | Low | ----- | | High |

Table 4.3.11 Carrier frequency settings

If wire length between the inverter and the motor is too long, the high-frequency leakage current will cause an increase in inverter output current, which may affect peripheral devices. Adjust the carrier frequency to avoid this as shown in Table 4.3.12.

Table 4.3.12 Wire length and carrier frequency

| Wire length | < 30 Meter (98ft) | up to 50 Meter (164 ft) | up to 100 Meter (328ft) | > 100 Meter > 328ft |
|----------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------------------------|
| Carrier frequency (11-01 value) | Max. value 16KHz (11-01=16KHz) | Max. value 10KHz (11-01=10KHz) | Maxi. value 5KHz (11-01=5KHz) | Max. value 2KHz (11-01=2KHz) |

Notes:

- Reduce the carrier frequency if the torque does not match the speed.
- In V/F control mode, the carrier frequency is determined by parameters 11-30 (Carrier frequency max. limit), 11-31 (Carrier frequency lower limit) and 11-32 (Carrier frequency proportional gain) when 11-01 is set to 0.

| | |
|---------------|--|
| 11- 02 | Soft PWM Function Selection |
| Range | 【0】 : Disable 【1】 : Soft PWM 1 【2】 : Soft PWM 2 |

11-02=0: Soft PWM control disabled.

11-02=1: Soft PWM 1 control enabled. Software PWM control can improve noise produced by the motor, more comfortable for the human ear. At the same time, Software PWM also limits RFI noise to a minimum level. The default setting of Soft PWM control is disabled.

11-02=2: Soft PWM 2 control enabled. Use parameters 11-66 (2_3 Phase PWM Switch Frequency), 11-67 (Soft PWM 2 Frequency Range) and 11-68 (Soft PWM 2 Switch Frequency) to manually adjust for noise coming from the motor.

| | |
|---------------|--|
| 11- 66 | 2 Phase/ 3 Phase PWM Switch Frequency |
| Range | 【6.00~60.00】 |

When the inverter's output frequency rises above the value set in 11-66 the inverter will between 2 and 3 phase modulation.

| | |
|---------------|---|
| 11- 67 | Detection Range at Soft PWM Function 2 |
| Range | 【0~12000】 |
| 11- 68 | Detecting Start Frequency at Soft PWM Function 2 |
| Range | 【6.00~60.00】 |

Noise detection function is enabled when the inverter output frequency rises above the value set in parameter 11-68 and the Inverter will change the electromagnetic noise in operation according to the PWM mode setting of parameter 11-67.

Notes:

When 11-02=2, the sum of 11-01+11-67 cannot higher than the upper limit of carrier frequency, please refer to the error conditions:

An error message is shown when parameter 11-02=2 and the sum of 11-66+11-67 is higher than the upper limit of the carrier frequency, adjust the value of 11-02 or 11-67.

| | |
|---------------|---|
| 11- 03 | Automatic Carrier Lowering Selection |
| Range | 【0】 : Disable 【1】 : Enable |

11-03=0: Automatic carrier frequency reduction during an overheat condition is disabled.

11-03=1: Carrier frequency is automatically lowered in case the inverter heatsink overheated and will return to carrier frequency set in parameter 11-01 when the inverter temperature returns to normal. See section 3 for more information.

| | |
|---------------|--|
| 11- 04 | S-curve Time Setting at the Start of Acceleration |
| 11- 05 | S-curve Time Setting at the End of Acceleration |
| 11- 06 | S-curve Time Setting at the Start of Deceleration |
| 11- 07 | S-curve Time Setting at the End of Deceleration |
| Range | 【0.00~2.50】 Sec |

The S curve function for acceleration / deceleration is used to reduce mechanical impact caused by the load during momentary starting and stopping of the inverter. To use the S curve function set the time for acceleration start point (11-04), acceleration end point (11-05), deceleration start point (11-06) and deceleration end point (11-07). Refer to Fig.4.3.76 for more information.

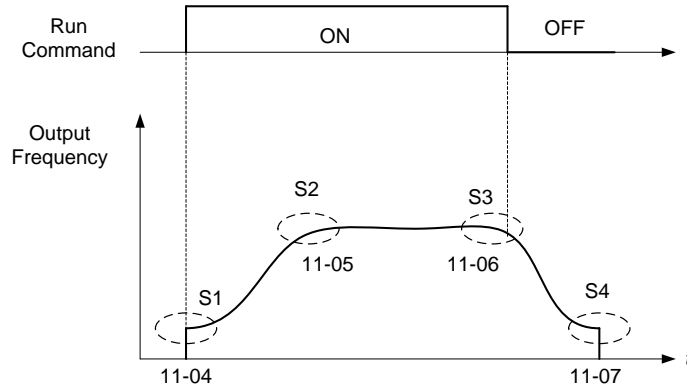


Figure 4.3.76 S curve characteristic

Total acceleration and deceleration time when the S curve is used:

$$\text{Accelerating time} = \text{Accelerating time 1 (or 2)} + \frac{(11-04) + (11-05)}{2}$$

$$\text{Deceleration time} = \text{Deceleration time 1 (or 2)} + \frac{(11-06) + (11-07)}{2}$$

| | |
|---------------|-----------------------------|
| 11- 08 | Jump Frequency 1 |
| 11- 09 | Jump Frequency 2 |
| 11-10 | Jump Frequency 3 |
| Range | 【0.0~400.0】 Hz |
| 11-11 | Jump Frequency Width |
| Range | 【0.0~25.5】 Hz |

These parameters allow “jumping over” of certain frequencies that can cause unstable operation due to resonance within certain applications.

Note: Prohibit any operation within the jump frequency range. During acceleration and deceleration the frequency is continuous without skipping the jump frequency.

To enable jump frequency 1 – 3 (11-08 – 11-10) set the frequency to a value greater than 0.0 Hz.

Use the jump frequency width (11-11) to create a jump frequency range. Refer to Fig.4.3.77.

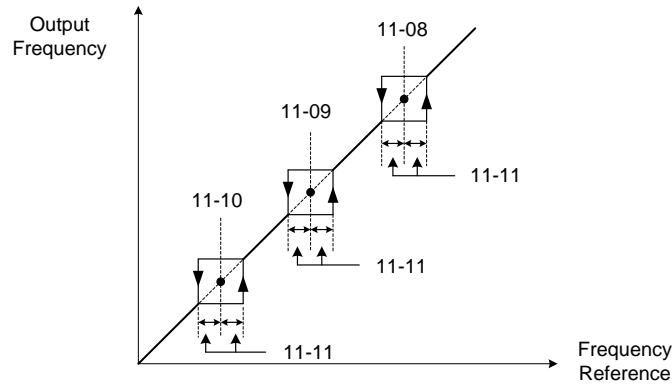


Figure 4.3.77 Jump frequency operation

Jump frequency via Analog Input.

Set parameter 04-05 (AI2 function selection) to 9 (frequency jump setting 4) for controlling the jump frequency via analog input AI2. Refer to Fig. 4.3.38.

Note: When jump frequency overlap the sum of the overlapped jump frequencies will be used as the jump frequency range. Refer to Fig.4.3.78.

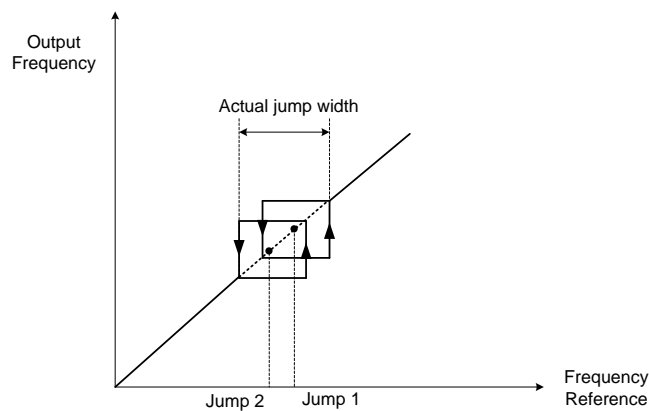


Figure 4.3.78 Jump frequency overlap

| | |
|---------------|------------------------------|
| 11- 13 | Automatic Return Time |
| Range | 【0~120】 Sec |

If no keypad button is pressed within the time set by 11-13, it will automatically return to the mode screen.

When it is set to 0, function of automatic return key is off. Press the return key to return to the previous directory.

| | |
|---------------|---------------------------------------|
| 11- 12 | Manual Energy Saving Gain |
| Range | 【0~100】 % |
| 11- 18 | Manual Energy Saving Frequency |
| Range | 【0.00~400.00】 Hz |

Manual energy savings reduces the output voltage for the purpose of saving energy.

To enable manual energy savings set one of the multi-function digital input (03-00 to 03-05) to 20 and activate the input or use parameter 11-18 to set the manual energy savings activation frequency.

When the output frequency rises above the value set in parameter 11-18 manual energy savings function is enabled. Setting parameter 11-18 manual energy savings frequency to 0.0 Hz disables the manual energy savings frequency activation function. Refer to Figure 4.3.88 for more information.

Note: Only use manual energy savings functions in combination with light loads.

Manual energy saving gain (11-12) determines the output voltage of the inverter when manual energy savings is enabled. Output voltage is percentage gain times the V/F voltage.

Manual energy saving control uses the voltage recovery time (07-23) to change the output voltage, refer to figure 4.3.79.

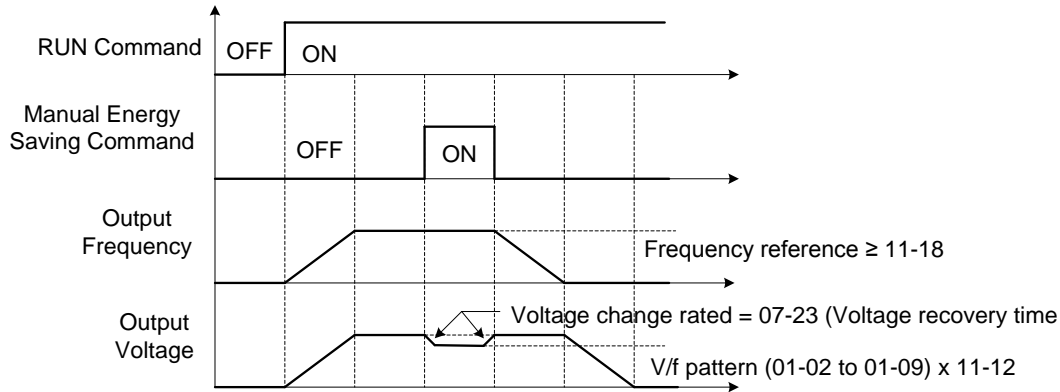


Figure 4.3.79 Manual energy saving operation

| | |
|---------------|---|
| 11- 19 | Automatic Energy Saving Function |
| Range | 【0】 : Automatic Energy Saving is Disabled. 【1】 : Automatic Energy Saving is Enabled. |
| 11- 20 | Filter Time of Automatic Energy Saving |
| Range | 【0~200】 msec |
| 11- 21 | Voltage Upper Limit of Energy Saving Tuning |
| Range | 【0~100】 % |
| 11- 22 | Adjustment Time of Automatic Energy Saving |
| Range | 【0~5000】 msec |
| 11- 23 | Detection Level of Automatic Energy Saving |
| Range | 【0~100】 % |
| 11- 24 | Coefficient of Automatic Energy Saving |
| Range | 【0.00~655.34】 |

In the V/F control mode the automatic energy saving (AES) function automatically adjusts the output voltage and reduces the output current of the inverter to optimize energy savings based on the load. The output power changes proportional to the motor load. Energy savings is minimal when the load exceeds 70% of the output power and savings is greater when the load decreases.

AES function is suitable for variable torque loads such as fan or pump application. Do not use this function to when the motor load is unstable to avoid having not enough output torque required for the application.

These parameters have been factory set and for most application does not to be adjusted. If the motor characteristic are different from the TECO standard adjusting may be required, please refer to the following commands for adjusting these parameters:

Enable Automatic Energy Savings Function

- (1) To enable automatic energy saving function set 11-19 to 1.
- (2) Adjust automatic energy savings filter time (11-20)
- (3) Adjust energy savings parameters (11-21 to 11-22)

In AES mode, the optimum voltage value is calculated based on the load power requirement. Adjusting motor voltage will also affect motor temperature and motor performance.

In certain applications the optimum AES voltage needs to be adjusted in order to achieve optimum energy savings. Use the following AES parameters for manual adjustment:

11-21: Voltage limit value of AES commissioning operation

Set the voltage upper limit during automatic energy saving. 100% corresponds to the value in parameter 01-03 (Maximum Output Voltage) depending on the inverter class used. Refer to the Fig.4.3.80.

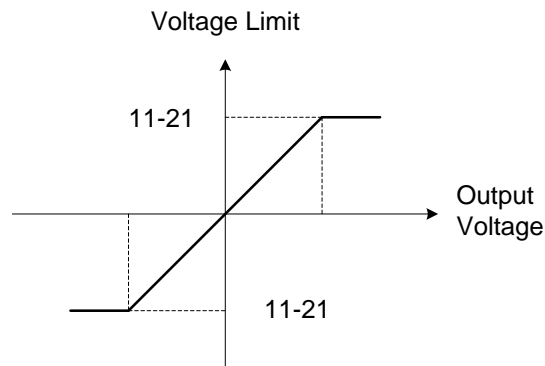


Figure 4.3.80 Voltage limit value of commissioning operation

11-22: Adjustment time of automatic energy saving

Set sample time constant for measuring output power.

Reduce the value of 11-22 to increase response when the load changes.

Note: If the value of 11-22 is too low and the load is reduced the motor may become unstable.

11-23: Detection level of automatic energy saving

Set the automatic energy saving output power detection level.

11-24: Coefficient of automatic energy saving

The coefficient is used to tune the automatic energy saving. Adjust the coefficient while running the inverter on light load while monitoring the output power. A lower setting results in a lower output voltage.

Notes:

- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Adjust parameter 13-00 if the motor power does not match the inverter rating.

| | |
|---------------|---|
| 11- 29 | Auto De-rating Selection |
| Range | 【0】 : Disable 【1】 : Enable |

The automatic de-rating function automatically reduces the output frequency by 30% of the nominal motor speed when the inverter detects an overheat condition (heatsink).

Automatic de-rating function depends on the automatic carrier frequency reduction selection (11-03).

If automatic carrier frequency reduction is disabled (11-03=0), the output frequency is reduced by 30% of the nominal motor speed when an overheat condition is detected.

If automatic carrier frequency reduction is enabled (11-03=1), the output frequency is reduced by 30% of the nominal motor speed when the carrier frequency is at its minimum setting.

11-29=0: Auto de-rating selection disabled, carrier frequency is based on 11-01 or 11-03.

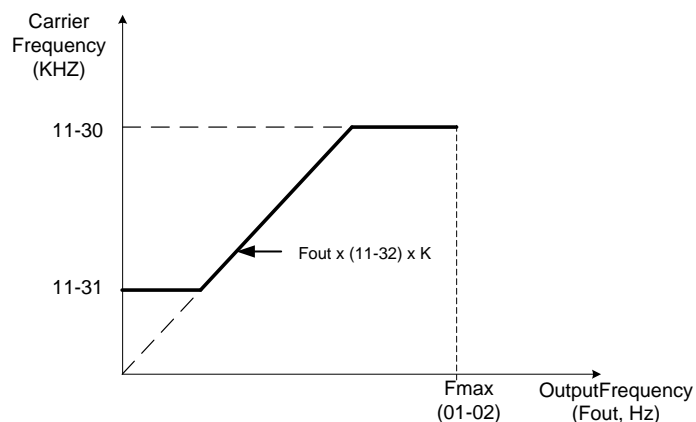
11-29=1: Auto de-rating selection is enabled.

| | |
|---------------|---|
| 11- 30 | Variable Carrier Frequency Max. Limit |
| Range | 【2~16】 KHz |
| 11- 31 | Variable Carrier Frequency Min. Limit |
| Range | 【1~16】 KHz |
| 11- 32 | Variable Carrier Frequency Proportional Gain |
| Range | 【00~99】 |

Carrier frequency method depend on the selected control mode.

| Control Mode | Variable Carrier Frequency (11-01 = 0) | Fixed Carrier Frequency (11-01 = 2-16 kHz) |
|---------------------|---|---|
| V/F | Available | Available |
| SLV | Not available | Available |

Variable carrier frequency can be adjust with parameter 11-30 ~ 11-32.



K is a coefficient; the value of K is based on the following based on the maximum carrier frequency:

K=1: when 11-30 < 5 KHz

K=2: when 10 KHz > 11-30 ≥ 5 KHz

K=3: when 11-30 ≥ 10KHz

Notes:

- In V/F control mode if the speed and torque are constant, the variable carrier frequency mode (11-01=0) can be selected to reduce the carrier frequency based on output frequency.
- If the carrier frequency proportional gain (11-32) > 6 and 11-30 < 11-31, error message "SE01" out of range will appear on the keypad.
- If the minimum limit (11-31) is set higher than the maximum limit (11-30), the minimum limit will be ignored and the carrier frequency will be set at the highest limit (11-30).
- In fixed carrier frequency mode (11-01 = 2-16) parameters 11-30, 11-31 and 11-32 are not used.
- In SLV control mode, the maximum limit of the carrier frequency is fixed at 11-30.

| | |
|---------------|---|
| 11- 28 | Frequency Gain of Overvoltage Prevention 2 |
| Range | 【1~200】 % |
| 11- 33 | Rise Amount of DC Voltage Filter |
| Range | 【0.1~10.0】 V |
| 11- 34 | Fall Amount of DC Voltage Filter |
| Range | 【0.1~10.0】 V |
| 11- 35 | Dead band Level of DC Voltage Filter |
| Range | 【0.0~99.0】 V |

| | |
|---------------|---|
| 11- 36 | Frequency gain of OV prevention |
| Range | 【0.000~1.000】 |
| 11- 37 | * Frequency limit of OV prevention |
| Range | 【0.00~400.00】 Hz |
| 11- 38 | Deceleration start voltage of OV prevention |
| Range | 200V : 【200~400】 V 400V : 【400~800】 V |
| 11- 39 | Deceleration end voltage of OV prevention |
| Range | 200V : 【300~400】 V 400V : 【600~800】 V |
| 11- 40 | OV prevention selection |
| Range | 【0】 : Disable 【1】 : OV prevention Mode 1 【2】 : OV prevention Mode 2 【3】 : OV Prevention Mode 3 |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

Overvoltage suppression is used in application that will likely cause regenerative energy.

Example: Press Application

In this application there are two conditions causing regenerative energy back to the inverter and therefore recharging the DC bus.

- (1) When the brake is not set, the motor will accelerate and rotate the flywheel. When motor decelerates, the rotation speed will exceed the motor speed due to the large flywheel's inertia feeding back regenerative energy to the inverter resulting in an increased DC bus.
- (2) When the brake is set, the motor will rotate the flywheel and compress the spring. At the highest point when the press moves beyond its center, the spring will release its stored energy back to the flywheel and therefore feeding back regenerative energy to the inverter resulting in an increased DC bus.

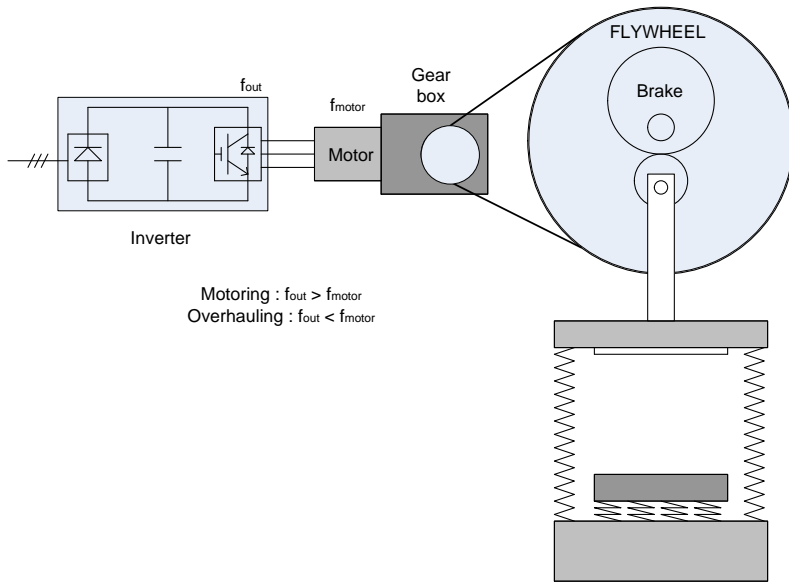


Figure 4.3.80.a Stamping Operation

Over-voltage prevention (OVP) function monitors the DC-bus voltage and adjusts the speed reference, acceleration and deceleration rate, to prevent the inverter from tripping on an overvoltage condition.

When the speed reference is reduced, the motor will start to decelerate. When the inverter is operating at a fixed output frequency and excessive regenerative energy back to the inverter is detected the inverter will accelerate the motor in order to reduce the DC-bus voltage. Refer to Figure 4.3.80.b.

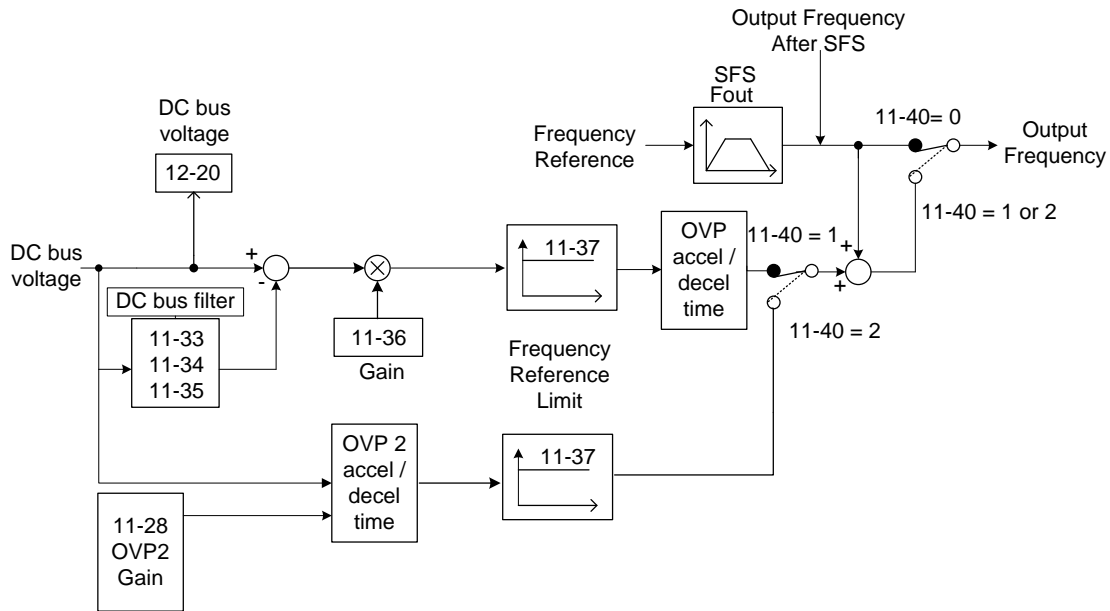


Figure 4.3.80.b operation

11-40=1: OV prevention Mode 1

1) DC voltage filter is used to provide a stable reference value for determining the change in DC voltage during regenerative operation.

- Adjust the DC voltage filtering increase rate parameter 11-33 (DC Voltage Filter Rise Amount). When the DC voltage exceeds 11-33 +11-35 (DC Voltage Filter Dead-band Level), the output of the filter will increase.
- Adjust the DC voltage filtering decrease rate parameter 11-34 (DC Voltage Filter Fall Amount). When the DC voltage exceeds 11-33 +11-35 (DC Voltage Filter Dead-band Level), the output of the filter will decrease.
- Monitor the DC voltage filter output by 12-20 (DC voltage filter value).
- Set the DC voltage filter decrease rate (11-34) to a greater value than the value of the DC voltage filtering increase rate (11-33).

2) When the inverter is operating at a fixed output frequency, the OVP function will monitor the DC-bus voltage to detect regenerative operation.

In case of a regenerative condition the inverter calculates the delta DC bus voltage value and multiplies the value with parameter 11-36, the result is added to the frequency reference accelerating the motor to prevent on an overvoltage condition.

When the regenerative energy decreases, the inverter output frequency will return to the actual frequency reference. Deceleration rate is based on the DC voltage, as shown in Figure 4.3.80.c.

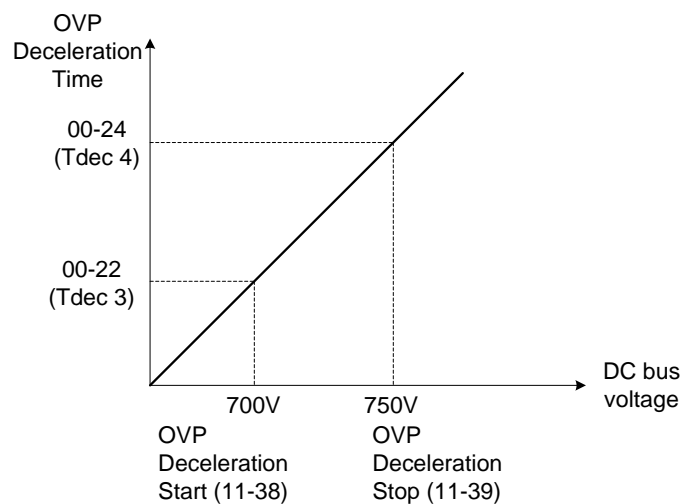


Figure 4.3.80.c OVP deceleration time

3) When the inverter is stopped, the deceleration rate can be set with parameter 00-15 (Tdec1). In case the DC voltage is too high, the inverter will decelerate based on the OVP deceleration time as shown in Figure 4.3.80c.

- Set DC-bus voltage in parameter 11-38 (start voltage of OVP deceleration) and set OVP deceleration rate in 00-22 (Tdec3).
- When the DC voltage reaches this level, it is necessary to decelerate rapidly in order to prevent the delta DC voltage of becoming too large.
- When DC voltage reaches the setting of 11-39 (stop voltage of OVP deceleration), it will decelerate based on the set value of 00-24 (Tdec4)
- Deceleration rate is linear based on the slope defined by the start point (11-38) and end point (11-39).

4). Enable the OVP function with parameter 11-40 set to 1 or 2. The following parameter default values will be

changed when the OVP function is enabled:

07-09=1 (Stop mode: coast to stop)

00-14(Tacc1) = 5.0 Sec (the frequency reference acceleration rate when DC voltage is too high.)

00-22(Tdec3) = 20.0 Sec (low setting point of OVP deceleration rate).

00-24(Tdec4) = 100.0 Sec (high setting point of OVP deceleration rate).

Note: S curve should be disabled when using the OVP function (11-04~11-07=0.0sec).

11-40=2: OV prevention Mode 2

This mode is similar to OV prevention mode 1 but uses frequency gain of OV prevention 2 (11-28) in combination with the accel/decel times, see Fig. 4.4.80b and 4.4.80c for additional information.

11-40=3: OV prevention Mode 3

In this mode the inverter will raise the output frequency temporarily to avoid an OV condition; the output frequency will not go higher than the value of 01-02 (Maximum Output Frequency of Motor 1). Please adjust the value of 01-02 according to application. Raise the value of 11-64 in 0.1 increments if an OV condition still occurs when 11-40=3 is selected.

| | |
|---------------|--|
| 11- 64 | Acceleration Speed Gain Adjustment |
| Range | 【0.1~10.0】 |
| 11- 65 | Target Main Circuit Voltage |
| Range | 200V : 【200~400】 V 400V : 【400~800】 V |

When 11-40 =3 (OV Prevention Mode 3), user can temporarily increase the output frequency to avoid an OV condition from occurring. The maximum output frequency of motor 1 is limited to the value set in parameter 01-02 (maximum output frequency of motor 1); adjust 10-02 depending on the application.

Adjustment modes

If an OV condition still occurs in using prevention mode 3, increase the value of parameter 11-64 in 0.1 increments. Note: increasing value of parameter 11-64 results in an increase in motor speed and current.

| | |
|---------------|---|
| 11- 41 | Reference Frequency Loss Detection |
| Range | 【0】 : Deceleration to Stop when Reference Frequency Disappears 【1】 : Operation is Set by 11-42 when Reference Frequency Disappears |
| 11- 42 | Reference Frequency Loss Level |
| Range | 【0.0~100.0】 % |

A reference frequency loss is detected when the frequency command falls 90% within 360ms.

When 11-41=1, the main frequency command is continuously compared with the previous value of the reference within the 360ms sample rate

When a frequency reference loss occurs the inverter set the Frequency command to the maximum output frequency of motor 1 (01-02) x the level set in parameter 11-42

Note: When reference command is restored reference operation returns to before the reference loss condition.

Notes:

1. Frequency command (11-42) 100% corresponds to the maximum output frequency of motor 1 (01-02).
2. Reference loss detection can only be use when frequency reference is set via an analog signal (1: AI1; 7:AI2) see main frequency source (00-05).

Fig.4.3.81 shows the operation of the multi-function digital output (03-11~03-12) set for reference loss during a frequency reference loss condition.

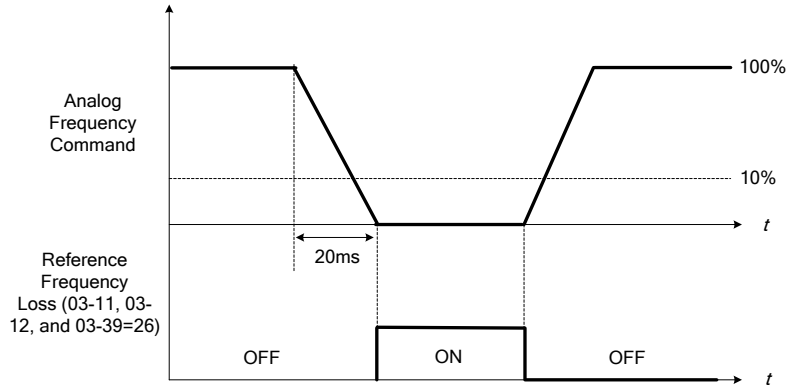


Figure 4.3.81 Operation for reference frequency loss

| | |
|---------------|-------------------------------------|
| 11- 43 | Hold Frequency at Start |
| Range | 【0.0~400.0】 Hz |
| 11- 44 | Frequency Hold Time at Start |
| Range | 【0.0~10.0】 Sec |
| 11- 45 | Hold Frequency at Stop |
| Range | 【0.0~400.0】 Hz |
| 11- 46 | Frequency Hold Time at Stop |
| Range | 【0.0~10.0】 Sec |

The hold function is used to temporarily hold the reference frequency, in order to prevent stalling the motor or preventing an over current condition during starting or stopping due to load conditions.

During start, the inverter will operate at the hold frequency at start for the time specified in the parameter 11-44 in order to establish the magnetic flux.

Note: The acceleration or deceleration time does not include the start and stop hold time. Refer to the Fig. 4.3.82.

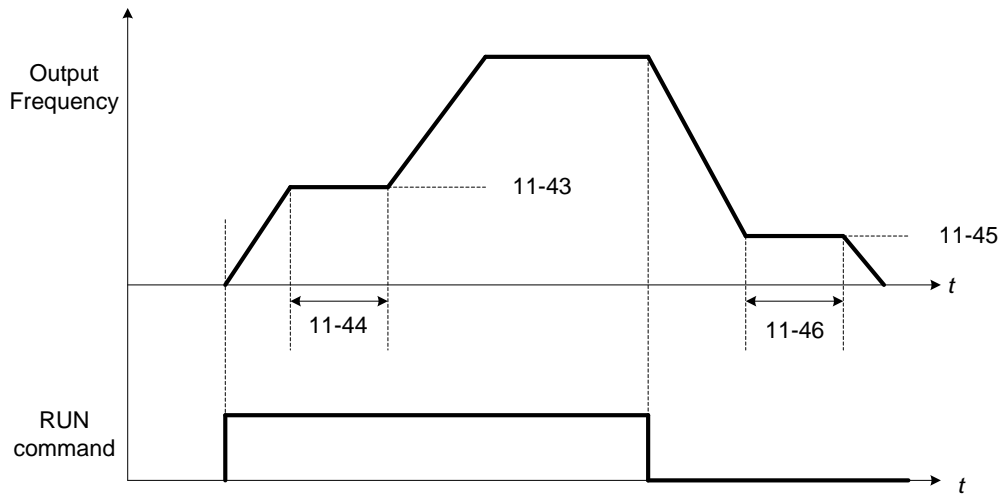


Figure 4.3.82 Reserved function

When the inverter is in stop mode, this function can also be used to prevent wind milling. In addition, it can be used for the purpose of braking using the motor to consume the braking energy resulting in a better controlled stop. Refer to the DC brake parameter 07-16 for DC braking during start.

Notes:

- The hold function at start is inactive when the hold frequency at start (11-43) is set to a value less than Fmin (01-08).
- The hold function at stop is inactive when the hold frequency at stop (11-45) is set to a value less than Fmin (01-08).

| | |
|---------------|--|
| 11- 47 | KEB Deceleration Time |
| Range | 【0.0~25.5】 Sec |
| 11- 48 | KEB Detection Level |
| Range | 200V : 【190~210】 V 400V : 【380~420】 V |

KEB function can be used to keep the inverter from tripping on a under voltage condition due to a momentary power-loss. To enable the KEB function set parameter 11-47 to a value greater than 0.0 sec.

Upon detection of a power-loss the inverter uses the KEB deceleration time (11-47) to decelerate the motor and using the regenerative energy from the motor to maintain the DC-bus at a nominal level.

11-48: KEB detection level

If the DC-bus voltage falls below the value set in 11-48, the KEB is activated and the inverter starts decelerating according to the value set in 11-47.

To accelerate back to the original output frequency one of the digital inputs (03-00 to 03-05) set for 48 (KEB acceleration) has to be activated and the DC voltage has to rise above 11-48 + delta V (Delta V = +10V for 200V series, Delta V = +20 V for 400V series).

Refer to the example in Fig.4.3.83.

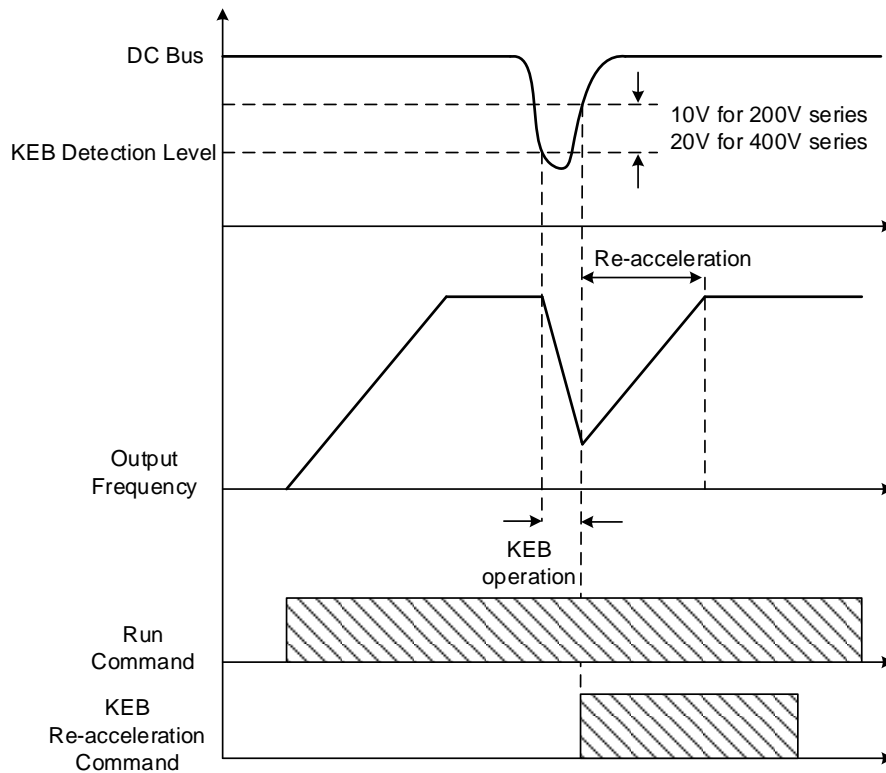


Figure 4.3.83 KEB operation

| | |
|--------|---|
| 11- 51 | Braking Selection of Zero Speed |
| Range | 【0】 : Disable 【1】 : Enable |

11-51: Operation selection of zero-speed braking

In V/F control mode, the DC braking operation can be used to the motor shaft.
Set 11-51 to select zero-speed braking operation to 1 to enable this function.

To use DC braking operation set parameter 00-02 (operation command selection) to 1 and parameter 00-05 (frequency reference selection) to 1, the operation command and frequency reference are now set for external control. When the frequency reference is 0V (or less than 4mA), and the operation command is turned on, the zero-speed 'DC' braking operation is activated and holding torque is generated using DC braking.

Refer to Fig.4.3.84 for more information on zero-speed DC braking operation.

Note: DC braking 07-07 is limited to 20% of the inverter rated current.

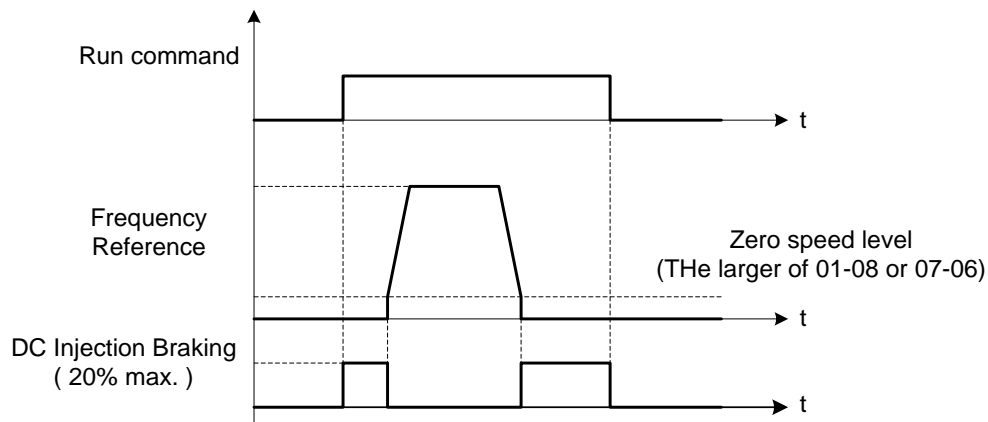


Figure 4.3.84 Zero-speed braking operation

| | |
|---------------|---|
| 11- 54 | Initialization of Cumulative Energy |
| Range | 【0】 : Do not Clear Cumulative Energy 【1】 : Clear Cumulative Energy |

Reset the cumulative energy (kWhr) (12-67) and the cumulative energy (MWhr) (12-68) via parameter 11-54.

| | |
|---------------|---|
| 11- 55 | STOP Key Selection |
| Range | 【0】 : Stop Key is Disabled when the Operation Command is not Provided by Keypad. 【1】 : Stop Key is Enabled when the Operation Command is not Provided by Keypad. |

11-55= 0: Stop button disabled when operation command is set for terminals (00-02=1) or communication (00-02=3).

11-55= 1: Stop button enabled.

| | |
|---------------|--|
| 11- 56 | UP/DOWN Selection |
| Range | 【0】 : When UP/DOWN in Keypad is Disabled, it will be Enabled if Pressing ENTER after Frequency Modification. 【1】 : When UP/DOWN in Keypad is Enabled, it will be Enabled upon Frequency Modification. |

11-56= 0: Changing the reference frequency on the keypad in UP/DOWN control requires the ENTER button to be pressed for the inverter to accept the modified reference frequency.

11-56= 1: Changing the reference frequency on the keypad in UP/DOWN control immediately changes the reference frequency and there for the output frequency.

Note: The reference frequency can be changed (up or down) via the keypad or by setting one of multi-functional digital input terminals (03-00 to 03-05) to 8 and 9. Refer to instructions of (03-00 to 03-05 = 8 or 9).

| | |
|---------------|---|
| 11- 58 | Record Reference Frequency |
| Range | 【0】 : Disable 【1】 : Enable |

This function is enabled only when one of multi-function digital input terminals (03-00 to 03-07) is set to 11 (ACC / DEC Inhibition command).

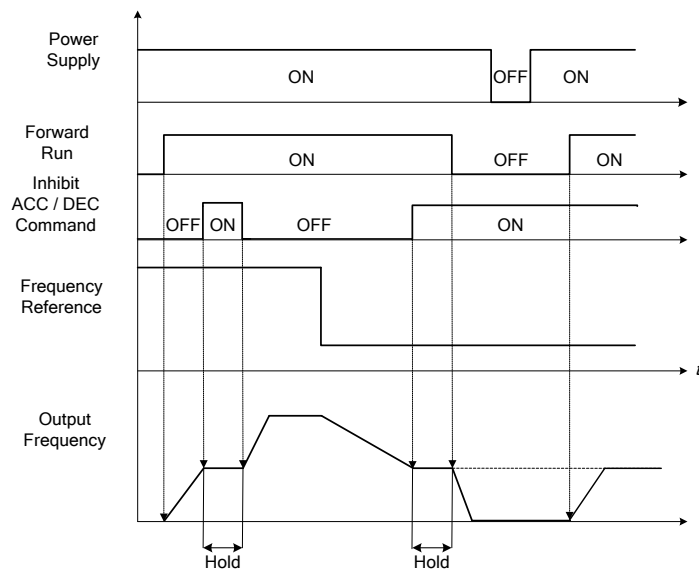
11-58= 0: When ACC / DEC inhibit command is enabled, the motor will stop accelerating or decelerating and the frequency at that moment will be used as frequency command. If ACC / DEC inhibit command is disabled or a stop command is active, the frequency command will return to its original frequency.

When a stop command active, power is turned off the frequency will be set to 0 Hz

Note: If ACC/DEC inhibit command is enabled before running, the display shows STP0 after running to indicate that there is no reference frequency record.

11-58= 1: When ACC / DEC inhibit command is enabled, the output frequency is recorded and used as frequency command. When the inverter is stopped with ACC / DEC inhibit command active and power is turned off, the frequency command is recorded and restored after power has been restored.

Please refer to the following figure.



| | |
|---------------|---------------------------------------|
| 11- 59 | Gain of Preventing Oscillation |
| Range | 【0.00~2.50】 |

This parameter is used to prevent motor oscillation (hunting prevention).

If oscillation (hunting) occurs under normal operation (normal duty mode), increase the setting value by 0.01 increments.

| | |
|---------------|--|
| 11- 60 | Upper Limit of Preventing Oscillation |
| Range | 【0~100】 % |

Motor oscillation (hunting) prevention upper limit.

| | |
|---------------|---|
| 11- 61 | Time Parameter of Preventing Oscillation |
| Range | 【0~100】 |

Hunting prevention response delay time is the delay time used to prevent motor oscillation.

| | |
|---------------|---|
| 11- 62 | Prevention of Oscillation Selection |
| Range | 【0】 : Mode 1 【1】 : Mode 2 【2】 : Mode 3 |

11-62=0: Mode 1, lower response to prevent oscillation.
11-62=1: Mode 2, medium response to prevent oscillation.
11-62=2: Mode 3, fast response to preventing oscillation.

| | |
|---------------|---|
| 11- 63 | Flux- Strengthening Selection |
| Range | 【0】 : Disable 【1】 : Enable |

11-63=0: It has no function of flux-strengthening, the no-load current of high speed and low speed are the same.
11-63=1: It has function of flux-strengthening, the torque of low speed is higher, but the no-load current is also higher, it is suitable for big load in low speed.

| | |
|---------------|---|
| 11- 69 | Gain of Preventing Oscillation 3 |
| Range | 0.00~200.00 % |

Increase value in steps of 0.01 in case of motor vibration in ND mode.

| | |
|---------------|--|
| 11- 70 | Upper Limit of Preventing Oscillation 3 |
| Range | 0.01~100.00 % |

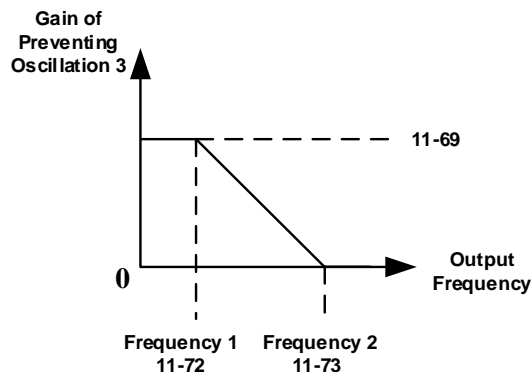
Set upper limit for the oscillation prevention function.

| | |
|---------------|---|
| 11- 71 | Time Parameter of Preventing Oscillation 3 |
| Range | 0~30000 ms |

Set oscillation 2 prevention response time. A lower value increases response time but may cause instability.

| | |
|---------------|---|
| 11- 72 | Switch Frequency 1 for Preventing Oscillation Gain |
| Range | 0.01~300.00 Hz |
| 11- 73 | Switch Frequency 2 for Preventing Oscillation Gain |
| Range | 0.01~300.00 Hz |

Parameters 11-72 and 11-73 define the oscillation prevention mode switching frequencies.



| |
|--|
| Group 12: Monitoring Parameters |
|--|

| | | |
|---------------|---|---|
| 12- 00 | Display Screen Selection (LED) | |
| Range | Highest bit => <u>0 0 0 0</u> <= lowest bit The value range of each bit is 0~7 from the highest bit to the lowest bit, | |
| | 【0】 : No display 【2】 : Output Voltage 【4】 : heatsink Temperature 【6】 : AI1 Value | 【1】 : Output Current 【3】 : DC Bus Voltage 【5】 : PID Feedback 【7】 : AI2 Value |

Note: The highest bit is used for power-up monitor. The 4 least significant bits can be used to customize the display sequence see section 4.1.3.

| | | |
|---------------|--|--|
| 12- 01 | PID Feedback Display Mode (LED) | |
| Range | 【0】 : Display the Feedback Value as Integer (xxx) | |
| | 【1】 : Display the Feedback Value with one decimal place (xx.x) | |
| | 【2】 : Display the Feedback Value with two decimal places (x.xx) | |
| 12- 02 | PID Feedback Display Unit Setting (LED) | |
| Range | 【0】 : xxxxx (no unit) | |
| | 【1】 : xxxPb (pressure) | |
| | 【2】 : xxxFL (flow) | |

When 12-00= xxx5, PID Feedback value is based on the scaling set in parameter 10-33 and displays the feedback value as XXX.XX.

For example, when parameter 10-33= 9999,
 12-01=0, the default display is 99;
 12-01=1, the default display is 99.9;
 12-01=2, the default display is 99.99;

When 12-01=1 and 12-02=1, the display will show 99.9Pb using five segments; when 12-01=2 and 12-02=2, the display shows 9.99FL and tenth digit most significant digit 9 is not shown.

| | | |
|---------------|---|--|
| 12- 03 | Line Speed Display (LED) | |
| Range | 【0~60000】 RPM | |
| 12- 04 | Line Speed Display Mode (LED) | |
| Range | 【0】 : Display Inverter Output Frequency | |
| | 【1】 : Line Speed Display as Integer.(xxxxx) | |
| | 【2】 : Line Speed Display with One Decimal Place. (xxxx.x) | |
| | 【3】 : Line Speed Display with Two Decimal Places. (xxx.xx) | |
| | 【4】 : Line Speed Display with Three Decimal Places. (xx.xxx) | |

12-04≠0, line speed is always displayed in run or stop mode. Set 12-03 to the maximum line speed that corresponds to the maximum output frequency.

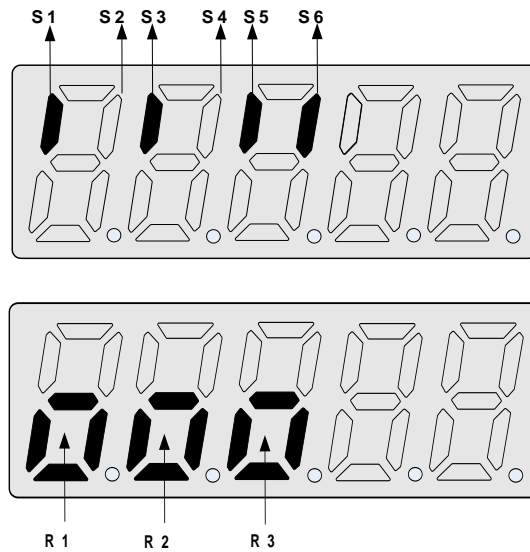
Example: Line speed display 12-03 is 1800, the keypad display will show 900 when the output frequency is 30Hz.

| | |
|---------------|---|
| 12- 05 | Status Display of Digital Input Terminal (LED/LCD) |
| Range | Read-only |

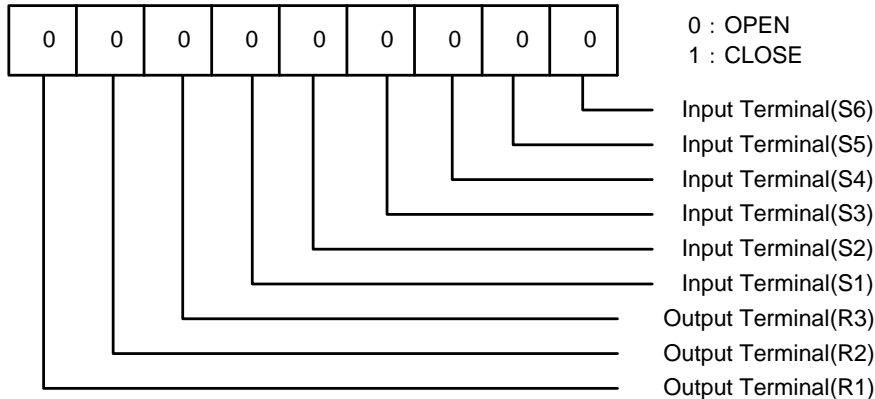
Terminals S1-S6 are represented using two segments of each digit. Segment turns on when input is active. The bottom segments of each of the first three digits are used to represent the digital outputs (R1, R2, R3). Segments turn on when output is active.

When operation command is changed to PLC, press RUN key and it will light up.

Example1: S1~S6, R1, R2 and R3 are ON



Example2: S1~S6, R1, R2 and R3 are OFF



Note: Refer to section 4.3 for other monitor parameters 12-11~12-79.

Monitor parameters 12-67 (KWHr) and 12-68 (MWHr) displays energy used.

Note: Parameter 11-54 can clear the monitor parameter.

If monitor parameter 12-76 (No-load voltage) is required refer to the descriptions of parameter 02-09 (Motor 1 excitation current) and 17-09 (Motor excitation current).

| |
|--|
| Group 13 Maintenance Function Group |
|--|

| | |
|---------------|----------------------------------|
| 13- 00 | Inverter Rating Selection |
| Range | ---- |

| Inverter model | 13- 00 display | Inverter model | 13- 00 display |
|----------------|----------------|----------------|----------------|
| F510-2001-XXX | 201 | F510-4001-XXX | 401 |
| F510-2002-XXX | 202 | F510-4002-XXX | 402 |
| F510-2003-XXX | 203 | F510-4003-XXX | 403 |
| F510-2005-XXX | 205 | F510-4005-XXX | 405 |
| F510-2008-XXX | 208 | F510-4008-XXX | 408 |
| F510-2010-XXX | 210 | F510-4010-XXX | 410 |
| F510-2015-XXX | 215 | F510-4015-XXX | 415 |
| F510-2020-XXX | 220 | F510-4020-XXX | 420 |
| F510-2025-XXX | 225 | F510-4025-XXX | 425 |
| F510-2030-XXX | 230 | F510-4030-XXX | 430 |
| F510-2040-XXX | 240 | F510-4040-XXX | 440 |
| F510-2050-XXX | 250 | F510-4050-XXX | 450 |
| F510-2060-XXX | 260 | F510-4060-XXX | 460 |
| F510-2075-XXX | 275 | F510-4075-XXX | 475 |
| F510-2100-XXX | 2100 | F510-4100-XXX | 4100 |
| F510-2125-XXX | 2125 | F510-4125-XXX | 4125 |
| F510-2150-XXX | 2150 | F510-4150-XXX | 4150 |
| F510-2175-XXX | 2175 | F510-4175-XXX | 4175 |
| | | F510-4215-XXX | 4215 |
| | | F510-4250-XXX | 4250 |
| | | F510-4300-XXX | 4300 |
| | | F510-4375-XXX | 4375 |
| | | F510-4425-XXX | 4425 |
| | | F510-4535-XXX | 4535 |
| | | F510-4670-XXX | 4670 |
| | | F510-4800-XXX | 4800 |

| | |
|---------------|---|
| 13- 01 | Software Version |
| Range | 0.00-9.99 |
| 13- 02 | Clear Cumulative Operation Hours Function |
| Range | 【0】 : Disable 【1】 : Clear Cumulative Operation Hours |
| 13- 03 | Cumulative Operation Hours 1 |
| Range | 【0~23】 hours |
| 13- 04 | Cumulative Operation Hours 2 |
| Range | 【0~65534】 days |
| 13- 05 | Selection of Accumulative Operation Time |
| Range | 【0】 : Accumulative time in power on 【1】 : Accumulative time in operation |

When 13-02 is set to 1, values in 13-03/13-04 will be cleared.

13-05= 0: Inverter logs the time when the inverter is powered-up.

13-05= 1: Inverter logs the time when the inverter is running.

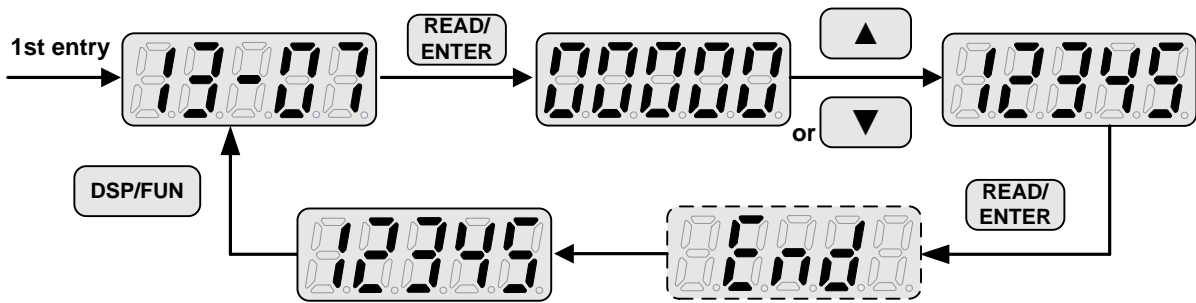
| | |
|---------------|--|
| 13- 06 | Parameters Locked |
| Range | 【0】 : Parameters are read-only except 13-06 and main frequency 05 【1】 : Only user parameter are enabled. 【2】 : All parameters are writable. |

| | |
|---------------|------------------------------------|
| 13- 07 | Parameter Password Function |
| Range | 【00000~65534】 |

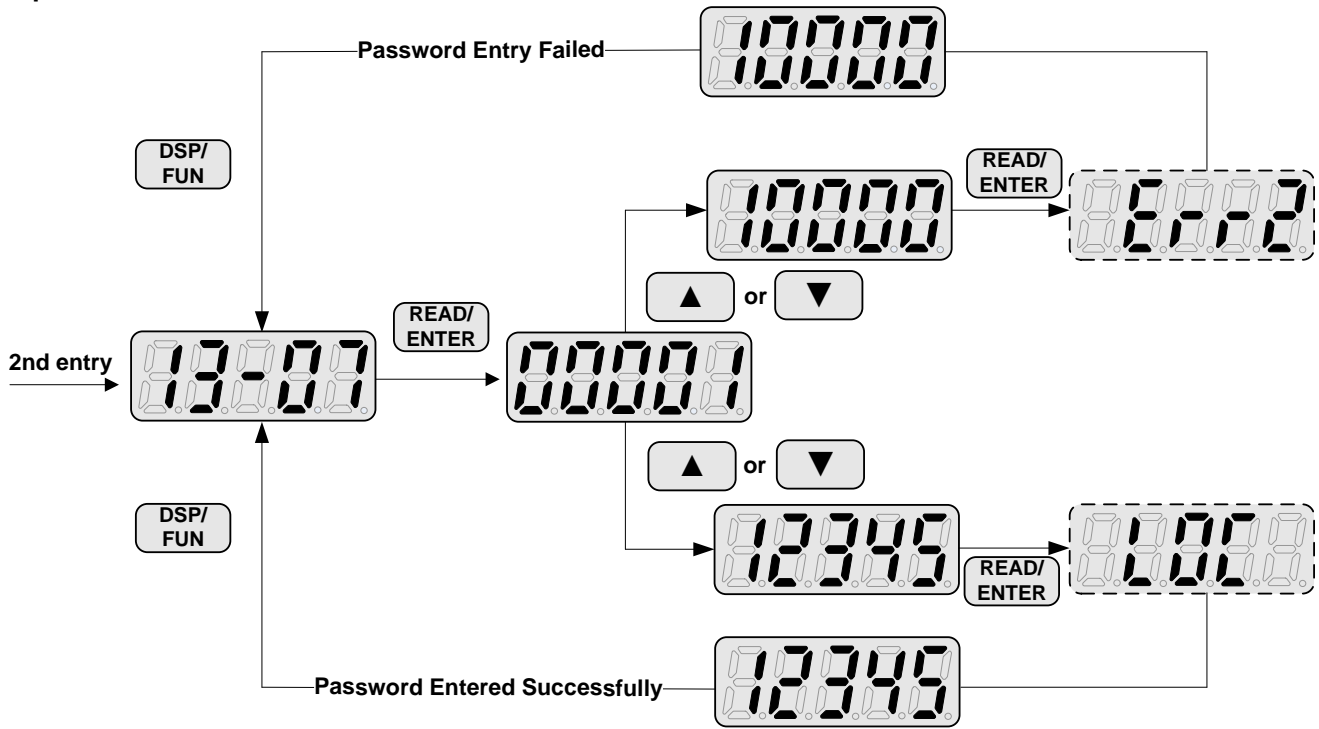
When parameter lock key code is enabled (13- 07>0), all parameters except the main frequency can be modified.

Example: Setting parameter lock key number

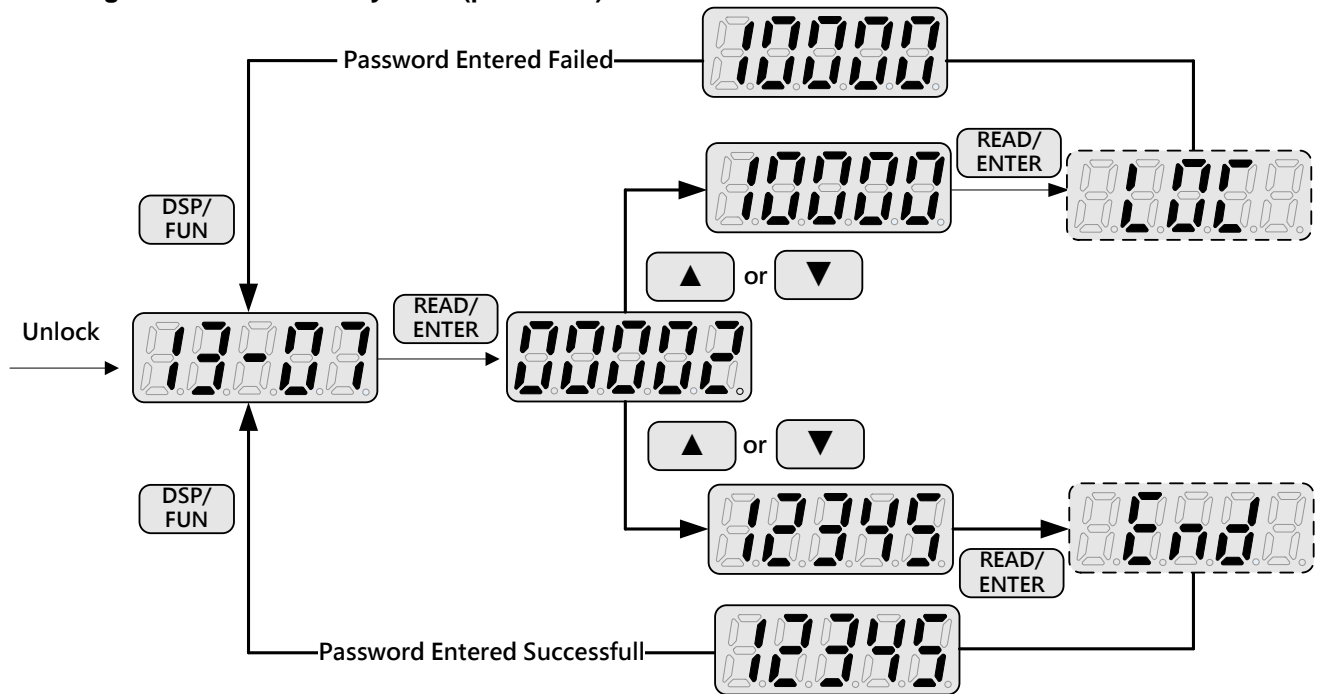
Step 1:



Step 2:



Unlocking the inverter with key code (password):



| 13- 08 | Restore Factory Setting |
|--------|--|
| Range | <p> 【0】 : No Initialization 【1】 : Reserved 【2】 : 2 Wire Initialization (220/440V, 60Hz) 【3】 : 3 Wire Initialization (220/440V, 60Hz) 【4】 : 2 Wire Initialization (230/415V, 50Hz) 【5】 : 3 Wire Initialization (230/415V, 50Hz) 【6】 : 2 Wire Initialization (200/380V, 50Hz) 【7】 : 3 Wire Initialization (200/380V, 50Hz) 【8】 : PLC Initialization 【9】 : 2 Wire Initialization (230V/460V, 60Hz) 【10】 : 3 Wire Initialization (230V/460V, 60Hz) 【11】 : 2 wire Initialization (230V/400V, 60Hz) 【12】 : 3 wire Initialization (230V/400V, 60Hz) 【13】 : 2 wire Initialization (230V/400V, 50Hz) 【14】 : 3 wire Initialization (230V/400V, 50Hz) 【15】 : 2 wire Initialization (220V/380V, 50Hz) 【16】 : 3 wire Initialization (220V/380V, 50Hz) 【Others】 : Reserved </p> |

Note: Main frequency setting 12-16 value is equal to frequency setting of speed-stage 0 (05-01)

Use parameter 13-08 to initialize the inverter back to factory default. It is recommended to write down the modified parameters before initializing the inverter. After initialization, the value of 13-08 will return to zero automatically.

13-08=2: 2-wire initialization (220V/440V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=3: 3-wire initialization (220V/440V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=4: 2-wire initialization (230V/415V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=5: 3-wire initialization (230V/415V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=6: 2-wire initialization (200V/380V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=7: 3-wire initialization (200V/380V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=8: PLC initialization

Clear built-in PLC ladder logic and related values.

13-08=9: 2 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=10: 3 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=11: 2 wire initialization (230V/400V, 60Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=12: 3 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=13: 2 wire initialization (230V/400V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=14: 3 wire initialization (230V/460V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=15: 2 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=16: 3 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

Note: Restore factory setting (13-08) will not affect the setting of 01-00 (V/F curve).

The following parameters are not affected parameter 13-08 Restore to Factory / Initialization

| No. | Parameter Name |
|-------|--|
| 00-00 | Control Mode Selection |
| 00-04 | Language Selection |
| 01-00 | V/F Curve Selection |
| 13-00 | Inverter Rating Selection |
| 13-03 | Cumulative Operation Hours 1 |
| 13-04 | Cumulative Operation Hours 2 |
| 13-05 | Selection of Accumulative Operation Time |

| 13- 09 | Fault History Clearance Function |
|--------|---|
| Range | 【0】 : Do not Clear Fault History 【1】 : Clear Fault History |

13-09=1: Clear inverter fault history including (12-11~12-15/12-45~12-64)

| 13- 10 | Situation 2 |
|--------|-----------------|
| Range | 0 ~ 9999 |

| 13- 11 | C/B CPLD Ver. | *1 |
|--------|--------------------|----|
| Range | 【0.00~9.99】 | |

This parameter displays CPLD version of the control board.

| 13- 12 | Option Card Id | *1 |
|--------|----------------|----|
| Range | 【0~255】 | |

This parameter displays option card ID when an option card is plugged into the control board.

- 【0】 : None**
- 【6】 : CM-PBUS**
- 【8】 : IO-8DO**

| 13- 13 | Option Card CPLD Ver. | *1 |
|--------|-----------------------|----|
| Range | 【0.00~9.99】 | |

***1: It is new added in inverter software V1.4.**

This parameter displays option card CPLD version when an option card is plugged into the control board.

| 13- 14 | Fault Storage Selection |
|--------|--|
| Range | 【0】 : Auto Restart Fault Messages are not saved in fault history during Auto-Restart. 【1】 : Auto Restart Fault Messages are saved in fault history during Auto-Restart. |

13-14=0,

Fault messages are not saved in fault history (12-46~12-49 & 13-21~13-50) during the process when auto restart function is active.

13-14=1,

Fault messages are saved in fault history (12-46~12-49 & 13-21~13-50) during the process when auto restart function is active.

Group 14: PLC Setting Parameters

| | |
|-------|-------------------------|
| 14-00 | T1 Set Value 1 |
| 14-01 | T1 Set Value 2 (Mode 7) |
| 14-02 | T2 Set Value 1 |
| 14-03 | T2 Set Value 2 (Mode 7) |
| 14-04 | T3 Set Value 1 |
| 14-05 | T3 Set Value 2 (Mode 7) |
| 14-06 | T4 Set Value 1 |
| 14-07 | T4 Set Value 2 (Mode 7) |
| 14-08 | T5 Set Value 1 |
| 14-09 | T5 Set Value 2 (Mode 7) |
| 14-10 | T6 Set Value 1 |
| 14-11 | T6 Set Value 2 (Mode 7) |
| 14-12 | T7 Set Value 1 |
| 14-13 | T7 Set Value 2 (Mode 7) |
| 14-14 | T8 Set Value 1 |
| 14-15 | T8 Set Value 2 (Mode 7) |
| Range | 【0~9999】 |

| | |
|-------|--------------|
| 14-16 | C1 Set Value |
| 14-17 | C2 Set Value |
| 14-18 | C3 Set Value |
| 14-19 | C4 Set Value |
| 14-20 | C5 Set Value |
| 14-21 | C6 Set Value |
| 14-22 | C7 Set Value |
| 14-23 | C8 Set Value |
| Range | 【0~65534】 |

| | |
|-------|-----------------|
| 14-24 | AS1 Set Value 1 |
| 14-25 | AS1 Set Value 2 |
| 14-26 | AS1 Set Value 3 |
| 14-27 | AS2 Set Value 1 |
| 14-28 | AS2 Set Value 2 |
| 14-29 | AS2 Set Value 3 |
| 14-30 | AS3 Set Value 1 |
| 14-31 | AS3 Set Value 2 |
| 14-32 | AS3 Set Value 3 |
| 14-33 | AS4 Set Value 1 |
| 14-34 | AS4 Set Value 2 |
| 14-35 | AS4 Set Value 3 |
| Range | 【0~65534】 |

| | |
|--------------|------------------|
| 14-36 | MD1 Set Value 1 |
| 14-37 | MD1 Set Value 2 |
| 14-38 | MD1 Set Value 3 |
| 14-39 | MD2 Set Value 1 |
| 14-40 | MD2 Set Value 2 |
| 14-41 | MD2 Set Value 3 |
| 14-42 | MD3 Set Value 1 |
| 14-43 | MD3 Set Value 2 |
| 14-44 | MD3 Set Value 3 |
| 14-45 | MD4 Set Value 1 |
| 14-46 | MD4 Set Value 2 |
| 14-47 | MD4 Set Value 3 |
| Range | 【0~65534】 |

Please refer to section 4.5 for built-in PLC function.

Group 15: PLC Monitoring Parameters

| | |
|--------|-----------------------------|
| 15- 00 | T1 Current Value 1 |
| 15- 01 | T1 Current Value 2 (Mode 7) |
| 15- 02 | T2 Current Value 1 |
| 15- 03 | T2 Current Value 2 (Mode 7) |
| 15- 04 | T3 Current Value 1 |
| 15- 05 | T3 Current Value 2 (Mode 7) |
| 15- 06 | T4 Current Value 1 |
| 15- 07 | T4 Current Value 2 (Mode 7) |
| 15- 08 | T5 Current Value 1 |
| 15- 09 | T5 Current Value 2 (Mode 7) |
| 15- 10 | T6 Current Value 1 |
| 15- 11 | T6 Current Value 2 (Mode 7) |
| 15- 12 | T7 Current Value 1 |
| 15- 13 | T7 Current Value 2 (Mode 7) |
| 15- 14 | T8 Current Value 1 |
| 15- 15 | T8 Current Value 2 (Mode 7) |
| Range | 【0~9999】 |

| | |
|-------|------------------|
| 15-16 | C1 Current Value |
| 15-17 | C2 Current Value |
| 15-18 | C3 Current Value |
| 15-19 | C4 Current Value |
| 15-20 | C5 Current Value |
| 15-21 | C6 Current Value |
| 15-22 | C7 Current Value |
| 15-23 | C8 Current Value |
| Range | 【0~65534】 |

| | |
|-------|------------------|
| 15-24 | AS1 Results |
| 15-25 | AS2 Results |
| 15-26 | AS3 Results |
| 15-27 | AS4 Results |
| 15-28 | MD1 Results |
| 15-29 | MD2 Results |
| 15-30 | MD3 Results |
| 15-31 | MD4 Results |
| 15-32 | TD Current Value |
| Range | 【0~65534】 |

| |
|--|
| Group 16: LCD Function Parameters |
|--|

| | |
|---------------|--------------------------------|
| 16- 00 | Main Screen Monitoring |
| Range | 【5~79】 |
| 16- 01 | Sub-Screen Monitoring 1 |
| Range | 【5~79】 |
| 16- 02 | Sub-Screen Monitoring 2 |
| Range | 【5~79】 |

At power-up the inverter shows two monitor section on the display, main monitor section and the sub-screen monitor section (smaller font).

Choose the monitor signal to be displayed as the main-screen monitor screen in parameter 16-00, and the monitor signals to be displayed on the sub-screen monitor in parameters 16-01 and 16-02, similar to monitor parameters 12-5 ~ 12-79.

Note: The setting value of 16-00, 16-01 and 16-02 can be modified. It also can reset except PID modes (refer to the setting description of parameter 10-03) and PUMP modes (refer to the setting description of parameter 23-00), but these two modes can be modified in inverter software V1.4.

| | |
|---------------|---|
| 16- 03 | Selection of Display Unit |
| Range | <p>【0】 : Display unit is Hz (Resolution is 0.01Hz) 【1】 : Display unit is % (Resolution is 0.01%) 【2】: Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate. 【3~39】 : Reserved 【40~9999】 : 100% is XXXX with no decimals (integer only) 【10001~19999】 : 100% is XXX.X with 1 decimal 【20001~29999】 : 100% is XX.XX with 2 decimals 【30001~39999】 : 100% is X.XXX with 3 decimals</p> |
| 16- 04 | Selection of Engineering Unit |
| Range | <p>【0】 : No Unit 【1】 : FPM 【2】 : CFM 【3】 : PSI 【4】 : GPH 【5】 : GPM 【6】 : IN 【7】 : FT 【8】 : /s 【9】 : /m 【10】 : /h 【11】 : °F 【12】 : inW 【13】 : HP 【14】 : m/s 【15】 : MPM 【16】 : CMM 【17】 : W 【18】 : KW</p> |

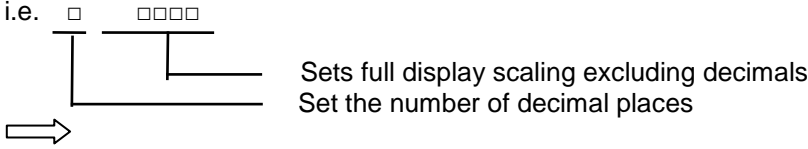
| |
|---|
| 【19】 : m 【20】 : °C 【21】 : RPM 【21】 : RPM 【22】 : Bar 【23】 : Pa 【24】 : KPa |
|---|

16-03: Display unit of digital operator

Set the units of the following items to be displayed, the frequency reference (05-01, 00-18, 06-01~06-15) and the monitoring frequency 12-16, 12-17 (Output frequency)

16-04: Display unit of engineering

When 16-03 = 00040-39999, engineering units are enabled. The displayed set range and the frequency range of unit (05-01, 06-01~06-15) as well as the monitoring frequency (12-16, 12-17) are changed by parameters 16-04 and 16-03.

| 16-03 | Set / displayed contents | | | |
|---------------------|--|--|----------------------|--|
| 0 | 0.01 Hz | | | |
| 1 | 0.01 % (maximum output frequency 01-02=100%) | | | |
| 2 | RPM (RPM = 120 x reference frequency / numbers of motor pole. The numbers of motor pole is set by 02-07 in the control modes of V/F or SLV and is set by 22-03 in PMSLV.) | | | |
| 3-39 | Reserved | | | |
| 00040 - 39999 | Set the decimal point by using the fifth place. i.e.  00040 - 09999 : □□□□ (Integer only e.g. 1000) 10001 - 19999 : □□□. □ (1 decimal place e.g. 10.0) 20001 - 29999 : □□. □□ (2 decimal places, e.g. 10.00) 30001 - 39999 : □. □□□ (3 decimal places, e.g. 10.000) | | | |
| | <example> | | | |
| | 16-03 | Display | Display unit | Display example |
| | 00040 - 09999 | □□□□ | use 16-04 setting | Example: 100 % speed is 0200 > set 16-03=00200 (from 05-01, 06-01 to 06-15, set range from 0040 to 9999). > set 16-04=0 (no unit) |
| | 10001 - 19999 | □□□. □ | | Example: 100 % speed is 200.0 CFM > set 16-03=12000 (05-01, 06-01 to 06-15, set range from 0000 to 9999). > set 16-04=2 (CFM) > 60% speed will be displayed as 120.0 CFM |
| 20001 - 29999 | □□. □□ | Example: 100 % speed is 65.00°C > set 16-03=26500 (05-01, 06-01 to 06-15, set range from 0000 to 9999) > set 16-04=20 (°C) > 60% of speed is displayed as 39.00 °C | | |
| 30001 - 39999 | □. □□□ | Example: 100 % speed is 2.555 m/s > set 16-03=32555 > set 16-04=14 (m/s) > 60% speed is displayed as 1.533 m/s | | |

| | |
|---------------|----------------------|
| 16- 05 | LCD Backlight |
| Range | 【0~7】 |

Adjust the screen contrast of the digital operator. If it is set to 0, the screen backlight is turned off.

| | |
|---------------|--|
| 16- 07 | Copy Function Selection |
| Range | 【0】 : Do not copy parameters 【1】 : Read inverter parameters and save to the operator. 【2】 : Write the operator parameters to inverter. 【3】 : Compare parameters of inverter and operator. |
| 16- 08 | Selection of Allowing Reading |
| Range | 【0】 : Do not allow to read inverter parameters and save to the operator. 【1】 : Allow to read inverter parameters and save to the operator. |

LCD digital operator with built-in memory (EEPROM) can be used to store and retrieve parameters:

- (1) Read: Save inverter parameters to the digital operator (INV → OP).
- (2) Write: Write the parameters from the digital operator to the inverter and save (OP → INV).
- (3) Verify: Compare the inverter parameters against the parameters in the digital operator.

16-07=0: No action

16-07=1: Read (all parameters are copied from the inverter to the keypad).

16-07=2: Write (all parameter are copied from the keypad to the inverter).

16-07=3: Verify (Compare the set value of the inverter to the parameter of the digital operator).

Set 16-08 = 0, to prevent the saved parameter data stored in the digital operator from accidentally being overwritten.

When parameter 16-08=0 and the read operation is executed (16-07=1) a warning message of "RDP Read Prohibited" will be displayed on the keypad and the read operation is cancelled.

Refer to the following steps for copy function operation.

For the write-in operation requires the following items to match.

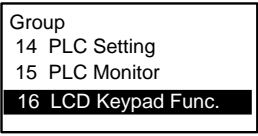
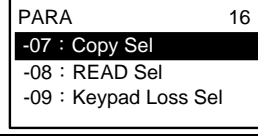
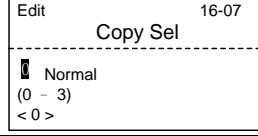
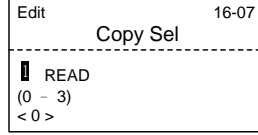
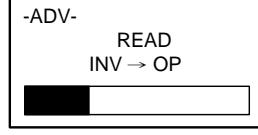
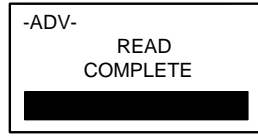
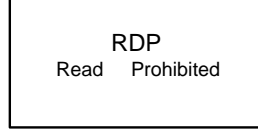
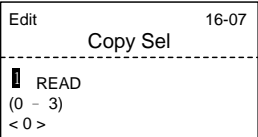
- (1) Software version
- (2) Control method
- (3) Inverter type
- (4) Inverter rated capacity and voltage

Set one of the parameters 03-00 to 03-05 (multi-function digital input selection) to 49 (Enable the parameter write-in function) to enable or disable the parameter write-in function.

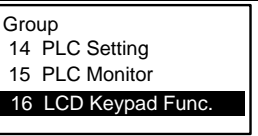
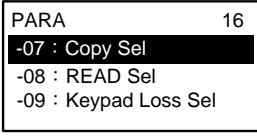
When terminal is active, parameters can be copied from the digital operator to the inverter. When the terminal is not active inverter parameters are prohibited from write-in, excluding the reference frequency (00-05).

Note: Parameter 16-11 (RTC date setting) and 16-12 (RTC time setting) require resetting, after parameter setting in the keypad is written and saved in the inverter (OP→INV).

■ **READ: Copy inverter parameters to the keypad**

| Steps | LCD Display (English) | Description |
|-------|---|---|
| 1 |  | Select the copy function group (16) from the group menu. |
| 2 |  | Press the Read / Enter key and select parameter (16-07) copy sel. |
| 3 |  | Press the Read / Enter key to display the data setting / read screen (LCD display is inverted). |
| 4 |  | Change the set value to 1 (read) by using the up arrow key. |
| 5 |  | <ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress s. |
| 6 |  | "READ COMPLETE" will be displayed on the keypad when reading was successful. |
| |  | <ul style="list-style-type: none"> • The error message of "RDP Read Prohibited" may occur on the keypad when reading parameters from the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07. |
| 7 |  | When DSP/FUN key is pressed, the display returns to parameter 16-07. |



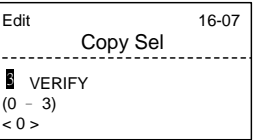
■ **WRITE: Copy Keypad parameters to the Inverter**

| Steps | LCD Display (English) | Description |
|-------|---|---|
| 1 |  | Select the copy function group (16) from the group menu. |
| 2 |  | Press the Read / Enter key and select parameter (16-07) copy sel. |

| Steps | LCD Display (English) | Description |
|-------|-----------------------|--|
| 3 | | Press the Read / Enter key to display the data setting / read screen (LCD display is inversed). |
| 4 | | Change the set value to 2 (write) by using the up arrow key. |
| 5 | | <ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress. |
| 6 | | "WRITE COMPLETE" will be displayed on the keypad when writing was successful. |
| | | <ul style="list-style-type: none"> • The error message of "WRE Write Error " may occur on the keypad when writing parameters to the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07. |
| 7 | | When DSP/FUN key is pressed, the display returns to parameter 16-07. |

■ **Verify: Compare Inverter Parameters against Keypad Parameters.**

| Steps | LCD Display (English) | Description |
|-------|-----------------------|--|
| 1 | | Select the copy function group (16) from the group menu. |
| 2 | | Press the Read / Enter key and select parameter (16-07) copy sel. |
| 3 | | Press the Read / Enter key to display the data setting / read screen (LCD display is inversed). |
| 4 | | Change the set value to 3 (verify) by using the up arrow key. |
| 5 | | <ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress. |

| Steps | LCD Display (English) | Description |
|-------|---|--|
| 6 |  | “VERIFY COMPLETE” will be displayed on the keypad when writing was successful. |
| |  | <ul style="list-style-type: none"> The error message of “VRYE Verify Error ” may occur on the keypad when writing parameters to the inverter is prohibited. If the error is displayed, press any key to remove the error message and go back to parameter 16-07. |
| 7 |  | When DSP/FUN key is pressed, the display returns to parameter 16-07. |

| 16- 09 | Selection of Operator Removed (LCD) |
|--------|--|
| Range | 【0】 : Keep operating when LCD operator is removed. 【1】 : Display fault to stop when LCD operator is removed |

16-09=0: Continue operating when keypad is removed.

16-09=1: Trip inverter when keypad is removed while operating in local mode.

| 16- 10 | RTC Time Display Setting |
|--------|---|
| Range | 【0】 : Hide 【1】 : Display |
| 16- 11 | RTC Date Setting |
| Range | 【12.01.01 ~ 99.12.31】 |
| 16- 12 | RTC Time Setting |
| Range | 【00:00 ~ 23:59】 |

Note: Set the internal clock before using the function of Real Time Clock (RTC).

RTC date is set with parameter 16-11 and RTC time is set with parameter 16-12.

RTC is displayed in the top line of the keypad, please refer to Fig.4.3.85, RTC time display (16-10) set to 1.

| | |
|----------|-------------------|
| Monitor | 00:00 |
| Freq Ref | 12-16 = 000.00 Hz |
| | 12-17 = 000.00 Hz |
| | 12-18 = 0000.0A |

Figure 4.3.85 RTC Time Display (Example)

Notes:

- RTC is not enabled when the keypad is connected to the inverter.
- The operation/run timer operates independent of the RTC.

Users can set parameters 12-72 and 12-73 to monitor the RTC date and time.

The RTC function has the following features:

- Four independent start/stop times per day over a span of 4 weeks.
- RTC offset function (preset time)
- RTC can be enabled via a multi-function digital input
- RTC controlled constant speed for fixed time period
- RTC controlled multi-function digital output

| | |
|---------------|--|
| 16- 13 | RTC Timer Function |
| Range | 【0】 : Disable 【1】 : Enable 【2】 : Set by DI |
| 16- 14 | P1 Start Time |
| 16- 15 | P1 Stop Time |
| 16- 18 | P2 Start Time |
| 16- 19 | P2 Stop Time |
| 16- 22 | P3 Start Time |
| 16- 23 | P3 Stop Time |
| 16- 26 | P4 Start Time |
| 16- 27 | P4 Stop Time |
| Range | 【00:00 ~ 23:59】 |
| 16- 16 | P1 Start Date |
| 16- 17 | P1 Stop Date |
| 16-20 | P2 Start Date |
| 16- 21 | P2 Stop Date |
| 16- 24 | P3 Start Date |
| 16- 25 | P3 Stop Date |
| 16- 28 | P4 Start Date |
| 16- 29 | P4 Stop Date |
| Range | 【1】 : Mon 【2】 : Tue 【3】 : Wed 【4】 : Thu 【5】 : Fri 【6】 : Sat 【7】 : Sun |
| 16- 30 | Selection of RTC Offset |
| Range | 【0】 : Disable 【1】 : Enable 【2】 : Set by DI |
| 16- 31 | RTC Offset Time Setting |
| Range | 【00:00 ~ 23:59】 |
| 16- 32 | Source of Timer 1 |
| 16- 33 | Source of Timer 2 |
| 16- 34 | Source of Timer 3 |
| 16- 35 | Source of Timer 4 |
| Range | 【0~31】 : Refer to Table 4.3.13 |

| | |
|---------------|--|
| 16- 36 | Selection of RTC Speed |
| Range | 【0】 : Off 【1】 : By Timer 1 【2】 : By Timer 2 【3】 : By Timer 3 【4】 : By Timer 4 【5】 : By Timer 1+2 |
| 16- 37 | Selection of RTC Rotation Direction |
| Range | 【xxx0 B】 : RTC Run1 Forward Rotation 【xxx1 B】 : RTC Run1 Reverse Rotation 【xx0x B】 : RTC Run2 Forward Rotation 【xx1x B】 : RTC Run2 Reverse Rotation 【x0xx B】 : RTC Run3 Forward Rotation 【x1xx B】 : RTC Run3 Reverse Rotation 【0xxx B】 : RTC Run4 Forward Rotation 【1xxx B】 : RTC Run4 Reverse Rotation |

Source of timer can be selected to link multiple time periods and one time period can be set to multiple timers.

Follow these steps to set the timer:

① **Start the timer:**

Enable RTC timer function by setting parameter 16-13.

② **Set the time period:**

Set the start/stop time and date. If the start time is set the same as the stop time, timing period is disabled.

③ **Set timer period:**

Set time period for specific timer (16-32~16-35).

④ **Link timer to relay output and other parameters:**

The timer can be linked to the relay output. One relay output can be linked to one timer (example: 03-11, 03-12 and 03-39, 16-36).

Note: If the stop time is set to 12:00, Motor transfers from start to stop at 12:01.

Refer to Fig.4.3.86 for RTC structure.

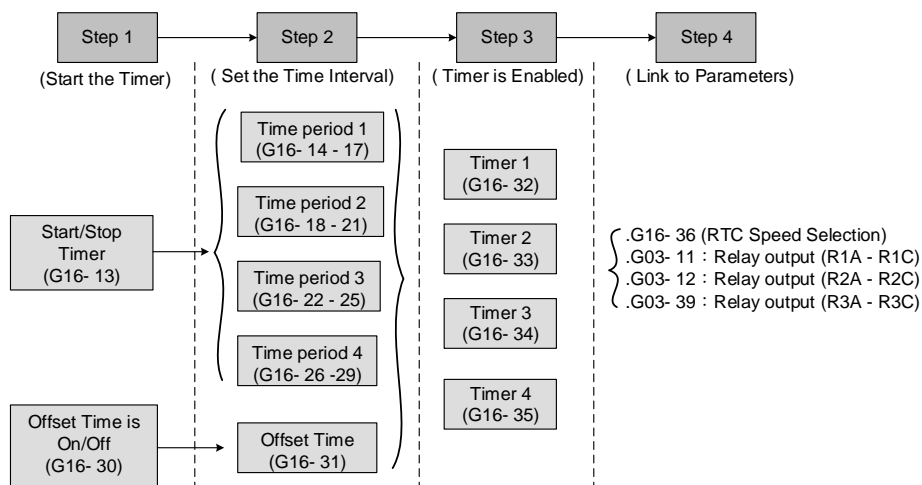


Figure 4.3.86 RTC structure

Refer to the following Table 4.3.13 for the selection of timer operation cycles.

Table 4.3.13 Available time period settings for timer function

| 16-32 ~ 16-35 | O | P4 | P3 | P2 | P1 | Timer Function | Display |
|---------------------|---|----|----|----|----|--|---------------|
| 0 | 0 | 0 | 0 | 0 | 0 | Without the selection of timer | None |
| 1 | 0 | 0 | 0 | 0 | 1 | Time Period 1 | P1 |
| 2 | 0 | 0 | 0 | 1 | 0 | Time Period 2 | P2 |
| 3 | 0 | 0 | 0 | 1 | 1 | Time Period 1 and 2 | P1+P2 |
| 4 | 0 | 0 | 1 | 0 | 0 | Time Period 3 | P3 |
| 5 | 0 | 0 | 1 | 0 | 1 | Time Period 1 and 3 | P1+P3 |
| 6 | 0 | 0 | 1 | 1 | 0 | Time Period 2 and 3 | P2+P3 |
| 7 | 0 | 0 | 1 | 1 | 1 | Time Period 1 , 2 and 3 | P1+P2+P3 |
| 8 | 0 | 1 | 0 | 0 | 0 | Time Period 4 | P4 |
| 9 | 0 | 1 | 0 | 0 | 1 | Time Period 1 and 4 | P1+P4 |
| 10 | 0 | 1 | 0 | 1 | 0 | Time Period 2 and 4 | P2+P4 |
| 11 | 0 | 1 | 0 | 1 | 1 | Time Period 1 , 2 and 4 | P1+P2+P4 |
| 12 | 0 | 1 | 1 | 0 | 0 | Time Period 3 and 4 | P3+P4 |
| 13 | 0 | 1 | 1 | 0 | 1 | Time Period 1 , 3 and 4 | P1+P3+P4 |
| 14 | 0 | 1 | 1 | 1 | 0 | Time Period 2 , 3 and 4 | P2+P3+P4 |
| 15 | 0 | 1 | 1 | 1 | 1 | Time Period 1 , 2 , 3 and 4 | P1+P2+P3+P4 |
| 16 | 1 | 0 | 0 | 0 | 0 | Offset selection | Offset (O) |
| 17 | 1 | 0 | 0 | 0 | 1 | Offset and time period 1 | O+P1 |
| 18 | 1 | 0 | 0 | 1 | 0 | Offset and time period 2 | O+P2 |
| 19 | 1 | 0 | 0 | 1 | 1 | Offset and time period 1 and 2 | O+P1+P2 |
| 20 | 1 | 0 | 1 | 0 | 0 | Offset and time period 3 | O+P3 |
| 21 | 1 | 0 | 1 | 0 | 1 | Offset and time period 1 and 3 | O+P1+P3 |
| 22 | 1 | 0 | 1 | 1 | 0 | Offset and time period 2 and 3 | O+P2+P3 |
| 23 | 1 | 0 | 1 | 1 | 1 | Offset and time period 1 , 2 and 3 | O+P1+P2+P3 |
| 24 | 1 | 1 | 0 | 0 | 0 | Offset and time period 4 | O+P4 |
| 25 | 1 | 1 | 0 | 0 | 1 | Offset and time period 1 and 4 | O+P1+P4 |
| 26 | 1 | 1 | 0 | 1 | 0 | Offset and time period 2 and 4 | O+P2+P4 |
| 27 | 1 | 1 | 0 | 1 | 1 | Offset and time period 1 , 2 and 4 | O+P1+P2+P4 |
| 28 | 1 | 1 | 1 | 0 | 0 | Offset and time period 3 and 4 | O+P3+P4 |
| 29 | 1 | 1 | 1 | 0 | 1 | Offset and time period 1 , 3 and 4 | O+P1+P3+P4 |
| 30 | 1 | 1 | 1 | 1 | 0 | Offset and time period 2 , 3 and 4 | O+P2+P3+P4 |
| 31 | 1 | 1 | 1 | 1 | 1 | Offset and time period 1 , 2 , 3 and 4 | O+P1+P2+P3+P4 |

Reference frequency and motor rotation direction are controlled by RTC function.

16-36=0: RTC speed selection is disabled.

16-36=1: Timer 1 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=2: Timer 2 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=3: Timer 3 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=4: Timer 4 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=4: Timer 1 and 2 are enabled.

Reference frequency is enabled by the simultaneous operation of timer 1 and 2.

Notes:

- The inverter runs via the start of the specific timer without the influence of other timers.
- The RTC speed setting selection (16-36) is depends on time period 1 to 4 (P1~P4) which is corresponding to the selection of RTC rotation direction (16-37).

Example:

When the selection of RTC speed is set to 5 (by timer 1+2), run command source (00-02) and source of frequency command (00-05) are required to be set to RTC, so reference frequency is controlled by RTC timer 1 and 2 and the inverter continues running.

Refer to Table 4.3.14 for the RTC reference frequency.

Note: RTC Rotation Direction (16-37) depends on the Motor Direction Lock Selection (11-00).

Table 4.3.14 Reference frequency is determined by timer 1 and 2

| Timer 1 | Timer 2 | Main Frequency Command Source Selection (00-05) | Source of frequency setting | Selection of rotation direction |
|---------|---------|---|---|---------------------------------|
| 0 | 0 | 6(RTC) | Set by frequency setting of speed-stage 0 (05-01) | By RTC 1 (16-37) |
| 1 | 0 | 6(RTC) | Set by frequency setting of speed-stage 1 (05-02) | By RTC 2 (16-37) |
| 0 | 1 | 6(RTC) | Set by frequency setting of speed-stage 2 (05-03) | By RTC 3 (16-37) |
| 1 | 1 | 6(RTC) | Set by frequency setting of speed-stage 3 (05-04) | By RTC 4 (16-37) |

Important Notes:

RTC function cannot run normally when:

- When multi-function terminal (03-00~03-05) is set to fire mode.
- When KEB function is enabled
 - Main frequency source of the RTC function is set according to Table 4.3.14; settings pertain to the main and alternative frequency command modes (00-07).
 - If main run command source selection (00-02) is set to 0~3 (0: keypad, 1: external terminal, 2: communication control, 3: PLC), refer to Table 4.3.15 for the relationship between the master run command and RTC timer status.

Table 4.3.15 Relationship between main run command and RTC timer status

| Main run command 00-02 | RTC timer x status | Inverter status |
|------------------------|--------------------|---|
| 0~3 | 0 | Inverter cannot run (without run command) |
| 0~3 | 1 | Inverter cannot run (without run command) |
| 4 | 0 | Inverter cannot run (RTC timer is disabled) |
| 4 | 1 | Inverter runs and rotates depending on the function of 16-37. |

Example: RTC timer using multiple parameters:

Inverter running on Monday from 6:00 AM to 10:00 PM.

Inverter running from Tuesday to Friday from 8:00 AM to 8:00 PM.

Inverter running on Saturday from 8:00 AM to 6:00 PM.

Inverter running on Sunday from 8:00 AM to 12:00 PM.

Motor runs on weekdays (Mon. to Fri.) at speed 1 and on weekends at speed 2.

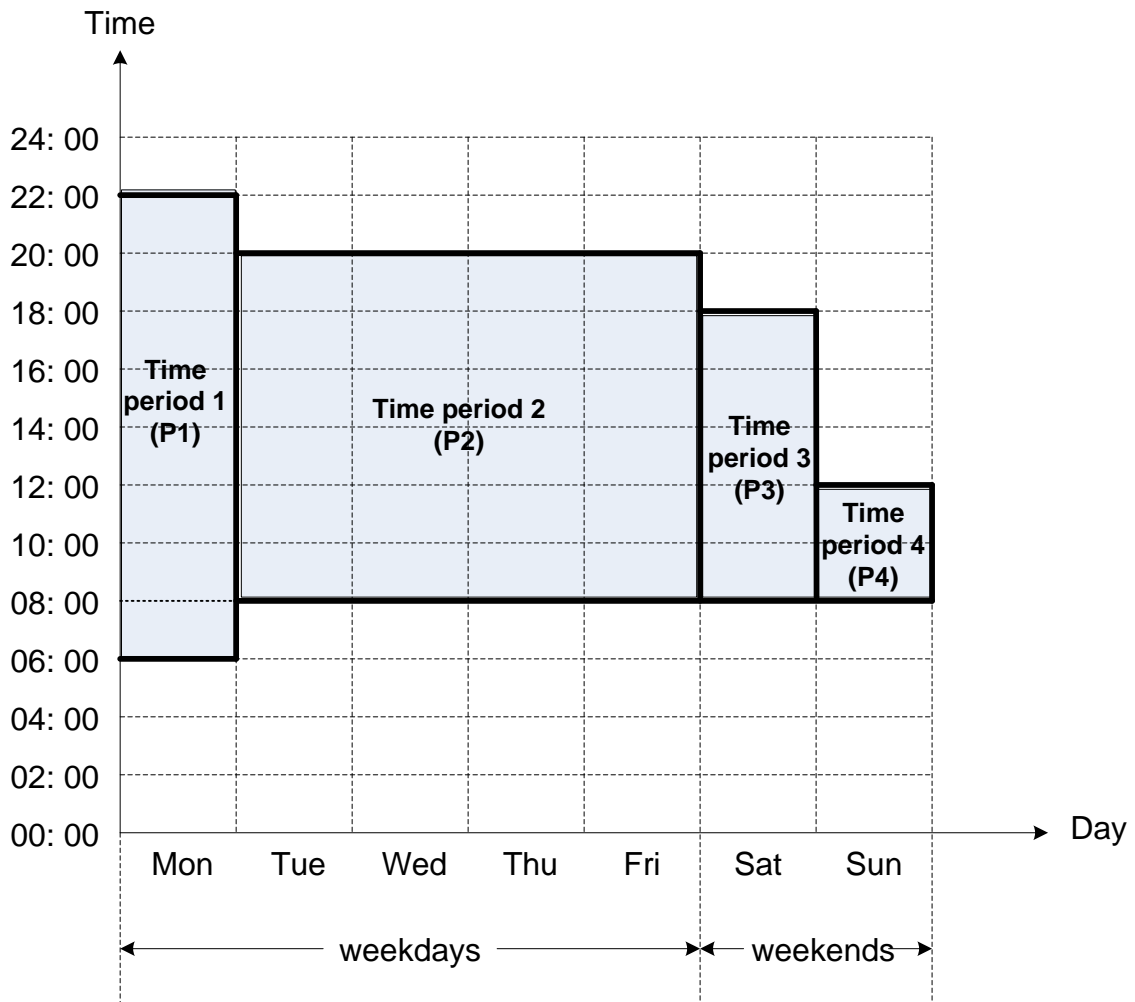


Figure 4.3.87 RTC timer (example)

① **Initialize the RTC Timer in parameter group 16**

Set the correct date and time in the parameters 16-11 and 16-12 and set parameter 16-13 to 1 (enable RTC timer function).

② **Set time period 1 (P1)**

Start time 1: 16-14 = 06:00:00 (6:00 AM)
Stop time 1: 16-15 = 22:00:00 (10:00 PM)
Start date 1: 16-16 = 1 (Monday)
Stop date 1: 16-17 = 1 (Monday)

③ **Set time period 2 (P2)**

Start time 2: 16-18 = 08:00:00 (8:00 AM)
Stop time 2: 16-19 = 20:00:00 (8:00 PM)
Start date 2: 16-20 = 2 (Tuesday)
Stop date 2: 16-21 = 5 (Friday)

④ **Set time period 3 (P3)**

Start time 3: 16-22 = 08:00:00 (8:00 AM)
Stop time 3: 16-23 = 18:00:00 (6:00 PM)
Start date 3: 16-24 = 6 (Saturday)
Stop date 3: 16-25 = 6 (Saturday)

⑤ **Set time period 4 (P4)**

Start time 4: 16-26 = 08:00:00 (8:00 AM)
Stop time 4: 16-27 = 12:00:00 (12:00 AM)
Start date 4: 16-28 = 7 (Sunday)
Stop date 4: 16-29 = 7 (Sunday)

⑥ **Timer 1 is enabled to set all the time periods (P1, P2, P3, and P4)**

16-32 = 15: Source of timer 1 = P1 + P2 + P3 + P4)

⑦ **Selection of RTC speed is determined by timer 1**

16-36 = 1: Timer 1 is enabled.
Frequency reference setting is speed-stage 0 (05-01).
Rotation direction (16-37) is set to 0000b.
Rotation direction for time period 1~4 (P1~P4) is determined by parameter 16-37.

⑧ **Choose two constant speeds (speed 1 & speed 2)**

16-36 = 5: Timer 1+2 is enabled.
When timer 1 is active frequency reference setting is speed-stage 1; when timer 2 is active, frequency reference setting is speed-stage 2.
Rotation direction (16-37) is set to 0000b.
When timer 1 and timer 2 are active motor direction is forward.

Note: To enable the offset time function select RTC offset (16-30) and set RTC offset time (16-31). The Inverter runs depending on the set time period. Refer to the following Fig.4.3.88.

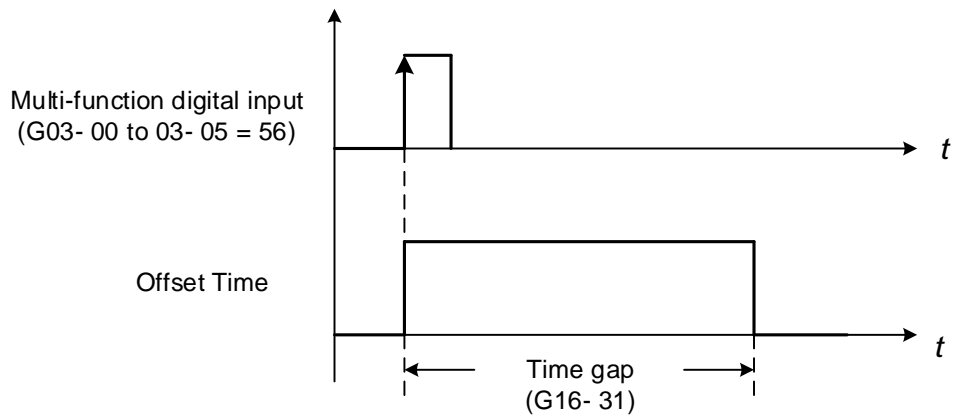


Figure 4.3.88 Operation of offset time

For example:

Inverter runs at the time period exclusive P1:

When 16-36=1 (selection of RTC speed is set to timer 1) and 16-32=17 (offset + PI), RTC offset (16-30) is activated via a digital input and the offset time is set in 16-31. When digital input is activated the RTC function starts.

If the source of the timer is set to 15 (P1+P2+P3+P4), and the "STOP" key is pressed while time period 1 (P1) is active the inverter will stop and the RTC will re-start automatically at the next time period (P2). The RTC can also be re-started via a digital input by setting 16-30 to 2 (set by DI).

Notes:

If press "STOP" key is pressed during a time period the inverter can be re-started by:

- Set the selection of RTC offset (16-30) to 2 (set by DI) and set DI to 56 (RTC Offset Enable).
- Switch the selection of RTC offset (16-30) to enable.

Note:

RTC Accuracy:

| Temperature | Deviation |
|--------------------------|----------------|
| +25 °C (77 °F) | +/-3 sec./ day |
| -20 / +50 °C (-4/ 122°F) | +/-6 sec./ day |

Group 17: IM Motor Automatic Tuning Parameters

| | |
|---------------|---|
| 17- 00 | Mode Selection of Automatic Tuning |
| Range | 【0】 : Rotation Auto-tune 【1】 : Static Auto-tune 【2】 : Stator Resistance Measurement 【4】 : Loop Tuning 【5】 : Rotational Auto-tuning Combination (Item: 4+2+0) 【6】 : Static Auto-tuning Combination (Item: 4+2+1) |
| 17- 01 | Motor Rated Output Power |
| Range | 【0.00~600.00】 KW |
| 17- 02 | Motor Rated Current |
| Range | 10%~200% of the inverter rated current in V/F control mode 25%~200% of the inverter rated current in SLV control mode |
| 17- 03 | Motor Rated Voltage |
| Range | 200V: 【50.0~240.0】 V 400V: 【100.0~480.0】 V |
| 17- 04 | Motor Rated Frequency |
| Range | 【4.8~400.0】 Hz |
| 17- 05 | Motor Rated Speed |
| Range | 【0~24000】 rpm |
| 17- 06 | Pole Number of Motor |
| Range | 【2~16】 pole (Even) |
| 17- 08 | Motor No-load Voltage |
| Range | 200V: 【50~240】 V 400V: 【100~480】 V |
| 17- 09 | Motor Excitation Current |
| Range | 【0.01~600.00】 A (15%~70% motor rated current) |
| 17- 10 | Automatic Tuning Start |
| Range | 【0】 : Disable 【1】 : Enable |
| 17- 11 | Error History of Automatic Tuning |
| Range | 【0】 : No Error 【1】 : Motor Data Error 【2】 : Stator Resistance Tuning Error 【3】 : Leakage Induction Tuning Error 【4】 : Rotor Resistance Tuning Error 【5】 : Mutual Induction Tuning Error 【6】 : Reserved 【7】 : DT Error 【8】 : Motor Acceleration Error 【9】 : Warning |
| 17-12 | Leakage Inductance Ratio |
| Range | 【0.1~15.0】 % |
| 17-13 | Slip Frequency |
| Range | 【0.10~20.00】 Hz |

| | |
|--------------|--|
| 17-14 | Rotational Tuning Mode Selection |
| Range | 【0】 : VF Mode 【1】 : Vector Mode |

Auto-tuning

Based on the motor nameplate set the motor rated output power (17-01), motor output rated current (17-02), motor rated voltage (17-03), motor rated frequency (17-04), motor rated speed (17-05) and number of motor poles (17-06) to perform an auto-tune.

Automatic tuning mode selection (17-00=0)

Rotational auto-tuning (17-00=0)

Perform rotational auto-tune (High performance auto-tune)

Static auto-tuning (17-00=1)

Motor does not rotate during auto-tuning and this tuning causes lower power at low speed.

Stator resistance measurement (17-00=2)

Perform stator resistance non-rotational auto-tune (V/F mode) suitable when using long motor leads. This tuning mode causes results in lower torque at low speed.

Loop tuning (17-00=4)

Performance improvement (speed and torque regulation) in vector control mode

Rotation Auto-tuning Combination (17-00=5)

This tuning mode is a combination of three auto-tuning modes, Loop tuning (17-00=4), Stator resistance tuning (17-00=2) and Rotational auto-tuning (17-00=0).

Static Auto-tune Combination (17-00=6)

This tuning mode is a combination of three auto-tuning modes, Loop tuning (17-00=4), Stator resistance measurement (17-00=2) and Static auto-tuning (17-00=1)

Motor rated output power (17-01)

Set motor power rating based on the motor nameplate, input range depends on the inverter rating (13-00).

Motor rated current (17-02)

- (1) Set motor FLA based on the motor nameplate, input range depends on the inverter rating (13-00).
- (2) In V/F mode, range is 10~200 % of the inverter rated current.
- (3) In SLV mode, range is 25~200% of the inverter rated current.

Motor rated voltage (17-03)

Set motor voltage based on the motor nameplate. Prevent motor from saturating when the motor rated voltage is greater than the inverter input voltage (see Example 1).

Motor rated frequency (17-04)

Set motor base frequency based on the motor nameplate.

Motor rated speed (17-05)

Set motor base speed frequency based on the motor nameplate.

Number of poles (17-06)

Set number of motor poles, range is 2~16 poles.

Motor no-load voltage (17-08)

- (1) Motor no-load voltage is mainly used in SLV mode, set to a value of 10~50V lower than the input voltage to ensure good torque performance at the motor rated frequency.
- (2) Set 17-08 to 85~95% of the motor rated voltage. In general, the no-load voltage can be closer to the motor rated voltage for larger motors, but cannot exceed the motor rated voltage.
- (3) The motor no-load voltage can be set to a value greater than the actual input voltage. In this condition the motor can only operate at relatively low frequency. If the motor operates at the rated frequency an over voltage condition may occur.
- (4) The higher the motor power, the higher the no-load voltage is.
- (5) A smaller no-load voltage will reduce the no-load current. When a load is applied the magnetic flux weakens and the motor current increases.
- (6) A higher no-load voltage results in a higher no-load current. When a load is applied the magnetic flux weakens and the motor current increases. Increasing the magnetic flux generates back EMF and results in poor torque control.

Motor excitation current (17-09)

- (1) Only available for static-type or stator resistance measurement auto-tuning (17-00=1 or 17-00=2). The data can be obtained by manual tuning. Normally this parameter does not have to be adjusted.
- (2) Motor excitation current is used for rotational auto-tune.
- (3) Set motor excitation current to 33% of the motor rated current. During auto-tune the keypad will display "Atune" to indicate Auto-tuning is in progress. When the motor is successfully tuned, the keypad shows "AtEnd".

Automatic tuning start (17-10)

Set parameter 17-10 to 1 and press ENTER the inverter will display "Atrdy" for Auto-tune ready. Next, press RUN key to start the auto-tune procedure. During auto-tuning the keypad will display "Atune" for Auto-tune in progress. When the motor is successfully tuned, the keypad shows "AtEnd".

Error history of automatic tuning (17-11)

- (1) If auto-tuning fails the keypad will display the "AtErr" message and the auto-tune cause is shown in parameter 17-11.
- (2) Refer to section 10 for auto-tuning troubleshooting and possible causes.

Note:

The motor tuning error history (17-11) shows the tuning result of the last auto-tune. Tuning history does not show any error when auto-tune is aborted or when the last auto-tune was successful.

Proportion of Motor Leakage Inductance (17-12)

- (1) Parameter can only be set when using stator resistance auto tuning (17-00=2).
- (2) Static non-rotational and rotational type auto tuning automatically measure the proportion of motor leakage inductance so there for this parameter is not active in these tuning modes.
- (3) Default value is 4%. It is required to perform an auto tune to save the adjusted value into parameter 02-33.

Motor Slip Frequency (17-13)

- (1) Parameter can only be set when using stator resistance auto tuning (17-00=2).
- (2) Static non-rotational and rotational type auto tuning automatically measure the proportion of motor leakage inductance so there for this parameter is not active in these tuning modes.
- (3) It is required to perform an auto tune to save the adjusted value into parameter 02-34.

Example 1:

Motor rated voltage (440V/60Hz) is higher than the inverter input voltage (380V/50 Hz).

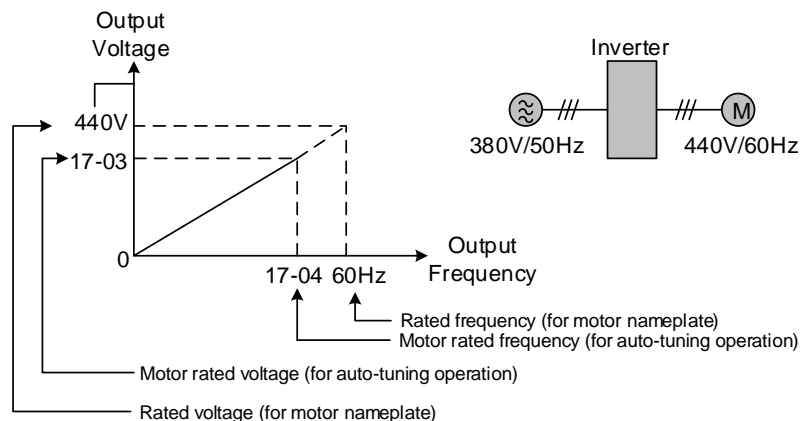


Figure 4.3.89 Rated voltage and frequency settings

- Step 1:** Select auto-tuning mode (17-00) and set motor rated output power (17-01) and motor rated current (17-02) based on the motor nameplate data.
- Step 2:** Set the motor rated voltage (17-03) to 440V based on the motor nameplate data.
- Step 3:** Set the motor rated frequency (17-04) to 60Hz
- Step 4:** Set the motor no-load speed (17-05) and number of motor poles (17-06)
- Step 5:** Set the motor no-load voltage (17-08) to 360V and value 20V lower than input voltage when using torque control.
- Step 6:** Execute auto-tuning by setting auto-tuning parameter 17-10 to 1, next go to main screen and press RUN to start auto-tuning. The value of motor rated frequency (17-04) is automatically set the base frequency of motor 1. The inverter will automatically adjust the value of maximum output frequency of motor 1 (01-02) to the same value as base frequency of the motor 1 (01-12) if the maximum output frequency set in parameter 01-02 is different from the base frequency of the motor 1 (01-12),

When the inverter input voltage (or frequency) is higher than the motor rated voltage (or frequency), set the motor rated voltage (17-03) and the motor rated frequency (17-04) to the values of the motor nameplate.

Example 2:

The inverter input voltage and frequency (460V/50Hz) are higher than the motor rated voltage and frequency (380V/33Hz), set 17-03 to 380V (rated motor voltage) and 17-04 to 33Hz (motor rated frequency).

Rotational Auto-tuning (17-14)

- (1) The parameter can only be set when rotational auto-tuning (17-00=0) or rotational auto-tuning combination (17-00=5) is selected.
- (2) VF type rotational auto-tuning (17-14=0) is best suited for unloaded IM motors
- (3) Vector type rotational auto-tuning (17-14=1) is best suited for unloaded vector duty IM motors. This tuning mode can be used for high speed motors. Use Vector type rotational auto-tuning if VF type rotational auto-tuning (17-14=0) is unsuccessfully.
- (4) Vector type rotational auto-tuning (17-14=1) measures the motor no-loading current to avoid motor current oscillation that can be present in V/F mode.

| | |
|---|--|
| Group 18: Slip Compensation Parameters | |
|---|--|

| | |
|---------------|---|
| 18- 00 | Slip Compensation Gain at Low Speed |
| Range | 【0.00~2.50 】 |
| 18- 01 | Slip Compensation Gain at High Speed |
| Range | 【-1.00~1.00】 |
| 18- 02 | Slip Compensation Limit |
| Range | 【0~250】 % |
| 18- 03 | Slip Compensation Filter Time |
| Range | 【0.0~10.0】 sec |
| 18- 04 | Regenerative Slip Compensation Selection |
| Range | 【0】 : Disable 【1】 : Enable |
| 18- 05 | FOC Delay Time |
| Range | 【1~1000】 msec |
| 18- 06 | FOC Gain |
| Range | 【0.00~2.00】 |

Slip compensation automatically adjusts the output frequency based on the motor load to improve the speed accuracy of the motor mainly in V/F mode.

The slip compensation function compensates for the motor slip to match the actual motor speed to the reference frequency.

Slip compensation adjustment in V/F mode

18-00: Slip compensation gain at low speed

The adjustment of slip compensation gain at low speed follows the below procedure:

1. Set the rated slip and the motor no-load current (02-00).
2. Set the slip compensation (18-00) to 1.0 (factory default setting is 0.0 in V / F control mode)
3. For the operation with a load attached, measure the speed and adjust the slip gain (18-00) accordingly (increase in steps of 0.1).
 - If the motor speed is lower than frequency reference, increase the value of 18-00.
 - If the motor speed is higher than frequency reference, decrease the value of 18-00.

When the output current is greater than the no-load current (02-00), the slip compensation is enabled and the output frequency increases from f1 to f2. Refer to Fig.4.3.90, the slip compensation value is calculated as follows:

$$\text{Slip Compensation Value} = \text{Motor rated slip frequency} \times \frac{[\text{Output current (12-18)} - \text{no-load current of Motor 1 (02-00)}]}{[\text{Rated current of Motor 1(02-01)} - \text{no-load current of Motor 1 (02-00)}]}$$

$$\text{Motor Rated Slip Frequency (f)} = \frac{(\text{Motor no-load synchronous speed} - \text{Motor full load rated speed})(N) \times \text{Motor Poles (P)}}{120}$$

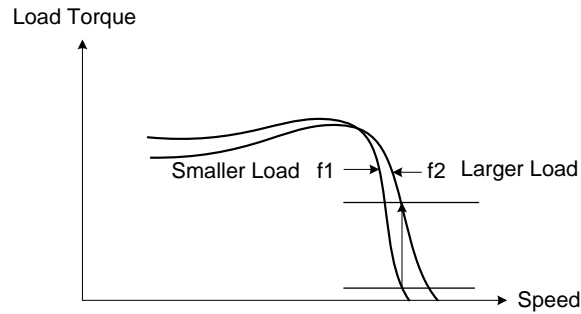


Figure 4.3.90 Slip compensation output frequency

18-01: Slip compensation gain at high speed

- (1) It is not required to adjust the Slip compensation gain at high speed for a loaded motor.
- (2) After adjusting parameter 18-00 it is recommended to increase the reference frequency and check the motor speed. Increase the value of 18-01 to adjust the slip compensation in case the motor speed does not match.
- (3) To reduce speed errors Increase the motor rated frequency (01-12 base frequency) and increase the value of 18-01.
- (3) Compared to 18-00, 18-01 serves as a variable gain for the full speed range.
- (4) If the speed accuracy becomes worse due to an increase in motor temperature it is recommended to use a combination of 18-00 and 18-01 to adjustment motor slip.

Parameter 18-01 determines the slip compensation at the motor rated speed and is calculated follows:

$$\text{Slip Compensation Gain} = (\text{Slip Compensation Gain at low speed} + \text{Slip Compensation Gain at high speed}) \times \frac{\text{Reference Frequency}}{\text{Motor rated frequency (01-12)}}$$

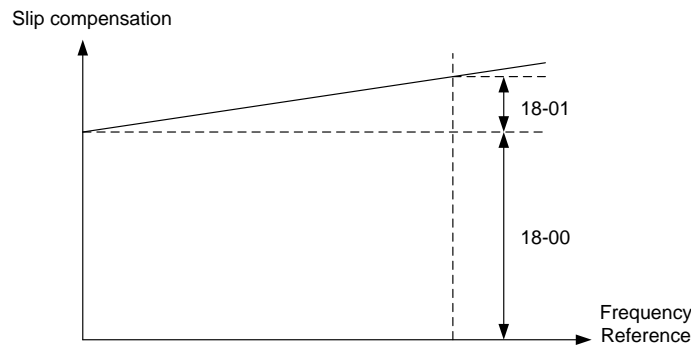


Figure 4.3.91 Parameter 18-00/18-01 Slip compensation gain versus frequency reference

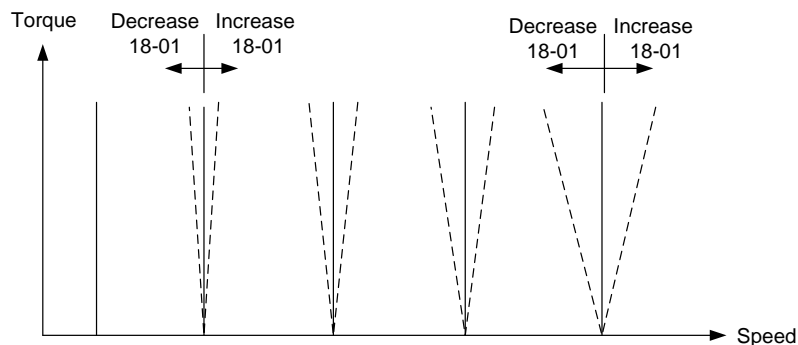


Figure 4.3.92 Parameter 18-01 Effect on speed/torque curve

18-02: Slip compensation limit

Sets slip compensation limit in constant torque and the constant power operation (Figure 4.3.93). If 18-02 is set to 0%, the slip compensation limit is disabled.

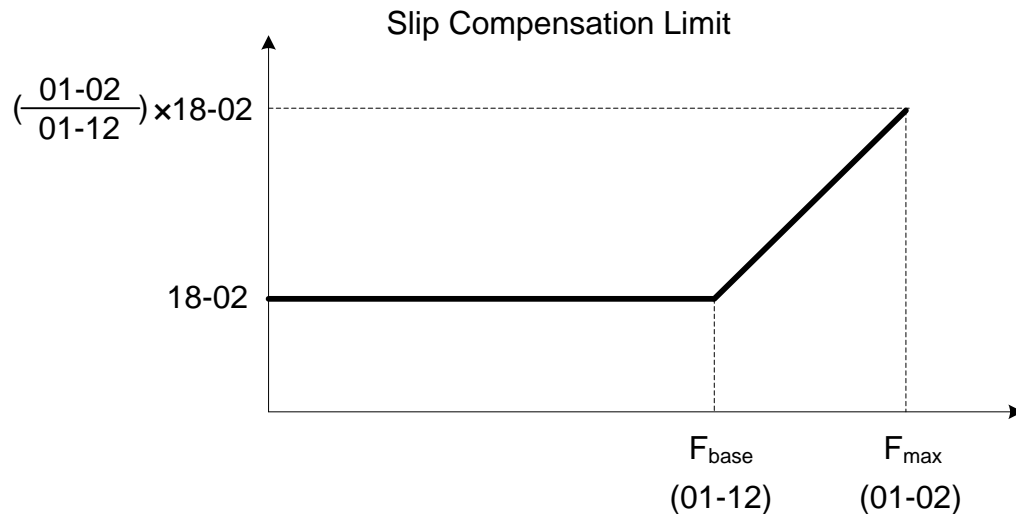


Figure 4.3.93 Slip compensation limit

When the slip compensation gain 18-00 at low speed is adjusted, and the actual motor speed is still lower than the reference frequency, the motor may be limited by the slip compensation limit.

18-03: Slip compensation filter

Sets slip compensation filter time in V/F mode

18-04: Regenerating slip compensation selection

Enable or disable slip compensation during regeneration.

Enable slip compensation during regeneration (18-04=1) in case speed accuracy is required when experiencing regeneration caused by deceleration (SLV mode). When the slip compensation function is used regenerative energy might increase temporarily (18-04=1) and a braking module might be required.

SLV mode adjustment

18-00: Slip compensation gain

- Slip compensation can be used to control the full range speed accuracy under load condition.
- If the output frequency is lower than 2 Hz and the motor speed decreases, increase the value of 18-00.
- If the output frequency is lower than 2 Hz and the motor speed increases, reduce the value of 18-00.

Slip compensation gain uses a single value for the full speed range. As a result the slip compensation accuracy at low speed is high but slight inaccuracies might occur at high speeds. Slip compensation gain is fixed for the full speed range. Adjust 18-00 or 18-01 to improve speed accuracy at higher speed, however adjusting these parameters might impact the accuracy at lower speeds.

The impact of 18-00 on the speed and torque are shown in figure 4.3.94

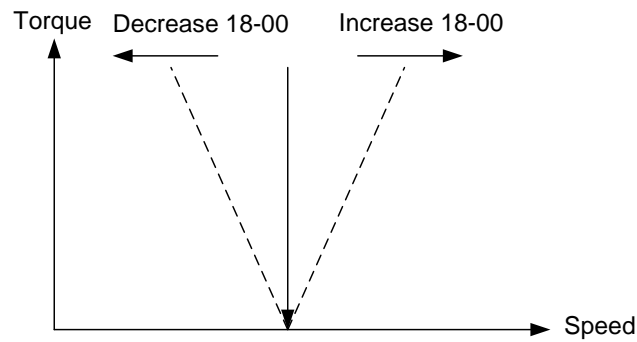


Figure 4.3.94 18-00 Effect on the torque and speed

18-05: FOC (Flux Orient Control) delay time (18-05)

In the SLV mode, the slip compensation of the magnetic flux depends on the torque current and excitation current. If the motor load rises above 100% while running at the motor rated frequency, the motor voltage and resistance drop sharply, which may cause the inverter output to saturate and current jitter may occur.

The magnetic flux slip compensation will independently control the torque current and the excitation current to prevent increasing and decreasing of the current (jitter). For slow speed or fixed speed operation, 18-05 may be increased. For fast operation adjust 18-06.

18-06: Slip compensation gain (18-06)

If the motor is jittering at the rated frequency under full load, the value of 18-06 may gradually be reduced to zero to reduce current jitter.

| | |
|--|--|
| Group 20 Speed Control Parameters | |
|--|--|

| | |
|--------|---|
| 20- 00 | ASR Gain 1 |
| Range | 【0.00~250.00】 |
| 20- 01 | ASR Integral Time 1 |
| Range | 【0.001~10.000】 Sec |
| 20- 02 | ASR Gain 2 |
| Range | 【0.00~250.00】 |
| 20- 03 | ASR Integral Time 2 |
| Range | 【0.001~10.000】 Sec |
| 20- 04 | ASR Integral Time Limit |
| Range | 【0~300】 % |
| 20- 07 | Selection of Acceleration and Deceleration of P/PI |
| Range | <p>【0】: PI speed control will be enabled only in constant speed. For accel/decel, only use P control.</p> <p>【1】: Speed control is enabled either in constant speed or accel/decal.</p> |
| 20- 08 | ASR Delay Time |
| Range | 【0.000~0.500】 Sec |
| 20- 09 | Speed Observer Proportional (P) Gain 1 |
| Range | 【0.00~2.55】 |
| 20- 10 | Speed Observer Integral(I) Time 1 |
| Range | 【0.01~10.00】 Sec |
| 20- 11 | Speed Observer Proportional (P) Gain 2 |
| Range | 【0.00~2.55】 |
| 20- 12 | Speed Observer Integral(I) Time 2 |
| Range | 【0.01~10.00】 Sec |
| 20- 13 | Low-pass Filter Time Constant of Speed Feedback 1 |
| Range | 【1~1000】 mSec |
| 20- 14 | Low-pass Filter Time Constant of Speed Feedback 2 |
| Range | 【1~1000】 mSec |
| 20- 15 | ASR Gain Change Frequency 1 |
| Range | 【0.0~400.0】 Hz |
| 20- 16 | ASR Gain Change Frequency 2 |
| Range | 【0.0~400.0】 Hz |
| 20- 17 | Torque Compensation Gain at Low Speed |
| Range | 【0.00~2.50】 |
| 20- 18 | Torque Compensation Gain at High Speed |
| Range | 【-10~10】 % |
| 20-33 | Constant Speed Detection Level |
| Range | 【0.1~5.0】 % |

Parameter 20-33 is used when 20-07 is set to 0 and frequency command source is set to analog input. A noisy analog input signal might cause a problem where the inverter determines that the operation does not reach its constant speed. Adjust parameter 20-33 according to avoid this situation from occurring.

The following diagram is an overview of the automatic speed regulator (ASR) block.

SLV control mode:

The ASR function adjusts the output frequency to control the motor speed to minimize the difference between the frequency reference and actual motor speed.

The ASR controller in SLV mode uses a speed estimator to estimate the motor speed. In order to reduce speed feedback signal interference, a low-pass filter and speed feedback compensator can be enabled.

The ASR integrator output can be disabled or limited (03-00 to 03-05= 43). The ASR output is passed through a low-pass filter.

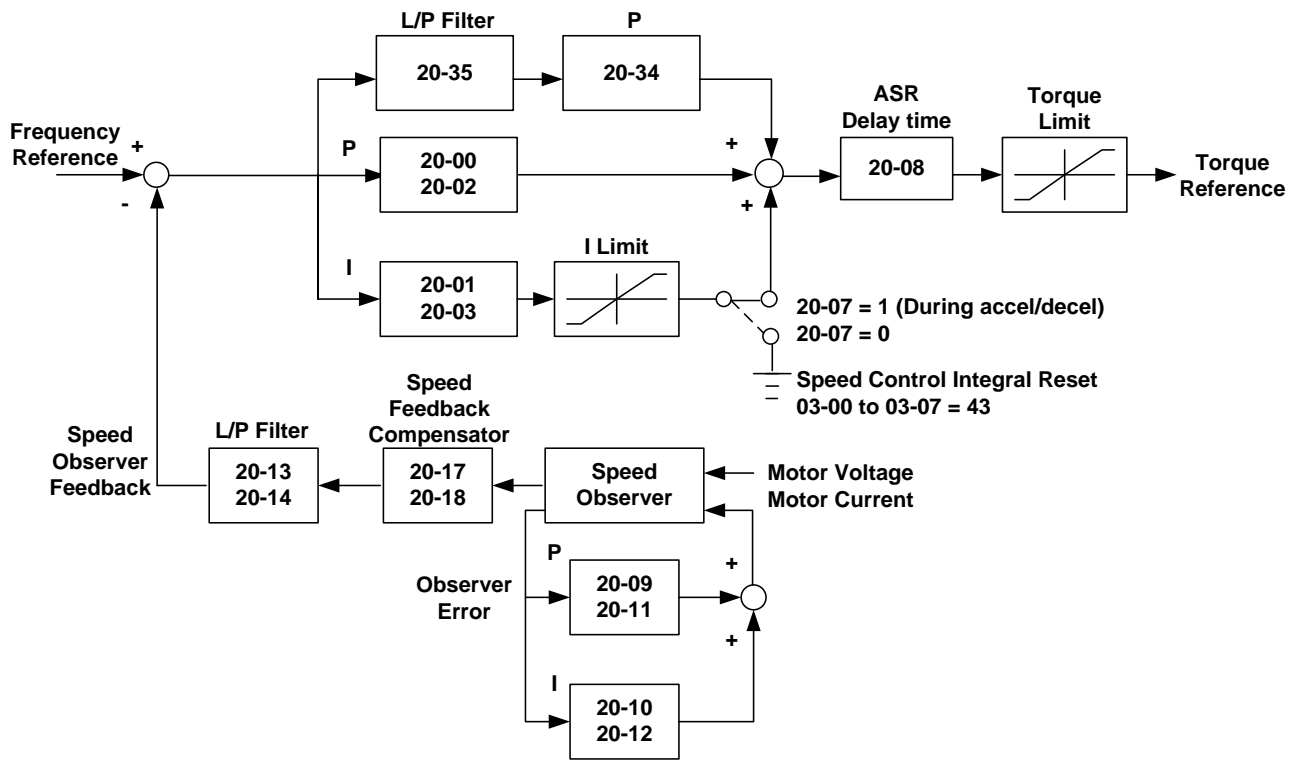


Figure 4.3.95 ASR block diagram (SLV mode)

ASR setting (SLV control mode)

In SLV mode the ASR gain is divided into a high-speed and low-speed section. The speed controller has a high-speed gain 20-00/20-01 and a low-speed gain 20-02/20-03 that can be set independently.

- a) The high/low switch frequency can be set with parameter 20-15 and 20-16. Similar to the ASR gain, the speed estimator has a high-speed gain 20-09/20-10 and a low-speed gain 20-11/20-12.
- b) The speed estimator has a low-pass filter to reduce the speed feedback interference, parameter 20-13 and 20-14 are active at high speed as well as low speed. The switch between the high-speed and the low-speed is set by parameter 20-15 and 20-16.
- c) 20-17 sets the low-speed compensation gain of the speed feedback.

- d) 20-18 sets the high-speed compensation gain of the speed feedback.
- e) When the frequency reference rises above the value set in 20-16, the ASR gain used is set by parameters 20-00 and 20-01.
- f) When the frequency reference falls below the value set in 20-15, the ASR gain used is set by parameters 20-02 and 20-03.
- g) Gain time constant is adjusted linearly when the speed command falls within the range of 20-15 to 20-16, for a smooth operation.

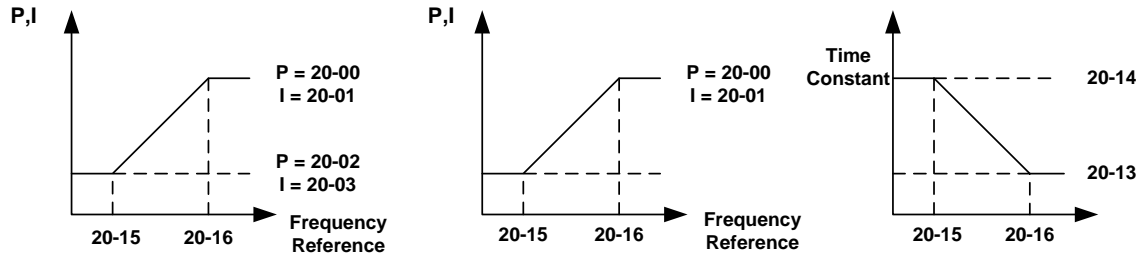


Figure 4.3.96 ASR gain setting (SLV mode)

Tune the speed control gain

Refer to the following steps:

- a. Gain adjustment at minimum output frequency
 - Motor running at minimum output frequency (Fmin, 01-08).
 - Increase value of ASR proportional gain 2 (20-02) make sure setting does not affect stability.
 - Decrease value of ASR integration time 2 (20-03), make sure setting does not affect stability.
 - Ensure the output current is lower than 50% of inverter rated current. If the output current is greater than 50% of inverter rated current, decrease the value of parameter 20-02 and increase value of parameter 20-03.
- b. Gain adjustment at maximum output frequency
 - Motor running at maximum output frequency (Fmax, 01-02).
 - Increase ASR proportional gain1 (20-00), make sure setting does not affect stability.
 - Decrease ASR integration time 1 (20-02) make sure setting does not affect stability.
- c. Gain adjustment of accel./ decel. integral control
 - When 20-07=1, PI speed control is enabled for constant speed and during accel./ decel.
 - Integral control allows the motor speed to quickly reach its the target speed but may cause overshoot or instability. Refer to Fig. 4.3.97 & Fig.4.3.98.

When 20-07=1, ASR Proportion (P) and Integer (I) control during accel/ decel. and constant speed.

When 20-07=0, ASR Proportion (P) and Integer (I) control only during constant state and ASR P control is used during accel/ decel..

Parameter 20-33 (Constant Speed Detection Level) is active when 20-07 is set to 0 and frequency command source is set to analog input. Adjust the value of parameter 20-33 when noise of the analog causes the inverter not being able to determine a constant speed condition.

During ASR gain tuning, the multi-function analog output (AO1 and AO2 terminal) can be used to monitor the output frequency and motor speed (as shown in Fig.4.3.96).

SLV mode gain tuning (20-00~20-03, 20-09~20-18)

- a) Complete the parameter tuning in normal operation.
- b) Increase ASR proportional gain 1 (20-00), ASR proportional gain 2 (20-02) and carefully monitor system stability.

Use parameter 20-00 and 20-02 to adjust the speed response for each cycle. Increasing the values of 20-00, 20-02 increases system response, but may cause system instability. See Fig.4.3.97.

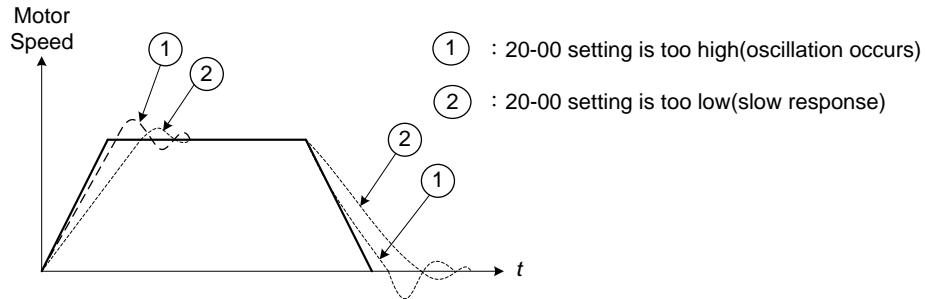


Figure 4.3.97 System response of ASR proportion gain

- a) Reduce ASR integral time 1(20-01), ASR integral time 2 (20-02) and carefully monitor system stability.
 1. A long integral time will result in poor system response.
 2. If the integral time is set to small, the system may become unstable. Refer to the following figure.

While tuning ASR P and I gain the system may overshoot and an over voltage condition may occur. A braking unit (braking resistor) can be used to avoid an over voltage condition.

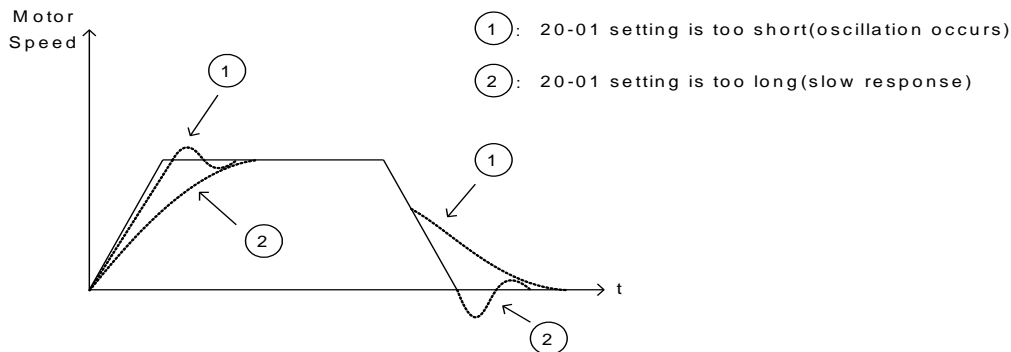


Figure 4.3.98 The response of ASR integral time

Both low-speed ASR gain and the high-speed gain can be set to the same values and only require to be adjusted in case of system instability.

In case tuning of the ASR P and I gain 20-00~20-03 does not improve the system response, reduce the low-pass filter time constant 20-13~20-14 to increase the bandwidth of the feedback system and re-tune the ASR gain.

- 1) Tune the low-speed ASR P and I gain 20-02 ~ 20-03, make sure the reference frequency is set below the value of parameter 20-15.
- 2) Tune the high-speed ASR PI gain 20-00~20-01, make sure the reference frequency is above the value set in parameter 20-16 value.
- 3) Both low-speed ASR gain and the high-speed gain can be set to the same values and only require to be adjusted in case of system instability.
- 4) reduce the low-pass filter time constant 20-13~20-14 to decrease the bandwidth of the feedback system and

re-tune the ASR gain, in case tuning of the ASR P and I gain 20-00~20-03 does not improve the system response.

- 5) Tune low-speed low-pass filter time constant 20-14, make sure the reference frequency is below parameter 20-15 value.
- 6) Tune high-speed low-pass filter time constant 20-13 at frequency reference, make sure the reference frequency is above parameter 20-16 value.
- 7) Increasing the low-pass filter time constant can limit the bandwidth of the speed feedback system and may reduce the system response. Increasing the low-pass time reduces the speed feedback signal interference but may result in sluggish system response when the load suddenly changes. Adjust the low-pass filter time if the load stays fairly constant during normal operation. The low bandwidth of the speed feedback must be supported by the low gain of ASR to ensure the stable operation.
- 8) Decreasing the low-pass filter time constant may increase the bandwidth of the speed feedback and the system response. Decreasing the low-pass time may increase the speed feedback interference resulting in system instability when the load suddenly changes. Decrease the low-pass filter time if a quick system response is required for rapidly changing loads. The high bandwidth of the speed feedback allows for a relative high ASR gain.
- 9) In case tuning 20-00~20-03 and the low-pass filter time constant 20-13~20-14 do not improve the system response time, tuning the PI gain 20-09~20-12 of the speed estimator may be required.
- 10) Setting a high gain for the speed estimator (high proportion (P) gain and small integral (I) time) increases the bandwidth of the speed feedback, but may cause speed feedback interference resulting in system instability.
- 11) Setting a low gain for the speed estimator (small proportion (P) gain and high integral time) decreases the bandwidth of the speed feedback, may improve speed feedback interference resulting in a more stable system.
- 12) The default values for the ASR can be used in most applications, no adjustment is required. Adjusting the low-pass filter time and speed estimator gain requires a good understanding of the overall system. If a high-speed system response in combination with stable operation is required consider using SLV control mode.
- 13) Parameter 20-15 sets the gain switch frequency at low-speed and parameter 20-16 sets the gain switch frequency at high-speed.
- 14) Operating at a speed below 20-15 will result in an increased excitation current for low-speed operation accuracy. When the frequency reference rises above 20-16, the inverter will output the rated excitation current at the no-load voltage (02-19).
- 15) For general purpose applications parameter 20-15 should be set to a value of 5~50% of the motor base frequency. If this value is too high, the inverter output may saturate. Parameter 20-16 should be set to a value of 4Hz or more above the value of 20-08.
- 16) When experiencing speed jitter at high speed and stable operation during mid-range speed while operating a heavy load (>100%), it is recommended to reduce the no-load voltage (02-19) or tune the FOC parameters (18-05 ~ 18-06).
- 17) Parameter 20-17 and 20-18 are for compensating speed feedback at low speed and high speed.

- 18) Use parameter 20-17 to adjust the torque compensation gain for the low speed range. By tuning 20-17 an offset is added to the torque-speed curve. Increase 20-17 when the no-load speed is lower than the frequency reference. Decrease 20-17 when the no-load speed is higher than the frequency reference.

The effect on the torque-speed curve from 20-17 is shown as the following figure:

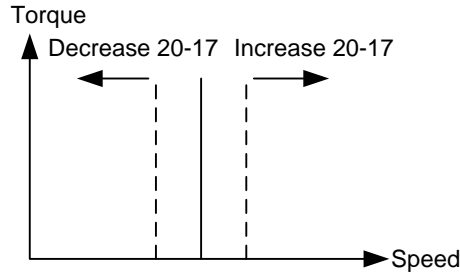


Figure 4.3.99 Effect on the torque-speed curve from 20-17

- Use parameter 20-18 to adjust the torque compensation gain for middle to high speed range. For most general purpose applications it is not necessary to adjust the 20-18. By tuning 20-18 an offset is added to the torque-speed curve. Increase 20-18 when the no-load speed is lower than the frequency reference. Decrease 20-18 when the no-load speed is higher than the frequency reference. The effect on the torque-speed curve from 20-18 is shown as the following Fig.4.3.100.

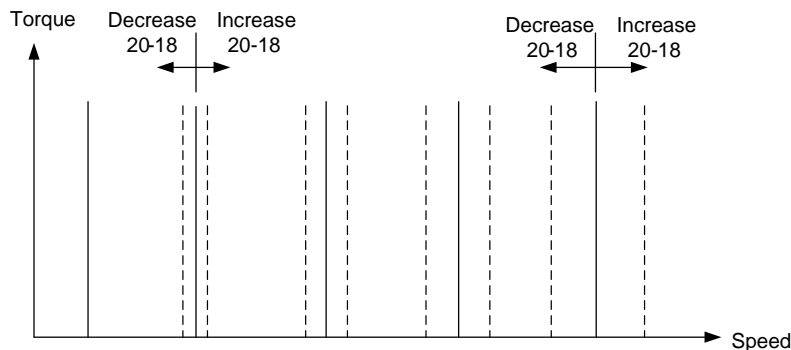


Figure 4.3.100 Effect on the torque-speed curve from 20-17

- ASR main delay time (20-08).
 - a) Does not required to be adjusted for general purpose applications
 - b) When the set value of 20-08 is set high, the speed response will and therefore system response will decrease improving system stability.
- a. ASR Integral Time Limit (20-04)
 - a) Setting a small value may prevent system response when the load suddenly changes.

Note:

- Response specifications of no-load speed circuit bandwidth at vector control:
 1. 50 Hz is at the control modes of SV / PMSV.
 2. 10 Hz is at the control modes of SLV / PMSLV.
- Speed response will be affected by kp adjustment, inertia, load and motor temperature, etc. so that the bandwidth decrease slightly in application.

| | |
|---------------|--------------------------------------|
| 20- 34 | Derating of Compensation Gain |
| Range | 【0.00~25600】 |
| 20- 35 | Derating of Compensation Time |
| Range | 【0~30000】 mSec |

Derating of torque compensation function can reduce the ASR impact during a sudden load change. Refer to Fig. 4.3.97 & Fig. 4.3.98.

Parameter 20-34 functions the same as ASR proportional gain (20-00, 20-02) but with an additional low-pass filter time constant (20-35) to avoid oscillation. Typical value for parameter 20-34 is between 30~50.

This time constant is used for suppressing the oscillation produced by 20-34. Increasing the compensation time constant results in a slower output response and might affect the overall application. Typical value for parameter 20-34 is between 50~100ms.

Decreasing the torque compensation value can reduce the response of the ASR during a sudden load change. Refer to Fig. 4.3.108 & Fig. 4.3.109.

20-34 Compensation Gain During Speed Drop:

The effect of parameter 20-34 is the same as the proportional gain of the ASR (20-00, 20-02) but active only for the time specified in 20-35 for large speed fluctuation to prevent system instability.

20-35 Compensation Time During Speed Drop:

This parameter sets the time constant used to prevent system instability caused by parameter 20-34. An increased compensation time can lead to a slower output response which is can affect derating compensation in a negative way.

The recommended setting value of 20-34 is between 30~50 and for 20-35 between 50~100ms.

| | |
|---|--|
| Group 21 Torque Control Parameters | |
|---|--|

| | |
|---------------|---|
| 21- 05 | Positive Torque Limit |
| Range | 【0~160】 % |
| 21- 06 | Negative Torque Limit |
| Range | 【0~160】 % |
| 21- 07 | Forward Regenerative Torque Limit |
| Range | 【0~160】 % |
| 21- 08 | Reversal Regenerative Torque Limit |
| Range | 【0~160】 % |

Torque limit can be set in two ways:

- Use torque limit parameters (21-05 to 21-08) to set a fixed torque limit.
- Set the torque limit by using the multi-function analog input (AI2).

There are four torque limits that can be set separately, one for each quadrant:

- I. Positive torque limit in forward direction (21-05 positive torque limit)
- II. Positive torque limit of reverse direction (21-06 negative torque limit)
- III. Negative torque limit in reverse direction (21-07 forward regenerating torque limit)
- IV. Negative torque limit in forward direction (21-08 reversal regenerating torque limit)

Refer to Fig.4.3.101.

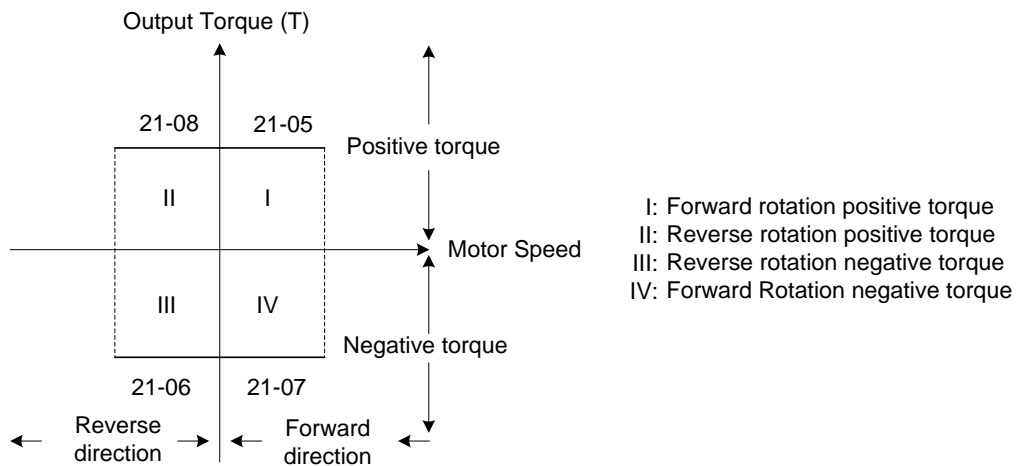


Figure 4.3.101 Torque limit setting

Torque limit setting using multi-function analog input AI2 (04-05)

Table 4.3.16 Torque limit analog input

| 04-05 (AI2) | Function |
|-------------|--|
| 11 | Positive torque limit |
| 12 | Negative torque limit |
| 13 | Regenerative torque limit (for both forward and reversal directions). |
| 14 | Positive/negative torque limit (positive and negative detection torque limit) |

Set the analog input terminal (AI2) signal level (04-00), gain (04-07) and bias (04-08)

The default setting for the analog input AI2 is 0 -10V representing 0 – 100% of the motor rated torque.

Fig.4.3.102 shows the relationship between the output torque and the torque limit.

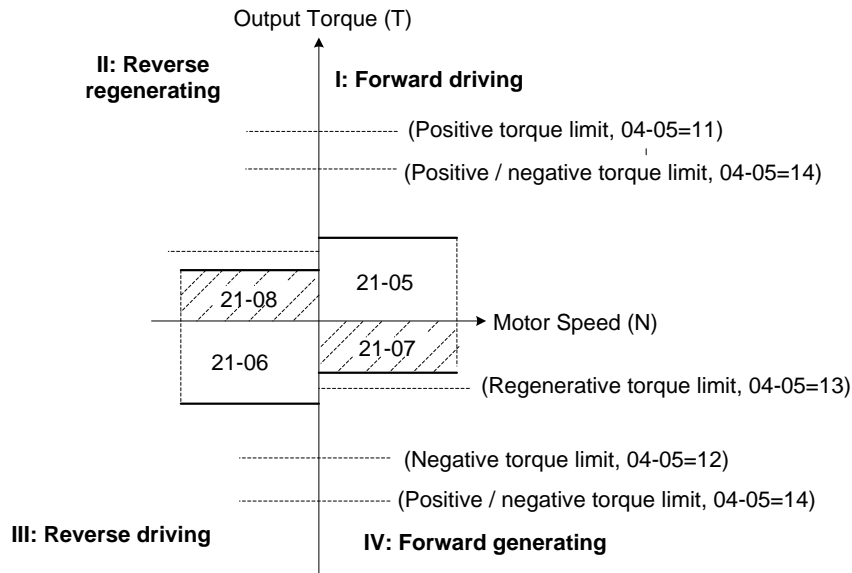


Figure 4.3.102 Analog input torque limit (AI2)

When the analog input is set to positive torque limit (value = 11) the torque limit is active in the third and fourth quadrant in reverse direction (regenerative torque in the second quadrant).

When the analog input is set to negative torque limit (value = 12) the torque limit is active in the third and fourth quadrant.

When the analog input is set to regenerative torque limit (value = 13) the torque limit is active in the second and fourth quadrant can be controlled.

When the analog input is set to positive/negative torque limit (value = 14) the torque limit is active in all four quadrants.

When the analog input is at maximum (10V or 20mA), the torque limit is 100% of the motor rated torque. In order to increase the torque limit above 100% the analog input gain (04-07) has to set to a value greater than 100%. For example: 160.0% of the gain will result in the torque limit of 160% of motor rated torque at 10V (20mA) analog input level.

| |
|--------------------------------------|
| Group 22: PM Motor Parameters |
|--------------------------------------|

Note: Parameters in Group 22 are only available when PM Control Mode is selected

| | |
|---------------|---|
| 22- 00 | Rated Power of PM Motor |
| Range | 【0.00~600.00】 Kw |
| 22- 02 | Rated Current of PM Motor |
| Range | 25%~200% of inverter's rated current |
| 22- 03 | Pole Number of PM Motor |
| Range | 【2~96】 Poles |
| 22- 04 | Rated Rotation Speed of PM Motor |
| Range | 【6~60000】 rpm |
| 22- 05 | Maximum Rotation Speed of PM Motor |
| Range | 【6~60000】 rpm |
| 22- 06 | PM Motor Rated Frequency |
| Range | 【4.8~400.0】 Hz |
| 22- 10 | PM SLV Start Current |
| Range | 【20 ~ 200】 % |
| 22- 11 | I/F Mode Start Frequency Switching Point |
| Range | 【1.0 ~ 20.0】 % |
| 22- 12 | Speed Estimation kp Value |
| Range | 【1 ~ 10000】 |
| 22- 13 | Speed Estimation ki Value |
| Range | 【1 ~ 1024】 |
| 22- 14 | PM Motor Armature Resistance |
| Range | 【0.001 ~ 30.000】 Ω |
| 22- 15 | PM Motor D-axis Inductance |
| Range | 【0.01 ~ 300.00】 mH |
| 22- 16 | PM Motor Q-axis Inductance |
| Range | 【0.01 ~ 300.00】 mH |
| 22- 17 | Reserved |
| Range | Reserved |
| 22- 18 | Flux-Weakening Control |
| Range | 【0 ~ 100】 % |

The PM parameter group can be restored to factory default by initializing the inverter (13-08). Set the motor rating before initializing the inverter (13-00).

22-00: PM motor rated power

Set the motor power according to the motor nameplate.

22-02: PM motor rated current

Set the motor full load according to the motor nameplate.

22-03: PM motor pole number

Set the number of motor poles according to the motor nameplate.

22-04: PM motor rated speed

Set parameter 22-04 or 22-06, the inverter will automatically calculate one or the other.

Set the motor rated speed in rpm according to the motor nameplate.

Note:

Only set parameter 22-04 or 22-06, the inverter will automatically calculate the other one.

Formula (22-04) = $120 \times f$ (22-06) / Number of Poles (22-03)

22-05: PM motor maximum rotation speed

Set the maximum motor rated speed in rpm according to the motor nameplate.

22-06: PM motor rated frequency

Set the motor rated frequency according to the motor nameplate.

Only one of the two values is required, either PM motor rated speed (22-04) or PM motor rated frequency (22-06), the inverter will automatically calculate the other upon entering the data based on the formula below:

$$\text{(PM motor rated speed) } N = \frac{120 \times f \text{ (PM motor rated frequency)}}{P \text{ (PM motor pole number)}}$$

22-10: PMSLV Start Current

Set the torque current at start up as % of motor rated current.

22-11: I/F Mode Start Frequency Switching Point

Function for the switching from open-loop to closed-loop in PMSLV mode. The unit is percentage of rated speed of the motor. It recommended setting this parameters to a value greater than 5% for 400V and a value greater than 10% for 200V.

22-12 Speed Estimation kp Value & 22-13 Speed Estimation kl Value

Performance of speed response adjustment

The greater the value, the faster the motor response; Please note system may become unstable when value is set too high.

The lower the value, the greater the speed deviation. Please adjust setting based on system requirements.

22-14: Armature Resistance of PM Motor

Set resistor for each phase of the motor in increments of 0.001Ω. Value is set automatically during motor tuning (22-21).

22-15: D-axis Inductance of PM Motor

Set motor D-axis inductance in increments of 0.001mH. Value is set automatically during motor tuning (22-21).

22-16: Q-axis Inductance of PM Motor

Set motor's Q-axis Inductance in increments of 0.001mH. Value is set automatically during motor tuning (22-21).

22-18: Flux-Weakening Limit

Sets the flux-weakening limit as a percentage of the motor rated current. If the motor maximum rotation speed (22-05) is set to a value greater than the motor rated rotation speed (22-04) the inverter will automatically enable flux-weakening control.

| | |
|---------------|---|
| 22- 21 | SLV PM Motor Tuning |
| Range | 【0】 : Disable 【1】 : Enable |
| 22- 22 | Fault History of SLV PM Motor Tuning |
| Range | 【0】 : No Error 【1】 ~ 【4】 : Reserved 【5】 : Circuit tuning time out 【6】 : Reserved 【7】 : Other motor tuning errors 【8】 : Reserved 【9】 : Current Abnormity Occurs while Loop Adjustment 【10】 : Reserved 【11】 : Stator Resistance Measurement is Timeout 【12】 : Reserved |
| 22- 25 | Detection Mode Selection of Default Magnetic Pole |
| Range | 【0】 : Angle before Stop 【1】 : Mode 1 【2】 : Mode 2 【3】 : Mode 3 |
| 22- 27 | Mode 2 Voltage Command |
| Range | 【5~100】 % |
| 22- 28 | Mode 2 Frequency Division Ratio |
| Range | 【0~4】 |
| 22- 29 | Field-Weakening Voltage Control |
| Range | 【80~100】 % |

SLV PM Motor Tuning (22-21)

WARNING!

Sudden start: The inverter and motor may start unexpectedly during Auto-Tuning, which could result in death or serious injury. Make sure the area surrounding of the motor and load are clear before proceeding with Auto-Tuning.

WARNING! Electric Shock Hazard

High voltage is applied to the motor when performing an auto-tune, even when the motor is stopped, which could result in death or serious injury. Do not touch the motor before performing the auto-tuning procedure is completed.

WARNING! Holding Brake

Do not perform an auto-tuning procedure when the motor is connected to a mechanical brake this may result in incorrect motor data calculation. Disconnect the motor and the load and confirm the motor can operate freely.

1. Before selecting PM motor tuning, enter the motor data (22-00) - (22-06) according to the motor nameplate.
2. Use parameter 22-21 to select tuning mode.
 - a) Next press the enter key to go to the PM motor tuning screen. The keypad will show "IPrdy" (Ready to Tune).
 - b) Press run to start the PM motor tuning. The keypad will display the "IPtun" message during auto-tune.
 - c) If the motor is successfully tuned, the message of "IPEnd " will be displayed. If auto-tune is aborted with the stop key, the operator will display the message of " IPbrd " (PM motor tuning aborted).

Notes:

1. Perform a magnetic pole alignment auto-tune before adjusting the speed loop.
2. It is not required to perform a magnetic pole alignment auto-tune each time the inverter is powered up.

Fault History of SLV PM Motor Tuning (22-22)

If PM motor tuning has failed, the "IPErr" message is shown on the keypad (PM motor tuning failure). Refer to section 10 for the possible error causes and trouble shooting.

PM motor tuning fault history (22-22) only stores the result of the last auto-tune performed .If auto-tuning was successful or aborted, no error will be displayed.

22-25: Initial position detection of PM motor

Used in PMSLV control mode only. When 22-25=1, the inverter will automatically detect the initial position of motor rotor while the motor running to prevent the motor from running in the opposite direction.

22-25=0: detection function is disabled

22-25=1: Mode 1

Pulse input signals are used to detect the rotor position by using a successive pulses.

22-25=2, Mode 2

Variable frequency signals are used to detect the rotor position.

22-25=3, Mode 3

Pulse input signals are used to detect the rotor position.

22-27 Mode 2 Voltage Command)

When 22-25=2 (Mode 2), if the rotor position is unstable at start, increase the value of mode 2 voltage command to ensure the accuracy of the detection angle.

Note: When the voltage value is set too high, an overcurrent condition may be occurs.

22-28 Mode 2 Frequency Division Ratio

When 22-25=2 (Mode 2), the input continuous signal frequency of mode 2 depends on the carrier frequency setting (parameter 11-01). The higher the carrier frequency then higher the frequency ratio needs to be to reduce the input continuous signal frequency to ensure the accuracy of the detection angle.

22-29 Field-Weakening Voltage Control

Parameter is used to prevent output voltage saturation. This value is used to control field-weakening as a percentage of the inverter's input voltage to limit the inverter output voltage. If parameter 22-18 (Flux-Weakening Control) is set too low, the inverter's output voltage will rise above the inverter voltage command.

| |
|---|
| Group 23 Pump & HVAC Function Parameters |
|---|

| 23- 00 | Function Selection |
|--------|---|
| Range | 【0】 : Disable 【1】 : Pump 【2】 : HVAC 【3】 : Compressor |

Select between pump, HVAC or compressor application. This parameter automatically enables PID control mode (10-03) when Pump or HVAC is selected and enabled parameter group 23.

When 23-00=1, LCD keypad switches main screen monitoring automatically (16-00) to operating pressure setting (12-74), the sub-screen monitoring 1 (16-01) to pressure feedback value (12-75) and sub-screen monitoring 2 (16-02) to output frequency (12-17).

When 23-00=2, LCD keypad switches main screen monitoring automatically (16-00) to flow meter target setting (12-77), the sub-screen monitoring 1 (16-01) to flow meter feedback (12-71) and sub-screen monitoring 2 (16-02) to output frequency (12-17).

When 23-00=3, PID option for main frequency command source (00-05) cannot be selected and V/F curve is limited to F (01-00). Middle output voltage (01-07) is automatically set to half of then maximum output voltage and parameter 01-00 is hidden.

Notes:

- It is required to set parameters 00-05 and 10-03 in inverter software V1.3.
- It is disabled in switching display setting in inverter software V1.3.
- Refer to parameter 23-05 when using a LED keypad.
- Pump or Compressor selections are only available when control mode (00-00) is set for V/f.

| 23- 01 | Setting of Single & Multiple Pumps and Master & Alternative |
|--------|---|
| Range | 【0】 : Single Pump 【1】 : Master 【2】 : Slave 1 【3】 : Slave 2 【4】 : Slave 3 |

Select inverter as the Master or Slave 1~3 via parameter 23-01. Refer to Fig.4.3.111 for the description of a duplex pump system. Inverter needs to reconnect after parameter is changed.

| 23- 02 | Operation Pressure Setting |
|--------|----------------------------|
| Range | 【0.10 ~ 650.00】 PSI |

Set the setpoint pressure value based on the pressure transducer of the pump system after setting 10-00 to 0 (keypad entered).

| | |
|---------------|---|
| 23- 03 | Maximum Pressure of Pressure Transmitter |
| Range | 【0.10 ~ 650.00】 PSI |

Set the maximum pressure value based on the pressure transducer of the pump system. Parameter 23-02 is limited to this maximum value.

| | |
|---------------|---|
| 23- 04 | Pump Pressure Command Source |
| Range | 【0】 : Set by 23-02 【1】 : Set by AI |
| 23-71 | Maximum Pressure Setting |
| Range | 【0.10 ~ 650.00】 PSI |

Pressure command source can be entered in 23-02 (Operation Pressure Setting) or by using an analog input. Refer to parameter 10-00 on how to select AI terminal.

Note: Refer to section 3.3.4.1 for single/ Multi-pump wiring diagram.

23-02 (Operation pressure setting) is limited by 23-71 (Maximum pressure setting). 23-71 is limited by 23-03 (Maximum Pressure of Pressure Transducer)

| | |
|---------------|---|
| 23- 20 | Switching of Pressure and Percentage |
| Range | 【0】 : Pressure 【1】 : Percentage |

23-20=1: Parameters 23-09, 23-24, 23-34, 23-38 and 23-39 are set as a percentage of parameter 23-02 and parameters 23-12 & 23-15 are set as a percentage of parameter 23-03.

23-20=0: Parameters 23-09, 23-24, 23-34, 23-38, 23-39, 23-12 and 23-15 are set as absolute value in Pump units (23-36).

For example, 23-02=4.00PSI, 23-03=10.00PSI, 23-09=0.5PSI, 23-12=5.00PSI

When **23-20=0→1**,

$$\begin{aligned} ((23-09) \div (23-02)) * 100 &\Rightarrow 23-09 = 13\% \text{ (Rounded to integer)} \\ ((23-15) \div (23-03)) * 100 &\Rightarrow 23-15 = 50\% \text{ (Rounded to integer)} \end{aligned}$$

When **23-20=1→0**,

$$\begin{aligned} ((23-09)/100) \times 23-02 &\Rightarrow 23-09 = 0.52\text{PSI} \\ ((23-15)/100) \times 23-03 &\Rightarrow 23-15 = 5.00\text{PSI} \end{aligned}$$

| | | |
|---------------|---|--------------------------|
| 23- 36 | PUMP Unit Display | (LCD Keypad only) |
| Range | 【0】 : PSI 【1】 : inW 【2】 : Bar 【3】 : Pa | |

When 23-00=1 and 23-20=0, the LCD keypad displays engineering unit based on the value set in parameter for parameters 12-74,12-75,23-02,23-03,23-09,23-12,23-15,23-23-24,23-34,23-38 and 23-39.

| | | |
|---------------|---|-----------|
| 23- 05 | Display Mode Selection | *2 |
| Range | 【0】 : Display Target (setpoint) and Pressure Feedback 【1】 : Only Display Target (setpoint) Pressure 【2】 : Only Display Pressure Feedback | |

Select main display setup for target (setpoint) and feedback pressure.

① When 23-05=0000: Led keypad displays pressure setpoint value and pressure feedback value.

The image shows a four-digit LED display with a decimal point. The first two digits are '20' and the last two are '10'. There is a small horizontal line above the first digit and a small vertical line below the first digit, indicating a decimal point at the first position.

Two-digit to the left is pressure setpoint value setting and two-digit to the right is the pressure feedback value when using an LED keypad.

Note: When 23-00=2 (HVAC), the unit are multiplied by 1000 times. A value of 5.0, means 5000 GPM.

② When 23-05=0001: Led keypad only displays the pressure setpoint value.

The image shows a four-digit LED display with a decimal point. The first two digits are '02' and the last two are '00'. There is a small horizontal line above the first digit and a small vertical line below the first digit, indicating a decimal point at the first position.

③ When 23-05=0002: Led keypad only displays the pressure feedback value.

The image shows a four-digit LED display with a decimal point. The first digit is '0' and the last two are '10'. There is a small horizontal line above the first digit and a small vertical line below the first digit, indicating a decimal point at the first position.

Notes:

- When the target (setpoint) value is greater than 10, the target (setpoint) value is only shown as an "integer" value instead of a "decimal" value when 10-33 is set below 1000 and 10-34=1 using PID mode.
- If Pump mode is used parameter 23-03 requires needs set to value smaller than 10.0 PSI.

| | |
|---------------|------------------------------|
| 23- 06 | Proportion Gain (P) |
| Range | 【0.00~10.00】 |
| 23- 07 | Integral Time (I) |
| Range | 【0.0~100.0】 Sec |
| 23- 08 | Differential Time (D) |
| Range | 【0.00~10.00】 Sec |

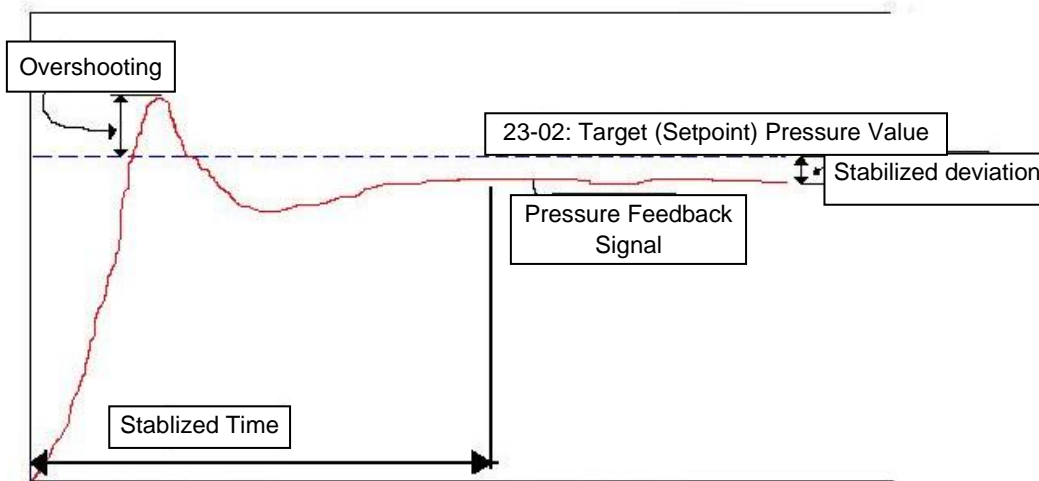


Figure 4.3.103 Diagram of pressure feedback value

Table 4.3.17 Guide for PID parameter adjustment

| | Increase Setting Value | Decrease Setting Value | Main Feature |
|-----------------------|--|--|------------------------------------|
| Proportional Gain (P) | (Pros) Increase response time | (Pros) Reduce instability | Increase stabilization time |
| | (Cons) Might cause pump instability | (Cons) Slow down response | |
| Integral Time (I) | (Pros) Smooth output frequency | (Pros) Fast response | For smooth feedback variations |
| | (Cons) Slow down response | (Cons) Change rapidly output frequency | |
| Differential Time (D) | (Pros) Avoid overshooting | (Pros) System stability | Respond to system rapid variations |
| | (Cons) System instability or motor instability | (Cons) Overshooting easily | |

Notes:

- PID parameters can be modified while the inverter is running.
- Cons: Disadvantage, Pros: Advantage.

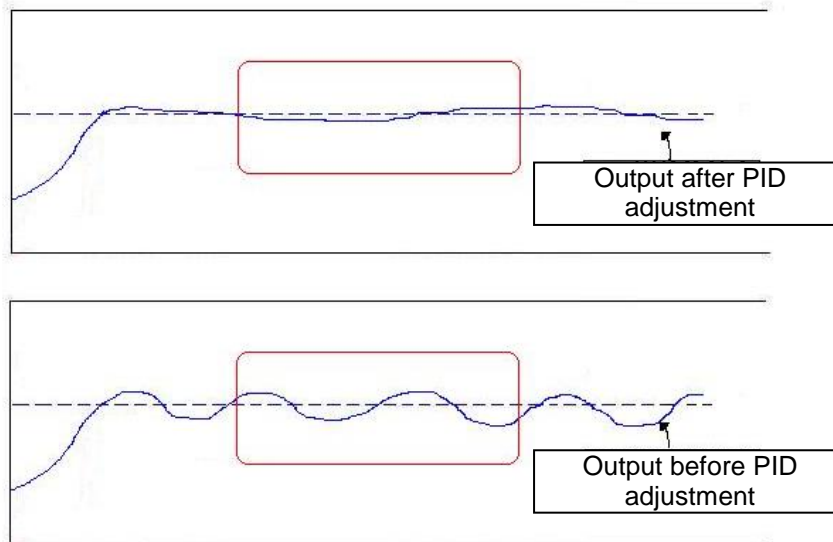


Figure 4.3.104 Diagram for PID parameter adjustment

| | | |
|---------------|---|-----------|
| 23- 09 | Tolerance Range of Constant Pressure | |
| Range | 【0.01~650.00】 PSI | *1 |
| | 【1~100】 % | *2 |
| 23- 34 | Tolerance Range of Constant Pressure 2 | |
| Range | 【0.01 ~ 650.00】 PSI | *1 |
| | 【1~100】 % | *2 |

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

When pressure feedback value rises above value set in 23-02 (operation pressure setpoint setting), inverter output frequency will decrease go to sleep when output frequency falls below value set in (23-10) for time specified in (23-11). PID starts (output frequency will increase) when pressure feedback value falls below (23-02) – (23-09).

| | | |
|---------------|--|--|
| 23- 10 | *Sleep Frequency of Constant Pressure | |
| Range | 【0.0~400.0】 Hz | |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

When inverter output frequency falls below 23-10 (sleep frequency) for time specified in (23-11) the inverter will enter sleep mode.

| | | |
|---------------|--|--|
| 23- 11 | Sleep Time of Constant Pressure | |
| Range | 【0.0~255.5】 Sec | |

When the inverter output frequency falls below 23-10 (sleep frequency) for the time specified in (23-11) the inverter will enter sleep mode.

Note: Parameter 23-10 (sleep frequency for constant pressure) is a dedicated parameter for pump applications (23-00=1) do not use 10-17 (start frequency of PID sleep).

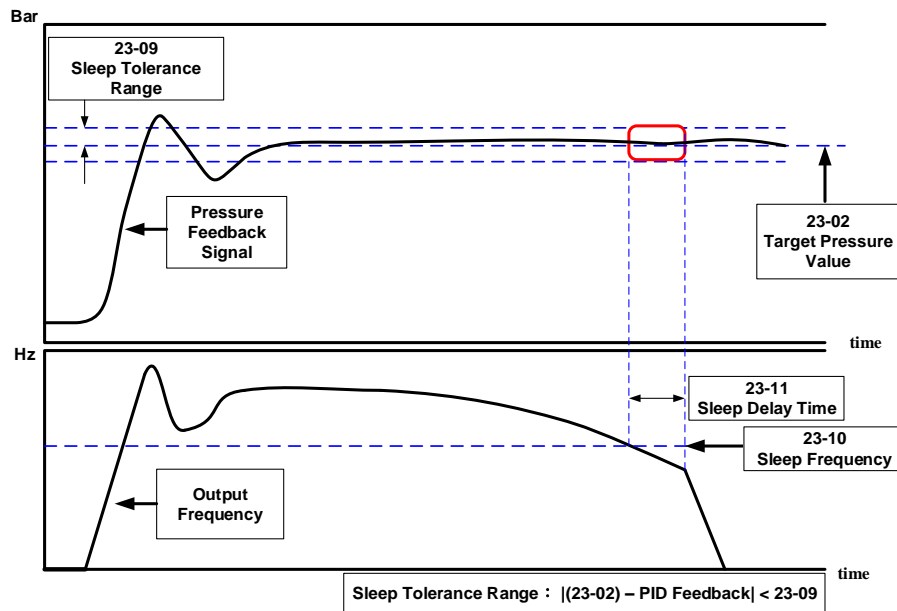


Figure 4.3.105 Sleep function for constant pressure applications

| 23- 12 | Maximum Pressure Limit | |
|--------|----------------------------|----|
| Range | 【0.10 ~ 650.00】 PSI | *1 |
| | 【0~100】 % | *2 |

Parameter 23-12 sets the high pressure limit. When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-13 the inverter displays high pressure warning, when time exceeds value set in 23-14 the inverter displays high pressure fault and stop.

| 23- 15 | Minimum Pressure Limit | |
|--------|---------------------------|----|
| Range | 【0.00 ~650.00】 PSI | *1 |
| | 【0~100】 % | *2 |

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

Parameter 23-15 sets the low pressure limit. When the pressure feedback falls below the value set in 23-15 for the time specified in 23-16 the inverter displays low pressure warning, when time exceeds value set in 23-16 the inverter displays low pressure fault and stop.

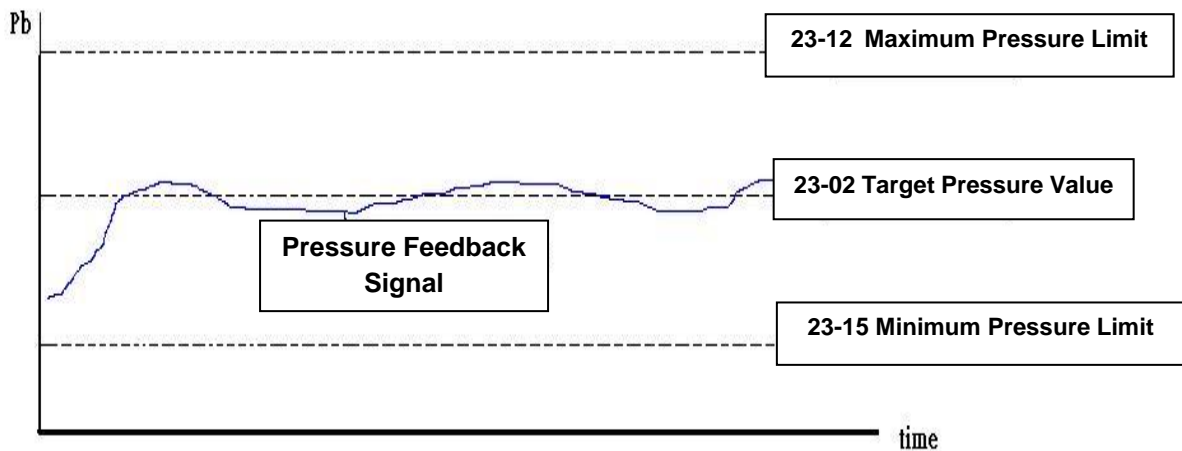


Figure 4.3.106 Diagram for pressure feedback limit

Note: The pressure under the control of PID is between the maximum pressure limit (23-12) and minimum pressure limit (23-15).

| | |
|---------------|--------------------------------------|
| 23- 13 | Warning Time of High Pressure |
| Range | 【0.0 ~ 600.0】 Sec |

When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-13 the inverter displays high pressure warning (HIPb).

| | |
|---------------|-----------------------------------|
| 23- 14 | Stop Time of High Pressure |
| Range | 【0.0 ~ 600.0】 Sec |

When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-14 the inverter displays high pressure fault (OPbFt) and stops.

Note: To disable the high pressure detection function set the warning time of high pressure to zero.

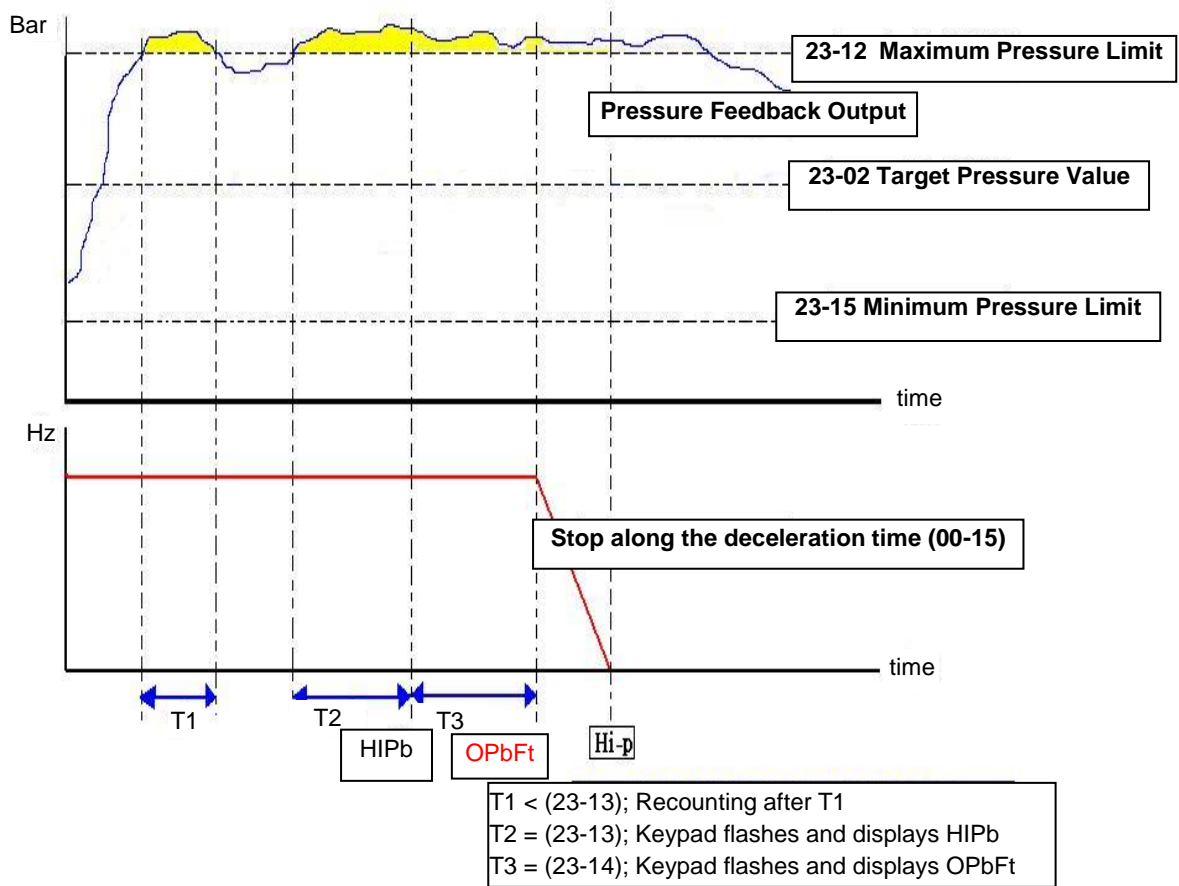


Figure 4.3.107 Diagram for warning to stop under the limit of high pressure

| | |
|---------------|-------------------------------------|
| 23- 16 | Warning Time of Low Pressure |
| Range | 【0.0 ~ 600.0】 Sec |

When the pressure feedback falls below the value set in 23-15 for the time specified in 23-16 the inverter displays low pressure warning (LoPb).

| | |
|---------------|--|
| 23- 17 | Fault Stop Time of Low Pressure |
| Range | 【0.0 ~ 600.0】 Sec |

When the pressure feedback falls below the value set in 23-15 for the time specified in 23-17 the inverter displays low pressure fault (LPbFt).

Note: To disable the low pressure detection function set the warning time of low pressure to zero.

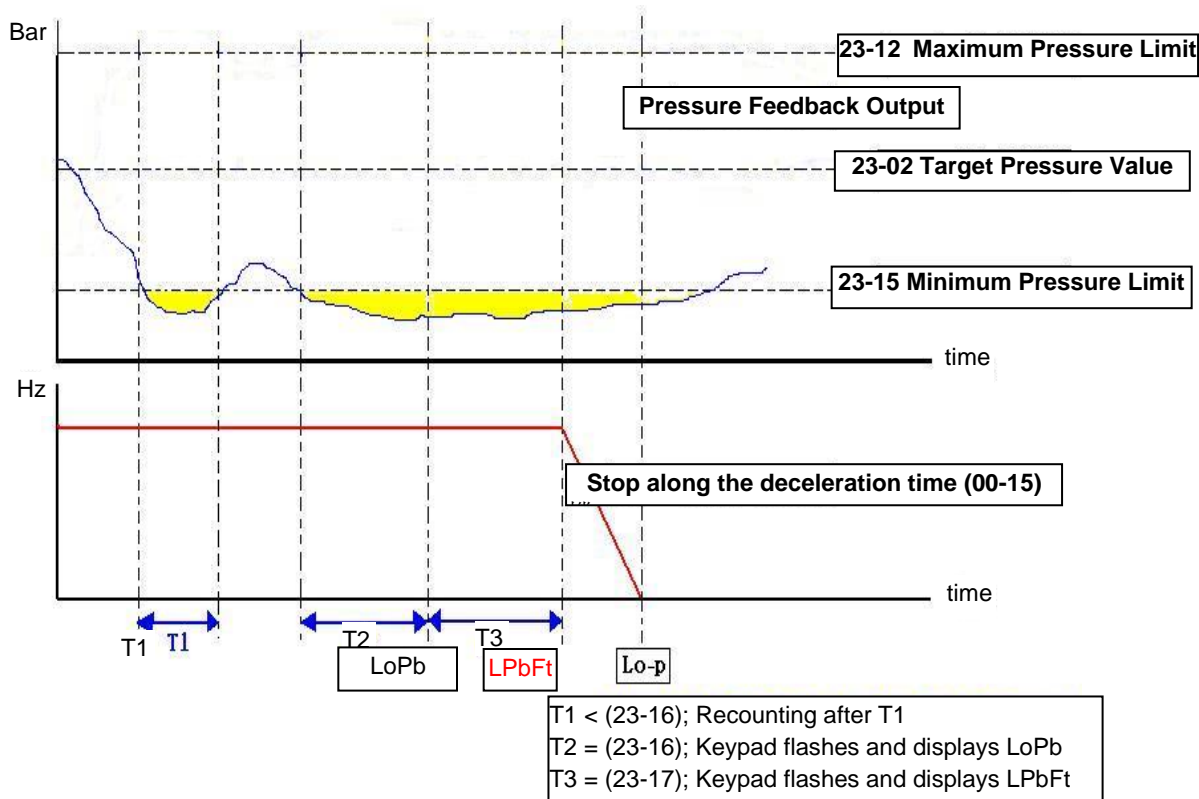


Figure 4.3.108 Diagram for warning to stop under the limit of low pressure

| | |
|--------|---------------------------------------|
| 23- 18 | Detection Time of Loss Pressure |
| Range | 【0.0 ~ 600.0】 Sec |
| 23- 19 | Detection Proportion of Loss Pressure |
| Range | 【0 ~ 100.0】 % |

23-19 = 0: Disabled

23-19 > 0: If the feedback pressure value falls below the value calculated by 【 (23-02) x (23-19) 】 for the time specified in time of loss pressure (23-18), the inverter shows a FBLSS fault and stops.

| | |
|--------|--|
| 23-23 | Direction of Water Pressure Detection |
| Range | 【0】 : Upward Detection 【1】 : Downward Detection |
| 23- 24 | Range of Water Pressure Detection |
| Range | 【0.0 ~ 65.00】 PSI *1 【0~10】 % *2 |
| 23- 25 | Period of Water Pressure Detection |
| Range | 【0.0 ~ 200.0】 Sec |
| 23- 26 | Acceleration Time of Water Pressure Detection |
| Range | 【0.1 ~ 600.0】 Sec |
| 23- 27 | Deceleration Time of Water Pressure Detection |
| Range | 【0.1 ~ 600.0】 Sec |

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

Water pressure detection (23-26) acceleration and deceleration time (23-27) are the same acceleration time 2 (00-16) and the deceleration time 2 (00-17), so when setting of 23-26 the value of 00-16 also change. Avoid using the multi-speed application function when the PUMP application function is enabled.

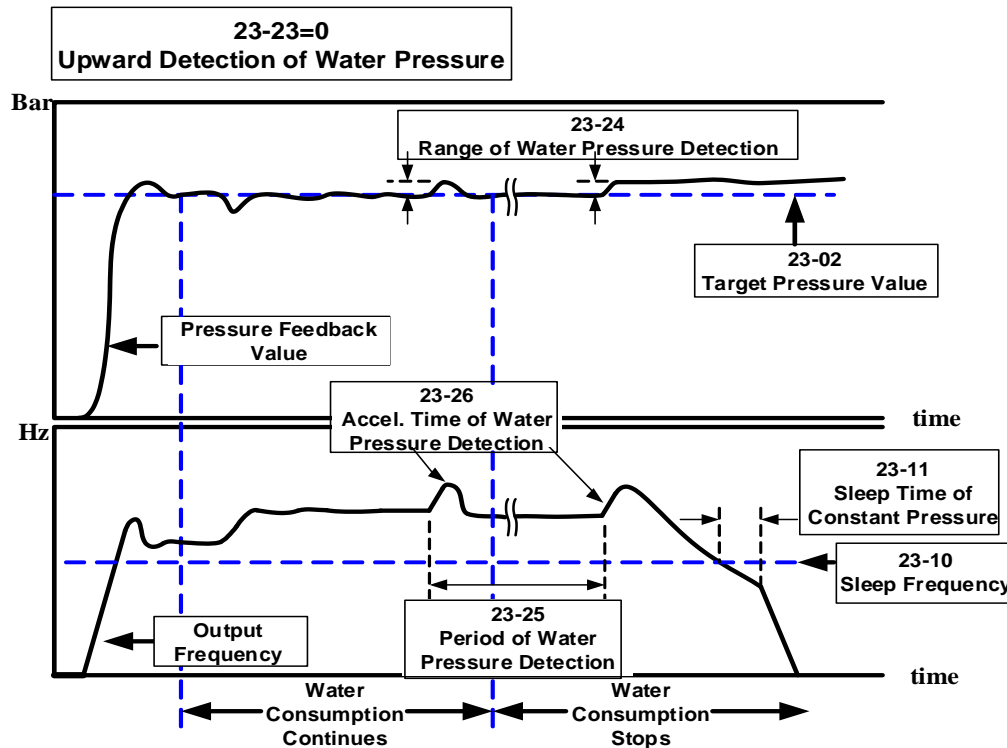


Figure 4.3.109 Diagram for upward detection of water pressure

23-25 = 0.0 (sec) water pressure detection is disabled.

Water pressure detection detects a no-flow or small leak condition and allows the inverter to go sleep.

It is recommended to extend the water pressure detection time (23-25) to avoid cycling in and out of sleep mode in case a no-flow detection occurs too often.

During a no-flow check, pressure increases slightly. During this time the pressure can fluctuate if there is flow. To reduce fluctuation of the pressure lower the water pressure detection range (23-24). Please note that lowering the setting for 23-24 will extend the time it takes for the inverter to detect a no-flow or small leak condition.

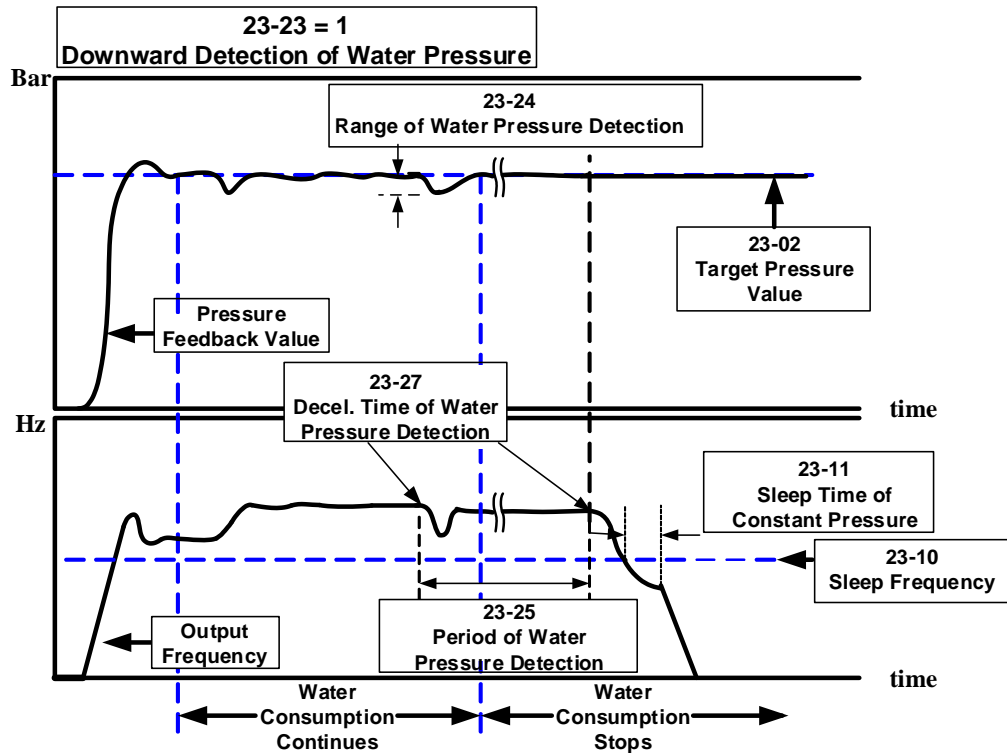


Figure 4.3.110 Diagram for downward detection of water pressure

23-25 = 0.0 (sec) means to disable the function of water pressure detection.

When function of water pressure detection is enabled, it can shorten the time of inverter jumping into sleep without water consumption or with mild water consumption.

It is recommended to extend the water pressure detection time (23-25) to avoid cycling in and out of sleep mode in case a no-flow detection occurs too often.

During a no-flow check, the output frequency will be lowered using the deceleration time 23-27 and pressure reduces slightly. During this time the pressure can fluctuate if there is flow. To reduce fluctuation of the pressure lower the water pressure detection range (23-24). Please note that lowering the setting for 23-24 will extend the time it takes for the inverter to detect a no-flow or small leak condition.

If pressure feedback value falls below the target (setpoint) pressure value (23-02) minus the range of water pressure detection (23-24), the output frequency will increase again.

Table 4.3.18 Guideline for no-flow detection direction

| | Pros | Cons |
|---|--|--|
| Upward detection of water pressure | <ul style="list-style-type: none"> Keeps the pressure above the target pressure during the detection process. Recommended for strict and precise applications | <ul style="list-style-type: none"> If minimum head is too high, operation frequency is greater during a no-flow or leak condition preventing the system from going to sleep. Minimal energy-saving because slave pumps don't go to sleep when multiple pumps in parallel are used. |
| Downward detection of water pressure | <ul style="list-style-type: none"> Goes to sleep when no-flow or small leak occurs. Save energy, when using multiple pumps in parallel to regulating pumps for best optimum operation. Startup sequence is Master, Slave 1, Slave 2, and Slave 3. Sleep sequence is Slave 1, Slave 2, and Slave 3 and Master last. After the alternation timer has expires. | <ul style="list-style-type: none"> Pressure fluctuations may occur during this process if range of water pressure detection (23-24) and the deceleration time of water pressure detection (23-27) are set incorrectly. |

| | |
|---------------|--|
| 23- 28 | *Forced Run Command (Hand Mode) |
| Range | 【0.00 ~ 400.00】 Hz |

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

This function is enabled when PID mode (10-03) is selected.

When PID is disabled (Multi-function digital input (S1~S6) is set to 16 (PID control disable) and active, pump operation is not regulated based on feedback and runs at the selected frequency source set by 00-05 (Frequency command). Multi-function digital input (S1~S6) is set to 16 (PID control disable).

When digital input is set to 57(forced frequency run) with PID disabled, the inverter will run at frequency set in parameter 23-28 (forced run command) when input is activated. If PID function is enabled the inverter is controlled by the PID.

Forced run command is applied to the situation when pressure sensor disconnects, control inverter output via the external pressure sensor (ex. differential pressure switch).

| | |
|--------------|---|
| 23-29 | Switching Time of Multiple Pumps in Parallel |
| Range | 【0 ~ 240】 hour/min |
| 23-72 | Switching Time of Alternation in Parallel |
| Range | 【0】 : Hour 【1】 : Minute |

| | |
|--------------|---|
| 23-35 | Selection of Multiple Pumps Shift Operation |
| Range | 【0】 : No function 【1】 : Timer Alternative Selection 【2】 : Sleep Stop Alternative Selection 【3】 : Timer and Sleep Stop Alternative Selection 【4】 : Multiple Pumps Test Mode |

If the multi-pump function is enabled, the alternation sequence is Master→Slave1→ Slave2→Slave3 → Master → ... and the alternation time is set by parameter 23-29.

Parameter 23-72 Switching Time for Pump Alternation

23-72=0, parameter 23-29 (Alternating Time) is set hours.

23-72=1, parameter 23-29 (Alternating Time) is set in minutes.

Note: Alternation timer is reset when parameter 23-29 is changed and power to the inverter is cycled.

Multiple Pump Alternation Operation Selection (23-35)

23-35=1: Timer Alternative Selection

The Master and Slave pumps alternate after alternation timer expires.

23-35=2: Sleep Stop Alternative Selection

Alternate on next start when system is in sleep mode. Please refer to the diagram of sleep stop alternate selection.

23-35=3: Timer and Sleep Stop Alternative Selection

Alternate on next start when system is in sleep mode and alternation timer has expired. Please refer to the diagram of sleep stop alternate selection.

23-35=4: Multiple Pumps Test Mode

When then master stops running and the slave pump needs to run set 23-35=4, alternation is disabled.

| | |
|---------------|---|
| 23- 30 | Detection Time of Multiple Pumps in Parallel Running Start |
| Range | 【0.0 ~ 30.0】 Sec |

When parameter 23-31 is set to 1 or 3, the detection time to bring on multiple pumps is enabled. If water pressure cannot meet setpoint and falls outside the detection bandwidth and water flow time exceeds the detection time (23-30) the master will bring on an additional slave pump.

| | |
|---------------|---|
| 23- 31 | Synchronous Selection of Multiple Pumps in Parallel |
| Range | 【0】 : Disable 【1】 : Pressure Setting and Run/ Stop 【2】 : Pressure Setting 【3】 : Run/Stop |

23-31=0: Disabled

23-31=1: Pressure Setting and Run/ Stop

Set 23-01 to 1, Pressure setting and Run/ Stop command are controlled by the Master; the slave follows the Master's command and setpoint. Run/Stop command from the Slave is disregarded except the emergency stop command which has the highest priority.

23-31=2: Pressure Setting

Set 23-01 to 2, Pressure setpoint setting is controlled by then Master and Slave follows Master's setpoint command.

23-31=3: Run/Stop

Set 23-01 to 3, Run/ Stop command is controlled by the Master and Slave follows Master's command. Run/Stop command from the Slave is disregarded except the emergency stop command which has the highest priority.

Notes:

- When setpoint pressure of the Master is changed it is required to press the ENTER key to modify the pressure setpoint of the slave pumps.
- Alternation time is reset when the Alternation time for multiple pumps in parallel (23-29) is changed.

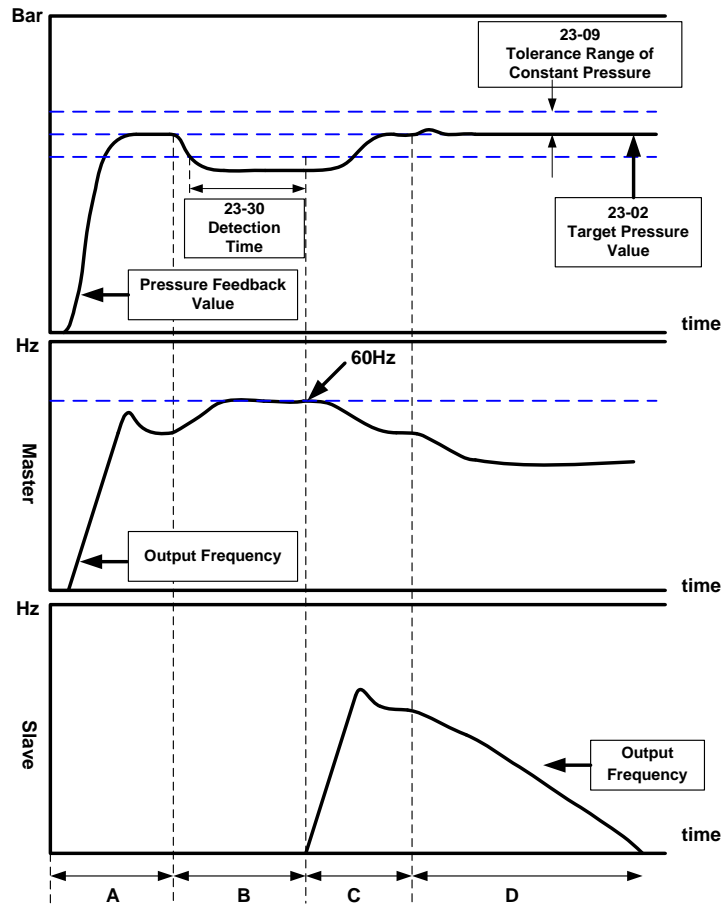


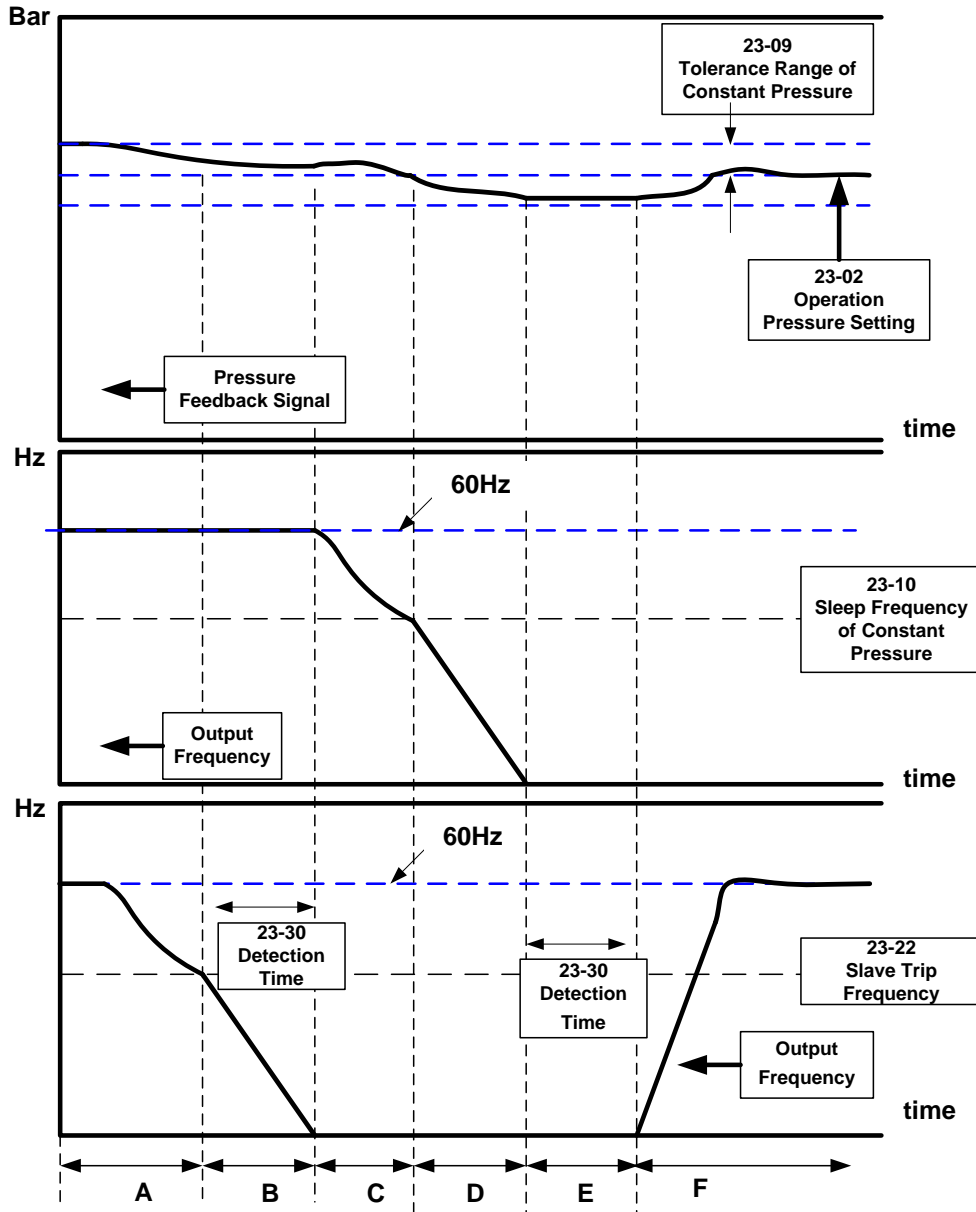
Figure 4.3.111 Dual pumps start up process

- A. Dual pump control is enabled. Master pump starts first and Slave pump is in standby in constant-pressure operation.
- B. Higher operation frequency of the Master results in an increased system flow. If the system pressure cannot reach the setpoint but does not falls outside the pressure detection bandwidth and the operation time has not expired (23-30) the Slave does not come on and is still in standby.
- C. If the Master runs at 60Hz and operation detection time (23-30) has expired the Master turns on the slave pump. When the master and slave are both running the operation frequency of the master and slave are automatically reduced to meet setpoint pressure.

D. When both the master and slave pumps are running and flow demand decreases the output frequency of the slave also decreases. When then slave pump output frequency falls below the sleep frequency for the time specified by the sleep detection time the slave will go to sleep and the master operates to meet the constant pressure setpoint (please refer to parameter 23-22 for dual pump slave sleep requirements).

Notes:

- When 23-35=3, If the pump run time is greater than alternation time (23-29) or the inverter goes from sleep to stop when operating dual pumps, the Master and Slave will alternate.
- When 23-01≠0, parameter 23-01 of the two inverters cannot be simultaneously set to 1 or 2. One inverter needs to be set to 1 and that of the other inverter should be set to 2.



Sleep stop alternation operation diagram

Notes:

A: Dual pumps are enabled during this time. When system pressure rises the Master keeps operation and Slave output frequency decreases.

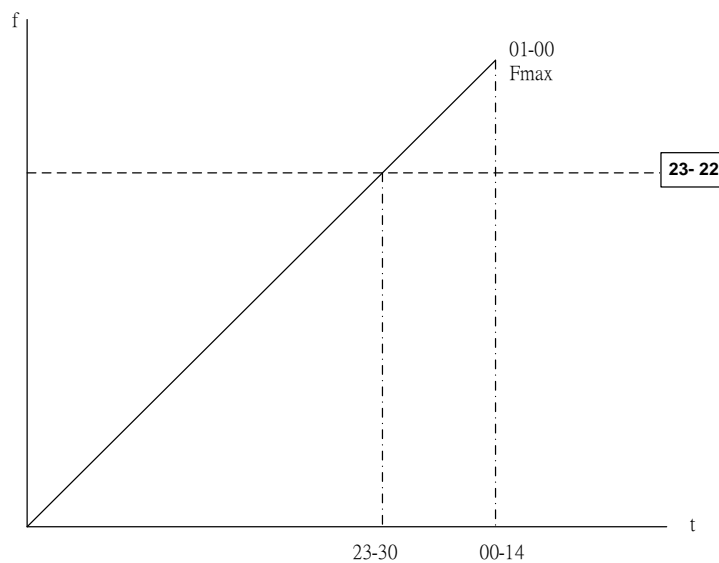
- B: Master operation frequency remains at 60Hz. If system pressure does not decrease to the system setpoint pressure the Slave continuously decreases until it reaches the trip frequency (23-22). Once the detection time (23-30) expires the Slave decelerates to a stop.
- C: The Master output frequency decreases after the detection time (23-30) expires when the Slave is in sleep mode and a low system flow in combination with a higher system pressure occurs.
- D: When then Master operation frequency reaches the sleep frequency (23-10), Master will decelerate to a stop, system flow and pressure will reduce slowly.
- E: When there is no flow the Master will go to sleep, system pressure remains constant and Slave's detection time (23-30) starts.
- F: When the detection time (23-30) expires, operation stops and virtual Master now becomes the Slave. The new Master inverter now regulates system pressure based on the target (setpoint) pressure value.

| 23-73 | Slave Wake-up Selection |
|-------|---|
| Range | 【0】 Disable 【1】 Enable |

Set parameter 23-73=1 and follow instructions in a multi-pump system where slaves do not wake-up due to system characteristics.

1. Master is running at full speed operation (01-02 maximum output frequency) but system pressure feedback value is unable to reach target (setpoint) pressure value.
2. Slave is forced to start after one minute and stays operating to achieve the target pressure value. (Even if the requirement of sleep to wake-up is not achieved and the pressure feedback value is under the tolerance range of constant pressure).
3. It is required to follow the formula (23-73=1) and refer to the following diagram to set the wake-up requirements.

$$\frac{23 - 30}{00 - 14} \geq \frac{23 - 22}{01 - 02} \text{ ----- set method 1}$$



Slave wake-up diagram

| | |
|--------------|-----------------------------|
| 23-22 | Slave Trip Frequency |
| Range | 【0.0~400.0】 Hz |

If Master and Slave are running, the Slave will stop depending on the condition described below.

23-22=0 Hz: if the Slave output frequency falls below 23-10 (Sleep Frequency of Constant Pressure) for the time specified in 23-11 (Sleep Time of Constant Pressure), the Slave will stop automatically.

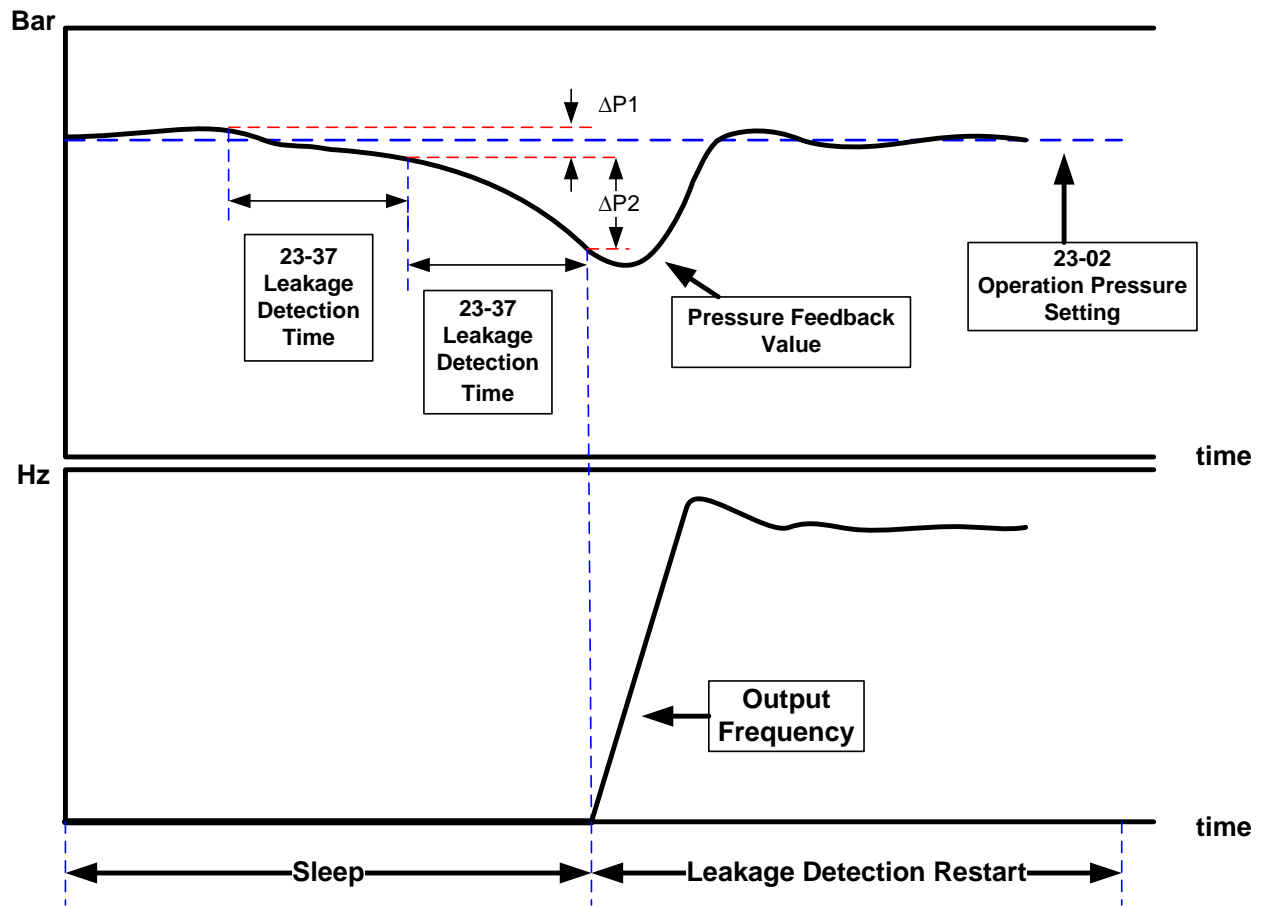
23-22 = 1 ~ 400 Hz: (The maximum frequency set by 01-02), if the output frequency of Slave falls below 23-22, the Master will inform the Slave to stop and enter sleep mode. If the Slave output frequency of falls below 23-10 (Sleep Frequency of Constant Pressure) for time specified in 23-11 (Sleep Time of Constant Pressure), the Slave will stop automatically.

| | | |
|--------------|--|-----------|
| 23-37 | Leakage Detection Time | *3 |
| Range | 【0.0~100.0】 Sec | |
| 23-38 | Pressure Variation of Leakage Detection Restart | *3 |
| Range | 【0.01~65.00】 PSI *1 【1~10】 % *2 | |
| 23-39 | Pressure Tolerance Range of Leakage Detection Restart | *3 |
| Range | 【0.01~650.00】 PSI *1 【1~100】 % *2 | |

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

Leakage Detection Case #1: Pressure Variation > 23-38



Pressure Variation of Leakage Detection Restart

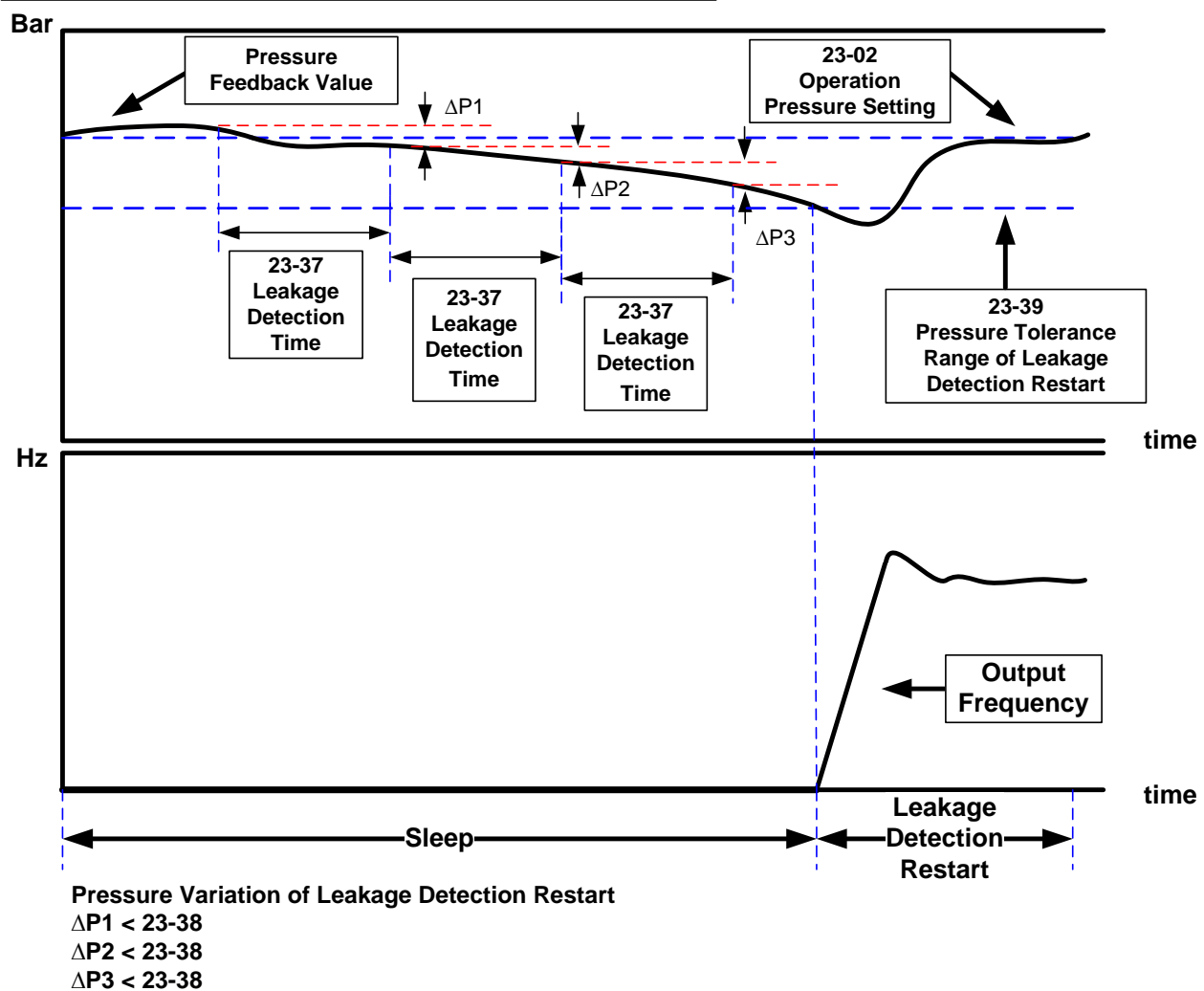
$\Delta P1 < 23-38$

$\Delta P2 > 23-38$

Notes:

- 23-37 = 0.0 (sec), function is disabled
- Pump will start if pressure variation is greater than the value of parameter 23-38 for time specified in detection time (23-37).

Leakage Detection Case #2: Pressure Variation <23-38



Notes:

- 23-37 = 0.0 (sec), function is disabled
- When pump is at shutdown state, pressure will drop over time if pipeline leaks.
- Pump will stay in sleep mode if pressure variation is smaller than parameter 23-38 for time specified in detection time (23-37) and restart when pressure variation is greater than 23-38 for time specified in detection time (23-37) or pressure variation is greater than pressure tolerance range of leak detection restart (23-39).
- Adjust parameters 23-37, 23-38 and 23-39 for proper pump start / stop control based on system pressure characteristics.
- Leakage detection function is only available for single pump applications.

| | |
|--------------|---|
| 23-41 | Local/ Remote Key |
| Range | 【0】 : Disable 【1】 : Enable |

Switch between Local/Remote mode for frequency reference and run/stop command.
 Frequency command is set by (00-05) and the operation command is set by (00-02).

23-41=0: Disable

Frequency command is controlled by terminal AI1 and AI2 and run command is controlled by terminal S1, S2 or RS485 when both SEQ and REF lights are on.

23-41=1: Enable

User can control FWD/REV with Local / Remote key.

Frequency command and run/stop command are controlled by the keypad when SEQ and REF signal light are off.

Note: Local mode is controlled by the keypad and remote mode is controlled by control circuit terminals or RS485 connection.

| | |
|--------------|---|
| 23-42 | Energy Recalculating |
| Range | 【0】 : Disable (Energy Accumulating) 【1】 : Enable |
| 23-43 | Electricity Price per kWh |
| Range | 【0.000~5.000】 |

When the inverter is powered up, user can view energy usage by checking parameter 12-67 (unit: kWh) and 12-68 (unit: MWh) and adjust by setting parameter 23-42 to 1.

Set utility price in kWh (23-43), View parameter 12-69 and 12-70 for total energy cost.

| | |
|--------------|--|
| 23-44 | Selection of Accumulative Electricity Pulse Output Unit |
| Range | 【0】 : Disable 【1】 : Unit for 0.1kWh 【2】 : Unit for 1kWh 【3】 : Unit for 10kWh 【4】 : Unit for 100kWh 【5】 : Unit for 1000kWh |

Sets pulse output signal (23-44) energy usage units in kWh. Pulse output activates for 200msec each time the specified kWh setting is consumed. Pulse output signal can be used for auxiliary electric meter or PLC.

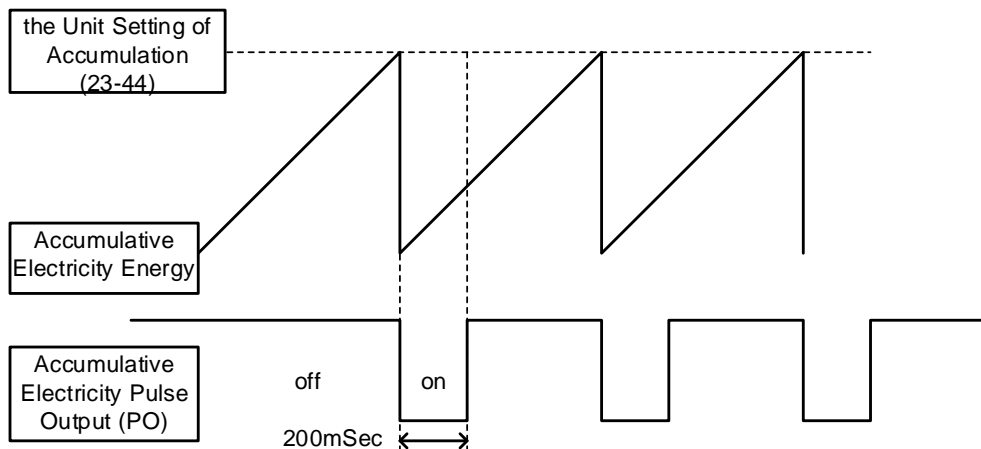


Figure 4.3.112 Diagram for accumulative electricity pulse output

| | |
|---------------|---|
| 23-45 | Given Modes of Flow Meters Feedback |
| Range | 【0】 : Disable 【1】 : Analog Input 【2】 : Pulse Input |
| 23- 46 | Maximum Value of Flow Meters |
| Range | 【1~50000】 GPM |
| 23- 47 | Target Value of Flow Meters |
| Range | 【1~50000】 GPM |

Flow meter function is enabled when HVAC mode is selected (23-00-2) and main frequency command source (00-05) is set to 5 (PID given) and PID mode is enabled (10-03).

23-45: Given Modes of Flow Meters Feedback

Select flow meter input source; Analog input (AI) or pulse input (PI).
Flow meter feedback value can be viewed in parameters (12-71).

23-46: Maximum Value of Flow Meters

Specify flow meter maximum value

23-47: Target Value of Flow Meters

Specify target (setpoint) value when flow meters is used in HVAC system
Note: Requires 10-00 set to 0 (PID target value source is set by keypad.)

| | |
|---------------|---|
| 23- 60 | HVAC Unit Display (only for LCD) |
| Range | 【0】 : GPM 【1】 : FPM 【2】 : CFM 【3】 : GPH |

When 23-00=2, the LCD keypad displays the engineering unit based on value of parameter 23-6. Engineering unit is used by parameters 12-71, 12-77, 23-46, 23-47.

| | |
|--------------|---------------------------------------|
| 23-48 | Maximum Flow Value of Feedback |
| Range | 【0.01~99.00】 % |

Set the maximum flow limit value. When the flow feedback value rises above the maximum flow value the inverter will display a warning when the warning timer (23-49) expires and stop when the stop timer expires (23-50).

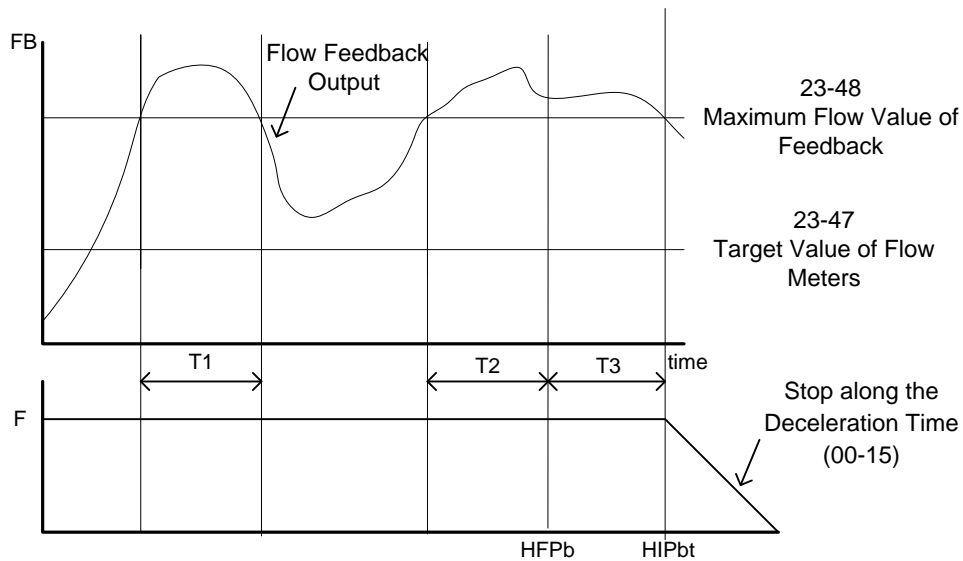
Note: Disable high flow limit by setting 23-48 to 0.

| | |
|---------------|--|
| 23- 49 | Maximum Flow Warning Time of Feedback |
| Range | 【0~255】 Sec |

When the flow feedback value rises above the maximum flow value for time specified in 23-49 the inverter will display a warning HFPb. When flow falls below the maximum flow value the flow warning timer is reset.

| | |
|---------------|---|
| 23- 50 | Maximum Flow Stop Time of Feedback |
| Range | 【0~255】 Sec |

When the flow feedback value rises above the maximum flow value for time specified in 23-49 the inverter will display fault HIBFt and stop. When flow falls below the maximum flow value the flow stop timer is reset.



T1 < (23-49): Recounting after T1.
 T2 = (23-49): Keypad flashes and displays HFPb
 T3 = (23-50): Keypad flashes and displays HIPbt

Figure 4.3.113 Diagram for high flow limited warning of stop

| | |
|--------------|---------------------------------------|
| 23-51 | Minimum Flow Value of Feedback |
| Range | 【0.01~99.00】 % |

Set the minimum flow limit value. When the flow feedback value falls below the minimum flow value the inverter will display a warning when the warning timer (23-52) expires and stop when the stop timer expires (23-53).

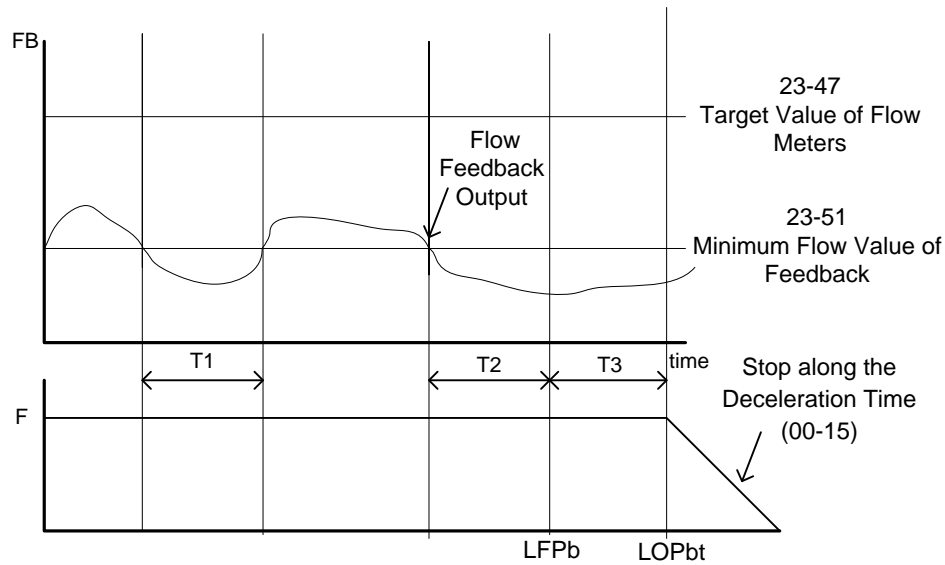
Note: Disable low flow limit by setting 23518 to 0.

| | |
|---------------|--|
| 23- 52 | Minimum Flow Warning Time of Feedback |
| Range | 【0~255】 Sec |

When the flow feedback value falls below the minimum flow value for time specified in 23-52 the inverter will display a warning LFPb. When flow falls below the minimum flow value the flow warning timer is reset.

| | |
|---------------|---|
| 23- 53 | Minimum Flow Stop Time of Feedback |
| Range | 【0~255】 Sec |

When the flow feedback value falls below the minimum flow value for time specified in 23-53 the inverter will display fault LObFt and stop. When flow falls below the minimum flow value the flow stop timer is reset.



| | |
|---------------|-----------------------------------|
| T1 < (23-52): | Recounting after T1. |
| T2 = (23-52): | Keypad flashes and displays LFPb |
| T3 = (23-53): | Keypad flashes and displays LOPbt |

Figure 4.3.114 Diagram for low flow limited warning of stop

| | |
|--------------|--|
| 23-54 | Detection Function of Low Suction |
| Range | 【0】 : Disable 【1】 : PID Error Value 【2】 : Current 【3】 : Current and PID Error Value |
| 23-55 | Detection Time of Low Suction |
| Range | 【0~30.0】 Sec |
| 23-56 | PID Error Level of Low Suction |
| Range | 【0 ~ 30】 % |
| 23-57 | Current Level of Low Suction (Motor Rated Current) |
| Range | 【0 ~ 100】 % |
| 23-58 | Reaction of Low Suction |
| Range | 【0】 : Disable 【1】 : Warning 【2】 : Fault 【3】 : Fault & Restart |

For storage tank applications having insufficient water results in a low suction condition. The inverter can be setup to detect a low suction condition and how to react with parameter 23-58. The process signal to use for detecting a Low suction condition is set by parameter 23-54. Refer to Fig.4.3.115 for low suction detection diagram.

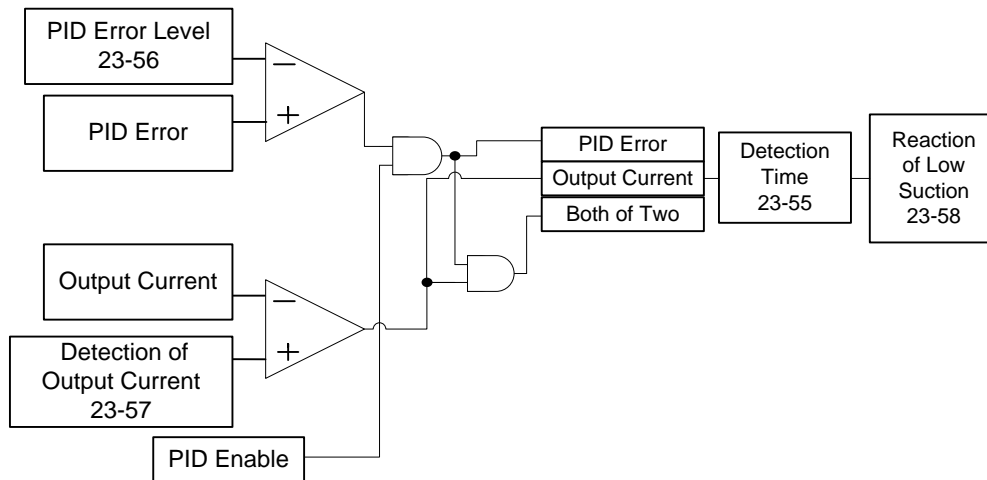


Figure 4.3.115 Diagram for the process of low suction

When 23-54=0, low suction detection is disabled.

Refer to Table 4.3.19 for the detection logic based on parameter 23-54. Select between PID error and/or inverter output current as the detection signal.

Table 4.3.19 the detection logic of low suction

| 23-54 | Detection Signal | |
|-------|------------------|----------------|
| | PID Error | Output Current |
| 1 | 1 | 0 |
| 2 | 0 | 1 |
| 3 | 1 | 1 |

Set the detection level parameter 23-56 when using PID error level and detection level parameter 23-57 when using the inverter output current signal or both.

A low suction condition is detected when the selected low suction process signal (23-54) rises above the low suction detection level (PID Error / Output Current) for the time specified by the low suction detection time (23-55).

The inverter response in case of a low suction condition is based on setting of parameter 23-58. Refer to Table 4.3.20.

Table 4.3.20 Detection signal of water used

| 23-58 | Inverter Status | Keypad Signal | Error Signal |
|-------|--------------------|---------------|---|
| 0 | Continuous Running | None | None |
| 1 | Continuous Running | LSCFT(Flash) | Warning of Low Suction |
| 2 | Stop | LSCFT | Jump to Error for Low Suction |
| 3 | Stop and Restart | LSCFT | Jump to Error for Low Suction and Restart |

| | |
|---------------|---|
| 23- 59 | Source of HVAC Pressure Command |
| Range | 【0】 : Set by 23-47 【1】 : Set by AI |

23-59=0: Target (setpoint) value set by parameter 23-47.

23-59=1: Target (setpoint) value set by AI1 input voltage value. Refer to parameter 10-00 for the setting of AI terminal.

| | |
|---------------|---|
| 23- 66 | Derating of Current Level (for Compressor Current) |
| Range | 【10 ~ 200】 % |
| 23- 67 | Derating of Delay Time |
| Range | 【1.0 ~ 20.0】 Sec |
| 23- 68 | Derating of Frequency Gain |
| Range | 【1~100】 % |
| 23- 69 | OL4 Current Level |
| Range | 【10~200】 % |
| 23-70 | OL4 Delay Time |
| Range | 【0.0 ~ 20.0】 Sec |

The inverter has a built-in two- stage protection function for use in compressor applications to prevent damage when operating at rated current for several minutes.

First stage protection:

When the inverter is at constant speed and the current is higher than the derating current level (23-66) (set as a percentage of the compressor rated current), the derating delay timer starts. When the timer expires the frequency command is multiplied by the frequency gain (23-68) reducing the output frequency and so lowering the current of the compressor.

When the current falls below the derating current level (23-66), the output frequency is restored to its previous level. When the cycle of derating and restore exceeds 3 times the output frequency will remain at the last derating frequency until the current falls below the derating current level (23-66).

Example: Set 23-66 set to 80%, 23-67 set to 10sec, 23-68 set to 90% and frequency command set to 60.0 Hz. The rated current of compressor is 30A. When the output current reaches 27A, which is higher than 24A (30A x 80%) for 10 sec (derating of delay time), the output frequency decreases to 54 Hz (frequency command 60Hz x 90%). If the output current decreases to 25A, which is still above 24A and another 10 sec pass, the output frequency becomes 60Hz x 81%=48.6Hz. Once the output current drops to 23A the output frequency is restored to 60Hz. If the output current rises again to 27A and this cycle repeats itself for a maximum of three times, after this the output frequency will remain at 48.6Hz until the output current drops to 23A.

Second stage protection:

After the current reaches the OL4 current level (23-69) for the time specified in the OL4 delay time (23-70) the inverter will decelerate to a stop and display OL4 Compressor Overload.

If a fault occurs, the run command has to be removed in order to reset the inverter when the inverter command source (00-02) is not set to 0 (Keypad).

Note: It is recommended to set the rated current of compressor lower than that of the inverter.

Group 24 Pump Control Function Parameters

| 24- 00 | Selection of Pump Control Function |
|--------|--|
| Range | <p>【0】 : Function of 1 to 8 Pump Card and 1 to 3 Relay are Disabled.</p> <p>【1】 : Fixed Modes of Inverter Pump: First on and Last off; then Stop All.</p> <p>【2】 : Fixed Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【3】 : Fixed Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【4】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【5】 : Cycle Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【6】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First off; then Stop All.</p> <p>【7】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【8】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【9】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: Only Stop Inverter Pump. And First Boot Relay in Cycling.</p> |

An inverter with built-in PID controller alongside a simple programmable logic controller (PLC) is widely used to control a pump system. With the available 1 to 8 pump option card is no longer required to use a separate PLC and the pump system can be controlled directly by the inverter.

The inverter controls the power to each of the pumps and uses the build-in PID controller to regulate pressure.

There are two basic operation modes for use with the 1 to 8 pump card:

1. Fixed Mode:

Up to 8 non-alternating pumps controlled by the inverter

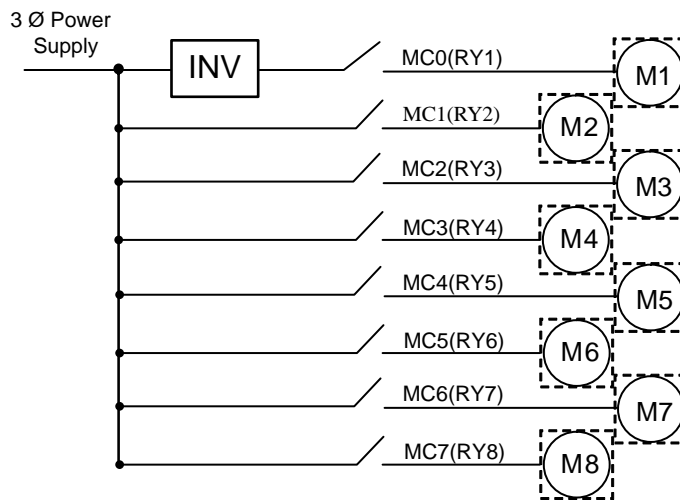


Figure 4.3.116 Fixed modes of inverter pump

2. Alternation Mode:

Up to 4 alternating pumps controlled by the inverter

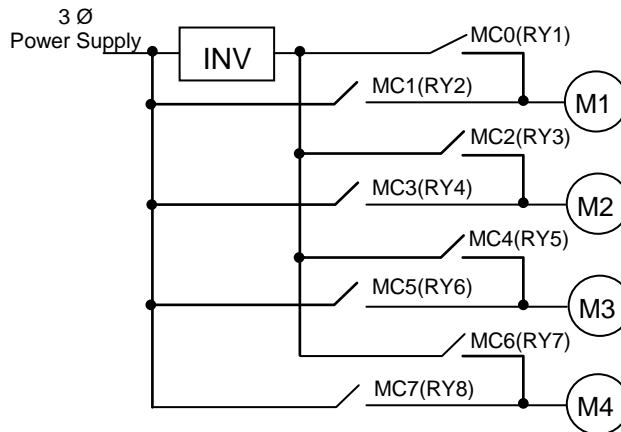


Figure 4.3.117 Cycle modes of inverter pump

In addition to the two basic operation modes provided by the 1 to 8 pump card, the relay outputs on the control board can also be used to control up to 3 alternating pumps.

* Cycle modes of inverter pump in the control board:

Run via a Relay with a pump to start the cycle modes of inverter pump.

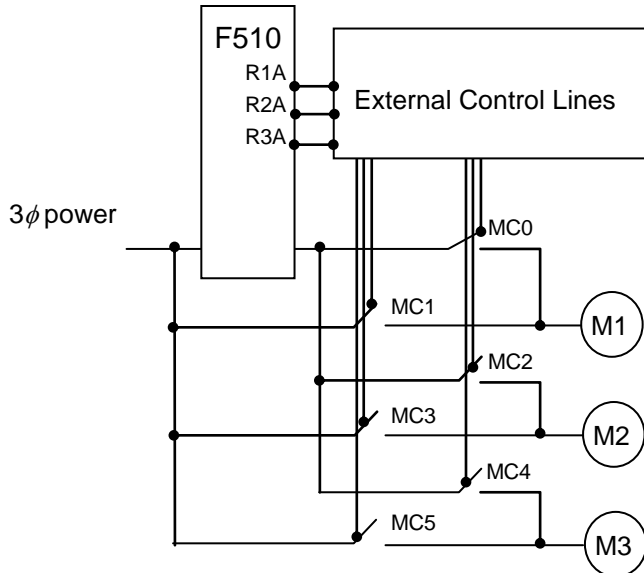


Figure 4.3.118 Cycle modes of inverter pump in the control board

24-00=0: Pump Control is disabled

24-00=1: Fixed mode (non-alternation), first on and last off; then stop all.

Pump (motor) controlled by the inverter does not alternate. Pumps (motor) are controlled in sequence First on and last off. This mode can be used when the pump system uses different size pump (motor) ratings.

24-00=2: Fixed mode (non-alternation), only inverter controlled pump stops.

Pump control without alternation. When the inverter sends a stop command only the pump motor controlled by the inverter stops all other control relays stay on.

24-00=3: Fixed mode (non-alternation), first on and first off; then stop all.

Switching off a pump (motor) is based on pump motor runtime so each pump has equal pump wear. This mode is can be used in systems with similar size pump motors.

24-00=4: Alternation Mode, first on and first off; then stop all.

All the pump motors except for the main pump are controlled by the inverter. Pump control is based on first on and first off.

24-00=5: Alternation Mode, only inverter pump stops.

Pump control with alternation. When the inverter sends a stop command only the pump motor controlled by the inverter stops all other control relays stay on.

24-00=6: Alternating Inverter Pump: 1 to 3 Relay: First on and first off; then Stop All.

This mode uses the output relays on the control board and can be used to control up to 3 pumps with alternation. Set 24-07=1 to enable the relays on the control board.

24-00=7: Alternating Inverter Pump: 1 to 3 Relay: First on and First Off; then stop all and alternate on startup.

Pump motor selected to be controlled by the inverter depends on the Relay switching time (24-08).

24-00=8: Alternating Inverter Pump: First on and First Off; then stop all and alternate on startup.

Pump motor selected to be controlled by the inverter depends on the Relay switching time (24-08). Users can switch the alternation order for each pump with the setting of parameter 24-07.

24-00=9: Alternating Inverter Pump 1 to 3 Relay: Only Stop Inverter Pump. And First Boot Relay in Cycling.

Similar to fixed modes, first on and first off, only stops the inverter driven pump. At start the inverter drives the motor depending on the Relay switching time (24-08). (Relay switching is enabled only in one motor.)

Notes:

- When the 1 to 8 pump card is not installed, parameter 24-00 is set to 0.
- When parameter 24-00 (pump control selection) is enabled, DI functions selection 16 (PID function disable) and 57 (forced frequency run) are disabled.
- Set 24-07=1 to enable the relays on the control board to control pump system up to three pumps.
- Setting of parameter 24-00 determines if 1 to 8 pump card is enabled or disabled.
- PID Setting:

PID function is enabled when PID control mode (10-03) is set to xxx1b (PID enable). Set PID target (setpoint) value source (10-00) to 4 (10-02 given) and the target (setpoint) value is set 10-02. If the feedback value source (10-01) is set to 2 (AI2 given) and AI input signal type (04-00) is set to 0 (AI2: 0~10V), requires SW2 to be set to the V position on the control board.

| | |
|---------------|--|
| 24- 01 | Selection of Relay 2-4 Function |
| Range | 【xxx0b】 : Reserved 【xxx1b】 : Reserved 【xx0xb】 : Relay 2 Disable 【xx1xb】 : Relay 2 Enable 【x0xxb】 : Relay 3 Disable 【x1xxb】 : Relay 3 Enable 【0xxxb】 : Relay 4 Disable 【1xxxb】 : Relay 4 Enable |
| 24- 02 | Selection of Relay 5-8 Function |
| Range | 【xxx0b】 : Relay 5 Disable 【xxx1b】 : Relay 5 Enable 【xx0xb】 : Relay 6 Disable 【xx1xb】 : Relay 6 Enable 【x0xxb】 : Relay 7 Disable 【x1xxb】 : Relay 7 Enable 【0xxxb】 : Relay 8 Disable 【1xxxb】 : Relay 8 Enable |

Fixed modes of inverter pump:

In the fixed pump control mode (non-alternating), RY1 is permanently used and RY2~RY8 can be used if required.

PID control is temporarily disabled when Inverter decelerates / accelerates to lower / upper limit frequency when demand increases / decreases. When the inverter reaches the lower / upper limit frequency, PID control is restored and the inverter output is determined by the feedback.

Alternation modes (1-8 Pump Card):

When alternation mode is active, RY2 and RY1 are always used. RY3~RY8 is split into groups of two, RY3/RY4, RY5/RY6, and RY7/RY8. If any one of the relays in the group is set to disabled the group is disabled.

The inverter output is automatically disconnected from the pump that switches to the new pump that is brought online. Switching time of the magnetic contactor (24-05) needs to be set to a value greater than the contactor switching delay time.

Switch off the motor of the first on when user decreases pumps to make the pump (motor) be the equal using frequency.

Alternation modes (Control board Relays):

When alternation mode is active, RY1 is permanently used and RY2~RY3 can be used if required. 24-01 can only be set to 0xxx (Relay 4 cannot be set.) and 24-02 can only be set to 0000 (Relay 5-8 cannot be set.).

| | |
|---------------|--|
| 24- 03 | Duration of Upper Limit Frequency |
| Range | 【1.0 ~ 600.0】 Sec |

Parameter specifies the time required for the inverter controlled pump motor operating at the upper limit frequency (00-12) before turning on the next pump inline.

If the value for 24-03 is set to low value the pump system might switch pumps on and off to quickly causing system oscillation.

| | |
|---------------|--|
| 24- 04 | Duration of Lower Limit Frequency |
| Range | 【1.0 ~ 600.0】 Sec |

Parameter specifies the time required for the inverter controlled pump motor operating at the lower limit frequency (00-13) before shutting down the pump and switching to the previous pump in line.

If the value for 24-03 is set to low value the pump system might switch pumps on and off to quickly causing system oscillation.

| | |
|---------------|---|
| 24- 05 | Switching Time of Magnetic Contactor |
| Range | 【0.1 ~ 20.0】 Sec |

When a motor controlled by the inverter is switched across the line (commercial AC power supply) or switched from across the line to inverter control, parameter 24-05 is used to set the external magnetic contactor switching delay to avoid a short circuit between the inverter output and AC power supply.

The setting value of 24-05 requires to be set greater than the time it takes to switch from the inverter Relay controlling the external magnetic contactor. In general the transition from off to on for a magnetic contactor takes longer than the on to off time. Set parameter 24-05 greater than the longest time.

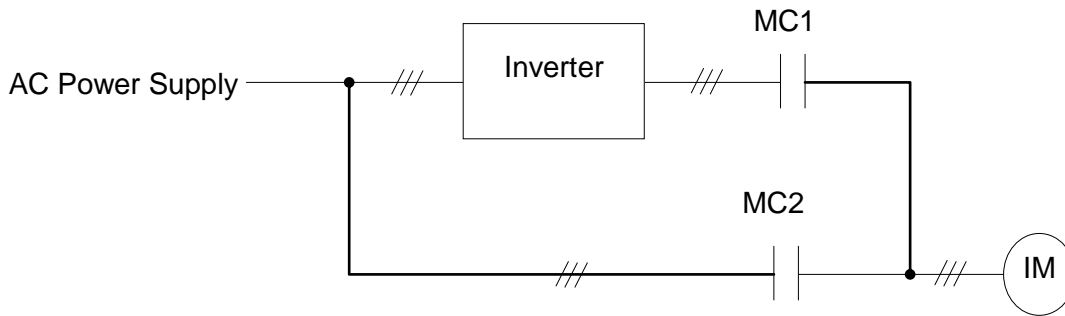


Figure 4.3.119 Diagram for the single cycle modes of inverter pump

| | |
|---------------|--------------------------------------|
| 24- 06 | Allowable Bias of Pump Switch |
| Range | 【0.0~20.0】 % |

This parameter specifies the frequency bandwidth used when adding and removing a pump from the pump system.

To turn on the next pump in line the output frequency has to reach the upper limit frequency (00-12) minus the bandwidth set by 24-06 for the time specified in 24-03.

To turn off the active pump and switch to the previous pump in line the output frequency has to fall below the lower limit frequency (00-13) plus the bandwidth set by 24-06 for the time specified in 24-04.

Example, 00-12 = 80% and 00-13 = 20%, then:

- If 24-06 = 0% switching frequency to add a pump is 80% of the maximum frequency and to remove a ump the switching frequency is 20% of the maximum frequency.
- If 24-06 = 5%, switching frequency to add a pump is 75% of the maximum frequency and to remove a ump the switching frequency is 25% of the maximum frequency.

| | |
|---------------|--|
| 24- 07 | Pump Control Source Selection |
| Range | 【0】 : 1 to 8 Pump Card 【1】 : Built-in 1 to 3 Control Mode |

24-07 = 0: 1 to 8 Pump Card

1 to 8 pump card is used for pump control function.

24-07 = 1: Built-in 1 to 3 Control Mode

Relay R1A~R3A on the control board are used for pump control function.

Note: 1 to 8 pump card cannot be used when 24-07 is set to 1.

Set the following parameters to enable pump control mode using the 3 relays on the control card”

1. 24-00 set to 1~3 or 6~9.
2. 24-01 set to 0xxx (Relay 4 disabled).
3. 24-02 set to 0000 (Relay 5~8 disabled).

Note: Not setting parameter 24-00, 24-01, 24-02, and 24-07 to the required settings results in pump system control errors.

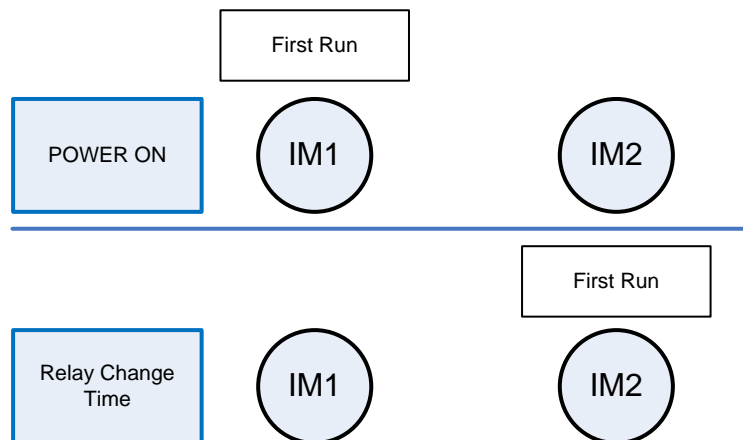
Refer to the following table for controlling the maximum number of pump based on 24-00 and 24-07 settings.

| Setting value of 24-00 | Inverter pump Modes | One pump with Relay | 24-07=0 (Relay in 1 to 8 pump Option card) | 24-07=1 (Relay in the control board) |
|------------------------|---------------------|---------------------|---|---|
| 1,2,3 | Fixed Modes | 1 | 8 PUMP | 3 PUMP |
| 4,5,8 | Cycle Modes | 2 | 4 PUMP | None |
| 6,7,9 | Cycle Modes | 1 | None | 3 PUMP |

- If 24-07=1, R1A (Relay 1) is used for pump control and parameter 03-11 is disabled.
- If 24-07=1 and 24-01= xx1x, R2A (Relay 2) is used for pump control and parameter 03-12 is disabled.
- If 24-07 = 1 and 24-01 = x1xx, R3A (Relay 3) is used for pump control and parameter 03-39 is disabled.

| | |
|---------------|-----------------------------|
| 24- 08 | Relay Switching Time |
| Range | 【0 ~ 240】 hour |

Active when 24-00 = 7 or 8. Upon start the first motor starts running. When the relay switching time expires and all motors are in sleep condition, motor 2 will start when the system wakes up. Please refer to the following figure.



Note: Timer will reset when pump control mode is active and settings of 24-08 is changed or power is cycled to the inverter.

| | |
|---------------|--|
| 24- 09 | Frequency/ Target Switch |
| Range | 【0】 Disable 【1】 Enable |
| 24- 10 | Stop Mode Selection on Mode 6/7/9 |
| Range | 【0】 Disable 【1】 Enable |

When 24-09=0, Uses lower limit frequency and the delay time of lower limit frequency to de-stage a pump.

When 24-09=1, Uses PID feedback (12-39) > PID setting (12-38) to de-stage pump.

When 24-10=1, all relays open when stopped and first relay closes upon next start.

Note: 24-10 is enabled only when 24-00=6, 7 or 9.

| | |
|---------------|---------------------------------|
| 24- 11 | High Voltage Limit Level |
| Range | 【0~10000】 |
| 24- 14 | Low Voltage Limit Level |
| Range | 【0~10000】 |

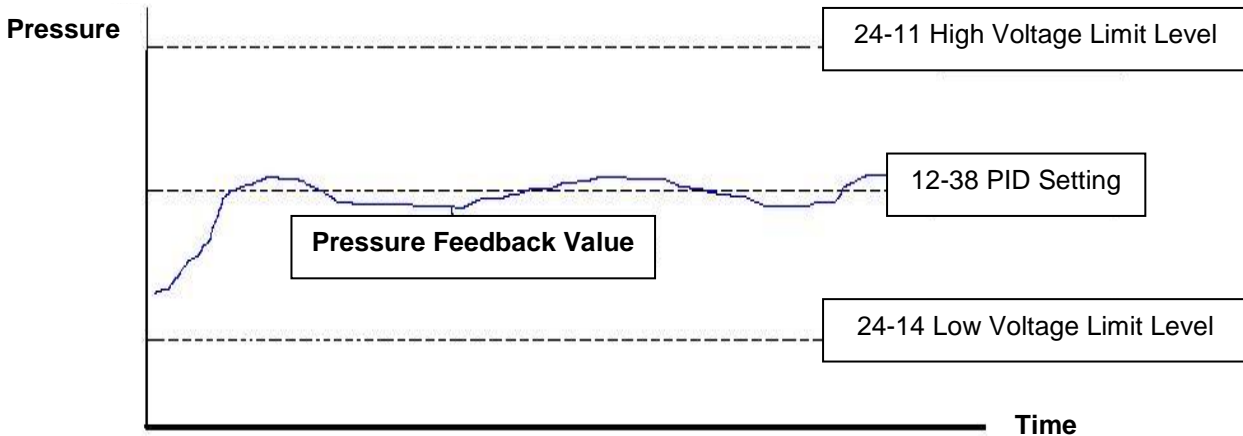
24-11 High Voltage Limit Level:

When pressure feedback value rises above the high voltage limit level for the time specified in 24-13 the inverter shows a fault and stops.

24-14 Low Voltage Limit Level:

When pressure feedback value falls below the low voltage limit level for the time specified in 24-16 the inverter shows a fault and stops.

Parameters 24-11 & 24-14 are active when 10-00=4. Set upper limit value with parameter 10-33. Set decimal point position with parameter 10-34 and engineering unit with parameter 10-35.



Pressure feedback value limit diagram

Note: Pressure feedback value operates between the high voltage limit level (24-11) and the low voltage limit level.

| | |
|---------------|---|
| 24- 12 | Delay Time of High Voltage Warning |
| Range | 【0.0 ~600.0】 Sec |
| 24- 13 | Delay Time of High Voltage Error |
| Range | 【0.0 ~ 600.0】 Sec |

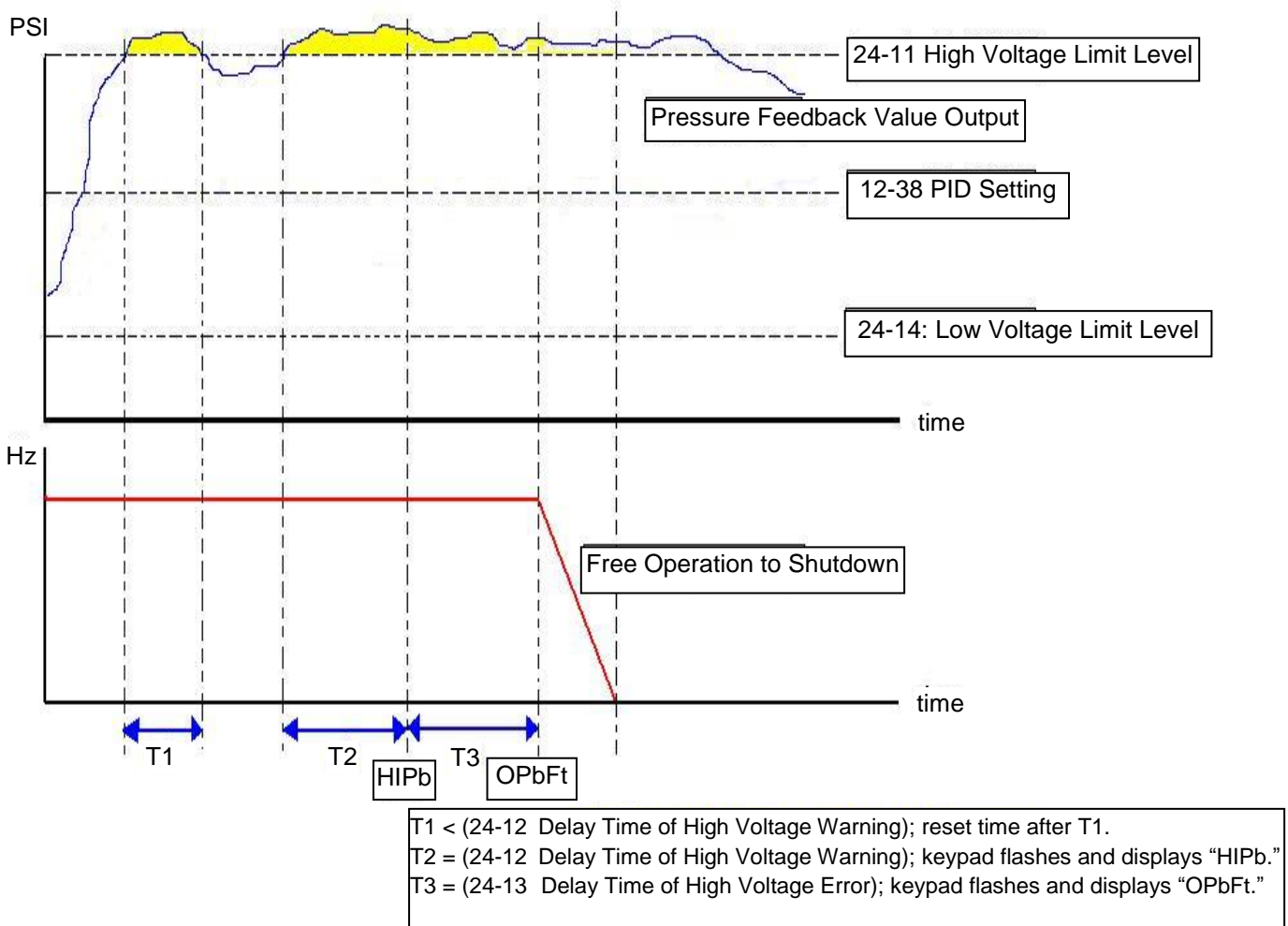
24-12 Delay Time of High Voltage Warning

When pressure feedback value rises above the high voltage limit level (24-11) for the time specified in 24-12 the inverter displays “HIPb” warning. Timer will reset when pressure falls below the limit level 24.11.

24-13 Delay Time of High Voltage Error

When pressure feedback value rises above the high voltage limit level (24-11) for the time specified in 24-12 the inverter displays “OPbFt” fault and stops. Timer will reset when pressure falls below the limit level 24.11.

Note: To disable the high voltage limit set 24-12 to 0.



High voltage limit warning and shutdown diagram

| | |
|---------------|--|
| 24- 15 | Delay Time of Low Voltage Warning |
| Range | 【0.0 ~ 600.0】 Sec |
| 24- 16 | Delay Time of Low Voltage Error |
| Range | 【0.0 ~ 600.0】 Sec |

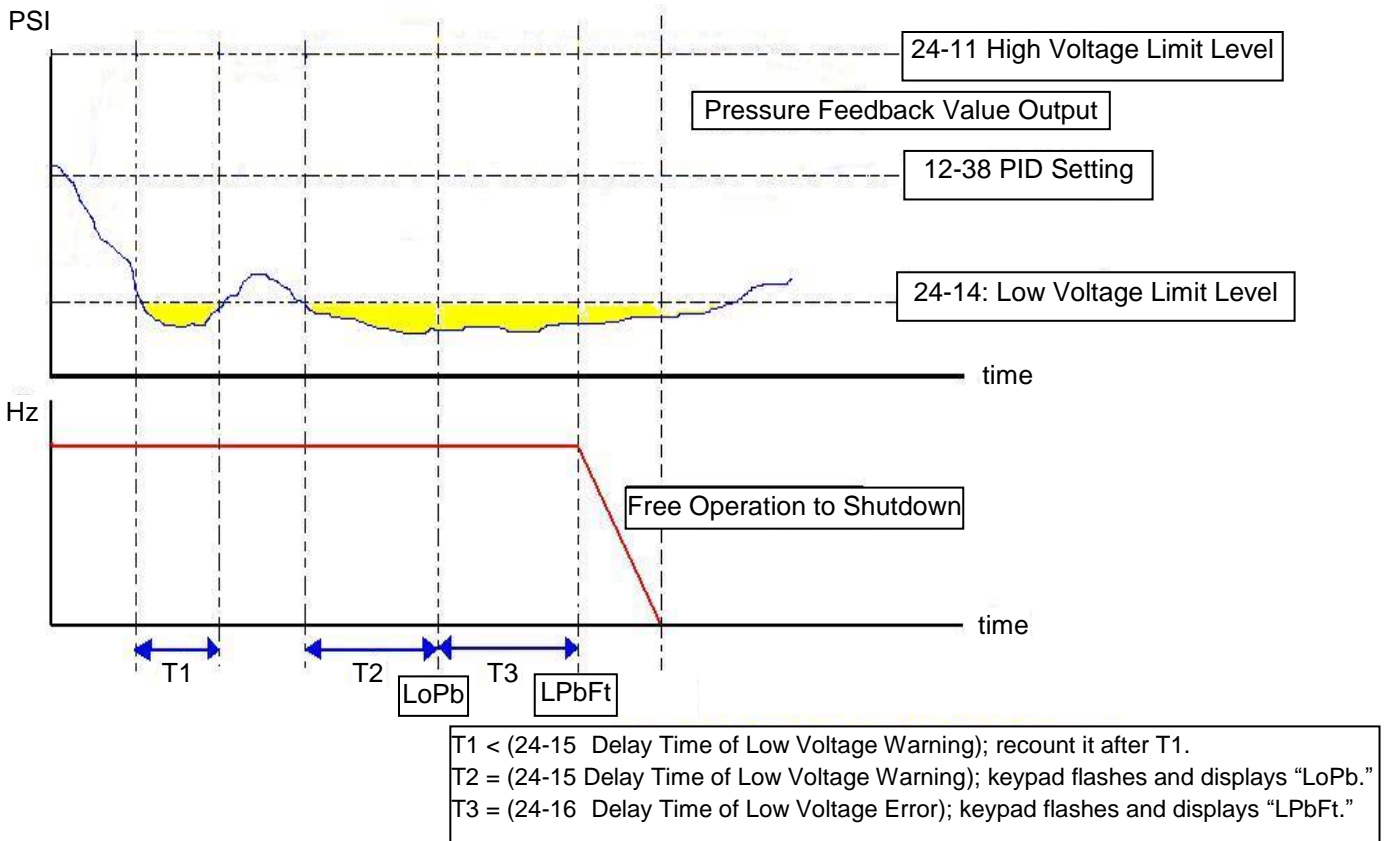
24-15 Delay Time of Low Voltage Warning

When pressure feedback value falls below the low voltage limit level (24-14) for the time specified in 24-15 the inverter displays “LoPb” warning. Timer will reset when pressure rises above the limit level 24.12.

24-16 Delay Time of Low Voltage Error

When pressure feedback value falls below the low voltage limit level (24-14) for the time specified in 24-16 the inverter displays “LPbFt” fault and stops. Timer will reset when pressure rises below the limit level 24.14.

Note: To disable the high voltage limit set 24-15 to 0



Low voltage limit warning and shutdown diagram

The following examples show staging and de-staging of pumps operating in fixed inverter mode. Relay 1~Relay 4 of 1 to 8 pump card are enabled. Motor 1 is connected to inverter and motor 2~4 are connected to the AC power supply via a magnetic contactor which is controlled by the relays. Refer to Fig. 4.3.126.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (F_{out}) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 2 is activated and pump 2 is turned on.

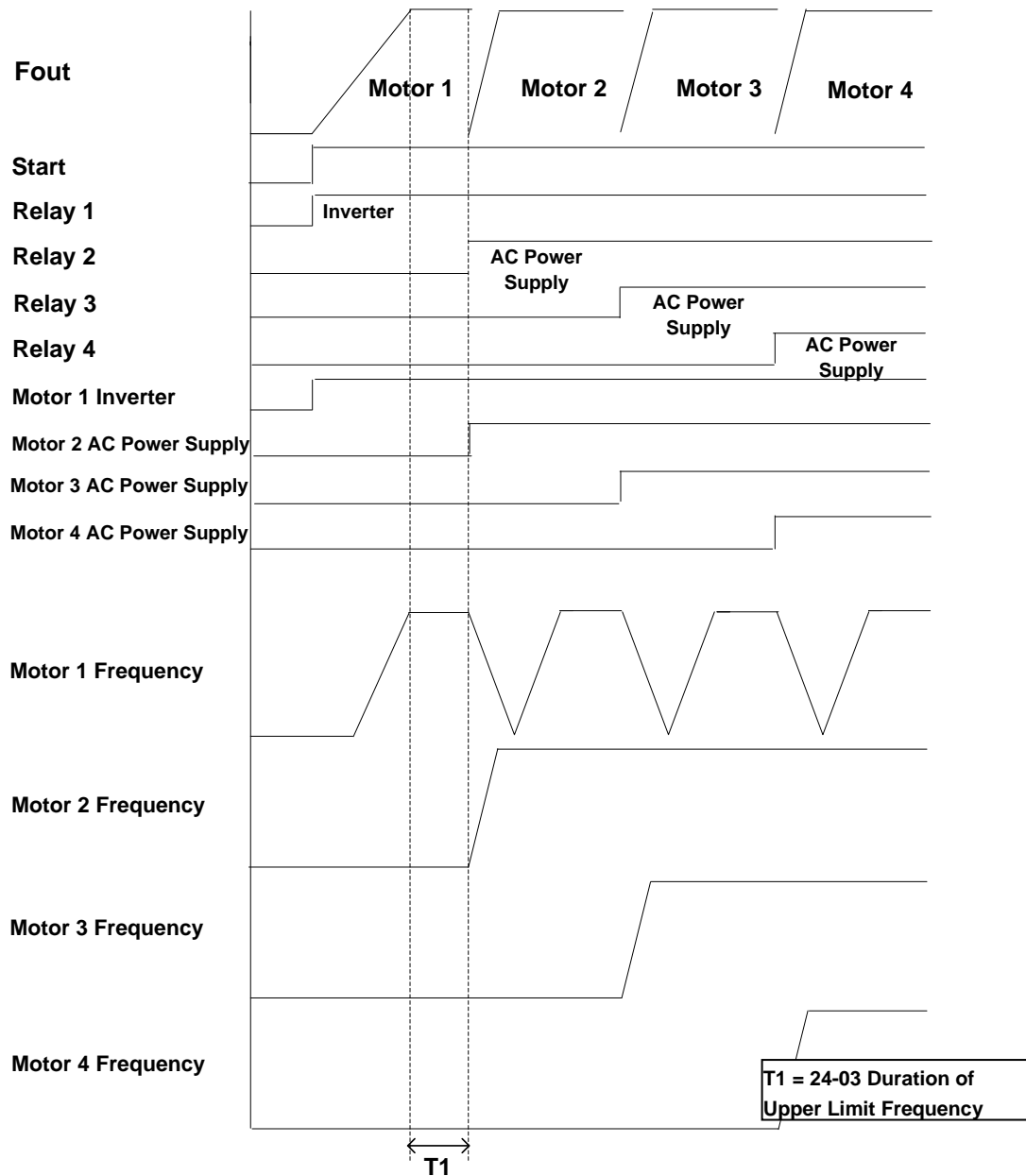


Figure 4.3.120 Staging pumps operating in fixed inverter mode

- When output frequency (F_{out}) falls below the lower limit frequency (00-13) for the time specified by the duration of the upper limit frequency (24-04), relay 4 is de-activated turning off pump 4 and the inverter accelerates to the upper limit frequency (00-12). When the output frequency (F_{out}) reaches the upper limit frequency (00-12) the inverter starts to decelerate.

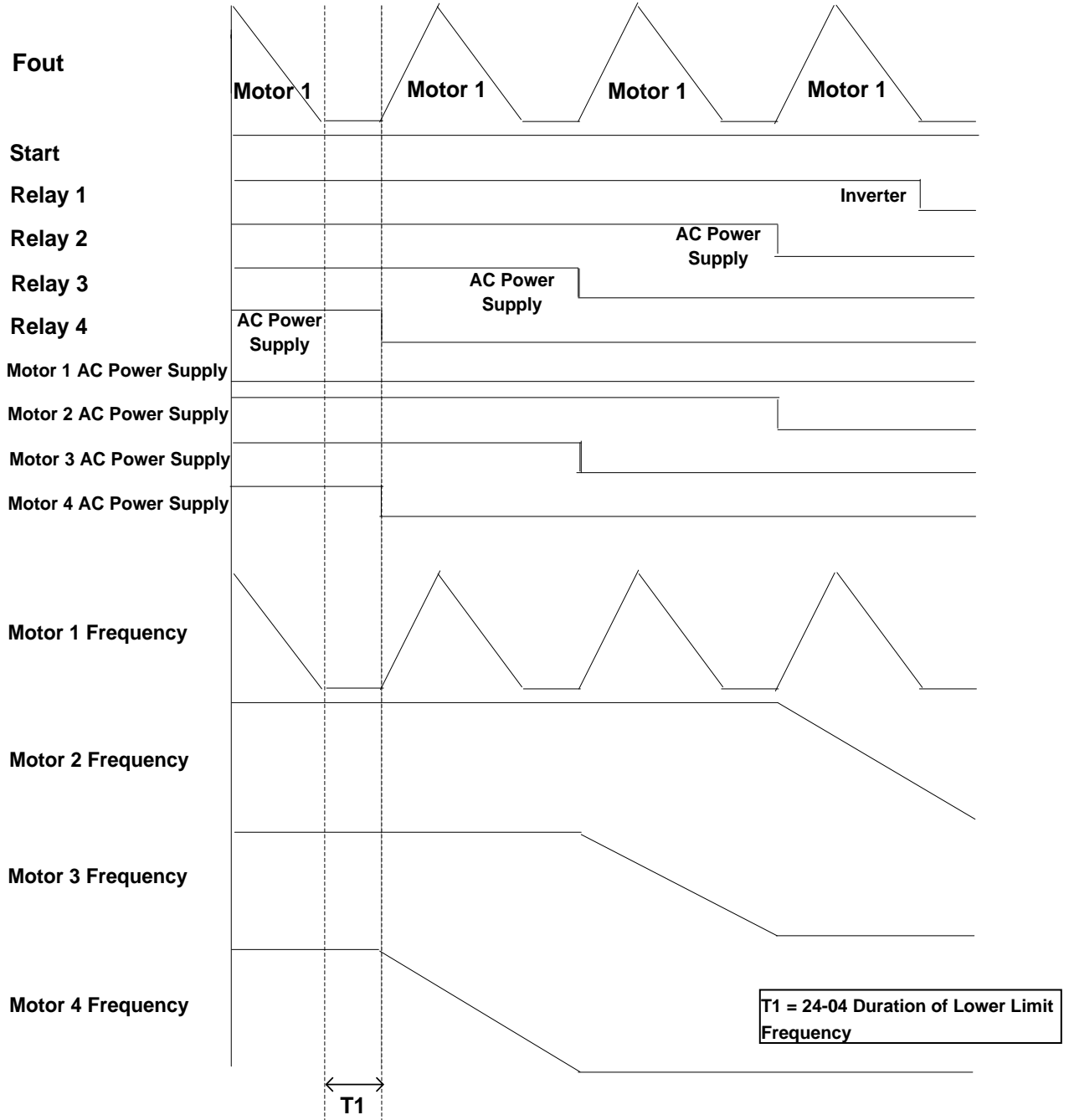


Figure 4.3.121 De-staging pumps in fixed inverter mode

The following examples show staging and de-staging of pumps operating in inverter alternation mode. Relay 1~Relay 4 of 1 to 8 pump card are enabled. Motor 1 is connected to inverter and motor 2~4 are connected to the AC power supply via a magnetic contactor which is controlled by the relays. Refer to Fig. 4.3.127.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (F_{out}) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 1 is de-activated and the inverter stops.
- Relay 1 and Relay 2 are turned on and the inverter starts to accelerate after the switching time for the magnetic contactor (24-05) expires.

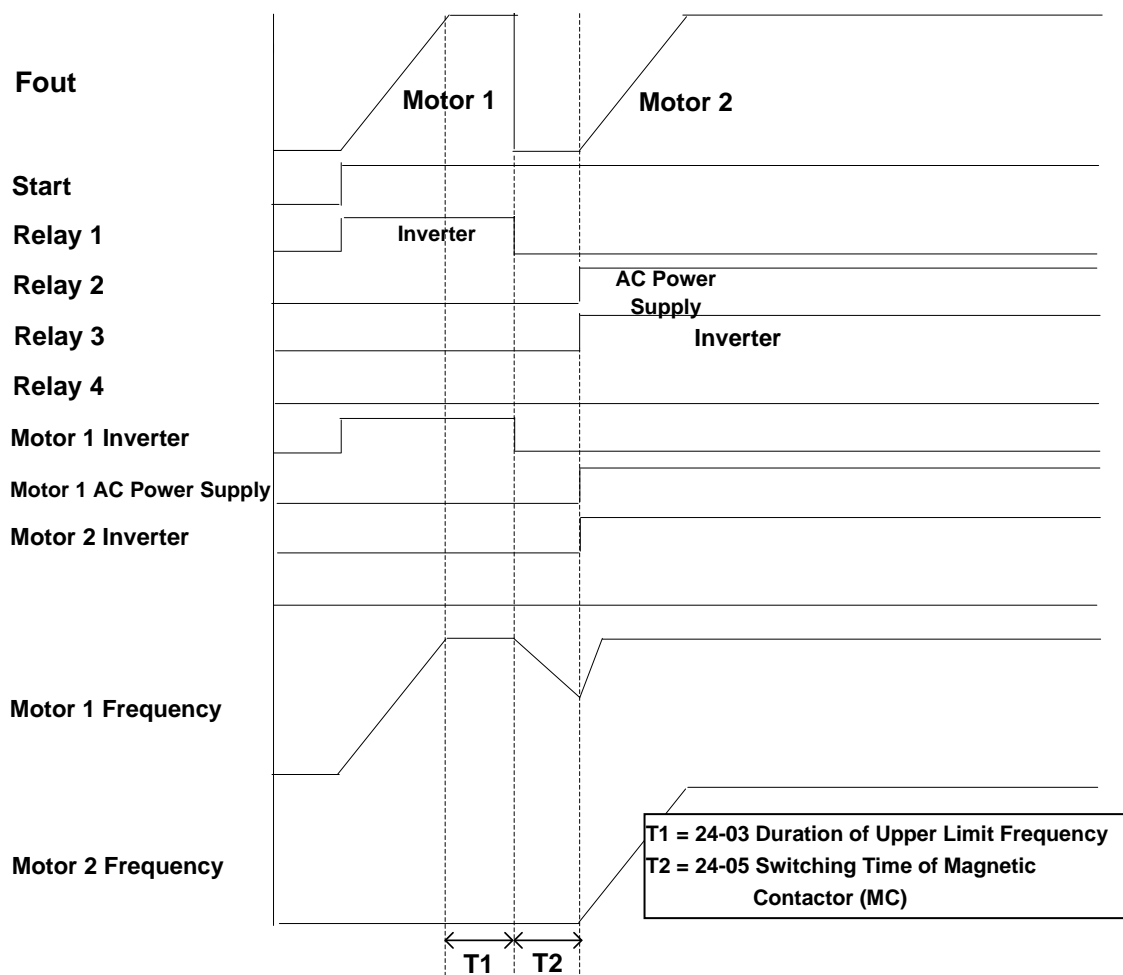


Figure 4.3.122 Staging pumps in inverter alternation mode

- When output frequency (F_{out}) falls below the lower limit frequency (00-13) for the time specified by the duration of the upper limit frequency (24-04), relay 1 and 2 are de-activated. Relay 1 is turned on and the inverter starts to decelerate after the switching time for the magnetic contactor (24-05) expires.

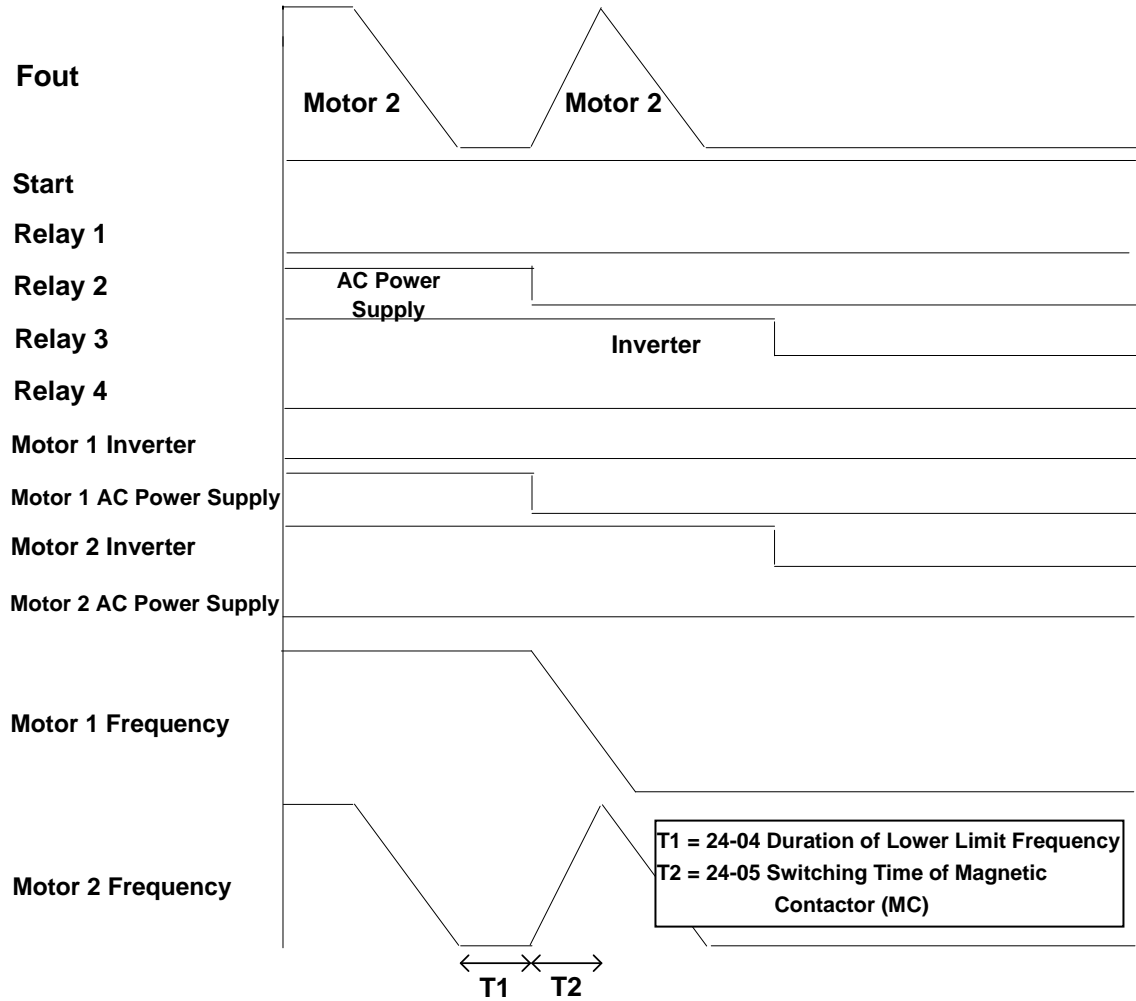


Figure 4.3.123 De-staging pumps in the inverter alternation mode

The following examples show staging and de-staging of pumps operating in fixed inverter mode. Relay 1~Relay 3 (R1A-R3A on the control board are enabled). Motor 1 is connected to the inverter and motor 2 and 3 are connected to the AC power supply via a magnetic contactor controlled by the relays. Refer to Fig. 4.3.128.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (F_{out}) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 1 is de-activated and the inverter is turned off.
- Relay 2 is activated after the switching time of magnetic contactor (24-05) expires.
- Relay 1 is activated and the inverter starts to accelerate after relay 2 and after the switching time of magnetic contactor (24-05) expires

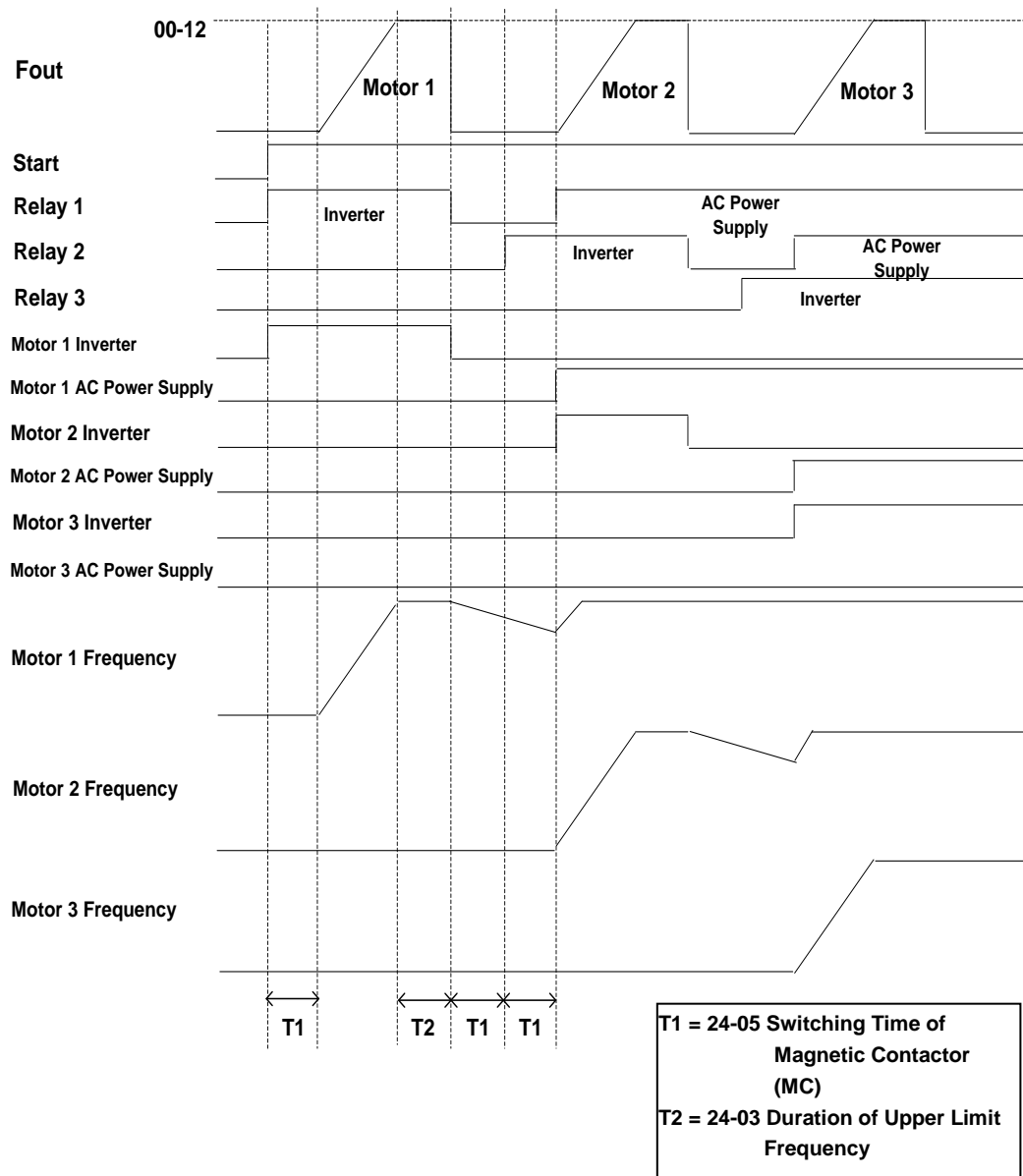


Figure 4.3.124 Staging of pumps in 1 to 3 Relay modes

- When pressure feedback value rises above the target (setpoint) value, inverter output frequency (F_{out}) decreases. Relay 1 is de-activated when the output frequency reaches to the lower limit frequency (00-13) and remains there for the duration of lower limit frequency (24-04).

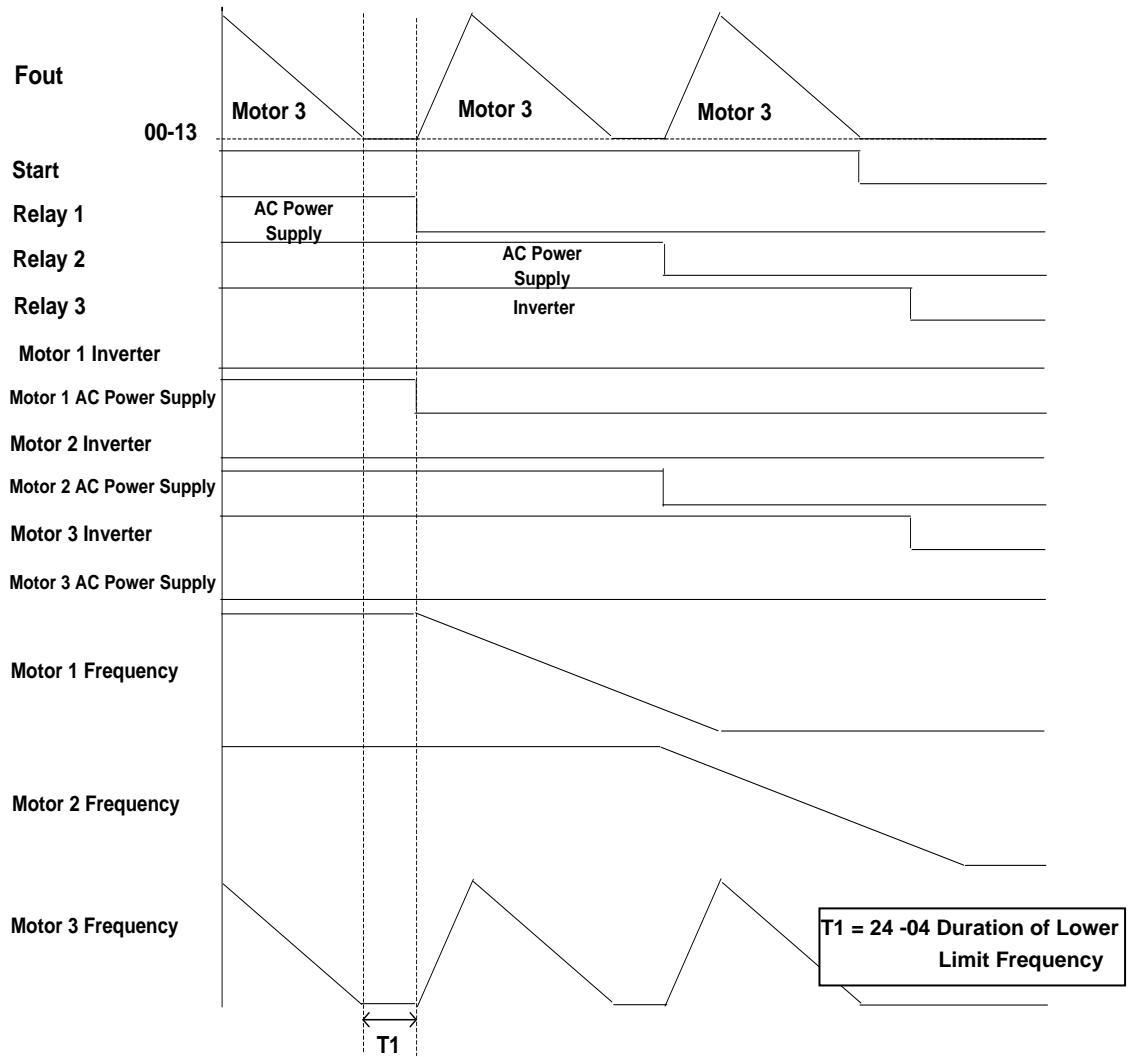


Figure 4.3.125 De-staging pumps in 1 to 3 Relay modes

■ Wiring using the 1 to 8 Pump Card and 1 to 3 Relay Modes

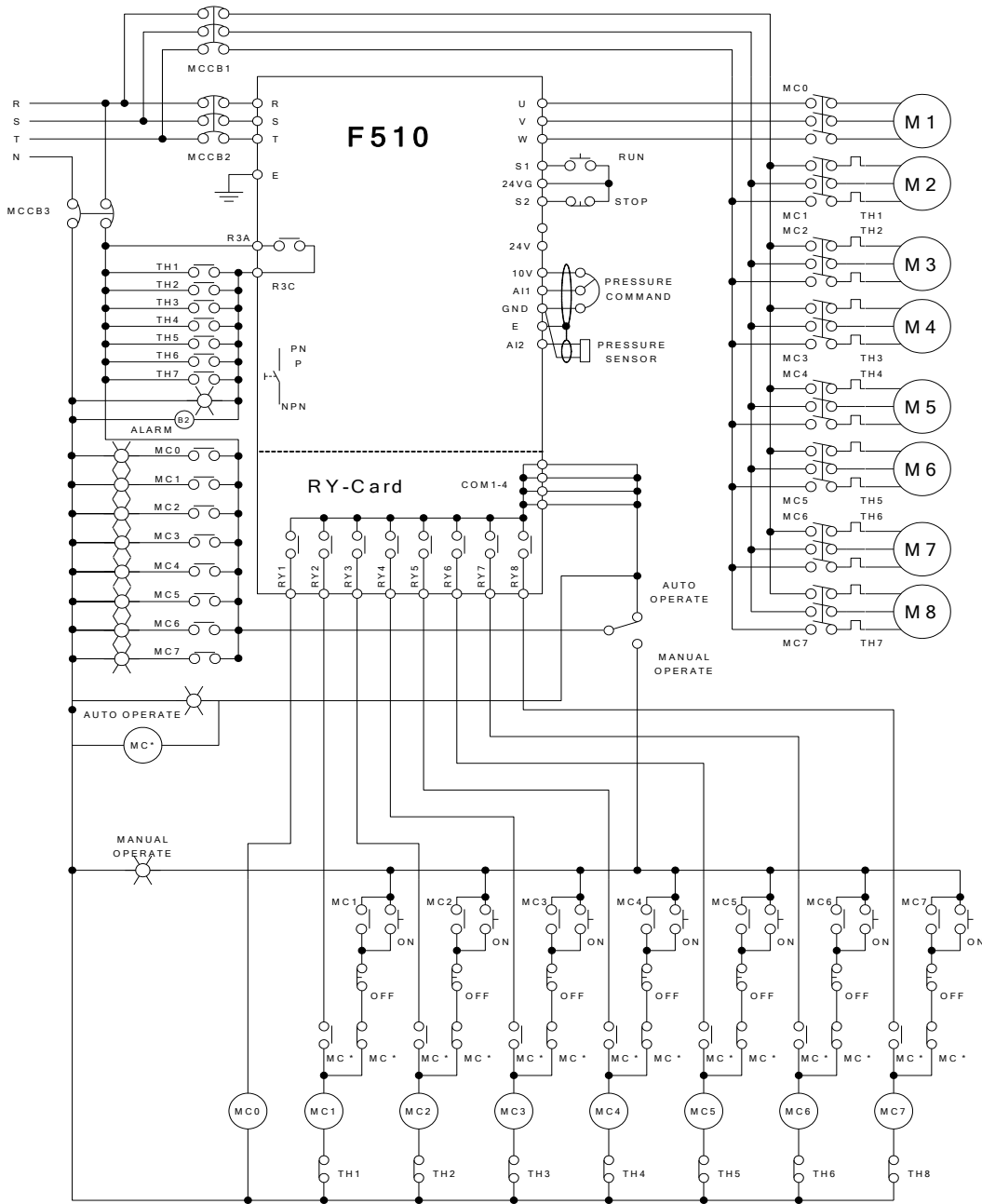


Figure 4.3.126 Inverter fixed mode wiring

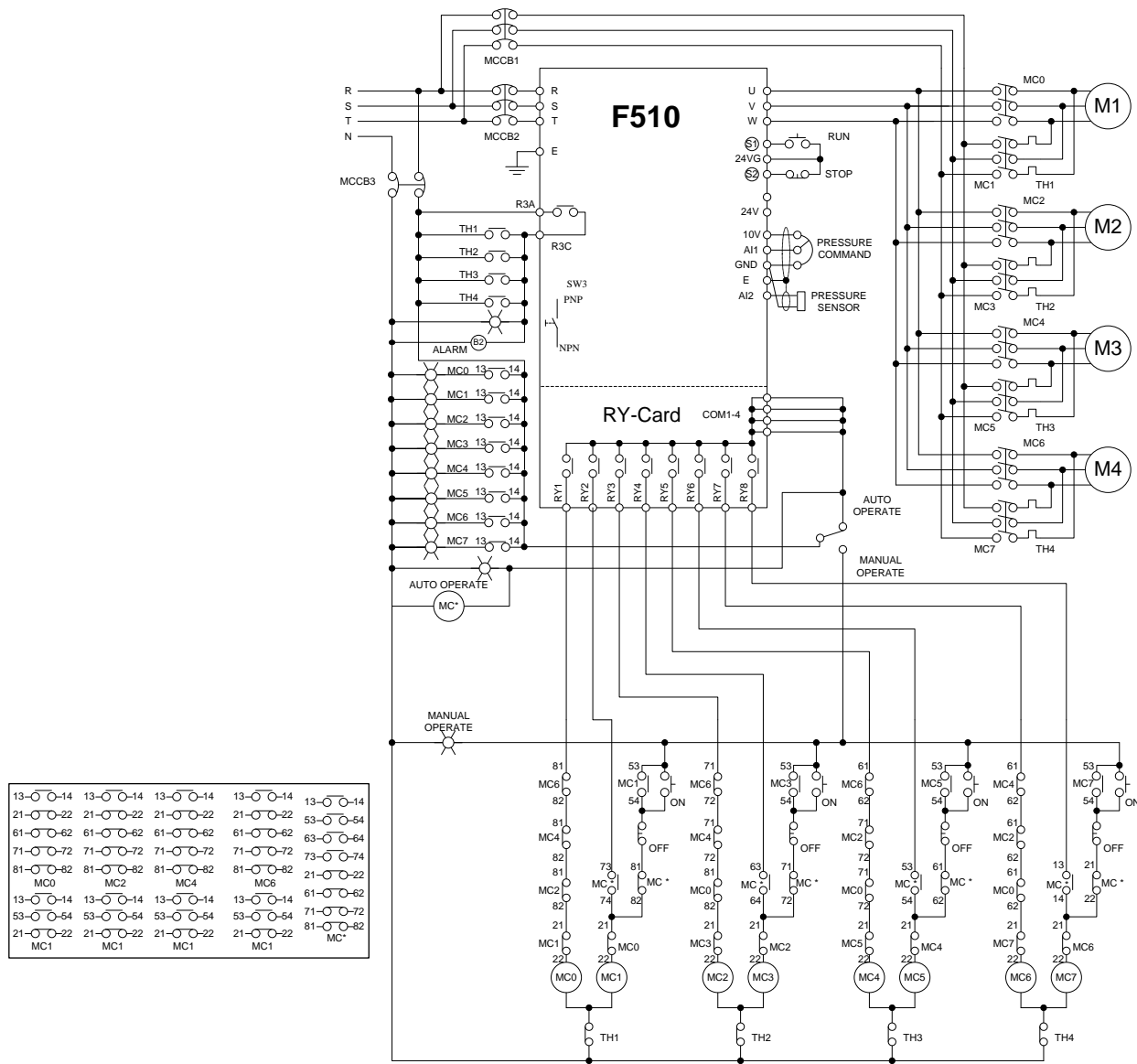


Figure 4.3.127 Inverter alternation mode wiring

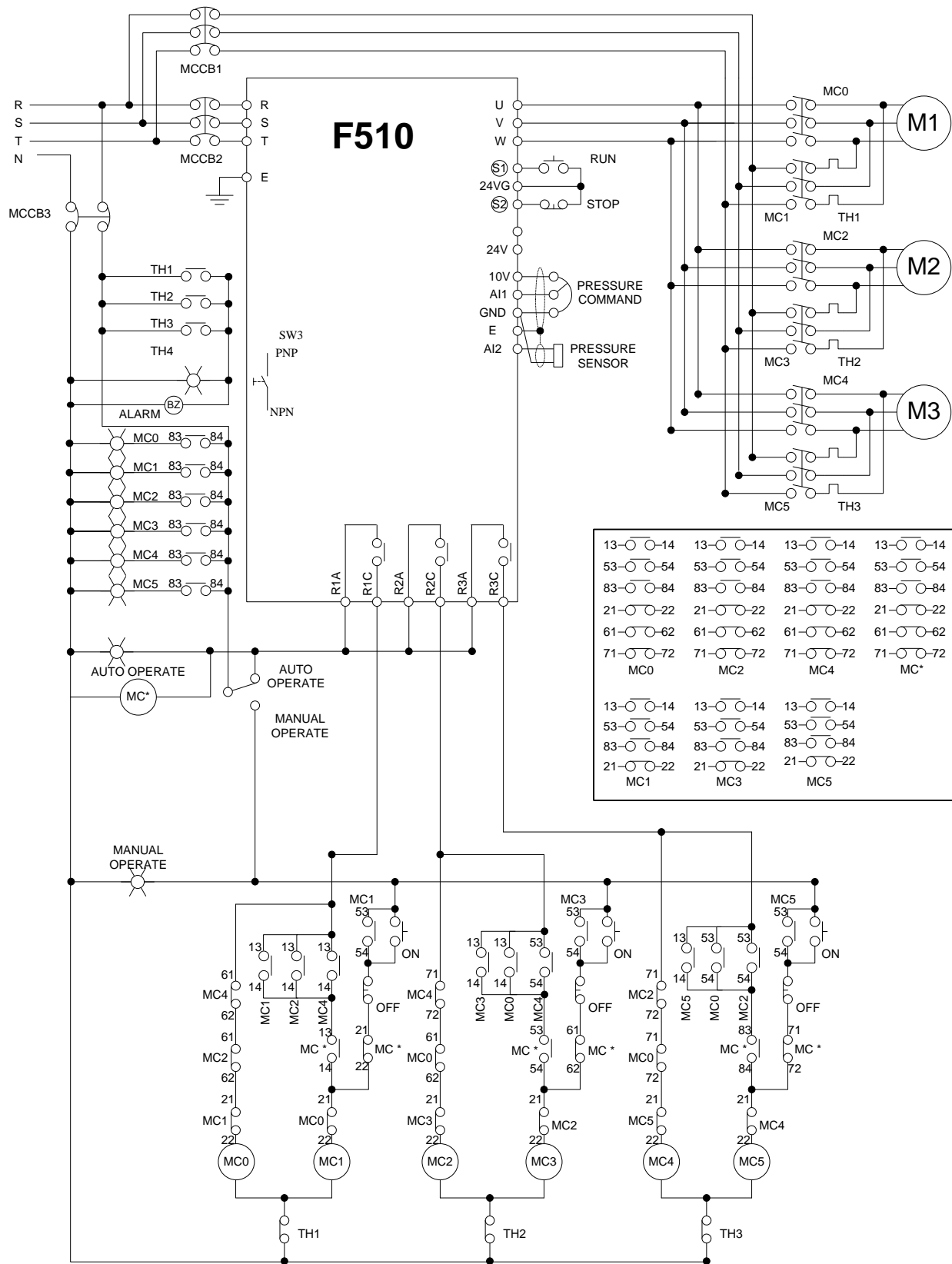


Figure 4.3.128 Inverter alternation mode wiring for 1 to 3 relay modes

5. Check motor rotation and direction

This test is to be performed solely from the inverter keypad. Apply power to the inverter after all the electrical connections have been made and protective covers have been re-attached. At this point, **DO NOT RUN THE MOTOR**, the keypad should display as shown below in Fig. 5.1 and the speed reference 12-16=005.00Hz should be blinking at the parameter code “12-16”.

Important: Motor rotation and direction only applies to standard AC motors with a base frequency of 60Hz. For 50Hz or other frequency AC motors please set the max frequency and base frequency in group 01 accordingly before running the motors.



Fig 5.1: Keypad (Stopped)



Fig 5.2: Keypad (Running)

Next press the **RUN** key, see Fig 5.2. The motor should now be operating at low speed running in forward (clockwise) direction. The parameter code 12-17 shown at the bottom left corner of the screen will change from 12-17=000.00Hz to 12-17=005.00Hz. Next press **STOP** key to stop the motor.

If the motor rotation is incorrect, power down the inverter.

After the power has been turned OFF, wait at least ten minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

Using Safety precaution, and referring to section 3.8 exchange any two of the three output leads to the motor (U/T1, V/T2 and W/T3). After the wiring change, repeat this step and recheck motor direction.

6. Speed Reference Command Configuration

The inverter offers users several choices to set the speed reference source. The most commonly used methods are described in the next sections.

Frequency reference command is selected with parameter 00-05.

00-05: Main Frequency Command (Frequency Source)

This function sets the frequency command source.

Setting Range: 0 to 7

To set parameter 00-05:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -05 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

In the parameter list move cursor to 00-05 with the **UP/DOWN** keys and press **READ/ ENTER** key to select.

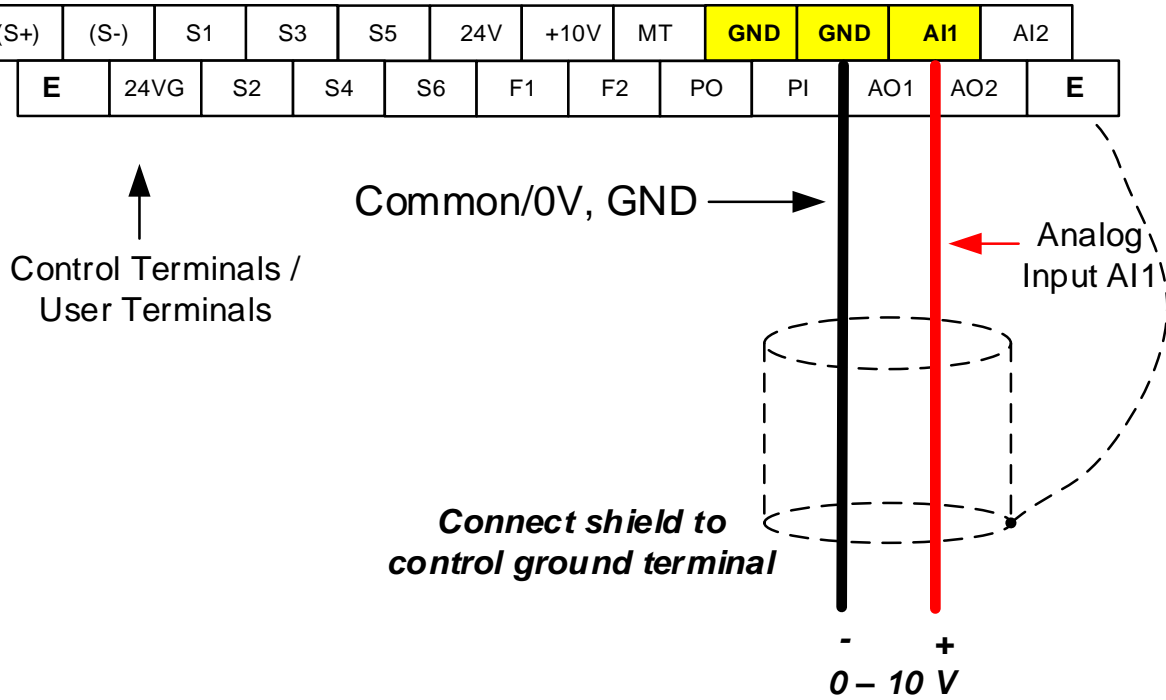
| 00-05 | Main Frequency Command Source Selection |
|-------|--|
| Range | 0: Keypad 1: External control (analog) 2: Terminal UP / DOWN 3: Communication control 6: RTC 7: AI2 Auxiliary Frequency |

6.1 Reference from Keypad

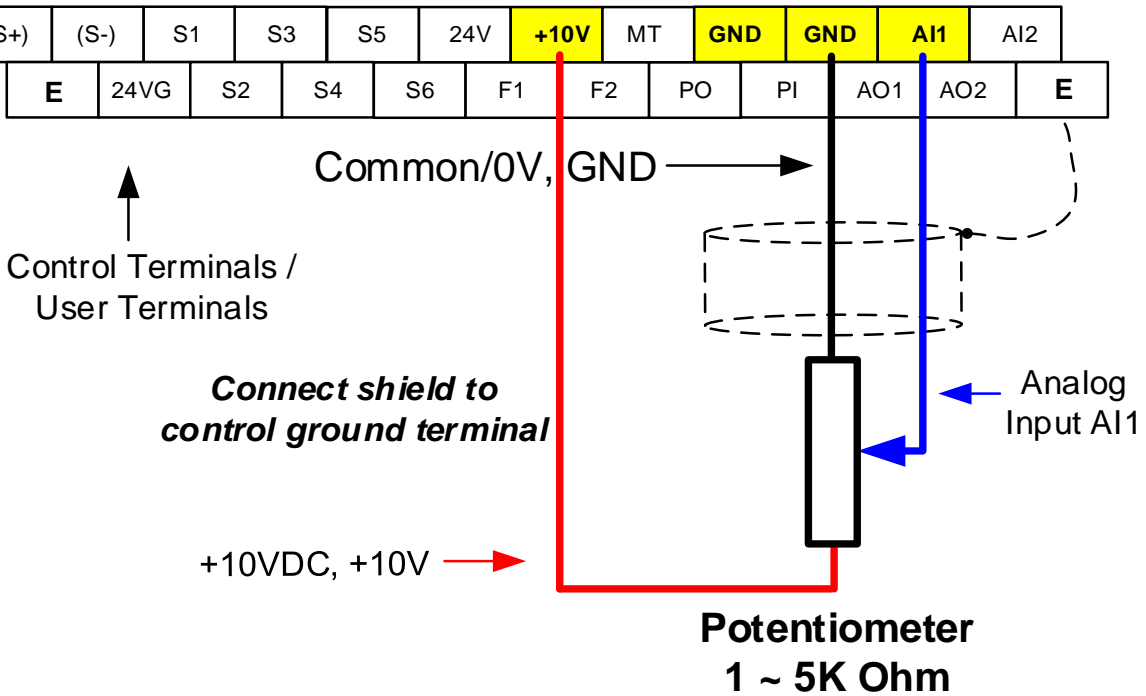
Speed reference from the keypad is the default setting. Press the **READ/ ENTER** key first and use the **</RESET**, **▲** and **▼** keys to change the speed reference.

6.2 Reference from External Analog Signal (0-10V / 4-20mA)

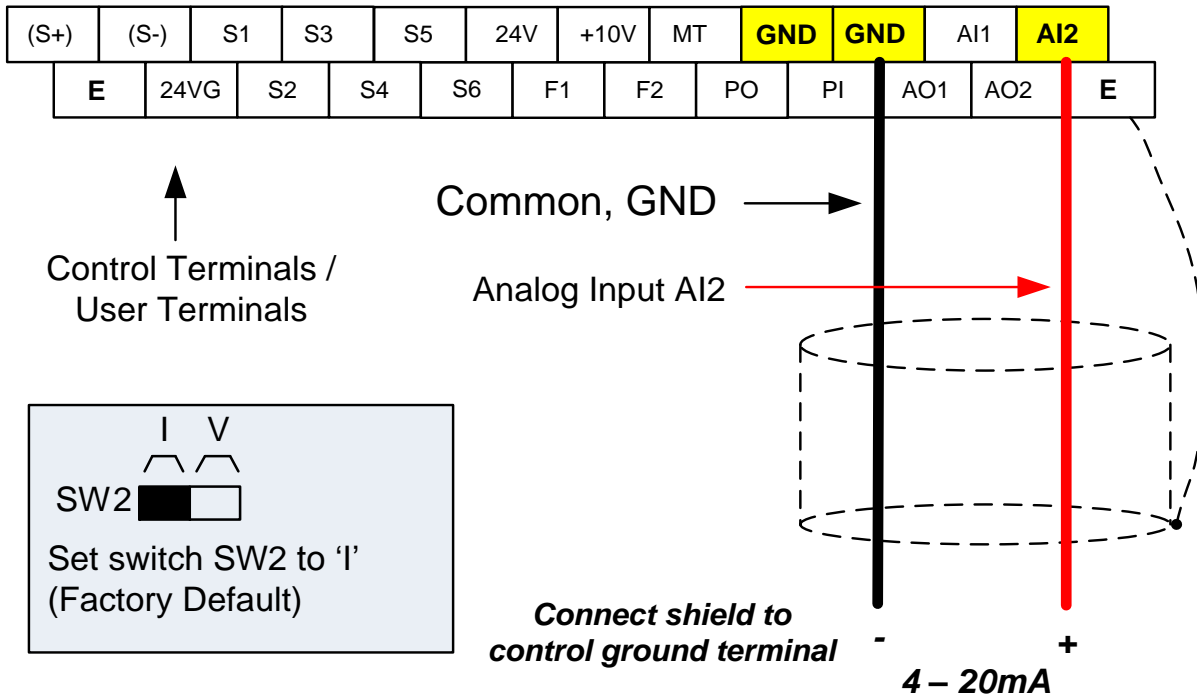
Analog Reference: 0 – 10 V (Setting 00-05 = 1)



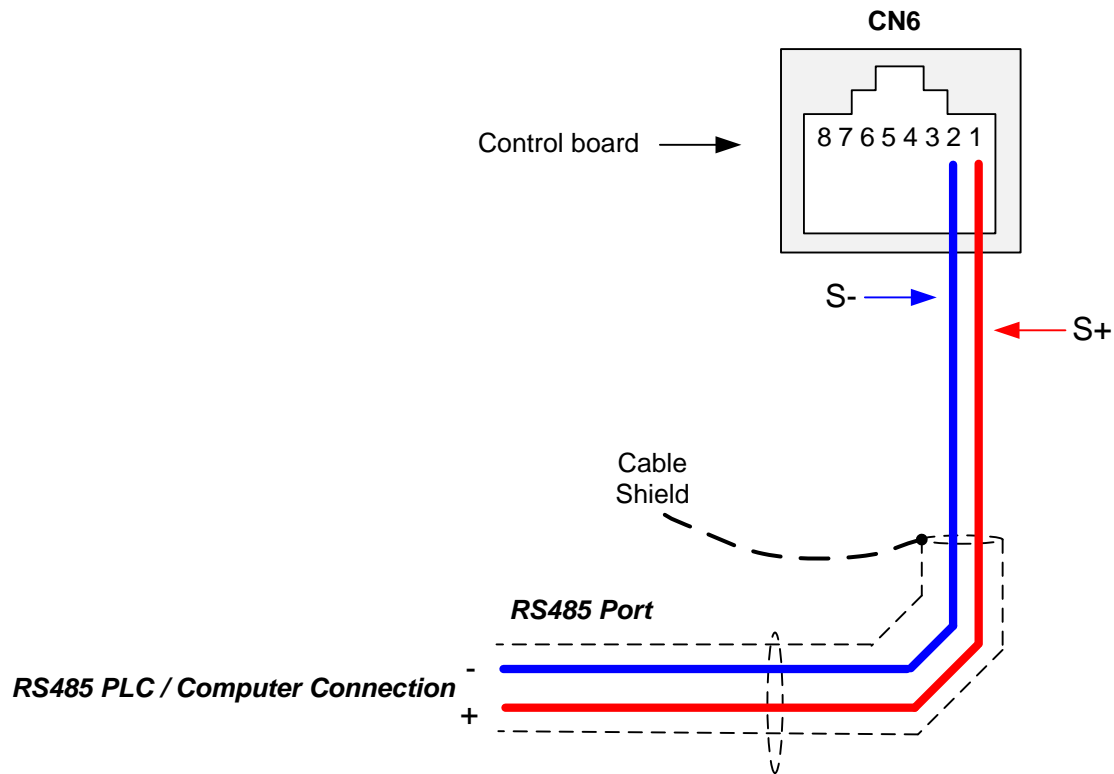
Analog Reference: Potentiometer / Speed Pot (Setting 00-05 = 1)



Analog Reference: 4 – 20mA (Setting 00-05 = 1)



6.3 Reference from Serial Communication RS485 (00-05=3)



To set the speed reference for the inverter via serial communication parameter 00-05 has be set to “3” for frequency command via serial communication.

Default Communication Setting is: Address “1”, 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

The serial communication link function uses RS485 Modbus RTU protocol and allows for:

- 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.

Frequency Reference Command Register

Inverter Frequency Reference Register: 2502 (Hexadecimal) - Bit 0 – Bit 15: 0.00 ~ 400.00 Hz

Examples:

Frequency Reference Command: 10.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 03 E8 23 B8

To set the frequency reference to 10.00, a value of '1000' (03E8h) has to be send to the inverter.

Frequency Reference Command: 30.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 0B B8 24 44

To set the frequency reference to 30.00, a value of '3000' (0BB8h) has to be send to the inverter.

Frequency Reference Command: 60.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 17 70 2D 12

To set the frequency reference to 60.00, a value of '6000' (1770h) has to be send to the inverter

Note: The last 2 bytes of the command strings consist of a CRC16 checksum.

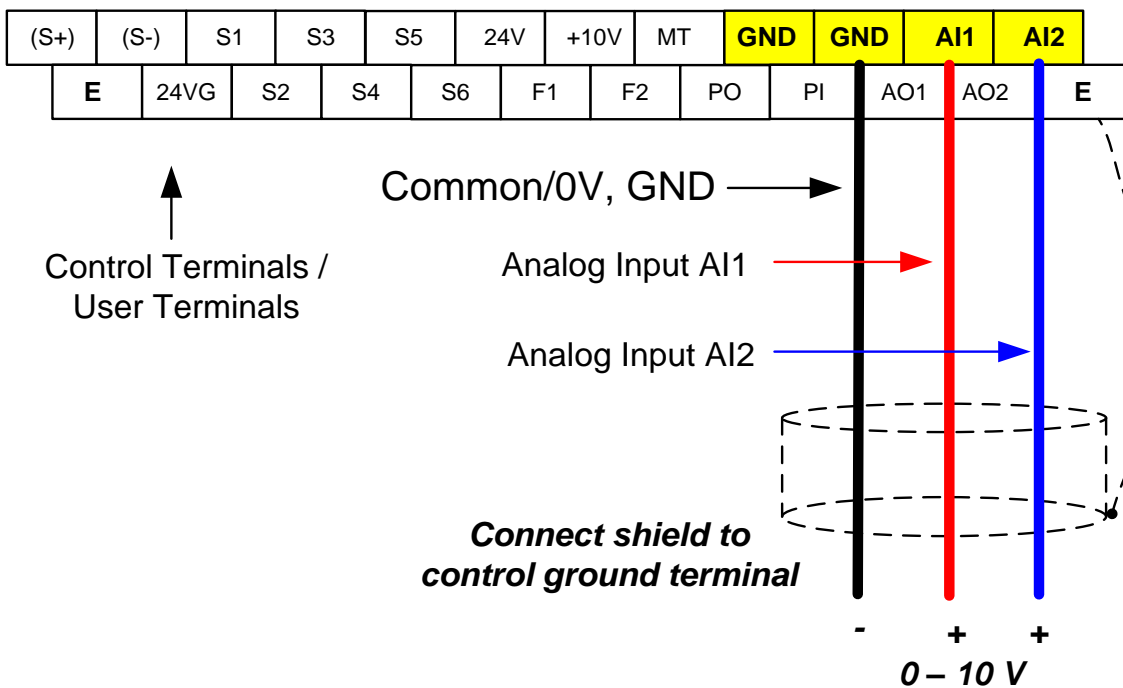
6.4 Reference from two Analog Inputs

Analog input AI1 is used as master frequency reference and analog input AI2 is used as auxiliary frequency reference.

Analog Reference AI1: 0 – 10 V (Setting 00-05 = 1)

Analog Reference AI2: 0 – 10 V (Setting 00-06 = 7, 00-07 =1, 04-05 = 0)

| AI1 – Analog Input 1 | AI2 – Analog Input 2 | 04-00 Setting (Default = 1) | Dipswitch SW2 (Default 'V') |
|----------------------|----------------------|-----------------------------|-----------------------------|
| 0 ~ 10V | 0 ~ 10V | 0 | Set to 'V' |
| 0 ~ 10V | 4 ~ 20mA | 1 | Set to 'I' |



6.5 Change Frequency Unit from Hz to rpm

Enter the number of motor poles in 16-03 to change the display units from Hz to rpm.

| 16-03 | Display unit |
|-------|--|
| Range | 0: Display unit is Hz (Resolution is 0.01Hz) |
| | 1: Display unit is % (Resolution is 0.01%) |
| | 2~39: Display unit rpm, (uses number of motor poles to calculate) |
| | 40~9999: 100% is XXXX with no decimals (integer only) |
| | 10001~19999: 100% is XXX.X with 1 decimal |
| | 20001~29999: 100% is XX.XX with 2 decimals |
| | 30001~39999: 100% is X.XXX with 3 decimals |

Example: Motor poles 4, 16-03 = 4.

7. Operation Method Configuration (Run / Stop)

The inverter offers users several choices to run and stop from different sources. The most commonly used methods are described in the next sections.

Operation command is selected with parameter 00-02.

00-02: Run Command Selection

This function sets the frequency command source.

Setting Range: 0 to 4

To set parameter 00-01:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

In the parameter list move cursor to 00-01 with the **UP/DOWN** keys and press **READ/ ENTER** key to select.

| 00-02 | Run Command Selection |
|-------|--|
| Range | 0: Keypad control 1: External terminal control 2: Communication control 3: PLC 4: RTC |

7.1 Run/Stop from the Keypad (00-02=0) – Default Setting

Use the **RUN** key to run the drive in forward direction and the **FWD/REV** key to change the motor direction. (Note: to disable reverse direction set parameter 11-00 to 1)

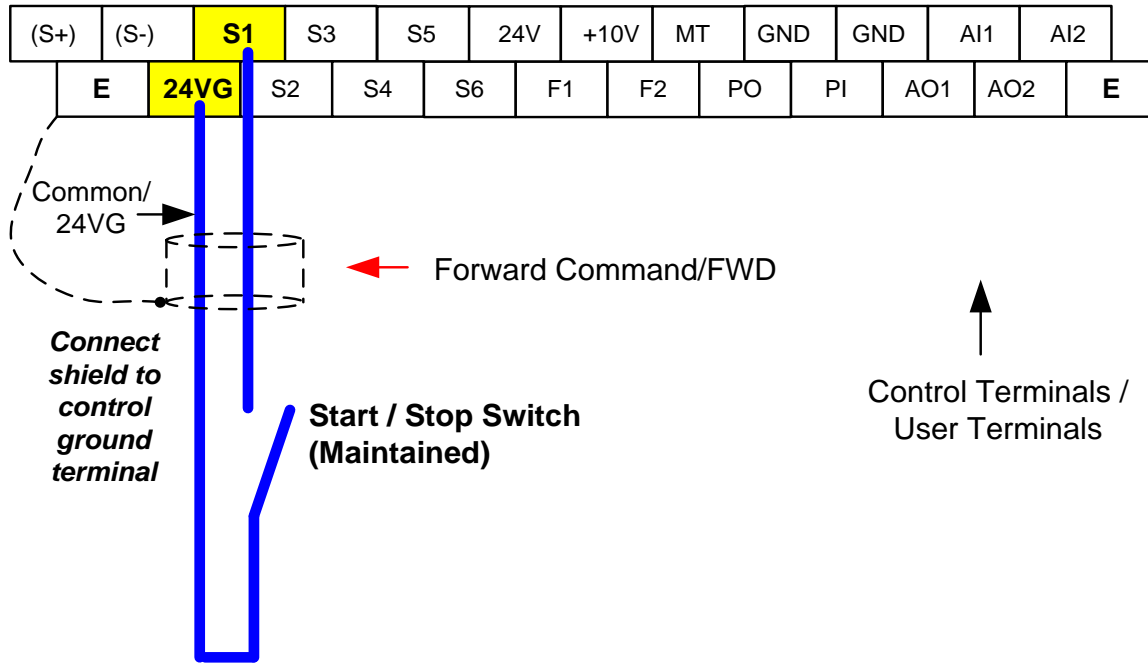
Press **STOP** key to stop the inverter. (Note: Stop method can be set with parameter 07-09, default is **deceleration to stop**).



7.2 Run/Stop from External Switch / Contact or Pushbutton (00-02=1)

Use an external contact or switch to Run and Stop the inverter.

Permanent Switch / Contact



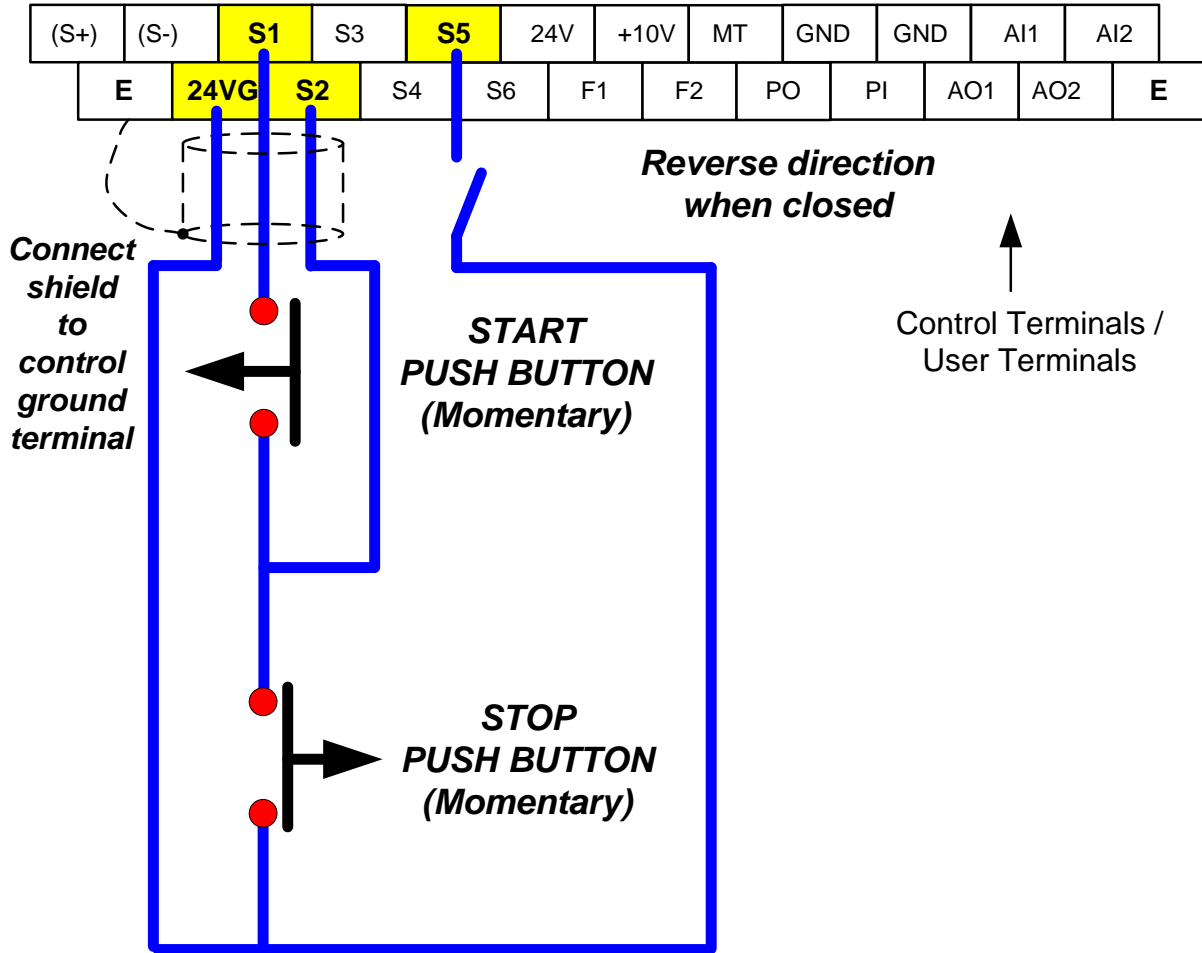
Momentary Contacts (Push Buttons)

Use push button / momentary switch to Run and Stop the inverter.

Set parameter 13-08 to 3, 5 or 7 for 3-wire program initialization, multi-function input terminal S1 is set to run operation, S2 for stop operation and S5 for forward/reverse command.

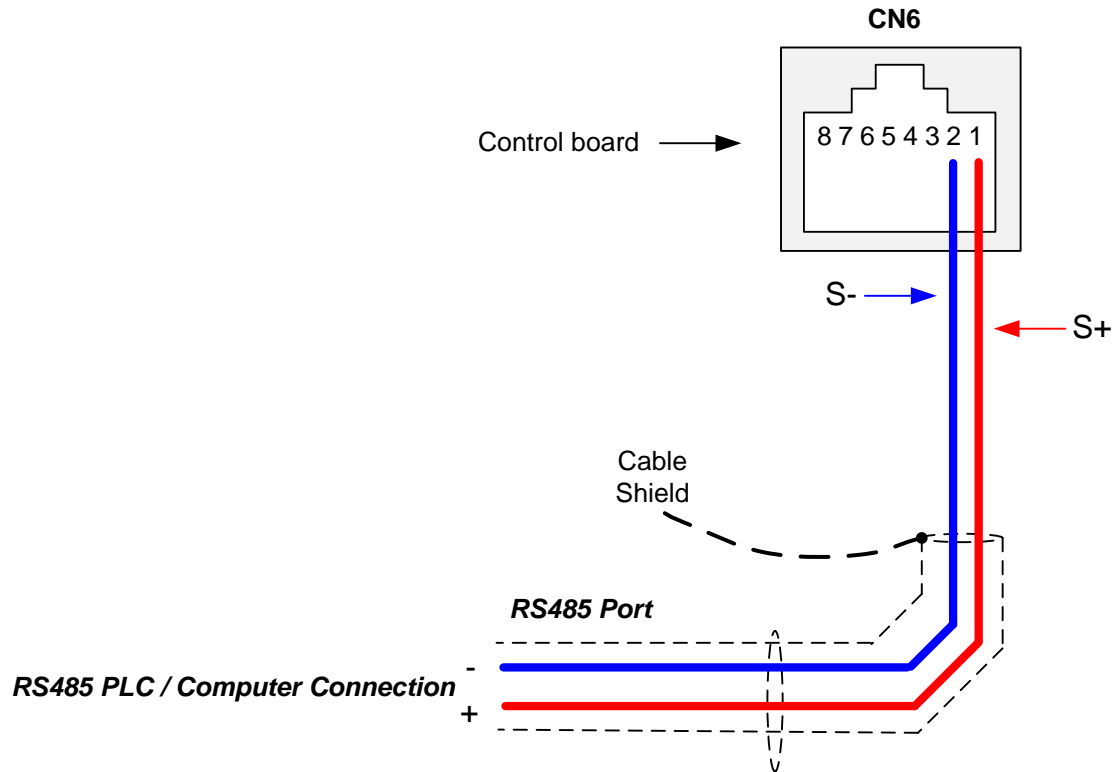
00-01 Operation Method = 1

03-05 Terminal S5 Function = 26



Note: Stop mode selection can be set with parameter 07-09, default is **deceleration to stop**.

7.3 Run/Stop from Serial Communication RS485 (00-02=3)



To control (Run/Stop) the inverter via serial communication parameter 00-02 has be set to either a “3” for communication control.

Default Communication Setting is: Address “1”, 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

The serial communication link function uses RS485 Modbus RTU protocol and allows for:

- 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.

Command Register

Inverter Command Register: 2501 (Hexadecimal)

Bit 0: Run Forward

Bit 1: Run Reverse

Bit 2 ~ Bit 15: Refer to the chapter XX of this manual

Examples:

Run Forward Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 01 12 C6

Run Reverse Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 03 93 07

Stop Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 00 D3 06

Note: The last 2 bytes of the command strings consist of a CRC16 checksum.

8. Motor and Application Specific Settings

It is essential that before running the motor, the motor nameplate data matches the motor data in the inverter.

8.1 Set Motor Nameplate Data (02-01, 02-05)

02-05 Rated power of motor 1

The nominal motor rated capacity is set at the factory. Please verify that the motor name plate data matches the motor rated capacity shown in parameter 02-05. The setting should only be changed when driving a motor with a different capacity.

Range: 0.00 to 600.00 kW (1HP = 0.746 kW)

To set parameter 02-05:

- After power-up press the **DSP/FUN** key
- Select **02 Motor Parameter**
- Press **READ/ ENTER** key
- Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

Default values vary based on the inverter model.

02-01 Rated current of motor 1

The motor rated current is set at the factory based on the inverter model. Enter the motor rated current from the motor nameplate if it does not match the value shown in parameter 02-01.

Setting range: 0.01 to 600.00A

To set parameter 02-01:

- After power-up press the **DSP/FUN** key
 - Select **02 Motor Parameter**
 - Press **READ/ ENTER** key
 - Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.
-

8.2 Acceleration and Deceleration Time (00-14, 00-15)

Acceleration and Deceleration times directly control the system dynamic response. In general, the longer the acceleration and deceleration time, the slower the system response, and the shorter time, the faster the response. An excessive amount of time can result in sluggish system performance while too short of a time may result in system instability.

The default values suggested normally result in good system performance for the majority of general purpose applications. If the values need to be adjusted, caution should be exercised, and the changes should be in small increments to avoid system instability.

00-14 Acceleration time 1

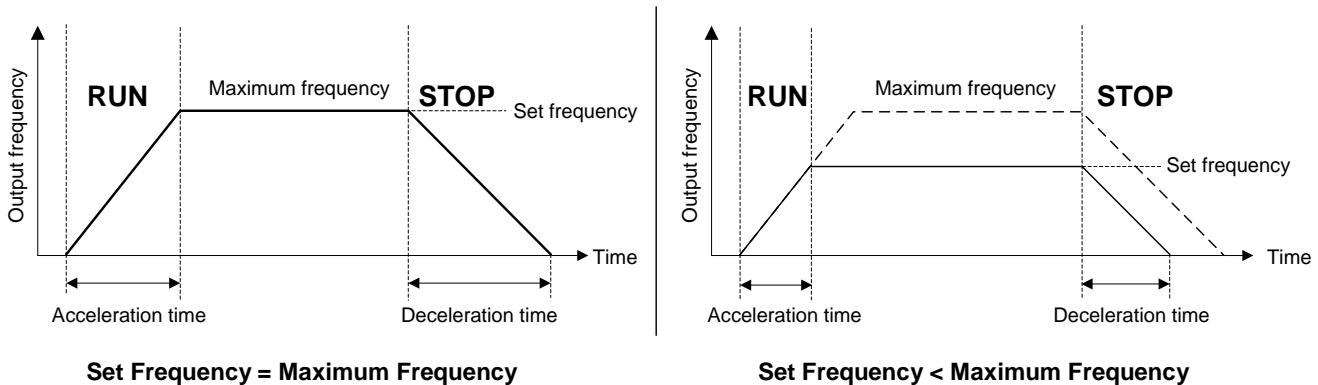
00-15 Deceleration time 1

These parameters set the acceleration and deceleration times of the output frequency from 0 to maximum frequency and from maximum frequency to 0.

To set parameter 00-14 or 00-15:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -14 or -15 with the **UP/DOWN ▲ and ▼** keys and press the **READ/ ENTER** key.

Acceleration and deceleration times are represented by the three most significant (high order) digits. Set acceleration and deceleration times with respect to maximum frequency. The relationship between the set frequency value and acceleration/deceleration times is as follows:



Note: If the set acceleration and deceleration times are set too low, the torque limiting function or stall prevention function can become activated if the load torque and or inertia are relatively high. This will prolong the acceleration and or deceleration times and not allow the set times to be followed. In this case the acceleration and or the deceleration times should be adjusted.

8.3 Automatic Energy Savings Function (11-19)

In the V/F control mode the automatic energy saving (AES) function automatically adjusts the output voltage and reduces the output current of the inverter to optimize energy savings based on the load.

The output power changes proportional to the motor load. Energy savings is minimal when the load exceeds 70% of the output power and savings become greater when the load decreases.

The parameter of automatic energy saving function has been set at the factory before shipment. In general, it is no need to adjust. If the motor characteristic has significant difference from TECO standard, please refer to the following commands for adjusting parameters:

Enable Automatic Energy Savings Function

To set parameters 11-19 to 11-24:

- After power-up press the **DSP/FUN** key
- Select **11 Auxiliary Function Group**
- Press **READ/ ENTER** key
- Select parameter -19 to -24 with the **UP/DOWN ▲ and ▼** keys and press the **READ/ ENTER** key.

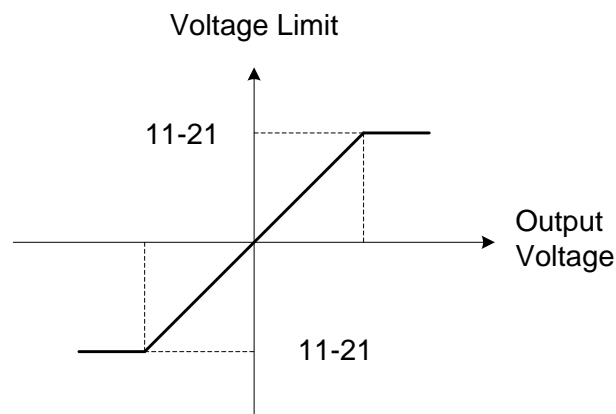
- (1) To enable automatic energy saving function set 11-19 to 1.
- (2) Filter time of automatic energy saving (11-20)
- (3) Commissioning parameter of energy saving (11-21 to 11-22)

In AES mode, the optimum voltage value is calculated based on the load power requirement but is also affected by motor temperature and motor characteristic.

In certain applications the optimum AES voltage needs to be adjusted in order to achieve optimum energy savings. Use the following AES parameters for manual adjustment:

11-21: Voltage limit value of AES commissioning operation

Sets the voltage upper limit during automatic energy saving. 100% corresponds to 230V or 460V depending on the inverter class used.



Voltage limit value of commissioning operation

11-22: Adjustment time of automatic energy saving

Sets sample time constant for measuring output power.

Reduce the value of 11-22 to increase response when the load changes.

Note: If the value of 11-22 is too low and the load is reduced the motor may become unstable.

11-23: Detection level of automatic energy saving

Sets the automatic energy saving output power detection level.

11-24: Coefficient of automatic energy saving

The coefficient is used to tune the automatic energy saving. Adjust the coefficient while running the inverter on light load while monitoring the output power. A lower setting means lower output voltage.

Notes:

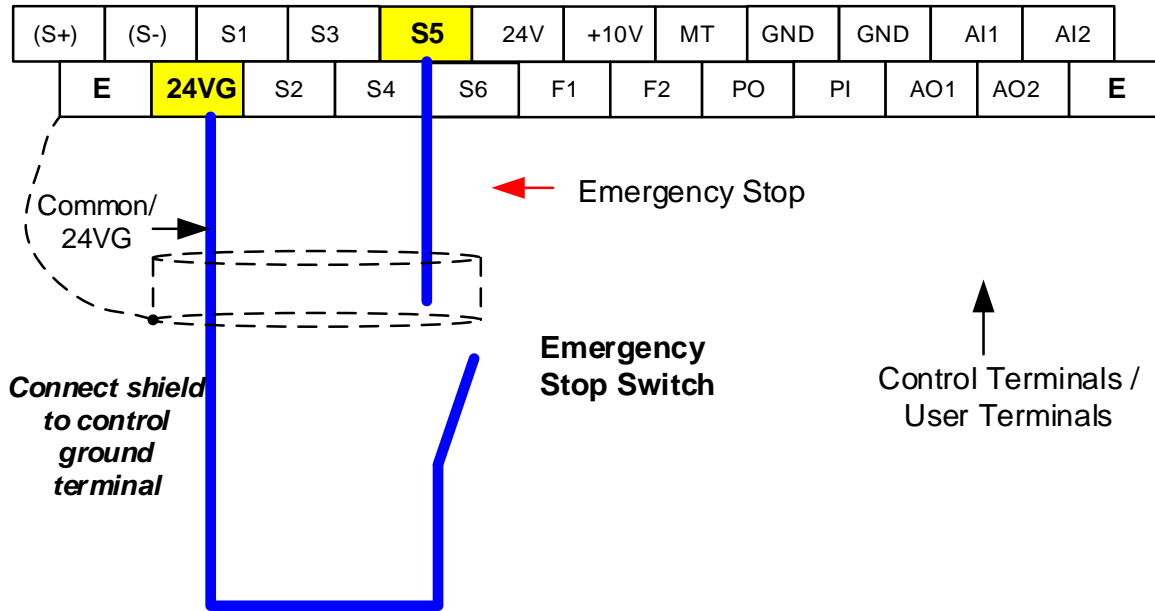
- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Set parameter 13-00. If the motor power does not match the inverter rating.

8.4 Emergency Stop

The emergency stop time is used in combination with multi-function digital input function #14 (Emergency stop). When emergency stop input is activated the inverter will decelerate to a stop using the Emergency stop time (00-26) and display the [EM STOP] condition on the keypad.

Note: To cancel the emergency stop condition the run command has to be removed and emergency stop input deactivated.

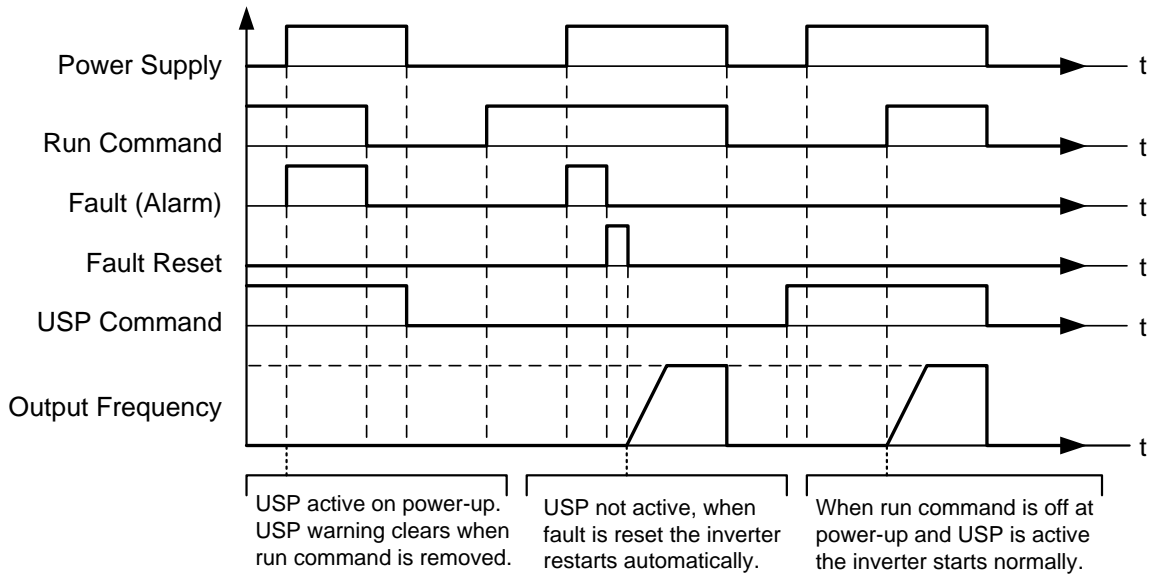
Example: Emergency Stop Switch set for input terminal S5 (03-04 = 14).



| | |
|--------------|----------------------------|
| 00-26 | Emergency stop time |
| Range | 0.0~6000.0 Sec |

8.5 Direct / Unattended Startup

The unattended startup function prevents the inverter from starting automatically when a run command is present at time of power-up. To use USP command set one of the multi-function digital input functions to #50 (USP Startup).



Unattended Startup Protection

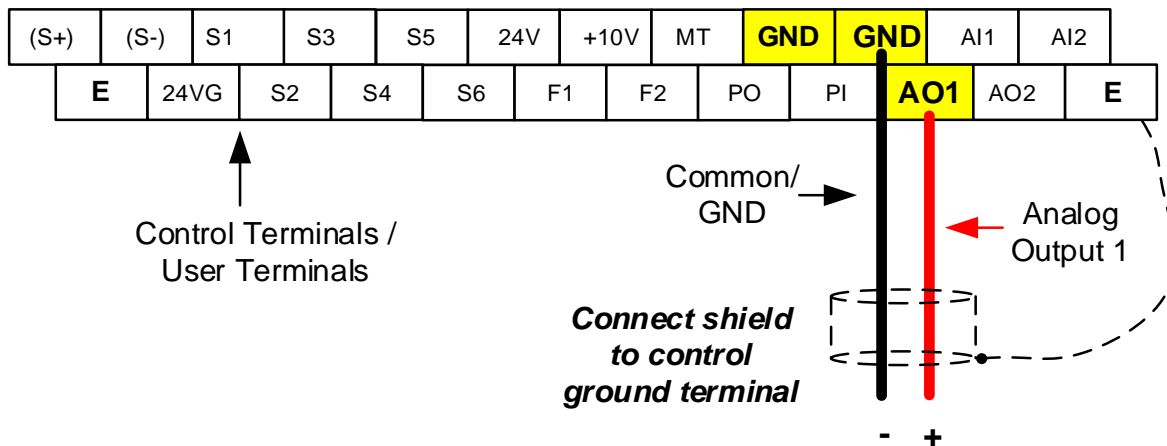
8.6 Analog Output Setup

Signal: Use parameter 04-11 to select the analog output signal for AO1 and parameter 04-16 to select the analog output signal for AO2.

Gain: Use parameter 04-12 to adjust the gain for AO1 and parameter 04-17 to adjust the gain for AO2. Adjust the gain so that the analog output (10V/20mA) matches 100% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

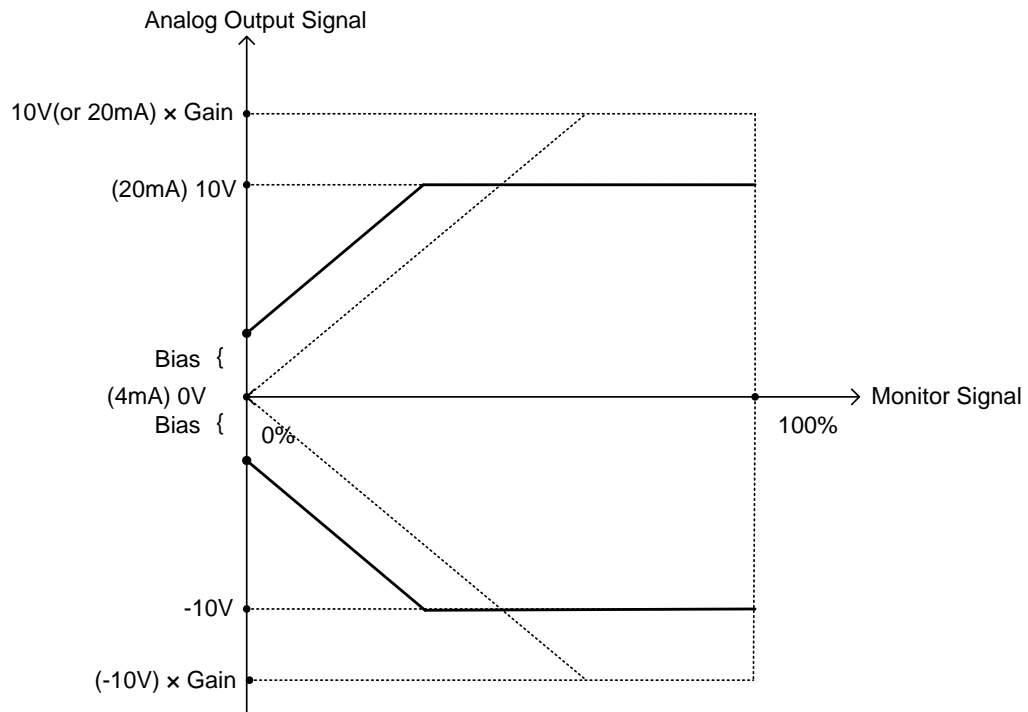
Bias: Use parameter 04-13 to adjust the bias for AO1 and parameter 04-18 to adjust the bias for AO2. Adjust the bias so that the analog output (0V/4mA) matches 0% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

Example: Analog Output 1 Wiring



| 04-11 | AO1 function Setting | |
|-------|------------------------|--|
| Range | 0: Output frequency | 14: Reserved |
| | 1: Frequency command | 15: ASR output |
| | 2: Output voltage | 16: Reserved |
| | 3: DC voltage | 17: q-axis voltage |
| | 4: Output current | 18: d-axis voltage |
| | 5: Output power | 19: Reserved |
| | 6: Motor speed | 20: Reserved |
| | 7: Output power factor | 21: PID input |
| | 8: AI1 input | 22: PID output |
| | 9: AI2 input | 23: PID target value |
| | 10: Torque command | 24: PID feedback value |
| | 11: q -axis current | 25: Output frequency of the soft starter |
| | 12: d-axis current | 26 ~ 27: Reserved |
| | 13: Speed deviation | 28: Communication Control |

| | |
|--------------|-------------------------------|
| 04-12 | AO1 gain value |
| Range | 0.0~1000.0% |
| 04-13 | AO1 bias-voltage value |
| Range | -100.0~100.0% |
| 04-16 | AO2 function Setting |
| Range | See parameter 04-11 |
| 04-17 | AO2 gain value |
| Range | 0.0~1000.0% |
| 04-18 | AO2 bias-voltage value |
| Range | -100.0~100.0% |



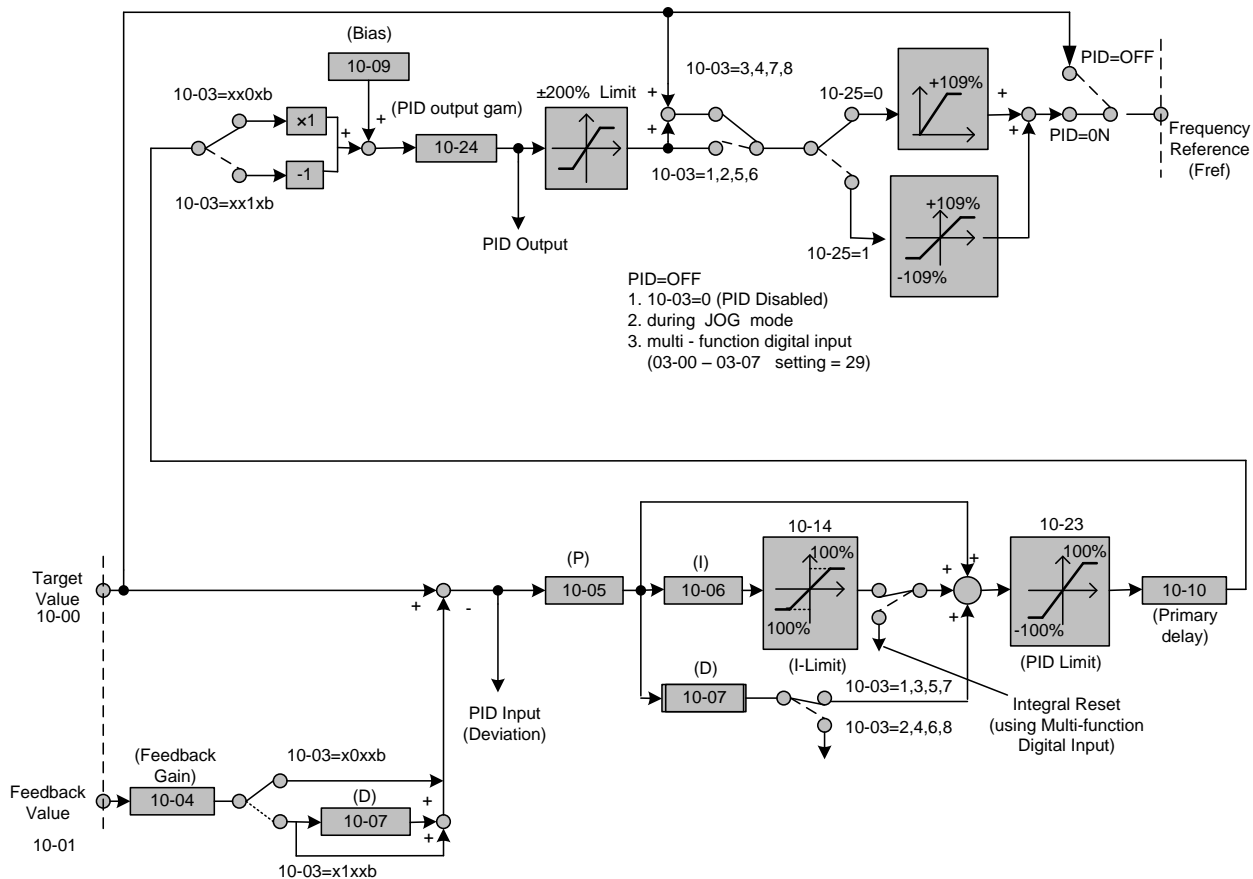
Analog output level adjustment

9. Using PID Control for Constant Flow / Pressure Applications

9.1 What is PID Control?

The PID function in the inverter can be used to maintain a constant process variable such as pressure, flow, temperature by regulating the output frequency (motor speed). A feedback device (transducer) signal is used to compare the actual process variable to a specified setpoint. The difference between the set-point and feedback signal is called the error signal.

The PID control tries to minimize this error to maintain a constant process variable by regulating the output frequency (motor speed).



The amplitude of the error can be adjusted with the Proportional Gain parameter 10-05 and is directly related to the output of the PID controller, so the larger gain the larger the output correction.

Example 1:

Gain = 1.0

Set-Point = 80%

Feedback = 78%

Error = Set-point - Feedback = 2%

Control Error = Gain x Error = 2%

Example 2:

Gain = 2.0

Set-Point = 80%

Feedback = 78%

Error = Set-point - Feedback = 2%

Control Error = Gain x Error = 4%

Please note that an excessive gain can make the system unstable and oscillation may occur.

The response time of the system can be adjusted with the Integral Gain set by parameter 10-06. Increasing the Integral Time will make the system less responsive and decreasing the Integral Gain Time will increase response but may result in instability of the total system.

Slowing the system down too much may be unsatisfactory for the process. The end result is that these two parameters in conjunction with the acceleration (00-14) and deceleration (00-15) times are adjusted to achieve optimum performance for a particular application.

For typical fan and pump applications a Proportional Gain (10-05) of 2.0 and an Integral Time (10-06) of 5.0 sec is recommended.

10-03 PID control mode

PID control can be enabled by setting parameter 10-03 to 'xxx1b'

| 10-03 | PID control mode |
|-------|--|
| Range | xxx0b: PID disable xxx1b: PID enable xx0xb: PID positive characteristic xx1xb: PID negative characteristic x0xxb: PID error value of D control x1xxb: PID feedback value of D control 0xxxb: PID output 1xxxb: PID output +target value |

Commonly used PID control modes

0001b: Forward operation: PID operation enabled, motor speeds increases when feedback signal is smaller than set-point (most fan and pump applications)

0011b: Reverse operation: PID operation enabled, motor slows down when feedback signal is smaller than set-point (e.g. level control applications)

To set parameter 10-03:

- After power-up press the **DSP/FUN** key
- Select **10 PID Control**
- Press **READ/ ENTER** key
- Select parameter -03 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

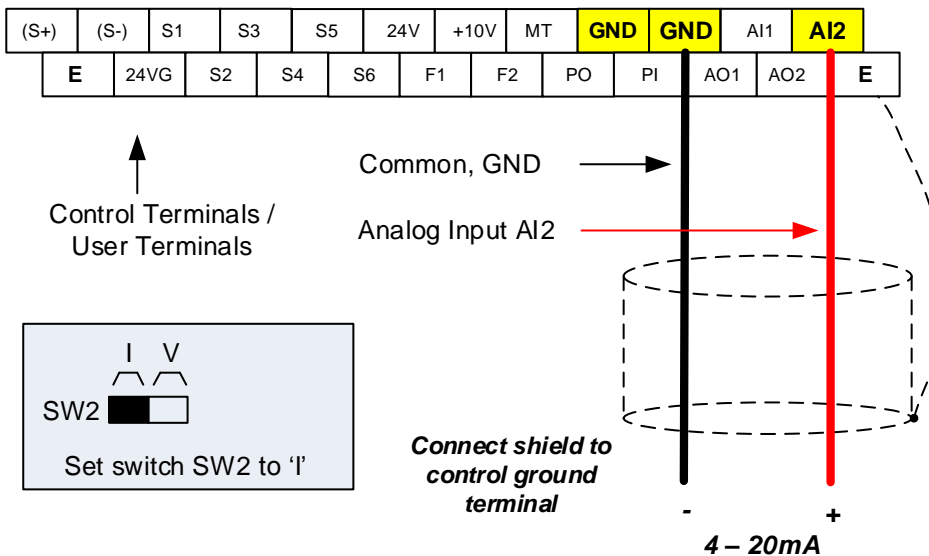
Important: To use the PID function parameter 00-05 (Main Frequency Command Source Selection) has to be set to 5 for PID reference.

9.2 Connect Transducer Feedback Signal (10-01)

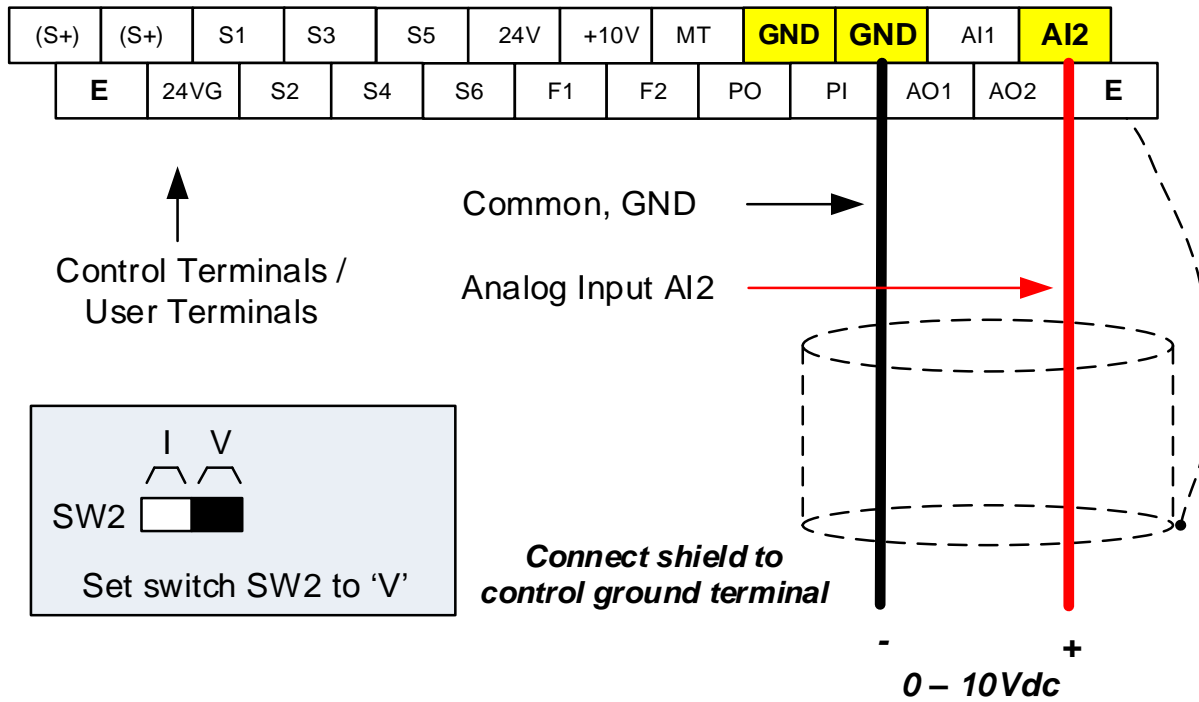
The PID function in the inverter

Depending on the type of feedback transducer used, the inverter can be setup for either 0-10V or a 4-20mA feedback transducer.

Feedback Signal 4 – 20mA (10-01 = 2) – SW2 = I



Feedback Signal 0 – 10V (10-01 = 1) – SW2 = V



9.3 Engineering Units

The PID setpoint scaling can be selected with parameter 16-03 and 16-04.

Example: 0 – 200.0 PSI Setpoint, set 16-03 to 12000 (1 decimal, range 0 – 200) and 16-04 to 2 (PSI).

9.4 Sleep / Wakeup Function

The PID Sleep function can be used to prevent a system from running at low speeds and is frequently used in pumping application. The PID Sleep function is turned on by parameter 10-29 set to 1. The inverter output turns off when the PID output falls below the PID sleep level (10-17) for the time specified in the PID sleep delay time parameter (10-18).

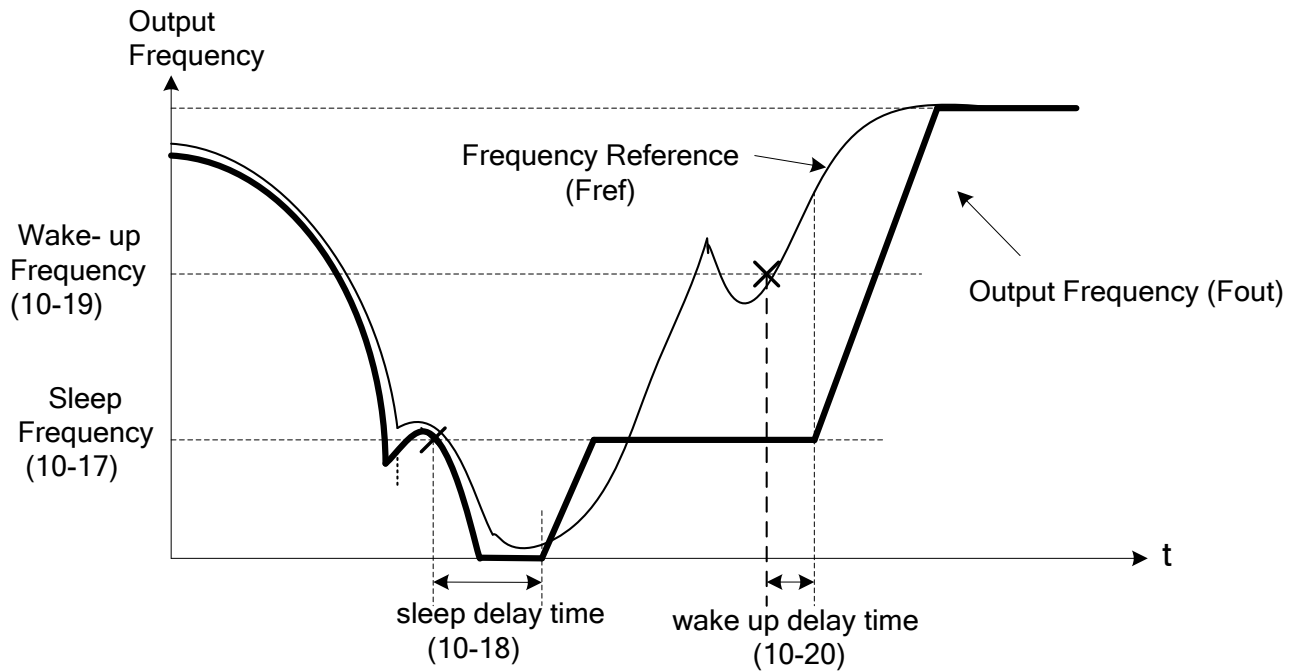
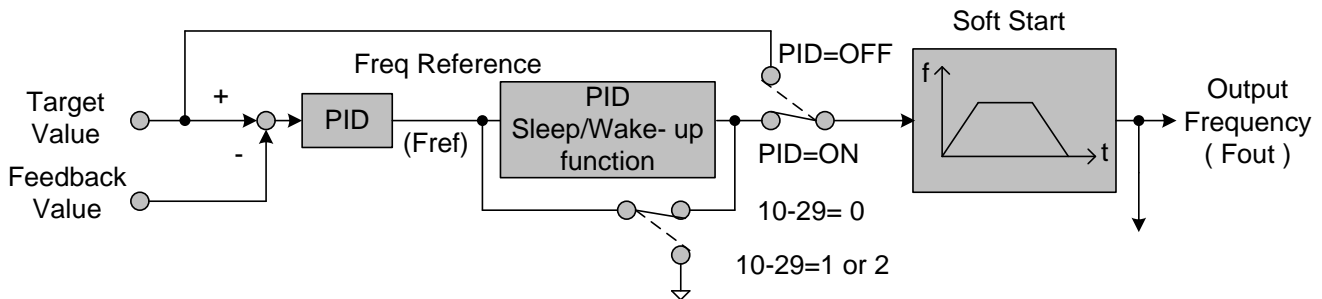
The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

10-29 =0: PID Sleep function is disabled.

10-29 =1: PID sleep operation is based on parameters of 10-17 and 10-18.

10-29 =2: PID sleep mode is enabled by multi-function digital input

Refer to figure 4.3.74 (a) and (b) for PID sleep / wakeup operation.



PID Sleep Function

10. Troubleshooting and Fault Diagnostics

10.1 General

Inverter fault detection and early warning / self-diagnosis function. When the inverter detects a fault, a fault message is displayed on the keypad. The fault contact output energizes and the motor will coast to stop (The stop method can be selected for specific faults).

When the inverter detects a warning / self-diagnostics error, the digital operator will display a warning or self-diagnostic code, the fault output does not energize in this case. Once the warning is removed, the system will automatically return to its original state.

10.2 Fault Detection Function




When a fault occurs, please refer to Table 10.2.1 for possible causes and take appropriate measures.

Use one of the following methods to restart:

1. Set one of multi-function digital input terminals (03-00, 03-07) to 17 (Fault reset); activate input
2. Press the reset button on the keypad.
3. Power down inverter wait until keypad goes blank and power-up the inverter again.

When a fault occurs, the fault message is stored in the fault history (see group 12 parameters).


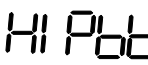


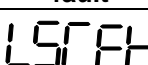
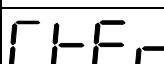
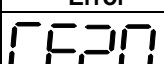
Table 10.2.1 Fault information and possible solutions

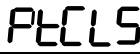



| LED display | Description | Cause | Possible solutions |
|---|---|--|---|
| OC over current | The inverter output current exceeds the overcurrent level (200% of the inverter rated current). | <ul style="list-style-type: none"> • Acceleration / Deceleration time is too short. • Contactor at the inverter output side. • A special motor or applicable capacity is greater than the inverter rated value. • Short circuit or ground fault. | <ul style="list-style-type: none"> • Extend acceleration / deceleration time. • Check the motor wiring. • Disconnect motor and try running inverter. |
|  | | | |
| SC short circuit | Inverter output short circuit or ground fault. | <ul style="list-style-type: none"> • Short circuit or ground fault (08-23 = 1). • Motor damaged (insulation). • Wire damage or deterioration. | <ul style="list-style-type: none"> • Check the motor wiring. • Disconnect motor and try running inverter. |
|  | | | |
| GF Ground fault | The current to ground exceeds 50% of the inverter rated output current (08-23 = 1, GF function is enabled). | <ul style="list-style-type: none"> • Motor damaged (insulation). • Wire damage or deterioration. • Inverter DCCT sensors defect. | <ul style="list-style-type: none"> • Replace motor. • Check the motor wiring. • Disconnect motor and try running inverter. • Check resistance between cables and ground. • Reduce carrier frequency. |
|  | | | |

| LED display | Description | Cause | Possible solutions |
|-----------------------------------|--|---|--|
| OV Over voltage | DC bus voltage exceeds the OV detection level: 410Vdc: 230V class 20Vdc: 460V class (For 440V class, if input voltage 01-14 is set lower than 460V, the OV detection value will be decreased to 700Vdc). | <ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. | <ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters. |
| OU | | | |
| UV Under voltage | DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 230V class; 380Vdc: 460V class (The detection value can be adjusted by 07-13). | <ul style="list-style-type: none"> The input voltage is too low. Input phase loss. Acceleration time set too short. Input voltage fluctuation. Pre-charge contactor damaged. DC bus voltage feedback signal value not correct. | <ul style="list-style-type: none"> Check the input voltage. Check input wiring. Increase acceleration time. Check power source Replace pre-charge contactor Replace control board or complete inverter. |
| UU | | | |
| IPL input phase loss | Phase loss at the input side of the inverter or input voltage imbalance, active when 08-09 = 1 (enabled). | <ul style="list-style-type: none"> Wiring loose in inverter input terminal. Momentary power loss. Input voltage imbalance. | <ul style="list-style-type: none"> Check input wiring / faster screws. Check power supply. |
| IPL | | | |
| OPL output phase loss | Phase loss at the output side of the inverter, active when 08-10 = 1 (enabled). | <ul style="list-style-type: none"> Wiring loose in inverter output terminal. Motor rated current is less than 10% of the inverter rated current. | <ul style="list-style-type: none"> Check output wiring / faster screws. Check motor & inverter rating. |
| OPL | | | |
| OH1 Heatsink overheat | The temperature of the heat sink is too high. Note: when OH1 fault occurs three times within five minutes, it is required to wait 10 minutes before resetting the fault. | <ul style="list-style-type: none"> Ambient temperature too high. cooling fan failed Carrier frequency set too high. Load too heavy. | <ul style="list-style-type: none"> Install fan or AC to cool surroundings. Replace cooling fan. Reduce carrier frequency. Reduce load / Measure output current |
| OH1 | | | |
| OL1 Motor overload | Internal motor overload protection tripped, active when protection curve 08-05 = xxx1. | <ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting in over-excitation of the motor. Motor rated current (02-01) set incorrectly. Load too heavy. | <ul style="list-style-type: none"> Check V/f curve. Check motor rated current Check and reduce motor load, check and operation duty cycle. |
| OL1 | | | |

| LED display | Description | Cause | Possible solutions |
|--|---|--|--|
| OL2 Inverter overload | Inverter thermal overload protection tripped. | <ul style="list-style-type: none"> • Voltage setting V/F mode too high, resulting • Over-excitation of the motor. • Inverter rating too small. • Load too heavy. | <ul style="list-style-type: none"> • Check V/f curve. • Replace inverter with larger rating. • Check and reduce motor load, check and operation duty cycle. |
| OL2 | If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault. | | |
| OT Over torque detection | Inverter output torque is higher than 08-15 (over torque detection level) for the time specified in 08-16. Parameter 08-14 = 0 to activate. | <ul style="list-style-type: none"> • Load too heavy. | <ul style="list-style-type: none"> • Check over torque detection parameters (08-15 / 08-16). • Check and reduce motor load, check and operation duty cycle. |
| OT | | | |
| UT Under torque detection | Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 to activate. | <ul style="list-style-type: none"> • Sudden drop in load. • Belt break. | <ul style="list-style-type: none"> • Check under torque detection parameters (08-19 / 08-20). • Check load / application. |
| UT | | | |
| CE communicatio n error | No Modbus communication received in for the time specified in 09-06 (communication error detection time). Active when 09-07(= 0 to 2). | <ul style="list-style-type: none"> • Connection lost or wire broken. • Host stopped communicating. | <ul style="list-style-type: none"> • Check connection • Check host computer / software. |
| CE | | | |
| FB PID feedback loss | PID feedback signal falls below level specified in 10-12 (PID feedback loss | <ul style="list-style-type: none"> • Feedback signal wire broken • Feedback sensor broken. | <ul style="list-style-type: none"> • Check feedback wiring • Replace feedback sensor. |
| Fb | detection level) for the time specified in 10-13 (Feedback loss detection time). Active when parameter (10-11 = 2). | | |
| STO Safety switch | Inverter safety switches open. | <ul style="list-style-type: none"> • Terminal board Input F1 and F2 are not connected • 08-30 is set to 1: Coast to stop and digital input (58) is active. | <ul style="list-style-type: none"> • Check F1 and F2 connection |
| STO | | | |

| LED display | Description | • Possible causes | • Corrective action | | |
|---|---|---|--|--|---|
| DEV Speed deviation 551 | Inverter safety switches open. | <ul style="list-style-type: none"> When 08-30 is set to 0: Deceleration to stop, and digital input (58) is active. | <ul style="list-style-type: none"> Check if digital terminal (58) is active. | | |
| EF1 External fault (S1) EF1 | External fault (Terminal S1) Active when 03-00= 25, and Inverter external fault selection 08-24=0 or 1. | <ul style="list-style-type: none"> Multifunction digital input external fault active. | <ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring | | |
| EF2 External fault (S2) EF2 | External fault (Terminal S2) Active when 03-01= 25, and Inverter external fault selection 08-24=0 or 1. | | | | |
| EF3 External fault (S3) EF3 | External fault (Terminal S3) Active when 03-02= 25, and Inverter external fault selection 08-24=0 or 1. | | | | |
| EF4 External fault (S4) EF4 | External fault (Terminal S4) Active when 03-03= 25, and Inverter external fault selection 08-24=0 or 1. | | | | |
| EF5 External fault (S5) EF5 | External fault (Terminal S5) Active when 03-04= 25, and Inverter external fault selection 08-24=0 or 1. | | | | |
| EF6 External fault (S6) EF6 | External fault (Terminal S6) Active when 03-05= 25, and Inverter external fault selection 08-24=0 or 1. | | | | |
| CF07 Motor control fault CF07 | Motor control fault | | | <ul style="list-style-type: none"> SLV mode unable to run motor. | <ul style="list-style-type: none"> Perform rotational or stationary auto-tune Increase minimum output frequency (01-08) |
| FU fuse open FU | DC bus fuse blown DC fuse (Models 230V 50HP and above, 460V 75HP and above) open circuit. | | | <ul style="list-style-type: none"> IGBT damaged. Short circuit output terminals. | <ul style="list-style-type: none"> Check IGBTs Check for short circuit at inverter output. Replace inverter. |

| LED display | Description | • Possible causes | • Corrective action |
|---|---|---|--|
| LOPBT Low flow fault | Low flow fault | <ul style="list-style-type: none"> The feedback signal is disconnected. Feedback value is lower than minimum flow limit. | <ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is lower than minimum flow limit (23-51). |
|  | | | |
| HIPBT High flow fault | High flow fault | <ul style="list-style-type: none"> Feedback value is greater than maximum flow value. | <ul style="list-style-type: none"> Check feedback value Check if feedback value is lower than maximum flow limit (23-48). |
|  | | | |
| LPBFT Low pressure fault | Low pressure fault | <ul style="list-style-type: none"> The feedback signal is not connected. Feedback value is lower than minimum feedback value. | <ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is lower than minimum limit (23-15). |
|  | | | |
| OPBFT High pressure fault | High pressure fault | <ul style="list-style-type: none"> Feedback value is greater than maximum feedback value. | <ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is greater than maximum limit (23-12). |
|  | | | |
| LSCFT Low suction fault | Low suction fault | <ul style="list-style-type: none"> Low water flow or not enough suction Difference between setpoint and feedback value is too high. Output current is too low. | <ul style="list-style-type: none"> Check water flow Check feedback value Check output current |
|  | | | |
| CF00 Operator Communication Error | LCD keypad data communication fault | <ul style="list-style-type: none"> No communication between LCD keypad and inverter for more than 5 seconds after power up. | <ul style="list-style-type: none"> Disconnect the keypad and then reconnect. Replace the control board Check keypad cable |
| LCD display only* | | | |
| CF01 Operator Communication Error 2 | LCD keypad data communication fault | <ul style="list-style-type: none"> Communication errors between LCD keypad and inverter for more than 2 seconds. | <ul style="list-style-type: none"> Disconnect the keypad and then reconnect. Replace the control board Check keypad cable |
| LCD display only* | | | |
| CT Fault | Input voltage fault | <ul style="list-style-type: none"> Abnormal input voltage, too much noise or malfunctioning control board. | <ul style="list-style-type: none"> Check input voltage signal and the voltage on the control board. |
|  | | | |
| Double Communication Error | Both Profibus and Modbus communication selected | <ul style="list-style-type: none"> Two communication protocols are active simultaneously. | <ul style="list-style-type: none"> Select only one communication protocol. |
|  | | | |

| LED display | Description | Possible causes | Corrective action |
|--|--|--|---|
| PTC Signal Loss  | Motor PTC Signal Loss detected. | <ul style="list-style-type: none"> Motor PTC disconnected for more for more than 10 seconds | <ul style="list-style-type: none"> Check if MT terminal and GND terminal are connected. |
| OPR Disconnection  | Run command is set to keypad operation (00-02=0). Operator was removed during running. Parameter 16-09 determines if the inverter stops or displays a fault. | <ul style="list-style-type: none"> The inverter set for keypad run (00-02=0), Warning of operator disconnected/ removed occurs. | <ul style="list-style-type: none"> Check if operator has removed. |
| FBLSS PID Feedback Signal Loss  | When 23-19 > 0, the inverter will display a fault when the feedback pressure falls below the operation pressure setting (23-02) x detection proportion of loss pressure (23-19) for the times specified in parameters (23-18). | <ul style="list-style-type: none"> Feedback loss (23-19) is enabled feedback signal falls below Feedback device broken wire or not connected properly. | <ul style="list-style-type: none"> Check if the proportion of loss pressure (23-19) is set correctly. Make sure feedback sensor is wired correctly and PID feedback signal reads correctly. |
| SC Short Circuit  | Inverter output short circuit. | <ul style="list-style-type: none"> Short circuit or ground fault (08-23=1) occurs from the damage to motor, insulation deterioration or wire break. | <ul style="list-style-type: none"> Check motor and wiring. |

10.3 Warning / Self-diagnosis Detection Function

When the inverter detects a warning, the keypad displays a warning code (flash).

Note: The fault contact output does not energize on a warning and the inverter continues operation. When the warning is no longer active the keypad will return to its original state.


When the inverter detected a programming error (for example two parameters contradict each other or are set to an invalid setting), the keypad displays a self-diagnostics code.








Note: The fault contact output does not energize on a self-diagnostics error. While a self-diagnostics code is active the inverter does not accept a run command until the programming error is corrected.







Note: When a warning or self-diagnostic error is active the warning or error code will flash on the keypad. When the RESET key is pressed, the warning message (flash) disappears and returns after 5 sec. If the warning or self-diagnostic error still exists.








Refer to Table 10.3.1 for an overview, cause and corrective action for inverter warnings and self-diagnostic errors.






Table 10.3.1 warning / self-diagnosis and corrective actions








| LED display | Description | Possible causes | Corrective action |
|--|--|---|--|
| OV (flash) Over voltage |  DC bus voltage exceeds the OV detection level: 410Vdc: 230V class 820Vdc: 460V class (for 440V class, if input voltage 01-14 is set lower than 460V, the OV detection value will be decreased to 700Vdc) | <ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. | <ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters. |
| UV (flash) under voltage | | | |
| OH2 (flash) Inverter over heating warning | Inverter overheat warning Multi-function digital input set to 32. (Terminal S1 ~ S8) Active when 03-00 ~ 03-07 = 31). | <ul style="list-style-type: none"> Multifunction digital input overheat warning active. | <ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring |



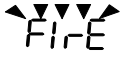




| LED display | Description | Possible causes | Corrective action |
|---|---|--|---|
|  | | | |
| OT (flash) over torque detection | Inverter output torque is higher than 08-15 (over torque detection level) for the time specified in 08-16. Parameter 08-14 = 0 to activate. | <ul style="list-style-type: none"> Load too heavy. | <ul style="list-style-type: none"> Check over torque detection parameters (08-15 / 08-16). Check and reduce motor load, check and operation duty cycle. |
|  | | | |
| UT (flash) under torque detection | Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 to activate. | <ul style="list-style-type: none"> Sudden drop in load. Belt break. | <ul style="list-style-type: none"> Check under torque detection parameters (08-19 / 08-20). Check load / application. |
|  | | | |
| bb1 (flash) External baseblock | External base block (Terminal S1) | <ul style="list-style-type: none"> Multifunction digital input external baseblock active. | <ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring |
|  | | | |
| bb2 (flash) External baseblock | External base block (Terminal S2) | | |
|  | | | |
| Bb3 (flash) External baseblock | External base block (Terminal S3) | | |
|  | | | |
| Bb4 (flash) External baseblock | External base block (Terminal S4) | | |
|  | | | |









| LED display | Description | Possible causes | Corrective action |
|---|--|--|---|
| bb5 (flash) External baseblock  | External base block (Terminal S5) | | |
| bb6 (flash) External baseblock  | External base block (Terminal S6) | <ul style="list-style-type: none"> • Multifunction digital input external baseblock active. | <ul style="list-style-type: none"> • Multi-function input function set incorrectly. • Check wiring |
| OL1 Motor overload  | Internal motor overload protection tripped, active when protection curve 08-05 = xxx1. | <ul style="list-style-type: none"> • Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Motor rated current (02-01) set incorrectly. • Load too heavy. | <ul style="list-style-type: none"> • Check V/f curve. • Check motor rated current • Check and reduce motor load, check and operation duty cycle. |
| OL2 Inverter overload  | Inverter thermal overload protection tripped. If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault. | <ul style="list-style-type: none"> • Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Inverter rating too small. • Load too heavy. | <ul style="list-style-type: none"> • Check V/f curve. • Replace inverter with larger rating. • Check and reduce motor load, check and operation duty cycle |
| CE (flash) communication error  | No Modbus communication received for 2 sec. Active when 09-07=3. | <ul style="list-style-type: none"> • Connection lost or wire broken. • Host stopped communicating. | <ul style="list-style-type: none"> • Check connection • Check host computer / software. |
| CLB over current protection level B  | Inverter current reaches the current protection level B. | <ul style="list-style-type: none"> • Inverter current too high. • Load too heavy. | <ul style="list-style-type: none"> • Check load and duty cycle operation. |





| LED display | Description | Possible causes | Corrective action |
|---|---|--|--|
| Retry (flash) retry  | Automatic reset activated, warning is displayed until restart delay time set (07-01) expires. | <ul style="list-style-type: none"> Parameter 07-01 set to a value greater than 0. Parameter 07-02 set to a value greater than 0. | <ul style="list-style-type: none"> Warning disappears after automatic reset. |
| F1 (flash) External fault (S1)  | External fault (Terminal S1) Active when 03-00=25, and Inverter external fault selection 08-24=2. | <ul style="list-style-type: none"> Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue. | <ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring Multi-function input function set incorrectly. Check wiring |
| EF2 (flash) External fault (S2)  | External fault (Terminal S2) Active when 03-01=25, and Inverter external fault selection 08-24=2. | | |
| EF3 (flash) External fault (S3)  | External fault (Terminal S3) Active when 03-02=25, and Inverter external fault selection 08-24=2. | | |
| EF4 (flash) External fault (S4)  | External fault (Terminal S4) Active when 03-03=25, and Inverter external fault selection 08-24=2. | | |
| EF5 (flash) External fault (S5)  | External fault (Terminal S5) Active when 03-04=25, and Inverter external fault selection 08-24=2. | | |
| EF6 (flash) External fault (S6)  | External fault (Terminal S6) Active when 03-05=25, and Inverter external fault selection 08-24=2. | | |

| LED display | Description | Possible causes | Corrective action |
|---|--|---|---|
| EF9 (flash) error of forward/reve rsal rotation  | Forward run and reverse run are active within 0.5 sec of each other. Stop method set by parameter 07-09. | <ul style="list-style-type: none"> Forward run and reverse run active (see 2-wire control). | <ul style="list-style-type: none"> Check run command wiring |
| SE01 Rang setting error  | Parameter setting falls outside the allowed range. | <ul style="list-style-type: none"> Some parameter ranges are determined by other inverter parameters which could cause an out of range warning when the dependency parameter is adjusted. Example: 02-00 > 02-01, 02-20 > 02-21, 00-12 > 00-13 etc...). | <ul style="list-style-type: none"> Check parameter setting. |
| SE02 Digital input terminal error  | Multi-function input setting error. | <ul style="list-style-type: none"> Multi-function digital input terminals (03-00 to 03-07) are set to the same function (not including ext. fault and not used.) or ①UP/DOWN commands are not set at the same time(they must be used together). ②UP/DOWN commands (08 and 09) and ACC/DEC commands (11) are set at the same time. ③Speed search 1(19, maximum frequency) and Speed search 2 (34, from the set frequency) are set at the same time. | <ul style="list-style-type: none"> Check multi-function input setting. |
| SE03 V/f curve error  | V/f curve setting error. | <ul style="list-style-type: none"> V/F curve setting error. ① 01-02 > 01-12 > 01-06 > 01-08; • (Fmax) (Fbase) (Fmid1) (Fmin) • ②01-16 > 01-24 > 01-20 > 01-22; • (Fmax2) (Fbase2)(Fmid1) (Fmin2) | <ul style="list-style-type: none"> Check V/F parameters |
| SE05 PID selection error  | PID selection error. | <ul style="list-style-type: none"> 10-00 and 10-01are set to the same analog input 1 (AI1) or 2 (AI2) | <ul style="list-style-type: none"> Check parameters 10-00 and 10-01. |

| LED display | Description | Possible causes | Corrective action |
|---|---|--|---|
| HPErr Model selection error  | Inverter capacity setting error: Inverter capacity setting 13-00 does not match the rated voltage. | <ul style="list-style-type: none"> Inverter capacity setting does not match voltage class (13-00). | <ul style="list-style-type: none"> Check inverter capacity setting 13-00. |
| SE09 PI setting error  | | | |
| FB (flash) PID feedback breaking  | PID feedback signal falls below level specified in 10-12 (PID feedback loss detection level) for the time specified in 10-13 (Feedback loss detection time). Active when parameter (10-11 = 1). | <ul style="list-style-type: none"> Feedback signal wire broken Feedback sensor broken. | <ul style="list-style-type: none"> Check feedback wiring Replace feedback sensor. |
| USP (flash) Unattended Start Protection  | | | |
| LFPB Low flow error  | Low flow error | <ul style="list-style-type: none"> The feedback signal is not connected. Due to HVAC feedback value is lower than limit of minimum flow. | <ul style="list-style-type: none"> Check feedback signal is correct and with right connection. Check if feedback value is lower than limit of minimum flow. |
| HFPB High flow error  | | | |
| LPBFT Low pressure error  | Low pressure error | <ul style="list-style-type: none"> The feedback signal is not connected. Due to feedback value of pump pressure is lower than limit of minimum flow. | <ul style="list-style-type: none"> Check feedback signal is correct and with connection. Check if feedback value of pressure is lower than limit of minimum pressure. |
| | | | |

| LED display | Description | Possible causes | Corrective action |
|---|---|--|--|
| OPBFT High pressure error | High pressure error | <ul style="list-style-type: none"> Due to feedback value of pump pressure is lower than limit of maximum flow. | <ul style="list-style-type: none"> Check feedback signal is correct. Check if feedback value of pressure is lower than limit of maximum pressure. |
|  | | | |
| LSCFT Low suction error | Inadequate suction error | <ul style="list-style-type: none"> Insufficient water of supply tank leads to insufficient suction. PID difference is higher than its level or current is lower than output current level. | <ul style="list-style-type: none"> Check if water of supply tank is enough, and water supply is regular. Check PID difference is higher than its level or current is lower than output current level |
|  | | | |
| FIRE Fire override mode | Fire override mode | <ul style="list-style-type: none"> Fire override mode is active | <ul style="list-style-type: none"> None (Fire override mode is not a kind of warning). |
|  | | | |
| SE10 PUMP/HVAC Setting error | PUMP/HVAC settings of inverter error | <ul style="list-style-type: none"> PUMP selection of inverter (23-02)> (23-03). HVAC selection of inverter (23-46)> (23-47). | <ul style="list-style-type: none"> Check pump selection of inverter (23-02) and (23-03) settings. Check HVAC selection of inverter (23-02) and (23-03) settings. |
|  | | | |
| COPUP PUMP communication breaking error | Breaking error of multiple pumps communication | <ul style="list-style-type: none"> Communication breaking or disconnection of pump cascade control. | <ul style="list-style-type: none"> Check if it has setting issue or is not properly connected. |
|  | | | |
| Parameter Setting Error | Parameter setting error | <ul style="list-style-type: none"> Error of Parameter setting occurs. | <ul style="list-style-type: none"> Refer to the instruction manual or this parameter is selected to be disabled. |
|  | | | |
| Warning of Direct Start | When 07-04 is set to 1, the inverter cannot start directly but displays the warning signal. | <ul style="list-style-type: none"> Set the digital input terminal (S1-S6) to run and simultaneously set 07-04=1. | <ul style="list-style-type: none"> Check the digital input terminal and disconnect it. Then reconnect the DI terminal after the setting delay time (07-05) ends. |
|  | | | |

| LED display | Description | Possible causes | Corrective action |
|---|--|---|---|
| External Terminal Stop Error  | Stop key pressed during running when Inverter Run command set for External (00-02=1) terminal control. | <ul style="list-style-type: none"> Stop key pressed while running from external terminals | <ul style="list-style-type: none"> Remove the run command from external terminal |
| ADC Voltage Error  | | | |
| EEPROM Archiving Error  | EEPROM memory error | <ul style="list-style-type: none"> EEPROM memory error EEPROM Checksum fault on startup. | <ul style="list-style-type: none"> Cycle power to the inverter and if EEPROM error occurs again replace control board. Contact TECO for more information. |
| Control Board Error  | | | |
| Wrong running direction Error  | Inverter is only allowed to run in one direction; opposite direction command is not allowed. | <ul style="list-style-type: none"> Run command for opposite direction active on the terminal of control board. | <ul style="list-style-type: none"> Remove run command for opposite direction. |
| PTC Signal Loss  | | | |
| Parameters Locked  | Parameter password has been set and parameters have been locked | <ul style="list-style-type: none"> Parameter password function (13-07) starts. | <ul style="list-style-type: none"> Enter correct password Set parameter 13-07 |
| Password Setting Error  | | | |
| Operator Reading Error RDE* | Operator cannot read data from the inverter. | <ul style="list-style-type: none"> Operator is unable to communicate with the inverter. | <ul style="list-style-type: none"> Check connection between operator and inverter. |

| LED display | Description | Possible causes | Corrective action |
|---|---|--|---|
| Operator Writing Error | Operator cannot write data to the inverter. | <ul style="list-style-type: none"> Operator is unable to communicate with the inverter. KVA setting does not match Operator firmware not compatible | <ul style="list-style-type: none"> Check the inverter's firmware version/ control mode/ models |
| WRE* | | | |
| Operator Verifying Error | Operator data does not match inverter data. | <ul style="list-style-type: none"> The data in the operator is different from the inverter. | <ul style="list-style-type: none"> Check connection between operator and inverter. Check drive settings. |
| VRYE* | | | |
| Repeat Run Command | The inverter is only allowed to run in one direction and cannot run in forward and reverse direction simultaneously. | <ul style="list-style-type: none"> Forward and reverse command present at inverter terminals. | <ul style="list-style-type: none"> Remove run reverse command from the external terminal. |
|  | | | |
| Operator Read Prohibit | Operator backup parameter function is disabled. Check if parameter 16-08 is set to 0. | <ul style="list-style-type: none"> Parameter 16-08 set to 0. | <ul style="list-style-type: none"> Set parameter 16-08 to 1 (Allow operator to read inverter parameters and save to the operator). |
| RDP* | | | |
| External Emergency Stop | External emergency stop input active. | <ul style="list-style-type: none"> Parameter 03-00~03-08 is set to 14 (Emergency stop is enabled.) | <ul style="list-style-type: none"> Remove external emergency stop command from inverter control terminals. |
|  | | | |
| Zero Speed Stop Warning | Output frequency command falls below the minimum output frequency (01-08) and DC brake is disabled. | <ul style="list-style-type: none"> Frequency command set too low. | <ul style="list-style-type: none"> Increase frequency command. |
|  | | | |
| Overload of Air Compressor | If the inverter's output current rises above OL4 current level (23-69) for the time specified in OL4 Delay Time (23-70) passed. Inverter will automatically decelerate to stop and displays a warning signal. | <ul style="list-style-type: none"> Current level (23- 69) set too low for compressor application. | <ul style="list-style-type: none"> Check compressor load. |
|  | | | |

10.4 Auto-tuning Error

When a fault occurs during auto-tuning of a standard AC motor, the display will show the “AtErr” fault and the motor stops. The fault information is displayed in parameter 17-11.

Note: The fault contact output does not energize with an auto-tuning fault. Refer to Table 10.4.1, for fault information during tuning, cause and corrective action.

Table 10.4.1 Auto-tuning fault and corrective actions

| Error | Description | Cause | Corrective action |
|-------|--|---|--|
| 01 | Motor data input error. | <ul style="list-style-type: none"> Motor Input data error during auto-tuning. Inverter output current does not match motor rated current. | <ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check inverter capacity |
| 02 | Motor lead to lead resistance R1 tuning error. | <ul style="list-style-type: none"> Auto-tuning is not completed within the specified time Auto-tuning results fall outside parameter setting range. Motor rated current exceeded. Motor was disconnected. | <ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection. Disconnect motor load. Check inverter current detection circuit and DCCTs. Check motor installation. |
| 03 | Motor leakage inductance tuning error. | | |
| 04 | Motor rotor resistance R2 tuning error. | | |
| 05 | Motor mutual inductance Lm tuning error. | | |
| 07 | Deadtime compensation detection error | | |
| 06 | Motor encoder error | <ul style="list-style-type: none"> PG feedback noise | <ul style="list-style-type: none"> Check motor rated current. Check PG card grounding. |
| 08 | Motor acceleration error (Rotational type auto-tuning only). | <ul style="list-style-type: none"> Motor fails to accelerate in the specified time (00-14= 20sec). | <ul style="list-style-type: none"> Increase acceleration time (00-14). Disconnect motor load. |
| 09 | Other | <ul style="list-style-type: none"> No load current is higher than 70% of the motor rated current. Torque reference exceeds 100%. Errors other than ATE01~ATE08. | <ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection. |

10.5 PM Motor Auto-tuning Error

When a fault occurs during auto-tuning of a PM motor, the display will show the “IPErr” fault and the motor stops. The fault information is displayed in parameter 22-18.

Note: The fault contact output does not energize with an auto-tuning fault. Refer to Table 10.5.1, for fault information during tuning, cause and corrective action.

Table 10.5.1 Auto-tuning fault and corrective actions for PM motor

| Error | Description | Cause | Corrective action |
|----------------|--|---|---|
| 01 | Magnetic pole alignment tuning failure (static). | <ul style="list-style-type: none"> Inverter output current does not match motor current. | <ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity |
| 02 - 04 | Reserved | | |
| 05 | Circuit tuning time out. | <ul style="list-style-type: none"> System abnormality during circuit tuning. | <ul style="list-style-type: none"> Check for active protection functions preventing auto-tuning. |
| 06 | Encoder error | <ul style="list-style-type: none"> PG feedback noise | <ul style="list-style-type: none"> Check motor rated current. Check PG card grounding. |
| 07 | Other motor tuning errors. | <ul style="list-style-type: none"> Other tuning errors. | <ul style="list-style-type: none"> Check the motor tuning data (22-02). Check motor connection. |
| 08 | Reserved | | |
| 09 | Current out of range during circuit tuning. | <ul style="list-style-type: none"> Inverter output current does not match motor current. | <ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity |
| 10 | Reserved | | |
| 11 | Parameter tuning time out. | <ul style="list-style-type: none"> Error relationship between voltage and current. | <ul style="list-style-type: none"> Check if value for parameter 22-11 is set too low, value cannot exceed 100% of the inverter rated current. Check motor connection. |

11. Inverter Peripheral devices and Options

11.1 Braking Resistors and Braking Units

Inverters ratings 230V 5 ~ 30HP / 460V 5 ~ 40HP (IP20) have a built-in braking transistor. For applications requiring more braking torque an external braking resistor can be connected to terminals B1 / P and B2; for inverter ratings above 230V 40HP / 460V 50HP (IP20), an external braking unit (connected to ⊕ - ⊖ of the inverter) and a braking resistor (connected to two ends of the detection module B-P0) is required.

Table 11.1 List of braking resistors and braking units (IP20)

| Inverter | | | Braking unit | | Braking resistor | | | | Braking torque (Peak / Continues) | Minimum resistance | |
|------------|-----|-------------------|--------------|---------|------------------|------------------------|----------|-------------------------------|--------------------------------------|--------------------|------|
| V | HP | Rated Current (A) | Model | Qty Req | Part Number | Resistor specification | Qty Req. | Resistor dimensions (L*W*H)mm | | (Ω) | (W) |
| 3φ 230V | 5 | 14.5 | - | - | JNBR-390W40 | 390W/40Ω | 1 | 395*34*78 | 126%,10%ED | 25 | 680 |
| | 7.5 | 21 | - | - | JNBR-520W30 | 520W/30Ω | 1 | 400*40*100 | 114%,10%ED | 21 | 800 |
| | 10 | 30 | - | - | JNBR-780W20 | 780W/20Ω | 1 | 400*40*100 | 126%,10%ED | 18 | 900 |
| | 15 | 40 | - | - | JNBR-2R4KW13R6 | 2400W/13.6Ω | 1 | 535*50*110 (*2 pcs) | 124%, 10%ED | 11 | 1500 |
| | 20 | 56 | - | - | JNBR-3KW10 | 3000W/10Ω | 1 | 615*50*110 (*2 pcs) | 126%, 10%ED | 9.5 | 1800 |
| | 25 | 69 | - | - | JNBR-4R8KW8 | 4800W/8Ω | 1 | 535*50*110 (*4 pcs) | 126%, 10%ED | 7.2 | 2400 |
| | 30 | 79 | - | - | JNBR-4R8KW6R8 | 4800W/6.8Ω | 1 | 535*50*110 (*4 pcs) | 124%, 10%ED | 6.5 | 2400 |
| | 40 | 110 | JNTBU-230 | 2 | JNBR-3KW10 | 3000W/10Ω | 2 | 615*50*110 (*4 pcs) | 126%, 10%ED | 2.7 | 3000 |
| | 50 | 138 | JNTBU-230 | 2 | JNBR-3KW10 | 3000W/10Ω | 2 | 615*50*110 (*4 pcs) | 105%, 10%ED | 2.7 | 3000 |
| | 60 | 169 | JNTBU-230 | 2 | JNBR-4R8KW6R8 | 4800W/6.8Ω | 2 | 535*50*110 (*8 pcs) | 124%, 10%ED | *note1 | |
| | 75 | 200 | JNTBU-230 | 3 | JNBR-4R8KW8 | 4800W/8Ω | 3 | 535*50*110 (*12 pcs) | 124%, 10%ED | *note1 | |
| | 100 | 250 | JNTBU-230 | 3 | JNBR-4R8KW6R8 | 4800W/6.8Ω | 3 | 535*50*110 (*12 pcs) | 116%, 10%ED | *note1 | |
| | 125 | 312 | JNTBU-230 | 4 | JNBR-4R8KW6R8 | 4800W/6.8Ω | 4 | 535*50*110 (*16 pcs) | 119%,10%ED | *note1 | |
| | 150 | 400 | JNTBU-230 | 5 | JNBR-4R8KW6R8 | 4800W/6.8Ω | 4 | 535*50*110 (*16 pcs) | 108%,10%ED | *note1 | |

| Inverter | | | Braking unit | | Braking resistor | | | | Braking torque (Peak / Continues) | Minimum resistance | |
|------------|-----|-------------------|--------------|----------------|------------------|------------------------|-------------------------|-------------------------------|--------------------------------------|--------------------|------|
| V | HP | Rated Current (A) | Model | Qty Req | Part Number | Resistor specification | Qty Req. | Resistor dimensions (L*W*H)mm | | (Ω) | (W) |
| 3φ 460V | 5 | 9.2 | - | - | JNBR-400W150 | 400W/150Ω | 1 | 395*34*78 | 133%, 10%ED | 60 | 1200 |
| | 7.5 | 11.1 | - | - | JNBR-600W130 | 600W/130Ω | 1 | 400*40*100 | 107%, 10%ED | 60 | 1200 |
| | 10 | 17.5 | - | - | JNBR-800W100 | 800W/100Ω | 1 | 535*50*110 | 105%, 10%ED | 43 | 1600 |
| | 15 | 23 | - | - | JNBR-1R6KW50 | 1600W/50Ω | 1 | 615*50*110 | 133%, 10%ED | 43 | 1600 |
| | 20 | 31 | - | - | JNBR-1R5KW40 | 1500W/40Ω | 1 | 615*50*110 | 126%, 10%ED | 39 | 1600 |
| | 25 | 38 | - | - | JNBR-4R8KW32 | 4800W/32Ω | 1 | 535*50*110 (*4 pcs) | 126%, 10%ED | 22 | 3000 |
| | 30 | 44 | - | - | JNBR-4R8KW27R2 | 4800W/27.2Ω | 1 | 535*50*110 (*4 pcs) | 124%, 10%ED | 13.5 | 4800 |
| | 40 | 54 | - | - | JNBR-6KW20 | 6000W/20Ω | 1 | 615*50*110 (*4 pcs) | 124%, 10%ED | 13.5 | 4800 |
| | 50 | 72 | JNTBU-430 | 2 | JNBR-4R8KW32 | 4800W/32Ω | 2 | 535*50*110 (*8 pcs) | 126%, 10%ED | 11 | 3000 |
| | 60 | 88 | JNTBU-430 | 2 | JNBR-4R8KW27R2 | 4800W/27.2Ω | 2 | 535*50*110 (*8 pcs) | 124%, 10%ED | 11 | 3000 |
| | 75 | 103 | JNTBU-430 | 2 | JNBR-6KW20 | 6000W/20Ω | 2 | 615*50*110 (*8 pcs) | 133%, 10%ED | 11 | 3000 |
| | 100 | 145 | JNTBU-430 | 3 | JNBR-4R8KW27R2 | 4800W/27.2Ω | 3 | 535*50*110 (*12 pcs) | 113%, 10%ED | *note1 | |
| | 125 | 165 | JNTBU-430 | 3 | JNBR-6KW20 | 6000W/20Ω | 3 | 615*50*110 (*12 pcs) | 121%, 10%ED | *note1 | |
| | 150 | 208 | JNTBU-430 | 3 | JNBR-6KW20 | 6000W/20Ω | 3 | 615*50*110 (*12 pcs) | 104%, 10%ED | *note1 | |
| | 175 | 250 | JNTBU-430 | 5 | JNBR-4R8KW27R2 | 4800W/27.2Ω | 5 | 535*50*110 (*20 pcs) | 109%, 10%ED | *note1 | |
| 215 | 296 | JNTBU-430 | 6 | JNBR-4R8KW27R2 | 4800W/27.2Ω | 6 | 535*50*110 (*24 pcs) | 107%, 10%ED | *note1 | | |
| 250 | 328 | JNTBU-430 | 5 | JNBR-6KW20 | 6000W/20Ω | 5 | 615*50*110 (*20 pcs) | 105%, 10%ED | *note1 | | |

*1: Minimum resistance is the acceptable minimum value of the braking resistor for a single braking unit.

Note: Keep sufficient space between inverter, braking unit and braking resistor and ensure proper cooling is provided for.

11.2 AC Line Reactors

An AC line reactor can be used for any of the following:

- Capacity of power system is much larger than the inverter rating.
- Inverter mounted close to the power system (in 33ft / 10 meters).
- Reduce harmonic contribution (improve power factor) back to the power line.
- Protect inverter input diode front-end by reducing short-circuit current.
- Minimize overvoltage trips due to voltage transients.

Please select the AC line reactor based on the inverter rating according to the following table.

Table11.2.1 List of AC Line Reactors (3%) - Chassis

| Model | | AC reactor | |
|------------------|----------|-------------|-------------------|
| Voltage | HP | Part Number | Rated Current (A) |
| 3 ϕ 230V | 5 | KDRULB22L | 16.7 |
| | 7.5 | KDRULB23L | 24.2 |
| | 10 | KDRULD25L | 30.8 |
| | 15 | KDRULD24L | 46.2 |
| | 20 | KDRULD26L | 59.4 |
| | 25 | KDRULC22L | 74.8 |
| | 30 | KDRULF24L | 88 |
| | 40 | KDRULF25L | 114 |
| | 50 | KDRULF26L | 143 |
| | 60 | KDRULH22L | 169 |
| | 75 | KDRULI23L | 211 |
| | 100 | KDRULI24L | 273 |
| | 125 | KDRULG22L | 377 |
| 3 ϕ 460V | 5/7.5 | KDRULA3L | 7.6 |
| | 10 | KDRULA4L | 11 |
| | 15 | KDRULA5L | 14 |
| | 20 | KDRULB2L | 21 |
| | 25 | KDRULB1L | 27 |
| | 30 | KDRULD1L | 34 |
| | 40 | KDRULD2L | 40 |
| | 50 | KDRULC1L | 52 |
| | 60 | KDRULF2L | 65 |
| | 75 | KDRULF4L | 77 |
| | 100 | KDRULF3L | 96 |
| | 125 | KDRULH3L | 124 |
| | 150 | KDRULH2L | 156 |
| | 175/215 | KDRULH1L | 180 |
| 250 | KDRULG3L | 240 | |

Contact TWMC for any assistance

Note: AC reactors listed in this table can only be used for the inverter input side. Do not connect AC reactor to the inverter output side. Both 230V class 60HP~125HP (IP20) and 460V class 100HP~425HP (IP20) have built-in DC reactors. If required by the application an AC reactor may be added.

11.3 Output Filters

Table 11.3 List of Output Filters

| Model | | | |
|---------------|-----|---------------------------|-------------|
| Input Voltage | HP | Rated Current(A) HD/ND | Part Number |
| 460V 3Ø | 1 | 3 | V1K3A00 |
| | 2 | 4 | V1K4A00 |
| | 3 | 6 | V1K6A00 |
| | 5 | 8 | V1K8A00 |
| | 7.5 | 12 | V1K12A00 |
| | 10 | 18 | V1K18A00 |
| | 15 | 25 | V1K25A00 |
| | 20 | 27 | V1K27A00 |
| | 25 | 35 | V1K35A00 |
| | 30 | 45 | V1K45A00 |
| | 40 | 55 | V1K55A00 |
| | 50 | 80 | V1K80A00 |
| | 60 | 80 | V1K80A00 |
| | 75 | 110 | V1K110A00 |
| | 100 | 130 | V1K130A00 |
| | 125 | 160 | V1K160A00 |
| | 150 | 200 | V1K200A00 |
| 200 | 250 | V1K250A00 | |
| 250 | 305 | V1K305A00 | |

Contact TWMC for any assistance

11.4 Input Current and Fuse Specifications

230V class (IP20)

| Model | Horse power | KVA | 100% of rated output current | Rated input current | Fuse rating |
|--------------|-------------|------|------------------------------|---------------------|-------------|
| F510-2005-C3 | 5 | 5.5 | 14.5 | 16 | 30 |
| F510-2008-C3 | 7.5 | 8.0 | 21 | 22.3 | 45 |
| F510-2010-C3 | 10 | 11.4 | 30 | 31.6 | 60 |
| F510-2015-C3 | 15 | 15 | 40 | 41.7 | 80 |
| F510-2020-C3 | 20 | 21 | 56 | 60.9 | 125 |
| F510-2025-C3 | 25 | 26 | 69 | 75 | 150 |
| F510-2030-C3 | 30 | 30 | 79 | 85.9 | 175 |
| F510-2040-C3 | 40 | 42 | 110 | 119.6 | 225 |
| F510-2050-C3 | 50 | 53 | 138 | 150 | 275 |
| F510-2060-C3 | 60 | 64 | 169 | 186 | 325 |
| F510-2075-C3 | 75 | 76 | 200 | 232 | 400 |
| F510-2100-C3 | 100 | 95 | 250 | 275 | 500 |
| F510-2125-C3 | 125 | 119 | 312 | 343 | 600 |
| F510-2150-C3 | 150 | 152 | 400 | 440 | 800 |

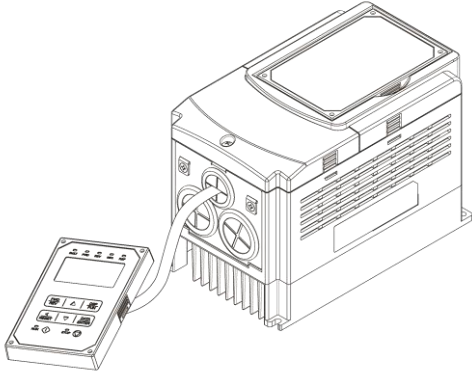
460V class (IP20)

| Model | Horse power | KVA | 100% of rated output current | Rated input current | Fuse rating |
|--------------|-------------|------|------------------------------|---------------------|-------------|
| F510-4005-C3 | 5 | 7.0 | 9.2 | 9.6 | 20 |
| F510-4008-C3 | 7.5 | 8.5 | 11.1 | 11.6 | 20 |
| F510-4010-C3 | 10 | 13.3 | 17.5 | 18.2 | 30 |
| F510-4015-C3 | 15 | 18 | 23 | 24 | 40 |
| F510-4020-C3 | 20 | 24 | 31 | 32.3 | 50 |
| F510-4025-C3 | 25 | 29 | 38 | 41.3 | 70 |
| F510-4030-C3 | 30 | 34 | 44 | 47.8 | 80 |
| F510-4040-C3 | 40 | 41 | 54 | 58.7 | 100 |
| F510-4050-C3 | 50 | 55 | 72 | 75 | 125 |
| F510-4060-C3 | 60 | 67 | 88 | 95.7 | 150 |
| F510-4075-C3 | 75 | 79 | 103 | 112 | 200 |
| F510-4100-C3 | 100 | 111 | 145 | 141 | 250 |
| F510-4125-C3 | 125 | 126 | 165 | 181 | 300 |
| F510-4150-C3 | 150 | 159 | 208 | 229 | 350 |
| F510-4175-C3 | 175 | 191 | 250 | 275 | 500 |
| F510-4215-C3 | 215 | 226 | 296 | 325 | 600 |
| F510-4250-C3 | 250 | 250 | 328 | 360 | 700 |

11.5 Other Options

A. Blank cover and keypad extension cable

When used for remote control purposes, the keypad can be removed and remotely connected with an extension cable. Extension cables are available in the following lengths: 1m (3.3ft), 2m (6.6ft), 3m (10ft), and 5m (16.4ft).



| Name | Model | specification |
|---------------------------|------------|--------------------|
| LED digital operator wire | JN5-CB-01M | 1m (3.3ft) |
| | JN5-CB-02M | 2m (6.6ft) |
| | JN5-CB-03M | 3m (10ft) |
| | JN5-CB-05M | 5m (16.4ft) |

When using a remote mount keypad a blank cover can be installed in place of the original keypad to prevent dust and debris from entering the inverter.



Blank keypad cover

| Name | Model | specification |
|-------------|------------|---------------|
| Blank cover | JN5-OP-A03 | Blank cover |

B. 1 to 8 Pump Card

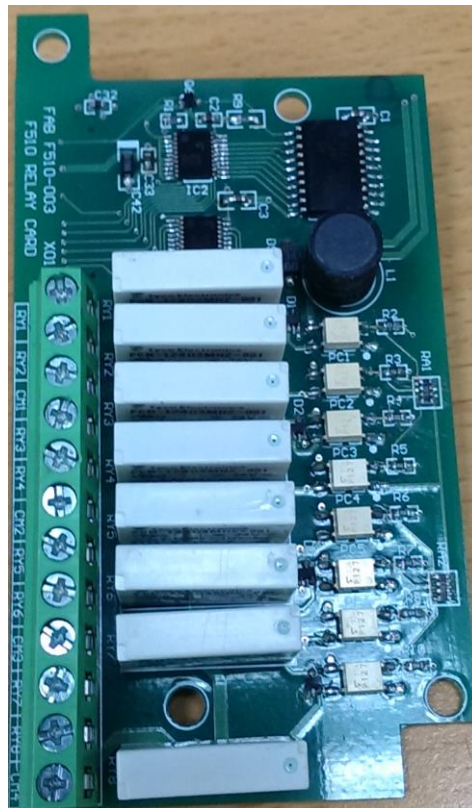
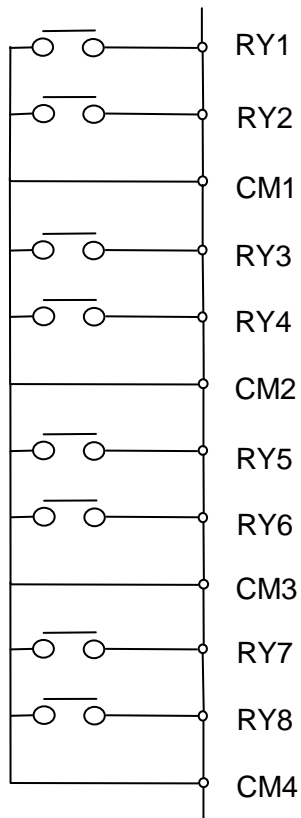
Refer to instruction manual of the option card on how to install.

JN5-IO-8DO Card: 8 Relay Output Card.

Terminals of JN5-IO-8DO:

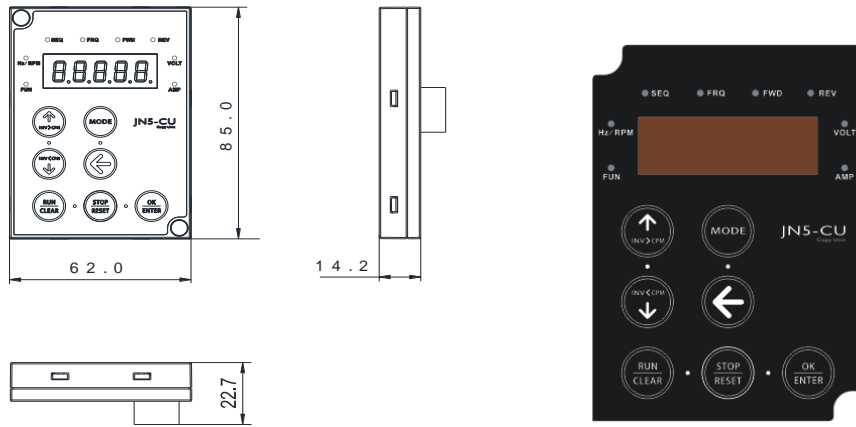
| Terminal | Description |
|----------|-----------------------------|
| RY1~RY8 | Relay1~Relay8 Form A output |
| CM1~CM4 | Common terminal output |

Wiring of JN5-IO-8DO (Example):



C. Copy Unit (JN5-CU)

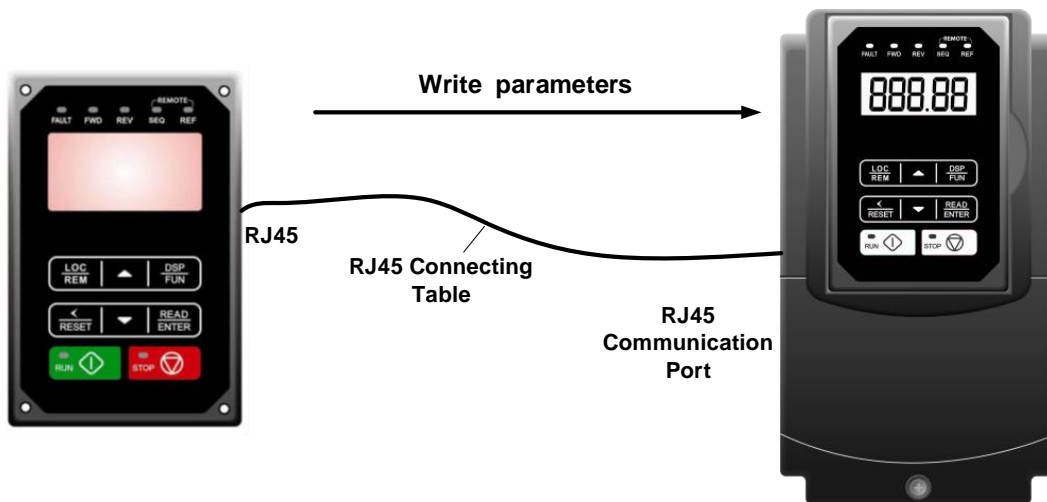
The copy unit is used to copy an inverter parameter setup to another inverter. The copy unit saves time in applications with multiple inverters requiring the same parameter setup.



Copy Unit (JN5-CU) dimensions

D. Copy Module (JN5-CU-M)

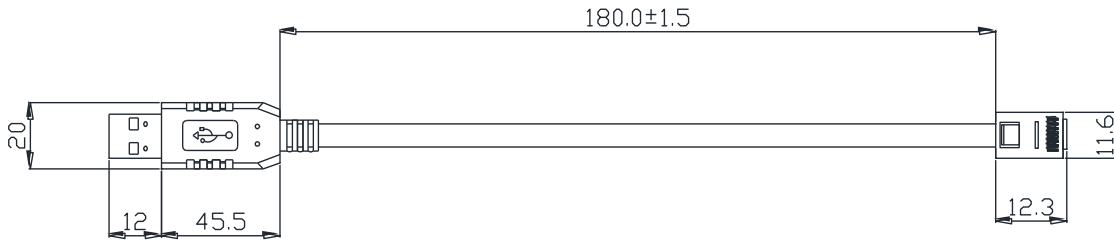
The copy module is used to copy up to 128 parameters from one inverter to another inverter.



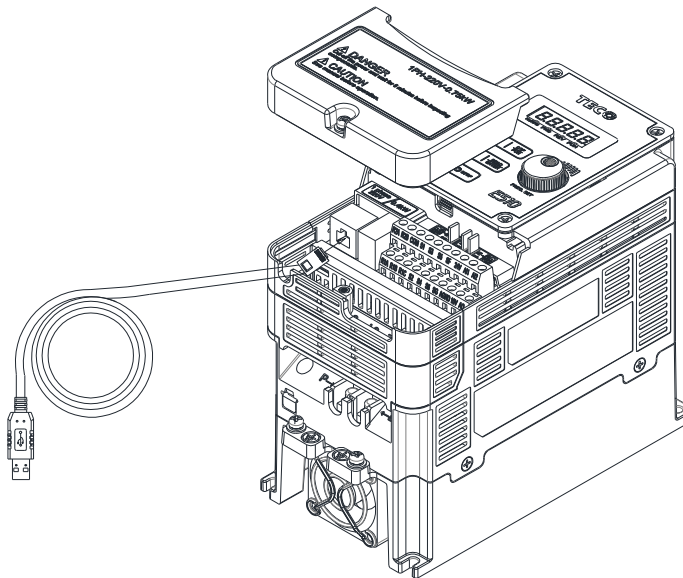
E. RJ45 to USB Communication Cable (6ft / 1.8m) (JN5-CM-USB)

The communication cable is used to communicate with the TECO Link software directly to the inverter using the PC USB port.

- Cable:



- Connect to the RS45 port:



11.6 Communication options

(a) PROFIBUS communication interface module (JN5-CM-PDP)

For wiring example and communication setup refer to JN5-CM-PDP communication option manual.

(b) DEVICENET communication interface module (JN5-CM-DNET)

For wiring example and communication setup refer to JN5-CM-DNET communication option manual.

(c) CANopen communication interface module (JN5-CM-CAN)

For wiring example and communication setup refer to JN5-CM-VAN communication option manual.

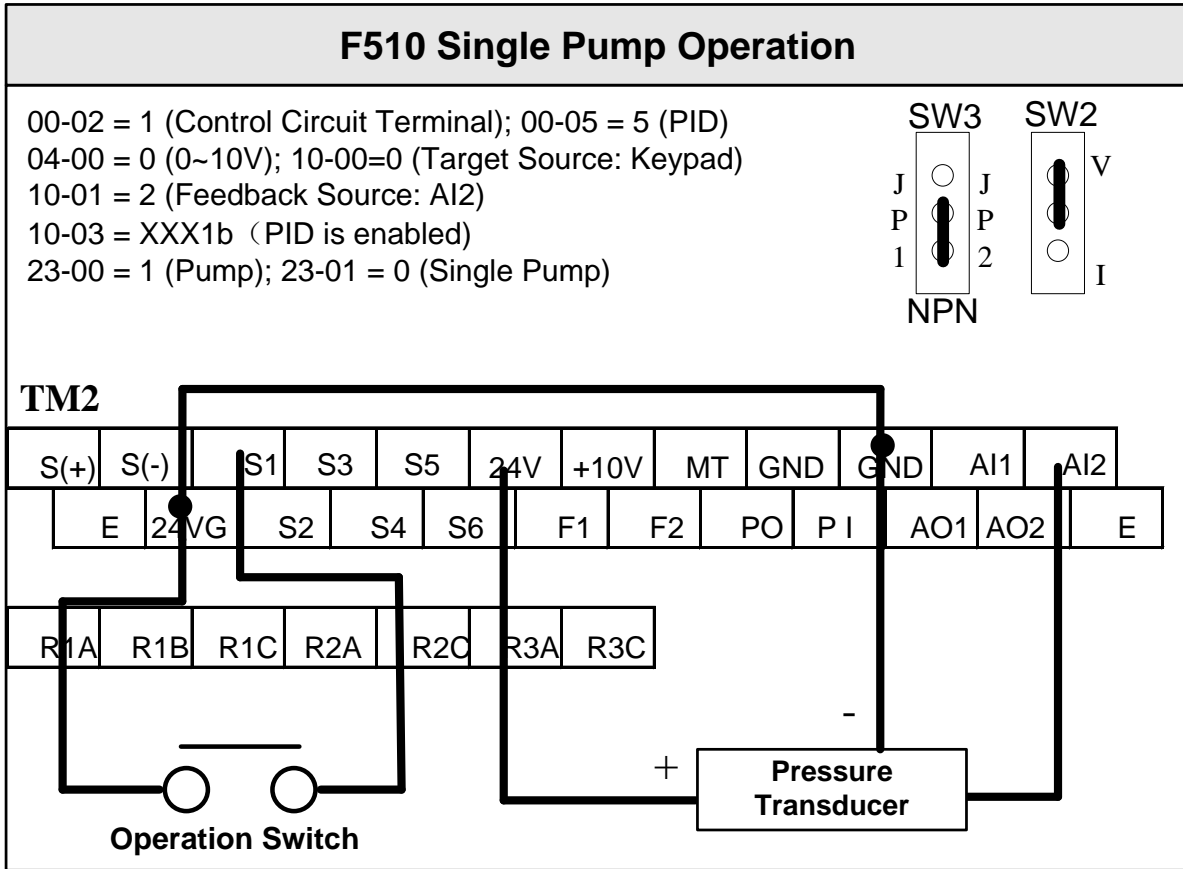
(d) TCP-IP communication interface module (JN5-CM-TCPIP)

For wiring example and communication setup refer to JN5-CM-TCPIP communication option manual.

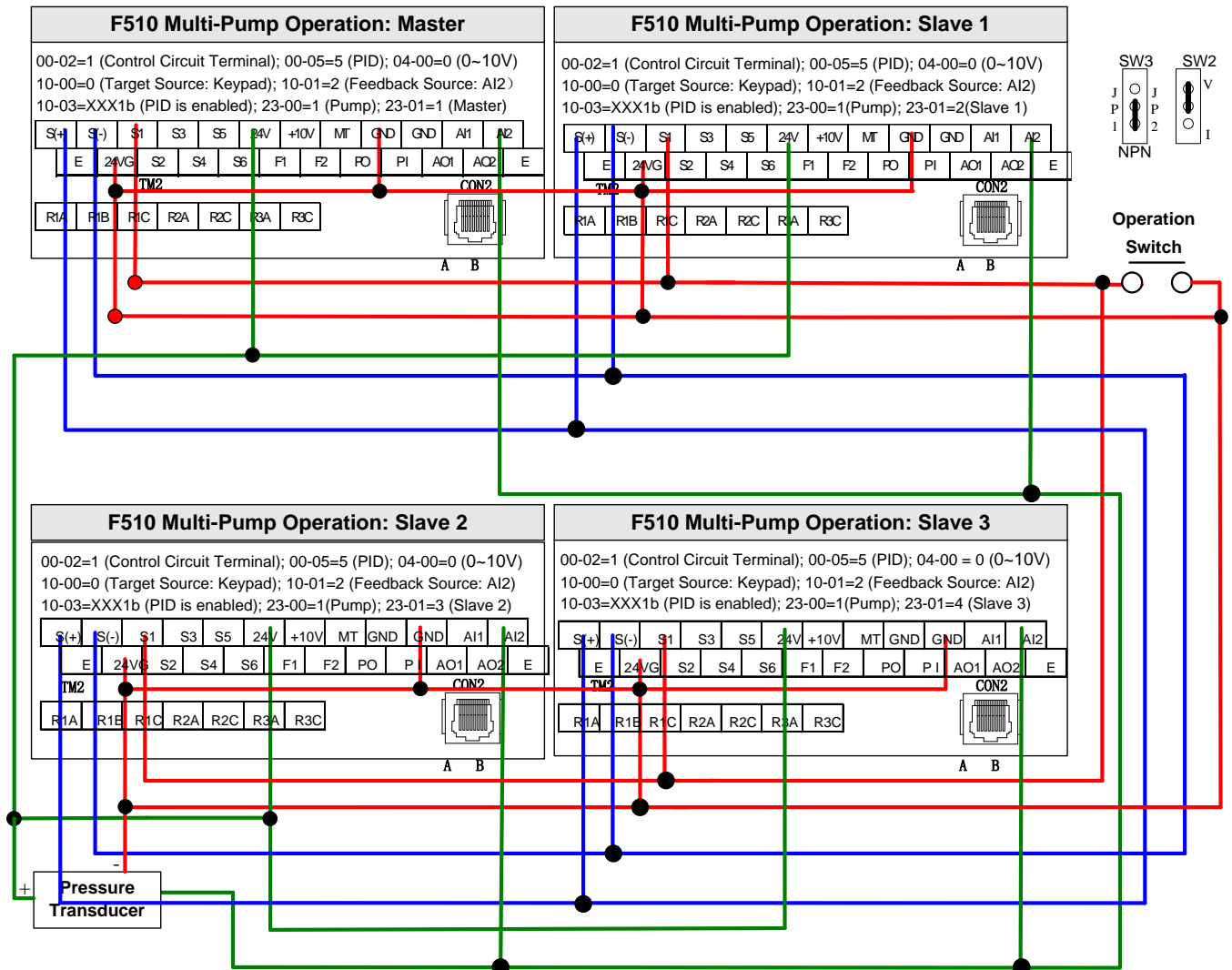
Appendix A: Single and Multi-Pump Wiring

■ PUMP Wiring Diagram for Pressure Sensor of Voltage Type

Single Pump:

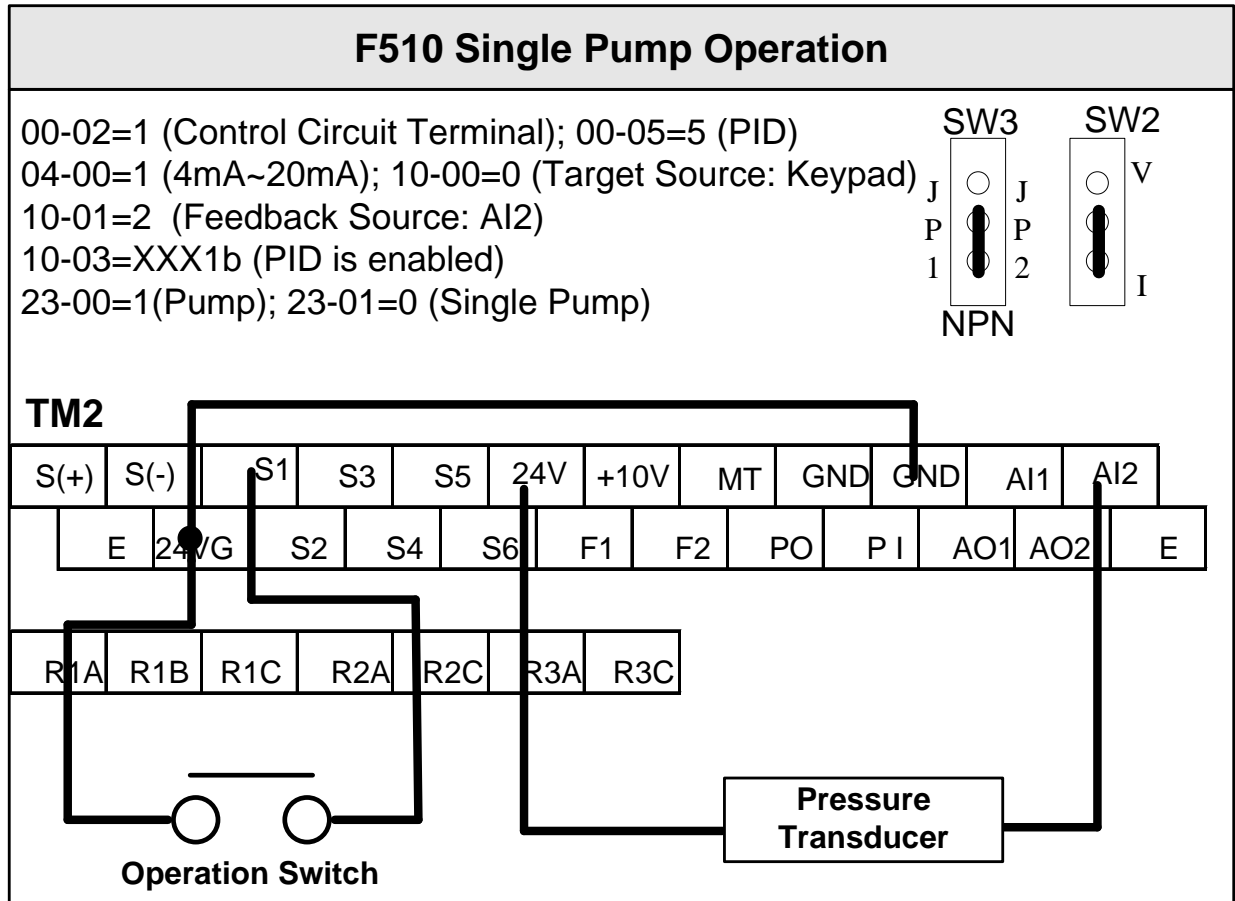


Multi-Pump:

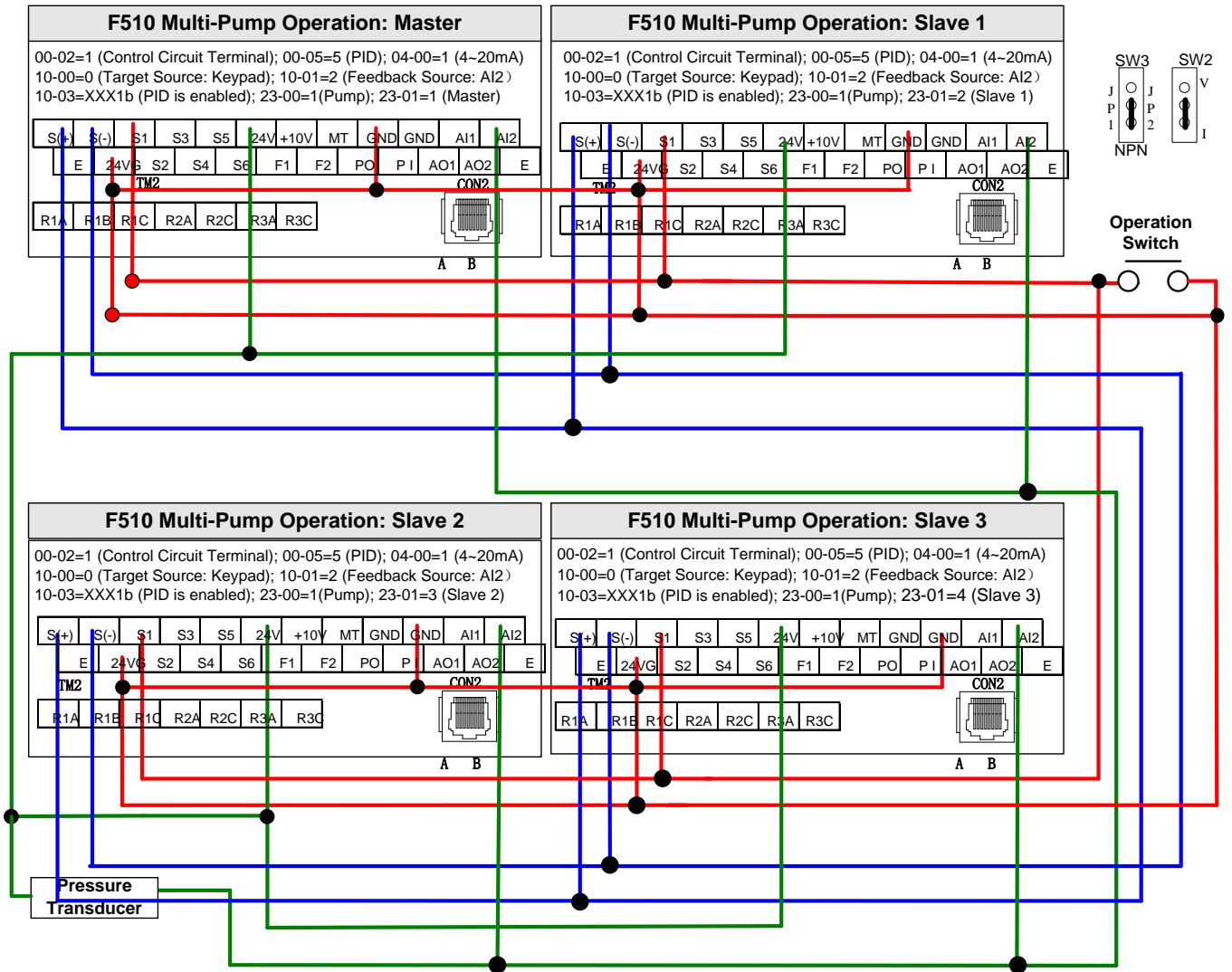


■ PUMP Wiring Diagram for Pressure Sensor of Current Type

Single Pump:



Multi-Pump:



Notes:

1. Check position of dip switch SW2 and SW3.
2. It is required to reconnect after setting Master/ Follower.
3. 24VG and GND have to be connected together.
4. When the communication mode is selected for multiple pumps in parallel connection (09-01=3), baud rate settings (09-02) of both Master and Follower have to be the same. Refer to parameter 23-31.
5. When wiring pressure sensor to multi-pump units make sure to set Follower parameter 04-07(AI2 Gain) =252.0% and 04-08(AI1 Bias) =25.0%.

Appendix B: UL Instructions

Danger

Electric Shock Hazard

Do not connect or disconnect wiring while the power is on.
Failure to comply will result in death or serious injury.

Warning

Electric Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show inverters without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the inverters and run the inverters according to the instructions described in this manual.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the inverter before touching any components.

Do not allow unqualified personnel to perform work on the inverter.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of inverters.

Do not perform work on the inverter while wearing loose clothing, jewelry, or lack of eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the inverter.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in death or serious injury.

Warning

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the inverter matches the voltage of the incoming power supply before applying power.

Do not use improper combustible materials.

Failure to comply could result in death or serious injury by fire. Attach the inverter to metal or other noncombustible material.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the inverter and circuit boards.

Failure to comply may result in ESD damage to the inverter circuitry.

Never connect or disconnect the motor from the inverter while the inverter is outputting voltage.

Improper equipment sequencing could result in damage to the inverter.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the inverter.

Do not modify the inverter circuitry.

Failure to comply could result in damage to the inverter and will void warranty. TECO is not responsible for any modification of the product made by the user. This product must not be modified.

Check all the wiring to ensure that all connections are correct after installing the inverter and connecting any other devices.

Failure to comply could result in damage to the inverter.

❖ **UL Standards**

The UL/cUL mark applies to products in the United States and Canada and it means that UL has performed product testing and evaluation and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.



❖ **UL Standards Compliance**

This inverter is tested in accordance with UL standard UL508C and complies with UL requirements. To ensure continued compliance when using this inverter in combination with other equipment, meet the following conditions:

■ **Installation Area**

Do not install the inverter to an area greater than pollution severity 2 (UL standard).

■ Main Circuit Terminal Wiring

UL approval requires crimp terminals when wiring the inverter's main circuit terminals. Use crimping tools as specified by the crimp terminal manufacturer. TECO recommends crimp terminals made by NICHIFU for the insulation cap.

The table below matches inverter models with crimp terminals and insulation caps. Orders can be placed with a TECO representative or directly with the TECO sales department.

Closed-Loop Crimp Terminal Size

| Drive Model F510 | Wire Gauge mm ² , (AWG) | | Terminal | Crimp Terminal | Tool | Insulation Cap |
|---------------------|---------------------------------------|---------------------|----------|-------------------|--------------------------|----------------|
| | R/L1, S/L2, T/L3 | U/T1, V/T2, W/T3 | Screws | Model No. | Machine No. | Model No. |
| 2008 | 5.5 (10) | | M4 | R5.5-4 | Nichifu NH 1 / 9 | TIC 5.5 |
| 2015 | 14 (6) | | M4 | R14-6 | Nichifu NOP 60 | TIC 8 |
| 2030 | 38 (2) | | M6 | R38-6 | Nichifu NOP 60 / 150H | TIC 22 |
| 2050 | 80 (3/0) | | M8 | R80-8 | Nichifu NOP 60 / 150H | TIC 60 |
| 2075 | 150 (4/0) | | M8 | R150-8 | Nichifu NOP 150H | TIC 80 |
| 2125 | 300 (4/0)*2 | | M10 | R150-10 | Nichifu NOP 150H | TIC 100 |
| 4010 | 5.5 (10) | | M4 | R5.5-4 | Nichifu NH | 9-Jan |
| 4020 | 8 (8) | | M6 | R8-6 | Nichifu NOP 60 | TIC 8 |
| 4040 | 22 (6) | | M6 | R22-6 | Nichifu NOP 60 / 150H | TIC 14 |
| 4075 | 60 (2) | | M8 | R60-8 | Nichifu NOP 60 / 150H | TIC 38 |
| 4125 | 150 (3/0) | | M8 | R150-8 | Nichifu NOP 150H | TIC 80 |
| 4250 | 300 (4/0)*2 | | M10 | R150-10 | Nichifu NOP 150H | TIC 100 |

❖ Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.

Note: Contact TECO for inverter ratings 2125 - 2150 and 4250 - 4425.

230V Class

| Drive Model F510 | Fuse Type | |
|---------------------------------------|---|------------------------|
| | Manufacturer: Bussmann / FERRAZ SHAWMUT | |
| | Model | Fuse Ampere Rating (A) |
| 200 V Class Three-Phase Drives | | |
| 2005 | Bussmann 50FE | 690V 50A |
| 2008 | Bussmann 50FE | 690V 50A |
| 2010 | Bussmann 63FE | 690V 63A |
| 2015 | FERRAZ SHAWMUT A50QS100-4 | 500V 100A |
| 2020 | Bussmann 120FEE / FERRAZ A50QS150-4 | 690V 120A / 500V 150A |
| 2025 | FERRAZ SHAWMUT A50QS150-4 | 500V 150A |
| 2030 | FERRAZ SHAWMUT A50QS200-4 | 500V 200A |
| 2040 | FERRAZ SHAWMUT A50QS250-4 | 500V 250A |
| 2050 | FERRAZ SHAWMUT A50QS300-4 | 500V 300A |
| 2060 | FERRAZ SHAWMUT A50QS400-4 | 500V 400A |
| 2075 | FERRAZ SHAWMUT A50QS500-4 | 500V 500A |
| 2100 | FERRAZ SHAWMUT A50QS600-4 | 500V 600A |
| 2125 | FERRAZ SHAWMUT A50QS700-4 | 500V 700A |

460V Class

| Drive Model F510 | Fuse Type | |
|---------------------------------------|---|------------------------|
| | Manufacturer: Bussmann / FERRAZ SHAWMUT | |
| | Model | Fuse Ampere Rating (A) |
| 400 V Class Three-Phase Drives | | |
| 4005 | Bussmann 16CT | 690V 16A |
| 4008 | Bussmann 25ET | 690V 25A |
| 4010 | Bussmann 40FE | 690V 40A |
| 4015 | Bussmann 50FE | 690V 50A |
| 4020 | Bussmann 63FE | 690V 63A |
| 4025 | Bussmann 80FE | 500V 80A |
| 4030 | Bussmann 100FE / FERRAZ A50QS100-4 | 690V 100A / 500V 100A |
| 4040 | Bussmann 120FEE | 500V 120A |
| 4050 | FERRAZ SHAWMUT A50QS150-4 | 500V 15A |
| 4060 | FERRAZ SHAWMUT A50QS200-4 | 500V 200A |
| 4075 | FERRAZ SHAWMUT A50QS250-4 | 500V 250A |
| 4100 | FERRAZ SHAWMUT A50QS300-4 | 500V 300A |
| 4125 | FERRAZ SHAWMUT A50QS400-4 | 500V 400A |
| 4150 | FERRAZ SHAWMUT A50QS500-4 | 500V 500A |
| 4175 | FERRAZ SHAWMUT A50QS600-4 | 500V 600A |
| 4215 | FERRAZ SHAWMUT A50QS700-4 | 500V 700A |
| 4250 | FERRAZ SHAWMUT A50QS700-4 | 500V 700A |

❖ **Motor Over Temperature Protection**

Motor over temperature protection shall be provided in the end use application.

■ **Field Wiring Terminals**

All input and output field wiring terminals not located within the motor circuit shall be marked to indicate the proper connections that are to be made to each terminal and indicate that copper conductors, rated 75°C are to be used.

■ **Inverter Short-Circuit Rating**

This inverter has undergone the UL short-circuit test, which certifies that during a short circuit in the power supply the current flow will not rise above value. Please see electrical ratings for maximum voltage and table below for current.

- The MCCB and breaker protection and fuse ratings (refer to the preceding table) shall be equal to or greater than the short-circuit tolerance of the power supply being used.
- Suitable for use on a circuit capable of delivering not more than (A) RMS symmetrical amperes for DiJ2.IHp in 240 / 480 V class drives motor overload protection.

| Horse Power (Hp) | Current (A) | Voltage (V) |
|--------------------|---------------|---------------|
| 1 - 50 | 5,000 | 240 / 480 |
| 51 - 200 | 10,000 | 240 / 480 |
| 201 - 400 | 18,000 | 240 / 480 |
| 401 - 600 | 30,000 | 240 / 480 |

❖ Inverter Motor Overload Protection

Set parameter 02-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ 02-01 Motor Rated Current

Setting Range Model Dependent

Factory Default: Model Dependent

The motor rated current parameter (02-01) protects the motor and allows for proper vector control when using open loop vector or flux vector control methods (00-00 = 2 or 3). The motor protection parameter 08-05 is set as factory default. Set 02-01 to the full load amps (FLA) stamped on the nameplate of the motor. The operator must enter the rated current of the motor (17-02) in the menu during auto-tuning. If the auto-tuning operation completes successfully (17-00 = 0), the value entered into 17-02 will automatically write into 02-01.

■ 08-05 Motor Overload Protection Selection

The inverter has an electronic overload protection function (OL1) based on time, output current, and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal overload relay for single motor operation. This parameter selects the motor overload curve used according to the type of motor applied.

| 08-05 | Selection for motor overload protection (OL1) |
|-------|---|
| Range | xxx0b : Motor overload is disabled xxx1b : Motor overload is enabled xx0xb : Cold start of motor overload xx1xb : Hot start of motor overload x0xxb : Standard motor x1xxb : Special motor |

Sets the motor overload protection function in 08-05 according to the applicable motor.

08-05 = ---OB: Disables the motor overload protection function when two or more motors are connected to a single inverter. Use an alternative method to provide separate overload protection for each motor such as connecting a thermal overload relay to the power line of each motor.

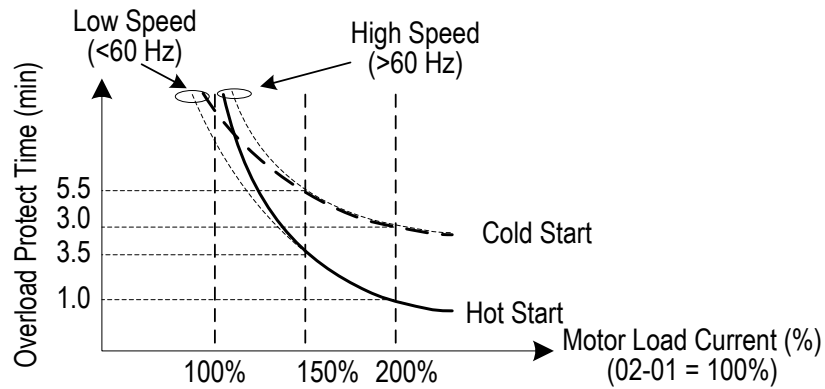
08-05 = --1-B: The motor overload protection function should be set to hot start protection characteristic curve when the power supply is turned on and off frequently, because the thermal values are reset each time when the power is turned off.

08-05 = -0—B: For motors without a forced cooling fan (general purpose standard motor), the heat dissipation capability is lower when in low speed operation.

08-05 = -1—B: For motors with a forced cooling fan (inverter duty or VIF motor), the heat dissipation capability is not dependent upon the rotating speed.

To protect the motor from overload by using electronic overload protection, be sure to set parameter 02-01 according to the rated current value shown on the motor nameplate.

Refer to the following "Motor Overload Protection Time" for the standard motor overload protection curve example: Setting 08-05 = -0--B.



■ **08-06 Motor Overload Operation Selection**

| | |
|--------------|--|
| 08-06 | Start-up mode of overload protection operation (OL1) |
| Range | 0: Stop output after overload protection 1: Continuous operation after overload protection. |

08-06=0: When the inverter detects a motor overload the inverter output is turned off and the OL1 fault message will flash on the keypad. Press RESET button on the keypad or activate the reset function through the multi-function inputs to reset the OL1 fault.

08-06=1: When the inverter detects a motor overload the inverter will continue running and the OL1 alarm message will flash on the keypad until the motor current falls within the normal operating range.

UL- Additional Data

Closed-Loop Crimp Terminal Size

| Drive Model | Wire Gauge mm ² (AWG) | | Terminal | Crimp Terminal | Tool | Insulation Cap |
|-------------|-------------------------------------|---------------------|----------|-------------------|------------------|-------------------|
| | R/L1, S/L2, T/L3 | U/T1, V/T2, W/T3 | Screws | Model No. | Machine No. | Model No. |
| F510 | | | | | | |
| 2175 | 152 (300)*2 | | M12 | R150-12*2 | Nichifu NOP 150H | TIC 150 |
| 4300 | 203 (400)*2 | | | R200-12S*2 | Nichifu NOH 300K | TIC 200 |
| 4375 | 253 (500)*2 | | M12 | R325-12S*2 | Nichifu NOH 300K | TIC 325 |
| 4425 | 253 (500)*2 | | M12 | R325-12S*2 | Nichifu NOH 300K | TIC 325 |

❖ Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used

Recommended Input Fuse Selection

| Drive Model F510 | Fuse Type | |
|---------------------------------------|---|------------------------|
| | Manufacturer: Bussmann / FERRAZ SHAWMUT | |
| | Model | Fuse Ampere Rating (A) |
| 200 V Class Three-Phase Drives | | |
| 2150 | Bussmann 170M5464 | 690V 800A |
| 2175 | Bussmann 170M5464 | 690V 800A |

| Drive Model F510 | Fuse Type | |
|---------------------------------------|---|------------------------|
| | Manufacturer: Bussmann / FERRAZ SHAWMUT | |
| | Model | Fuse Ampere Rating (A) |
| 400 V Class Three-Phase Drives | | |
| 4300 | Bussmann 170M5464 | 690V 800A |
| 4375 | Bussmann 170M5464 | 690V 800A |
| 4425 | Bussmann 170M5466 | 690V 1000A |
| 4425 | Bussmann 170M5466 | 690V 1000A |

TECO   **Westinghouse**

INVERTER

F510

Teco-Westinghouse Motor Company
5100 N. IH-35
Round Rock, Texas 78681
1-800-279-4007
www.tecowestinghouse.com

Distributor

Ver 01: 2017.12